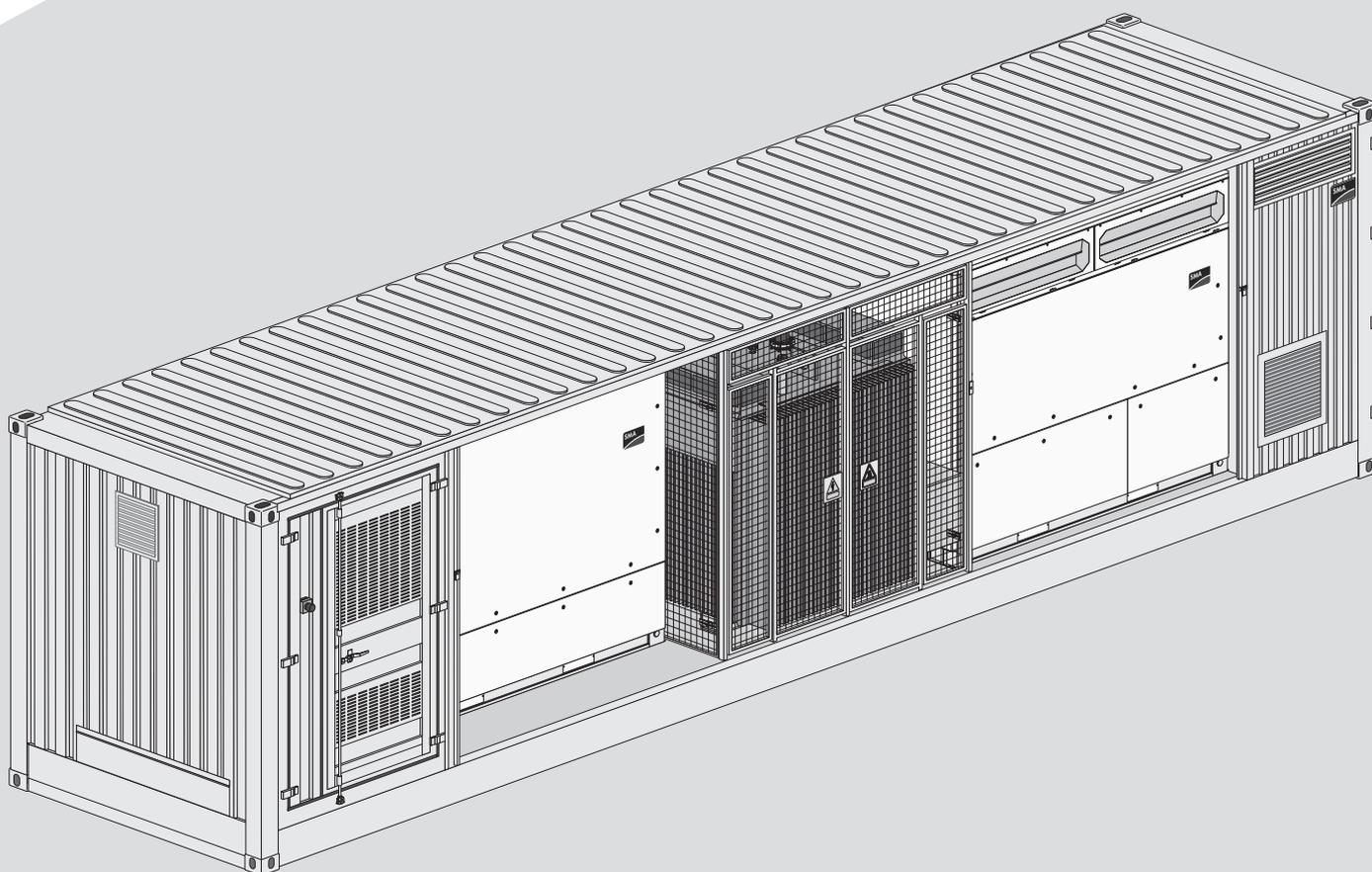


System Manual

# MEDIUM VOLTAGE POWER STATION with 2 SUNNY CENTRAL



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# 1 Information on this Document

## 1.1 Validity

This document is valid for:

### Medium Voltage Power Station from production version B3

- MVPS-4400-20 (medium voltage power station 4400)
- MVPS-4950-20 (medium voltage power station 4950)
- MVPS-5000-20 (medium voltage power station 5000)
- MVPS-5500-20 (medium voltage power station 5500)
- MVPS-6000-20 (medium voltage power station 6000)

### Inverters from product version B3 and firmware version 6.00.xx.R

- SC-2200-10 (Sunny Central 2200)
- SC-2475-10 (Sunny Central 2475)
- SC-2500-EV-10 (Sunny Central 2500-EV)
- SC-2750-EV-10 (Sunny Central 2750-EV)
- SC-3000-EV-10 (Sunny Central 3000-EV)

Depending on the functions and selected options, individual sections may be irrelevant for installation and operation.

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

SMA Solar Technology reserves the right to make changes to the 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
- Training in how to deal with the dangers and risks associated with installing, repairing and using electrical devices and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of all applicable laws, standards and directives
- Knowledge of and compliance with this document and all safety information

## 1.3 Levels of Warning Messages

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

### DANGER

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

### WARNING

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

### CAUTION

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

## NOTICE

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

### 1.4 Symbols in the Document

Symbol	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
<input type="checkbox"/>	Indicates a requirement for meeting a specific goal
<input checked="" type="checkbox"/>	Desired result
<b>x</b>	A problem that might occur
	Example
	The description is applicable for use on the touch display.
	The description is applicable for use via Internet access.

### 1.5 Typographies in the Document

Typography	Use	Example
<b>bold</b>	<ul style="list-style-type: none"> <li>Messages</li> <li>Terminals</li> <li>Elements on a user interface</li> <li>Elements to be selected</li> <li>Elements to be entered</li> </ul>	<ul style="list-style-type: none"> <li>Connect the insulated conductors to the terminals <b>X703:1</b> to <b>X703:6</b>.</li> <li>Enter <b>10</b> in the field <b>Minutes</b>.</li> </ul>
>	<ul style="list-style-type: none"> <li>Connects several elements to be selected</li> </ul>	<ul style="list-style-type: none"> <li>Select <b>Settings &gt; Date</b>.</li> </ul>
[Button] [Key]	<ul style="list-style-type: none"> <li>Button or key to be selected or pressed</li> </ul>	<ul style="list-style-type: none"> <li>Select <b>[Enter]</b>.</li> </ul>
#	<ul style="list-style-type: none"> <li>Placeholder for variable components (e.g., parameter names)</li> </ul>	<ul style="list-style-type: none"> <li>Parameter <b>WCiHz.Hz#</b></li> </ul>

### 1.6 Designation in the document

Complete designation	Designation in this document
Medium Voltage Power Station	MV Power Station
Medium-voltage switchgear	MV switchgear
Medium-voltage transformer	MV transformer
Sunny Central	Inverter

The products installed in the MV Power Station, such as the inverters and the MV transformer, are also referred to as components.

## 1.7 Additional Information

For more information, please go to [www.SMA-Solar.com](http://www.SMA-Solar.com).

Title and information content	Type of 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](http://www.abb.com):

Component	Document number
DC switchgear: T-Max	1SDH000707R0001
AC disconnection unit: E-Max	1SDH000460R0003

## 2 Safety

### 2.1 Intended Use

The MV Power Station is a complete system for PV power plants. All components that are necessary to convert the direct current generated by the PV modules into alternating current and to feed this current into the medium-voltage grid are a part of the MV Power Station including the Sunny Central. The Sunny Central is a PV inverter which converts the direct current generated in the PV modules into alternating current. The MV transformer feeds the generated alternating current into the utility grid.

#### Environment

The product is intended for use in industrial environments.

The product is designed for outdoor use only.

The inverter is classified under Class 4C2 as per IEC 60721-3-4 and is suitable for operation in a chemically active environment. The inverter corresponds to degree of protection IP65 and can also be operated in rain, sleet and snow.

Operation of the MV Power Station is only permitted providing that the maximum permissible DC input voltage, AC output voltage and the required ambient conditions are adhered to. The maximum permissible DC input voltage, AC output voltage and the required ambient conditions are subject to the respective configuration of the MV Power Station. Ensure that the ambient conditions and the maximum permissible voltage are complied with prior to commissioning the MV Power Station.

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

It is only permitted to use the product in a PV power plant which is designed as a closed electrical operating area as per IEC 61936-1.

The inverter is suitable for operation with grounded and insulated PV arrays.

An overvoltage test according to IEEE C37.90.1 at a voltage of up to 2.5 kV was carried out for the inputs in the control path.

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 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 Terminal

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

The maximum DC short-circuit current is  $I_{ks\ DC} = 6.4\text{ kA}$ .

#### AC Terminal

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

#### Statutory Warranty

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

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

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

This document does not replace and is not intended to replace any local, state, provincial, federal or national laws, regulations or codes applicable 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

### SAVE THESE INSTRUCTIONS

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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- 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**

When exposed to light, the PV modules generate high DC voltage which is present in the DC cables. Touching live DC cables results in death or lethal injuries 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 system 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 from electric shock from improperly operating the tap changer of the MV transformer**

Operating the tap changer of the MV transformer while energized will create a short circuit in the MV transformer. The resulting voltages will lead to death or serious injury.

- Only operate the tap changer when the MV transformer is fully de-energized.
- Have a duly authorized person ensure that the MV transformer is de-energized prior to any work or adjustments to settings.
- Any work on the MV transformer or adjustments to settings may only be performed by qualified service partners.
- Wear suitable protective equipment for all work.

**⚠ 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. Touching live parts will result in death or serious injury due to electric shock.

- 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.
- 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 PV power plant**

Lethal ground currents due to damaged insulations of the PV field. Lethal electric shocks can result.

- Ensure that the insulation resistance of the PV array exceeds the minimum value. The minimum value of the insulation resistance is: 14 k $\Omega$ .
- Before entering the PV field, switch the PV power plants with ground fault monitoring to insulated operation.
- After entering the PV power plant, immediately ensure that the inverter does not display an insulation error.
- Disconnect the product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- Wear suitable personal protective equipment for all work on the product.
- Configure the PV power plant as a closed electrical operating area.

**⚠ WARNING****Danger to life due to arc fault in the event of faults in the MV switchgear**

If there is a fault in the MV switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. The pressure of the arc fault is diverted to the side of the station container.

- Only perform work on the MV switchgear when it is in a de-energized state.
- Prior to commissioning and operating the MV switchgear, close the MV switchgear kick plate.
- All work and switching operations on the MV switchgear may only be performed by qualified persons wearing adequate personal protective equipment.
- Open and secure the medium-voltage compartment door fully prior to performing switching operations.
- It is imperative that the escape route is freely accessible at all times.
- Prior to performing switching operations, ensure that no persons or flammable materials are within the internal arc pressure safety area.
- Ensure that the covering plate in front of the electric-arc opening has been removed.
- All persons that are not in the medium-voltage compartment are to keep a safe distance from the product when switching operations are performed. The internal arc pressure safety area is to be cordoned off.
- Only perform switching operations on the MV switchgear in the medium-voltage compartment.

**⚠ WARNING****Danger to life from electric shock when entering the PV power plant outside of the feed-in operation**

With the order option "Backfeed Power", DC voltage can be applied to the inverter outside of the feed-in operation. Lethal electric shocks can result.

- Before entering the PV power plant, make sure via the user interface that the inverter is not in backfeed power mode.
- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the PV power plant.
- Wear suitable personal protective equipment for all work on the product.
- Configure the PV power plant as 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 inverter 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 inverter, 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 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 from collapse of roof under excessive snow load**

If the maximum permissible snow load is exceeded, the roof of the product may collapse or snap. As a result, persons can be injured by falling metal parts.

- Prior to entering the product, ensure that the snow load on the roof is not exceeded. The maximum permissible snow load is: 2500 N/m<sup>2</sup>.
- Keep roof free of snow.
- Wear suitable personal protective equipment for all work on 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.

**⚠ CAUTION****Risk of injury due to doors being opened in strong winds**

The doors of the MV Power Station are secured via a latch when opened. When winds are high, the shear force generated by the wind can pull the latch out of the stay. This can result in injuries or property damage.

- Do not open the doors of the MV Power Station during high winds.

**⚠ CAUTION****Danger of slipping due to wet conditions**

Wet conditions can lead to slippery surfaces. This can result in minor injuries.

- Ensure that the floors are dry prior to accessing the product.
- Lay out anti-slip mats where necessary.
- Wear personal protective equipment for all work on the product.

**NOTICE****Unwanted inverter 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 inverter. It can lead to the inverter switching off due to voltage limits being undershot. This can result in yield losses.

- Before changing the parameter by simulation, ensure that the grid stability at the AC connecting rails of the inverter as well as at the grid-connection point 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 PV farm 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 inverter 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 the control gear for PV farm must be adjusted.
- Ensure that the grid limits at the AC connecting rails of the inverter 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 PV power plant at the grid-connection point are observed.

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

Sand, dust and moisture penetration can damage the system 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.

**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 24-month-maintenance check that is not subject to the maintenance schedule.
- 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.

## NOTICE

### Damage to the oil tray due to ice

Water in the oil tray can freeze at low temperatures and damage the oil tray.

- Check the oil spill containment regularly for water. Remove water (if necessary).
- Ensure that the water can drain off.

### **i** Electromagnetic compatibility of MV transformers without shield winding

MV transformers without shield winding can compromise the functioning of electrical devices. The shield winding reduces harmonics, protects against surge voltage peaks and reduces disturbances of ripple control signals.

- The MV transformer should be ordered with shield winding.
- Electromagnetic compatibility requirements must be observed in terms of adjacent devices.

## 2.3 Personal Protective Equipment

### **i** 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

Any other prescribed protective equipment must also be used.

When carrying out work on live parts of the inverter, protective equipment of the respective 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.

Always wear suitable protective equipment when performing switching operations on the MV switchgear. 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](http://www.SMA-Solar.com).

### 3 Product Overview

#### 3.1 System Overview

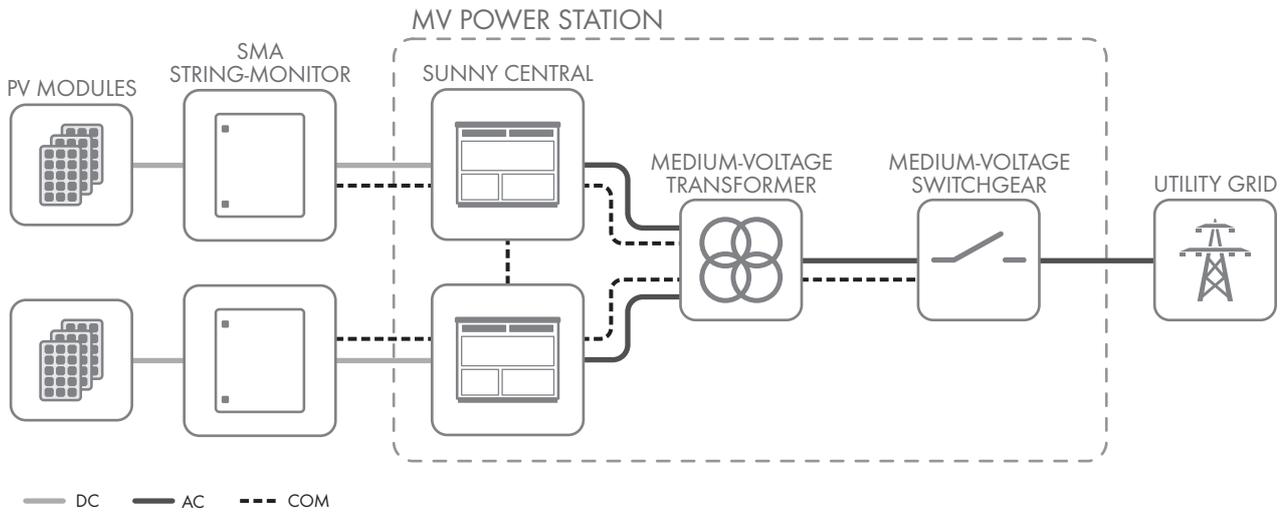


Figure 1: Design of the system (example)

#### 3.2 Design of the MV Power Station

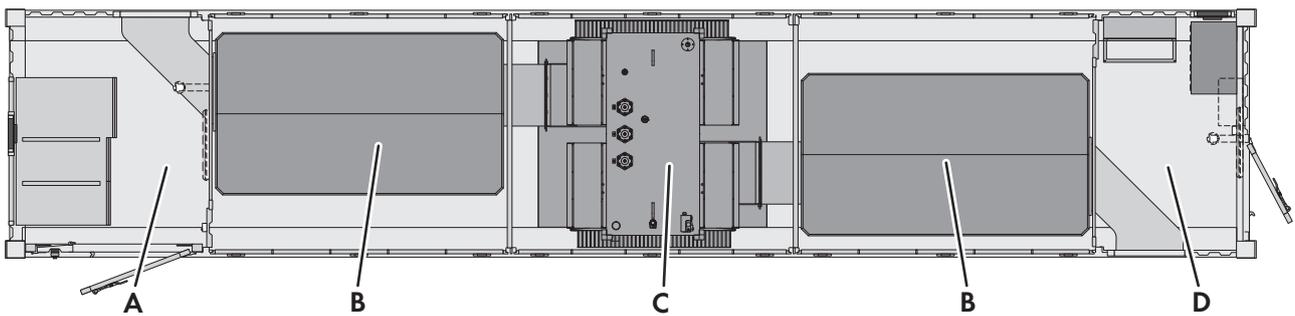


Figure 2: Design of the MV Power Station

Position	Designation	Explanation
A	Medium-voltage compartment	<b>MV switchgear</b> The MV switchgear connects and disconnects the MV transformer to and from the medium-voltage grid.
B	Sunny Central	The Sunny Central is a PV inverter that converts the direct current generated in the PV arrays into grid-compliant alternating current.
C	MV transformer	The MV transformer converts the inverter output voltage to the voltage level of the medium-voltage grid.

Position	Designation	Explanation
D	Low-voltage compartment	<p><b>Station subdistribution</b></p> <p>The station subdistribution contains fuse and switching elements for the supply voltage.</p> <hr/> <p><b>MV Power Station low-voltage transformer</b></p> <p>The low-voltage transformer provides the supply voltage for the MV Power Station and its components.</p> <hr/> <p><b>Customer installation location</b></p> <p>The MV Power Station customer installation location is reserved for customer-supplied devices.</p>

### 3.3 Devices of the Medium-Voltage Compartment

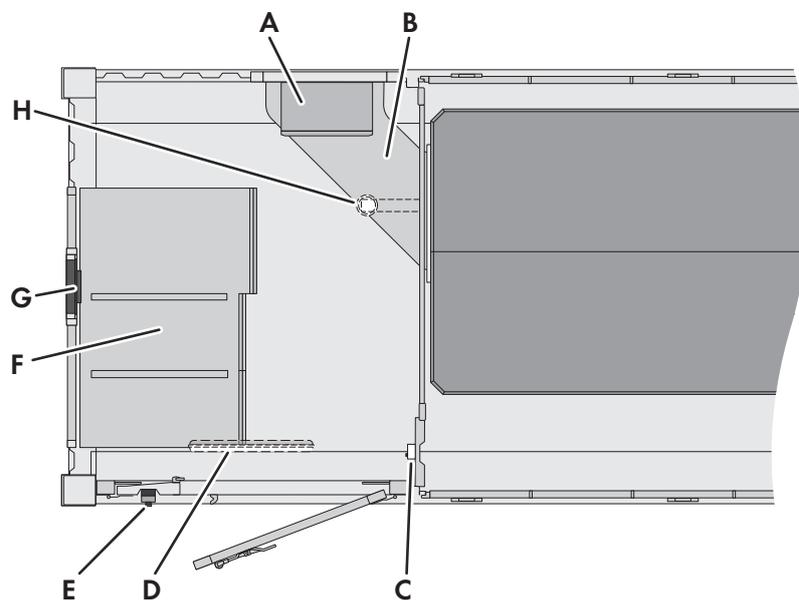


Figure 3: Devices of the medium-voltage compartment (example)

Position	Designation
A	Cascade control*
B	Exhaust channel of the inverter
C	Light switch and outlet
D	Lighting
E	Fast-stop switch*
F	MV switchgear
G	Fans*
H	Heat detector*

\* Optional

### 3.4 Low-Voltage Compartment Components

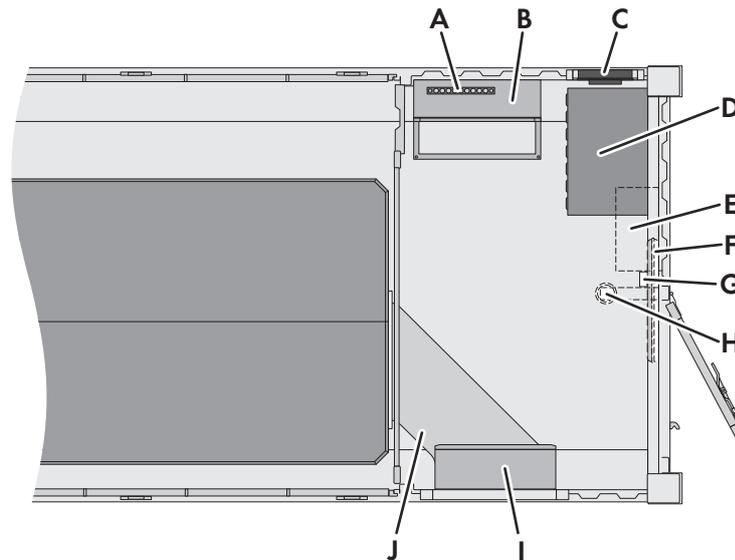


Figure 4: Low-voltage compartment components

Position	Designation
A	Grounding busbar for the low-voltage compartment and customer devices
B	Station subdistribution
C	Fans*
D	Low-voltage transformer*
E	Customer installation location
F	Lighting
G	Light switch and outlet
H	Heat detector*
I	Uninterruptible power supply (UPS)*
J	Exhaust channel of the inverter

\* Optional

The MV Power Station customer installation location is reserved for customer-supplied devices. The customer installations must satisfy the following requirements:

- The maximum dimensions of the customer installations may not exceed 1000 mm x 600 mm x 300 mm (height x width x depth).
- Maximum connection power for customer installations: power of the low-voltage transformer less 20 kVA
- Connection voltage for customer installations: 230 V / 400 V  $\pm$ 10% tolerance, 50 Hz / 60 Hz
- Maximum power loss of customer installations: 1 kW

### 3.5 Station Subdistribution

All fuse switches for the MV Power Station are located in the station subdistribution. The subdistribution is still the central connection point for communication. The positions of the components can vary depending on the order option. Reference designations are attached to the individual devices of the station subdistribution.

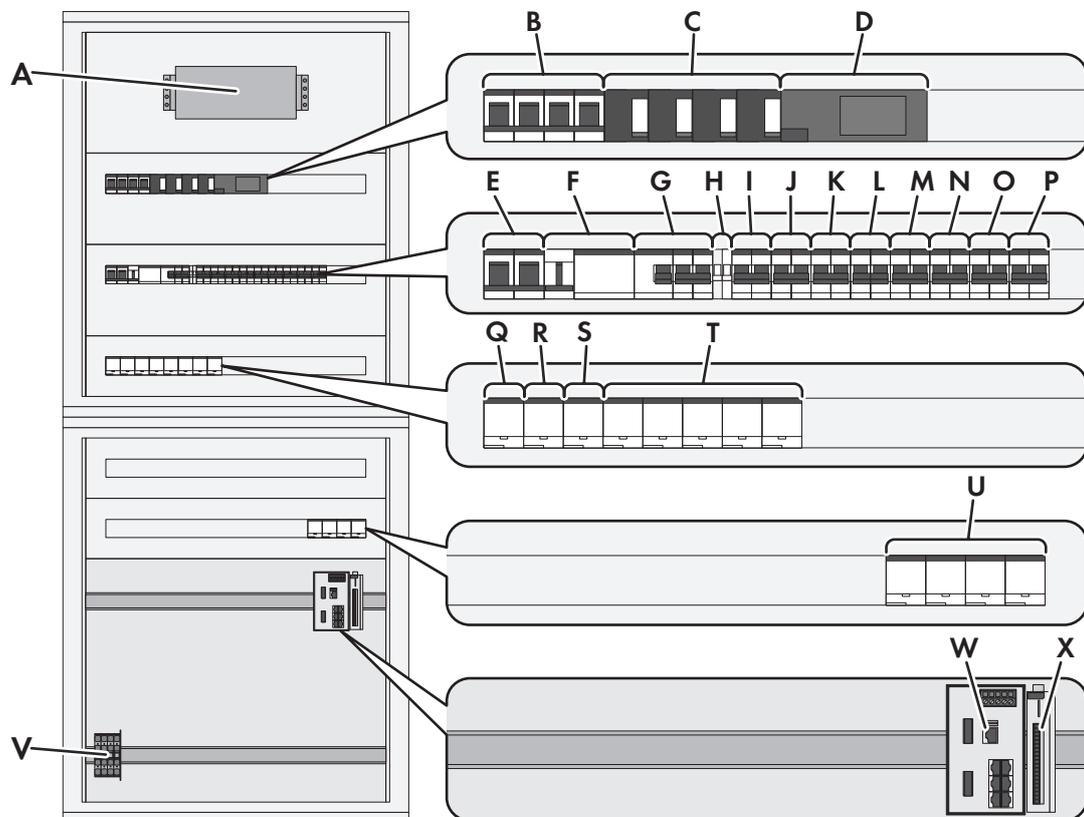


Figure 5: Devices in the station subdistribution (example)

Position	Designation
A	Low-voltage transformer EMC filtering device
B	Station subdistribution main switch
C	Surge arrester
D	Low-voltage meter*
E	Circuit-breakers for the outlets
F	Residual-current devices for the outlets
G	Circuit breaker and residual-current device for the MV transformer
H	Contacts for the safety chain
I	Circuit breaker for the safety chain
J	Circuit breaker for the lighting
K	Circuit breaker for the fan in the low-voltage compartment*
L	Circuit breaker for the fan in the medium-voltage compartment*
M	Circuit breaker for the heating in the station subdistribution

Position	Designation
N	Cascade control circuit breaker*
O	Circuit breaker of uninterruptible power supply*
P	Circuit breaker of low-voltage meter*
Q	Multi-voltage supply switch (24 V supply from inverter 1 or 2)
R	Relay for the safety chain
S	Voltage supply for fan monitoring
T	Fan monitoring devices for the fans 1 to 10 on the MV transformer
U	Fuse switch-disconnector for the low-voltage transformer
V	Terminal for external supply voltage*
W	Connecting the communication unit*
X	Fiber media converter or terminals for monitoring*

\* Optional

Further details are to be found in the circuit diagram.

### 3.6 Uninterruptible power supply

The MV Power Station can be equipped with an uninterruptible power supply depending on the order option. During grid incidents of the supply voltage for the MV Power Station, the power supply for the loads can be ensured for a certain time.

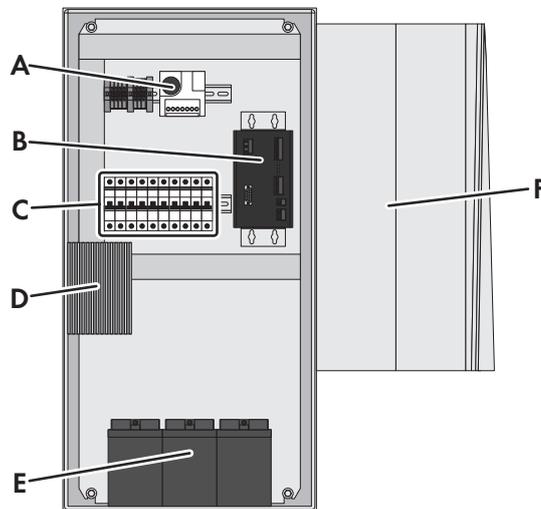


Figure 6: Devices of the UPS (example)

Position	Designation
A	Thermostat
B	Control module
C	Fuse switch
D	Heating

Position	Designation
E	Battery
F	Air conditioner

The uninterruptible power supply powers:

- MV Power Station monitoring
- Communication of MV Power Station
- Remote control of the MV switchgear motor-driven circuit breaker
- Customer devices

Depending on the order option, the following power classes for customer-supplied devices are available:

UPS output power	Available power for the customer
24 V / 200 W for 1 h	approx. 180 W
230 V / 500 W for 1 h	approx. 470 W

If the springs of the MV switchgear are tensioned by the motor or in the event of switching operations via MV switchgear remote control, less power is available for up to 15 seconds.

### 3.7 MV Power Station Low-Voltage Transformer

With the order option "LV Transformer", the MV Power Station is equipped with a low-voltage transformer. The low-voltage transformer of the MV Power Station provides the supply voltage for the inverter, MV transformer, lighting, outlets and customer-supplied devices (see MV Power Station circuit diagram). The low-voltage transformer is equipped with an EMC filtering device and is fused via a dedicated fuse switch-disconnector.

Depending on the ordered low-voltage transformer, the following power classes for customer-supplied devices are available:

Power of the low-voltage transformer	Available power for the customer
30 kVA	10 kVA
40 kVA	20 kVA
50 kVA	30 kVA
60 kVA	40 kVA

### 3.8 Low-Voltage Meter

The "LV Meter" option enables measurement of the power consumption of the entire MV Power Station. For this purpose, a low-voltage meter is installed in the station subdistribution. The low-voltage meter measures current, voltage, power and other values with the UMG 604E power analyzer from Janitza electronics GmbH.

Low-voltage meter for	Required transducers
Measuring the self-consumption of the MV Power Station	Four current transformers with voltage tap are installed. The transformers and converters are connected in the station subdistribution downstream the main switch (for information on wiring, refer to the circuit diagram).

Communication with the low-voltage meter is via the RS485 interface and Ethernet (for operating information, refer to the documentation of the low-voltage meter). With the option without "Communication Package", the communication terminal is located on the DIN rail of the station subdistribution. With the option with "Communication Package", the low-voltage meter is connected directly to the managed switch. Laying the communication cables is within the responsibility of the customer.

Available power	Accuracy class of converter	Accuracy class of measuring device
30 kVA	1 for 35 A	0.5
40 kVA	0.5 for 64 A	
50 kVA	1 for 100 A	
60 kVA	1 for 100 A	

### 3.9 Design of the Inverter

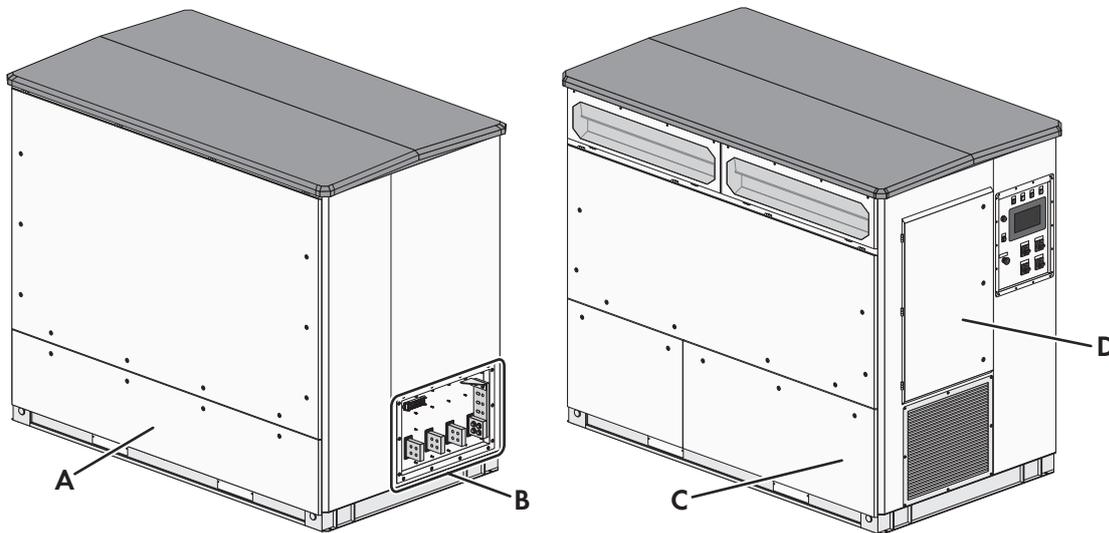


Figure 7: Design of the inverter

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

### 3.10 Components of the Medium-Voltage Transformer

The MV transformer is the link between the inverter and the medium-voltage grid.

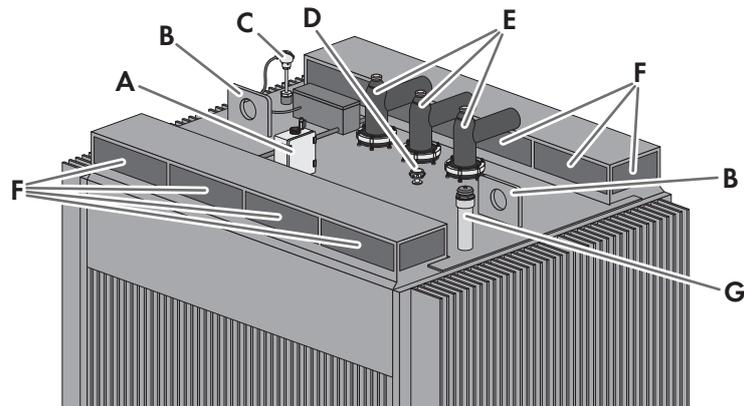


Figure 8: Devices of the MV transformer

Position	Designation
A	Hermetic protection device*
B	Lifting lugs
C	Thermometer PT100
D	Tap changer for adjusting the transmission ratio*
E	High-voltage enclosure openings for the AC cables
F	10x fans
G	Oil filler neck with pressure relief valve*

\* Optional

### 3.11 MV Switchgear Components

The MV switchgear is used to disconnect the MV Power Station from the medium-voltage grid.

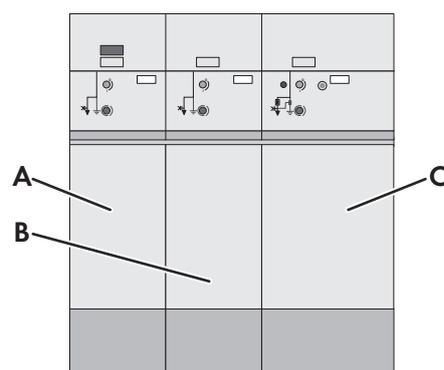


Figure 9: MV switchgear components (example)

Position	Designation
A	Outer cable panel with load-break switch
B	Central cable panel with load-break switch
C	Transformer panel with circuit breaker

### 3.12 Oil spill containment

The MV Power Station is equipped with an integrated oil spill containment depending on the order option. The oil spill containment collects oil which may leak from the MV transformer under fault conditions.

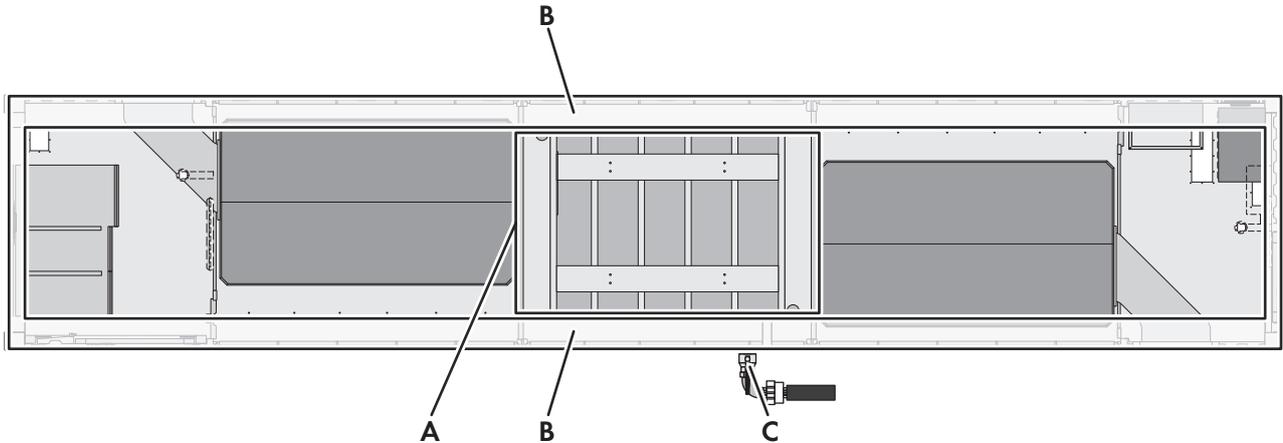


Figure 10: Position of the oil spill containment

Position	Designation
A	Integrated oil spill containment below the MV transformer
B	Oil spill containment in the station container substructure
C	Oil filter

The MV Power Station oil spill containment is integrated into the floor and the station container substructure. In the event of damage, the MV transformer oil runs directly into the oil spill containment lying directly below it. Once this oil spill containment is full, the oil runs via an overflow into the oil spill containment in the substructure of the station container.

In normal operation, penetrating rain water drains off via the mounted oil filter. If the MV transformer leaks and oil flows into the integrated oil spill containment and hence into the oil filter, the oil filter granulate reacts and prevents the oil being released into the environment. The oil filter consists of an angle joint, stopcock and filter and is not assembled for delivery. This assembly work must be performed once the MV Power Station has been installed and the stopcock valve must be opened in order that water can drain off.

The oil to be found in the oil spill containment directly below the MV transformer in the event of damage can be removed once the oil separator has been removed from the oil drain valve.

In order to remove leaked oil from the substructure oil spill containment, an oil suction pump is required.

### 3.13 Circuitry Principle of the MV Power Station

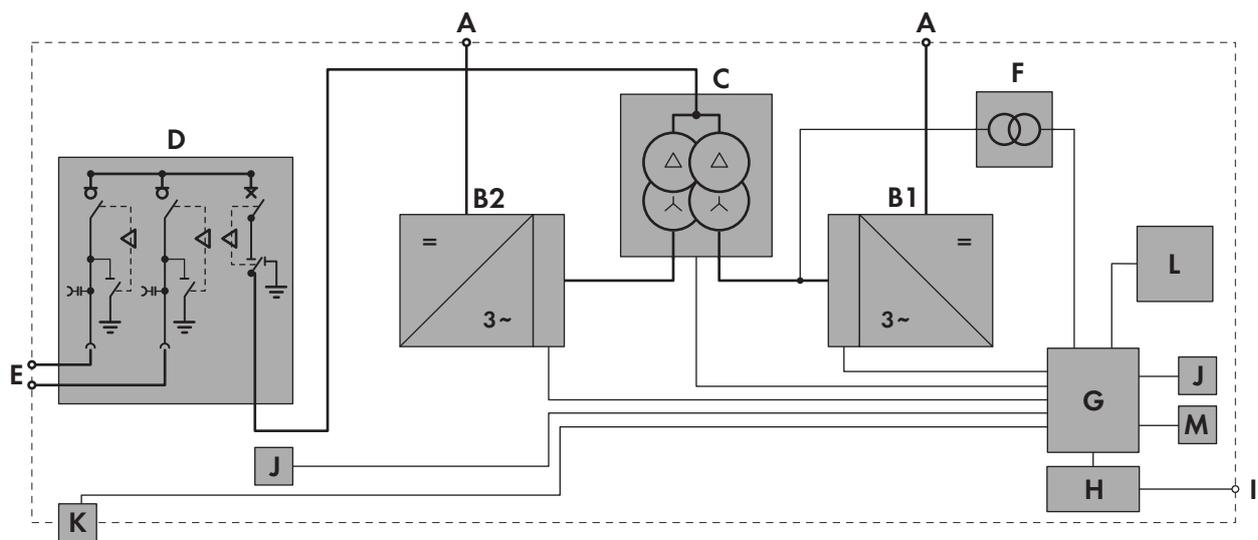


Figure 11: Circuitry principle of the MV Power Station (example)

Position	Designation
A	DC Input
B1	Inverter at the low-voltage compartment
B2	Inverter at the medium-voltage compartment
C	MV transformer
D	MV switchgear
E	AC Output
F	Low-voltage transformer*
G	Station subdistribution
H	Customer installation location
I	Connection for external components
J	Heat detector*
K	Fast-stop switch*
L	Uninterruptible power supply*
M	Cascade control*

\* Optional

Further details are to be found in the circuit diagram.

## 3.14 Operating and Display Elements

### 3.14.1 Overview of the Operating and Display Elements on the Inverter

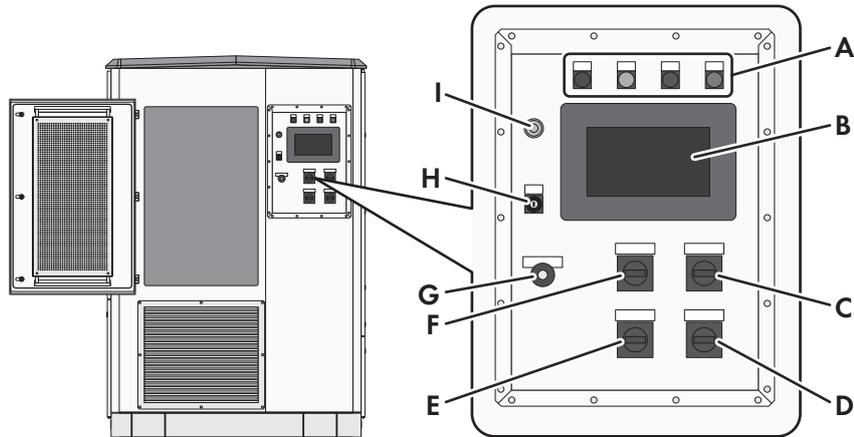


Figure 12: Inverter Components

Position	Designation
A	Light repeater <b>-P1, -P2, -P3, -P4*</b>
B	Touch display <b>-A60**</b>
C	Load-break switch <b>-Q63</b> for AC disconnection unit
D	Load-break switch <b>-Q64</b> for additional voltage supply***
E	Load-break switch <b>-Q62</b> for supply voltage
F	Load-break switch <b>-Q61</b> for DC switchgear
G	Key switch <b>-S2</b> for fast stop
H	Key switch <b>-S1</b> for start/stop
I	Service interface <b>-X500</b>

\* Standard equipment. Not available for option "Touch display".

\*\* Only for option "Touch display". The light repeaters are not included in this option.

\*\*\* Only for option "With additional supply for external loads".

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.

### 3.14.2 Switch on the inverter

#### 3.14.2.1 Start/Stop Key Switch -S1

##### "Start" Switch Position

If the key switch is set to **Start**, the inverter switches from the "Stop" operating state 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 irradiation is sufficient, the inverter connects the DC switchgear and changes to the "GridFeed" operating state. If the irradiation 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.

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".

#### 3.14.2.2 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.

#### **i** Actuation of the fast-stop key switch -S2

The fast-stop key switch -S2 should only be tripped in case of imminent 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 -X433 should be used.

#### 3.14.2.3 Load-Break Switch for DC Disconnection Unit -Q61

The load-break switch switches the motor drive of the DC switchgears -Q21 to -Q23 on or off. In addition, the following devices are switched on or off:

- Switch-cabinet heater -E1
- Heaters for low-temperature option -E2 to -E4
- 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

#### 3.14.2.4 Load-Break Switch for Supply Voltage -Q62

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

- Switch-cabinet heater -E1
- Heaters for low-temperature option -E2 to -E4
- Inverter bridge fans -G1
- Switch cabinet fans -G10 and -G11
- The terminal -X1 of the transformer protection
- Service interface -X300
- The optional customer installation location -X310
- Assemblies -A50 and -A1
- Communication unit -A3
- The optional touch display -A60
- The current measurement for the optional PQ-Meter -A61

#### 3.14.2.5 Load-Break Switch for AC Switchgear and Precharge Unit -Q63

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

- precharge unit -Q50

- AC switchgear -**Q1**

### 3.14.2.6 Load-break switch for auxiliary voltage supply -**Q64**

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

- customer loads at the connecting terminal plates -**X371** to -**X373**
- the outlets -**X374** and -**X375**

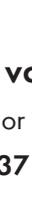
For inverters that are installed in Great Britain or Australia, only outlet -**X374** is located in the customer installation location.

### 3.14.3 Indicator lights at the Control Panel

In the standard option, the inverter is fitted with indicator lights. If the inverter is fitted with a touch display, it does not have any indicator lights.

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 Yellow: glowing Green: glowing Orange: glowing	Initialization The inverter is now in the initialization phase.
	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	Disturbance The inverter has detected an error.
	Yellow: glowing	Warning The inverter has detected a warning.
	Yellow: flashing	Power 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.

### 3.14.4 Touch Display

Depending on the order option, the inverter may be equipped with a touch display. On the touch display, you can display and configure parameters, instantaneous values, diagrams and maintenance intervals via the user interface. Any disturbances which have occurred can be displayed on the user interface and measures for their elimination can be initiated.

If the inverter is fitted with a touch display, it does not have any indicator lights.

The user interface is basically structured in the same way for both touch display and Internet access.

### 3.14.5 MV Transformer Hermetic Protection Device

With the order option "PT100 + Hermetic protection", the MV transformer is equipped with a hermetic protection device.

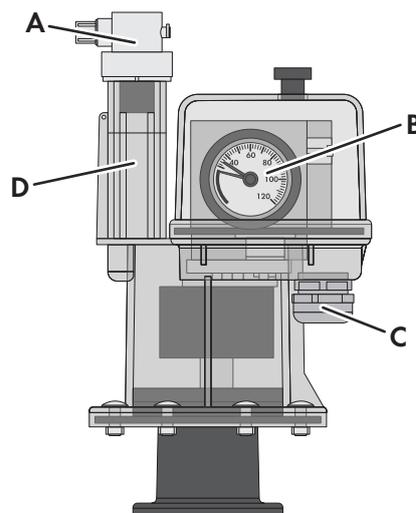


Figure 13: MV transformer hermetic protection device (example)

Position	Designation
A	Gas exhaust- and extraction valve
B	Temperature display with drag pointer
C	Cable entry
D	Oil level indicator / gas indicator

### 3.14.6 Switches on the Cascade Control

The MV Power Station is equipped with a cascade control depending on the order option. With the cascade control, the switch-on behavior for each MV Power Station can be configured so that the stations can be connected to the utility grid in a staggered manner after a grid failure. The configuration is carried out during commissioning.

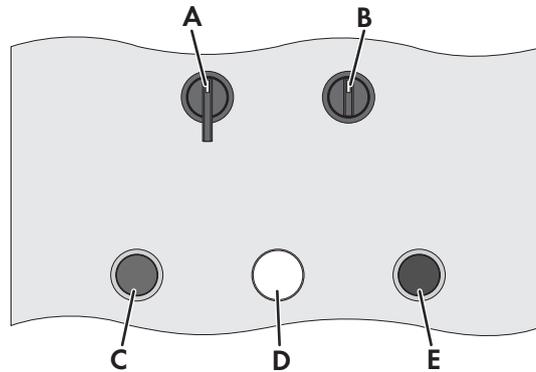


Figure 14: Cascade control switches

Position	Explanation
A	Main switch <b>S1</b> : <ul style="list-style-type: none"> <li>• <b>Local / Remote control</b>: Local control and remote control are activated.</li> <li>• <b>OFF</b>: All controls are deactivated.</li> <li>• <b>Local / Remote control / Cascade control</b>: Cascade control, local control and remote control are activated.</li> </ul>
B	Switch to activate the cascade- and remote control <b>S3</b> .
C	Switch for switching on the MV-switchgear circuit breaker <b>S10</b>
D	Status display of cascade control <b>H1</b>
E	Switch for switching off the MV-switchgear circuit breaker <b>S11</b>

### 3.14.7 Switches on the MV Switchgear

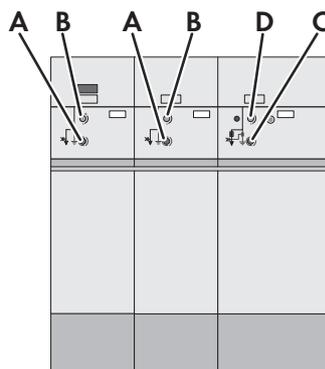


Figure 15: MV switchgear control panels with circuit breaker in the transformer panel (example)

Position	Designation
A	Grounding switch of the cable panel
B	Load-break switch of the cable panel

Position	Designation
C	Grounding switch of the transformer panel
D	Circuit breaker of the transformer panel

### 3.14.8 Fast-stop switch of the MV Power Station

The MV Power Station is equipped with a fast-stop switch depending on the order option.

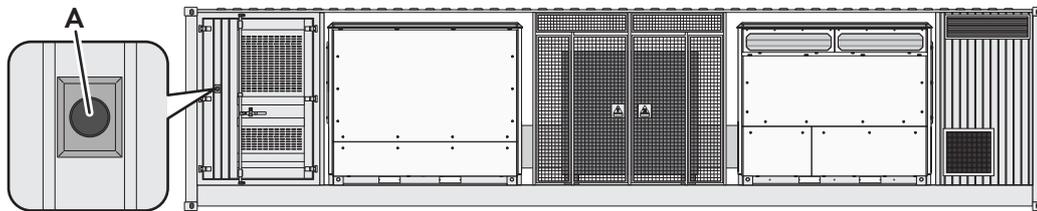


Figure 16: Position of the fast-stop switch

Position	Designation
A	Fast-stop switch

The medium-voltage switchgear and the inverter can be switched off with the fast-stop switch.

The fast-stop switch is only to be used in the event of emergencies.

## 3.15 Symbols on the Product

Symbol	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.
	No heavy loads The product may not be loaded with additional weight during transport or during installation.
	Extinguishing with water forbidden In the event of fire on or in the product, the fire must not be extinguished with water. Extinguishing fires in electrical installations or burning substances (e.g. oil) with water can have serious consequences.
	Switching forbidden Switching operations may not be performed on the product.

Symbol	Explanation
	<p>Unauthorized access prohibited</p> <p>Unauthorized persons must not operate the product and must be kept at a safe distance from the product.</p>
	<p>Use hearing protection</p> <p>The product generates loud noises.</p>
	<p>Observe the documentation</p> <p>Observe all documentation supplied with the product.</p>
	<p>Protection class I</p> <p>All electrical equipment is connected to the grounding conductor system of the product.</p>
	<p>Degree of protection IP65</p> <p>The product is protected against the penetration of dust and water that is directed as a jet against the enclosure from all directions.</p>
	<p>CE marking</p> <p>The product complies with the requirements of the applicable EU directives.</p>

## 4 User interface of the inverter

### 4.1 Design of the User Interface

The user interface can be operated via the touch display on the inverter or a web browser. The user interface is basically structured in the same way for both touch display and web browser.



The user interface is available in English and German.



The user interface 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.

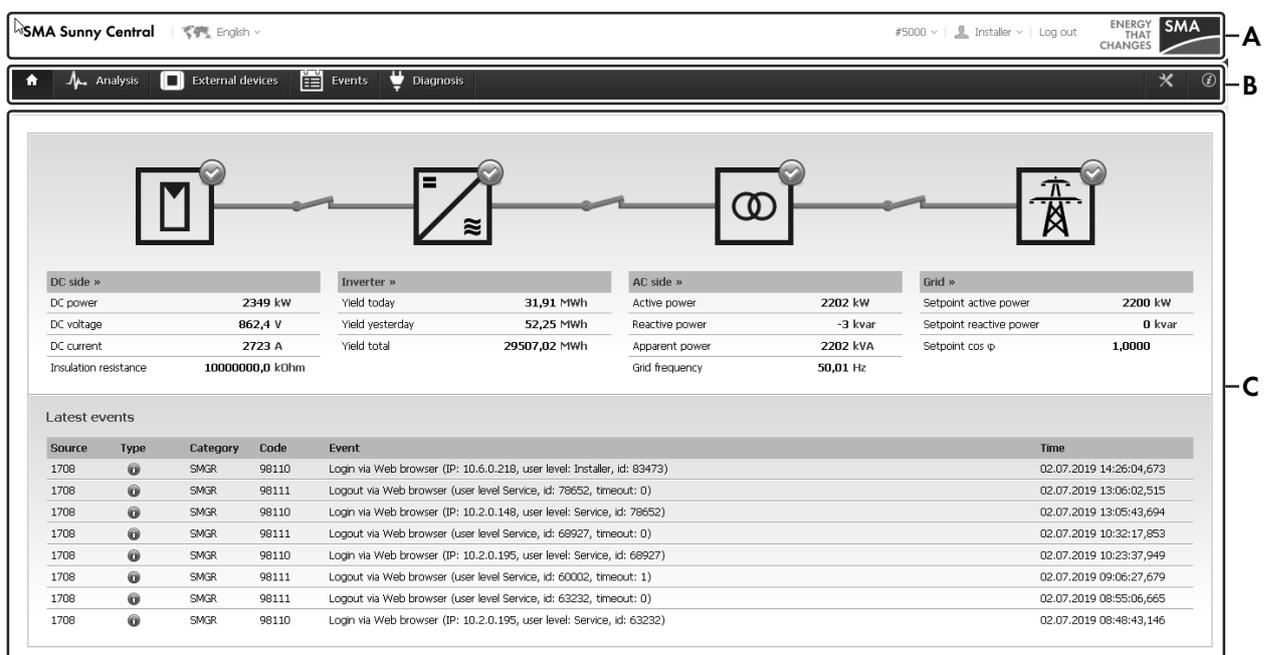


Figure 17: Design of the user interface (example: web browser)

Position	Designation	Explanation
A	User info line	Settings for language as well as quick navigation and password input.  Settings for brightness and the time
B	Main navigation	Navigation area  The main navigation bar is located on the right margin of the user interface.  The main navigation bar is located on the upper margin of the user interface.

Position	Designation	Explanation
C	Content area	Data overview depending on the selected menu
D	Status info line	<p>Information on serial numbers of the inverter, installed firmware version and inverter status.</p> <p> When the inverter is in the operating state "Error", the remaining error time from the instantaneous value <b>Er-rRmgTm</b> is displayed.</p> <p> When the inverter is in the operating state "WaitAC", the grid monitoring time from the instantaneous value <b>WaitGriTm</b> is displayed.</p>

## 4.2 Explanation of Symbols

### User info line

Symbol	Designation	Description
	Language selection	 In addition to the language selection, a dialog for localization of the user interface is available.
	Brightness setting	 The brightness settings can only be made on the touch display.
	Time display	 The time settings can only be made on the touch display.
	Navigation aid	<p>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.</p> <p>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.</p>
	Log in	<p>Login as user, installer, service partner or SMA Service with password entry.</p> <p>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.</p> <p> The role <b>User</b> is always logged in.</p>

## Main navigation

The selected menu item is color-highlighted.

Symbol	Designation	Description
	Arrow buttons	<p> The left arrow takes you back one page at a time if several pages are already activated. Once you have gone back at least one page, the right arrow is activated and will take you forward one page at a time.</p> <p> To navigate to the previous or next page, use the arrow buttons of the web browser.</p>
	Home	<p>Fast overview of system status</p> <p>For each component of the PV system, the key instantaneous values and the status of the assemblies and switches are displayed.</p>
	Analysis	<p>Switches to the analysis area of the user interface</p> <p>Detailed information on the following areas:</p> <ul style="list-style-type: none"> <li>• DC side</li> <li>• DC-coupled battery</li> <li>• Inverters</li> <li>• AC side</li> <li>• Utility Grid</li> <li>• Instantaneous values</li> <li>• Detailed analysis</li> </ul>
	Events	<p>Display of all saved events.</p> <p>The events can be filtered.</p>
	Configuration	<p>Configuration options for:</p> <ul style="list-style-type: none"> <li>• Instantaneous values</li> <li>• Parameters</li> <li>• Import and export of parameters, settings and measured values</li> </ul> <p>In addition, the setup assistant can be used here to carry out the parameter configuration for specific applications in a step-by-step process.</p>
	Information	<p>Important data for identification of the system</p>
	External devices	<p>Overview of the connected external devices</p>

## Content area

Symbol	Designation
	DC side

Symbol	Designation
	Inverter
	MV 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.

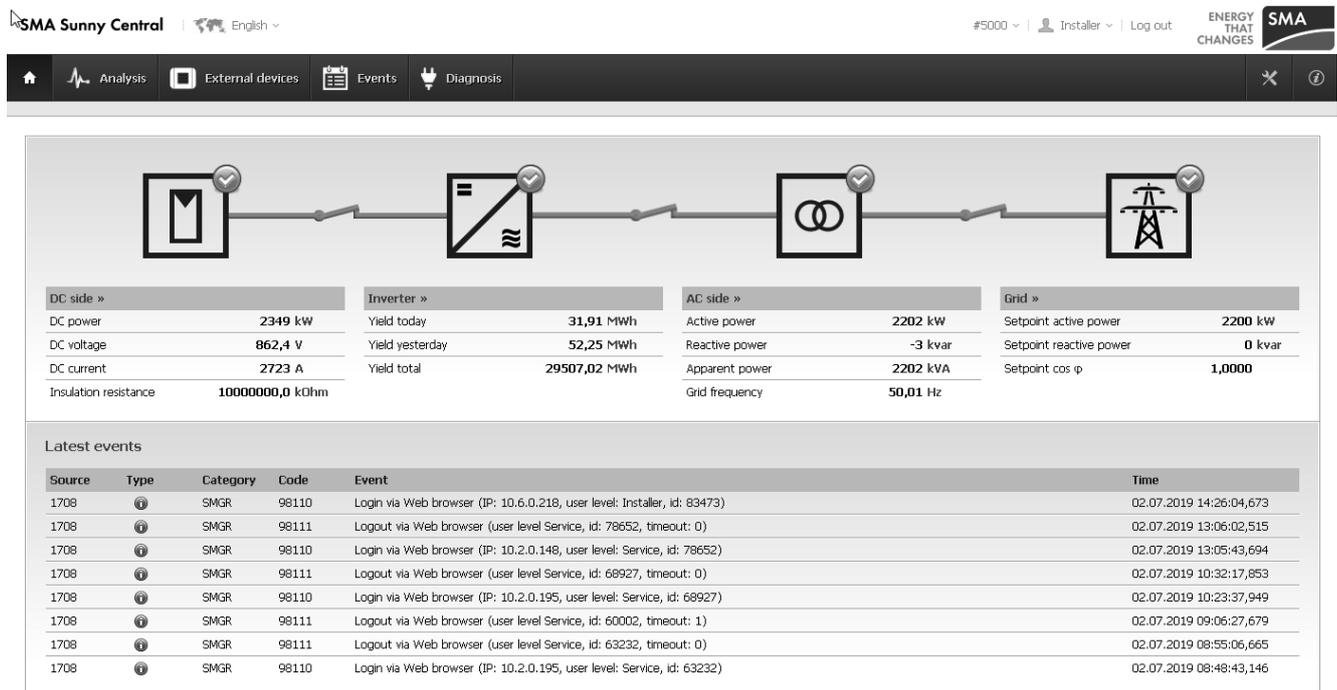


Figure 18: Page **Home** of the user interface

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 42). 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 46).

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 53).

## 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 19: 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.

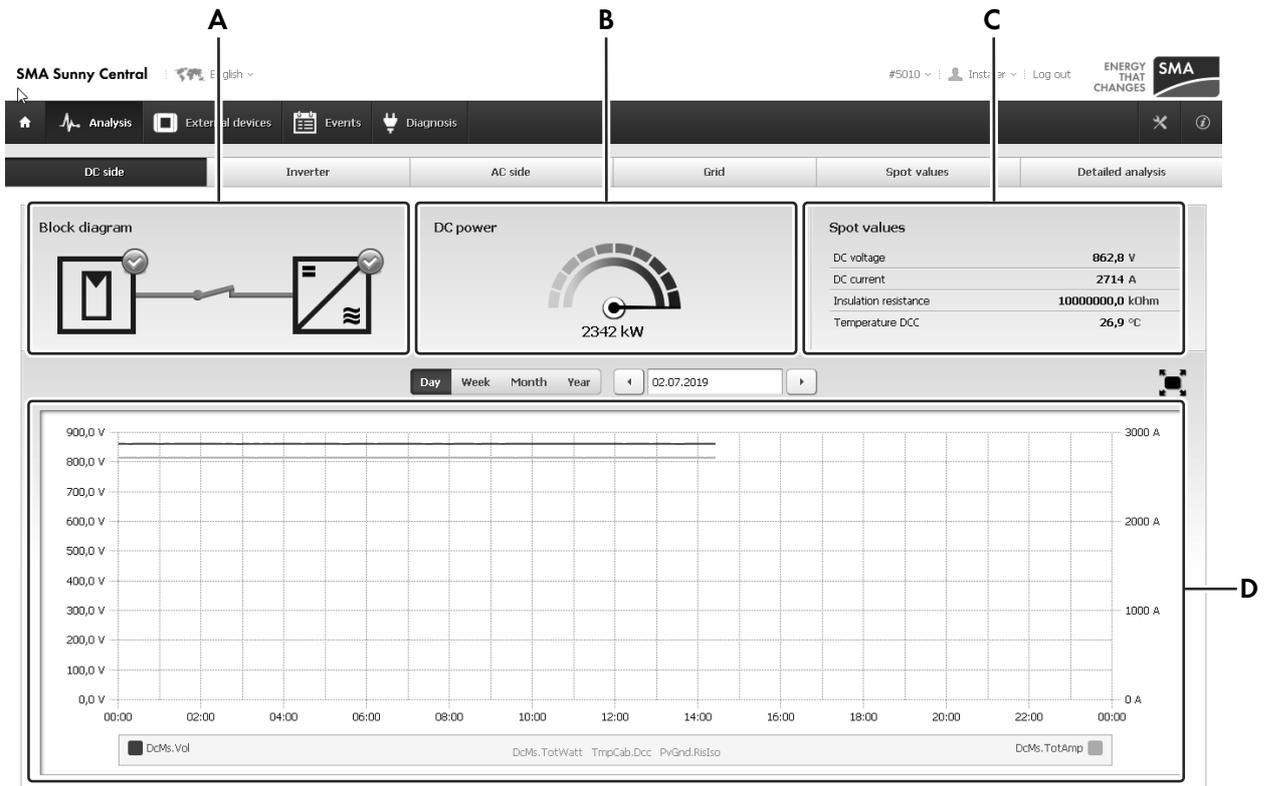


Figure 20: Page **DC side** of the user interface (example)

Position	Description
A	Overview of the status of the PV array 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
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 21: **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 22: 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.

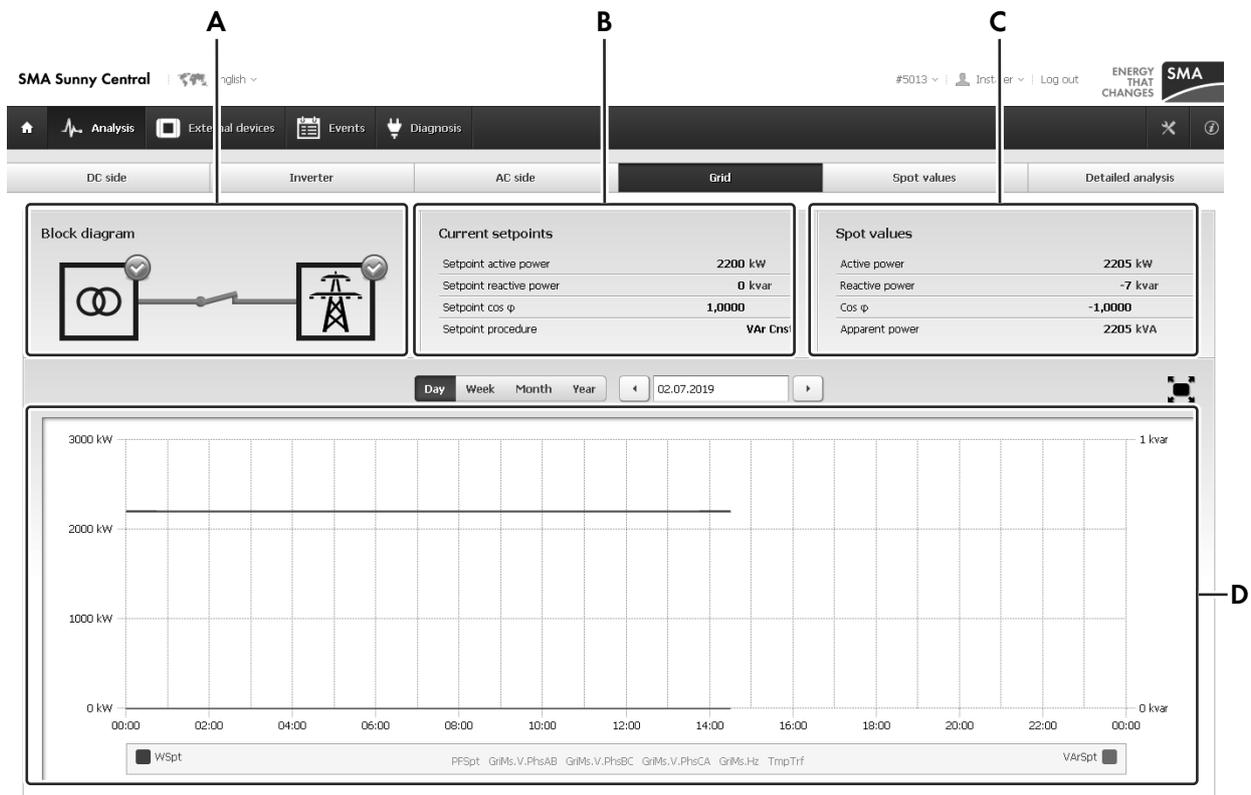


Figure 23: Page **Utility grid** of the user interface (example)

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.

The screenshot shows the SMA Sunny Central interface with the 'Spot values' tab selected. The main content area is titled 'All Spot values / favorites / top' and 'Grouped display'. A filter input field (B) is present, along with a sorting dropdown (D) set to 'Number'. The table (A) displays various instantaneous values, including active power, reactive power, power factor, and AC/DC currents and voltages. A star icon (E) is visible at the end of each row in the table.

Number	Short name	Long name
#320	WSpt	Active power, setpoint
#321	VARspt	Reactive power, setpoint
#322	PFSpt	Power factor cos (phi), setpoint
#332	OpStt	Operating state of the inverter
#401	InvMs.TotVA	Apparent power, total
#402	InvMs.TotW	Active power, total
#403	InvMs.TotVar	Reactive power, total
#404	InvMs.PF	Power factor (cos phi)
#405	GridMs.V.PhsAB	Line-to-line voltage L1-L2, grid
#406	GridMs.V.PhsBC	Line-to-line voltage L2-L3, grid
#407	GridMs.V.PhsCA	Line-to-line voltage L3-L1, grid
#408	InvMs.Total.PhsA	AC current L1, total
#409	InvMs.Total.PhsB	AC current L2, total
#410	InvMs.Total.PhsC	AC current L3, total
#597	DcMs.Vol	DC voltage DC plus to DC minus
#600	DcMs.Amp.Stk1	DC current inverter bridge 1
#601	DcMs.Amp.Stk2	DC current inverter bridge 2

Figure 24: Page **Instantaneous values** of the user interface (example)

Position	Description
A	Display of instantaneous values <b>All instantaneous values</b> , a list with user-defined <b>Favorites</b> or a pre-defined list of the <b>Top 50</b> 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 <b>Favorites</b> . If you select a line in the list, a star appears at the end of the line. Click the star to mark this instantaneous value for inclusion in <b>Favorites</b> .

