



SUNNY CENTRAL STORAGE UP for AC-coupled Storage Solutions

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1 Information on this Document

1.1 Validity

This document is valid for:

Inverters as of firmware version 9.00.##.R

- SCS 3450 UP (Sunny Central Storage 3450 UP)
- SCS 3600 UP (Sunny Central Storage 3600 UP)
- SCS 3800 UP (Sunny Central Storage 3800 UP)
- SCS 3950 UP (Sunny Central Storage 3950 UP)
- SCS 2300 UP-XT (Sunny Central Storage 2300 UP-XT)
- SCS 2400 UP-XT (Sunny Central Storage 2400 UP-XT)
- SCS 2530 UP-XT (Sunny Central Storage 2530 UP-XT)
- SCS 2630 UP-XT (Sunny Central Storage 2630 UP-XT)
- SCS 3450 UP-XT (Sunny Central Storage 3450 UP-XT)
- SCS 3600 UP-XT (Sunny Central Storage 3600 UP-XT)
- SCS 3800 UP-XT (Sunny Central Storage 3800 UP-XT)
- SCS 3950 UP-XT (Sunny Central Storage 3950 UP-XT)

Illustrations in this document are reduced to the essential information and may deviate from the real product.

1.2 Target Group

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

- Knowledge of how the product works and is operated
- Knowledge of how batteries work and are operated
- Training in how to deal with the dangers and risks associated with installing, repairing and using electrical devices, batteries and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of all applicable laws, standards and directives
- Knowledge of and compliance with this document and all safety information
- Knowledge of and compliance with the documents of the battery manufacturer with all safety information

1.3 Levels of warning messages

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

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

1.4 Symbols in the Document

Icon	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
	Indicates a requirement for meeting a specific goal
	Desired result
	A problem that might occur.
	Example

1.5 Typographical Elements in the Document

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

1.6 Designations in the Document

Complete designation	Designation in this document
Battery Management System	BMS
Medium-voltage transformer	MV transformer
Sunny Central Storage UP	Sunny Central or inverter

1.7 Additional Information

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

Title and information content	Type of information
"Requirements for medium-voltage transformers and transformers for internal power supply for SUNNY CENTRAL and SUNNY CENTRAL STORAGE"	Technical Information
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical Information
For information on maintenance activities of the DC switchgear and AC disconnect unit please visit www.abb.com :	
Component	Document number
DC switchgear: T-Max	1SDH000707R0001

2 Safety

2.1 Intended Use

The Sunny Central Storage UP is a bidirectional battery inverter that converts the direct current supplied by a battery into grid-compliant alternating current. A downstream, external medium-voltage transformer galvanically isolates the inverter from the utility grid. The Sunny Central Storage UP can be used in off-grid systems based on diesel generators (gensets) as well as in utility grids for the provision of grid services.

Environment

The product is intended for use in industrial environments.

The product is designed for outdoor use only.

The inverter is suitable for operation in a chemically active environment. The inverter corresponds to degree of protection IP54 and can also be operated in rain, sleet and snow.

The inverter must only be operated with its air inlets open.

The pollution degree of the inverter corresponds to category PD3.

The product must not be opened when it is raining or when humidity exceeds 95%.

System requirements

To safely disconnect the short-circuit current of the battery in the event of a fault, fuses must be installed between the battery and the inverter. In addition, the installation of a fuse switch disconnect or circuit breaker is recommended.

If the inverter is operated outside the operating and fault ranges specified in IEC 62109-1, SMA Solar Technology AG does not assume liability if external fuses are tripped.

An overvoltage test according to IEEE C62.41.2 at a voltage of up to 6 kV was carried out for the inputs in the power path.

For the inputs in the control path, an overvoltage test was performed as per IEEE C37.90.1 at a voltage of 2.5 kV.

The specified minimum clearances must be observed.

In accordance with EN 55011, the product must only be operated at locations where the distance between the product and third-party radio-communication installations is greater than 30 m.

The product is not intended to be used in living areas and cannot provide protection of radio reception against interference signals in such environments.

The required fresh-air supply must be assured. Ensure that no exhaust air from other devices interferes with the air intake.

The product must not be operated with open covers or doors.

DC connection

The product must only be operated in connection with an intrinsically safe battery. The battery's entire voltage range must be completely within the permissible DC input voltage range of the inverter.

The maximum permissible DC input voltage of the inverter must not be exceeded.

The inverter cannot safely disconnect a short-circuit current from the battery. An ultra-fast thermal fuse must be installed between inverter and battery. It can safely switch off the battery's short-circuit current in the event of a fault.

The disconnection capability of the installed load-break switches is 8.4 kA, and withstanding electric currents of 19 kA for 1 second. No switching operations must be performed in the meantime.

When the fuses on the battery side did not exceed a maximum melting integral of 10.75 MA²s for inverters with busbar and a maximum melting integral of 8 MA²s per input for inverters with split DC rail, the DC connection of the inverter was successfully tested with an unaffected DC short-circuit current surge of 220 kA without causing any danger.

AC connection

The switching capacity of the AC disconnection unit with steady short-circuit current is 70 kA.

The inverter may only be operated in connection with a separate suitable medium-voltage transformer.

The medium-voltage transformer must be designed for voltages that arise from pulsed mode of the inverter.

Medium-voltage transformers for inverters from the SCS UP-XT series must be able to carry the energy discharging direction.

Do not deactivate or modify settings that affect grid management services without first obtaining approval from the grid operator.

Statutory warranty

Use SMA products only in accordance with the information provided in the enclosed documentation and with the locally applicable laws, regulations, standards and directives. Any other application may cause personal injury or property damage.

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

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

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

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

The product must not be operated with any technical defects.

The type label must remain permanently attached to the product.

2.2 IMPORTANT SAFETY INSTRUCTIONS

Keep the manual for future reference.

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

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

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ DANGER**Danger to life due to high short-circuit current in the battery**

Despite careful construction, a short circuit may occur in the inverter under fault conditions. In case of a short circuit in the inverter, the connected battery can supply a very high short-circuit current. The resulting electric arc and pressure wave lead to death or serious injuries.

- Install the inverter in a closed electrical operating area.
- Always close and lock the inverter.
- Before opening the inverter, externally disconnect the inverter on the AC and DC side and secure against reconnection.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.

⚠ DANGER**Danger to life due to electric shock when live components or DC cables are touched**

The DC cables connected to a battery may be live. Touching live DC cables results in death or serious injury due to electric shock.

- Do not touch non-insulated parts or cables.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ DANGER**Danger to life due to electric shock when operating a damaged product**

Operating a damaged product can lead to hazardous situations since high voltages can be present on accessible product parts. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Only operate the product when it is in a flawless technical condition and safe to operate.
- Make sure that all external safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ DANGER**Danger to life due to electric shock in case of a ground fault**

If there is a ground fault, components that are supposedly grounded may in fact be live and components that are normally ungrounded may be grounded. The PV field is not grounded when the inverter is disconnected or during the measurement of the insulation resistance. Touching live parts will result in death or serious injury due to electric shock.

- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- Before working on the system, ensure that no ground fault is present.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life from electric shock when the product is left unlocked**

If the product is not locked, unauthorized persons will have access to components carrying lethal voltages. Touching live components can result in death or serious injury due to electric shock.

- Always close and lock the product.
- Ensure that unauthorized persons do not have access to the closed electrical operating area.

⚠ WARNING**Danger to life due to fire when failing to observe torque specifications on live bolted connections**

Failure to follow the specified torques reduces the ampacity of live bolted connections and the contact resistances increase. This can cause components to overheat and catch fire. Death or lethal injuries can result.

- Ensure that live bolted connections are always tightened with the exact torque specified in this document.
- Ensure that the terminal lugs used do not exceed the maximum material thickness. In this way, you avoid that the screws supplied are too short for the installation and that the required torque cannot build up.
- Only use suitable tools when working on the device.
- Avoid repeated tightening of live bolted connections as this may result in inadmissibly high torques.

⚠ WARNING**Danger to life from electric shock when entering the battery storage system**

Damaged insulation in the storage system can cause lethal ground currents. Lethal electric shocks can result.

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Install the product in a closed electrical operating area.

⚠ WARNING**Danger to life due to electric shock when the internal power supply is switched off**

After switching off the internal power supply at the load-break switch -Q62, lethal voltages are still present in the cables to load-break switch -Q62. Only after the power path has been enabled are all cables of the internal power supply de-energized. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the product from the power path and ensure that it cannot be reconnected.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Hearing impairment due to high-frequency noises of the product**

The product generates high-frequency noises during operation. This can result in hearing impairment.

- Wear hearing protection.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting and in operation, an electric arc can arise if conductive foreign parts (e.g. tools) are located in the product and establishes a conductive connection between live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ CAUTION**Risk of burns due to hot components**

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

NOTICE**Damage to the inverter due to unauthorized connection of the surge protection device F26**

After a defined number of brief overvoltage events or triggering the surge arrester **F26**, the error message **7804** is displayed. Switching on the surge arrester again results in the destruction of the assembly.

- Have the assembly replaced by SMA Service.

NOTICE

Unwanted product behavior following a Firmware update

When the firmware is updated, the default values for several parameters might be newly defined. Adopting default settings after a Firmware update without checking them can change the previous settings and result in unwanted behavior of the product. It can cause the product to disconnect because voltage limits are exceeded. This can result in yield losses.

- Before changing the parameter by simulation, ensure that the grid stability at the AC connecting rails of the product as well as at the point of interconnection is observed, also with the extended reactive power range.
- Ensure that MV transformer is designed for the permanent feed-in of reactive power.
- Check whether the reactive power range extension requires changes to the SCADA system or the system control. If changes are necessary, perform them.
- After adjusting the parameters for the reactive power setpoint, check whether the Modbus specifications for the reactive power values fed in by the product correspond to the specifications before the change and correspond to the expected values. If the specifications do not match, the percentage value for the reactive power setpoint in the SCADA system or of system controller must be adjusted.
- Ensure that the grid limits at the AC connecting rails of the product are observed with the extended reactive power range.
- Ensure that the grid limits as well as the specifications of the grid operator regarding the reactive power limits of the battery storage system at the grid-connection point are observed.

NOTICE

Unwanted active power feed-in despite setting the active power setpoint to 0 kW

The inverter feeds in at 0.2% of the maximum power for the time defined in the parameter **PwrSpt2StbyTm**, even with low power setpoints. This may result in contract penalties.

- Ensure that the active power setpoint is set to 0 kW and reactive power setpoint is set to 0 kVar. Set the parameter **PwrSpt2StbyTm** to the minimum value.
- Alternatively, set the inverter specifically to the "Standby" operating state.

NOTICE

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

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

- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- Do not open the product during a dust storm or precipitation.
- In case of interruption of work or after finishing work, mount all enclosure parts and close and lock all doors.
- Only operate the product when it is closed.
- Store the closed product in a dry and covered location. Observe storage conditions.
- The temperature at the storage location must be in the specified range. The temperature range is: -40°C to $+70^{\circ}\text{C}$.

NOTICE

Damage due to environmental disturbances

The product can be damaged by environmental disturbances e.g. earthquakes, storms or flooding. With a damaged product, a safe and trouble-free operation is not guaranteed. Considerable damages to the product and yield losses can result.

- Always disconnect the product from voltage sources as quickly as possible after large-scale environmental disturbances.
- Once disconnected from voltage sources, perform a thorough 12-month-maintenance check that is not subject to the maintenance schedule. Shorten the maintenance intervals depending on the determined maintenance requirements.
- After a dust or snow storm, ensure that the air inlets and outlets are not covered by any objects (e.g., sand).
- Only recommission the product once any damages have been rectified.

Additional hazard labels

Additional labeling of sources of danger (e.g. high voltage) must be carried out in accordance with the locally applicable standards, guidelines and laws.

2.3 Personal Protective Equipment

Always wear suitable protective equipment

When working on the product, always wear the appropriate personal protective equipment for the specific job.

The following personal protective equipment is regarded to be the minimum requirement:

- ☐ In a dry environment, safety shoes of category S3 with perforation-proof soles and steel toe caps
- ☐ During precipitation or on moist ground, safety boots of category S5 with perforation-proof soles and steel toe caps
- ☐ Tight-fitting work clothes made of 100% cotton
- ☐ Suitable work pants
- ☐ Proper hearing protection
- ☐ Safety gloves
- ☐ Proper head protection
- ☐ LV/HRC fuse extractor

If necessary, LV/HRC fuse extractors can be ordered from SMA using the following material number: 61-0193.

Any other prescribed protective equipment must also be used.

When working on live parts of the product, protective equipment with suitable hazard risk category is required. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels. The required protective equipment must comply with the national regulations.

2.4 Cyber Security

Most operating activities such as monitoring and control of systems can be done locally by the PV system operator or service personnel without the need for data communication via public Internet infrastructure. These operating activities, including data communication between PV system operator/service personnel and data logger, inverter or additional equipment, can be accessed by using local displays, keypads or using local access of the webserver of a device in the LAN of the PV system or of the building.

In other use cases of systems, the PV systems are also part of the global communication system, which is based on Internet infrastructures.

The data communication via Internet is an up-to-date, economically viable and customer-friendly approach in order to enable easy access for the following modern applications such as:

- Cloud platforms (e.g. Sunny Portal)
- Smartphones or other mobile devices (iOS or Android apps)
- SCADA systems, which are remotely connected
- Utility interfaces for grid management services

Alternatively, selected and secured communication interfaces may be used. These solutions are no longer state of the art and are very expensive to use (special communication interfaces, separate wide area networks and more).

When using the Internet infrastructure, the systems connected to the Internet are entering a basically unsecure area. Potential attackers constantly seek vulnerable systems. Usually, they are criminally motivated, have a terrorist background or aim to disrupt business operations. Without taking any measures to protect systems and other systems from such misuse, a data communication system should not be connected to the Internet.

You can find the current recommendations by SMA Solar Technology AG on the topic of Cyber Security in the Technical Information "PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication" at www.SMA-Solar.com.

3 Product Overview

3.1 Design of the Inverter

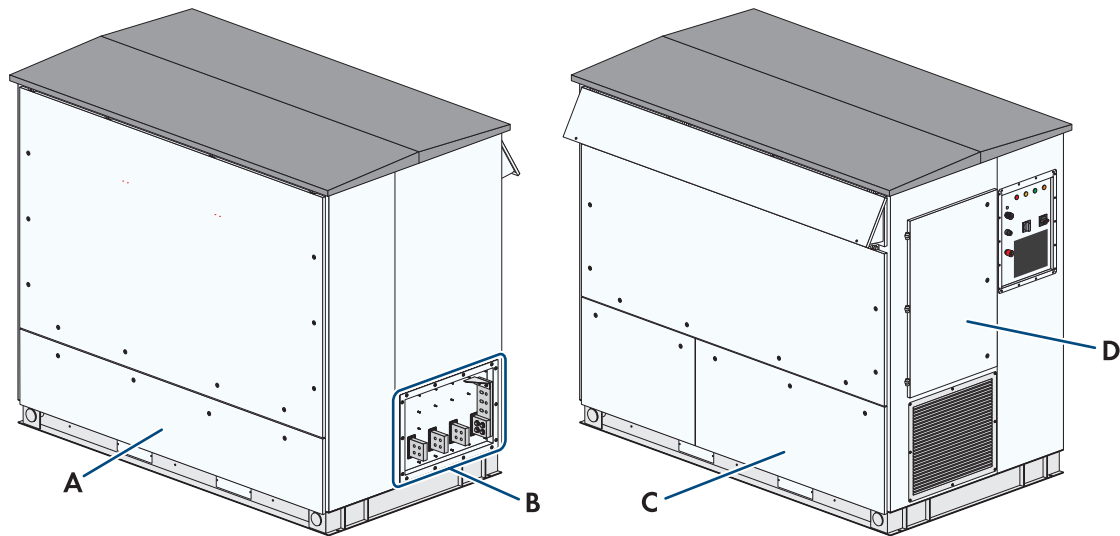


Figure 1: Design of the inverter

Position	Designation
A	DC connection area and grounding
B	AC connection area and grounding
C	Connection area for electronics
D	Customer installation location

3.2 Operating and Display Elements

3.2.1 Overview of the Operating and Display Elements on the Inverter

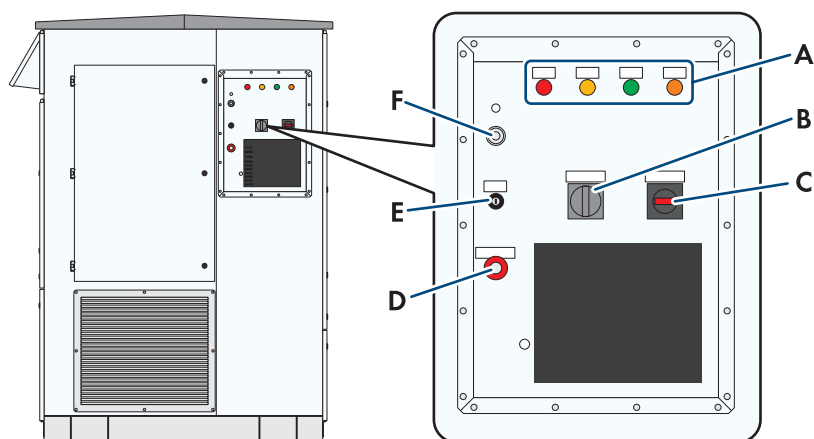


Figure 2: Inverter components

Position	Designation
A	Light repeater -P1, -P2, -P3, -P4
B	Load-break switch -Q62 for supply voltage

Position	Designation
C	Load-break switch -Q61 for AC/DC disconnection unit
D	Key switch -S2 for fast stop
E	Key switch -S1 for start/stop
F	Service interface -X500

The AC disconnection unit is equipped with a lock. The device can be locked to provide a safe environment for maintenance work in switched-off state.

3.2.2 Function of the Switches

3.2.2.1 Start/Stop Key Switch -S1

"Start" switch position

If the key switch is set to **Start**, the inverter remains in the "Stop" operating state and waits for an external start command. Depending on the configuration, the inverter can be started manually via the user interface or by an external signal. The inverter then switches to the "WaitAC" operating state. If the utility grid is valid, the inverter switches on the AC disconnection unit and changes the inverter to the "WaitDC" operating state. If the battery voltage is sufficient, the inverter connects the DC switchgear and changes to the "GridFeed" operating state. If the battery voltage is insufficient and the input voltage is therefore too low, the DC switchgear remains open and the inverter remains in the "WaitDC" state.

"Stop" switch position

If the key switch is turned to **Stop** while the inverter is in the "WaitDC" operating state, the inverter switches to the "Stop" operating state and the AC disconnection unit is switched off. The battery is not disconnected from the inverter when the key switch is turned. To do this, the battery must be disconnected via the external fuse switch-disconnector or circuit breaker.

If the key switch is turned to **Stop** while the inverter is in the "GridFeed" operating state, the inverter switches to the "RampDown" operating state. Once shutdown is complete, the AC disconnection unit and the DC switchgear are switched off automatically and the inverter switches to the operating state "Stop". The battery is not disconnected from the inverter when the key switch is turned. To do this, the battery must be disconnected via the external fuse switch-disconnector or circuit breaker.

3.2.2.2 Fast-Stop Key Switch -S2

When the key switch is actuated, the inverter disconnects from the utility grid in under 100 ms by opening the DC switch-disconnector and the AC disconnection unit.

The supply voltage and the optional additional auxiliary power supply remain connected so that the inverter can continue to be accessed.

Actuation of the fast-stop key switch -S2

The fast-stop key switch **-S2** must only be released if there is immediate danger. Tripping occurs without previous rapid discharge of the link-circuit capacitors. If the inverter is to be switched off and properly shut down via an external signal, the external start/stop function **-X441** should be used.

3.2.2.3 Load-Break Switch -Q61 for AC Switching Device and DC Disconnection Unit

The load-break switch switches the following devices on or off:

- the motor drive of the DC switchgears **-Q21** to **-Q23**
- AC switchgear **-Q1**
- Inverter bridge fans **-G1**

- Switch cabinet fans **-G10** and **-G11**
- The terminal **-X1** of the transformer protection
- The optional customer installation location **-X310**
- The current measurement for the optional PQ-Meter **-A61**
- precharge unit **-Q50**

3.2.2.4 Load-Break Switch **-Q62** for Supply Voltage

Depending on the selected option "Energy self-sufficiency inverter", the function of the load-break switch **-Q62** differs.

Internal supply voltage

The load-break switch fully disconnects the supply voltage of all internal components, e.g.:

- Fans of the inverter bridge **-G1**
- Switch cabinet fans **-G10** and **-G11**
- Service interface **-X300**
- The optional customer installation location **-X310**
- The current measurement for the optional PQ-Meter **-A61**
- customer loads at the connecting terminal plates **-X371** to **-X373**
- the outlets **-X374** and **-X375**

For inverters that are installed in Great Britain or Australia, only outlet **-X374** is located in the customer installation location.

External supply voltage

The supply voltage of the energy self-sufficiency can only be disconnected from voltage sources via the upstream switching device to be provided by the customer.

i Voltage in the inverter even after switching off the load-break switch **-Q62**

With external energy self-sufficiency, there is still voltage applied to many components after switching off the load-break switch **-Q62**.

- Observe the safety information.
- Prior to all work on the inverter, externally disconnect the external energy self-sufficiency from voltage sources.
- Prior to all work, ensure that no voltage is present in the inverter.

3.2.3 Indicator lights at the Control Panel

The individual indicator lights can glow in various combinations. In this case, the meanings of the indicator lights complement each other.

Indicator lights designated with ○ can be in one of the following states: off / glowing / flashing.

Indicator lights status	Designation	Description
	Red: glowing	Initialization The inverter is now in the initialization phase.
	Yellow: glowing	
	Green: glowing	
	Orange: glowing	

Indicator lights status		Designation	Description
	Red: flashing Yellow: flashing Green: flashing Orange: flashing	Indicator lights test	The inverter carries out a indicator-light test.
	Red: off Yellow: off Green: off	Stop mode	The inverter is in the operating state "Stop".
	Red: glowing	Event message	The inverter has detected an error.
	Yellow: glowing	Warning	The inverter has detected a warning.
	Yellow: flashing	Output limitation	The inverter operates with reduced power. An external or temperature derating is active.
	Green: glowing	Automatic operation	The green LED indicates automatic operation of the inverter (Wait AC / Wait DC / feed-in operation).
	Green: flashing	Standby	The inverter is in standby mode.
	Orange: glowing	Stop mode with ground fault	The inverter has detected a ground fault.
	Orange: flashing	Stop mode with insulation error	The inverter has detected an insulation error.

3.3 Symbols on the Product

Icon	Explanation
	Beware of a danger zone This warning symbol indicates a danger zone.
	Beware of electrical voltage The product operates at high voltages.
	Electric arc hazards The product has large electrical potential differences between its conductors. Arc flashes can occur through air when high-voltage current flows.
	Beware of hot surface The product can get hot during operation.
	Use hearing protection The product generates loud noises.

Icon	Explanation
	Observe the documentations Observe all documentations supplied with the product.
	Protection class I All electrical equipment is connected to the grounding conductor system of the product.
	Degree of protection IP54 The product is protected against interior dust deposits and against water splashing from all angles against the enclosure.
	CE marking The product complies with the requirements of the applicable EU directives.
	UKCA marking The product complies with the regulations of the applicable laws of England, Wales and Scotland.

4 User Interface

4.1 Design of the User Interface

The user interface can be operated via a web browser and is available in English, German, Spanish, French, Italian, Greek, Czech, Portuguese, Japanese and Korean.

On the user interface, it is possible to display and configure parameters, instantaneous values and diagrams. Any disturbances which have occurred can be displayed on the user interface and measures for their elimination can be initiated.

Tapping the symbols on the touch display enables the respective functions.

The user interface is divided into several areas.

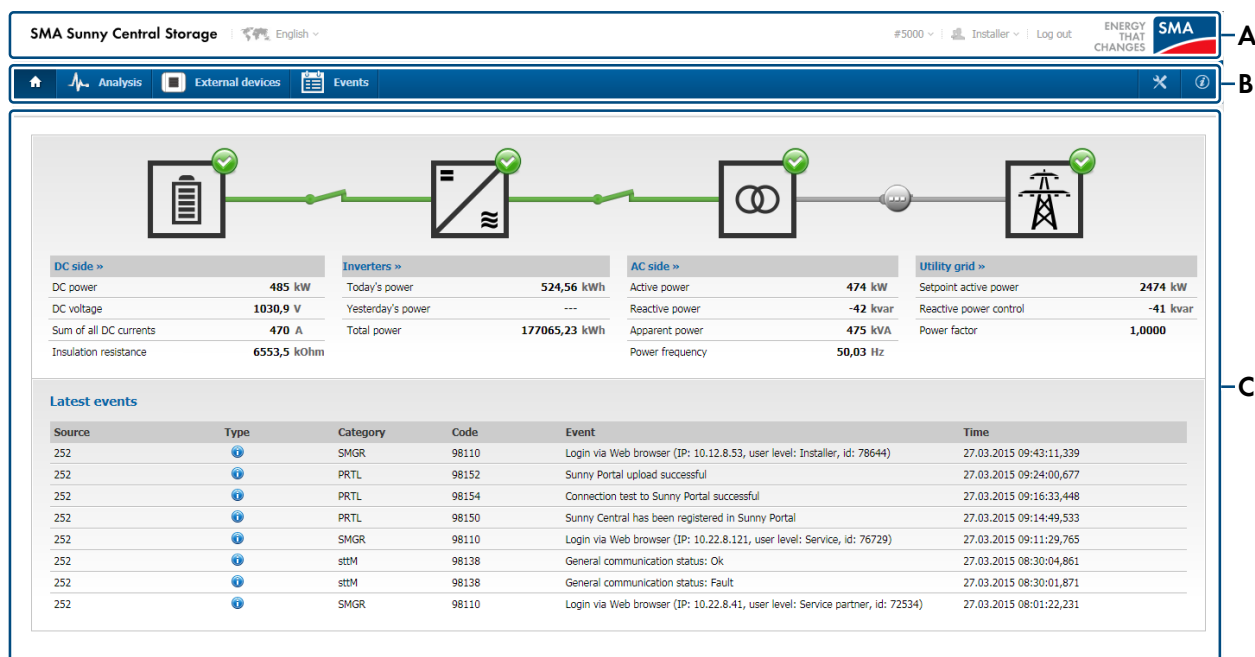


Figure 3: Design of the user interface (example: web browser)

Position	Designation	Explanation
A	Status info line	Settings for language as well as quick navigation and password input.
B	Main navigation	Navigation area The main navigation bar is located on the upper margin of the user interface.
C	Content area	Data overview depending on the selected menu

4.2 Explanation of Symbols

User Info Line

Icon	Designation	Description
 English v	Language selection	The indicated language can be selected during login.

Icon	Designation	Description
#xxxx ▾	Navigation aid	Each view, parameter and instantaneous value is assigned a unique number. Using the quick navigation, you can enter the desired number. The user interface then switches direct to the corresponding page. Navigation via these numbers is mainly used for the coordination of several users working simultaneously on the inverter. Using the same page number, each user will see the same screen.
	Log in	Login as user, installer, service partner or SMA Service with password entry. The number of silhouettes visible indicates how many users are logged into the user interface. In the list of possible users, the number of users logged in for each role is displayed.

Main navigation

The selected menu item is color-highlighted. To navigate to the previous or next page, use the arrow buttons of the web browser.

Icon	Designation	Description
	Home	Fast overview of system status For each component of the PV system, the key instantaneous values and the status of the assemblies and switches are displayed.
	Analysis	Switches to the analysis area of the user interface Detailed information on the following areas: • DC side • Inverter • AC side • Utility Grid • Instantaneous values • Detailed analysis
	Events	Display of all saved events. The events can be filtered.
	Configuration	Configuration options for: • Instantaneous values • Parameters • Import and export of parameters, settings and measured values In addition, the setup assistant can be used here to carry out the parameter configuration for specific applications in a step-by-step process.

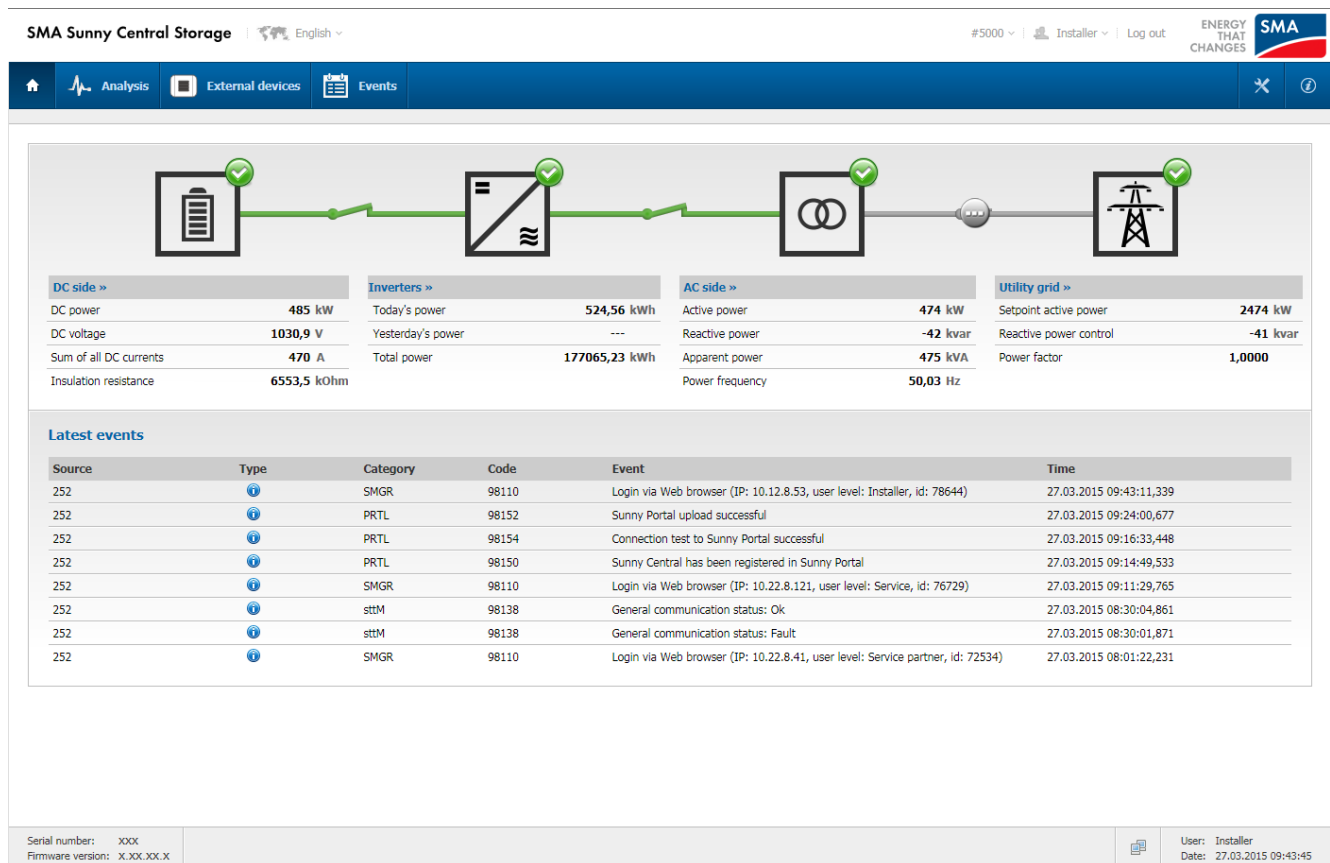
Icon	Designation	Description
	Information	Important data for identification of the system
	External devices	Overview of the external connected devices, e.g. battery

Content area

Icon	Designation
	DC side
	Inverter
	Medium-voltage transformer
	Utility grid
	Switch closed
	Switch open
	Switching status unknown
	Device running / status OK
	Device is not running / fault
	Device status unknown
	Device status unknown / not connected

4.3 Home Page

The **Home** page gives you a first overview of the status of the overall system. This includes the DC side, the inverter, the AC side and the utility grid.

Figure 4: Page **Home** of the user interface

The overall system's components are displayed as symbols in the block circuit diagram. The status of each component is indicated by a symbol. Under each symbol, the key instantaneous values of that system component are displayed. The status of the switches between the overall system's components is indicated by the corresponding switch symbols (see Section 4.2, page 27). If there are several switches between the individual components, a closed switch symbol is always displayed as soon as at least one of the switches has been closed.

If you select the button of a component, e.g. **[DC side]**, the corresponding analysis page opens (see Section 4.4, page 30).

Depending on the user role of the person logged in, differing information will be displayed in the bottom section of the user interface:

User view

In addition, the AC power of the inverter over the last 24 hours is depicted in a diagram. The diagram can be enlarged to full-screen view.

Installer view

In addition, a list of the last eight events is displayed. To open the event list, select **Latest events** (see Section 4.6, page 37).

4.4 Analysis

4.4.1 Structure of the Analysis Pages

The Analysis pages consist of an analysis menu and the menu-dependent content area.

Figure 5: Menu of the page **Analysis** on the user interface

The menu items **Instantaneous values** and **Detail analysis** are only available to the Installer and will not be visible to the User.

4.4.2 Diagrams on the Analysis Pages

On the analysis pages **DC side**, **Inverter**, **AC side** and **Utility grid**, there is a diagram in the bottom half of the content area. In the diagrams, you can select and display the relevant data. Here, it is possible to select different display periods.

In each diagram there are two Y axes available for the representation of the data. This enables instantaneous values with two different physical units to be displayed in the same diagram. You can allocate any number of instantaneous values with the same physical unit to each of the Y axes. In this case, the horizontal grid lines in the diagram are always drawn corresponding to the labelling of the two Y axes.

You can see which instantaneous value is allocated to which curve by the legend.

If you move the mouse pointer over the diagram, the detail values of each curve are shown in a legend window. As soon as you take the mouse pointer off the content area of the diagram, the legend window is hidden.

4.4.3 DC Side

The content area of the page **DC side** is subdivided into four sections. The DC power shows whether the battery is being charged (negative power value) or discharged (positive power value).

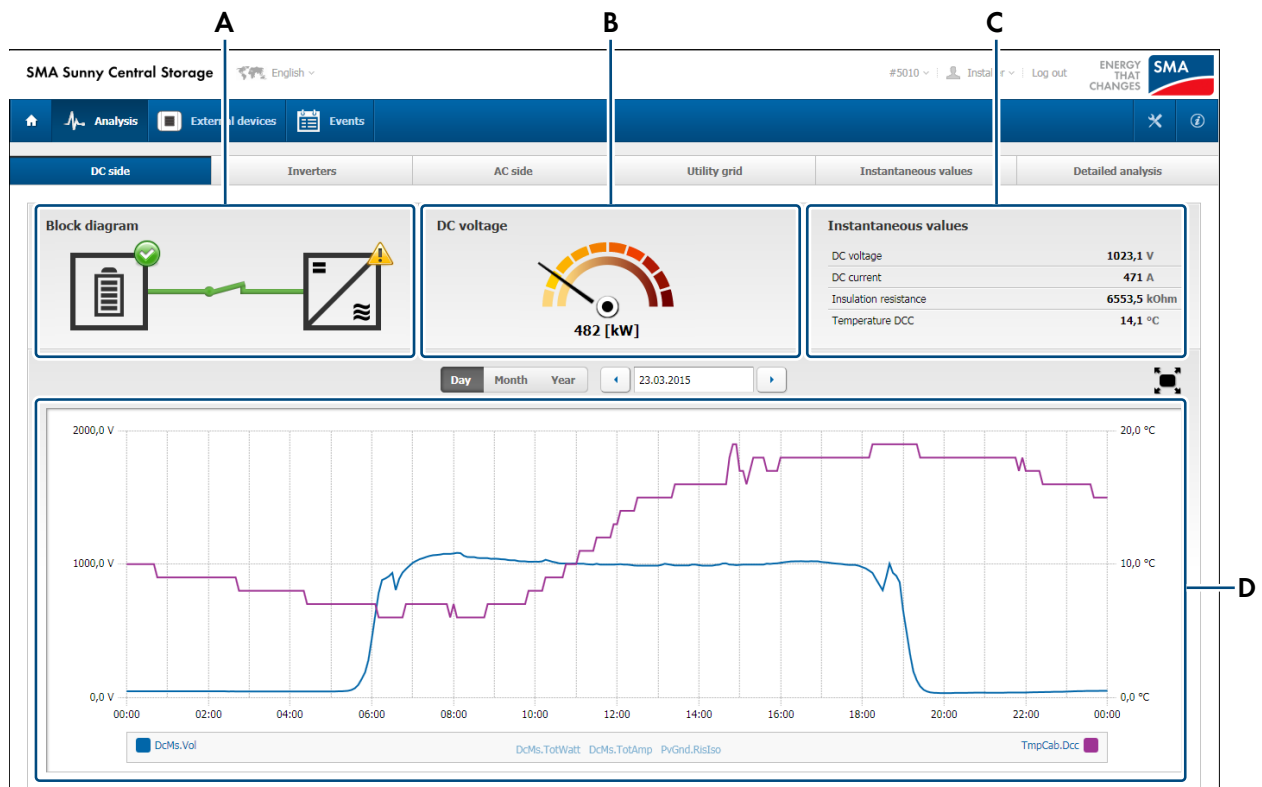


Figure 6: Page **DC side** of the user interface (example)

Position	Description
A	Overview of the status of the battery and the inverter as well as the switch positions of the DC side, as detail of the block diagram on the Home page
B	Depiction of the current DC power

Position	Description
C	Display of current voltage, electrical current strength and insulation resistance on the DC side of the inverter
D	Diagram with display of instantaneous values for DC voltage, DC power, DC current strength and interior temperature of the inverter

4.4.4 Inverter

The content area of the page **Inverter** is subdivided into four sections.



Figure 7: **Inverter** page of the user interface (example)

Position	Description
A	Overview of the status of the DC side, the inverter and the MV transformer, as well as the switch positions of the DC and AC sides, as detail of the block diagram on the Home page The inverter is highlighted.
B	Display of the energy fed in on the current day, the total energy fed in and the operating state of the inverter
C	Display of the current temperature inside the inverter and of the environment
D	Diagram with instantaneous values for ambient temperature and interior temperature of the inverter

4.4.5 AC Side

The content on the page **AC side** is subdivided into four sections.



Figure 8: Page **AC side** of the user interface (example)

Position	Description
A	Overview of the status of the inverter and the MV transformer as well as the switch positions of the AC side, as detail of the block diagram on the Home page.
B	Display of the current voltage and electrical current strength on the AC side for each line conductor
C	Display of the current active power, reactive power, apparent power and frequency of the utility grid
D	Diagram with instantaneous values Here you can choose data groups with two physical units from the instantaneous values for voltage and current strength of each line conductor, the instantaneous active, reactive and apparent power, and the power frequency.

4.4.6 Utility Grid

The content area of the page **Utility grid** is subdivided into four sections.



Figure 9: Page **Utility grid** of the user interface (example)

Position	Description
A	Overview of the status of the MV transformer and the utility grid as well as the switch positions of connections to the utility grid, as detail of the block diagram on the Home page.
B	Display of the current setpoints for active and reactive power
C	Display of the current active power, reactive power and apparent power
D	Diagram with instantaneous values Here you can choose data groups with two physical units from the instantaneous values for voltage and current strength of each line conductor, the instantaneous active, reactive and apparent power, and the power frequency.

4.4.7 Instantaneous Values

The number of available instantaneous values depends on the role for which you are logged in.

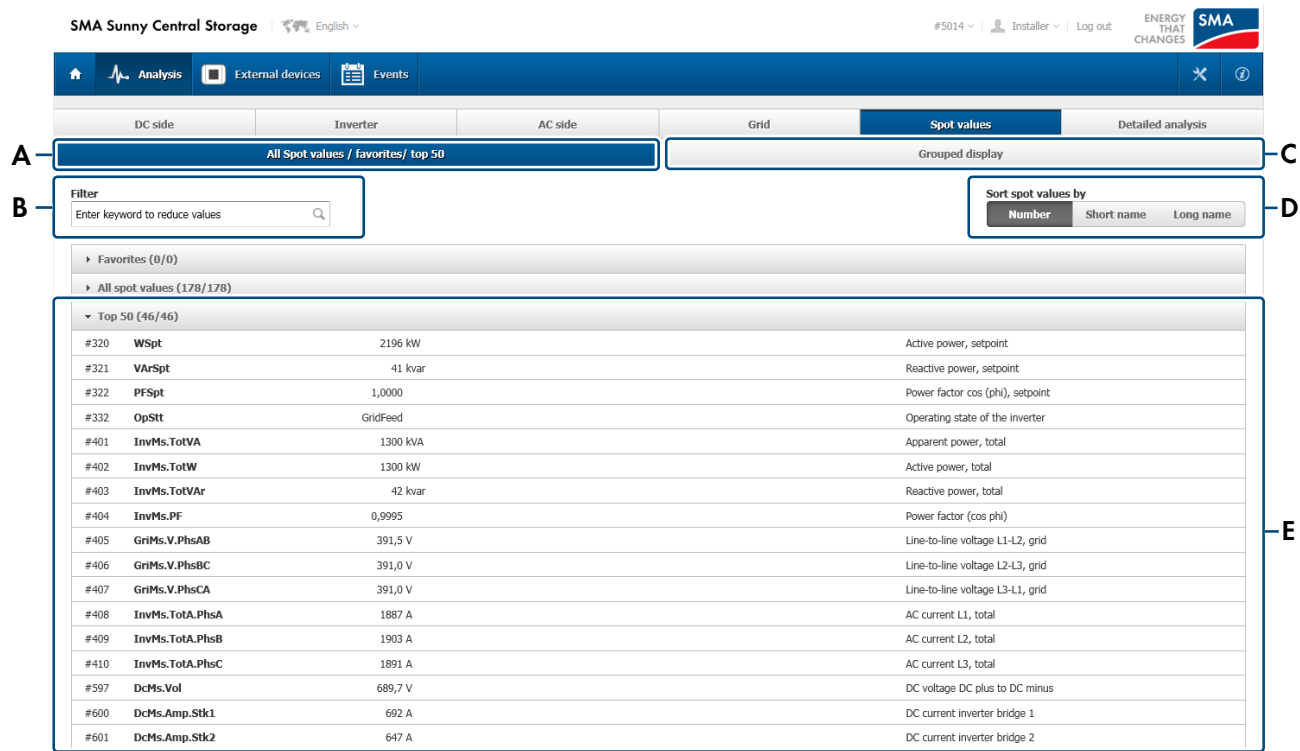


Figure 10: Page **Instantaneous values** of the user interface (example)

Position	Description
A	Display of instantaneous values All instantaneous values , a list with user-defined Favorites or a pre-defined list of the Top 50 instantaneous values can be displayed.
B	Search field for targeted search of instantaneous values. The search function refers to the numbers, long and short names. Additionally, you can search for the numbers of the instantaneous values in the user info line.
C	Display of grouped instantaneous values and parameters Instantaneous values and parameters are grouped under various headings. It is possible that certain instantaneous values are allocated to several groups.
D	Sorting of the instantaneous values and parameters according to the long and short names by which they are designated in this document, and by their number. Sorting takes place by lines, the columns always remain in the same order.
E	Overview of instantaneous values Depending on your selection, a list with instantaneous values or the categories of grouped data organized in a tree structure will appear. If you hover the cursor over the list, a star appears at the end of the line. By clicking on the star, you can mark this instantaneous value for inclusion in Favorites .

At the lowest navigation level, the instantaneous values are represented in a table. Values which have changed since the last page update are highlighted.

If you select a particular instantaneous value, a detailed view for that value opens.

Detailed View of Instantaneous Values

You can enable a detailed view for each instantaneous value. In the detailed view, the instantaneous value is displayed in a separate, strongly magnified window. This enables the value to be read off from a distance, e.g., during maintenance work.

You can open several detailed views simultaneously. The window size can be adjusted and the windows can be arranged at random on the screen.

4.4.8 Detailed analysis

In the detailed analysis, the recorded instantaneous values can be represented in the diagram over various time periods.

The number of available instantaneous values depends on the role for which you are logged in.

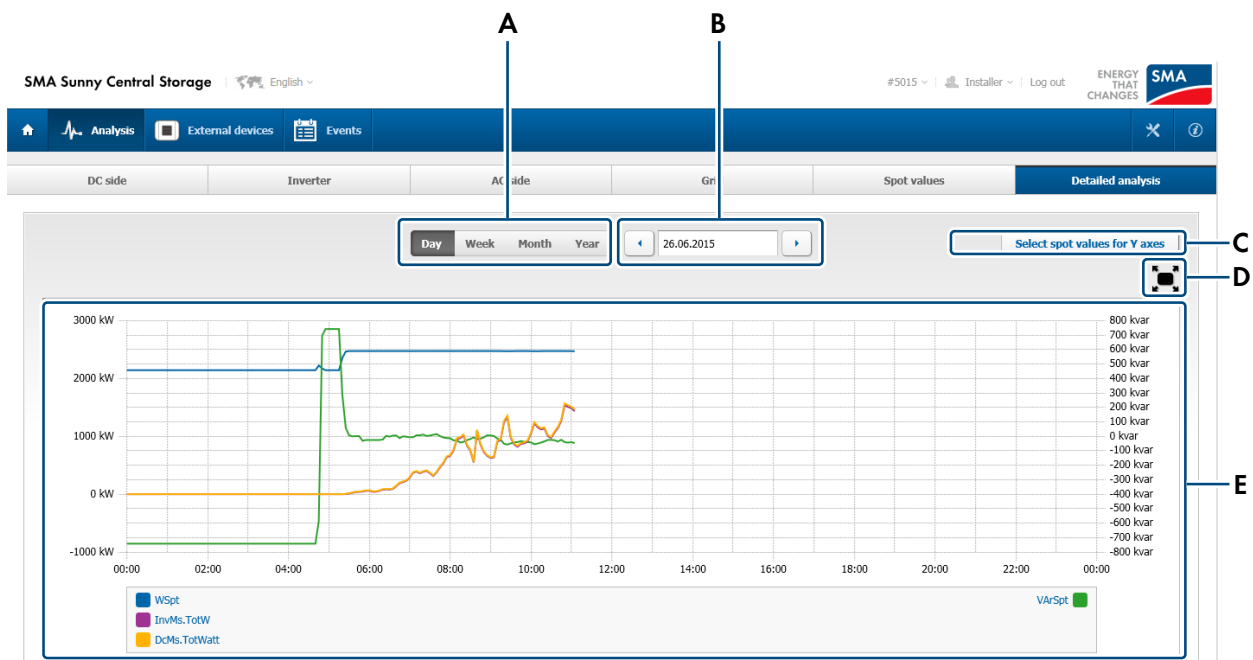


Figure 11: Page **Detail analysis** of the user interface (example)

Position	Explanation
A	Selection of the displayed time period - Day - Display of the selected day from 00:00 a.m. to 11:59 p.m. - Month - Display of the selected month Dates are always displayed from 1 to 31 to avoid any confusion. - Year - Display of the selected year
B	Selecting the period to be displayed You can select the date or the time period either by using the arrow buttons next to the date field or by making a direct entry in the date field.
C	Allocation of instantaneous values to the two Y axes Any number of instantaneous values having the same physical unit can be allocated to each of the Y axes. If instantaneous values have been allocated to each Y axis and a further instantaneous value with a third physical unit is selected, an error message is generated.

Position	Explanation
D	Enlarging the diagram to full screen If you move the mouse pointer over the diagram, the detail values of each curve are shown in a legend window. As soon as you take the mouse pointer or your finger off the content area of the diagram, the legend window is hidden.
E	Representation of the selected instantaneous values in the diagram You can see which instantaneous value is allocated to which curve by the legend. The displayed instantaneous values can be disabled by clicking the instantaneous values in the legend.

4.5 External Devices

On the page **External devices**, all connected external devices are shown in a list. The IP address, device name and device status are displayed for each external device. The device status shows whether there is a connection from the device to the inverter communication unit or not.

Select an external device to display the corresponding parameters and instantaneous values. When this is done, the parameters and instantaneous values can be filtered by the targeted search.

The battery operating data displayed on the **Instantaneous values** and **Parameters** pages are universally valid values and do not depend on the battery manufacturer. The instantaneous values and battery parameters that do depend on the battery manufacturer are shown on the **External devices** page in the form of an external communication unit. Communication with the battery is set up during commissioning and has been defined by a specific Modbus profile. The designations, parameters and instantaneous values displayed there depend on the battery type used.

4.6 Events

All events and disturbances which have occurred are listed in the Events list.

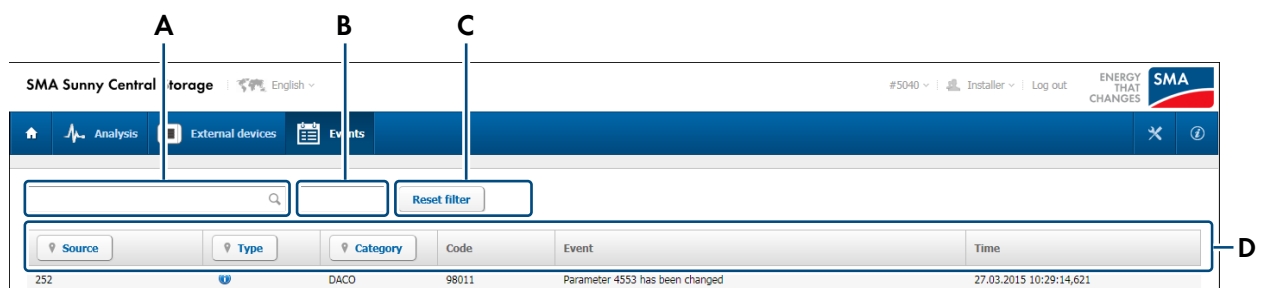


Figure 12: Events dialog

Position	Explanation
A	Search field for targeted search of events. The search function refers to the column Event or Code .
B	Selection of the day the events of which are to be displayed in the center of the list. The list continues above and below this central area.

Position	Explanation
C	Reset of the filter configured in the event list
D	List of events For each event, the following information is displayed: • Source - Indication of the device in which the event was generated • Type - The event type is represented by symbols. • Category - Detailed localization of the event at the given source • Code - The event number serves as an orientation aid for Service. • Event - Description of the event • Time - Time when event occurred

The type of event can be identified by the displayed symbol:

Icon	Explanation
	An event of subordinate priority, e.g. a parameter change or user login, has occurred in the inverter. Events of this type do not influence feed-in operation.
	A warning has occurred in the inverter. Warnings do not influence the inverter feed-in operation. The cause of the warning must be remedied.
	An error has occurred in the inverter. Feed-in operation of the inverter is interrupted. The cause of the error must be remedied and the error acknowledged.
	Incoming event; the cause is still present
	Going event; the cause is no longer present

Category of events

Localization abbreviation	Exact localization
NETW	Network daemon
FLR	File system observer
STUP	Startup manager
STTM	Status manager parameter
PARI	Import/Export
TM	Time
PRTL	Sunny Portal
MMST	Modbus master
DCMO	DC monitoring
IOM	I/O manager
LOG	Data logger

Localization abbreviation	Exact localization
BATC	Battery controller
MSLV	Modbus slave
UPD	Update
SMGR	Session manager
FTPP	FTPpush
ALR	Alarm
DACO	DataCollector
CONT	SC30CONT

4.7 Diagnosis

The diagnosis page is divided into two sections: service information and management of Modbus connections.

Diagnosis

▼ Service information

Please select a time period (max. 14 days)

Start date: 29.06.2019 End date: 02.07.2019 Download Send

► Overview of the Modbus connections (1)

► Blocked Modbus connections (0)

▼ Modbus whitelist (2)

IP address	GSM	Read	Write	
10.2.0.195	☐	☒	☒	Delete
10.200.3.36	☒	☒	☒	Delete
	☐	☐	☐	OK

Start learning mode Save Delete

► Profile information

Figure 13: Page Diagnosis of the user interface (example)

Position	Description
A	Service information You can download and store relevant service information on your computer. In addition, you can send this data directly to the Service department. A maximum period of 14 days can be selected.
B	Management of Modbus connections The Modbus connections area can only be viewed if you are logged in as an installer. The following information about the PV module database is shown in this area: - Overview of the Modbus connections: All active, accepted Modbus connections are shown. - Blocked Modbus connections: All Modbus accesses from unaccepted IP addresses are shown. It is possible to accept the IP addresses and add them to the Modbus whitelist. - Modbus whitelist: All accepted IP addresses with the corresponding rights are shown. Only Modbus commands from accepted IP addresses are permitted to ensure system security. To create the Modbus whitelist, the learning mode is enabled (e.g. after commissioning or firmware update). The learning mode starts automatically after the first Modbus access. It is active for 24 hours. The IP addresses of all devices that have accessed the product, are automatically transferred to the Whitelist during that time. Information on access permissions (read or write) or whether an NSM control command was used is also added to the list. To create the Modbus Whitelist, a learning mode is started after the first Modbus access after commissioning. All IP addresses from which Modbus commands are sent are included in the list of blocked Modbus connections and must be accepted. To extend the Modbus whitelist, the learning mode can be restarted or IP addresses can be added to the list manually. - Profile information: All loaded Modbus profiles that can be accessed are shown.

4.8 Configuration Options

4.8.1 Parameters

The **Parameter** page can only be viewed if you are logged in as an installer.

On the Parameters page those parameters can be changed which are accessible to the currently logged-in user. The parameters are displayed in various constellations.

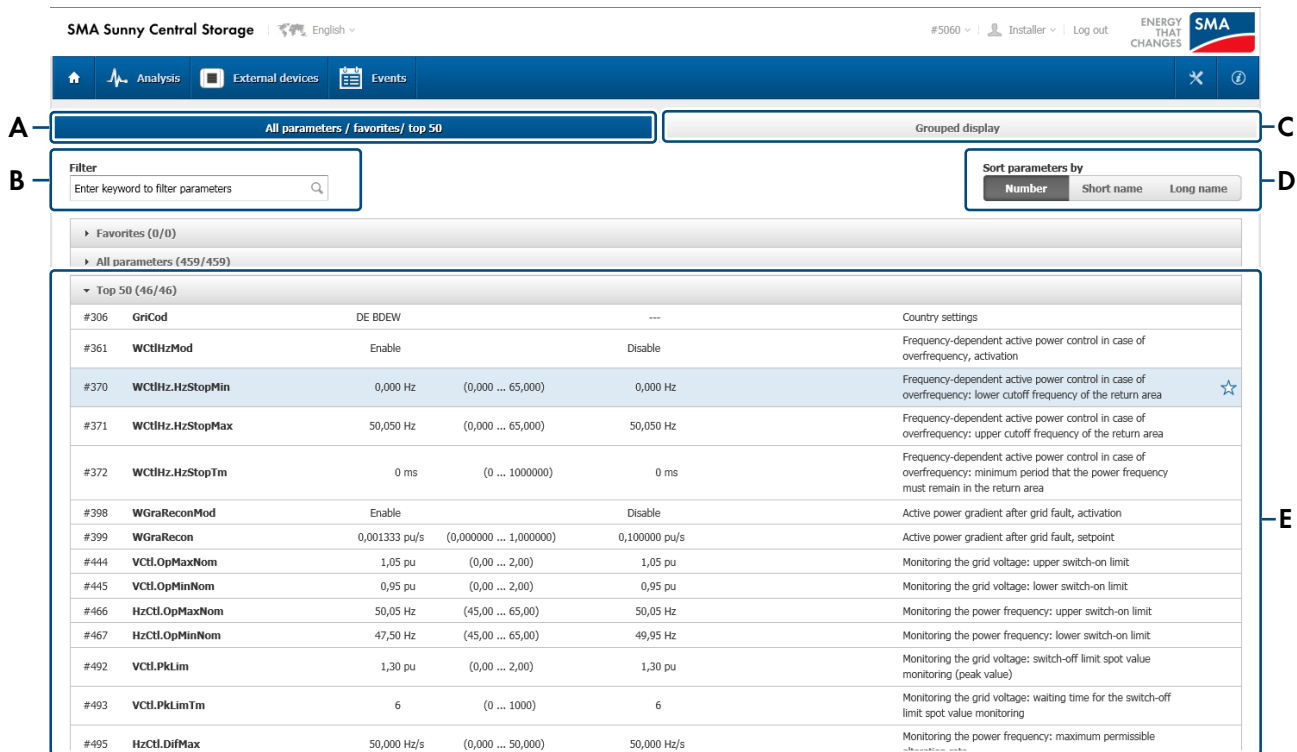


Figure 14: Page **Parameters** of the user interface

Position	Explanation
A	Display of parameter lists All parameters , a list with user-defined Favorites or a pre-defined list of the Top 50 parameters can be displayed.
B	Search field for the targeted search of parameters. The search function refers to the numbers, long and short names. Additionally, you can search for the numbers of the parameters in the user info line. The search function is not available for the grouped parameters.
C	Display of grouped parameters The parameters are grouped by default under various headings. It is possible that certain parameters are allocated to several groups.

Position	Explanation
D	Sorting of the parameters according to their long and short names as designated in this document, and by number. Sorting takes place by lines, the columns always remain in the same order. The sort function is not available for the grouped parameters.
E	Parameter overview Depending on the display type selected, a list with parameters or the categories of grouped parameters organized in a tree structure will appear. For each parameter, the short name, number, set value, unit, possible configuration range, long name and favorite status are displayed. You can enable a parameter by clicking on the line. If you possess write privileges for the given parameter, an input field or drop-down list will open. A star appears at the end of the line for enabled parameters. By clicking on the star, you can mark this parameter to include it in Favorites. Once the parameter change is saved, a check mark appears in the line. This check mark is displayed until the next logout. If a parameter change has not been saved, a red "X" appears in the line and an error message appears above the input field. In this case, the parameter is still highlighted. The parameter will only revert to an inactive state when the parameter has been changed successfully or the change has been canceled.

4.8.2 Update

One update package each is brought to the inverter for a firmware update. This update package contains updates for the individual assemblies of the inverter. When updating, there is not a new version for the individual assemblies in every update, so that the assemblies can have different version statuses.

The currently installed firmware version is displayed for the **Installer** user group on the update page.

For this, the version number of the installed update package is specified in the **Update version** column and the firmware version of the respective assembly is in the **Current version** column.

4.8.3 Import

4.8.3.1 Import Concept

If you are logged in as the installer, you have the option of importing various data sets:

Data type	Explanation
Favorites	Import of favorite lists of instantaneous values and parameters
Modbus profile	Import of Modbus profiles
Parameters and settings	Import of parameters. The parameter file can contain the entire parameter list including IP addresses of the inverter, the entire parameter list excluding IP addresses of the inverter, or individual parameters.

File imports are performed via a menu dialog in the web browser via which you can select a file saved on the computer.

In the first step of the import function, the selected import file is uploaded to the internal cache. In the second step, the import file can be imported from the internal cache to the given application or deleted from the internal cache. If you do not delete the file, it will be retained in the internal memory and can be used as a backup copy.

4.8.3.2 Structure of the Import Page

On the page **import**, the data types that can be imported are displayed. Once you have selected the type of file to be imported, a page opens in which you can select the file to be imported.

4.8.4 Export

4.8.4.1 Export Concept

If you are logged in as the installer, you have the option of exporting various data sets:

Data type	Explanation
Event log files	Export of the user-role-specific events for a selected time period
Favorites	Export of the list of favorites. The settings assigned to the favorites are not exported.
Modbus profiles	Export of Modbus profiles
Parameters and settings	Export of parameters and their assigned settings. Here, different formats can be selected: • Cloning: The parameters and settings are exported without the IP address of the inverter. • All: All parameters and settings are exported. • Selection: The specific parameters to be exported can be selected from a list.
CSV files	Export of the instantaneous values
Open source licenses	Export of the used open source licenses
Service information	Export of service information. These files are not accessible for customers.

In the first step of the export process, an export file is generated from the selected data. The export file is written to the internal cache and the size of the generated file is displayed on the user interface. In the second step, the export file can be downloaded from the internal cache or deleted. If you do not delete the file, it will be retained in the internal memory and can be used as a backup copy.

4.8.4.2 Structure of the Export Page

On the page **Export**, the data types that can be exported are displayed. Once you have selected the type of file to be exported, a page opens in which you can select the file to be exported.

4.8.5 File Manager

The saved files from the inverter are listed on the **File manager** page. The following information is shown to you for each file:

Designation	Explanation
Source	Event information that was saved in the file. The following events are possible: EVENTLOG: Protocol of the events that have occurred INVERTERLOG: Recorded measuring data LICENSE: License file MODBUS: Modbus profile of the individual devices UPDATE: Update file FAVORITES: List of the saved favorites PARIMEX: Imported and exported parameter lists
File name	Name of the file
Date changed	Time point of the last change to the file
File size	Size of the created file

You can save or delete individual files. When saving, you have the option to save the files on an external storage medium or download them to the computer. Deletion is recommended so that the inverter's internal storage will always have enough space for the files to be saved. When deleting, it is ensured that system-relevant files are not deleted.

4.8.6 Setup Assistant

4.8.6.1 Concept of the Setup Assistants

The setup assistants support the user in performing certain procedures, e.g. commissioning. They enable you to make the necessary configurations in a step-by-step process. This ensures that all the parameters required for the given procedure can be set.

You can choose the required assistant from a list of available setup assistants. Once you have chosen the appropriate setup assistant, the overview page opens.

You need to perform each consecutive step given in the setup assistant. It is also possible to return to previously executed steps without canceling the entries you have already made. On the last page of the setup assistant, all entries are again displayed in a summary. The entries can only be saved when all steps have been executed. It is possible to exit the setup assistant after each step. Any entries made up to this point will not be implemented.

4.8.6.2 General Setup Assistant

In the General Setup Assistant you can enter the system time and the network addresses, and make localization settings.

The overview page of the General Setup Assistant provides a summary of the steps to be performed:

1. **Time** - Input of time, date and time zone. After this step, the entries are immediately saved and the inverter operates with the configured time.
2. **Name** - Input of a name for the inverter
3. **Localization** - Definition of display formats for time, date, thousands separator, decimal separator and the first day of the week
4. **Network setting LAN 2** - Input of the network configuration for the LAN 2 interface.
5. **Network setting LAN 3** - Input of the network configuration for the LAN 3 interface.

6. **Managed switch** - Input of the network configuration for the optional managed switch.
7. **Summary** - Display of all entries made. Any fields in which changes have been made are color-highlighted. Apart from the settings in **Step 1**, it is possible to change all entries.

4.8.7 Restart & reset

The **Restart & reset** page can only be viewed if you are logged in as an installer.

On this page, you can restart the system or load default settings partially.

Restart: All services are terminated. The communication unit is stopped and restarted.

Reload default settings partially: All data and settings (except network settings) are rejected. The communication unit is restarted, including default settings and existing network settings. The device-specific parameterization is overwritten.

4.9 Information

In the dialog box **Information** the most important data on the identification of the converter are displayed. There is information relating to the inverter and network-relevant information.

The license texts of the Open Source Elements used for this product can be downloaded via a link.

Information :	
System	Network
Device type: KVA2200 V385 IEC V1100 SCS	LAN 1 (IP): 192.168.100.1
Serial number: 11111105	LAN 2 (IP/MAC): 10.177.1.140 [00-40-ad-93-31-ac]
Software package: 03.00.25.B	Switch (IP/MAC): 172.24.1.91 [ec-e5-55-91-a6-48]
Operating time: 1 Day(s) 00:25:55	LAN 3 (IP/MAC): 172.16.1.51 [00-40-ad-93-31-ad]
Open source licenses (approx. 500 kB)	

Figure 15: Dialog box **Information** (example)

5 Additionally required material

The required material listed in the following sections are not included in the scope of delivery.

5.1 Additionally required mounting material

Prepare fastening holes for installing the product on the mounting holes in the base (see Section 6.6, page 52)

- ☐ 4 x suitable concrete anchors

Attach the inverter to the foundation (see Section 6.8.1, page 55)

- ☐ 4 x clamping plates
- ☐ 4 x washers
- ☐ 4 x screws
- ☐ 4 x concrete dowels

Fasten the product to the mounting holes in the base (see Section 6.8.2, page 57)

- ☐ 4 x screws suitable for the concrete anchors
- ☐ 4 x suitable washers

5.2 Additionally required installation material

General Installation Material

- ☐ Clean cloth
- ☐ Ethanol cleaning agent

Connecting the Foundation Ground Arrangement(see Section 7.4.2.3, page 65)

- ☐ 1 x single-hole terminal lug M12 or 2 x single-hole terminal lug M12
- ☐ Nut M12
- ☐ Screw M12
- ☐ Conical spring washers M12
- ☐ Fender washers M12

Connecting Protective Grounding of MV Transformer(see Section 7.4.3.3, page 67)

- ☐ Grounding cable for the protective grounding of the MV transformer
- ☐ One-hole terminal lugs M8 (quantity depends on the number of grounding cables to be connected)
- ☐ Nuts M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Screws M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Spring washers M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Fender washer M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Two-hole terminal lugs M12 (quantity depends on the number of grounding cables to be connected)

Connecting the Grounding for Reduction of the Radiant Interference Emission (see Section 7.4.4.3, page 68)

- ☐ 7 x ribbon cables, minimum cross-section: 16 mm²
- ☐ 7 x screws M12

- ☐ 7 x spring washers M12
- ☐ 7 x fender washers M12

Installing the AC Connection (see Section 7.6.3, page 81)

- ☐ 12 x screw (M12)
- ☐ 12 x nut (M12)
- ☐ 24 x conical spring washer
- ☐ 24 x fender washer

In France: Mount Ronis lock on the AC circuit breaker by Eaton

- ☐ Ronis lock. Information on the installation of the lock can be found in the document **IL01301040E** at <https://www.eaton.com>.

5.3 Additionally Required Material for Disconnecting the Inverter

- ☐ 3 x padlocks. Diameter of the shackle: 5 mm to 8 mm
One lock each is needed for the switch **-Q61** and **-Q62** as well as for the AC disconnection unit by Eaton if necessary.
- ☐ Grounding and short-circuiting equipment

5.4 Additionally Required Maintenance Material

- ☐ Brush for removing dust deposits
- ☐ Vacuum cleaner
- ☐ Angled telescopic mirror for inspecting the air duct
- ☐ Micro-ohmmeter
- ☐ Talcum, petroleum jelly or wax
- ☐ Non-greasing antifreeze agent, e.g. PS88
- ☐ Abrasive cloth
- ☐ Degreaser
- ☐ Suitable water-free, heat-resistant lubricant, e.g. WD40
- ☐ Use touch-up stick in the appropriate RAL color to repair small-area surface damage.
- ☐ Replacement fuse

6 Transport and Mounting

6.1 Safety during Transport and Mounting

WARNING

Danger of crushing if raised or suspended loads tip over, fall or sway

Vibrations or careless or hasty lifting and transportation may cause loads to tip over or fall. This can result in death or serious injury.

- Follow all national transportation standards and regulations.
- Before each transport, inspect the product for rust and visible deformations. If necessary, take safety measures.
- Never allow anyone to walk or stand under a suspended load at any time.
- Always transport the load as close to the ground as possible.
- Use all suspension points for transportation.
- Use the tie-down and crane points provided for transportation.
- Avoid fast or jerky movements during transport.
- Always maintain an adequate safety distance during transport.
- All means of transport and auxiliary equipment used must be designed for the weight of the product.
- Wear suitable personal protective equipment for all work on the product.

CAUTION

Danger of crushing and collision when carelessly working on the product

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

CAUTION

Risk of injury when releasing the tie-down straps

Since there is tension on the tie-down straps, there is a risk of whiplash when they are released. This can result in cuts or crushing of limbs.

- Ensure that the tie-down straps cannot whiplash.
- Observe all manufacturer instructions on handling the tie-down straps.

CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

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

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

- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- Do not open the product during a dust storm or precipitation.
- In case of interruption of work or after finishing work, mount all enclosure parts and close and lock all doors.
- Only operate the product when it is closed.
- Store the closed product in a dry and covered location. Observe storage conditions.
- The temperature at the storage location must be in the specified range. The temperature range is: -40°C to $+70^{\circ}\text{C}$.

NOTICE**Damage to the frame construction due to uneven support surface**

If the product is set down on uneven surfaces, components may distort. This may lead to moisture and dust penetration into the components.

- Never place the devices on an unstable, uneven surface even for a short period of time.
- The unevenness of the support surface must be less than 0.25%.
- The support surface must be suitable for the weight of the product.

NOTICE**Damage due to intake of exhaust air or blocked ventilation openings**

The supply air is intended to cool the product components. Failure to observe the specified minimum clearances can result in warm exhaust air from other devices being drawn in. This increases the risk of a thermal short circuit. Property damage due to yield loss and damage to the components may result.

- Ensure that no exhaust air can be drawn in.
- Ensure that it is not possible for exhaust air to be drawn into the air intake of other devices.
- Make sure that the ventilation openings are not obstructed.
- Make sure that the ventilation openings are accessible for cleaning at all times.
- Ensure that the minimum clearances are complied with.

6.2 Requirements for Transport and Mounting

6.2.1 Requirements for Mounting and Ambient Conditions

- ☐ The requirements for the ambient conditions must be complied with (see Section 17.1, page 258).
- ☐ The requirements for the foundation must be complied with (see Section 17.4, page 262).
- ☐ Minimum clearances must be observed (see Section 17.3, page 261).

