System Manual

MEDIUM VOLTAGE POWER STATION with SUNNY CENTRAL STORAGE US for AC-coupled Storage Solutions

ENGLISH

MVPS-S2-SCS-US-B8-SH-en-11 | 124895-00.02 | Version 1.1

Legal Provisions

The information contained in these documents is the property of SMA Solar Technology AG. No part of this document may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, be it electronic, mechanical, photographic, magnetic or otherwise, without the prior written permission of SMA Solar Technology AG. Internal reproduction used solely for the purpose of product evaluation or other proper use is allowed and does not require prior approval.

SMA Solar Technology AG makes no representations or warranties, express or implied, with respect to this documentation or any of the equipment and/or software it may describe, including (with no limitation) any implied warranties of utility, merchantability, or fitness for any particular purpose. All such representations or warranties are expressly disclaimed. Neither SMA Solar Technology AG nor its distributors or dealers shall be liable for any indirect, incidental, or consequential damages under any circumstances.

The exclusion of implied warranties may not apply in all cases under some statutes, and thus the above exclusion may not apply.

Specifications are subject to change without notice. Every attempt has been made to make this document complete, accurate and up-to-date. Readers are cautioned, however, that product improvements and field usage experience may cause SMA Solar Technology AG to make changes to these specifications without advance notice or per contract provisions. SMA Solar Technology AG shall not be responsible for any damages, including indirect, incidental or consequential damages, caused by reliance on the material presented, including, but not limited to, omissions, typographical errors, arithmetical errors or listing errors in the content material.

SMA Warranty

You can download the current warranty conditions from the Internet at www.SMA-Solar.com.

Software licenses

The licenses for the installed software modules (open source) can be found in the user interface of the product.

Trademarks

All trademarks are recognized, even if not explicitly identified as such. Missing designations do not mean that a product or brand is not a registered trademark.

SMA Solar Technology AG

Sonnenallee 1

34266 Niestetal

Germany

Phone +49 561 9522-0

Fax +49 561 9522 100

www.SMA.de

E-mail: info@SMA.de

Status: 11/17/2022

Table of Contents

1 Information on this Document

1.1 Validity

This document is valid for:

Medium Voltage Power Station from production version 1.0

- MVPS-2200-S2-US-11 (Medium Voltage Power Station with 1 Sunny Central Storage 2200-US)
- MVPS-2475-S2-US-11 (Medium Voltage Power Station with 1 Sunny Central Storage 2475-US)
- MVPS-2900-S2-US-11 (Medium Voltage Power Station with 1 Sunny Central Storage 2900-US)

Inverters as of firmware version 8.00.##.R

- SCS-2200-US-10 (Sunny Central Storage 2200-US)
- SCS-2475-US-10 (Sunny Central Storage 2475-US)
- SCS-2900-US-10 (Sunny Central Storage 2900-US)

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 medium-voltage transformers work and are operated
- Knowledge of how the product works and is operated
- 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
- Training in dealing with dangers and risks in electrical installations according to 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC and NFPA 70E
- Training in risk prevention when working with electrical installations

1.3 Levels of warning messages

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

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

1.4 Symbols in the Document

Icon	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Desired result
	Example
	The description is applicable for use on the touch display.
	The description is applicable for use via Internet access.

1.5 Typographical Elements in the Document

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

1.6 Designations in the Document

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

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.

Title and information content	Type of information
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical Information
"Grid Support Utility Interactive Inverters for Sunny Central-US and Sunny Central Storage-US" Information on setting the grid support in accordance with UL 1741 SA.	Technical information

For information on maintenance activities of the DC switchgear and AC disconnect unit please visit www.abb.com:

Component	Document number
DC switchgear: T-Max	1SDH000707R0001

2 Safety

2.1 Intended Use

The MV Power Station is a complete system for battery storage systems. It includes - apart from Sunny Central Storage - all components required to convert battery-stored direct current into alternating current and to feed it into the medium-voltage grid or to charge the battery with grid power. The MV Power Station can be used in off-grid systems based on diesel generators (gensets) as well as in utility grids for the provision of grid services.

Environment

The product is intended for use in commercial, industrial or business sectors.

The product is designed for outdoor use only.

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 inverter must only be operated with its air inlets open.

The pollution degree of the inverter corresponds to category PD3.

The surge category corresponds to OC IV in accordance with Clause 5.34 b of C22.2 No. 107.1-16.

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

System requirements

The product must only be used in a battery storage system which is designed as a closed electrical operating area as per IEC 61936-1.

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

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

The requirements of the IEEE 1547 were tested on the inverter terminals and not on the medium-voltage switchgear.

The influence of inverter and medium-voltage transformer on electrical rated values, grid impedance and the resulting effects at the grid-connection point must be observed and comply with the requirements of the IEEE 1547.

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

The specified minimum clearances must be observed.

In accordance with EN 55011, the product must only be operated at locations where the distance between the product and third-party radio-communication installations is greater than 30 m (98 ft).

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

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

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

DC connection

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

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

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

The DC connection of the inverter was tested successfully with an unaffected DC short-circuit current impulse of 160 kA without creating any danger. A Joule integral of 25 MA^2s was determined.

AC connection

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

Statutory warranty

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

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

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

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

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

The product must not be operated with any technical defects.

The type label must remain permanently attached to the product.

2.2 IMPORTANT SAFETY INSTRUCTIONS

Keep the manual for future reference.

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

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

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ DANGER

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

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

- Install the inverter in a closed electrical operating area.
- Always close and lock the inverter.
- After switching off the converter, wait at least 15 minutes before opening the converter to allow the capacitors to discharge completely.

⚠ DANGER

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

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

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

⚠ DANGER

Danger to life due to electric shock when operating a damaged product

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

- 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 stepping on the protective cover between the inverter and the MV transformer

The protective cover between the inverter and the MV transformer guards against accidental contact with the AC connection busbars. The protective cover may become permanently bent when stepped on and may allow accidental contact with live components. Touching live parts will result in death or serious injury due to electric shock.

- Never step on the protective cover between the inverter and the MV transformer.

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

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

⚠ WARNING

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

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

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

⚠ WARNING

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

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

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

⚠ WARNING

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

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

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the 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.
- Install the product in a closed electrical operating area.

⚠ WARNING

Danger to life due to arc fault caused by fault in the medium-voltage switchgear

If there is a fault in the medium-voltage switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. In the event of arc faults in the medium-voltage switchgear, the pressure escapes to the rear into the medium-voltage transformer compartment.

- Only perform work on the medium-voltage switchgear when it is in a voltage-free state.
- Prior to commissioning and operating the medium-voltage switchgear, close the front panels of the base below the medium-voltage switchgear.
- When performing switching operations, make sure that the hatch of the arc fault opening can be easily opened and is not covered by objects (e.g., ice, vegetation).
- When performing switching operations, open the doors of the medium-voltage cabinet and attach the doors to the designated positions.
- All work and switching operations on the medium-voltage switchgear must only be performed by qualified persons wearing adequate personal protective equipment.
- All other persons 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.
- Do not touch or access the roof of the medium-voltage switchgear when medium voltage is connected.

⚠ WARNING

Danger to life due to electric shock when switching the MV switchgear when the level of SF6 gas is too low

When the level of SF6 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 SF6 gas level.

⚠ WARNING

Life threatening electric shock when entering the PV power plant in the event of a power outage or stand-alone grid

With the "black start" option, a DC voltage can also be applied to the inverter in the event of a power outage or stand-alone grid. Lethal electric shocks can result.

- Always disconnect all poles of the inverter from the voltage sources if no voltage is required for work on the battery-storage system.
- After switching off the inverter, wait at least 25 minutes before opening the inverter to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment for all work on the product.
- Design the 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 product from the power path and ensure that it cannot be reconnected.
- Do not touch the orange cables in the inside of the product. These cables are used for connecting the external supply voltage and can be dangerous to touch.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different.

⚠ WARNING

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

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

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

⚠ WARNING

Hearing impairment due to high-frequency noises of the product

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

- Wear hearing protection.