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.

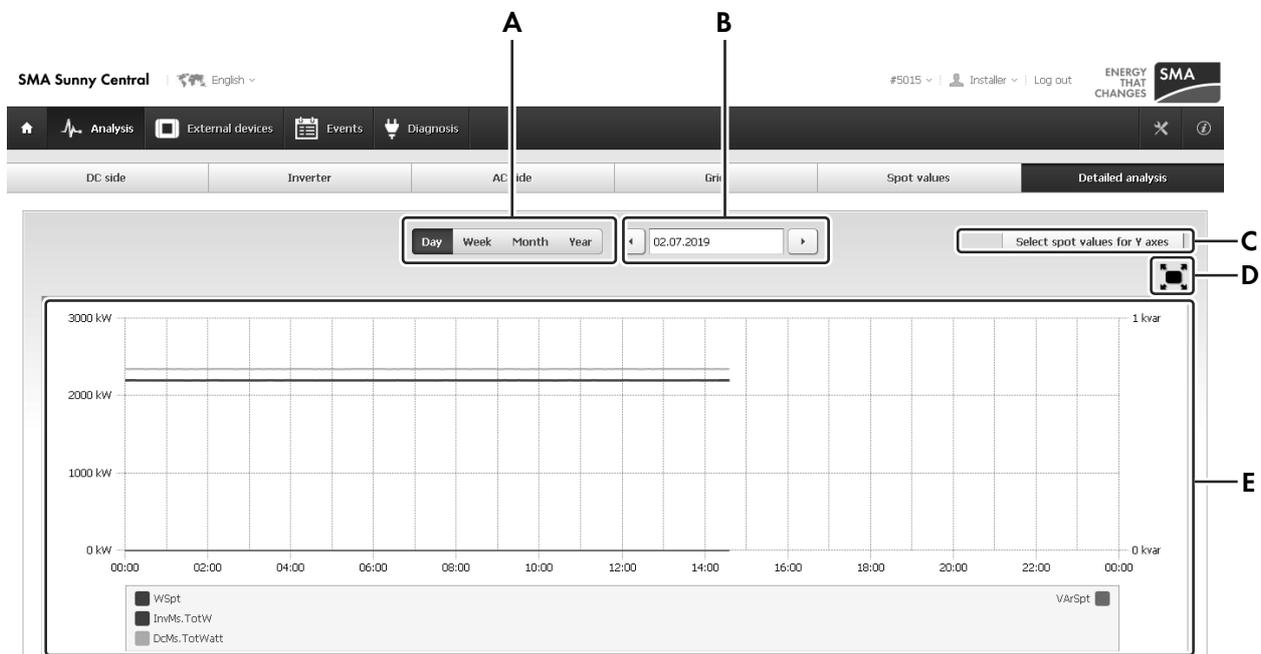


Figure 25: Page **Detail analysis** of the user interface (example)

Position	Explanation
A	<p>Selection of the displayed time period</p> <ul style="list-style-type: none"> <li>Day - Display of the selected day from 00:00 a.m. to 11:59 p.m.</li> <li>Month - Display of the selected month Dates are always displayed from 1 to 31 to avoid any confusion.</li> <li>Year - Display of the selected year</li> </ul>
B	<p>Selecting the period to be displayed</p> <p>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.</p>

Position	Explanation
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.
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.

## 4.6 Events

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

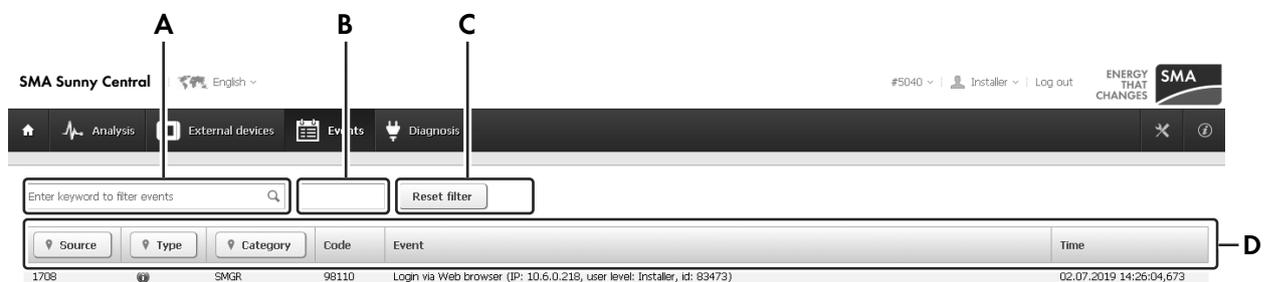


Figure 26: Events dialog

Position	Explanation
A	Search field for targeted search of events. The search function refers to the column <b>Event</b> or <b>Code</b> .
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: <ul style="list-style-type: none"> <li>• <b>Source</b> - Indication of the device in which the event was generated</li> <li>• <b>Type</b> - The event type is represented by symbols.</li> <li>• <b>Category</b> - Detailed localization of the event at the given source</li> <li>• <b>Code</b> - The event number serves as an orientation aid for Service.</li> <li>• <b>Event</b> - Description of the event</li> <li>• <b>Time</b> - Time of occurrence of the event</li> </ul>

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

Symbol	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

<b>Localization abbreviation</b>	<b>Exact localization</b>
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.

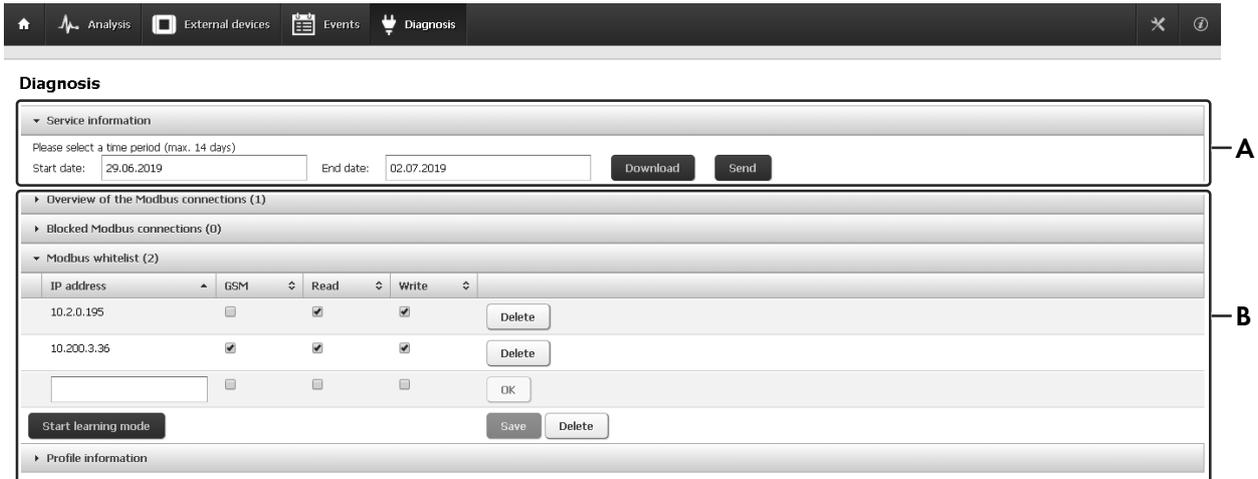


Figure 27: Page Diagnosis of the user interface (example)

Position	Description
A	<p><b>Service information</b></p> <p>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.</p>
B	<p><b>Management of Modbus connections</b></p> <p>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:</p> <ul style="list-style-type: none"> <li>• Overview of the Modbus connections: All active, accepted Modbus connections are shown.</li> <li>• 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.</li> <li>• 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.</li> </ul> <p>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 accessed the inverter are automatically added to the whitelist during this time. Information on access permissions (read or write) or whether an NSM control command was used is also added to the list.</p> <p>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.</p> <p>To extend the Modbus whitelist, the learning mode can be restarted or IP addresses can be added to the list manually.</p> <ul style="list-style-type: none"> <li>• Profile information: All loaded Modbus profiles that can be accessed are shown.</li> </ul>

## 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.

Top (16/16)					
#306	GriCod	Custom	---	Country settings	
#361	WctlHzMod	Enable	Disable	Frequency-dependent active power control in case of overfrequency, activation	
#370	WctlHz.HzStopMin	0,000 Hz	(0,000 ... 70,000)	0,000 Hz	Frequency-dependent active power control in case of overfrequency: lower cutoff frequency of the return area
#371	WctlHz.HzStopMax	50,050 Hz	(0,000 ... 70,000)	50,050 Hz	Frequency-dependent active power control in case of overfrequency: upper cutoff frequency of the return area
#372	WctlHz.HzStopTm	0 ms	(0 ... 1000000)	0 ms	Frequency-dependent active power control in case of overfrequency: minimum period that the power frequency must remain in the return area
#398	WGraReconMod	Disable	Disable	Active power gradient after grid fault, activation	
#399	WGraRecon	0,001333 pu/s	(0,000000 ... 1,000000)	0,100000 pu/s	Active power gradient after grid fault, setpoint
#444	Vctl.OpMaxNom	1,05 pu	(0,00 ... 2,00)	1,05 pu	Monitoring the grid voltage: upper switch-on limit
#445	Vctl.OpMinNom	0,95 pu	(0,00 ... 2,00)	0,95 pu	Monitoring the grid voltage: lower switch-on limit
#466	Hzctl.OpMaxNom	50,05 Hz	(40,00 ... 70,00)	50,05 Hz	Monitoring the power frequency: upper switch-on limit
#467	Hzctl.OpMinNom	47,50 Hz	(40,00 ... 70,00)	49,95 Hz	Monitoring the power frequency: lower switch-on limit
#492	Vctl.PkLim	2,00 pu	(0,00 ... 2,00)	1,30 pu	Monitoring the grid voltage: switch-off limit: spot value monitoring (peak value)
#493	Vctl.PkLimTm	6	(0 ... 1000)	6	Monitoring the grid voltage: waiting time for the switch-off limit spot value monitoring
#495	Hzctl.DifMax	50,000 Hz/s	(0,000 ... 50,000)	50,000 Hz/s	Monitoring the power frequency: maximum permissible

Figure 28: Page **Parameters** of the user interface

Position	Explanation
A	<p>Display of parameter lists</p> <p><b>All parameters</b>, a list with user-defined <b>Favorites</b> or a pre-defined list of the <b>Top 50</b> parameters can be displayed.</p>
B	<p>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.</p> <p>The search function is not available for the grouped parameters.</p>
C	<p>Display of grouped parameters</p> <p>The parameters are grouped by default under various headings. It is possible that certain parameters are allocated to several groups.</p>

Position	Explanation
D	<p>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.</p> <p>The sort function is not available for the grouped parameters.</p>
E	<p>Parameter overview</p> <p>Depending on the display type selected, a list with parameters or the categories of grouped parameters organized in a tree structure will appear.</p> <p>For each parameter, the short name, number, set value, unit, possible configuration range, long name and favorite status are displayed.</p> <p>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.</p> <p> In the entry field of an activated parameter, the favorite identifier can be activated.</p> <p> At the end of the line a star appears by activated parameters. By clicking on the star, you can mark this parameter to include it in <b>Favorites</b>.</p> <p>Once the parameter change is saved, a check mark appears in the line. This check mark is displayed until the next logout.</p> <p>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.</p>

## 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.

 File imports are performed from a storage medium connected to the communication interface, e.g. a USB flash drive.

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: <ul style="list-style-type: none"> <li>• Cloning: The parameters and settings are exported without the IP address of the inverter.</li> <li>• All: All parameters and settings are exported.</li> <li>• Selection: The specific parameters to be exported can be selected from a list.</li> </ul>
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.
Picture recordings of the local UI	Export of the screenshots created on the touch display

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	<p>Event information that was saved in the file.</p> <p>The following events are possible:</p> <p>EVENTLOG: Protocol of the events that have occurred</p> <p>INVERTERLOG: Recorded measuring data</p> <p>LICENSE: License file</p> <p>MODBUS: Modbus profile of the individual devices</p> <p>UPDATE: Update file</p> <p>FAVORITES: List of the saved favorites</p> <p>PARIMEX: Imported and exported parameter lists</p>
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 possibility to save the files on an external storage medium or to download them onto 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 key data for identification of the inverter is displayed. This includes inverter-relevant and network-relevant information.



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

Information : Kodiak 1500V / SC.KODI.21			
System		Network	
Device type:	KVA2500 V550 IEC V1500	LAN 1 (IP)	192.168.100.1
Serial number	11111111	LAN 2 (IP/MAC)	10.177.1.137 [00-40-ad-93-31-8e]
Software package	01.02.07.S	SWITCH (IP/MAC)	10.177.1.138 [ec-e5-55-91-a3-08]
System runtime	5 Day(s) 02:51:47	LAN 3 (IP/MAC)	172.16.1.51 [00-40-ad-93-31-8f]

Figure 29: Dialog box **Information** (example)

## 5 Transport and Mounting

### 5.1 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.

#### 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 product on an unstable, uneven surface; not 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.
- Prior to storage, ensure that the doors of the product are tightly closed.

#### **i Clean the closed station with clear water after maritime transport**

High humidity and salt water can cause corrosion of the station during maritime transport.

- Clean the station with clear water prior to installation. This will inhibit the corrosion process. By processing and painting the affected areas further corrosion can be prevented.

## 5.2 Requirements for Transport and Mounting

### 5.2.1 External dimensions and weights

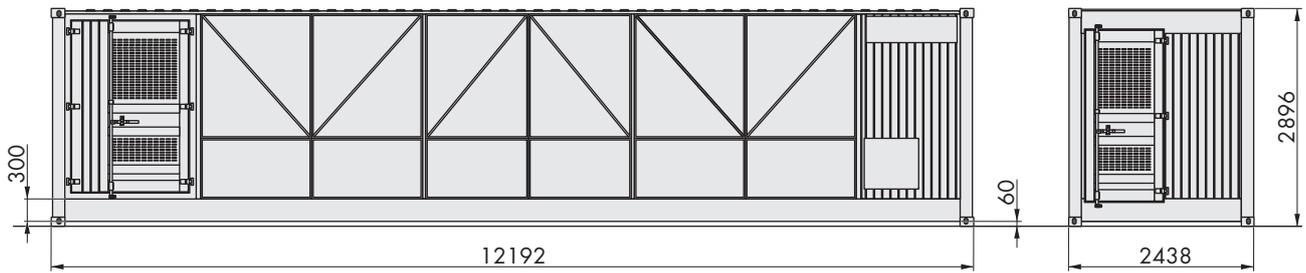


Figure 30: Dimensions of the MV Power Station (in mm)

Width	Height	Depth	Weight
12192 mm	2896 mm	2438 mm	< 26.5 t

### 5.2.2 Minimum Clearances

The minimum clearances are necessary to ensure trouble-free installation of the MV Power Station and easy replacement of the devices (e.g. with a crane) during service and maintenance. In addition, locally applicable regulations must be observed.

To prevent personal injury, the internal arc pressure safety area is to be cordoned off and labelled accordingly.

Observe the following minimum clearances to ensure trouble-free operation and servicing of the MV Power Station:

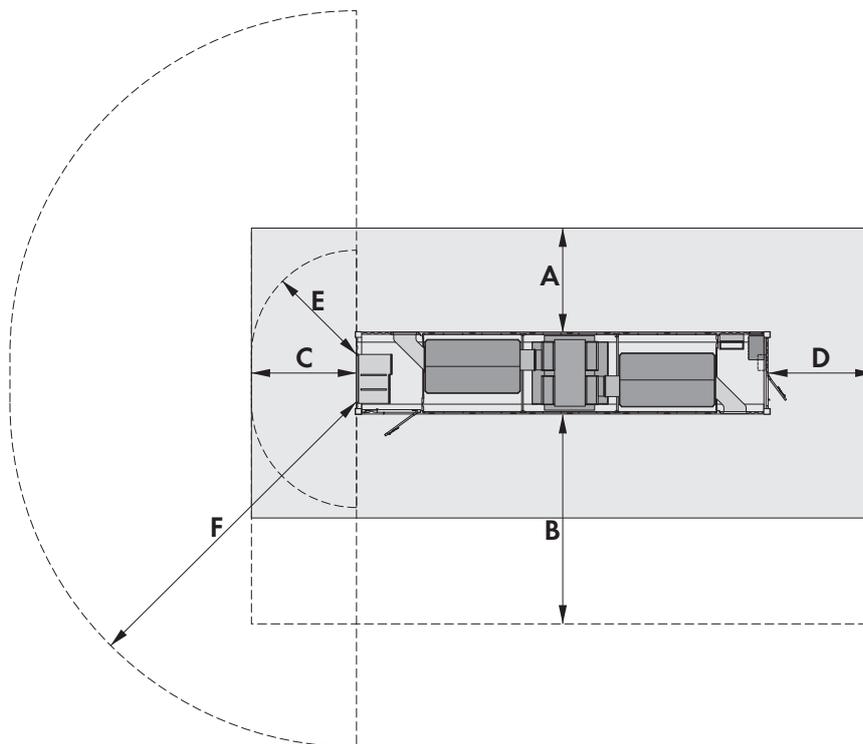


Figure 31: Minimum clearances

Position	Minimum clearance for servicing	Minimum clearance for trouble-free operation
A	3000 mm	2000 mm
B	6000 mm*	2000 mm

Position	Minimum clearance for servicing	Minimum clearance for trouble-free operation
C	3000 mm	2000 mm
D	3000 mm	2000 mm

\* On the door side of the medium-voltage compartment for servicing work on the MV switchgear

#### Internal arc pressure safety areas to be observed during MV switchgear switching operations

E	Minimum clearance for inflammable materials: 3000 mm
F	Minimum clearance for personnel: 10000 mm

A 3000 mm area of compacted ground surrounding the station container is recommended to simplify service work.

### 5.2.3 Air circulation in the MV Power Station

#### 5.2.3.1 Air Circulation in the MV Transformer

Depending on the manufacturer of the MV transformer, temperature control via 10 or 12 fans is supported.

The fans draw cold ambient air from below into the MV transformer and direct this across the cooling fins. The heated air is diverted back out of the MV transformer by the fans at the top.

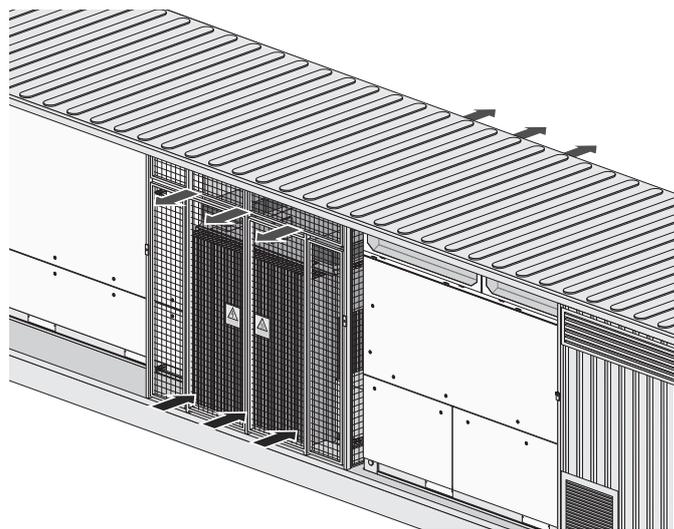


Figure 32: Air circulation principle in the MV transformer

#### 5.2.3.2 Air Circulation in the Medium-Voltage and Lower Voltage Compartments

Air circulation in the medium-voltage and low-voltage compartments is supported by one fan each.

The fans draw in cold ambient air through the grilles in the doors and the fan exhausts divert the heated air back out of the medium-voltage or low-voltage compartment.

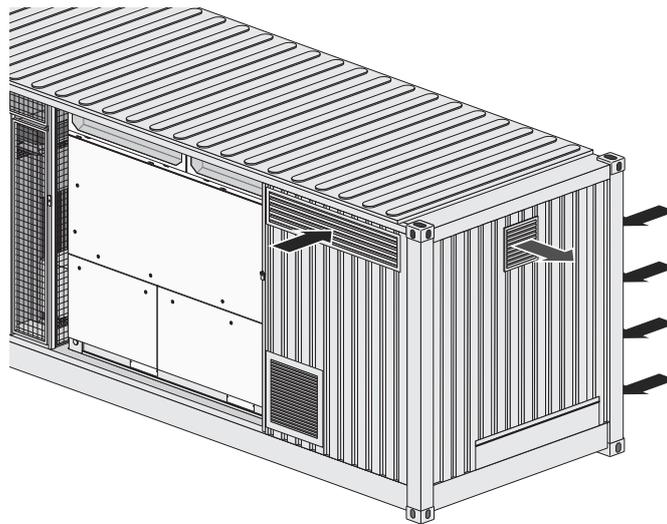


Figure 33: Air circulation principle in the medium-voltage and low-voltage compartments

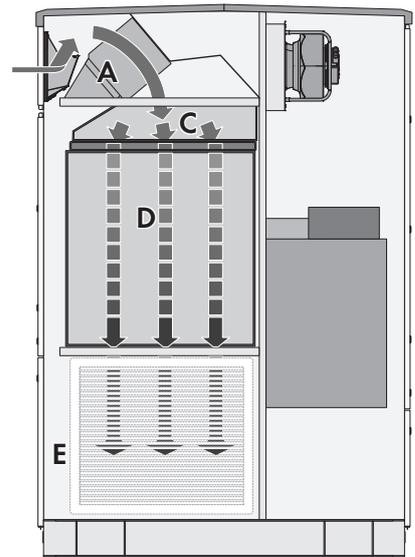
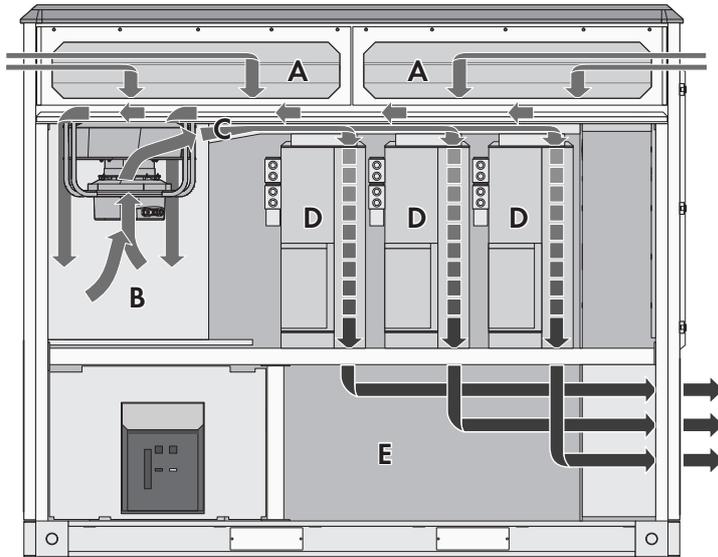
## 5.2.4 Air Circulation in the Inverter

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 IP65. To meet the requirements of the degree of protection IP65, 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 IP65.

**IP34**



**IP65**

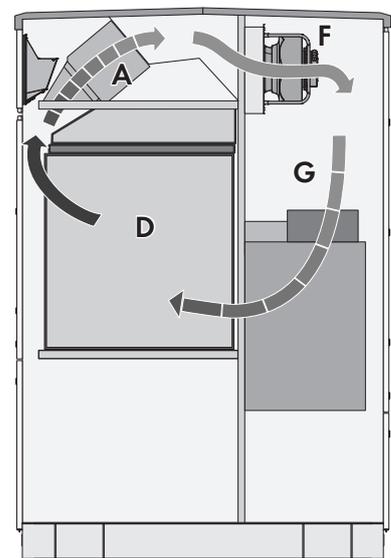
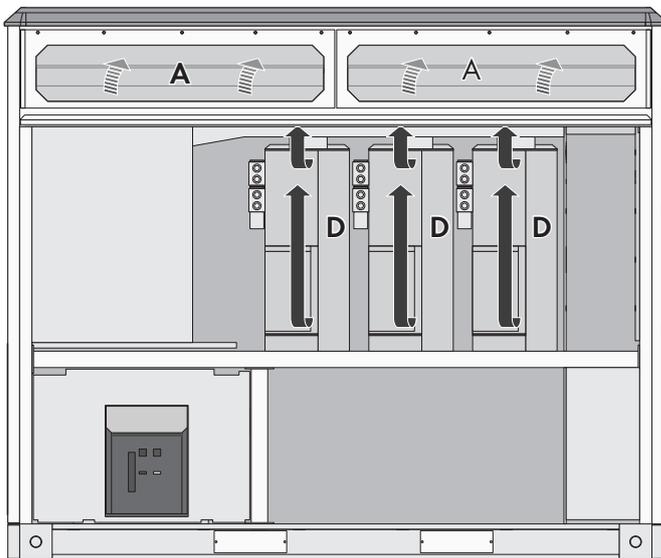


Figure 34: Air circulation in the inverter

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 IP65 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 IP65 air circuit with the cooler ambient air of the IP34 air circuit so that the heat of the IP65 air circuit is transferred to the IP34 air circuit.

After the air inside the IP65 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.

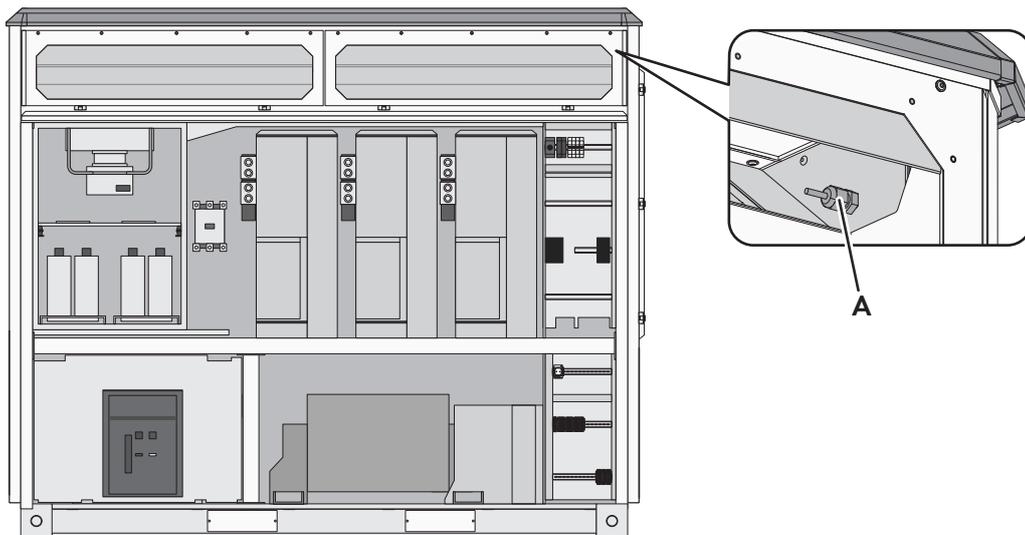


Figure 35: Position of the temperature sensor in the inverter

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 inverter air intake temperature is the ambient temperature of the MV Power Station.

The temperature is measured with a PT100 temperature sensor.

## 5.2.5 Foundation

### 5.2.5.1 Design of the System with MV Power Station

#### **i** Closed electrical operating area

For safety reasons, the system with the MV Power Station must be installed in a closed electrical operating area in accordance with IEC 61936-1.

- Ensure that unauthorized persons have no access to the MV Power Station.
- Only appropriately trained and qualified persons may operate inverters and perform MV switchgear switching operations.

### 5.2.5.2 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.
- Do not mount the MV Power Station into ground depressions to prevent water ingress.
- The support surface underneath the MV Power Station must be clean and firm to avoid any dust circulation.

### 5.2.5.3 Pea gravel ground

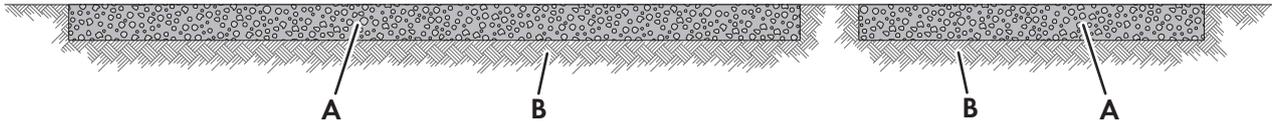


Figure 36: Structure of the support surface

Position	Designation
A	Pea gravel ground
B	Solid ground, e.g. gravel

The subgrade must meet the following minimum requirements:

- The compression ratio of the subgrade must be 98%.
- The soil pressure must be 150 kN/m<sup>2</sup>.
- The unevenness must be less than 1.5%.
- Minimum clearances for servicing operations must be observed (see Section 5.2.2, page 63).
- Access roads and areas must be passable, without any obstructions, for service vehicles (e.g. forklifts).

### 5.2.5.4 Weight load on the support points

The MV Power Station sits on six support points:

- 4 support points at the outer corner feet
- 2 support points underneath the MV transformer compartment

The installation surfaces must have the following properties:

- The installation surfaces (e.g. strip foundations) must be designed for the weight load of the support points. The weight load on each of the six support points of the MV Power Station is 8000 kg.
- The 30 mm feet underneath the inverter compartments must not be used as support points.

### 5.2.5.5 Mounting options

The foundation must have the following properties:

- The foundation must be suitable for the weight of the product.
- The foundation must be mounted on solid ground.
- The burial depth of the foundation must satisfy the structural requirements.
- The protrusion of the outer corner castings and center support points must be taken into consideration. The height difference is 60 mm.
- With the order option "Earthquake and Storm Package", additional space is required for anchoring the side twistlocks. The surface area of the side twistlocks is 100 mm x 100 mm.

The design of the mounting foundation is the responsibility of the customer.

Mounting option 1

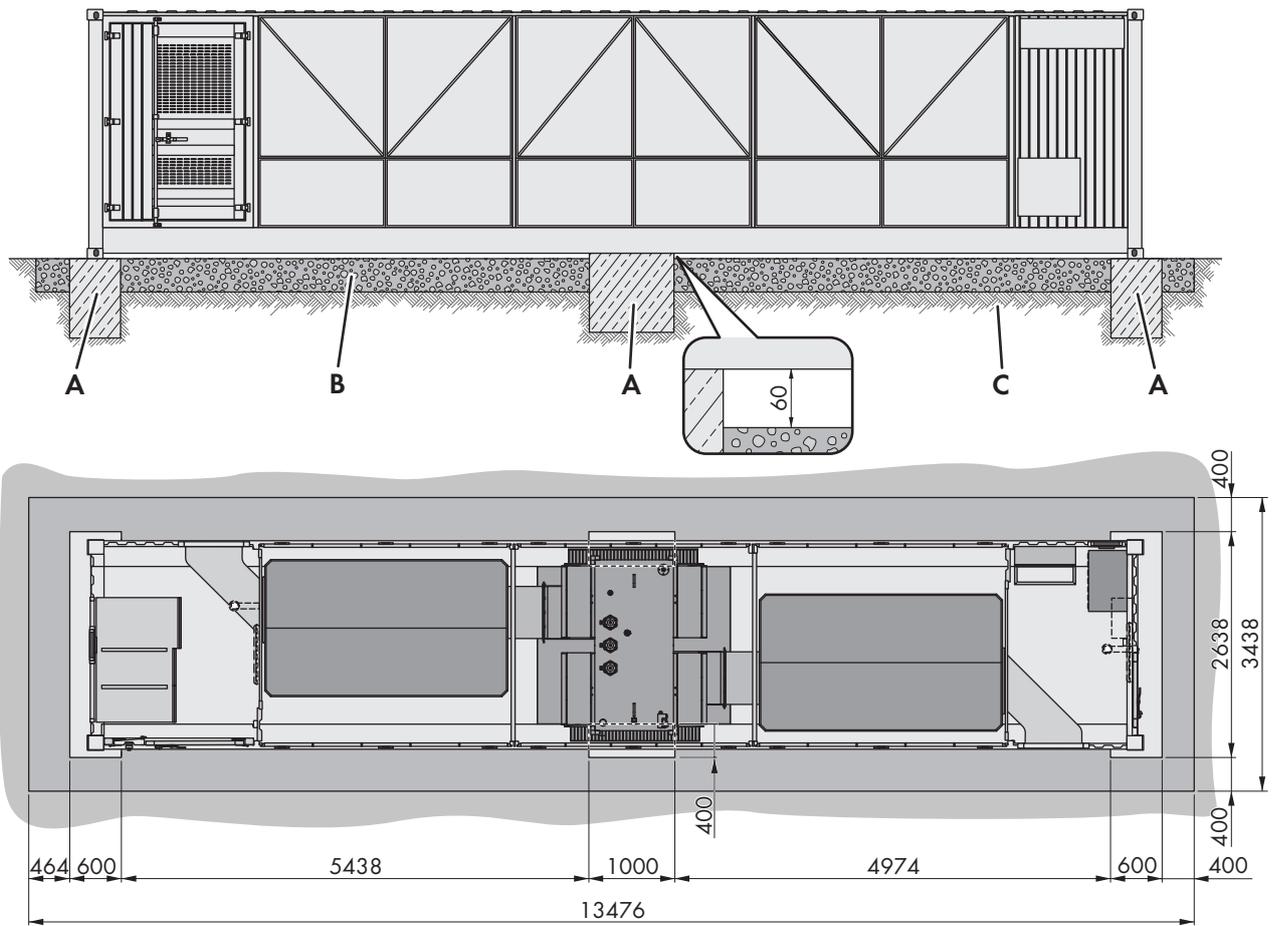


Figure 37: Mounting option 1 (dimensions in mm)

Position	Designation
A	Strip foundation
B	Pea gravel ground
C	Solid ground, e.g. gravel

Mounting option 2

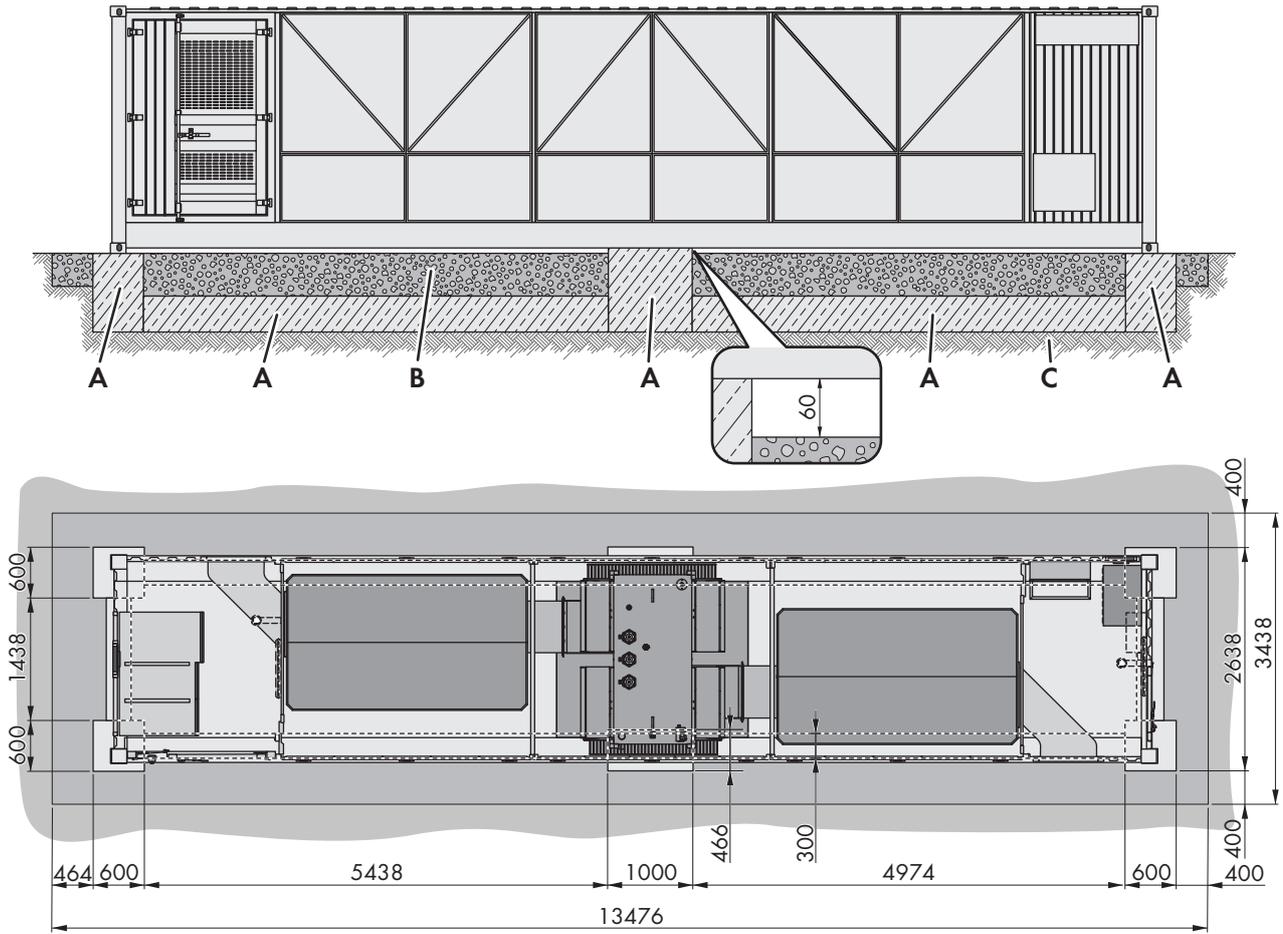


Figure 38: Mounting option 2 (dimensions in mm)

Position	Designation
A	Strip foundation
B	Pea gravel ground
C	Solid ground, e.g. gravel

## 5.2.6 Overview of openings in the base plate on the MV Power Station

The MV Power Station is fitted with openings through which the cables are inserted. In the standard version of the MV Power Station, filler plates are intended for the enclosure openings. With the order option "Cable Entry Kit", the configuration depends on the opening. The cables should be protected between the foundation and the MV Power Station. Cable protection measures are customer responsibility.

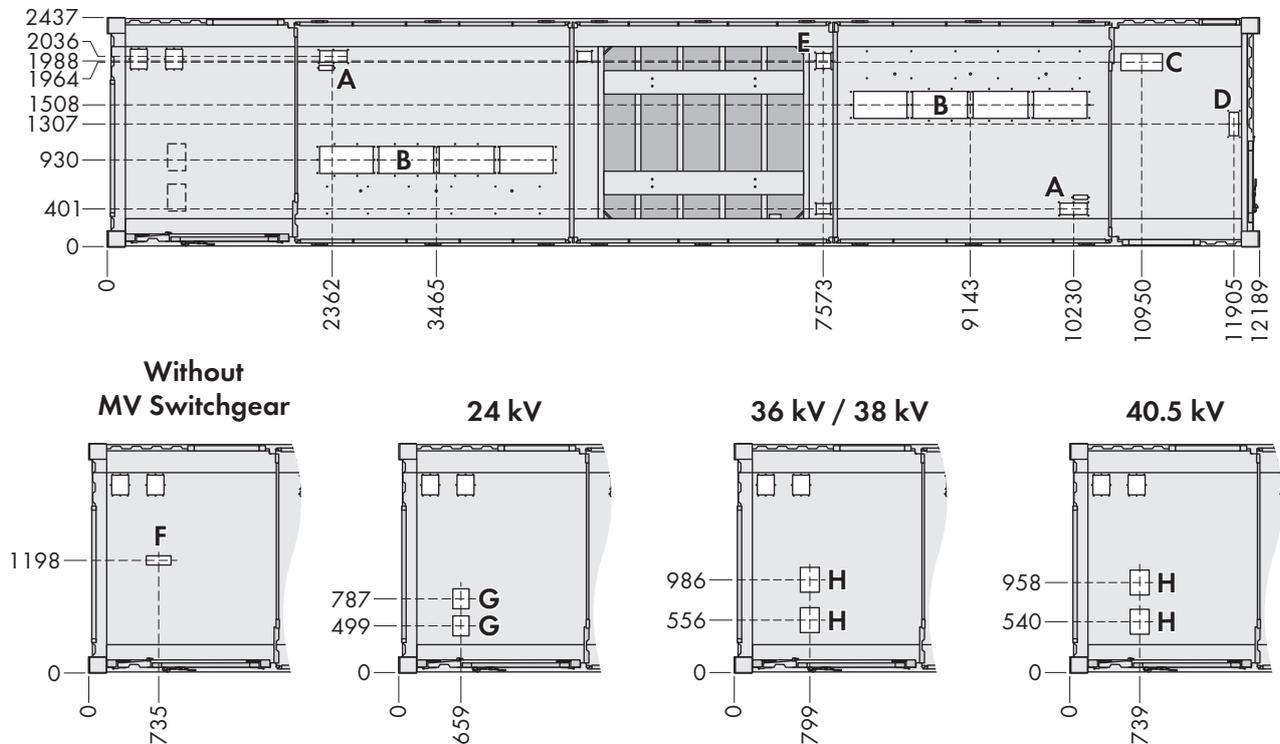


Figure 39: Position of openings (Dimensions in mm)

Position	Designation	Width x depth
A	Opening underneath the inverter for insertion of the cables for communication, control, monitoring and cables leading to the customer device installation area of the inverter.  With the order option "Cable Entry Kit", the opening is fitted with a sliding panel.	290 mm x 120 mm
B	Opening underneath the inverter for insertion of the DC and grounding cables  With the order option "Cable Entry Kit", the opening is fitted with two sliding panels.	2454 mm x 289 mm
C	Opening underneath the station subdistribution for insertion of the cables for communication with the MV Power Station, control, monitoring, external voltage supply, low-voltage meter and customer devices  With the order option "Cable Entry Kit", the opening is fitted with a sliding panel.	440 mm x 180 mm
D	Opening underneath the customer installation location inside the low-voltage compartment, e.g. for supplying tracker motors  With the order option "Cable Entry Kit", the opening is fitted with a sliding panel.	100 mm x 250 mm

Position	Designation	Width x depth
E	Opening underneath the MV transformer for insertion of ground-electrode cable  With the order option "Cable Entry Kit", the opening below is fitted with a sliding panel and above with cable glands.	160 mm x 160 mm
F	Opening for insertion of the AC cables without MV switchgear  With the order option "Cable Entry Kit", the opening is fitted with two cable support sleeves.	260 mm x 100 mm
G	Opening underneath the MV switchgear of 24 kV for insertion of the AC cables:  With the order option "Cable Entry Kit", the opening is fitted with two cable support sleeves.	172 mm x 213 mm
H	Opening underneath the MV switchgear of 36 kV, 38 kV and 40.5 kV for insertion of the AC cables  With the order option "Cable Entry Kit", the opening is fitted with two cable support sleeves.	200 mm x 265 mm

## 5.2.7 Requirements for Transport Routes and Means of Transport

### **i** Requirements for transport routes and means of transport

The product complies with the requirements of 2M2 in accordance with IEC 60721-3-2, with the exception of the free-fall requirements. The transport routes and means of transport must be such that they comply with the requirements described in the standard.

- The maximum permissible gradient of the access road is 15%.
- During unloading, a distance of at least 2 m to neighboring obstacles must be observed.
- The access roads and the unloading site must be designed to accommodate the length, width, height, total weight and curve radius of the truck.
- Transport must be carried out by truck with air-sprung chassis.
- The unloading site for the crane and truck must be firm, dry and horizontal.
- There must be no obstacles above the unloading site (e.g. live overhead power lines).

## 5.2.8 Center of Gravity Marker

The center of gravity of the MV Power Station is not in the middle of the unit. Take this into consideration when transporting the MV Power Station. The center of gravity depends on the device class of the MV Power Station.

The center of gravity of the MV Power Station is marked on the product.



Figure 40: Center of gravity symbol

## 5.3 Transporting the MV Power Station Using a Crane

### ⚠ 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.

### NOTICE

#### Damage to the product due to inappropriate transport

Lifting using chain slings on the upper corner castings can lead to damage to the product.

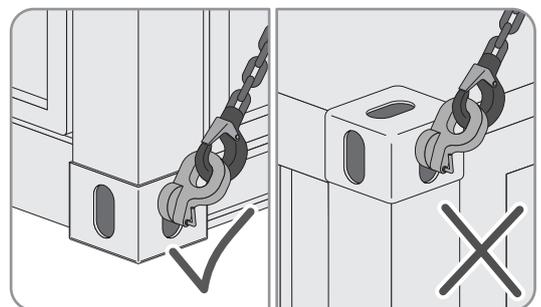
- Only use the upper corner castings with a hoist frame.
- Work may only be carried out in accordance with this document.

#### Requirements:

- The crane and hoist must be suitable for the weight.
- The hoist must be properly connected to the crane.
- The factory-fitted transport lock on the devices of the MV Power Station must be in place.
- All doors of the MV Power Station must be closed.

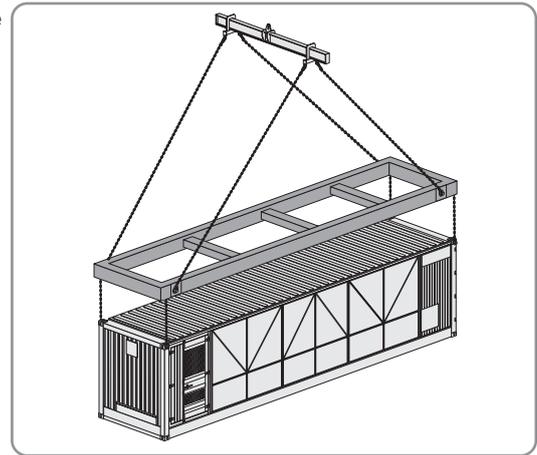
#### Procedure:

1. If the MV Power Station is to be transported by the lower corner castings, transport the MV Power Station with container cross beam and chain slings. To do so, attach the chain slings to the 4 lower corner castings on the MV Power Station with lifting lugs and protect the MV Power Station enclosure from mechanical damage caused by the hoist.

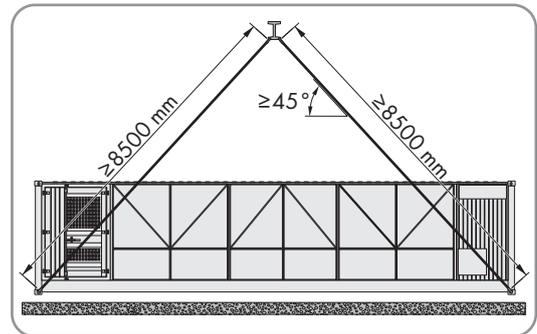


If required, the lifting lugs can be ordered from SMA (material number: 104672-00.01).

- For the "Sea freight" order option: If the MV Power Station is to be transported by the upper corner castings, attach the chain slings with hoist frame to the upper corner castings.



- Ensure that the hoist is attached correctly.
- Slowly raise the MV Power Station and check if the hoist is taut evenly.



- If the MV Power Station is not level when raised, lower it back down to the ground.
- Make sure that the hoist is attached so that the MV Power Station will be lifted level. If necessary extend the chains of the hoist with shackles, so that the MV Power Station is in a horizontal position.
- Raise the MV Power Station slightly.
- Transport the MV Power Station to its final position as close to the ground as possible.
- Set the MV Power Station down. The support surface must be suitable for the weight of the MV Power Station in accordance with the requirements (see Section 5.2.1, page 63).

## 5.4 Transport by truck or ship

The dimensions and shape of the MV Power Station correspond to those of an ISO container (40 ft high cube container) and can be transported by truck or ship. Transport by railroad or by plane is not permitted.

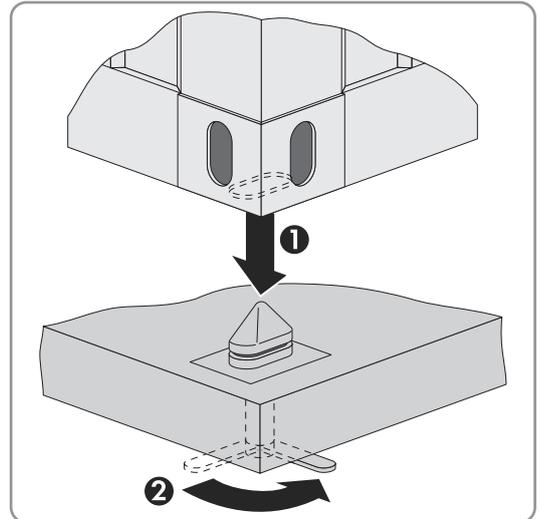
All transport vehicles must be suitable for transporting station containers.

During transport and unloading, the station container paint may become damaged. Paint damage does not impair the function of the MV Power Station, but must be repaired by the customer using the spare paint supplied within three weeks after delivery.

For transportation by truck or ship, the MV Power Station must be secured at least at all four lower corner castings. This can be done by various methods, depending on the fastening system of the means of transportation. The most common methods are described below.

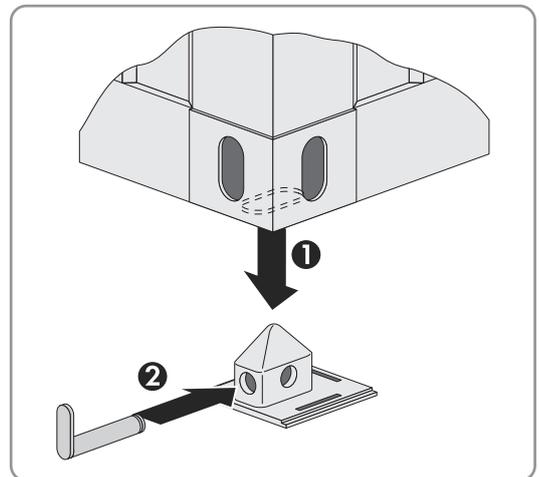
### Twistlock

- The MV Power Station is set down on the locking mechanisms. By turning the twistlock, an interlocking is made.



### Pinlock

- The MV Power Station is set down on the locking mechanisms. Any slippage of the load is prevented by inserting the pinlock.



## 5.5 Storage

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

### NOTICE

#### Damage to the system due to sand, dust and moisture ingress

Sand, dust and moisture penetration can damage the system 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.

#### **i** Storage more than four months

In order to protect the electronic components against moisture, the desiccant bag in the inverter must be replaced every two months (see Section 6.3.6.2, page 86). If necessary, desiccant bags can be ordered from SMA 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.

For storage of the MV Power Station note the following points:

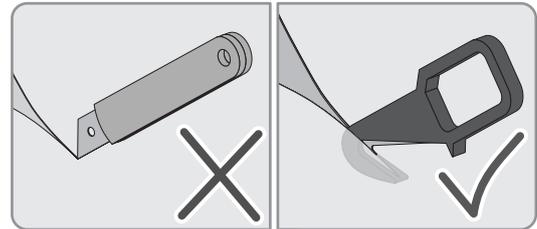
- Do not place the MV Power Station on an unstable, uneven surface.
- Once the MV Power Station has been set down on the surface, do not attempt to adjust its position by pulling or pushing.
- Prior to storage, ensure that the doors of the MV Power Station are tightly closed.
- When the protection plates on the sides have been removed, ensure that the oil drain valve is installed and the stopcock is open to provide for station container drainage.
- The moisture levels within the product must be checked every day. When moisture levels are excessive, the ventilation openings and protection plates must be opened to avoid condensation.
- The battery must be charged on a regular basis when using an uninterruptible power supply. Long transport and storage times pose a risk to the capacity and service life of the battery. On delivery, a note referring to the latest recharging date can be found on the enclosure of the uninterruptible power supply.

## 5.6 Removing the foil in case of order option "Sea freight special"

With the order option "Sea freight special", the MV Power Station is covered with a protective foil made of polyethylene in addition to the covers. This foil must be removed in a timely manner upon arrival at the mounting location and prior to final installation.

### Procedure:

1. Remove the foil from the station container. Do not use any sharp objects to avoid damage to paintwork.



2. Dispose foil (material: polyethylene C2H4) in accordance with the local disposal regulations.

## 5.7 Mounting the MV Power Station

The MV Power Station can be mounted and anchored on strip foundations (see Section 5.2.5, page 67). The customer is responsible for mounting and anchoring the MV Power Station on the support surface. Which foundation option is selected is at the discretion of the customer.

The medium-voltage and low-voltage compartment doors must be closed during normal operation.

### Requirements:

- The pea gravel ground and strip foundation must be prepared.
- The requirements on the strip foundation must be complied with.
- Empty conduits for the cables must be laid under the support surface. The empty conduits may not project more than 240 mm out of the ground.

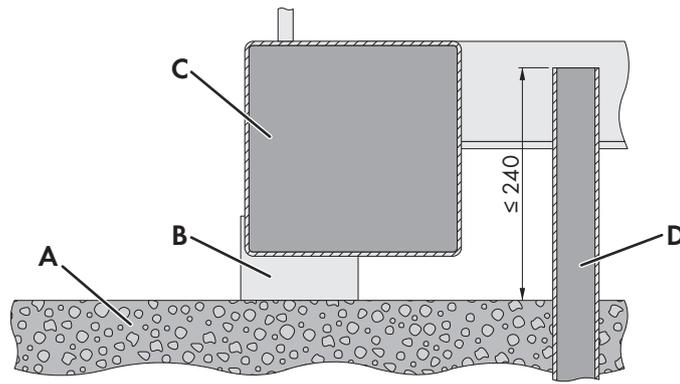


Figure 41: Schematic of the cable entries below the MV Power Station (Dimensions in mm)

Position	Designation
A	Support surface
B	Station container corner foot
C	Station container substructure
D	Empty conduit

### **i** Avoid damaging the cables when installing the MV Power Station

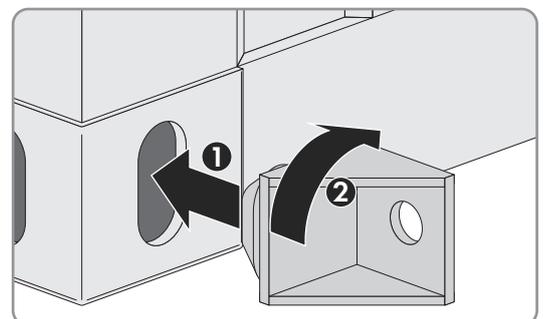
To avoid damaging the cables during installation, the cables may only be fed through the empty conduits once the MV Power Station has been set in place. The use of pull wires is recommended.

#### Additional tools:

- Bolt cutters
- For attaching the side twistlock: screws and screw anchors

#### Procedure:

1. Transport the MV Power Station to the mounting location (see Section 5.3, page 73).
2. Set the MV Power Station down on the support surface. Use the base plates to compensate any unevenness. The unevenness must be less than 1.5%.
3. Open the shackle locks on the doors of the medium-voltage and low-voltage compartments using bolt cutters.
4. In case of the order option "Earthquake and Storm Package":
  - Attach the side twistlocks at the four corners of station container.



- Drill holes for the screw anchors (diameter of side twistlocks: 32 mm).
- Attach the side twistlocks to the foundation using screw anchors and screws.

## 6 Installation

### 6.1 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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- 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**

When exposed to light, the PV modules generate high DC voltage which is present in the DC cables. Touching live DC cables results in death or lethal injuries 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 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.

**⚠ 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. Touching live parts will result in death or serious injury due to electric shock.

- 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 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.
- 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.

**NOTICE****Damage to the PV array due to faulty connection of the DC cables**

When installing a one-pole fused PV array, a short circuit can occur by connecting ungrounded DC cables to the fused DC input. The PV array can be damaged as a result.

- During the installation, ensure that the ungrounded DC cables are connected to the fused connection lugs.
- During the installation, ensure that the grounded DC cables are connected to the busbar or that busbars are inserted in the fuse holders.

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

Sand, dust and moisture penetration can damage the system 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.

**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 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.

**NOTICE****Damage to the product due to non-removal of transport lock**

The product is provided with a special security lock for transport to protect it from moisture. Non-removal of the transport lock can cause condensation and overheating during operation.

- Prior to installation work, ensure that all transport locks on the product are removed.

**i DC-side disconnection**

The DC main distributions and DC subdistributions should be equipped with load-break switches or circuit breakers at plant level. Load-break switches or circuit breakers enable trouble-free DC-side disconnection of the inverter.

## 6.2 Installation Sequence

The sequence of installation work given in this section is recommended by SMA. It is important to begin the installation with the preparatory work and the grounding connection. Therefore, SMA recommends that you adhere to this sequence to avoid problems during installation. Some of the installation work will only need to be carried out for certain order options.

Task	See
Removing the covers in case of order option "Sea freight"	Section 6.3.1, page 81
Working in the inverter compartment	Section 6.3.2, page 83
Working in the MV transformer compartment	Section 6.3.3, page 83
Working in the medium-voltage compartment	Section 6.3.4, page 84
Working in the low-voltage compartment	Section 6.3.5, page 85
Removing the desiccant bag	Section 6.3.6, page 85
Replacing the desiccant bag in the inverter	Section 6.3.6.2, page 86
Mounting the oil filter	Section 6.3.7, page 86
Preparing the cable entry	Section 6.3.8, page 87
Inserting the cables	Section 12.5.2, page 211
Grounding the station container	Section 6.4.3, page 89
Connecting the DC cables	Section 6.5, page 90
Connecting the AC cables	Section 6.6, page 102
Connecting the cables for communication, control and monitoring	Section 6.7, page 105
Connecting the cable for the supply voltage	Section 6.8, page 115
Connecting the cable to customer installation location of the Inverter	Section 6.9.2, page 121
Connecting the cable for remote control of cascade control	Section 6.10, page 125
Sealing the cable entries	Section 6.11.1, page 126
Closing the base plates on the inverter	Section 6.11.2, page 126
Mounting the inverter panels	Section 12.3.1.1, page 203
Checking the surface of the station container and the MV transformer	Section 6.11.3, page 127

## 6.3 Preparatory Work

### 6.3.1 Removing the covers in case of order option "Sea freight"

With the order options "Sea freight" and "Sea freight special", some of the MV Power Station components must be protected by covering plates against climatic influences. These covering plates must be removed in a timely manner after installation. The desiccant is saturated and no longer able to absorb moisture from the air. The MV Power Station should be well ventilated to prevent corrosion.

## Removing covering plates located in front of the inverters and the MV transformer

### ⚠ CAUTION

#### Risk of injury when lifting the covering plates or if they are dropped

When removing the covering plates, there is a risk of injury if the covering plates are lifted incorrectly or dropped. Weight per covering plate: maximum 45 kg.

- Assign at least two people for the removal of the covering plates.
- Secure the covering plates against falling before removing the screws.
- Wear personal protective equipment when removing the covering plates.

#### Procedure:

1. Remove the upper covering plates located in front of the MV transformer.
2. Remove the lower covering plates located in front of the MV transformer.

## Removing the covering plates located in front of the fan openings, ventilation grids and fast-stop switch

1. Remove the covering plates in front of the fans in the medium-voltage and low-voltage compartments.
2. Remove the covering plates in front of the ventilation grids on the medium-voltage and low-voltage compartments.
3. Remove the covering plate located in front of the optional fast-stop switch using an Allen key.
4. To protect the station container against corrosion, screw all of the bolts back into the screw holes. If screws are missing, they must be replaced.
5. Remove the adhesive foils on the inner surfaces of the doors of the MV and LV compartment.

## Open the drain orifices and remove the foil at the cable entry openings.

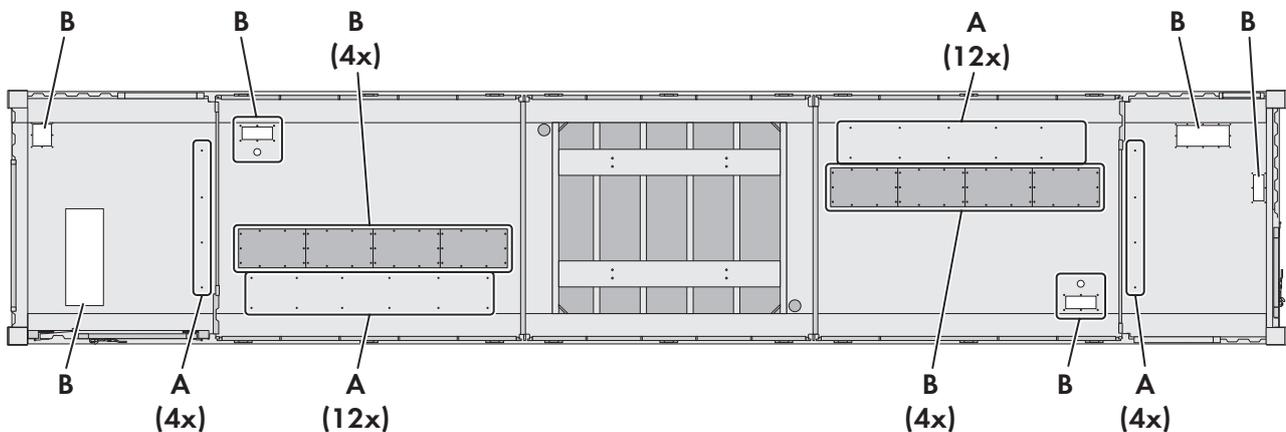


Figure 42: Position of the covers in the area of the inverters

Position	Designation
A	Drain orifice
B	Cable entry openings

#### Procedure:

1. Remove the plugs from the drain orifices in the floor of the station container.
2. With the order option "Cable Entry Kit", remove the adhesive foil at the cable entry openings.

## 6.3.2 Working in the inverter compartment

### 6.3.2.1 Loosening the Tie-Down Straps

#### ⚠ 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.

#### **Procedure:**

- Loosen the tie-down straps.

### 6.3.2.2 Opening the Drain Orifices in the Inverter Compartment

With the order option "Sea freight", the drain openings in the inverter compartment are closed with plugs and the cable entry openings with adhesive foil.

#### **Procedure:**

1. Remove the plugs from the drain orifices in the floor of the station container.
2. Remove the inverter panels (see Section 12.3.1.1, page 203).
3. With the order option "Cable Entry Kit", remove the adhesive foil from the DC inputs if the MV Power Station was delivered by sea.

## 6.3.3 Working in the MV Transformer Compartment

The tie-down straps of the MV transformer must be removed.

In the MV transformer compartment, the protective grilles in front of the MV transformer must be set forwards depending on the order option "Grids for MVT Room".

#### ⚠ CAUTION

##### **Risk of injury when releasing the tie-down straps**

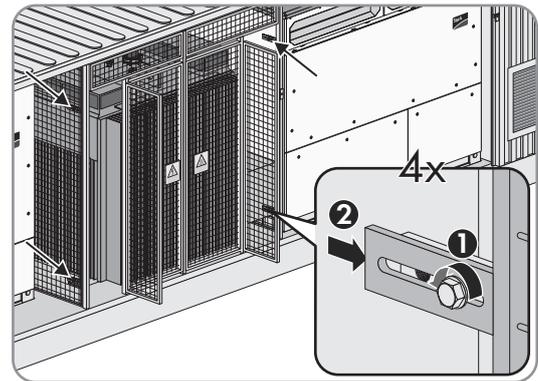
Since there is tension on the tie-down straps, there is a risk of whiplash when they are released. This can result in cuts or crushing of limbs.

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

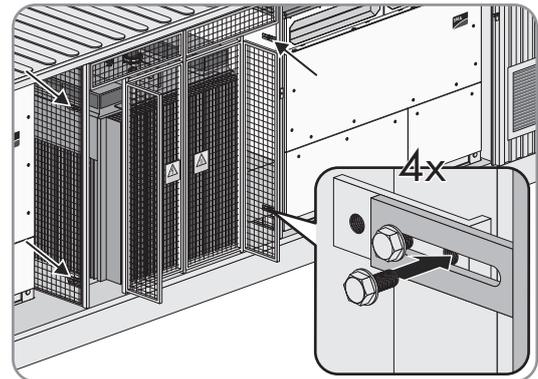
#### **Procedure:**

1. When the MV Power Station has been delivered with the order option "Grids for MVT Room":
  - Open the lattice doors of the MV transformer. To do this, use a square key.
  - Remove the rear guide bolts from the lattice doors, the upper grilles and the door hinges.

- Partly release the front bolts and pull lattice doors, upper grilles and door hinges forwards.



- Use the rear bolts to attach the guides in the forward position and tighten all bolts.



- Remove the foam rubber covers on the MV transformer.
- Loosen the four tie-down straps.
- If the MV Power Station has been delivered with the order option "Grids for MVT Room", close the lattice doors of the MV transformer. To do this, use a square key.

### 6.3.4 Working in the Medium-Voltage Compartment

#### ⚠ WARNING

##### **Danger to life due to inhibited pressure diversion in the event of an arc fault in the MV switchgear**

Covering plates are mounted on the station container to protect the product from weather influences during sea transport. If there is a fault in the MV switchgear, arc faults may occur during operation of the product. In the event of an arc fault, pressure builds up which is diverted via the electric-arc opening in the station container. If the sea transport covering plate in front of the electric-arc opening is not removed, this pressure cannot dissipate. This can result in death or serious injury.

- Remove all covering plates.
- Ensure that all covering plates have been removed prior to commissioning.
- Ensure that the hatch is mounted in front of the electric-arc opening.

#### ⚠ CAUTION

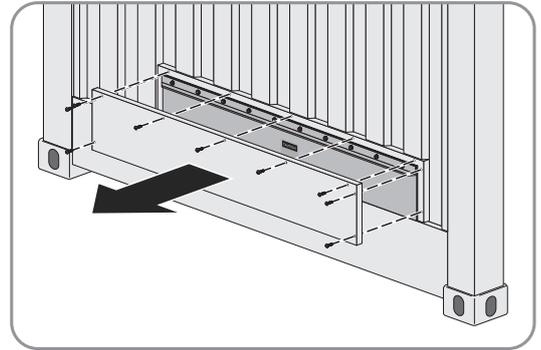
##### **Risk of injury when releasing the tie-down straps**

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.

**Procedure:**

1. Open the medium-voltage compartment (see Section 12.1, page 200).
2. Release the tie-down straps on the MV switchgear.
3. Remove the covering plate in front of the electric-arc opening.



4. With the order option "Sea freight", remove the foils on the ventilation openings in the medium-voltage compartment doors:
  - Remove the grids on the inside of the doors.
  - Remove the foil from the ventilation openings. Do not use any sharp objects to avoid damage to paintwork.
  - Mount the grids on the inside of the doors. The grilles prevent the ingress of animals.
5. Remove the covers on the upper air inlets without fan.
6. Close the medium-voltage compartment (see Section 12.1, page 200).

### 6.3.5 Working in the Low-Voltage Compartment

1. Open the low-voltage compartment (see Section 12.1, page 200).
2. With the order option "Sea freight", remove the foils on the ventilation openings of the doors:
  - Remove the grids on the inside of the doors.
  - Remove the foil from the ventilation openings. Do not use any sharp objects to avoid damage to paintwork.
  - Mount the grids on the inside of the doors. The grilles prevent the ingress of animals.
3. With the order option "Sea freight", mount the base plate for the cable entry:
  - Remove the bolts of the cover plate.
  - Remove the cover plate. The cover plate is no longer needed.
4. Remove the covers on the upper air inlets without fan.
5. Close the low-voltage compartment (see Section 12.1, page 200).

### 6.3.6 Removing the Desiccant Bags

#### 6.3.6.1 Removing the Desiccant Bag from the Station Container

The desiccant bags absorb moisture formed during transport.