6.2.2 Requirements for Transport

i Requirements for transport routes and means of transport

The product complies with the requirements of 2M4 in accordance with IEC 60721-3-2:2018. The transport routes and means of transport must be such that they comply with the requirements described in the standard.

Requirements for transport routes:

- ☐ A possibility for a truck and the mobile crane to turn must be available.

- ☐ The transport routes and crane space must be designed for the truck and mobile crane used.
- ☐ The transport routes must be designed to handle the maximum gross axle weight rating.
- ☐ The transport routes must be passable year-round.

6.3 Center of Gravity Marker

The center of gravity is not in the middle of the product. Take this into consideration during transport of the product. The product's center of gravity is marked on the packaging and on the enclosure with the center of gravity symbol.



Figure 16: Center of gravity symbol

6.4 Storage

If you need to store the product prior to final installation, note the following points:

NOTICE
Damage to the product due to sand, dust and moisture ingress Sand, dust and moisture penetration can damage the product and impair its functionality. • Only open the product if the humidity is within the thresholds and the environment is free of sand and dust. • Do not open the product during a dust storm or precipitation. • In case of interruption of work or after finishing work, mount all enclosure parts and close and lock all doors. • Only operate the product when it is closed. • Store the closed product in a dry and covered location. Observe storage conditions. • The temperature at the storage location must be in the specified range. The temperature range is: -40°C to $+70^{\circ}\text{C}$.

i Desiccant bag in the inverter

The desiccant bag in the inverter protects the electronic components from moisture. The desiccant bag must be replaced by a new desiccant bag included in the scope of delivery one day before commissioning.

The commissioning is delayed by one day if the desiccant bag has not been replaced in the 24 hours prior to commissioning. Additional travel costs for SMA service personnel must be paid by the customer.

i Storage more than 2 months

In order to protect the electronic components against moisture, the desiccant bag in the inverter must be replaced every 2 months. If necessary, desiccant bags can be ordered from SMA Solar Technology AG using the following material number: 85-0081.

i Storage more than 18 months

If the product is stored for more than 18 months, measures other than those described here must be taken. You can get the required information from SMA Solar Technology AG.

6.5 Securing the product for transport

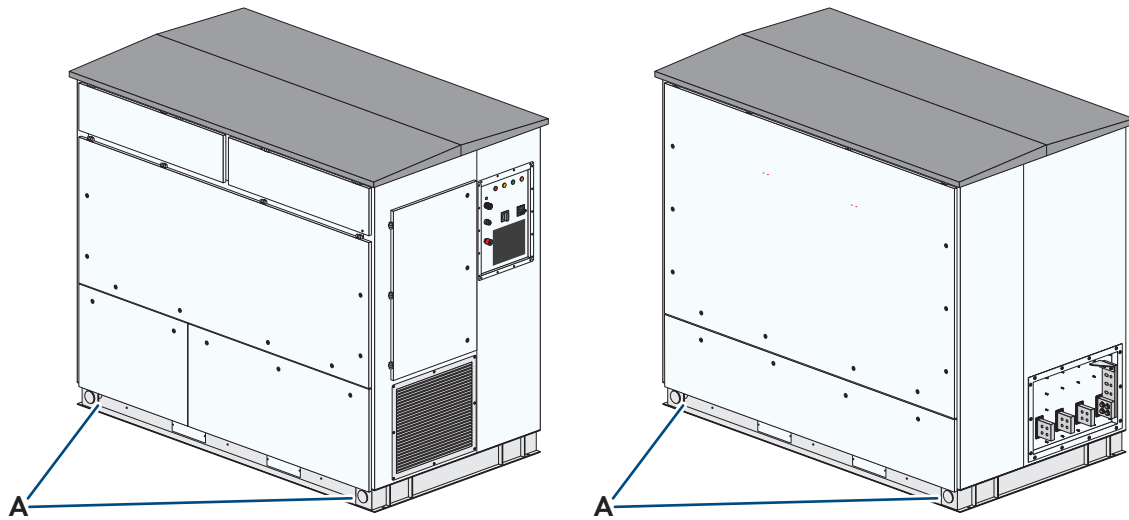
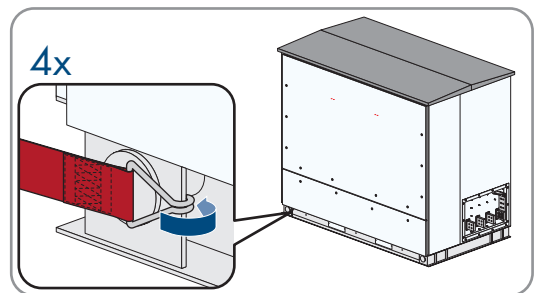


Figure 17: Position of the suspension points for the transport locks

Position	Designation
A	Suspension points for the transport locks

Procedure:

- Attach transport locks to the suspension points and to the means of transport.



6.6 Preparing fastening holes for installing the product on the mounting holes in the base

The product can be attached with 4 screws through the base on the foundation. For this, there are mounting holes in the base of the product for anchoring to the support surface.

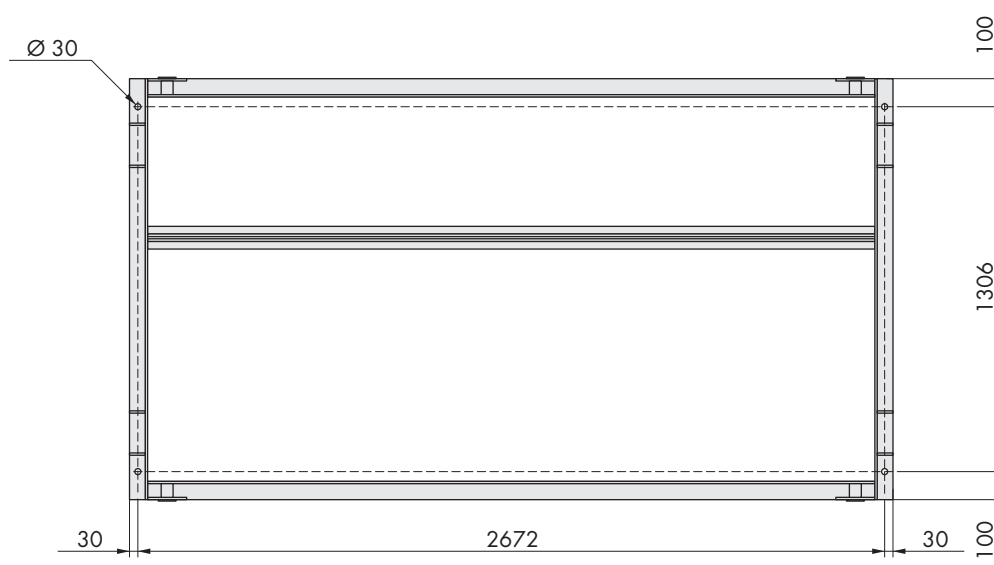


Figure 18: Position of the anchoring points (Dimensions in mm)

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

- 4 suitable concrete anchors

Procedure:

1. Mark position of the anchoring points on the support surface.
2. Drill the fixing holes at the marked positions. The recommended diameter is: 25 mm.
3. Press the concrete anchors into the drill holes.

6.7 Transporting and mounting the product

6.7.1 Unloading product with the forklift

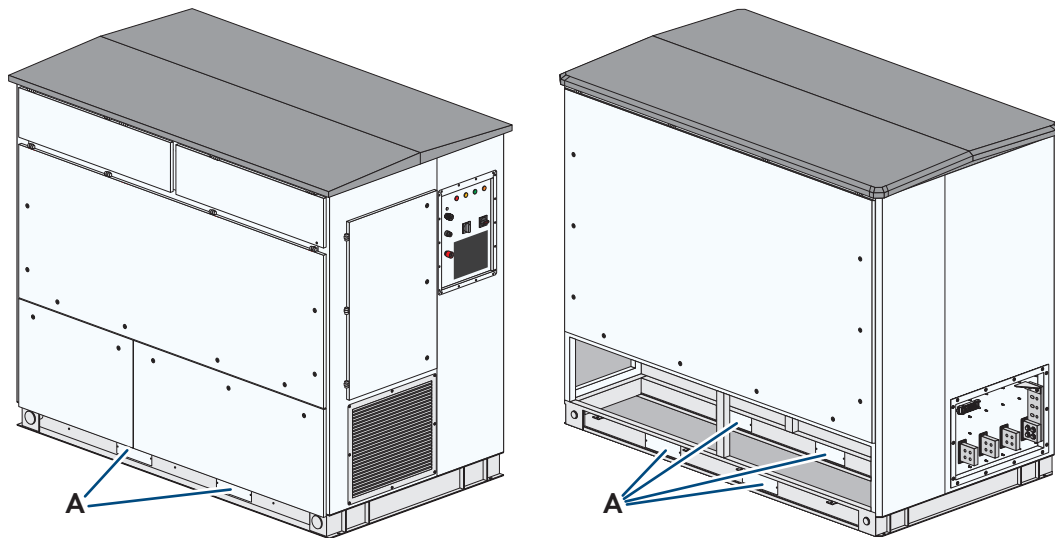


Figure 19: Position of the protective covers

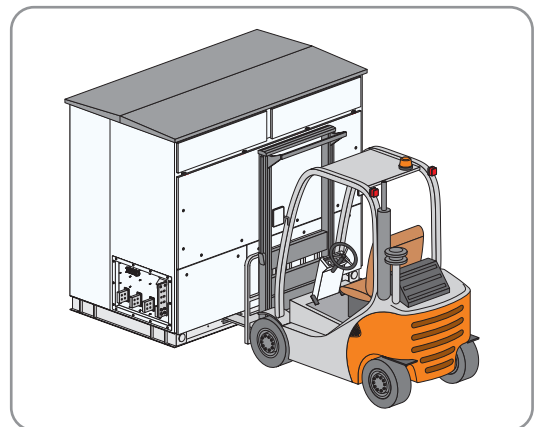
Position	Designation
A	Protective covers

Requirements:

- ☐ The forklift is designed for the given weight. The weight of the product with packaging is: < 3800 kg.

Procedure:

1. Disassemble panels on the product (see Section 13.2.1, page 170).
2. Prior to the final mounting of the product, remove the product from the transport pallet. To do so, remove the 4 screws (M14) in the base area of the product.
3. Move the fork prongs of the material-handling equipment under the product from the front or from the back. The fork prongs must protrude on the other side.



4. Secure the product against tipping, e.g. with tie-down straps.
5. Lift the product slightly. Take the center of gravity of the product into account.
6. Transport the product to its final position as close to the ground as possible.
7. Insert the DC cable and cables for the communication, control and monitoring into the product while lowering the product, e.g. with a tube snake.
8. Set the product down.

9. Mount the protective covers from the scope of delivery before the transport openings. This will protect the product from animals entering it. Use a Torx screwdriver.
10. Mount panels on the product (see Section 13.2.1, page 170).

6.7.2 Unloading product with the crane

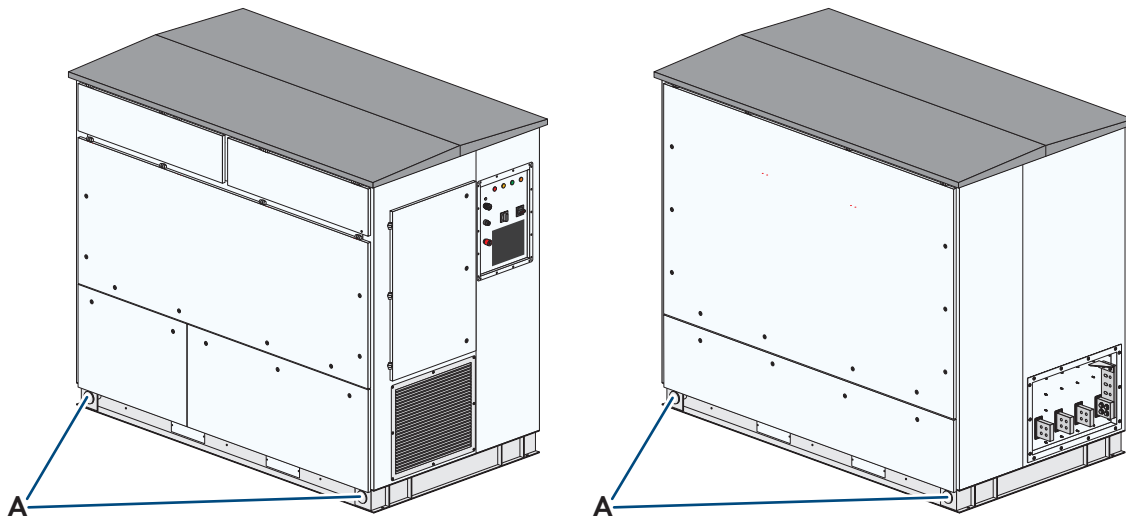


Figure 20: Position of the suspension points

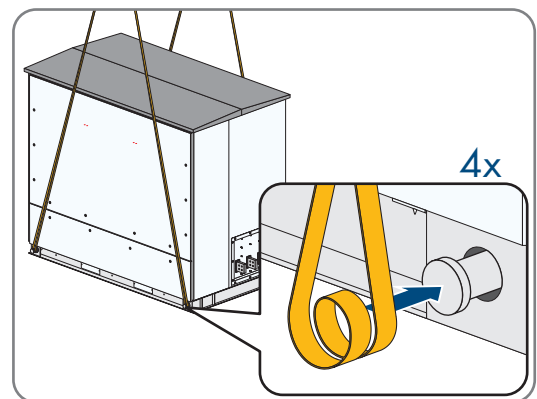
Position	Designation
A	Suspension points

Requirements:

- ☐ Crane and hoist are designed to take the given weight. The weight of the product with packaging is: < 3800 kg.
- ☐ Endless loop straps are used.
- ☐ The hoist is properly attached to the crane.
- ☐ A traverse is used that is long enough so that the sling gear does not touch the roof of the product during transport.

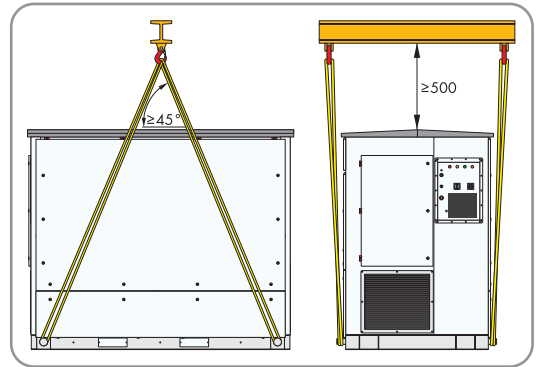
Procedure:

1. Disassemble panels on the product (see Section 13.2.1, page 170).
2. Pull the suspension points out of the enclosure.
3. Attach the endless loop straps to the suspension points. Lead the endless loop straps around the suspension points twice.



4. Tighten the endless loop straps.
5. Ensure that the hoist is attached correctly.

6. Lift the product slightly. The angle between the sling gear and the ground must be at least 45° and the minimum distance between the traverse and the roof of the product must not be undercut. The minimum clearance is: 500 mm.



7. Transport the product to its final position as close to the ground as possible.
 8. Insert the DC cable and cables for the communication, control and monitoring into the product while lowering the product, e.g. with a tube snake.
 9. Set the product down.
 10. Release the sling gear.
 11. Reinsert the suspension points in the enclosure.
 12. Mount panels on the product (see Section 13.2.1, page 170).

6.8 Attaching to the Support Surface

6.8.1 Attaching the product to the foundation

After mounting, the product can be fastened to the foundation using clamping plates.

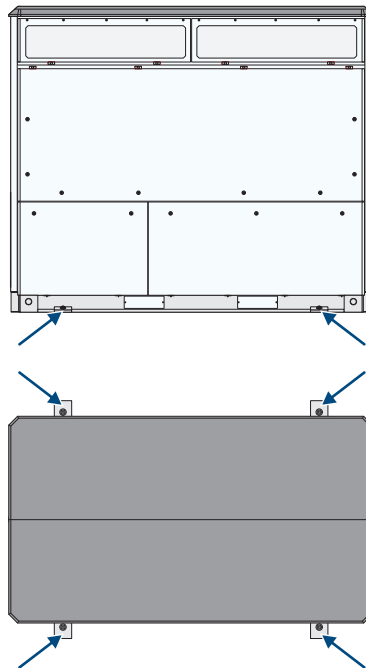


Figure 21: Recommended position of the anchoring points on the product

The clamping plates must be provided by the customer.

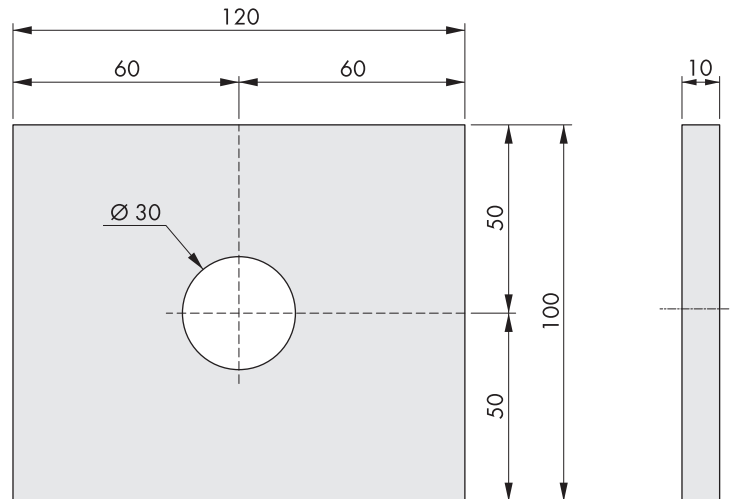


Figure 22: Recommended dimensions of the clamping plate (Dimensions in mm)

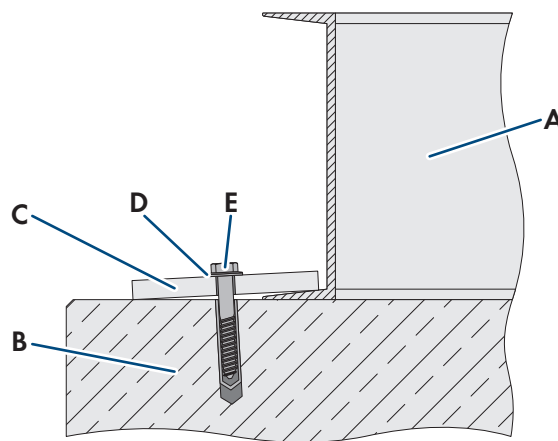


Figure 23: Structure of attachment with clamping plate

Position	Designation
A	Substructure of the product
B	Support surface (foundation or ballast bed)
C	Clamping plate
D	Washer for attachment to the foundation
E	Screw for attachment to the foundation Ground anchor for attachment to the ballast bed

Requirement:

- ☐ The product must be mounted on the foundation.

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

- ☐ 4 clamping plates
- ☐ 4 washers
- ☐ 4 screws
- ☐ 4 concrete dowels

Procedure:

1. Check whether the base of the product is deformed. If there are any deformations, contact SMA Service and find out whether the functionality of the product is impaired.
2. Drill the fixing holes in the foundation.
3. Insert the concrete dowels into the fixing holes.
4. Insert the screws with the washers into the clamping plates.
5. Insert the screws with the washers into the fixing holes in accordance with the required assembly and tighten them with the required torque. The torque depends on the screw size and material.

6.8.2 Fastening the product to the mounting holes in the base

The product can be attached to the foundation on the mounting holes in the base of the product.

Requirements:

- ☐ The fixing holes must be drilled (see Section 6.6, page 52). The recommended diameter is: 25 mm.
- ☐ Suitable concrete anchors must be inserted into the fixing holes.
- ☐ The product must be mounted on the foundation.

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

- 4 x screws suitable for the concrete anchors
- 4 x suitable washers

Procedure:

- Insert the screws with the washers into the fixing holes and tighten them with the required torque.

6.9 Disposing of Packaging Materials

Packaging material consists of valuable materials that can be reclaimed as secondary raw materials.

The following materials are used when packing the product:

Packaging	Material
Transport pallets	Softwood Steel nails
Transport case ¹⁾	Water-resistant glued plywood and solid wood Steel nails
Foil-cover around the product in the transport case	Aluminum composite foil consisting of: • 12 µm PET foil • 12 µm aluminum • 75 µm HDPE
Padding of the product in the transport case	PE foam made of LPDE
Desiccant to absorb the excess moisture	Clay or white gel in a fleece cover
Folding cartons	Corrugated cardboard made partly of waste paper
Bubble wrap	LDPE
Strapping tape	PET

¹⁾ Only for transport by sea

Procedure:

- Dispose of the packaging materials in accordance with the local directives.

7 Installation

7.1 Safety during Installation

DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

DANGER

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

DC cables connected to a battery are live. Touching live DC cables results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Prior to connecting the DC cables, ensure that the DC cables are voltage-free.

DANGER

Danger to life by electric arc when there is a reverse-poled connection of the DC cables

A reverse-poled connection of the DC cables can cause an electric arc. Electric arcs can result in death or serious injury.

- Ensure that the polarity of the DC cables is correct prior to connection.

⚠ WARNING**Danger to life due to fire when failing to observe torque specifications on live bolted connections**

Failure to follow the specified torques reduces the ampacity of live bolted connections and the contact resistances increase. This can cause components to overheat and catch fire. Death or lethal injuries can result.

- Ensure that live bolted connections are always tightened with the exact torque specified in this document.
- Ensure that the terminal lugs used do not exceed the maximum material thickness. In this way, you avoid that the screws supplied are too short for the installation and that the required torque cannot build up.
- Only use suitable tools when working on the device.
- Avoid repeated tightening of live bolted connections as this may result in inadmissibly high torques.

⚠ WARNING**Danger to life due to arc fault caused by damaged connection busbars**

If excessive force is exerted while connecting the cables, the connection busbars can be bent or damaged. This will lead to reduced clearances and creepage distances. Reduced clearances and creepage distances can lead to arc faults.

- Cut the cables to the correct length and prepare them for connection.
- Position the terminal lugs on the connection busbars ensuring a large contact surface.
- Tighten to the specified torque.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

NOTICE

Damage to electronic components due to electrostatic discharge

Electrostatic discharge can damage or destroy electronic components.

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

i DC-side disconnection

If the battery has no fuse switch-disconnector or circuit breaker, a fuse switch-disconnector or circuit breaker must be installed between the battery and the inverter which is able to securely switch off the short-circuit current of the battery under fault conditions.

i Cable route

Communication cables must be laid separately from the DC cables.

7.2 Replacing the Desiccant Bag in the Inverter

Desiccant bags absorb moisture formed during transport.

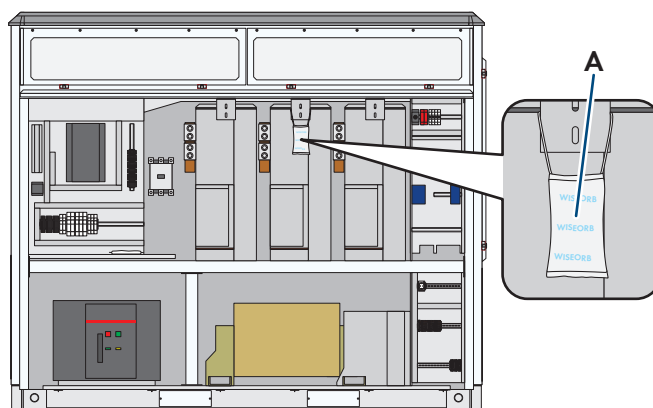


Figure 24: Position of desiccant bag

Position	Designation
A	Desiccant bag

i Desiccant bag in the inverter

The desiccant bag in the inverter protects the electronic components from moisture. The desiccant bag must be replaced by a new desiccant bag included in the scope of delivery one day before commissioning.

The commissioning is delayed by one day if the desiccant bag has not been replaced in the 24 hours prior to commissioning. Additional travel costs for SMA service personnel must be paid by the customer.

Procedure:

1. Remove and dispose the desiccant bag.
2. Remove the supplied desiccant bag from the foil and attach it in the same position.
3. Remove the desiccant bag in the inverter on the day of commissioning.

7.3 Design of the Bolted Connections

Assembly of the bolted connection with two-hole terminal lugs

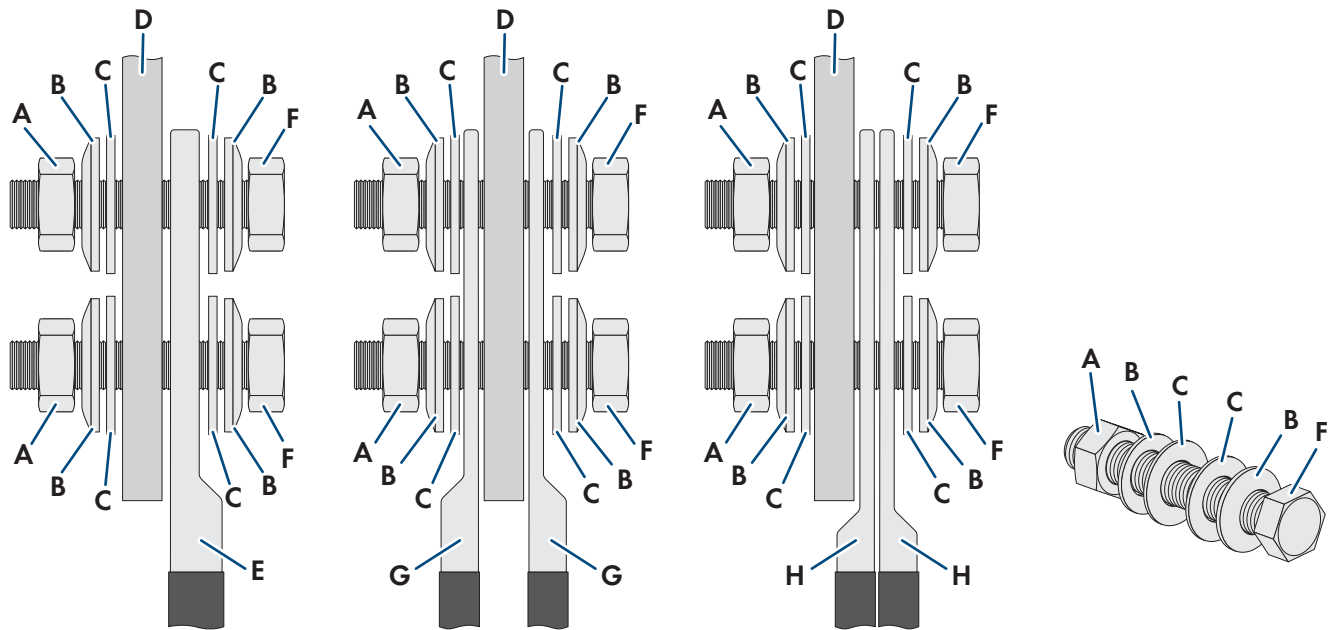


Figure 25: Assembly of the bolted connection

Position	Designation
A	Nut
B	Spring washer
C	Fender washer
D	Connection busbar
E	Two-hole terminal lug, maximum material thickness: 22.5 mm
F	Bolt
G	Two-hole terminal lug, maximum material thickness: 11.25 mm, maximum material width: 48 mm
H	Two-hole terminal lug, maximum material thickness: 11.25 mm; minimum material width: 48 mm The minimum contact area of the terminal lug must be observed. Minimum contact area from the center of the lower drill hole to the end of the contact area: 20 mm.

Assembly of the bolted connection with single-hole terminal lugs

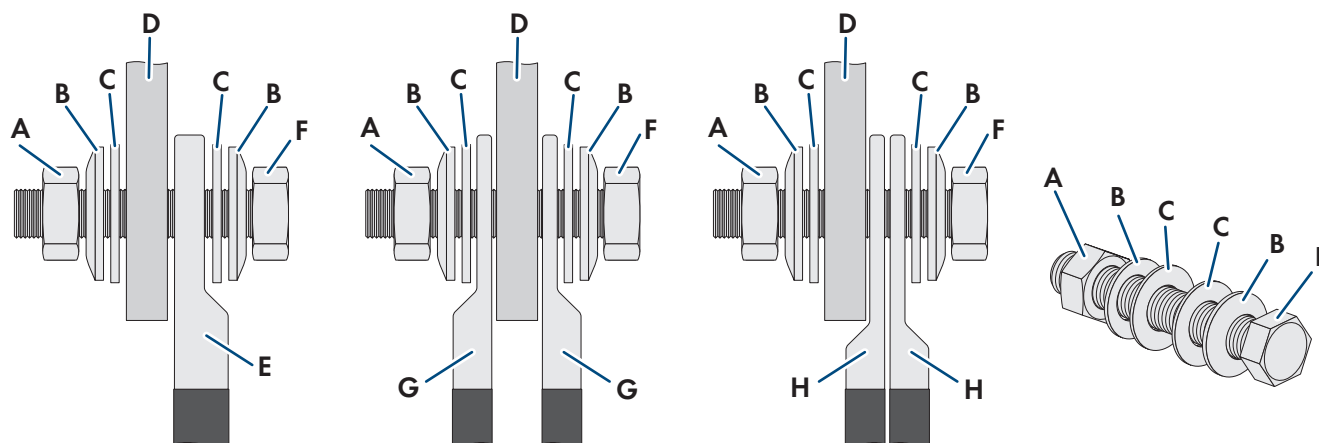


Figure 26: Assembly of the bolted connection

Position	Designation
A	Nut
B	Spring washer
C	Fender washer
D	Connection busbar
E	One-hole terminal lug, maximum material thickness: 22.5 mm
F	Bolt
G	One-hole terminal lug, maximum material thickness: 11.25 mm
H	One-hole terminal lug, maximum material thickness: 11.25 mm; minimum material width: 48 mm The minimum contact area of the terminal lug must be observed. Minimum contact area from the center of the drill hole to the end of the contact area: 20 mm.

7.4 Grounding

7.4.1 Grounding Concept

In accordance with the latest technology, the inverters are discharged to ground. As a result, leakage currents to ground occur which must be taken into account when planning the storage system. The magnitude and distribution of these leakage currents are influenced by the grounding concept of all components in the battery storage system.

The configuration of grounding depends on the project and is the responsibility of the installer.

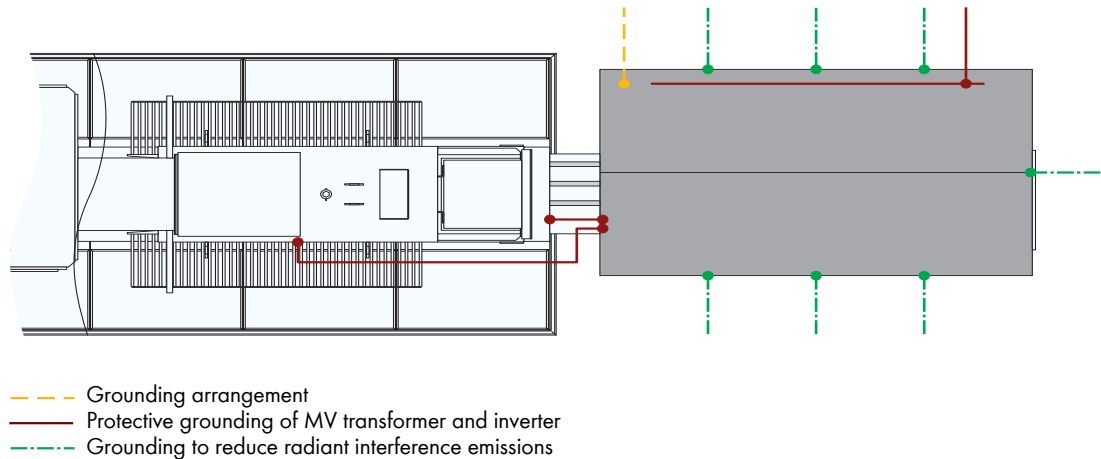


Figure 27: Grounding concept

Grounding arrangement

For protection against hazardous voltages, the inverter must be connected to the grounding arrangement.

Protective Grounding of MV Transformer and Battery

The protective grounding of the MV transformer is led to the inverter and connected there with the grounding arrangement. The protective grounding of the battery depends on the battery manufacturer.

Grounding for Reduction of the Radiant Interference Emission

In order to fulfill IEC 61000-6-4 and IEC 62920 (CISPR 11), both a meshed grounding configuration for the inverter and an MV transformer are required and also signal transmission via optical fiber technology when using cameras and monitoring technology. This will counteract possible interference sources.

7.4.2 Grounding Arrangement

7.4.2.1 Requirements for the Grounding Arrangement

Cable Requirements for the Grounding Connection:

- ☐ All cables must be suitable for temperatures of up 90°C and must be in accordance with the national standards and directives.
- ☐ All cables must be suitable for outdoor applications. They must be resistant to solar irradiation and, if necessary, oil.
- ☐ Use copper or aluminum cables only.
- ☐ The cable cross-sections of the grounding conductor connections depend on the installed overcurrent protective device. Calculating the required cross-sections depends on the national standards and directives.
- ☐ The grounding of the system must be designed in accordance with the national standards and directives and is the responsibility of the installer.

Requirements for the cable connection with terminal lugs:

- ☐ All terminal lugs used must be suitable for temperatures of up 90°C and must be in accordance with the national standards and directives.
- ☐ The maximum material thickness of the terminal lugs must be observed:
 - When connecting with 1 terminal lug: 22.5 mm
 - When connecting with 2 terminal lugs: 11.25 mm

- ☐ The width of the terminal lugs must exceed the washer diameter. This will ensure that the specified torques are effective over the whole surface.
- ☐ Use only tin-plated terminal lugs made from copper or aluminum.
- ☐ The specified torques must always be complied with.

7.4.2.2 Connection Area for the Grounding Arrangement on the Inverter

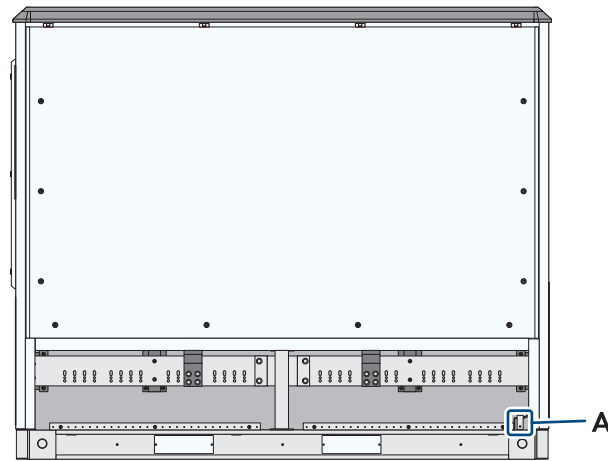


Figure 28: Position of the grounding connections in the inverter

Position	Designation
A	Connection point for the protective grounding of the inverter X103

7.4.2.3 Connecting the Foundation Ground Arrangement

The terminal lugs must be connected according to the recommended bolted connection (see Section 7.3, page 62).

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

- ☐ Clean cloth
- ☐ Ethanol cleaning agent
- ☐ 1 x one-hole terminal lug M12 or 2 x one-hole terminal lug M12
- ☐ Nut M12
- ☐ Screw M12
- ☐ Conical spring washers M12
- ☐ Fender washers M12

Procedure:

1. Ensure that no voltage is present.
2. Strip the cable.
3. Attach a terminal lug to the cable.
4. Clean the contact surfaces of the terminal lug using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
5. Connect the grounding cable to the connection busbar **-X103** in the DC connection area (torque: 60 Nm).
6. Connect the ground cable to the foundation ground.

7.4.3 Protective Grounding of the MV Transformer

7.4.3.1 Requirements for cables and terminal lugs for the protective grounding

Cable Requirements for the Grounding Connection:

- ☐ All cables must be suitable for temperatures of up to 90 °C and must be in accordance with the national standards and directives.
- ☐ Use copper or aluminum cables only.
- ☐ The cable cross-sections of the grounding conductor connections in the AC connection area and for grounding of the MV transformer are dependent on the installed overcurrent protective device. Calculating the required cross-sections depends on the national standards and directives. The following cable cross-sections are recommended:
For copper cable, at least: 240 mm²
For aluminum cable, at least: 400 mm²
- ☐ The grounding of the system must be designed in accordance with the national standards and directives and is the responsibility of the installer.

Requirements for the cable connection with terminal lugs:

- ☐ All terminal lugs used must be suitable for temperatures of up to 90 °C and must be in accordance with the national standards and directives.
- ☐ The maximum material thickness of the terminal lugs must be observed:
 - When connecting with 1 terminal lug: 22.5 mm
 - When connecting with 2 terminal lugs: 11.25 mm
- ☐ The width of the terminal lugs must exceed the washer diameter. This will ensure that the specified torques are effective over the whole surface.
- ☐ Use only tin-plated terminal lugs made from copper or aluminum.
- ☐ The specified torques must always be complied with.

7.4.3.2 Connection Area for Protective Grounding

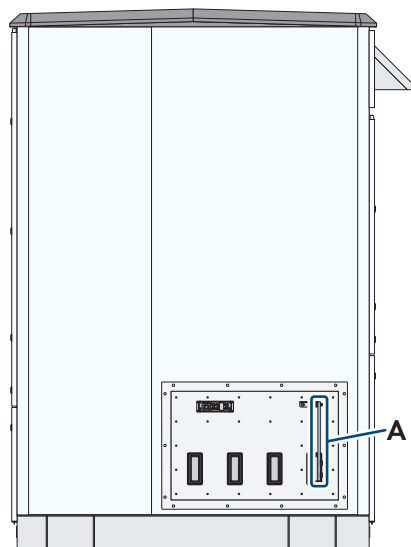


Figure 29: Position of the connection points for protective grounding of the MV transformer and battery

Position	Designation
A	Connection point for protective grounding of the MV transformer X100

7.4.3.3 Connecting the Protective Grounding

The terminal lugs must be connected according to the recommended bolted connection (see Section 7.3, page 62).

Additionally required mounting material for the protective grounding of the MV transformer (not included in the scope of delivery):

- ☐ Clean cloth
- ☐ Ethanol cleaning agent
- ☐ Grounding cable for the protective grounding of the medium-voltage transformer
- ☐ Terminal lugs (quantity depends on the number of grounding cables to be connected)
- ☐ Nuts M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Screws M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Spring washers M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Fender washer M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Two-hole terminal lugs M12 (quantity depends on the number of grounding cables to be connected)

Procedure:

1. Ensure that no voltage is present.
2. Connect cables for grounding the battery as specified by the battery manufacturer.
3. Clean the contact surfaces of the terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
4. Connect the grounding cable of the MV transformer to the connection busbar **-X100** in the AC connection area (M12, torque: 60 Nm).
5. Connect the grounding cable of the MV transformer to the connection point for the grounding on the MV transformer (M12, torque: 60 Nm).

7.4.4 Grounding for Reduction of the Radiant Interference Emission

7.4.4.1 Requirements for the grounding to reduce the radiant interference emission

- ☐ For the connection on the base of the inverter, the use of grounding straps with a minimum cross-section is recommended. The minimum cross-section equals: 16 mm².
- ☐ A meshed configuration for the grounding of the inverter and MV transformer is recommended. This reduces the level of leakage currents and the radiated interference in medium and long-wave ranges.
- ☐ It is recommended that you make use of all connection points for the grounding connection on the base.
- ☐ In the case of concrete foundations, six grounding connections must be planned for connecting the inverter, and these must be connected galvanically over a large surface area (e.g. reinforced concrete).
- ☐ Grounding connections on the foundation or platform that are not used must be insulated. This will prevent inadvertent touching.

7.4.4.2 Connection Area for Grounding for Reduction of the Radiant Interference Emission

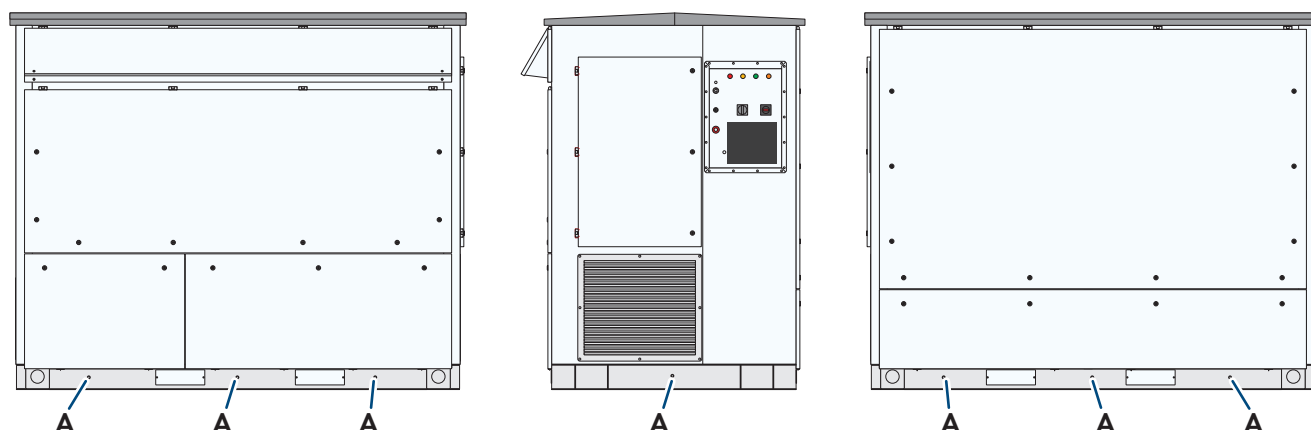


Figure 30: Position of the connection points for grounding for reduction of the radiant interference emission

Position	Designation
A	Connection point for meshed grounding for reduction of the radiant interference emission

7.4.4.3 Connecting the Grounding for Reduction of the Radiant Interference Emission

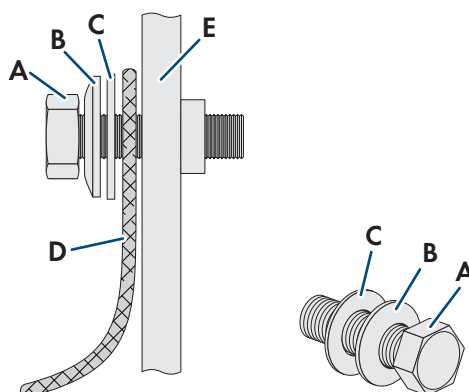


Figure 31: Assembly of the bolted connection

Position	Designation
A	Bolt
B	Spring washer
C	Fender washer
D	Ribbon cable
E	Connection point

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

- ☐ Clean cloth
- ☐ Ethanol cleaning agent
- ☐ 7 x screws M12
- ☐ 7 x spring washers M12

- ☐ 7 x fender washers M12

Procedure:

1. Ensure that no voltage is present.
2. Strip ribbon cable if necessary.
3. Clean the contact surfaces of the terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
4. Connect a grounding cable each to the 7 connection points on the base of the inverter (torque: 14.4 Nm to 17.6 Nm).
5. Connect all grounding cables to the foundation ground electrode.

7.5 DC Connection

7.5.1 Requirements for the Cables and Terminal Lugs for the DC Connection

Cable requirements on the DC connection:

- ☐ All cables must be suitable for temperatures of up to $+90^{\circ}\text{C}$ and must be in accordance with the national standards and directives.
- ☐ Maximum cable cross-section per DC cable: 400 mm^2 .
- ☐ Use copper or aluminum cables only.
- ☐ The dielectric strength must be dimensioned for the maximum permanent DC voltage.
 - Minimum dielectric strength: 1500 V
- ☐ The ampacity of the DC cables must be calculated according to IEC 60287. The maximum occurring DC current must not exceed the ampacity of the DC cables.
- ☐ Parallel connected DC cables must have the same characteristics in order to prevent uneven current distribution.
- ☐ Higher ground voltages can occur in the event of an insulation error until the inverter is switched off. The battery-side components must be insulated for the voltage that occurs in the event of a fault.
 - Voltage to ground: $\pm 2400\text{ V}$

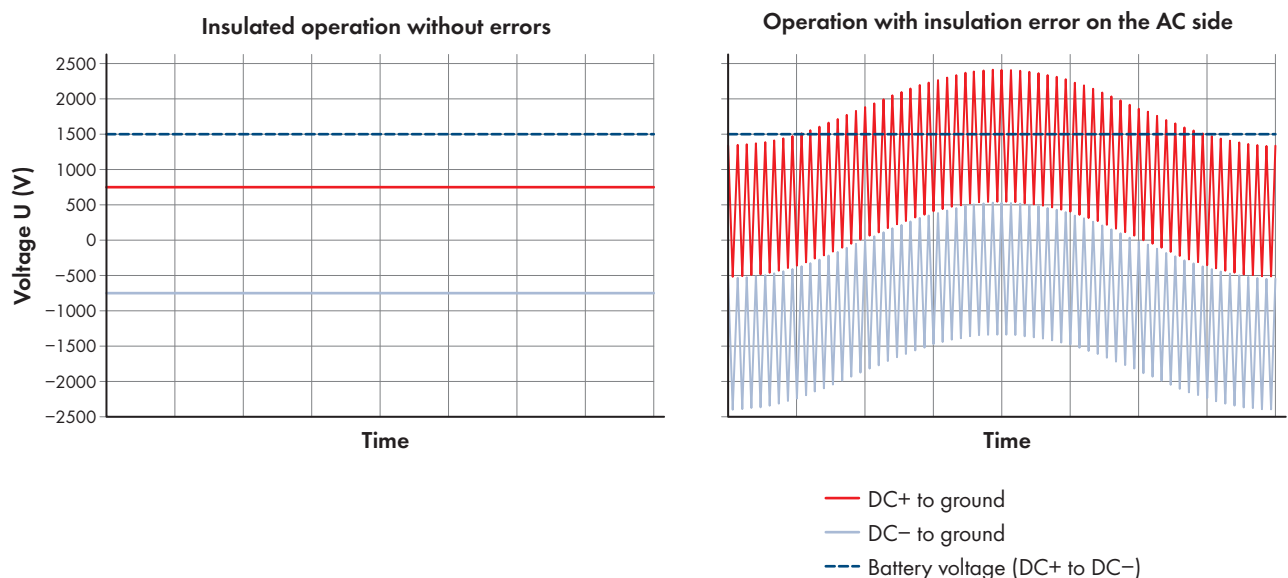


Figure 32: DC-side voltages on the product in an ungrounded system (example)

Cable requirements for the cable connection with terminal lugs:

- ☐ All terminal lugs used must be suitable for temperatures of up to $+90^{\circ}\text{C}$ and have a valid approval.
- ☐ If not all DC inputs are used, the DC cables must be distributed symmetrically via the DC connection brackets.

- ☐ The maximum material thickness of the terminal lugs must be observed:
 - When connecting with 1 terminal lug: 22.5 mm
 - When connecting with 2 terminal lugs: 11.25 mm
- ☐ Using terminal lugs with two mounting holes (diameter: 13 mm) is recommended.
 - Minimum clearance between the holes: 40 mm
 - Maximum clearance between the holes: 50 mm
 - Recommended clearance between the holes: 45 mm
- ☐ Both holes have to be used if two-hole terminal lugs are fitted.
- ☐ If terminal lugs with just 1 mounting hole are used, it must be ensured that the cables always lead downwards and do not twist. Cables laid in a different way reduce the clearance and creepage distances.
- ☐ The terminal lug width must be larger than the diameter of the washers (32 mm). This will ensure that the specified torques are effective over the whole surface.
- ☐ Use only tin-plated terminal lugs made from copper or aluminum.
- ☐ The terminal lugs must be crimped to the cables in accordance with the manufacturer's technical specifications and our recommendations (see Section 17.7, page 266).
- ☐ At a width of max. 48 mm, no more than 1 terminal lug may be connected per side of each terminal.. At a width of min. 48 mm, the terminal lugs must be connected over the entire surface from the rear.
- ☐ The bolted connection must be made according to this document.
- ☐ The specified torques must always be complied with.

Requirements for laying in conduits:

- ☐ If conduits are used, they must be rain-tight and moisture-proof.

7.5.2 Battery-storage system requirements

- ☐ The battery must include a fuse switch-disconnector or circuit breaker for a safe disconnection. It is able to safely switch off the battery's short-circuit current in the event of an error.
- ☐ Only batteries approved by SMA Solar Technology AG must be used.
- ☐ The battery's entire voltage range must be completely within the permissible DC input voltage range of the inverter.
- ☐ The maximum permissible DC input voltage of the inverter must not be exceeded.
- ☐ The design of the DC cable between the battery and the inverter must ensure that the DC time constant $\tau < 1$ ms is complied with ($\tau = L/R$).
- ☐ To promote a symmetrical power flow, all DC cables must have the same length.
- ☐ In each case, cables of both polarities (DC+ and DC-) should be routed next to each other in pairs.
- ☐ The connected battery must be protected by a very fast acting thermal fuse or a combination of fuses with a melting time < 1 ms. The melting integral depends on the DC connection area: 10.75 MA²s for inverters with a busbar, 8 MA²s per input for inverters with a split DC rail.
- ☐ For communication with the inverter, the battery system must be equipped with an Ethernet port.
- ☐ Higher ground voltages can occur in the event of an insulation error until the inverter is switched off. The insulation of the DC cables must have an appropriate dielectric strength.
 - Voltage to ground: ± 2400 V

7.5.3 DC connection area

7.5.3.1 DC Busbar

Cable requirement:

- ☐ A maximum of 36 cables can be connected per pole.

Requirements for DC terminals:

- ☐ The DC cables must be protected externally.
- ☐ The DC cables must be able to be disconnected from all voltage sources.
- ☐ It is the customer's responsibility to ensure that no short circuits occur on the DC side through proper cable protection.

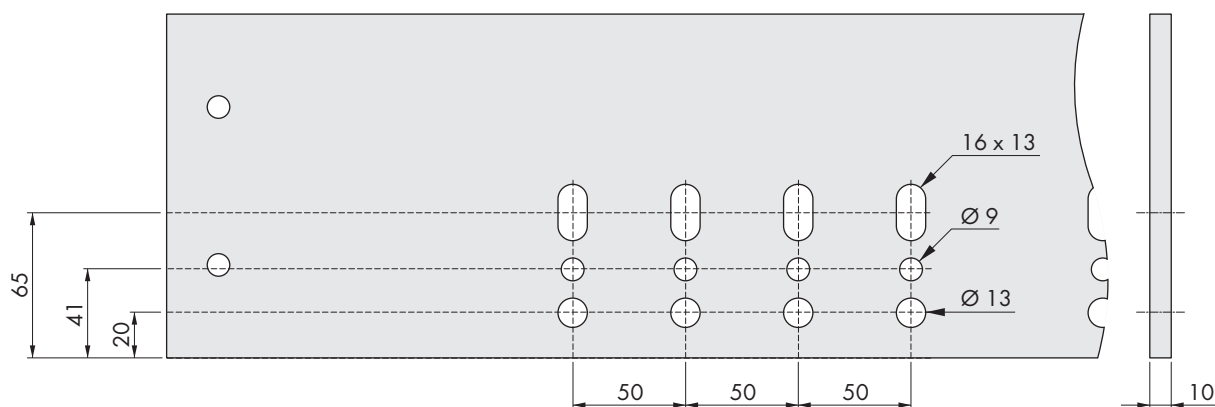


Figure 33: Dimensions of the DC busbar (Dimensions in mm)

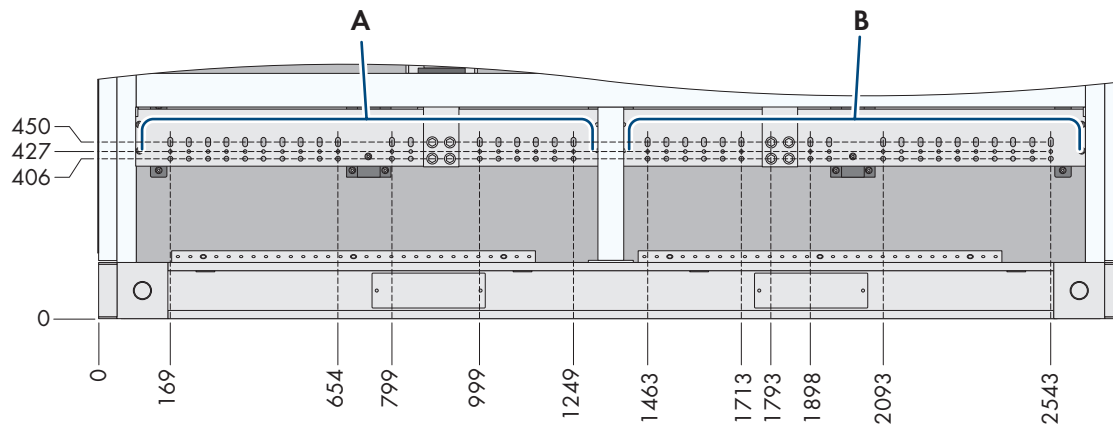


Figure 34: Position and dimensions of the DC busbar (Dimensions in mm)

Position	Designation
A	DC+ busbar
B	DC- busbar

7.5.3.2 Split DC Rail

As an option, the DC+ pole can be split into partial strings and connected to split connecting rails. The split terminals are interconnected in a neutral point via fuses to make equalizing currents between the strings possible. Equalizing currents can be caused by asymmetries in the electrical arrangement of the connecting cables and the batteries, among other things.

In case of a short circuit at a terminal, the increasing short-circuit current of the adjacent terminals is limited and deleted by the ultra-fast fuses (see Section 14.2.2.11, page 195). This reduces the maximum short-circuit current and the arc fault energy in the fault location and protects the battery string fuses of the other terminals.

Requirements for DC terminals:

- ☐ The DC cables must be protected externally.
- ☐ The DC cables must be able to be disconnected from all voltage sources.
- ☐ The line resistances of the DC cables must be as similar as possible. The permitted difference of the line resistances must be requested from the battery manufacturer.
- ☐ It is the customer's responsibility to ensure that no short circuits occur on the DC side through proper cable protection.
- ☐ To protect against short-circuit currents from the battery, each DC+ rail must be protected with fuses that have a maximum melting integral of $8 \text{ MA}^2\text{s}$ per input (see Section 14.2.2.11, page 195). The fuses must be designed in such a way that the nominal current of the inverter is reached.
- ☐ For the symmetrical distribution of the DC currents at the DC terminals, as many batteries as possible must be connected to each DC+ rail as evenly as possible.
- ☐ The asymmetry between the DC inputs must not exceed 280 A.
- ☐ Higher ground voltages can occur in the event of an insulation error until the inverter is switched off.
 - Voltage to ground: $\pm 2400 \text{ V}$

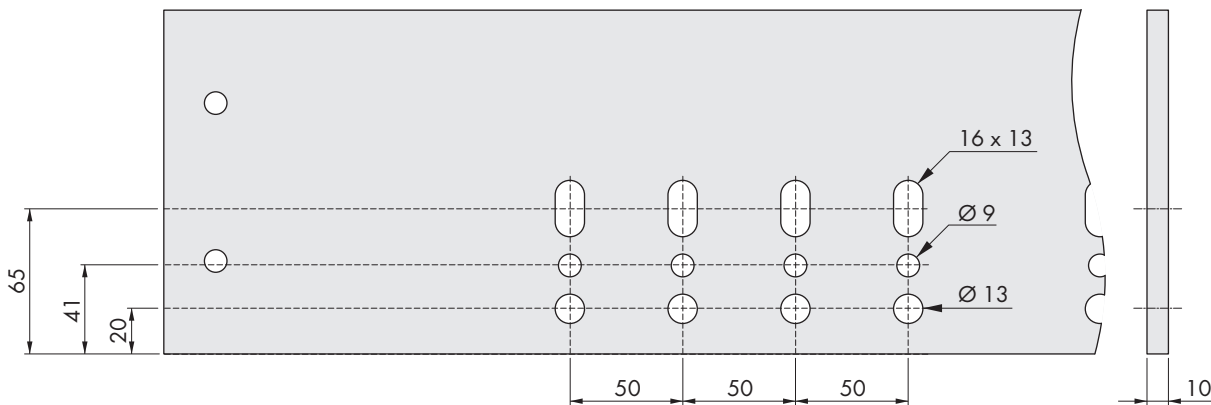


Figure 35: Dimensions of the DC busbars (Dimensions in mm)

Connection area in the inverter with 3 split DC rails

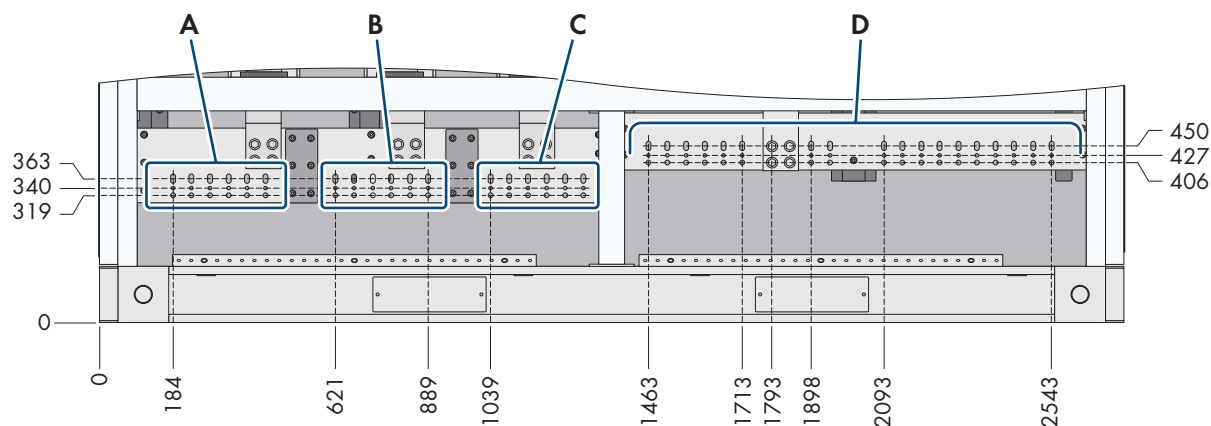


Figure 36: Position and dimensions of the DC rails (Dimensions in mm)

Position	Designation
A	DC+ rail for the connection of 12 DC cables
B	DC+ rail for the connection of 12 DC cables
C	DC+ rail for the connection of 12 DC cables
D	DC- busbar for the connection of 36 DC cables

Connection area in the inverter with 2 split DC rails

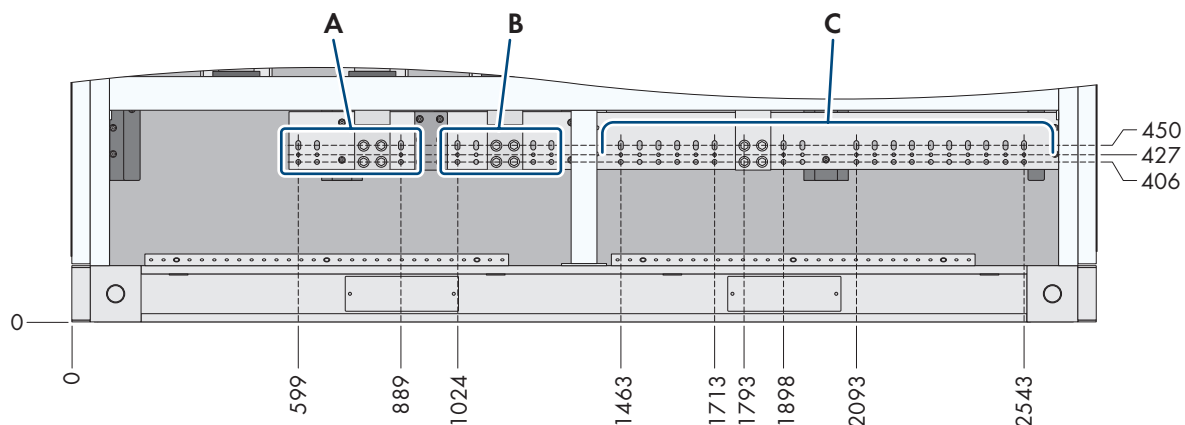


Figure 37: Position and dimension of the DC rails

Position	Designation
A	DC+ rail for the connection of 5 DC cables
B	DC+ rail for the connection of 6 DC cables
C	DC- busbar

7.5.3.3 DC busbar with additional fusing

As an option, it is possible to fuse the inverter internally. To do this, DC switches are each protected by a maximum of 3 fuses. The fuses must be designed specifically for the project in accordance with the maximum DC current and ordered from SMA.

Requirements for DC terminals:

- ☐ The DC cables must be protected externally.
- ☐ The DC cables must be able to be disconnected from all voltage sources.
- ☐ The line resistances of the DC cables must be as similar as possible. The permitted difference of the line resistances must be requested from the battery manufacturer.
- ☐ It is the customer's responsibility to ensure that no short circuits occur on the DC side through proper cable protection.
- ☐ To protect against short-circuit currents from the battery, each DC+ rail must be protected with fuses that have a maximum melting integral of $10.75 \text{ MA}^2\text{s}$. The fuses must be designed in such a way that the nominal current of the inverter is reached.
- ☐ Higher ground voltages can occur in the event of an insulation error until the inverter is switched off.
 - Voltage to ground: $\pm 2400 \text{ V}$

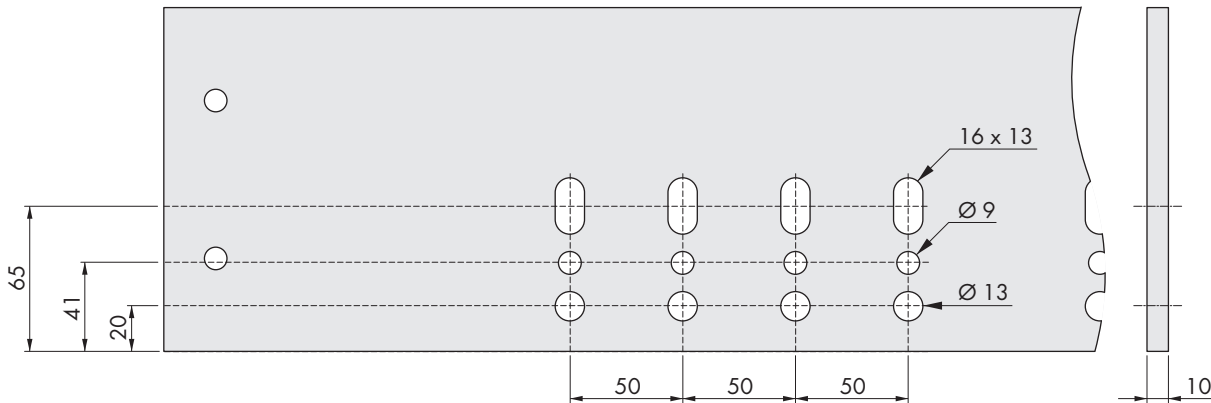


Figure 38: Dimensions of the DC busbars (Dimensions in mm)

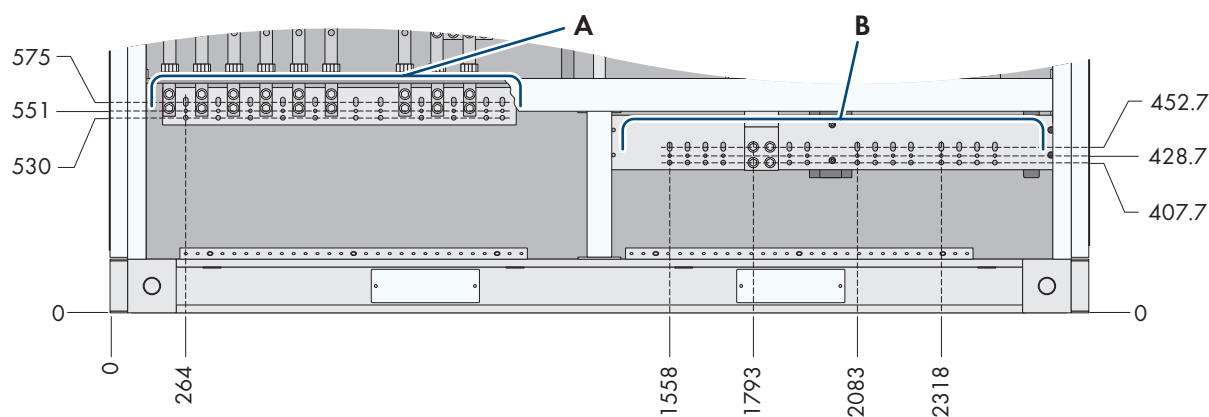


Figure 39: Position and dimensions of the DC rails (Dimensions in mm)

Position	Designation
A	DC+ busbar
B	DC- busbar

Design of the internal fusing

The design of the fuses is specific to each project and depends on the maximum DC current of the system. If a configuration with 2 fuses for each input unit is used, the right and the left fuse slot must be used for each unit. In this design, the center fuse slot remains unused.

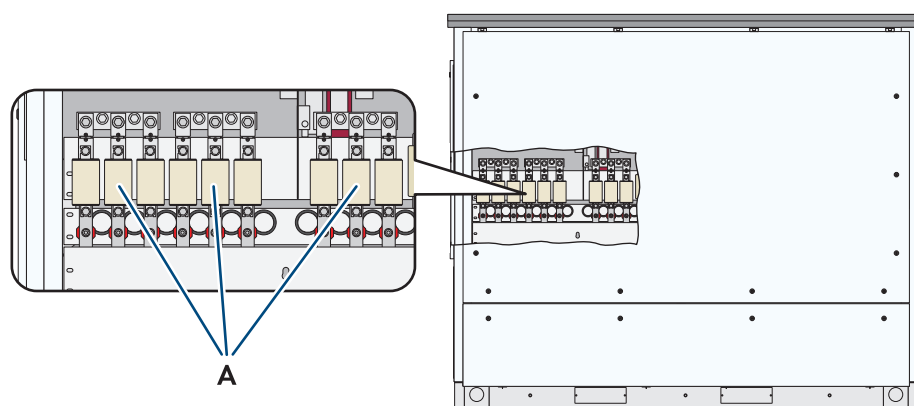


Figure 40: Overview of the internal fusing

Position	Designation
A	Unused fuse slots for a design that has 2 fuses for each input unit

Fuse variant	Maximum permissible DC current
3 x 3 x 1250 A	Maximum DC current of the inverter
3 x 2 x 1250 A	4165 A
3 x 3 x 750 A	4000 A
3 x 2 x 900 A	3000 A

7.5.4 Connecting the DC Cables

The terminal lugs must be connected according to the recommended bolted connection (see Section 7.3, page 62).

i Polarities of the connection points

The polarities of the connection points are marked with labels.

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

- ☐ Clean cloth
- ☐ Ethanol cleaning agent

Additionally required mounting material (included in the scope of delivery):

- ☐ Nut M12 (quantity depends on the number of DC cables to be connected)
- ☐ Screw M12 (quantity depends on the number of DC cables to be connected)
- ☐ Conical spring washer M12 (quantity depends on the number of DC cables to be connected)
- ☐ Fender washer M12 (quantity depends on the number of DC cables to be connected)

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Strip the cable insulation.
3. Crimp the cables with the terminal lugs according to the manufacturer's technical specifications and our recommendations (see Section 17.7, page 266).
4. Clean the contact surfaces of the terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
5. Connect the DC cables to the connection busbars (torque: 60 Nm). A symmetrical distribution of the DC cables is to be ensured. The polarity of the DC connecting rails is marked with labels.

7.5.5 Inserting the DC Fuses

Depending on the DC input configuration, the procedure and the material used for mounting the DC fuses differs.

The DC fuses can be ordered from SMA using the following material number:

Nominal current	Material number
750 A	114172-00.01
900 A	203079-00.01
1250 A	125896-00.01

Assembly of the bolted connection

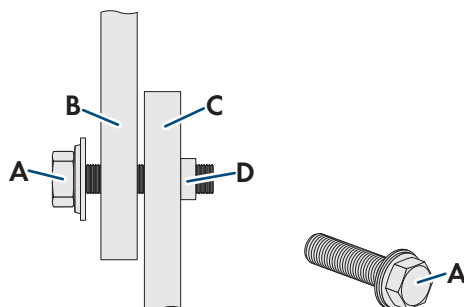


Figure 41: Assembly of the bolted connection with bolt and washer assembly (M10)

Position	Designation
A	Bolt and washer assembly (M10)
B	Connection bracket of the DC fuse
C	Connection busbar of inverter
D	Self-clinching nut

Additionally required installation material (included in the scope of delivery):

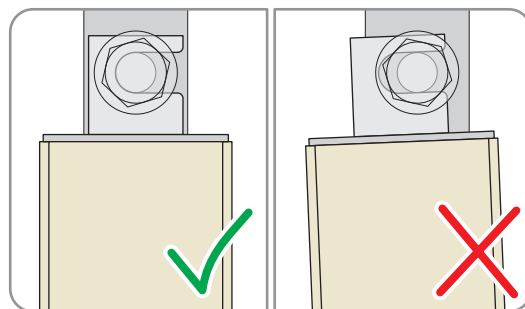
- ☐ DC fuses in accordance with the PV system design
- ☐ Bolt and washer assembly M10, quantity according to the input configuration

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

- ☐ Torque wrench, dimension at the side of the release head with wrench socket: max. 68 mm
There is not enough room to use torque wrenches with larger dimensions.
- ☐ Ethanol cleaning agent
- ☐ Clean cloth

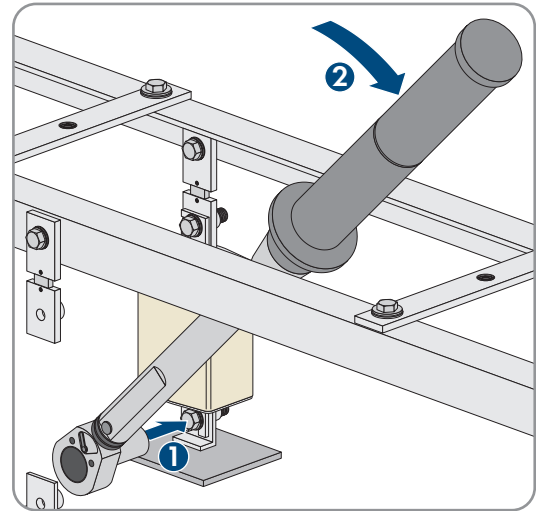
Procedure:

1. Ensure that no voltage is present.
2. Clean the contact surfaces of the DC fuses and connection busbars with a clean cloth and ethanol cleaning agent. Do not touch the contact surfaces again after cleaning.
3. Screw the bolt and washer assembly 1 to 2 threads into the lower connection busbar. Start with the DC fuses in the rear.
4. Place the connection lug of the DC fuse holder onto the bolt and washer assembly.
5. Place the DC fuse holder completely onto the upper bolt and washer assembly.