⚠ WARNING

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

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

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

⚠ WARNING

California Proposition 65

The product can expose you to hazardous substances including antimony trioxide and diethylhexyl phthalate (DEHP). These chemicals are known to the State of California to cause cancer and birth defects or other reproductive harm.

- For more information, visit https://www.P65warnings.ca.gov.

⚠ CAUTION

Risk of burns due to hot components

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

NOTICE

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

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

- Have the assembly replaced by SMA Service.

NOTICE

Unwanted product behavior following a Firmware update

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

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

NOTICE

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

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

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

NOTICE

Damage to the 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 12-month-maintenance check that is not subject to the maintenance schedule. Shorten the maintenance intervals depending on the determined maintenance requirements.
- After a dust or snow storm, ensure that the air inlets and outlets are not covered by any objects (e.g., sand).
- Only recommission the product once any damages have been rectified.

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 Additional hazard labels

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

2.3 Personal Protective Equipment

i Always wear suitable protective equipment

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

Clothing according to NFPA 70E Section 130.7. If necessary, gloves adequately insulated for protection against electric shock should be worn in accordance with NFPA 70E Section 130.7(C).

An LV/HRC fuse extractor must be used to replace LV/HRC fuses. If necessary, LV/HRC fuse extractors can be ordered from SMA using the following material number: 61-0193.

Any other prescribed protective equipment must also be used. When working on live parts of the inverter, according to NEMA NFPA 70 E, Table 130.7(C)(16) protective equipment with appropriate hazard risk category is required.

Personal protective equipment required

SMA has conducted an electric arc risk analysis in accordance with NFPA 70E. Based on this electric arc risk assessment, the hazard risk category of the inverter has to be identified through a plant-specific risk analysis. The PV system operator is responsible for the risk analysis. PPE is required for all routine maintenance, diagnostics, and commissioning activities as described in the SMA protocols. There are areas within the product that cannot, under any circumstances, be exposed while energized.

For further information, contact us (see Section 18, page 284).

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.

3 Scope of Delivery

After the MV Power Station has arrived, check the scope of delivery for completeness and any apparent external damage. For this purpose, complete a digital transport checklist and send it back to the customer project manager of SMA Solar Technology AG no later than 3 days after the arrival at the construction site or warehouse.

Scope of delivery of the MV Power Station

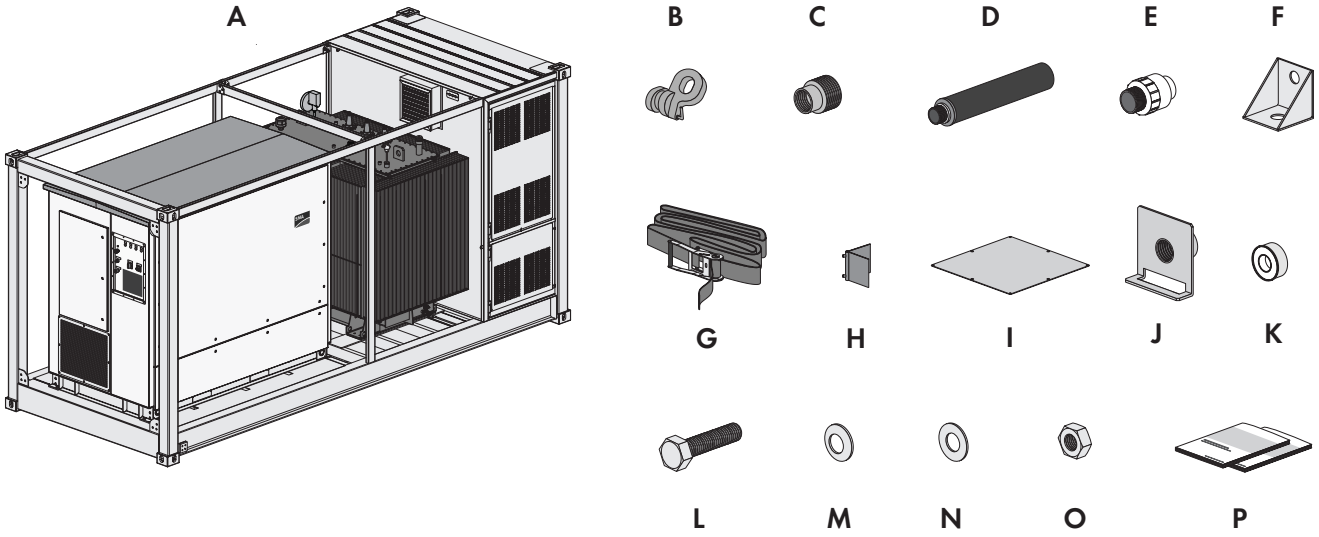


Figure 1: Scope of delivery of the MV Power Station

Position	Quantity	Designation
A	1	MV Power Station
B	4	Lifting lugs[1)]
C	1	Reducer[2)]
D	1	Oil filter[2)]
E	1	Pre-filter[2)]
F	4	Side twistlock[3)]
G	2	Tie-down strap[4)]
H	8	Edge protection angle[4)]
I	1	Cover plate[4)]
J	depending on the order option	Mounting brackets for DC fuses
K	1	Teflon tape[2)]
L	8	Screw M12 for the grounding connection
M	8	Spring washer M12 for the grounding connection

[1)] Optional

[2)] In case of order option "Oil Containment"

[3)] For the order option "Earthquake and Storm Package"

[4)] For the order option "Earthquake and Storm Special"

Position	Quantity	Designation
N	16	Fender washer M12 for the grounding connection
O	8	Nut M12 for the grounding connection
P	1	Documentation, circuit diagram

Scope of Delivery of the Medium-Voltage Switchgear

The scope of delivery of the medium-voltage switchgear is located in the medium-voltage cabinet.

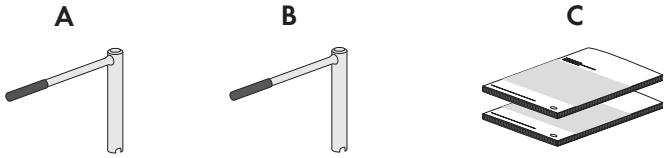


Figure 2: Scope of Delivery of the Medium-Voltage Switchgear

Position	Quantity	Designation
A	1	Actuation lever for grounding switch
B	1 / 2[5)]	Actuation lever for disconnection unit, load-break switch and circuit breaker
C	1	Documentation for the medium-voltage switchgear

Scope of Delivery of the Inverter for Order Option "DC Input Configuration"

The scope of delivery is located in the DC connection area of the inverter.

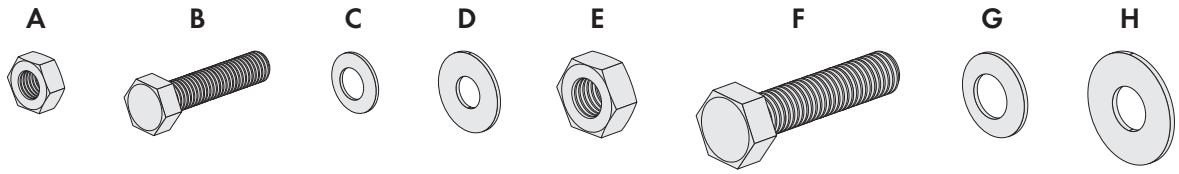


Figure 3: Scope of Delivery

Position	Designation	Application
A	Nut M8	-
B	Bolt M8	
C	Spring washer M8	
D	Fender washer M8	
E	Nut M12	Connection of the DC inputs
F	Bolt M12	
G	Spring washer M12	
H	Fender washer M12	