**Procedure:**

1. Open the medium-voltage compartment and the low-voltage compartment (see Section 12.1, page 200).
2. Remove the desiccant bags from the station container. The desiccant bags are to be found at the following positions:
  - 24 in the MV transformer compartment
  - 24 in the area of inverter 1
  - 24 in the area of inverter 2
  - 24 in the medium-voltage compartment

- 24 in the low-voltage compartment
3. Close the medium-voltage compartment and the low-voltage compartment (see Section 12.1, page 200).

### 6.3.6.2 Replacing the Desiccant Bag in the Inverter

Desiccant bags absorb moisture formed during transport.

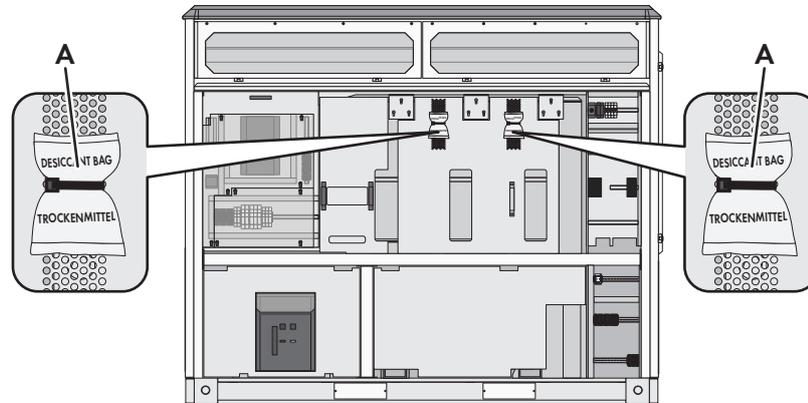


Figure 43: Position of the desiccant bags

Position	Designation
A	Desiccant bag

#### **i** Desiccant bag in the inverter

There are two desiccant bags in the inverter to protect the electronic components against moisture. The desiccant bag must be replaced by a new desiccant bag included in the scope of delivery one day before commissioning.

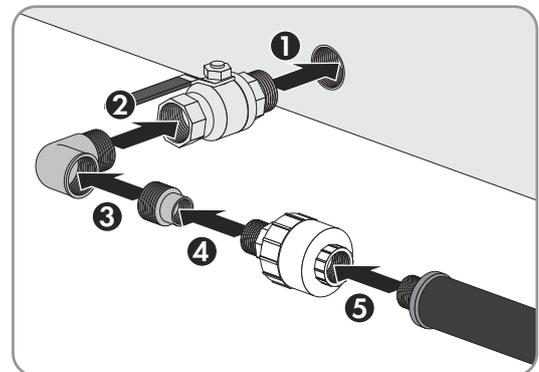
The commissioning is delayed by one day if the desiccant bag has not been replaced in the 24 hours prior to commissioning. Additional travel costs for SMA service personnel must be paid by the customer.

#### Procedure:

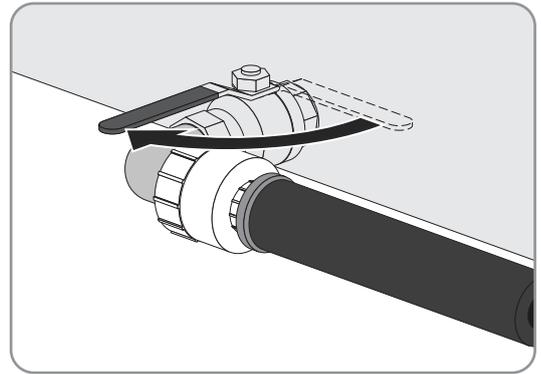
1. Remove and dispose of the desiccant bags.
2. Remove the supplied desiccant bags from the foil and attach them in the same position.
3. Remove the desiccant bags in the inverter on the day of commissioning.

### 6.3.7 Mounting the oil filter

1. Unscrew the screw filler plugs from the oil outlet in the station container.
2. Mount the oil filter on the MV Power Station:
  - Mount the oil filter angle joint on the outlet of the integrated oil spill containment below the MV transformer. When doing so, ensure that the oil filter angle joint is angled downward slightly. Use the Teflon tape from the scope of delivery for this.
  - Mount the oil drain valve with Teflon tape included in the scope of delivery to the oil drain angle joint.
  - Screw the oil filter and pre-filter together.
  - Screw the oil filter onto the oil drain valve.



3. Ensure that the shut-off valve on the oil filter is open.

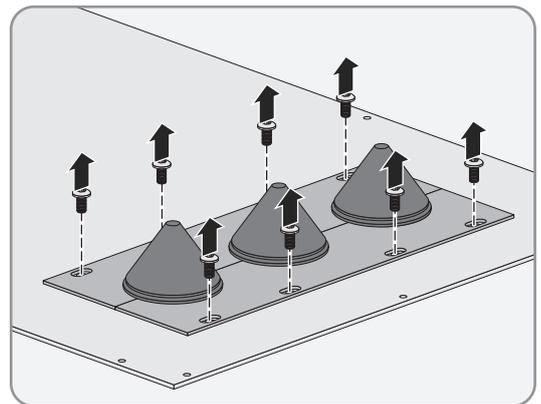


### 6.3.8 Preparing the Cable Entry

Cable entries are fitted underneath the inverters, MV switchgear, grounding busbar for the ground electrode and station sub-distribution. The cable entries must be prepared differently depending on the order option.

#### Preparing the cable entry with order option "Cable Entry Kit"

1. Loosen and open the sliding panels underneath the station subdistribution, grounding busbar for the ground electrode and inverter.
2. Before inserting the cables for the MV switchgear, perform the following tasks:
  - Unscrew the base plates.
  - Remove the rubber gaskets.
  - Cut the rubber gaskets accordingly to fit the cable diameter.
  - Thread the rubber gaskets onto the cables.



#### Preparing the Cable Entry without order option "Cable Entry Kit"

##### Additional tools:

- Drill
- Cable glands

##### Procedure:

1. Drill holes for the cables in the covering plate in accordance with the cable cross-section.
2. Install cable glands in the covering plate holes.
3. Mount the covering plate onto the station container.

## 6.4 Grounding

### 6.4.1 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 system. The magnitude and distribution of such leakage currents is influenced by the grounding concept of all devices in the system. It is recommended that optical fiber technology is used for the transmission of signals, for example, when using cameras and monitoring equipment. This will counteract possible interference sources.

The factory meshed design of the grounding of inverter and MV transformer reduces leakage current levels.

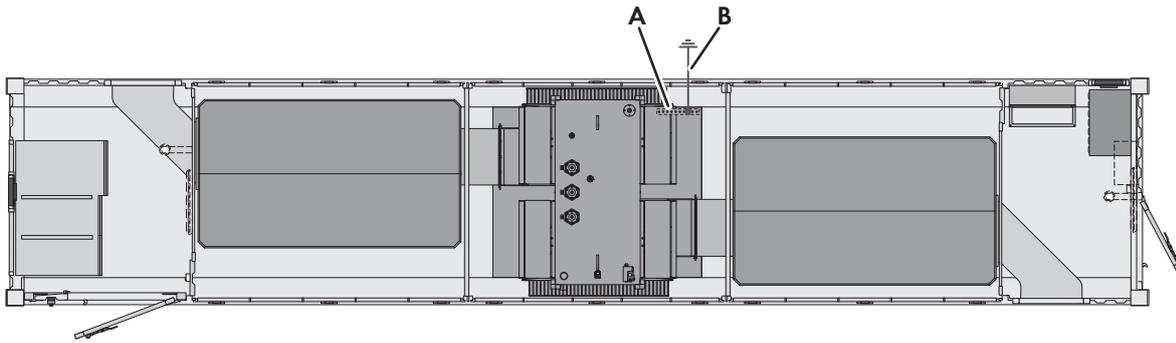


Figure 44: Grounding concept

Position	Designation
A	Grounding busbar for the ground electrode
B	Ground electrode

#### **i** Double grounding of the MV Power Station

We recommend that the grounding concept provides for double grounding of the MV Power Station.

#### **i** MV switchgear circuit breaker panel tripping times

The grounding inside the MV Power Station is laid out in such a way that the tripping time of the circuit breaker panel is less than 170 ms in the event of a short circuit. The MV switchgear's grounding is designed for a short-circuit current of 20 kA with a tripping time of max. 1 s. The protection device must be configured accordingly and the response times of the protective device and circuit breaker observed. SMA Solar Technology AG recommends setting the parameter for the tripping time  $t_{>>}$  in the event of a short circuit to 40 ms in order to avoid damages to the grounding device and injury to persons.

The inrush current of the MV transformer must be considered to guarantee a smooth operation. The inrush-current curve can be made available by SMA Solar Technology AG upon request.

The MV Power Station will be delivered with system-optimized default settings. The settings must be adjusted to the local conditions (selective coordination with upstream safety devices). The actual tripping times must be verified through selective measurements and documented prior to commissioning. Selective measurement and configuration is the responsibility of the farm operator.

### 6.4.2 Requirements for the Grounding Arrangement

#### 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 depend on the installed overcurrent protective device. Calculating the required cross-sections depends on the national standards and directives.

- Connect a maximum of two grounding cables to the grounding connection.
- 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 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.

#### Requirements for the Grounding Arrangement Design:

- The connection of the grounding arrangement must be made with at least one grounding conductor on the equipotential bonding rail in the MV transformer compartment. The opening diameter is 110 mm.
- Use copper or aluminum cables only.
- The cable cross-sections of the grounding depend 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 mm<sup>2</sup>

For aluminum cable, at least: 400 mm<sup>2</sup>

### 6.4.3 Installing the Grounding on the Station Container

The ground electrode must be connected to the grounding busbar of the product. For the connection of the ground electrode there are two terminals available on the grounding busbar.

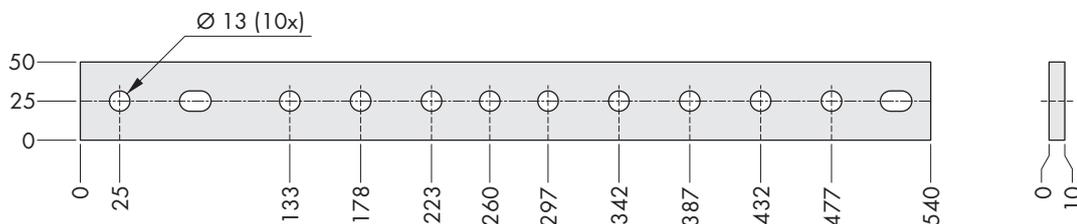


Figure 45: Dimensions of the grounding busbar for the ground electrode (Dimensions in mm)

#### Required mounting material (included in the scope of delivery):

- 2 bolts M12 x 40
- Spring washers M12
- Fender washers M12
- 2 nuts M12

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

- Ground electrode in accordance with the grounding concept of the PV system
- Clean cloth
- Ethanol cleaning agent
- Tin-plated terminal lugs for the connection to M12 bolts suitable for the selected cable cross-section (hole diameter: 13 mm, maximum thickness: 9.4 mm)

#### Procedure:

1. Install the ground electrodes in accordance with the applicable regulations.

2. Ensure that the required grounding resistance is achieved.
3. If insulated grounding cables are used, strip off the insulation.
4. Fit the grounding cables with terminal lugs.
5. Clean the contact surfaces of the terminal lugs with a clean cloth and ethanol cleaning agent.
6. Remove metal dust using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces again after cleaning.
7. Route the grounding cable through the cable entry to the grounding busbar of the MV Power Station.
8. Connect the grounding cable to the grounding busbar of the MV Power Station (torque: 60 Nm).
9. Connect the grounding cables to the ground electrodes of the system.

## 6.5 DC Connection

### 6.5.1 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 °C and must be in accordance with the national standards and directives.
- Maximum cable cross-section per DC cable: 400 mm<sup>2</sup>.
- Use copper or aluminum cables only.
- The dielectric strength must be dimensioned for the maximum DC voltage.
  - Minimum dielectric strength for Sunny Central 2200: 1100 V
  - Minimum dielectric strength for Sunny Central 2475: 1100 V
  - Minimum dielectric strength for Sunny Central 2500-EV-US: 1500 V
  - Minimum dielectric strength for Sunny Central 2750-EV-US: 1500 V
  - Minimum dielectric strength for Sunny Central 3000-EV-US: 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.
- Higher ground voltages can occur in the event of an insulation error until the inverter is switched off. The battery-side fuse must be designed for the voltage that occurs in the event of a fault.
  - Voltage to ground for Sunny Central 2200: ±1800 V
  - Voltage to ground for Sunny Central 2475: ±1800 V
  - Voltage to ground for Sunny Central 2500-EV: ±2400 V
  - Voltage to ground for Sunny Central 2750-EV: ±2420 V
  - Voltage to ground for Sunny Central 3000-EV: ±2420 V

#### Cable requirements for the cable connection with terminal lugs:

- All terminal lugs used must be suitable for temperatures of up to +90 °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.
- 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 one 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.
- No more than one terminal lug may be connected per side of each terminal.
- Only use screws, nuts and washers included in the scope of delivery.
- 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.

## 6.5.2 DC Connection Area on the Inverter

### 6.5.2.1 DC Busbar

#### Cable requirements:

- On the rear of the busbars, a maximum of 12 cables can be connected per pole.
- On the front of the busbars, a maximum of 14 cables can be connected per pole.
- A maximum of 26 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.

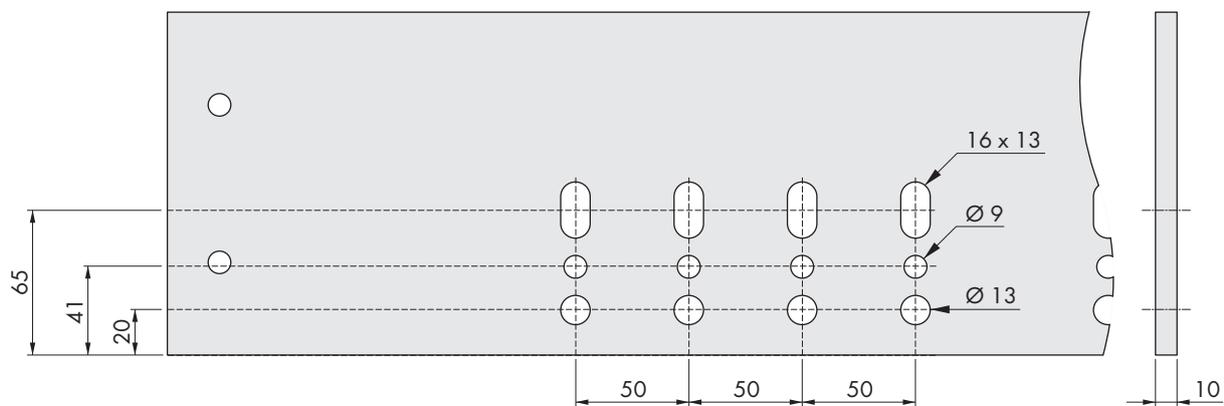


Figure 46: Dimensions of the DC busbar(Dimensions in mm)

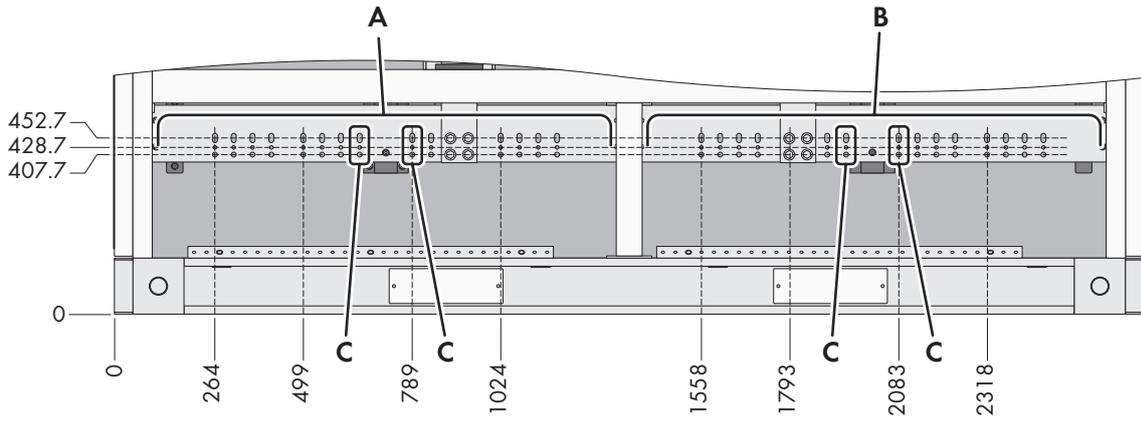


Figure 47: Position and dimensions of the DC busbar (Dimensions in mm)

Position	Designation
A	DC+ busbar
B	DC- busbar
C	Drill holes can only be used from the front.

### 6.5.2.2 DC Connection Lugs

The design of the DC connection area and the assignment of the DC inputs to the DC fuses depend on the order option (see Section 6.5.3, page 95).

Labels are affixed in the connection area to indicate the polarity of the connection busbars.

#### Insulated system with two-pole fuse protection

##### Inverter with a maximum of 24 DC inputs

Overview of the DC connection area for the following options:

- DC input configuration: 12 fused inputs
- DC input configuration: 18 fused inputs
- DC input configuration: 21 fused inputs
- DC input configuration: 24 fused inputs
- DC input configuration: 32 fused inputs

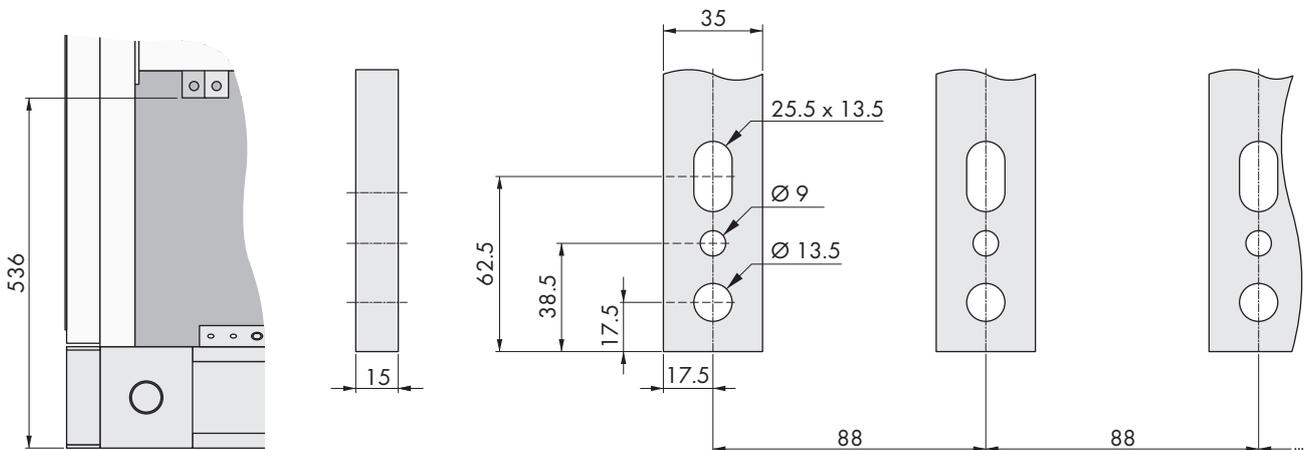


Figure 48: Dimensions with 24 DC terminal lugs (maximum equipment) (Dimensions in mm)

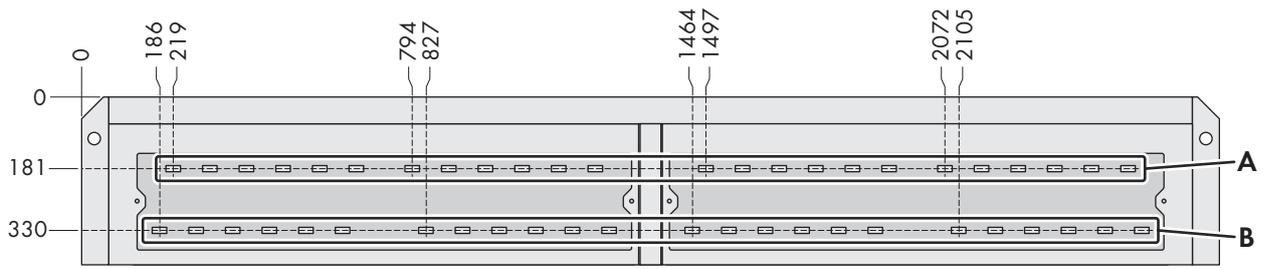


Figure 49: Insulated system with two-pole fuse protection: Position with 24 DC connection brackets (maximum equipment), view from below (Dimensions in mm)

Position	Designation
A	DC+ connection
B	DC- connection

**Grounded in insulated system with one-pole fuse protection**

**Inverter with a maximum of 24 DC inputs**

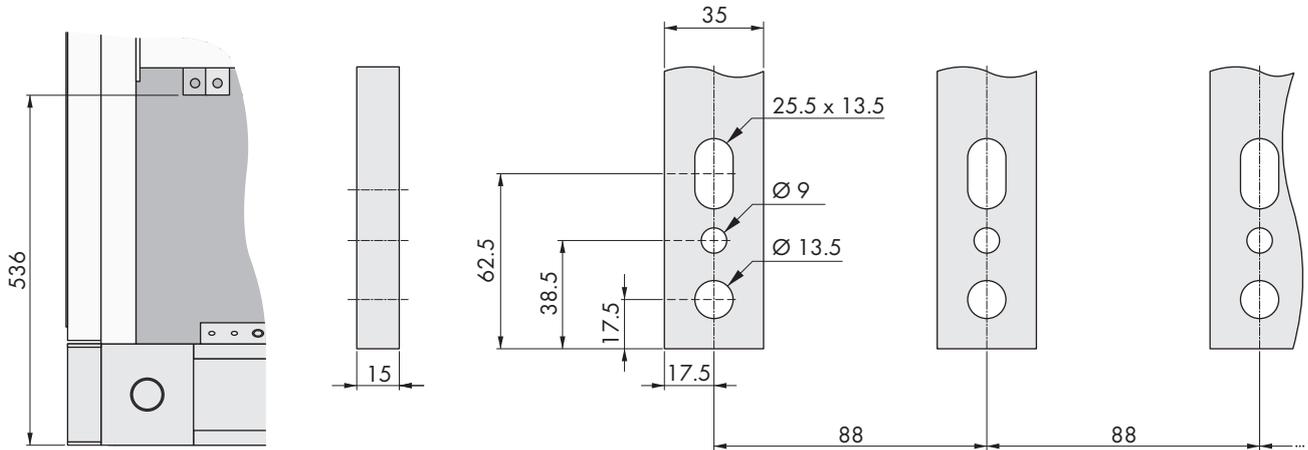


Figure 50: Dimensions with 24 DC terminal lugs (maximum equipment) (Dimensions in mm)

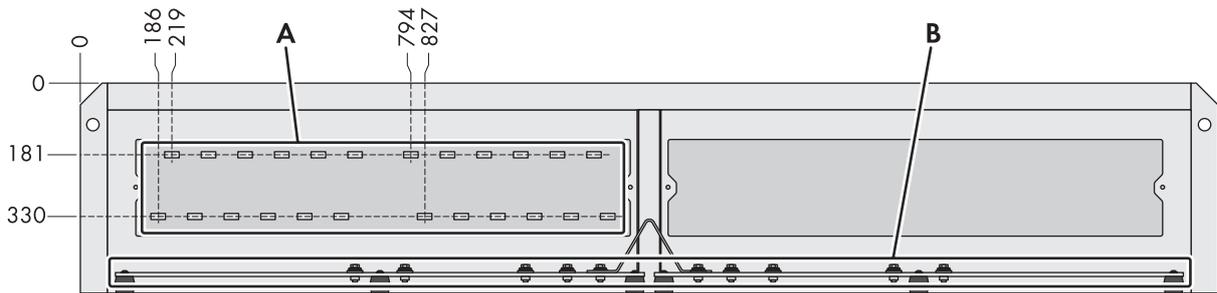


Figure 51: Grounded and insulated system with one-pole fuse protection: Position with 24 DC connection brackets (maximum equipment), view from below (Dimensions in mm)

Position	Designation
A	Connection DC+ (ungrounded pole)
B	Connection DC- (grounded pole)

Inverters with 32 DC inputs

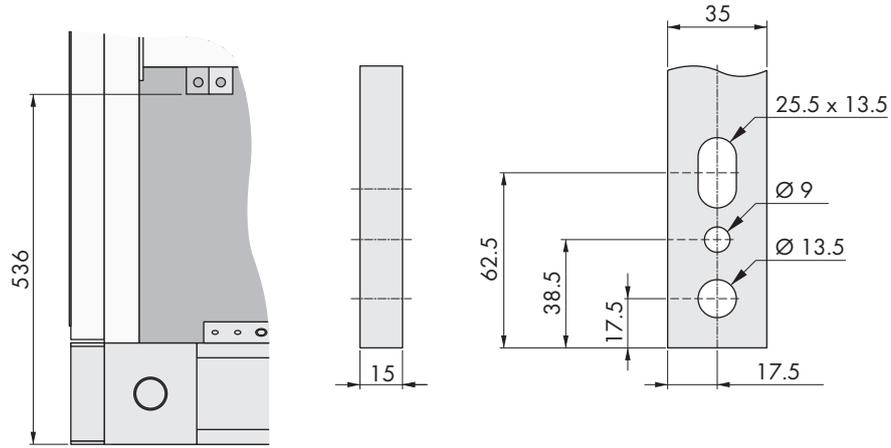


Figure 52: Dimensions with 32 DC terminal lugs (Dimensions in mm)

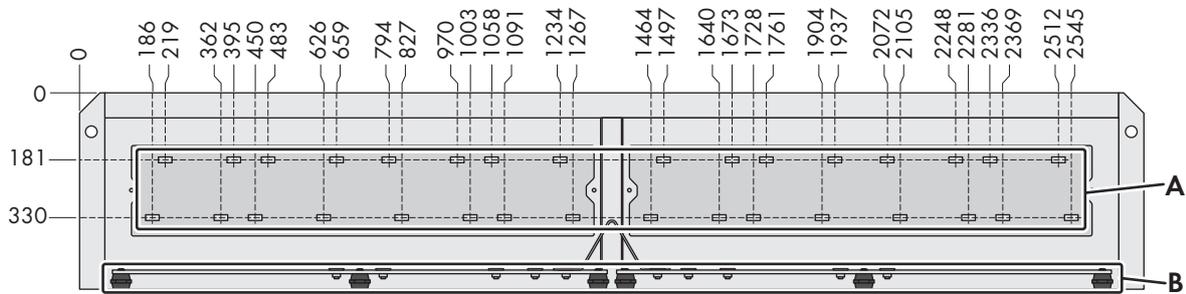


Figure 53: Position with 32 DC connection brackets, view from below (Dimensions in mm)

Position	Designation
A	Connection DC+ (ungrounded pole)
B	Connection DC- (grounded pole)

If not all DC inputs are used, the DC cables should be distributed symmetrically via the DC connection brackets.

### 6.5.3 Assignment of the DC Inputs to the DC Fuses

#### Insulated system with two-pole fuse protection

#### Inverter with a maximum of 24 DC inputs

The DC connection and the LV/HRC fuses to be used change based on the DC input configuration and grounding.

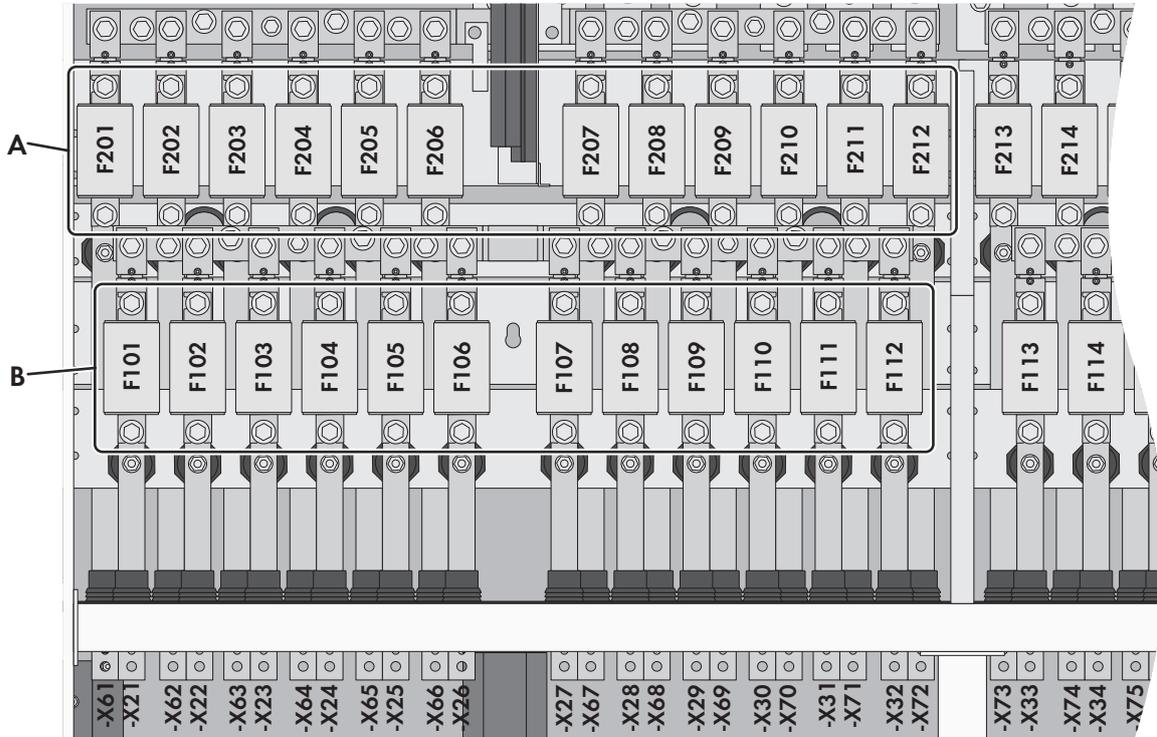


Figure 54: Assignment of DC inputs to DC fuses in the insulated system with two-pole fuse protection (maximum equipment)

Position	Designation
A	DC fuses with negative terminal DC-
B	DC fuses with positive terminal DC+

#### Assignment of the LV/HRC fuses depending on the DC input configuration

Depending on the order option, not all connection lugs and DC fuses might be present in the inverter.

Number of fused DC inputs	Use of LV/HRC fuses
12 fused inputs	The input straps <b>X22, X24, X25, X28, X30, X31, X34, X36, X37, X40, X42</b> and <b>X43</b> as well as <b>X62, X64, X65, X68, X70, X71, X74, X76, X77, X80, X82</b> and <b>X83</b> cannot be used with the option "12 fused inputs".
18 fused inputs	The input straps <b>X24, X28, X32, X36, X40</b> and <b>X44</b> as well as <b>X64, X68, X72, X76, X80</b> and <b>X84</b> cannot be used with the option "18 fused inputs".
21 fused inputs	The input straps <b>X36, X40</b> and <b>X44</b> as well as <b>X76, X80</b> and <b>X84</b> cannot be used with the option "21 fused inputs".
24 fused inputs	All input straps can be used.

### Grounded in insulated system with one-pole fuse protection

In grounded systems, the ungrounded pole must be connected to the fused DC connection brackets and the grounded pole to the DC busbar.

The DC connection and the LV/HRC fuses to be used change based on the DC input configuration and grounding.

#### Inverter with a maximum of 24 DC inputs

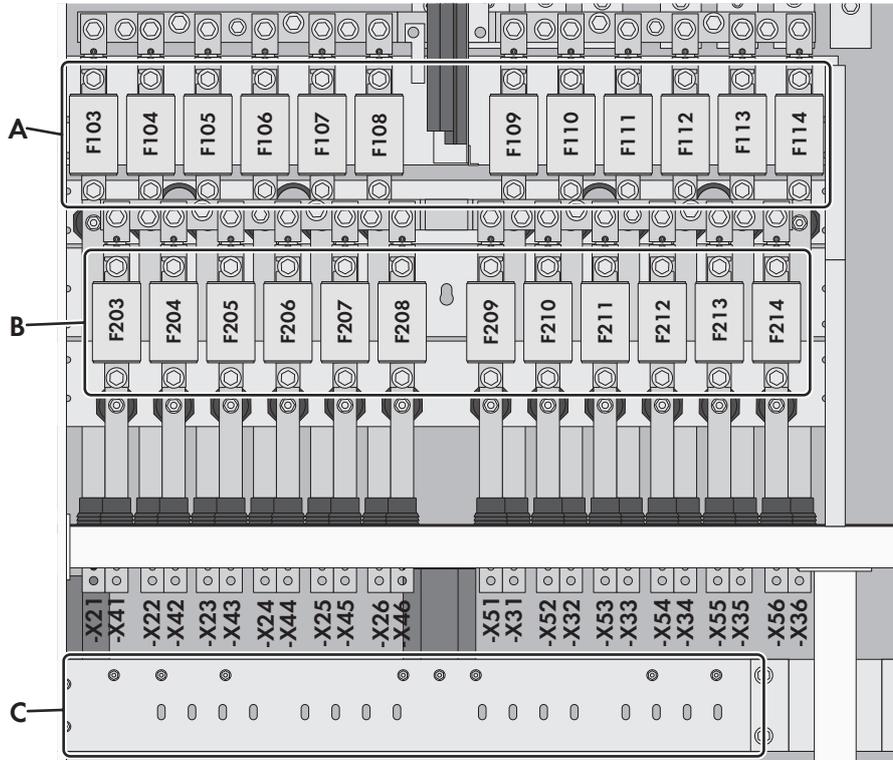


Figure 55: Assignment of DC inputs to DC fuses in the insulated and grounded system with one-pole fuse protection (maximum equipment)

Position	Designation
A	DC fuses to the rear row of the DC connection brackets. The ungrounded poles must have the same polarity.
B	DC fuses to the front row of the DC terminal lugs
C	Busbar for connecting the grounded pole

#### Assignment of the LV/HRC fuses depending on the DC input configuration

Depending on the order option, not all connection lugs and DC fuses might be present in the inverter.

Number of fused DC inputs	Use of LV/HRC fuses
12 fused inputs	The input straps X21 to X24, X33 to X36 as well as X45, X46, X51 and X52 cannot be used with option "12 fused inputs".
18 fused inputs	The input straps X25, X26, X31, X32, as well as X46 and X51 cannot be used with the option "18 fused inputs".
21 fused inputs	The input straps X26, X31 and X51 cannot be used with the option "21 fused inputs".
24 fused inputs	All input straps can be used.

Inverters with 32 DC inputs

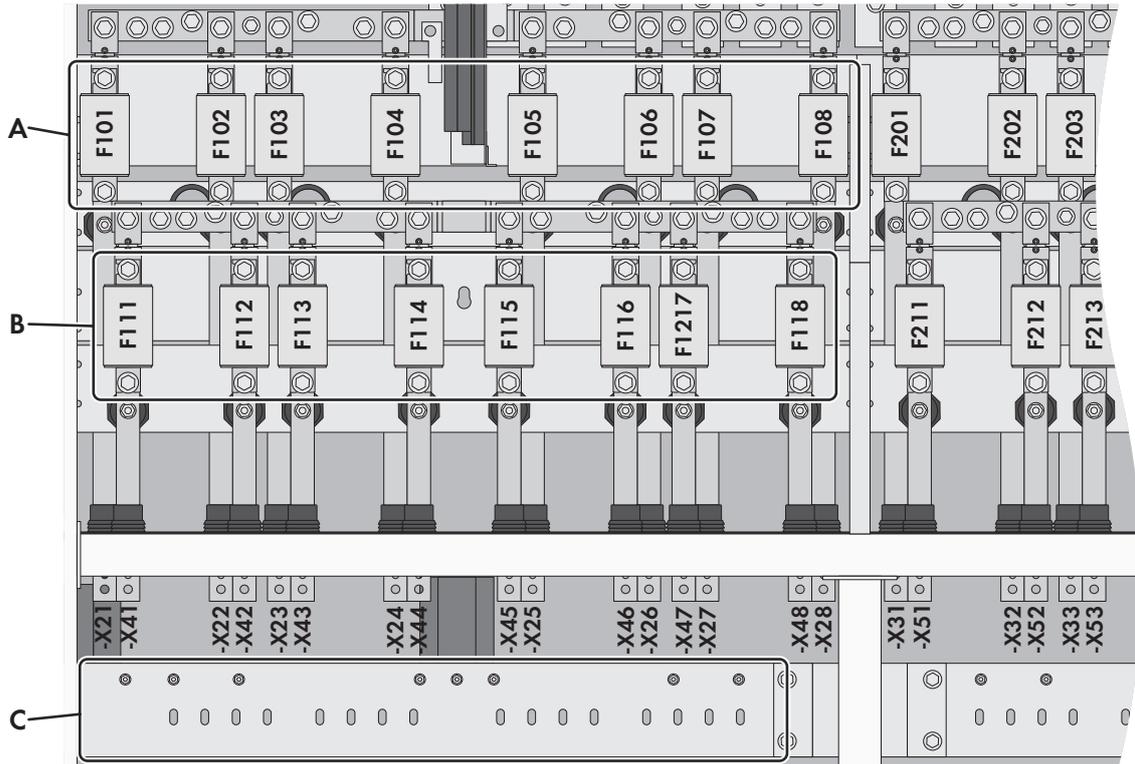


Figure 56: Assignment of DC inputs to DC fuses

Position	Designation	
A	DC fuses to the rear row of the DC connection brackets.	The ungrounded poles must have the same polarity.
B	DC fuses to the front row of the DC connection brackets	
C	Busbar for connecting the grounded pole	

**Assignment of the LV/HRC fuses depending on the DC input configuration**

Depending on the order option, not all connection lugs and DC fuses might be present in the inverter.

Number of fused DC inputs	Use of LV/HRC fuses
28 fused inputs	The input straps <b>X41</b> to <b>X44</b> cannot be used with the option "28 fused inputs".
32 fused inputs	All input straps can be used.

### 6.5.4 Connecting the DC Cables

#### Assembly of the bolted connection with two-hole terminal lugs

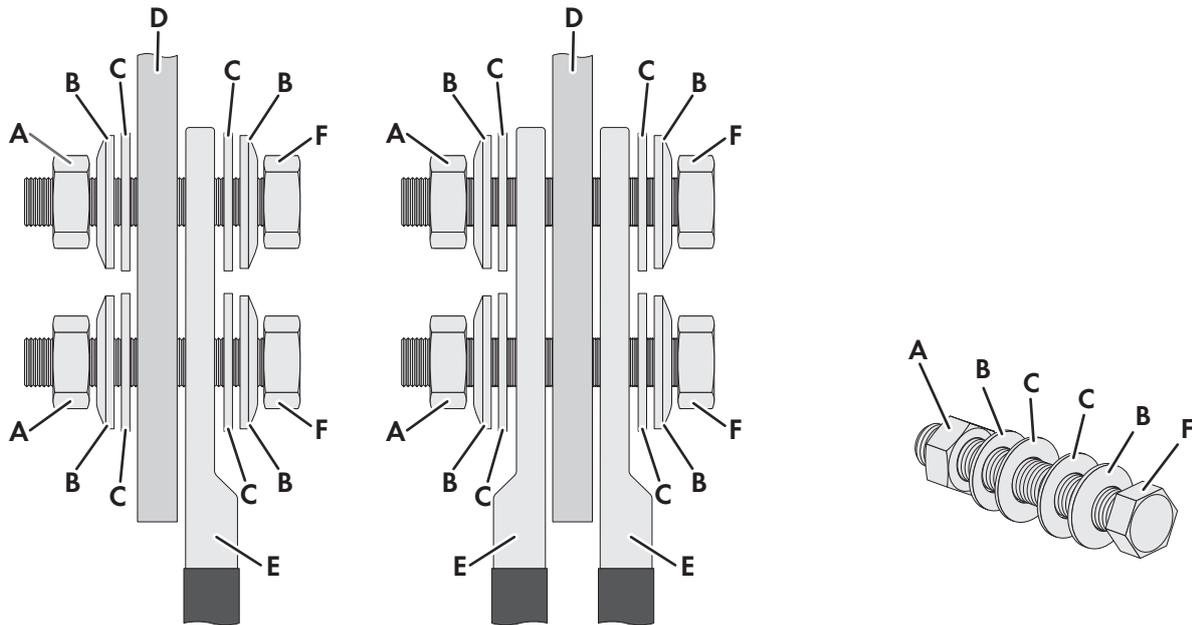


Figure 57: Assembly of the bolted connection

Position	Designation
A	Nut
B	Spring washer
C	Fender washer
D	Connection busbar
E	Two-hole terminal lug
F	Bolt

### Assembly of the bolted connection with single-hole terminal lugs

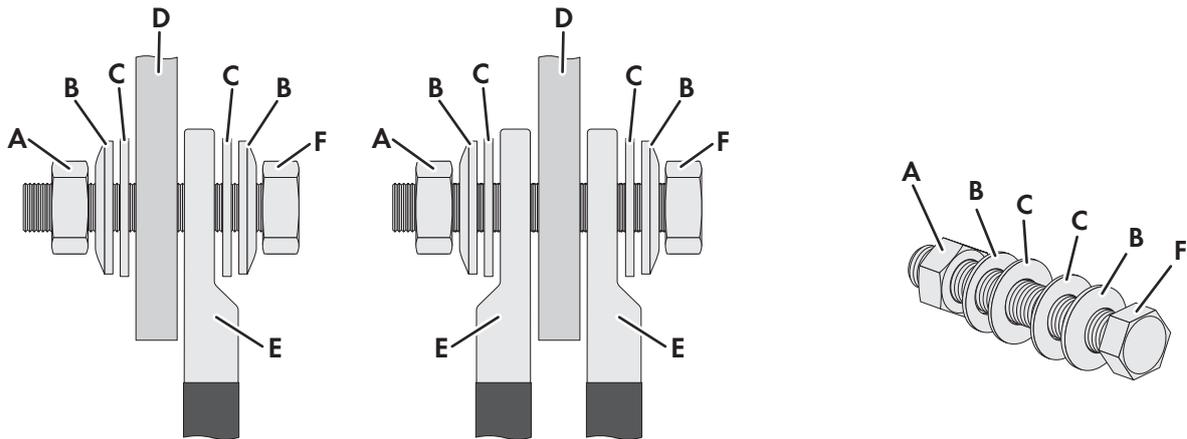


Figure 58: Assembly of the bolted connection

Position	Designation
A	Nut
B	Spring washer
C	Fender washer
D	Connection busbar
E	One-hole terminal lug
F	Bolt

#### **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 no voltage is present.
2. Strip the cable insulation.
3. Crimp the cables with the terminal lugs according to the manufacturer specifications.
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 in accordance with the circuit diagram (torque: 60 Nm). The polarities and connection brackets that must not be assigned are marked with labels.

### 6.5.5 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:

Inverter	Nominal current	Material number
• SC-2200-10 (Sunny Central 2200)	200 A	61-103100.01
• SC-2475-10 (Sunny Central 2475)	250 A	61-103200.01
	315 A	61-103300.01
	350 A	61-103400.01
	400 A	61-103500.01
	450 A	101839-00.01
	500 A	101846-00.01

Inverters	Nominal current	Material number
• SC-2500-EV-10 (Sunny Central 2500-EV)	200 A	101815-00.01
• SC-2750-EV-10 (Sunny Central 2750-EV)	250 A	101821-00.01
• SC-3000-EV-10 (Sunny Central 3000-EV)	315 A	101829-00.01
	350 A	101834-00.01
	400 A	101835-00.01
	450 A	101839-00.01
	500 A	101846-00.01

#### Assembly of the upper bolted connection with bolt and washer assembly and special bolt

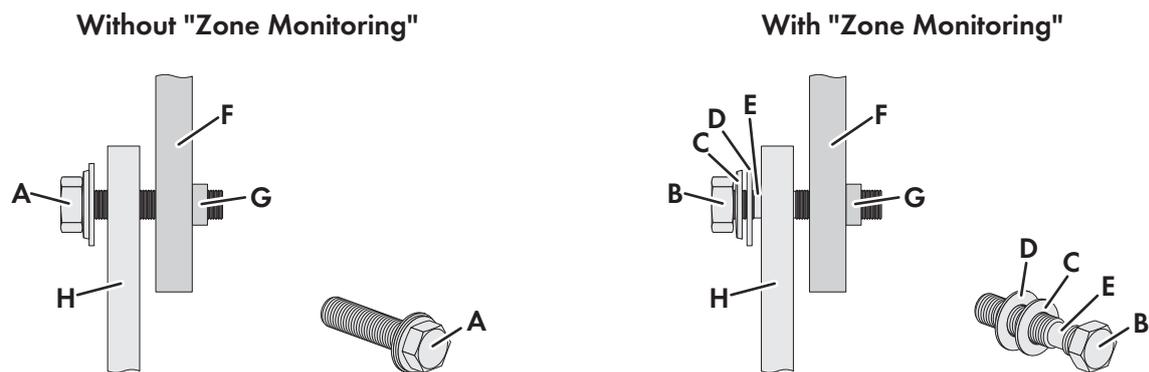


Figure 59: Assembly of the upper bolted connection with bolt and washer assembly (left) and special bolt (right)

Position	Designation
A	Bolt and washer assembly (M10)
B	Special bolt (M12)
C	Spring washer
D	Fender washer

Position	Designation
E	Shaft of the bolt
F	Connection busbar of inverter
G	Self-clinching nut
H	Connection bracket of the DC fuse

### Assembly of the lower bolted connection

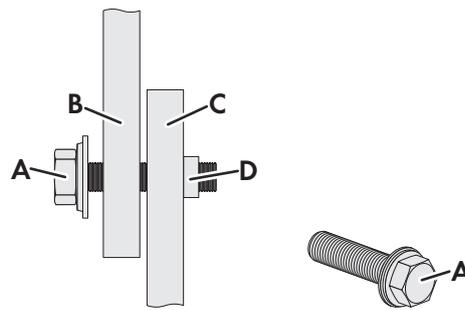


Figure 60: Assembly of the lower bolted connection with bolt and washer assembly (M10)

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):

- Bolt and washer assembly M10, quantity according to the input configuration
- Special bolt M12, quantity according to the input configuration (Option "Zone Monitoring")
- Conical spring washer M12, quantity according to the input configuration (Option "Zone Monitoring")
- Fender washer M12, quantity according to the input configuration (Option "Zone Monitoring")
- DC fuses in accordance with the PV system design

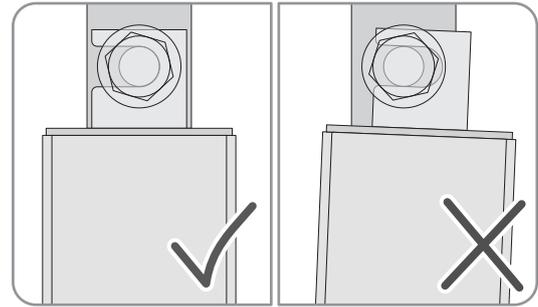
### Additionally required installation material (not included in the scope of delivery):

- Torque wrench, dimension at the side of the release head with wrench socket: max. 68 mm
- Ethanol cleaning agent
- Clean cloth

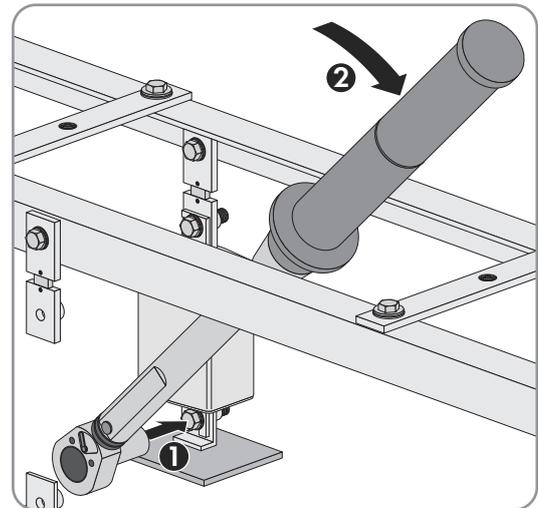
### Procedure:

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. Screw the bolt and washer assembly or the special bolt (M12) 1 to 2 threads into the upper connection busbar as per the assembly of the bolted connection.
6. Place the DC fuse holder completely onto the upper bolt and washer assembly or special bolt.



7. Align the DC fuse vertically between both connecting rails.
8. Ensure that the upper connecting rail is not twisted.
9. Tighten bolts (torque: 30 Nm).



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

## 6.6 AC Connection

### 6.6.1 Cable Requirements for Medium-Voltage Connections

#### Cable and plug requirements:

- The cables used must be made of aluminum or copper.
- The cable cross sections used depend on the nominal currents of the MV transformer and the layout of the PV power plant and are the responsibility of the customer.
- In the standard version of the MV Power Station, filler plates are intended for the enclosure openings. The required holes must be drilled by the customer.
- With the order option "Cable Entry Kit", six cable entries per cable panel, three strain relief devices for single-core cables and one cable support rail are provided for. Three additional strain relief devices can be provided by SMA Solar Technology AG upon request External diameter per cable: 36 mm to 52 mm
- Replace and adapt the strain reliefs of the MV switchgear if the diameter of the used cable is smaller than 36 mm or greater than 52 mm.
- Outer-cone angle plugs of type C with 630 A and the required rated voltage must be used. The equipment for the two-core terminal can be provided by SMA Solar Technology AG upon request.
- Depending on the connector type, the cable cross-section of the line conductor can be as high as 400 mm<sup>2</sup>.
- If three-core cables are to be used, the conductors must be separated before insertion into the MV Power Station.

## 6.6.2 Installing the AC Connection on the Medium-Voltage Switchgear

### Overview of the connection area of the MV switchgear

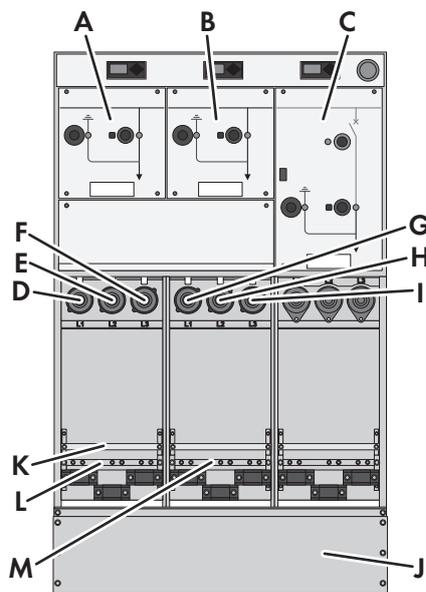


Figure 61: MV switchgear connection area (example)

Position	Designation
A	Cable panel 1
B	Cable panel 2
C	Transformer panel
D	Line conductor L1 from cable panel 1
E	Line conductor L2 from cable panel 1
F	Line conductor L3 from cable panel 1
G	Line conductor L1 from cable panel 2
H	Line conductor L2 from cable panel 2
I	Line conductor L3 from cable panel 2
J	Kick plate
K	Grounding busbar for connecting AC cable shielding
L	Cable support rail cable panel 1*
M	Cable support rail cable panel 2*

\* Three strain relief devices per cable panel are mounted on the cable support rail for attaching the cables (clamping range: 36 mm to 52 mm). The equipment for the two-core terminal can be provided by SMA Solar Technology AG upon request.

#### **i** Qualified persons must make medium-voltage connections

Medium-voltage connections should only be made by a qualified person who is authorized to make medium-voltage connections.

#### Requirements:

- The cables must be inserted through the openings in the base plate (see Section 12.5, page 211).

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

- 3 cable connectors per cable panel, type C, rated voltage in accordance with the MV switchgear (see manufacturer's documentation)

**Procedure:**

1. Disassemble the kick plate of the MV switchgear.
2. Remove the base plates of the cable entries. Also remove the rubber bushings.
3. Cut the rubber bushings to size in accordance with the outer diameter of the cable insulation.
4. Thread the rubber bushings onto the cables.
5. Connect the cables to the MV switchgear (see manufacturer documentation). The manufacturer torque specifications must be adhered to in order to prevent the emission of SF<sub>6</sub> gas.
6. Remove the strain relief devices from the cable support rail.
7. Attach the cables with the cable clamps. Make sure that the cables run straight down.  
This helps to prevent mechanical strain on the outer cone bushings of the MV switchgear.  
Use the insertion bushings when doing so and ensure that the AC cable shielding is not mounted in the strain relief device.
8. Connect the shielding of the AC cables to the grounding busbar.
9. Mount the base plates of the cable entries with the rubber bushings. When doing so, ensure that the base plates lie in the groove of the rubber bushings. This prevents animals from entering the product.
10. Seal all unused cable entries with filler plugs.
11. Seal the cable entries to ensure a proper pressure relief during an arc fault.
12. Mount the MV switchgear kick plate.

**6.6.3 Installing the AC Connection at the Medium-Voltage Transformer**

If the MV Power Station was ordered without MV switchgear, the AC cables must be connected to the MV transformer. To do this, the AC cables must be inserted through the opening in the base of the medium-voltage compartment.

**Requirement:**

- The AC cables must be correctly inserted and attached.
- The MV transformer is equipped with outer cone, type C bushings according to EN50180 and EN50181. Appropriate touch-proof connectors must be used.

**Additionally required equipment**

- Conductor

**Procedure:**

1. Insert the AC cables into the cable entries in the medium-voltage compartment and route it to the MV transformer.
2. Connect the AC cables to the MV transformer (see manufacturer documentation).
3. Retain the AC cables on the wall of the container with the pre-mounted cable clamps. Make sure that no compression or tension force is exerted on the outer cone bushings of the MV transformer.
4. Secure the AC cables on the cable rail.

## 6.7 Cables for communication, control and monitoring

### 6.7.1 Inserting the Communication Cables into the MV Power Station

There are openings for inserting the communication cables below the MV Power Station. The type of opening depends on the selected order option. Predefined cable channels are to be found in the floor of the station container for routing customer-supplied communication cables within the MV Power Station. It is easier to route the cables in the cable channels using puller wires. The puller wires are supplied ex works.

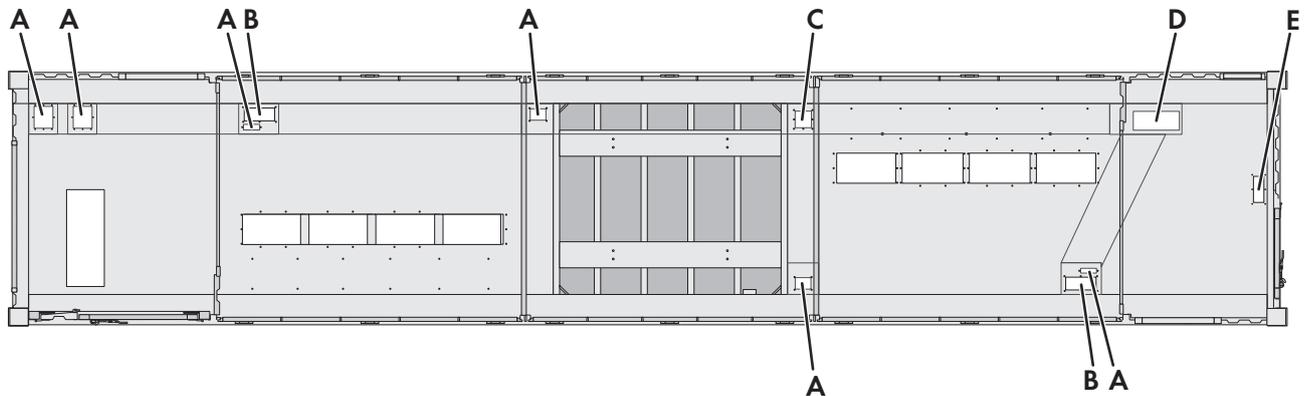


Figure 62: Cable channels in the station container (plan view)

Position	Designation
A	Cable channel opening for station-internal cable routing
B	Opening underneath the inverter for insertion of the inverter cables
C	Opening underneath the MV transformer for insertion of ground-electrode cable
D	Opening underneath the station subdistribution for insertion of the cables for communication, control, and monitoring
E	Opening underneath the customer installation location inside the low-voltage compartment

#### Procedure:

1. Prepare the cable entries (see Section 6.3.8, page 87).
2. Thread cables through the cable glands.
3. Sealing the cable entries (see Section 6.11.1, page 126)

## 6.7.2 Connecting the Cable in the Inverter

### 6.7.2.1 Connecting Cables for Feedback 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.

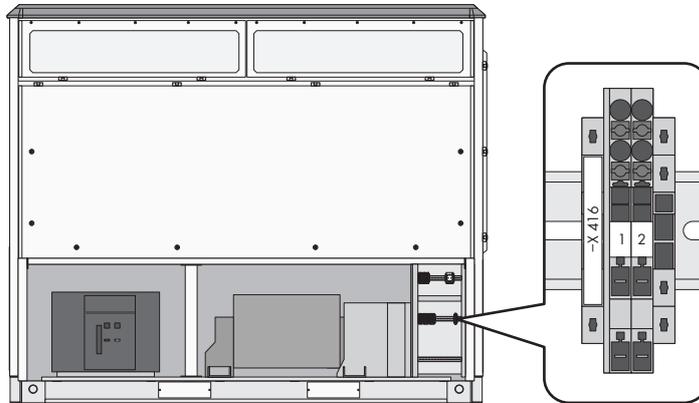


Figure 63: Position of the connecting terminal plate for the switching-state light repeater of the DC switch

#### Cable requirements:

- Multi-wire cable with bootlace ferrules: 2.5 mm<sup>2</sup>
- Single-wire cable: 4 mm<sup>2</sup>
- Number of conductors: 2

#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Connect the cable to the terminals **-X416:1** and **-X416:2** in accordance with the circuit diagram (see Section 12.4.2, page 209).
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 12.3.1.1, page 203).

### 6.7.2.2 Connecting the Cable for External Fast-Stop Function

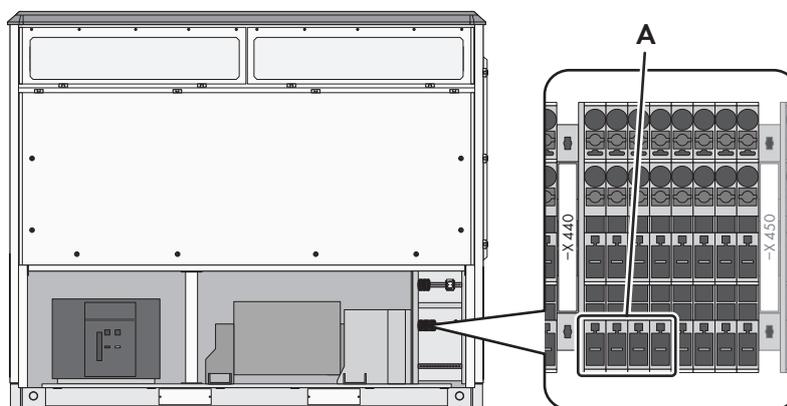


Figure 64: Position of the terminal block for external fast stop function

Position	Designation
A	Terminal block

**Cable requirements:**

- Multi-wire cable with bootlace ferrules: 2.5 mm<sup>2</sup>
- Single-wire cable: 4 mm<sup>2</sup>
- Number of conductors: 2

**Requirements:**

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

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
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<sub>out</sub> to the female connector **-X441:1** and 24 V<sub>in</sub> to the female connector **-X441:2** in accordance with the circuit diagram (see Section 12.4.2, page 209).
6. Plug the female connector **-X441** into the terminals **1** and **2** in the terminal block **-X440**.
7. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
8. Mount the panels (see Section 12.3.1.1, page 203).
9. Connect the first insulated conductor of the cable to the input side of the switch.
10. Connect the second insulated conductor of the cable to the output side of the switch.

**6.7.2.3 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.

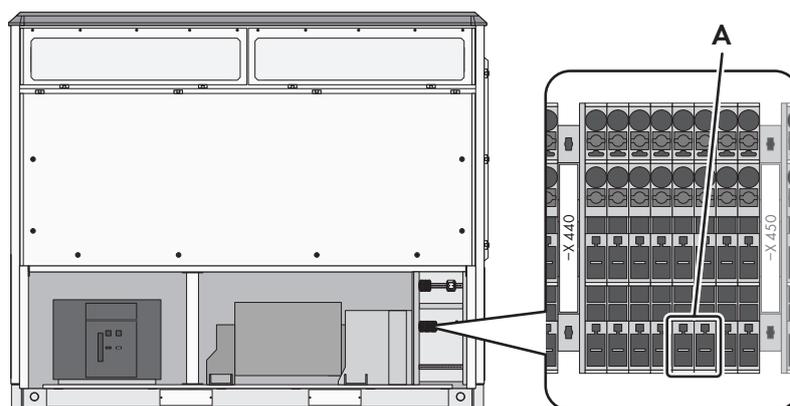


Figure 65: Position of the terminal block for external standby

Position	Designation
A	Terminal block

**Cable requirements:**

- Multi-wire cable with bootlace ferrules: 2.5 mm<sup>2</sup>
- Single-wire cable: 4 mm<sup>2</sup>
- Number of conductors: 2

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
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 12.4.2, page 209).
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 12.3.1.1, page 203).

**6.7.2.4 Connecting the Cable for External Active Power Setpoint**

If the setpoints for active power limitation are not transmitted via the network, you can use the terminals for connecting external setpoints. The inverter processes standard analog signals from 4.0 mA to 20.0 mA.

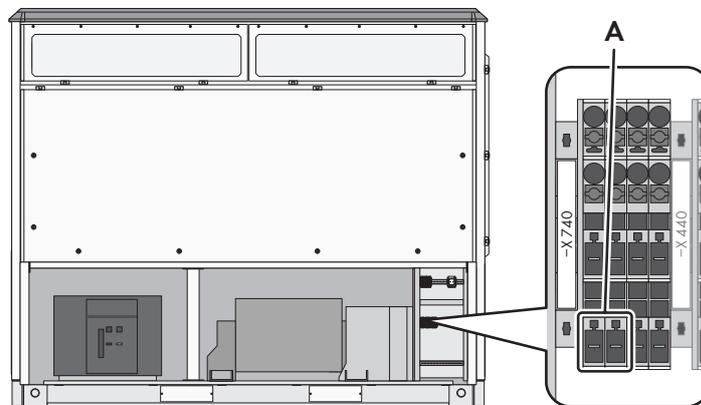


Figure 66: Position of the terminal block for external setpoint of active power limitation

Position	Designation
A	Terminal block

**Cable requirements:**

- Multi-wire cable with bootlace ferrules: 2.5 mm<sup>2</sup>
- Single-wire cable: 4 mm<sup>2</sup>
- Number of conductors: 2

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Remove the female connector **-X741** from the terminals **1** and **3** of the terminal block **-X740**.
4. Connect the cable to the female connector **-X741** in accordance with the circuit diagram (see Section 12.4.2, page 209).
5. Plug the female connector **-X741** into the terminals **1** and **3** in the terminal block **-X740**.
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 12.3.1.1, page 203).

### 6.7.2.5 Connecting the Cable for External Reactive Power Setpoint

If the setpoints for the reactive power control are not transmitted via the network, you can use the terminals for connecting external setpoints. The inverter processes standard analog signals from 4.0 mA to 20.0 mA.

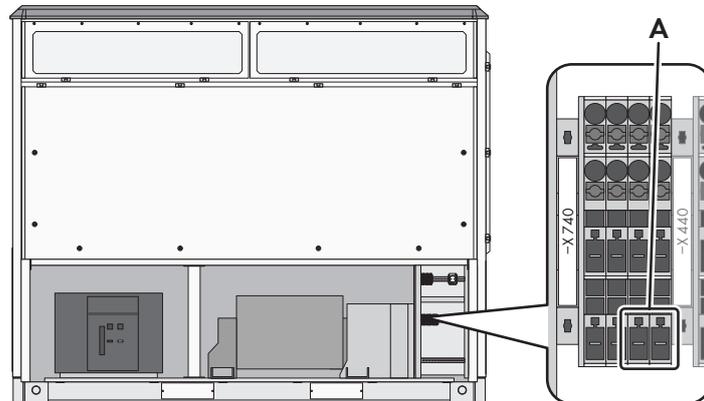


Figure 67: Position of the terminal block for external setpoint of reactive power control

Position	Designation
A	Terminal block

#### Cable requirements:

- Multi-wire cable with bootlace ferrules: 2.5 mm<sup>2</sup>
- Single-wire cable: 4 mm<sup>2</sup>
- Number of conductors: 2

#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Remove the female connector **-X742** from the terminals **5** and **7** of the terminal block **-X740**.
4. Connect the cable to the female connector **-X742** in accordance with the circuit diagram (see Section 12.4.2, page 209).
5. Plug the female connector **-X742** into the terminals **5** and **7** in the terminal block **-X740**.
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 12.3.1.1, page 203).

### 6.7.2.6 Connecting the Cables for Communication Connection of the String Monitor

#### Connection with Ethernet Cable

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

- DC string monitoring: external, SMA string monitoring, Cu

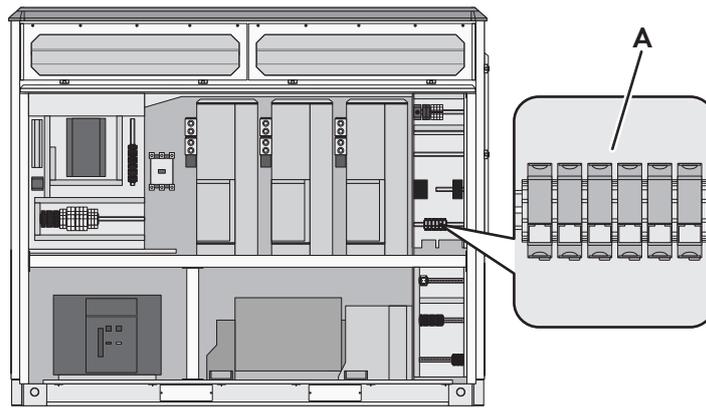


Figure 68: Position of the string monitoring patch panel

Position	Designation
A	Patch panel

**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. Disassemble the panels (see Section 12.3.1.1, page 203).
2. Plug the cables into the network ports **-F81** to **-F86**.
3. Attach the cables to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
4. Mount the panels (see Section 12.3.1.1, page 203).

**Connection with Optical Fibers**

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

- DC string monitoring: external, SMA string monitoring, optical fiber

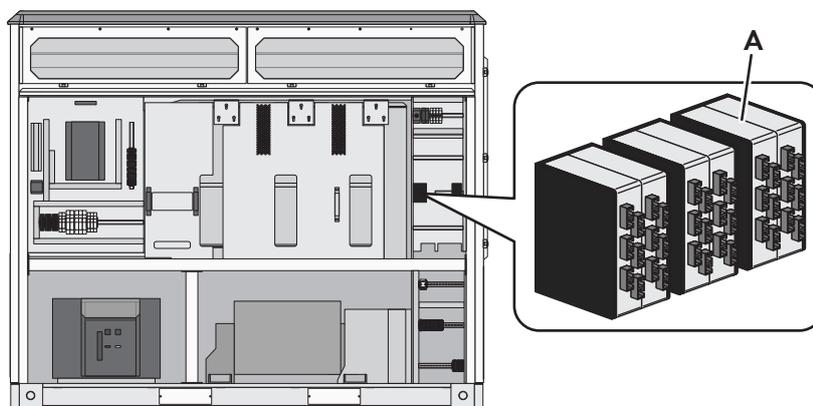


Figure 69: Position of the splice box for string monitoring

Position	Designation
A	Splice box for string monitoring

## 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.

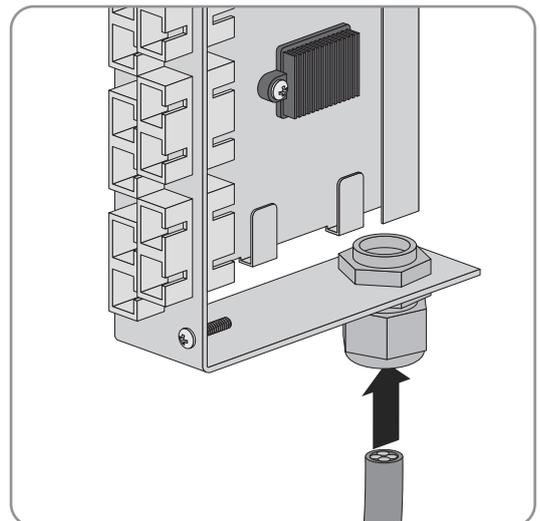
- Observe the minimum permissible bend radii of the optical fibers.