6. Align the DC fuse vertically between both the connecting rails.
7. Ensure that the upper connecting rail is not twisted.

8. Tighten bolts (torque: 30 Nm).



9. Install all DC fuses in accordance with this procedure.

7.6 AC Connection

7.6.1 AC requirements

Requirement for power connection between inverter and MV transformer:

- ☐ Only tin-plated connection busbars made of aluminum or copper may be used. Connecting several cables to 1 line conductor is not recommended because of the poor distribution of the current symmetry. Connection busbars can be ordered from SMA Solar Technology AG. Please contact us (see Section 18, page 270).
- ☐ The connection busbars may not exceed the maximum horizontal length. Maximum horizontal length: 500 mm.
- ☐ Protecting the connection busbars against contact and pollution by installing a cover is recommended (see Section 7.6.4, page 82).
- ☐ The temperature of the connection busbars must not exceed a specific maximum. The maximum temperature is: 120°C. Compliance with the maximum temperature can not be guaranteed when using cables.
- ☐ A minimum clearance must be observed between the connection busbars and the grounded parts (e.g. enclosure parts). The minimum clearance equals: 12.7 mm.
- ☐ The connection busbars used must be designed for a maximum continuous current. The maximum continuous current depends on the material of the connection busbars. Maximum continuous current copper: 1.55 A/mm², maximum continuous current aluminum: 1.09 A/mm²
- ☐ The calculation of the cross-sections of the connection busbars must be made based on these specifications and also on the material used. It is the responsibility of the installer.
- ☐ The power connection used must have a suitable insulation resistance, since voltages to ground occur in pulsed mode of the product.

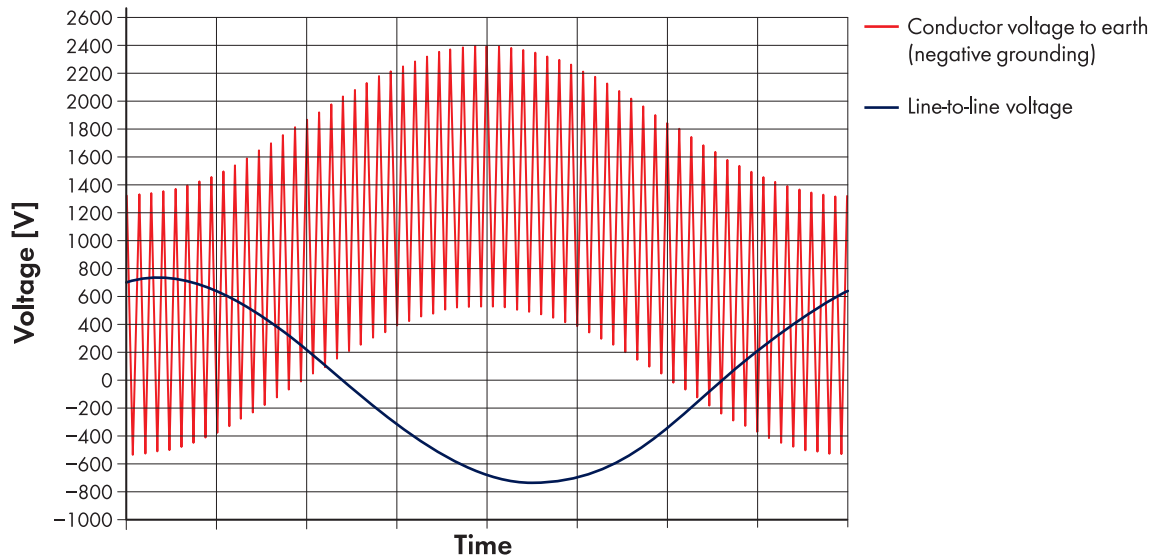
Voltage to ground:

Figure 42: Voltages in pulsed mode (example)

Medium-voltage transformer requirements:

- ☐ Each Sunny Central Storage must be operated on its own medium-voltage transformer. Operating several Sunny Central Storage on one medium-voltage transformer is only possible under specific conditions. This is only possible on request. You can find further information on the requirements placed on the medium-voltage transformer in the technical information "Requirements for Medium-Voltage Transformers and Transformers for Internal Power Supply for the SUNNY CENTRAL".
- ☐ The medium-voltage transformer must be suitable for any voltage fluctuations that occur at the point of interconnection.
- ☐ The impedance voltage of the medium-voltage transformer must be in the permissible range. The permissible range of the impedance voltage is: 5.0% to 8.5%.
- ☐ The enclosure of the medium-voltage transformer must be grounded.

i Ensuring EMC compliance

SMA inverters comply with the EMC interference emission standards set out in the declaration of conformity. If customer-side low-voltage components are installed between the inverter and medium-voltage transformer, the customer must ensure that the decoupling is performed to comply with the applicable requirements of the low-voltage connection. This disconnection from the inverter's AC output can be ensured by using a correspondingly designed transformer and through further filtering measures. For more information on the design of the transformer, please go to <http://www.SMA-Solar.com>.

Alternatively, a medium-voltage transformer can be installed for any additional customer requirements.

7.6.2 AC connection area

Overview of the AC Connection Area

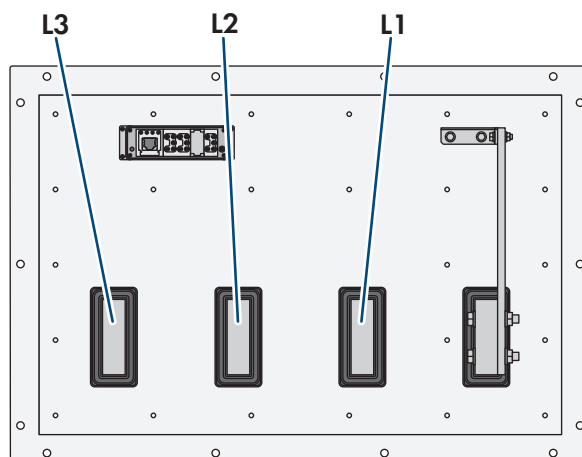


Figure 43: Overview of the AC connection area

Dimensions and position of the AC connection busbars

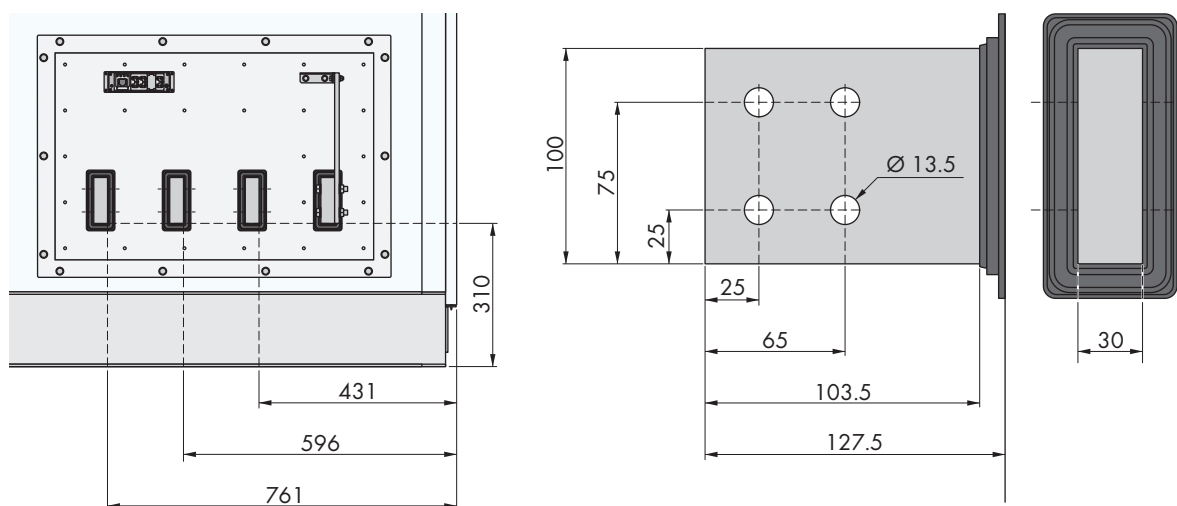


Figure 44: Dimensions and position of the AC connection busbars(Dimensions in mm)

7.6.3 Installing the AC Connection

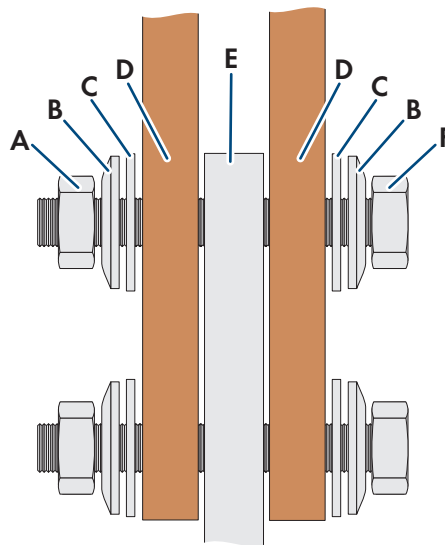


Figure 45: Assembly of the bolted connection

Position	Designation
A	Nut M12
B	Spring washer
C	Fender washer
D	Flexible connection busbars
E	Connection busbar of the converter
F	Bolts M12

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

- ☐ 12 x screw (M12)
- ☐ 12 x nut (M12)
- ☐ 24 x conical spring washer
- ☐ 24 x fender washer
- ☐ Clean cloth
- ☐ Ethanol cleaning agent

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

- ☐ Micro-ohmmeter

⚠ WARNING

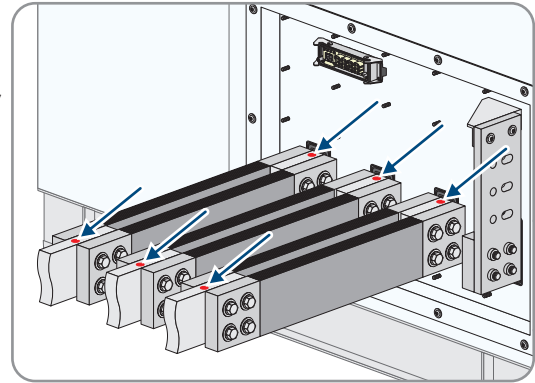
Risk of fire due to the impedance voltage of the MV transformer being too low

An insufficient impedance voltage results in an increased short-circuit current in case of a short circuit. An increased short-circuit current can cause a fire. This can result in death or serious injury.

- Ensure that the impedance voltage of the MV transformer is in the permissible range. The admissible range of the impedance voltage is: u_k : 5.0% to 8.5%.

Procedure:

1. Ensure that no voltage is present.
2. Clean the contact surfaces of the connection busbars with a clean cloth and ethanol cleaning agent.
3. Remove metal dust using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces again after cleaning.
4. Connect the AC busbars to the connection busbars on the converter according to the design of the bolted connection (torque: 60 Nm).
5. Check the contact resistors. The target value of the contact resistance is 3 $\mu\Omega$. The maximum value of the contact resistance is 4 $\mu\Omega$. If a contact resistance is too high, contact us (see Section 18, page 270).

**7.6.4 Requirements for and position of the protective cover****⚠ DANGER**

Danger to life due to electric shock when live parts are touched if the protective cover was incorrectly mounted

The AC connection busbars are live when in operation. If no protective cover has been mounted, the AC connection busbars are not protected against contact. Touching live parts results in death or lethal injuries due to electric shock.

- Mount the protective cover between the MV transformer and the inverter.

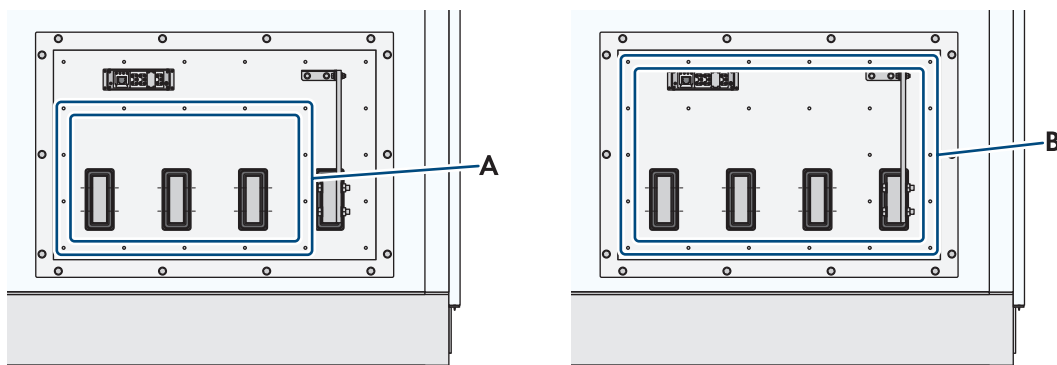
Types of Protective Covers

Figure 46: Bolts to be used for mounting the protective cover

Position	Designation
A	Bolts for mounting the protective cover when only the AC connection busbars should be covered
B	Bolts for mounting the protective cover when the AC connection busbars, the protective cover, the foundation ground electrode and the transformer protection should be covered

Position of the bolts for mounting the protective cover

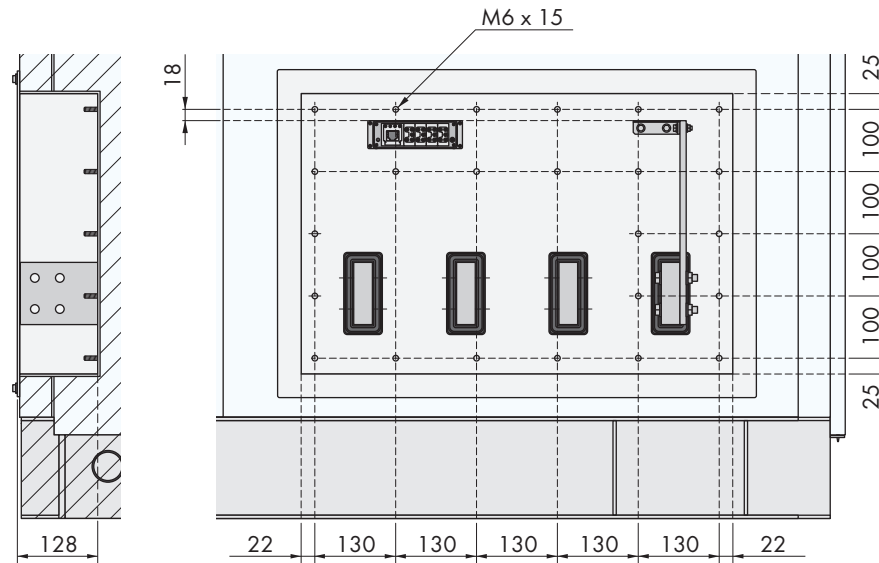


Figure 47: Position of the bolts for mounting the protective cover (Dimensions in mm)

Protective cover properties:

- The protective cover must prevent the connection busbars from being touched inadvertently.
- The protective cover may not have a conductive connection to the connection busbars.
- The protective cover must be flush with the product to ensure adequate protection against contact.
- The protective cover must be mounted to the product on all bolts intended for the protective cover.
- The clearance between the connection busbars and the protective cover must be at least 12.7 mm. Take the thermal expansion of the connection busbars into account.
- The creeping distance between the connection busbars and the protective cover must be at least 25.4 mm. Take the thermal expansion of the connection busbars into account.
- The protective cover must establish a conductive connection between the enclosure of the product and the MV transformer.

A protective cover is available from SMA Solar Technology AG that complies with the listed requirements (material number 119041-00.01). Please contact us (see Section 18, page 270).

Requirements for the protective cover:

- ☐ The protective cover must be attached to the product with a permissible torque. The torque equals: 10 Nm.

7.7 Cables for communication, control and monitoring

7.7.1 Connect the battery's communication cable

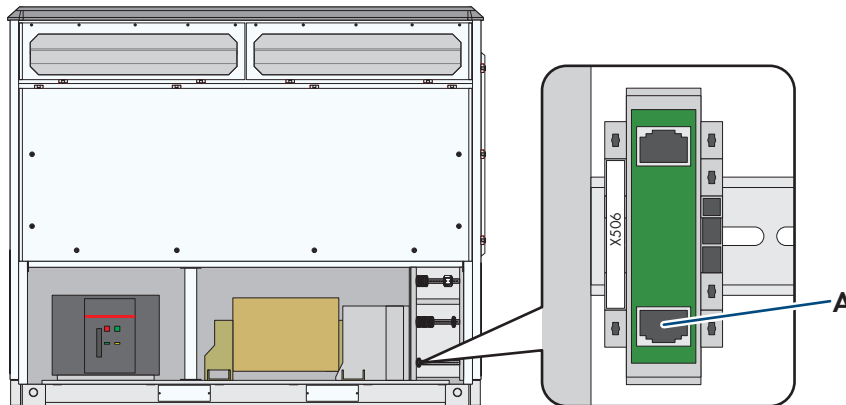


Figure 48: Position of the connection for battery communication

Position	Designation
A	Connection for battery communication

Ethernet cable requirements:

- ☐ The cable must be shielded.
- ☐ The cable must be pair-twisted.
- ☐ The cable must be of at least category 5 (CAT 5).
- ☐ The cable must be fitted with an RJ45 connector.

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Plug the cable into the network port **-X506** for the internal interface **LAN 1 Port 2**.
4. Attach the cable to the cable support rail using a cable tie. This will prevent the cable from being pulled out inadvertently.
5. Mount the panels (see Section 13.2.1, page 170).

7.7.2 Connecting the cable for feedback on the battery release status

The inverter is factory-equipped with a floating output that enables the inverter to use a signal to open or close the safety chain to the battery.

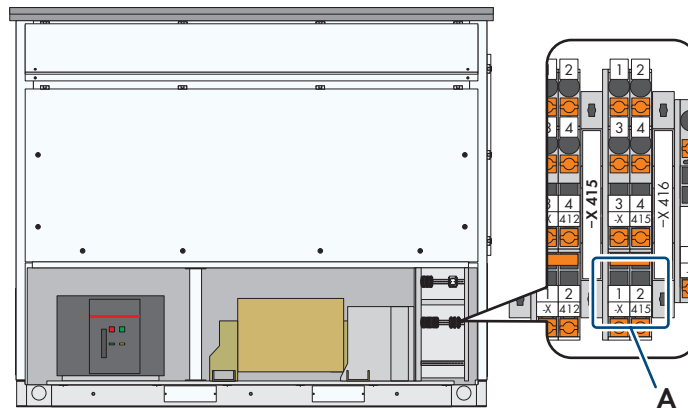


Figure 49: Position of the terminal block for feedback on the battery release status

Position	Designation
A	Terminal block

Requirement:

- An external voltage supply must be present: maximum 250 V, 6 A

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2
- ☐ Maximum cable length: 30 m

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connector **-X415** from the terminal block.
4. Connect the cable on the female connector **-X415:3** and **-X415:4** according to the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connector **-X415** into the terminal block.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

7.7.3 Connecting cable for external start-stop function

The inverter is equipped by default with an external input with which the inverter can be started and stopped via a signal.

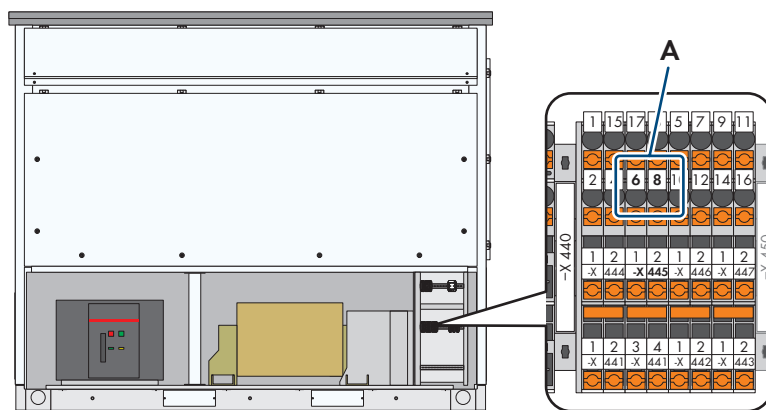


Figure 50: Position of the terminal block for the external start-stop function

Position	Designation
A	Terminal block

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 6
- ☐ Maximum cable length: 30 m

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connector **-X445** from the terminals **6** and **8** of the terminal block **-X440**.
4. Connect the cable to the female connector **-X445** in accordance with the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connector **-X445** into the terminals **6** and **8** in the terminal block **-X440**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

7.7.4 Connecting the Cable for External Fast-Stop Function

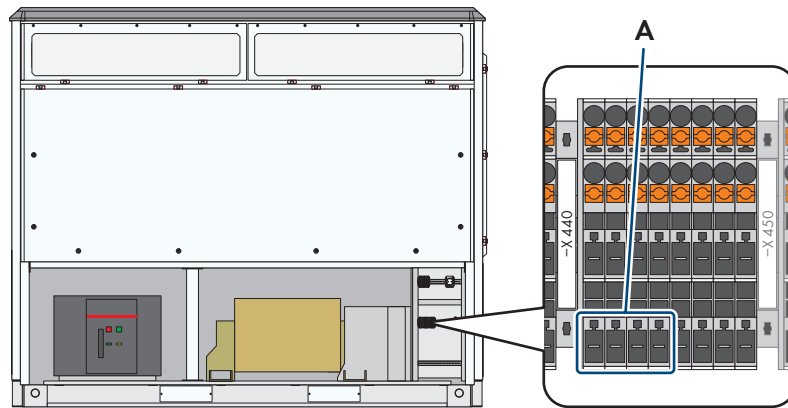


Figure 51: Position of the terminal block for external fast stop function

Position	Designation
A	Terminal block

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2
- ☐ Maximum cable length: 30 m

Requirements:

- ☐ A single-pole switch (break contact) is used.

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connector **-X441** from the terminals **1** and **2** of the terminal block **-X440**.
4. Remove the bridge from the female connector **-X441**.
5. Connect 24 V_{out} to the female connector **-X441:1** and 24 V_{in} to the female connector **-X441:2** in accordance with the circuit diagram (see Section 13.3.2, page 177).
6. If necessary, connect a second break contact series. To do so, connect 24 V_{out} to the female connector **-X441:3** and 24 V_{in} to the female connector **-X441:4** in accordance with the circuit diagram (see Section 13.3.2, page 177). These terminals are bridged by default.
7. Plug the female connector **-X441** into the terminals **1** and **2** in the terminal block **-X440**.
8. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
9. Mount the panels (see Section 13.2.1, page 170).

7.7.5 Connecting cable for the status of the fast-stop switch

The inverter is factory-equipped with a potential-free output with which external equipment can be switched according to the switching status of the fast-stop switch.

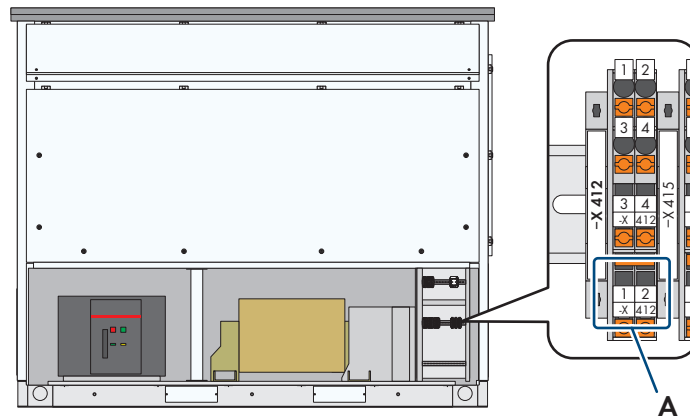


Figure 52: Position of the terminal block for the switching status of the fast-stop switch

Position	Designation
A	Terminal block

Requirement:

- ☐ An external voltage supply must be present: 24 V_{DC}, 0.3 A

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2
- ☐ Maximum cable length: 30 m

Procedure:

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connector **-X412** from the terminal block.
4. Connect the cable on the female connector **-X412:1** and **-X412:2** according to the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connector **-X412** into the terminal block.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

7.7.6 Connecting cable for reporting an insulation error

The inverter is factory-equipped with a potential-free output via which an insulation error can be issued.

The insulation error can be queried via a break contact or make contact.

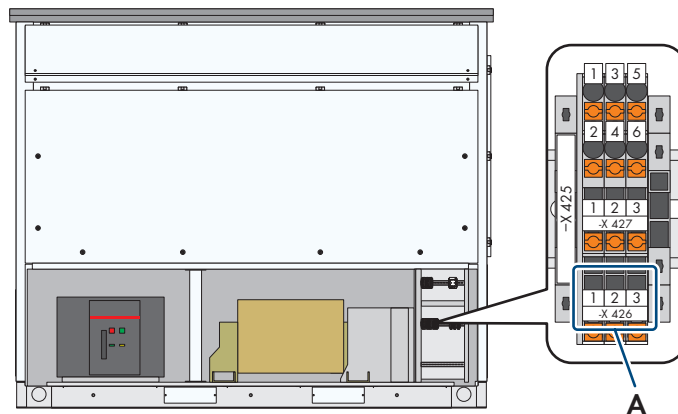


Figure 53: Position of the terminal block for reporting an insulation error

Position	Designation
A	Terminal block

Requirement:

- ☐ An external voltage supply must be present: maximum 250 V, 5 A

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2

Querying the insulation error via break contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connectors **-X427:1** and **-X427:2** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X427:1,2** according to the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connectors **-X427:1** and **-X427:2** into the terminal block **-X425:2** and **-X425:4**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

Querying the insulation error via make contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connectors **-X427:1** and **-X427:3** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X427:1,3** according to the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connectors **-X427:1** and **-X427:3** into the terminal block **-X425:2** and **-X425:6**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

7.7.7 Connecting cable for reporting an insulation warning

The inverter is factory-equipped with a potential-free output via which a warning of a disturbance of the insulation can be issued.

The insulation warning can be queried via a break contact or make contact.

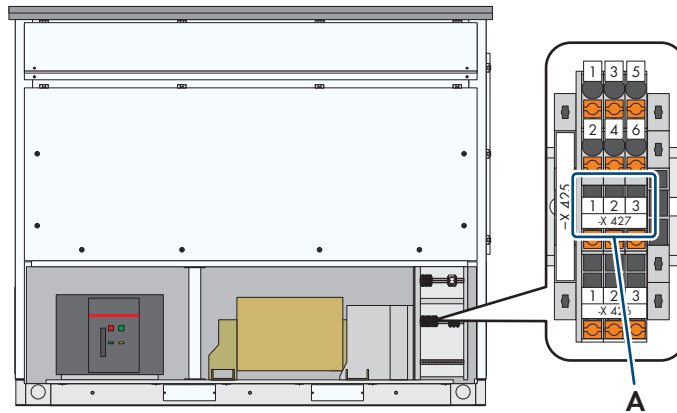


Figure 54: Position of the terminal block for reporting an insulation warning

Position	Designation
A	Terminal block

Requirement:

- ☐ An external voltage supply must be present: maximum 250 V, 5 A

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2

Querying the insulation warning via break contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connectors **-X426:1** and **-X426:2** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X426:1,2** according to the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connectors **-X426:1** and **-X426:2** into the terminal block **-X425:1** and **-X425:3**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

Querying the insulation warning via make contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connectors **-X426:1** and **-X426:3** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X426:1,3** according to the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connectors **-X426:1** and **-X426:3** into the terminal block **-X425:1** and **-X425:5**.

6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

7.7.8 Connecting cable for the status of the DC switch

The inverter comes equipped with a switching status indicator. The switching status of the DC switch for applications provided by the customer can be displayed via this terminal.

Contact	Status
0	All switches are open.
1	At least one DC switch is closed.

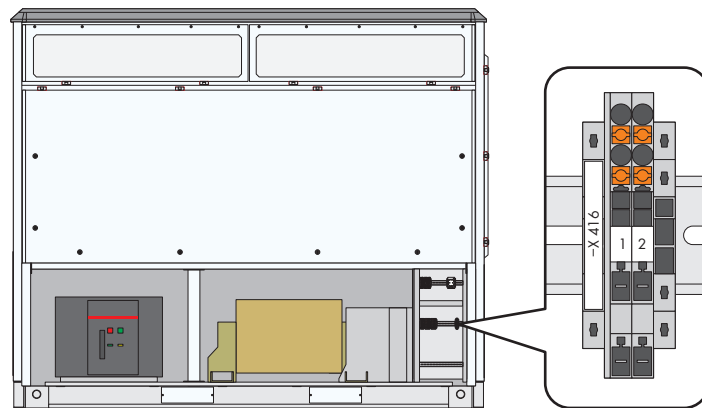


Figure 55: Position of the connecting terminal plate for the switching-state light repeater of the DC switch

Requirement:

- ☐ An external voltage supply must be present: maximum 250 V, 6 A

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2
- ☐ Maximum cable length: 30 m

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Connect the cable to the terminals **-X416:1** and **-X416:2** in accordance with the circuit diagram (see Section 13.3.2, page 177).
4. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 13.2.1, page 170).

7.7.9 Connecting the Cable for External Standby

The inverter comes equipped with an external standby input. This function lets you switch the inverter to the operating state "Standby" within six seconds from a control room, for example. The AC disconnection unit and the DC switchgear of the inverter remain closed. This makes a fast switch to the operating state "GridFeed" possible if the standby signal has been reset.

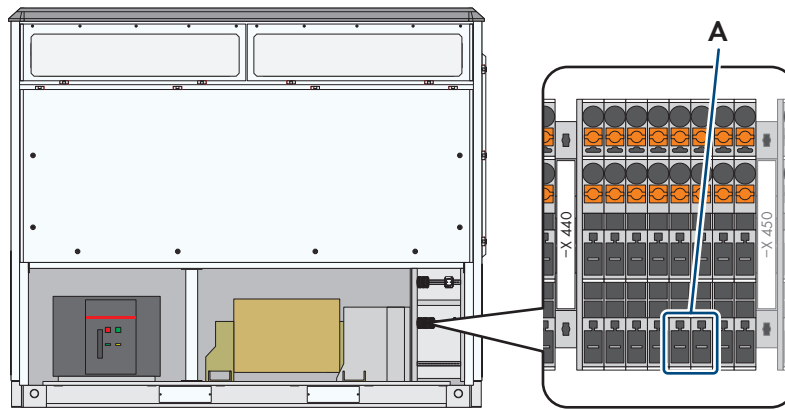


Figure 56: Position of the terminal block for external standby

Position	Designation
A	Terminal block

Requirements:

- ☐ The input must be actuated with a potential-free break or make contact.
- ☐ The contact must be closed for operation.

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2
- ☐ Maximum cable length: 30 m

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Remove the female connector **-X442** from the terminals **5** and **7** of the terminal block **-X440**.
4. Connect the cable to the female connector **-X442** in accordance with the circuit diagram (see Section 13.3.2, page 177).
5. Plug the female connector **-X442** into the terminals **5** and **7** in the terminal block **-X440**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.2.1, page 170).

7.7.10 Connecting the Cables to the Remote I/O Module

Depending on the order option, the inverter may be equipped with a Remote I/O module. Direct connections via the Modbus protocol can be made with this.

The following order options available:

- Without
- 16 digital inputs
- 4 analog and 8 digital inputs

O/I modules used

Industrial fiber media converters of MOXA are being used.

By default, the Remote I/O module is preset to "Voltage Mode" for analog inputs. You can find further information on the configuration in the manufacturer documentation.

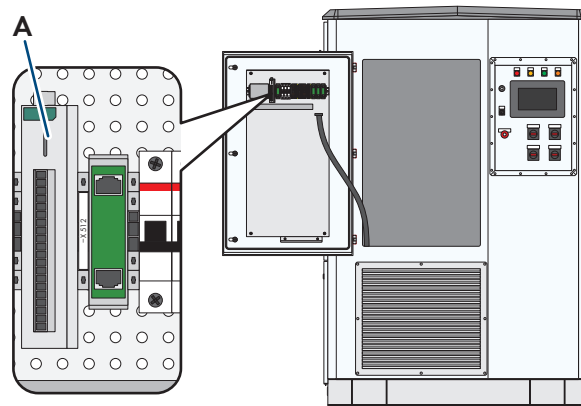


Figure 57: Position of the Remote I/O module

Position	Designation
A	Remote I/O module

Ethernet cable requirements:

- ☐ The cable must be shielded.
- ☐ The insulated conductors must be twisted pairs.
- ☐ The cable must be at least of category 5 (CAT 5).

Cable requirements for digital/analog connections:

- ☐ Maximum cable cross-section 0.75 mm²

Requirements for terminals:

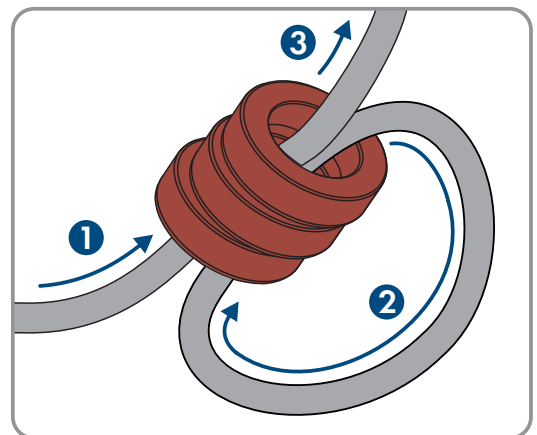
- ☐ A surge protection is recommended for the Ethernet cable.

Additionally required material (included in the scope of delivery):

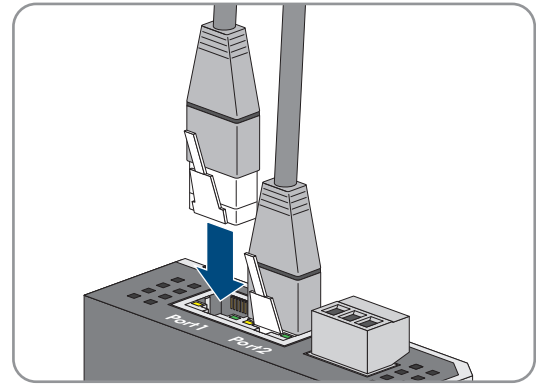
- ☐ 3 ferrites (material number: 124886-00.01)

Procedure:

1. Insert the cables into the inverter (see Section 13.4, page 178).
2. Lead the Ethernet cables through the 3 ferrites from the scope of delivery, form a ring with the cables and lead the cables through the ferrites again.



3. Plug the Ethernet cables into the network port **-X5**.



4. Plug the cables into the digital/analog inputs on the Remote I/O module.

7.7.11 Connecting the Cable for Communication via Optical Fiber

The following contents are only part of the product if one of the following options was selected:

- Communication System A: Managed Switch MMF
- Communication System A: Managed Switch SMF
- Communication System B: Managed Switch MMF Backbone
- Communication System B: Managed Switch SMF Backbone

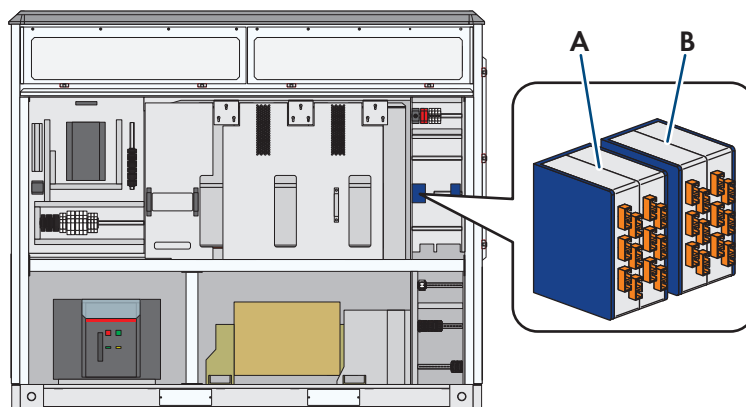


Figure 58: Position of the splice box of the communication via optical fiber backbone ring

Position	Designation
A	Splice box for communication system A (cluster ring)
B	Splice box for communication system B (backbone ring)

In accordance with the selected option, the communication connection with optical fibers must either be made in single mode or multimode. All components connected to one communication system must be of the same standard. Furthermore, using the same standard in the communication systems A and B is also recommended.

Optical fiber requirements in single mode:

- 9/125 μm
- Category: at least OS2
- Plug: SC-PC SMF

Optical fiber requirements in multi mode:

- ☐ 50/125 μm
- ☐ Category: at least OM2
- ☐ Plug: SC-PC MMF

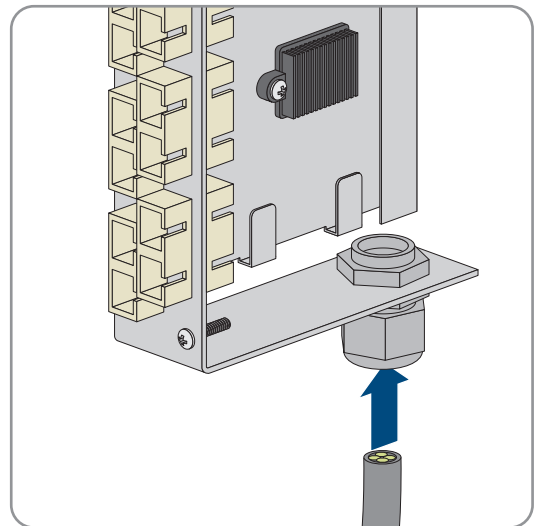
NOTICE**Damage to optical fibers due to too tight bend radii**

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

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

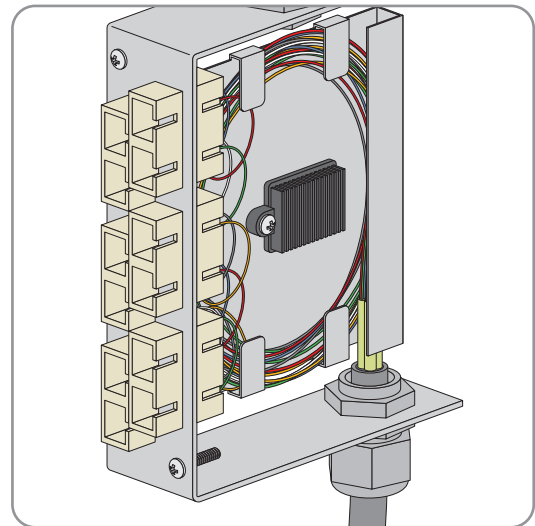
Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Open the hatch in front of the AC area of the product (see Section 13.1, page 168).
4. Insert the optical fibers with received signal and with transmitting signal through the electronics connection area and the cable gland to the splice box inside the inverter (see Section 13.4, page 178).
5. Loosen the upper and lower screw on the front of the splice box.
6. Pull the insert forwards out of the splice box and remove.
7. Insert the optical fiber with the receiving signal from below through the cable gland into the splice box of the corresponding communication ring.



8. Insert the optical fiber with the transmitting signal from above through the cable gland into the splice box of the corresponding communication ring.
9. Splice the SC-CP connectors with the optical fibers.
10. Plug the SC-CP connectors at the rear of the insert into the SC-P plugs **-X502**. Ensure that the send and receive direction of the optical fiber nodes is observed.

11. Coil the residual optical fibers around the fiber reservoir. Observe the permissible bend radii.



12. Slide the insert into the enclosure of the splice box.
13. Tighten the upper and lower screw at the front of the splice boxes.
14. Attach the optical fibers to the cable support rail using a cable tie. This ensures that the optical fibers cannot be pulled out inadvertently.
15. Seal the enclosure openings with silicone
16. Close the hatch in front of the AC area of the product (see Section 13.1, page 168).
17. Mount the panels (see Section 13.2.1, page 170).

7.7.12 Connecting the Cable for Communication via Ethernet

The Ethernet interface may only be used if there is no mounting plate on the door of the customer installation location and the following option has been selected:

- Communication system A: Customer communication system

Requirements for cable routing:

- ☐ Data cables must be laid in a conduit or cable channel. This prevents crushing or squeezing of the cables.

Ethernet cable requirements:

- ☐ The cable must be shielded.
- ☐ The insulated conductors must be twisted pairs.
- ☐ The cable must be at least of category 5 (CAT 5).

Requirements for wired communication:

- ☐ In case of wired communication, an overvoltage protection for the data cables must be provided.

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Insert the cables into the inverter (see Section 13.4, page 178).
4. Plug the cable into the network port **LAN 2 Port 4** of the SC30COM assembly.
5. Attach the cables to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 13.2.1, page 170).

7.7.13 Transformer Protection

7.7.13.1 Terminal Assignment of the Transformer Protection

Position of the transformer protection

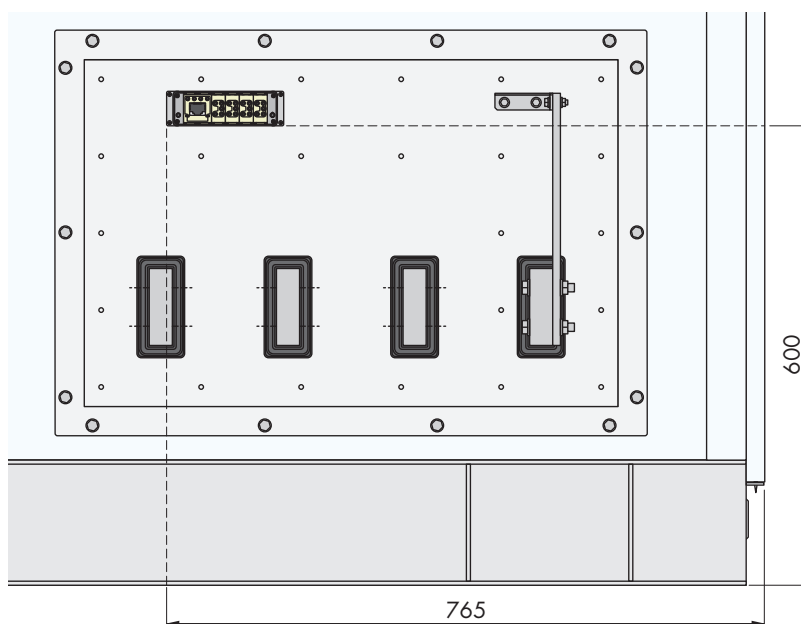


Figure 59: Position of the transformer protection (Dimensions in mm)

Terminal assignment of the transformer protection

The plug is pre-mounted and is included in the scope of delivery.

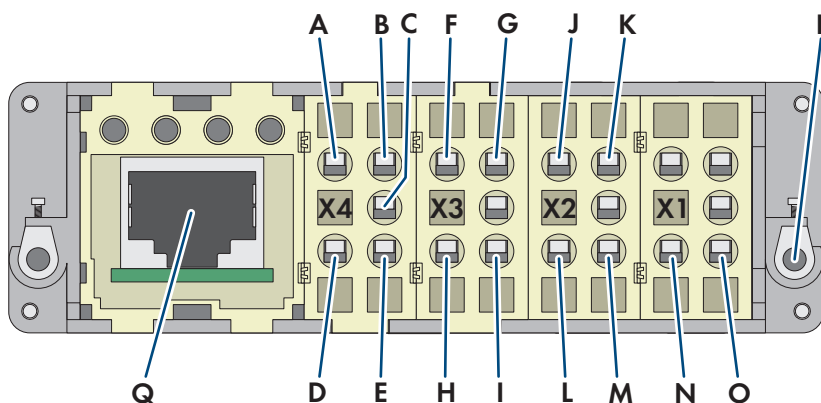


Figure 60: Plug assignment, cable entry side view

Position	Reference Designation	Designation at the plug	Description
A	-X4:1	Module insert 4: Connection designation: 1	Input: Disconnection of temperature monitoring via change-over contact
B	-X4:2	Module insert 4: Connection designation: 2	Input: Alarm of temperature monitoring via change-over contact

Position	Reference Designation	Designation at the plug	Description
C	-X4:3	Module insert 4: Connection designation: 3	Output: 24 V voltage supply
D	-X4:4	Module insert 4: Connection designation: 4	Input: Pressure monitoring and fast stop
E	-X4:5	Module insert 4: Connection designation: 5	Input: Alarm gas fill level
F	-X3:1	Module insert 3: Connection designation: 1	Output: +24 V voltage supply for the analog temperature monitoring
G	-X3:2	Module insert 3: Connection designation: 2	Input: GND for analog temperature monitoring
H	-X3:4	Module insert 3: Connection designation: 4	Output: SIGN+ of the analog temperature sensor Scaling: 4 mA to 20 mA = -40 °C to +120 °C, linear
I	-X3:5	Module insert 3: Connection designation: 5	Input: SIGN- of the analog temperature sensor
J	-X2:1	Module insert 2: Connection designation: 1	Output: +24 V voltage supply for the analog pressure sensor
K	-X2:2	Module insert 2: Connection designation: 2	Input: GND for the analog pressure sensor
L	-X2:4	Module insert 2: Connection designation: 4	Input: SIGN+ of the analog pressure sensor
M	-X2:5	Module insert 2: Connection designation: 5	Output: SIGN- of the analog pressure sensor Scaling: 4 mA to 20 mA = -14.5 psi to +14.5 psi, linear. The scaling can be adjusted via the parameters PresTrf.CrvLo and PresTrf.CrvHi
N	-X1:4	Module insert 1: Connection designation: 4	Output: L1
O	-X1:5	Module insert 1: Connection designation: 5	Output: N

Position	Reference Designation	Designation at the plug	Description
P	-X1: grounding conductor	Module insert 1: Connection designation: PE	Output: Grounding conductor
Q	X5	Module insert 5: Connection designation: X5	LAN2/Port 4

7.7.13.2 Connecting the Transformer Protection

Requirements:

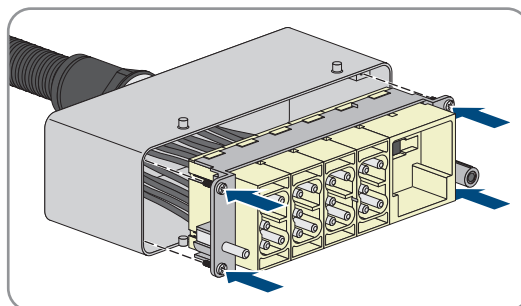
- ☐ Maximum cable length: 30 m

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

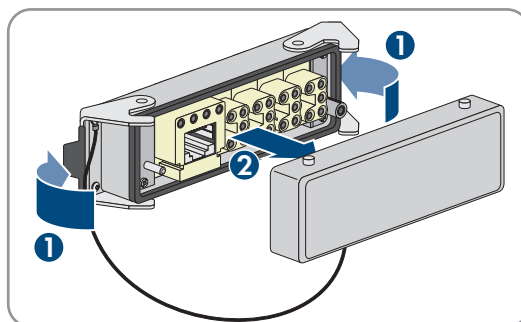
- ☐ Cable gland M32

Procedure:

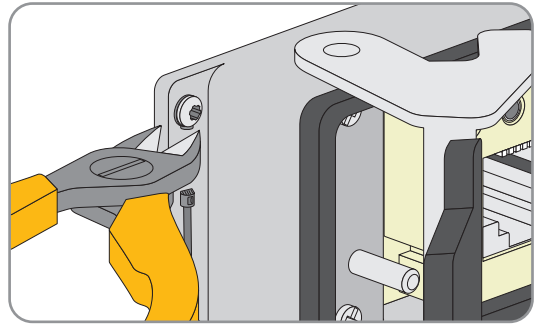
1. Ensure that no voltage is present.
2. Disassemble the supporting frame on the coupling housing.
3. Lead the cable of the transformer monitoring unit through the cable gland and the coupling housing.
4. Dismantle the cable.
5. Strip the insulation off the wires. Insulation stripping length: 9 mm to 11 mm.
6. Connect the cables according to terminal assignment. Insert the screwdriver in the opening of the module insert. This will release the opening for the insulated conductors in the module insert.
7. Mount the supporting frame on the coupling housing (torque: 1.2 Nm).



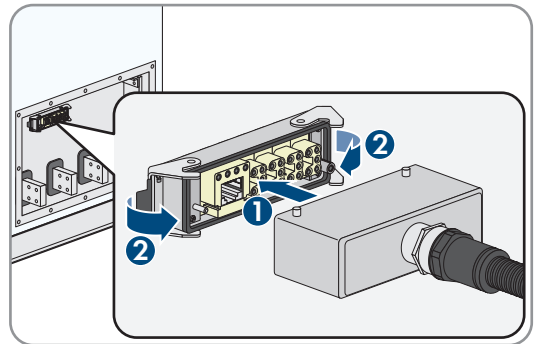
8. Tighten the cable gland.
9. To remove the transport cover from the slot, open the protective cover retaining clips and remove the protective cover.



10. Cut through the captive washer using diagonal cutting pliers and completely remove with the protective cover.



11. Insert the plug into the pin connector on the inverter and close the retaining clip.



7.7.14 Important Measures in the Case of Non-Utilized Options

If the functions of the transformer protection are not used and the plug is not connected, the signal lines of the terminal **X4:1,2,4,5** to the 24 V voltage supply **X4:3** must be bridged (see Section 7.7.13, page 97). If these bridges are not placed, the fast-stop function is triggered and the product remains in the operating state "Stop". The bridges can be placed in the plug and the plug can be plugged in without further connections.

7.8 Supply voltage

7.8.1 Connecting the Cables for External Loads to the Auxiliary Voltage Supply

The following contents are only part of the product if one of the following options was selected:

- Additional supply for external loads: 2.5 kVA / 230 V
- Additional supply for external loads: 2.5 kVA / 120 V

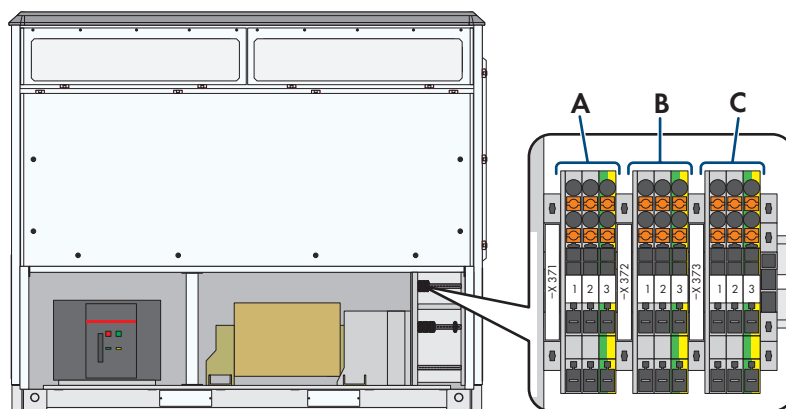


Figure 61: Position of the terminal blocks for external loads

Position	Designation
A	Connecting terminal plate -X371

Position	Designation
B	Connecting terminal plate -X372
C	Connecting terminal plate -X373

The supply voltage applied is indicated by a label.

The outlets -X374 and -X375 for external loads are located in the customer installation location. For inverters that are installed in Great Britain or Australia, only outlet -X374 is located in the customer installation location.

The supply voltage applied is indicated by a label.

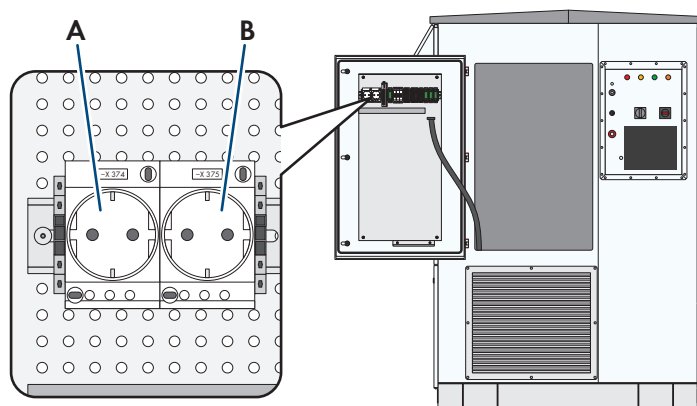


Figure 62: Position of the outlets for external loads

Position	Designation
A	Outlet -X374
B	Outlet -X375 Not for inverters that are installed in Great Britain or Australia.

Requirements for the connection of customer devices to the outlets -X374 and -X375:

- ☐ The total maximum power consumption of all customer devices at both outlets must not be exceeded. The maximum continuous power consumption is: 1 440 VA.
- ☐ The customer devices must be designed for the permissible voltage. The permitted voltage corresponds to the grid voltage at the operation site.
- ☐ The customer devices must be suitable for the connection to the circuit breaker. The type of the miniature circuit breaker is: B16 A.

Requirements for the connection of customer devices to the outlet -X374:

- ☐ The total maximum power consumption of all customer devices at the outlet must not be exceeded. The maximum continuous power consumption is: 1 440 VA.
- ☐ The customer devices must be designed for the permissible voltage. The permissible voltage is: 230 V.
- ☐ The customer devices must be suitable for the connection to the circuit breaker. The circuit breaker type is: B16 A.

This option only applies to inverters that are installed in Great Britain or Australia.

Requirements for the connection of customer devices to the terminal block -X371 to -X373:

- ☐ The total maximum power consumption of all customer devices at the connecting terminal plates must not be exceeded. The maximum continuous power consumption for every single terminal block is: 350 VA.
- ☐ The customer devices must be suitable for the connection to the circuit breaker. The circuit breaker type is: B16 A.

Requirements for cable routing:

- ☐ Data cables must be laid in a conduit or cable channel. This prevents crushing or squeezing of the cables.

Cable requirements for -X371 and -X372:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 2

Cable requirements for -X373:

- ☐ Multi-wire cable with bootlace ferrules: 0.5 mm² to 10 mm²
- ☐ Single-wire cable: 0.5 mm² to 10 mm²
- ☐ Number of conductors: 3

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Connect the cable to the female connector **-X371** in accordance with the circuit diagram (see Section 13.3.2, page 177).
4. Plug the female connector into the terminals **1**, **2** and **3** in the terminal block **-X371**.
5. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
6. Connect the cable to the female connector **-X372** in accordance with the circuit diagram (see Section 13.3.2, page 177).
7. Plug the female connector into the terminals **1**, **2** and **3** in the terminal block **-X372**.
8. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
9. Connect the cable to the female connector **-X373** in accordance with the circuit diagram (see Section 13.3.2, page 177).
10. Plug the female connector into the terminals **1**, **2** and **3** in the terminal block **-X373**.
11. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
12. Mount the panels (see Section 13.2.1, page 170).

7.9 External supply voltage

7.9.1 Connecting Single-Phase External Supply Voltage of Inverter

The following contents are only part of the product if 1 of the following options was selected:

- Supply voltage of inverter: external (single-phase) 120 V
- Supply voltage of inverter: external (single-phase) 230 V
- Energy self-sufficiency inverter: external (three-phase and single-phase) 230 V

With this option, the terminals for the single-phase as well as the three-phase energy self-sufficiency must be installed and permanently supplied with the necessary voltage and electric current. If only 1 of the 2 energy self-sufficiency systems is installed and supplied, the inverter cannot start operation.

The voltage that may be connected to the inverter is indicated by a label.

The terminal block and internal fusing **F30** are connected with orange cables.

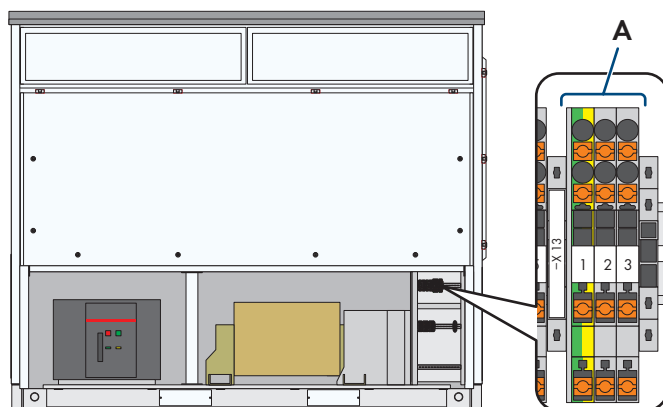


Figure 63: Position of terminals for external voltage supply

Position	Designation
A	Terminal block

Requirements for the external voltage and fusing:

- ☐ Line-to-line voltage 230 V (L/N/PE) / 120 V (L/N/PE) (depending on option), 50 Hz / 60 Hz
- ☐ The external voltage source must supply a power of at least 2.0 kVA.
- ☐ The upstream fuses for external disconnection must be designed selectively by the customer. The nearest protective device in the inverter is a circuit breaker with characteristic B16A.
- ☐ The input short-circuit current must be limited to 10 kA.

Requirement for cable routing:

- ☐ The electrical connection must be carried out in accordance with overvoltage category III.
- ☐ The cables must be routed in such a way that direct lightning coupling is not possible.

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 1.5 mm² to 10 mm²
- ☐ Single-wire cable: 1.5 mm² to 16 mm²
- ☐ Number of conductors: 3

NOTICE

Inverter damage due to incorrect supply voltage at terminal

The components in the inverter are designed for a supply voltage of 230 V. Depending on the option selected, the externally applied supply voltage (120 V or 230 V) is converted by an internal low-voltage transformer. If an incorrect supply voltage is applied externally, components may be damaged or malfunctions may occur.

- Ensure that the voltage source connected supplies the correct voltage.
- Observe and adhere to the specifications for the required supply voltage at the terminal.

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Connect the insulated conductors for **L1**, **N** and **PE** to the female connector-**X13** according to the circuit diagram (see Section 13.3.2, page 177).

4. Attach the cable to the cable support rail using cable ties. This will prevent the cable from being pulled out inadvertently.
5. Mount the panels (see Section 13.2.1, page 170).

7.9.2 Connecting Three-Phase External Supply Voltage of Inverter

The following contents are only part of the product if the following option was selected:

- Auxiliary power supply for the inverter: external
- Energy self-sufficiency inverter: external (three-phase and single-phase) 230 V

With this option, the terminals for the single-phase as well as the three-phase energy self-sufficiency must be installed and permanently supplied with the necessary voltage and electric current. If only 1 of the 2 energy self-sufficiency systems is installed and supplied, the inverter cannot start operation.

This option enables the inverter to be supplied with voltage by an external low-voltage transformer. The terminal block and internal fusing **F30** are connected with orange cables.

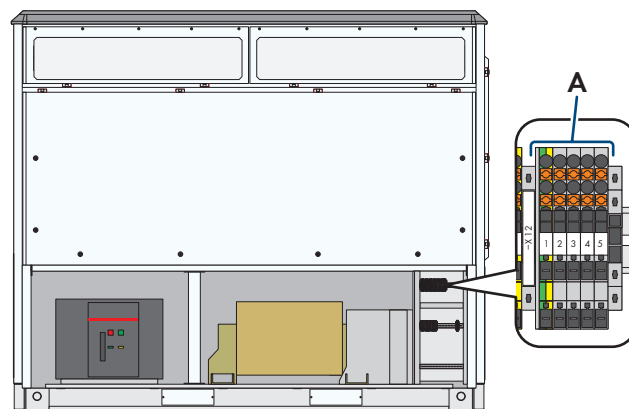


Figure 64: Position of terminals for external voltage supply

Position	Designation
A	Terminal block

Requirements for the external low-voltage transformer and fusing:

- ☐ An external auxiliary power supply is only permitted when a transformer with a Dyn vector group is used.
- ☐ The low-voltage transformer must have the following technical specifications:
 - each 230 V line voltage / 400 V line-to-line voltage (3/N/PE)
 - 50 Hz / 60 Hz
- ☐ The secondary side of the low-voltage transformer must supply a power of at least 8.4 kVA.
- ☐ The low-voltage transformer must be provided with a shield winding between primary and secondary side.
- ☐ The upstream fuses must be rated accordingly by the customer.
- ☐ The input short-circuit current must be limited to 10 kA.

Requirement for cable routing:

- ☐ The electrical connection must be carried out in accordance with overvoltage category III.
- ☐ The cables must be routed in such a way that direct lightning coupling is not possible.

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 1.5 mm² to 6 mm²
- ☐ Single-wire cable: 1.5 mm² to 10 mm²
- ☐ Number of conductors: 5

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Connect the insulated conductors for **L1**, **L2**, **L3**, **N** and **PE** to the female conductor **-X12** according to the circuit diagram (see Section 13.3.2, page 177).
4. Attach the cable to the cable support rail using cable ties. This will prevent the cable from being pulled out inadvertently.
5. Mount the panels (see Section 13.2.1, page 170).

7.10 Customer installation location of the inverter

Depending on the order option, the customer installation location is equipped with mounting plate, DIN rail and outlets. If none of the options "Customer mounting plate", "Auxiliary power supply external", "Remote I/O module" or "PQ meter" was selected, the inverter is not equipped with these assemblies.

7.10.1 Connecting the Cable for Supply Voltage to Customer Installation Location

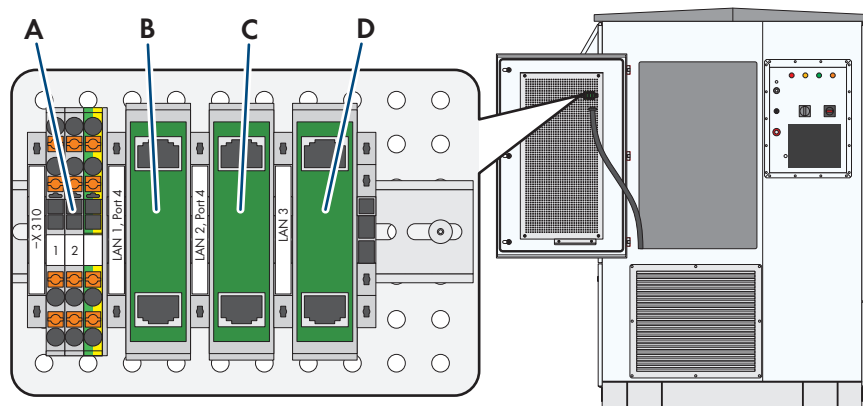


Figure 65: Position of the connections at the customer installation location

Position	Designation
A	Connecting terminal plate for voltage supply at customer installation location -X310
B	Interface for the optional remote I/O module LAN 1 Port 4
C	Ethernet interface for connecting customer communication devices LAN 2 Port 4²⁾
D	Internal Ethernet interface LAN 3

²⁾ Only for option: Communication System A: Ethernet RJ45

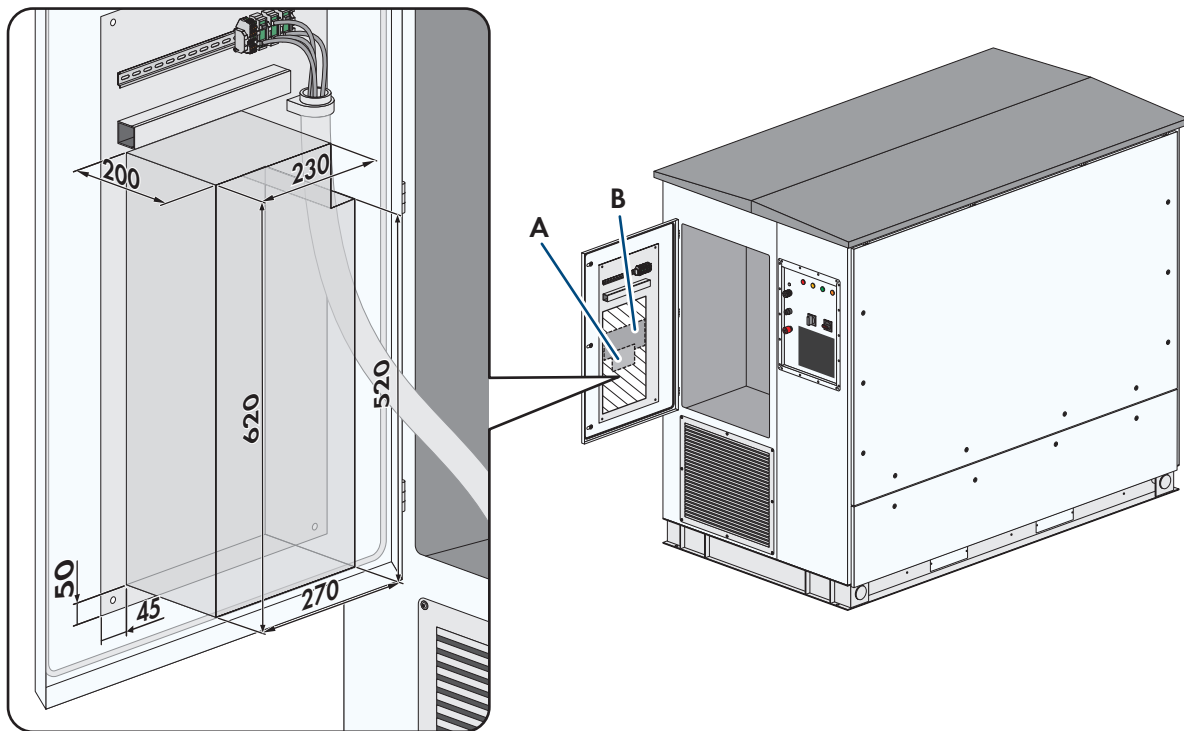


Figure 66: Area for customer devices in the customer installation location (Dimensions in mm)

Position	Designation
A	Data Manager (optional) The Data Manager reduces the space available in the customer installation location.
B	Optional holder for tablet PC (only for Korea)

Requirements for the Connection of Customer Devices:

- ☐ The total maximum power consumption of all customer devices at terminal block **-X310** must not be exceeded. The maximum continuous power consumption is: 300 VA.
- ☐ The customer devices must be designed for the permissible voltage. The permissible voltage is: 230 V.
- ☐ Voltage fluctuations that occur at the grid-connection point are transmitted to terminal block **-X310** in the same proportion. The customer devices must be designed for these voltage fluctuations.
- ☐ The device-internal voltage supply is not buffered. To avoid switch off of customer devices during supply voltage failures (e.g., grid failures), a buffered power supply unit must be used by the customer.
- ☐ The total weight of all customer devices may not be exceeded. The total weight is: 20 kg.
- ☐ Customer devices may be mounted on the mounting plate. An area of 270 mm x 620 mm x 200 mm is available for this. The area may not be exceeded.
- ☐ The customer devices must be designed for a temperature of 60°C in normal operation.

Requirements for cable routing:

- ☐ Data cables must be laid in a conduit or cable channel. This prevents crushing or squeezing of the cables.