[5)] Quantity depending on the manufacturer of the medium-voltage switchgear

4 Product Overview

4.1 System Overview

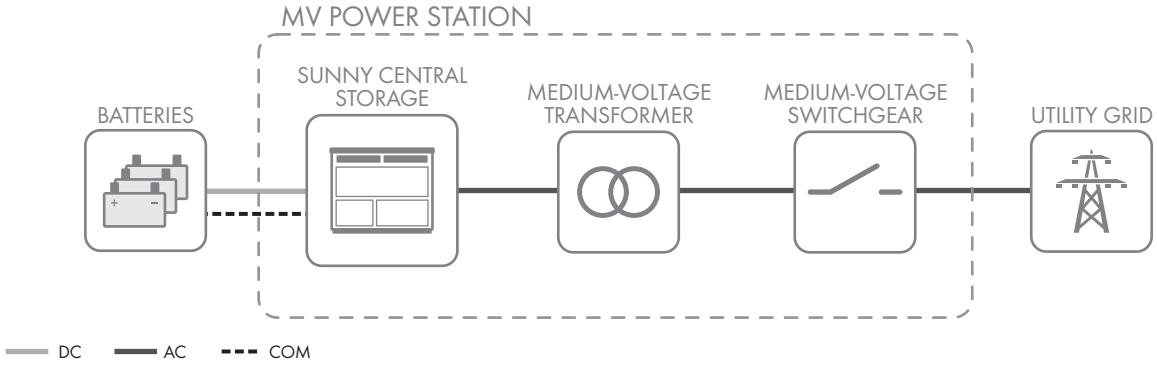


Figure 4: Design of the system (example)

4.2 Design of the MV Power Station

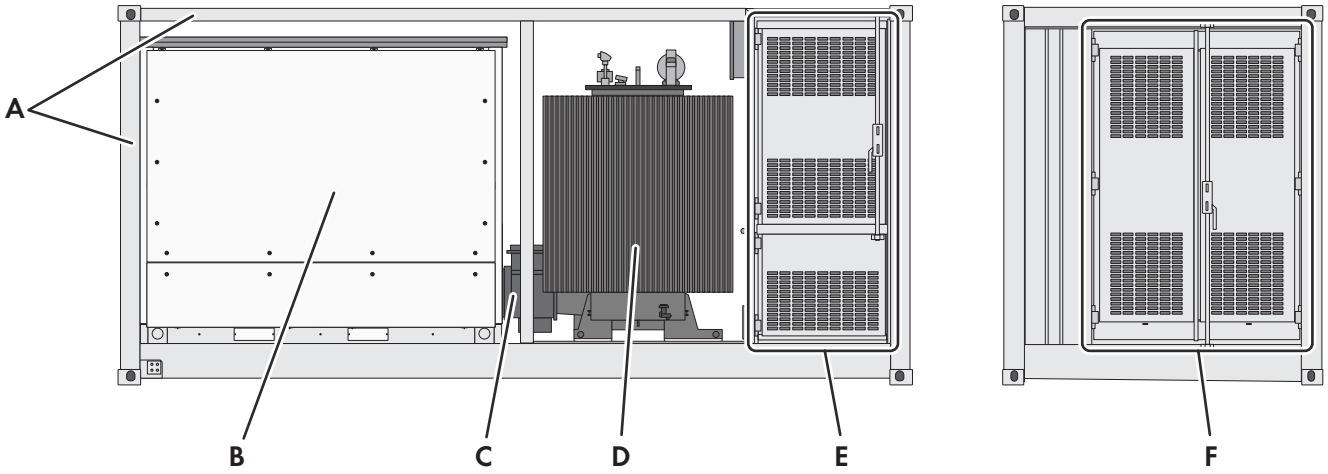


Figure 5: Design of the MV Power Station

Position	Designation	Explanation
A	Rack	For the order option "Sea Freight", the MV Power Station is equipped with a rack.
B	Sunny Central Storage	The Sunny Central Storage is a battery inverter that converts the direct current supplied by a battery into grid-compliant alternating current. It also charges the battery with energy drawn from the medium-voltage grid.
C	Low-voltage connection	Low-voltage connection between medium-voltage transformer and inverter with protective cover.
D	Medium-voltage transformer	The MV transformer converts the inverter output voltage to the voltage level of the medium-voltage grid.
E	LV cabinet	The low-voltage cabinet contains the station subdistribution and the optional low-voltage transformer.
F	Medium-voltage cabinet	The medium-voltage switchgear connects and disconnects the medium-voltage transformer to and from the medium-voltage grid.

Depending on the order option, the medium-voltage transformer is protected with a protective grid.

4.3 Components of the Medium-Voltage Cabinet

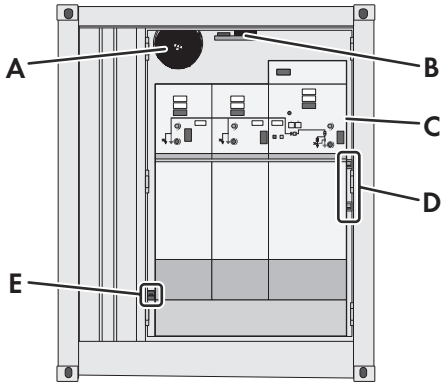


Figure 6: Components of the medium-voltage cabinet (example)

Position	Designation
A	Fan[6)]
B	Lighting[6)]/ heat detector[6)]
C	Medium-voltage switchgear[6)]
D	Thermostats for heating and safety shutdown of the medium-voltage switchgear[7)]
E	Heating[7)]

Further details are to be found in the circuit diagram.

4.4 Components of the Low-Voltage Cabinet

The low-voltage cabinet is divided into separate areas, one for the station subdistribution and one for the low-voltage transformer.

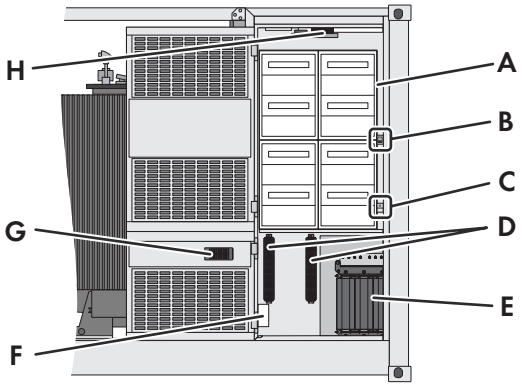


Figure 7: Components of the low-voltage cabinet (example)

Position	Designation
A	Station subdistribution[8)]
B	Thermostat for fan control[9)]

6) Optional

7) With order option "Ambient Temperature: -40°C to +45°C"

8) Optional, quantity and size depending on the order option

9) Optional

Position	Designation
C	Hygrostat[10)]
D	Fuse holder with thermal fuse for the low-voltage transformer[8)]
E	Low-voltage transformer[8)]
F	Terminal blocks for the connection of external loads such as tracker motors, DC-DC converters or the supply of battery containers[8)]
G	Heating[10)]
H	Lighting[9)]

All miniature circuit breakers for the MV Power Station are located in the station subdistribution. The positions of the components vary depending on the order option. Reference designations are attached to the individual devices of the station subdistribution.

With the "LV Transformer" order option the MV Power Station is equipped with a low-voltage transformer.

The MV Power Station low-voltage transformer provides the supply voltage for various components (see MV Power Station circuit diagram). The low-voltage transformer is equipped with an EMC filtering device and lightning protection and protected by a thermal fuse on the primary side.