### Optical fiber requirements:

- 50/125  $\mu\text{m}$
- Category: OM2
- Plug: SC MMF

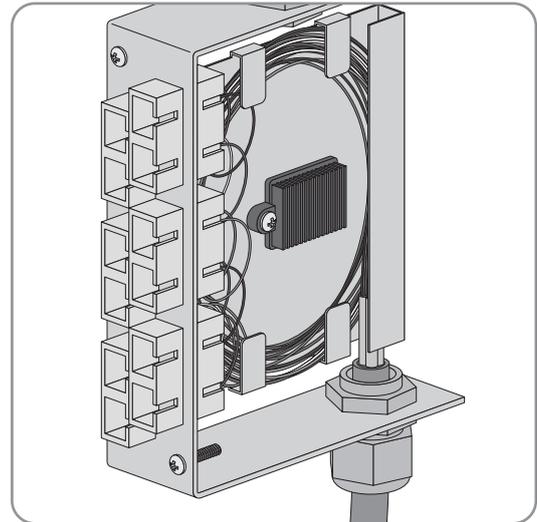
### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. 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 12.5.2, page 211).
4. Loosen the upper and lower screw on the front of the splice box.
5. Pull the insert forwards out of the splice box and remove.
6. Insert the optical fiber with the received signal for the cluster ring from below through the cable gland into the splice box.



7. Insert the optical fiber with the transmitting signal for the cluster ring from above through the cable gland into the splice box.
8. Splice the subscriber connectors with the optical fibers.
9. Plug the subscriber connectors at the rear of the insert into the SC-P plugs **-X501**. Ensure that the send and receive direction of the optical fiber nodes is observed.

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



11. Slide the insert into the enclosure of the splice box.  
 12. Tighten the upper and lower screws on the front of the splice box.  
 13. Attach the optical fibers to the cable support rail using a cable tie. This ensures that the optical fibers cannot be pulled out inadvertently.  
 14. Seal the enclosure openings with silicone  
 15. Mount the panels (see Section 12.3.1.1, page 203).

### 6.7.2.7 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
- 8 analog inputs
- 4 analog and 8 digital inputs
- 6 RTD channels

#### 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.

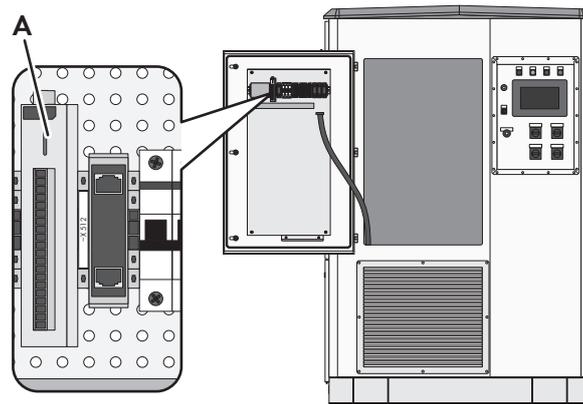


Figure 70: Position of the Remote I/O module

Position	Designation
A	Remote I/O module

#### Ethernet cable requirements:

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

#### Cable requirements for digital/analog connections:

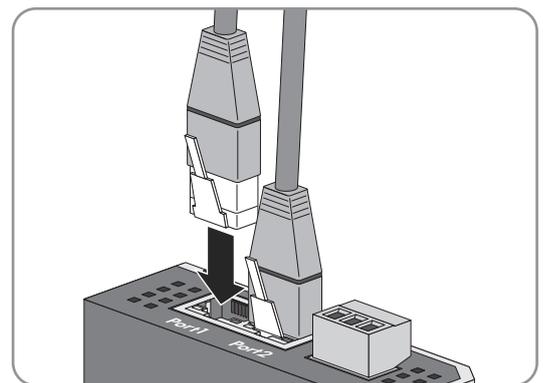
- Maximum cable cross-section 0.75 mm<sup>2</sup>

#### Requirements for terminals:

- A surge protection is recommended for the Ethernet cable.

#### Procedure:

1. Insert the cables into the inverter (see Section 12.5.2, page 211).
2. Plug the Ethernet cable into the network port -X5.



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

### 6.7.2.8 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

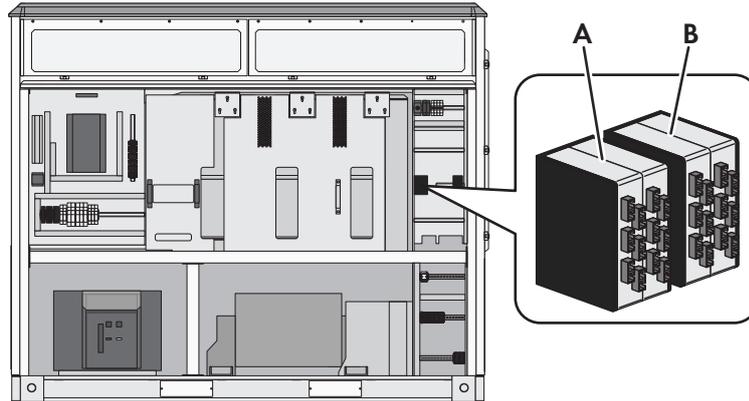


Figure 71: Position of the splice box of the communication via optical fiber backbone ring

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  $\mu\text{m}$
- Category: at least OS2
- Plug: SC-PC SMF

#### Optical fiber requirements in multi mode:

- 50/125  $\mu\text{m}$
- Category: at least OM2
- Plug: SC-PC MMF

### NOTICE

#### Damage to optical fibers due to too tight bend radii

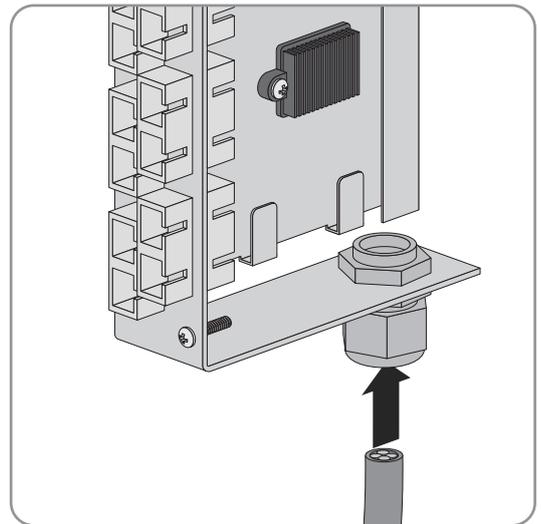
Excessive bending or kinking will drop below of the permissible bend radii. When dropping below the permissible bend radii, the optical fibers may be damaged.

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

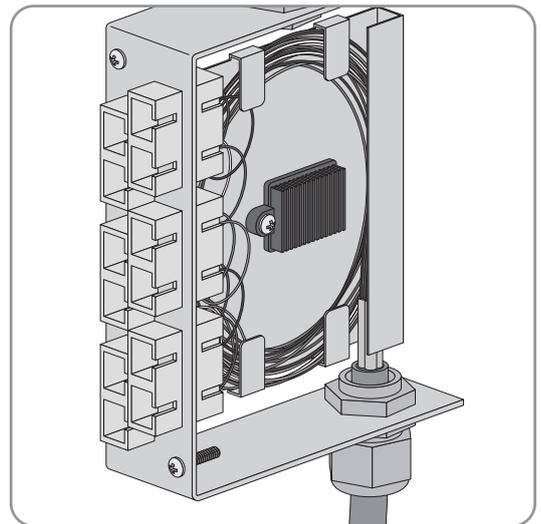
#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Open the hatch in front of the AC area of the inverter (see Section 12.2, page 202).
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 12.5.2, page 211).
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 inverter (see Section 12.2, page 202).
17. Mount the panels (see Section 12.3.1.1, page 203).

## 6.8 Supply voltage

### 6.8.1 Connecting the External Supply Voltage for the MV Power Station

Depending on the order option, the MV Power Station is not equipped with a low-voltage transformer. If a low-voltage transformer has not been installed, the supply voltage can be provided by an external supply transformer.

**Requirements:**

- The nominal voltage of the external supply voltage between each line conductor must be 400 V /  $\pm 10\%$  at 50 Hz / 60 Hz.
- The minimum power requirement of the MV Power Station must be 20 kVA.
- The maximum cable cross-section must be 50 mm<sup>2</sup>.

**Procedure:**

1. Ensure that the external supply voltage is disconnected.
2. Connect the cables for the external supply transformer in the station subdistribution as follows:
  - Connect the cable **L1** to the terminal **-X220:1**.
  - Connect the cable **L2** to the terminal **-X220:2**.
  - Connect the cable **L3** to the terminal **-X220:3**.
  - Connect the cable **N** to the terminal **-X220:4**.
  - Connect the **grounding conductor** cable to the grounding busbar in the station subdistribution.

### 6.8.2 Connecting External Supply Voltage for Motor-Driven Circuit Breaker of MV Switchgear

If the MV Power Station is no longer equipped with an uninterruptible power supply (option 19\_0) and the remote control of the motor-driven circuit breaker of the MV switchgear (option 24\_2 or 24\_4) is used, the motor-driven circuit breaker must be supplied by an external voltage supply.

**Requirements:**

- The nominal voltage of the external supply voltage between line conductor and neutral conductor must be 230 V /  $\pm 10\%$  at 50 Hz / 60 Hz.
- The maximum power requirement is 550 W for 15 seconds.

**Procedure:**

1. Ensure that the external supply voltage is disconnected.
2. Connect the external supply voltage for the motor-driven circuit breaker of the MV switchgear in the station subdistribution as follows:
  - Connect the cable **L1** to the terminal **-X220:33**.
  - Connect the cable **N** to the terminal **-X220:34**.
  - Connect the **grounding conductor** cable to the grounding busbar in the station subdistribution.

### 6.8.3 Connecting the Cables for External Loads to the Auxiliary Voltage Supply

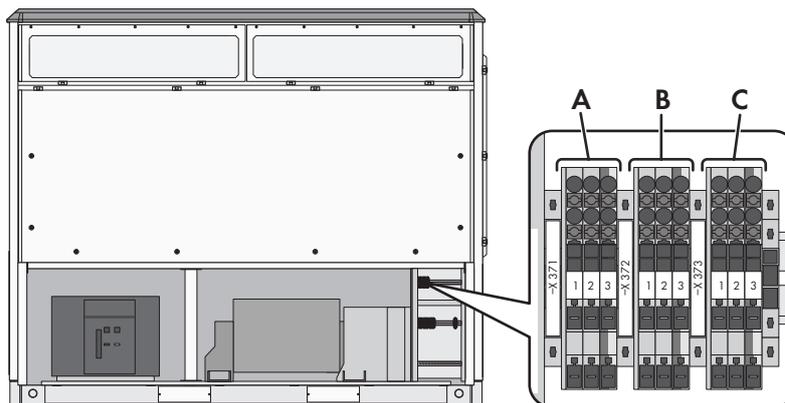


Figure 72: Position of the terminal blocks for external loads

Position	Designation
A	Connecting terminal plate <b>-X371</b>
B	Connecting terminal plate <b>-X372</b>
C	Connecting terminal plate <b>-X373</b>

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.

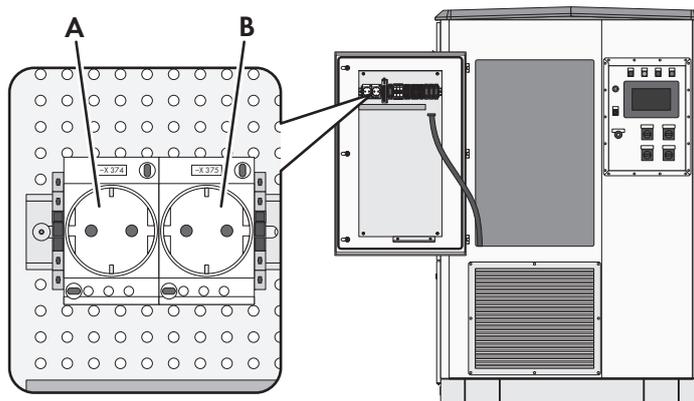


Figure 73: Position of the outlets for external loads

Position	Designation
A	Outlet <b>-X374</b>
B	Outlet <b>-X375</b> 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: 1440 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 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 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 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:**

- Multi-wire cable with bootlace ferrules: 0.14 mm<sup>2</sup> to 2.5 mm<sup>2</sup>
- Single-wire cable: 4 mm<sup>2</sup>
- Number of conductors: 3

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Connect the cable to the female connector **-X371** in accordance with the circuit diagram (see Section 12.4.2, page 209).
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 12.4.2, page 209).
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 12.4.2, page 209).
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 12.3.1.1, page 203).

## 6.8.4 Connecting the Cables for the External Supply Transformer for the Auxiliary Power Supply

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

- Auxiliary power supply external: external transformer 230 V
- Auxiliary power supply external: external transformer 120 V

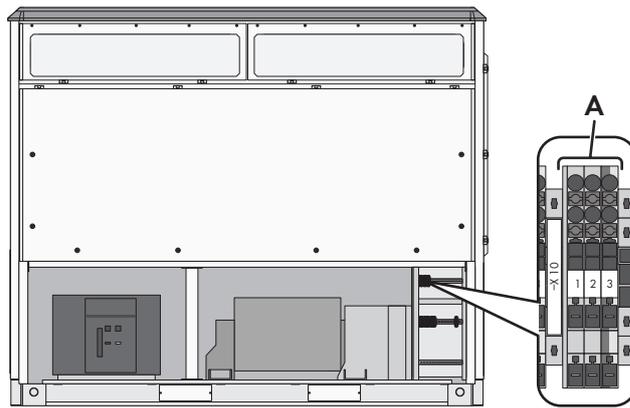


Figure 74: Position of the terminal block for the external supply voltage

Position	Designation
A	Terminal block

**Cable requirements:**

- Multi-wire cable with bootlace ferrules: maximum 0.14 mm<sup>2</sup> to 2.5 mm<sup>2</sup>
- Single-wire cable: maximum 4 mm<sup>2</sup>
- Number of conductors: 3

**Requirements for the connection of customer devices to the external transformer:**

- There is an internal fuse of 25 A in B characteristic for the external supply.
- The external line protection must be realized by the customer.
- The external supply voltage must supply the permitted voltage. The permitted voltage corresponds to the grid voltage at the operation site.
- The sum of the power of all devices must not exceed the maximum power of the external supply voltage. The maximum power is: 2.5 kVA.
- The cables must be routed in such a way that direct lightning coupling is not possible.

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Connect the cable to the female connector **-X10** in accordance with the circuit diagram (see Section 12.4.2, page 209).
4. Plug the female connector into the terminals **1**, **2** and **3** in the terminal block.
5. Attach the cable to the cable support rail using cable ties. This will prevent the cable from being pulled out inadvertently.
6. Mount the panels (see Section 12.3.1.1, page 203).

## 6.9 Customer installation location of the inverter

### 6.9.1 Connecting the Cable for Supply Voltage to Customer Installation Location

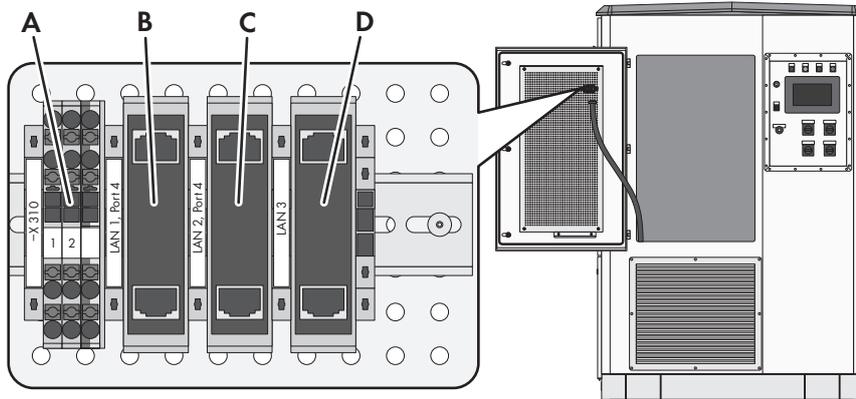


Figure 75: Position of the connections at the customer installation location

Position	Designation
A	Connecting terminal plate for voltage supply at customer installation location <b>-X310</b>
B	Interface for the monitoring option or optional remote I/O module <b>LAN 1 Port 4</b>
C	Ethernet interface for connecting to the station subdistribution <b>LAN 2 Port 4</b>
D	Internal Ethernet interface <b>LAN 3</b>

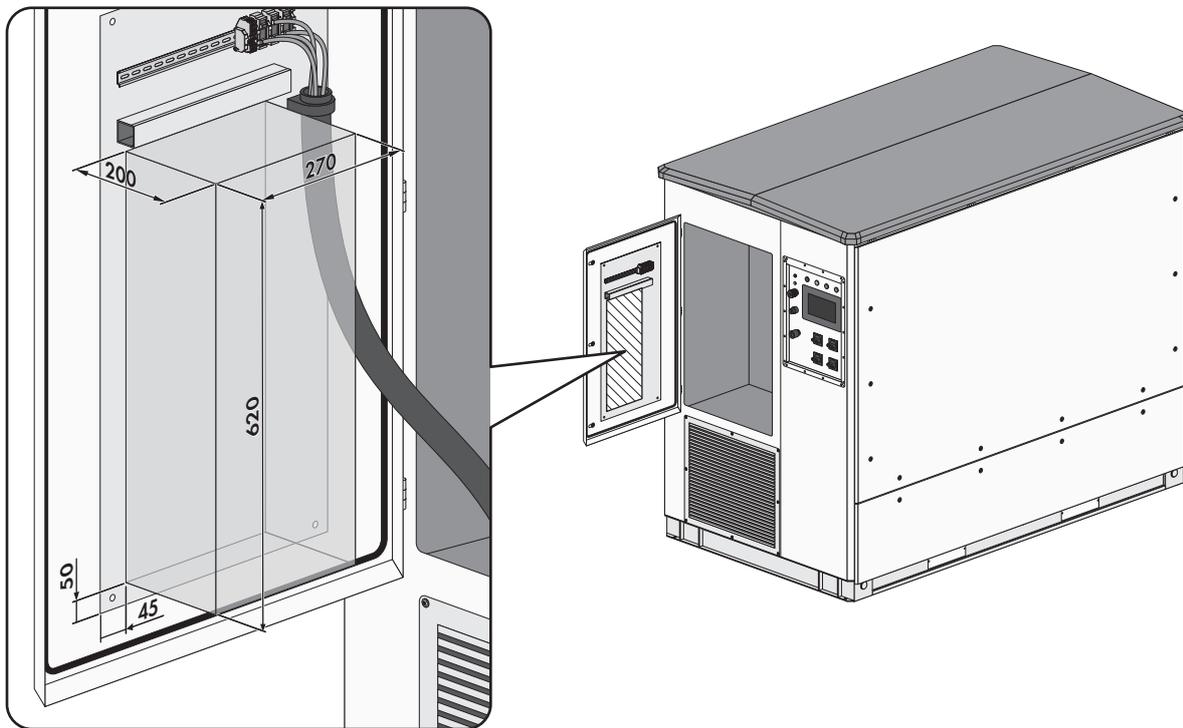


Figure 76: Area for customer devices in the customer installation location (Dimensions in mm)

**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 internal inverter 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: maximum 0.14 mm<sup>2</sup> to 2.5 mm<sup>2</sup>
- Single-wire cable: maximum 4 mm<sup>2</sup>
- Number of conductors: 3

**Procedure:**

1. Ensure that no voltage is present.
2. Connect the cable to the terminal block **-X310** (see Section 12.4.1, page 208).

**6.9.2 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

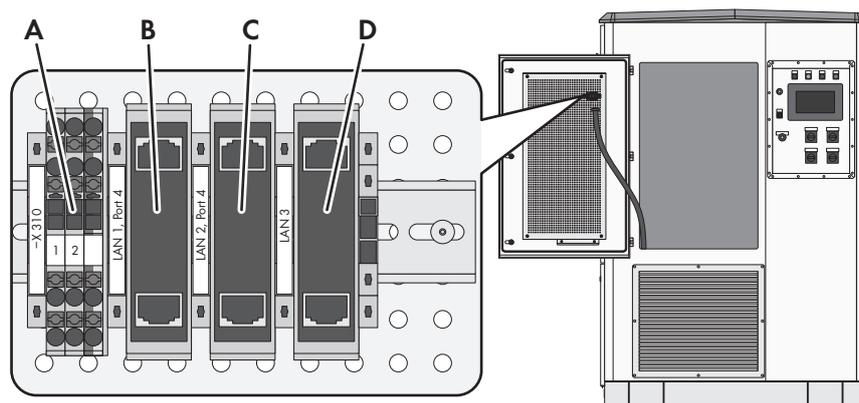


Figure 77: Position of the connections at the customer installation location

Position	Designation
A	Connecting terminal plate for voltage supply at customer installation location <b>-X310</b>
B	Interface for the monitoring option or optional remote I/O module <b>LAN 1 Port 4</b>

Position	Designation
C	Ethernet interface for connecting to the station subdistribution <b>LAN 2 Port 4</b>
D	Internal Ethernet interface <b>LAN 3</b>

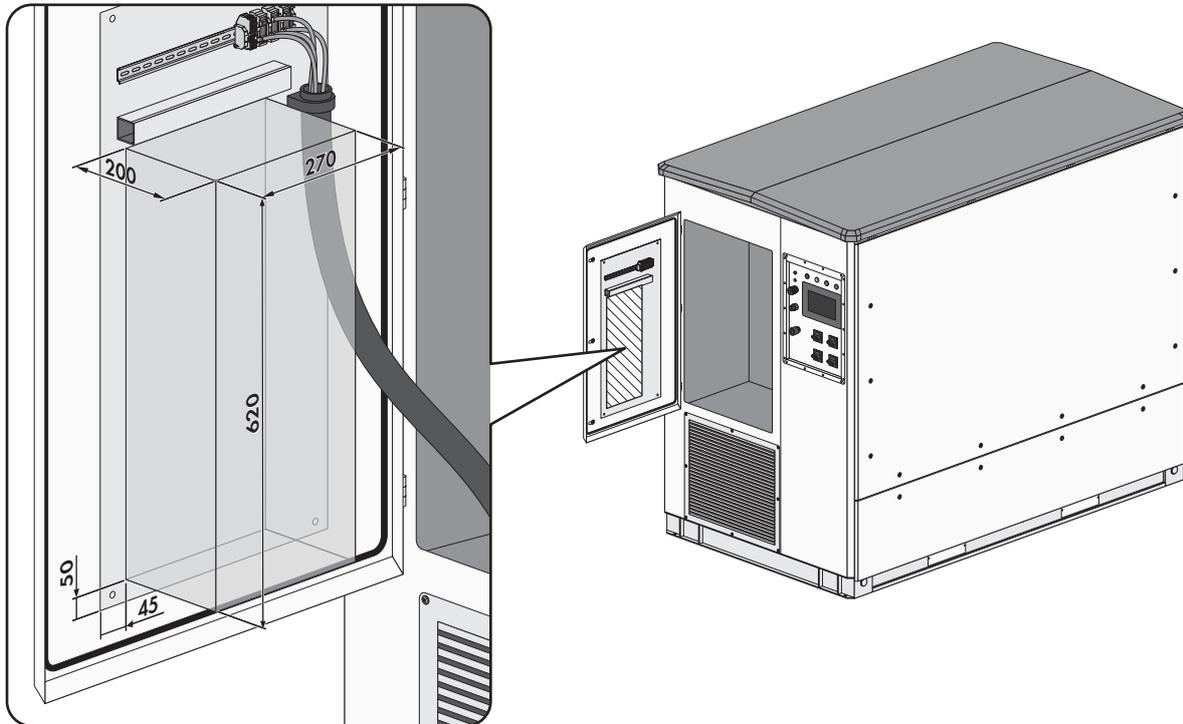


Figure 78: Area for customer devices in the customer installation location (Dimensions in mm)

#### 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 pair-twisted.
- 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 no voltage is present.
2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Insert the cables (see Section 12.5.2, page 211).
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 12.3.1.1, page 203).

### 6.9.3 Connecting the PQ-Meter

The inverter is ready for the installation of a customer-supplied PQ-Meter.

The inverter provides the following signals:

- Current measurement: 3 channels, 0 A to 5 A each. 5 A is equivalent to a measuring range end value of 5000 A. Maximum load: 50 m $\Omega$ .
- Voltage measurement: 3 phases with conductor-conductor voltage: 0 V to 400 V. 400 V are equivalent to a measuring range end value of 600 V conductor-conductor voltage at the AC output.
- Voltage supply: 230 V  $\pm$ 20%
- Maximum output power: 300 W

#### PQ-Meter requirements:

- The PQ-Meter must be suitable for the signals provided.
- The measurement accuracies of the PQ-Meter must meet the following values:
  - Current measurement: 1% based on the measuring range end value
  - Voltage measurement: 2% based on the measuring range end value
- Permissible temperature range: -25°C to 60°C In this case, a temperature increase inside the inverter compared to the outside temperature of 10 K must be assumed.

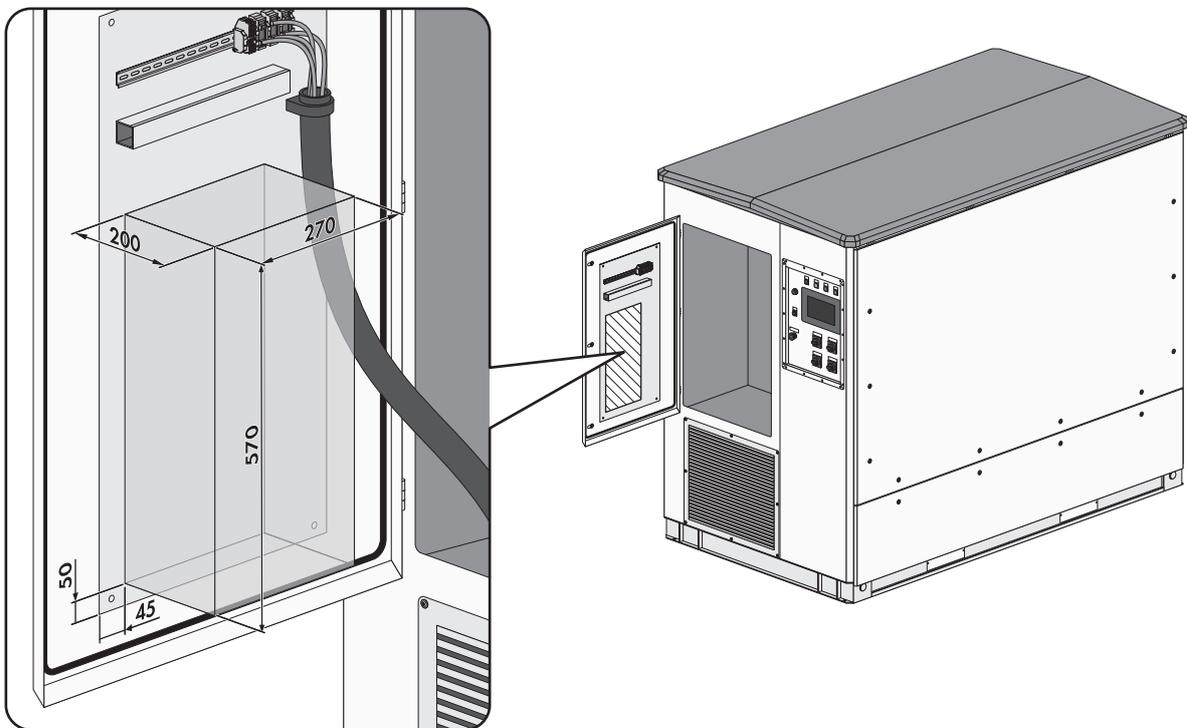


Figure 79: Area for the installation of the PQ-Meter in the customer installation location

The following PQ-Meter are recommended for the conditions in the inverter:

- ELSPEC G44xx from Sinus-energetics
- The UMG 604E from Janitza electronics GmbH
- The UMG 604EP from Janitza electronics GmbH

The following additional installations are recommended:

- An additional surge arrester is recommended for utility grids with large fluctuations.
- The voltage measurement of the PQ-Meter is fused with 10 A. If the PQ-Meter used requires a smaller fuse protection, it must be installed by the customer.

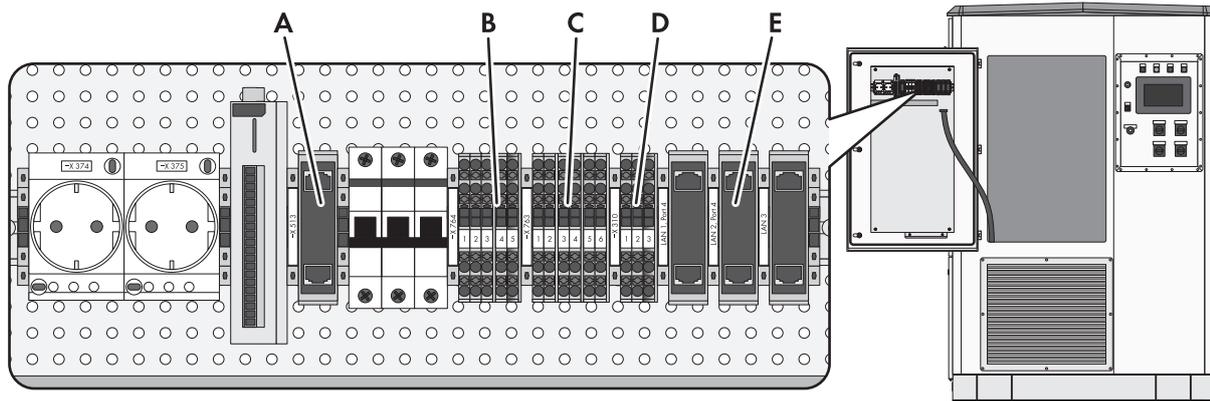


Figure 80: Connection positions for the PQ-Meter

Position	Designation
A	Ethernet interface for connecting the PQ-Meter <b>-X513</b>
B	Terminal block for connecting the voltage measurement <b>-X764</b>
C	Terminal block for connecting the current measurement <b>-X763</b>
D	Terminal block for connecting the supply voltage of the PQ-Meter <b>-X310</b> (230 V/±20%)
E	Ethernet interface for the network connection <b>LAN 2 port 4</b>

**Cable requirements:**

- For voltage measurement and voltage supply of all PQ-Meters: multi-wire cables with bootlace ferrule: 0.14 mm<sup>2</sup> to 2.5 mm<sup>2</sup>, single-wire cables: 4 mm<sup>2</sup>
- For current measurement with PQ-Meter model **ELSPEC**: multi-wire cables with bootlace ferrule: 6 mm<sup>2</sup>
- For current measurement with PQ-Meter by Janitza: multi-wire cables with bootlace ferrule: 2.5 mm<sup>2</sup>
- It is recommended to observe the maximum cable length. The maximum cable length is 1350 mm.

The PQ-Meter can be connected to the communication network for transmitting the measurement data.

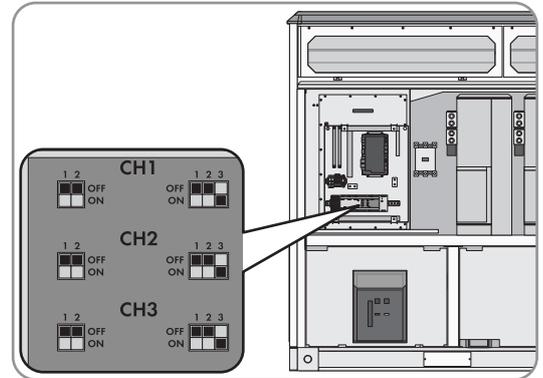
**Ethernet cable requirements:**

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

**Procedure:**

1. Ensure that no voltage is present.
2. Mount the PQ-Meter in the customer installation location (see the manufacturer documentation).
3. Connect the cable for the current measurement to terminal **-X763** according to the circuit diagram (see Section 12.4.1, page 208).
4. Connect the cable for the voltage measurement to terminal **-X764** according to the circuit diagram (see Section 12.4.1, page 208).
5. Connect the cable for the voltage supply of the PQ-Meter to terminal **-X310** according to the circuit diagram (see Section 12.4.1, page 208).
6. If the measurement data of the PQ-Meter are to be called up via the network, integrate the PQ-Meter into the network.
  - Establish a connection between the PQ-Meter and jack **-X513** of the Ethernet interface in the door.

- Disassemble the panels (see Section 12.3.1.1, page 203).
  - Insert the cables (see Section 12.5.2, page 211).
  - Plug the cable into the network port **LAN 2 Port 4**.
  - Attach the cables to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
  - Mount the panels (see Section 12.3.1.1, page 203).
7. Make sure that the DIP switches of the analysis unit in the inverter display the correct switch setting.



8. Calibrate the measuring modules of the PQ-Meter (see the manufacturer documentation).
9. Make sure that the parameter settings for current measurement are adjusted after commissioning.

## 6.10 Connecting the cable for remote control of cascade control

With the order option "Aux Co + ReCo + Cascade control", the cascade control can be connected to a signal generator.

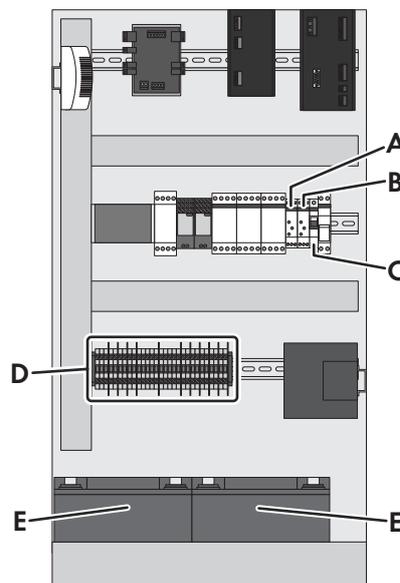


Figure 81: Cascade control layout

Position	Designation
A	Time relay <b>K1</b>
B	Time relay <b>K2</b>
C	Fuse service switch <b>F71</b> for the battery voltage

Position	Designation
D	Terminal block
E	Batteries

**Requirements:**

- The output and input signal must be make contacts.

**Procedure:**

1. Switch off the fuse service switch **F70** for the supply voltage in the station subdistribution.
2. Open the cascade control door.
3. Switch off the fuse service switch **F71** for the battery voltage.
4. Insert the cables for remote control.
5. Connect the output signal cables to terminals **XC13** und **XC14**.
6. Connect the input signal cables to terminals **XC15** und **XC16**.
7. Switch on the fuse service switch **F71** for the battery voltage.
8. Close the cascade control door.
9. Switch on the fuse service switch **F70** for the supply voltage in the station subdistribution.

## 6.11 Completion Work

### 6.11.1 Sealing the Cable Entries

**Requirement:**

- All cables must be inserted in and connected to the MV Power Station.

**Sealing the Cable Entry with order option "Cable Entry Kit"**

1. Close and fasten the sliding panels underneath the station subdistribution, grounding busbar for the ground electrode and inverter. Ensure that the enclosure openings close tightly. This prevents animals from entering the product.
2. Screw the cable entry kit with rubber gaskets to the base plate in case of the order option without MV switchgear.

**Sealing the Cable Entry without order option "Cable Entry Kit"**

1. Seal the cable entries properly.
2. Remount the covering plate onto the station container. This prevents animals from entering the product.

### 6.11.2 Closing the Base Plates on the Inverter

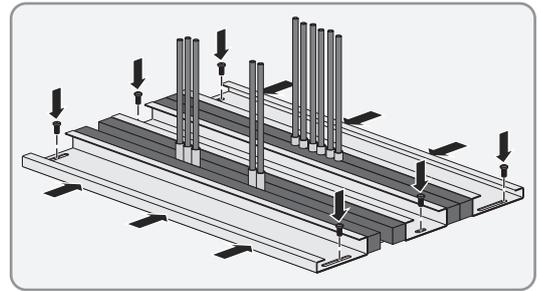
**Requirement:**

- All cables must be inserted in and connected to the MV Power Station.

**Procedure:**

1. Insert the base plates under the inverter. The base plates must be aligned as close as possible to each other.

2. Tighten the base plates. Ensure that the enclosure openings close tightly.



### 6.11.3 Checking the Surface of the Station Container and the MV Transformer

**Required maintenance material (not included in the scope of delivery):**

- Abrasive cloth
- Degreaser
- Use touch-up sticks, paint brushes, cans of spray paint or, alternatively, 2K-PUR acrylic paint in the appropriate RAL color to repair small-area surface damage. Observe the relevant instructions of the paint manufacturer.
- Use touch-up paint or alternatively 2K-PUR acrylic paint in the appropriate RAL color to repair large-area surface damage. Observe the relevant instructions of the paint manufacturer.
- Use zinc plating with thick-layer passivation to repair damage on the zinc-plated steel frame in the base area, e.g. LZ-09. Observe the relevant instructions of the manufacturer.

Position	RAL color	Color
Station container	RAL 7004	Signal gray
MV transformer	RAL 7033	Cement gray

**Procedure:**

1. Check surfaces for damage or corrosion.  
If the surfaces are damaged or corroded, repair them without delay.
2. To remove small-area surface damage:
  - Sand the surface.
  - Clean the surface with degreaser.
  - Paint the surface.
3. To remove large-area surface damage:
  - Sand the surface.
  - Clean the surface with degreaser.
  - Paint the entire surface.

## 6.12 Requirements for Commissioning

### General requirements:

- None of the devices must display any damage.
- Paintwork damage on the product must be repaired.
- All devices must be correctly installed.
- All devices must be properly grounded.
- All transport locks and desiccant bags must be removed.
- The covering plates from the sea transport and in front of the electric-arc opening 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 leading to the MV Power Station must be correctly routed, connected and attached to the cable support rail.

### DC side:

- The PV array must be checked.
- All cables of the PV array must be correctly connected to the DC main and sub-distribution.
- All cables of the DC main and sub-distribution must be correctly connected to the inverters.
- The polarity of the strings must be checked.
- The DC voltages must be checked.
- An insulation measurement must be carried out and recorded.
- At least 50% of the PV modules of the entire PV system must be installed and connected to the inverter. The minimum power for commissioning may deviate depending on the country. Please contact your project manager for the exact power value.

### AC side:

- The AC circuit breaker on the inverter must be opened.
- The MV transformer must be connected to the utility grid.
- The MV transformer must not have any oil leaks.
- The pressure gauge for the SF<sub>6</sub> gas on the medium-voltage switchgear gas must be in the green range.
- The accessories for the medium-voltage switchgear must be available.

### Communication:

- Communication connections and the supply voltage must be connected and checked.
- The cable entries must be sealed against moisture penetrating from the outside.

### 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.

## 7 Disconnecting and Reconnecting

### 7.1 Safety When Disconnecting and Reconnecting Voltage Sources

#### **⚠ 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.

- Always disconnect the product from the power transmission path and from the control path if no voltage is required for working on the product (see Section 7, page 129).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 7.3, page 134).
- 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. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

#### **⚠ 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. Touching live parts will result in death or serious injury due to electric shock.

- 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.

#### **⚠ 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 PV power plant**

Lethal ground currents due to damaged insulations of the PV field. Lethal electric shocks can result.

- Ensure that the insulation resistance of the PV array exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- Before entering the PV field, switch the PV power plants with ground fault monitoring to insulated operation.
- After entering the PV power plant, immediately ensure that the inverter does not display an insulation error.
- Disconnect the product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- Wear suitable personal protective equipment for all work on the product.
- Configure the PV power plant as a closed electrical operating area.

**⚠ WARNING****Danger to life due to electric shock if the battery of the uninterruptible power supply is not disconnected**

When using an uninterruptible power supply, even after disconnecting the supply voltage, there may still be lethal voltages present in cables for monitoring, communication and customer devices. Touching live components can result in death or serious injury due to electric shock.

- Disconnect the battery of the uninterruptible power supply from all voltages sources.
- Ensure that there is no voltage prior to working on components of monitoring, communication and customer devices.

**⚠ WARNING****Danger to life due to arc fault in the event of faults in the MV switchgear**

If there is a fault in the MV switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. The pressure of the arc fault is diverted to the side of the station container.

- Only perform work on the MV switchgear when it is in a de-energized state.
- Prior to commissioning and operating the MV switchgear, close the MV switchgear kick plate.
- All work and switching operations on the MV switchgear may only be performed by qualified persons wearing adequate personal protective equipment.
- Open and secure the medium-voltage compartment door fully prior to performing switching operations.
- It is imperative that the escape route is freely accessible at all times.
- Prior to performing switching operations, ensure that no persons or flammable materials are within the internal arc pressure safety area.
- Ensure that the covering plate in front of the electric-arc opening has been removed.
- All persons that are not in the medium-voltage compartment are to keep a safe distance from the product when switching operations are performed. The internal arc pressure safety area is to be cordoned off.
- Only perform switching operations on the MV switchgear in the medium-voltage compartment.

**⚠ WARNING****Danger to life due to electric shock when switching the MV switchgear when the level of SF<sub>6</sub> gas is too low**

When the level of SF<sub>6</sub> gas is too low, life-threatening electric shocks may arise when switching the MV switchgear which can lead to death or serious injuries.

- Prior to switching the MV switchgear, check the SF<sub>6</sub> gas level.

**⚠ 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.

**⚠ 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.

**i Connecting and disconnecting medium voltage**

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

## 7.2 Connection Point Overview

### 7.2.1 Power Connection Points

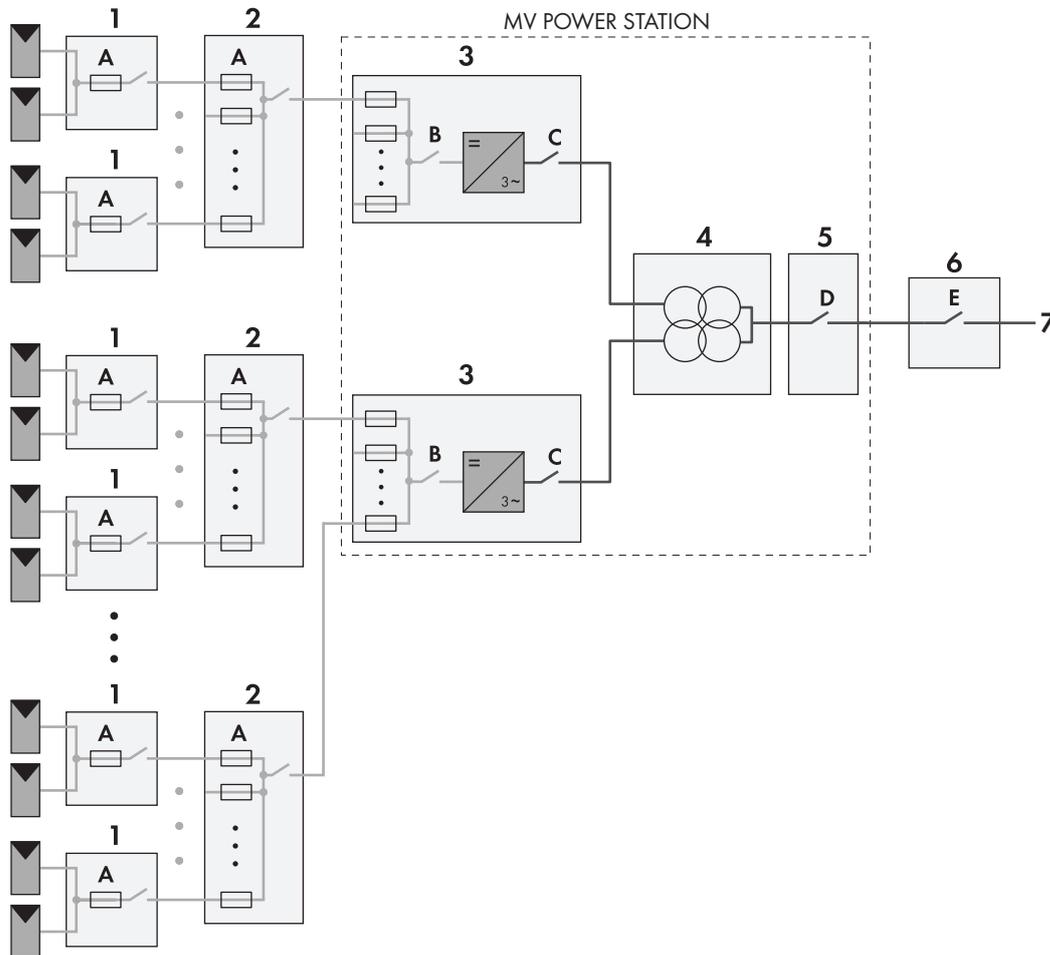


Figure 82: Overview of the power connection points

Position	Designation
1	DC subdistribution, e.g. Sunny String-Monitor
2	DC main distribution unit
3	Inverter
4	Medium-voltage transformer
5	MV switchgear
6	Superordinate MV switchgear (string, ring or transfer station)
7	Utility grid
A	Disconnection device of the DC subdistribution or the DC main distribution
B	Inverter DC switchgear
C	Inverter AC disconnection unit

Position	Designation
D	Medium-voltage circuit breaker
E	Transfer station disconnection device

## 7.2.2 Connection Points for Supply Voltage

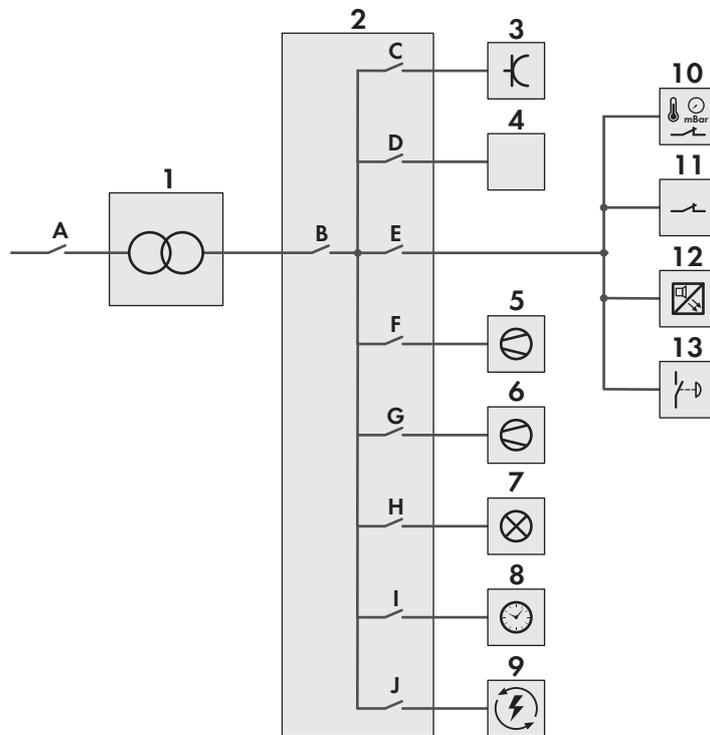


Figure 83: Connection points for supply voltage (example)

Position	Designation
1	MV Power Station low-voltage transformer
2	Station subdistribution
3	Outlet
4	Customer installation location
5	Fans in the medium-voltage and low-voltage compartment
6	Fans on the MV transformer
7	Lighting
8	Cascade control
9	Uninterruptible power supply*
10	MV transformer hermetic full-protection device
11	MV switchgear shunt release
12	Heat detector*
13	Fast-stop switch*

Position	Designation
A	Fuse switch-disconnector for the low-voltage transformer
B	Circuit breaker of the entire station subdistribution
C	Residual-current devices for the outlets
D	Circuit breakers for the customer installation location devices
E	Alarm chain circuit breaker
F	Fan circuit breakers for the medium-voltage and low-voltage compartments respectively
G	MV transformer fan residual-current device
H	Circuit breaker for the lighting
I	Cascade control circuit breaker*
J	Circuit breaker for the uninterruptible power supply*

\* Optional

Further details are to be found in the circuit diagram.

## 7.3 Disconnecting the Inverter

### 7.3.1 Switching off the Inverter

1. Turn the key switch **-S1** to **Stop**.
2. Remove the key. This will protect the inverter from inadvertent reconnection.

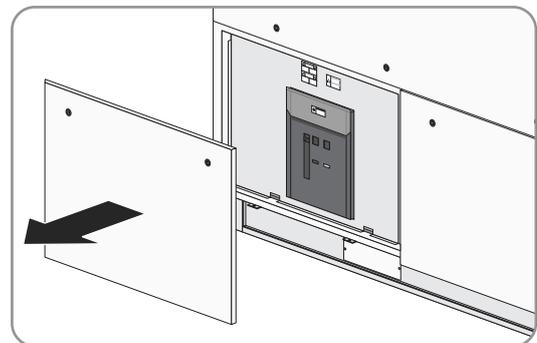
### 7.3.2 Disconnecting the Inverter from the Power Transmission Path on the AC Side

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

- 1 padlock. Diameter of the shackle: 5 mm to 8 mm.

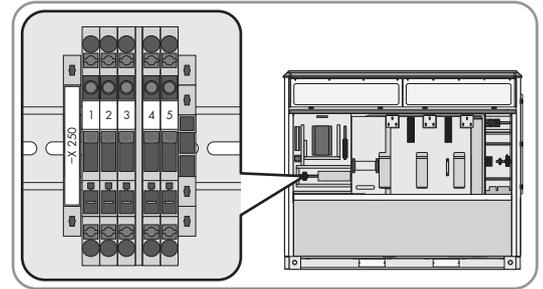
**Procedure:**

1. Switch off both inverters (see Section 7.3.1, page 134).
2. Turn the load-break switch of the AC disconnection unit and of the precharge unit **-Q63** to the **OFF** position.
3. Pull the brackets out of the switch levers.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
5. Disassemble the outer panel of the AC switch module (see Section 12.3.1.1, page 203).



6. Verify that the switch state display of the AC disconnection unit is in the **OPEN** position.
7. Mount the outer panel of the AC switch module (see Section 12.3.1.1, page 203).

8. Open the hatch on the AC side of the inverter (see Section 12.2, page 202).
9. Ensure that no voltage is present on the **-X250** terminal.



### 7.3.3 Disconnecting the Inverter from the Power Transmission Path on the DC Side

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

- 2 padlocks. Diameter of the shackle: 5 mm to 8 mm

**Procedure:**

1. Switch off both inverters (see Section 7.3.1, page 134).
2. Turn the load-break switch of the DC switchgear **-Q61** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
5. 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.
6. Pull the bracket out of the switch lever.
7. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
8. Remove the fuses from the String-Combiners or switch off the circuit breakers of the String-Combiners and ensure that it cannot be reconnected.
9. Open the hatch on the DC side of the inverter (see Section 12.2, page 202).
10. Ensure that no voltage is present for each DC input. Use the measuring points on the bottom of the fuse holders.
 

Tip: There are drill holes in the protective covers above the fuse holder. Through these drill holes you can determine the voltage-free status with suitable test probes without having to disassemble the protective covers.

### 7.3.4 Disconnecting the Supply Voltage at the Inverter from Voltage Sources

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

- 4 padlocks. Diameter of the shackle: 5 mm to 8 mm

**Switching Off the Supply Voltage**

1. Switch off both inverters (see Section 7.3.1, page 134).
2. Turn the load-break switch for the supply voltage **-Q62** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

### Switch off the auxiliary voltage supply

1. Turn the optional load-break switch of the auxiliary energy supply **-Q64** to the **OFF** position. Note that the cable to the load-break switch is still energized.
2. When the auxiliary voltage supply is provided via an external transformer, disconnect the external voltage from voltage sources.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

### Switching Off the Precharge Unit and AC Disconnection Unit

1. Switch off both inverters (see Section 7.3.1, page 134).
2. Turn the load-break switch of the AC disconnection unit **-Q63** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

### Switching off the Fans, Heating Elements, String Monitoring and DC Load-Break Switch

1. Switch off both inverters (see Section 7.3.1, page 134).
2. Turn the load-break switch of the DC switchgear **-Q61** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

## 7.4 Disconnecting the Supply Voltages of the Station Subdistribution

The circuit breakers for the different devices of the MV Power Station are located in the station subdistribution.

#### Procedure:

1. Switch off the circuit breaker in the USP when using an uninterruptible power supply.
2. Ensure that the inverter is disconnected from all voltage sources (see Section 7.3.1, page 134).
3. Switch off the station subdistribution main switch **F101**.
4. If external supply voltages are used, disconnect the external supply transformer from voltage sources.

## 7.5 Disconnecting the Medium-Voltage Transformer

The disconnection process of the medium-voltage transformer may vary depending on the order option. Observe the additional instructions in terms of the order option "Country Package France".

#### 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 inverters are disconnected from all voltage sources (see Section 7.3, page 134).
2. If the MV Power Station is equipped with the order option "Aux Co + ReCo + Cascade control", set the main switch of the cascade control to **0**.
3. Make sure that the safety clearances around the MV Power Station are complied with.

4. Ensure that the area behind the medium-voltage switchgear is isolated in case of the medium-voltage switchgear devices 36 kV, 38 kV and 40.5 kV.
5. Switch off the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
6. Ensure that no voltage is present.
7. Ground the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
8. Lock the circuit breaker for the medium-voltage switchgear using a padlock. This will protect the switch levers from inadvertent reconnection.
9. Attach magnetic signs indicating the name of the duly authorized person to the transformer panel.
10. Connect the grounding- and short-circuiting equipment to the AC busbars between the inverter and medium-voltage transformer.
11. Disconnect any additional external voltage.
12. Cover or isolate any adjacent live components.

## 7.6 Disconnecting the MV Power Station

Only when the entire MV Power Station has been disconnected will you be able to work on the devices of the MV Power Station without risk.

### Procedure:

1. Disconnect any additional external supply voltages.
2. Disconnect the inverter (see Section 7.3, page 134).
3. Disconnect the supply voltage of the station subdistribution (see Section 7.4, page 136).
4. Disconnect the MV transformer from voltage sources (see Section 7.5, page 136).
5. Switch off the MV switchgear ring circuit (refer to manufacturer documentation).
6. Disconnect the MV Power Station from the utility grid at the superordinate MV switchgear (refer to manufacturer documentation). Always observe the five safety rules.
7. Ground the MV switchgear ring circuit (refer to manufacturer documentation).
8. Cover or isolate any adjacent live components.

## 7.7 Reconnecting the MV Power Station

1. Remove the grounding on the MV switchgear ring circuit (refer to manufacturer documentation).
2. Connect the MV Power Station to the utility grid at the superordinate MV switchgear (refer to manufacturer documentation).
3. Switch on the MV switchgear ring circuit (refer to manufacturer documentation).
4. Reconnect the MV transformer (see Section 7.8, page 137).
5. Reconnect the supply voltage of the station subdistribution (see Section 7.9, page 138).
6. Reconnect the inverter (see Section 7.10, page 138).
7. Reconnect any additional external supply voltages.

## 7.8 Reconnecting the Medium-Voltage Transformer

To connect the MV transformer, the MV switchgear must be switched on. The switch on of the MV transformer may vary depending on the order option. Observe the additional instructions in terms of the order option "Country Package France".

### Procedure:

1. Make sure that the safety clearances around the MV Power Station are complied with.

2. Remove the grounding- and short-circuiting equipment from the AC busbars between the inverter and MV transformer.
3. Remove the grounding on the MV switchgear transformer panel (refer to manufacturer documentation).
4. Switch on the MV switchgear transformer panel (refer to manufacturer documentation).
5. If the MV Power Station is equipped with the order option "Aux Co + ReCo + Cascade control", switch the main switch on using the cascade control.

## 7.9 Reconnecting the Supply Voltage of the Station Subdistribution

1. If external supply voltages are used, reconnect the external supply transformer.
2. If the transformer for internal power supply has been disconnected, switch on the fuse switch-disconnector **F100**.
3. Switch on the station subdistribution main switch **F101**.

## 7.10 Reconnecting the Inverter

### 7.10.1 Reconnecting the Supply Voltage at 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 12.3.1.1, page 203).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 12.2, page 202).

#### Switching On the Supply Voltage

1. Make sure that all desiccant bags have been removed from the inverter.
2. Remove the padlock from the bracket of the load-break switch **-Q62**.
3. Turn the DC load-break switch **-Q62** to the **ON** position.

#### Switch on the auxiliary voltage supply

1. When the auxiliary voltage supply is provided via an external transformer, connect the external voltage.
2. Remove the padlock from the bracket of the load-break switch **-Q64**.
3. Turn the DC load-break switch **-Q64** to the **ON** position.

#### Switching On the Precharge Unit and the AC Circuit Breaker

1. Remove the padlock from the bracket of the load-break switch **-Q63**.
2. Turn the DC load-break switch **-Q63** to the **ON** position.

#### Switching on the Fans, Heating Elements, String Monitoring and DC Load-Break Switch

1. Remove the padlock from the bracket of the load-break switch **-Q61**.
2. Turn the DC load-break switch **-Q61** to the **ON** position.

## 7.10.2 Reconnecting the DC Side

### ⚠ 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 12.3.1.1, page 203).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 12.2, page 202).

#### Procedure:

1. Actuate upstream switchpoint. Insert fuses in the String-Combiners or switch on the circuit breakers of the String-Combiners.
2. Remove the padlock from the bracket of the load-break switch **-Q61**.
3. Turn the DC load-break switch **-Q61** to the **ON** position.

## 7.10.3 Reconnecting the AC Side

### ⚠ 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 12.3.1.1, page 203).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 12.2, page 202).

#### Procedure:

1. Ensure that the panel is mounted in front of the AC disconnection unit.
2. Remove the padlock from the bracket of the load-break switch **-Q63**.
3. Turn the DC load-break switch **-Q63** to the **ON** position.

## 7.10.4 Restarting 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 12.3.1.1, page 203).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 12.2, page 202).

#### Procedure:

1. Reconnect the supply voltage of the station subdistribution (see Section 7.10.1, page 138)
2. Turn the key switch **-S1** to **Start**.

## 8 Operation

The information in the following sections affect the inverters and cascade control only. Information on the operation of further optional MV Power Station components, such as the MV switchgear, can be found in the documentation of the respective component.

### 8.1 Safety during Operation

#### ⚠ WARNING

##### **Danger to life due to arc fault in the event of faults in the MV switchgear**

If there is a fault in the MV switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. The pressure of the arc fault is diverted to the side of the station container.

- Only perform work on the MV switchgear when it is in a de-energized state.
- Prior to commissioning and operating the MV switchgear, close the MV switchgear kick plate.
- All work and switching operations on the MV switchgear may only be performed by qualified persons wearing adequate personal protective equipment.
- Open and secure the medium-voltage compartment door fully prior to performing switching operations.
- It is imperative that the escape route is freely accessible at all times.
- Prior to performing switching operations, ensure that no persons or flammable materials are within the internal arc pressure safety area.
- Ensure that the covering plate in front of the electric-arc opening has been removed.
- All persons that are not in the medium-voltage compartment are to keep a safe distance from the product when switching operations are performed. The internal arc pressure safety area is to be cordoned off.
- Only perform switching operations on the MV switchgear in the medium-voltage compartment.

#### NOTICE

##### **Operation failure of the PV power plant due to incorrectly set parameters**

If the parameter settings for grid management services are incorrect, the PV power plant 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.
- If the inverter is operated with a Power Plant Controller, ensure that the mode **WCtCom** for active power limitation and the mode **VArCtCom** for reactive power control are selected in the inverter.

## NOTICE

### Unwanted inverter 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 inverter. It can lead to the inverter switching off due to voltage limits being undershot. This can result in yield losses.

- Before changing the parameter by simulation, ensure that the grid stability at the AC connecting rails of the inverter as well as at the grid-connection point 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 PV farm 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 inverter 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 the control gear for PV farm must be adjusted.
- Ensure that the grid limits at the AC connecting rails of the inverter 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 PV power plant at the grid-connection point are observed.

## 8.2 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 will be active until the next change.



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

### Procedure:

1.  In the user info line, select  English ▾ and select the option **Localization**.  
 Select [**Localize**] in the drop-down menu.
2. Adjust the desired localizations.
3.  Select [**OK**].  
 Select [**Log in**].

## 8.3 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 will be active until the next change.



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 12.6, page 215).
2. In the user info line select  English ▾ and select the desired language from the drop-down list.

## 8.4 Setting the System Time

1. Log into the user interface as an installer (see Section 12.6, page 215).
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.

## 8.5 Setting the Brightness on the Touch Display

1. Select ☀ ☀ in the status info line.
2. Adjust brightness via the arrow keys on a scale of ten. The selected brightness is shown on a test screen.
3. Select [**Save**] to save the change to the brightness setting.

## 8.6 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 12.6, page 215).
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 special characters ! \_ ? - can be used optionally.
4. To confirm, enter the new password again.
5. Click on [**Save**].

## 8.7 Resetting Passwords

### Resetting the "User" user group password

1. Log into the user interface as an installer (see Section 12.6, page 215).
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 17, page 294).
2. Once the password has been reset, change the standard password to a secure password immediately.

## 8.8 Display of Measured Values

### 8.8.1 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 12.6, page 215).
2. In the main navigation select .
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 [Select data].
  - To select instantaneous values for one of the two Y axes, select the instantaneous values in the appropriate column of the drop-down box. Tip: If the same unit is assigned to both axes, all instantaneous values with another unit are grayed out.
  - To adopt the selection, select [Load].
6.  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.

### 8.8.2 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 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 12.6, page 215).
2. In the main navigation select .
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 left Y axis].

- To select the instantaneous values for the left Y axis, select the corresponding instantaneous values in the left column of the drop-down box.

To select the instantaneous values for the right Y axis, select the corresponding instantaneous values in the right column of the drop-down box. Tip: If the same unit is assigned to both axes, all instantaneous values with another unit are grayed out.

- Select **[OK]** to create the diagram.
- To delete data from the display, select the instantaneous value in the legend. The corresponding curve will be removed from the diagram.
- To display data with other units, select **[Select instantaneous values for left Y axis]** again and select the data of the Y axis again. The curves will be deleted from the diagram and you can select other data.

### 8.8.3 Displaying Measured Values of the External Devices

- Log into the user interface as an installer (see Section 12.6, page 215).
- In the main navigation select **[External devices]**.
- In the list of the external devices, select the row of the device for which the measured values are to be displayed.
- Select the button **[Spot values]**.
- To return to the overview of all external devices, select the button **[Back]**.

## 8.9 Enabling Communication via FTP Server

The inverter supports the exchange of data both via an unencrypted FTP and via the 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.

In order to continue to ensure any existing communications even after updates of older firmware versions, the FTP and FTPS access is enabled after the update.

#### Procedure:

- Log into the user interface as an installer (see Section 12.6, page 215).
- 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.

## 8.10 Configuring External Devices

Various external devices can be connected to the inverter. When these devices send a Modbus profile that is recognized by the inverter, they are shown on the page **External devices**. The SMA String-Monitor devices and current measurement assemblies for zone monitoring (measuring shunts, DCM) are shown as standard. For further I/O devices, the Modbus profiles must be generated by the customer.

#### Procedure:

- Log into the user interface as an installer (see Section 12.6, page 215).
- In the main navigation select **[External devices]**.
- In the list of the external devices, select the row of the device that has to be configured.

4. Select the button [**Parameter**].
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. To return to the overview of all external devices, select the button [**Back**].

## 8.11 Setting the String-Current Monitoring

The string-current monitoring in the inverter must be configured for evaluation. The procedures for zone monitoring and string monitoring are standardized.

As of firmware version 5.2, the parameters for configuring the string-current monitoring have been extended. Contact us in order to update the firmware version (see Section 17, page 294).

### Procedure:

1. Log into the user interface as an installer (see Section 12.6, page 215).
2. In the main navigation select [**External devices**].
3. In the list of the external devices, select the row of the device for which string monitoring is to be set.
4. Select the button [**Parameter**].
5. To activate string monitoring for the selected external devices, set the parameter **Operation.StrFltDet.OpMod** to **Ein**.
6. Enter the number of connected string for each individual DC input into the parameter field **Operation.StrFltDet.ChStrgNum.\***.
7. To set the sensitivity above which a deviation of the currents from the average value is identified as being an error, adjust the settings in the parameter **Operation.StrFltDet.Tol**.
8. To set the duration above which a deviation is to be rated as being an error, adjust the settings in the parameter **Operation.StrFltDet.WrnTm**.
9. To return to the overview of all external devices, select the button [**Back**].

## 8.12 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 7.3, page 134).
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 12.8, page 215).

## 8.13 Registering the Inverter in Sunny Portal

### Requirements:

- There must be a user created in Sunny Portal.
- The system network must be configured.

### Procedure:

1. Call up the parameter overview (see Section 12.7, page 215).

2. Enter the name of the system in the parameter **Portald.Plnt.Nam**.
3. Enter the ID number of the system in the parameter **Portald.Plnt.ID**.
4. Select the connection type in the parameter **Portald.Upld.Mod**.
5. To change the e-mail address to which messages are to be sent, enter the desired address in the parameter **Portald.Usr.Mail**.
6. To register the system in Sunny Portal, select the button [**Execute action**] in the parameter **Portald.Act.Rgst.Plnt**.
7. To register the inverter in Sunny Portal, select the button [**Execute action**] in the parameter **Portald.Act.Rgst.Dev**.
8. To test the connection from the inverter to Sunny Portal, select the button [**Execute action**] in the parameter **Portald.Act.Conn.Chk**.
9. Call up the overview of instantaneous values (see Section 12.8, page 215).
10. In the instantaneous value **Portald.Act.Conn.Chk.Rsl**, check whether the connection has been successfully established.

Indication	Result / measures
Ok	Connection test has been successful.
not Ok	<p>The connection to Sunny Portal has not been established.</p> <ul style="list-style-type: none"> <li>• Ensure that all settings for Sunny Portal in the parameters and the proxy server settings comply with the system configuration.</li> <li>• Ensure that the inverter can be accessed via the IP address.</li> <li>• Contact Service.</li> </ul>

11. Select the data upload frequency in the parameter **Portald.Upld.Cyc**.
12. To complete the registration process, register the new devices in Sunny Portal.

## 8.14 Search Function

### 8.14.1 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 12.6, page 215).
2. Enter the required ID number of the page, parameter or instantaneous value in the user info line in the field **#XXXX**.