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm²
- ☐ Single-wire cable: maximum 0.14 mm² to 4.0 mm²
- ☐ Number of conductors: 3

Procedure:

1. Ensure that no voltage is present.
2. Connect the cable to the terminal block **-X310**.

7.10.2 Cable for Option Communication System A: Connecting Customer Communication:

The Ethernet interface may only be used if the following option was selected:

- Communication system A: Customer communication system

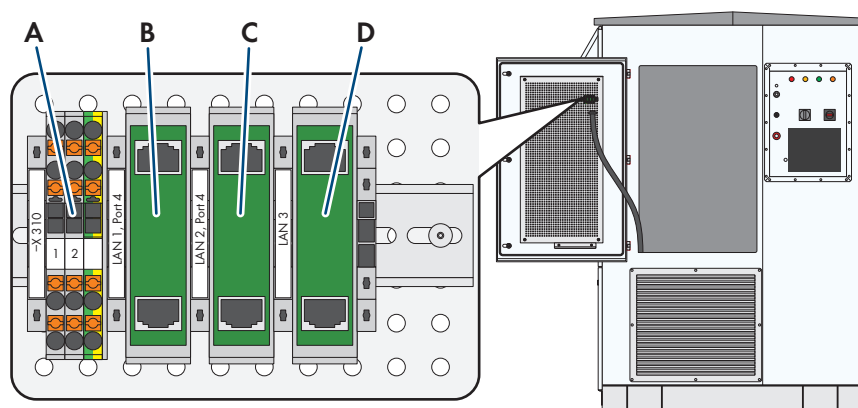


Figure 67: Position of the connections at the customer installation location

Position	Designation
A	Connecting terminal plate for voltage supply at customer installation location -X310
B	Interface for the optional remote I/O module LAN 1 Port 4
C	Ethernet interface for connecting customer communication devices LAN 2 Port 4³⁾
D	Internal Ethernet interface LAN 3

³⁾ Only for option: Communication System A: Ethernet RJ45

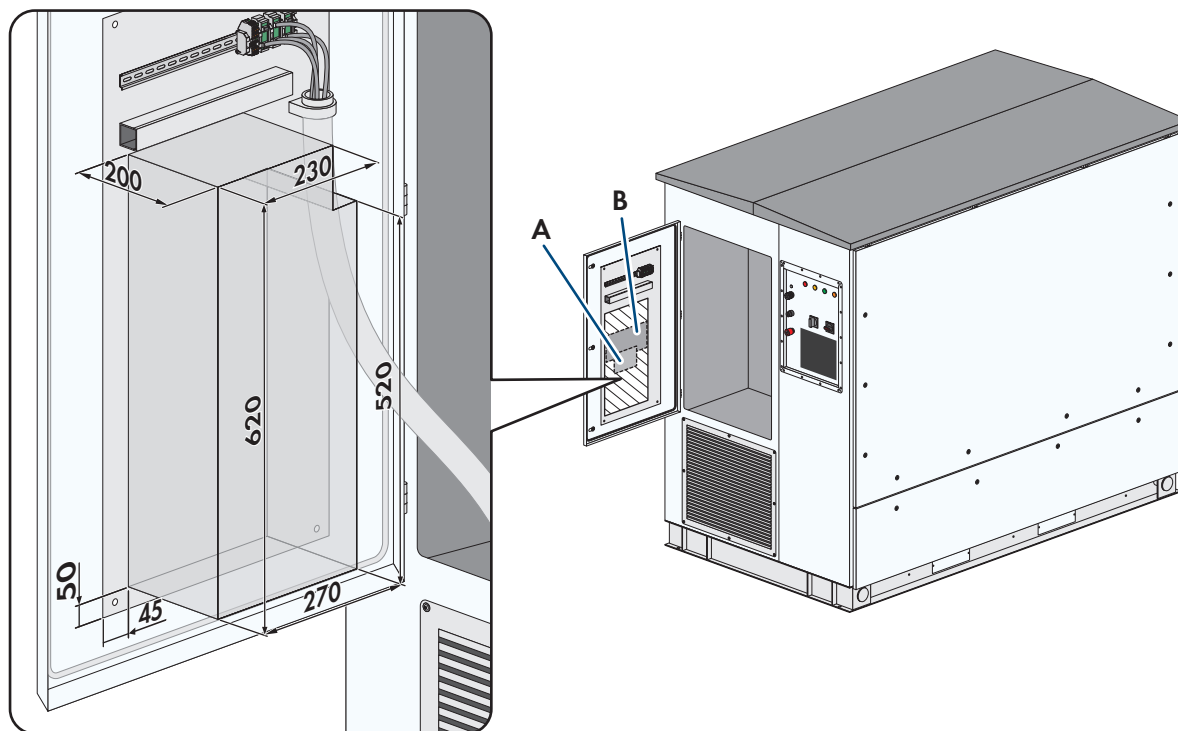


Figure 68: Area for customer devices in the customer installation location (Dimensions in mm)

Position	Designation
A	Data Manager (optional) The Data Manager reduces the space available in the customer installation location.
B	Optional holder for tablet PC (only for Korea)

Requirements for cable routing:

- ☐ Data cables must be laid in a conduit or cable channel. This prevents crushing or squeezing of the cables.

Ethernet cable requirements:

- ☐ The cable must be shielded.
- ☐ The insulated conductors must be twisted pairs.
- ☐ The cable must be at least of category 5 (CAT 5).

Requirements for wired communication:

- ☐ In case of wired communication, an overvoltage protection for the data cables must be provided.

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Disassemble the panels (see Section 13.2.1, page 170).
3. Insert the cables into the inverter (see Section 13.4, page 178).
4. Plug the cable into the network port **LAN 2 Port 4**.
5. Attach the cables to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 13.2.1, page 170).

7.11 Covering the Cable Insertion Area

The cable entry area must be covered by suitable measures (e.g. a concrete base) in such a way that foreign bodies cannot enter the product.

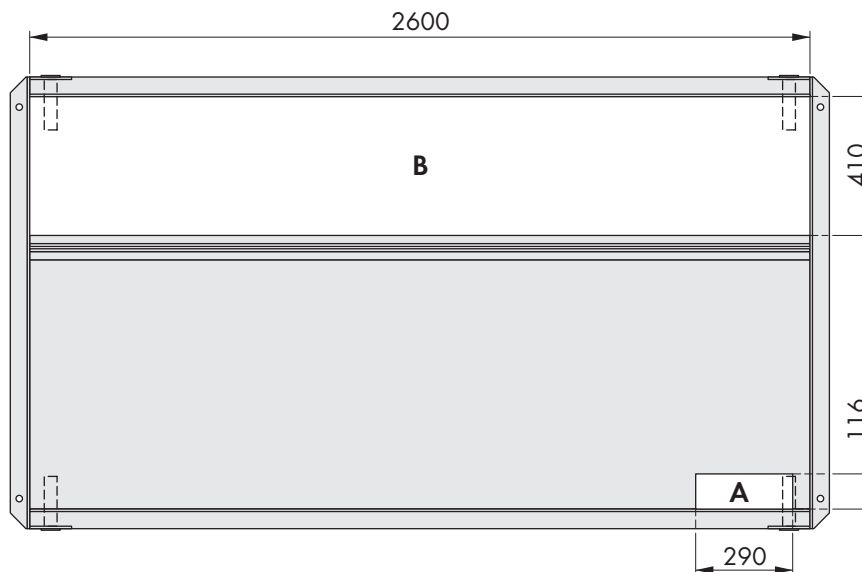


Figure 69: Recess in the base area of the product (Dimensions in mm)

Position	Designation
A	Cable insertion area of the cables for communication, control, and monitoring
B	Cable insertion area of the DC cables and grounding cables

i Construction and mounting of the cover

The installer is responsible for constructing and mounting the cover for the cable insertion areas.

Requirements for the cover of the cable insertion areas:

- ☐ The connection area of the product must be protected against solid foreign objects from a diameter of 12.5 mm.
- ☐ The connection area of the product must be protected against falling spray water up to 60° from the vertical.

Procedure:

- Cover the cable insertion areas.

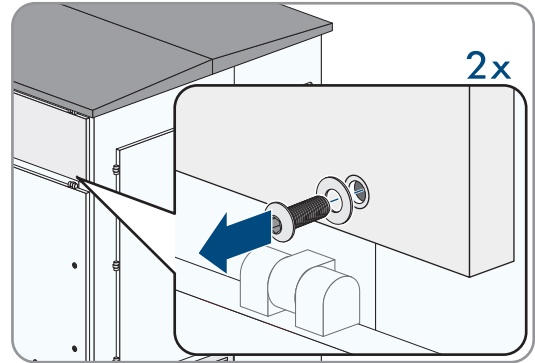
7.12 Opening Air Inlet

Requirements:

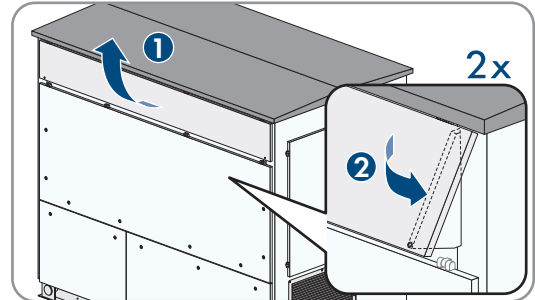
- ☐ The installation work on the product has been completed.
- ☐ The system will be commissioned within the next week.

Procedure:

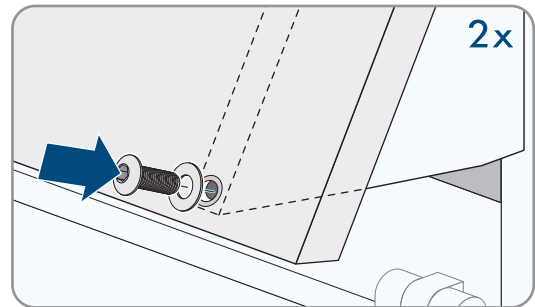
1. Remove the two screws on the cover of the air inlet and keep for later use.



2. Lift the air inlet and fold up the support angle.



3. Mount the two screws on the air inlet cover.



7.13 Requirements for Commissioning

General requirements:

- ☐ All foils and packaging must have been removed.
- ☐ None of the devices must display any damage.
- ☐ The base of the product must not be deformed.
- ☐ All devices must be correctly installed.
- ☐ All devices must be properly grounded.
- ☐ All transport locks and desiccant bags must be removed.
- ☐ All devices must be properly closed and sealed.
- ☐ All doors and locks must function properly.
- ☐ All labels and signs must be in place.
- ☐ All cables of the product must be properly routed and connected.
- ☐ Air inlets must be opened.

DC side:

- ☐ All DC cables must be correctly connected to the inverter. The installer is responsible for the execution of the bolted connection.
- ☐ The battery must have been checked.

- ☐ All the battery's cables must be correctly connected to the inverter.
- ☐ It must be ensured that the polarity of the connected cables matches the polarity of the DC connection busbars.
- ☐ The DC voltages must be checked.
- ☐ An insulation measurement must be carried out and recorded.

AC side:

- ☐ The AC circuit breaker must be opened.
- ☐ The medium-voltage transformer must be connected to the utility grid.
- ☐ The medium-voltage transformer must not show any oil leakage.
- ☐ The pressure gauge for the SF₆ gas on the medium-voltage switchgear gas must be in the green range.
- ☐ In France: If the inverter is equipped with an AC circuit breaker by EATON, the AC circuit breaker must be secured with a Ronis lock. The Ronis lock must be provided and installed by the project side. Information on the installation of the lock can be found in the document **IL01301040E** at <https://www.eaton.com>.

Communication:

- ☐ Communication connections and the supply voltage must be connected and checked.
- ☐ The external supply voltage for the auxiliary power supply of external loads must be checked for the permitted voltage and match the grid voltage at the operating site.
- ☐ The cable entries must be sealed against moisture penetrating from the outside.
- ☐ It is recommended to assign the IP address 192.168.100.36 to the battery. This makes easy commissioning possible.

Documentation:

- ☐ All documentation must be available.
- ☐ SMA Solar Technology AG must have access to the safety documentation for the construction site.
- ☐ All system documentation, such as cabling diagrams, must be present.

**Development of odors after commissioning**

In the first days after commissioning of the product, odors may develop. Despite the development of odors, no substances hazardous to health are released. The odor subsides after a few days.

- If the inverter is installed in closed rooms, ensure sufficient fresh air supply.

8 Disconnecting and Reconnecting

8.1 Safety When Disconnecting and Reconnecting Voltage Sources

DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

DANGER

Danger to life due to high short-circuit current in the battery

Despite careful construction, a short circuit may occur in the inverter under fault conditions. In case of a short circuit in the inverter, the connected battery can supply a very high short-circuit current. The resulting electric arc and pressure wave lead to death or serious injuries.

- Install the inverter in a closed electrical operating area.
- Always close and lock the inverter.
- Before opening the inverter, externally disconnect the inverter on the AC and DC side and secure against reconnection.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.

DANGER

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

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

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

⚠ WARNING**Danger to life from electric shock when entering the battery storage system**

Damaged insulation in the storage system can cause lethal ground currents. Lethal electric shocks can result.

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Install the product in a closed electrical operating area.

⚠ WARNING**Danger to life due to electric shock when the internal power supply is switched off**

After switching off the internal power supply at the load-break switch -Q62, lethal voltages are still present in the cables to load-break switch -Q62. Only after the power path has been enabled are all cables of the internal power supply de-energized. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the product from the power path and ensure that it cannot be reconnected.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting and in operation, an electric arc can arise if conductive foreign parts (e.g. tools) are located in the product and establishes a conductive connection between live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ WARNING**Hearing impairment due to high-frequency noises of the product**

The product generates high-frequency noises during operation. This can result in hearing impairment.

- Wear hearing protection.

⚠ CAUTION**Risk of burns due to hot components**

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

8.2 Disconnecting the Battery Storage System

1. Log into the user interface.
 2. Set the parameter **InvOpMod** to **Stop** via the user interface.
 3. If the battery is not controlled via the inverter, stop the battery manually and secure it against re-activation.
 4. On the user interface, check whether the switch between the DC side and the inverter is open.
 5. Disconnect the battery voltage at the external fuse switch-disconnector or circuit breaker and secure against reconnection.
- ☒ Entering the operating area is permitted.

8.3 Disconnecting the Inverter

To ensure that the DC side is de-energized before opening the inverter, the inverter is equipped with measuring points for determining the DC voltage. The voltage present on the DC side is displayed in a ratio of 10:1.

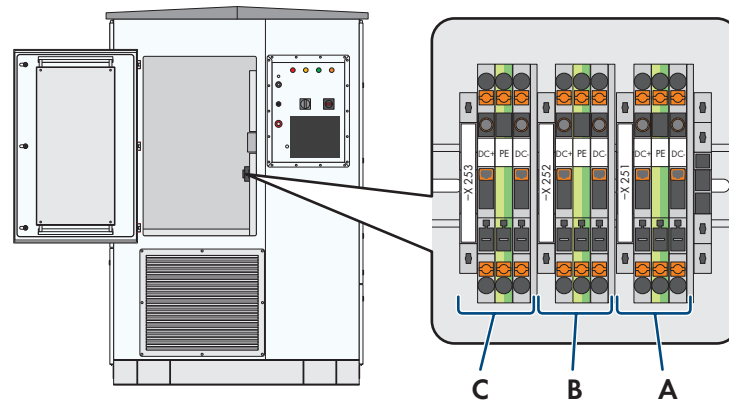


Figure 70: Position of measuring points in the customer installation location

Position	Designation
A	-X251 for measuring battery voltage
B	-X252 for measuring the battery voltage with split DC busbar
C	-X253 for measuring the battery voltage with split DC busbar (only for option with 3 split DC busbars)

For the greatest possible safety during the disconnection process, the DC voltage must be measured before and after disconnecting the batteries from voltage sources. Thus, a flawless measuring chain is ensured.

Measuring points	Measurement result
DC+ to DC-	10% of the battery voltage applied
DC+ to grounding conductor / DC- to grounding conductor	In the case of an isolated system: when the battery voltage is present, the battery is not released With a grounded system: 0 V

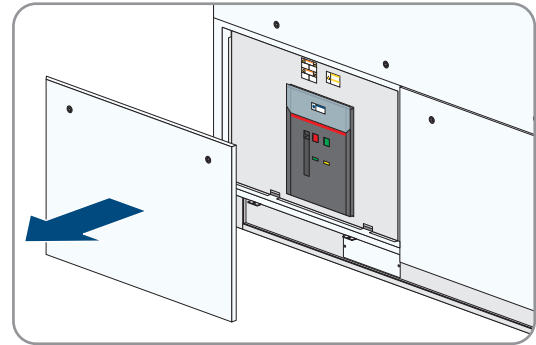
Additionally required material (not included in the scope of delivery):

- ☐ Measuring device according to locally applicable standards and directives with a DC input voltage range of at least 1500 V, suitable for the mounting location
- ☐ 2 padlocks for key switch. Diameter of the shackle: 5 mm to 8 mm.
- ☐ Depends on variant: 1 padlock for AC disconnection unit. Diameter of the shackle: 5 mm to 8 mm

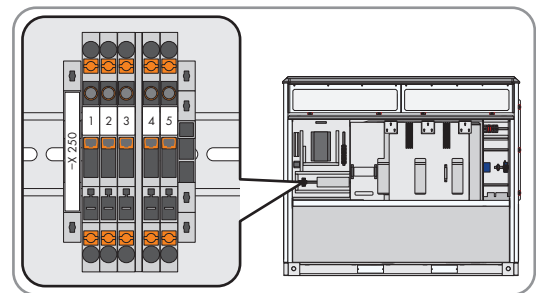
Procedure:

1. On the user interface make sure that error **6494** is not present (see Section 10.3, page 133).
2. Turn the key switch **-S1** to **Stop**.
3. Remove the key. In this way, you secure the product against inadvertent reconnection.
4. Turn the DC load-break switch **-Q61** to the **OFF** position. Note that the cable to the load-break switch is still energized.
5. Pull the bracket out of the switch lever.
6. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
7. To ensure the correct functioning of the measuring chain, measure the DC voltage at the terminal **-X251** and the option-dependent terminals **-X252** and **-X253**. Measure DC+ against DC- and both poles against the grounding conductor.

8. Turn the load-break switch of the supply voltage **-Q62** to the **OFF** position. Note that the cable to the load-break switch is still energized.
9. Pull the bracket out of the switch lever.
10. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
11. If external supply voltage is used, disconnect the supply voltage via upstream switching devices.
12. Ensure that 25 minutes have passed after switching off the load-break switch **-Q61**.
13. Disassemble the outer panel of the AC switch module (see Section 13.2.1, page 170).



14. Verify that the switch state display of the AC disconnection unit is in the **OPEN** position.
15. Ensure that the AC disconnection unit cannot be reconnected. Use the key supplied or a padlock, depending on the version of the AC disconnection unit.
16. Open the hatch on the AC side of the product (see Section 13.1, page 168).
17. Ensure that no voltage is present on the **-X250** terminal.



☒ The inverter must be disconnected from all voltage sources on the AC side.

18. Disconnect all-pole the battery at the external fuse switch-disconnector or circuit breaker and secure against reconnection.
19. Measure the DC voltage at terminals **-X251**, **-X252** and **-X253**. Measure DC+ against DC- and both poles against the grounding conductor. The DC voltage must be 0 V.
20. Open the hatch on the DC side of the product (see Section 13.1, page 168).

☒ The inverter is completely disconnected from all voltage sources.

8.4 Disconnecting the Medium-Voltage Transformer

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

- ☐ 1 padlock. Diameter of the shackle: 5 mm to 8 mm
- ☐ Grounding and short-circuiting equipment

Procedure:

1. Ensure that the inverter is disconnected from all voltage sources (see Section 8.3, page 114).
2. Make sure that there is sufficient SF₆ gas in the medium-voltage switchgear and the display is green.
3. Switch off the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
4. Ensure that no voltage is present.

5. Ground the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
6. Lock the circuit breaker for the medium-voltage switchgear using a padlock. This will protect the switch levers from inadvertent reconnection.
7. Attach magnetic signs indicating the name of the duly authorized person to the transformer panel.
8. Connect the grounding- and short-circuiting equipment to the AC busbars between the inverter and medium-voltage transformer.
9. Disconnect any additional external voltage.
10. Cover or isolate any adjacent live components.

8.5 Reconnecting the Medium-Voltage Transformer

Connecting and disconnecting medium voltage

Only a duly authorized person trained in electrical safety is allowed to connect and disconnect the medium voltage.

Requirements:

- The protective cover that protects the low-voltage area between the inverter and the MV transformer must be mounted.
- The cover at the medium-voltage connection area on the MV Transformer must be mounted.

Procedure:

1. Remove the grounding- and short-circuiting equipment from the AC busbars between the inverter and MV transformer.
2. Remove the magnetic signs indicating the name of the duly authorized person from the circuit breaker panel and the "Do not operate!" magnetic sign. varistor.
3. Remove the padlock from the circuit breaker for the MV switchgear.
4. Open the grounding switch at the transformer panel of the MV switchgear.
5. Close the circuit breaker for the transformer panel of the MV switchgear.
6. Restart the inverter (see Section 8.6, page 117).

8.6 Reconnecting the Inverter

DANGER

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

High voltages are present in the live parts of the product. Touching live parts will result in death or serious injury due to electric shock.

- Before reconnecting, make sure that the panels are mounted (see Section 13.2.1, page 170).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 13.1, page 168).

Procedure:

1. Make sure that all hatches are closed and locked.
2. If the inverter is equipped with a Remote GFDI, set the parameter **PvGnd.OpnRemGfdi** to **Enable** and thus cancel the grounding of the PV field.
3. If the inverter is equipped with a Remote GFDI, set the parameter **PvGnd.OpnRemGfdi** to **Disable** and thus activate the grounding of the PV field.
4. Remove protection against reconnection at the AC disconnection unit.
5. Mount the outer panel of the AC switch module (see Section 13.2.1, page 170).

6. If external supply voltage is used, reconnect the external supply voltage
7. Remove the padlocks from the brackets of the DC switches **-Q61** and **-Q62**.
8. Turn the DC load-break switch **-Q62** to the **ON** position.
9. Turn the DC load-break switch **-Q61** to the **ON** position.
10. Turn the key switch **-S1** to **Start**.

8.7 Reconnect the battery storage system

1. Ensure that there are no more people in the operating area.
2. Leave the operating area and lock it.
3. Externally connect the battery voltage.
4. If the batter is not controlled via the inverter, start the battery.
5. Log into the user interface.
6. Set the parameter **InvOpMod** to **Operation** via the user interface.

9 Operation

9.1 Safety during Operation

⚠ WARNING

Danger to life due to electric shock when opening the customer installation location

Dangerous contact voltages are present in the customer installation location during operation. Touching live parts can result in death or lethal injuries due to electric shock.

- Wear suitable personal protective equipment when opening the customer installation location.

NOTICE

Disturbance of the battery storage system due to incorrectly set parameters

If the parameter settings for grid management services are incorrect, the battery may not be able to meet the requirements of the grid operator. This can involve yield losses and the inverter may have to be disconnected by the grid operator.

- When setting the modes of grid management services, ensure that the control procedures agreed with the grid operator are parameterized.

NOTICE

Unwanted product behavior following a Firmware update

When the firmware is updated, the default values for several parameters might be newly defined. Adopting default settings after a Firmware update without checking them can change the previous settings and result in unwanted behavior of the product. It can cause the product to disconnect because voltage limits are exceeded. This can result in yield losses.

- Before changing the parameter by simulation, ensure that the grid stability at the AC connecting rails of the product as well as at the point of interconnection is observed, also with the extended reactive power range.
- Ensure that MV transformer is designed for the permanent feed-in of reactive power.
- Check whether the reactive power range extension requires changes to the SCADA system or the system control. If changes are necessary, perform them.
- After adjusting the parameters for the reactive power setpoint, check whether the Modbus specifications for the reactive power values fed in by the product correspond to the specifications before the change and correspond to the expected values. If the specifications do not match, the percentage value for the reactive power setpoint in the SCADA system or of system controller must be adjusted.
- Ensure that the grid limits at the AC connecting rails of the product are observed with the extended reactive power range.
- Ensure that the grid limits as well as the specifications of the grid operator regarding the reactive power limits of the battery storage system at the grid-connection point are observed.

9.2 Localization of the User Interface

You have the option of localizing the user interface so that it differs from the country settings. You can localize the date format, time format, decimal and thousand separators and the first day of the week.

The localization settings can be changed at login and will be active until the next logout.

Procedure:

1. Select [**Localize**] in the drop-down menu.

2. Adjust the desired localizations.
3. Select **[Login]**.

9.3 Selecting the Language

You have the option of setting the language of the user interface so that it differs from the country settings. The setting always applies locally.

The localization settings can be changed at login and will be active until the next logout.

Procedure:

1. Log into the user interface (see Section 13.5, page 182).
2. In the user info line select  English ▾ and select the desired language from the drop-down list.

9.4 Setting the System Time

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. Select the area with date and time in the status info line.
3. Enter the current time.
4. Select **[Save]** to save the time change.

9.5 Changing the Password for the User Groups

To change the password for the "installer" user group, you must be logged in as an installer.

To change the password for the user group "User", you can be logged in as a user or an installer.

NOTICE

Property damage due to unauthorized access to the system when the standard password is used

The standard password of the product is publically available. If you do not change the standard password after commissioning, unauthorized access to your system can be gained. Yield losses and system damage can arise as a result of unauthorized access.

- Change the standard password to a secure password immediately after commissioning.

Procedure:

1. Log into the user interface (see Section 13.5, page 182).
2. Select the role of the user group for which the password is to be changed.
3. Enter the new password: The new password must have at least 8 characters, including at least one lowercase letter, one uppercase letter and one number. The following 4 special characters can be used optionally: ! _ ? -
[Save] can only be selected when the password meets the requirements.
4. To confirm, enter the new password again.
5. Click on **[Save]**.

9.6 Resetting Passwords

Resetting the "User" user group password

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. Enter the link <https://<IP-Adresse>/SunnyCentral/public/#/Security> in the browser line.
☒ The page **[Password security]** opens.

3. Select the button **[Reset password]** in the "User" user group.
 - ☒ The password for the "User" user group is reset to the standard password. Before leaving this page, the password must be changed
4. Change the standard password to a secure password.

Resetting the "Installer" user group password

The password of the "Installer" user group can only be reset by SMA Service.

Procedure:

1. To reset the password, contact Service (see Section 18, page 270).
2. Once the password has been reset, change the standard password to a secure password immediately.

9.7 Display of Measured Values

9.7.1 Displaying Measured Values in the Components View

On the Analysis pages **[DC side]**, **[Inverters]**, **[AC side]** and **[Utility grid]**, you can have the corresponding instantaneous values displayed in a diagram. It is possible to have data with two different units displayed on two Y axes.

Depending on the selected time period, you can select different measured values for display.

Procedure:

1. Log into the user interface (see Section 13.5, page 182).
2. Select  **Analyze** in the main navigation.
3. Select the page with the desired component.
4. Select the desired time period for the display in the lower part of the content area. For reasons of better comparison, all months are displayed with 31 days. Tip: You can also change the display time period after selection of the instantaneous values for display.
5. Select the instantaneous values to be displayed from the instantaneous values below the diagram. Data with the same units are automatically assigned to one Y axis and the horizontal gridlines are adjusted to fit the data.
6. Select the instantaneous values to be displayed from the list which now appears. The instantaneous values can be assigned to the left or right Y axis.
7. To delete data from the display, select the instantaneous value again. The corresponding curve will be removed from the diagram.
8. To display data with other units, select the data on the left or right Y axis again. The curves will be deleted from the diagram and you can select other data.

9.7.2 Displaying Measured Values in the Detail Analysis

On the page **Detail analysis**, instantaneous value can be displayed in a diagram. It is possible to have data with 2 different units displayed on two Y axes.

Depending on the selected time period, you can select different measured values for display.

Procedure:

1. Log into the user interface (see Section 13.5, page 182).
2. Select  **Analyze** in the main navigation.
3. Select the page **[Detail analysis]**.
4. Select the desired time period for the display in the upper part of the content area. For reasons of better comparison, all months are displayed with 31 days. Tip: You can also change the display time period after selection of the instantaneous values for display.

5. To select the instantaneous values for the diagram, select [**Select instantaneous values for Y axes**].
6. To select the instantaneous values for the left Y axis, select the corresponding instantaneous values in the left column of the drop-down box.
7. To select instantaneous values for the right Y-axis, select the corresponding instantaneous values in the right-hand column of the selection box. Tip: If both axes are assigned a unit, all instantaneous values with a different unit are grayed out.
8. Select [**OK**] to create the diagram.
9. To delete data from the display, select the instantaneous value in the legend. The corresponding curve will be removed from the diagram.
10. To display data with other units, select [**Select instantaneous values for left Y axes**] again and select the data of the Y axis again. The curves will be deleted from the diagram and you can select other data.

9.7.3 Displaying Measured Values of the External Devices

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. In the main navigation select [**External devices**].
3. In the list of the external devices, select the row of the device for which the measured values are to be displayed.
4. Select the button [**All instantaneous values**].
5. To return to the overview of all external devices, select the button [**Back**].

9.8 Enabling Communication via FTP Server

The product supports the exchange of data both via unencrypted FTP and via FTPS. For secure FTPS access, an individual certificate is created, which is retained even if the firmware is updated or the settings are reset to default settings. It can be configured device-specifically whether access to the supporting servers is permitted.

The FTP and FTPS access are disabled in the default settings.

Procedure:

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. In the parameter **FtpSrv.Mode**, select the type of access to the FTP server.

Set value	Description
Off	The communication via FTP is disabled.
FTP server on	The FTP server is enabled.
FTPS server on	The FTPS server is enabled.
FTPS server on	The FTP and FTPS servers are enabled.

9.9 Setting up communication with the battery

Direct communication between inverter and battery

Direct communication can be established between the inverter and the battery via Modbus TCP. This communication is set up by SMA Service during commissioning.

Indirect communication via the system controller of a third-party company

In the case of indirect communication using a system controller, the system controller handles the control of the battery and also evaluates and monitors the status and limiting values. For this, the communication between the inverter and the battery must be deactivated.

Procedure:

1. Call up the parameter overview (see Section 13.6, page 182).
2. Set the parameter **Bsc.BatEna** to **DISABLED**.

9.10 Configuring External Devices

Various external devices can be connected to the inverter. For the I/O devices, the Modbus profiles must be generated by the customer. For further information on this subject, see the Technical Information "Modbus® interface for SUNNY CENTRAL STORAGE."

Procedure:

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. In the main navigation select **[External devices]**.
3. In the list of the external devices, select the row of the device that has to be configured.
4. Select the button **[All parameters]**.
5. Adjust the name of the selected device in the parameter field **Dev.Nam**. The identification of the individual devices is carried out via this name and the IP address later on.
6. Set the request cycles for the Modbus registers in the parameter fields **Dev.Poll.Cyc** and **Dev.Poll.Cyc.Red**.
7. Check whether the appropriate battery profile for the battery used is set in the parameter **Bsc.BatPrf**.
If the appropriate battery profile is not being used, select the correct one from the list.
8. To return to the overview of all external devices, select the button **[Back]**.

9.11 Adjusting the Parameter Settings on the PQ-Meter

In order to ensure correct conversion of the measured values, the parameter settings on the PQ-Meter must be adjusted after commissioning.

Procedure:

1. Ensure that the inverter is disconnected from all voltage sources (see Section 8.3, page 114).
2. Adjust the parameters for current measurement on the PQ-Meter for the channels 1 to 3 to the following values:
Primary 5100 A / secondary 5 A (relation 1020:1) (see documentation of manufacturer).
3. Compare the instantaneous values **GriMs.V.PhsAB**, **GriMs.V.PhsBC** and **GriMs.V.PhsCA** for the voltage measurement as well as the measured values **InvMs.TotA.PhsA**, **InvMs.TotA.PhsB** and **InvMs.TotA.PhsC** for the current measurement with the measured values of the PQ-Meter, and ensure that the measured values of the PQ-Meter are correctly converted (see Section 13.7, page 182).

9.12 Search Function

9.12.1 Search based on the ID Number

Parameters, instantaneous values and the pages of the user interface have unique ID numbers. By means of these numbers, parameters, instantaneous values or pages can be found quickly.

Procedure:

1. Log into the user interface (see Section 13.5, page 182).
2. Enter the required ID number of the page, parameter or instantaneous value in the user info line in the field **#XXXX**.

9.12.2 Targeted Search

It is possible to narrow the search down to obtain faster results when searching for parameters and instantaneous values. The search is carried out in the favorites, in the top 50 and in all parameters or instantaneous values.

Procedure:

1. Call up parameter overview (see Section 13.6, page 182) or instantaneous value overview (see Section 13.7, page 182).
 2. In the field **Search parameter** or **Search instantaneous value**, enter the searched parameter or instantaneous value. You can search for long names, short names, numbers or parts of it.
- ☒ As you make your entry in the search field, the list of parameters or instantaneous values will be reduced to the matching entries.
 - ☒ In the tabs of the subnavigations, the number of filtered parameters and instantaneous values is displayed.

9.13 Creating Favorites

Parameters and instantaneous values can be marked as favorites. The marked parameters and instantaneous values are displayed in a separate list. You can create a list with the most important parameters and instantaneous values.

The favorites are created separately for the individual user groups and stored on the computer. Thus, the favorites of a particular inverter are automatically adopted when you log in to another system.

An exchange of favorites lists between the individual user groups, the inverter and the computer is possible via export and import.

Procedure:

1. Call up the overview for parameters or instantaneous values (see Section 13, page 168).
2. In the line of the parameter or instantaneous value, select the favorite identifier ★.

9.14 Using Parameters to Activate and Deactivate the Inverter Standby

1. Call up the parameter overview (see Section 13.6, page 182).
2. To set the inverter to operating state "Standby", set the parameter **RemRdy** to **DISABLED**.
3. To restart the inverter, set the parameter **RemRdy** to **ENABLED**.

9.15 Setting the operating mode

The inverter's operating mode can be changed manually via the user interface or by an external signal generator.

If the parameter **Bsc.SrcSel** has been set to **Manual control**, external setpoints do not apply.

Procedure:

1. Set the parameter **Bsc.SrcSel** to **Manual control** or **External control**.
2. Set the parameter **Bsc.SCSOpCmdMan** to the required operating mode in the case of manual control, or the parameter **AuxCtl.SCSOpCmd** to the required operating mode if there is an external signal generator:

Operating mode	Description
Battery standby	The inverter switches to the operating state "Stop". The battery's DC switching device remains closed.
Inverter standby	The inverter switches to the operating state "Standby". The battery's DC switching device remains closed. This reduces the battery's standby consumption.

Operating mode	Description
Power control	The inverter switches to the operating state "GridFeed". The setpoint of the active power is set in the parameter Bsc.WSptMan or, if there is an external signal generator, via the Modbus protocol. The active power setpoint currently used can be read off in the instantaneous value WSpt. The setpoint of the reactive power is set in the parameter Bsc.VArSptMan or, if there is an external signal generator, via the Modbus protocol. The reactive power setpoint currently used can be read off in the instantaneous value VArSpt. When the parameter GriMng.VArMod is set to PFCtlCom, the power factor can be preset via the parameter Bsc.PFSptMan. The reactive power setpoint currently used can be read off in the instantaneous value PFSpt.
DC Voltage Control	The inverter switches to the operating state "GridFeed". The battery's charge and discharge voltage is set in the parameter Bsc.DcVolSptMan or, if there is an external signal generator, via the Modbus protocol. The charge and discharge voltage currently used can be read off in the instantaneous value DcVolSpt. A fixed voltage setpoint can thus be created, one that determines the exchange of active power with the utility grid. When controlling the DC voltage, the inverter takes into consideration all other active limits (active power, DC current and DC voltage). The setpoint of the reactive power is set in the parameter Bsc.VArSptMan or, if there is an external signal generator, via the Modbus protocol. The reactive power setpoint currently used can be read off in the instantaneous value VArSpt. When the parameter GriMng.VArMod is set to PFCtlCom, the power factor can be preset via the parameter Bsc.PFSptMan. The reactive power setpoint currently used can be read off in the instantaneous value PFSpt. The active power gradients set in the parameter WGra and WGraRecon have no effect.
QonDemand	The inverter switches to the operating state "Q on Demand". The battery stops and the DC switchgears of the battery and inverter are opened. The setpoint of the reactive power is set in the parameter Bsc.VArSptMan or, if there is an external signal generator, via the Modbus protocol. The reactive power setpoint currently used can be read off in the instantaneous value VArSpt. When the parameter GriMng.VArMod is set to PFCtlCom, the power factor can be preset via the parameter Bsc.PFSptMan. The reactive power setpoint currently used can be read off in the instantaneous value PFSpt.

9.16 Import file

For importing files, you have the following options: transfer via an FTP program, reading from a medium (SD memory card, USB flash drive) connected to the communication interface, or reading from a file in the local directory of the computer used.

The files to be imported must be uploaded to the internal cache. In the second step, the import file can be imported from the internal cache to the given application. This enables several files to be uploaded to the cache before performing the second step.

The uploaded files can be deleted from the internal cache after importing.

Procedure:

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. Select  in the main navigation and select **Import** from the drop-down list.

3. Select the required data type for import from the list.
4. To import a file to the cache, select [**Copy file from external device**].
5. If the file can be imported from a connected medium, select the desired file from the list. The file source is indicated in the first column of the list.
6. If the file is to be read from a local directory of the computer used, select [**Browse...**] and then select the desired file in the directory.
7. To upload the file to the internal cache, select the desired file from the list.
8. To execute the file in the appropriate application, select the desired file from the list.

9.17 Exporting Files

For better management of data and settings, you have the following options for exporting different types of information: transfer via an FTP program, export to an external storage medium (SD memory card, USB flash drive) or export to a file in the local directory of a computer. To do this, a storage medium must be connected to the communication interface or the computer must be connected to the inverter.

First, the files to be exported must be generated and uploaded to the internal cache. In the second step, the export file can be exported from the internal cache to the corresponding storage location. This enables several files of the same data type to be exported from the cache at the same time.

After exporting, you can delete the exported files from the internal cache.

Procedure:

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. In the main navigation, select  and select **Export** from the drop-down list.
3. Select **Service information**.
4. Select [**Create service information**].
5. Set the desired time period.
6. Select [**Generate**].

9.18 Adjusting Network Ports

If you want the inverter to be accessible via the Internet, you may have to configure port forwarding in your router. This may require adjustment of the network ports.

Unauthorized access to the inverter

If you activate the Modbus protocol, unauthorized access to the inverter will be possible during the learning mode. In this case, users without a password will be able to view the instantaneous values of supported devices or even change parameters. After that, only access by IP addresses that are accepted in the whitelist is possible.

- Using a VPN is recommended.
- Accepting only known IP addresses in the whitelist is recommended.

Procedure:

1. Call up the parameter overview (see Section 13.6, page 182).
2. In the parameter **Netw.StdGw.IpAdr**, enter the IP address of the standard gateway via which the inverter can be accessed.
3. Enter the IP address of the DNS server in the parameter **Netw.Dns.SrvIpAdr**.
4. If you want to use a proxy authentication, activate the parameter **Netw.Proxy.AuthEna**.
5. Enter the port of the proxy server in the parameter **Netw.Proxy.Port**. The default setting is **8080**.

6. Enter the address of the proxy server in the parameter **Netw.Proxy.Adr**.
7. Enter the user names and password of your proxy server in the parameters **Netw.Proxy.Usr** and **Netw.Proxy.Pwd**.

9.19 Setting and Testing the FTP Push Function

The communication unit of the inverter is equipped with an FTP push function. With this function, the data collected from your PV system can be saved as an CSV file to a local FTP server.

Since errors and problems can be detected and rectified faster by means of FTP push, we recommend activating this function.

Requirement:

- ☐ A local FTP server must have been configured.

General FTP settings

1. Call up the parameter overview (see Section 13.6, page 182).
2. In the parameter **Ftpush.SrvAdr** enter the DNS name or the IP address of the FTP server.
3. In the parameter **Ftpush.SrvPort**, enter the port of the FTP server.
4. In the parameter **Ftpush.SrvUsr**, enter the user name if a login is required on the FTP server.
5. In the parameter **Ftpush.SrvPwd**, enter the password if a login is required on the FTP server.
6. In the parameter **Ftpush.SrvDir**, enter the directory where the files should be saved.
7. To execute a connection test immediately, select the button **[Execute action]** in the **Ftpush.Tst** parameter.
8. To execute an upload immediately, select the button **[Execute action]** in the **Ftpush.Upld** parameter.
9. To execute a cyclic upload, in the drop-down list select the desired frequency in the **Ftpush.UpldCyc** parameter.

Additional SFTP settings

To further increase security when using SFTP, you can use a certificate with password for the transfer. You can request the certificate from your server operator. It must be in the format "RSA private key".

Procedure:

1. If necessary, ensure that the certificate is in RSA private key format Open the file in a text editor. Check that the file begins with the line **—BEGIN RSA PRIVATE KEY—** and ends with the line **—END RSA PRIVATE KEY—**. If the format is not correct, contact your server operator.
2. Import the certificate of your server operator (see Section 9.16, page 125).
3. Activate the certificate for transfer via the parameter **Ftpush.Cert.Ena**.
4. Enter the password that you received from your server operator in the parameter **Ftpush.Cert.Pass** if the certificate is password-protected.

9.20 Secure Transmission of Control Commands

9.20.1 Information for a Secure Transmission of Control Commands

A list of IP addresses protects the inverter against unauthorized access via the network. The list that accepts the reading of instantaneous values, writing of parameters and setting of control values is stored in the inverter. This list can be created in various ways:

- Automatic capture of the accepted IP addresses in a whitelist during a 24-hour phase of learning If there is no whitelist or it is empty, this learning phase starts automatically after the first Modbus access to the inverter after commissioning or firmware update.
- Creation of a list with accepted IP addresses via the user interface

- Manual transfer of IP addresses from a list of unauthorized Modbus accesses

Different rights can be assigned to the individual IP addresses:

- **GMS** - The IP address can be used to transmit control commands in terms of grid management services.
- **Read** - The IP address can be used to read instantaneous values and parameters.
- **Write** - The IP address can be used to transmit parameters that do not concern grid management services.

9.20.2 Starting the automatic capture of the accepted IP addresses

In learning mode, the inverter captures the IP addresses of the computers that access the inverter. The learning mode starts automatically after commissioning and the first connection setup via Modbus to the inverter and lasts 24 hours. The IP addresses are added to a so called whitelist stored in the inverter. The inverter also stores whether a device had read or write access or sent GMS commands. A device that has read-only access during learn mode may read-only access the inverter even after the learn mode is completed. The access rights for the individual IP addresses can be changed manually (see Section 9.20.3, page 128).

The learning mode can be started manually via the user interface. Log in as "Installer" for this. This adds any new IP addresses to an existing whitelist.

Procedure:

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. Select **Diagnosis**.
3. Select the button [**Start learning mode**].

9.20.3 Entering accepted IP addresses via the user interface

The automatically created Modbus whitelist can be edited and extended. Entries can also be deleted. If all entries have been deleted, the learning mode will automatically restart on the next access via Modbus.

Procedure:

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. Select **Diagnosis**.
3. To add new IP addresses to the GMS whitelist, enter the accepted IP address in the **IP address** field in the **Modbus Whitelist** area.
4. To add blocked IP addresses to the whitelist, click on the **Add** button in the **Blocked Modbus connections** area.
5. To adjust the rights of individual IP addresses, assign the required rights in the **Modbus whitelist** area.
6. Select the button [**Save**]. Tip: Unsaved changes are lost when you exit the page.

9.21 Transferring of operating data

9.21.1 Saving operating data of inverters manually

The inverter records data of all activities permanently. The data includes both the inverter parameters and all event messages.

This data helps the SMA service department to analyze problems. Therefore, it makes sense to transfer the operating data of the inverter to SMA on a regular basis. With the SMA Remote Download Tool, operating data of all inverters in your system can be downloaded from the inverters and transferred to SMA simultaneously.

Since the transfer time depends on the amount of data transferred, we recommend that you back up the data at least quarterly.

Installing the SMA Remote Download Tool

To upload the operating data into the Field Data Management System, the SMA Remote Download Tool must be installed once.

Procedure:

1. Download the file **Install-SMARemoteDownloader-1_0_#_R.zip** at www.SMA-Solar.com and save it in the selected location.
2. Decompress the ZIP file.
3. Install the **Install-SMARemoteDownloader-1.0.#.R.exe** file. Confirm the security prompt.
☒ An installation assistant will open.
4. Accept the license agreement and click **[Next]**.
5. Select the installation folder and click on **[Next]**. Make sure that 2.5 MB of free memory is available in the directory.
6. To create shortcuts to the desktop, select the appropriate option and click on **[Next]**.
7. To complete the installation, click on **[Finish]**.

Saving operating data of inverters

The backup of the operating data is done in 2 steps:

1. Downloading the operating data to the computer
2. Uploading all operating data to the Field Data Management System

For each backup of the operating data, you can specify the list of inverters whose data is to be downloaded and the time period for the data.

Procedure:

1. Open the SMA Remote Download Tool.
2. Click on **[Settings]**.
3. In the **Download Folder** field, enter the folder in which the data is to be stored.
4. In the **IP address field**, enter the IP addresses of all inverters one after the other from which the data is to be saved and select **[+]**. This transfers the IP address to the device list. Tip: Entering the address 192.168.2.[1-3] automatically takes over the inverters with the IP addresses 192.168.2.1, 192.168.2.2 and 192.168.2.3.
5. To remove inverters from the device list, select the IP address of the desired inverter and **[-]**.
6. In the **Start Date** and **End Date** fields, enter the selected time period of the saved data.
7. To save all relevant data, select the fields **Include Data Log**, **Include System Log** and **Include archived Syslogs**.
8. Click on **[Accept]**. This saves the settings for the data transfer.
9. Click on **[Download service information]**. This will download the data of all inverters. Depending on the amount of data, this process may take several minutes.
10. To download the parameter separately, click on **[Download Parameters]**. The parameters are saved in separate CSV files for each inverter.
11. Click on **[Upload service information to FMS]**. This uploads the data of all inverters into the Field Data Management System.

9.21.2 Set up automatic backup of operating data

To ensure the regular backup of the operating data of the inverter, automatic backup of the inverter data can be set up. This means that the data is uploaded to the Field Data Management System between 2:00 and 4:00 a.m. every day and is available for later problem analysis.

Procedure:

1. Call up the parameter overview (see Section 13.6, page 182).
2. Set the parameter **Fmshpush.UpdCyc** to **Daily**.

9.22 Preparing Update of Firmware Version

With the Remote Service option, it is possible to have the firmware update carried out remotely by the SMA Service. As soon as a new version of the firmware is available, SMA informs about it via a Product Change Information (PCI). You can then contact SMA Service to arrange an appointment for the update and the update procedure. You can define the order and timing of the update on the individual inverters. You can find more information on Remote Service in the technical information Remote Service for Sunny Central UP.

For data exchange with the SMA Service, the system is equipped with 1 SMA Power Plant Manager or 1 SMA Data Manager L. All necessary settings are made during commissioning by the SMA Service.

Requirement:

- ☐ There is a Product Change Information from SMA about a new firmware version.
- ☐ The IP addresses of the inverters are known.

Procedure:

1. Contact SMA Service by telephone and specify the date for the update and the order of the update on the system.
2. In Sunny Portal under **Configuration > System properties > Access > Service access** ensure that the option **Automatic download** is activated. It is advisable to activate the automatic activation 24 hours before the agreed date so that the required files can be downloaded.
3. In Sunny Portal under **Configuration > System properties > Access > Service access** ensure that the option **External parameterization** is activated. Only with this option, the SMA Service can execute the update on the system.

9.23 Recording network traffic

To get an overview of the network traffic in the system, the data traffic in the network can be recorded and stored. This allows problems in data traffic to be better analyzed. The data can be recorded for a maximum of 5 minutes or 15 MByte and are then available for download.

Procedure:

1. Log into the user interface as an installer (see Section 13.5, page 182).
2. In the main navigation, select [**Diagnosis**].
3. Select [**Start TcpDump**] in the **Network diagnosis** area.
4. Select the network from which the data traffic is to be recorded.
5. If the data traffic of a specific external device is to be recorded, select the appropriate device from the drop-down menu **Devices**.
6. Select [**Execute**].
7. To stop the recording, select [**Stop TcpDump**].
8. To download the data for evaluation, select [**Download**].

10 Troubleshooting

10.1 Safety during Troubleshooting

DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

DANGER

Danger to life from electric shock due to high voltages on the product

High voltages can be present on the product under fault conditions. Touching live components results in death or serious injury due to electric shock.

- Observe all safety information when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- If you cannot remedy the disturbance with the help of this document, contact the Service (see Section 18, page 270).

⚠ WARNING**Danger to life from electric shock when entering the battery storage system**

Damaged insulation in the storage system can cause lethal ground currents. Lethal electric shocks can result.

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Install the product in a closed electrical operating area.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Hearing impairment due to high-frequency noises of the product**

The product generates high-frequency noises during operation. This can result in hearing impairment.

- Wear hearing protection.

⚠ WARNING**Danger to life due to electric shock when opening the customer installation location**

Dangerous contact voltages are present in the customer installation location during operation. Touching live parts can result in death or lethal injuries due to electric shock.

- Wear suitable personal protective equipment when opening the customer installation location.

⚠ CAUTION**Risk of burns due to hot components**

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

10.2 Activating Alert under Fault Conditions

You can be notified by e-mail of events that have occurred. This allows a rapid response to failures and minimizes downtimes. The alert is deactivated upon delivery.

Procedure:

1. Call up the parameter overview (see Section 13.6, page 182).
2. To activate the alarm via e-mail, set the parameter **Alrm.Mail.Ena** to **On**.
3. Enter the address or IP address of the relevant SMTP server in the parameter **Alrm.Smtp.Adr**.
4. Enter the port of the relevant SMTP server in the parameter **Alrm.Smtp.Port**.
5. Enter the user name for the SMTP authentication in the parameter **Alrm.Smtp.Usr**.
6. Enter the password for the SMTP authentication in the parameter **Alrm.Smtp.Pwd**.
7. Enter the required encryption in the parameter **Alrm.Smtp.Cry**.
8. Enter the e-mail address to which e-mails are to be sent in the parameter **Alrm.Smtp.Recp**.
9. If you do not wish the sender of the e-mail to contain the address of the SMTP server, enter the desired address in the parameter **Alrm.Smtp.TxAdr**.
10. To create a test e-mail, select the parameter **Alrm.Smtp.Tst** and click the button **[Execute action]**. A test e-mail will be sent to the specified e-mail address.
11. If no test e-mail has arrived, check whether the test e-mail is in the spam folder and make sure that the network settings of the communication unit and the settings of the SMTP server are correct.

10.3 Displaying Disturbance Messages

The current disturbance is displayed in the instantaneous value **ErrNo**. In addition, the location of the cause of disturbance can be read off in the instantaneous value **ErrLcn**.

In the event overview, all disturbance messages are displayed detailing the events that have occurred. If there are several warnings and error messages, the inverter shows the current error messages using the following instantaneous values: **ActErrNo#**, **ActErrTxt#** and **ActErrLcn#**. Messages for a maximum of ten disturbances can be displayed.

Display current error message

1. Call up the instantaneous value overview (see Section 13.7, page 182).
2. Read off the current disturbance in the instantaneous value **ErrNo**.
3. Read off the location of the current cause of disturbance in the instantaneous value **ErrLcn**.

Display all error messages

1. Call up the event overview (see Section 13.8, page 182). All events will be displayed in chronological order.
2. To find warnings and error messages faster, select . This will filter the events.

10.4 Acknowledging Disturbance Messages

10.4.1 Acknowledging Disturbance Messages via the User Interface

Dealing with disturbances

Disturbance messages should only be acknowledged once the underlying causes have been eliminated.

If the causes of the disturbance have not been eliminated, the disturbance will still be detected after acknowledgment and the disturbance message will reappear.

Acknowledge the battery's disturbances

Errors on the battery are acknowledged via the inverter. The inverter enters the operating state "Stop" for the waiting time set in the parameter **Bsc.ErrClrTime**. This allows the battery to disconnect.

Occurred errors can be reset via parameters. To prevent a reoccurring error from being reset, the value set in the parameter is automatically reset to the default value after 2 seconds.

Procedure:

1. Call up the parameter overview (see Section 13.6, page 182).
2. To acknowledge the current error, set the parameter **ErrClr** to **Ackn** for each error respectively. Click on **[Save]** to confirm the change of the parameter.
3. To acknowledge any further errors, set the parameter **ErrClr** to **Ackn** again. The current error can be found in the instantaneous value **ErrNo**.

10.4.2 Acknowledging Safety-Relevant Errors via the User Interface

To acknowledge a safety-relevant error, a parameter must first be set to enable acknowledgement of this error.

Dealing with disturbances

Disturbance messages should only be acknowledged once the underlying causes have been eliminated.

If the causes of the disturbance have not been eliminated, the disturbance will still be detected after acknowledgment and the disturbance message will reappear.

Requirement:

- ☐ A safety-relevant error will be indicated via the status **Error: Critical Error, ProErr active** in the instantaneous value **PwrOffReas**. The source of this error can be read off in the instantaneous value **ErrNo**.

Procedure:

1. Call up the parameter overview (see Section 13.6, page 182).
2. To acknowledge a safety-relevant error, select the error source to be acknowledged in the parameter **ErrClr.ProErr**.
3. Adopt changes of the parameter with **[Save]**.
 - ☒ The safety-relevant error will be set as a regular error.
4. To acknowledge the error before the waiting time has expired, set the parameter **ErrClr** to **Ackn**.
5. Adopt changes of the parameter with **[Save]**.

10.4.3 Acknowledging Disturbance Messages via the Start/Stop Key Switch -S1

i Dealing with disturbances

Disturbance messages should only be acknowledged once the underlying causes have been eliminated.

If the causes of the disturbance have not been eliminated, the disturbance will still be detected after acknowledgment and the disturbance message will reappear.

Procedure:

1. Before entering the battery storage system, disconnect the battery storage system from voltage sources (see Section 8.2, page 114).
2. Turn the start-stop key switch **-S1** to **Stop**.
3. Turn the start-stop key switch **-S1** to **Start**.
4. Turn the start-stop key switch **-S1** back to **Stop** within ten seconds.
5. Turn the start-stop key switch **-S1** back to **Start** again within ten seconds. This will acknowledge the disturbance from the last switching procedure and the disturbance message will be deleted from the fault memory.

10.5 Remedial Action in Case of Disturbances

10.5.1 Troubleshooting for non-feeding of the inverter

It can occur under certain circumstances that the inverter does not feed into the utility grid or the battery does not charge. The cause for not feeding in is displayed in the instantaneous value **PwrOffReas**.

Only when all error causes have been corrected can the inverter change back over to feed-in operation.

Value of the instantaneous value	Possible causes and remedies
No Power Off Reason	There are no disturbances. • Wait for a short period for a reaction.
Error: Error	An error has occurred. • View the cause of the error in the ErrNo instantaneous value. • Check the cause of the error, where necessary eliminate the error and acknowledge via the parameter ErrClr (see Section 10.4.1, page 134).
Stop: Battery System Controller	The internal unit for approving battery operation prevents the grid feed-in. • Set the parameter Bsc.SCSOpCmdMan to the required operating mode.
Stop: Key Switch	The inverter has been switched to the "Stop" operating state with the -S1 start-stop key switch. • Turn the key switch -S1 to the Start position.
Stop: Parameter InvOpMod	The inverter has been switched to the "Stop" operating state via the parameter InvOpMod . • Set the parameter InvOpMod to Operation.
Stop: Stop External X440:3	The inverter has been switched to the "Stop" operating state via the external stop function. • If a signal was not issued via the external stop input, check the input -X440:3. To do so, measure the voltage and check the cable where necessary.

Value of the instantaneous value	Possible causes and remedies
Stop: Scada or PPC, Modbus	The inverter has been switched to the "Stop" operating state via the Modbus protocol. Switch the inverter back to the "GridFeed" operating state via a Modbus signal.
Standby: Scada or PPC, Modbus	The inverter has been switched to the "Standby" operating state via the Modbus protocol. Switch the inverter back to the "GridFeed" operating state via a Modbus signal.
Standby: AC Synchronization	The inverter cannot be synchronized with the utility grid and switches to the "Standby" operating state. Check the AC voltage at the inverter.
Standby: External Grid Error	An external network error has been reported via the Modbus protocol and the inverter has switched to the "Standby" operating state. Switch the inverter back to the "Start" operating state via a Modbus signal and acknowledge the error via a Modbus signal. Here, the status of the utility grid is transmitted via one channel and a special acknowledgement of the network error is transmitted via a second channel to avoid communication errors.
Standby: Power Monitoring Module	The inverter has been switched to the "Standby" operating state due to missing default values for the power regulation and the corresponding configuration in the parameters BatCtl.ComFlb.BatEna and BatCtl.ComFlb.AuxCtlEna (see Section 14.3.5, page 201).
Standby: Parameter RemRdy	The inverter has been switched to the "Standby" operating state via the parameter RemRdy. Set the parameter RemRdy to Enable.
Standby: Standby External X440:7	The inverter has been switched to the "Standby" operating state via the external standby function. If a signal was not issued via the external standby input, check the input -X440:7. To do so, measure the voltage and check the cable where necessary.
Wait AC	The grid limits entered in the parameters VCtl.xxx or HxCtl.xxx have been violated and the inverter has disconnected from the utility grid. - Check the waiting time for reconnection to the grid in the parameter WaitGriTm. - Check the settings for the grid limits in the parameters VCtl.xxx (see Section 14.2.2.2, page 190) or HxCtl.xxx (see Section 14.2.2.1, page 189). The voltage of the utility grid does not satisfy the requirements for connection to the utility grid. - Check the amplitude of the voltage in the utility grid. - Check the frequency of the voltage in the utility grid. - Check the line conductor of the voltage in the utility grid.

Value of the instantaneous value	Possible causes and remedies
Wait DC: DC Voltage	The DC voltage at the inverter is too low or too high. • Wait or adjust the DC voltage.
Wait DC: Bender	The insulation monitoring device is measuring the insulation resistance. The time period of the measurement is defined in the parameter PvGnd.AcIsoMonTm . • Wait until the measurement of the insulation resistance has been completed.
Self Test active	The inverter is performing a self test. • Wait until the self test has been completed.
IO Test active	The inverter is in test mode. Please contact (see Section 18, page 270).

10.5.2 Inverter Behavior in Case of Disturbances

If a disturbance occurs during operation, this may be caused by a warning or an error. In case of an error, inverter operation will be interrupted.

There are 2 levels assigned to each disturbance which influence the display and system behavior. Only in the case of certain disturbances will the inverter behavior differ depending on the level. The level is increased from 1 to 2 if the disturbance occurs 5 times within 2 hours or without interruption for 2 hours.

If a disturbance occurs, an "incoming" disturbance entry is generated in the event overview. This entry includes the device in which the disturbance was detected, a warning symbol, the exact location of the error source within the assembly, an error number, a description of the disturbance and the time when the disturbance occurred.

The cause of the disturbance must be determined and remedied before you acknowledge the disturbance.

Once the disturbance has been acknowledged, the inverter checks whether the cause of the disturbance is eliminated. If the cause of the disturbance still exists after the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance." If the disturbance is no longer present, the disturbance is entered in the event list as "outgoing."

Inverter behavior in the disturbance levels 1 and 2:

- **Waiting time**

In case of an error, the inverter switches to the operating state "Disturbance" and opens the AC disconnection unit and DC switchgear. The inverter does not feed into the grid for the defined waiting time.

The waiting time specifies how long the inverter will be prevented from feeding into the utility grid. Once the waiting time has elapsed, the inverter checks whether the cause of the disturbance has been remedied.

If the cause of the disturbance still exists after the waiting time has expired or the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance."

- **Waiting for acknowledgement**

The inverter switches to the operating state "Disturbance" and opens the AC disconnection unit and DC switchgear. The inverter does not feed in until the disturbance is acknowledged.

- **Day change**

The inverter switches to the operating state "Disturbance" and opens the AC disconnection unit and DC switchgear. The inverter does not feed in.

The disturbance is automatically reset after a day change, or it can be acknowledged once the cause has been eliminated.

- **Warning**

A warning does not affect inverter behavior.

Once the cause of the disturbance has been rectified and the disturbance is no longer displayed, it is deleted from the fault memory. To view previous disturbances after they have been acknowledged on the user interface, an event report is saved on the CF memory card. The event report logs the time and type of disturbance. The event report can also be displayed on the user interface. For an analysis in case of problems, the result reports can be transferred to SMA as a CSV file together with the parameters and the data of your system (see Section 9.21, page 128).

Depending on the type of disturbance, a reset may be performed. When this happens, the relays are checked and the supply voltage of the control system is switched off. This process takes less than 1 minute. While the control system is booting, the regular waiting times for grid monitoring are complied with.

10.5.3 Content and structure of the error tables

You will find the following information in the error tables in the following sections:

Error no.	Explanation	A		B	Corrective measures
		S1	S2	R	
9009	Fast stop tripped by processor assembly.	5 min	Q	-	Eliminate error and switch fast stop back on.

Figure 71: Explanation of the error table (example)

Position	Explanation
A	Behavior of the inverter: disturbance level S1, disturbance level S2 - s / min: waiting time - D: day change - Q: waiting for acknowledgement - W: warning
B	Reset

10.5.4 Error Numbers 01xx to 13xx – Disturbance at the AC Connection

After a grid failure, the inverter monitors the utility grid for a specific period before reconnecting.

When the inverter monitors the utility grid after a grid error, the grid monitoring time is complied with.

Certain errors, such as grid errors, cause the inverter to shut down. In this case, the instantaneous value **WaitGriTm** indicates the time for which the inverter monitors the utility grid before reconnecting. This grid monitoring time can be defined in parameter **GriErrTm**.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
0104	Grid voltage is too high. Overvoltage detected by standard monitoring.	30 s	30 s	-	- Check the grid voltage. - Check grid connections.
0204	Grid voltage is too low. Undervoltage detected by standard monitoring.	30 s	30 s	-	- Check stability of the utility grid. - Make sure the external fuses work properly. - Make sure the AC cable connections are tight. - Check the configured grid limits.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
0205	An error has occurred for the grid synchronization.	W	W	–	–
0404	A frequency change in the utility grid greater than permitted has been detected.	30 s	30 s	–	• Check power frequency. • Check stability of the utility grid.
0405	The inverter has disconnected from the utility grid because a stand-alone grid has formed.	30 s	30 s	–	• Check the grid voltage. • Check stability of the utility grid.
0502	Power frequency is too low. Power frequency disturbance detected by standard monitoring.	30 s	30 s	–	• Check power frequency. • Check the display of the grid monitoring relay.
0503	Power frequency is too high. Power frequency disturbance detected by standard monitoring.	30 s	30 s	–	• Make sure the fuses in the load circuit function properly. • Check the configured grid limits.
0802	One line conductor of the utility grid has failed.	5 min	Q	–	• Check the grid voltage. • Check grid connections. • Check stability of the utility grid. • Make sure the external fuses work properly. • Make sure the AC cable connections are tight. • Check the configured grid limits.
0803	The supply voltage for the assemblies has failed.	5 min	Q	–	• Contact Service.
1304	The rotating magnetic field of the utility grid is incorrect.	Q	Q	–	• Check the phase assignment. • Contact Service.
1417	The inverter load is not symmetrical.	30 s	30 s	–	–

10.5.5 Error Numbers 34xx to 40xx – Disturbance at the DC Connection

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
3403	An overvoltage has occurred at the DC source.	15 min	30 min	–	• Check the DC source.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
3501	Error: The insulation monitoring device has measured a too low ground- ing resistance.	30 min	Q	–	• Check the DC source for ground faults.
3502	The GFDI has tripped.	30 min	30 min	–	
3511	Warning: a ground fault has occurred. The inverter remains in feed-in operation.	W	W	–	• Check the DC source.
3517	At the moment insulation measurement is being performed. The inverter is in standby mode.	W	W	–	–
3518	The GFDI is thermally overloaded.	5 min	Q	–	• Check the DC source.
3521	The DC voltage to ground is too high. The insulation measurement was canceled.	15 min	D	–	• Check the DC source.
3522	The insulation resistance is too low.	5 min	5 min	–	• Check the DC source.
3601	Warning: In isolated operation, leakage current to ground has occurred at the PV modules or the limiting value defined in the Gfdi.FltEnWarnLim parameter has been reached.	W	W	–	• Check the grounding and equipotential bonding of the PV modules. • Check the circuitry and PV system design. • Check parameter Gfdi.FltEnWarnLim.
3602	Warning: In grounded operation, leakage current to ground has occurred at the PV modules or the limiting value defined in the Gfdi.FltEnWarnLim parameter has been reached.	W	W	–	• Check the grounding and equipotential bonding of the PV modules. • Check the circuitry and PV system design. • Check parameter Gfdi.FltEnWarnLim.
3803	An incidence of overcurrent at the DC input has occurred.	1 min	D	–	• Check the DC source.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
4003	Reverse currents detected in the DC source or DC connection polarity reversed.	Q	Q	-	• Check the DC source for short circuits. • Check the circuitry and PV system design. • Check the DC terminals for correct polarity. • Check the functionality of the DC input.
4401	Error in the backfeed power module	W	W	-	• Check the backfeed power module

10.5.6 Error Numbers 6xxx to 9xxx - Disturbance on the Inverter

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6002	Internal memory is defective.	1 min	Q	-	• Contact Service.
6013	Calibration data of AC or DC measurement cannot be loaded.	1 min	Q	-	• Contact Service.
6014	Calibration data of AC or DC voltage measurement cannot be loaded.	1 min	Q	-	• Contact Service.
6119	Disturbance in internal communication of the processor assembly	30 s	180 min	-	• Contact Service.
6136	Timeout following an internal communication failure.	30 s	30 s	-	• Contact Service.
6318	Missing internal connection of an assembly.	30 s	5 min	-	• Contact Service.
6319	Incorrect internal connection of an assembly.	30 s	5 min	-	• Contact Service.
6321	A measurement error has occurred in the Remote GFDI.	15 min	Q	-	• Contact Service.
6405	Overvoltage in the DC link of the inverter bridge.	30 s	5 min	-	• Contact Service.
6410	An error has occurred in the Remote GFDI.	15 min	Q	-	• Contact Service.
6422	Inverter bridge in undefined state	30 s	5 min	-	• Contact Service.
6423	Error: Temperature of the medium-voltage transformer is too high. Disconnection limit exceeded. Inverter stops feed-in operation.	Q	Q	-	• Check the medium-voltage transformer.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6426	Overvoltage at the DC input.	30 s	5 min	–	• Check the battery.
6440	Hermetic protection (oil level) of the medium voltage transformer is no longer given.	Q	Q	–	• Check the medium-voltage transformer.
6443	A general error has occurred.	30 s	5 min	–	• Contact Service.
6456	Pre-charging circuit of DC link is defective.	5 min	5 min	–	• Contact Service.
6479	Data of coding plug is inconsistent.	Q	Q	–	• Contact Service.
6480	Coding plug is not plugged in or not readable.	Q	Q	–	• Contact Service.
6481	Coding plug is defective.	Q	Q	–	• Contact Service.
6482	Storage area in coding plug is defective.	W	W	–	• Contact Service.
6483	Coding plug and detected hardware are inconsistent.	Q	Q	–	• Contact Service.
6484	Invalid firmware version found.	Q	Q	–	• Contact Service.
6485	Hermetic protection (gas fill level) of the medium voltage transformer is no longer given.	30 s	5 min	–	• Check the medium-voltage transformer.
6487	A ground fault has occurred on the AC side.	Q	Q	–	• Contact Service.
6494	Light repeater of the insulation monitoring is defective.	W	W	–	• Check the light repeater and replace it if necessary.
6495	The insulation monitoring device has detected a device fault.	5 min	5 min	–	If the fault 3501 is also displayed, a ground fault may have occurred while the battery was disconnected. • Check the external insulation resistance. • Contact Service.
6496	The driver control of the GFDI has reported an error.	5 min	D		• Contact Service.
6497	The voltage supply is faulty.	W	W	–	• Contact Service.
6498	The circuit breaker for heating and interior fan has tripped.	30 s	30 s	–	• Check the circuit breaker.
6499	An overload at the pre-charging contactor of the sinusoidal filter capacitor was detected.	30 s	Q	–	• Contact Service.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6502	Temperature of inverter bridge is too high.	30 s	30 s	-	• Check function of the fans. • Clean the fans. • Clean clogged fan inlets and ventilation plates.
6506	Warning: Temperature of the medium-voltage transformer is too high.	30 s	30 s	-	• Check the medium-voltage transformer.
6508	Intake temperature is too high.	30 s	30 s	-	-
6512	Intake temperature is too low.	30 s	30 s	-	-
6515	Temperature inside the inverter is too high.	30 s	30 s	-	-
6517	Error: temperature at the sine-wave filter choke is too high. Disconnection limit exceeded. Inverter stops feed-in operation.	5 min	Q	-	• Contact Service.
6518	The temperature at the AC bus-bars is too high.	Q	Q	-	• Check the torque on the AC connection on the inverter. • Check the design of the AC connection on the inverter.
6519	Temperature in the interior of the inverter is undershot.	30 s	30 s	-	-
6520	Warning: Temperature in the interior of the inverter is low. The inverter might be disconnected.	W	W	-	-
6607	Maximum static charge current (DcAmpOpMin) of battery exceeded.	Q	Q	-	• Check the battery.
6608	Maximum static discharge current (DcAmpOpMax) of battery exceeded.	Q	Q	-	• Check the battery.
6609	Minimum static discharge voltage (DcVolOpMin) of the battery undershot.	Q	Q	-	• Check the battery.
6610	Maximum static charge voltage (DcVolOpMax) of the battery exceeded.	Q	Q	-	• Check the battery.
6625	The current on the inverter bridge is too high and is therefore limited to the maximum current.	1 min	1 min	-	• Contact Service.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6626	Maximum dynamic charge current (DcAmpDynMin) of battery exceeded.	W	W	-	• Check the battery.
6627	Maximum dynamic discharge current (DcAmpDynMax) of battery exceeded.	W	W	-	• Check the battery.
6628	Minimum dynamic discharge voltage (DcVolDynMin) of the battery undershot.	W	W	-	• Check the battery.
6629	Maximum dynamic charge voltage (DcVolDynMax) of the battery exceeded.	W	W	-	• Check the battery.
6634	The short-term overcurrent protection has triggered.	30 s	30 s	-	-
6635	The inverter was in the state "Grid-forming-FRT" for too long.	1 min	Q	-	-
6636	The inverter was in current limitation mode for too long during the black start procedure.	5 min	Q	-	-
7002	Cable break or short circuit at inverter temperature sensor	W	W	-	• Check the wiring of the temperature sensor. • Contact Service.
7004		W	W	-	
7005		W	W	-	
7016		W	W	-	
7501	Interior fan is defective.	W	W	-	• Check function of the fans. • Clean the fans. • Contact Service.
7502		W	W	-	
7503	Inverter bridge fan is defective.	W	W	-	
7505	Medium-voltage transformer fan is defective.	W	W	-	
7600	Internal communication error has occurred or communication is interrupted.	30 s	5 min	-	• Contact Service.
7601		30 s	180 min	-	• Contact Service.
7602		30 s	30 s	-	• Contact Service.
7605		30 s	5 min	-	• Contact Service.
7620		30 s	180 min	-	• Contact Service.
7621		30 s	180 min	-	• Contact Service.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
7700	An error at the internal switches has occurred.	30 s	Q	-	• Contact Service.
7704	An error has occurred at the DC switchgear.	30 s	Q	-	• Contact Service.
7707	An error has occurred at the AC disconnection unit.	30 s	Q	-	• Contact Service.
7708	Faulty switching status of Remote GFDI.	5 min	D	-	• Contact Service.
7709	90% of the switch cycles of the DC switching devices have been reached.	-	-	-	-
7710	100% of the switching cycles of the DC switching devices have been reached. The electrical endurance of the DC switching devices has been reached, the DC switching devices must be replaced.	30 s	30 s	-	• Contact Service.
7721	The DC link could not be charged sufficiently.	5 min	Q	-	• Contact Service.
7722	IO test aborted due to voltage at the inverter (AC, DC).	5 min	Q	-	• Contact Service.
7723	No response from the Remote GFDI to the switching commands.	15 min	Q	-	• Contact Service.
7724	The number of switch cycles of the DC switching devices at high current is almost reached.	-	-	-	• Contact Service.
7725	The number of switch cycles of the DC switching devices at high current has been reached. The electrical endurance of the DC switching devices has been reached, the DC switching devices must be replaced.	30 s	30 s	-	• Contact Service.
7801	The surge arrester is defective or the back-up fuse of the surge arrester has tripped.	5 min	Q	-	• Check the surge arrester. • Check the back-up fuse of the surge arrester.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
7804	A defined number of brief overvoltage events have occurred or the surge arrester has triggered. Overvoltage protection F26 must not be switched on again. Prior to switching on the overvoltage protection -F26 again, the assemblies must be replaced by SMA Service.	-	-		Contact Service.
8402	High ripple currents have occurred due to defective sine-wave filter capacitors.	30 s	30 s	-	Contact Service.
8712	Warning: failure of power setpoints transmitted via communication. The inverter behavior depends on the parameter settings GriMng.ComFltFlbWMod and GriMng.ComFltFlbVArMod: Last setpoint: The inverter feeds in with the last valid value. W: The inverter feeds in with the substitute value given for the selected procedure. Once valid setpoints are available again, these will be used.	W	W	-	Contact Service.
8713	Failure of power setpoints transmitted via communication. Inverter stops feed-in operation. The inverter behavior depends on the parameter settings GriMng.ComFltFlbWMod and GriMng.ComFltFlbVArMod: Standby: The inverter switches to the operating state "Standby." The AC disconnection unit and the DC switchgear remain closed. Error: Standby: The inverter switches to the operating state "Error." The AC disconnection unit and the DC switchgear are opened and the inverter disconnects from the utility grid.	1 min	1 min	-	Contact Service.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
8715	Communication between inverters failed.	W	W	-	• Check communication of both inverters. • Contact Service.
9009	Fast stop tripped by processor assembly.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9017	Fast stop was manually tripped.	30 s	5 min	-	-
9019	A fast stop has been tripped for an unknown reason	30 s	5 min	-	• Check the fast stop cabling. • Eliminate error and switch fast stop back on.
9023	Fast stop tripped by DC overcurrent.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9024	Fast stop tripped by Remote GFDI.	5 min	Q	-	• Check the fast stop cabling. • Eliminate error and switch fast stop back on.
9025	Fast stop manually tripped at key switch -S2 .	5 min	Q	-	• Eliminate error and switch fast stop back on.
9026	Fast stop tripped by the external fast stop.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9027	Fast stop tripped by AC overcurrent.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9028	Fast stop was tripped by AC disconnection unit.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9029	Fast stop has tripped.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9030	Fast stop tripped by the external watchdog.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9031	Fast stop tripped by redundant monitoring of the processor assembly.	5 min	Q	-	• Eliminate error and switch fast stop back on.
9104	An error has occurred at the control clock timing.	30 s	5 min	-	• Contact Service.
9307	The battery management system has reported a fault.	30 s	30 s	-	• Contact Service.
9308	Failure of communication with the battery. The inverter behavior depends on the parameter settings BatCtl.ComFlb.FlbMod.	W	W	-	• Check communication. • Contact Service.
9346	The battery is not configured.	W	W	-	• Check the battery's communication.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
9347	The battery reports an event.	W	W	–	• Check the battery.
9348	Failure of communication with the external control. The inverter behavior depends on the parameter settings BatCtl.ComFlb.FlbMod.	W	W	–	• Check communication. • Contact Service.
9349	The state of charge limits are too narrow. Hysteresis is not used.	W	W	–	• Check the parameters of the state of charge limit (see Section 14.3.7, page 204).
9350	Timeout when the battery status is changing	W	W	–	• Check the battery.
9501	The Remote GFDI fuse has tripped.	15 min	Q	x	• Contact Service.