4.5 Customer Installation Location

4.5.1 Design of the Customer Installation Location

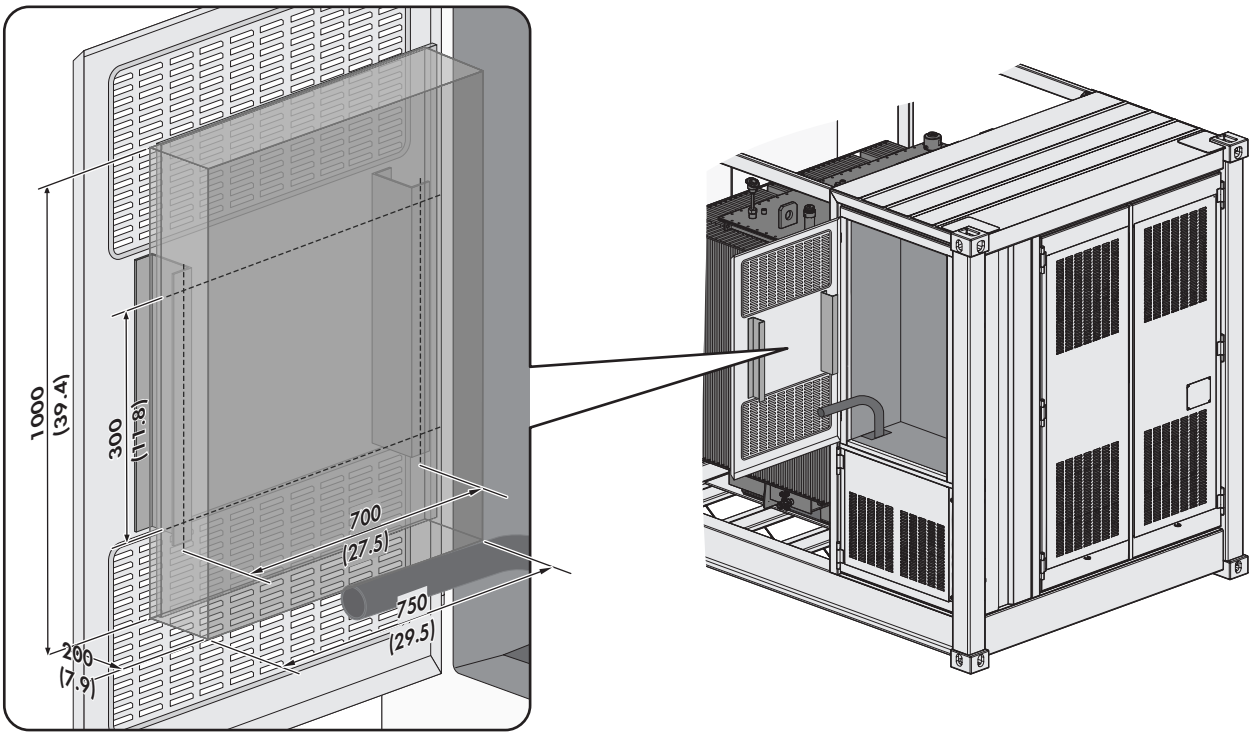


Figure 8: Position of customer installation location

The customer installation location on the inside of the door of the low-voltage cabinet is reserved for customer-supplied devices. Brackets are provided on the mounting plate for mounting customer devices.

The customer installations must satisfy the following requirements:

[10)] With order option "Ambient Temperature: -40°C to +45°C"

- ☐ The maximum dimensions of the customer installations may not exceed 1000 mm x 750 mm x 200 mm (39.4 in x 29.5 in x 7.9 in) (height x width x depth).
- ☐ Narrow units with higher depth must not exceed 800 mm x 600 mm x 210 mm (31.4 in x 23.6 in x 8.2 in) (height x width x depth) and must be mounted on the holders using 2 profile rails or 1 mounting plate (not included in the scope of delivery).
- ☐ The maximum weight is 80 kg (176 lb)
- ☐ The 4 anchoring points for the brackets have the following distances: width 700 mm, height 340 mm, hole diameter 10 mm for bolts with 8 mm diameter
- ☐ Input voltage for customer installations: 120 V ±10% tolerance, 60 Hz
- ☐ Maximum power loss of customer installations: 300 W
- ☐ Maximum power available for connection of customer equipment depending on the order option: 2500 VA
- ☐ 2 miniature circuit breakers of type C16A are available to protect the customer equipment.
- ☐ Depending on application, the customer installations must be designed for temperatures from -40°C (-40°F) to 60°C (140°F).
- ☐ The customer installations must be at least degree of protection IP54.
- ☐ The customer devices must be designed to cope with voltage fluctuations that can occur at the point of interconnection.

The MV Power Station is equipped with cable channels (inside diameter: 45 mm (1.77 in)) at the factory from the opening in the low-voltage cabinet to the customer installation location and from the station subdistribution to the customer installation location. The feed-throughs for the cables into the MV Power Station must be prepared. A network cable with RJ45 plug is located on the door to the customer installation location for the network connection. The length of the network cable from the customer installation location to the customer installations is 2000 mm.

Further details are to be found in the circuit diagram.

4.5.2 Power for Customer Devices

- ☐ Input voltage for customer installations: 120 V ±10% tolerance, 60 Hz
- ☐ Maximum power loss of customer installations: 300 W
- ☐ In addition, 2 miniature circuit breakers of type C16A (120 V) are available to protect the customer equipment.
- ☐ The maximum power available for connection of customer equipment depending on the order option:
  - As standard: 2500 VA

The following powers must be taken into consideration:

Component	Order option	Power
Fan in the medium-voltage cabinet	"Ambient Temperature -25° to +55°C", "Ambient Temperature -35°C to +55°C", "Environment: Harsh" or "Low-voltage transformer 40 / 50 / 60 kVA"	200 W
Lighting in the medium-voltage and low-voltage cabinet	"Lighting"	50 W
Monitoring and communication	"Monitoring"	100 W
Heaters in the medium-voltage and low-voltage cabinet	"Ambient temperature: -40°C to +45°C"	2300 W
Heaters in the station subdistribution	"Ambient temperature: -35°C to +55°C"	200 W

4.6 Configuration of Station Subdistribution

All fuse switches for the MV Power Station are located in the station subdistribution. The station 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.

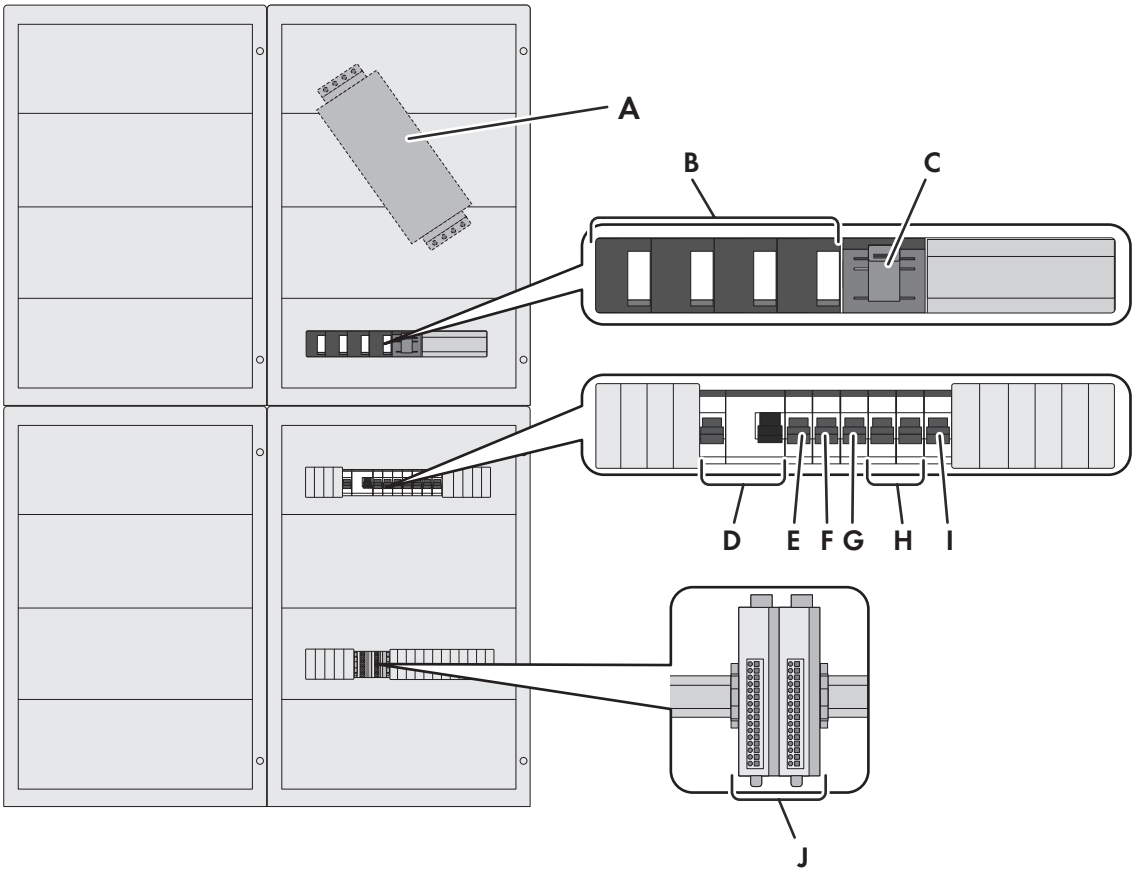


Figure 9: Devices in the station subdistribution (example)

Position	Designation
A	Low-voltage transformer EMC filtering device[11)]
B	Surge arrester **-F1** for customer-supplied devices[11)]
C	Circuit breaker **-F101** for customer-supplied devices[11)]
D	Miniature circuit breaker **-F32** and residual-current device **-F32D** for lighting systems[11)]
E	Miniature circuit breaker **-F34** for the fan[11)]
F	Miniature circuit breaker **-F36** for monitoring and communication in terms of order option "Monitoring Package"[11)]
G	Miniature circuit breaker **-F37** for cascade control[11)]
H	Miniature circuit breaker **-F41** and **-F42** for protection of the customer equipment
I	Miniature circuit breaker **-F50** for the heating[11)]
J	I/O System Monitoring Package[11)]

Further details are to be found in the circuit diagram.