### 8.14.2 Targeted Search

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

**Procedure:**

1. Call up the parameter overview (see Section 12.7, page 215).  
or  
Call up the overview of instantaneous values (see Section 12.8, page 215).
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.

## 8.15 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 saved separately for access via touch display on the device itself or via Internet.



The favorites are saved to the device.



The favorites are saved to the computer. Thus, the favorites of a particular inverter are automatically adopted when you log in to another system.

An exchange of favorite 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 12, page 200).
2.  Select the parameter or instantaneous value and select the favorite identifier ★ in the entry field.
3.  In the line of the parameter or instantaneous value, select the favorite identifier ★.

## 8.16 Using Parameters to Activate and Deactivate the Inverter Standby

1. Call up the parameter overview (see Section 12.7, page 215).
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**.

## 8.17 Changing the Insulation Monitoring

### 8.17.1 Information on Insulating PV Modules with Remote GFDI

Ground-fault monitoring does not provide protection from personal injury.

Ground fault monitoring with Remote GFDI enables the PV array to be switched from grounded operation to insulated operation via the user interface. Temporary switching to insulated operation is useful, for example, when any maintenance or service work is to be performed on or near the PV array, such as cutting the grass.

Switching the inverter from feed-in operation to insulated operation is recommended.

#### **Maintaining insulated operation even after the inverter has failed**

The inverter automatically restarts in insulated operation after a failure while in insulated operation. It is not necessary to switch off the Remote GFDI again. To switch the inverter back to grounded operation, the Remote GFDI must be switched on via the user interface.

### 8.17.2 Switching to Insulated Operation

1. Log into the user interface as an installer (see Section 12.6, page 215).

2. Set the parameter **PvGnd.OpnRemGfdi** to **Enable**.
3. Call up the instantaneous value **GfdiSwStt** (see Section 12.8, page 215).
  - The instantaneous value displays **Open**. The Remote GFDI is open. It is safe to enter the PV system.
4. Ensure that the parameter **PvGnd.OpnRemGfdi** is not altered whilst people are within the system.

### 8.17.3 Switching to Grounded Operation

1. Ensure that there are no people within the PV system.
2. Log into the user interface as an installer (see Section 12.6, page 215).
3. Set the parameter **PvGnd.OpnRemGfdi** to **Disable**.
4. Call up the instantaneous value **GfdiSwStt** (see Section 12.8, page 215).
  - The instantaneous value displays **Closed**. The Remote GFDI is closed.  
If the instantaneous value continues to display **Open** and the inverter is equipped with insulation monitoring, the insulation resistance is currently being measured. Wait a few minutes and then check the instantaneous value again.

## 8.18 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 12.6, page 215).
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.

In order to upload the file to the internal cache, select the desired file from the list.

7. To execute the file in the appropriate application, select the desired file from the list.

## 8.19 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 12.6, page 215).
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**].

## 8.20 Adjusting Network Ports

If you want the inverter to be accessible via the Internet so that, for instance, you have direct access from Sunny Portal, 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 12.7, page 215).
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 the proxy server for Sunny Portal, activate the parameter **Netw.Proxy.SunnyPortalEna**.
5. If you want to use a proxy authentication, activate the parameter **Netw.Proxy.AuthEna**.
6. Enter the port of the proxy server in the parameter **Netw.Proxy.Port**. The default setting is **8080**.
7. Enter the address of the proxy server in the parameter **Netw.Proxy.Adr**.
8. Enter the user names and password of your proxy server in the parameters **Netw.Proxy.Usr** and **Netw.Proxy.Pwd**.

## 8.21 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.

**Requirement:**

- A local FTP server must have been configured.

**Procedure:**

1. Call up the parameter overview (see Section 12.7, page 215).
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 services on 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.

## 8.22 Secure Transmission of Control Commands

### 8.22.1 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 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.

### 8.22.2 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 8.22.3, page 150).

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 12.6, page 215).
2. Select **Diagnosis**.
3. Select the button [**Start learning mode**].

### 8.22.3 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 12.6, page 215).
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.

## 8.23 Setting the MV Switchgear Protective Device

### **i** MV switchgear circuit breaker panel tripping times

The grounding inside the MV Power Station is laid out in such a way that the tripping time of the circuit breaker panel is less than 170 ms in the event of a short circuit. The MV switchgear's grounding is designed for a short-circuit current of 20 kA with a tripping time of max. 1 s. The protection device must be configured accordingly and the response times of the protective device and circuit breaker observed. SMA Solar Technology AG recommends setting the parameter for the tripping time **t>>** in the event of a short circuit to 40 ms in order to avoid damages to the grounding device and injury to persons.

The inrush current of the MV transformer must be considered to guarantee a smooth operation. The inrush-current curve can be made available by SMA Solar Technology AG upon request.

The MV Power Station will be delivered with system-optimized default settings. The settings must be adjusted to the local conditions (selective coordination with upstream safety devices). The actual tripping times must be verified through selective measurements and documented prior to commissioning. Selective measurement and configuration is the responsibility of the farm operator.

The procedure for setting the parameters for the MV switchgear protective device is to be found in the manufacturer documentation.

## 8.24 Activating the Cascade Control

To control the MV Power Station via the cascade control, the cascade control must be activated.

### Requirement:

- The communication connection must be installed to control the cascade control remotely.

### Activating the Cascade Control

1. Ensure that the fuse in the fuse switch **F71** in the switch cabinet is inserted. The fuse is included in the scope of delivery.
  2. Switch on the fuse service switch **F70** for the supply voltage in the station subdistribution.
  3. Set the switch **S1** to **Local / Remote control / Cascade control**.
  4. Set the switch-on delay at the relay **K1** in the switch cabinet. Set the proper default values by turning the control knobs **Range** und **Time**. The set default value is 1 minute.
  5. Set the switch-off delay at the relay **K2** in the switch cabinet. Set the proper default values by turning the control knobs **Range** und **Time**. The set default value is 5 seconds.
- The status display of the cascade control **H1** is glowing and the automatic control is activated.

## 8.25 Operating the Cascade Control

The MV Power Station can be controlled locally via the remote control or cascade control. Several control types can be used in parallel depending on the configuration.

### Requirement:

- The communication connection must be installed to control the cascade control remotely.
- Supply voltage for the cascade control must be present.

### Resetting the Control after Commissioning or Emergency Shutdown

- Operate the switch **S3**.

### Activating the Local Control

- Set the switch **S1** to **Local / Remote control** or **Local / Remote control / Cascade control**.
- The circuit breaker can locally be switched on via the switch **S10** and switched off via the switch **S11**.

### Activating the Remote Control

- Set the switch **S1** to **Local / Remote control** or **Local / Remote control / Cascade control**.
- The circuit breaker can be switched on and off via the remote control.

### Deactivating the Cascade Control

- Set the switch **S1** to **OFF** or **Local / Remote control**.
- The status display of the cascade control **H1** is not glowing.

### Switching off the Cascade Control

It is recommended to switch off the cascade control when the MV Power Station is to be taken out of operation longer than 24 hours. The discharging of the batteries is avoided.

1. Set the switch **S1** to **OFF**.
2. Switch off the fuse service switch **F70** for the supply voltage in the station subdistribution.
3. Operate the switch **S2** of the cascade control to switch off the uninterruptible power supply of the cascade control.
4. Open the battery fuse if the cascade control will be inactive for a longer period.

### Reactivating the Cascade Control

1. Set the switch **S1** to **Local / Remote control / Cascade control**.
  2. If necessary (e.g. after a grid incident), press the switch **S3** to reset the cascade control.
- The status display of the cascade control **H1** is glowing and the automatic control is activated.

## 9 Troubleshooting

### 9.1 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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- 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 17 "Contact", page 294).

#### **⚠ WARNING**

##### **Danger to life from electric shock when entering the PV power plant**

Lethal ground currents due to damaged insulations of the PV field. Lethal electric shocks can result.

- Ensure that the insulation resistance of the PV array exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- Before entering the PV field, switch the PV power plants with ground fault monitoring to insulated operation.
- After entering the PV power plant, immediately ensure that the inverter does not display an insulation error.
- Disconnect the product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- Wear suitable personal protective equipment for all work on the product.
- Configure the PV power plant as 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 inverter, 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.

**⚠ 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.

## 9.2 Troubleshooting in the Medium-Voltage Compartment, Low-Voltage Compartment and on the MV Transformer

Error	Cause and corrective measures
Supply voltage is not present.	<p>The low-voltage transformer is not supplying voltage.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the low-voltage transformer is in operation (see error "The low-voltage transformer is not supplying voltage").</li> </ul>
	<p>The main breaker has tripped.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the main breaker is intact.</li> </ul>

Error	Cause and corrective measures
The low-voltage transformer is not supplying voltage.	<p>The transformer circuit breaker has tripped.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the nominal current on the primary side of the low-voltage transformer is correctly set.</li> <li>• Switch the transformer circuit breaker back on.</li> </ul>
	<p>The low-voltage transformer is defective.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Replace the low-voltage transformer. Please contact us regarding this (see Section 17, page 294).</li> </ul>
	<p>The EMC filtering device is defective.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Replace the EMC filtering device. Please contact us regarding this (see Section 17, page 294).</li> </ul>
	<p>The cabling is damaged.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the cabling is intact.</li> </ul>
The lighting is not working.	<p>The lamps are defective.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Replace the lamps.</li> </ul>
	<p>The circuit breaker has tripped.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Check whether apparent damage is visible in the corresponding electrical circuit. If any damage is present, remove it.</li> <li>• Switch the circuit breaker back on.</li> </ul>
	<p>The voltage supply of the MV Power Station failed.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the supply voltage is present (see error "Supply voltage is not present").</li> </ul>

Error	Cause and corrective measures
The fans in the control rooms do not start up.	<p>The required temperature has not been reached.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• To check the function of the fans, turn down the thermostat. <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> The fans start up.</li> </ul> </li> </ul>
	<p>The circuit breaker has tripped.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Check whether apparent damage is visible in the corresponding electrical circuit. If any damage is present, remove it.</li> <li>• Switch the circuit breaker back on.</li> </ul>
	<p>The fans are defective.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Replace the fans. Please contact us regarding this (see Section 17, page 294).</li> </ul>
	<p>The voltage supply of the MV Power Station failed.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the supply voltage is present (see error "Supply voltage is not present").</li> </ul>
	<p>The cabling is damaged.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the cabling is intact.</li> </ul>

Error	Cause and corrective measures
The MV transformer cannot be reconnected.	<p>The MV transformer is defective.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Replace the MV transformer. Use the lifting tool for the MV transformer (material number: 1 10397-00.01) when doing so. Please contact us (see Section 17, page 294).</li> </ul>
	<p>There is air in the MV transformer.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Check the protective devices.</li> <li>• Ensure that no air is in the MV transformer.</li> <li>• Refill the oil.</li> </ul>
	<p>The MV transformer is too warm.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Read off the temperature of the MV transformer from the inverter.</li> <li>• Allow the MV transformer to cool down.</li> <li>• Check the MV transformer fans.</li> <li>• Contact us if the error reoccurs (see Section 17, page 294).</li> </ul>
	<p>The relays <b>Q1</b> to <b>Q2</b> of the hermetic full-protection in the station subdistribution are not working properly.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the relays in the station subdistribution are correctly functioning.</li> <li>• Ensure that the cabling of the relays is intact.</li> </ul>
	<p>The relay <b>Q4</b> of the hermetic full-protection in the station subdistribution is not set to the correct switching position.</p> <p><b>Corrective measures:</b></p> <ul style="list-style-type: none"> <li>• Ensure that the relay <b>Q4</b> is set to the inverter currently feeding electricity into the grid.</li> <li>• Ensure that the cabling of the relay is intact.</li> </ul>
The MV switchgear protective device has triggered.	<ul style="list-style-type: none"> <li>• Read the error of the protective device (see manufacturer's documentation).</li> <li>• Please contact us (see Section 17, page 294).</li> </ul>

## 9.3 Troubleshooting in the Inverter

### 9.3.1 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 12.7, page 215).
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 **[test]**. A test e-mail will be sent to the specified e-mail address.
11. If no test e-mail has yet been received, carry out the following steps:
  - Check whether the test e-mail is in the spam folder.
  - Make sure that the network settings of the communication unit are correct.
  - Ensure that the settings of the SMTP server are correct.

### 9.3.2 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.

#### Procedure:

1. To display current disturbance messages:
  - Call up the instantaneous value overview (see Section 12.8, page 215).
  - Read off the current disturbance in the instantaneous value **ErrNo**.
  - Read off the location of the current cause of disturbance in the instantaneous value **ErrNo**.
2. To display all disturbance messages:
  - Call up the event overview (see Section 12.9, page 215). All events will be displayed in chronological order.
  - To find warnings and error messages faster, select . This will filter the events.

### 9.3.3 Acknowledging Disturbance Messages

#### 9.3.3.1 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.

#### Procedure:

1. Call up the parameter overview (see Section 12.7, page 215).
2. To acknowledge all current errors, set the parameter **ErrClr** to **Ackn** for each error respectively.
3. To acknowledge any further errors, set the parameter **ErrClr** to **Ackn** again.
4. Adopt changes of the parameter with **[Save]**.

### 9.3.3.2 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. Turn the start-stop key switch **-S1** to **Stop**.
2. Turn the start-stop key switch **-S1** to **Start**.
3. Turn the start-stop key switch **-S1** back to **Stop** within ten seconds.
4. 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.

### 9.3.4 Remedial Action in Case of Disturbances

#### 9.3.4.1 Troubleshooting for non-feeding of the inverter

It can occur under certain circumstances that the inverter does not feed into the utility grid. 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. <ul style="list-style-type: none"> <li>• Wait for a short period for a reaction.</li> </ul>
Error: Error	An error has occurred. <ul style="list-style-type: none"> <li>• View the cause of the error in the <b>ErrNo</b> instantaneous value.</li> <li>• Check the cause of the error, where necessary eliminate the error and acknowledge via the parameter <b>ErrClr</b> (see Section 9.3.3.1, page 158).</li> </ul>
Stop: Key Switch	The inverter has been switched to the "Stop" operating state with the <b>-S1</b> start-stop key switch. <ul style="list-style-type: none"> <li>• Turn the key switch <b>-S1</b> to the <b>Start</b> position.</li> </ul>
Stop: Parameter InvOpMod	The inverter has been switched to the "Stop" operating state via the parameter <b>InvOpMod</b> . <ul style="list-style-type: none"> <li>• Set the parameter <b>InvOpMod</b> to <b>Operation</b>.</li> </ul>
Stop: Stop External X440:3	The inverter has been switched to the "Stop" operating state via the external stop function. <ul style="list-style-type: none"> <li>• If a signal was not issued via the external stop input, check the input - <b>X440:3</b>. To do so, measure the voltage and check the cable where necessary.</li> </ul>
Stop: Scada or PPC, Modbus	The inverter has been switched to the "Stop" operating state via the Modbus protocol. <ul style="list-style-type: none"> <li>• Switch the inverter back to the "Start" operating state via a Modbus signal.</li> </ul>

Value of the instantaneous value	Possible causes and remedies
Standby: Scada or PPC, Modbus	<p>The inverter has been switched to the "Standby" operating state via the Modbus protocol.</p> <ul style="list-style-type: none"> <li>Switch the inverter back to the "Start" operating state via a Modbus signal.</li> </ul>
Standby: AC synchronization	<p>The inverter can not be synchronized with the utility grid and switches to the "Standby" operating state.</p> <ul style="list-style-type: none"> <li>Check the AC voltage at the inverter.</li> </ul>
Standby: Low DC Power	<p>The PV power generated is below the minimum feed-in power of the inverter and the inverter switches to the "Standby" operating state.</p> <ul style="list-style-type: none"> <li>Wait for more PV power.</li> </ul>
Standby: External Grid Error	<p>An external network error has been reported via the Modbus protocol and the inverter has switched to the "Standby" operating state.</p> <ul style="list-style-type: none"> <li>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.</li> </ul>
Standby: Power Monitoring Module	<p>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 <b>GriMng.ComFltFlbVArMod</b> and <b>GriMng.ComFltFlbWMod</b> (see Section 13.4.6, page 241).</p>
Standby: Parameter RemRdy	<p>The inverter has been switched to the "Standby" operating state via the parameter <b>RemRdy</b>.</p> <ul style="list-style-type: none"> <li>Set the parameter <b>RemRdy</b> to <b>Enable</b>.</li> </ul>
Standby: Standby External X440:7	<p>The inverter has been switched to the "Standby" operating state via the external standby function.</p> <ul style="list-style-type: none"> <li>If a signal was not issued via the external standby input, check the input - <b>X440:7</b>. To do so, measure the voltage and check the cable where necessary.</li> </ul>
Wait AC	<p>The entered grid limits in the <b>VCtl.xxx</b> or <b>HzCtl. xxx</b> parameters were violated and the inverter has disconnected from the utility grid.</p> <ul style="list-style-type: none"> <li>Check the waiting time for reconnection to the grid in the parameter <b>WaitGriTm</b>.</li> <li>Check the settings for the grid limits in the parameters <b>VCtl.xxx</b> (see Section 13.2.2.2, page 222) or <b>HzCtl.xxx</b> (see Section 13.2.2.1, page 221).</li> </ul> <p>The voltage of the utility grid does not satisfy the requirements for connection to the utility grid.</p> <ul style="list-style-type: none"> <li>Check the amplitude of the voltage in the utility grid.</li> <li>Check the frequency of the voltage in the utility grid.</li> <li>Check the line conductor of the voltage in the utility grid.</li> </ul>

Value of the instantaneous value	Possible causes and remedies
Wait DC: DC Voltage	The PV voltage at the inverter is too low or too high. <ul style="list-style-type: none"> <li>• Wait or adjust the DC voltage.</li> </ul>
Wait DC: Bender	The insulation monitoring device is measuring the insulation resistance of the PV system. The time period of the measurement ist defined in the parameter <b>PvGnd.AcIsoMonTm</b> . <ul style="list-style-type: none"> <li>• Wait until the measurement of the insulation resistance has been completed.</li> </ul>
Self Test active	The inverter is performing a self test. <ul style="list-style-type: none"> <li>• Wait until the self test has been completed.</li> </ul>
IO Test active	The inverter is in test mode. Please contact us (see Section 17, page 294).

### 9.3.4.2 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 two 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 five times within two hours or without interruption for two 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 SD memory card. The event report logs the time and type of disturbance. The event report can also be displayed on the user interface.

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 one minute. While the control system is booting, the regular waiting times for grid monitoring are complied with.

### 9.3.4.3 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	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>

Figure 84: Explanation of the error table (example)

Position	Explanation
A	Behavior of the inverter: disturbance level S1, disturbance level S2 <ul style="list-style-type: none"> <li>s / min: waiting time</li> <li>D: day change</li> <li>Q: waiting for acknowledgement</li> <li>W: warning</li> </ul>
B	Reset

### 9.3.4.4 Error Numbers 01xx to 13xx - Disturbance on the Utility Grid

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	-	<ul style="list-style-type: none"> <li>Check the grid voltage.</li> <li>Check grid connections.</li> </ul>
0204	Grid voltage is too low. Undervoltage detected by standard monitoring.	30 s	30 s	-	<ul style="list-style-type: none"> <li>Check stability of the utility grid.</li> <li>Make sure the external fuses work properly.</li> </ul>
0205	One line conductor of the utility grid has failed.	30 s	30 s	-	<ul style="list-style-type: none"> <li>Make sure the AC cable connections are tight.</li> <li>Check the configured grid limits.</li> </ul>

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
0404	A frequency change in the utility grid greater than permitted has been detected.	30 s	30 s	-	<ul style="list-style-type: none"> <li>• Check power frequency.</li> <li>• Check stability of the utility grid.</li> </ul>
0405	The inverter has disconnected from the utility grid because a stand-alone grid has formed.	30 s	30 s	-	<ul style="list-style-type: none"> <li>• Check the grid voltage.</li> <li>• Check stability of the utility grid.</li> </ul>
0502	Power frequency is too low. Power frequency disturbance detected by standard monitoring.	30 s	30 s	-	<ul style="list-style-type: none"> <li>• Check power frequency.</li> <li>• Check the display of the grid monitoring relay.</li> </ul>
0503	Power frequency is too high. Power frequency disturbance detected by standard monitoring.	30 s	30 s	-	<ul style="list-style-type: none"> <li>• Make sure the fuses in the load circuit function properly.</li> <li>• Check the configured grid limits.</li> </ul>
0802	An error has occurred for the grid synchronization.	5 min	Q	-	<ul style="list-style-type: none"> <li>• Check the grid voltage.</li> <li>• Check grid connections.</li> <li>• Check stability of the utility grid.</li> <li>• Make sure the external fuses work properly.</li> <li>• Make sure the AC cable connections are tight.</li> <li>• Check the configured grid limits.</li> </ul>
0803	The supply voltage for the assemblies has failed.	5 min	Q	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
1304	The rotating magnetic field of the utility grid is incorrect.	Q	Q	-	<ul style="list-style-type: none"> <li>• Check the phase assignment.</li> <li>• Contact Service.</li> </ul>
1417	The inverter load is not symmetrical.	30 s	30 s	-	-

#### 9.3.4.5 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	-	<ul style="list-style-type: none"> <li>• Check the DC source.</li> </ul>

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
3501	Error: The insulation monitoring device has measured a too low grounding resistance.	30 min	Q	-	<ul style="list-style-type: none"> <li>Check the DC source for ground faults.</li> </ul>
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	-	<ul style="list-style-type: none"> <li>Check the DC source.</li> </ul>
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	-	<ul style="list-style-type: none"> <li>Check the DC source.</li> </ul>
3521	The DC voltage to ground is too high. The insulation measurement was canceled.	15 min	D	-	<ul style="list-style-type: none"> <li>Check the DC source.</li> </ul>
3522	The insulation resistance is too low.	5 min	5 min	-	<ul style="list-style-type: none"> <li>Check the DC source.</li> </ul>
3601	Warning: Leakage current to ground has occurred at the PV modules or the threshold defined in the <b>PvGnd.RisIsoWarnLim</b> parameter has been reached.	W	W	-	<ul style="list-style-type: none"> <li>Check the grounding and equipotential bonding of the PV modules.</li> <li>Check the circuitry and PV system design.</li> <li>Check the <b>PvGnd.RisIsoWarnLim</b> parameter.</li> </ul>
3602	Warning: high leakage current has occurred at the GFDI.	W	W	-	<ul style="list-style-type: none"> <li>Check the DC source.</li> </ul>
3803	An incidence of overcurrent at the DC input has occurred.	1 min	D	-	<ul style="list-style-type: none"> <li>Check the DC source.</li> </ul>
4003	Reverse currents detected in the DC source or DC connection polarity reversed.	Q	Q	-	<ul style="list-style-type: none"> <li>Check the DC source for short circuits.</li> <li>Check the circuitry and PV system design.</li> <li>Check the DC terminals for correct polarity.</li> <li>Check the functionality of the DC input.</li> </ul>
4401	Error in the backfeed power module	W	W	-	<ul style="list-style-type: none"> <li>Check the backfeed power module</li> </ul>

### 9.3.4.6 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 MV transformer is too high. Disconnection limit exceeded. Inverter stops feed-in operation.	Q	Q	-	• Check the MV transformer.
6426	Overvoltage at the DC input.	30 s	5 min	-	• Check the PV array.
6440	Hermetic protection (oil level) of the MV transformer no longer assured.	Q	Q	-	• Check the MV 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.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
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 MV transformer is no longer assured.	30 s	5 min	-	• Check the MV 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	-	• 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	-	• Clean the fans. • Check the fuse of the heating and interior fan.
6499	An error in the sinusoidal capacitor was detected.	30 s	Q	-	• Contact Service.
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 MV transformer is too high.	30 s	30 s	-	• Check the MV 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.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6518	The temperature at the AC bus-bars is too high.	Q	Q	-	<ul style="list-style-type: none"> <li>• Check the torque on the AC connection on the inverter.</li> <li>• Check the design of the AC connection on the inverter.</li> </ul>
6625	The current on the inverter bridge is too high and is therefore limited to the maximum current.	1 min	1 min	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
7002	Cable break or short circuit at inverter temperature sensor	W	W	-	<ul style="list-style-type: none"> <li>• Check the wiring of the temperature sensor.</li> <li>• Contact Service.</li> </ul>
7004		W	W	-	
7005		W	W	-	
7016		W	W	-	
7501	Interior fan is defective.	W	W	-	<ul style="list-style-type: none"> <li>• Check function of the fans.</li> <li>• Clean the fans.</li> <li>• Contact Service.</li> </ul>
7502		W	W	-	
7503		W	W	-	
7505	Fans of the MV transformers are defective.	W	W	-	
7600	Internal communication error has occurred or communication is interrupted.	30 s	5 min	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
7601		30 s	180 min	-	
7602		30 s	30 s	-	
7605		30 s	5 min	-	
7620		30 s	180 min	-	
7621		30 s	180 min	-	
7634	A communication error has occurred in terms of the DC-DC Converter.	-	-	-	-
7700	An error at the internal switches has occurred.	30 s	Q	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
7704	An error has occurred at the DC switchgear.	30 s	Q	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
7707	An error has occurred at the AC disconnection unit.	30 s	Q	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
7708	Faulty switching status of Remote GFDI.	5 min	D	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
7709	90% of the switch cycles of the DC switching devices have been reached.	-	-	-	-
7710	100% of the switch 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.
7901	Reverse current has occurred in PV array.	30 s	1 min	-	• Contact Service.
8402	High ripple currents have occurred due to defective sine-wave filter capacitors.	30 s	30 s	-	• Contact Service.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
8712	<p>Warning: failure of power setpoints transmitted via communication.</p> <p>The inverter behavior depends on the parameter settings <b>GriMng.ComFltFlbWMod</b> and <b>GriMng.ComFltFlbVArMod</b>:</p> <ul style="list-style-type: none"> <li>• <b>Last setpoint</b>: The inverter feeds in with the last valid value.</li> <li>• <b>W</b>: The inverter feeds in with the substitute value given for the selected procedure.</li> </ul> <p>Once valid setpoints are available again, these will be used.</p>	W	W	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
8713	<p>Failure of power setpoints transmitted via communication. Inverter stops feed-in operation.</p> <p>The inverter behavior depends on the parameter settings <b>GriMng.ComFltFlbWMod</b> and <b>GriMng.ComFltFlbVArMod</b>:</p> <ul style="list-style-type: none"> <li>• <b>Standby</b>: The inverter switches to the operating state "Standby." The AC disconnection unit and the DC switchgear remain closed.</li> <li>• <b>Error</b>: 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.</li> </ul>	1 min	1 min	-	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>
8715	Communication between inverters failed.	W	W	-	<ul style="list-style-type: none"> <li>• Check communication of both inverters.</li> <li>• Contact Service.</li> </ul>
9009	Fast stop tripped by processor assembly.	5 min	Q	-	<ul style="list-style-type: none"> <li>• Eliminate error and switch fast stop back on.</li> </ul>
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	-	<ul style="list-style-type: none"> <li>• Check the fast stop cabling.</li> <li>• Eliminate error and switch fast stop back on.</li> </ul>

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
9023	Fast stop tripped by DC overcurrent.	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9024	Fast stop tripped by Remote GFDI.	5 min	Q	-	<ul style="list-style-type: none"> <li>Check the fast stop cabling.</li> <li>Eliminate error and switch fast stop back on.</li> </ul>
9025	Fast stop manually tripped at key switch <b>-S2</b> .	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9026	Fast stop tripped by the external fast stop.	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9027	Fast stop tripped by AC overcurrent.	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9028	Fast stop was tripped by AC disconnection unit.	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9029	Fast stop has tripped.	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9030	Fast stop tripped by the external watchdog.	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9031	Fast stop tripped by redundant monitoring of the processor assembly.	5 min	Q	-	<ul style="list-style-type: none"> <li>Eliminate error and switch fast stop back on.</li> </ul>
9103	A thyristor has not opened after a test.	Q	Q	-	<ul style="list-style-type: none"> <li>Replace thyristors.</li> <li>Contact Service.</li> </ul>
9104	An error has occurred at the control clock timing.	30 s	5 min	-	<ul style="list-style-type: none"> <li>Contact Service.</li> </ul>
9105	An error has occurred at the DC-DC Converter.	W	W	-	-
9106	The DC-DC converter reports a warning.	W	W	-	-
9307	The battery management system has reported a fault.	W	W	-	<ul style="list-style-type: none"> <li>Contact Service.</li> </ul>
9308	<p>Failure of communication with the battery.</p> <p>The inverter behavior depends on the parameter settings <b>BatCtl.ComFlb.FlbMod</b>.</p>	W	W	-	<ul style="list-style-type: none"> <li>Check communication.</li> <li>Contact Service.</li> </ul>
9346	The battery is not configured.	W	W	-	<ul style="list-style-type: none"> <li>Check the battery's communication.</li> </ul>
9347	The battery reports an event.	W	W	-	<ul style="list-style-type: none"> <li>Check the battery.</li> </ul>

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
9348	Failure of communication with the external control. The inverter behavior depends on the parameter settings <b>BatCtl.ComFlb.FlbMod.</b>	W	W	-	<ul style="list-style-type: none"> <li>• Check communication.</li> <li>• Contact Service.</li> </ul>
9349	The state of charge limits are too narrow. Hysteresis is not used.	W	W	-	<ul style="list-style-type: none"> <li>• Check the parameters of the state of charge limit.</li> </ul>
9350	Time overshooting when the battery status is changing	W	W	-	<ul style="list-style-type: none"> <li>• Check the battery.</li> </ul>
9501	The Remote GFDI fuse has tripped.	1.5 min	Q	x	<ul style="list-style-type: none"> <li>• Contact Service.</li> </ul>

### 9.3.5 Troubleshooting the PQ-Meter

Error	Possible causes and remedies
The PQ-Meter is not supplying measured values.	<p>There is a wiring fault.</p> <ul style="list-style-type: none"> <li>• Check the installation of the PQ-Meter (see Section 6.9.3, page 122).</li> </ul>
The PQ-Meter is not supplying measured values.	<p>The communication between inverter and PQ-Meter is disturbed.</p> <ul style="list-style-type: none"> <li>• In the customer connection area of the inverter, remove the grounding conductor line at terminal <b>-X764</b> for the voltage measurement.</li> </ul>
The measured values of PQ-Meter and inverter differ.	<p>The PQ-Meter is not correctly parameterized.</p> <ul style="list-style-type: none"> <li>• Check the parameter setting of the PQ-Meter (see Section 8.12, page 145).</li> </ul>

## 10 Maintenance

### 10.1 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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

#### DANGER

##### **Danger to life from electric shock from improperly operating the tap changer of the MV transformer**

Operating the tap changer of the MV transformer while energized will create a short circuit in the MV transformer. The resulting voltages will lead to death or serious injury.

- Only operate the tap changer when the MV transformer is fully de-energized.
- Have a duly authorized person ensure that the MV transformer is de-energized prior to any work or adjustments to settings.
- Any work on the MV transformer or adjustments to settings may only be performed by qualified service partners.
- Wear suitable protective equipment for all work.

**⚠ WARNING****Danger to life from electric shock when entering the PV power plant**

Lethal ground currents due to damaged insulations of the PV field. Lethal electric shocks can result.

- Ensure that the insulation resistance of the PV array exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- Before entering the PV field, switch the PV power plants with ground fault monitoring to insulated operation.
- After entering the PV power plant, immediately ensure that the inverter does not display an insulation error.
- Disconnect the product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- Wear suitable personal protective equipment for all work on the product.
- Configure the PV power plant as 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 inverter, 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.

**⚠ 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.

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

Sand, dust and moisture penetration can damage the system 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.

**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 Maintenance report for maintenance**

All maintenance work must be documented in a maintenance report. Contact us for the maintenance report (see Section 17, page 294).

- After maintenance work, save the maintenance report.
- In addition, a copy is to be sent to [maintenance.service@sma.de](mailto: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.

## 10.2 Servicing Schedule

### 10.2.1 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 17, page 294).

- After maintenance work, save the maintenance report.
- In addition, a copy is to be sent to [maintenance.service@sma.de](mailto: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 17 "Contact", page 294).

## 10.2.2 Servicing Schedule for General Work

### Required maintenance materials and tools (not included in the scope of delivery):

- 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 for the standard MV Power Station are available using the following order number:

Position	RAL color	Color	Order number
Station container	RAL 7004	Signal gray	87-5010121
Enclosure of the inverter	RAL 9016	Traffic white	87-5051310
MV transformer	RAL 7033	Cement gray	109015-00.01

### Maintenance under voltage-free conditions:

Task	Interval	See
Maintain the key switches and seals.	24 months	Section 10.3.1.2, page 182
Perform visual inspection.	24 months	Section 10.3.1.3, page 183
Check the latches, door stops and hinges.	24 months	Section 10.3.1.4, page 183
Clean the interior.	24 months*	Section 10.3.1.5, page 184
Check the labels.	24 months*	Section 10.3.2.4, page 190
Check all components of the product and ensure operational safety after environmental disturbances (e.g. earthquakes, storms or flooding).	Where necessary	-
Contact the SMA Service Line after each short circuit.	After any short circuit	-

\* If the product is subject to adverse ambient conditions, SMA Solar Technology AG recommends that the maintenance interval be reduced in accordance with the ambient conditions.

## 10.2.3 Servicing Schedule for Work on the Station Container

Task	Interval
Ensure that there are no objects in front of the MV Power Station that could prevent arc fault diversion.	Prior to each switching procedure and every 12 months*

Task	Interval
Check whether the protective grids in front of the transformer compartment are intact.**	12 months
Check the doors and structural components of the door frame for damage. Ensure that the doors and locks function properly.	12 months
Check the station container on the inside and outside for cracks, holes and rust. Remove any rust patches and repaint (if necessary).	12 months
Check whether the warning labels and circuit diagrams are present, complete and legible.	12 months
Remove dirt, dust and moisture from the inverter compartments.	12 months*
Remove dirt, dust and moisture from the MV transformer compartment.	12 months*
Make sure that all grounding contacts in the MV transformer compartment are securely in place and show no discoloration or corrosion. If necessary, coat with acid-free grease.	12 months

\* If the product is subject to adverse ambient conditions, SMA Solar Technology AG recommends that the maintenance interval be reduced in accordance with the ambient conditions.

\*\* Depending on the order option

## 10.2.4 Servicing Schedule for Work on the Inverter

### Additionally required equipment

- Brush for removing dust deposits
- Vacuum cleaner
- Angled telescopic mirror for inspecting the air duct

Maintenance work	Interval	See
Clean the air duct and ventilation grids.	24 months	Section 10.3.2.2, page 185
Clean the heating elements.	24 months	Section 10.3.2.3, page 189
Check the fuse of the DC surge arrester for continuity.	24 months	Section 10.3.2.5, page 192
Check the fans.	24 months	Section 10.3.2.6, page 193
Check the heating elements.	24 months	Section 10.3.2.7, page 193
Check the functioning of the indicator lights.	24 months	Section 10.3.2.8, page 194
Clean the DC load-break switch.	24 months*	Manufacturer documentation (see Section 1.7, page 13)
Clean the AC disconnection unit.	24 months*	Manufacturer documentation (see Section 1.7, page 13)
Maintain the AC circuit breaker.	4 years / after a short circuit**	Manufacturer documentation (see Section 1.7, page 13)
Replace the fuse of the DC surge arrester.	Once triggered	Section 10.3.2.9, page 194
Replace the lithium-ion rechargeable battery.***	10 years	-
Replace the Industrial Compact Flash card.***	10 years or after an error message	-

Maintenance work	Interval	See
Replace the interior fan.***	14 years	-
Replace the inverter bridge fan.***	14 years	-
Replace the DC fuses.	After a fault	Section 10.3.2.10, page 195

\* In deviation to the maintenance interval of 12 months specified by ABB, the maintenance interval stated in this documentation applies.

\*\* In deviation to the maintenance interval of three years specified by ABB, the maintenance interval stated in this documentation applies.

\*\*\* Repair work that must only be performed by SMA Service.

## 10.2.5 Servicing Schedule For Work On The Low-Voltage Connection Between Inverter and Medium-Voltage Transformer

Task	Interval	See
Check whether the ventilation grid function is given. Remove the filter for cleaning, wash with clear water, dry and reinsert. Change the filter after ten cleaning cycles.	12 months*	-

\* If the product is subject to adverse ambient conditions, SMA Solar Technology AG recommends that the maintenance interval be reduced in accordance with the ambient conditions.

## 10.2.6 Servicing Schedule for Work on the Medium-Voltage Transformer

**Maintenance under voltage-free conditions:**

Task	Interval	See
Check the oil level on the hermetic protection device.*	12 months	Section 10.3.3.1, page 195
Check low-voltage and medium-voltage cable entries for discolorations and damages.	12 months	Section 10.3.3.4, page 196
Check electrical connections for dirt and signs of electric arcs.	12 months	Section 10.3.3.5, page 196
Check the cooling surfaces for dirt and damages.	12 months	Section 10.3.3.2, page 195
Check maintenance seal and security seals for damage.	12 months	Section 10.3.3.3, page 195
Check torque of the grounding connection.	12 months	Section 10.3.3.6, page 196
Check the function of the control elements of the hermetic full-protection device.*	12 months	Section 10.3.3.7, page 196
Check function of the tap changer.*	12 months	Section 10.3.3.8, page 197
Check the MV transformer for paint damage and rust. Remove any rust patches and repaint (if necessary).	12 months	-
Check the cabling.	12 months	-
Check all the sealings on the MV transformer for leakages and slightly retighten the screws (if necessary).	12 months	-
Clean the ventilation shaft of the fans and ventilation grids.	12 months	-
Check the function of the fans.	12 months**	-

Task	Interval	See
Compare the temperature on the display of the hermetic protection device with the parameters of the inverter.*	12 months	–
Take an oil sample and have it tested.	Recommended after a failure when, for example, the hermetic protection device has tripped.	Manufacturer documentation
Replace the MV transformer's fan (material number: 109013-00.01).	10 years	–

\* Depending on the order option

\*\* If the product is subject to adverse ambient conditions, SMA Solar Technology AG recommends that the maintenance interval be reduced in accordance with the ambient conditions.

You can find further information in the manufacturer documentation.

## 10.2.7 Servicing Schedule for Work in the Medium-Voltage Compartment

### Required maintenance materials and tools (not included in the scope of delivery):

- A suitable water-free, temperature-resistant lubricant
- Abrasive cloth

### Maintenance work with supply voltage present

Task	Interval
Check whether the ventilation grid function is given.	12 months*
In case of the dust option: Clean the filter pad at the air inlets and outlets. For this, wash with clear water, dry and reinsert the filter pad. The filter pad must be replaced by a new one after ten washes. Filter pads can be ordered from us (material number: 113059-00.01).	12 months*
Clean the medium-voltage compartment.	12 months*
Clean the ventilation shaft of the fan and the ventilation grids on the doors.	12 months*
Make sure that all grounding contacts are securely in place and show no discoloration or corrosion.	12 months
Check the function of the lighting.	12 months
Check the function of the fans. To do this, change the setting of the room thermostat and return to the original value after the function check.**	12 months*
Check the function of the doors and hinges and lubricate them.	12 months
Replace the cascade control battery (material number: 109005-00.01).**	5 years*
Safety equipment for order option "Country Package France" or "Country Package Italian"	In accordance with manufacturer specifications / country-specific standards

\* If the product is subject to adverse ambient conditions, SMA Solar Technology AG recommends that the maintenance interval be reduced in accordance with the ambient conditions.

\*\* Depending on the order option

## 10.2.8 Servicing Schedule for Work in the Low-Voltage Compartment

### Required maintenance materials and tools (not included in the scope of delivery):

- A suitable water-free, temperature-resistant lubricant
- Abrasive cloth

### Maintenance work with supply voltage present

Task	Interval
Check whether the ventilation grid function is given.	12 months*
In case of the dust option: Clean the filter pad at the air inlets and outlets. For this, wash with clear water, dry and reinsert the filter pad. The filter pad must be replaced by a new one after ten washes. Filter pads can be ordered from us (material number: 113059-00.01).	12 months*
Clean the low-voltage compartment.	12 months*
Clean the ventilation shaft of the fan and the ventilation grids on the doors.	12 months*
Make sure that all grounding contacts are securely in place and show no discoloration or corrosion.	12 months
Check the function of the lighting.	12 months
Check the function of the fans. To do this, change the setting of the room thermostat and return to the original value after the function check.**	12 months*
Check the function of the doors and hinges and lubricate them.	12 months
Check the function of the uninterruptible power supply.** <ul style="list-style-type: none"> <li>• Check whether the air conditioner is soiled. Clean it if necessary.</li> <li>• Clean the filter and replace it (if necessary).</li> <li>• Check the functioning of the air conditioner. Listen whether the compressor and fan make any unusual noises.</li> <li>• Check the battery voltages and replace it (if necessary).</li> <li>• Check hoses and terminals of the central degassing system for cracks and kinks and replace them (if necessary).</li> <li>• Ensure that the filter of the central degassing system is clean.</li> </ul>	Six months after commissioning, then twelve months*
Further information about maintenance and intervals can be found in the component documentation. The manufacturer documentation can be required upon request.	
Check the functioning of the control of the emergency lighting equipment in case of the "Country Package France". Check also battery voltage (type 6F22 9V).**	12 months

\* If the product is subject to adverse ambient conditions, SMA Solar Technology AG recommends that the maintenance interval be reduced in accordance with the ambient conditions.

\*\* Depending on the order option

## 10.2.9 Servicing Schedule for Work on the MV Switchgear

Task	Interval	See
Check the MV switchgear's level of gas.	Prior to each switching procedure:	Section 10.3.4.1, page 197

Task	Interval	See
Carry out the visual inspection of the general condition (cleanliness, no corrosion, etc.). If required, clean the enclosure and repair corroded surfaces.	12 months	-
Check the lid of electric-arc opening.	12 months	Section 10.3.4.2, page 197
Check grounding connections.	24 months	Section 10.3.4.4, page 198
Check functionality of the circuit breaker.	24 months	Section 10.3.4.5, page 198
Check the circuit breaker.	24 months	Manufacturer documentation
Check the motor-drive function.	24 months	Manufacturer documentation
Check functionality of the over-current protection device.*	4 years	-
Check electrical connections.	6 years	Section 10.3.4.3, page 197
Check the accessory for completeness and its current state.	6 years	Manufacturer documentation
Check that switch position indicators are aligned.	6 years	Section 10.3.4.6, page 198
Replace the battery (Saft Type LS 17500, 3.6 V) of the overcurrent protection devices IKI 30E and IKI 35.	15 years	Manufacturer documentation

\* This task must only be performed by qualified protection tester.

You can find further information in the manufacturer documentation.

### 10.2.10 Servicing Schedule for Work on the Station Subdistribution

Task	Interval
Check the residual-current device of the outlet.	12 months
Check the residual-current devices for the MV transformer fans	12 months
Check that the protective covers of the fuses are securely in place and correct, if necessary.	12 months
Check the function of the relay in the safety loop.	12 months
Check the switch cabinet heating.	12 months
Clean the inside of the enclosure.	24 months

### 10.2.11 Servicing Schedule for Work on the Oil Spill Containment

#### Additionally required maintenance materials:

- Sealant (e.g. Teflon tape) to seal the connections between the oil drain valve, oil filter and pre-filter
- If necessary, filter media for the pre-filter
- Oil filter and pre-filter dependent on the replacement interval

Position	Order number
Oil filter for mineral oil	58-940100.01
Oil filter for organic oil	58-940200.01

Position	Order number
Pre-filter	58-940000.01
Filter media for the pre-filter	65-171800.01

Task	Interval
Check the oil spill containment underneath the MV transformer and clean it if necessary. Ensure that the openings to the main spars are free.	12 months*
Check the oil spill containment underneath the MV transformer regularly for leakages. If necessary, eliminate leakages.	12 months*
Check the oil spill containment underneath the MV transformer regularly for dirt contamination. Clean if necessary.	12 months*
Check the oil spill containment underneath the MV transformer regularly for water to prevent frost damage. Remove water, if necessary.	12 months*
Check oil filter and pre-filter.	12 months
Clean oil filter and pre-filter.	12 months*
Remove pre-filter.	36 months
Replace oil filter when, normally, clean and clear water flows through the filter.	5 years

\* If the product is subject to adverse ambient conditions, SMA Solar Technology AG recommends that the maintenance interval be reduced in accordance with the ambient conditions.

## 10.3 Maintenance Work

### 10.3.1 General Maintenance Work

The general maintenance work must be performed on all components of the product according to the required intervals (see Section 10.2.1, page 174).

#### 10.3.1.1 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.

#### 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 24-month-maintenance check that is not subject to the maintenance schedule.
- 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 inverter surface for damages (see Section 10.3.1.3, page 183).
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 10.3.2.2, page 185).

### Maintenance within four weeks after the environmental incident

1. Check the inverter behavior for errors. If errors occur more frequently than before the environmental incident, contact us (see Section 17, page 294).
2. Check the inverter behavior for derating. If the inverter is in derating mode more frequently than before the environmental incident, clean the ventilation grids and the air duct again (see Section 10.3.2.2, page 185).

### 10.3.1.2 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

#### **⚠ 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.

- Observe the safety information when disconnecting and reconnecting voltage sources (see Section 7.1, page 129).
- Disconnect the inverter from the control path (see Section 7.3.4, page 135).
- Ensure that the inverter is disconnected from the power transmission path on the AC side (see Section 7.3.2, page 134).
- Ensure that the inverter is disconnected from the power transmission path on the DC side (see Section 7.3.3, page 135).
- After switching off the inverter, wait at least 15 minutes before opening the inverter to allow the capacitors to discharge completely.

#### 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 17, page 294).
2. Apply talcum, petroleum jelly or wax to seals. This will prevent frost damage.
3. If the inverter is installed in regions where below-freezing temperatures occur, apply the non-greasing antifreeze agent to the key switch in order to protect against freezing.

### 10.3.1.3 Performing the Visual Inspection

#### **⚠ DANGER**

##### **Danger to life due to electric shock or electric arc if live components are touched**

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7, page 129).
- After switching off the inverter, wait at least 15 minutes before opening the inverter to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

##### **Procedure:**

1. Check all surfaces for dirt. Remove dirt (if necessary).
2. Ensure that there are no foreign materials or objects in or on the MV Power Station and its devices that are flammable or that could otherwise endanger operational safety. If necessary, remove foreign materials and seal any holes to prevent further intrusion.
3. Ensure that there are no objects behind the medium-voltage compartment which endanger operational safety in case of arc faults and prevent arc-flash diversion.
4. Ensure that all cable entries are intact and that the cables are not damaged (e.g. due to animal bites).
5. Ensure that the ventilation and exhaust air vents of the inverter are not obstructed.
6. Ensure that there are no objects around the product which prevent the cooling air from circulating.
7. Check that no visual defects are present on the walls and the roof of all components and the station container (e.g. discoloration, dirt, damage, scratches or cracks).  
If the surfaces are damaged, repair them without delay or within three weeks at the latest.
8. Check the welded joints on the devices for damage.  
Contact the SMA Service Line if any welded joints are damaged.
9. Check whether all type labels of the MV Power Station (incl. MV transformer, MV switchgear and low-voltage transformer) are present, complete and legible.  
Replace the type label if it is not legible. Contact us (see Section 17, page 294).
10. Check whether the circuit diagram and documentation are complete and legible.  
If the circuit diagram or documentation is not legible, contact us (see Section 17, page 294).

### 10.3.1.4 Checking the Latches, Door Stops and Hinges

##### **Required maintenance material (not included in the scope of delivery):**

- A suitable water-free, heat-resistant lubricant, e.g. WD40
- Non-greasing antifreeze agent, e.g. PS88

**⚠ DANGER****Danger to life due to electric shock or electric arc if live components are touched**

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7, page 129).
- After switching off the inverter, wait at least 15 minutes before opening the inverter to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

**Procedure:**

1. Check whether the doors latch easily. Open and close the doors several times.  
If the doors do not latch easily, lubricate all moving parts of the latch.
2. Check whether the stops hold the doors in place.  
If the doors cannot be arrested, lubricate the door stops.
3. Check whether the door hinges move easily.  
If the door hinges do not move easily, apply lubricant.
4. Lubricate all moving parts and movement points.
5. Tighten any loose screws with the appropriate torque.
6. If the product is installed in regions where below-freezing temperatures occur, apply the non-greasing antifreeze to the profile cylinder of the door lock and the key switch in order to protect them from icing up.

**10.3.1.5 Cleaning the Interior****⚠ DANGER****Danger to life due to electric shock or electric arc if live components are touched**

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7, page 129).
- After switching off the inverter, wait at least 15 minutes before opening the inverter to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

**Procedure:**

1. Remove dirt and dust from all interiors and from all devices.
2. Check the interior for leaks.  
If leaks are present, fix them.
3. Remove moisture.

**10.3.1.6 Cleaning the Ventilation Grid on the Station Container****Additionally required tools included in scope of delivery):**

- Brush for removing dust deposits

**Procedure:**

1. Ensure that the MV Power Station is disconnected (see Section 7, page 129).
2. Clean the ventilation grids of the MV Power Station with a brush.

## 10.3.2 Maintenance Work on the Inverter

### 10.3.2.1 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.

#### 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 24-month-maintenance check that is not subject to the maintenance schedule.
- 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 inverter surface for damages (see Section 10.3.1.3, page 183).
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 10.3.2.2, page 185).

#### Maintenance within four weeks after the environmental incident

1. Check the inverter behavior for errors. If errors occur more frequently than before the environmental incident, contact us (see Section 17, page 294).
2. Check the inverter behavior for derating. If the inverter is in derating mode more frequently than before the environmental incident, clean the ventilation grids and the air duct again (see Section 10.3.2.2, page 185).

### 10.3.2.2 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

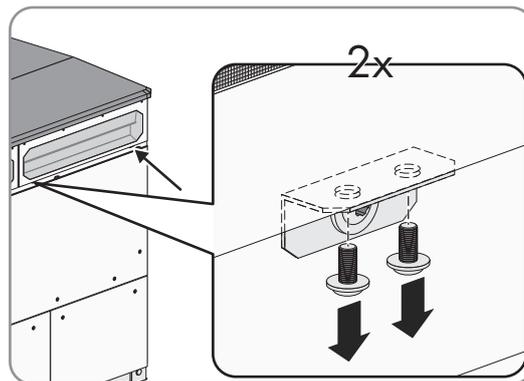
One fan weighs 25 kg. Injuries may occur if the fan is lifted incorrectly or if the fan falls during mounting or removal.

- Mount and remove the fan with all due care.
- Wear personal protective equipment for all work on the product.

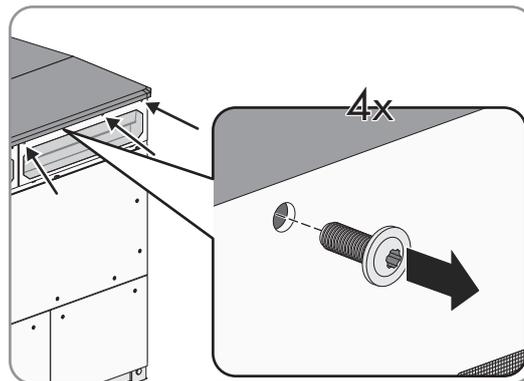
#### Cleaning the air inlet

1. Clean the air inlet grids using a brush and a vacuum cleaner.

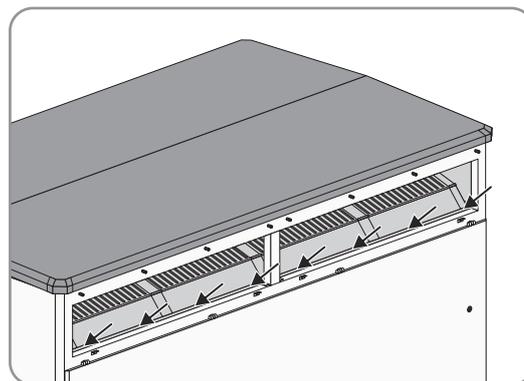
2. Remove the screws on the corner of the air inlet grids.



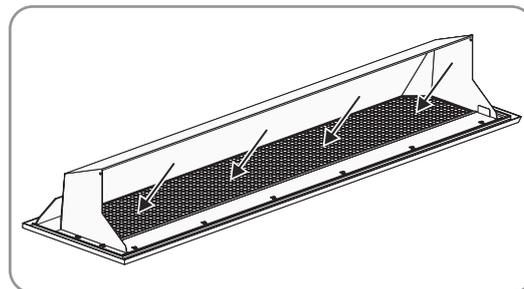
3. Unfasten the air inlet grid screws.



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.



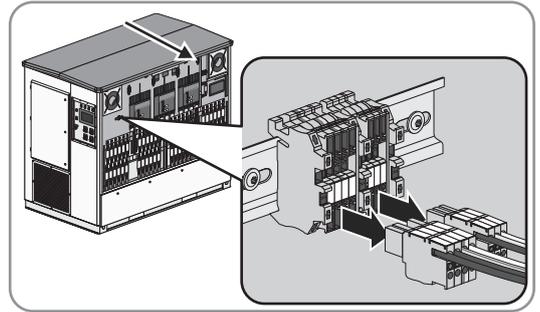
7. Check the ventilation grid for visible damage. If ventilation grids are damaged, contact us (see Section 17, page 294).
8. Vacuum the air duct from the outside or clean it with a brush.
9. If moisture is present in the air duct, remove it with a damp cloth.
10. Fold the ventilation grids upwards and tighten the screws (torque: 8 Nm to 10 Nm).

### Cleaning the fans and air duct

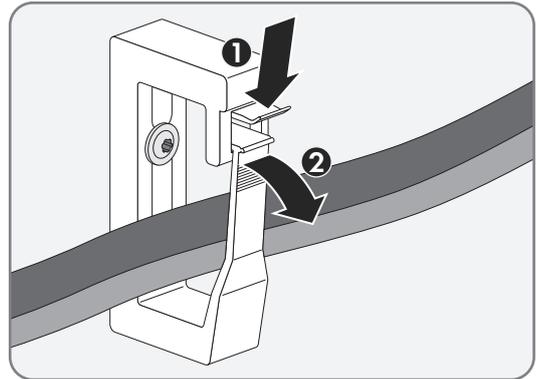
1. Open the hatch on the DC side of the inverter (see Section 12.2, page 202).

## 2. Remove the two fans:

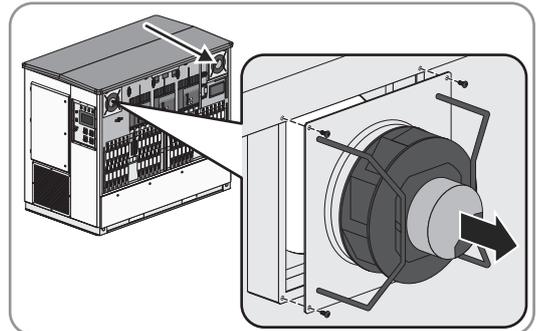
- Disconnect the connection plugs of the fans -X341, -X741, -X342, -X742.



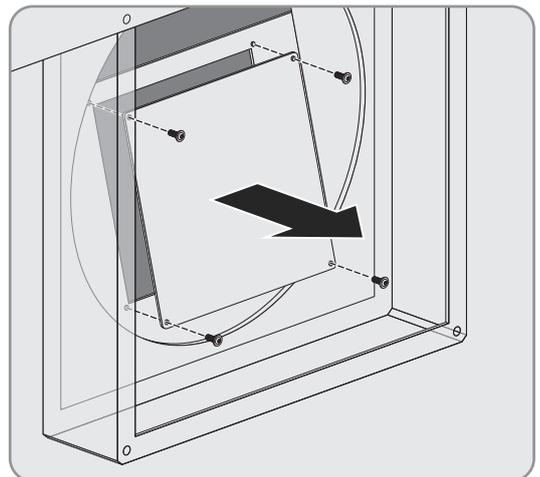
- Open the cable holders and pull the connection plugs of the fans out of the cable holders.



- Remove the screws of the fans and pull the fans out towards you.



## 3. Remove the inspection hatches. To do so, unfasten the screws of the inspection hatches.



## 4. 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 dust deposits in the air duct behind the inspection hatches, remove the dust deposits. Use a vacuum cleaner for this.

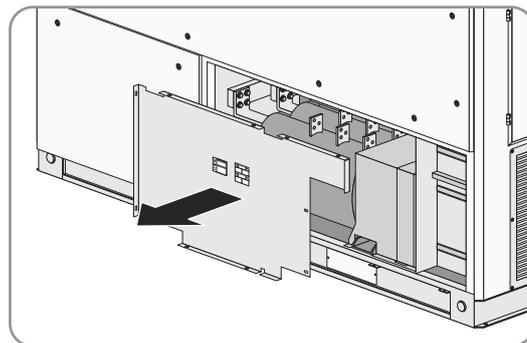
## 5. Remount the inspection hatches. To do so, tighten the screws of the inspection hatches (torque: 8 Nm to 10 Nm).

## 6. Remount the fans:

- Position the fans over the screwing points and tighten the screws (torque: 8 Nm to 10 Nm).
- Lay the connection plugs of the fans in the cable holders and close the cable holders.
- Connect the connection plugs of the fans to the terminals -X341, -X741, -X342, -X742.

### Cleaning the sine-wave filter

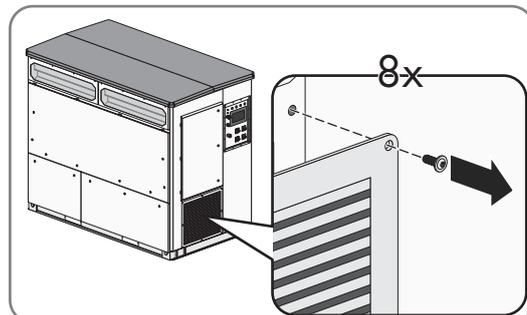
1. Remove the cover in front of the sine-wave filter capacitors (see Section 12.3.1.2, page 206).
2. Remove any dust deposits from the area around the sine-wave filter capacitors.
3. Mount the cover in front of the sine-wave filter capacitors (see Section 12.3.1.2, page 206).
4. Disassemble the panels (see Section 12.3.1.1, page 203).
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).

### 10.3.2.3 Cleaning the Heating Element

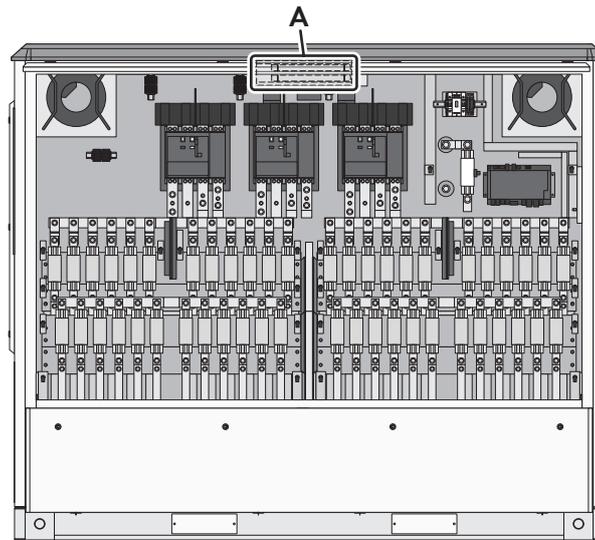


Figure 85: Position of heating element -E1

Position	Designation
A	Heating element -E1

**Procedure:**

1. Open the hatch (see Section 12.2, page 202).
2. Remove dirt and dust from the heating element.
3. Remove moisture.

### 10.3.2.4 Checking the Labels

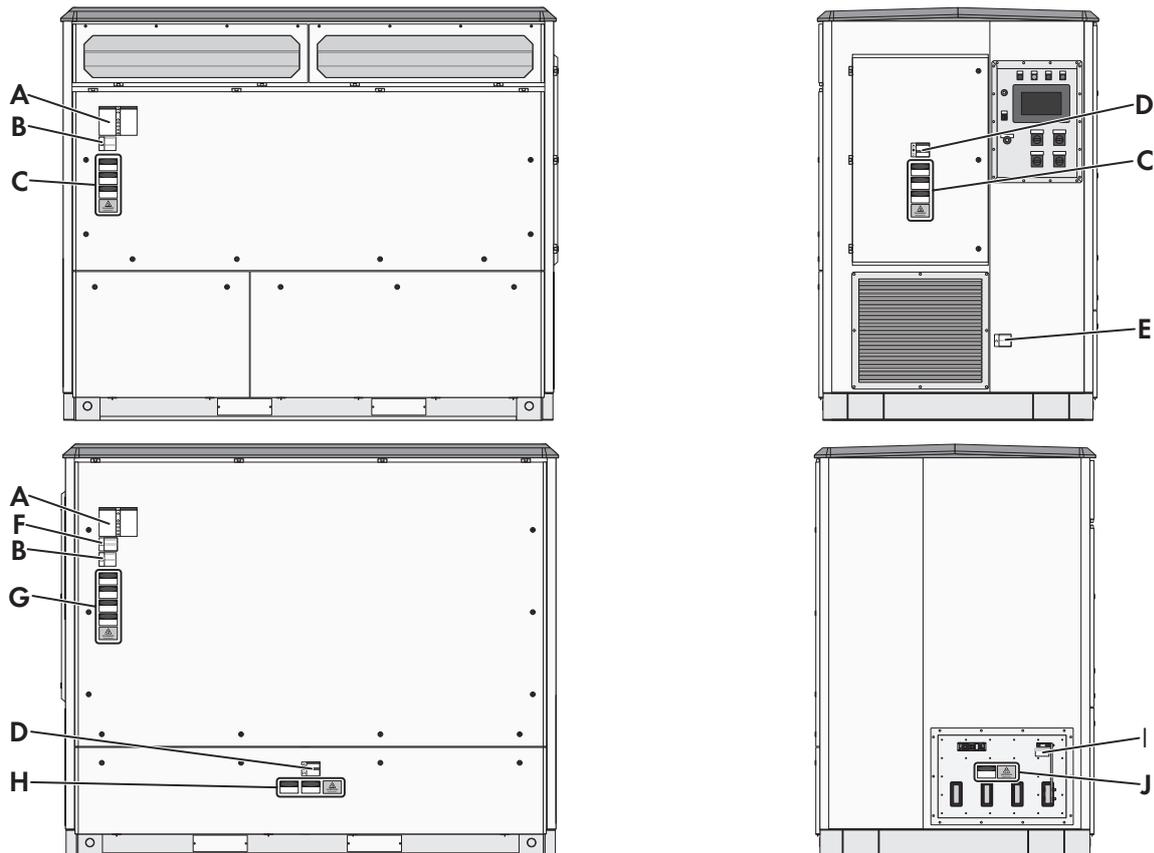


Figure 86: Position of the warning labels on the enclosure

Position	Order number
A	102809-00.01 (en/es)   102810-00.01 (en/fr)   103047-00.01 (en)   102811-00.01 (en/de)   102812-00.01 (en/it)   102813-00.01 (en/el)   102814-00.01 (en/ar)   102815-00.01 (en/th)   105040-00.01 (en/he)   111767-00.01 (en/ja)
B	86-110600.01 (en/es)   86-110700.01 (en/fr)   86-121100.01 (en/de)   86-121200.01 (en/it)   86-121300.01 (en/el)   86-121400.01 (en/ar)   86-121500.01 (en/th)   102721-00.01 (en)   105044-00.01 (en/he)   111867-00.01 (en/ja)
C*	111615-00.01 (en)   111616-00.01 (en)   111617-00.01 (en)   112221-00.01 (en) 111623-00.01 (en) 111621-00.01 (en) 111622-00.01 (en)
D	86-106100.01 (en/es)   86-106200.01 (en/fr)   102723-00-0.0 (en)   86-123000.01 (en/de)   86-123100.01 (en/it)   86-123200.01 (en/el)   86-123300.01 (en/ar)   86-123400.01 (en/th)   86-123400.01 (en/ja)
E	86-00340131 (en/es)   86-79616 (en/fr)   102718-00-0.1 (en)   86-121600.01 (en/de)   86-121700.01 (en/it)   86-121800.01 (en/el)   86-121900.01 (en/ar)   86-122000.01 (en/th)   111764-00.01 (en/ja)
F	86-117900.01 (en/es)   86-117800.01 (en/fr)   102720-00.01 (en)   86-119900.01 (en/de)   86-120000.01 (en/it)   86-120100.01 (en/el)   86-120200.01 (en/ar)   86-120300.01 (en/th)   111749-00.01 (en/ja)

Position	Order number
G*	111615-00.01 (en)   111616-00.01 (en)   111617-00.01 (en)   112221-00.01 (en) 111618-00.01 (en)   111619-00.01 (en)   111620-00.01 (en) 111623-00.01 (en) 111621-00.01 (en) 111622-00.01 (en)
H*	111618-00.01 (en)   111619-00.01 (en)   111620-00.01 (en) 111623-00.01 (en) 111622-00.01 (en)
I	86-0043460 (en)   86-120500.01 (es)   86-120400.01 (fr)   86-118400.01 (de)   86-118500.01 (it)   86-118600.01 (el)   86-118700.01 (ar)   86-118800.01 (th)   111755-00.01 (ja)
J*	111615-00.01 (en)   111616-00.01 (en)   111617-00.01 (en)   112221-00.01 (en) 111622-00.01 (en)

\* Only for option: destination country: Australia

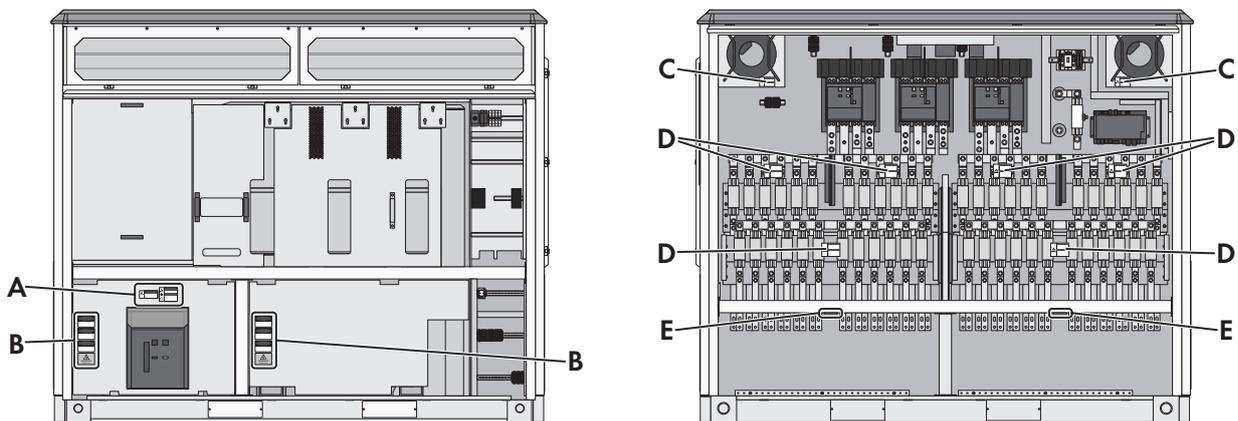


Figure 87: Position of the warning labels inside the inverter

Position	Order number
A	86-106100.01 (en/es)   86-106200.01 (en/fr)   86-123000.01 (en/de)   86-123100.01 (en/ it)   86-123200.01 (en/el)   86-123300.01 (en/ar)   86-123400.01 (en/th)   102723-00.01 (en)   105046-00.01 (en/he)   111765-00.01 (en/ja) 103029-00.01
B*	111615-00.01 (en)   111616-00.01 (en)   111617-00.01 (en)   112221-00.01 (en) 111623-00.01 (en) 111621-00.01 (en) 111622-00.01 (en)
C	86-110600.01 (en/es)   86-110700.01 (en/fr)   86-121100.01 (en/de)   86-121200.01 (en/it)   86-121300.01 (en/el)   86-121400.01 (en/ar)   86-121500.01 (en/th)   102721-00.01 (en)   105044-00.01 (en/he)   111867-00.01 (en/ja)

Position	Order number
D	103251-00.01 (en/es)   103252-00.01 (en/fr)   103219-00.01 (en/de)   103220-00.01 (en/it)   103221-00.01 (en/el)   103222-00.01 (en/ar)   103223-00.01 (en/th)   102722-00.01 (en)   105041-00.01 (en/he)   111765-00.01 (en/ja)
E	Depending on the grounding: 86-110400.01 (positive grounding) or or 86-110500.01 (negative grounding).