11 Maintenance

11.1 Safety during Maintenance

DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

WARNING

Danger to life from electric shock when entering the battery storage system

Damaged insulation in the storage system can cause lethal ground currents. Lethal electric shocks can result.

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Install the product in a closed electrical operating area.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Hearing impairment due to high-frequency noises of the product**

The product generates high-frequency noises during operation. This can result in hearing impairment.

- Wear hearing protection.

⚠ WARNING**Danger to life due to electric shock when opening the customer installation location**

Dangerous contact voltages are present in the customer installation location during operation. Touching live parts can result in death or lethal injuries due to electric shock.

- Wear suitable personal protective equipment when opening the customer installation location.

⚠ CAUTION**Risk of burns due to hot components**

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

NOTICE**Damage to the product due to moisture penetration during maintenance work at night**

When the product is opened for more than 2 hours during nightly maintenance work, humidity can condense on the components. This can result in the destruction of the components when reconnecting or in functional impairment.

- After the nightly maintenance work has been completed, hang 1 desiccant bag in front of the inverter bridge in the inverter for at least 6 hours.
- Before reconnecting, make sure that desiccant bag has been removed from the product.

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

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

- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- Do not open the product during a dust storm or precipitation.
- In case of interruption of work or after finishing work, mount all enclosure parts and close and lock all doors.
- Only operate the product when it is closed.
- Store the closed product in a dry and covered location. Observe storage conditions.
- The temperature at the storage location must be in the specified range. The temperature range is: -40°C to $+70^{\circ}\text{C}$.

NOTICE**Damage to electronic components due to electrostatic discharge**

Electrostatic discharge can damage or destroy electronic components.

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

NOTICE**Damage due to environmental disturbances**

The product can be damaged by environmental disturbances e.g. earthquakes, storms or flooding. With a damaged product, a safe and trouble-free operation is not guaranteed. Considerable damages to the product and yield losses can result.

- Always disconnect the product from voltage sources as quickly as possible after large-scale environmental disturbances.
- Once disconnected from voltage sources, perform a thorough 12-month-maintenance check that is not subject to the maintenance schedule. Shorten the maintenance intervals depending on the determined maintenance requirements.
- After a dust or snow storm, ensure that the air inlets and outlets are not covered by any objects (e.g., sand).
- Only recommission the product once any damages have been rectified.

11.2 Servicing Schedule

11.2.1 Information on Maintenance

Observance of the maintenance intervals ensures trouble-free operation.

i Correct performance of maintenance work

All maintenance work must be performed as described in this document. Deviations from procedures or failure to comply with the maintenance intervals will lead to any guarantee- or warranty claims becoming null and void.

i Maintenance report for maintenance

All maintenance work must be documented in a maintenance report. Contact us for the maintenance report (see Section 18, page 270).

- After maintenance work, save the maintenance report.
- In addition, a copy ist to be sent to maintenance.service@sma.de at the latest four weeks after completion of the maintenance work. Enter the serial number of the system on which maintenance was carried out in the subject line.

i Consumables and maintenance materials

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

i Spare parts

Only original parts or parts recommended by SMA Solar Technology AG are to be used as spare parts when replacing components.

Spare parts can be identified via the reference designation and the circuit diagram. The spare-parts list includes the article numbers of each spare part. For information on a specific article number, contact us (see Section 18, page 270).

11.2.2 Maintenance Schedule for Qualified Persons and Consumables

Required maintenance material:

- ☐ Brush for removing dust deposits
- ☐ Vacuum cleaner
- ☐ Angled telescopic mirror for inspecting the air duct
- ☐ Talcum, petroleum jelly or wax
- ☐ Non-greasing antifreeze agent, e.g. PS88
- ☐ Abrasive cloth
- ☐ Degreaser
- ☐ Suitable water-free, heat-resistant lubricant, e.g. WD40
- ☐ Use touch-up stick in the appropriate RAL color to repair small-area surface damage. Observe the relevant instructions of the paint manufacturer. Touch-up sticks are available using the following order number:

Position	RAL color	Color	Order number:
Enclosure of the inverter	RAL 9016	Traffic white	87-5051310
Inverter's roof	RAL 7004	Signal gray	87-5051311

Maintenance Work:

Task	Interval	See
Clean the air duct and ventilation grids.	12 months ⁴⁾	Section 11.3.2, page 155
Maintain the key switches and seals.	12 months	Section 11.3.3, page 157
Perform visual inspection.	C5M: 6 months ⁵⁾ C4M: 12 months C3H: 24 months	Section 11.3.4, page 158
Clean the interior.	12 months ⁴⁾	Section 11.3.5, page 158
Check the grounding.	12 months	Section 11.3.6, page 159
Save the operating data of the inverter.	12 months ⁶⁾	Section 9.21.1, page 128
Check the labels.	24 months ⁴⁾	Section 11.3.7, page 159
Check the fuse of the DC surge arrester for continuity.	24 months	Section 11.3.8, page 159
Check the fans.	24 months	Section 11.3.9, page 160
Check the functioning of the indicator lights.	24 months	Section 11.3.10, page 160
Maintain the DC load-break switch.	24 months ⁷⁾	Manufacturer documentation (see Section 1.7, page 11)
Clean the AC disconnection unit.	24 months ⁷⁾	Manufacturer documentation (see Section 1.7, page 11)
Maintain the AC disconnection unit.	48 months/after a short circuit ⁸⁾⁶⁾	Manufacturer documentation (see Section 1.7, page 11)
Replace the fuse of the DC surge arrester.	Once triggered	Section 11.3.12, page 163
Check the optional sound absorber.	24 months ⁴⁾	Section 11.3.11, page 160
Replace the DC fuses.	After a fault	Section 11.3.14, page 165

11.2.3 Servicing Schedule for Service Work

Activities according to this maintenance plan must be carried out by SMA Service.

⁴⁾ After exceptional environmental incidents (e.g. sand or snow storm, volcanic eruption, forest fire), maintenance must be carried out within 1 week.

⁵⁾ The length of the maintenance interval affects the term of protection of the coating system.

⁶⁾ In order to reduce the data transmission time, the interval should be shortened.

⁷⁾ In deviation to the maintenance interval of 12 months specified by ABB, the maintenance interval stated in this documentation applies.

⁸⁾ In deviation to the maintenance interval of 36 months specified by ABB, the maintenance interval stated in this documentation applies.

Activities according to this maintenance plan must be carried out as needed or according to the stated intervals. Only in this way is the trouble-free operation of the product ensured.

i Spare parts

Only original parts or parts recommended by SMA Solar Technology AG are to be used as spare parts when replacing components.

Spare parts can be identified via the reference designation and the circuit diagram. The spare-parts list includes the article numbers of each spare part. For information on a specific article number, contact us (see Section 18, page 270).

Task	Interval
DC load-break switch	After error message
AC disconnection unit	After error message
Replace the lithium-ion rechargeable battery.	10 years
Replace the Industrial Compact Flash card.	10 years or after an error message
Replace the interior fan.	14 years
Replace the inverter bridge fan.	14 years

11.3 Maintenance Work

11.3.1 Maintenance Tasks after Extraordinary Environmental Incidents

After extraordinary environmental incidents (e.g., sand or snow storm, volcanic eruption, forest fire) have occurred, unscheduled maintenance is required to ensure trouble-free operation. In case of salt spray, the salt must be removed from the product surface on a regular basis to prevent rust damage.

NOTICE

Damage due to environmental disturbances

The product can be damaged by environmental disturbances e.g. earthquakes, storms or flooding. With a damaged product, a safe and trouble-free operation is not guaranteed. Considerable damages to the product and yield losses can result.

- Always disconnect the product from voltage sources as quickly as possible after large-scale environmental disturbances.
- Once disconnected from voltage sources, perform a thorough 12-month-maintenance check that is not subject to the maintenance schedule. Shorten the maintenance intervals depending on the determined maintenance requirements.
- After a dust or snow storm, ensure that the air inlets and outlets are not covered by any objects (e.g., sand).
- Only recommission the product once any damages have been rectified.

Maintenance within one week after the environmental incident

1. Check the product surface for damages (see Section 11.3.4, page 158).
2. Check ventilation grids and air duct for pollution and deposits. If dust or other deposits cover the air inlets and outlets, clean the ventilation grids and air duct (see Section 11.3.2, page 155).

Maintenance within four weeks after the environmental incident

1. Check the product behavior for errors. If errors occur more frequently than before the environmental incident, contact us.
2. Check the product behavior for derating. If the product is in derating mode more frequently than before the environmental incident, clean the ventilation grids and the air duct again (see Section 11.3.2, page 155).

11.3.2 Cleaning the Air Duct and Ventilation Grids

Required maintenance material (not included in the scope of delivery):

- ☐ Brush for removing dust deposits
- ☐ Vacuum cleaner
- ☐ Angled telescopic mirror for inspecting the air duct

⚠ CAUTION

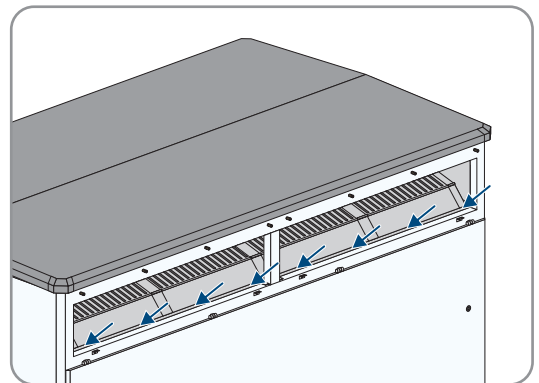
Risk of injury when mounting and removing the fans

One fan weighs 25 kg. Injuries may occur if the fan is lifted incorrectly or if the fan falls during mounting or removal.

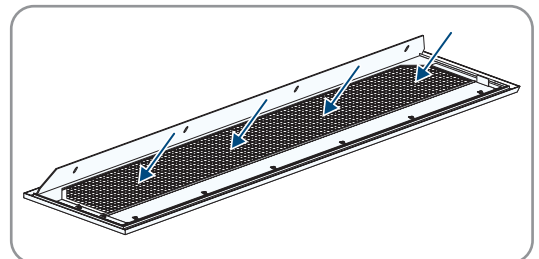
- Mount and remove the fan with all due care.
- Wear personal protective equipment for all work on the product.

Cleaning the air inlet

1. Clean the air inlet grids using a brush and a vacuum cleaner.
2. Remove the screws on the corner of the air inlet grids.
3. Unfasten the air inlet grid screws.
4. Take the air inlet grids off and store them safely. Take the heavy weight of the ventilation grid into account (13 kg).
5. Vacuum the edge under the ventilation grid and clean it with a brush.



6. Vacuum the ventilation grid and clean them with a brush.

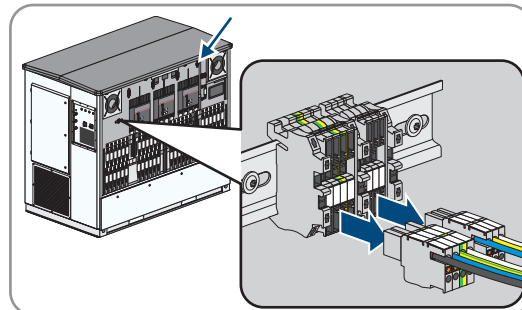


7. Check the ventilation grid for visible damage. If ventilation grids are damaged, contact us (see Section 18, page 270).
8. Vacuum the air duct from the outside or clean it with a brush.

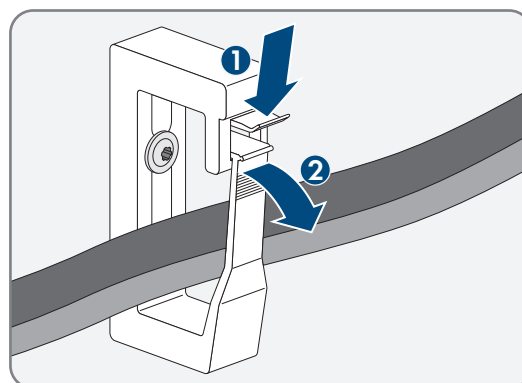
9. If moisture is present in the air duct, remove it with a damp cloth.
10. Fold the ventilation grids upwards and tighten the screws (torque: 8 Nm to 10 Nm).

Cleaning the fans and air duct

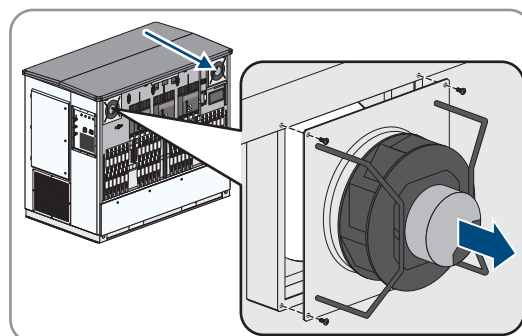
1. Open the hatch on the DC side of the inverter (see Section 13.1, page 168).
2. Disassemble both fans. To do this, loosen the connectors of the fans -**X341**, -**X741**, -**X342**, -**X742**.



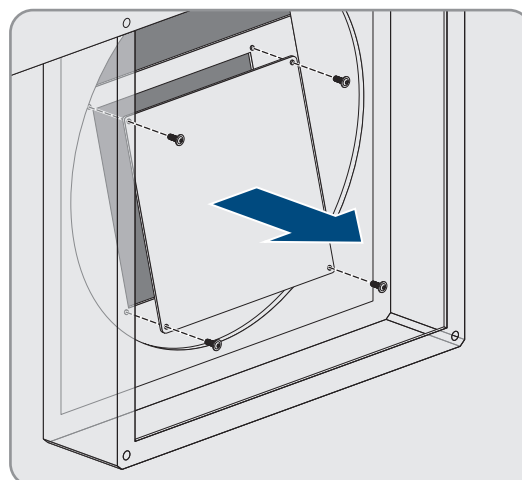
3. Open the cable brackets and pull the connectors of the fans out of the cable brackets.



4. Remove the screws of the fans and pull the fans out towards you.



5. Remove the inspection hatches. To do so, unfasten the screws of the inspection hatches.

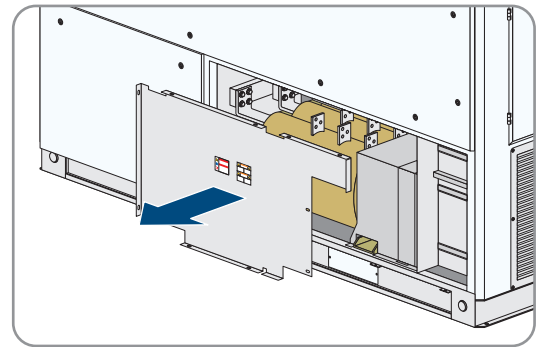


6. Check whether there are any dust deposits in the air duct behind the inspection hatches. Use an angled telescopic mirror for this. If there are any dust deposits in the air duct behind the inspection hatches, remove the dust deposits. Use a vacuum cleaner for this.

7. Remount the inspection hatches. To do so, tighten the screws of the inspection hatches (torque: 8 Nm to 10 Nm).
8. Position the fans over the bolting points and tighten the screws (torque: 8 Nm to 10 Nm).
9. Place the connectors of the fans into the cable brackets and close the cable brackets.
10. Connect the connectors of the fans to the terminals **-X341**, **-X741**, **-X342**, **-X742**.

Cleaning the sine-wave filter

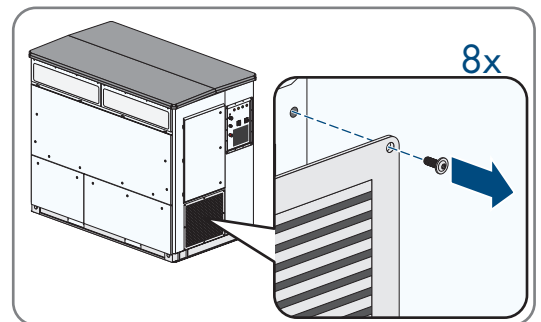
1. Remove the cover in front of the sine-wave filter capacitors (see Section 13.2.3, page 174).
2. Remove any dust deposits from the area around the sine-wave filter capacitors.
3. Mount the cover in front of the sine-wave filter capacitors (see Section 13.2.3, page 174).
4. Disassemble the panels (see Section 13.2.1, page 170).
5. Remove the protective cover of the sine-wave filter choke.



6. Remove any dust deposits from the area around the sine-wave filter choke.
7. Mount the protective cover of the sine-wave filter choke (torque: 8 Nm to 10 Nm).

Cleaning the air outlet

1. Remove the air outlet grid.



2. Remove any dust deposits from the area behind the air outlet grid.
3. Clean the air outlet grid. Use a brush for this.
4. Mount the air outlet grid (torque: 8 Nm to 10 Nm).

11.3.3 Maintaining Key Switches and Seals

Required maintenance material (not included in the scope of delivery):

- ☐ Talcum, petroleum jelly or wax for maintaining the seals
- ☐ Non-greasing antifreeze agent

Procedure:

1. Check whether the seals in the sealing area of the enclosure opening show any signs of damage. If seals are damaged, contact us (see Section 18, page 270).

2. Apply talcum, petroleum jelly or wax to seals. This will prevent frost damage.
3. If the product is installed in regions in which temperatures below freezing occur, protect the key switch from icing-up with non-greasy antifreeze agent.

11.3.4 Performing the Visual Inspection

i Change of the inverter surface when deploying at locations with ambient conditions rating C3 to C5

The surface of the inverter is treated in such away that the inverter is also suitable to be installed in the standard version in locations with ambient conditions rating C3 to C5. Changes to the inverter surface do not have any effect on the functionality.

Required maintenance material (not included in the scope of delivery):

- ☐ Abrasive cloth
- ☐ Degreaser
- ☐ Use a touch-up stick in the appropriate RAL color to repair small-area surface damage to the paint. Observe the relevant instructions of the paint manufacturer. Touch-up sticks are available using the following order number:

Position	RAL color	Color	Order number:
Roof	RAL 9016	Traffic white	87-5051310
Base	RAL 7004	Signal gray	87-5051311

- ☐ Use a suitable zinc repair to touch up minor damage to the product's galvanized base. Observe the relevant instructions of the manufacturer.

Procedure:

1. Remove dirt.
2. Check surfaces for damage or corrosion. If surfaces are damaged or corroded, carry out repair work immediately, or within 3 weeks at the latest.
3. If painted surfaces are damaged or corroded, carry out repair work immediately, or within 3 weeks at the latest.
4. If unpainted surfaces show corrosion of an area greater than 1 cm² per damaged area, contact SMA Service.
5. Treat the affected area. Slightly sand the surface, clean the area with a degreaser and paint the area.
6. Check the state of the gas pressure dampers at the flaps in front of the AC and DC area. Ensure that the dampers do not feature any corrosion and are working correctly.

11.3.5 Cleaning the Interior

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Open the hatch (see Section 13.1, page 168).
3. Remove dirt and dust with a dry cloth from the inverter interior and from all components.
4. Check the inverter for leaks. If there are any leaks, please contact us (see Section 18, page 270).
5. Remove moisture.

11.3.6 Checking the Grounding

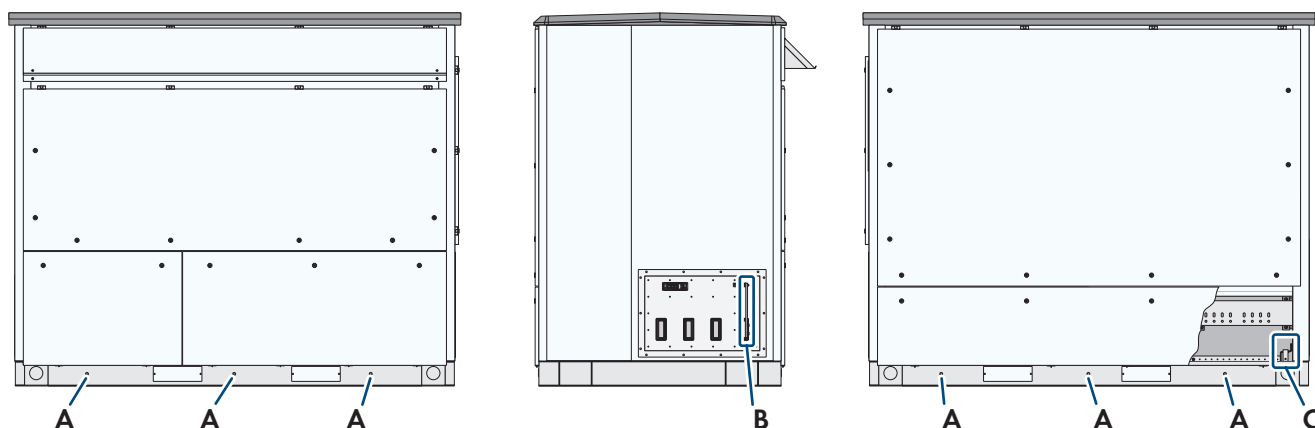


Figure 72: Overview of the grounding connections

Position	Designation
A	Connection point for meshed grounding for reduction of the radiant interference emission
B	Connection point for protective grounding of the MV transformer X100
C	Connection point for the protective ground wire of the inverter X103

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Open the hatch (see Section 13.1, page 168).
3. Ensure that the connections for the grounding system, the grounding of the medium-voltage transformer and for reducing the radiant emitted interference have a low impedance.
4. Close the hatch.

11.3.7 Checking the Labels

- Check whether any warning message or label is damaged or missing. Replace any warning messages and labels which are missing or illegible. If needed, you can obtain a whole set of labels. Contact us (see Section 18, page 270).

11.3.8 Checking the DC Surge Arrester Fuse for Continuity

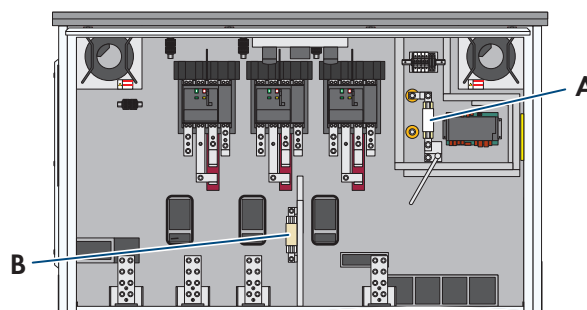


Figure 73: DC surge arrester fuse

Position	Designation
A	DC surge arrester fuse, 125 A
B	DC surge arrester fuse, 315 A

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Open the hatch (see Section 13.1, page 168).
3. Disassemble the protective cover in front of the DC fuses and the electronics area (see Section 13.2.2, page 172).
4. Perform a continuity check on the fuse. If there is no continuity in the fuse, contact us (see Section 18, page 270).
5. Mount the protective cover in front of the DC fuses and the electronics area (see Section 13.2.2, page 172).
6. Close the hatch (see Section 13.1, page 168).

11.3.9 Checking the Fans**NOTICE****Damage to the product due to test operation at low temperatures**

Test operation at low temperatures leads to a cold start of the fan. This can damage the fan.

- Only carry out the test operation of the fans at temperatures above -25 °C.

Procedure:

1. Call up the parameter overview (see Section 13.6, page 182).
2. Set the parameter **InvOpMod** to **Operation**.
3. Set the parameter **InvTstMod** to **Fan**. If the fans do not start running, contact the Service (see Section 18, page 270).
4. Set the parameter **InvTstMod** to **No test**.
5. Set the parameter **InvOpMod** to **Stop**.

11.3.10 Checking the Functioning of the Light Repeaters

1. Call up the parameter overview (see Section 13.6, page 182).
2. Set the parameter **InvOpMod** to **Operation**.
3. Set the parameter **InvTstMod** to **Signal lamp**.
4. Check whether the light repeaters flash briefly. If the indicator lights do not flash, contact us (see Section 18, page 270).
5. Set the parameter **InvTstMod** to **No test**.
6. Set the parameter **InvOpMod** to **Stop**.

11.3.11 Checking the Sound Absorber

Depending on the order option, the inverter is equipped with a sound absorber at the air outlet.

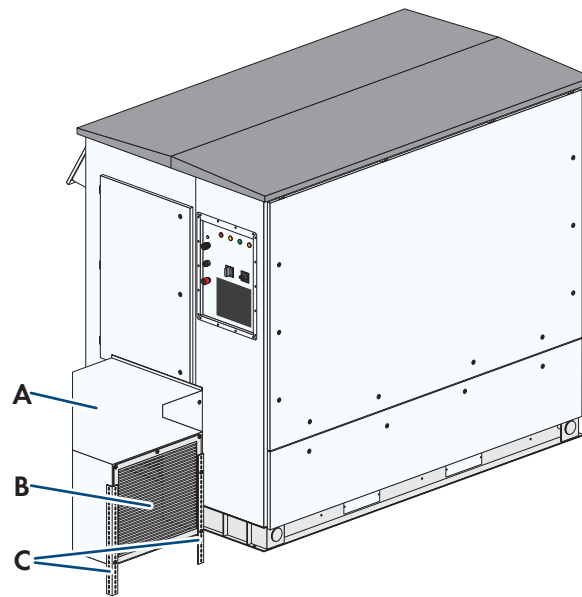


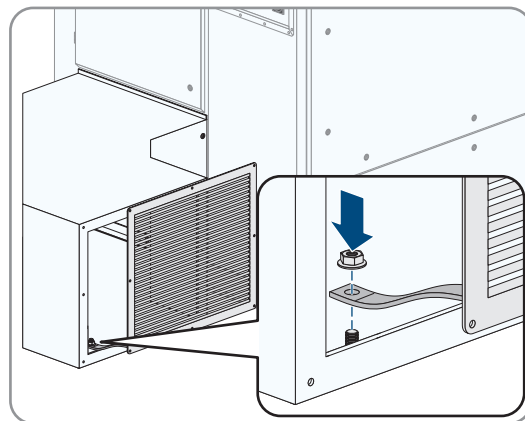
Figure 74: Position of the sound absorber at the air outlet

Position	Designation
A	Sound absorber
B	Air outlet grid
C	Support foot

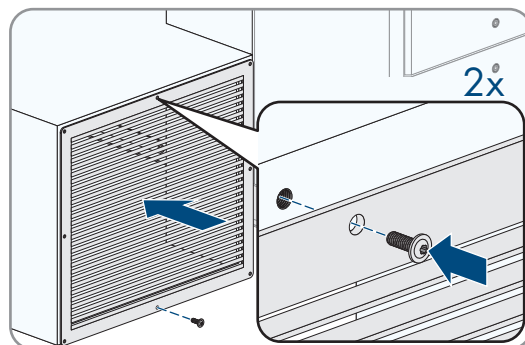
Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Check the ventilation grids for visible damage. If ventilation grids are damaged, contact us (see Section 18, page 270).
3. Clean the air inlet grids using a brush and a vacuum cleaner.
4. Remove the support feet from the sound absorber.
5. Check support feet for damage or corrosion.
If the support feet are damaged or corroded, replace the support feet. You can order new support feet from us.
6. Remove the air outlet grid from the sound absorber and pull forwards with caution.
7. Remove the air outlet grid grounding strap.
8. Remove any dust deposits from the area behind the air outlet grid.
9. Clean the air outlet grid. Use a brush for this.
10. Check whether the sound absorber insulating material has become separated from the sound absorber. If the insulating material has become separated, contact us (see Section 18, page 270).

11. Mount the air outlet grid ground strap to the sound absorber (AF13, torque: 20 Nm). Ensure that the grounding conductor connection is electrically correct.



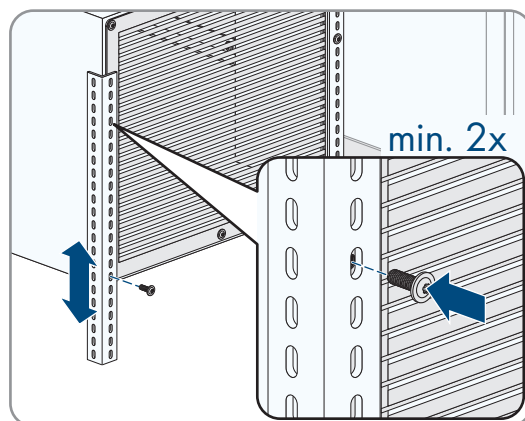
12. Mount the ventilation grid to the sound absorber using the 2 middle screws (TX30, torque: 10 Nm).



13. Check whether the foundation is suitable for the mounting.

14. Align the support feet with the sound absorber. Ensure that both support feet stand on the foundation.

15. Mount each support foot to the sound absorber using at least 2 screws (TX30, torque: 10 Nm). Ensure that the support feet are in contact with the support surface.



16. If the upper edges of the ventilation grid are not covered by the support feet, tighten the upper edges of the ventilation grid (TX30, torque: 10 Nm).

11.3.12 Replacing the Fuse of the DC Surge Arrester

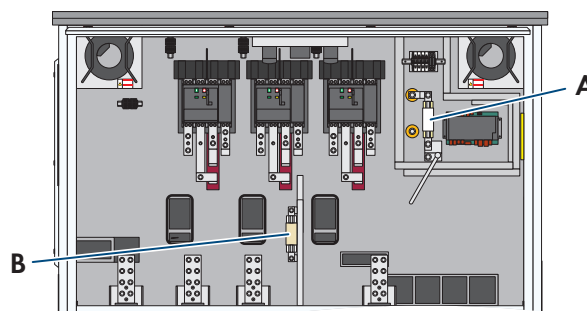


Figure 75: DC surge arrester fuse

Position	Designation
A	DC surge arrester fuse, 125 A
B	DC surge arrester fuse, 315 A

Additionally required material:

- ☐ Replacement fuse 125 A. The replacement fuse can be ordered under the material number 119839-00.01.
- ☐ Replacement fuse 315 A for option Split DC Rail. The replacement fuse can be ordered under the material number 121889-00.01.

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Open the hatch (see Section 13.1, page 168).
3. Disassemble the protective cover in front of the DC fuses and the electronics area (see Section 13.2.2, page 172).
4. Remove the alarm contact of the DC surge arrester.
5. Remove the defective fuse. Use an LV/HRC fuse extractor.
6. Insert the replacement fuse. Use an LV/HRC fuse extractor.
7. Mount the alarm contact of the DC surge arrester.
8. Mount the protective cover in front of the DC fuses and the electronics area (see Section 13.2.2, page 172).
9. Close the hatches (see Section 13.1, page 168).

11.3.13 Checking the Sound Absorber

Depending on the order option, the inverter is equipped with a sound absorber at the air outlet.

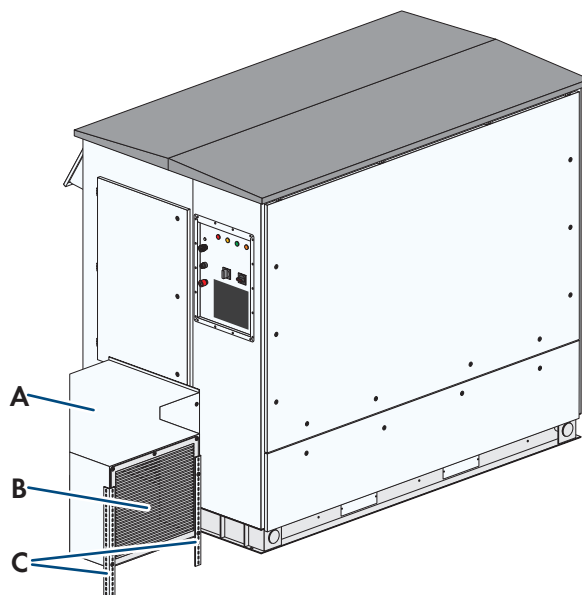


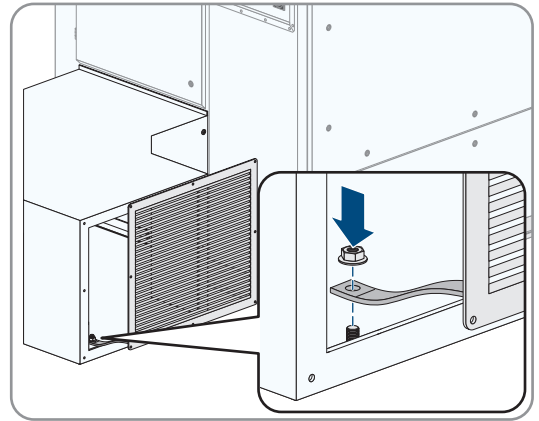
Figure 76: Position of the sound absorber at the air outlet

Position	Designation
A	Sound absorber
B	Air outlet grid
C	Support foot

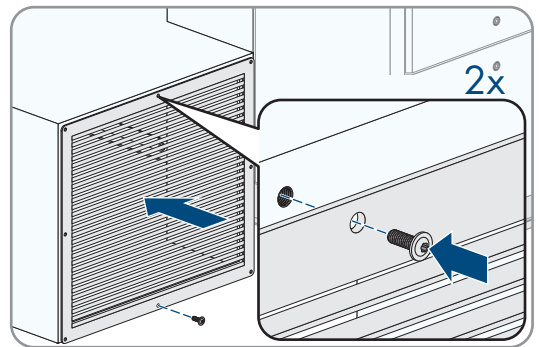
Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).
2. Check the ventilation grids for visible damage. If ventilation grids are damaged, contact us (see Section 18, page 270).
3. Clean the air inlet grids using a brush and a vacuum cleaner.
4. Remove the support feet from the sound absorber.
5. Check support feet for damage or corrosion.
If the support feet are damaged or corroded, replace the support feet. You can order new support feet from us.
6. Remove the air outlet grid from the sound absorber and pull forwards with caution.
7. Remove the air outlet grid grounding strap.
8. Remove any dust deposits from the area behind the air outlet grid.
9. Clean the air outlet grid. Use a brush for this.
10. Check whether the sound absorber insulating material has become separated from the sound absorber. If the insulating material has become separated, contact us (see Section 18, page 270).

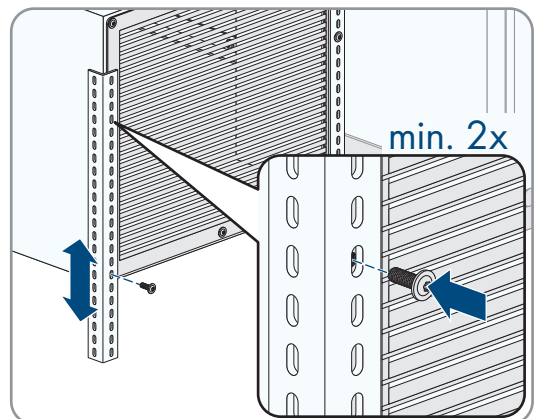
11. Mount the air outlet grid ground strap to the sound absorber (AF13, torque: 20 Nm). Ensure that the grounding conductor connection is electrically correct.



12. Mount the ventilation grid to the sound absorber using the 2 middle screws (TX30, torque: 10 Nm).



13. Check whether the foundation is suitable for the mounting.
 14. Align the support feet with the sound absorber. Ensure that both support feet stand on the foundation.
 15. Mount each support foot to the sound absorber using at least 2 screws (TX30, torque: 10 Nm). Ensure that the support feet are in contact with the support surface.



16. If the upper edges of the ventilation grid are not covered by the support feet, tighten the upper edges of the ventilation grid (TX30, torque: 10 Nm).

11.3.14 Replacing the DC Fuses

⚠ WARNING

Danger to life due to electric arc if there are tools inside the product

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

Procedure:

1. Ensure that all DC sources are disconnected from all voltage sources.
2. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).

3. Open the hatch on the DC side of the inverter (see Section 13.1, page 168).
4. Loosen the screws of the defective DC fuse.
5. Remove the DC fuse from the inverter. If the DC fuse cannot be removed using the NH fuse handle, remove the screws from the connection busbars and then remove the DC fuse.
6. Insert the new DC fuse into the inverter (see Section 7.5.5, page 76).
7. Close the hatch on the DC side of the inverter (see Section 13.1, page 168).

12 Disposal

i Proper disassembly and disposal

When the inverter has reached the end of its service life, it becomes electronic waste. Electronic waste contains on the one hand valuable materials which can be recycled as secondary raw materials, and on the other, substances which are hazardous to the environment. Contact your local commercial disposal services for information on optimum material utilization.

- Prior to disassembly, perform a visual inspection to ensure that the supporting elements of the inverter are not rusted or unstable.

13 Periodic Actions

13.1 Opening and Closing the Hatches

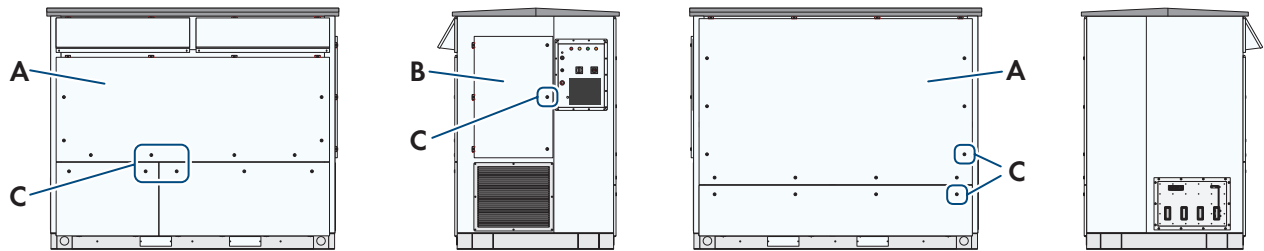


Figure 77: Overview of the hatches

Position	Designation
A	Hatch with gas springs
B	Door
C	Optional locking mechanism for padlock security

Additionally required material for the option "Enclosure lockable" (not included in the scope of delivery):

- ☐ 6 padlocks, horizontal shackle clearance: 13 mm

 **DANGER**

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting and in operation, an electric arc can arise if conductive foreign parts (e.g. tools) are located in the product and establishes a conductive connection between live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

Open hatches

1. Remove the two outer locking screws (width across flats: 18 mm) from the hatch in front of the DC area of the inverter and keep them.
2. If locking mechanisms are secured with padlocks, remove the corresponding padlock if necessary.
3. Open the hatch locks and the doors with a square key wrench. Press gently on the hatch and remember that the hatches with gas springs open to an intermediate position of 60°.
4. Press the hatch upwards to the required position. Observe the maximum opening angle.

Close hatches

1. Press the hatch down.
2. Close the locking mechanism of the hatches and the door with a square key wrench. Lightly press against the hatch or door.

3. If necessary, attach the removed padlocks to the locking mechanisms.
4. At the hatch in front of the DC area of the inverter, insert the locking screws (width across flats: 18 mm) into the outer mounting holes and tighten them (torque: 8 Nm to 10 Nm).

13.2 Mounting and Disassembly Work

13.2.1 Disassembling and Mounting the Panels

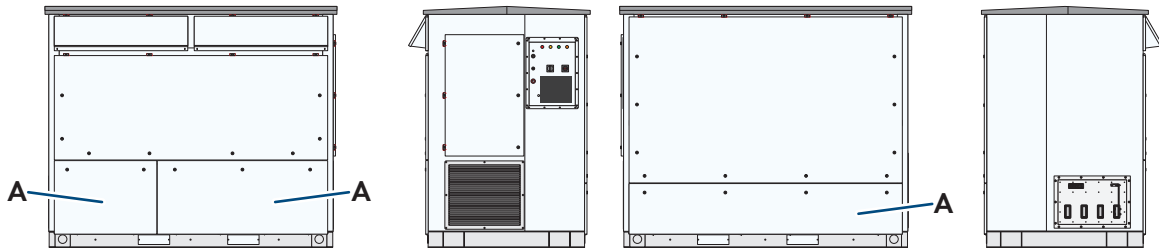


Figure 78: Overview of the panels

Position	Designation
A	Panel

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

NOTICE**Property damage due to rupture of grounding conductors**

The components are connected to the product via grounding conductors. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Make sure not to damage the grounding conductors during disassembly.

Disassembling the panels

1. Open the locks with a square key wrench.
2. Detach the grounding straps from the panels.
3. Slightly raise and remove the panels.

Mounting the panels**Requirement:**

- The protective covers in the AC connection area must be mounted.

Procedure:

1. Attach the grounding straps to the panels (torque: 8 Nm to 10 Nm).
2. Ensure that the grounding straps are firmly in place.
3. Mount the panels.
4. Close the locks with a square key wrench.

13.2.2 Disassembling and Mounting the Protective Covers on the Inverter

The protective covers are designed for precisely defined positions to optimally cover the areas in the inverter that are dangerous to touch.

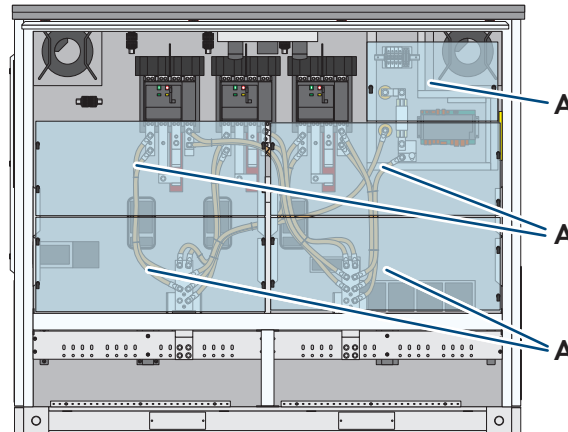


Figure 79: Position of the protective covers (example configuration of the inverter)

Position	Designation
A	Protective cover

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting and in operation, an electric arc can arise if conductive foreign parts (e.g. tools) are located in the product and establishes a conductive connection between live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

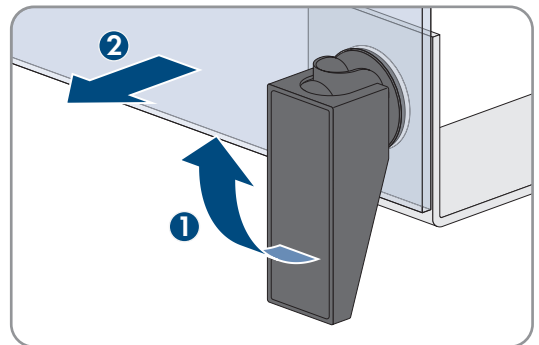
⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

Disassembling the protective covers

1. Ensure that no voltage is present.
2. Open the clamping brackets and remove the protective cover towards you. The clamping brackets remain in the protective cover.

**Mounting the protective covers**

1. Mount the protective cover to the bracket. Make sure that the protective covers are in the correct positions and that all areas that are dangerous to touch are covered again.
2. Close the clamping brackets.

13.2.3 Disassembling and Mounting Cover in Front of the Sine-Wave Filter Capacitors

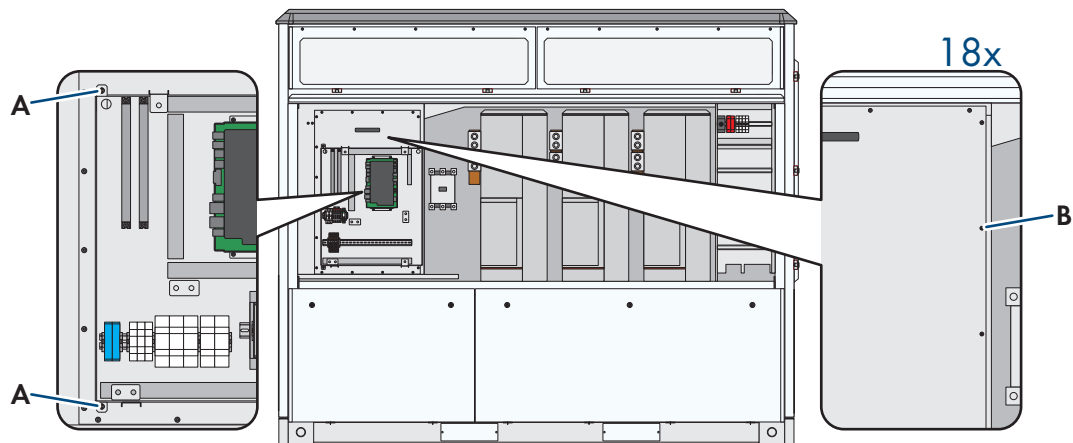


Figure 80: Position of the screw connections of the mounting plate and cover in front of the sine-wave filter capacitors

Position	Designation
A	Fastening points of the mounting plate
B	Bolting points of the cover

⚠ WARNING

Danger to life due to electric shock if external supply voltage is not disconnected

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING

Danger to life due to electric arc if there are tools inside the product

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

Disassembling the Cover in Front of the Sine-Wave Filter Capacitors

1. Open the hatch (see Section 13.1, page 168).
2. Loosen the fastening of the mounting plate. Unscrew the screws and keep for later use.
3. Fold the mounting plate to the right and hook it into the mounting hooks at the side openings of the mounting plate.
4. Loosen the screws of the cover and keep for later use.
5. Remove the cover. Pull the cover forwards while holding the handles.

Mounting the Cover in Front of the Sine-wave Filter Capacitors

1. Position the cover. Lift the cover by the handles.
2. Insert the screws removed earlier, and tighten (torque 8 Nm to 10 Nm).
3. Remove the mounting plate from the mounting hooks and place it on the cover of the sine-wave filter capacitors.
4. Insert the screws removed earlier, and tighten (torque 4.8 Nm to 7.2 Nm).
5. Close the hatch (see Section 13.1, page 168).

13.3 Clamp Connections**13.3.1 Connecting Cables to the Connecting Terminal Plates****⚠ DANGER****Danger to life due to electric shock when live components or cables are touched**

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

Procedure:

1. Ensure that no voltage is present.
2. Dismantle the cable outside the product. This prevents contamination in the product.
3. Strip the insulation of the insulated conductors. Insulation stripping length: 6 mm to 7 mm. Apply a bootlace ferrule to the multi-wire cable.
4. Connect the cable in accordance with the circuit diagram. To do this, insert the screwdriver into the square opening of the terminal block. This unlocks the opening for the insulated conductors of the terminal block.
5. Pull the screwdriver out of the terminal block.
6. Ensure that the cable is securely in place.

13.3.2 Connecting Cables to the Female Connectors

DANGER

Danger to life due to applied voltages

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Do not touch non-insulated parts or cables.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- Observe all safety information on components associated with the product.
- The product must not be operated with open covers or doors.

WARNING

Danger to life due to electric shock if external supply voltage is not disconnected

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

WARNING

Danger to life due to electric arc if there are tools inside the product

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

CAUTION

Danger of crushing and collision when carelessly working on the product

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

Procedure:

1. Ensure that no voltage is present.
2. Dismantle the cable outside the product. This prevents contamination in the product.
3. Strip the insulation of the insulated conductors. Insulation stripping length: 8 mm to 9 mm.
4. Connect the cable in accordance with the circuit diagram.
5. Pull the female connector from the terminal block.
6. Insert the screwdriver into the square opening of the female connector. This unlocks the opening for the insulated conductors of the female connector.
7. Insert the insulated conductors of the cable into the female connector according to the circuit diagram.
8. Remove the screwdriver from the female connector.
9. Plug the female connector into the terminal block.
10. Make sure that the cable and the female connector are securely in place.

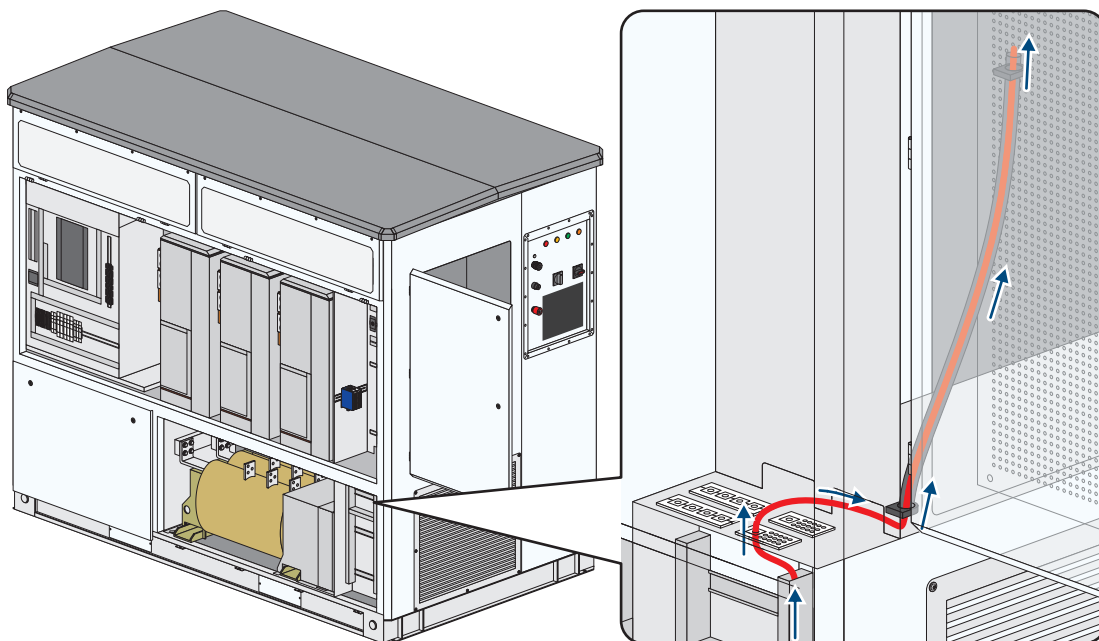
13.4 Insert the cable into the inverter.

Figure 81: Cable route from the base to the customer installation location

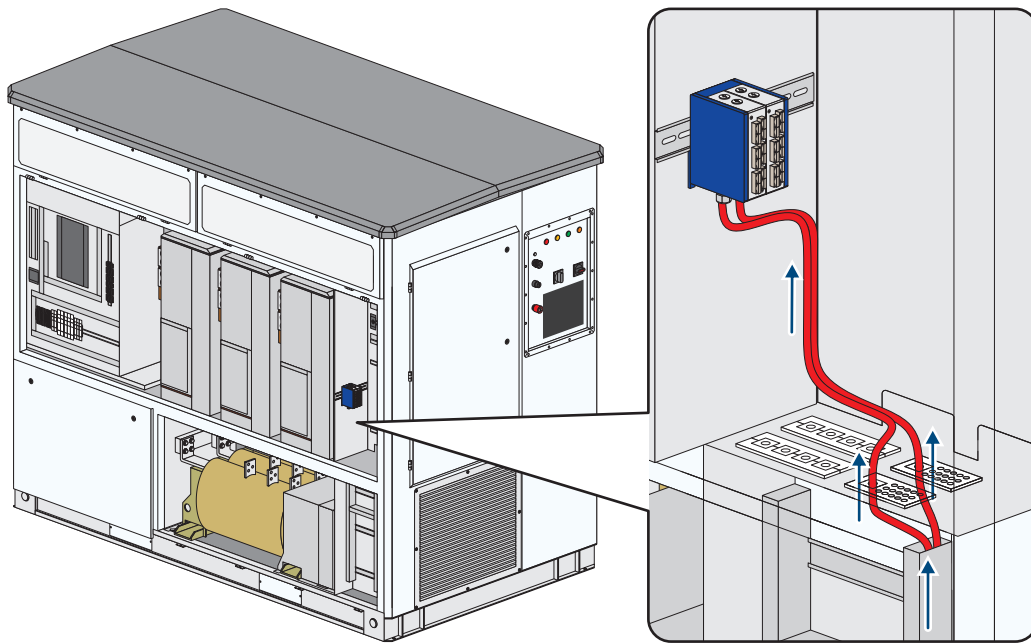


Figure 82: Cable route from the base to the splice box

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

- ☐ Material for sealing (e.g. silicone)

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the inverter from the power path and from the control path if no voltage is required for working on the product.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING**Danger to life due to electric shock if external supply voltage is not disconnected**

When using an external supply voltage, even after disconnecting the product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the external supply voltage.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING**Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

⚠ CAUTION**Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

⚠ CAUTION**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

NOTICE**Property damage due to rupture of grounding conductors**

The components are connected to the product via grounding conductors. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Make sure not to damage the grounding conductors during disassembly.

NOTICE**Damage to optical fibers due to too tight bend radii**

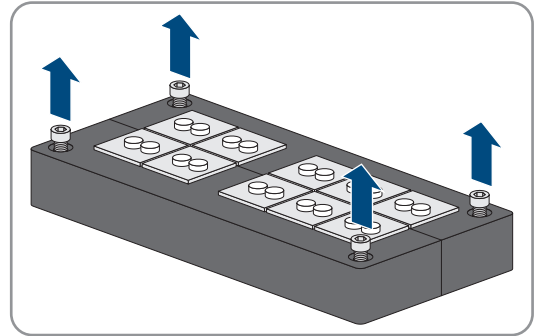
Excessive bending or kinking will drop below of the permissible bend radii. When dropping below the permissible bend radii, the optical fibers may be damaged.

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

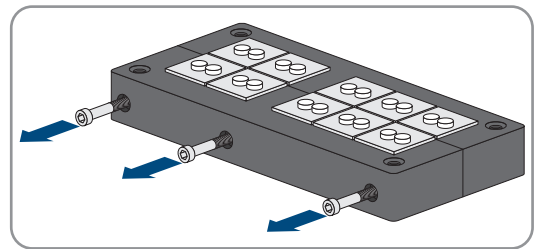
Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.3, page 114).

2. Disassemble the panels (see Section 13.2.1, page 170).
3. Open the hatches (see Section 13.1, page 168).
4. Open the cable channels.
5. Remove the screws at the top of the sealing plate.



6. Remove the sealing plate.
7. Loosen the screws at the side of the sealing plate.



8. Remove the required number of rubber seals from the sealing plate. Make sure that the diameter of the rubber seals corresponds to the diameter of the cables to be inserted. Use the additional rubber seals included in the scope of delivery, if necessary.
9. Remove the sealing plugs from those rubber seals through which the cables are to be led.
10. Lead the cables through the rubber seals.
11. Insert the rubber seals in the sealing plate avoiding any distortion. This will ensure the tightness of the seal.
12. Cables should be sealed using suitable means such that the IP65 degree of protection is maintained even after installation.
13. Tighten the screws at the side of the sealing plate (3 Nm).
14. Screw the sealing plate to the floor of the interface cabinet (1 Nm).
15. Lay the cables in the cable channel.
16. Close the cable channel.
17. For cables to the customer installation location, route the cables through the opening to the door and through the conduit to the customer installation location.
18. For cables to the splice box:
 - Loosen the 2 outer screws at the front of the splice box. There is no need to remove the screws as they are being held by plastic washers.
 - Remove the gray insert.
 - Unscrew the filler plug and nut.
 - Mount the enclosed cable gland and the nut previously removed.
 - Lead the cables to the splice box.
 - Guide the cable gland over the cable.
 - Insert the cable through the cable gland into the splice box.
 - Tighten the cable gland.
27. Seal the enclosure opening used with proper material to comply with the degree of protection IP54.

28. Mount the panels (see Section 13.2.1, page 170).

29. Close the hatches (see Section 13.1, page 168).

13.5 Logging Into the User Interface

Prior to performing any work, you must log into the user interface with your given user role. The following roles are available: user, installer, service partner and SMA Service.

If you start the user interface via **http://**, the HTTP page is redirected automatically to the secure HTTPS page. An individual certificate is generated during the first inverter start. Depending on the settings in the web browser, a security alert appears once or every time you visit the website.

If you are logged in as installer, you can change to the role of user at any time without entering a password. The next time you log in as installer, you will need to enter the password again.

On the **Login** page, not only the relevant login fields but also the instantaneous values for power, daily yield, previous-day yield and total yield are displayed.

To protect the system from unauthorized access, access to the user interface is blocked after ten unsuccessful login attempts. You will have to wait an hour before you can log in again.

Procedure:

1. Call up the user interface with the corresponding IP address. The IP address of the service interface is 192.168.100.1.

2. **Web browser signals a security vulnerability**

After the IP address has been entered, a message might appear indicating that the connection to the user interface of the product is not secure. SMA Solar Technology AG guarantees the security of the user interface.

- Continue loading the user interface.

3. Select your login role from the drop-down list in the field **Login**.
4. Enter the password in the field **Password**.
5. Select [**Login**].

13.6 Accessing the Parameter Overview

1. If you are not yet logged into the user interface, log in as installer.
2. In the main navigation, select  and select **Parameter** from the drop-down list.

13.7 Calling Up the Overview for Instantaneous Values

1. If you are not yet logged into the user interface, log in.
2. In the main navigation select .
3. Select [**Instantaneous values**] in the Analysis menu.

13.8 Calling Up the Event Overview

1. If you are not yet logged into the user interface, log in as installer.
2. In the main navigation select .
 - ☒ A table opens containing all events that have occurred.

14 Function Description

14.1 Operating States of the Inverter

14.1.1 Overview of the Operating States

The inverter cycles through various states during operation. The current operating state can be displayed in the instantaneous value **OpStt**.

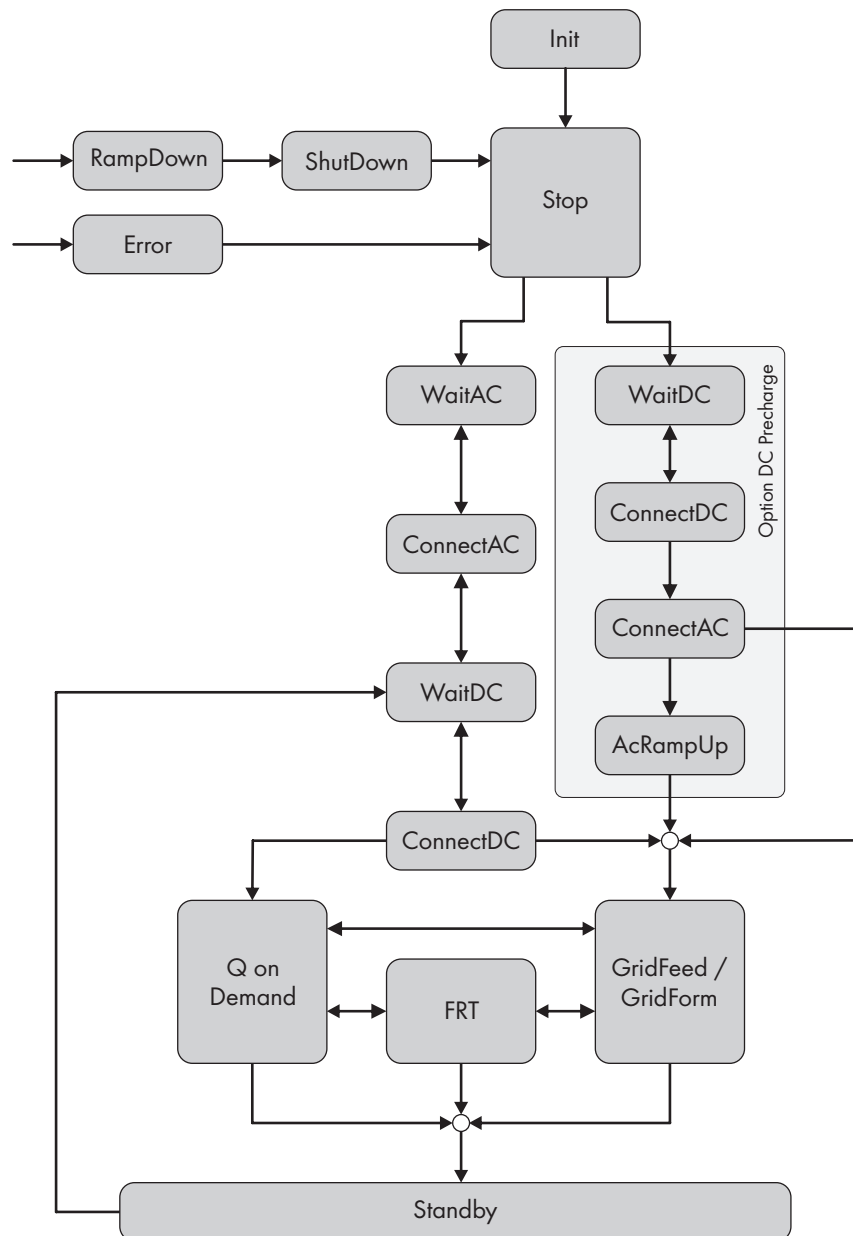


Figure 83: Principal overview of the operating states

The overview shows the names of the operating states as they appear on the user interface.

14.1.2 Stop

The inverter is switched off. The DC switchgear and the AC disconnection unit are switched off.

If the start-stop key switch **-S1** is set to **Start**, the inverter waits for an external start command. Depending on the configuration, the inverter can be started manually via the user interface or by an external signal. The inverter then switches to the "WaitAC" operating state.

Inverters that are equipped with the option "DC precharge", can either be started with AC voltage or with DC voltage. If the option **AC start** is selected in the parameter **Bsc.InvStrMod**, the inverter starts with AC voltage and switches to the operating state "WaitAC". If the option **DC start** is selected in the parameter **Bsc.InvStrMod**, the inverter starts with DC voltage and switches to the operating state "WaitDCStart".

14.1.3 Init

The inverter is prepared for operation and the functioning of all components is tested.

14.1.4 Starting the Inverter from the AC Grid

14.1.4.1 WaitAC

In the operating state "WaitAC", the inverter monitors the grid limits for the time defined in the parameter **GriErrTm**. The remaining time is displayed in the instantaneous value **WaitGriTm**. If no grid error occurs during the grid monitoring time, the inverter switches to the operating state "ConnectAC".

If the grid limits are exceeded during the grid monitoring time, the inverter remains in the operating state "WaitAC" and will restart grid monitoring.

14.1.4.2 ConnectAC

A valid AC grid is present in the operating state "ConnectAC" and the inverter connects to the utility grid. The inverter switches the AC disconnection unit on.

14.1.4.3 WaitDC

In the operating state "WaitDC", the inverter monitors the applied input voltage U_{DC} and compares it with the DC voltage necessary for operation. When the battery is ready for operation and the input voltage meets the requirements, the inverter switches to the operating state "ConnectDC".

If the battery is not yet ready for operation at this time and therefore does not provide a stable DC voltage, precharging may be aborted because the precharging contactor has closed. If the start-up process occurs using DC precharging, this will delay a possible restart of the inverter. The inverter interrupts the start-up process for 10 minutes to allow the precharge capacitors to cool down. The value **WaitDC: DC precharge period** is shown in the instantaneous value **PwrOffReas**.

Ensure that the system operates without communication between the inverter and the battery

If the inverter is used without its own communication to the battery, the system must coordinate the operation of the inverter and the battery. Initiate the start-up process of the inverter only when the battery is fully ready for use.

14.1.4.4 ConnectDC

When in the operating state "Connect DC", the inverter changes to the operating state "GridFeed" or into "Q on Demand" operation. For the operating state "GridFeed", the inverter connects the DC switchgear. If the battery is not ready for operation and the relevant setpoints for the reactive power control have been set, the inverter can provide reactive power in "Q on Demand" operation.

14.1.5 Starting the Inverter from the DC Grid

14.1.5.1 WaitDC

During the "WaitDC" operating state, the inverter checks the DC voltage of the battery with the "DC precharge" option. When the minimum battery voltage has been reached and the maximum battery voltage is not exceeded, the inverter switches to the "ConnectDC" operating state.

14.1.5.2 ConnectDC

During the "ConnectDC" operating state, the inverter checks the DC precharge waiting period with the "DC precharge" option. **WaitDc: DC precharge waiting period** is shown in the instantaneous value **PwrOffReas**. After the DC precharge waiting period has expired, the DC precharge contactor closes, the DC link is precharged by the battery, the inverter connects the DC switching device, and changes to the "ConnectAC" operating state.

14.1.5.3 ConnectAC from the DC grid

In the operating state "ConnectAC", the inverter checks whether an AC grid is present.

When at least 20% of the nominal AC voltage are connected, the inverter synchronizes to the AC grid, switches on the AC disconnection unit and changes to the "GridForm" operating state.

If the inverter started with a black start and thus there is no AC grid present, the inverter switches on the AC disconnection unit and changes to the "ACRampUp" operating state.

14.1.5.4 AcRampUp

During the operating state "ACRampUp", the inverter increases the AC voltage of the inverter to the specified setpoint. Switching to the operating state "GridFeed" occurs when the current voltage exceeds the parameter

VCl.OpMinNom and thus is within the operational operating limits.

14.1.6 GridFeed

In the operating state "GridFeed", the inverter feeds in active power and reactive power in accordance with the requirements or charges the battery.

If a grid-voltage dip occurs in the utility grid, the inverter switches from the operating state "GridFeed" to the operating state "FRT".

If the start/stop key switch **-S1** has been set to **Stop**, the inverter switches to the operating state "RampDown".

14.1.7 GridForm

In the operating state "GridForm", the inverter regulates the AC output voltage in accordance with the setpoint specifications. The parameters for this operating state are coordinated with the SMA application engineers for each specific project.

14.1.8 Q on Demand

In the operating state "Q on Demand", the inverter can provide reactive power if necessary or if the battery is not ready for operation. This function is independent of normal feed-in operation. In the operating state "Q on Demand", only limited dynamic grid support is available.

If the setpoint for controlling reactive power changes, the inverter does not return to the operating state "GridFeed".

14.1.9 Standby

To reduce switching losses, the inverter can be switched to the "Standby" state. The AC disconnection unit and the DC switchgear remain closed. The inverter remains in the "Standby" state until the setpoint for this state is reset.