[11)] Optional

4.7 Design of the Inverter

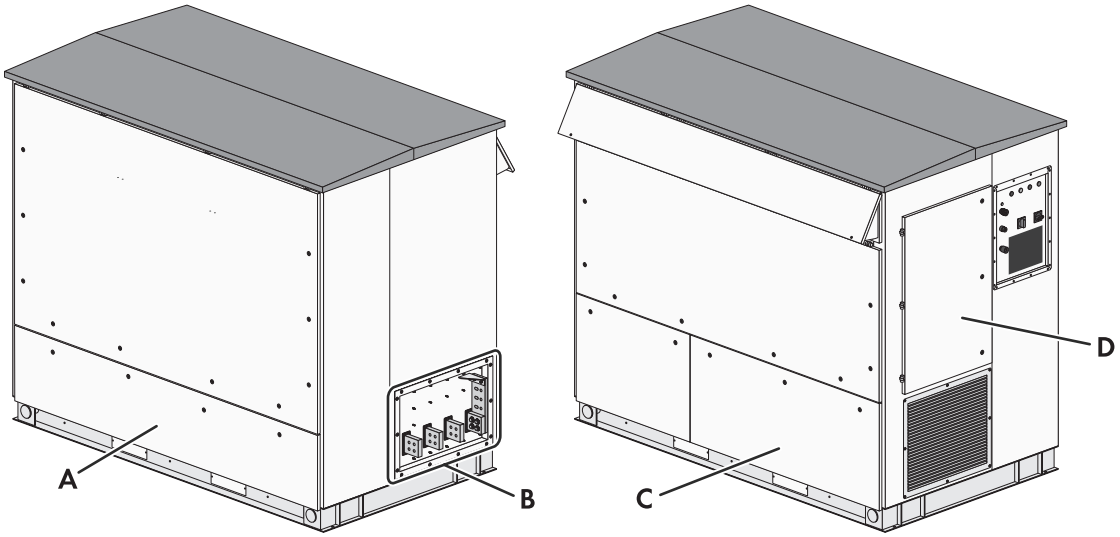


Figure 10: Design of the inverter

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

4.8 Components of the Medium-Voltage Transformer

The medium-voltage transformer is the link between the inverter and the medium-voltage grid. The positions of the operating- and display elements of the medium-voltage transformer can vary depending on the manufacturer and the selected order option. Pressure and oil level can be monitored via an hermetic protection relay depending on the order option.

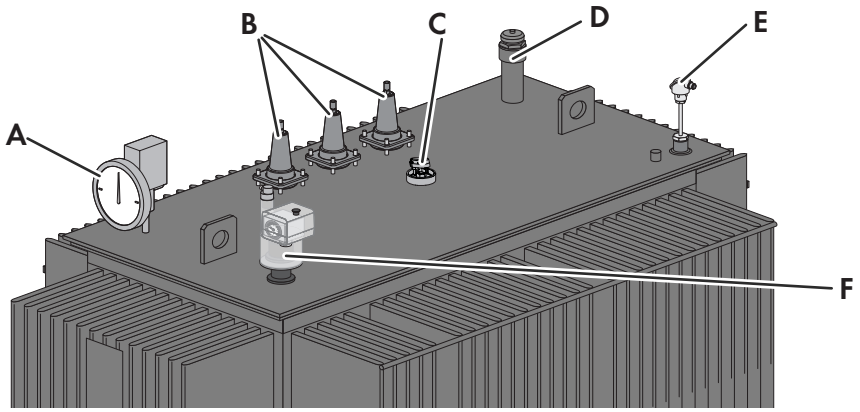


Figure 11: Components of the medium-voltage transformer (example)

Position	Designation
A	Oil pressure gauge
B	Medium-voltage bushings for connecting the AC cables

Position	Designation
C	Tap changer for adjusting the turn ratio[12)]
D	Oil filler neck with pressure relief valve
E	Oil temperature (thermometer PT100)
F	Hermetic protection device (pressure and oil level)

4.9 Protective grid in front of the medium-voltage transformer

For the order option "Grids MVT Room" and "Grids and Rodent Protection", the medium-voltage transformer is protected by a protective grid on the side. Access to the medium-voltage transformer is made via a 2 lockable grid doors. For the order option "Grids Special", the medium-voltage transformer is also protected by a protective grid on the top.

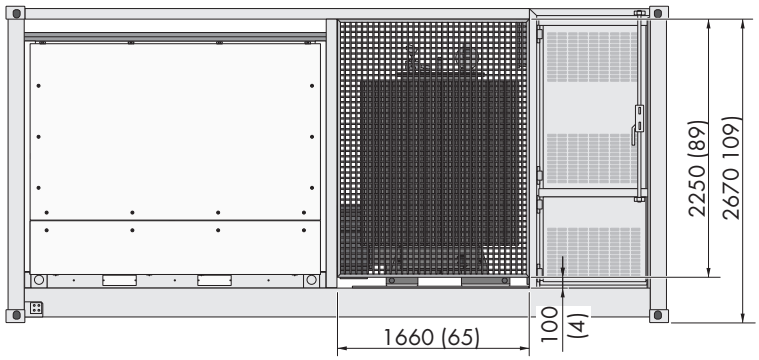


Figure 12: Position and dimensions of the protective grid in front of the medium-voltage transformer (Dimensions in mm (in))

4.10 Devices of the Medium-Voltage Switchgear

The MV Power Station is equipped with a medium-voltage switchgear depending on the order option. The medium-voltage switchgear is used to disconnect the MV Power Station from the medium-voltage grid.

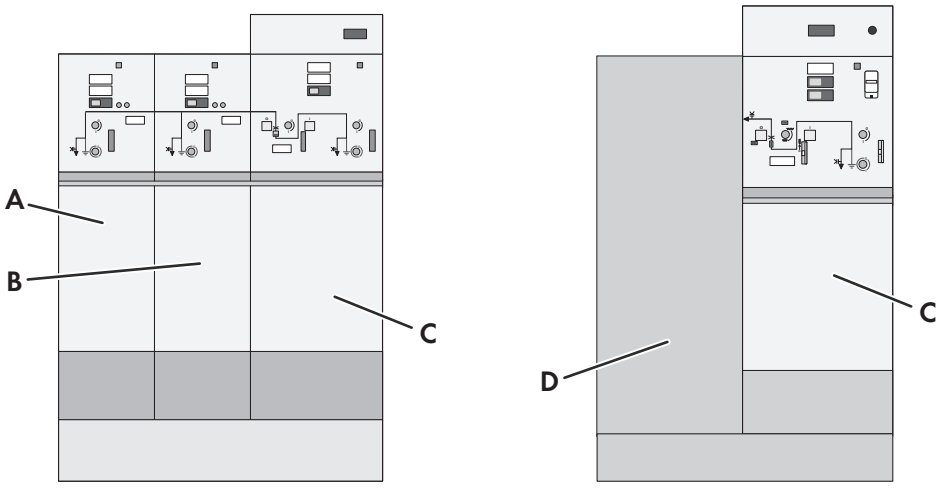


Figure 13: Components of the medium-voltage switchgear (example)

Position	Designation
A	Outer cable panel with load-break switch[13)]

[12)] Optional

[13)] Optional

Position	Designation
B	Central cable panel with load-break switch[13)]
C	Transformer compartment with disconnector
D	Side cable connection panel[13)]

4.11 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 medium-voltage transformer under fault conditions.