\* Only for option: destination country: Australia

## ⚠ 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.

- Observe the safety information when disconnecting and reconnecting voltage sources (see Section 7.1, page 129).
- Disconnect the inverter from the control path (see Section 7.3.4, page 135).
- Ensure that the inverter is disconnected from the power transmission path on the AC side (see Section 7.3.2, page 134).
- Ensure that the inverter is disconnected from the power transmission path on the DC side (see Section 7.3.3, page 135).
- Disconnect the MV transformer (see Section 7.5, page 136).
- After switching off the inverter, wait at least 15 minutes before opening the inverter to allow the capacitors to discharge completely.

#### Procedure:

- Check whether any warning message or label is damaged or missing.  
Replace any warning messages and labels which are missing or illegible. If necessary, you can order the labels using the order number stated above. Contact us (see Section 17, page 294).

### 10.3.2.5 Checking the DC Surge Arrester Fuse for Continuity

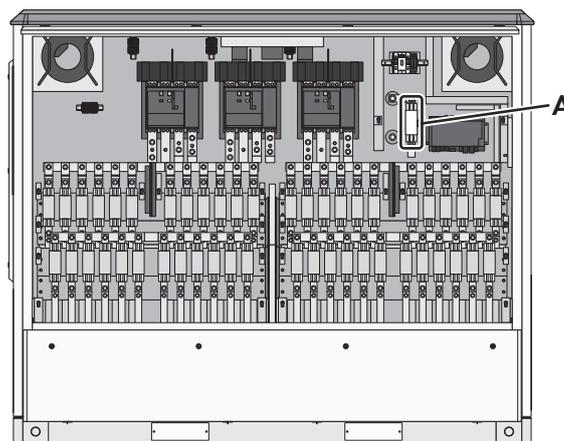


Figure 88: DC surge arrester fuse

Position	Designation
A	DC surge arrester fuse

## ⚠ 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.

- Observe the safety information when disconnecting and reconnecting voltage sources (see Section 7.1, page 129).
- Ensure that the inverter is disconnected from the power transmission path on the DC side (see Section 7.3.3, page 135).

#### Procedure:

1. Open the hatch (see Section 12.2, page 202).
2. Perform a continuity check on the fuse.  
If the fuse has no continuity, please contact (see Section 17, page 294).
3. Close the hatch (see Section 12.2, page 202).

### 10.3.2.6 Checking the Fans

1. Call up the parameter overview (see Section 12.7, page 215).
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 17, page 294).
4. Set the parameter **InvTstMod** to **No test**.
5. Set the parameter **InvOpMod** to **Stop**.

### 10.3.2.7 Checking the Heating Element

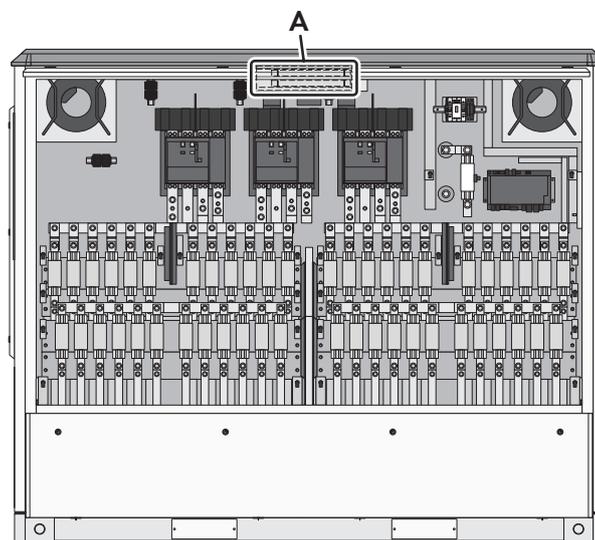


Figure 89: Position of heating element -E1

Position	Designation
A	Heating element -E1

#### Procedure:

1. Ensure that the inverter is disconnected from the power transmission path on both the AC- and DC sides.

2. Call up the parameter overview (see Section 12.7, page 215).
3. Set the parameter **HtSptUsr** to **HtElec on (DeHyd)**.
4. Check whether the heating element radiates heat.  
If the heating element is not radiating heat, contact us (see Section 17, page 294).
5. Set the parameter **HtSptUsr** to **Off**.

### 10.3.2.8 Checking the Functioning of the Light Repeaters

In the standard option, the inverter is fitted with indicator lights. If the inverter is fitted with a touch display, it does not have any indicator lights.

#### Procedure:

1. Call up the parameter overview (see Section 12.7, page 215).
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 light repeaters do not flash, contact us (see Section 17, page 294).
5. Set the parameter **InvTstMod** to **No test**.
6. Set the parameter **InvOpMod** to **Stop**.

### 10.3.2.9 Replacing the Fuse of the DC Surge Arrester

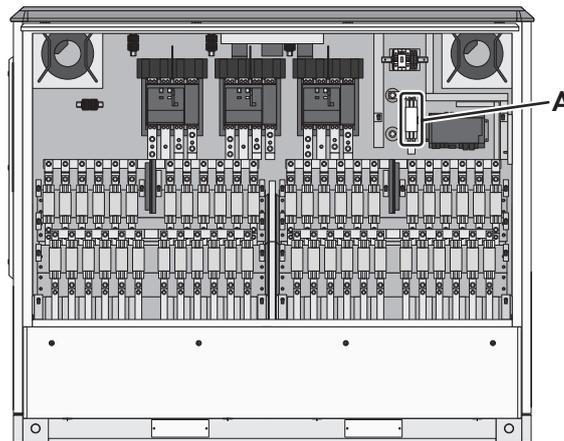


Figure 90: DC surge arrester fuse

Position	Designation
A	DC surge arrester fuse

#### Additionally required material:

- Replacement fuse. The replacement fuse can be ordered under the material number 61-01565.

#### Procedure:

1. Open the hatch (see Section 12.2, page 202).
2. Remove the alarm contact of the DC surge arrester.
3. Remove the defective fuse. Use an LV/HRC fuse extractor.
4. Insert the replacement fuse. Use an LV/HRC fuse extractor.
5. Mount the alarm contact of the DC surge arrester.
6. Close the hatches (see Section 12.2, page 202).

### 10.3.2.10 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 the inverter is disconnected from all voltage sources.
3. Open the hatch on the DC side of the inverter (see Section 12.2, page 202).
4. Loosen the screws of the defective DC fuse.
5. Remove the DC fuse from the inverter.

If it is not possible to remove the DC fuse, remove the screws from the connection busbars and then the DC fuse.

6. Insert the new DC fuse into the inverter (see Section 6.5.5, page 100).
7. Close the hatch on the DC side of the inverter (see Section 12.2, page 202).

### 10.3.3 Maintenance Work on the Medium-Voltage Transformer

#### 10.3.3.1 Checking Oil Level on Hermetic Protection Device

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Check the oil level of the MV transformer on the oil level indicator of the hermetic protection device. The float of the oil level indicator must be at the upper stop.

If the float is not at the upper stop, contact us (see Section 17, page 294).

#### 10.3.3.2 Checking the Cooling Surfaces for Dirt and Damages

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Clean the cooling surfaces of the MV transformer.
3. Check the cooling surfaces of the MV transformer for damages.

If the cooling surfaces are damaged, contact us (see Section 17, page 294).

#### 10.3.3.3 Checking Maintenance Seal and Security Seals for Damage

There are maintenance seals and security seals on the MV Power Station. These maintenance seals and security seals ensure that unauthorized access to the MV Power Station parts can be recognized.

#### **Procedure:**

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Check the security seals on the oil filler neck and oil drain valve.
3. Check the maintenance seals on the hermetic protection device.
4. If the maintenance seals or security seals are damaged, contact us (see Section 17, page 294).

### 10.3.3.4 Checking Low-Voltage and Medium-Voltage Cable Entries for Discolorations and Damages

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Check low-voltage and medium-voltage cable entries for discolorations and damages. If the cable entries are discolored or damaged, contact us (see Section 17, page 294).

### 10.3.3.5 Checking Electrical Connections for Dirt and Signs of Electric Arcs

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Check electrical connections for dirt. Remove dirt (if necessary).
3. Check electrical connections for signs of electric arcs. If the electrical connections show any discolorations, deformations or scorch marks, contact us (see Section 17, page 294).

### 10.3.3.6 Checking the Torque of Grounding Connections

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Check the torque of the grounding connections on the MV transformer (60 Nm) and retighten the bolted grounding connection if necessary.

### 10.3.3.7 Checking the Function of the Control Elements of the Hermetic Full-Protection Device

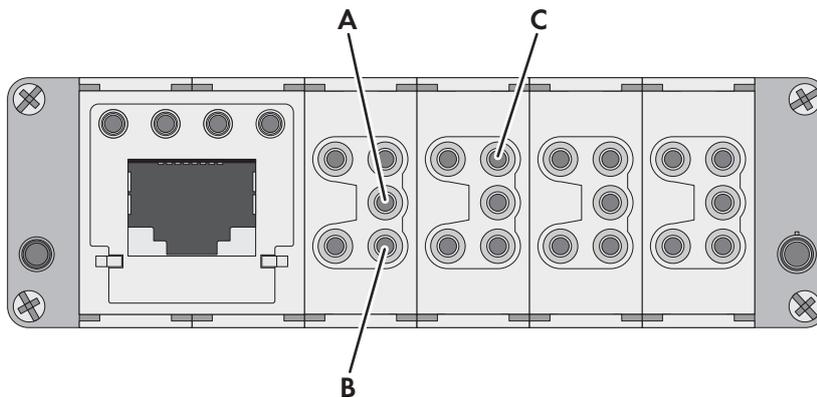


Figure 91: Terminal assignment of the transformer protection plug on the MV transformer side

Position	Reference designation	Designation at the plug	Description
A	-X4:3	Module insert 4: Connection designation: 3	Output: 24 V voltage supply
B	-X4:5	Module insert 4: Connection designation: 5	Input: Oil level or fill level
C	-X3:2	Module insert 3: Connection designation: 2	Input: GND for analog temperature monitoring

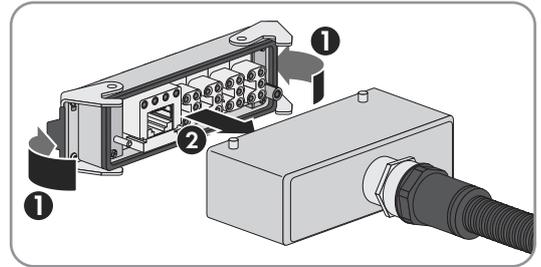
## Maintenance Work in Disconnected State

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

- Magnet to move the float ball in the oil level indicator

#### Procedure:

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Check functional capability of the oil-level monitoring system:
  - Open the brackets on the transformer protection plug. Then, remove the plug.



- Ensure through measurement on the transformer protection plug between the terminals **X4:3** and **X4:5** that the contact is closed.
- Pull the float of the oil level indicator down with a magnet.
- Measure on the transformer protection plug between the terminals **X4:3** and **X4:5** whether the contact is open. When the contact is closed, the function of the oil-level monitoring system is not ensured. Please contact us (see Section 17, page 294).

### 10.3.3.8 Checking the function of the tap changer

1. Ensure that the MV transformer and the inverters are disconnected from all voltage sources (see Section 7, page 129).
2. Make a note of the tap changer starting value.
3. Switch the MV transformer tap changer using at least 10 switching cycles across the entire voltage range. This will prevent oil and carbon deposits from accumulating on the tap changer contacts.
4. Reset the tap changer to the starting value (noted value).

## 10.3.4 Maintenance Work on the MV Switchgear

### 10.3.4.1 Checking the MV Switchgear's Level of Gas

The level of SF<sub>6</sub> gas must be checked before performing any switching operation.

#### Procedure:

- Check the MV switchgear's level of gas on the manometer.  
If the level of SF<sub>6</sub> gas is too low, contact us (see Section 17, page 294).

### 10.3.4.2 Checking the Internal Arc Pressure Relief

1. Ensure that the MV Power Station is disconnected (see Section 7, page 129).
2. Ensure that there are no objects behind the medium-voltage compartment which endanger operational safety in case of arc faults and prevent arc-flash diversion.
3. Ensure that the hatch in front of the electric-arc opening is undamaged.

### 10.3.4.3 Checking Electrical Connections

1. Ensure that the MV Power Station is disconnected (see Section 7, page 129).
2. Remove the MV switchgear covering plates in front of the cable panels and the transformer panel.

3. Ensure that the cable connections are securely in place. Retighten the connections (if necessary).
4. Ensure that the strain reliefs are securely in place. Retighten the strain reliefs (if necessary). Replace the strain reliefs if they are too small or too large.
5. Check electrical connections for dirt. Remove dirt (if necessary).
6. Check electrical connections for signs of electric arcs. If the electrical connections show any discolorations, deformations or scorch marks, contact us (see Section 17, page 294).

#### 10.3.4.4 Checking Grounding Connections

1. Ensure that the MV Power Station is disconnected (see Section 7, page 129).
2. Make sure that the grounding contacts on the grounding busbar inside the medium-voltage compartment are securely in place and show no discoloration or corrosion. Retighten the grounding contacts (if necessary). If the grounding contacts are discolored or corroded, contact us (see Section 17, page 294).

#### 10.3.4.5 Checking Functionality of the Circuit Breaker

1. Ensure that the MV Power Station is disconnected (see Section 7, page 129).
2. Check the functional capability of the circuit breaker of the MV switchgear by performing 1 to 2 switching cycles. If the circuit breakers do not function correctly, contact us (see Section 17, page 294).

#### 10.3.4.6 Checking the Alignment of the Switch Position Indicators

##### **i** Connecting and disconnecting medium voltage

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

##### Procedure:

1. Check the function of the lock. To do so, ensure that in the connected state, no control levers can be plugged into the grounding.
2. Switch the individual connection points of the MV switchgear in the specified order. Check thereby the display of the switch position before and after each switching operation.
  - The display of the switch position corresponds with the current switch position.
  - Does the display of the switch position not correspond with the current switch position?  
The MV switchgear is defective.
    - Please contact (see Section 17, page 294).

#### 10.3.5 Completing Maintenance Work

##### Requirements:

- All maintenance work must be completed.

##### Procedure:

1. Ensure that the MV Power Station is disconnected (see Section 7, page 129).
2. Close the inspection lid of the low-voltage connection between inverter and MV transformer. To do this, use a square key.
3. Close all inverter lids (see Section 12.2, page 202).
4. Mount the MV switchgear covering plates in front of the cable panels and the transformer panel.
5. Insert the transformer protection plug into the inverter and lay down the bracket attached to the plug.

## 11 Disposal

### 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.

#### **Proper disposal**

A MV Power Station which has come to the end of their service life constitute electronic waste. Electronic waste contains on the one hand valuable materials (e.g. copper, aluminum or steel) which can be recycled as secondary raw materials, and on the other, substances which are hazardous to the environment (e.g. oil or SF<sub>6</sub> gas). Contact your local commercial disposal services for information on optimum material utilization and environmentally friendly disposal.

Prior to transporting the MV Power Station, the MV transformer and the inverters must be removed from the station to prevent possible damages due to an instable frame construction.

For further information on disposal and recycling, refer to the respective documentation of the individual devices. For example, once its useful life has expired, the SF<sub>6</sub> gas used in MV switchgears can be extracted completely and then sent for recycling.

We can support you (see Section 17, page 294) in implementing the measures necessary for the disposal and recycling of the system.

## 12 Periodic Actions

### 12.1 Opening and Closing the Doors of the Station Container

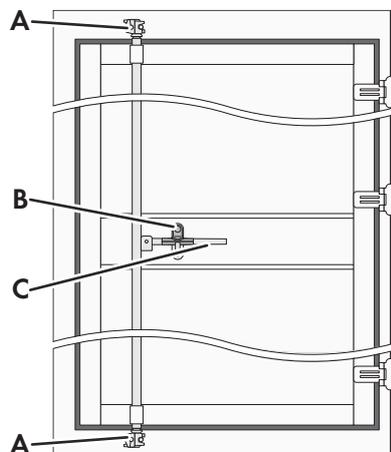


Figure 92: Elements of the station container doors

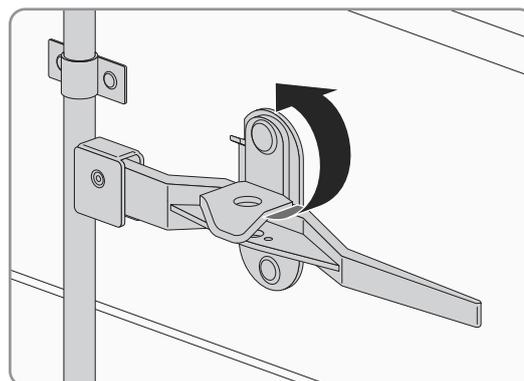
Position	Designation
A	Locking mechanism
B	Sealing mechanism
C	Door handle

#### Unlocking the doors of the station container

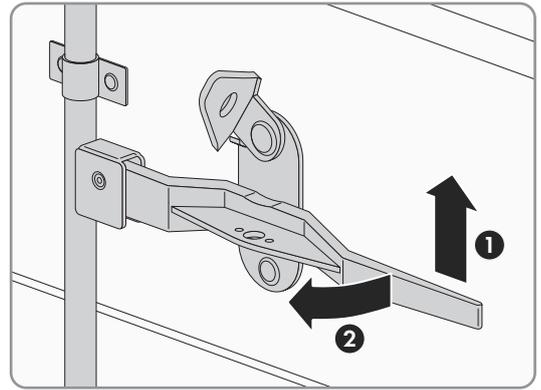
To access the MV switchgear and the low-voltage compartment and to perform maintenance work, you must unlock and open the doors of the station container.

##### Procedure:

1. Release the two sealing mechanisms on the door handles. Turn the sealing mechanisms counterclockwise.



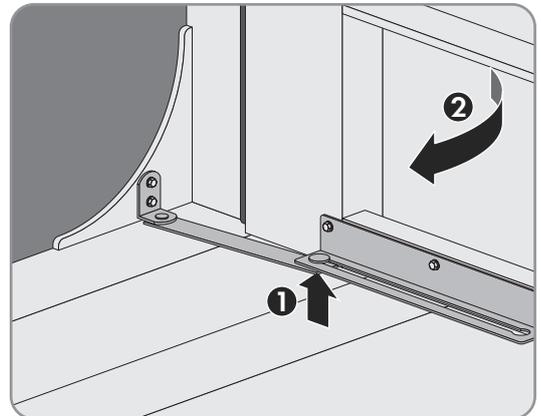
- Pull the door handles up and out.



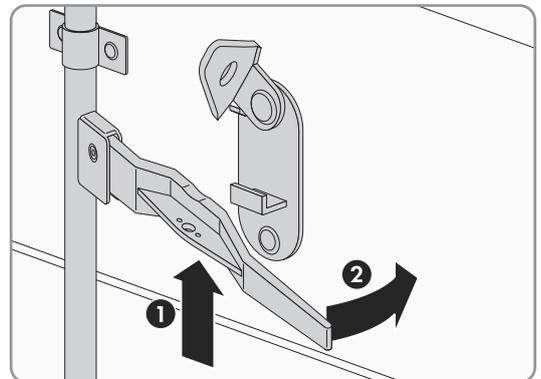
- Open the doors. The locking mechanism automatically secures the doors against closing.

### Locking the doors of the station container

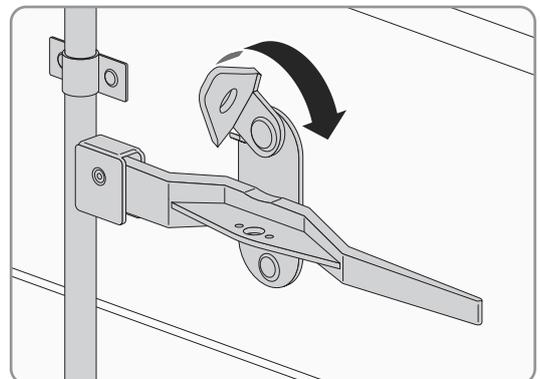
- Release and close the locking mechanism of the doors.



- Push the door handles in towards the door and press down.



- Lock the two sealing mechanisms on the door handles. Turn the sealing mechanisms clockwise.



- Make sure that the locking mechanisms are correctly engaged at the top and bottom.

## 12.2 Opening and Closing the Hatches

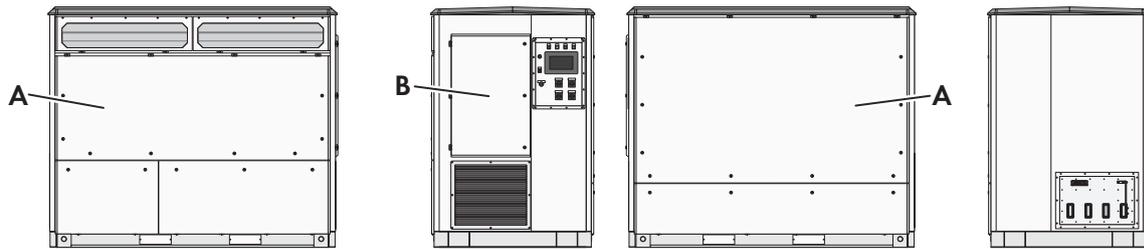


Figure 93: Overview of the hatches

Position	Designation
A	Hatch with gas springs
B	Door

### **⚠ 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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- 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 inverter, 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.

**Opening the Hatches**

- Open the hatch locks and the doors with a square key wrench. Push gently against the hatch and note that the hatches are automatically pushed upwards by the gas springs.

**Closing the Hatches**

1. Press the hatch down.
2. Close the locks of the hatches and the door with a square key wrench. Lightly press against the hatch or door.

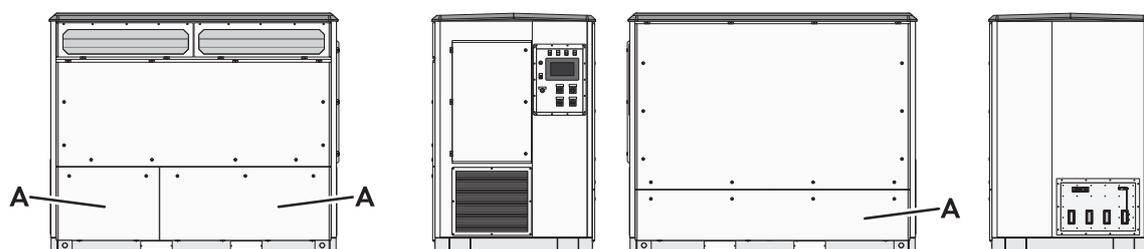
**12.3 Mounting and Disassembly Work****12.3.1 Mounting and Disassembly Work in the Inverter****12.3.1.1 Disassembling and Mounting the Panels**

Figure 94: 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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- 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 inverter, 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 inverter via the grounding conductor. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Take care 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.

### 12.3.1.2 Disassembling and Mounting Cover in Front of the Sine-Wave Filter Capacitors

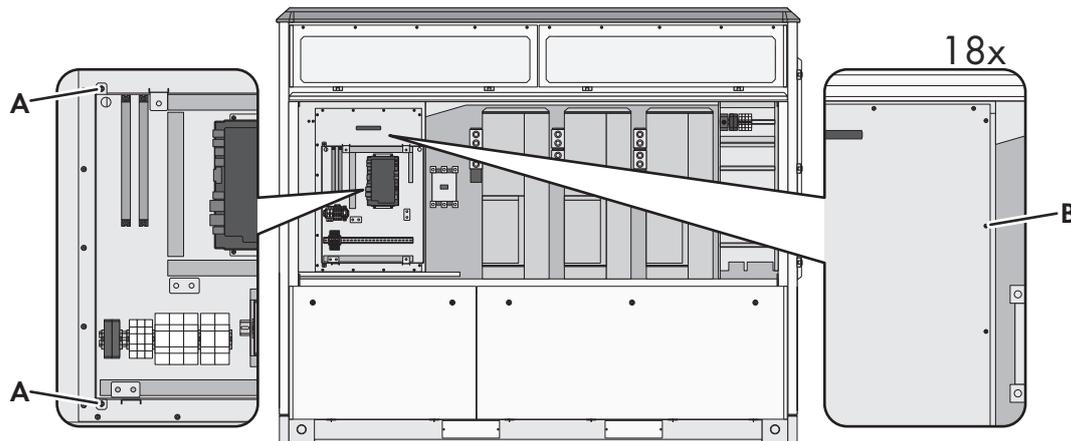


Figure 95: Position of the screw connections of the mounting plate and cover in front of the sine-wave filter capacitors

Position	Designation
A	Fastening points of the mounting plate
B	Bolting points of the cover

#### **⚠ 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.

- Observe the safety information when disconnecting and reconnecting voltage sources (see Section 7.1, page 129).
- Ensure that the inverter is disconnected from the power transmission path on the AC side (see Section 7.3.2, page 134).
- After switching off the inverter, wait at least 15 minutes before opening the inverter to allow the capacitors to discharge completely.

#### **⚠ 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 inverter, 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 12.2, page 202).
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 12.2, page 202).

**12.3.2 Mounting and Disassembly Work in the MV Switchgear****12.3.2.1 Disassembling and Mounting the Kick Plate of the MV Switchgear****Disassembling the kick plate**

1. Loosen all screws of the kick plate.
2. Carefully pull the kick plate forwards by 80 mm to 100 mm.
3. Loosen the grounding strap from the kick plate.
4. Remove the kick plate.

**Mounting the kick plate**

1. Position the kick plate.

2. Tighten the grounding strap on the panel (torque: 14 Nm).
3. Check that the grounding strap is securely attached.
4. Attach the kick plate with the previously removed screws.

## 12.4 Clamp Connections

### 12.4.1 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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- 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 inverter, 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 inverter. This prevents contamination in the inverter.
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.
  - Insert the screwdriver into the square-shaped opening of the terminal block. This will release the opening for the insulated conductors.
5. Pull the screwdriver out of the terminal block.
6. Ensure that the cable is securely in place.

**12.4.2 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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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.
- Observe all safety information on components associated with the product.
- The product must not be operated with open covers or doors.
- The low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- The product must be operated with the protective roofs of the transformer compartment open.

**⚠ 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 inverter, 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:**

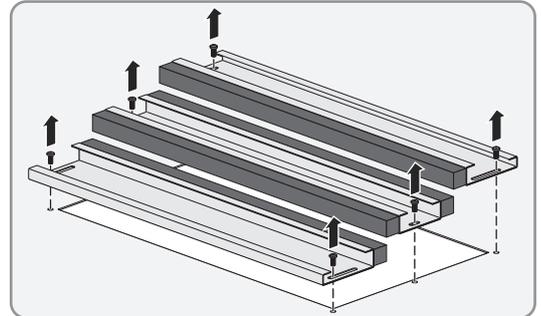
1. Ensure that no voltage is present.
2. Dismantle the cable outside the inverter. This prevents contamination in the inverter.
3. Strip the insulation of the insulated conductors. Insulation stripping length: 8 mm to 9 mm.
4. Connect the cable in accordance with the circuit diagram.
  - Remove the female connector from the terminal block.
  - Insert the screwdriver into the square-shaped opening of the female connector. This will release the opening for the insulated conductors of the female connector.
  - Insert the insulated conductors of the cable into the female connector in accordance with the circuit diagram.
  - Pull the screwdriver out of the female connector.
5. Ensure that the cable is securely in place.

## 12.5 Cable Entry

### 12.5.1 Inserting the Cables through the Base Plates

#### 12.5.1.1 Inserting Cables through the Base Plates of the Inverters

1. Cut the cables to the required length. Allow for some reserve.
2. Unscrew and remove all parts of the base plate underneath the connection area of the inverter. This will give you enough room for inserting the cables.



3. Lead all cables for the connection in the inverter through the opening. Make sure that the data cables are routed separately from the power cables.
4. Connect the cables and remount all parts of the base plate (see Section 6.11.2, page 126).

#### 12.5.1.2 Inserting Cables through the Base Plates of the MV Switchgear

##### Requirements:

- The doors must be open .
- The kick plates of the MV switchgear must be dismantled.

##### Procedure:

1. Cut the cables to the required length. Allow for some reserve.
2. Lead the cables into the MV switchgear.

#### 12.5.2 Insert the cable into the inverter.

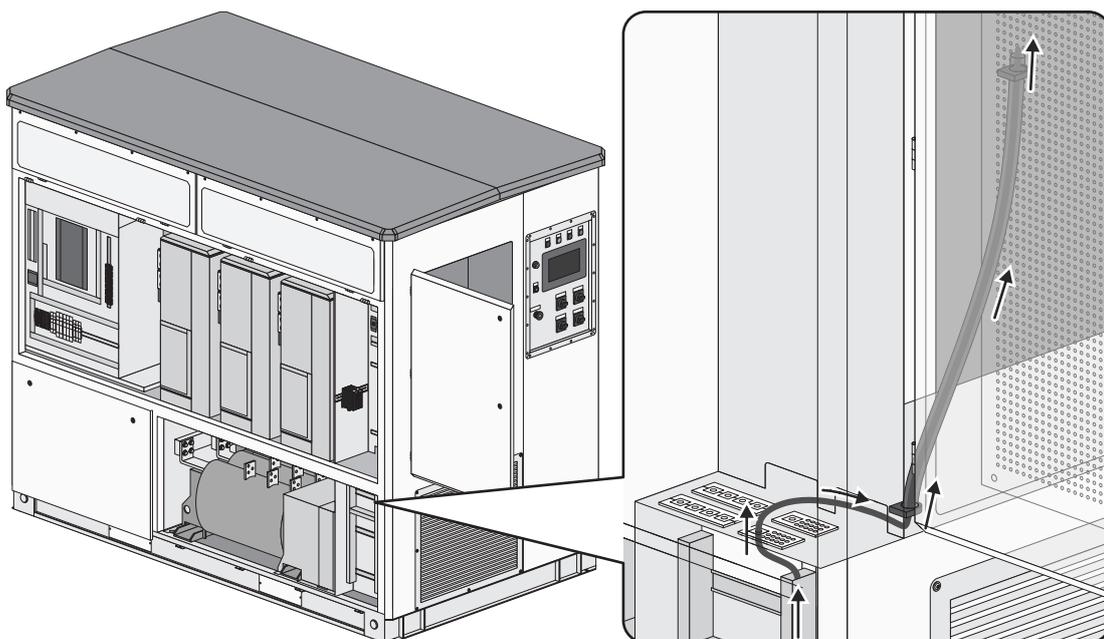


Figure 96: Cable route from the base to the customer installation location

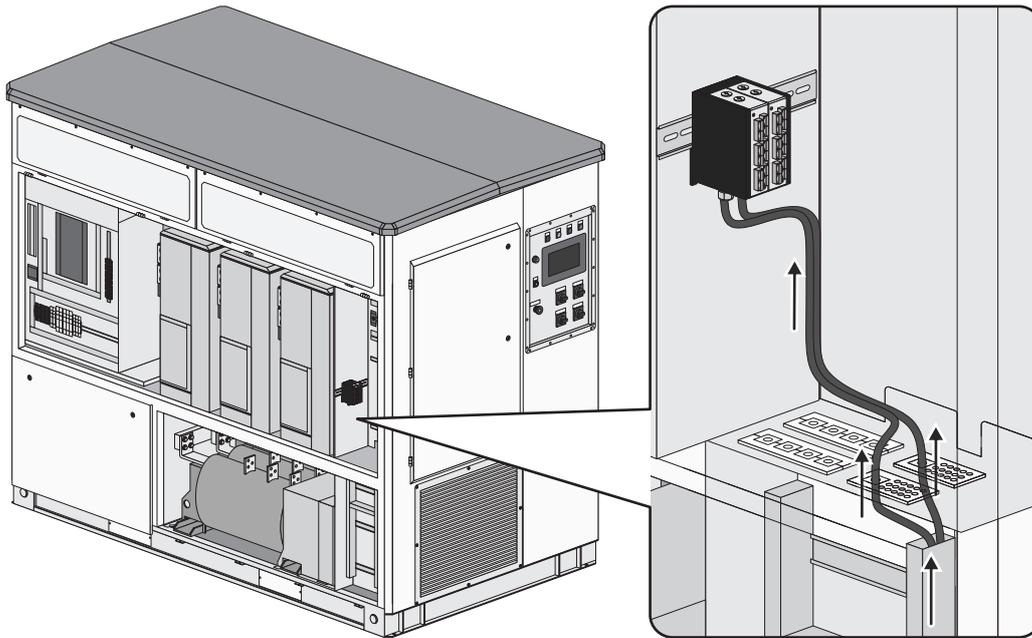


Figure 97: Cable route from the base to the splice box

**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 product from the power transmission path and from the control path if no voltage is required for working on the product and the connected components.
- After switching off the inverter, wait at least 15 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 low-voltage and medium-voltage compartments may only be accessed by authorized personnel.
- 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 inverter, 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 inverter via the grounding conductor. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Take care not to damage the grounding conductors during disassembly.

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

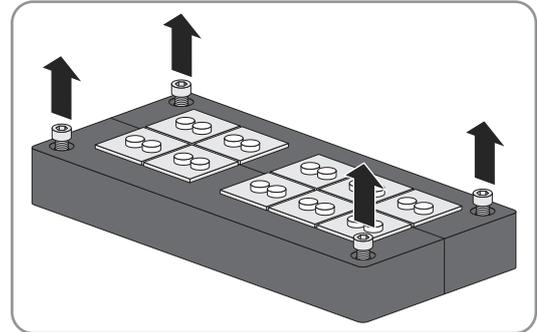
Excessive bending or kinking will drop below of the permissible bend radii. When dropping below the permissible bend radii, the optical fibers may be damaged.

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

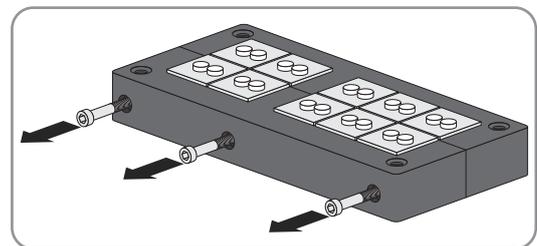
**Procedure:**

1. Ensure that no voltage is present.

2. Disassemble the panels (see Section 12.3.1.1, page 203).
3. Open the hatches (see Section 12.2, page 202).
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:
  - Lead the cables through the opening to the door.
  - Lead the cables through the conduit to the customer installation location.
18. For cables to the splice box:
  - Loosen the two outer screws on 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 previously removed nut.
  - Lead the cables to the splice box.
  - Lead the cable gland over the cable.
  - Lead the cable through the cable gland into the splice box.
  - Tighten the cable gland.

19. Seal the enclosure opening used with proper material to comply with the degree of protection IP65.
20. Mount the panels (see Section 12.3.1.1, page 203).
21. Close the hatches (see Section 12.2, page 202).

## 12.6 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 touch display, you are always logged in as **User**.



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. Tip: 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 confirmed by pressing the enter key, a message might appear indicating that the connection to the user interface of the inverter is not secure. SMA Solar Technology AG guarantees that calling up the user interface is secure.
  - Continue loading the user interface.
3.  Select your login role from the drop-down list in the field **Login**.  
 If you want to log in as installer, select the field **Login** in the user info line and select **Installer** from the drop-down list.
4. Enter the password in the field **Password**.
5. Select [**Login**].

## 12.7 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.

## 12.8 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.

## 12.9 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.

## 13 Function Description

### 13.1 Operating States of the Inverter

#### 13.1.1 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**.

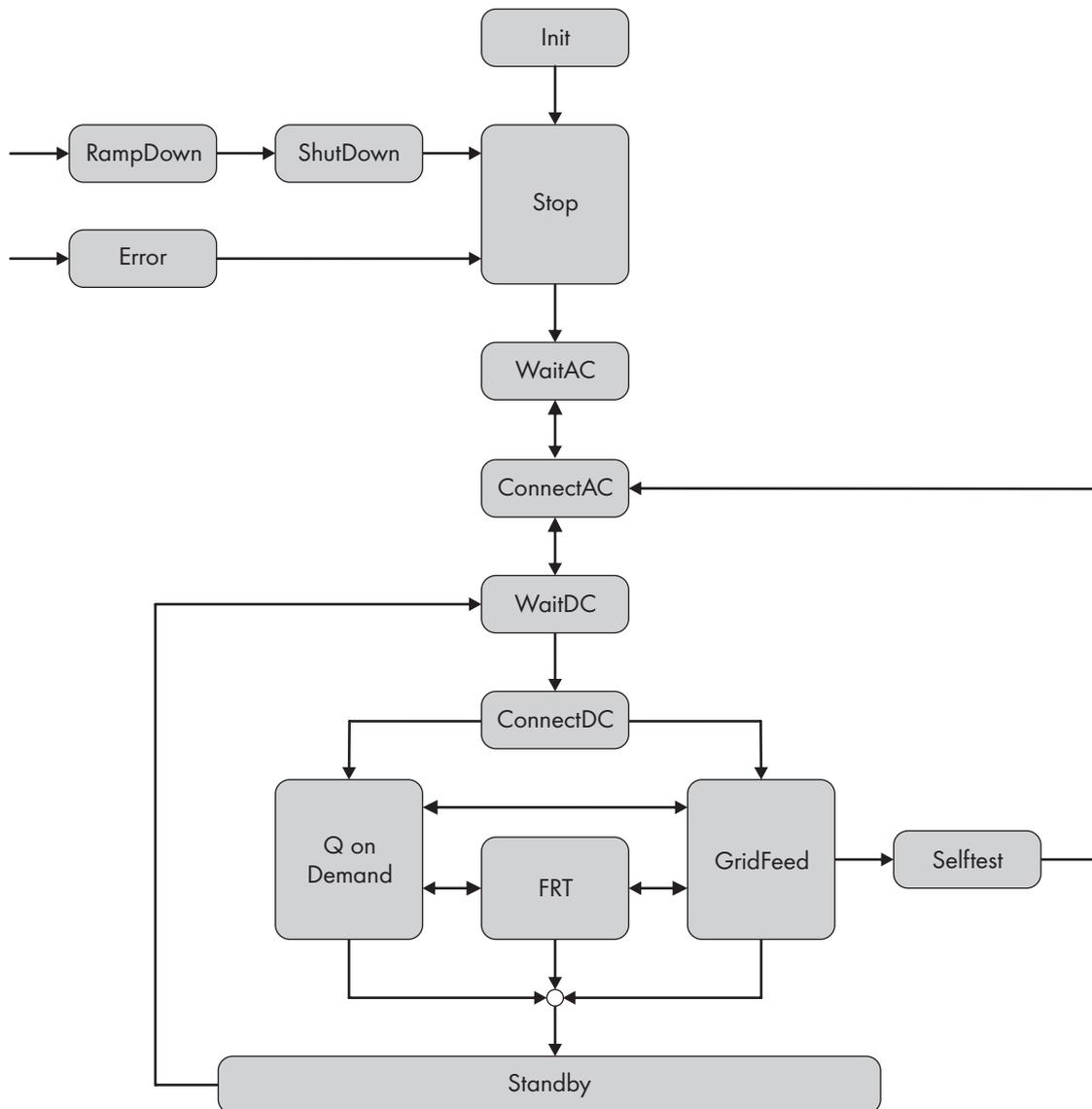


Figure 98: General overview of the operating states of the inverter

The overview shows the names of the operating states as they appear on the user interface.

#### 13.1.2 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 switches to the operating state "WaitAC".

#### 13.1.3 Init

The inverter is prepared for operation and the functioning of all components is tested.

## 13.1.4 Starting the Inverter from the AC Grid

### 13.1.4.1 WaitAC

In the operating state "WaitAC", the inverter monitors the grid limits for the time defined in the parameter **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.

### 13.1.4.2 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.

### 13.1.4.3 WaitDC

In the operating state "WaitDC", the inverter monitors the applied input voltage  $U_{PV}$  and compares it with the DC voltage necessary for operation. When the input voltage exceeds the required DC voltage, the inverter switches to the operating state "ConnectDC".

### 13.1.4.4 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. In "Q on Demand" operation, the inverter starts feeding in reactive power when there is no PV power available (e.g. at night).

## 13.1.5 GridFeed

In the operating state "GridFeed", the inverter feeds in active power and reactive power in accordance with the requirements. The inverter operates permanently at the Maximum Power Point (MPP). The current feed-in values can be read off from the user interface.

If the AC power generated by the inverter falls below the minimum feed-in power of 2 kW, the inverter switches to the operating state "Standby". Inverters with the order option "Q on Demand" switch to the operating state "Q on Demand".

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".

## 13.1.6 Q on Demand

With the order option "Q on Demand", the inverter can provide reactive power in order to stabilize the utility grid during non-feed-in operation, e.g. at night, or to compensate for reactive power in the PV power plant. 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 AC power generated by the inverter falls below 2 kW, the inverter switches from feed-in operation to "Q on Demand" operation. The inverter feeds in reactive power in accordance with the parameter settings. Since this status can also occur during the day, the DC switchgear remains closed at first in order to avoid unnecessary switching cycles of the DC switchgear. If the inverter is in "Q on Demand" operation for one hour or no active power is fed in, the DC switchgear opens. The inverter continues to feed in reactive power.

While the inverter is feeding in reactive power, the inverter monitors whether the conditions for active power feed-in are met. Once the feed-in requirements are met, the inverter closes the DC switchgear and switches to the operating state "GridFeed". By default, the amount of AC active current is set to -140 A to protect the PV array.

### 13.1.7 Standby

When the measured inverter power is below the minimum feed-in power of 2 kW and the inverter should not change to "Q on Demand" operation, the inverter interrupts the grid feed-in. The AC disconnection unit and the DC switchgear remain closed.

Depending on the configuration of the inverter, the inverter remains in this state or it switches via the "ConnectAC" operating state to the "WaitDC" operating state after a while. When switching to the "ConnectAC" operating state, the inverter opens the DC switchgear.

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
<b>Standby without capacitor</b>	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.
<b>Standby with capacitor</b>	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 fewer switch cycles.

### 13.1.8 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".

### 13.1.9 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".

### 13.1.10 Error

If an error has occurred in the inverter or the MV 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".

### 13.1.11 Selftest

To guarantee the safety of the inverter, the inverter cycles through a diagnostic test periodically. In this test, the AC-side safety devices are checked to ensure that they function correctly.

The diagnostic test is initiated if either the voltage supply to the inverter has been interrupted or if a time period of 3 weeks has elapsed.

The diagnostic test is performed at a reduced feed-in power and takes approximately 15 seconds.

### 13.1.12 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.
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.

## 13.2 Safety Functions of the Inverter

### 13.2.1 Manual Shutdown Functions

#### 13.2.1.1 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.			
Parameter	The inverter can be switched to the operating state "Standby" via the parameter <b>RemRdy</b> . 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 <b>InvOpMod</b> . When this happens, the AC disconnection unit and the DC switchgear 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.			
	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.			

### 13.2.1.2 Mode of Operation of the External Fast Stop

The inverter comes equipped with a fast stop input at terminal **-X440:1.3**.

The optional safety devices of the MV Power Station such as the fast-stop switch and heat detector are to be integrated with the external fast stop of the inverter.

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 should only be tripped in case of imminent 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.

### 13.2.1.3 Mode of Operation of the External Standby

The inverter comes equipped 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 is tripped, 24 V is present at terminal **-X440:5.7** and the inverter switches from the current operating state to the operating state "Standby".

## 13.2.2 Automatic Shutdown Functions

### 13.2.2.1 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.

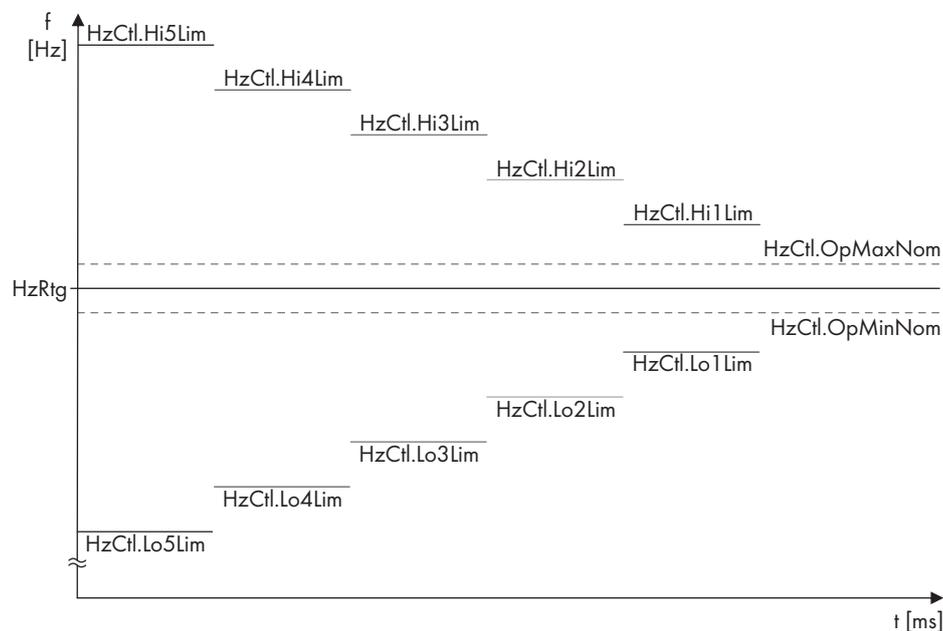


Figure 99: Monitoring of the power frequency

Parameter	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*
HzCtl.Hi#LimTm	Time lapse for the second to fifth threshold for overfrequency	10000 ms*
HzCtl.Lo1Lim	First threshold for underfrequency	49.00 Hz

Parameter	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*
HzCtl.Lo#LimTm	Time lapse for the second to fifth threshold for underfrequency	10000 ms*

\* In this parameterization, the thresholds are deactivated.

### 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.

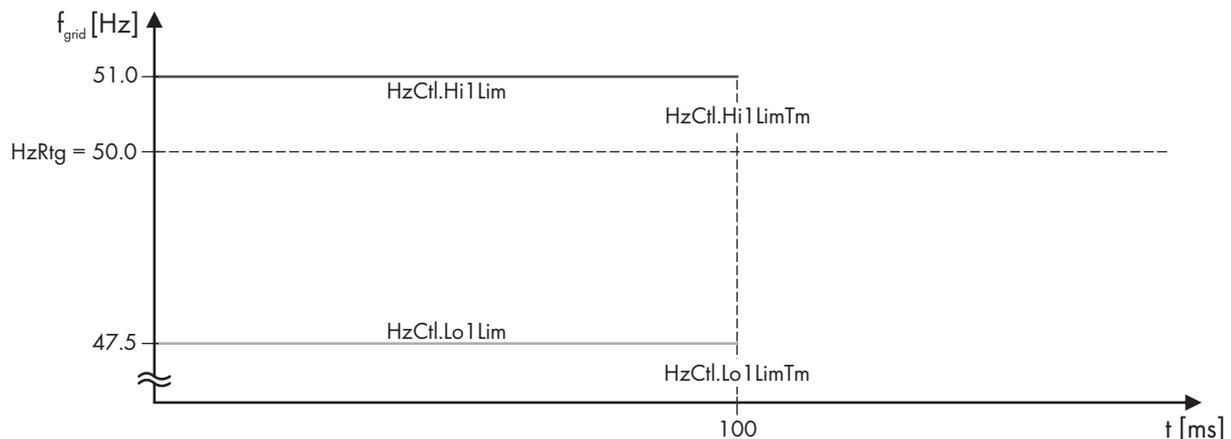


Figure 100: Parameters for monitoring the power frequency in accordance with BDEW

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

#### 13.2.2.2 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.

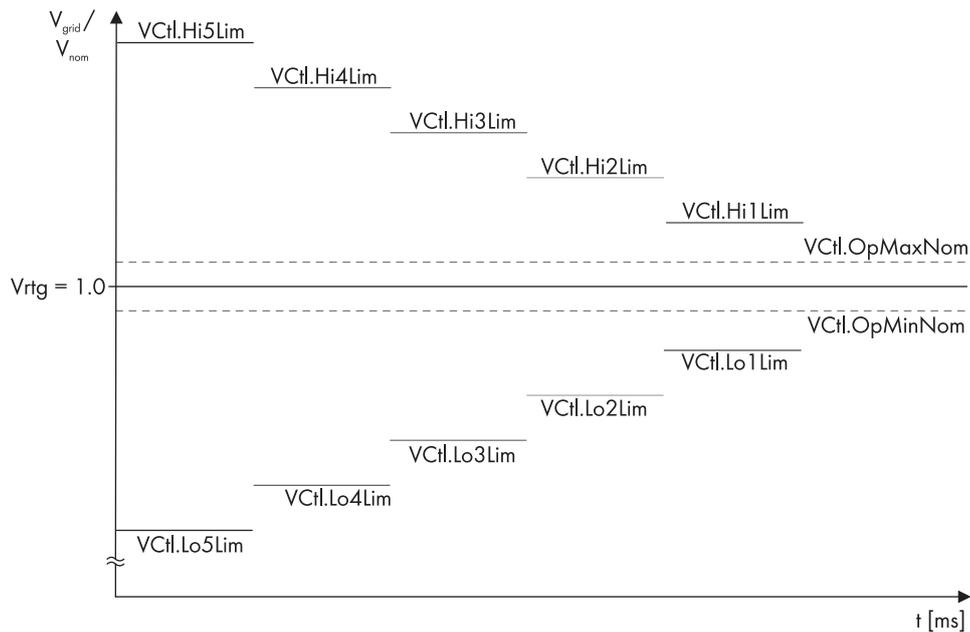


Figure 101: Monitoring of the grid voltage

Parameter	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.

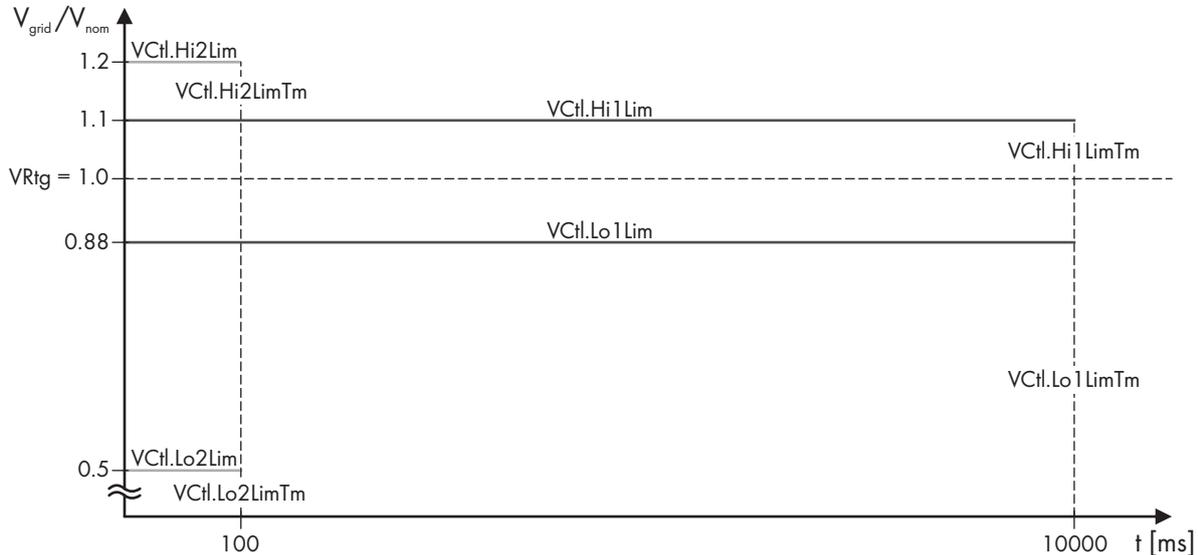


Figure 102: Parameters for monitoring the grid voltage in accordance with BDEW

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

#### 13.2.2.3 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 17 "Contact", page 294).

#### 13.2.2.4 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.

#### 13.2.2.5 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.

#### 13.2.2.6 Low-Temperature Shutdown

The interior temperature and the intake temperature in the inverters are monitored in order that the inverter can be disconnected in the event of temperatures leaving the operating temperature range of the inverter.

##### **Inverter with temperature range $-25^{\circ}\text{C}$ to $+55^{\circ}\text{C}$**

If the intake temperature falls below  $-25^{\circ}\text{C}$ , the inverter switches to the operating state "Stop" in order to protect the electronic components. As soon as the intake temperature increases to  $-20^{\circ}\text{C}$ , the inverter resumes feed-in operation.

#### 13.2.2.7 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:  $120^{\circ}\text{C}$ . The temperature at the AC connection busbars is continuously monitored.

If the required torque has not been complied with for the power connection between the inverter and MV transformer, the AC connection busbars may overheat. At an AC connection busbar temperature of  $125^{\circ}\text{C}$ , the inverter switches off to protect itself and the fault **6518** is displayed. To remedy this fault, the correct torque must be ensured on the AC connection busbars.

#### 13.2.2.8 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.

### 13.2.2.9 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.

#### MV Power Station 4400

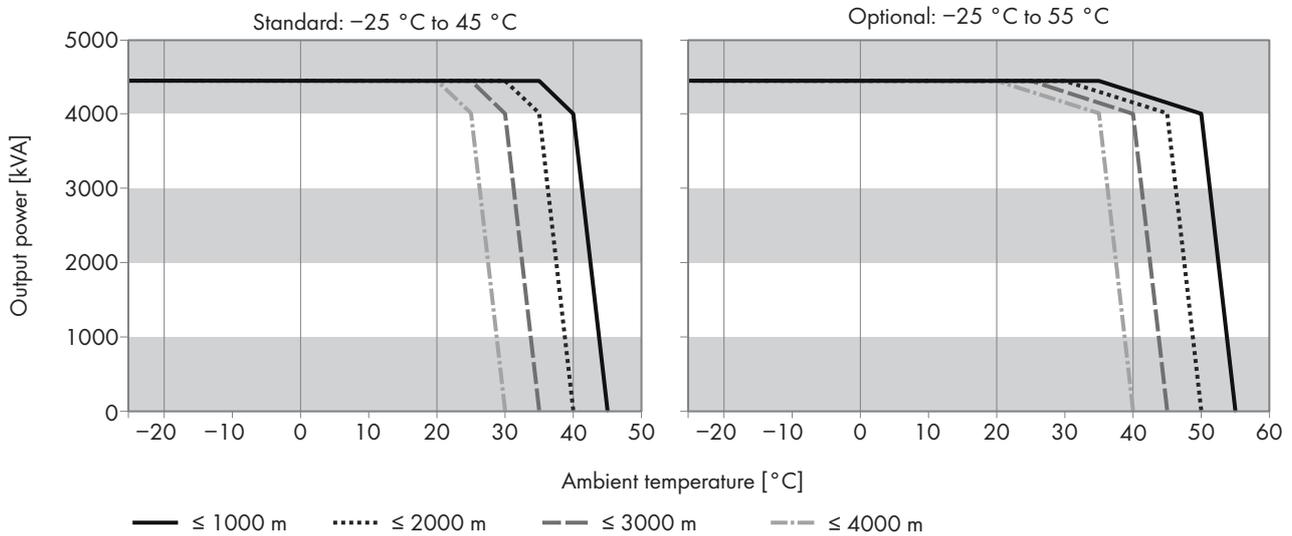


Figure 103: Dependency of the feed-in power on altitude of installation and temperature for MV Power Station 4400

#### MV Power Station 4950

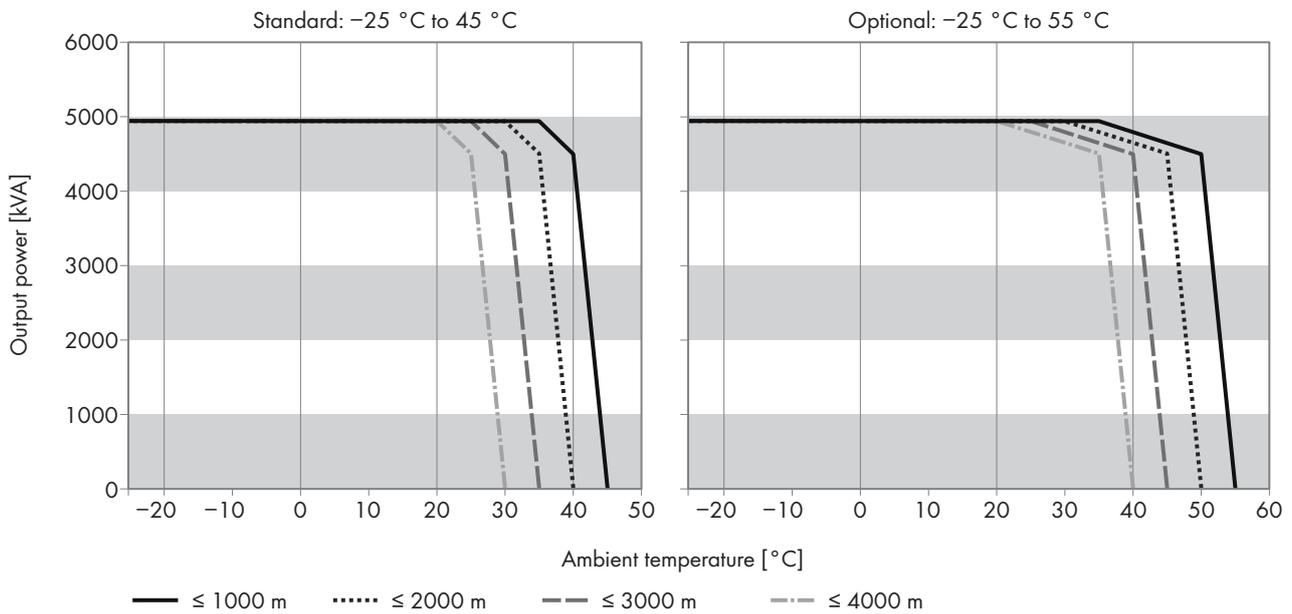


Figure 104: Dependency of the feed-in power on altitude of installation and temperature for MV Power Station 4950

**MV Power Station 5000**

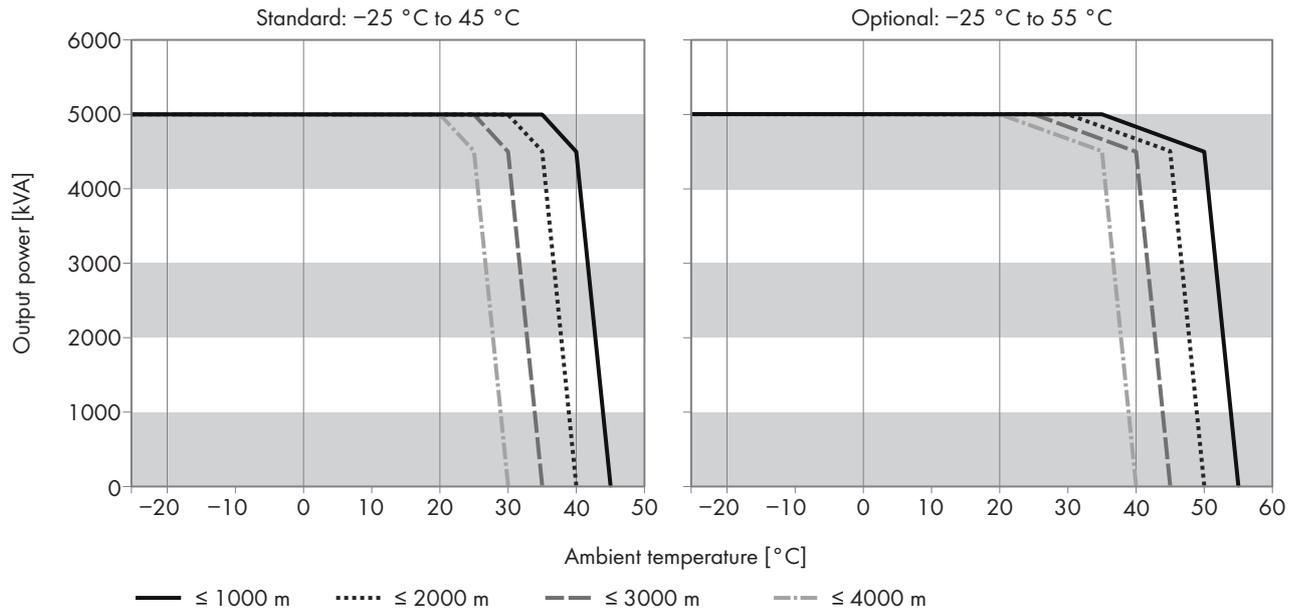


Figure 105: Dependency of the feed-in power on altitude of installation and temperature for MV Power Station 5000

**MV Power Station 5500**

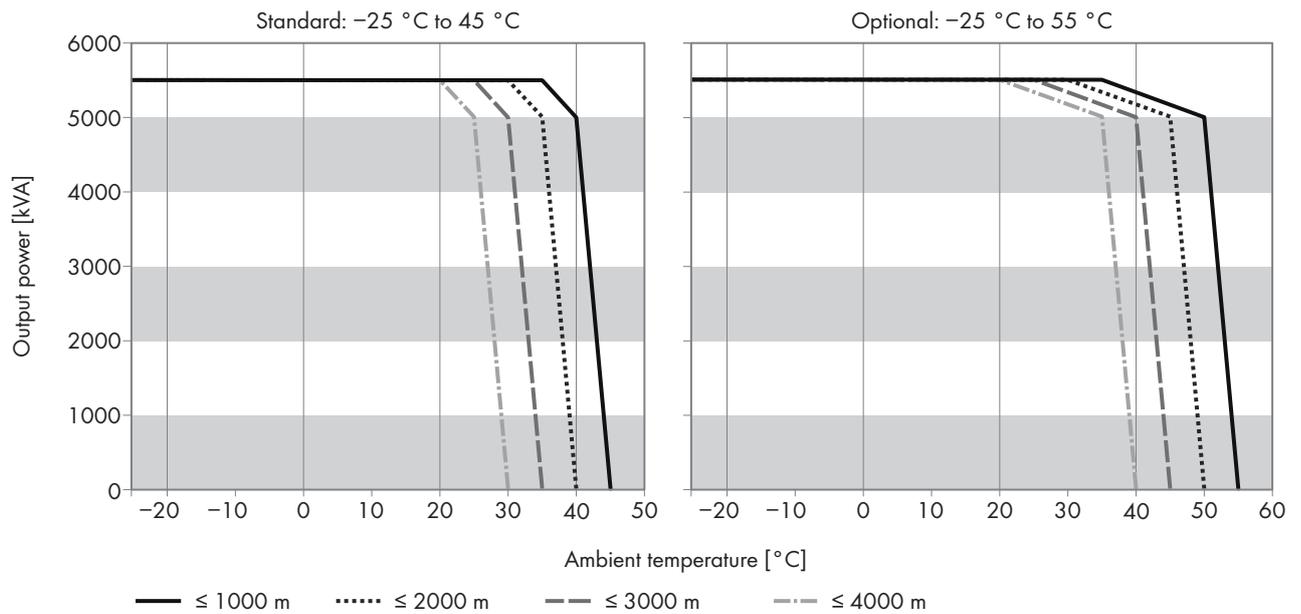


Figure 106: Dependency of the feed-in power on altitude of installation and temperature for MV Power Station 5500

## MV Power Station 6000

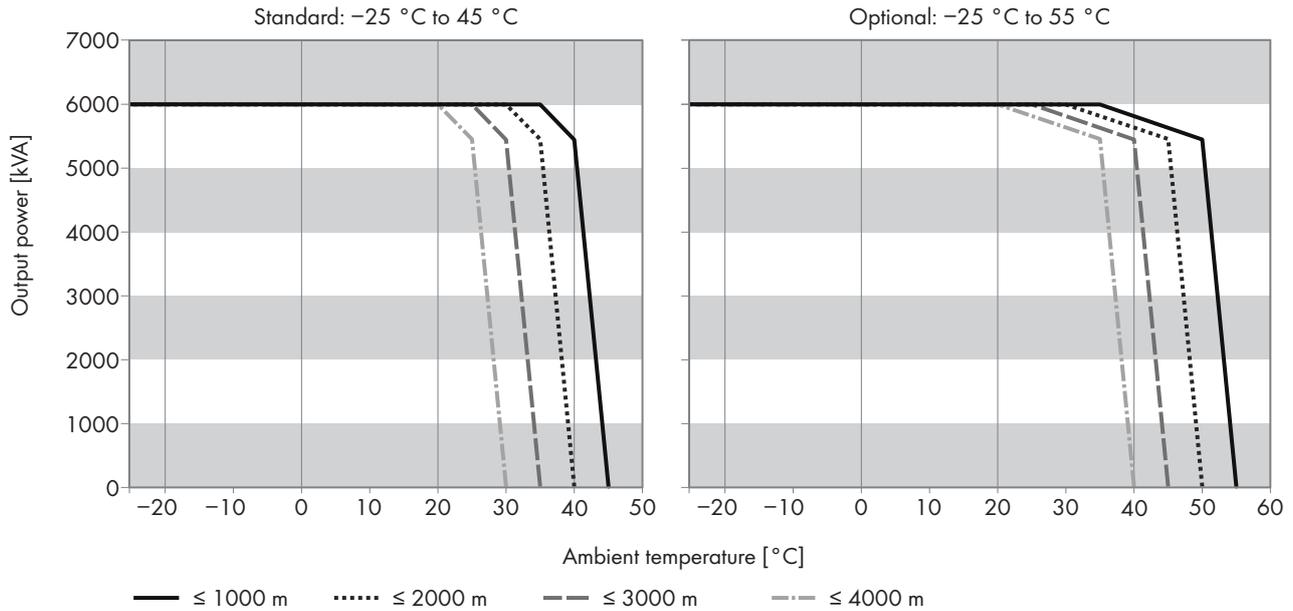


Figure 107: Dependency of the feed-in power on altitude of installation and temperature for MV Power Station 6000

## 13.2.3 Ground-Fault Monitoring and Insulation Monitoring

### 13.2.3.1 Mode of Operation

#### In grounded PV arrays

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 terminal of the PV array, the normally ungrounded terminal of the PV array is grounded non-specifically by the ground fault and a residual current flows to the grounded terminal. This residual current flows through the ground-fault monitoring device, e.g. the GFDI, and triggers it.

- **Ground fault on the grounded terminal**

The GFDI is bypassed when a ground fault occurs on the grounded terminal of the PV array. 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.