The parameter **StbySfCapacMod** can be used to set whether the capacitor contactor is opened in the "Standby" operating state. This setting is system-specific.

Set value	Explanation
Standby without capacitor	The capacitor contactor is opened. The sinusoidal filter capacitor is then disconnected from the utility grid. No additional reactive power is drawn from the utility grid.
Standby with capacitor	The capacitor contactor is not opened. As a result, the inverter draws reactive power from the utility grid. Depending on the requirements of the grid operator, the purchase of reactive power can lead to additional costs or the compensation of the reactive power may be required. With this setting and when the feed-in conditions are met, the inverter can switch faster to the operating state "GridFeed". This also prolongs the electrical endurance of the capacitor contactor due to lower number of switch cycles. In addition, possible switching overvoltages are prevented.

The parameter **DcSw.OpnStbyEna** can be used to set whether the DC switchgear is opened in the "Standby" operating state. This setting is system-specific.

Set value	Explanation
Enable	The DC switchgear is opened during the "Standby" operating state. This disconnects the batteries from the inverter. The AC disconnection unit remains closed.
Disable	The DC switchgear remains closed during the "Standby" operating state. The batteries remain connected to the inverter.

To enable the inverter to return to the "GridFeed" operating state, the inverter switches to the "WaitDC" operating state and checks the conditions for closing the DC switchgear.

14.1.10 RampDown

If the start/stop key switch **-S1** has been set to **Stop**, the inverter reduces its power to below 100 kVA, disconnects from the utility grid and opens the AC disconnection unit and the DC switchgear. Then the inverter switches to the operating state "ShutDown".

14.1.11 ShutDown

Once the inverter has disconnected from the utility grid in the operating state "RampDown", all capacitors are discharged. Then the inverter switches to the operating state "Stop".

14.1.12 Error

If an error has occurred in the inverter or the medium-voltage transformer or the fast stop key switch **-S2** was pressed, the AC disconnection unit and the DC switchgear are opened immediately, the inverter disconnects from the utility grid and switches to a safe state. In this state, the capacitors remain charged.

When the inverter switches to the operating state "Error" following an error, the error must be acknowledged. Then the inverter switches to the operating state "Stop". Depending on the type of error, the error must be rectified and acknowledged manually or the error will automatically be acknowledged after an error-dependent time period.

When the inverter switches to the operating state "Error" after the fast stop key switch **-S2** was pressed, the fast stop key switch **-S2** must be switched on again manually. Then the inverter switches to the operating state "Stop".

14.1.13 Selftest

To guarantee the safety of the inverter, the inverter must cycle through a diagnostic test periodically. For this, the inverter must cycle through the operating state **Stop** within a year. In this test, the AC and DC side safety devices are checked to ensure that they function correctly.

The instantaneous value **DiagRmgTm** shows how many days remain until the next self-test to be performed. The instantaneous value is counted to **0** and reset automatically as soon as the self-test has been completed or the inverter has entered the **Stop** operating state.

The diagnostic test is performed at a reduced feed-in power and takes approximately 15 seconds.

14.1.14 FRT

If a disturbance occurs in the utility grid whilst in the "GridFeed" operating state, the inverter switches to the "FRT" operating state and supports the utility grid via dynamic grid support in accordance with the grid operator requirements. There are three types of grid support:

Mode	Explanation
Complete dynamic grid support	The inverter feeds in reactive current during the grid failure.

Mode	Explanation
Limited dynamic grid support	The inverter interrupts feed-in operation during the grid failure.
Continuation of the requested feed-in operation	The inverter continues feeding into the utility grid with the currently specified set-points.

If a disturbance occurs in the utility grid while in "Q on Demand" operation, the inverter switches to the operating state "FRT" and discontinues feeding in. Once the grid error is no longer present, reactive power is supplied immediately.

14.2 Safety Functions of the Inverter

14.2.1 Manual Shutdown Functions

14.2.1.1 Overview of Manual Shutdown Functions

The inverter can be shut down via various functions. As soon as one of the functions is activated, the inverter remains in the given mode. Only when all functions have been switched to operation can the inverter switch over to feed-in operation.

Function	Inverter behavior	Inverter bridge	AC disconnection unit	DC load-break switch
Key switch	After actuating the key switch, the inverter switches to the operating state "Stop". In this case, the inverter disconnects from the utility grid, opens the AC disconnection unit and the DC switchgear, and discharges the capacitors.			
Fast-stop key switch	After actuating the key switch of the fast stop, the inverter switches to the operating state "Stop". In this case, the inverter disconnects from the utility grid and opens the AC disconnection unit and the DC switchgear.			
Parameters	The inverter can be switched to the operating state "Standby" via the parameter RemRdy . In this case, the inverter bridges are opened and feed-in is interrupted. The AC disconnection unit and the DC switchgear remain closed.			
	The inverter can be switched to the "Stop" operating state via the parameter InvOpMod . When this happens, the AC disconnection unit and the DC switchgear open.			
	Depending on the configuration of the parameter Bsc.SrcSel , the inverter can be deactivated manually via the user interface or externally. For this purpose, the parameter Bsc.SCSOpCmdMan or Aux-Ctl.SCSOpCmd must be set to Stop . Only the inverter switches off here. The AC disconnection unit and the DC switchgear remain open.			

Function	Inverter behavior	Inverter bridge	AC disconnection unit	DC load-break switch
External standby	The inverter can be switched to the operating state "Standby" via an external signal. In this case, the inverter bridges are opened and feed-in is interrupted. The AC disconnection unit and the DC switchgear remain closed.			
External stop	The inverter can be switched to the "Stop" operating state via a digital signal. When this happens, the AC disconnection unit and the DC switchgear open.			
External fast stop	The fast-stop function can be tripped on the inverter via a digital signal. The inverter switches immediately to the operating state "Stop". In this case, the inverter disconnects from the utility grid and opens the AC disconnection unit and the DC switchgear.			
	If the digital signal is applied again the inverter runs through the waiting period defined in the country data set, closes the AC disconnection unit, loads the DC link and then closes the DC switchgear. As a result, the inverter is reconnected with the utility grid and can feed-in.			

14.2.1.2 Mode of Operation of the External Fast Stop

The inverter is equipped by default with a fast stop input at terminal **-X440:1,3**.

The following options are available for configuring the external fast stop:

- **External fast stop is deactivated**

The terminals of the active fast stop are bridged. The fast stop function is thus deactivated. The terminals were bridged during production.

- **External fast stop is operated with internal or external 24 V supply**

An external switch (break contact) is connected to the inverter terminals via the internal supply voltage or the external 24 V supply of the inverter. When the switch is closed, the relay is activated and the inverter feeds into the grid. If the fast stop is tripped, the switch opens and the relay is deactivated. The inverter is stopped and no longer feeds into the utility grid.

If the external fast stop is tripped, the AC disconnection and the DC switchgear are opened. The external fast stop does not result in rapid discharge of the capacitors.

Tripping the fast stop

The fast stop must only be released if there is immediate danger. Tripping of the fast stop does not entail fast discharge of the capacitors. If the inverter is to be switched off and properly shut down via an external signal, the remote shutdown input is to be used.

No warranty claims can be submitted for damages to the inverter or yield losses caused by activating the fast stop for no reason.

14.2.1.3 Mode of Operation of the External Standby

The inverter is equipped by default with an external standby input at terminal **-X440:5,7**.

This function lets you switch the inverter to the "Standby" operating state from a control room, for example. The AC disconnection unit and the DC switchgear of the inverter remain closed. This makes a switch to the operating state "GridFeed" possible in less than one second if the standby signal has been reset.

If 0 V is present at the external standby, the inverter continues to operate in the current operating state. If the external standby has been triggered, 24 V are applied to terminal **-X440:5,7** and the inverter switches from the current operating state to the operating state "Standby".

14.2.2 Automatic Shutdown Functions

14.2.2.1 Monitoring the Power Frequency

The inverter continuously checks the power frequency. This enables the inverter to disconnect from the utility grid in case of overfrequency or underfrequency.

If the power frequency rises above or falls below the configured thresholds, the inverter waits for the time defined in the corresponding parameter and disconnects from the utility grid.

You can set the thresholds and the delay time in the parameters. For frequency monitoring, six limits for overfrequency and six limits for underfrequency can be configured.

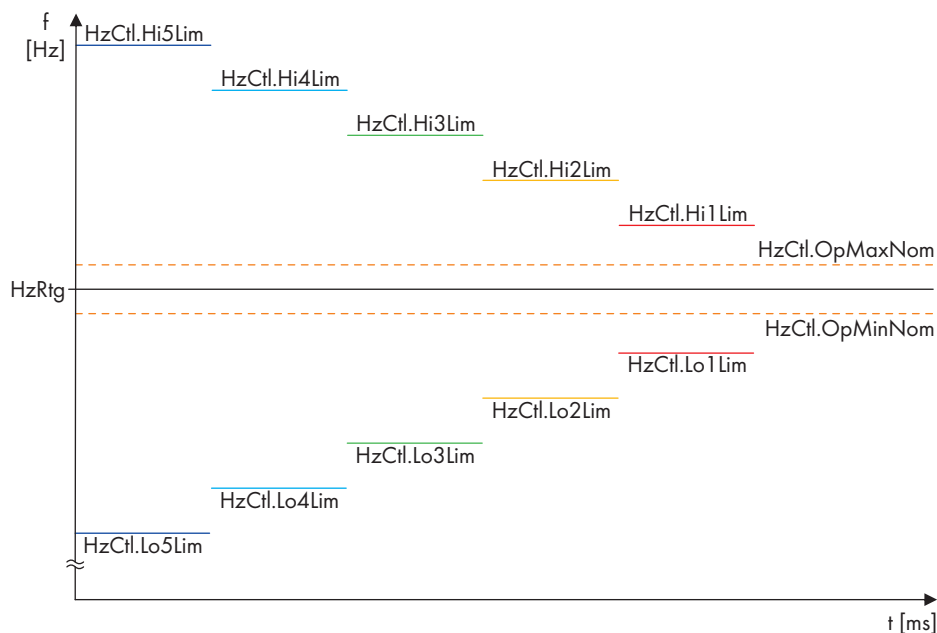


Figure 84: Monitoring of the power frequency

Parameters	Explanation	Default value
HzCtl.OpMaxNom	Frequency threshold for the upper connection limit of frequency monitoring	50.05 Hz
HzCtl.OpMinNom	Frequency threshold for the lower connection limit of frequency monitoring	49.50 Hz
HzCtl.Hi1Lim	First threshold for overfrequency	51.00 Hz
HzCtl.Hi1LimTm	Time lapse for the first threshold for overfrequency	1000 ms
HzCtl.Hi#Lim	Threshold of the second to fifth level for overfrequency	55.00 Hz ⁹⁾
HzCtl.Hi#LimTm	Time lapse for the second to fifth threshold for overfrequency	10000 ms ⁹⁾
HzCtl.Lo1Lim	First threshold for underfrequency	49.00 Hz

⁹⁾ In this parameterization, the thresholds are deactivated.

Parameters	Explanation	Default value
HzCtl.Lo1LimTm	Time lapse for the first threshold for underfrequency	1000 ms
HzCtl.Lo#Lim	Threshold of the second to fifth level for underfrequency	45.00 Hz ⁹⁾
HzCtl.Lo#LimTm	Time lapse for the second to fifth threshold for underfrequency	10000 ms ⁹⁾



Monitoring of the Power Frequency for Overfrequency and Underfrequency in Accordance with BDEW

If the power frequency exceeds or falls short of a defined frequency threshold, the inverter must disconnect from the utility grid within a defined time interval. In this case, the frequency thresholds as defined by relevant standards and the disconnection times form a window in which the individual parameters of the inverter must be located.

Implementation of power frequency monitoring in accordance with BDEW is two-tiered: there are two frequency thresholds each for overfrequency and underfrequency with corresponding monitoring times for each level. This means that at low frequency variation the power frequency can be monitored over a longer period before the inverter disconnects from the utility grid. In the event of severe infringement of the upper or lower frequency thresholds, a shorter monitoring time can be configured so that the inverter disconnects from the utility grid faster.

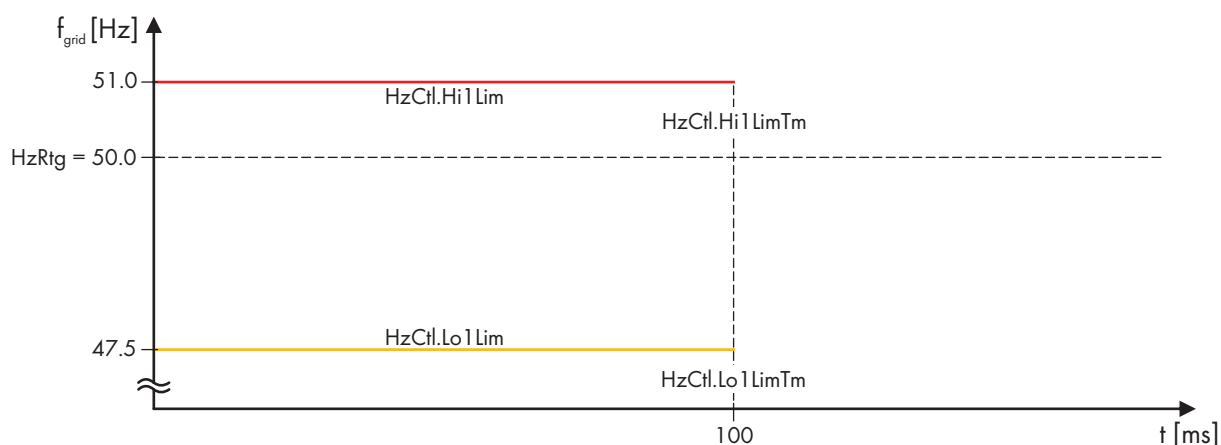


Figure 85: Parameters for monitoring the power frequency in accordance with BDEW

Parameters	Explanation	Default value
HzCtl.Hi1Lim	First threshold for overfrequency	51.0 Hz
HzCtl.Hi1LimTm	Time lapse for the first threshold for overfrequency	100 ms
HzCtl.Lo1Lim	First threshold for underfrequency	47.5 Hz
HzCtl.Lo1LimTm	Time lapse for the first threshold for underfrequency	100 ms

14.2.2.2 Monitoring the Grid Voltage

The inverter continuously checks the grid voltage. This enables the inverter to disconnect from the utility grid in case of overvoltage or undervoltage.

If the grid voltage rises above or falls below the configured thresholds, the inverter waits for the time defined in the corresponding parameter and disconnects from the utility grid.

You can set the thresholds and the delay time in the parameters. For voltage monitoring, you can set five limits for overvoltage and five limits for undervoltage.

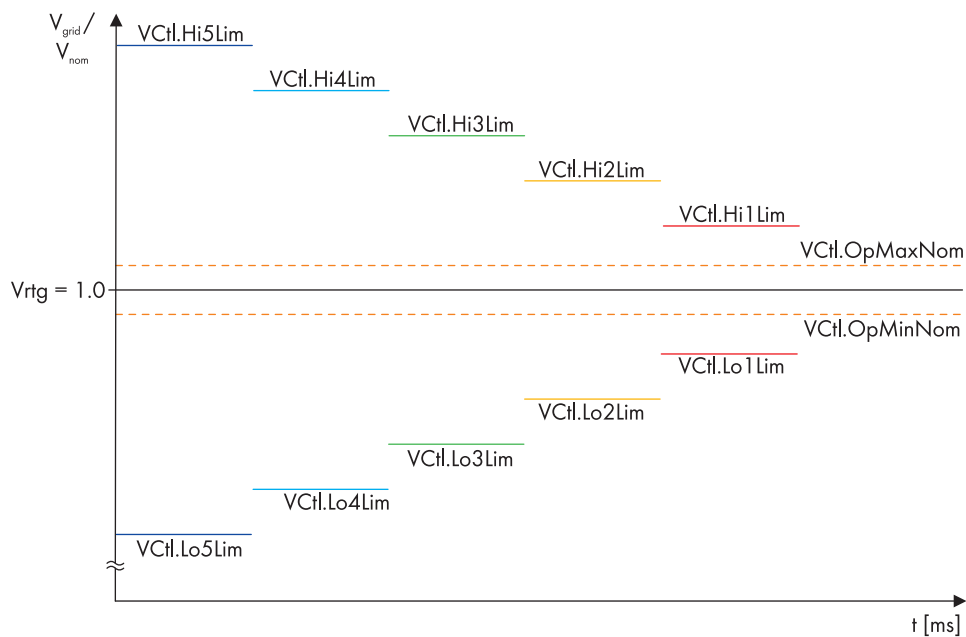


Figure 86: Monitoring of the grid voltage

Parameters	Explanation	Default value
VCtl.OpMaxNom	Voltage threshold for the upper connection limit of voltage monitoring	1.05
VCtl.OpMinNom	Voltage threshold for the lower connection limit of voltage monitoring	0.95
VCtl.Hi1Lim	First threshold for overvoltage	1.15
VCtl.Hi1LimTm	Time lapse for the first threshold for overvoltage	1000 ms
VCtl.Hi2Lim	Threshold of the second level for overvoltage	1.3
VCtl.Hi2LimTm	Time lapse for the second threshold for overvoltage	100 ms
VCtl.Hi#Lim	Threshold of the third to fifth level for overvoltage	2.00
VCtl.Hi#LimTm	Time lapse for the third to fifth threshold for overvoltage	10000 ms
VCtl.Lo1Lim	First threshold for undervoltage	0.80
VCtl.Lo1LimTm	Time lapse for the first threshold for undervoltage	1000 ms
VCtl.Lo2Lim	Threshold of the second level for undervoltage	0.45
VCtl.Lo2LimTm	Time lapse for the second threshold for undervoltage	300 ms
VCtl.Lo#Lim	Threshold of the third to fifth level for undervoltage	0.00
VCtl.Lo#LimTm	Time lapse for the third to fifth threshold of undervoltage	10000 ms

Monitoring the grid voltage in accordance with BDEW

Implementation of voltage monitoring is two-tiered: there are two thresholds each for over and undervoltage with corresponding monitoring times for each level. This means that at low voltage variation the grid voltage can be monitored over a longer period before the inverter disconnects from the utility grid. In the event of severe infringement of the upper or lower voltage thresholds, a shorter monitoring time can be configured so that the inverter disconnects from the utility grid faster.

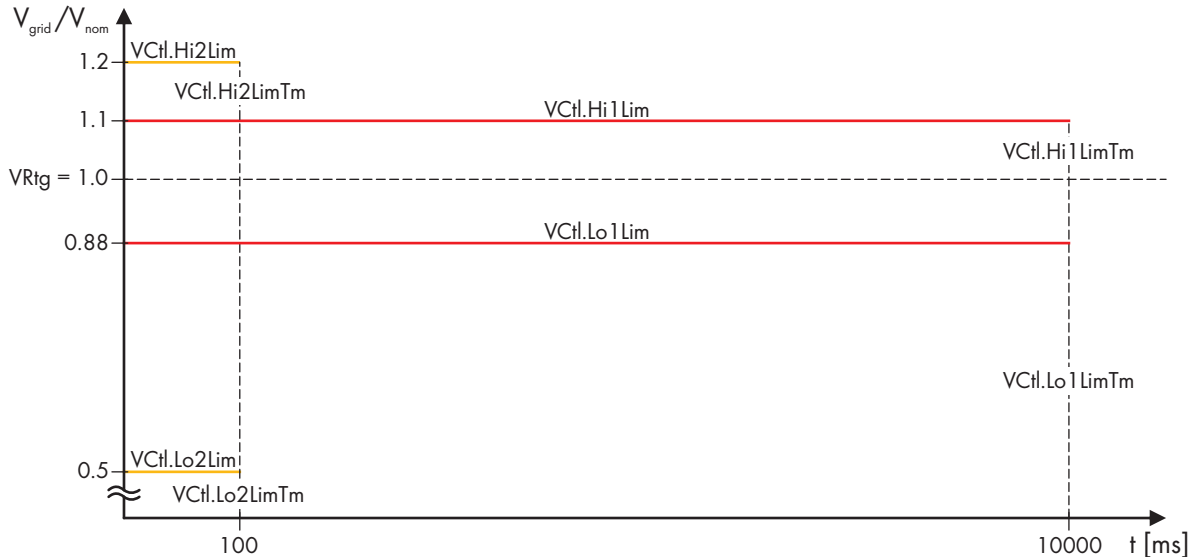


Figure 87: Parameters for monitoring the grid voltage in accordance with BDEW

Parameter	Explanation	Default value
$VCtl.Hi1Lim$	First threshold for overvoltage	1.1
$VCtl.Hi1LimTm$	Time lapse for the first threshold for overvoltage	1000 ms
$VCtl.Hi2Lim$	Second threshold for overvoltage	1.2
$VCtl.Hi2LimTm$	Time lapse for the second threshold for overvoltage	160 ms
$VCtl.Lo1Lim$	First threshold for undervoltage	0.88
$VCtl.Lo1LimTm$	Time lapse for the first threshold for undervoltage	2000 ms
$VCtl.Lo2Lim$	Second threshold for undervoltage	0.5
$VCtl.Lo2LimTm$	Time lapse for the second threshold for undervoltage	300 ms

14.2.2.3 Protection against transient overvoltage events

In parallel to monitoring the grid voltage using mean values, the inverter also monitors the grid voltage using instantaneous values. In this way, short-term high overvoltage events can be detected and the inverter can adapt its behavior accordingly.

Monitoring to protect the electronic components of the inverter

If the voltage exceeds the nominal voltage for 1 ms by a defined factor, the inverter immediately switches to the "Error" operating state. This will protect the electronic components against damages.

Monitoring to protect the utility grid

When the inverter is equipped with the option "Energy self-sufficiency: internal (tOVP)", the inverter additionally checks whether it is the cause for the overvoltage and adapts its behavior accordingly.

In the event of an overvoltage-related error that does not exceed the device-specific limiting values, the inverter briefly switches to the "Standby" operating state, checks for a defined period of time whether it is a high-resistance grid failure and reacts depending on the event.

Event after standby	Inverter behavior after standby
The voltage exceeds the nominal voltage by a defined factor for a defined period.	The inverter immediately switches to the operating state "Error".
The voltage remains below the defined factor within a defined time.	The inverter monitors the instantaneous voltage and switches back to feed-in operation when the voltage returns to the defined range. This ensures that the inverter is not the reason for the overvoltage and the normative requirement of the grid operator is thus met.
A grid failure has occurred.	The inverter detects a grid failure during the monitoring time and disconnects from the utility grid.

14.2.2.4 Active Islanding Detection

The islanding detection function detects the formation of stand-alone grids and disconnects the inverter from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power.

With active islanding detection, the inverter continuously checks the stability of the utility grid. If the utility grid is intact, this has no impact on the utility grid. Only if a stand-alone grid has formed will the inverter disconnect from the utility grid.

To enable the active islanding detection function, contact us (see Section 18, page 270).

14.2.2.5 Passive Islanding Detection

Depending on the order option, the inverter may be equipped with passive islanding detection. The islanding detection function detects the formation of stand-alone grids and disconnects the inverter from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power.

Unlike active islanding detection, with passive islanding detection the utility grid is not actively influenced, but simply passively monitored. This involves monitoring the speed of the frequency change.

If the power frequency changes by a certain amount in a certain time, a stand-alone grid is detected and the inverter disconnects from the utility grid. The magnitude of the frequency change and the time lapse in which this change must take place can be configured via parameters on the inverter.

14.2.2.6 External Islanding Detection

If the overall system is equipped with an external anti-islanding detection system with transfer trip, the formation of stand-alone grids can be detected at the plant level. If a stand-alone grid has formed, a signal is transmitted to the fast stop input of the inverter. A suitable cable must be connected at the fast stop input at terminal **-X440:1,3** of the inverter during installation.

During normal operation conditions, a 24 V signal is transmitted to the fast stop input of the inverter. If a stand-alone grid has formed, the signal switches to 0 V and the inverter switches to "Error" and is disconnected from the utility grid.

In order to switch back the inverter to the operating state "GridFeed", ensure that the external anti-islanding detection system generates the 24 V signal.

14.2.2.7 Low-Temperature Shutdown

The intake temperature is monitored in the inverter so that it can be shut down if the operating temperature range is infringed.

There are 2 options for disconnecting the inverter at low temperatures:

- Temperature range: -25°C to $+60^{\circ}\text{C}$ (standard option)
- Temperature range: -40°C to $+60^{\circ}\text{C}$

Temperature range: -25°C to $+60^{\circ}\text{C}$

If the intake temperature falls below -25°C , the inverter switches to the operating state "Stop" in order to protect the electronic components. As soon as the intake temperature increases to -20°C , the inverter resumes feed-in operation.

Temperature range: -40°C to $+60^{\circ}\text{C}$

In addition to the intake temperature, the interior temperature of the inverter is monitored.

At an intake temperature of up to -40°C , the inverter continues to operate in the current operating state as long as the interior temperature of the inverter is above -25°C . In order to keep the interior temperature above -25°C , additional heaters are activated in the inverter. In addition, the waste heat of the components is used to heat the interior.

If the inverter is put into the operating state "Stop" or "Standby" at an interior temperature of above -25°C , the AC disconnection unit and the DC switchgear are opened. The heaters stay switched on. Due to the lack of waste heat from the components, there is a risk that the inverter will cool down and trigger an insufficient temperature error. If the inverter was put into the "Stop" or "Standby" operating state at low temperatures, it can be switched back to feed-in operation within a limited time. This is possible as long as the interior temperature is above -25°C . It is therefore recommended to put the inverter into the operating state "Stop" or "Standby" only in exceptional situations at temperatures below -25°C .

If the temperature in the inverter falls below -25°C , the inverter switches to the operating state "Error" to protect the electronic components. If the internal temperature increases to at least -22°C , the inverter automatically switches to the previously selected operating state.

If the intake temperature falls below -40°C , the inverter switches to the operating state "Error" independently of the interior temperature in order to protect the electronic components. The AC disconnection unit and the DC switchgear are opened. If the intake temperature increases to -35°C and the interior temperature to at least -22°C , the inverter automatically switches to the previously selected operating state.

The self-consumption of the inverter increases by 3 kW due to the additional heaters.

14.2.2.8 Disconnecting at High Temperatures at the AC Connection

The connection busbars between the inverter and MV transformer must not exceed the maximum temperature. The maximum temperature is: 120°C . The temperature at the AC connection busbars is continuously monitored.

If the power connection between the inverter and MV transformer has not been designed correctly or if the required torque has not been complied with, the AC connection busbars may overheat. At an AC connection busbar temperature of 125°C , the inverter switches off to protect itself and the fault **6518** is displayed. To rectify the fault, the correct design of the power connection between the inverter and MV transformer and the correct torque must be guaranteed (see Section 7.6.1, page 78).

14.2.2.9 Reducing the Feed-In Power when there are High Temperatures in the Inverter

The temperature inside the inverter is continuously monitored.

The inverter reduces the feed-in power when a fan in the inverter fails and the temperature in the inverter increases. Disturbance **7501**, **7502** or **7503** is displayed. The **DrtCabTmp** instantaneous value displays whether the inverter is reducing the feed-in power due to excessive temperature inside the inverter.

If the temperature in the inverter exceeds the maximum interior temperature, the inverter switches off and the fault **6515** is displayed.

14.2.2.10 Reduction of the Output Power Depending on Altitude of Installation and Ambient Temperature

The inverter monitors the ambient temperature in order to reduce the feed-in power as protection for the electronic assemblies of the inverter where necessary. Here, the temperature at which the reduction of the feed-in power started is dependent on the altitude of installation of the inverter.

When it comes to DC voltages of more than 950 V at 25 °C and above and of more than 850 V at 50 °C and above, the feed-in power can be increasingly reduced depending on temperature.

The inverter reduces the feed-in power at 60 °C down to 0 kVA.

14.2.2.11 Reduction of Short-Circuit Currents due to Split DC Rails

A large number of connected battery strings can cause high short-circuit currents and a high arc fault energy in the inverter in case of a fault.

With the option Split DC Rail the inputs on the DC+ pole are distributed to several connecting rails. Two connecting rails are available for inverters with two inverter bridges. Three connecting rails are available for inverters with three inverter bridges. The DC rails, one below the other, are secured against rapidly increasing short-circuit currents with ultra-fast NH fuses. In order to reduce equalizing currents between the connecting rails, it is required to connect the battery strings symmetrically and to operate the inverter symmetrically. The asymmetry between the DC inputs must not permanently exceed 120 A.

In the event of a short circuit on a DC rail, the short-circuit current in the affected path is limited by the tripping of the ultra-fast LV/HRC fuses in the inverter. This protects the group fuses not affected by the short circuit and the battery strings fuses of the batteries not involved in the short circuit. Only the group fuse and the battery string fuses of the affected path are damaged. The customer is responsible for ensuring that the selectivity of the fuse chain is guaranteed. The cut-off integral of the ultra-fast LV/HRC fuses in the inverter is at most 1.325 MA²s. In order to ensure selectivity, the limiting load integrals of the upstream fuses must be significantly larger.

Even for a split DC rail, the setpoints of the inverter are controlled with 1 control value. It is not possible to set a separate setpoint for each DC path.

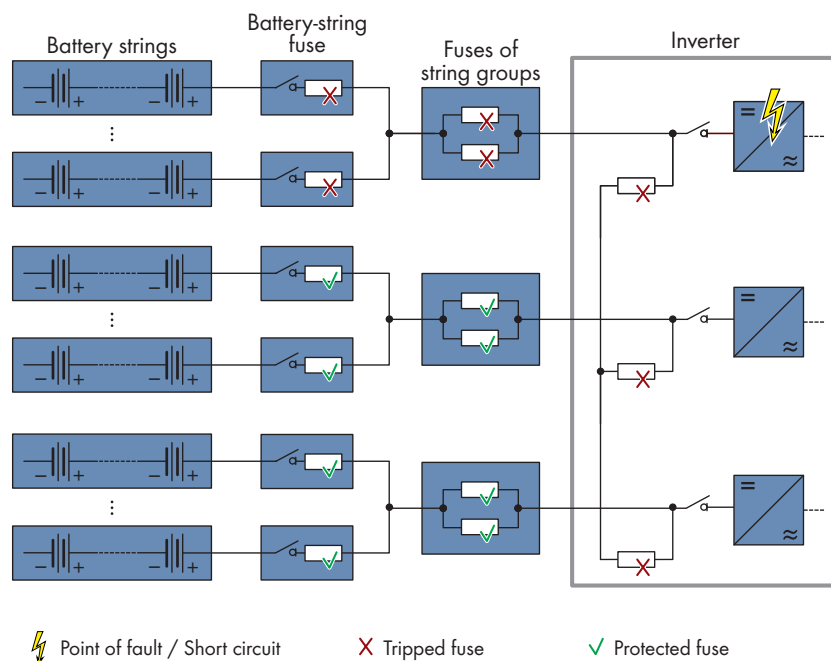


Figure 88: Reduction of the short-circuit current through fuses

Only fuses with a maximum melting integral of 8 MA²s per input may be used for the group fuses.

14.2.3 Ground-Fault Monitoring and Insulation Monitoring

14.2.3.1 Mode of Operation

In a grounded power system

The ground-fault monitoring is implemented by means of a residual-current monitoring device. If a ground fault occurs, the residual currents are detected and interrupted.

- **Ground fault on the ungrounded terminal**

If a ground fault occurs on the ungrounded pole of the battery, the normally ungrounded pole is grounded non-specifically by the ground fault and a residual current flows to the grounded pole. This residual current flows through the ground-fault monitoring device, e.g. the Remote GFDI, and triggers it.

- **Ground fault on the grounded terminal**

The ground-fault monitoring device is bypassed when a ground fault occurs on the grounded pole. A ground fault on the grounded terminal cannot be reliably detected. If an undetected ground fault occurs on the grounded terminal, this will pose a safety risk. A further ground fault occurring on the ungrounded terminal will lead to high residual currents that cannot be interrupted by the ground-fault monitoring unit.

Residual current monitoring in grounded systems

In order to ensure the residual current monitoring function in grounded systems, the insulation must be checked at regular intervals. The NEC 2014 (Section 690.5 (A)) and the TS 62548 © IEC:2013(E) regulations require the periodic measuring of the insulation resistance for the reliable detection of ground faults even in grounded systems. An additional insulation monitoring device is necessary for this.

- The operator of the power system must find out whether these standards apply to the power system and whether an additional insulation monitoring device is necessary.

In the non-grounded battery storage system

An insulation monitoring device constantly determines the insulation resistance using an active measurement procedure. As soon as the insulation resistance falls below the warning threshold specified in the insulation monitoring device, an insulation warning will be displayed. As a result, preventative measures can be taken before errors such as personal injury due to leakage currents or system failure occur. If the insulation resistance falls below the configured warning threshold, the inverter switches off.

14.2.3.2 Insulation Monitoring Device

In non-grounded battery storage systems, the insulation monitoring device monitors the battery storage system's insulation resistance.

In the operating state "GridFeed", the insulation resistance of the entire system, from the battery to the MV transformer, is measured.

If the inverter is in the operating states "Stop" or "WaitDC", only the insulation resistance from the battery to the inverter is measured.

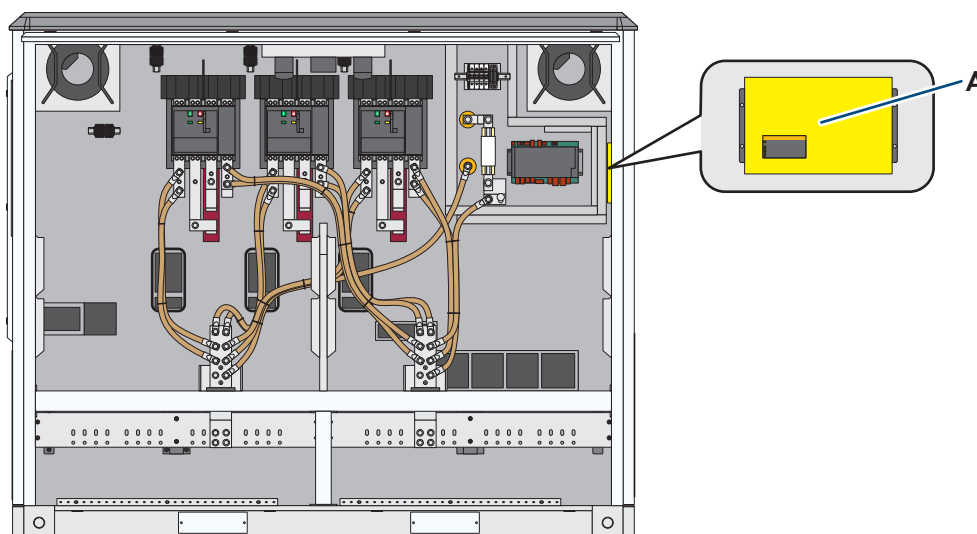


Figure 89: Position of the insulation monitoring device

Position	Designation
A	Insulation monitoring device

The insulation monitoring device is connected between the DC voltage and the grounding conductor.

If the insulation resistance falls below the threshold specified in the parameter **PvGnd.RisIsoWarnLim**, a warning is generated. The measuring circuit closes and the LED **ALARM1** on the insulation monitoring device glows. The inverter displays the disturbance message **3601** and continues feeding in. The orange light repeater at the inverter's control panel flashes.

If the insulation resistance falls below the threshold specified in the parameter **PvGnd.RisIsoErrLim**, an insulation error is generated. The measuring circuit closes and the LEDs **ALARM1** and **ALARM2** on the insulation monitoring device glow. The inverter displays the disturbance message **3501** and switches to the operating state "Error". The red light repeater at the inverter's control panel is lit.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

14.2.3.3 Remote GFDI and Insulation Monitoring Device

With the order option "Remote GFDI and Insulation Monitoring," it is possible to check the insulation via the integrated insulation monitoring device. Here, in the morning upon start-up of the inverter, or after the control voltage of the inverter has been switched off, the Remote GFDI will be opened and an insulation measurement will be performed.

When the Remote GFDI is closed, the battery is grounded. In this state, the insulation resistance cannot be determined.

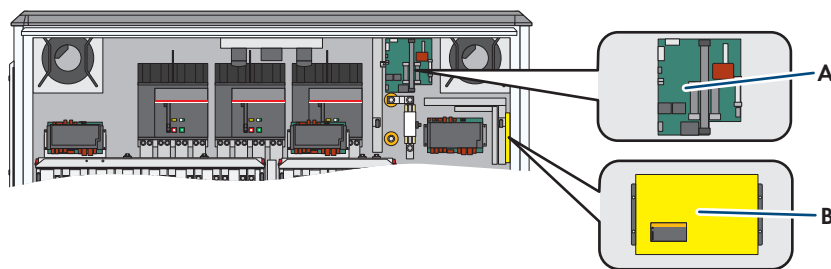


Figure 90: Position of Remote GFDI and insulation monitoring device

Position	Designation
A	Remote GFDI
B	Insulation monitoring device

Insulation Monitoring

During start-up of the inverter, the Remote GFDI will be opened and the insulation monitoring device begins measuring. The insulation monitoring device will initially assume that the insulation is poor.

The insulation monitoring device takes approximately ten minutes to detect the correct insulation resistance on the DC side. If the insulation is intact, the inverter switches to the operating state "GridFeed" and measures the insulation resistance for another 5 minutes. If the insulation is in good order, the Remote GFDI is closed and the DC source is switched to grounded operation. The value of the insulation resistance can be read off from the user interface in the instantaneous value **PvGnd.Rislso**.

If one of the disturbances **3501** or **3601** is displayed during the measurement of the insulation resistance, the insulation is defective. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error. The inverter does not switch on until the error has been acknowledged manually.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

14.3 Power Control

14.3.1 Power Control in the Battery Storage System

The battery storage system supports the stability of the utility grid by controlling the power fed in. The inverter can process various setpoints for the control:

- Parameters that are entered via the user interface
- Setpoints that are delivered via Modbus protocol
- Output values calculated in the inverter for controlling the inverter
- Adjusted substitute values for further operation in the event of a communication error

Using these values, the inverter can calculate setpoints for the active power and the reactive power to be fed in and the inverter can then feed in the appropriate power. These values are constantly being compared with the nominal values set in the inverter for active power, reactive power and apparent power and limited to them.

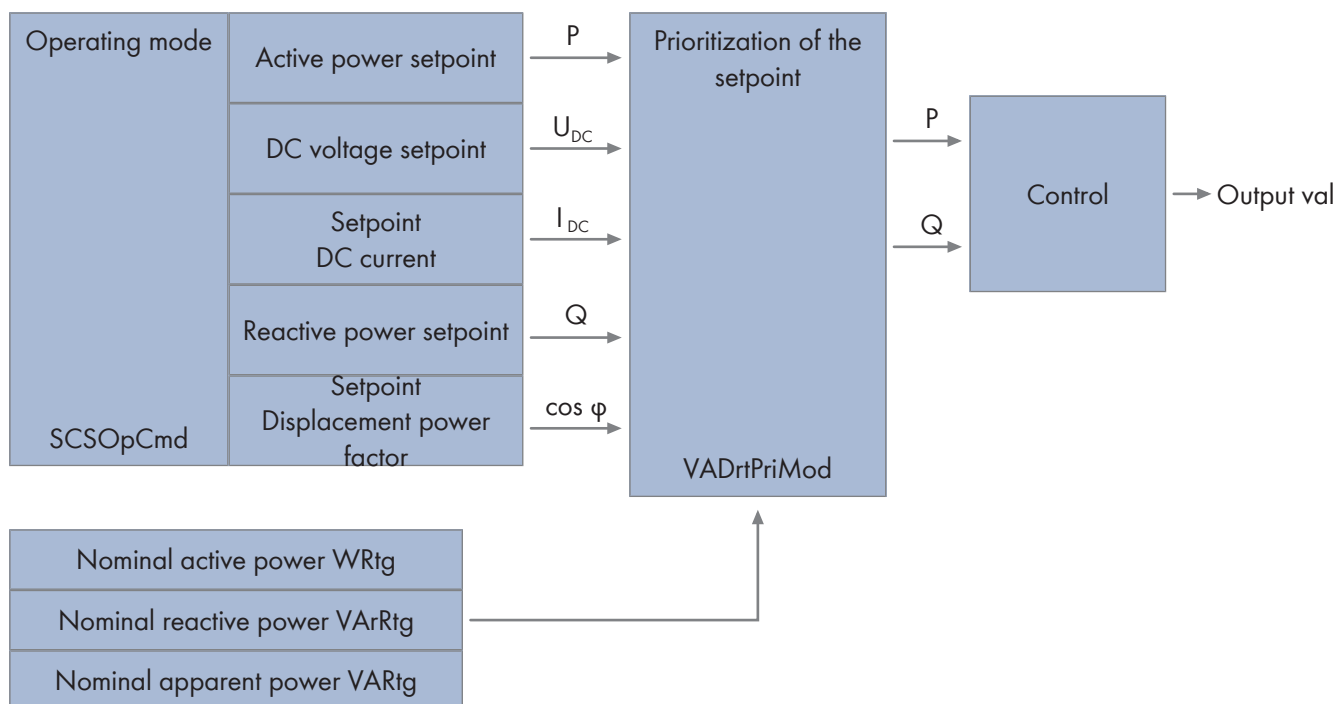


Figure 91: Principle of Power Control

In order to meet the requirements of the electric utility company, it can be adjusted in the parameter **VArDrtPriMod** whether the reduction of the active power or the control of the reactive power should have priority.

14.3.2 Principle of Active Power Control

The output value for the active power control is calculated using two setpoints.

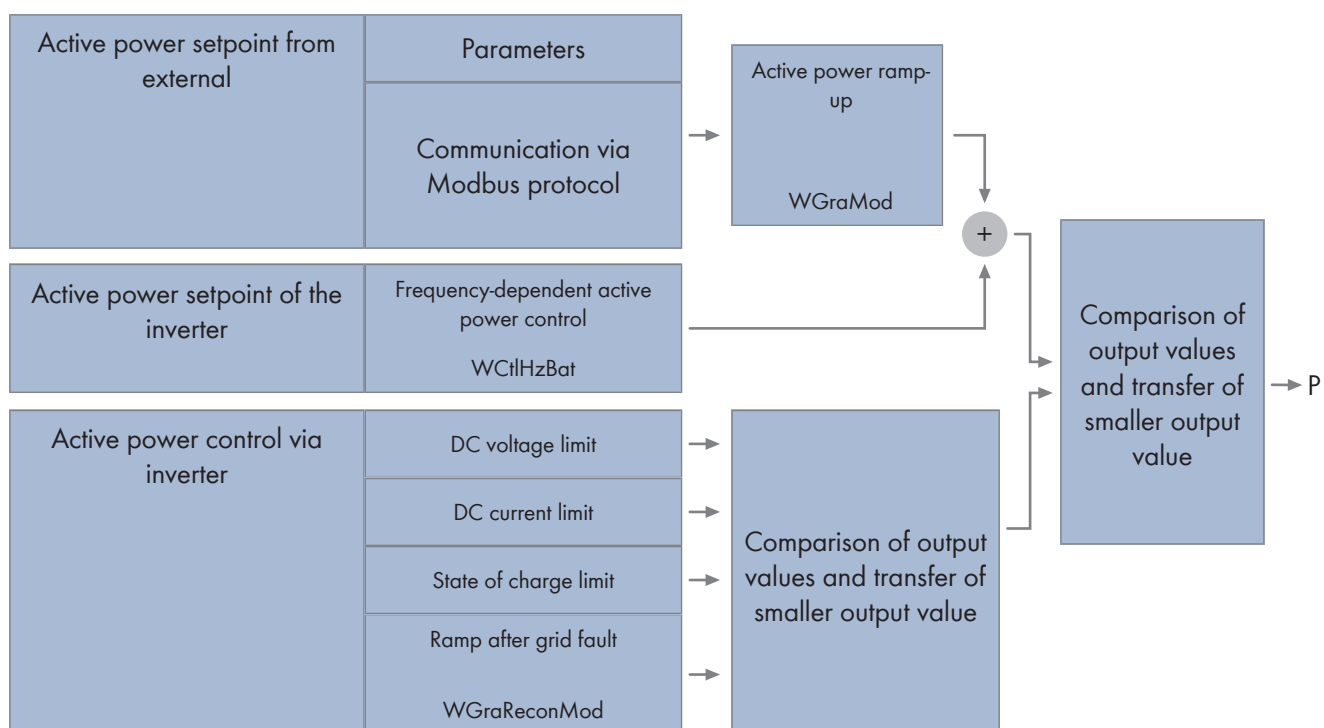


Figure 92: Principle of Active Power Limitation

The inverter processes the external setpoints when the intervals between data transmissions in the Modbus protocol are greater than 50 ms. It is recommended that the transmission interval be set as high as possible.

The inverter can start the specified active power feed-in using a ramp. This means that the inverter gradually increases the ratio of feed-in power per second by the value set in the parameter **WGra**. The ramp is activated and deactivated in the **WGraMod** parameter.

At the same time, the inverter processes the setpoints that were set on the inverter for the frequency-dependent active power limitation via the parameter **WCtrlHzBatMod**.

To ensure that the inverter does not feed in any active power, the reactive power must also be set to 0 kVar in addition to the 0 kW setpoint for the active power. Otherwise, the inverter will still feed in about 9 kW, which may result in contract penalties.

Following a grid error, the inverter starts to feed-in power with the ramp set up in the parameter **WGraRecon**.

The inverter control internally compares the setpoints for reducing the active power and generates the control value for the active power reduction using the smaller value.

14.3.3 Principle of Reactive Power Control

The output value for the reactive power control is calculated using two output values.

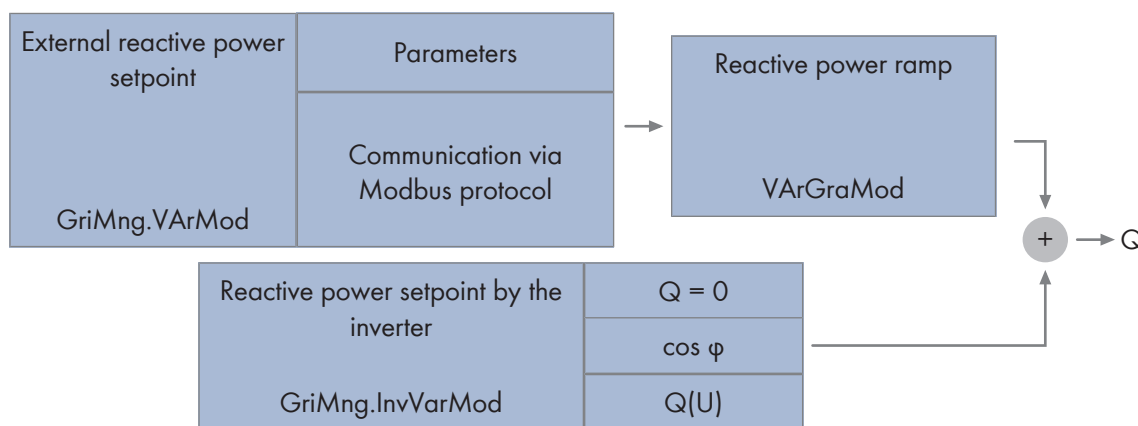


Figure 93: Principle of Reactive Power Control

The source for the specification of the external reactive power control is configured in the parameter **GriMng.VArMod**. The following setpoint sources can be set via this parameter:

- **VArCtrlCom** - Specifications of the electric utility company for the reactive power values transmitted via Modbus protocol.
- **PFCtrlCom** - Specifications of the electric utility company for the displacement power factor transmitted via Modbus protocol

A reactive power value or the displacement power factor can each be transmitted.

The inverter processes the external setpoints when the intervals between data transmissions in the Modbus protocol are greater than 50 ms. It is recommended that the transmission interval be set as high as possible.

When the setpoints are defined via the Modbus protocol, the reactive power is expressed as a percentage depending on the maximum reactive power. After resetting the parameters to the default setting, ensure that the specifications via the Modbus protocol continue to match the previous or expected specifications.

If an inverter is to be integrated into an existing SCADA system, the settings of all components of the SCADA system must be adjusted. For this, there are two options:

- Adjust the parameter **VArRtg** of the new inverter to the settings of the existing inverters
- Adjust the SCADA system:
 - When the maximum value for the reactive power is changed, simulate the grid stability at the AC connecting rails of the inverter.

- When the maximum value for the reactive power feed-in is changed, simulate the grid stability of the power plant at the grid-connection point.
- Ensure that the MV transformer is designed for the permanent reactive power feed-in with a new maximum value.
- Adjust the reactive power setpoints.

The inverter can feed the specified reactive power into the utility grid using a ramp. This means that the inverter gradually increases the reactive power by the value set in the **VArGra** parameter. The ramp is activated and deactivated in the **VArGraMod** parameter.

At the same time, the inverter processes the specifications set directly on the inverter for reactive power control via the parameter **GriMng.InvVArMod**. The following setpoints can be set via this parameter:

- **Off** - The inverter does not generate internal setpoints for the reactive power.
- **VArCtlVol** - The inverter controls the reactive power as a function of the voltage (see Section 14.4.4, page 212). The internal setpoints are added up with the external setpoints. The reactive power can also be controlled externally via voltage setpoint (see Section 14.3.4, page 201).
- **PFCtlW** - The inverter controls the reactive power via the displacement power factor as a function of the active power.

The inverter control adds up both reactive power setpoints and feeds the sum of the reactive power into the utility grid.

In order to use parameter **GriMng.InvVArMod**, please contact us.

14.3.4 Influencing of the Grid Voltage by Reactive Power

To safeguard the stability of the utility grid, a setpoint can be specified for the grid voltage. The inverter uses this setpoint to regulate the reactive power that is fed in and thus influences the utility grid.

The source for specifying the setpoint for the grid voltage is configured in the parameter **Bsc.SrcSel**. The following setpoint sources can be set via this parameter:

- **Manual control** - The inverter controls the reactive power via the parameter **Bsc.VolNomSptMan**, which is entered via the user interface.
- **External control** - Grid voltage setpoints are transmitted via Modbus protocol

The inverter processes the external setpoints when the intervals between data transmissions in the Modbus protocol are greater than 50 ms. It is recommended that the transmission interval be set as high as possible.

14.3.5 Inverter Behavior in Case of Communication Disturbances

Standard behavior in the event of a communication disturbance during operation

Via the parameter **Bsc.SrcSel**, the inverter can be set to receive the control setpoints via Modbus protocol. If these setpoints for the active and reactive power control or the battery's parameters cannot be transmitted correctly via Modbus protocol, the error detection function controls the inverter's behavior.

There are three possible causes for communication failure:

Cause	Explanation
External communication	The communication between SCADA system and inverter is disturbed.
	Communication between battery and inverter is disturbed.
Internal communication	Internal communication in the inverter is disturbed.

Since an external communication failure caused by various sources can be viewed to be critical in different ways, a tolerance time is taken into account by the inverter. The tolerance time for SCADA system communication failures can be set with the parameter **BatCtl.ComFlb.AuxCtlTmLim**. The tolerance time for battery communication failures can be set with the parameter **BatCtl.ComFlb.BatTmLim**.

The inverter automatically takes the shorter period of the tolerance time into account during an internal communication failure.

The inverter goes into fallback mode only after the expiration of the tolerance time mentioned above.

The status of error detection is displayed in the instantaneous value **BatCtl.ComFlb.FlbStt**.

Indication	Status of the inverter
Ok	The inverter is operating in automatic mode.
Fallback	The inverter has detected a communication failure and is in fallback mode for a defined period of time.
Error	The inverter is in the operating state "Error" due to a communication error. Possible sources of error: • The battery communication is disrupted. • The SCADA communication is disrupted. • The communication to SCADA system and battery is disrupted.

The inverter automatically activates the error detection for the battery and external signal generators separately from each other. The status of the respective setting is shown in the parameters **BatCtl.ComFlb.BatEna** or **BatCtl.ComFlb.AuxCtlEna**. If one of the two external communication paths is disrupted, the signals of the other communication path are still used.

If the time period set in the parameter **BatCtl.ComFlt.FlbTmLim** has expired after entering the fallback mode, the inverter switches to the operating state "Error" and no longer feeds into the utility grid. If the parameter **BatCtl.ComFlt.FlbTmLim** has been set to 0 seconds, the inverter immediately switches to the operating state "Error".

If the inverter again receives valid setpoints via the Modbus protocol, the inverter voids the communication error and switches back to normal operation.

The inverter's behavior in the absence of setpoints is set in the parameter **BatCtl.ComFlb.FlbMod**:

Setting	Behavior in the event of communication disturbances
Error	The inverter switches to the operating state "Error". The AC disconnection unit and the DC switchgear are opened and the inverter disconnects from the utility grid and battery.
Standby	The inverter switches to the operating state "Standby". The AC disconnection unit and the DC switchgear remain closed.

Setting	Behavior in the event of communication disturbances
Predefined	The inverter switches to a predefined operating state. The inverter's behavior is set by the following parameters: • BatCtl.ComFlb.CtlMod: Selection of the operating mode – Power Control: The active power is controlled by the value set in the parameter BatCtl.ComFlb.WSpt. – DC Voltage Control: The DC voltage is controlled by the value set in the parameter BatCtl.ComFlb.DclVolSpt. – Last Control Mode: Use last control mode. • BatCtl.ComFlb.WSpt: Specify the active power in the absence of setpoints. • BatCtl.ComFlb.VArSpt: Specify the reactive power in the absence of setpoints. • BatCtl.ComFlb.PFSpt: Specify the power factor in the absence of setpoints. • BatCtl.ComFlb.DclVolSpt: Specify the DC voltage in the absence of setpoints. • BatCtl.ComFlb.VolNomSpt: Specify the nominal voltage in the absence of setpoints.
Last setpoint	The inverter uses the last known specified setpoint. If setpoints could not be transmitted via communication (e.g. after switching the inverter on), a last known value is missing and the inverter remains in the operating state "Standby".

Alongside the behavior specification via the parameter **BatCtl.ComFlb.FlbMod** during a communication failure, the parameter **WClHzBatMod** is set depending on how the frequency-dependent active power is controlled during disturbed communication (see Section 14.4.3, page 210).

Enhanced behavior in the event of a communication disturbance during operation

In comparison to standard behavior, enhanced behavior can be activated in the parameter **GriMng.ExtdFlbEna**.

In this case, the inverter detects a communication error after the time set in the parameter **GriMng.ComFltTmLim** and issues the warning **9348**. In addition, the state **Timeout, 30 sec** is displayed in the instantaneous value **GriMng.ExtdFlbStt**. A check is made for 30 seconds to see if the communication error occurs again.

- The communication remains interrupted:

If communication is still interrupted after this period (30 seconds) has elapsed, the inverter switches to the fallback state in accordance with the configured setpoints. After the time defined in the parameter **GriMng.ComFltFlbTmLim** has elapsed, the inverter switches to the operating state "Error". It no longer feeds into the utility grid, and it issues the error message **6136**. The state **Fallback and error** is displayed in the instantaneous value **GriMng.ExtdFlbStt**. Before the inverter can return to the operating state "GridFeed", the communication error must be resolved and the error must be confirmed manually via the parameter **GriMng.ExtdFlbErrClr**.

- The communication error is resolved within the 30 seconds but it occurs again.

If the communication error is resolved within this period (30 seconds), the inverter will monitor the communication for the next 60 minutes. The state **Timeout, 1 hour** is displayed in the instantaneous value **GriMng.ExtdFlbStt**.

If communication is interrupted again during this time, the inverter switches to the fallback state in accordance with the configured setpoints. After the time defined in the parameter **GriMng.ComFltFlbTmLim** has elapsed, the inverter switches to the operating state "Error". It no longer feeds into the utility grid, and it issues the error message **6136**. The state **Fallback and error** is displayed in the instantaneous value **GriMng.ExtdFlbStt**. Before the inverter can return to the operating state "GridFeed", the communication error must be resolved and the error must be confirmed manually via the parameter **GriMng.ExtdFlbErrClr**.

- The communication error is resolved within the 30 seconds and it does not occur again.

If no further communication error occurs during this time, the communication error is considered to be resolved. If a communication error occurs again, the inverter monitors the communication error again for 30 seconds. The state **Timeout, inactive** is displayed in the instantaneous value **GriMng.ExtFlbStt**.

This behavior during a lack of communication is required in Australia.

14.3.6 Static and dynamic DC limits of the battery

To protect the battery, DC current and DC voltage can be limited. If a static DC limit is overshoot or undershot, the inverter switches off after a specified period of time. The time in terms of exceeding the voltage limit is specified in the parameter **BatCtl.DcVolOpLimTm**. The time in terms of exceeding the current limit is specified in the parameter **BatCtl.DcAmpOpLimTm**.

Depending on the battery type, the current and voltage must be limited according to the dynamic DC limits. If the dynamic DC limits are reached, the inverter goes into derating. The instantaneous value **DrtStt** displays the states **Bat.DcAmp** or **Bat.DcVol**.

The actual DC limits are calculated on the basis of the battery's thresholds and the internal thresholds. The narrower threshold is used.

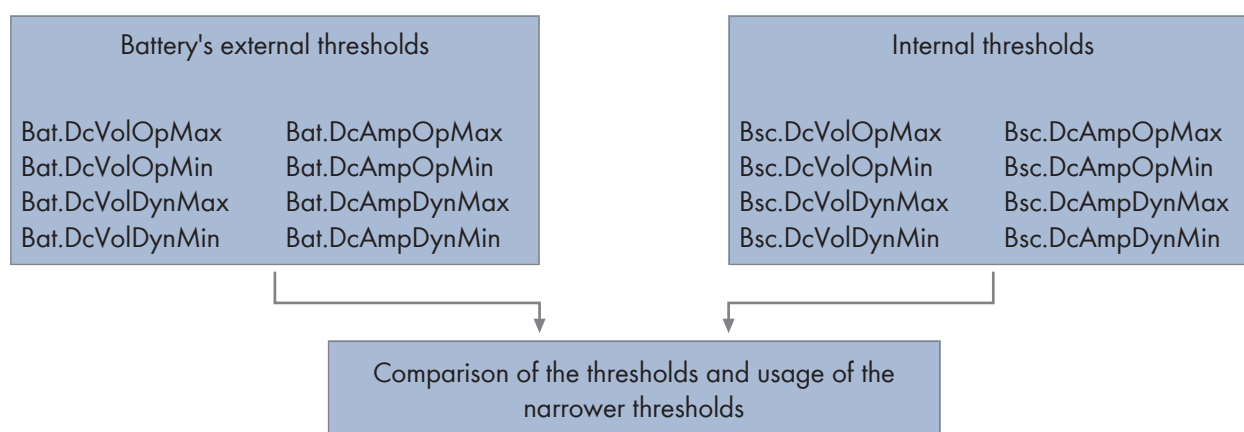


Figure 94: Principle for calculating the thresholds

Parameters	Explanation
DcVolOpMax	Maximum static charge voltage, overshooting leads to deactivation of the inverter
DcVolOpMin	Minimum static discharge voltage, undershooting leads to deactivation of the inverter
DcVolDynMax	Maximum dynamic charge voltage, overshooting leads to derating
DcVolDynMin	Minimum dynamic discharge voltage, undershooting leads to derating
DcAmpOpMax	Maximum static discharge current, overshooting leads to deactivation of the inverter
DcAmpOpMin	Maximum static charge current, undershooting leads to deactivation of the inverter
DcAmpDynMax	Maximum dynamic discharge current, overshooting leads to derating
DcAmpDynMin	Maximum dynamic charge current, undershooting leads to derating

14.3.7 State of charge limit of the battery

The state of charge limit controls the dynamic DC limits or the active power depending on the battery's charge state. If the state of charge limits are overshoot or undershot, the inverter stops charging or discharging the battery. In this way, an overcharge or deep discharge of the battery is prevented.

To prevent large current or power leaps at the state of charge limits, a transition area can be defined.

Depending on the resolution of the battery's state of charge that is transmitted, power leaps may occur. This can be avoided by estimating the state of charge. Instead of the battery's state of charge that is sent, a state of charge is then calculated based on the nominal battery capacity, the measured DC current, the transmitted state of charge and the set resolution.

Parameter	Explanation
Bsc.SOCLimEna	Activates the state of charge limit
Bsc.SOCLimMod	Operating mode of the state of charge limit • DC Amp derating: Limits the DC current (recommended setting) • AC power derating: Limits the active power
Bsc.SOCOpMax / AuxCtl.SOCOpMax	Maximum state of charge
Bsc.SOCOpMin / AuxCtl.SOCOpMin	Minimum state of charge
Bsc.SOCOpHys	Width of the transition area at the state of charge limits
Bsc.SOCestEna	Activates estimation of the state of charge
Bsc.SOCRes	Resolution of the state of charge

14.3.8 Zero power correction

Through the self-consumption of the inverter, at a power specification of 0 kW on the AC side, power will continue to be drawn from the battery. This leads to a small but possibly unwanted electric discharge of the battery. By offsetting the zero power correction, the power required for self-consumption is drawn from the AC utility grid. This avoids electric discharges and premature ageing of the battery. Where necessary, the offset of the zero power correction can be adjusted during commissioning.

Parameters	Description
Bsc.ZPO.ZeroPwrAtOfsEna	Activates the zero power correction
Bsc.ZPO.ZeroPwrAtOfs	Offset of the zero power correction

14.4 Grid Management Services

14.4.1 Start-Up Behavior

14.4.1.1 Start-Up in Normal Operation

It can be defined in the **WGraMod** and **VArGraMod** parameters whether the inverter gradually ramps up to the set active power and reactive power after a parameter change. This means that the inverter increases the power per second in steps according to the parameter settings.

Parameter	Description
WGra	The maximum feed-in power is increased by the configured amount per second.
VarGra	The configured reactive power is increased by the configured amount per second.

14.4.1.2 Start-Up after Grid Fault

In parameter **WGraReconMod**, you can define how the inverter is to begin with active power feed-in after a grid fault:

Parameter	Description
Disable	The inverter reverts to maximum power within one second.
Enable	The inverter restarts using a ramp of max. 10% of nominal power per minute. The gradient of this ramp is defined in parameter WGraRecon .

14.4.1.3 Switching the inverter after a protective device was triggered

In accordance with AR-N 4120, after a protective device has been triggered, the inverter is not allowed to switch to feed-in operation until it receives permission from the control gear for the PV farm. This ensures that the defined grid limits for voltage and frequency are maintained both at the control gear for the PV farm and at the point of interconnection to the grid.

The function is deactivated by default. To activate this function, the parameter **ExlConnEna** must be set to **Enable**.

As soon as the defined values for the grid limits are reached at the point of interconnection, the parameter **ExlConn** is set to the value **Enable** by the control gear for the PV farm via Modbus and transmitted to the inverter. This will enable the inverter to switch back to feed-in operation as soon as the defined grid limits are met at the inverter inputs. If the parameter **ExlConn** is set to **Disable** after this, the inverter continues to remain in the current operating state. The inverter waits again for the value **Enable** of the parameter **ExlConn** only if a protective device is triggered again.

14.4.2 Dynamic Grid Support (FRT)

14.4.2.1 Principle of Dynamic Grid Support

With dynamic grid support (Fault Ride Through – FRT), the inverter supports the utility grid during a brief grid-voltage dip (Low Voltage Ride Through – LVRT) or during a short period of overvoltage (High Voltage Ride Through – HVRT).

With full dynamic grid support, grid support is ensured by feeding in reactive current.

With limited dynamic grid support, the inverter interrupts grid feed-in during a grid instability without disconnecting from the utility grid.

In the event of dynamic grid support, the inverter uses the last calculated values for the active and reactive power. If this results in a decreasing voltage, it is no longer possible to feed in at rated power. The power setpoints are normalized to **VolNomSpt**.

Q on Demand and dynamic grid support

In the operating state "Q on Demand", limited dynamic grid support is available.

The inverter behavior can be set via the parameter **Frt.Mod**.

Parameter	Description
Disable	Dynamic grid support is deactivated.
Full	Complete dynamic grid support is activated.
Partial	Limited dynamic grid support is activated.
Active Current Constant	The inverter supplies reactive power without reducing the active current fed in and without exceeding the nominal current.

Parameter	Description
Momentary Cessation	The limited dynamic grid support is activated while the apparent current is reduced simultaneously.
Maximum Active Current	Unlike with full dynamic grid support, the inverter increases the active power to the maximum regardless of the pre-fault condition, without limiting the reactive current for full dynamic grid support.

The grid limits and deactivation delays vary depending on the country standard and can be set via parameters.

14.4.2.2 Complete Dynamic Grid Support

The inverter can support the utility grid during a brief grid-voltage dip by injecting reactive current.

If the grid voltage is outside a defined range for a certain time, the inverter feeds in reactive current both in case of undervoltage and in case of overvoltage.

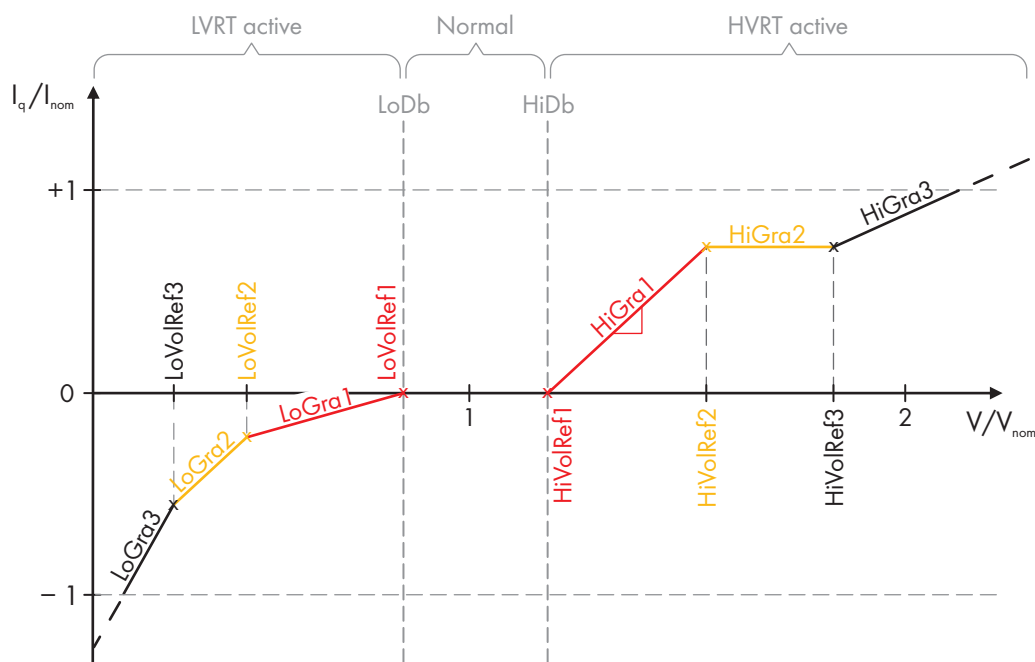


Figure 95: Characteristic curve of full dynamic grid support

Two ranges each with different gradients can be defined for undervoltage and overvoltage in the characteristic curve.

Parameter	Description
Frt.LoDb	Lower threshold for the voltage band in which dynamic grid support is not required
Frt.HiDb	Upper threshold for the voltage band in which dynamic grid support is not required
Frt.WaitTmLo	Minimum duration for which grid support is active once grid voltage has returned to the voltage band
Frt.WaitTmHi	Maximum duration for which grid support is active once grid voltage has returned to the voltage band
Frt.LoVolRef1	First reference value of undervoltage up to which the corresponding gradient is effective
Frt.LoVolRef2	Second reference value of undervoltage up to which the corresponding gradient is effective
Frt.LoVolRef3	Third reference value of undervoltage up to which the corresponding gradient is effective

Parameter	Description
Frt.LoGra1	First gradient of current change which is effective up to the corresponding reference value
Frt.LoGra2	Second gradient of current change which is effective up to the corresponding reference value
Frt.LoGra3	Third gradient of current change which is effective up to the corresponding reference value
Frt.HiVolRef1	First reference value of overvoltage from which the corresponding gradient is effective
Frt.HiVolRef2	Second reference value of overvoltage from which the corresponding gradient is effective
Frt.HiVolRef3	Third reference value of overvoltage from which the corresponding gradient is effective
Frt.HiGra1	First gradient of current change which is effective from the corresponding reference value
Frt.HiGra2	Second gradient of current change which is effective from the corresponding reference value
Frt.HiGra3	Third gradient of current change which is effective up to the corresponding reference value
Frt.AmpDGRA	Rate of current increase with which the active power feed-in continues after grid support ends.
Frt.VolFilMod	Definition of the reference value during grid support: The voltage refers to the nominal voltage. The voltage refers to a filtered value of the measured voltage.

If active current or reactive current has to be limited during grid support, please contact us.



Parameters in accordance with BDEW and SDLWindV

The characteristic curves can be individually adapted by the implementation of legal specification or requirements of the grid operator.