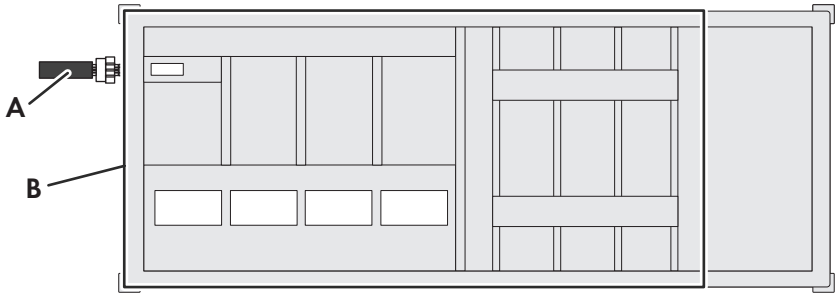


Figure 14: Position of the oil spill containment

Position	Designation
A	Oil filter[14)]
B	Integrated oil spill containment[14)]

The MV Power Station oil spill containment is integrated into the floor and the station container substructure.

In normal operation, penetrating rain water drains off via the mounted oil filter. If the medium-voltage 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 is not mounted at the factory and must be installed after the MV Power Station has been set up.

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

[14)] In case of order option "Oil Containment"

4.12 Circuitry Principle of the MV Power Station

Setup of 1 MV Power Station

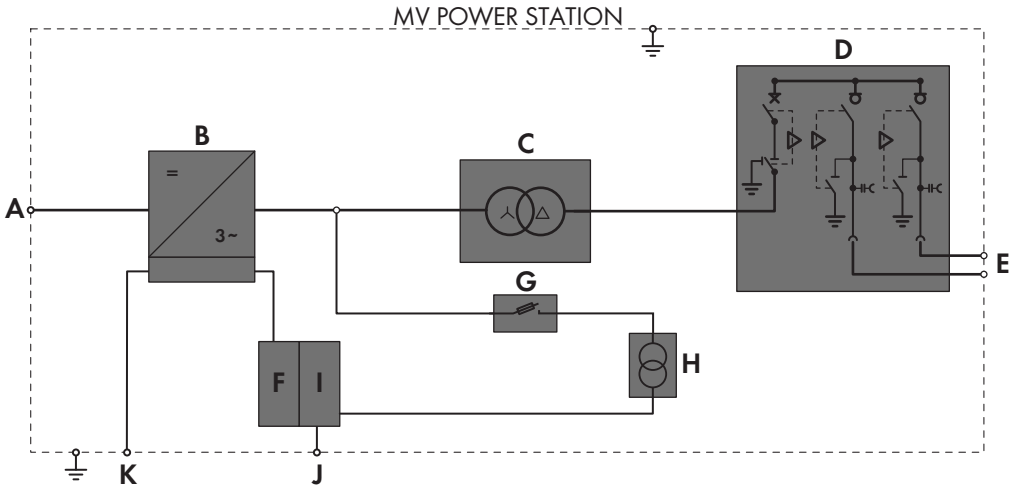


Figure 15: Circuitry principle of the MV Power Station (example)

Setup of 2 MV Power Stations with 1 medium-voltage switchgear

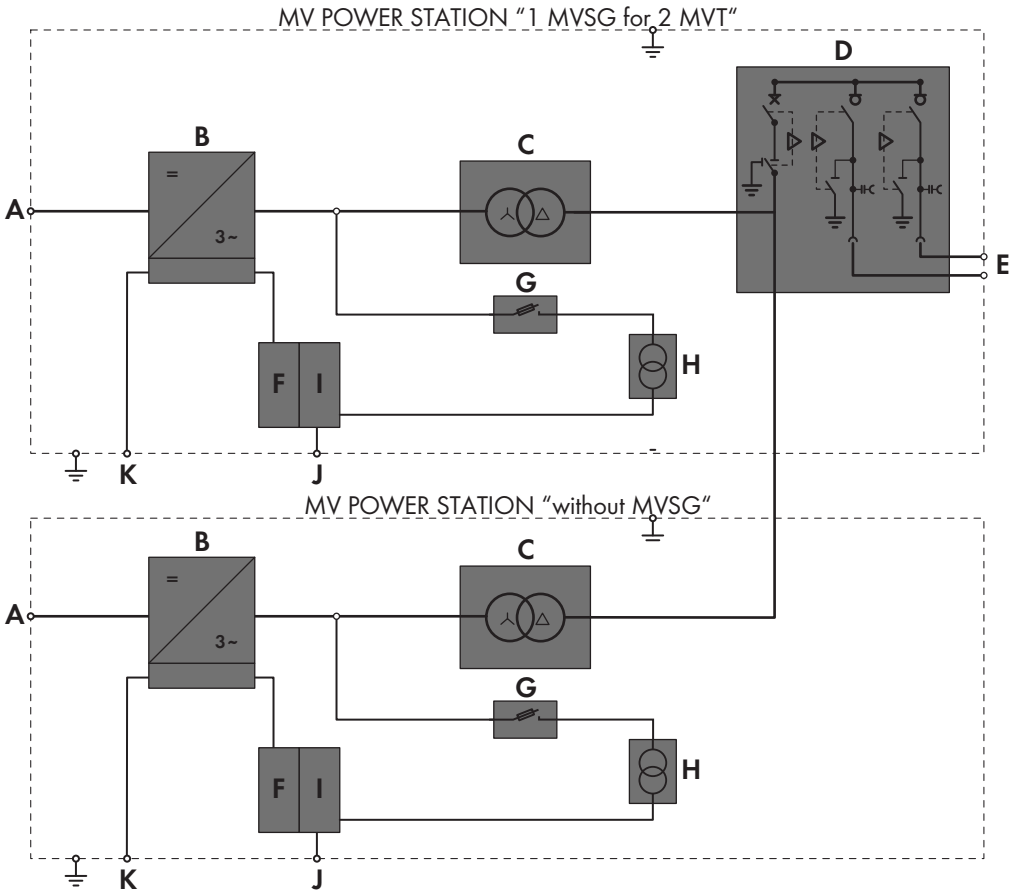


Figure 16: Circuitry principle of 2 MV Power Stations with 1 medium-voltage switchgear (example)

Position	Designation
A	DC Input

Position	Designation
B	Inverter
C	Medium-voltage transformer
D	Medium-voltage switchgear[15)]
E	AC output
F	Station subdistribution
G	Fuse holder with thermal fuse of the low-voltage transformer[15)]
H	Low-voltage transformer[15)]
I	Surge protection device, load-break switch and EMC filtering device of the low-voltage transformer and miniature circuit breakers for tracker motors[15)]
J	Connection of additional components (e.g. tracker motors)[15)]
K	Customer connection point[16)]

4.13 Operating and Display Elements

4.13.1 Overview of the Operating and Display Elements on the Inverter

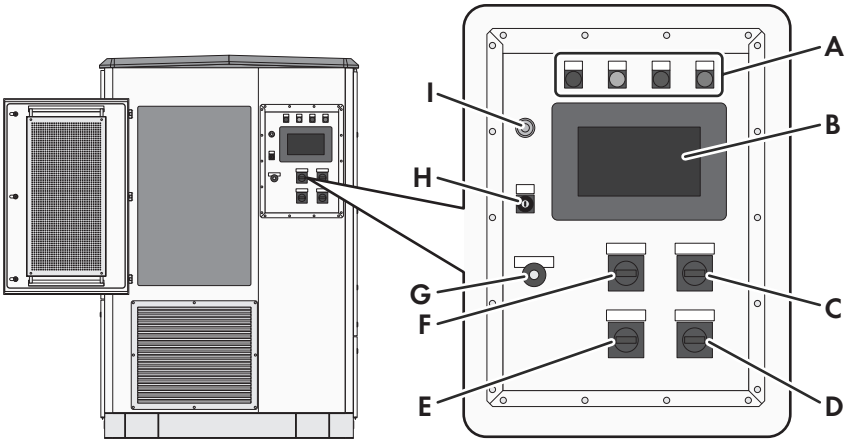


Figure 17: Inverter components

Position	Designation
A	Light repeater **-P1**, **-P2**, **-P3**, **-P4**[17)]
B	Touch display **-A60**[18)]
C	Load-break switch **-Q63** for AC disconnection unit
D	Load-break switch **-Q64** for additional voltage supply[19)]

15) Optional

16) Depending on the order option, the terminal for the external communication is located on the station subdistribution or inverter.