#### **i** Residual current monitoring in grounded systems

In order to ensure the residual current monitoring function in grounded systems, the PV array 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 PV power plant operator must determine whether these standards apply to the PV power plant and whether an additional insulation monitoring device is necessary.
- Regardless of whether an insulation measurement is necessary in accordance with the standards, SMA Solar Technology AG recommends always using an additional insulation monitoring device for grounded systems.

### In ungrounded PV arrays

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.

#### 13.2.3.2 GFDI

Depending on the order option, ground-fault monitoring in the inverter may be carried out via ground fault detection and interruption (GFDI). This grounds one terminal of the PV array. If a residual current is detected that is too high, the GFDI triggers and interrupts the feed-in operation of the inverter and a disturbance is displayed on the inverter. Once the error has been remedied, the GFDI must be switched back on manually.

GFDI is performed via a K-type circuit breaker with an operating current of 5° A. The GFDI is integrated in the inverter and connected between an input busbar and the grounding busbar.

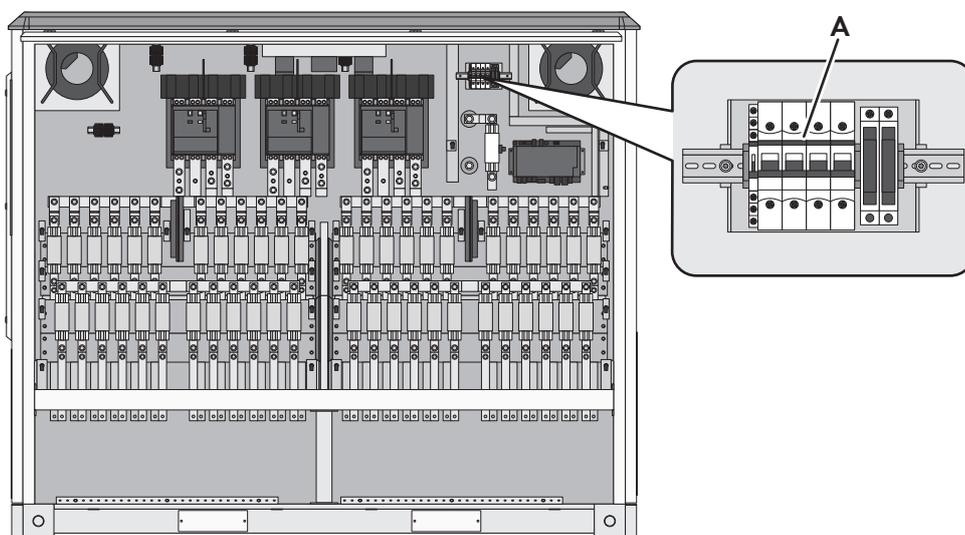


Figure 108: Position of the GFDI

Position	Designation
A	GFDI

#### 13.2.3.3 Remote GFDI

Depending on the order option, ground fault monitoring in the inverter may be carried out via ground fault detection and interruption with motor drive, in short "Remote GFDI". This grounds one terminal of the PV array. Remote GFDI also enables automatic error processing. This reduces downtimes and avoids service calls due to temporary insulation errors such as when condensation occurs on the PV modules. Remote GFDI is performed via a high-performance K-type circuit breaker with an operating current of 5 A. The remote GFDI is integrated in the inverter and connected between an input busbar and the grounding busbar.

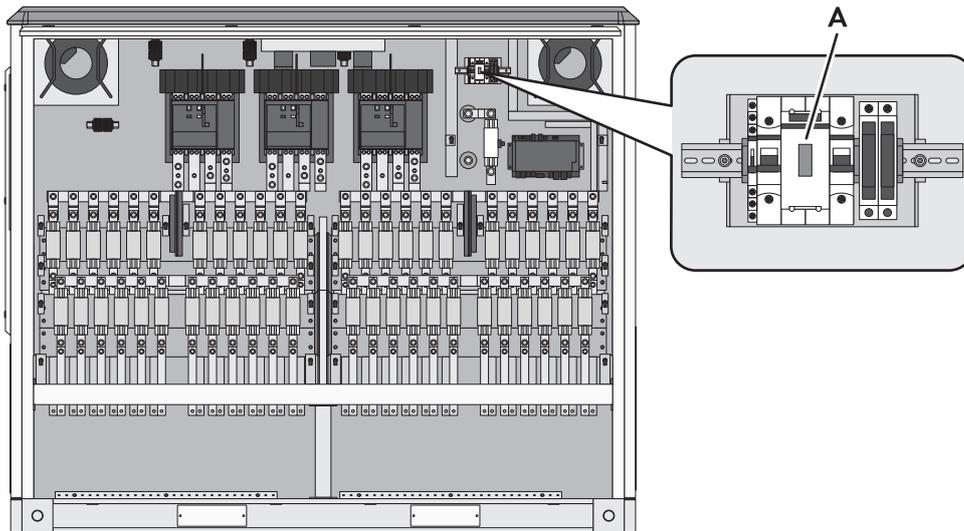


Figure 109: Position of the remote GFDI

Position	Designation
A	Remote GFDI

If the Remote GFDI trips, initially a temporary error will be assumed and a motor drive will close the Remote GFDI after a day change. No external switch command is required to close the tripped Remote GFDI.

If the Remote GFDI shall be closed before a day change, the error can be acknowledged immediately.

In case of failure, a qualified person must check and, if necessary, repair the insulation and then acknowledge the error.

#### 13.2.3.4 Insulation Monitoring Device

Depending on the order option, an insulation monitoring device can monitor the insulation resistance of the PV power plant in ungrounded PV arrays.

In the operating state "GridFeed", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured.

If the inverter is in the operating states "Stop" or "WaitDC", only the insulation resistance from the PV array to the inverter will be measured.

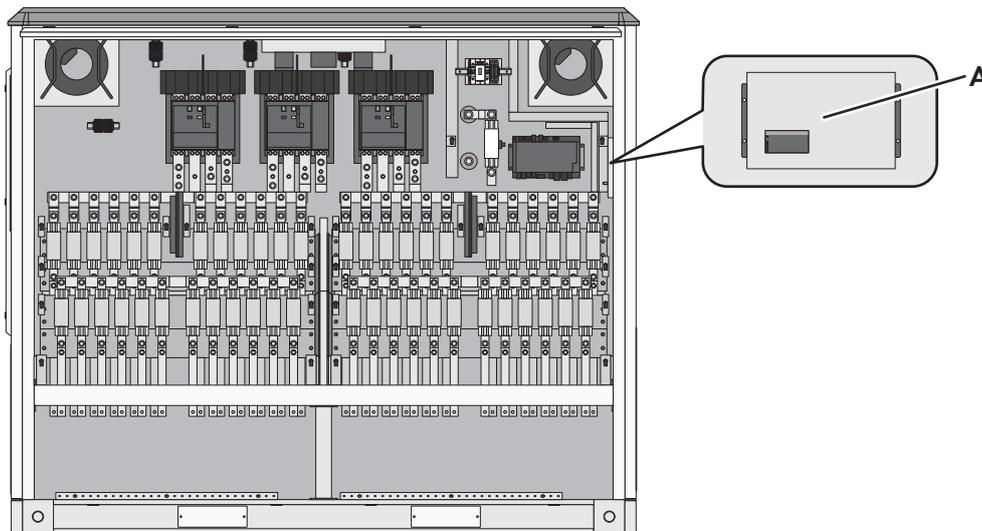


Figure 110: Position of the insulation monitoring device

Position	Designation
A	Insulation monitoring device

The insulation monitoring device is connected between the PV 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.

#### 13.2.3.5 GFDI and Insulation Monitoring Device

The order option "GFDI and insulation monitoring device" allows you to manually switch the PV power plant from grounded operation to insulated operation to measure the insulation resistance. To ensure that there is no insulation error on the grounded terminal, an insulation measurement is carried out. After switching to insulated operation, the insulation monitoring device checks all poles of the PV power plant for potential insulation errors.

When the GFDI is closed, the PV array is grounded. In this state, the insulation resistance cannot be determined.

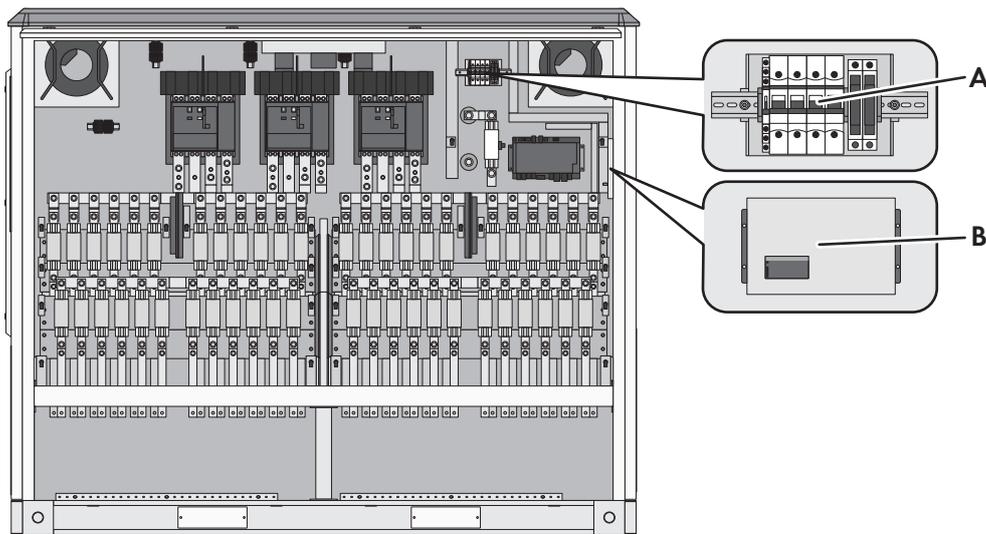


Figure 111: Position of GFDI and insulation monitoring device

Position	Designation
A	GFDI
B	Insulation monitoring device

### Insulation monitoring

During start-up of the inverter, the 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 GFDI is closed and the PV array is switched to grounded operation. The value of the insulation resistance can be read off from the user interface in the instantaneous value **PvGnd.RisIso**.

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.

### 13.2.3.6 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 PV array is grounded. In this state, the insulation resistance cannot be determined.

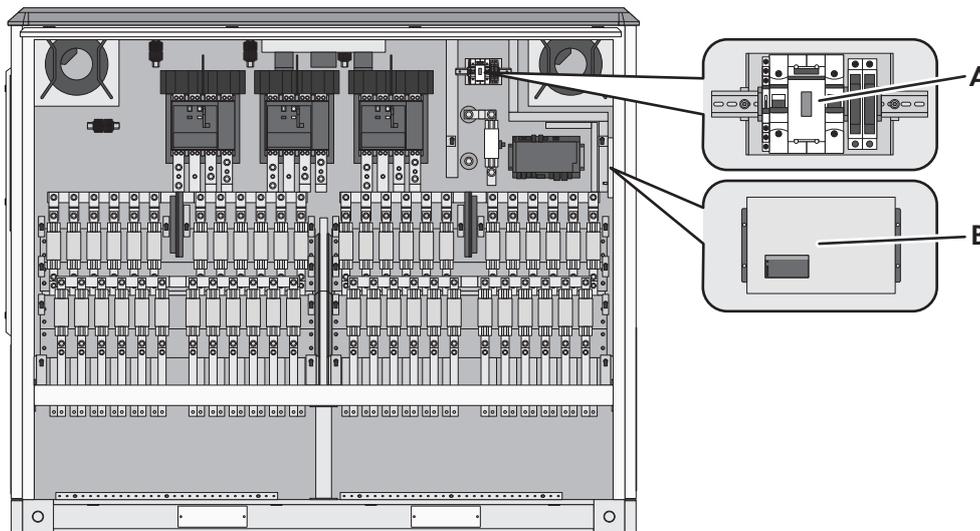


Figure 112: Position of Remote GFDI and insulation monitoring device

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.RisIso**.

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.

## 13.2.4 String-Current Monitoring

### 13.2.4.1 Zone Monitoring

The order option "Zone Monitoring" provides the option of monitoring the input currents of the individual DC inputs of the inverter, of detecting failures, and, in this way, minimizing power and yield losses. The input currents are measured by the measuring shunts installed on the DC rails. The measured input currents can be called up via Modbus protocol by the communication unit. Thus, occurring errors can be detected.

The total currents required for the control and the internal monitoring are measured independently of Zone Monitoring at another position. Therefore, there can be time differences between the total currents measured by default for the internal control and the total currents supplied by Zone Monitoring.

### 13.2.4.2 External String Monitoring

The order option "External SMA String Monitoring" offers the possibility to monitor the input currents of individual strings, to detect failures, and in this way, to minimize the power and yield losses. With external string monitoring, current conversion is already taking place in the String-Combiners.

A communication network must be set up for external string monitoring. The following requirements apply:

- There can be used up to 24 SMA String-Monitor devices within the communication network.
- Up to six communication strands can be connected to the inverter.
- Up to ten SMA String-Monitor devices can be connected per communication strand.

When a possible string failure is detected on one of the SMA String-Monitor devices, a warning message is displayed on the page **External devices**. The impaired string can be determined via the spot values of the respective SMA String-Monitor device.

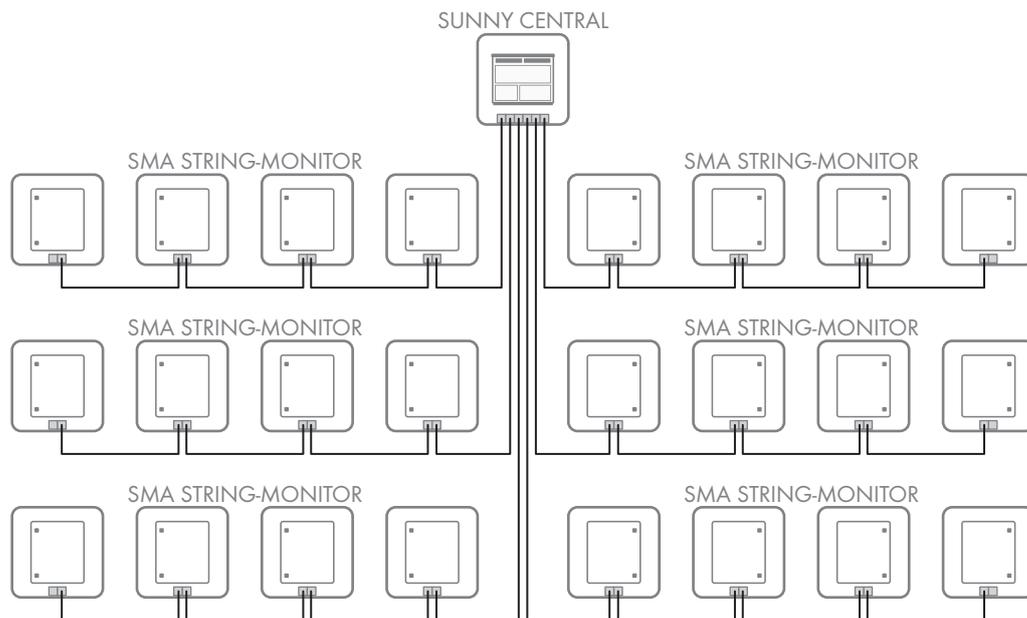


Figure 113: Principle of external string monitoring: connection of all six possible communication strands (example)

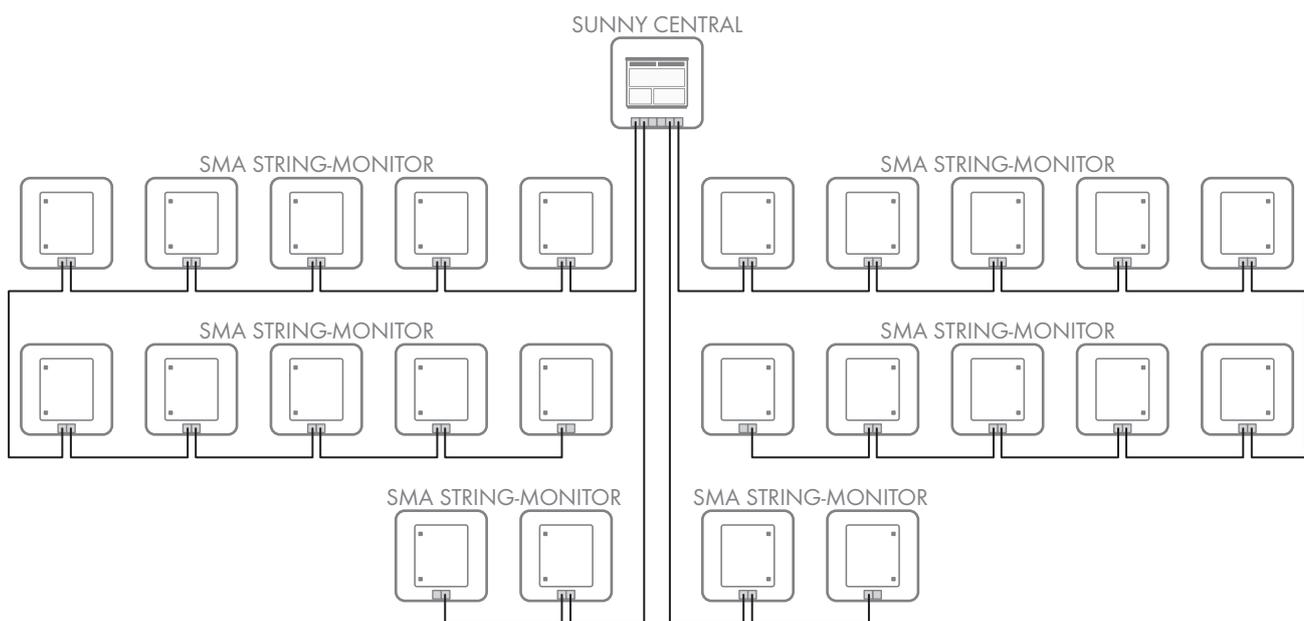


Figure 114: Principle of external string monitoring: connection of communication strands with max. number of nodes (example)

The assignment of the SMA String-Monitor devices is carried out via the IP address in the user interface.

The connection of SMA String-Monitor devices is site-dependant:

- **External String Monitoring, Cu**

SMA String-Monitor devices are connected to the inverter via copper cables. Thereby, the maximum distance between the SMA String-Monitor devices and the SMA String-Monitor devices to the inverter is 100 m. The overvoltage protection is provided by six surge arresters.

- **External String Monitoring, OF**

SMA String-Monitor devices are connected to the inverter via optical fibers.

## 13.3 Safety Functions of the MV Power Station

### 13.3.1 Full hermetic protection

The MV Power Station is equipped with a hermetic protection device depending on the order option. The protection device monitors the tank pressure and oil level of the MV transformer and detects the development of gas. The temperature of the MV transformer is monitored by the thermometer PT100.

The MV transformer is connected to the first inverter via a plug. The inverter provides a 24 V<sub>DC</sub> signal. This signal can be used to supply the analog sensor and the change-over contact. The hermetic full-protection device is only active if the supply voltage is applied. During a communication failure, the system derates.

The hermetic full-protection device is integrated into the safety chain. Fast stop is tripped in case an error occurs. The inverter and MV switchgear are disconnected. The inverter switches immediately to the operating state "RampDown" in the event of a wire break.

#### Monitoring of temperature

The thermometer PT100 offers the possibility to measure the oil temperature of the MV transformer.

The measured temperature is used to control the fans at the MV transformer.

Both inverters derate to 20% of their rated power if one of the two fan controls fails. Both inverters derate to 20% of their rated power if both fan controls fail.

The temperature signals can be called up via Modbus protocol at the communication interface.

To guarantee safety, two temperature levels are monitored: a warning temperature and a switch-off temperature.

If the temperature in the MV transformer exceeds the warning temperature of 100°C for ten seconds, the inverter switches to the operating state "Error" via the operating state "RampDown" and issues the error **6506**. Once the error waiting time of 30 minutes has passed, the inverter checks whether the temperature in the MV transformer has fallen below the warning temperature again. When the temperature has dropped sufficiently, the inverter switches to the "WaitAC" operating state. Once the feed-in conditions are fulfilled again, the inverter switches to the operating state "GridFeed".

If the MV transformer exceeds the switch-off temperature of 105°C for ten seconds, the inverter switches to the operating state "Error" via the operating state "RampDown" and issues the error **6423**. This error must be rectified manually and acknowledged.

#### Monitoring of boiler pressure

- **With change-over contact**

If the tank pressure in the MV transformer reaches the minimum or the maximum value, the signal at terminal - **X4:4** is interrupted by the protective device of the MV transformer. The inverter switches immediately to operating state "Error" and switches off. The circuit breaker of MV switchgear is switched off.

The pressure thresholds depend on the MV transformer used. The thresholds are set ex works for each individual project and must not be changed.

### Monitoring the oil level

If the MV transformer loses oil and the oil level falls below a threshold, the protective device sends the signal to terminal **-X4:5** on the inverter. Gas formation in the MV transformer can still be detected. If the oil level is too low or if gases appear in the MV transformer, the protective device of the MV transformer sends a signal. The inverter switches to operating state "Error" via the operating state "RampDown". The circuit breaker of MV switchgear is switched off.

### 13.3.2 MV Transformer Fan Control

The MV transformer fans are controlled in relation to the measured oil temperature of the MV transformer and the current power of the inverters. The fans are controlled via the inverter at the low-voltage compartment.

The fans start up at an oil temperature of 60°C. The rotational speed of the fans depends on the current total power of the system. The fans run at full power above an oil temperature of 95°C. The fans are switched off when the oil temperature falls below 55°C.

The rotational speeds of the fans is monitored. The fans are divided into two safety circuits and each one is connected to a separate inverter. If a safety circuit reports an error, the total power of the system is reduced to protect the MV transformer. The inverter displays an error message in this case.

### 13.3.3 Cascade Control

The order option "Cascade control" enables staggered reconnection of the MV Power Station after a grid failure or maintenance work. For this option, the following changes are implemented by default:

- The MV switchgear is motorized in the transformer outgoing feeder panel.
- The capacitive voltage detection system in the left cable panel of the MV switchgear is equipped with an alarm contact.
- A control device is integrated in the medium-voltage compartment of the MV Power Station.

The control device is connected to the outgoing feeder panel of the MV switchgear transformer and controls an integrated motor. Furthermore, the control device is connected to the alarm contact of the voltage detection system integrated in the MV switchgear. The alarm contact of the voltage detection system is used for connecting and disconnecting the transformer outgoing feeder panel. The switching limiting value for the voltage detection system is set in accordance with IEC 61 243-5. The voltage is measured upstream the load-break switch in the left cable panel.

If the voltage falls below the permissible switching limit value, a signal is sent to the control device and the transformer outgoing feeder panel of the MV switchgear is switched off with an adjustable delay. If the voltage detection system measures a voltage whose value is above the permissible switching limit value, a signal is sent to the control device and the transformer outgoing feeder panel of the MV switchgear is switched on with an adjustable delay. The time delay for disconnection and connection must be set in accordance with the grid operator's specifications. The time delay for disconnection is set to five seconds and for connection to one minute by default. The disconnection time should not be set less than 5 seconds so that the MV Power Station does not impact the utility grid during dynamic grid support.

The cascade control can be operated manually on site via remote control or during automatic control operation.

In order that the MV switchgear can also be controlled remotely, the customer can connect 2 switches to the cascade control terminal block.

### 13.3.4 Safety shutdown

The MV Power Station is equipped with a safety chain for the disconnection of the system depending on the order option. For triggering, the MV Power Station can be equipped with a fast stop switch, heat detector or hermetic full-protection device. The fast-stop function can also be tripped by an external signal.

By triggering the safety chain, the fast stop signal is sent to both inverters and the MV switchgear is switched off.

## 13.4 Power Control

### 13.4.1 Power Control in the PV Power Plant

The PV power plant 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 of the electric utility company that are transmitted per 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.

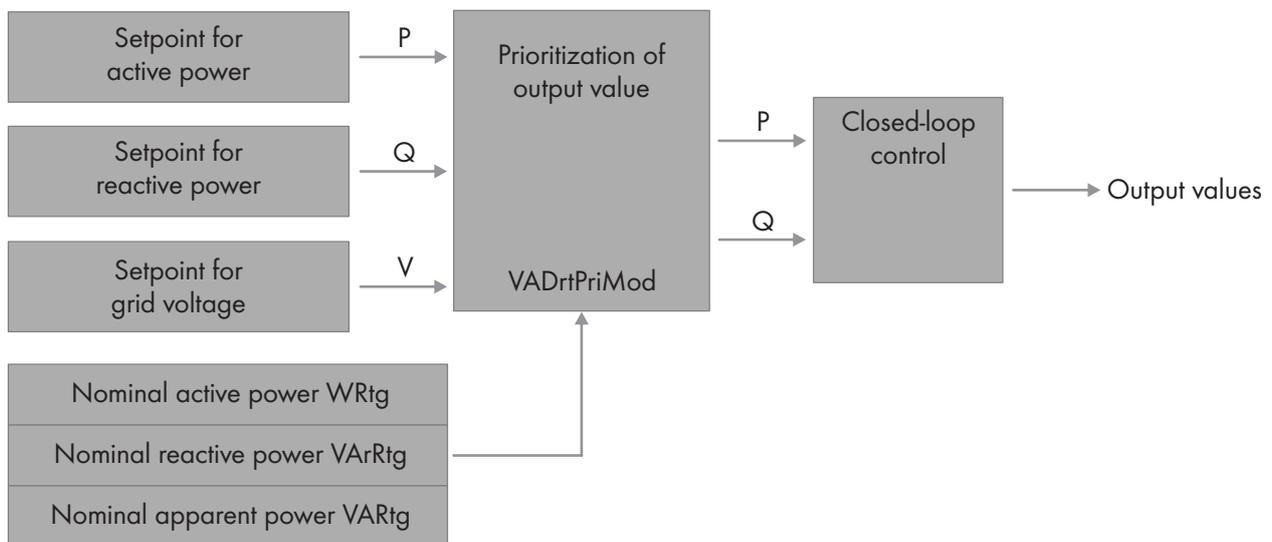


Figure 115: Principle of Power Control

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. In the instantaneous value **DrtStt**, the currently selected prioritization is shown.

## 13.4.2 Active Power Limitation

### 13.4.2.1 Principle of Active Power Limitation

The output value for the active power limitation is calculated using two setpoints.

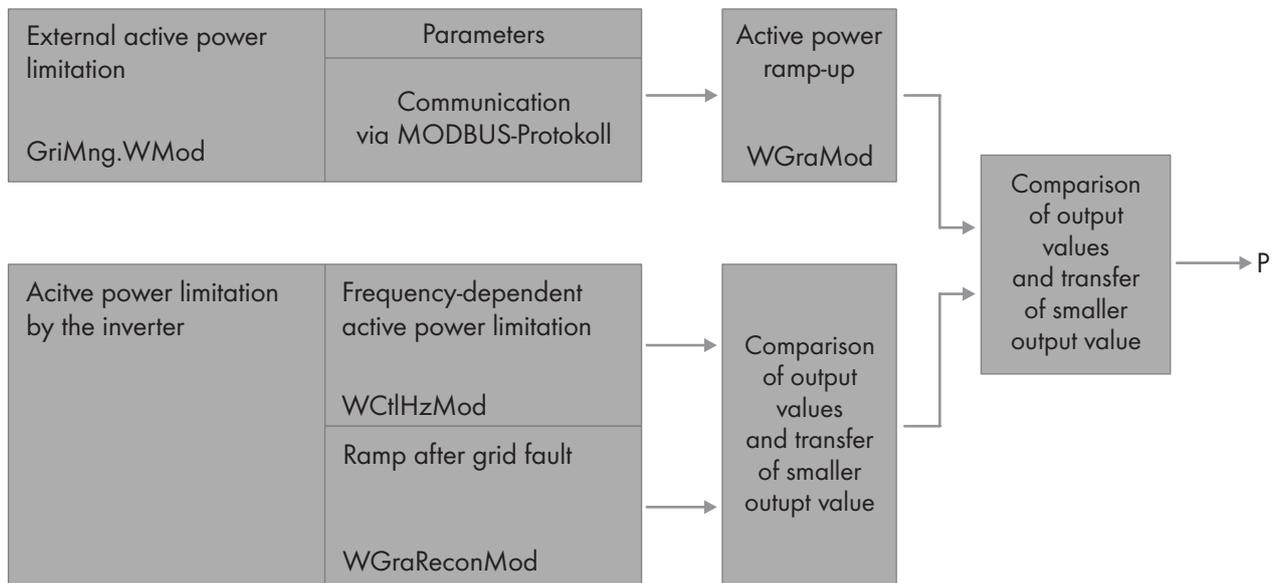


Figure 116: Principle of Active Power Limitation

The source for the specification of the external active power control is configured in the parameter **GriMng.WMod**. The following setpoint sources can be set via this parameter:

- **Off** - The inverter does not control the active power via external specifications.
- **WCtlMan** - Parameters that are entered via the user interface
- **WCtlCom** - Specifications of the electric utility company that are transmitted via Modbus protocol
- **WCtlAnIn** - 4.0 mA to 20.0 mA input, ripple control signals via the analog inputs of the inverter

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 according to the process **WCtlHz** (see Section 13.5.3, page 248) and for the grid-voltage dependent active power limitation (see Section 13.5.5, page 252).

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 output value for the active power reduction using the smaller value.

### 13.4.2.2 Active Power Limitation via Parameters

#### Active power limitation with absolute value: **WSptMan**

The active power limitation is entered as an absolute value via the parameter **WSptMan**. The parameter **WSptMan** defines the amount of active power to be fed in and can be changed during feed-in operation. The parameter **WSptMan** must not be greater than the parameter **WRtg**. To be able to control the active power limitation via the parameter **WSptMan**, the parameter **GriMng.WMod** must be set to **WCtlMan**.

### 13.4.2.3 Active Power Limitation via Analog Input

The active power limitation is set via an analog signal at the input terminals for the setpoint. This is usually implemented by a ripple control signal. The electrical current strength of the connected signal determines the nominal active power. The analog measured values must be between 4.0 mA and 20.0 mA. Here, 4.0 mA equates to an active power of 0% of the nominal active power and 20.0 mA to an active power of 100% of the nominal active power. Signals between 4.0 mA and 20.0 mA are converted linearly in accordance with the nominal active power.

Signals between 3.0 mA and 4.0 mA will be translated as 0% of the nominal active power. Signals between 20.0 mA and 21.0 mA will be translated as 100% of the nominal active power.

A wire break will be assumed if the analog signal is less than 3.0 mA. An overcurrent will be assumed if the analog signal is greater than 21.0 mA. In both cases, the behavior of the inverter is determined by the settings for the inverter behavior in the event of communication disturbances (see Section 13.4.6, page 241).

## 13.4.3 Reactive Power Control

### 13.4.3.1 Principle of Reactive Power Control

The output value for the reactive power control is calculated using two output values.

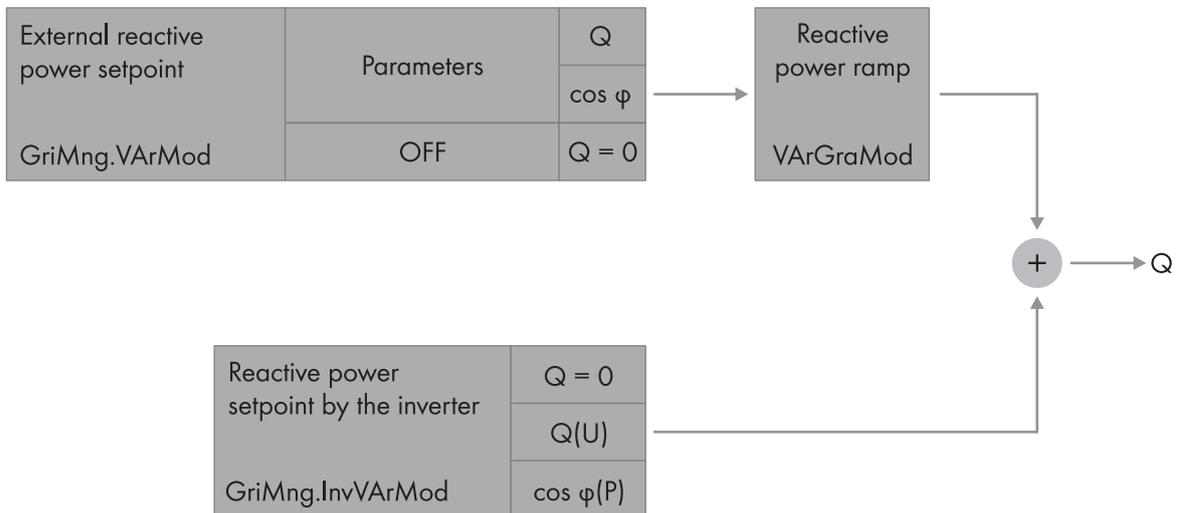


Figure 117: Principle of Reactive Power Control

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:

- **Off** - The inverter does not provide reactive power.
- **VArCtlCom** - Specifications of the electric utility company for the reactive power values transmitted via Modbus protocol.
- **PFCtlCom** - Specifications of the electric utility company for the displacement power factor transmitted via Modbus protocol
- **AutoCom** - Specifications of the electric utility company that are transmitted via Modbus protocol. The inverter recognizes automatically from the data format whether a reactive power value or a displacement power factor is being used.
- **VArCtlMan** - Entry of reactive power via fixed specification defined in parameter **VArSptMan**
- **PFCtlMan** - Entry of displacement power factor via fixed specification defined in parameter **PFSptMan**
- **VArCtlAnIn, PFCtlAnIn** - 4.0 mA to 20.0 mA input, ripple control signals via the analog inputs of the inverter

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 PV 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 provide reactive power.
- **VArCtlVol** - The inverter controls the reactive power as a function of the voltage (see Section 13.5.6, page 253).
- **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.

### 13.4.3.2 Reactive Power Control via Parameters

The reactive power setpoint is set via the parameter **VArSpnMan**. The parameter **VArSpnMan** is permitted to be within the range from **-VArRtg** to **+VArRtg**.

The reactive power setpoint is set via the parameter **PFSpnMan**. Both the displacement power factor value and the type of excitation are to be entered here.

### 13.4.3.3 Reactive Power Limitation via Analog Input

The reactive power limitation is set via an analog signal at the input terminals for the setpoint. This is usually implemented by a ripple control signal. The electrical current strength of the connected signal determines the nominal reactive power. The analog measured values must be between 4.0 mA and 20.0 mA. Here, 4.0 mA equates to a reactive power of 0% of the nominal reactive power and 20.0 mA to a reactive power of 100% of the nominal reactive power. Signals between 4.0 mA and 20.0 mA are converted linearly in accordance with the nominal reactive power.

Signals between 3.0 mA and 4.0 mA will be translated as 0% of the nominal reactive power. Signals between 20.0 mA and 21.0 mA will be translated as 100% of the nominal reactive power.

A wire break will be assumed if the analog signal is less than 3.0 mA. An overcurrent will be assumed if the analog signal is greater than 21.0 mA. In both cases, the behavior of the inverter is determined by the settings for the inverter behavior in the event of communication disturbances (see Section 13.4.6, page 241).

### 13.4.4 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 **GriMng.VolNomMod**. The following setpoint sources can be set via this parameter:

- **Off** - The inverter does not control the reactive power via the external grid voltage setpoints.
- **VolNomCtlMan** - The inverter controls the reactive power via the parameter **VolNomSptMan**, which is entered via the user interface.
- **VolNomCtlCom** - 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.

### 13.4.5 Inverter Behavior with Low Power Setpoints

If the setpoints for active and reactive power are below 0.1% of the rated power, the inverter monitors the electric utility company setpoints for the time period defined in the parameter **PwrStp2StbyTm**. If the setpoints remain below 0.1% of the rated power once this time period has elapsed, the inverter switches operating states.

Operating state when a low power setpoint is received	Inverter behavior
GridFeed, QonDemand	The inverter switches to the operating state "Standby" after the time period defined in the parameter <b>PwrStp2StbyTm</b> . Once the feed-in setpoints are again sufficient for grid feed-in, the inverter switches back to the operating state "GridFeed" within one second.
Stop, Error	The inverter remains in the current operating state and does not switch to "GridFeed" even after the feed-in setpoints are increased.
WaitAC, ConnectAC, WaitDC, Connect DC	The inverter runs through the entire start-up routine and then switches to the operating state "Standby". Once the feed-in setpoints are again sufficient for grid feed-in, the inverter switches back to the operating state "GridFeed" within one second.

### 13.4.6 Inverter Behavior in Case of Communication Disturbances

#### Disturbance in Communication during Operation

Via the parameters **GriMng.WMod**, **GriMng.VArMod** and **GriMng.VolNomMod**, the inverter can be set to receive the control setpoints via Modbus protocol. If these setpoints for controlling the active power, reactive power control and voltage cannot be sent via Modbus protocol and are therefore lost, the inverter waits for the time period set in the parameter **GriMng.ComFltTmLim**, after which the loss is classified as a communication error. How the inverter behaves in the event of missing setpoints for the active power, reactive power or voltage can be defined individually. If the parameter **GriMng.ComFltTmLim** is set to 0 seconds, a communication error is not detected and the inverter continues to operate with the last received values.

As long as the inverter does not receive any updated setpoint values, it will feed power into the grid according to the settings made in **GriMng.ComFltFlbWMod**, **GriMng.ComFltFlbVArMod** and **GriMng.ComFltFlbVolNomMod** for the missing active power, reactive power and voltage setpoint. Here, separate substitute values for feed-in operation and grid monitoring can be set. If the time period set in the parameter **GriMng.ComFltFlbTmLim** has expired after detection of the communication error, the inverter switches to the operating state "Standby" and no longer feeds into the utility grid. If the parameter **GriMng.ComFltFlbTmLim** is set to 0 and the use of substitute values is configured, the inverter will operate permanently using the substitute values and will not switch to the operating state "Standby".

If the inverter again receives setpoints via the Modbus protocol, the inverter voids the communication error and switches back to the operating state "GridFeed" and approaches the setpoint. During this process, if a ramp-up has been activated in the parameter **WGraMod** or **VArGraMod**, the inverter approaches the setpoints with a slow increase of the active power or reactive power. The increase of this ramp is defined in the parameter **WGra** or **VArGra**.

### Disturbance of communication between the two inverters

If the communication between the inverters malfunctions, both inverters reduce their power to 20% to ensure the electrical and thermal protection of the MV transformer. The inverter issues the error message 8715 and the message **Derating VAMax Transformer** is displayed in the instantaneous value **DrtExlTmpStt**.

### Disturbance in Communication when the Inverter Restarts

If the inverter discovers a communication fault during the re-start, the control values cannot be sent via Modbus protocol. In the parameters **GriMng.ComFltFlbRstrWMod**, **GriMng.ComFltFlbRstrVArMod** and **GriMng.ComFltFlbRstrVolNomMod**, the behavior of the inverter for the missing active power, reactive power and voltage setpoint during a restart can be set.

### Missing Active Power Setpoint

How the inverter behaves in the event of a missing active power setpoint is configured in the parameter **GriMng.ComFltFlbWMod** for disturbances during operation and in the parameter **GriMng.ComFltFlbRstrWMod** for disturbances during restart:

Setting	Behavior in the event of communication disturbances
Error	The inverter switches to the operating state "Error" and stops feeding into the utility grid. The AC disconnection unit and the DC switchgear are opened and the inverter disconnects from the utility grid.
Standby	The inverter switches to the operating state "Standby" and stops feeding into the utility grid. The AC disconnection unit and the DC switchgear remain closed.
W	The inverter feeds in active power at a fixed substitute value. The substitute value for active power is configured in parameter <b>WSptFlb</b> .
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".

\* This option can only be selected in the parameter **GriMng.ComFltFlbWMod**.

### Missing Reactive Power Setpoint

How the inverter behaves in the event of a missing reactive power setpoint is configured in the parameter **GriMng.ComFltFlbVArMod** for disturbances during operation and in the parameter **GriMng.ComFltFlbRstrVArMod** for disturbances during restart:

Setting	Behavior in the event of communication disturbances
Error	The inverter switches to the operating state "Error" and stops feeding into the utility grid. The AC disconnection unit and the DC switchgear are opened and the inverter disconnects from the utility grid.
Standby	The inverter switches to the operating state "Standby" and stops feeding into the utility grid. The AC disconnection unit and the DC switchgear remain closed.

Setting	Behavior in the event of communication disturbances
PF	The inverter feeds in with a substitute value for the displacement power factor. The substitute value for the displacement power factor is configured in parameter <b>PFSptFlb</b> .
PFMeas*	The inverter feeds in with the last measured displacement power factor.
VAr	The inverter feeds in reactive power at a fixed substitute value. The substitute value for the displacement power factor is configured in parameter <b>VArSptFlb</b> .
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".

\* This option can only be selected in the parameter **GriMng.ComFltFlbVArMod**.

### Missing Voltage Setpoint

How the inverter behaves in the event of a missing voltage setpoint is configured in the parameter **GriMng.ComFltFlbVolNomMod** for disturbances during operation and in the parameter **GriMng.ComFltFlbRstrVolNomMod** for disturbances during restart:

Setting	Behavior in the event of communication disturbances
Error	The inverter switches to the operating state "Error" and stops feeding into the utility grid. The AC disconnection unit and the DC switchgear are opened and the inverter disconnects from the utility grid.
Standby	The inverter switches to the operating state "Standby" and stops feeding into the utility grid. The AC disconnection unit and the DC switchgear remain closed.
VolNom	Required grid voltage setpoint The inverter uses this setpoint to calculate a reactive power value. The inverter feeds in the reactive power that has been calculated in order to influence the grid voltage. The substitute value for the required grid voltage is configured in the parameter <b>VolNomSptFlb</b> .
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".

\* This option can only be selected in the parameter **GriMng.ComFltFlbVolNomMod**.

## 13.5 Grid Management Services

### 13.5.1 Start-Up Behavior

#### 13.5.1.1 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.

### 13.5.1.2 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 <b>WGraRecon</b> .

## 13.5.2 Dynamic Grid Support (FRT)

### 13.5.2.1 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.

The inverter behavior can be set via the parameter **FrMod**.

Parameters	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 power fed in and without exceeding the nominal current.
Momentary Cessation	The limited dynamic grid support is activated while the apparent current is reduced simultaneously.

The grid limits and deactivation delays vary depending on the country standard and can be set via parameters.

### 13.5.2.2 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.

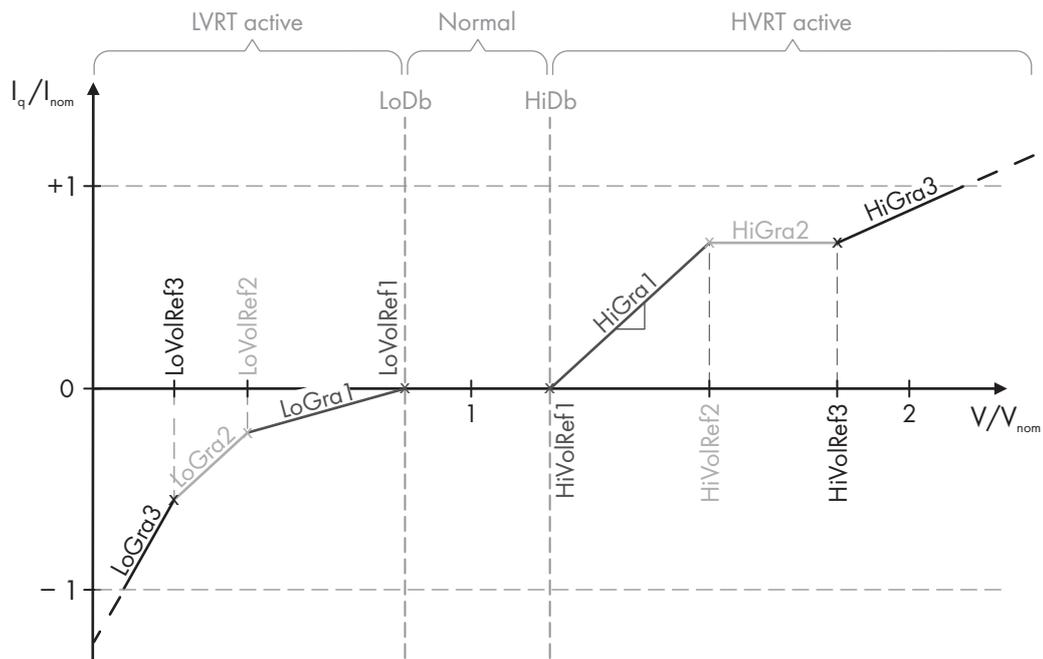


Figure 118: Characteristic curve of full dynamic grid support

Two ranges each with different gradients can be defined for undervoltage and overvoltage in the characteristic curve.

Parameters	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
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

Parameters	Description
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.AmpQGra	Rate of current increase with which the reactive 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.

**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.

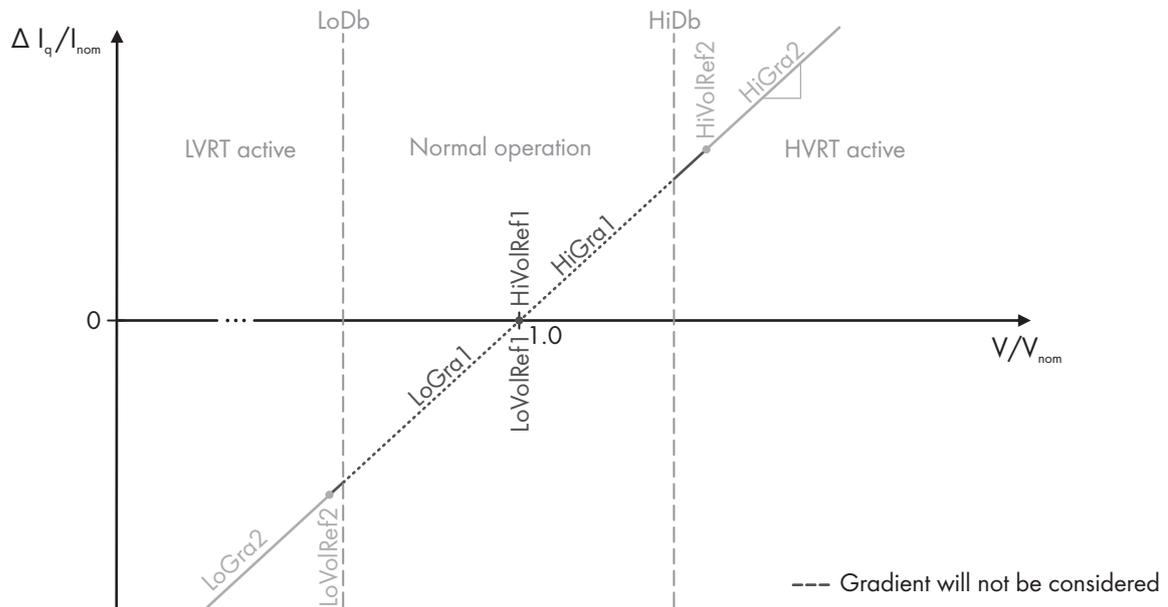


Figure 119: Characteristic curve of full dynamic grid monitoring according to BDEW

Parameters	Required value acc. to BDEW
Frt.Mod	Full
Frt.LoDb	0.9
Frt.HiDb	1.1
Frt.LoVolRef1	1.0
Frt.LoGra1	2
Frt.LoVolRef2	0.9
Frt.LoGra2	2
Frt.HiVolRef1	1.0

Parameters	Required value acc. to BDEW
Frnt.HiGra1	2
Frnt.HiVolRef2	1.1
Frnt.HiGra2	2

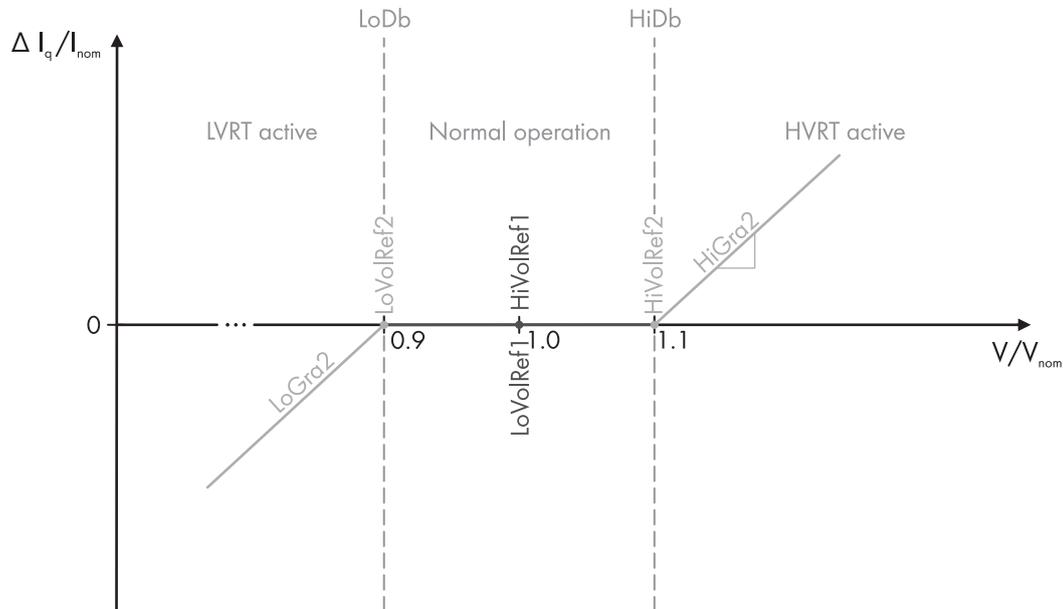


Figure 120: Characteristic curve of full dynamic grid monitoring acc. to SDLWindV

Parameters	Required value acc. to SDLWindV
Frnt.Mod	Full
Frnt.LoDb	0.9
Frnt.HiDb	1.1
Frnt.LoVolRef1	1.0
Frnt.LoGra1	0
Frnt.LoVolRef2	0.9
Frnt.LoGra2	2
Frnt.HiVolRef1	1.0
Frnt.HiGra1	0
Frnt.HiVolRef2	1.1
Frnt.HiGra2	2

### 13.5.2.3 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 **Frnt.WaitTmLo** and **Frnt.WaitTmHi**.

### 13.5.3 Active Power Limitation Depending on Power Frequency: Procedure WClHz

In the case of active power limitation depending on power frequency, the inverter constantly checks the connected power frequency and if necessary regulates the active power feed-in.

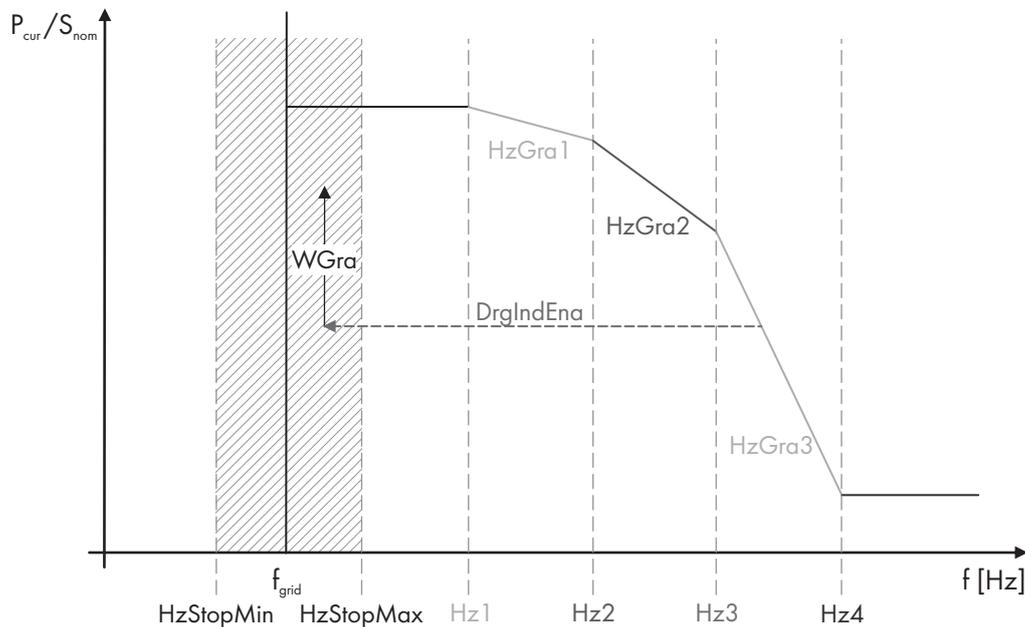


Figure 121: Active Power Limitation Depending on Power Frequency

If the power frequency exceeds a defined threshold, the inverter reduces the active power feed-in. It can be selected whether the active power should be reduced by a gradient or a set power. This reduction of active power depending on power frequency can be defined for three frequency bands. The active power reduction can be configured individually for each frequency band. This fulfills the requirements of the electric utility company.

If the power frequency exceeds the grid limit, the inverter will shut down and switch to the operating state "WaitAC". The inverter will remain in the operating state "WaitAC" until all feed-in conditions are fulfilled again. The behavior of the inverter during restart after a grid fault can be defined individually for each project (see Section 13.5.1.2, page 244).

According to the given requirement, it is possible to define how the inverter should react if the power frequency drops before the grid limit has been reached. If this definition stipulates that the inverter is to retain the active power reduction even when power frequency drops, the power frequency must first range within a so-called "rebound" zone for a defined time interval before the frequency-dependent active power reduction is suspended. When the inverter can feed in again at full active power, you can define how the inverter is to revert to full active power.

#### Overview of the relevant parameters

Parameters	Description
WClHzMod	Activation of frequency-dependent active power limitation <ul style="list-style-type: none"> <li>• <b>Disable</b> – process deactivated</li> <li>• <b>Enable</b> – process activated</li> </ul>

Parameters	Description
WCtlHz.RefMod	<p>Selection of the active power to be used as a reference for the active power reduction</p> <ul style="list-style-type: none"> <li>• <b>W</b> - Reduction is based on the instantaneous active power at the time of shortfall of the frequency threshold</li> <li>• <b>WNom</b> - Reduction is based on the nominal active power of the inverter (<b>WRtg</b>)</li> <li>• <b>VANom</b> - Reduction is based on the nominal apparent power of the inverter (<b>VARtg</b>)</li> </ul>
WCtlHz.CfgMod	<p>Selection of the reference values for the reduction</p> <ul style="list-style-type: none"> <li>• <b>HzGra</b> - Active power reduction takes place according to a reduction gradient.</li> <li>• <b>W</b> - Active power reduction takes place based on power values which the inverter should attain at the end of each frequency band</li> </ul>
WCtlHz.DrgIndMod	<p>Selection of inverter behavior when power frequency drops</p> <ul style="list-style-type: none"> <li>• <b>Disable</b> - The inverter increases its active power fed in along the characteristic curve.</li> <li>• <b>Enable</b> - The inverter still feeds in using the value of active power last fed in even when the power frequency is dropping. Only when the frequency defined in the parameter <b>WCtlHz.HzStopMax</b> is not met, may the power fed in be increased again.</li> </ul>
WCtlHz.Hz1/Hz2/Hz3	Frequency threshold of the given frequency band for frequency-dependent active power reduction
WCtlHz.HzGra1/HzGra2/HzGra3	Gradient of the active power limitation for the given frequency band
WCtlHz.W2/W3/W4	Active power setpoint to be attained at the end of the given frequency band
WCtlHz.HzStopMax	Upper frequency threshold of the rebound zone, from which active power limitation is suspended
WCtlHz.HzStopMin	Lower frequency threshold of the rebound zone, from which active power limitation is suspended
WCtlHz.HzStopTm	Minimum time interval for which the power frequency must be stable in the rebound zone before active power limitation is suspended
WCtlHz.WGraPosEna	<p>Selection of behavior during restart of full active power</p> <ul style="list-style-type: none"> <li>• <b>0</b> - The inverter rapidly reverts to maximum active power.</li> <li>• <b>1</b> - The inverter gradually ramps up the active power.</li> </ul>
WCtlHz.WGraPos	Gradient for the ramp by which the inverter ramps up to the maximum active power

### 13.5.4 Active power control depending on grid frequency: procedure WCtlLoHz

In the case of active power control depending on grid frequency, the inverter constantly checks the connected grid frequency and if necessary regulates the active power feed-in.

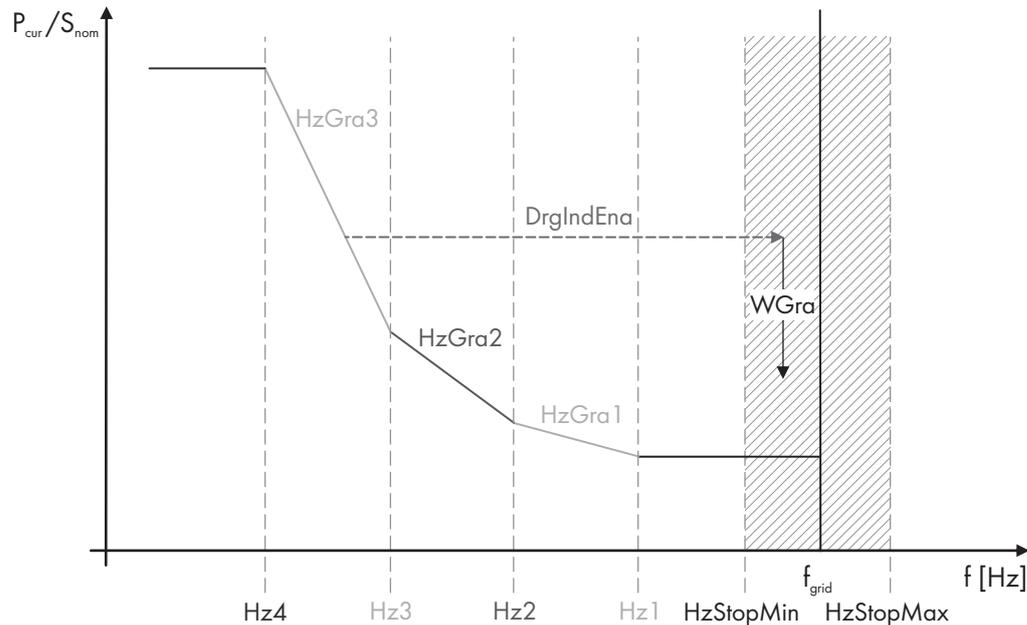


Figure 122: Active power control depending on grid frequency

If the grid frequency falls below a defined threshold, the inverter increases the active power feed-in as long as it is available from the DC side. For the grid support, the active power limitation (e.g. defined in the parameter **WSptMan**) is canceled and the active power fed in is increased, depending on the frequency, up to the nominal active power.

It can be selected whether the active power should be controlled by a gradient or a set power. This active power control depending on grid frequency can be defined for three radio spectrums. The active power transmittance can be configured individually for each radio spectrum. This fulfills the requirements of the electric utility company.

If the grid frequency falls below a grid limit, the inverter will shut down and switch to the operating state "WaitAC". The inverter will remain in the operating state "WaitAC" until all feed-in conditions are fulfilled again. The behavior of the inverter during restart after a grid fault can be defined individually for each project (see Section 13.5.1.2, page 244).

According to the given requirement, it is possible to define how the inverter should react if the grid frequency rises again before the grid limit has been reached. If this definition stipulates that the inverter is to retain the active power control even when grid frequency rises, the grid frequency must first range within a so-called "rebound" zone for a defined time interval before the frequency-dependent active power control is suspended.

#### Overview of the relevant parameters

Parameters	Description
WCtlLoHzMod	Activation of frequency-dependent active power control <ul style="list-style-type: none"> <li>• <b>Disable</b> – process deactivated</li> <li>• <b>Enable</b> – process activated</li> </ul>

Parameters	Description
WCtlLoHz.RefMod	<p>Selection of the active power to be used as a reference for the active power control</p> <ul style="list-style-type: none"> <li>• <b>W</b> - Control is based on the instantaneous active power at the time of shortfall of the frequency threshold</li> <li>• <b>WNom</b> - Control is based on the nominal active power of the inverter (<b>WRtg</b>)</li> <li>• <b>VANom</b> - Control is based on the nominal apparent power of the inverter (<b>VARtg</b>)</li> </ul>
WCtlLoHz.CfgMod	<p>Selection of the reference values for the control</p> <ul style="list-style-type: none"> <li>• <b>HzGra</b> - Active power control takes place according to an increase gradient.</li> <li>• <b>W</b> - Active power control takes place based on power values which the inverter should attain at the end of each radio spectrum.</li> </ul>
WCtlLoHz.DrgIndMod	<p>Selection of inverter behavior when frequency rises</p> <ul style="list-style-type: none"> <li>• <b>Disable</b> - The inverter increases its active power fed in along the characteristic curve.</li> <li>• <b>Enable</b> - The inverter still feeds in using the value of active power last fed in even when the power frequency is dropping. Only when the frequency defined in the parameter <b>WCtlLoHz.HzStopMax</b> is exceeded, may the power fed in be reduced again.</li> </ul>
WCtlLoHz.Hz1/Hz2/Hz3	Frequency threshold of the given radio spectrum for frequency-dependent active power control
WCtlLoHz.HzGra1/HzGra2/HzGra3	Gradient of the active power control for the given radio spectrum
WCtlLoHz.W2/W3/W4	Active power setpoint to be attained at the end of the given frequency band
WCtlLoHz.HzStopMax	Lower frequency threshold of the rebound zone, from which active power control is suspended
WCtlLoHz.HzStopMin	Upper frequency threshold of the rebound zone, from which active power control is suspended
WCtlLoHz.HzStopTm	Minimum time interval for which the grid frequency must be stable in the rebound zone before active power control is suspended
WCtlLoHz.WGraPosEna	<p>Selection of behavior during restart of full active power</p> <ul style="list-style-type: none"> <li>• <b>0</b> - The inverter rapidly reverts to maximum active power.</li> <li>• <b>1</b> - The inverter gradually ramps up the active power.</li> </ul>
WCtlLoHz.WGraPos	Gradient for the ramp by which the inverter ramps up to the maximum active power

### 13.5.5 Active Power Limitation Depending on Grid Voltage

To avoid an impermissible voltage increase at the grid-connection point, active power is reduced in relation to the grid voltage. The setpoint for active power is obtained from the voltage measured at the inverter. This function can be implemented in parallel to other procedures for reducing active power (e.g. external setpoint,  $P(f)$ ), whereby the lowest setpoint will be used.

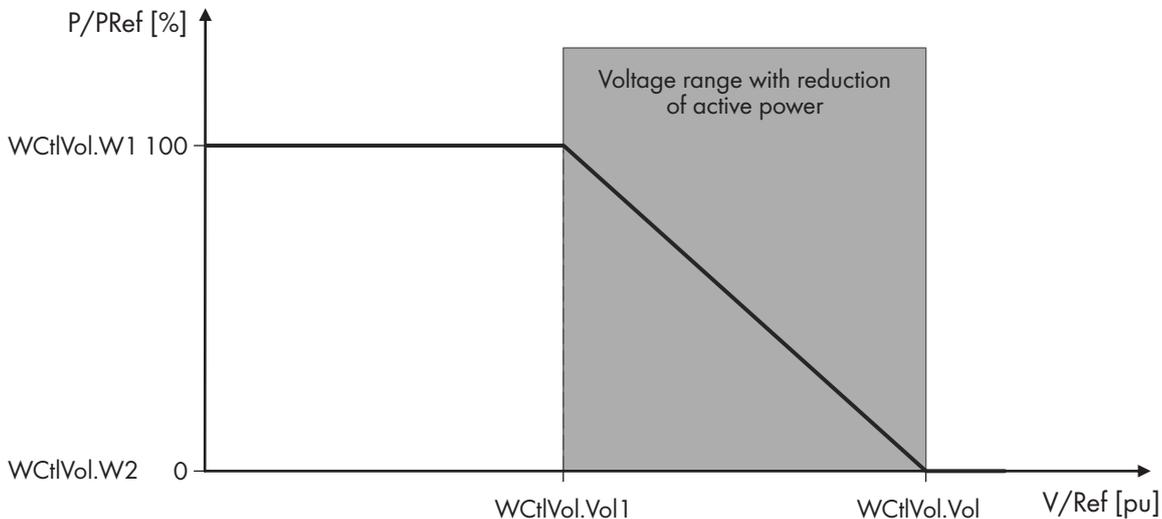


Figure 123: Active power limitation in relation to the grid voltage

If the grid voltage exceeds a defined threshold, the inverter reduces the active power feed-in. This reduction of active power depending on grid voltage can be defined for four voltage thresholds. An active power can be set for each voltage threshold. When the active power is reduced to 0 W, the inverter can keep providing reactive power. This fulfills the requirements of the electric utility company.

If the grid voltage exceeds the grid limit, the inverter will shut down and switch to the operating state "WaitAC". The inverter will remain in the operating state "WaitAC" until all feed-in conditions are fulfilled again. The behavior of the inverter during restart after a grid fault can be defined individually for each project (see Section 13.5.1.2, page 244).

#### Overview of the relevant parameters

Parameters	Description
WCtIVol.Ena	Activation of the voltage-dependent active power reduction <ul style="list-style-type: none"> <li>• <b>Disable</b> – process deactivated</li> <li>• <b>Enable</b> – process activated</li> </ul>
WCtIVol.CrvNumPt	Selection of the number of the used characteristic curve points for the active power reduction
WCtIVol.Vol#	Voltage threshold of the respective voltage band for the voltage-dependent active power reduction
WCtIVol.W#	Active power setpoint to be attained at the end of the given voltage band
WCtIVol.RefMod	Selection of the active power to be used as a reference for the active power reduction <ul style="list-style-type: none"> <li>• <b>WNom</b> - Reduction is based on the nominal active power of the inverter (<b>WRtg</b>)</li> <li>• <b>W actual</b> - Reduction is based on the instantaneous active power at the time of shortfall of the voltage threshold</li> <li>• <b>WSnptMax</b> - Reduction is based on the difference between the maximum charging and discharging power (for battery operation)</li> </ul>

Parameters	Description
WCtIVol.WGraEna	Activation of a gradient, by which the active power is changed at the most in case of a voltage variation <ul style="list-style-type: none"> <li>• <b>Disable</b> - gradient deactivated</li> <li>• <b>Enable</b> - gradient activated</li> </ul>
WCtIVol.WGraPos	Gradient for the ramp after a voltage reduction
WCtIVol.WGraNeg	Gradient for the ramp after a voltage increase

### 13.5.6 Reactive Power Control as a Function of Grid Voltage: VArCtIVol 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.