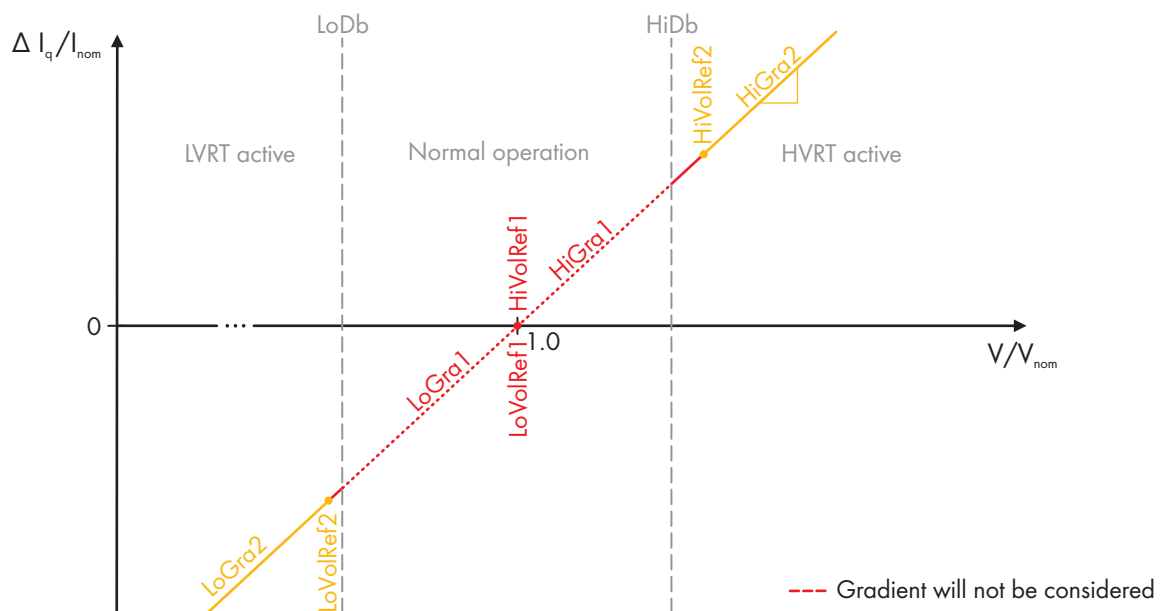


Figure 96: Characteristic curve of full dynamic grid monitoring according to BDEW

Parameters	Required value acc. to BDEW
Frt.Mod	Full
Frt.LoDb	0.9

Parameters	Required value acc. to BDEW
Fr.t.HiDb	1.1
Fr.t.LoVolRef1	1.0
Fr.t.LoGra1	2
Fr.t.LoVolRef2	0.9
Fr.t.LoGra2	2
Fr.t.HiVolRef1	1.0
Fr.t.HiGra1	2
Fr.t.HiVolRef2	1.1
Fr.t.HiGra2	2

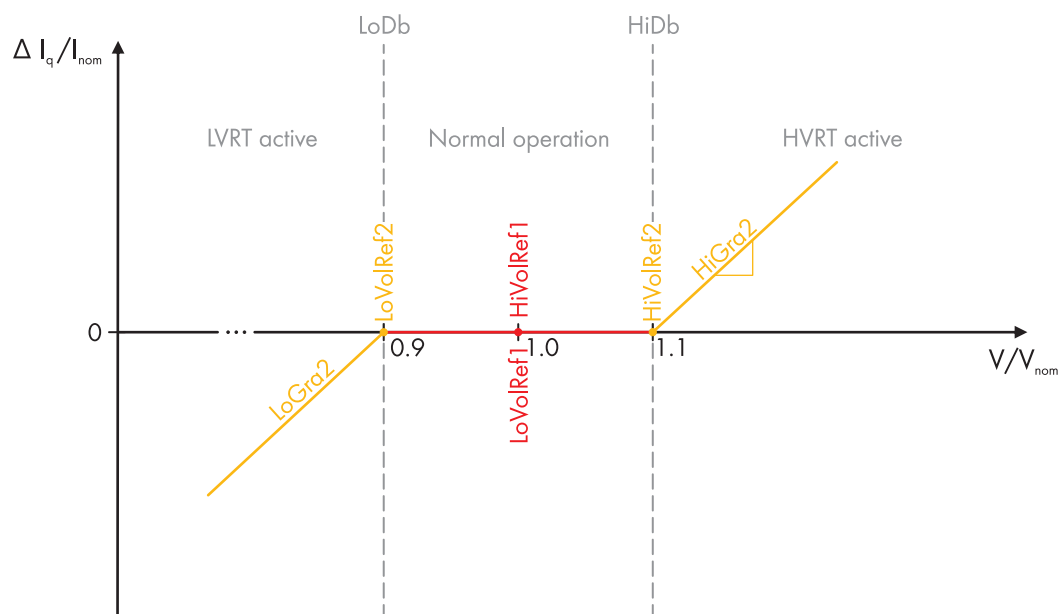


Figure 97: Characteristic curve of full dynamic grid monitoring acc. to SDLWindV

Parameters	Required value acc. to SDLWindV
Fr.t.Mod	Full
Fr.t.LoDb	0.9
Fr.t.HiDb	1.1
Fr.t.LoVolRef1	1.0
Fr.t.LoGra1	0
Fr.t.LoVolRef2	0.9
Fr.t.LoGra2	2
Fr.t.HiVolRef1	1.0
Fr.t.HiGra1	0

Parameters	Required value acc. to SDLWindV
Fr _t .HiVolRef2	1.1
Fr _t .HiGra2	2

14.4.2.3 Limited Dynamic Grid Support

With limited dynamic grid support, the inverter interrupts grid feed-in during grid instability for a configurable time without disconnecting from the utility grid. The duration for which the inverter interrupts feed-in can be set in the parameters **Fr_t.WaitTmLo** and **Fr_t.WaitTmHi**.

14.4.3 Active power control depending on grid frequency: procedure WCtlHzBat

With frequency-dependent active power control, the inverter continually checks the connected power frequency and changes the power in accordance with the frequency deviations. This function is activated via the parameter **WCtlHzBatMod**. Using the parameter **BatCtl.ComFlb.WCtlHzBatMod**, the function can be activated or deactivated separately in the event of a communication interruption. To control the behavior of the inverter in the event of power frequency deviations, a characteristic curve with eight support points is configurable. These support points can be adjusted on the user interface via the parameters **WCtlHzBat.Hzn** for the X axis, and via the parameters **WCtlHzBat.Wn** for the Y axis.

The frequency of the support point is entered as absolute value in Hz on the X axis.

The ratio of the power change in relation to the nominal power of the inverter must be entered on the Y axis in percent. The power change will be added to the current setpoint.

Parameter **HzNomSpt** can be used if the fixed point of the characteristic curve is to be adjusted during operation. This allows the entire characteristic curve to be moved on the X axis. This parameter can be configured in manual operation on the user interface in parameter **Bsc.HzNomSptMan**. In automatic operation, the parameter **HzNomSpt** can be configured via the Modbus interface. Keep in mind that the support points 5 to 8 must describe the behavior above the nominal frequency and the support points 1 to 4 the behavior below the nominal frequency. The X values must be set continuously rising and the Y values continuously falling.

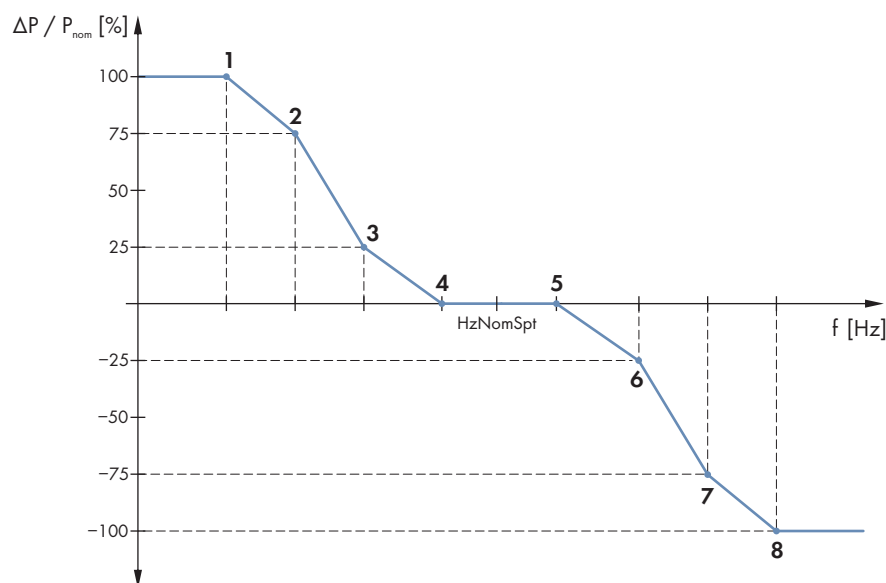


Figure 98: Active power control depending on grid frequency (example)

Example: Configuring the characteristic curve for overfrequency:

If the limits for the power reduction in the event of overfrequency are to be 50.2 Hz and 51 Hz, the support points 5 and 8 have to be set as follows:

Support point 5 - the point above which the power is to be reduced:

- x: 100.4% (equates to 50.2 Hz with the nominal frequency of 50 Hz)
- y: 0% (as yet no power change)

Support point 8 - the point at which the inverter must reduce the power by 100%:

- x: 102% (equates to 51 Hz with the nominal frequency of 50 Hz)
- y: -100% (power reduction)

Support points 6 and 7 can be used to make the characteristic curve steeper (see example diagram between support points 6 and 7) or flatter (see example diagram between support points 5 and 6 or 7 and 8).

Overview of the relevant parameters

Parameters	Description
WCtlHzBatMod	Activation of the active power control depending on grid frequency
WCtlHzBat.Hzn	Grid frequency at support point <i>n</i> for the frequency-dependent active power control
WCtlHzBat.Wn	Active power setpoint at support point <i>n</i> to be attained at the end of the given radio spectrum
HzNomSpt	The mid-point of the characteristic curve writable via Modbus interface, or readable on the user interface.
Bsc.HzNomSptMan	Mid-point of the characteristic curve in manual operation
BatCtl.ComFlb.WCtlHzBatMod	Activation of the function in case of a communication failure

14.4.4 Reactive Power Control as a Function of Grid Voltage: VArCtlVol Mode

The reactive power is controlled as a function of the grid voltage. By supplying reactive power, the inverter performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve. The characteristic curve can be flexibly configured by parameterizing the slope and a type of deadband through two voltage points.

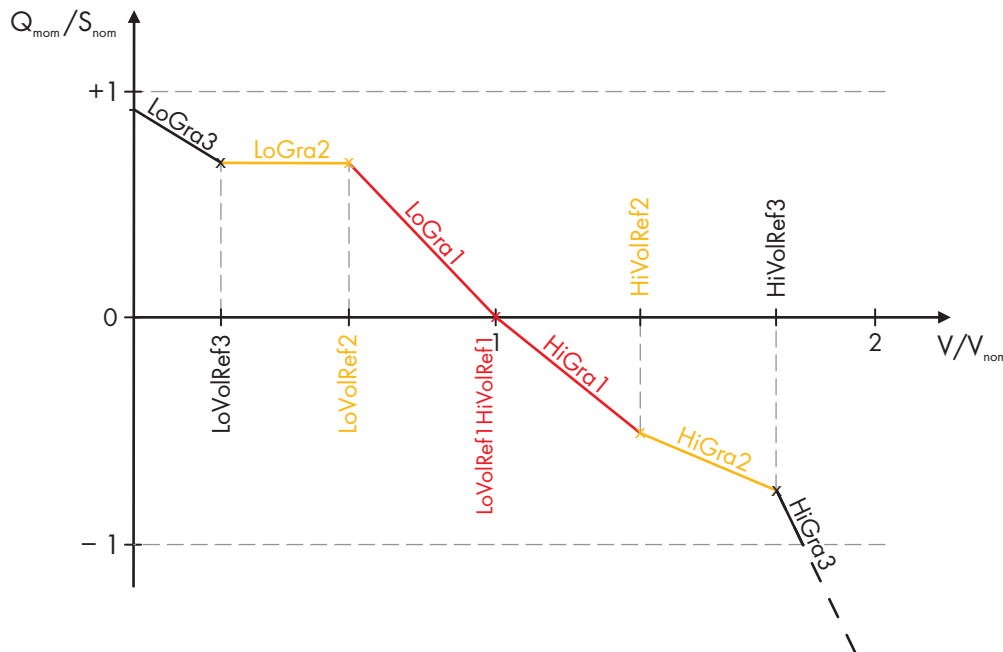


Figure 99: Characteristic curve of the voltage-dependent reactive power control

A quotient is derived from the ratio of grid voltage to nominal voltage.

When the grid voltage is equal to the defined nominal voltage, the reactive power feed-in is zero. If the grid voltage changes and exceeds or falls short of a defined threshold, the inverter reacts according to the voltage/reactive power characteristic curve by adjusting its reactive power feed-in. For each voltage quotient three thresholds can be configured, and the gradients of the reactive power adjustment for decreasing or increasing grid voltage can be defined individually for each threshold.

Overview of the relevant parameters

Parameter	Description
VArCtlVol.LoVolRef1 HiVolRef1	Voltage quotient at which reactive power feed-in is zero
VArCtlVol.HiVolRef2/HiVolRef3	Threshold of the voltage quotient at increased grid voltage
VArCtlVol.HiGra1/HiGra2/HiGra3	Gradient of reactive power adjustment of the given voltage band at increased grid voltage
VArCtlVol.LoVolRef2/LoVolRef3	Threshold of the voltage quotient at reduced grid voltage
VArCtlVol.LoGra1/LoGra2/LoGra3	Gradient of reactive power adjustment of the given voltage band at increased grid voltage

Parameter	Description
VArCtlVol.VArSptFilTm	Filter constant by which the measured values of the grid voltage are filtered This enables more stable control.
Bsc.VolNomSptMan	Voltage setpoint at 0 $Q_{\text{Mom}}/S_{\text{Nenn}}$ The replacement value in the event of faulty communication can be defined in the parameter BatCtl.ComFlb.VolNomSpt .

14.5 Communication

14.5.1 Communication Network in Cluster Ring with One Managed Switch

To set up a redundant network with several devices, a managed switch must be present in the inverter.

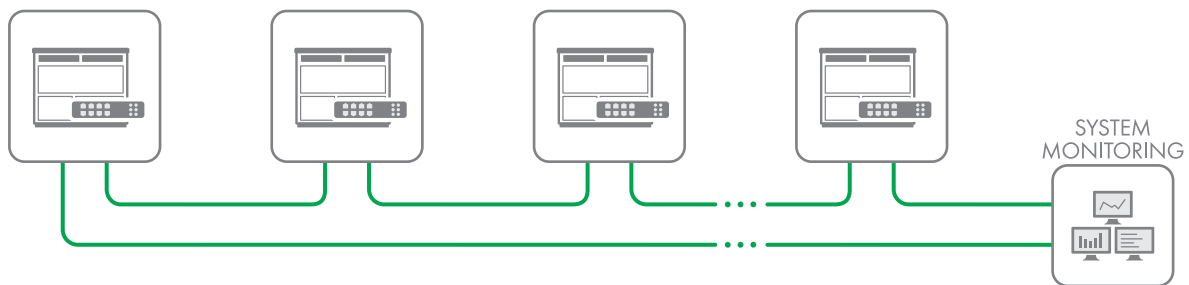


Figure 100: Inverter in cluster ring

The managed switch provides the option to set up a network with optical fibers via LAN 2 and to connect a customer communication system to the terminal **LAN 2 Port 4**. A connection of two ports of the managed switch to a splice box has been factory-set internally to which two optical fibers can be connected for the communication system A.

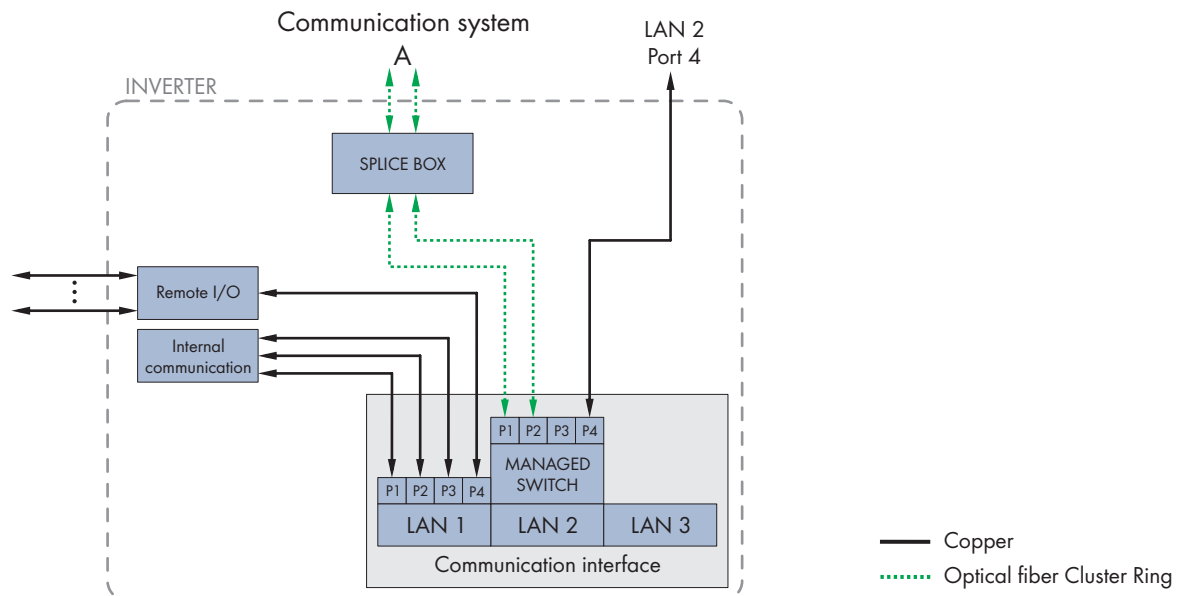


Figure 101: Inverter with one managed switch

In order to guarantee the implementation of control commands, the network that manages the control should be kept free from applications with a high network load, e.g. webcams. Using a separate network is recommended to implement data-heavy applications.

For a stable transmission of Modbus protocols, the frequency of the Modbus requests may not exceed 1/100 ms.

14.5.2 Communication Network in Backbone Ring with Two Managed Switches

To ensure a safe and fast system network, it is recommended to set up the system network with a ring coupling. Several cluster rings are coupled to a backbone ring.

In the cluster ring, ports 1 and 2 must be connected in each case. One of the managed switches in the cluster ring must be set up as the ring manager which controls the direction of the data flow. We recommend that the managed switch at the coupling point assumes this task.

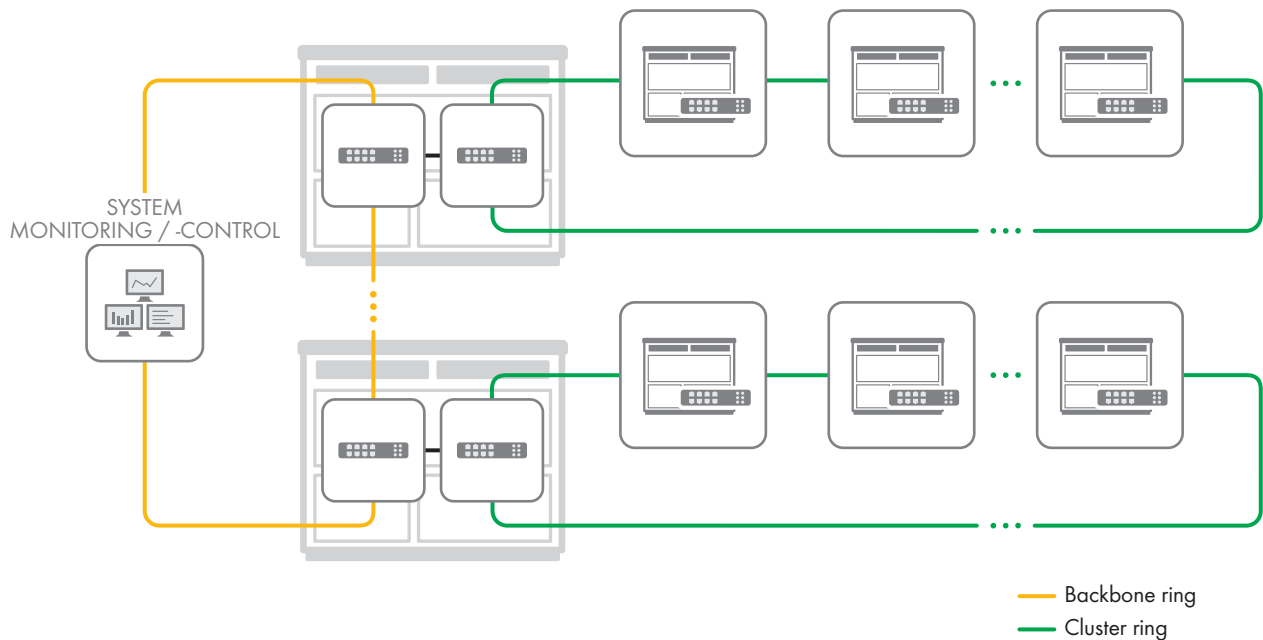


Figure 102: Communication network with backbone ring and cluster ring

The inverters at the coupling points must each contain two managed switches: one switch for the cluster ring in communication network A and one switch for the backbone ring in communication network B. These two managed switches have been connected internally ex works with a splice box to which two optical fibers can be connected for each communication network. In addition, a customer communication system can be connected to terminal **LAN 2 Port 4** of the managed switch of the cluster ring.

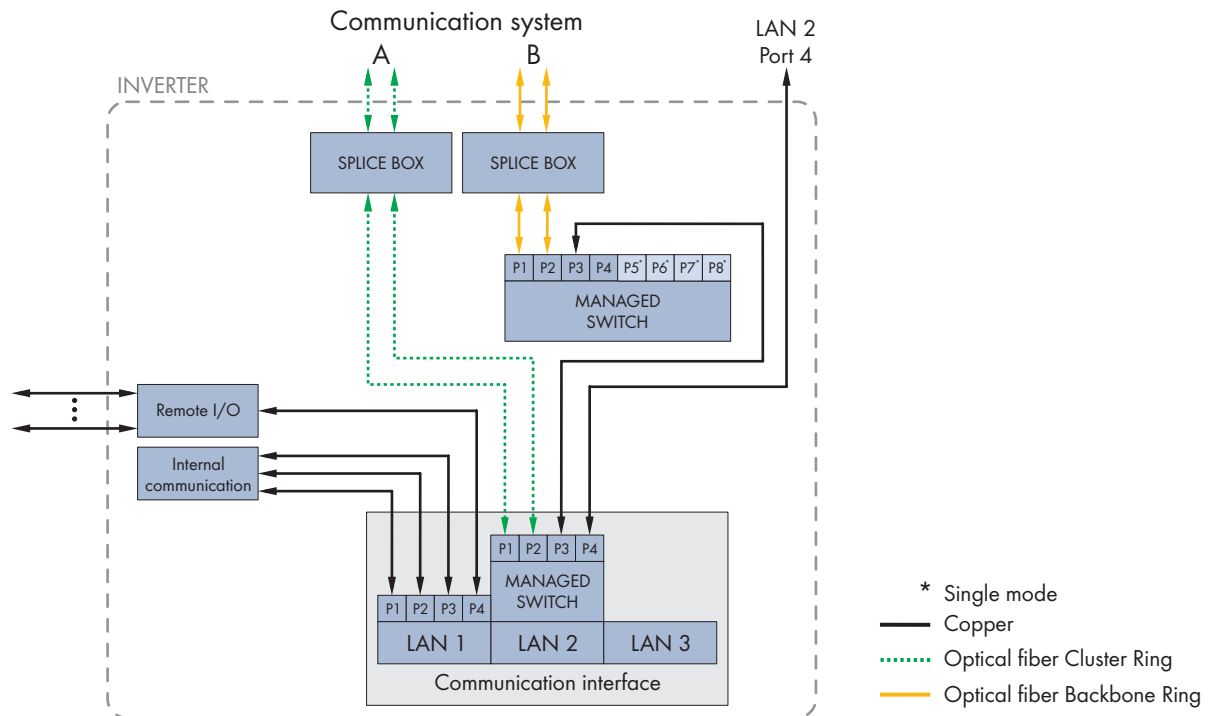


Figure 103: Inverter with two managed switches

In order to guarantee the implementation of control commands, the network that manages the control should be kept free from applications with a high network load, e.g. webcams. Using a separate network is recommended to implement data-heavy applications.

For a stable transmission of Modbus protocols, the frequency of the Modbus requests may not exceed 10 Hz.

Each managed switch must have its own IP address.

Depending on the order option, the managed switch is equipped with a different number of RJ45 terminals.

Features of the managed switch MMF backbone:

- 2 x RJ45 (ports 3 and 4)
- 2 x FO multimode (ports 1 and 2)

Features of the managed switch SMF backbone:

- 6 x RJ45 (ports 3 to 8)
- 2 x FOB single-mode (ports 1 and 2)

14.5.3 Communication Network in the Customer Communication System

If the inverter does not contain a managed switch, the inverter can be integrated in the system with single feeders.

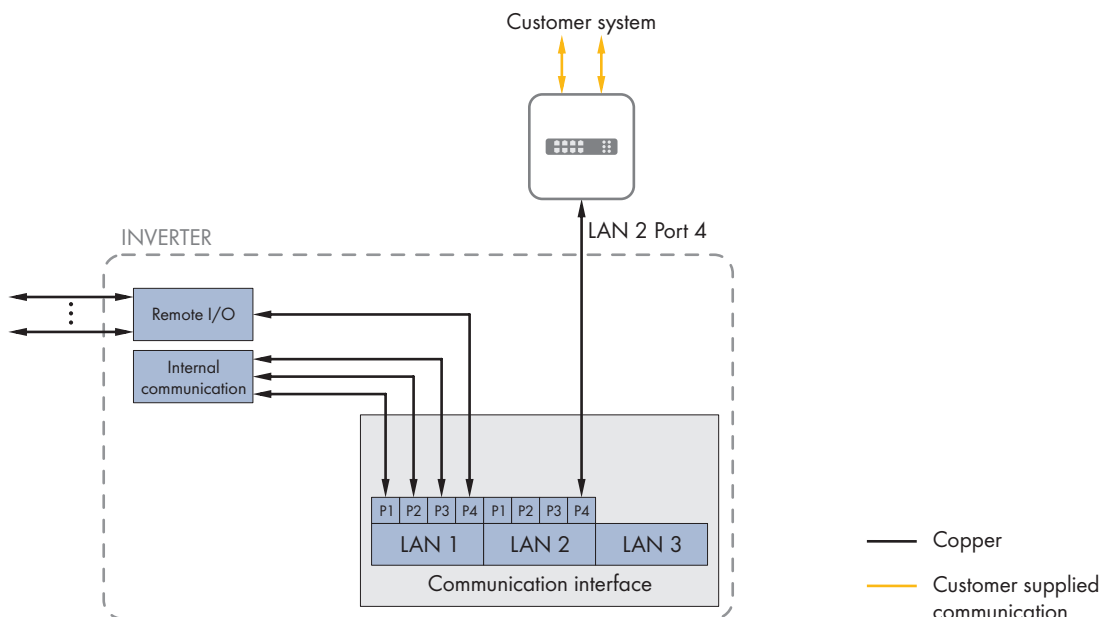


Figure 104: Inverter without managed switch

If the inverter without managed switch is to be integrated in a customer communication system, a switch can be installed in the customer installation location.

In order to guarantee the implementation of control commands, the network that manages the control should be kept free from applications with a high network load, e.g. webcams. Using a separate network is recommended to implement data-heavy applications.

For a stable transmission of Modbus protocols, the frequency of the Modbus requests may not exceed 1/100 ms.

14.6 Additional Features

14.6.1 Black start

A black start is the process of ramping up a power plant without existing power grid and restoring power supply. This is of particular relevance during a total blackout or in case of stand-alone grids.

Normally, power grids provide the required reference voltage to start a power plant. This is not possible during a power outage. To autonomously restore a power grid, at least one inverter of the power plant must be able to provide a black start. The inverter must include the options "External auxiliary power supply" and "Grid-forming inverter with DC pre-charge" to be able to do this. In addition, the external auxiliary power supply must be guaranteed during grid failure (e.g. using an uninterruptible power source for power supply).

For a black start, the battery must be switched on and the minimum DC voltage of the inverter provided. When starting the inverter in the operating mode "GridForming", the DC link of the DC voltage is pre-charged using the pre-charge unit. After closing the DC load-break switch, the inverter checks whether a voltage is already applied to the AC terminals. If no AC voltage is applied, the AC disconnection unit is closed and the configured AC voltage setpoint is ramped up. The AC voltage setpoint is usually specified via an external plant control using a Modbus protocol.

If an AC voltage is already applied to the inverter terminals, inverters with the option "External auxiliary power supply" can synchronize with the plant power supply, close the AC disconnection unit and support the power grid. The start voltage must be at least 20% of the nominal AC voltage.

For systems with more than one inverter, a superordinate plant control is required (e.g. SMA Power Plant Manager).

15 Instantaneous Values and Parameters

15.1 Instantaneous Values

No.	Name	Value/range
320	WSpt	-5000 kW to +5000 kW
321	VArSpt	-5000 kVAr to +5000 kVAr
322	PFSpt	-1.0000 to +1.0000
327	Rio.KeySw	On Off
328	ErrStt	Ok Error
332	OpStt	Unknown Bootloader Defect Init Stop Error Update Reset WaitAC ConnectAC WaitDC ConnectDC GridFeed FRT Standby QonDemand RampDown ShutDown Selftest Ctl Vloop IOTest DCSource CtlExt ChkGri Cwg CwgMpp RLC GridForm AcRampUp BatOnly
401	InvMs.TotVA	–
402	InvMs.TotW	–
403	InvMs.TotVAr	–
404	InvMs.PF	–
405	GriMs.V.PhsAB	–
406	GriMs.V.PhsBC	–
407	GriMs.V.PhsCA	–
408	InvMs.TotA.PhsA	–
409	InvMs.TotA.PhsB	–
410	InvMs.TotA.PhsC	–
506	TrfPro.TmpTrp	Ok Error
6382	Rio.Din.FloatCtl.Warn	True False
6383	Rio.Din.FloatCtl.Err	True False
7029	TrfPro.Pres	Ok Error
7170	TrfPro.GasOilLev	Ok Error
665	VAMaxSpt	–
666	AMaxSpt	–
673	DrtIgbtTmp	Off On
674	DrtCabTmp	Off On

No.	Name	Value/range
690	DrtExlStt	No VAMax Derating Derating VAMax MVPS Communication Derating VAMax External Temperature Derating VAMax Transformer Temperature
675	FanCtl.Stt	FanAll Min TmpCtl FanCoupling TmpCtl Cab and FanStk Min TmpCtl Igbt and FanCab Max TmpCtl Cab and FanStk Max FanAll Max TmpWrn Choke Heater Ctl -40degC Heater Ctl DeHyd Heater Ctl All Fan Test DifPres Test TmpCtl Cab Off TmpCtl Igbt Off TmpCtl All Off Heater Ctl All and TmpCtl Off TmpCtl Choke
597	DcMs.Vol	–
598	DcMs.Vol.PosGnd	–
599	DcMs.Vol.NegGnd	–
600	DcMs.Amp.Stk1	–
601	DcMs.Amp.Stk2	–
602	DcMs.Amp.Stk3	–
603	DcMs.TotWatt	–
604	DcMs.Watt.Stk1	–
605	DcMs.Watt.Stk2	–
606	DcMs.Watt.Stk3	–
607	GriMs.Hz	–
608	GriMs.RotDir	clockwise anticlockwise
609	GriMs.PllOpStt	Off Search Locked
611	DcSw1Stt	Open Closed
614	WaitGriTm	–
615	WaitGriRsReas	–
616	InvMs.DclVol.Stk1	–
617	InvMs.DclVol.Stk2	–
618	InvMs.DclVol.Stk3	–
721	DcSw2Stt	Open Closed
722	DcSw3Stt	Open Closed
750	TmpCab.Dcc	–
751	TmpCab.Acc	–
752	TmpCab.Rio	–
753	TmpStk1.Pcb	–

No.	Name	Value/range
754	TmpStk2.Pcb	–
755	TmpStk3.Pcb	–
756	TmpStk1.Igbt	–
757	TmpStk2.Igbt	–
758	TmpStk3.Igbt	–
759	TmpExl	–
823	ErrNo	–
830	DrtStt	Stk.DcAmpLim Frt AmpGra AMax VAMax WCtlLoHz WCtlHz WGraRecon WGra WMax WMaxExt VecLen Bat.DcAmp Bat.DcVol WGraStr WCtlHzBat WCtlVol Mvps.WRvLim VArPrio WSptMax WSptMin
6203	Eps.Stt	INIT IDLE SKIP_FRT EPS WAIT_STOP WAIT_RESET
6084	FanStk.Pct	–
6085	FanCab.Pct1	–
6086	FanCab.Pct2	–
6099	TmpStk.PcbMax	–
6100	TmpStk.IgbtMax	–
6107	TmpTrf	–
6131	TmpChoke.Sns	–
6146	DcMs.TotAmp	–
6202	AcSwStt	Open Closed
6365	GriMs.NspOpStt	Off Search Locked
6425	InvMs.A.Stk1.PhsA	–
6427	InvMs.A.Stk1.PhsB	–
6429	InvMs.A.Stk1.PhsC	–
6431	InvMs.A.Stk2.PhsA	–
6433	InvMs.A.Stk2.PhsB	–
6435	InvMs.A.Stk2.PhsC	–
6437	InvMs.A.Stk3.PhsA	–
6439	InvMs.A.Stk3.PhsB	–
6441	InvMs.A.Stk3.PhsC	–
6610	DevInf.ChkSum.AccFpga	–

No.	Name	Value/range
6611	DevInf.ChkSum.DccCpu	–
6613	DevInf.ChkSum.ContCpu2	–
6614	DevInf.ChkSum.DstFpga2	–
6644	PvGnd.RisIso	–
6706	GfdiSwStt	Open Closed
6707	PreChaSwStt	Open Closed
6708	CapacSwStt	Open Closed
6718	InvMs.V.PhsAB	–
6719	InvMs.V.PhsBC	–
6720	InvMs.V.PhsCA	–
6763	DevInf.SerNo	–
6764	InvMs.Eff	–
7118	Cnt.TotAcWhOut	–
6767	Cnt.AcWhOut	–
7119	Cnt.TotDcWhIn	–
6771	Cnt.DcWhIn	–
7120	Cnt.TotVArhOvExt	–
7121	Cnt.TotVArhUnExt	–
6777	Cnt.TotOpTm	–
6779	Cnt.TotFeedTm	–
6791	Cnt.FanStkTm	–
6793	Cnt.FanCab1Tm	–
6795	Cnt.FanCab2Tm	–
6797	Cnt.HtCabTm	–
6799	Cnt.HtLoExlTmpTm	–
6801	Cnt.AcSw	–
6803	Cnt.DcSw1	–
6805	Cnt.DcSw2	–
6807	Cnt.DcSw3	–
6809	Cnt.PreChaSw	–
6811	Cnt.CapacSw	–

No.	Name	Value/range
6813	Cnt.GfdiTr	–
6815	Cnt.GfdiSw	–
6819	TmpStk.IgbtSpt	–
6864	InvMs.TotEff	–
6968	ErrLcn	–
7000	VolNomSpt	0.0000 pu to 1.1500 pu
7073	Cnt.YstdAcWhOut	–
7081	Cnt.DrtTmExl	–
7083	Cnt.DrtTmInvCfg	–
7114	ErrRmgTm	–
7182	Cnt.TotAcWhIn	–
7180	Cnt.AcWhIn	–
7218	Eps.RmgTm	–
7221	PwrOffReas	No Power Off Reason Error: Critical Error, ProErr active Error Init: Wait Buffer Voltage Stop: Key Switch Stop: Parameter In-vOpmo Stop: Stop External X440:3 Stop: Scada or PPC, Modbus Stop: unspecified Stop: Battery System Controller Standby: Scada or PPC, Modbus Standby: AC Synchronisation Standby: Low DC Power Standby: External Grid Error Standby: Power Monitoring Module Standby: Parameter RemRdy Standby: Standby External X440:7 Standby: unspecified Reserve 19 WaitAc WaitDc: DC Voltage WaitDc: Bender WaitDc: DC precharge waiting period Selftest active IO Test active Reserve 26 Low Power Set Point Battery
7233	GriMs.Vol.PsNom	–
7242	DcMs.Vol.Max	0.0 V to 2000.0 V
7249	PresTrf	–
7253	PresTrf.ErrStt	Ok Error
7276	DcAmpSpt	-10000 A to +10000 A
7277	HzNomSpt	40.000 Hz to 70.000 Hz
7359	InvTyp	PV Battery PV and Battery
7304	BatCtl.ComFlb.FlbStt	Ok Battery Communication Timeout Auxiliary Control Communication Timeout Battery and Auxiliary Communication Timeout Battery Control Communication Timeout Error
7300	Cnt.TotDcWhOut	–
7302	Cnt.DcWhOut	–

No.	Name	Value/range
7343	Bat.ErrBits	–
7345	Bat.WarnBits	–
7346	Bat.InfBits	–
7488	DclVolSpt	0 V to 2000 V
7569	Mvps.ChkComStt	No test Test okay Test not okay
7571	Cnt.FanMvpsTm	–
7168	TrfPro.TmpWrn	Ok Error
7616	CapPreChaSwStt	Open Closed
7632	WAval	–
7633	VArAval	–
7675	InvMs.DclVol	–
7716	DiagRmgTm	–
7719	DcPreChaSwStt	Open Closed
7769	DevInf.ChkSum.GfdiCpu	–
7986	Gfdi.AmpPrc	–
7988	Gfdi.AmpErr	–
8045	ActErrNo1	–
8046	ActErrTxt1	–
8047	ActErrLcn1	–
8048	ActErrNo2	–
8049	ActErrTxt2	–
8050	ActErrLcn2	–
8051	ActErrNo3	–
8052	ActErrTxt3	–
8053	ActErrLcn3	–
8054	ActErrNo4	–
8055	ActErrTxt4	–
8056	ActErrLcn4	–
8057	ActErrNo5	–
8058	ActErrTxt5	–
8059	ActErrLcn5	–

No.	Name	Value/range
8060	ActErrNo6	–
8061	ActErrTxt6	–
8062	ActErrLcn6	–
8063	ActErrNo7	–
8064	ActErrTxt7	–
8065	ActErrLcn7	–
8066	ActErrNo8	–
8067	ActErrTxt8	–
8068	ActErrLcn8	–
8069	ActErrNo9	–
8070	ActErrTxt9	–
8071	ActErrLcn9	–
8072	ActErrNo10	–
8073	ActErrTxt10	–
8074	ActErrLcn10	–
8077	TmpStk.Chip	–
8078	TmpStk.Diode	–
8079	TmpStk.TmpAct	–
8140	Cnt.DcSwOvAmp1	–
8142	Cnt.DcSwOvAmp2	–
8144	Cnt.DcSwOvAmp3	–
8253	WSptMin	-5000 kW to +5000 kW
8271	VArExlSpt.RefVal	–
8272	WExlSpt.RefVal	–
8537	WSptMax	-5000 kW to +5000 kW
8570	WGraspt	–
8574	VArGraspt	–
8601	Cnt.ChopStd	–
8603	Cnt.ChopCrt	–
8969	GriForm.OvAmpStt	Disabled None Normal Short
8970	GriForm.OvAmp.AmpMaxFrtAval	–

No.	Name	Value/range
8971	GriForm.OvAmp.AmpMaxAval	–
8972	Cnt.GriForm.OvAmp	–
8974	Cnt.GriForm.OvAmpSec1	–
8976	Cnt.GriForm.OvAmpSec2	–
8978	Cnt.GriForm.OvAmpSec3	–
8993	GriMng.ExtFlbStt	Ok Timeout, inactive Timeout, 1 hour Timeout, 30 seconds Fallback and error

15.2 Parameters

No.	Name	Value/range	Default value
306	GriCod	DE BDEW US IEEE1547 US ERCOT US HECO US NERC US WECC US IESO CAISO US PGE CAISO 50Hz 60Hz FR GR IN TH IL US PRC024 W US PRC024 E US PRC024 ERCOT US MA NE ISO CL US Rule 21 IT CEI 0-16 AE JP 50Hz JP 60Hz IL-HV ES Off-Grid 50Hz Off-Grid 60Hz KR AU VDE-AR-N 4110 VDE-AR-N 4120 VDE-AR-N 4110 SCS VDE-AR-N 4120 SCS US IEEE1547:2018 US IEEE1547:2018 SCS US IEEE1547:2018 + NERC US IEEE1547:2018 + NERC SCS ES TED749 GB G99 PT Portaria 73 Custom	–
310	HzRtg	40.00 Hz to 70.00 Hz	country-specific
709	Aid.Mod	Enable Disable	country-specific
318	WRtg	1 kW to 5000 kW	device-specific
319	VARtg	1 kVAr to 5000 kVAr	device-specific
323	VARtg	1 kVA to 5000 kVA	device-specific
730	VADrtPriMod	VAr W	VAr
329	InvOpMod	Stop Operation	Stop
331	RemRdy	Enabled Disabled	Enabled
361	WCtlHzMod	Enable Disable	country-specific
362	WCtlHz.DrgIndMod	Enable Disable	country-specific
363	WCtlHz.RefMod	W WNom VANom	W
364	WCtlHz.Hz1	0.000 Hz to 70.000 Hz	country-specific

No.	Name	Value/range	Default value
365	WCtlHz.Hz2	0.000 Hz to 70.000 Hz	country-specific
366	WCtlHz.Hz3	0.000 Hz to 70.000 Hz	65.000 Hz
708	WCtlHz.Hz4	0.000 Hz to 70.000 Hz	65.000 Hz
367	WCtlHz.HzGra1	0.0000 pu/Hz to 10.0000 pu/Hz	country-specific
368	WCtlHz.HzGra2	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
369	WCtlHz.HzGra3	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
370	WCtlHz.HzStopMin	0.000 Hz to 70.000 Hz	0.000 Hz
371	WCtlHz.HzStopMax	0.000 Hz to 70.000 Hz	country-specific
372	WCtlHz.HzStopTm	0 ms to 1000000 ms	0 ms
373	WCtlHz.WGraPosEna	0 to 1	0
374	WCtlHz.WGraNegEna	0 to 1	0
375	WCtlHz.WGraPos	0.0000000 pu/s to 10.0000000 pu/s	country-specific
376	WCtlHz.WGraNeg	0.0000000 pu/s to 10.0000000 pu/s	country-specific
377	WCtlHz.HzQtllntv	0.000 Hz to 0.100 Hz	0.000 Hz
398	WGraReconMod	Enable Disable	country-specific
399	WGraRecon	0.000000 pu/s to 1.000000 pu/s	country-specific
424	Frt.LoDb	0.00 pu to 1.00 pu	country-specific
425	Frt.HiDb	1.00 pu to 1.50 pu	country-specific
426	Frt.WaitTmHi	0.02 s to 20.00 s	country-specific
427	Frt.LoVolRef1	0.00 pu to 1.00 pu	1.00 pu
428	Frt.LoVolRef2	0.00 pu to 1.00 pu	country-specific
429	Frt.LoVolRef3	0.00 pu to 1.00 pu	0.00 pu
430	Frt.LoGra1	0.00 to 10.00	country-specific
431	Frt.LoGra2	0.00 to 10.00	2.00
432	Frt.LoGra3	0.00 to 10.00	0.00
433	Frt.HiVolRef1	1.00 pu to 2.00 pu	1.00 pu
434	Frt.HiVolRef2	1.00 pu to 2.00 pu	country-specific
435	Frt.HiVolRef3	1.00 pu to 2.00 pu	country-specific
436	Frt.HiGra1	0.00 to 10.00	country-specific
437	Frt.HiGra2	0.00 to 10.00	country-specific
438	Frt.HiGra3	0.00 to 10.00	country-specific

No.	Name	Value/range	Default value
439	FrI.VoIDFilTm	0.0 s to 600.0 s	country-specific
440	FrI.AmpQFilTm	0.0 s to 600.0 s	country-specific
441	FrI.AmpDGrA	0.00 pu/s to 100.00 pu/s	country-specific
444	VCtl.OpMaxNom	0.000 pu to 2.000 pu	country-specific
445	VCtl.OpMinNom	0.000 pu to 2.000 pu	country-specific
446	VCtl.Hi1Lim	0.00 pu to 2.00 pu	country-specific
447	VCtl.Hi2Lim	0.00 pu to 2.00 pu	country-specific
448	VCtl.Hi3Lim	0.00 pu to 2.00 pu	country-specific
449	VCtl.Hi4Lim	0.00 pu to 2.00 pu	country-specific
450	VCtl.Hi5Lim	0.00 pu to 2.00 pu	country-specific
451	VCtl.Hi1LimTm	0 ms to 1000000 ms	country-specific
452	VCtl.Hi2LimTm	0 ms to 1000000 ms	country-specific
453	VCtl.Hi3LimTm	0 ms to 1000000 ms	country-specific
454	VCtl.Hi4LimTm	0 ms to 1000000 ms	country-specific
455	VCtl.Hi5LimTm	0 ms to 1000000 ms	country-specific
456	VCtl.Lo1Lim	0.00 pu to 2.00 pu	country-specific
457	VCtl.Lo2Lim	0.00 pu to 2.00 pu	country-specific
458	VCtl.Lo3Lim	0.00 pu to 2.00 pu	country-specific
459	VCtl.Lo4Lim	0.00 pu to 2.00 pu	country-specific
460	VCtl.Lo5Lim	0.00 pu to 2.00 pu	country-specific
461	VCtl.Lo1LimTm	0 ms to 1000000 ms	country-specific
462	VCtl.Lo2LimTm	0 ms to 1000000 ms	country-specific
463	VCtl.Lo3LimTm	0 ms to 1000000 ms	country-specific
464	VCtl.Lo4LimTm	0 ms to 1000000 ms	country-specific
465	VCtl.Lo5LimTm	0 ms to 1000000 ms	10000 ms
466	HzCtl.OpMaxNom	40.00 Hz to 70.00 Hz	country-specific
467	HzCtl.OpMinNom	40.00 Hz to 70.00 Hz	country-specific
468	HzCtl.Hi1Lim	40.00 Hz to 70.00 Hz	country-specific
469	HzCtl.Hi2Lim	40.00 Hz to 70.00 Hz	country-specific
470	HzCtl.Hi3Lim	40.00 Hz to 70.00 Hz	country-specific
471	HzCtl.Hi4Lim	40.00 Hz to 70.00 Hz	country-specific

No.	Name	Value/range	Default value
472	HzCtl.Hi5Lim	40.00 Hz to 70.00 Hz	country-specific
473	HzCtl.Hi6Lim	40.00 Hz to 70.00 Hz	country-specific
474	HzCtl.Hi1LimTm	0 ms to 1000000 ms	country-specific
475	HzCtl.Hi2LimTm	0 ms to 1000000 ms	country-specific
476	HzCtl.Hi3LimTm	0 ms to 1000000 ms	country-specific
477	HzCtl.Hi4LimTm	0 ms to 1000000 ms	country-specific
478	HzCtl.Hi5LimTm	0 ms to 1000000 ms	10000 ms
479	HzCtl.Hi6LimTm	0 ms to 1000000 ms	10000 ms
480	HzCtl.Lo1Lim	40.00 Hz to 70.00 Hz	country-specific
481	HzCtl.Lo2Lim	40.00 Hz to 70.00 Hz	country-specific
574	HzCtl.Lo3Lim	40.00 Hz to 70.00 Hz	country-specific
483	HzCtl.Lo4Lim	40.00 Hz to 70.00 Hz	country-specific
484	HzCtl.Lo5Lim	40.00 Hz to 70.00 Hz	country-specific
485	HzCtl.Lo6Lim	40.00 Hz to 70.00 Hz	country-specific
486	HzCtl.Lo1LimTm	0 ms to 10000000 ms	country-specific
487	HzCtl.Lo2LimTm	0 ms to 10000000 ms	country-specific
488	HzCtl.Lo3LimTm	0 ms to 10000000 ms	country-specific
489	HzCtl.Lo4LimTm	0 ms to 10000000 ms	country-specific
490	HzCtl.Lo5LimTm	0 ms to 10000000 ms	country-specific
491	HzCtl.Lo6LimTm	0 ms to 10000000 ms	10000 ms
492	VCtl.PkLim	0.00 pu to 2.00 pu	1.30 pu
493	VCtl.PkLimTm	0 to 1000	6
494	VCtl.Hyst	-0.100 pu to +0.100 pu	0.002 pu
495	HzCtl.DifMax	0.000 Hz/s to 50.000 Hz/s	50.000 Hz/s
496	HzCtl.DifMaxTm	0 ms to 1000000 ms	10000 ms
497	GriErrTm	0 s to 3600 s	country-specific
733	ErrClr	Ackn	—
718	Frt.Mod	Disable Full Partial Active Current Constant Momentary Cessation Maximum Active Current	country-specific
725	WGraMod	Enable Disable	Enable
726	WGra	0.000000 pu/s to 100.000000 pu/s	0.200000 pu/s

No.	Name	Value/range	Default value
727	VArGraMod	Enable Disable	Enable
728	VArGra	0.000 pu/s to 100.000 pu/s	0.100 pu/s
6029	PFCtlW.WRef1	-1.00 pu to +1.00 pu	0.00 pu
6030	PFCtlW.WRef2	-1.00 pu to +1.00 pu	1.00 pu
6031	PFCtlW.WRef3	-1.00 pu to +1.00 pu	1.00 pu
6032	PFCtlW.WRef4	-1.00 pu to +1.00 pu	1.00 pu
6033	PFCtlW.WRef5	-1.00 pu to +1.00 pu	1.00 pu
6034	PFCtlW.PFRef1	-1.00 to +1.00	-0.90
6035	PFCtlW.PFRef2	-1.00 to +1.00	0.90
6036	PFCtlW.PFRef3	-1.00 to +1.00	1.00
6037	PFCtlW.PFRef4	-1.00 to +1.00	1.00
6038	PFCtlW.PFRef5	-1.00 to +1.00	1.00
6040	PFCtlW.VolMod	0 to 1	0
6041	PFCtlW.VolDsaPF	-1.00 pu to +1.00 pu	1.00 pu
6042	PFCtlW.VolEnaVol	0.000 pu to 2.000 pu	1.050 pu
6043	PFCtlW.VolDsaVol	0.000 pu to 2.000 pu	1.000 pu
6044	PFCtlW.VolEnaTm	0 ms to 1000000 ms	1000 ms
6045	PFCtlW.VolDsaTm	0 ms to 1000000 ms	1000 ms
6047	VArCtlVol.VolOfs	-10.0000 pu to +10.0000 pu	0.0000 pu
6048	VArCtlVol.LoVolRef1 HiVolRef1	0.000 pu to 2.000 pu	1.000 pu
6050	VArCtlVol.LoVolRef2	0.000 pu to 2.000 pu	0.945 pu
6051	VArCtlVol.LoVolRef3	0.000 pu to 2.000 pu	0.000 pu
6052	VArCtlVol.HiVolRef2	0.000 pu to 2.000 pu	1.055 pu
6053	VArCtlVol.HiVolRef3	0.000 pu to 2.000 pu	2.000 pu
6054	VArCtlVol.LoGra1	0.00 pu to 100.00 pu	0.00 pu
6055	VArCtlVol.HiGra1	0.00 pu to 100.00 pu	0.00 pu
6056	VArCtlVol.LoGra2	0.00 pu to 100.00 pu	15.00 pu
6057	VArCtlVol.HiGra2	0.00 pu to 100.00 pu	15.00 pu
6058	VArCtlVol.LoGra3	0.00 pu to 100.00 pu	0.00 pu
6059	VArCtlVol.HiGra3	0.00 pu to 100.00 pu	0.00 pu
6060	VArCtlVol.VArSptFilTm	0.000 s to 1000.000 s	0.500 s

No.	Name	Value/range	Default value
6061	VArCtlVol.WMod	0 to 1	0
6062	VArCtlVol.WEnaW	0.00 pu to 1.00 pu	0.50 pu
6063	VArCtlVol.WDsaW	0.00 pu to 1.00 pu	0.50 pu
6064	VArCtlVol.WEnaTm	0 ms to 1000000 ms	1000 ms
6065	VArCtlVol.WDsaTm	0 ms to 1000000 ms	1000 ms
6073	GriMng.ComFltFlbTmLim	0 s to 86400 s	3600 s
6071	GriMng.ComFltFlbWMod	Error Standby WSptFlb Last setpoint	Error
6080	GriMng.VArMod	VArCtlAnIn PFctlAnIn VArCtlCom PFctlCom AutoCom VArCtlMan PFctlMan Off	VArCtlMan
6088	GriMng.InvVArMod	Off VArCtlVol VArCtlVolPi PFctlW VArCtlW	Off
6091	AmpGraMod	Enable Disable	Disable
6092	AmpRtg	1 A to 10000 A	3350 A
6093	AmpGra	0.0001 pu/s to 100.0000 pu/s	0.0500 pu/s
6095	VolRtg	1 V to 1000 V	385 V
6109	Frt.VolFilMod	PT1 filtered grid voltage VolRtg	PT1 filtered grid voltage
6204	HzCtl.PRC024EMod	Enable Disable	country-specific
6205	HzCtl.PRC024E.Hi1Lim	60.00 Hz to 63.00 Hz	60.50 Hz
6207	HzCtl.PRC024E.Hi2Lim	60.00 Hz to 63.00 Hz	61.80 Hz
6209	HzCtl.PRC024E.Lo1Lim	57.00 Hz to 60.00 Hz	59.50 Hz
6211	HzCtl.PRC024E.Lo2Lim	57.00 Hz to 60.00 Hz	57.80 Hz
6213	HzCtl.PRC024E.GainHi	-10.000000 Hz to 0.000000 Hz	-1.457130 Hz
6215	HzCtl.PRC024E.OfsHi	0.0000 Hz to 1000.0000 Hz	90.9350 Hz
6217	HzCtl.PRC024E.GainLo	0.000000 Hz to 10.000000 Hz	1.737300 Hz
6219	HzCtl.PRC024E.OfsLo	-1000.0000 Hz to 0.0000 Hz	-100.1160 Hz
6232	HtSptUsr	Off HtElec On (DeHyd) HtCab On (- 40 degC) All Heater On	Off
6310	PvGnd.Mod	Gfdi Gfdi and Bender Remote Gfdi Remote Gfdi UL Remote Gfdi and Bender Remote Gfdi and Bender UL Bender Float Controller and Bender Float Controller Disable	Remote Gfdi
6335	DclVollim	0 V to 2000 V	country-specific

No.	Name	Value/range	Default value
6582	WCtlHz.CfgMod	HzGra W	country-specific
6584	WCtlHz.W2	0.000 pu to 1.000 pu	0.000 pu
6586	WCtlHz.W3	0.000 pu to 1.000 pu	0.000 pu
6588	WCtlHz.W4	0.000 pu to 1.000 pu	0.000 pu
6640	PvGnd.RislsoWarnLim	0.1 kΩ to 6553.0 kΩ	device-specific
6642	PvGnd.RislsoErrLim	0.1 kΩ to 6553.0 kΩ	device-specific
6645	ImpAdpt.Mod	Enable Disable	Disable
6647	ImpAdpt.VARtgMVTrf	1 kVA to 100000 kVA	device-specific
6649	ImpAdpt.VolNomMVTrf	0.000 pu to 1.000 pu	device-specific
6651	ImpAdpt.ImpRisFacMVTrf	0.0 to 1000.0	device-specific
6653	ImpAdpt.VARtgHVTrf	0 kVA to 1000000 kVA	31500 kVA
6655	ImpAdpt.VolNomHVTrf	0.000 pu to 1.000 pu	0.161 pu
6657	ImpAdpt.ImpRisFacHVTrf	0.0 to 10000.0	26.0
6661	ImpAdpt.NumInv	0 to 10000	1
6672	PFCtlW.VArSptFilTm	0.000 s to 1000.000 s	0.500 s
6710	Pld.Mod	Enable Disable	Disable
6817	Cnt.Rs	Select counter to reset All counter Cnt.To- tAcWhOut + Cnt.TotDcWhIn Cnt.AcWhOut + Cnt.DcWhIn Cnt.Yst- dAcWhOut Cnt.TotDcWhOut + Cnt.To- tAcWhIn Cnt.DcWhOut + Cnt.AcWhIn Cnt.TotVArOvExt Cnt.TotVArUnExt Cnt.TotOpTm Cnt.TotFeedTm Cnt.DwnTm Cnt.FanStkTm Cnt.Fan- Cab1Tm Cnt.FanCab2Tm Cnt.FanMvp- sTm Cnt.HtCabTm Cnt.HtLoExlTmTm Cnt.AcSw Cnt.PreChaSw Cnt.CapacSw Cnt.GfdiSw Cnt.GfdiTr Cnt.Dcs.TotD- cWhIn + Cnt.Dcs.TotDcWhOut Cnt.Dcs.DcWhIn + Cnt.Dcs.DcWhOut	Select counter to re- set
6922	WCtlLoHzMod	Enable Disable	country-specific
6924	WCtlLoHz.DrgIndEna	0 to 1	0
6926	WCtlLoHz.RefMod	W WNom VANom	W
6928	WCtlLoHz.Hz1	0.000 Hz to 70.000 Hz	country-specific
6930	WCtlLoHz.Hz2	0.000 Hz to 70.000 Hz	country-specific
6932	WCtlLoHz.Hz3	0.000 Hz to 70.000 Hz	country-specific

No.	Name	Value/range	Default value
6934	WCtlLoHz.Hz4	0.000 Hz to 70.000 Hz	0.000 Hz
6936	WCtlLoHz.HzGra1	0.0000 pu/Hz to 10.0000 pu/Hz	0.3373 pu/Hz
6938	WCtlLoHz.HzGra2	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
6940	WCtlLoHz.HzGra3	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
6942	WCtlLoHz.HzStopMin	0.000 Hz to 70.000 Hz	country-specific
6944	WCtlLoHz.HzStopMax	0.000 Hz to 100.000 Hz	65.000 Hz
6946	WCtlLoHz.HzStopTm	0 ms to 1000000 ms	0 ms
6948	WCtlLoHz.WGraPosEna	0 to 1	1
6950	WCtlLoHz.WGraNegEna	0 to 1	1
6952	WCtlLoHz.WGraPos	0.0000 pu/s to 10.0000 pu/s	1.0000 pu/s
6954	WCtlLoHz.WGraNeg	0.0000 pu/s to 10.0000 pu/s	1.0000 pu/s
6956	WCtlLoHz.HzQtlIntv	0.000 Hz to 1.000 Hz	0.000 Hz
6958	WCtlLoHz.CfgMod	HzGra W	HzGra
6960	WCtlLoHz.W2	1.000 pu to 100.000 pu	country-specific
6962	WCtlLoHz.W3	1.000 pu to 100.000 pu	country-specific
6964	WCtlLoHz.W4	1.000 pu to 100.000 pu	10.000 pu
6989	AuxSply.AutoProtMod	Enable Disable	Enable
6991	AuxSply.OvVollim	0.00 pu to 2.00 pu	1.20 pu
6993	AuxSply.ConOpnTm	0 ms to 100000 ms	1 ms
6995	AuxSply.ConClsTm	0 ms to 100000 ms	500 ms
7048	PvGnd.AclsoMonTm	0.0 s to 86400.0 s	0.0 s
7085	AuxSply.UnVollim	0.00 pu to 2.00 pu	0.75 pu
7211	ErrClr.ProErr	Gfdi Aid Pld IsoBender Frq VCtl.LoLim VCtl.HiLim VCtl.PkLim All	—
7212	ProErr	0 to 1073741823	0
7214	PvGnd.WaitDclsoMonTm	5.0 s to 86400.0 s	2000.0 s
7216	Eps.Tm	0 to 2592000	0
7231	PwrSpt2StbyTm	0.1 s to 4294960.0 s	30.0 s
7239	InvTstMod	No test Fan Signal lamp MVTrf Fan Service test	No test
7278	BatCtl.ComFlb.FlbMod	Error Standby Predefined Last setpoint	Last setpoint

No.	Name	Value/range	Default value
7280	BatCtl.ComFlb.CtlMod	Power Control DC Voltage Control Last Control Mode	Last Control Mode
7282	BatCtl.ComFlb.DcAmpSpt	-10000 A to +10000 A	0 A
7284	BatCtl.ComFlb.DcVolSpt	0 V to 2000 V	750 V
7286	BatCtl.ComFlb.WSpt	-5000 kW to +5000 kW	0 kW
7288	BatCtl.ComFlb.VArSpt	-5000 kVAr to +5000 kVAr	0 kVAr
7298	BatCtl.ComFlb.FlbTmLim	0 s to 86400 s	300 s
7311	WCtlHzBat.Hz1	0.000 Hz to 70.000 Hz	44.000 Hz
7313	WCtlHzBat.Hz2	0.000 Hz to 70.000 Hz	46.000 Hz
7315	WCtlHzBat.Hz3	0.000 Hz to 70.000 Hz	48.000 Hz
7317	WCtlHzBat.Hz4	0.000 Hz to 70.000 Hz	49.500 Hz
7319	WCtlHzBat.Hz5	0.000 Hz to 70.000 Hz	50.500 Hz
7321	WCtlHzBat.Hz6	0.000 Hz to 70.000 Hz	52.000 Hz
7323	WCtlHzBat.Hz7	0.000 Hz to 70.000 Hz	54.000 Hz
7325	WCtlHzBat.Hz8	0.000 Hz to 70.000 Hz	56.000 Hz
7327	WCtlHzBat.W1	-1.000 pu to +1.000 pu	1.000 pu
7329	WCtlHzBat.W2	-1.000 pu to +1.000 pu	0.700 pu
7331	WCtlHzBat.W3	-1.000 pu to +1.000 pu	0.200 pu
7333	WCtlHzBat.W4	-1.000 pu to +1.000 pu	0.000 pu
7335	WCtlHzBat.W5	-1.000 pu to +1.000 pu	0.000 pu
7337	WCtlHzBat.W6	-1.000 pu to +1.000 pu	-0.200 pu
7339	WCtlHzBat.W7	-1.000 pu to +1.000 pu	-0.700 pu
7341	WCtlHzBat.W8	-1.000 pu to +1.000 pu	-1.000 pu
7352	BatCtl.ComFlb.AuxCtlEna	Off On	-
7353	BatCtl.ComFlb.BatEna	Off On	-
7406	Hw.MvpsMod	Disable (Single Inverter) MVPS SMA Double MVPS Customer Double MVPS SMA Single	Disable (Single Inverter)
7413	BatCtl.ComFlb.HzNomSpt	40.00 Hz to 70.00 Hz	50.00 Hz
7415	BatCtl.ComFlb.VolNomSpt	0.8500 pu to 1.1500 pu	1.0000 pu
7463	GriMng.ComFltFlbRstrWMod	Error Standby WSptFlb	Error
7469	InstFunc	Systemreset Acc, Dcc, Rio, Cont	—

No.	Name	Value/range	Default value
7523	WGraStr	0.001000 pu/s to 100.000000 pu/s	100.000000 pu/s
7525	VArCtlVol.EnaTm	0 ms to 100000 ms	0 ms
7527	WCtlHz.EnaTm	0 ms to 100000 ms	0 ms
7536	BatCtl.ComFlb.WCtlHzBatMod	Enable Disable	Disable
7534	WCtlHzBatMod	Enable Disable	Disable
7576	GriForm.AcCtl.DrpHz	-10.000D1P_UNIT_HZ_PER_PU to +10.000D1P_UNIT_HZ_PER_PU	-1,000D1P_UNIT_HZ_PER_PU
7577	GriForm.AcCtl.DrpVol	0.000 to 1.000	0.030
7646	HzNomSptLim	0.000 Hz to 20.000 Hz	2.000 Hz
7671	BatCtl.ComFlb.PFSpt	-1.0000 to +1.0000	1.0000
7682	PvGnd.OpnRemGfdi	Enable Disable	Disable
7684	HzCtl.OpMaxNomRecon	40.00 Hz to 70.00 Hz	50.05 Hz
7686	VArRtgQoD	1 kVAr to 5000 kVAr	device-specific
7712	DclVolSptGra	0.0 V/s to 100000.0 V/s	50.0 V/s
7714	DcAmpSptGra	0 A/s to 1000000 A/s	500 A/s
7892	Frt.WaitTmLo	0.02 s to 20.00 s	country-specific
7894	Frt.HystEna	Enable Disable	Disable
7896	Frt.LoDbHyst	0.00 pu to 1.00 pu	0.92 pu
7898	Frt.HiDbHyst	1.00 pu to 1.50 pu	1.08 pu
7900	Frt.ExpryEna	Enable Disable	Disable
7902	Frt.LoDbExpry	0.00 pu to 1.00 pu	0.90 pu
7904	Frt.HiDbExpry	1.00 pu to 1.50 pu	1.10 pu
7906	Frt.ExpryTm	0.00 s to 10000.00 s	60.00 s
7908	Frt.ExpryEndTm	0.00 s to 10000.00 s	1.00 s
7913	StbySfCapacMod	Standby with capacitor Standby without capacitor	Standby without capacitor
7929	Gfdi.FltEnWarnLim	0% to 100%	80 %
7931	Gfdi.CurLim	0.00 A to 32.00 A	device-specific
7997	GriForm.Frt.Mod	Disable Full (Virt. Impedance)	Full (Virt. Impedance)
8001	GriForm.Frt.AmpCtlEna	Enable Disable	Enable
8090	Frt.AmpQLim	0.00 pu to 2.00 pu	2.00 pu
8094	FrtStep.HiDb	1.00 pu to 1.50 pu	1.05 pu

No.	Name	Value/range	Default value
8096	FrtStep.LoDb	0.00 pu to 1.00 pu	0.95 pu
8098	FrtStep.ExpryTm	0.00 s to 10000.00 s	5.00 s
8100	FrtStep.Ena	Enable Disable	Disable
8102	FrtStep.VolFilTm	0.0 s to 600.0 s	1.0 s
8146	DcSwNormWrn	0 to 100000	9000
8148	DcSwNormErr	0 to 100000	10000
8150	DcSwOvAmpErr	0 to 100	device-specific
8156	WCtlVol.Ena	Enable Disable	Disable
8158	WCtlVol.CrvNumPt	1 to 4	2
8160	WCtlVol.Vol1	0.0000 pu to 2.0000 pu	1.1000 pu
8162	WCtlVol.Vol2	0.0000 pu to 2.0000 pu	1.2000 pu
8164	WCtlVol.Vol3	0.0000 pu to 2.0000 pu	2.0000 pu
8166	WCtlVol.Vol4	0.0000 pu to 2.0000 pu	2.0000 pu
8168	WCtlVol.W1	-200.00% to +200.00%	100.00 %
8170	WCtlVol.W2	-200.00% to +200.00%	0.00 %
8172	WCtlVol.W3	-200.00% to +200.00%	0.00 %
8174	WCtlVol.W4	-200.00% to +200.00%	0.00 %
8176	WCtlVol.WRefMod	WNom W actual WSnptMax	WNom
8178	WCtlVol.WFilEna	Enable Disable	Enable
8180	WCtlVol.WFilTm	0.000 s to 600.000 s	1.000 s
8182	WCtlVol.WGraEna	Enable Disable	Disable
8184	WCtlVol.WGraPos	0.000%/s to 1000.000%/s	100.000%/s
8186	WCtlVol.WGraNeg	0.000%/s to 1000.000%/s	100.000%/s
8188	WCtlVol.ActDITm	0.000 s to 600.000 s	0.000 s
8259	VArCtlVol.VolFilTm	0.00 s to 5000.00 s	0.50 s
8261	VArCtlVol.VolNomSptMod	VolNomSpt InvMs.Vol.PsNom InvMs.Vol.PsNom init. meas.	VolNomSpt
8276	VArCtlW.CrvNumPt	0 to 8	4
8278	VArCtlW.W1	-100.00% to +100.00%	50.00 %
8280	VArCtlW.W2	-100.00% to +100.00%	60.00 %
8282	VArCtlW.W3	-100.00% to +100.00%	90.00 %
8284	VArCtlW.W4	-100.00% to +100.00%	100.00 %

No.	Name	Value/range	Default value
8286	VArCtIW.W5	-100.00% to +100.00%	100.00 %
8288	VArCtIW.W6	-100.00% to +100.00%	100.00 %
8290	VArCtIW.W7	-100.00% to +100.00%	100.00 %
8292	VArCtIW.W8	-100.00% to +100.00%	100.00 %
8294	VArCtIW.VAr1	-100.00% to +100.00%	0.00 %
8296	VArCtIW.VAr2	-100.00% to +100.00%	-5.00 %
8298	VArCtIW.VAr3	-100.00% to +100.00%	-33.00 %
8300	VArCtIW.VAr4	-100.00% to +100.00%	-33.00 %
8302	VArCtIW.VAr5	-100.00% to +100.00%	-33.00 %
8304	VArCtIW.VAr6	-100.00% to +100.00%	-33.00 %
8306	VArCtIW.VAr7	-100.00% to +100.00%	-33.00 %
8308	VArCtIW.VAr8	-100.00% to +100.00%	-33.00 %
8310	VArCtIW.VArRefMod	WNom VArNom	VArNom
8312	VArCtIW.VArFilEna	Enable Disable	Enable
8314	VArCtIW.VArGraEna	Enable Disable	Disable
8316	VArCtIW.VArDynEna	Enable Disable	Disable
8318	VArCtIW.VArFilTm	0.010 s to 1000.000 s	10.000 s
8320	VArCtIW.VArGraPos	1.000%/s to 10000.000%/s	100.000%/s
8322	VArCtIW.VArGraNeg	1.000%/s to 10000.000%/s	100.000%/s
8324	GriMng.VArLimVolMod	Off Curve	Off
8326	VArLimVolCrv.Vol1	0.0000 pu to 2.0000 pu	0.9400 pu
8328	VArLimVolCrv.Vol2	0.0000 pu to 2.0000 pu	0.9600 pu
8330	VArLimVolCrv.Vol3	0.0000 pu to 2.0000 pu	1.0400 pu
8332	VArLimVolCrv.Vol4	0.0000 pu to 2.0000 pu	1.0600 pu
8334	VArLimVolCrv.VAr1	-100.00% to +100.00%	33.00 %
8336	VArLimVolCrv.VAr2	-100.00% to +100.00%	0.00 %
8338	VArLimVolCrv.VAr3	-100.00% to +100.00%	0.00 %
8340	VArLimVolCrv.VAr4	-100.00% to +100.00%	-33.00 %
8342	VArLimVolCrv.VArRefMod	WNom VArNom	VArNom
8346	VArLimVolCrv.VArFilEna	Enable Disable	Enable
8348	VArLimVolCrv.VArGraEna	Enable Disable	Disable