17) Standard equipment. Not available for option "Touch display".

18) Only for option "Touch display". The light repeaters are not included in this option.

19) Only for option "With additional supply for external loads".

Position	Designation
E	Load-break switch **-Q62** for supply voltage
F	Load-break switch **-Q61** for DC switchgear
G	Key switch **-S2** for fast stop
H	Key switch **-S1** for start/stop
I	Service interface**-X500**

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

4.13.2 Function of the Switches

4.13.2.1 Start/Stop Key Switch -S1

"Start" switch position

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

"Stop" switch position

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

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

4.13.2.2 Fast-Stop Key Switch -S2

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

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

Actuation of the fast-stop key switch -S2

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

4.13.2.3 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**
- Fans of converter bridges **-G1**
- Switch cabinet fans **-G10** and **-G11**
- The optional customer installation location **-X310**
- The current measurement for the optional PQ-Meter **-A61**

4.13.2.4 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**
- Fans of converter bridges **-G1**
- Switch cabinet fans **-G10** and **-G11**
- 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**

4.13.2.5 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**

4.13.2.6 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**
- outlet **-X374**

4.13.3 Indicator lights at the Control Panel

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

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

Indicator lights status		Designation	Description
● ○ ● ●	Red: glowing 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.

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

4.13.4 Switch on the Medium-Voltage Switchgear

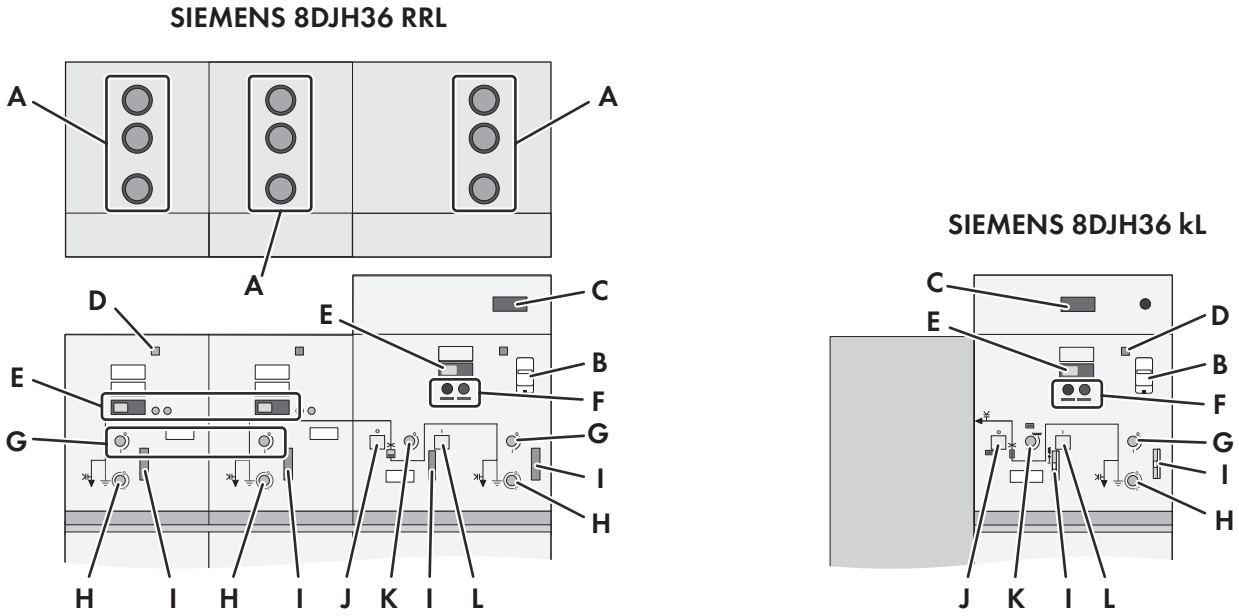


Figure 18: Medium-voltage switchgear control panels with circuit breaker in the transformer panel (example)

Position	Designation
A	Fixed sight glasses for determining the position of the load-break switch ("UL-Recognized" version)
B	Replaceable sight glass (VLS module) for determining the position of the load-break switch ("UL-Listed" version)

Position	Designation
C	Transformer protection relay
D	Standby indicator / Gas level indicator
E	Leading voltage indicator
F	Indicator light for determining the position of the circuit breaker ("UL-Listed" version)[20]
G	Opening for the operating lever – load-break switch
H	Opening for the operating lever – grounding switch
I	Locking function
J	OFF button for circuit breaker of the transformer panel
K	Opening for the operating lever / tension the spring mechanism
L	ON button for circuit breaker of the transformer panel

The switch position can also be checked via fixed or replaceable sight glasses (VLS module). A telescope mirror must be used for the fixed sight glasses.

The replaceable sight glasses (VLS modules) are not included in the scope of delivery and must be ordered separately in the required quantity (material number 122430-00.01). Switch position testing in accordance with NFPA 70E requirements is not possible without the VLS module. The VLS module is necessary for UL conformity. The number of VLS modules depends, among other things, on the operation and maintenance procedure and the physical layout of the system.

4.13.5 Fast-stop switch of the MV Power Station

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

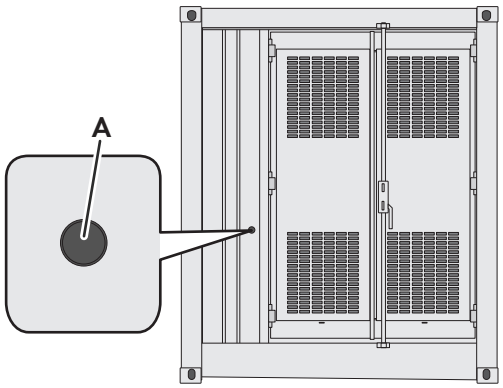


Figure 19: Position of the fast-stop switch

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.

[20] The indicator lights are not supplied by the MV Power Station and must be supplied externally if the function is required. Observe the information in the circuit diagram for the medium-voltage switchgear.

4.14 Symbols on the Product

Icon	Explanation
	Beware of a danger zone This warning symbol indicates a danger zone.
	Beware of electrical voltage The product operates at high voltages.
	Electric arc hazards The product has large electrical potential differences between its conductors. Arc flashes can occur through air when high-voltage current flows.
	Flammable substances warning Improper installation of the product may cause a fire.
	Beware of hot surface The product can get hot during operation.
	Do not step on this surface The protective cover between the inverter and the medium-voltage transformer guards against accidental contact with the AC connection busbars. Stepping on the protective cover can form permanent buckling in the protective cover and allow accidental contact with live components or can result in leakages.
	No heavy loads The product may not be loaded with additional weight during transport or during installation.
	Switching forbidden Switching operations may not be performed on the product.
	Unauthorized access prohibited Unauthorized persons must not operate the product and must be kept at a safe distance from the product.
	Use hearing protection The product generates loud noises.
	Observe the documentations Observe all documentations supplied with the product.
	Protection class I All electrical equipment is connected to the grounding conductor system of the product.

Icon	Explanation
	Degree of protection IP65 The product is protected against the penetration of dust and water that is directed as a jet against the enclosure from all directions.
CE	CE marking The product complies with the requirements of the applicable EU directives.