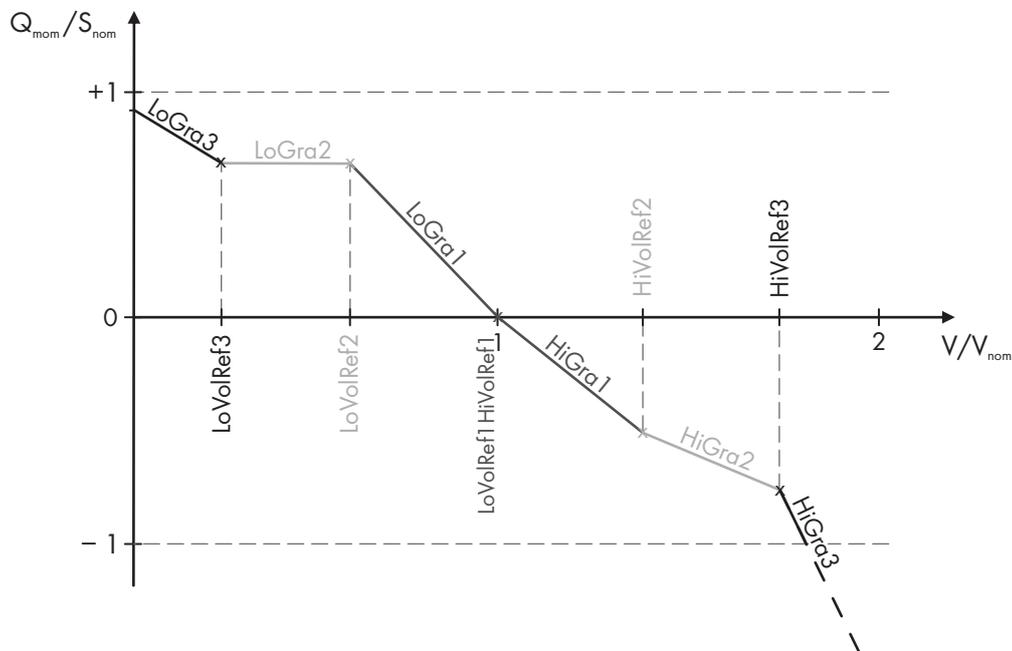


Figure 124: Characteristic curve of the voltage-dependent reactive power control

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
VArCtIVol.LoVolRef1 HiVolRef1	Voltage quotient at which reactive power feed-in is zero
VArCtIVol.HiVolRef2/HiVolRef3	Threshold of the voltage quotient at increased grid voltage
VArCtIVol.HiGra1/HiGra2/HiGra3	Gradient of reactive power adjustment of the given voltage band at increased grid voltage

Parameter	Description
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
VArCtlVol.VArSptFilTm	Filter constant by which the measured values of the grid voltage are filtered This enables more stable control.

### 13.5.7 Reactive Power Control as a Function of Active Power: PFctlW Mode

In the **PFctlW** mode, the displacement power factor is set as a function of feed-in power. This dependency is depicted by a freely configurable  $\cos \varphi(P)$  characteristic curve.

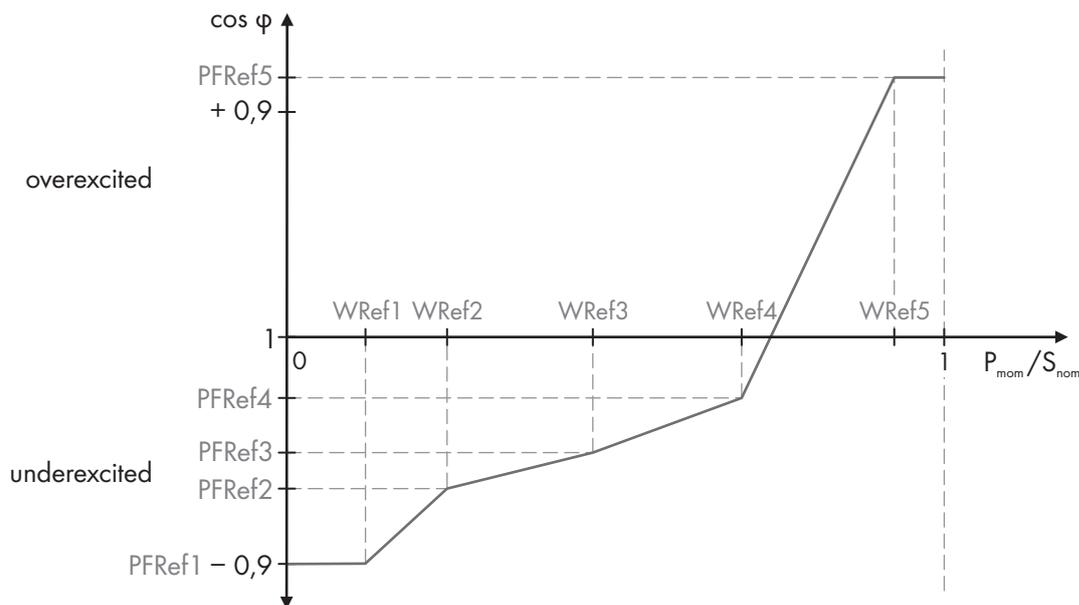


Figure 125: Reactive power control as a function of active power (example)

To implement the requirements of the grid operator as exactly as possible, the characteristic curve can be divided into four sectors, each with an individual gradient, based on five reference value pairs. The characteristic curve should be defined as monotonically increasing. The start and end points of the characteristic curve as well as the reference values of the displacement power factor can be configured by means of parameters.

If not all reference values are used, the  $\cos \varphi$  values of the following parameters must be set to the  $\cos \varphi$  value of the last required point of the characteristic curve. Furthermore, the reference value of the active power of the last required point of the characteristic curve should be set to **1**. All other reference values for active power are automatically set to **1**.

Parameter	Description
PFctlW.VolMod	Activation of the voltage band in which reactive power control should be effective
PFctlW.VolDsaPF	Reference point of the displacement power factor for activating the voltage band
PFctlW.VolEnaVol	Activation voltage
PFctlW.VolDsaVol	Deactivation voltage
PFctlW.VolEnaTm	Waiting time for which the activation voltage must be present before reactive power control is activated

Parameter	Description
PFCtIW.VolDsaTm	Waiting time for which the deactivation voltage must be present before reactive power control is deactivated
PFCtIW.WRef1	First reference point of the active power on the characteristic curve
PFCtIW.PFRef1	First reference point of the displacement power factor on the characteristic curve
PFCtIW.WRef2	Second reference point of the active power on the characteristic curve
PFCtIW.PFRef2	Second reference point of the displacement power factor on the characteristic curve
PFCtIW.WRef3	Third reference point of the active power on the characteristic curve
PFCtIW.PFRef3	Third reference point of the displacement power factor on the characteristic curve
PFCtIW.WRef4	Fourth reference point of the active power on the characteristic curve
PFCtIW.PFRef4	Fourth reference point of the displacement power factor on the characteristic curve
PFCtIW.WRef5	Fifth reference point of the active power on the characteristic curve
PFCtIW.PFRef5	Fifth reference point of the displacement power factor on the characteristic curve

### 13.6 Monitoring of the MV Power Station

The MV Power Station is equipped with media converters for the transmission of digital states depending on the order option.

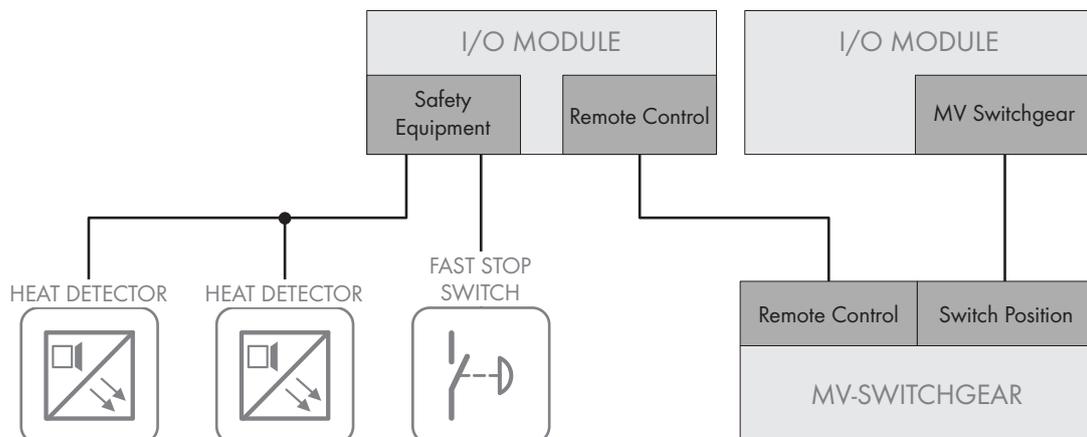


Figure 126: Circuitry principle in case of order option "Monitoring"

Depending on the selected order option, safety equipment, the MV switchgear and remote control can be monitored and controlled. The combination of monitoring options is also possible:

- Monitoring of the MV switchgear (option 24\_1)
- Monitoring of the MV switchgear and remote control (option 24\_2)
- Monitoring of MV switchgear and safety equipment (option 24\_3)
- Monitoring of MV switchgear, remote control and safety equipment (option 24\_4)
- Monitoring of safety equipment (option 24\_5)

Industrial fiber media converters of MOXA Inc. are being used. The number and types of used fiber media converters depend on the order option selected:

Order option	Equipment
"MVSG" or "Safety Equipment"	1 x MOXA 1210T
"MVSG + Safety Equipment"	2 x MOXA 1210T
"MVSG + Remote Control" or "MVSG + Remote Control + Safety Equipment"	1 x MOXA 1210T and 1 x MOXA 1212T

If the MV Power Station is no longer equipped with an uninterruptible power supply (option 19\_0), the media converter must be supplied by an external voltage supply. The grid voltage of the voltage supply must be 230 V /  $\pm 10\%$ , 50 Hz / 60 Hz. The required terminals are installed in the station subdistribution.

The customer must connect the fiber media converters to communication without the order option "Communication Package".

The default settings for the IP addresses of the fiber media converters can be found in the manufacturer documentation.

The terminals of the fiber media converters have the following assignments:

### MV Switchgear Components

Component	Signal type	Contact	Terminal
<b>Transformer panel</b>			
Circuit breaker	Closed	NC	D10
	Open	NO	D11
Disconnect switch	Closed	NC	D12
	Open	NO	D13
Ground switch	Closed	NC	D14
	Open	NO	D15
<b>Cable panel 1</b>			
Ground switch	Closed	NC	D16
	Open	NO	D17
Load-break switch	Closed	NC	D18
	Open	NO	D19
<b>Cable panel 2</b>			
Ground switch	Closed	NC	D110
	Open	NO	D111
Load-break switch	Closed	NC	D112
	Open	NO	D113
SF6 pressure gauge	Pressure OK / not OK	NO	D114
Protective relay trigger	Alarm tripped	NC	D115

**Components of safety equipment**

Component	Signal type	NC/NO	Terminal
Fast-stop switch	Enabled / not enabled	NO	DI0
Heat detector	Tripped	NC	DI1
	Tripped	NO	DI2

**Components of remote control**

Component	Signal type	NC/NO	Terminal
Local / remote switch	Local control	NC	DI3
	Remote control	NO	DI4
Condition of the control fields in the circuit breaker	Tensioned / not tensioned	NO	DI5
Not used	-	-	DI6
The capacitive voltage indicators at the transformer panel of the MV switchgear	Not available	NC	DI7
	Available	NO	DIO0
The capacitive voltage indicators at the cable panel 1 of the MV switchgear	Not available	NC	DIO1
	Available	NO	DIO2
The capacitive voltage indicators at the cable panel 2 of the MV switchgear	Not available	NC	DIO3
	Available	NO	DIO4
Circuit breaker	Open	Relay	DIO5
	Closing	Relay	DIO6

## 13.7 Communication

### 13.7.1 Communication Network in the MV Power Station

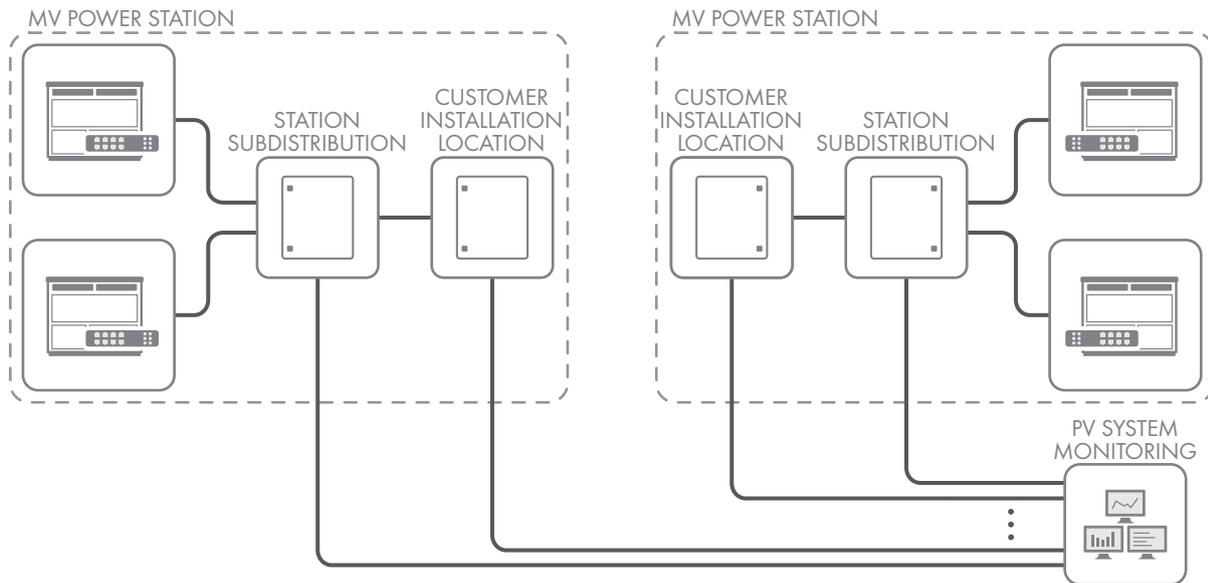


Figure 127: Communication Network in the MV Power Station with the Order Option "Communication Package"

The terminal for the communication network is inside the station subdistribution of the MV Power Station.

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.

## With the order option "Communication Package"

To set up a redundant network with several devices, a managed switch must be present in the station subdistribution. The managed switch provides the option to set up a network with copper cables or optical fibers. In the case of optical fibers, a connection from the managed switch to a splice box has been factory-set internally to which the optical fibers can be connected.

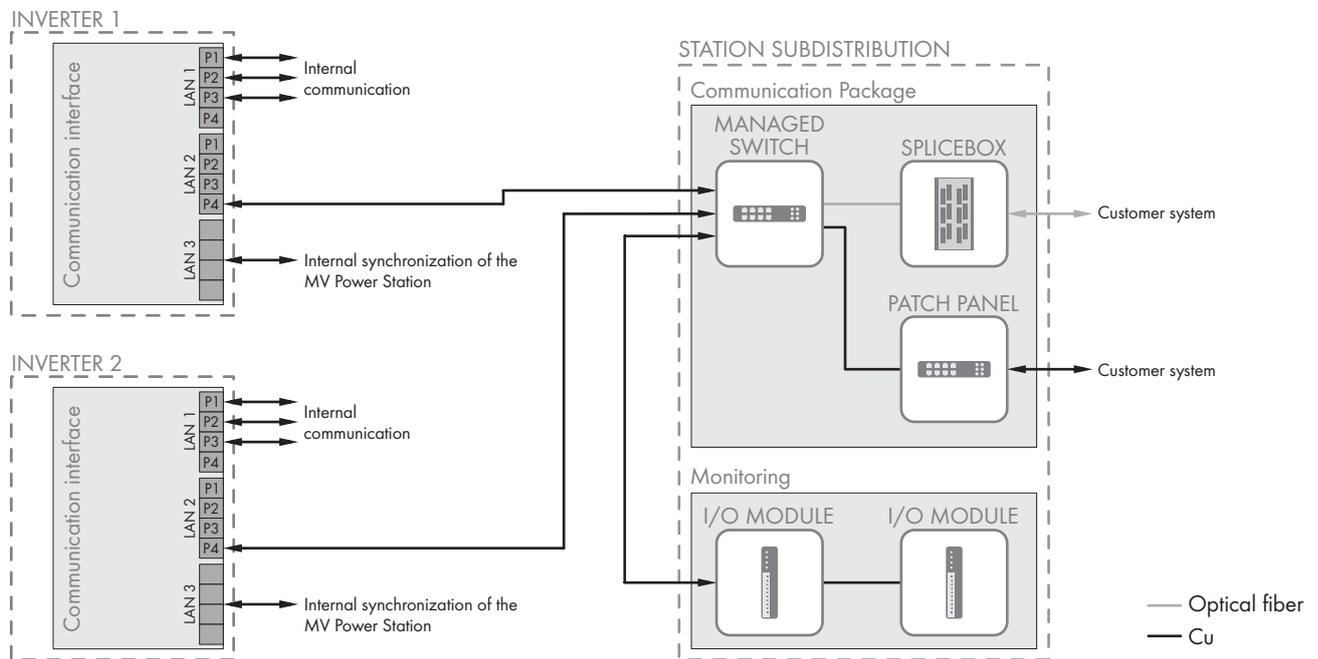


Figure 128: MV Power Station with order option "Communication Package"

The terminal **LAN 2 Port 4** of the inverter is directly connected to the managed switch in the station subdistribution. The default settings for the IP addresses of the managed switch can be found in the manufacturer documentation.

If the MV Power Station is no longer equipped with an uninterruptible power supply (option 19\_0), the managed switch must be supplied by an external voltage supply. The grid voltage of the voltage supply must be 230 V /  $\pm 10\%$ , 50 Hz / 60 Hz. The required terminals are installed in the station subdistribution.

### Without the order option "Communication Package"

With the order option without "Communication Package", no managed switch is available in the station subdistribution. To set up a redundant network with several devices, a managed switch must be present in the inverter. A connection from the managed switch of the inverter to the station subdistribution has been factory-set.

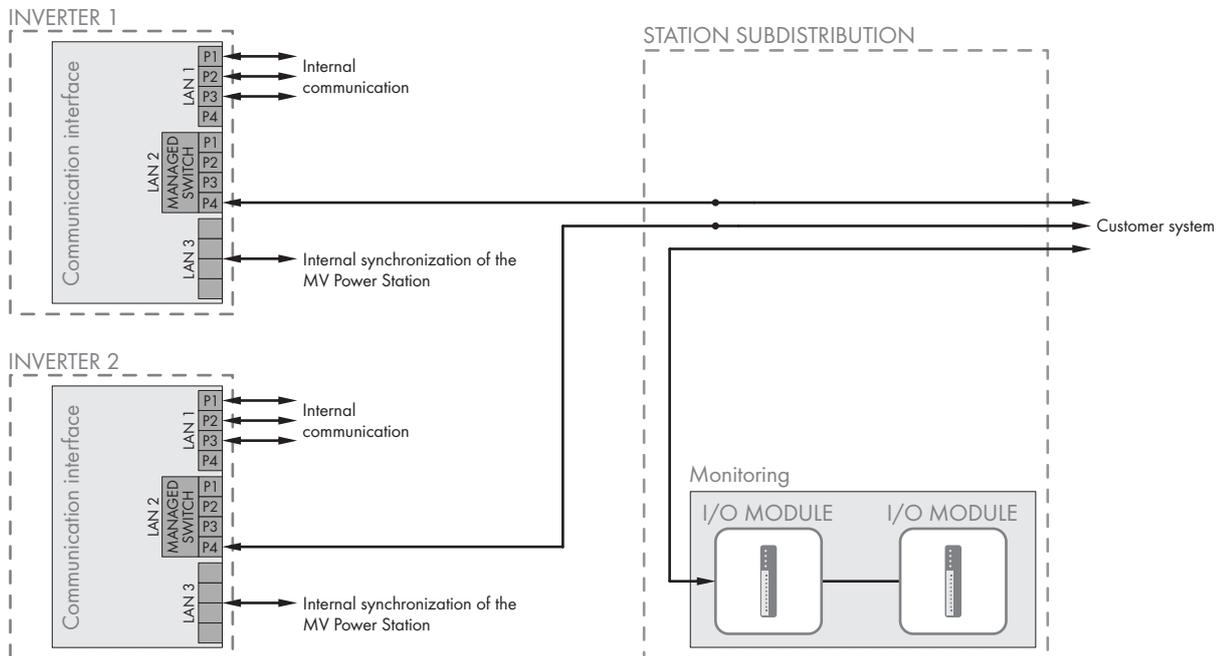


Figure 129: MV Power Station without order option "Communication Package"

### 13.7.2 Communication between the two inverters

In the MV Power Station, both inverters communicate with each other to exchange setpoints for example. The inverters communicate via Modbus protocol. One of the two inverters starts the master operation.

Both inverters of the MV Power Station implement the external specifications for setpoints and reactive power values. When the specifications for the reactive power values have been implemented, the inverter defined as slave reduces its feed-in power. The inverter defined as master continues feeding into the utility grid according to the specifications. If it is not possible for both inverters to implement the external specifications, the inverter defined as master implements the specifications.

Both inverters communicate via the internal communication interface **LAN 3**.

The monitoring of the fans of the MV transformer is shared by both inverters. If a fan of the MV transformer fails, the total active power is reduced.

Both inverters derate 20% of the rated power if the communication of the internal LAN3 connection between the inverters is disrupted.

The configuration of the communication between both inverters is carried out during commissioning. The parallel operation of both inverters is activated by the parameter **Hw.MvpsMod**.

## 14 Instantaneous Values and Parameters

### 14.1 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
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
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	DrtlgbtTmp	Off   On
674	DrtCabTmp	Off   On
690	DrtExlStt	No VAMax Derating   Derating VAMax MVPS Communication   Derating VAMax External Temperature   Derating VAMax Transformer Temperature

No.	Name	Value/range
675	FanCtl.Stt	FanAll 0 Percent   TmpCtl   FanCoupling   TmpCtl Cab FanStkMin   TmpCtl Igbt FanCabMax   TmpCtl Cab FanStkMax   FanAll 100 Percent   FanStkMax TmpColWarning   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
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	–
754	TmpStk2.Pcb	–
755	TmpStk3.Pcb	–

No.	Name	Value/range
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
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	–
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	–
6611	DevInf.ChkSum.DccCpu	–
6613	DevInf.ChkSum.ContCpu2	–
6614	DevInf.ChkSum.DstFpga2	–

No.	Name	Value/range
6644	PvGnd.Rislso	–
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	–
6813	Cnt.GfdiTr	–
6815	Cnt.GfdiSw	–
6819	TmpStk.IgbtSpt	–

No.	Name	Value/range
6820	TmpCab.Spt	–
6864	InvMs.TotEff	–
6968	ErrLcn	–
7000	VolNomSpt	0.000 pu to 1.150 pu
7073	Cnt.YstdAcWhOut	–
7081	Cnt.DrtTmExt	–
7083	Cnt.DrtTmInvCfg	–
7088	MppStt	Ms OpnCrcVol   Rampdown Pv Vol   Track   Track lmd   Ext PvVolSpt   Stop Track   Rmp After Stop
7089	Mpp.PvVolSpt	–
7114	ErrRmgTm	–
7182	Cnt.TotAcWhIn	–
7180	Cnt.AcWhIn	–
7218	Eps.RmgTm	–
7221	PwrOffReas	No Power Off Reason   Error: Critical Error, ProErr active   Error   Reserve 1   Stop: Key Switch   Stop: Parameter InvOpmod   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 3   WaitAc   WaitDc: DC Voltage   WaitDc: Bender   WaitDc: DC precharge waiting period   Selftest active   IO Test active   Reserve 5   Low Power Set Point   Battery   Reserve 6
7233	GriMs.Vol.PsNom	–
7242	DcMs.Vol.Max	0.0 V to 2000.0 V
7249	PresTrf	–
7253	PresTrf.ErrStt	Ok   Error
7359	InvTyp	PV   Battery   PV and Battery
7300	Cnt.TotDcWhOut	–
7302	Cnt.DcWhOut	–
7382	DcMs.BfpAmp	–
7383	BfpBits	–
7488	DclVolSpt	0 V to 2000 V
7569	Mvps.ChkComStt	No test   Test okay   Test not okay

No.	Name	Value/range
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	–
8060	ActErrNo6	–
8061	ActErrTxt6	–
8062	ActErrLcn6	–
8063	ActErrNo7	–
8064	ActErrTxt7	–

No.	Name	Value/range
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	–

## 14.2 Parameters

No.	Name	Value/range	Default value
305	DclVolSptMan	0 V to 2000 V	850 V
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   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	VArRtg	1 kVAr to 5000 kVAr	device-specific
323	VARtg	1 kVA to 5000 kVA	device-specific
730	VADrtPriMod	VAr   W	VAr

No.	Name	Value/range	Default value
329	InvOpMod	Stop   Operation	Operation
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
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.HzQilIntv	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	Frnt.LoDb	0.00 pu to 1.00 pu	country-specific
425	Frnt.HiDb	1.00 pu to 1.50 pu	country-specific
426	Frnt.WaitTmHi	0.02 s to 20.00 s	country-specific
427	Frnt.LoVolRef1	0.00 pu to 1.00 pu	1.00 pu
428	Frnt.LoVolRef2	0.00 pu to 1.00 pu	country-specific
429	Frnt.LoVolRef3	0.00 pu to 1.00 pu	0.00 pu
430	Frnt.LoGra1	0.00 to 10.00	country-specific
431	Frnt.LoGra2	0.00 to 10.00	2.00
432	Frnt.LoGra3	0.00 to 10.00	0.00

No.	Name	Value/range	Default value
433	Frnt.HiVolRef1	1.00 pu to 2.00 pu	1.00 pu
434	Frnt.HiVolRef2	1.00 pu to 2.00 pu	country-specific
435	Frnt.HiVolRef3	1.00 pu to 2.00 pu	country-specific
436	Frnt.HiGra1	0.00 to 10.00	country-specific
437	Frnt.HiGra2	0.00 to 10.00	country-specific
438	Frnt.HiGra3	0.00 to 10.00	country-specific
439	Frnt.VolDFilTm	0.0 s to 600.0 s	country-specific
440	Frnt.AmpQFilTm	0.0 s to 600.0 s	country-specific
441	Frnt.AmpDGRA	0.00 pu/s to 100.00 pu/s	country-specific
444	VCtl.OpMaxNom	0.00 pu to 2.00 pu	country-specific
445	VCtl.OpMinNom	0.00 pu to 2.00 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

No.	Name	Value/range	Default value
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
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

No.	Name	Value/range	Default value
497	GriErrTm	0 s to 3600 s	country-specific
512	Mpp.PvVolStrGain	0.20 to 1.00	0.80
733	ErrClr	Ackn	–
718	Frnt.Mod	Disable   Full   Partial   Active Current Constant   Momentary Cessation	country-specific
645	DrtCabTmp.Mod	0 to 2	1
725	WGraMod	Enable   Disable	Enable
726	WGra	0.000 pu/s to 100.000 pu/s	0.200 pu/s
727	VArGraMod	Enable   Disable	Enable
728	VArGra	0.000 pu/s to 100.000 pu/s	0.100 pu/s
6003	WSptMan	-5000 kW to +5000 kW	2000 kW
6004	WSptFlb	0 kW to 5000 kW	2000 kW
6005	VArSptMan	-5000 kVAr to +5000 kVAr	0 kVAr
6006	VArSptFlb	-5000 kVAr to +5000 kVAr	0 kVAr
6007	PFSptMan	-1.0000 to +1.0000	1.0000
6008	PFSptFlb	-1.0000 to +1.0000	1.0000
6009	GriMng.ComFltFlbVArMod	Error   Standby   PF   PFMeas   VAr   Last setpoint	Error
6029	PFCtlW.WRef1	0.00 pu to 1.00 pu	0.00 pu
6030	PFCtlW.WRef2	0.00 pu to 1.00 pu	1.00 pu
6031	PFCtlW.WRef3	0.00 pu to 1.00 pu	1.00 pu
6032	PFCtlW.WRef4	0.00 pu to 1.00 pu	1.00 pu
6033	PFCtlW.WRef5	0.00 pu to 1.00 pu	1.00 pu
6034	PFCtlW.PFRef1	-1.00 pu to +1.00 pu	-0.90 pu
6035	PFCtlW.PFRef2	-1.00 pu to +1.00 pu	0.90 pu
6036	PFCtlW.PFRef3	-1.00 pu to +1.00 pu	1.00 pu
6037	PFCtlW.PFRef4	-1.00 pu to +1.00 pu	1.00 pu
6038	PFCtlW.PFRef5	-1.00 pu to +1.00 pu	1.00 pu
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

No.	Name	Value/range	Default value
6044	PFCtlW.VolEnaTm	0 ms to 1000000 ms	1000 ms
6045	PFCtlW.VolDsaTm	0 ms to 1000000 ms	1000 ms
6047	VArCtIVol.VolOfs	-10.0000 pu to +10.0000 pu	0.0000 pu
6048	VArCtIVol.LoVolRef1HiVolRef1	0.000 pu to 2.000 pu	1.000 pu
6050	VArCtIVol.LoVolRef2	0.000 pu to 2.000 pu	0.945 pu
6051	VArCtIVol.LoVolRef3	0.000 pu to 2.000 pu	0.000 pu
6052	VArCtIVol.HiVolRef2	0.000 pu to 2.000 pu	1.055 pu
6053	VArCtIVol.HiVolRef3	0.000 pu to 2.000 pu	2.000 pu
6054	VArCtIVol.LoGra1	0.00 pu to 100.00 pu	0.00 pu
6055	VArCtIVol.HiGra1	0.00 pu to 100.00 pu	0.00 pu
6056	VArCtIVol.LoGra2	0.00 pu to 100.00 pu	15.00 pu
6057	VArCtIVol.HiGra2	0.00 pu to 100.00 pu	15.00 pu
6058	VArCtIVol.LoGra3	0.00 pu to 100.00 pu	0.00 pu
6059	VArCtIVol.HiGra3	0.00 pu to 100.00 pu	0.00 pu
6060	VArCtIVol.VArSptFilTm	0.00 s to 1000.00 s	0.50 s
6061	VArCtIVol.WMod	0 to 1	0
6062	VArCtIVol.WEnaW	0.00 pu to 1.00 pu	0.50 pu
6063	VArCtIVol.WDsaW	0.00 pu to 1.00 pu	0.50 pu
6064	VArCtIVol.WEnaTm	0 ms to 1000000 ms	1000 ms
6065	VArCtIVol.WDsaTm	0 ms to 1000000 ms	1000 ms
6074	GriMng.ComFltTmLim	0 s to 86400 s	300 s
6073	GriMng.ComFltFlbTmLim	0 s to 86400 s	3600 s
6071	GriMng.ComFltFlbWMod	Error   Standby   W   Last setpoint	Error
6078	GriMng.WMod	WCtlAnIn   WCtlCom   WCtlMan   Off	WCtlMan
6080	GriMng.VArMod	VArCtIVol   PFCtlAnIn   VArCtIVolPi   PFCtlW Com   AutoCom   VArCtIVol   PFCtlMan   Off	VArCtIVolMan
6088	GriMng.InvVArMod	Off   VArCtIVol   VArCtIVolPi   PFCtlW	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

No.	Name	Value/range	Default value
6109	Frnt.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	device-specific
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.RisIsoWarnLim	0.1 kΩ to 6553.0 kΩ	device-specific
6642	PvGnd.RisIsoErrLim	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	0.00 ms to 1000.00 ms	1.00 ms

No.	Name	Value/range	Default value
6710	Pld.Mod	Enable   Disable	Disable
6817	Cnt.Rs	Select counter to reset   All counter   TotAcWhOut, TotDcWhIn   AcWhOut, DcWhIn   YstdAcWhOut   TotDcWhOut, TotAcWhIn   DcWhOut, AcWhIn   TotVArOvExt   TotVArUnExt   TotOpTm   TotFeedTm   DwnTm   FanStkTm   FanCab1Tm   FanCab2Tm   FanMvpsTm   HtCabTm   HtLoExlTm   AcSw   PreChaSw   CapacSw   GfdiSw   GfdiTr	Select counter to reset
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
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

No.	Name	Value/range	Default value
6993	AuxSply.ConOpnTm	0 ms to 100000 ms	1 ms
6995	AuxSply.ConClsTm	0 ms to 100000 ms	500 ms
7048	PvGnd.AcIsoMonTm	0.0 s to 86400.0 s	300.0 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
7239	InvTstMod	No test   Fan   Signal lamp   MVTrf Fan   Service test	No test
7372	Bfp.Ena	Enable   Disable	Disable
7374	Bfp.Amplim	0 A to 500 A	35 A
7406	Hw.MvpsMod	Disable (Single Inverter)   MVPS SMA Double   MVPS Customer Double   MVPS SMA Single	Disable (Single Inverter)
7449	GriMng.VolNomMod	VolNomCtlCom   VolNomCtlMan   Off	VolNomCtlMan
7455	VolNomSptMan	0.850 pu to 1.150 pu	1.000 pu
7451	GriMng.ComFltFlbVolNomMod	Error   Standby   VolNom   Last setpoint	Error
7453	VolNomSptFlb	0.850 pu to 1.150 pu	1.000 pu
7461	GriMng.ComFltFlbRstrVArMod	Error   Standby   PF   VAr	Error
7463	GriMng.ComFltFlbRstrWMod	Error   Standby   W	Error
7465	GriMng.ComFltFlbRstrVolNomMod	Error   Standby   VolNom	Error
7469	InstFunc	Systemreset Acc, Dcc, Rio, Cont	–
7523	WGraStr	0.00100 pu/s to 100.00000 pu/s	100.00000 pu/s
7525	VArCtlVol.EnaTm	0 ms to 100000 ms	0 ms
7527	WCtlHz.EnaTm	0 ms to 100000 ms	0 ms
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
7892	Frnt.WaitTmLo	0.02 s to 20.00 s	country-specific
7894	Frnt.HystEna	Enable   Disable	Disable

No.	Name	Value/range	Default value
7896	Frnt.LoDbHyst	0.00 pu to 1.00 pu	0.92 pu
7898	Frnt.HiDbHyst	1.00 pu to 1.50 pu	1.08 pu
7900	Frnt.ExpryEna	Enable   Disable	Disable
7902	Frnt.LoDbExpry	0.00 pu to 1.00 pu	0.90 pu
7904	Frnt.HiDbExpry	1.00 pu to 1.50 pu	1.10 pu
7906	Frnt.ExpryTm	0.00 s to 10000.00 s	60.00 s
7908	Frnt.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
8094	FrntStep.HiDb	1.00 pu to 1.50 pu	1.03 pu
8096	FrntStep.LoDb	0.00 pu to 1.00 pu	0.97 pu
8098	FrntStep.ExpryTm	0.00 s to 10000.00 s	1.00 s
8100	FrntStep.Ena	Enable   Disable	Disable
8102	FrntStep.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.Crv.NumPt	1 to 4	country-specific
8160	WCtlVol.Vol1	0.00 pu to 2.00 pu	country-specific
8162	WCtlVol.Vol2	0.00 pu to 2.00 pu	country-specific
8164	WCtlVol.Vol3	0.00 pu to 2.00 pu	country-specific
8166	WCtlVol.Vol4	0.00 pu to 2.00 pu	country-specific
8168	WCtlVol.W1	0.00% to 200.00%	country-specific
8170	WCtlVol.W2	0.00% to 200.00%	country-specific
8472	WCtlVol.W3	0.00% to 200.00%	country-specific
8174	WCtlVol.W4	0.00% to 200.00%	country-specific
8176	WCtlVol.WRefMod	WNom   W actual   WSnptMax	WNom
8178	WCtlVol.WFilEna	Enable   Disable	Enable
8180	WCtlVol.WFilTm	1.00 s to 600.00 s	country-specific

No.	Name	Value/range	Default value
8182	WCtlVol.WGraEna	Enable   Disable	Disable
8184	WCtlVol.WGraPos	0.00%/s to 1000.00%/s	country-specific
8186	WCtlVol.WGraNeg	0.00%/s to 1000.00%/s	country-specific
8188	WCtlVol.AciDITm	0.00 s to 600.00 s	country-specific

## 15 Technical Data

### 15.1 MV Power Station 4400

<b>DC Input</b>	
Maximum input voltage	1100 V
Maximum input current	2 x 3960 A
Number of DC inputs	2 x 24 two-pole fuse (2 x 32 A single-pole fuse)
Available fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A
<b>AC output</b>	
Standard AC power at +35°C / +40°C / +45°C*	4400 kVA / 4000 kVA / 0 kVA
Optional AC power at +35°C / +50°C / +55°C*	4400 kVA / 4000 kVA / 0 kVA
Nominal AC voltage	11 kV to 35 kV
AC voltage tolerance	±10 %
AC power frequency	50 Hz / 60 Hz**
Transformer vector groups	Dy11y11 / YNd11d11**
Maximum output current at 33 kV	78 A
Maximum total harmonic distortion	< 3 %
Power factor at rated power/displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited
Feed-in phases	3
* Information based on inverter; depending on the order option with 1000 m	
** Optional	
<b>Efficiency</b>	
Maximum efficiency*	98.6 %
European weighted efficiency*	98.4 %
CEC weighted efficiency*	98.0 %
* Information based on inverter	
<b>General Data</b>	
Width x height x depth (transport dimensions)	12192 mm x 2896 mm x 2438 mm
Weight	< 26.0 t
Maximum self-consumption*	< 16.2 kW
Self-consumption at partial load*	< 3.6 kW
Average self-consumption *	< 4.0 kW
Standby consumption*	< 600 W

<b>General Data</b>	
Max. permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above MSL	1000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	2000 m / 3000 m / 4000 m
Fresh air consumption	20000 m <sup>3</sup> /h
Medium-voltage and low-voltage compartment degree of protection according to IEC 60529	IP23D
Inverter electronics degree of protection	IP65
Degree of protection of the busbar conduit between the inverter and MV transformer	IP54

\* Information based on inverter

## 15.2 MV Power Station 4950

<b>DC Input</b>	
Maximum input voltage	1100 V
Maximum input current	2 x 3960 A
Number of DC inputs	2 x 24 two-pole fuse (2 x 32 A single-pole fuse)
Available fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A
<b>AC output</b>	
Standard AC power at +35°C / +40°C / +45°C*	4950 kVA / 4500 kVA / 0 kVA
Optional AC power at +35°C / +50°C / +55°C*	4950 kVA / 4500 kVA / 0 kVA
Nominal AC voltage	11 kV to 35 kV
AC voltage tolerance	±10 %
AC power frequency	50 Hz / 60 Hz**
Transformer vector groups	Dy11y11 / YNd11d11**
Maximum output current at 33 kV	87 A
Maximum total harmonic distortion	< 3 %
Power factor at rated power/displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited
Feed-in phases	3

\* Information based on inverter; depending on the order option with 1000 m

\*\* Optional

<b>Efficiency</b>	
Maximum efficiency*	98.6 %

**Efficiency**

European weighted efficiency*	98.4 %
CEC weighted efficiency*	98.0 %

\* Information based on inverter

**General Data**

Width x height x depth (transport dimensions)	12192 mm x 2896 mm x 2438 mm
Weight	< 26.0 t
Maximum self-consumption *	< 16.2 kW
Self-consumption at partial load*	< 3.6 kW
Average self-consumption *	< 4.0 kW
Standby consumption*	< 600 W
Max. permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above MSL	1000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	2000 m / 3000 m / 4000 m
Fresh air consumption	20000 m <sup>3</sup> /h
Medium-voltage and low-voltage compartment degree of protection according to IEC 60529	IP23D
Inverter electronics degree of protection	IP65
Degree of protection of the busbar conduit between the inverter and MV transformer	IP54

\* Information based on inverter

**15.3 MV Power Station 5000****DC Input**

Maximum input voltage	1500 V
Maximum input current	2 x 3200 A
Number of DC inputs	2 x 24 two-pole fuse (2 x 32 A single-pole fuse)
Available fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A

**AC output**

Standard AC power at +35 °C / +40 °C / +45 °C*	5000 kVA / 4500 kVA / 0 kVA
Optional AC power at +35 °C / +50 °C / +55 °C*	5000 kVA / 4500 kVA / 0 kVA
Nominal AC voltage	11 kV to 35 kV
AC voltage tolerance	±10 %

<b>AC output</b>	
AC power frequency	50 Hz / 60 Hz**
Transformer vector groups	Dy11y11 / YNd11d11**
Maximum output current at 33 kV	88 A
Maximum total harmonic distortion	< 3 %
Power factor at rated power/displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited
Feed-in phases	3
* Information based on inverter; depending on the order option with 1000 m	
** Optional	
<b>Efficiency</b>	
Maximum efficiency*	98.6 %
European weighted efficiency*	98.3 %
CEC weighted efficiency*	98.0 %
* Information based on inverter	
<b>General Data</b>	
Width x height x depth (transport dimensions)	12192 mm x 2896 mm x 2438 mm
Weight	< 26.0 t
Maximum self-consumption*	< 16.2 kW
Self-consumption at partial load*	< 3.6 kW
Average self-consumption *	< 4.0 kW
Standby consumption*	< 740 W
Max. permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above MSL	1000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	2000 m / 3000 m / 4000 m
Fresh air consumption	20000 m <sup>3</sup> /h
Medium-voltage and low-voltage compartment degree of protection according to IEC 60529	IP23D
Inverter electronics degree of protection	IP65
Degree of protection of the busbar conduit between the inverter and MV transformer	IP54
* Information based on inverter	

## 15.4 MV Power Station 5500

DC Input	
Maximum input voltage	1500 V
Maximum input current	2 x 3200 A
Number of DC inputs	2 x 24 two-pole fuse (2 x 32 A single-pole fuse)
Available fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A
AC output	
Standard AC power at +35°C / +40°C / +45°C*	5500 kVA / 5000 kVA / 0 kVA
Optional AC power at +35°C / +50°C / +55°C*	5500 kVA / 5000 kVA / 0 kVA
Nominal AC voltage	11 kV to 35 kV
AC voltage tolerance	±10 %
AC power frequency	50 Hz / 60 Hz**
Transformer vector groups	Dy11y11 / YNd11d11**
Maximum output current at 33 kV	97 A
Maximum total harmonic distortion	< 3 %
Power factor at rated power/displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited
Feed-in phases	3
* Information based on inverter; depending on the order option with 1000 m	
** Optional	
Efficiency	
Maximum efficiency*	98.7 %
European weighted efficiency*	98.6 %
CEC weighted efficiency*	98.5 %
* Information based on inverter	
General Data	
Width x height x depth (transport dimensions)	12192 mm x 2896 mm x 2438 mm
Weight	< 26.0 t
Maximum self-consumption*	< 16.2 kW
Self-consumption at partial load*	< 3.6 kW
Average self-consumption*	< 4.0 kW
Standby consumption*	< 740 W
Max. permissible value for relative humidity (non-condensing)	15% to 95%

<b>General Data</b>	
Maximum operating altitude above MSL	1000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	2000 m / 3000 m / 4000 m
Fresh air consumption	20000 m <sup>3</sup> /h
Medium-voltage and low-voltage compartment degree of protection according to IEC 60529	IP23D
Inverter electronics degree of protection	IP65
Degree of protection of the busbar conduit between the inverter and MV transformer	IP54

\* Information based on inverter

## 15.5 MV Power Station 6000

<b>DC Input</b>	
Maximum input voltage	1500 V
Maximum input current	2 x 3200 A
Number of DC inputs	2 x 24 two-pole fuse (2 x 32 A single-pole fuse)
Available fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A

<b>AC output</b>	
Standard AC power at +35°C / +40°C / +45°C*	6000 kVA / 5400 kVA / 0 kVA
Optional AC power at +35°C / +50°C / +55°C*	6000 kVA / 5400 kVA / 0 kVA
Nominal AC voltage	11 kV to 35 kV
AC voltage tolerance	±10 %
AC power frequency	50 Hz / 60 Hz**
Transformer vector groups	Dy11y11 / YNd11d11**
Maximum output current at 33 kV	105 A
Maximum total harmonic distortion	< 3 %
Power factor at rated power/displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited
Feed-in phases	3

\* Information based on inverter; depending on the order option with 1000 m

\*\* Optional

<b>Efficiency</b>	
Maximum efficiency*	98.7 %
European weighted efficiency*	98.6 %

**Efficiency**

CEC weighted efficiency*	98.5 %
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\* Information based on inverter

**General Data**

Width x height x depth (transport dimensions)	12192 mm x 2896 mm x 2438 mm
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Weight	< 26.0 t
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Maximum self-consumption*	< 16.2 kW
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Self-consumption at partial load*	< 3.6 kW
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Average self-consumption *	< 4.0 kW
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Standby consumption*	< 740 W
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Max. permissible value for relative humidity (non-condensing)	15% to 95%
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Maximum operating altitude above MSL	1000 m
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Maximum operating altitude above MSL for option "Installation at high altitudes"	2000 m / 3000 m / 4000 m
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Fresh air consumption	20000 m <sup>3</sup> /h
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Medium-voltage and low-voltage compartment degree of protection according to IEC 60529	IP23D
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Inverter electronics degree of protection	IP65
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Degree of protection of the busbar conduit between the inverter and MV transformer	IP54
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\* Information based on inverter

## 16 Appendix

### 16.1 Requirement on the overall system

- When designing the components of the PV 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.
- During configuration of the PV system, the scale times of the various MV 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.

### 16.2 Load Profile of the MV Power Station

In order to operate the MV Power Station within the permitted temperature range, when planning the PV power plant it must be ensured that the MV Power Station feeds in with 100% station power for a maximum of twelve hours per day.

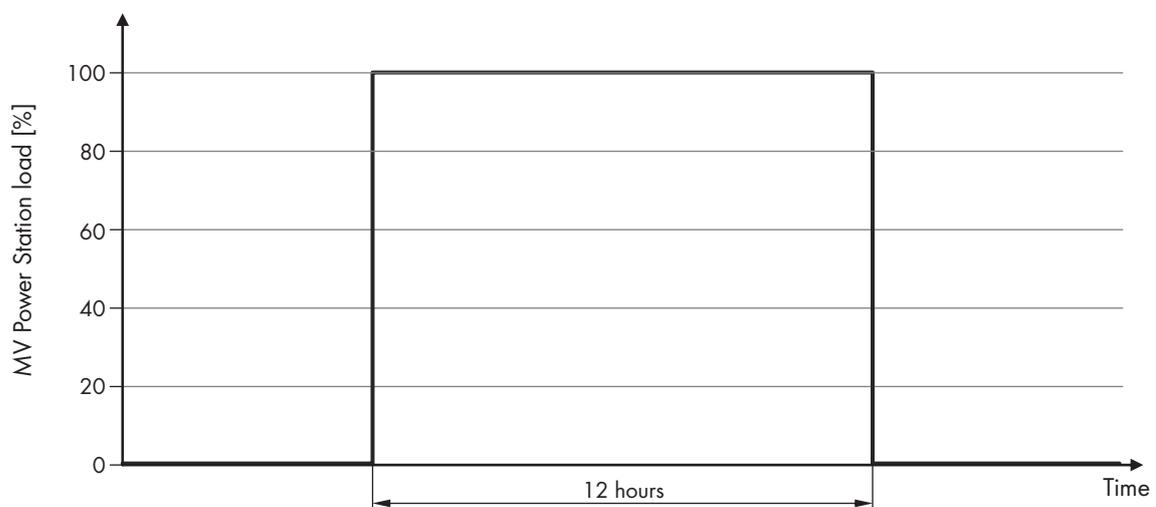


Figure 130: Maximum possible load profile of the MV Power Station without Q at Night

Depending on the order option, the MV Power Station can be operated with 60% of the station power outside this time.

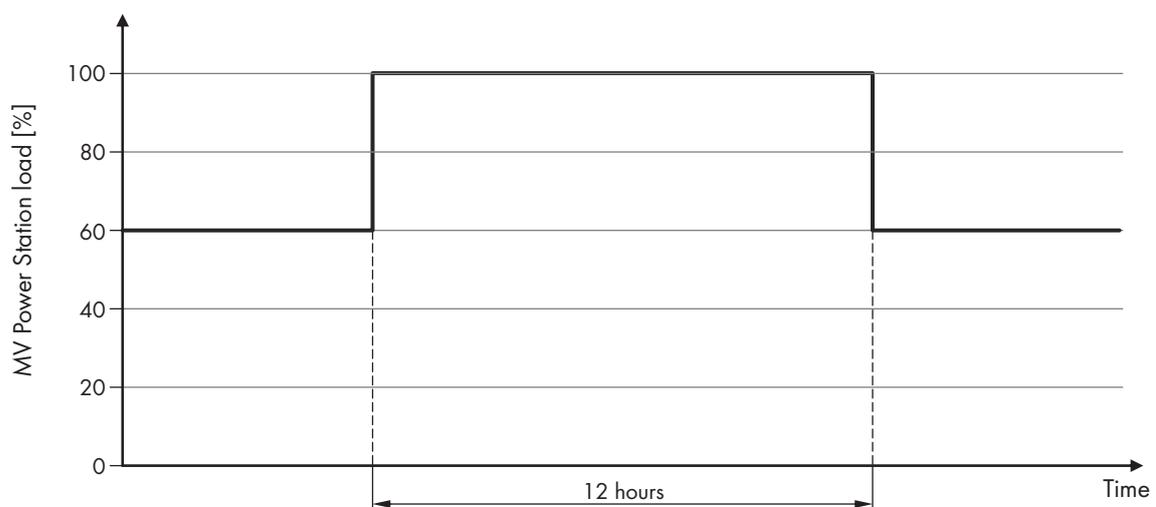


Figure 131: Maximum possible load profile of the MV Power Station with Q at Night

## 16.3 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 maximum value 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 requirement of the MV Power Station must be assured. The fresh air consumption is: 20000 m<sup>3</sup>/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 for mechanically active substances in accordance with IEC 60721-3-4: 1995 must be observed.
- The air quality for chemically active substances in accordance with IEC 60721-3-4: 1995 must be observed.
- If the inverter is deployed at locations with ambient conditions rating 4C2, it will be subject to a higher concentration of chemically active substances which can affect the surface of the inverter. Such changes to the surface do not have any effect on the functionality of the inverter.

### Equipment and ambient conditions of the MV Power Station:

Component / order option	Class
Inverter	4C2 / 4S4
MV Power Station order option "Standard"	4C1 / 4S2
MV Power Station order option "Chemically active"	4C2 / 4S2
MV Power Station order option "Chemically active and dusty"	4C2 / 4S4

### The air quality must comply with the following classification of air quality for mechanically active substances:

Ambient conditions for stationary application	Class 4S2	Class 4S4
a) Sand in air [mg/m <sup>3</sup> ]	300	4000
b) Dust (suspended matter) [mg/m <sup>3</sup> ]	5.0	20.0
c) Dust (deposited) [mg/m <sup>2</sup> h]	20	80
Installation sites in sparsely populated areas, not close to sand sources.	x	x
Installation sites in areas with sand- or dust sources, including densely populated areas	x	x
Installation sites where sand- or dust generating processes exist, or installation sites located in geographic areas in which the wind normally bears sand or dust.	-	x
Installation sites where the air can regularly contain high levels of sand or dust - either due to geographical or process-related circumstances.	-	x

The air quality must comply with the following classification of air quality for chemically active substances:

Ambient conditions for stationary application	Class 4C1	Class 4C2	
	Threshold value	Mean value	Threshold value
a) Sea salt	-	Occurrence of salt spray	
b) Sulfur dioxide [mg/m <sup>3</sup> ]	0.1	0.3	1.0
c) Hydrogen sulfide [mg/m <sup>3</sup> ]	0.01	0.1	0.5
d) Chlorine [mg/m <sup>3</sup> ]	0.1	0.1	0.3
e) Hydrogen chloride [mg/m <sup>3</sup> ]	0.1	0.1	0.5
f) Hydrogen fluoride [mg/m <sup>3</sup> ]	0.003	0.01	0.03
g) Ammonia [mg/m <sup>3</sup> ]	0.03	1.0	3.0
h) Ozone [mg/m <sup>3</sup> ]	0.01	0.05	0.1
i) Nitrogen oxides [mg/m <sup>3</sup> ]	0.1	0.5	1.0
Installation sites in rural or densely populated areas with little industry and moderate traffic volume	x		x
Installation sites in densely populated areas with industry and high traffic volume	-		x

### Treating the station container surface

The surface of the station container is to be treated differently depending on the "Environment" order option.

Surface components	Coating thickness in accordance with ambient conditions	
	Standard	Chemically active
Station container steel sheet	1.5 mm to 5 mm	1.5 mm to 5 mm
Primer	0.060 mm	0.060 mm
Color coating	0.120 mm	0.220 mm

## 16.4 The nominal current of the MV switchgear depends in the ambient temperature.

The nominal current of the MV switchgear depends in the ambient temperature of the MV Power Station. During PV power plant design, the maximum ampacity must be considered at high temperatures.

Ambient temperature of the MV Power Station	Nominal current
30°C	630 A
40°C	565 A
45°C	530 A
50°C	430 A

## 16.5 Measurement accuracy

The inverter is not equipped with a calibrated meter. The display values may deviate from the actual values and must not be used as a basis for invoicing. 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:  $\pm 5$  V
- Frequency measurement:  $\pm 0.06$  Hz
- Disconnect time:  $\pm 0.1\%$

## 16.6 Reduction of DC Input Currents for DC Fuses

The DC inputs are fused with LV/HRC fuses. Thermal stress and fluctuating loads result in a screening factor of 0.64. This screening factor must be taken into account in the DC cable design.

Fusing	Maximum DC short-circuit current $I_{SC\_STC}$ (Screening factor 0.64)
200 A	128.0 A
250 A	160.0 A
315 A	201.6 A
350 A	224.0 A
400 A	256.0 A
450 A	288.0 A
500 A	320.0 A

When selecting the fuse size, always consider the short-circuit current of the connected PV array at standard test conditions ( $I_{SC\_STC}$ ).

The reduction factors apply for a maximum irradiation of  $1200 \text{ W/m}^2$  (hourly average value of the horizontal global radiation). In case the irradiation is higher, the reduction factor must be adapted linearly.

## 16.7 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 up to three parts.
- Parameters and instantaneous values made up of just one part pertain to the entire inverter.
- The name begins with the module code to which the parameter or instantaneous value refers. As a result, those parameters and instantaneous values belonging e.g. to one process or one hardware component 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

Module acronym	Description
Bsc	Parameter of the battery system controller
Cnt	Energy meter for different instantaneous values
DcMs	Monitoring of the DC values
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 the AC values in the inverter
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

## 16.8 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
Measurements	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.

## 16.9 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.

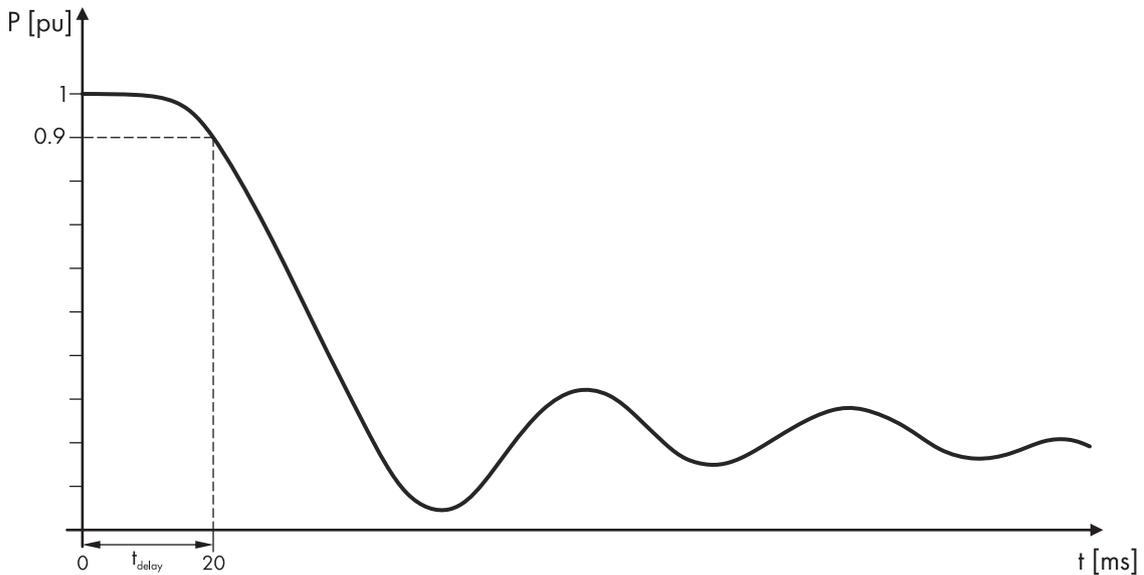


Figure 132: Reaction speed of the Modbus commands in the inverter

The reaction time  $T_{\text{delay}}$  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.

## 16.10 Scope of Delivery

### Scope of delivery of station container

The scope of delivery of the station container is located in the medium-voltage compartment.

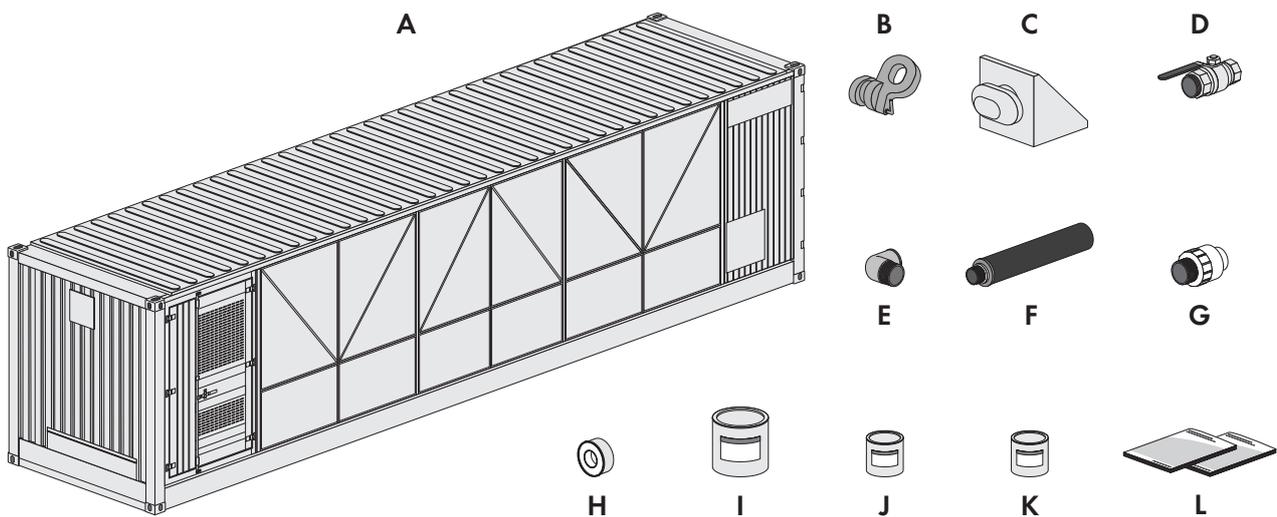


Figure 133: Scope of delivery of station container

Position	Quantity	Designation
A	1	MV Power Station
B	4	Lifting lugs*

Position	Quantity	Designation
C	4	Side twistlock**
D	1	Stopcock
E	1	Angle joint
F	1	Oil filter
G	1	Pre-filter
H	1	Teflon tape
I	2	1 liter spare paint for the station container
J	4	Hardener for the station container
K	2	0.5 liter spare paint for the MV transformer
L	1	Documentation, circuit diagram of the station

\* Optional

\*\* In case of the order option "Earthquake and Storm Package"

### Scope of delivery of the MV switchgear

The accessories of the MV switchgear are located in the medium-voltage compartment.

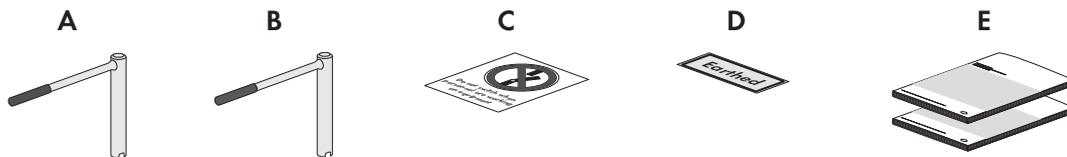


Figure 134: Scope of delivery of the MV switchgear

Position	Quantity	Designation
A	1	Actuation lever for grounding switch
B	1 / 2*	Actuation lever for disconnection unit, load-break switch and circuit breaker
C	1	Magnetic sign "Do not switch"
D	1	Magnetic sign "Earthed"
E	1	Documentation of the MV switchgear

\* Quantity depends on the manufacturer of the MV switchgear

### Additional scope of delivery for order option "Country Package France" and "Country Package Italy"

The additional accessories for the order option "Country Package France" and "Country Package Italy" are to be found in the medium-voltage compartment.

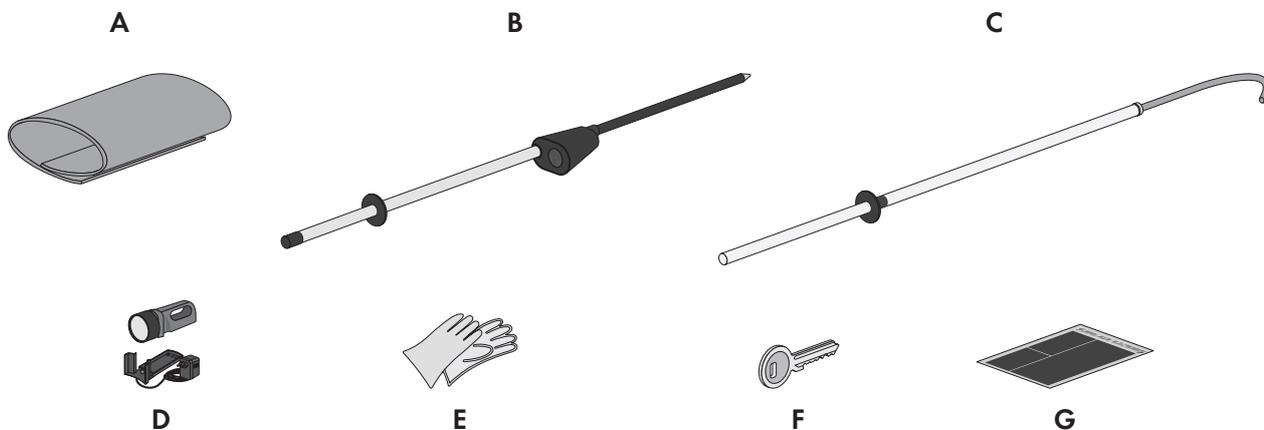


Figure 135: Scope of delivery for order option "Country Package France" and "Country Package Italy"

Position	Quantity	Designation	"France"	"Italy"
A	1	Insulation mat	x	-
B	1	Voltage detector	x	-
C	1	Safety bar	x	-
D	1	Hand lamp with rechargeable battery and charging station	x	-
E	1	Insulation gloves	x	x
F	3/4	Key for access lock for MV transformer	x	x
G	1	Safety Information	x	-

### Scope of delivery of the inverter for order option "DC Input Configuration"

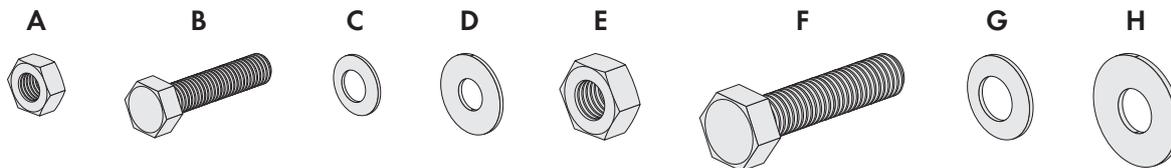


Figure 136: Scope of delivery

Position	Designation	Application
A	Nut M8	PV array grounding
B	Bolt M8	
C	Spring washer M8	
D	Fender washer M8	

Position	Designation	Application
E	Nut M12	Connection of the DC inputs
F	Bolt M12	
G	Spring washer M12	
H	Fender washer M12	

### Scope of delivery of the order option "DC fuse"

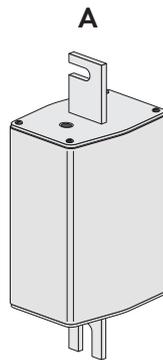


Figure 137: Scope of delivery

Position	Quantity	Designation
A	option-dependent	DC fuse

## 16.11 On-Site Services

The following provisions and services are not included in the product scope of delivery:

- Transport to the construction site (can be carried out by SMA Solar Technology AG on request)
- Crane for unloading the product at the construction site (can be supplied by SMA Solar Technology AG on request)
- Foundation for the product
- Protective tubes for cable entry
- External grounding system
- Disassembly and Disposal of the Packaging Materials
- All mounting and connection work at the construction site
- Door locks
- Setting and measurement of the set tripping times of the circuit breaker panels' protective device.
- Repainting of small rust spots that might develop during transport or storage, for example

For safe commissioning, the requirements for mounting must be fulfilled.

If you have any questions, please contact us (see Section 17, page 294).

## 17 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 numbers
- Firmware version
- Event message
- Type of communication
- Type and number of PV modules
- Type and size of additional energy sources
- Optional equipment, e.g. communication products
- Detailed description of the problem

Deutschland	SMA Solar Technology AG	Belgien	SMA Benelux BVBA/SPRL
Österreich	Niestetal	Belgique	Mechelen
Schweiz	Sunny Boy, Sunny Mini Central, Sunny Tripower, Sunny Highpower: +49 561 9522-1499	België	+32 15 286 730
	Monitoring Systems (Kommunikationsprodukte): +49 561 9522-2499	Luxemburg	for Netherlands: +31 30 2492 000
	Hybrid Controller: +49 561 9522-3199	Luxembourg	SMA Online Service Center: www.SMA-Service.com
	Sunny Island, Sunny Boy Storage, Sunny Backup: +49 561 9522-399	Nederland	
	Sunny Central, Sunny Central Storage: +49 561 9522-299	Česko	SMA Service Partner TERMS a.s.
	SMA Online Service Center: www.SMA-Service.com	Magyarország	+420 387 6 85 111
		Slovensko	SMA Online Service Center: www.SMA-Service.com
		Türkiye	SMA Service Partner DEKOM Ltd. Şti. +90 24 22430605 SMA Online Service Center: www.SMA-Service.com
France	SMA France S.A.S. Lyon +33 472 22 97 00 SMA Online Service Center : www.SMA-Service.com	Ελλάδα	SMA Service Partner AKTOR FM.
		Κύπρος	Αθήνα +30 210 8184550 SMA Online Service Center: www.SMA-Service.com
España	SMA Ibérica Tecnología Solar, S.L.U.	United Kingdom	SMA Solar UK Ltd.
Portugal	Barcelona +34 935 63 50 99 SMA Online Service Center: www.SMA-Service.com		Milton Keynes +44 1908 304899 SMA Online Service Center: www.SMA-Service.com

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United Arab Emirates	SMA Middle East LLC Abu Dhabi +971 2234 6177 SMA Online Service Center: www.SMA-Service.com	India	SMA Solar India Pvt. Ltd. Mumbai +91 22 61713888
ไทย	SMA Solar (Thailand) Co., Ltd. กรุงเทพฯ +66 2 670 6999	대한민국	SMA Technology Korea Co., Ltd. 서울 +82-2-520-2666
South Africa	SMA Solar Technology South Africa Pty Ltd. Cape Town 08600SUNNY (08600 78669) International: +27 (0)21 826 0699 SMA Online Service Center: www.SMA-Service.com	Argentina Brasil Chile Perú	SMA South America SPA Santiago de Chile +562 2820 2101
Other countries	International SMA Service Line Niestetal 00800 SMA SERVICE (+800 762 7378423) SMA Online Service Center: www.SMA-Service.com		

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