No.	Name	Value/range	Default value
8350	VARlimVolCrv.VArDynEna	Enable Disable	Disable
8352	VARlimVolCrv.VArFilTm	0.010 s to 1000.000 s	10.000 s
8354	VARlimVolCrv.VArGraPos	1.000%/s to 10000.000%/s	1200.000%/s
8356	VARlimVolCrv.VArGraNeg	1.000%/s to 10000.000%/s	1200.000%/s
8386	WSptMinMan	-5000 kW to +5000 kW	device-specific
8388	WSptMinFlb	-5000 kW to +5000 kW	device-specific
8390	GriMng.WMinMod	WMinCtlCom WMinCtlMan	WMinCtlMan
8416	VARFilMod	Enable Disable	Disable
8418	VARFilTm	0.000 s to 100.000 s	0.500 s
8420	WFilMod	Enable Disable	Disable
8422	WFilTm	0.000 s to 100.000 s	0.500 s
8451	WCtlHzLoHi.HzOv1	0.000 Hz to 70.000 Hz	50.200 Hz
8453	WCtlHzLoHi.HzOv2	0.000 Hz to 70.000 Hz	65.000 Hz
8455	WCtlHzLoHi.HzOv3	0.000 Hz to 70.000 Hz	65.000 Hz
8457	WCtlHzLoHi.HzOvGra1	-1000.000 %/Hz to 0.000 %/Hz	-40.000%/Hz
8459	WCtlHzLoHi.HzOvGra2	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8461	WCtlHzLoHi.HzOvGra3	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8463	WCtlHzLoHi.HzUn1	0.000 Hz to 70.000 Hz	49.800 Hz
8465	WCtlHzLoHi.HzUn2	0.000 Hz to 70.000 Hz	45.000 Hz
8467	WCtlHzLoHi.HzUn3	0.000 Hz to 70.000 Hz	45.000 Hz
8469	WCtlHzLoHi.HzUnGra1	-1000.000 %/Hz to 0.000 %/Hz	-40.000%/Hz
8471	WCtlHzLoHi.HzUnGra2	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8473	WCtlHzLoHi.HzUnGra3	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8475	WCtlHzLoHi.HzStopMax	0.000 Hz to 70.000 Hz	50.200 Hz
8477	WCtlHzLoHi.HzStopMin	0.000 Hz to 70.000 Hz	49.800 Hz
8479	WCtlHzLoHi.WSptFilTm	0.001 s to 100.000 s	0.001 s
8481	WCtlHzLoHi.WGra	0 %/min to 600000 %/min	9 %/min
8483	WCtlHzLoHi.OvGraWRefMod	WNom W actual WSnptMax	WNom
8485	WCtlHzLoHi.UnGraWRefMod	WNom W actual WSnptMax	WNom
8487	WCtlHzLoHi.DrgIndOvEna	Enable Disable	Disable
8489	WCtlHzLoHi.DrgIndUnEna	Enable Disable	Disable

No.	Name	Value/range	Default value
8491	WCtlHzLoHi.WSptDI	0 ms to 500 ms	0 ms
8493	WCtlHzLoHi.HzStopTm	0.000 s to 1000.000 s	0.000 s
8495	WCtlHzLoHiMod	Enable Disable	Disable
8497	VArCtlVol.VolPsNomHiLim	1.0000 pu to 2.0000 pu	1.1000 pu
8499	VArCtlVol.VolPsNomLoLim	0.0000 pu to 1.0000 pu	0.9000 pu
8524	HzCtl.OpMinNomRecon	40.00 Hz to 70.00 Hz	country-specific
8526	VCtl.OpMaxNomRecon	0.00 pu to 2.00 pu	country-specific
8528	VCtl.OpMinNomRecon	0.000 pu to 2.000 pu	country-specific
8538	WSptMaxMan	-5000 kW to +5000 kW	device-specific
8540	WSptMaxFlb	-5000 kW to +5000 kW	device-specific
8542	GriMng.WMaxMod	WMaxCtlCom WMaxCtlMan	WMaxCtlMan
8544	WSptMaxMinFilMod	Enable Disable	Disable
8546	WSptMaxMinFilTm	0.000 s to 100.000 s	0.500 s
8548	WSptMaxMinGraMod	Enable Disable	Enable
8550	WSptMaxMinGra	0.000000 pu/s to 100.000000 pu/s	0.200000 pu/s
8563	GriForm.VolSptGra	0.01 pu/s to 100.00 pu/s	5.00 pu/s
8565	GriForm.AcRmpUpVolGra	0.01 pu/s to 100.00 pu/s	5.00 pu/s
8568	WGraFlb	0.000000 pu/s to 100.000000 pu/s	country-specific
8572	VArGraFlb	0.000 pu/s to 100.000 pu/s	country-specific
8582	GriForm.HzSptGra	0.0001 Hz/s to 1000.0000 Hz/s	2.0000 Hz/s
8605	Chop.CrtMax	0 to 1000	50
8607	Frt.SepNsGraEna	Enable Disable	Disable
8609	Frt.SepNsGra	0.00 to 10.00	2.00
8620	VArCtlVol.VArOfs	-1.0000 pu to +1.0000 pu	0.0000 pu
8630	AcCtl.AmpABCtlEna	Enable Disable	Disable
8665	VCtl.PkLimBlkPwm.Ena	Enable Disable	Disable
8667	VCtl.PkLimBlkPwm.PkLimAct	0.00 pu to 2.00 pu	1.25 pu
8669	VCtl.PkLimBlkPwm.PkLimActTm	0 to 3000	6
8671	VCtl.PkLimBlkPwm.PkLimDeact	0.00 pu to 2.00 pu	0.50 pu
8673	VCtl.PkLimBlkPwm.PkLimDeactTm	0 to 3000	6
8675	VCtl.PkLimBlkPwm.BlkOffDITm	0 to 6000	300

No.	Name	Value/range	Default value
8677	AmpGraRmpDwn	0.0001 pu/s to 10.0000 pu/s	0.5000 pu/s
8679	InvPwrOnStpEna	Enable Disable	Disable
8687	GriMng.ComFltTmLim	0.0 s to 86400.0 s	300.0 s
8689	BatCtl.ComFlb.BatTmLim	0.1 s to 86400.0 s	500.0 s
8691	BatCtl.ComFlb.AuxCtlTmLim	0.1 s to 86400.0 s	300.0 s
8843	VArCtlVol.CfgMod	Gra VAr	Gra
8845	VArCtlVol.LoVAr2	-1.000 pu to +1.000 pu	0.000 pu
8847	VArCtlVol.HiVAr2	-1.000 pu to +1.000 pu	0.000 pu
8849	VArCtlVol.LoVAr3	-1.000 pu to +1.000 pu	0.440 pu
8851	VArCtlVol.HiVAr3	-1.000 pu to +1.000 pu	-0.440 pu
8945	ExlConnEna	Enable Disable	Disable
8947	ExlConn	Enable Disable	Disable
8957	DcSw.OpnStbyEna	Enable Disable	Disable
8991	GriMng.ExtFlbEna	Enable Disable	Disable
8994	GriMng.ExtFlbErrClr	Ackn	—
9036	VArCtlVol.VArRefMod	WNom VArNom VANom	VANom
4900	Alrm.Mail.Ena	—	—
4901	Alrm.Smtp.Adr	—	—
4902	Alrm.Smtp.Port	1 to 65535	25
4903	Alrm.Smtp.Usr	—	—
4904	Alrm.Smtp.Pwd	—	—
4905	Alrm.Smtp.Cry	None SSL StartTLS TryTLS	—
4906	Alrm.Mail.Recp	—	—
4907	Alrm.Smtp.TxAdr	—	—
4908	Alrm.Mail.Tst	—	—
4910	Alrm.Email.Lang	english german greek spanish french italian czech portuguese	english
3960	AuxCtl.SCSOpCmd	—	0
3961	AuxCtl.SOCOpMax	0 to 100	100
3962	AuxCtl.SOCOpMin	0 to 100	0
3959	Bat.OpMod.ReqCanc	—	0
3958	Bat.OpMod.ReqOk	—	0

No.	Name	Value/range	Default value
3921	Bsc.BatEna	–	1
3957	Bsc.BatOpTmLim	0 to 3600	60
3940	Bsc.BatStrProc	–	0
3926	Bsc.DcAmpDynMax	0 to 10000	4000
3927	Bsc.DcAmpDynMin	-10000 to 0	-4000
3928	Bsc.DcAmpOpMax	0 to 10000	5000
3929	Bsc.DcAmpOpMin	-10000 to 0	-5000
3930	Bsc.DcAmpSptMan	-10000 to +10000	0
3932	Bsc.DcVolDynMax	0 to 2000	1500
3933	Bsc.DcVolDynMin	0 to 2000	550
3934	Bsc.DcVolOpMax	0 to 2000	1600
3935	Bsc.DcVolOpMin	0 to 2000	500
3931	Bsc.DcVolSptMan	0 to 2000	850
3946	Bsc.ErrClrTime	0 to 1000000	0
3963	Bsc.ExtDcAmplimEna	–	0
3923	Bsc.HzNomSptMan	45 to 70	50
3939	Bsc.InvEff	50 to 100	97
3941	Bsc.InvStrMod	–	0
3956	Bsc.NomCapStrg	0 to 1000000	1
3936	Bsc.PFSptMan	-1 to +1	1
3955	Bsc.RisInStrg	0 to 10000	50
3943	Bsc.SCSOpCmdMan	–	0
3949	Bsc.SOClimEna	–	1
3951	Bsc.SOCOpHys	0 to 20	3
3952	Bsc.SOCOpMax	0 to 100	100
3953	Bsc.SOCOpMin	0 to 100	0
3954	Bsc.SOCRes	0 to 10	0.1
3948	Bsc.SOCestEna	–	1
3942	Bsc.SrcSel	–	1
3945	Bsc.VArSptMan	-5000 to +5000	0
3922	Bsc.VolNomSptMan	0 to 1.15	1

No.	Name	Value/range	Default value
3944	Bsc.WSptMan	-5000 to +5000	0
3924	Bsc.ZPO.ZeroPwrAtOfs	-20 to +20	-4
3925	Bsc.ZPO.ZeroPwrAtOfsEna	–	1
4969	FtpSrv.Mode	Off Ftp only secure FTP (FTPS) only secure FTP (FTPS) + FTP	Off
4971	Ftpush.CertEna	–	0
4972	Ftpush.CertPass	–	–
4970	Ftpush.Mode	active FTP passive FTP SFTP FTPS	active FTP
4950	Ftpush.SrvAdr	–	–
4954	Ftpush.SrvDir	–	–
4951	Ftpush.SrvPort	0 to 65535	21
4952	Ftpush.SrvUsr	–	–
4953	Ftpush.SrvPwd	–	–
4955	Ftpush.Upld	–	0
4956	Ftpush.UpldCyc	–	0
4962	Ftpush.Tst	–	0
4980	Fmshpush.Upld	–	–
4981	Fmshpush.UpldCyc	Off Daily	Off
4987	Fmshpush.Tst	–	–
4993	Fmshpush.LastTm	–	–
4129	Netw.Dns.SrvIpAdr	–	–
4106	Netw.Hima.IpAdrCfg	–	–
4109	Netw.Lan2.DhcpSrvCfg	–	–
4112	Netw.Lan2.DhcpSrvEna	–	0
4104	Netw.Lan2.IpAdrCfg	–	–
4101	Netw.Lan2.IfMod	Off Static DHCP Client	Static
4110	Netw.Lan3.DhcpSrvCfg	–	–
4113	Netw.Lan3.DhcpSrvEna	–	0
4105	Netw.Lan3.IpAdrCfg	–	–
4102	Netw.Lan3.IfMod	Off Static DHCP Client	Static
4137	Netw.Nat.Ena	–	0
4143	Netw.Proxy.Adr	–	–

No.	Name	Value/range	Default value
4141	Netw.Proxy.AuthEna	–	0
4138	Netw.Proxy.FtpEna	–	0
4140	Netw.Proxy.MailEna	–	0
4142	Netw.Proxy.Port	–	8080
4145	Netw.Proxy.Pwd	–	–
4139	Netw.Proxy.SunnyPortalEna	–	0
4144	Netw.Proxy.Usr	–	–
4114	Netw.StdGw.IpAdr	–	172.24.1.1
4568	Portald.Act.Conn.Chk	–	0
4566	Portald.Act.Rgst.Dev	–	0
4565	Portald.Act.Rgst.Plnt	–	0
4571	Portald.Act.Rgst.Sub.Dev	–	0
4567	Portald.Act.Upld	–	0
4562	Portald.Conn.Lim.Tm	10 s to 60 s	10 s
4552	Portald.Plnt.Id	–	–
4569	Portald.Plnt.Lang	–	–
4551	Portald.Plnt.Nam	–	–
4563	Portald.Rx.Lim.Tm	30 s to 120 s	30 s
4564	Portald.Tx.Lim.Tm	30 s to 120 s	30 s
4553	Portald.Upld.Cyc	Off 15min 30min 60min 2h 4h 6h 8h 12h 24h	Off
4561	Portald.Upld.Mod	HTTP HTTPS (SSL)	HTTP
4570	Portald.Usr.Lang	–	–
4550	Portald.Usr.Mail	–	–
4233	Smgr.Ui.SysDecPt	, .	,
4231	Smgr.Ui.SysDtFmt	DD.MM.YYYY YYYY-MM-DD MM/DD/YYYY	DD.MM.YYYY
4236	Smgr.Ui.SysInvNam	–	–
4230	Smgr.Ui.SysLang	english german	english
4234	Smgr.Ui.SysStrOfWeek	sunday monday	monday
4235	Smgr.Ui.SysThousandSep	. , –	–
4232	Smgr.Ui.SysTmFmt	HH:MM:SS HH:MM:SS AM/PM	HH:MM:SS

No.	Name	Value/range	Default value
4500	Tm.Sys.SynMod	None NTP	None
4502	Tm.Sys.Tm	–	–
4503	Tm.Sys.TmZn	–	–
4504	Tm.Ntp.SrvAdr	–	–
4505	Tm.Ntp.SynTm	15min 30min 60min 2h 4h 6h 8h 12h 24h	30 min

16 Technical Data

16.1 General Data

Protective devices	
Input-side disconnection point	DC load-break switch
AC disconnection point	AC circuit breaker
DC overvoltage protection	Surge arrester, type I, protection level 3 kV
AC overvoltage protection"	Surge arrester, class I
Overvoltage category AC power path	III
Overvoltage category DC power path	II
Overvoltage category AC control voltage (communication)	II
Overvoltage category AC control voltage (external)	III
Overvoltage category DC control voltage (communication)	I
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III
AC overcurrent protection device with 2 / 3 inverter bridges	2566 A nominal current / 3850 A nominal current 70 kA short-circuit current
Ground fault monitoring remote-controlled	Optional
Insulation monitoring	Standard features
Degree of protection (as per IEC 60529): electronics / air duct / connection area	IP54 / IP34 / IP34
Degree of protection (as per NEMA)	3R
Ambient conditions (as per DIN EN ISO 9223)	C5M
The protection period of the coating system depends on the conditions on site and the maintenance intervals.	C4M C3H
General data	
Width x height x depth	2815 mm x 2318 mm x 1588 mm
Weight without packaging	< 3700 kg (with 3 inverter bridges) < 3400 kg (with 2 inverter bridges)
Noise emission with distance 10 m	65.0 dB(A)
Maximum permissible value for relative humidity (non-condensing)	0% to 95%
Max. permissible value for relative humidity (condensing)	> 95% to 100% (up to two months per year)
Maximum self-consumption (rated operation) / self-consumption (standby)	< 8100 W / < 370 W

General data

Internal supply voltage / external supply voltage	Integrated 8.4 kVA transformer / optional
Fresh air consumption	6500 m ³ /h
Operating temperature range	-25°C to +60°C (optional: -40°C to +60°C)
Temperature range (stand-by)	-40°C to +60°C
Temperature range (storage)	-40°C to +70°C

Equipment

AC connection	Track system
Communication	Ethernet, Modbus master, Modbus slave
Type of communication with SMA String-Monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)
Color enclosure / roof	RAL 9016 / RAL 7004
Color of base	Galvanized steel
Supply transformer for external loads	Optional 2.5 kVA
Standards and directives complied with	CE, IEC / EN 62109-1, IEC / EN 62109-2, AR-N 4110, AR-N 4120, IEEE1547, UL 840 Cat. IV, Arrêté du 23/04/08
EMC standards	EN61000-6-2, CISPR 11 (EN55011 Class A), FCC Part 15 Class A
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001

16.2 Sunny Central Storage 2300 UP-XT**DC Input**

DC voltage range	880 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	3200 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs split DC busbar option (optional)	5 / 6 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²

AC output

Discharging direction: Nominal AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C	2665 kW
Discharging direction: AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	2667 kVA ¹⁰⁾ / 2427 kVA ¹⁰⁾ / 2267 kVA ¹⁰⁾ (AC apparent power at higher DC voltages available on request)
Charging direction: AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C / 40 °C / 50 °C ¹¹⁾	2393 kVA ¹⁰⁾ / 2179 kVA ¹⁰⁾ / 2001 kVA ¹⁰⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	2566 A / 2335 A / 2181 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	600 V / 480 V to 720 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited

Efficiency

Maximum efficiency, measured without energy self-sufficiency	98.7 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

16.3 Sunny Central Storage 2400 UP-XT**DC Input**

DC voltage range	921 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	3200 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole

¹⁰⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

¹¹⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

DC Input

Number of DC inputs split DC busbar option (optional) 5 / 6 connections to the DC+ pole, 36 connections to the DC- pole

Maximum cable cross-section per DC cable 400 mm²

AC output

Discharging direction: Nominal AC power at 1200 V_{dcr}
cos φ = 1.0 and 25 °C 2800 kW

Discharging direction: AC power at 1200 V_{dcr}
cos φ = 1.0 and 25 °C / 40 °C / 50 °C 2800 kVA¹²⁾ / 2548 kVA¹²⁾ / 2380 kVA¹²⁾
(AC apparent power at higher DC voltages available on request)

Charging direction: AC power at 1200 V_{dcr} cos φ = 1.0
and 25 °C / 40 °C / 50 °C¹³⁾ 2513 kVA¹²⁾ / 2288 kVA¹²⁾ / 2101 kVA¹²⁾
(AC apparent power at higher DC voltages available on request)

Maximum output current I_{AC, max} = Nominal AC current
I_{AC, nom} at 25 °C / 40 °C / 50 °C 2566 A / 2335 A / 2181 A

Maximum total harmonic distortion < 3% at nominal power

Nominal AC voltage / AC voltage range 630 V / 504 V to 756 V

AC grid frequency 50 Hz / 47 Hz to 53 Hz
60 Hz / 57 Hz to 63 Hz

Min. short-circuit ratio at the AC terminals > 2

Power factor at rated power / adjustable displacement
power factor 1 / 0.8 overexcited to 0.8 underexcited

Power factor at rated power/displacement power factor
adjustable by the SMA Service 1 / 0 overexcited to 0 underexcited

Efficiency

Maximum efficiency, measured without energy self-sufficiency 98.7 %

Maximum operating altitude up to MSL 1000 m /
2000 m Standard features / Optional

16.4 Sunny Central Storage 2530 UP-XT**DC Input**

DC voltage range 962 V to 1500 V

Maximum DC voltage 1500 V

Maximum DC current 3200 A

¹²⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

¹³⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

DC Input	
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs split DC busbar option (optional)	5 / 6 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²
AC output	
Discharging direction: Nominal AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C	2930 kW
Discharging direction: AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	2933 kVA ¹⁴⁾ / 2669 kVA ¹⁴⁾ / 2493 kVA ¹⁴⁾ (AC apparent power at higher DC voltages available on request)
Charging direction: AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C ¹⁵⁾	2633 kVA ¹⁴⁾ / 2397 kVA ¹⁴⁾ / 2201 kVA ¹⁴⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	2566 A / 2335 A / 2181 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	660 V / 528 V to 759 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited
Efficiency	
Maximum efficiency, measured without energy self-sufficiency	98.7 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

¹⁴⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

¹⁵⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

16.5 Sunny Central Storage 2630 UP-XT

DC Input	
DC voltage range	1003 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	3200 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs split DC busbar option (optional)	5 / 6 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²
AC output	
Discharging direction: Nominal AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C	3065 kW
Discharging direction: AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	3067 kW ¹⁶⁾ / 2791 kW ¹⁶⁾ / 2607 kW ¹⁶⁾ (AC apparent power at higher DC voltages available on request)
Charging direction: AC power at 1200 V _{dcr} , cos φ = 1.0 and 25 °C / 40 °C / 50 °C ¹⁷⁾	2752 kW ¹⁶⁾ / 2506 kW ¹⁶⁾ / 2302 kW ¹⁶⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	2566 A / 2335 A / 2181 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	690 V / 552 V to 759 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited

¹⁶⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

¹⁷⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

Efficiency

Maximum efficiency, measured without energy self-sufficiency	98.7 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

16.6 Sunny Central Storage 3450 UP**DC Input**

DC voltage range	880 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	4750 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs split DC busbar option (optional)	3 x 12 connections to the DC+ pole, 36 connections to the DC- pole
Number of DC inputs option DC busbar with additional fuse protection (optional)	22 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²

AC output

Nominal AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C	3450 kW
AC- power at 1200 V _{dc} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	3450 kVA ¹⁸⁾ / 3140 kVA ¹⁸⁾ / 2930 kVA ¹⁸⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	3320 A / 3020 A / 2820 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	600 V / 480 V to 720 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited

¹⁸⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

Efficiency

Maximum efficiency, measured without energy self-sufficiency

98.8 %

Maximum operating altitude up to MSL 1000 m / 2000 m

Standard features / Optional

16.7 Sunny Central Storage 3600 UP**DC Input**

DC voltage range

921 V to 1500 V

Maximum DC voltage

1500 V

Maximum DC current

4750 A

Maximum interruption current capability

8400 A

DC connection

Terminal lug

Number of DC inputs DC busbar option (standard)

36 connections per pole

Number of DC inputs option split DC busbar (optional)

3 x 12 connections to the DC+ pole, 36 connections to the DC- pole

Number of DC inputs option DC busbar with additional fuse protection (optional)

22 connections to the DC+ pole, 36 connections to the DC- pole

Maximum cable cross-section per DC cable

400 mm²**AC output**Nominal AC power at 1200 V_{dc}, cos φ = 1.0 and 25 °C

3620 kW

AC- power at 1200 V_{dc}, cos φ = 1.0 and 25 °C / 40 °C / 50 °C3620 kVA¹⁹⁾ / 3290 kVA¹⁹⁾ / 3075 kVA¹⁹⁾
(AC apparent power at higher DC voltages available on request)Maximum output current I_{AC, max} = Nominal AC current
I_{AC, nom} at 25 °C / 40 °C / 50 °C

3320 A / 3020 A / 2820 A

Maximum total harmonic distortion

< 3% at nominal power

Nominal AC voltage / AC voltage range

630 V / 504 V to 756 V

AC grid frequency

50 Hz / 47 Hz to 53 Hz
60 Hz / 57 Hz to 63 Hz

Min. short-circuit ratio at the AC terminals

> 2

Power factor at rated power / adjustable displacement power factor

1 / 0.8 overexcited to 0.8 underexcited

Power factor at rated power/displacement power factor adjustable by the SMA Service

1 / 0 overexcited to 0 underexcited

¹⁹⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

Efficiency

Maximum efficiency, measured without energy self-sufficiency	98.8 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

16.8 Sunny Central Storage 3800 UP**DC Input**

DC voltage range	962 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	4750 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs split DC busbar option (optional)	3 x 12 connections to the DC+ pole, 36 connections to the DC- pole
Number of DC inputs option DC busbar with additional fuse protection (optional)	22 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²

AC output

Nominal AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C	3800 kW
AC- power at 1200 V _{dc} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	3800 kVA ²⁰⁾ / 3455 kVA ²⁰⁾ / 3230 kVA ²⁰⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	3320 A / 3020 A / 2820 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	660 V / 528 V to 759 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited

²⁰⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

Efficiency

Maximum efficiency, measured without energy self-sufficiency 98.8 %

Maximum operating altitude up to MSL 1000 m / 2000 m Standard features / Optional

16.9 Sunny Central Storage 3950 UP**DC Input**

DC voltage range	1003 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	4750 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs option split DC busbar (optional)	3 x 12 connections to the DC+ pole, 36 connections to the DC- pole
Number of DC inputs option DC busbar with additional fuse protection (optional)	22 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²

AC output

Nominal AC power at 1200 V _{dc} , cos φ = 1.0 and 25 °C	3960 kW
AC- power at 1200 V _{dc} , cos φ = 1.0 and 25 °C / 40 °C / 50 °C	3960 kVA ²¹⁾ / 3610 kVA ²¹⁾ / 3365 kVA ²¹⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	3320 A / 3020 A / 2820 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	690 V / 552 V to 759 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited

²¹⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

Efficiency

Maximum efficiency, measured without energy self-sufficiency	98.8 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

16.10 Sunny Central Storage 3450 UP-XT**DC Input**

DC voltage range	880 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	4750 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs split DC busbar option (optional)	3 x 12 connections to the DC+ pole, 36 connections to the DC- pole
Number of DC inputs option DC busbar with additional fuse protection (optional)	22 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²

AC output

Discharging direction: Nominal AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C	4000 kW
Discharging direction: AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	4000 kW ²²⁾ / 3640 kW ²²⁾ / 3400 kW ²²⁾ (AC apparent power at higher DC voltages available on request.)
Charging direction: AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C ²³⁾	3589 kW ²²⁾ / 3268 kW ²²⁾ / 3001 kW ²²⁾ (AC apparent power at higher DC voltages available on request.)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	3850 A / 3504 A / 3273 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	600 V / 480 V to 720 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2

²²⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

²³⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

AC output

Power factor at rated power / adjustable displacement power factor 1 / 0.8 overexcited to 0.8 underexcited

Power factor at rated power/displacement power factor adjustable by the SMA Service 1 / 0 overexcited to 0 underexcited

Efficiency

Maximum efficiency, measured without energy self-sufficiency 98.8 %

Maximum operating altitude up to MSL 1000 m / 2000 m Standard features / Optional

16.11 Sunny Central Storage 3600 UP-XT**DC Input**

DC voltage range 921 V to 1500 V

Maximum DC voltage 1500 V

Maximum DC current 4750 A

Maximum interruption current capability 8400 A

DC connection Terminal lug

Number of DC inputs DC busbar option (standard) 36 connections per pole

Number of DC inputs option split DC busbar (optional) 3 x 12 connections to the DC+ pole, 36 connections to the DC- pole

Number of DC inputs option DC busbar with additional fuse protection (optional) 22 connections to the DC+ pole, 36 connections to the DC- pole

Maximum cable cross-section per DC cable 400 mm²

AC output

Discharging direction: Nominal AC power at 1200 V_{dcr} cos φ = 1.0 and 25 °C 4200 kW

Discharging direction: AC power at 1200 V_{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C 4200 kW²⁴⁾ / 3822 kW²⁴⁾ / 3570 kW²⁴⁾
(AC apparent power at higher DC voltages available on request)

Charging direction: AC power at 1200 V_{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C²⁵⁾ 3769 kW²⁴⁾ / 3432 kW²⁴⁾ / 3152 kW²⁴⁾
(AC apparent power at higher DC voltages available on request)

Maximum output current I_{AC, max} = Nominal AC current 3850 A / 3504 A / 3273 A
I_{AC, nom} at 25 °C / 40 °C / 50 °C

²⁴⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

²⁵⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

AC output	
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	630 V / 504 V to 756 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited
Efficiency	
Maximum efficiency, measured without energy self-sufficiency	98.8 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

16.12 Sunny Central Storage 3800 UP-XT

DC Input	
DC voltage range	962 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	4750 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs split DC busbar option (optional)	3 x 12 connections to the DC+ pole, 36 connections to the DC- pole
Number of DC inputs option DC busbar with additional fuse protection (optional)	22 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²
AC output	
Discharging direction: Nominal AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C	4400 kW
Discharging direction: AC power at 1200 V _{dcr} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	4400 kW ²⁶⁾ / 4004 kW ²⁶⁾ / 3740 kW ²⁶⁾ (AC apparent power at higher DC voltages available on request)

²⁶⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

AC output

Charging direction: AC power at 1200 V _{dc} , cos φ = 1.0 and 25 °C / 40 °C / 50 °C ²⁷⁾ – FEHLENDER LINK –	3949 kW ²⁶⁾ / 3596 kW ²⁶⁾ / 3302 kW ²⁶⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	3850 A / 3504 A / 3273 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	660 V / 528 V to 759 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited

Efficiency

Maximum efficiency, measured without energy self-sufficiency	98.8 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

16.13 Sunny Central Storage 3950 UP-XT**DC Input**

DC voltage range	1003 V to 1500 V
Maximum DC voltage	1500 V
Maximum DC current	4750 A
Maximum interruption current capability	8400 A
DC connection	Terminal lug
Number of DC inputs DC busbar option (standard)	36 connections per pole
Number of DC inputs option split DC busbar (optional)	3 x 12 connections to the DC+ pole, 36 connections to the DC- pole
Number of DC inputs option DC busbar with additional fuse protection (optional)	22 connections to the DC+ pole, 36 connections to the DC- pole
Maximum cable cross-section per DC cable	400 mm ²

²⁷⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

AC output	
Discharging direction: Nominal AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C	4600 kW
Discharging direction: AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C / 40 °C / 50 °C	4600 kW ²⁸⁾ / 4186 kW ²⁸⁾ / 3910 kW ²⁸⁾ (AC apparent power at higher DC voltages available on request)
Charging direction: AC power at 1200 V _{dc} cos φ = 1.0 and 25 °C / 40 °C / 50 °C ²⁹⁾	4129 kW ²⁸⁾ / 3759 kW ²⁸⁾ / 3453 kW ²⁸⁾ (AC apparent power at higher DC voltages available on request)
Maximum output current I _{AC, max} = Nominal AC current I _{AC, nom} at 25 °C / 40 °C / 50 °C	3850 A / 3504 A / 3273 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	690 V / 552 V to 759 V
AC grid frequency	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Min. short-circuit ratio at the AC terminals	> 2
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Power factor at rated power/displacement power factor adjustable by the SMA Service	1 / 0 overexcited to 0 underexcited
Efficiency	
Maximum efficiency, measured without energy self-sufficiency	98.8 %
Maximum operating altitude up to MSL 1000 m / 2000 m	Standard features / Optional

²⁸⁾ Depending on the share of reactive power (cos φ) and the DC voltage applied, an extended power derating may occur.

²⁹⁾ The specified power can be provided on a long-term basis. Depending on the ambient temperature or the inverter temperature, the maximum temperature-dependent nominal AC apparent power can occur.

17 Appendix

17.1 Ambient Conditions

Requirements for the mounting location:

- ☐ The mounting location must be freely accessible at all times.
- ☐ The permissible maximum value for non-condensing relative humidity must not be exceeded. The permissible range is: 0% to 95%.
- ☐ The permissible maximum value for condensing relative humidity must not be exceeded. The maximum value is: > 95% to 100% (up to two months per year).
- ☐ The fresh air consumption of the product must be assured. Fresh air consumption: 6500 m³/h.
- ☐ The mounting location must be below the maximum installation altitude.
- ☐ The system must have a minimum clearance of 30 m to radio equipment.
- ☐ The ambient temperature must be within the operating temperature range.
- ☐ The air quality in accordance with IEC 9223:2012 must be observed.
- ☐ The fresh air must comply with IEC60721-3-4 of classification 4S13.
- ☐ If the product is deployed at locations of the category C5 as per ISO12944-2, it will be subject to a higher concentration of chemically active substances which can affect the surface of the product. Such changes to the surface do not have any effect on the functionality of the product.

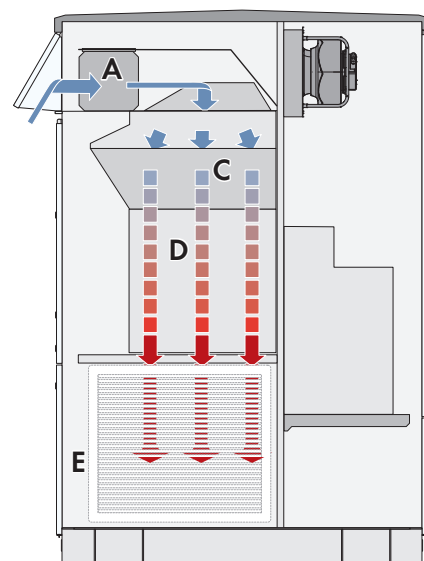
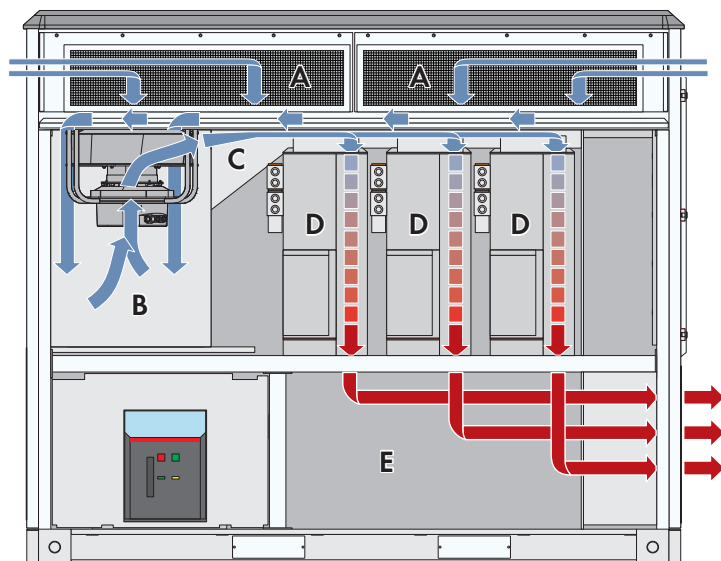
17.2 Air Circulation in the Inverter

The temperature in the inverter is controlled via two separate air circuits. In an air circuit, ambient air is drawn in, heated in the inverter and blown out again. The air circuit corresponds to the degree of protection IP34.

A second and parallel air circuit only circulates air inside the inverter. This air circuit corresponds to the degree of protection IP54. To meet the requirements of the degree of protection IP54, all transitions to other areas in the inverter must be sealed and protected against external influences.

The heat exchange between both air circuits takes place in the heat exchanger located in the roof of the inverter. The heat exchanger is constructed with separate ducts for the respective air ducts IP34 and IP54.

IP34



IP54

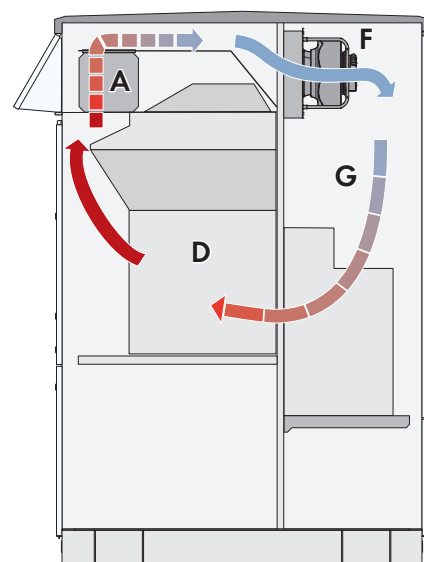
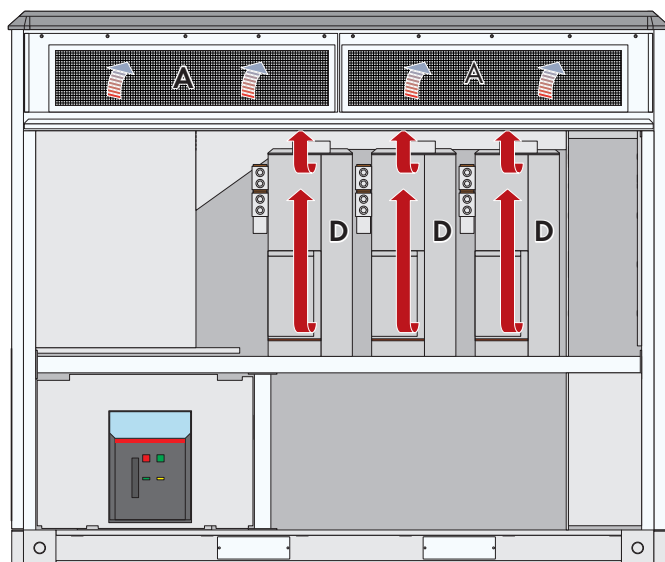


Figure 105: Air circulation in the inverter

Position	Designation
A	Heat exchanger
B	Main fan
C	Air duct
D	Inverter bridge
E	Area of the sine-wave filter choke
F	Fan of the DC area
G	DC area

Ambient air is drawn in through the main fan into the IP34 air duct and flows through the heat exchanger located in the roof of the inverter. The outside air subsequently passes the main fan, cools the underlying AC capacitors and is directed through the separate chambers in the inverter bridge. Each of the three chambers has a heat exchanger to efficiently cool the inverter bridges. Then the air flows through the area of the sine-wave filter choke and is finally expelled from the inverter laterally.

The air circuit with degree of protection IP54 does not come into contact with the ambient air. The air is cooled with help of the heat exchanger located in the roof of the inverter. This is done by flooding the warm air of the IP54 air circuit with the cooler ambient air of the IP34 air circuit so that the heat of the IP54 air circuit is transferred to the IP34 air circuit.

After the air inside the IP54 air circuit has been cooled down in the heat exchanger, it will be sucked in by the two fans of the DC area, transferred through the DC area and then through the chambers with the electronic components in the inverter bridges before it is cooled in the heat exchanger again.

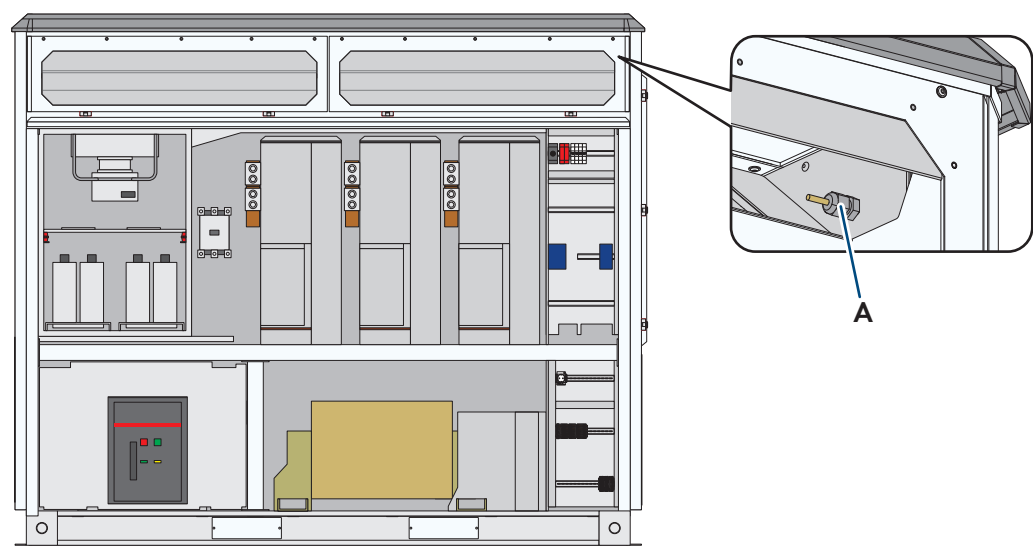


Figure 106: Position of the temperature sensor in the inverter

Position	Designation
A	Temperature sensor

The temperature of the air drawn in is measured in the area of the heat exchanger. Since a temperature exchange has already taken place, the temperature of the air drawn in no longer has the same value as the ambient temperature. The difference is generally 2 K to 4 K. This offset is compensated internally by the software. The difference in temperatures may be greater in the deactivated state as the heat from the sinusoidal filter choke rises and is measured by the sensor.

The temperature is measured with a PT100 temperature sensor.

17.3 Minimum Clearances and Free Spaces

The product must only be used in a closed electrical operating area. The locally applicable standards and directives must be complied with. The minimum clearances defined in the applicable standards and directives must be complied with.

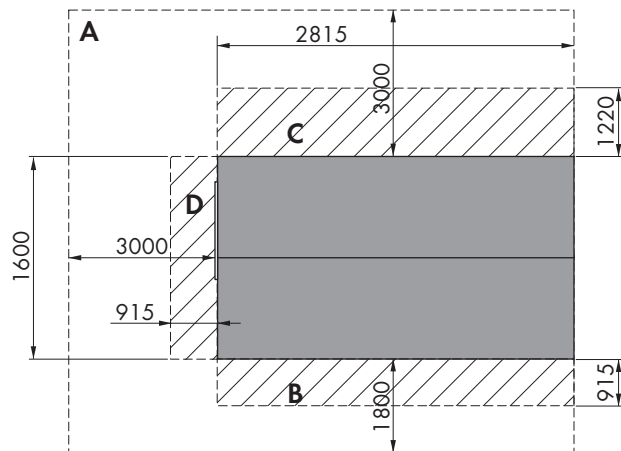


Figure 107: Clearances (Dimensions in mm)

Position	Designation	
A	Clearances for servicing	The area must be constructed of well-compacted earth (compaction at least 90%), gravel, tar, concrete, or similar material and be accessible.
B	Free space DC side	All ground-mounted areas must be paved, for example with concrete. It must be possible to put lifting aids and ladders on the surfaces.
C	Free space inverter bridge side	
D	Clearances on the operating side	The minimum clearances are to be determined in accordance with the <i>National Electrical Code</i> ® and in consultation with the responsible authorities. It depends on each individual project if functional clearances need to be maintained in addition.

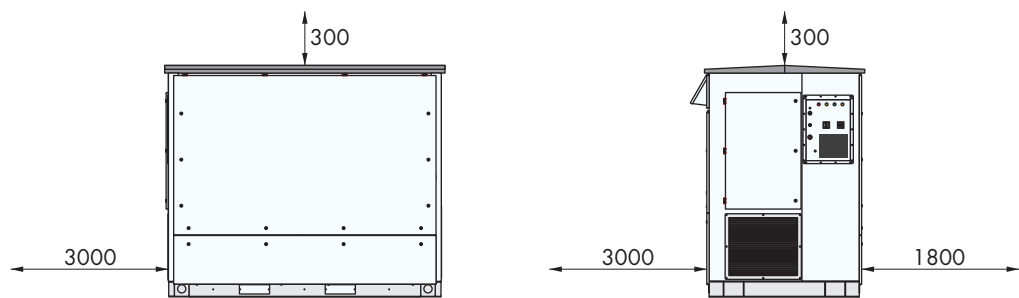


Figure 108: Minimum clearances for servicing (Dimensions in mm)

Requirements for the area surrounding the product:

i A safe repair and maintenance area is required.

The free spaces depicted above are required to allow for future servicing and maintenance of the equipment.

- ☐ The area must be permanently vehicle accessible.
- ☐ The area must be constructed of well-compacted earth (compaction at least 90%), gravel, tar, concrete, or similar material.
- ☐ The area must be suitable for use with lifting aids, truck mounted cranes, and forklift trucks.

- ☐ The area surrounding the product must be free of obstacles such as fences and barriers.
- ☐ The area can have a maximum grade of 3%.
- ☐ The area must be even with the foundation.
- ☐ The area must be compliant with the Occupational Safety & Health Regulation.
- ☐ The specific surface material can be agreed upon between the plant owner and SMA.
- ☐ The access routes to the product must be suitable for the use of lifting aids, truck mounted cranes and forklifts.

17.4 Foundation

17.4.1 Foundation Requirements

Requirements for the support surface:

- The support surface must be a dry and solid foundation, e.g. gravel.
- In areas subject to strong precipitation or high groundwater levels, a drainage system must be implemented.

Requirements for the subgrade:

- ☐ The level of compaction must be at least 98%.
- ☐ The soil pressure must be 150 kN/m².
- ☐ The unevenness at a distance of 100 mm must not exceed 5 mm.
- ☐ The unevenness at a distance of 1000 mm must not exceed 8 mm.
- ☐ The unevenness at a distance of 3000 mm must not exceed 10 mm.

Possible foundation types

The product can be mounted on different types of foundation. Possible foundation types include:

- Foundation slabs
- Pile-driven steel pillars

General requirements for foundations and platforms:

- ☐ The foundation must be suitable for the weight of the product and possible snow loads.
- ☐ The soil pressure must be 150 kN/m².
- ☐ The unevenness at a distance of 100 mm must not exceed 5 mm.
- ☐ The unevenness at a distance of 1000 mm must not exceed 8 mm.
- ☐ The unevenness at a distance of 3000 mm must not exceed 10 mm.
- ☐ In flood areas it is recommended to install the product on a raised position.
- ☐ The inclination must not exceed 1.5%.
- ☐ Prescribed safety measures such as railings or similar items must be installable or removable within ten minutes.
- ☐ It must be possible to use a manual pallet truck on the entire foundation area.

17.4.2 Dimensions and Openings in the Foundation

Variant: foundation

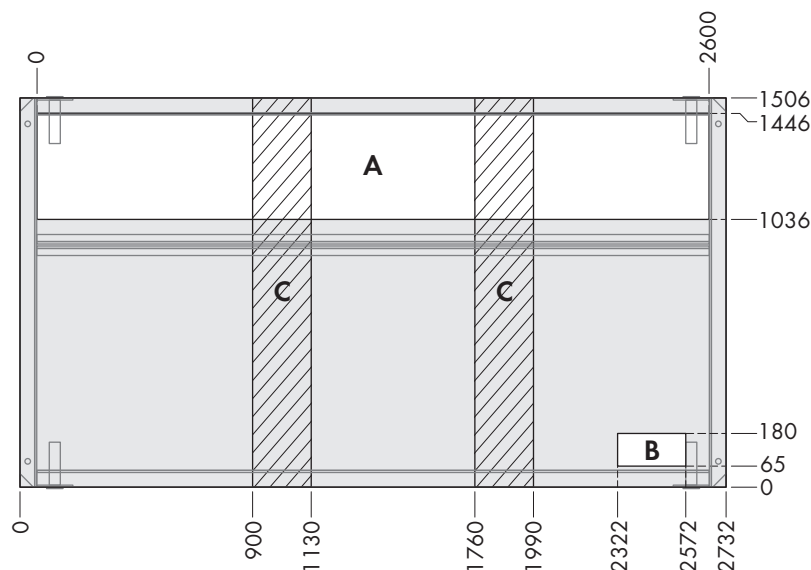


Figure 109: Minimum size of the foundation and position of the openings in the floor area for introduction of the cables (Dimensions in mm)

Position	Designation
A	Opening for introduction of the DC cable and the grounding cable
B	Opening for introduction of the cables for communication, control, and monitoring
C	Pick-up area for the crane fork of material handling equipment. There must be no conduits or cables in the area where the material-handling equipment is used for transportation.

Option: Pile-driven steel pillars

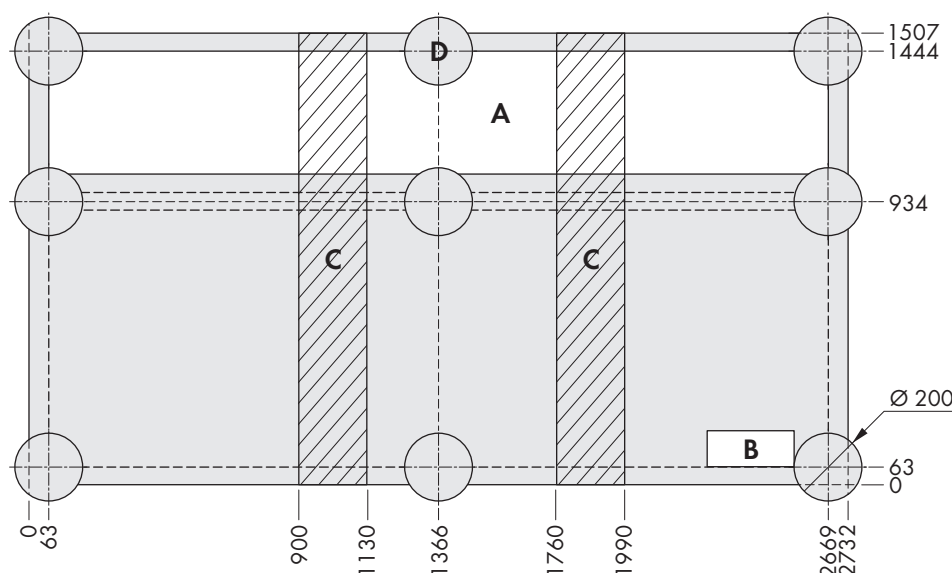


Figure 110: Arrangement of the pile-driven steel pillars and position of the openings in the floor area for introduction of the cables (Dimensions in mm)

Position	Designation
A	Openings in the floor area of the product to insert the DC cable and grounding cable

Position	Designation
B	Openings in the floor area of the product to insert the cables for communication, control and monitoring
C	Pick-up area for the crane fork of material handling equipment. There must be no conduits or cables in the area where the material-handling equipment is used for transportation.
D	Optional pile-driven steel pillar

17.5 Permitted Mounting Options

Mounting options: foundation or platform and minimum clearances

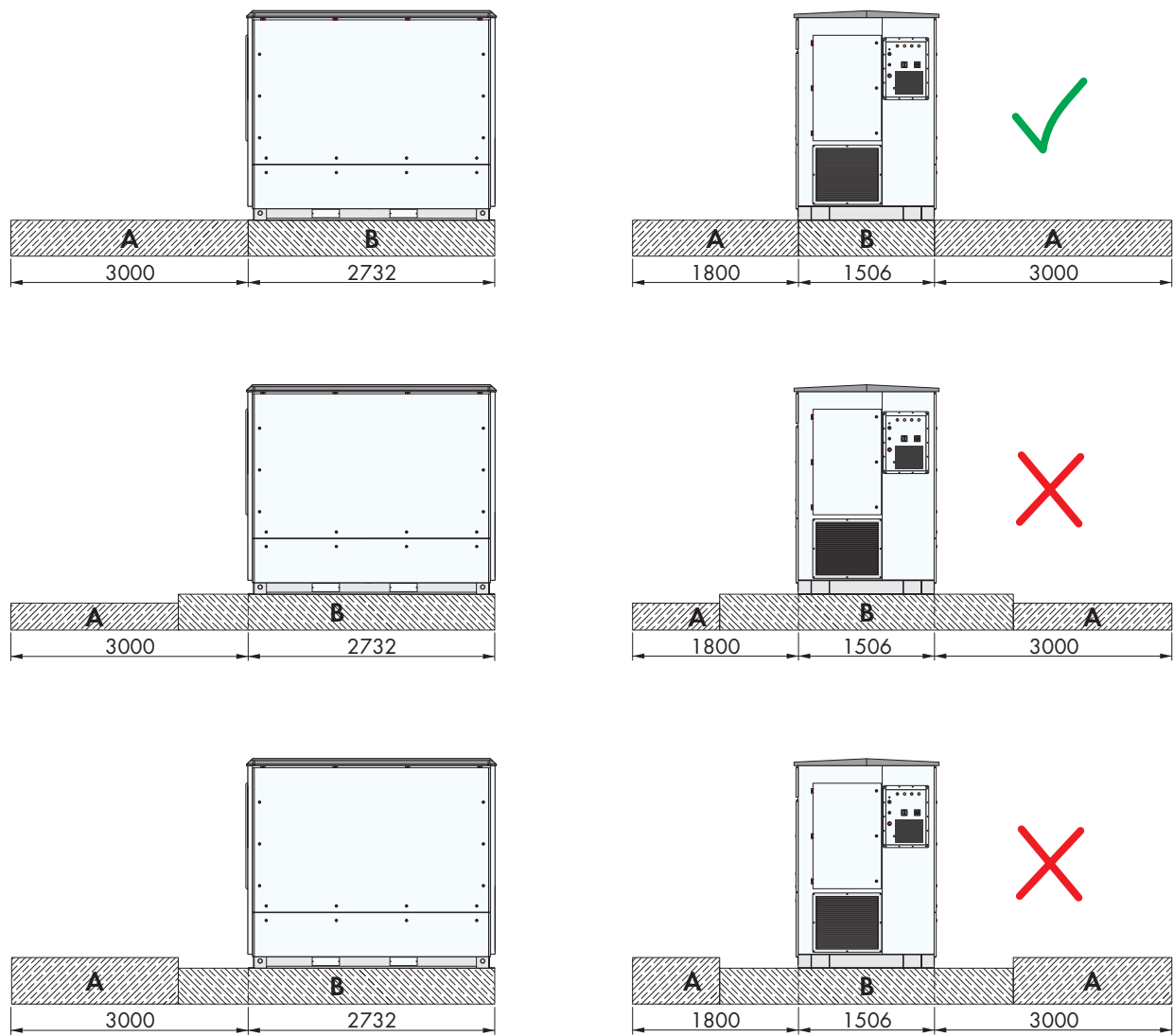


Figure 111: Mounting options: foundation and minimum clearances (Dimensions in mm)

Position	Designation
A	Free spaces
B	Foundation or platform

Mounting options: pile-driven steel pillars and minimum clearances

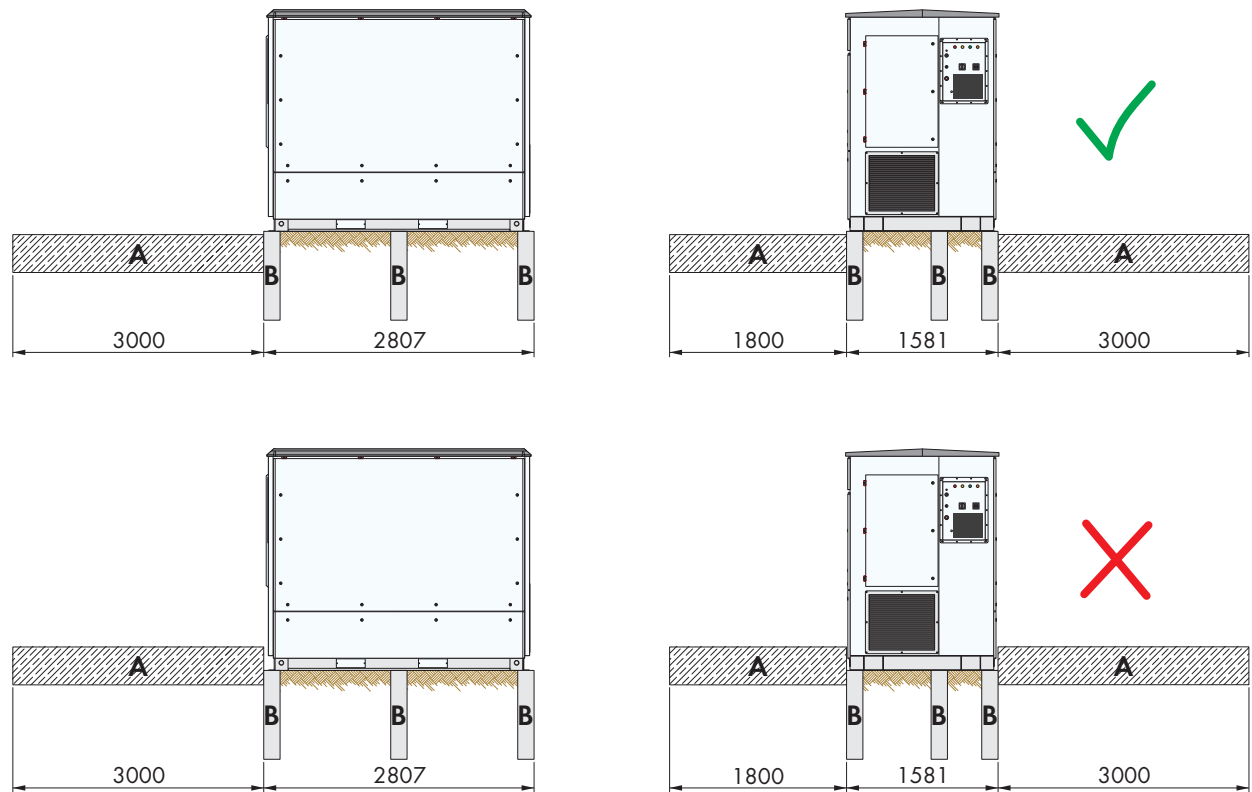


Figure 112: Mounting options: pile-driven steel pillars and minimum clearances (Dimensions in mm)

Position	Designation
A	Free spaces
B	Pile-driven steel pillars

Mounting options with the optional sound absorbers

By mounting the sound absorbers, the direction of the exhaust air changes. It must be ensured that the warm exhaust air of an inverter is not sucked in by an adjacent inverter.

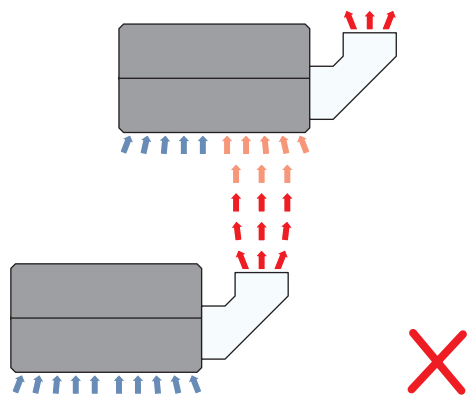


Figure 113: Set-up options of several inverters (top view)

17.6 Dimensions of the Inverter

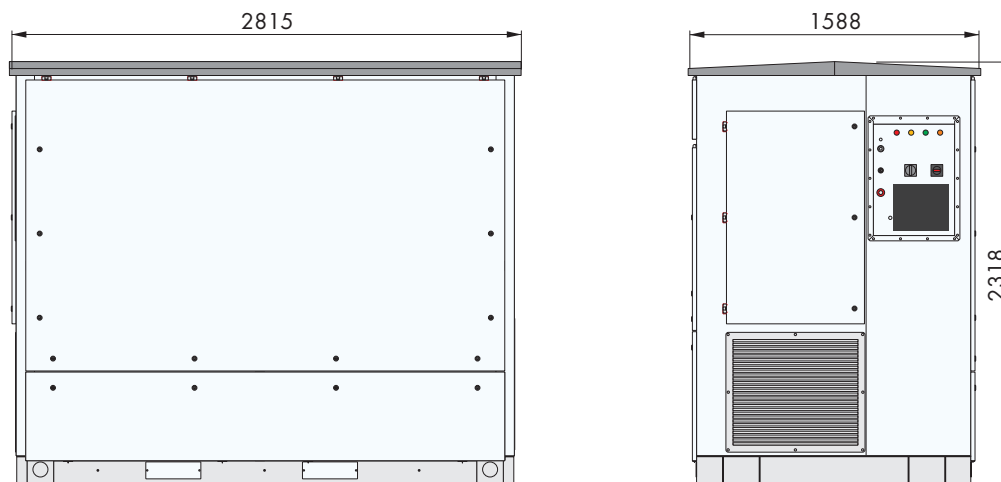


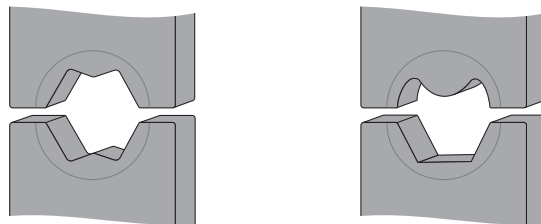
Figure 114: Dimensions of the inverter (Dimensions in mm)

17.7 Recommendations for mounting the terminal lugs

Proper installation of the terminal lugs on the cable is required for a correct connection and faultless operation of the product. We recommend using crimped terminal lugs, as proper crimping means a higher conductivity of the connection and lower space requirements.

Observe the following factors:

- ☐ Type of crimping in relation to the cable cross-section and type of cable
WM crimp and 6-mandrel crimping are the types most frequently used.

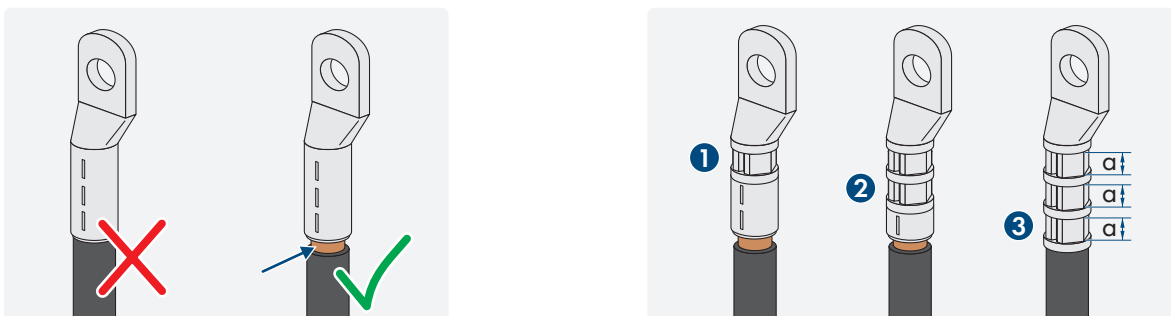


- ☐ Use of a tool and material recommended by the terminal lug manufacturer
- ☐ Regular calibration of the tool
- ☐ Ensuring clean contact surfaces

In order to connect the terminal lug and cable without errors, we recommend observing the following points:

- ☐ The terminal lugs must not be attached to the insulation of the cable. Keep in mind that crimping makes the terminal lug 10% longer so that the insulation is accordingly further away.

The number and sequence of the crimps depends on the cross-section of the cable. Marking on the terminal lug shows the number of crimps required for the terminal lug used. Make sure that the crimps are not turned in relation to each other and that they are evenly spaced.



- ☐ The cable and terminal lug must be fully crimped to avoid gaps between the individual conductors. This reduces the contact resistance and prevents the contact from heating up, which can lead to damage.



17.8 Measurement accuracy

The inverter is not equipped with a calibrated meter. The values on the user interface can deviate from the actual values and must not be used as a basis for billing. The inverter's measured values are required for the system management and to control the current to be fed to the grid.

Deviation:

- Voltage measurement: $\pm 5 \text{ V}$
- Frequency measurement: $\pm 0.06 \text{ Hz}$
- Disconnect time: $\pm 0.1\%$

17.9 Overall System Requirements

- ☐ When designing the components of the battery storage system, you should take account of the maximum inrush current.
- ☐ During configuration, you should take account of the fact that the closed-loop control of the compensation plant on the MV side does not affect the closed-loop control of the inverter.
- ☐ When configuring the battery storage system, the relay times of the various medium-voltage switchgear must be coordinated with each other. This means that only PV systems, in which a disturbance has occurred, are disconnected from the utility grid.

17.10 Structure of names for parameters and instantaneous values

The names of parameters and instantaneous values are allocated over the entire system according to a standardized concept. Accordingly, the names are made up of acronyms as defined in the standard IEC 61850.

In general, a name looks like this: **Modulecode.Namepart1.Namepart2**

- A name can consist of several parts each separated by a period. A name can consist of 3 parts.
- Parameters and instantaneous values only consisting of one part, pertain to the overall inverter.
- The name begins with the module code to which the parameter or instantaneous value refers. In this way, the parameters and instantaneous values that belong to a process or a hardware component, for example, are grouped.
- A part of a name can consist of several acronyms which together describe what the parameter or instantaneous value represents. The names are organized according to a tree structure.

The main module acronyms are explained below:

Module acronym	Description
Bat	Parameters for monitoring the battery
BatCtl	Parameter for controlling the battery
Bsc	Parameter of the battery system controller
Cnt	Energy meter for different instantaneous values
DcMs	Monitoring of the DC values

Module acronym	Description
Dcs	DC coupled storage system
Frt	Parameters for grid support
GriMng	Parameters for grid management services
GriMs	Monitoring of the utility grid
HzCtl	Parameters for monitoring the power frequency
InvMs	Monitoring of AC values
Mpp	Parameters for MPP tracking
PFCtlW	Parameters for power-dependent reactive power control
VArCtlVol	Parameters for voltage-dependent reactive power control
VCtl	Parameters for monitoring the grid voltage
WCtlHz	Parameters for frequency-dependent active power control

17.11 FTP-push protocols Used

The data collected from your PV system can be saved as an CSV file to a local FTP server. 4 different protocols can be used to transfer data with the FTP push function:

- **Active FTP:** The client opens a random port and sends the port number and its own IP address to the server. The communication with commands is only performed on the control port so that the communication partners can continue to communicate during data transmission. This protocol requires at least 2 separate connections.

Port of FTP server: Port 21 (default setting)

- **Passive FTP:** The client sends a request to the server. The server then opens a port and sends the port number and IP address to the client. This method is used if the server is unable to connect to the client. This may be due to the fact that the client's network is shielded from external access by a firewall. This protocol operates only with 1 connection between client and server.

Port of FTP server: Port 21 (default setting)

- **SFTP:** This protocol uses an SSH protocol for encrypted data communication. This protocol operates only with 1 connection between client and server.

Port of FTP server: Port 22 (default setting)

To use this protocol, a certificate of the server operator is used. In addition, this certificate can be protected by a password. The password and certificate are provided by the server operator.

- **FTPS:** This protocol uses SSL for encrypted data communication. Encryption with this protocol requires at least 2 separate connections.

Port of FTP server: Port 21 (default setting)

17.12 Information on Data Storage

The internal memory of the inverter can store the following data:

Type of data	Memory size
Events	10000 entries in the ring buffer
Measured values	Max. 1000 data points per second

The communication interface is delivered with a permanently installed CF memory card. Updates, events, measured values and export files, for example, can be stored on the CF memory card. 2 GB are available for this.

17.13 Reaction Speed of the Modbus Control

In order to meet the specifications of the electric utility company, the inverter must observe a particular reaction speed when implementing control commands via Modbus.

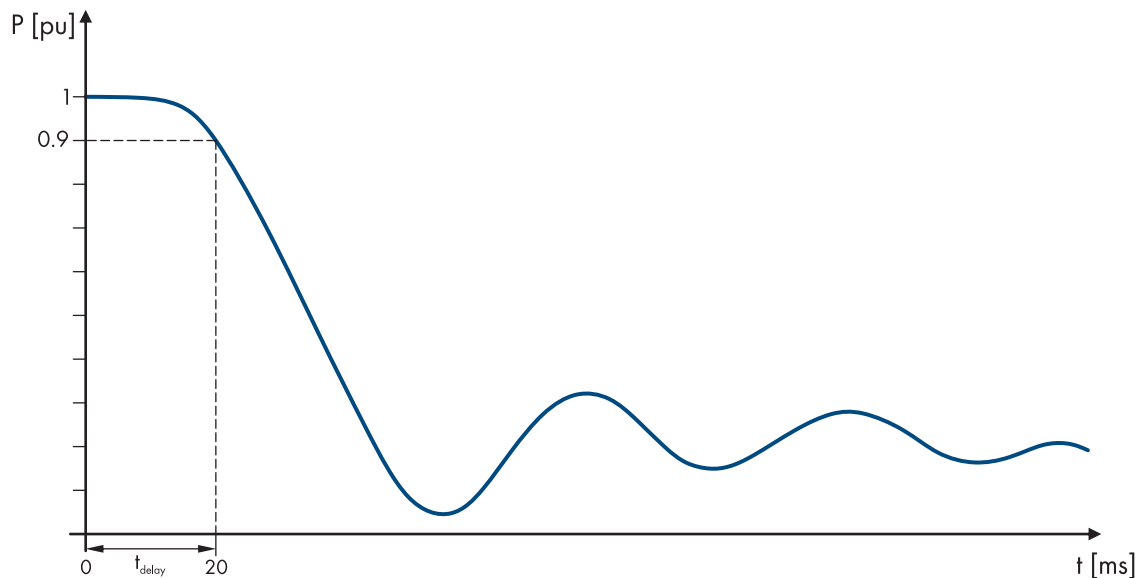


Figure 115: Reaction speed of the Modbus commands in the inverter

The reaction time T_{delay} is the time that the inverter requires to change the power on the AC side of the inverter by ten percent towards the new output value after having received a Modbus control command. The ten percent refer to the difference between the old and the new output value.

17.14 Scope of Delivery

The scope of delivery is located in the DC connection area of the inverter. You can find a content list in the "Delivery" checklist.

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

18 Contact

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

- Device type
- Serial number
- Firmware version
- Event message
- Type and size of additional energy sources
- Optional equipment, e.g. communication products
- Detailed description of the problem

You can find your country's contact information at:



<https://go.sma.de/service>

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