5 User interface of the inverter

5.1 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.

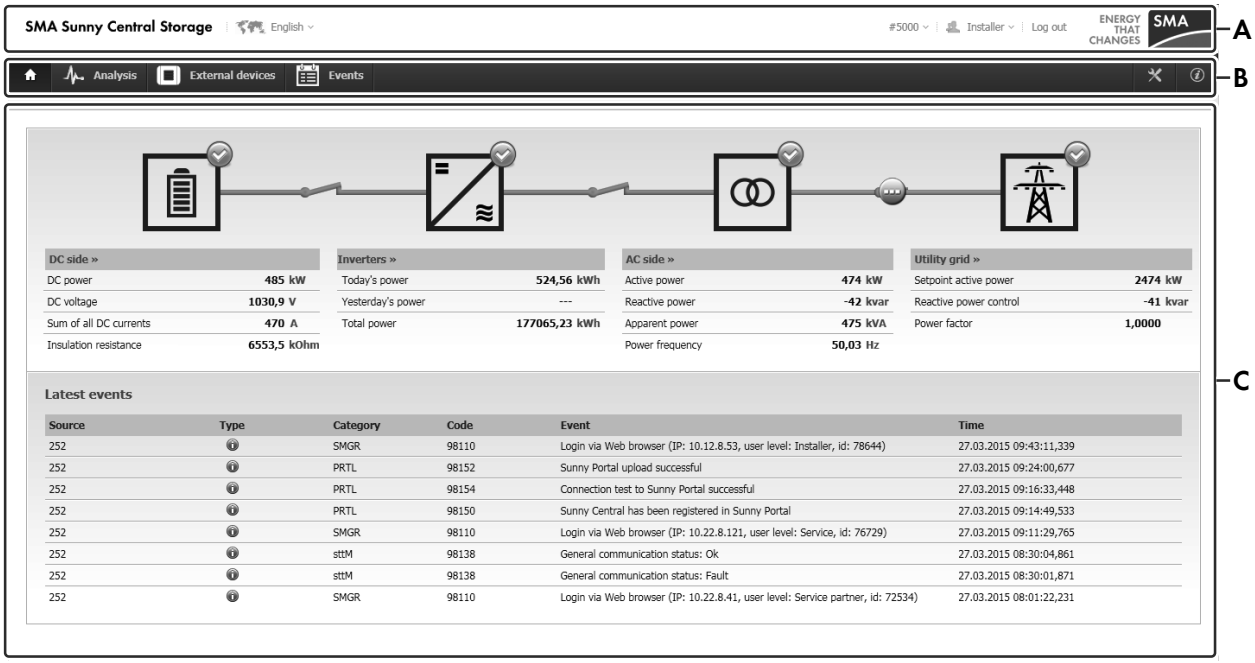


Figure 20: Design of the user interface (example: web browser)

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	Information on serial numbers of the inverter, installed firmware version and inverter status. 💻 When the inverter is in the operating state "Error", the remaining error time from the instantaneous value **ErrRmgTm** is displayed. 💻 When the inverter is in the operating state "WaitAC", the grid monitoring time from the instantaneous value **WaitGriTm** is displayed.

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

Main navigation

The selected menu item is color-highlighted.

Symbol	Designation	Description
	Arrow buttons	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. To navigate to the previous or next page, use the arrow buttons of the web browser.
	Home	Fast overview of system status For each component of the PV system, the key instantaneous values and the status of the assemblies and switches are displayed.
	Analysis	Switches to the analysis area of the user interface Detailed information on the following areas: • DC side • DC-coupled battery • Inverters • AC side • Utility Grid • Instantaneous values • Detailed analysis
	Events	Display of all saved events. The events can be filtered.
	Configuration	Configuration options for: • Instantaneous values • Parameters • Import and export of parameters, settings and measured values In addition, the setup assistant can be used here to carry out the parameter configuration for specific applications in a step-by-step process.
	Information	Important data for identification of the system
	External devices	Overview of the external connected devices, e.g. battery

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

5.3 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.

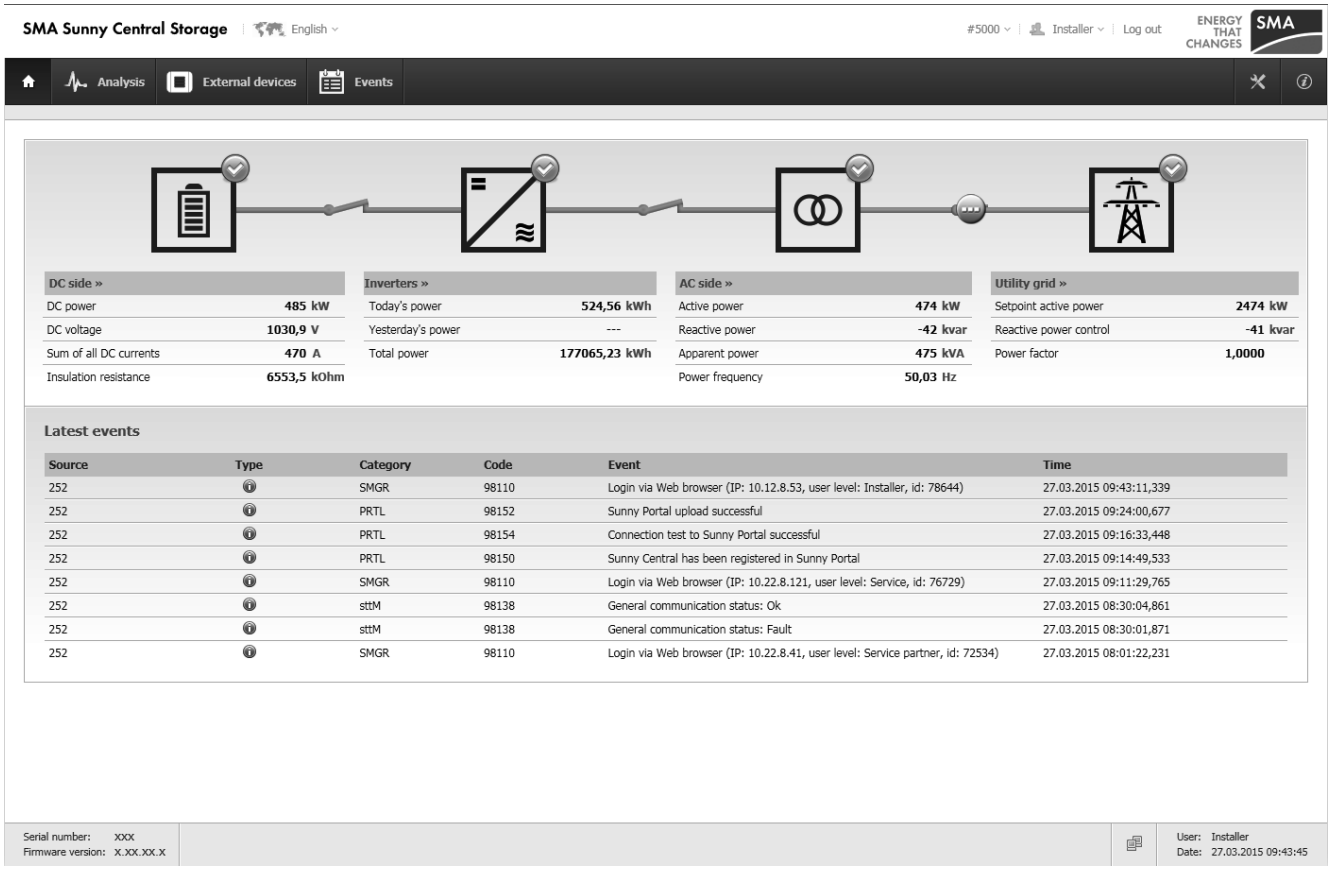


Figure 21: Page **Home** of the user interface

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 5.2, page 43). 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 5.4, 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 5.6, page 53).

5.4 Analysis

5.4.1 Structure of the Analysis Pages

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

Figure 22: 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.

5.4.2 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.

5.4.3 DC Side

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

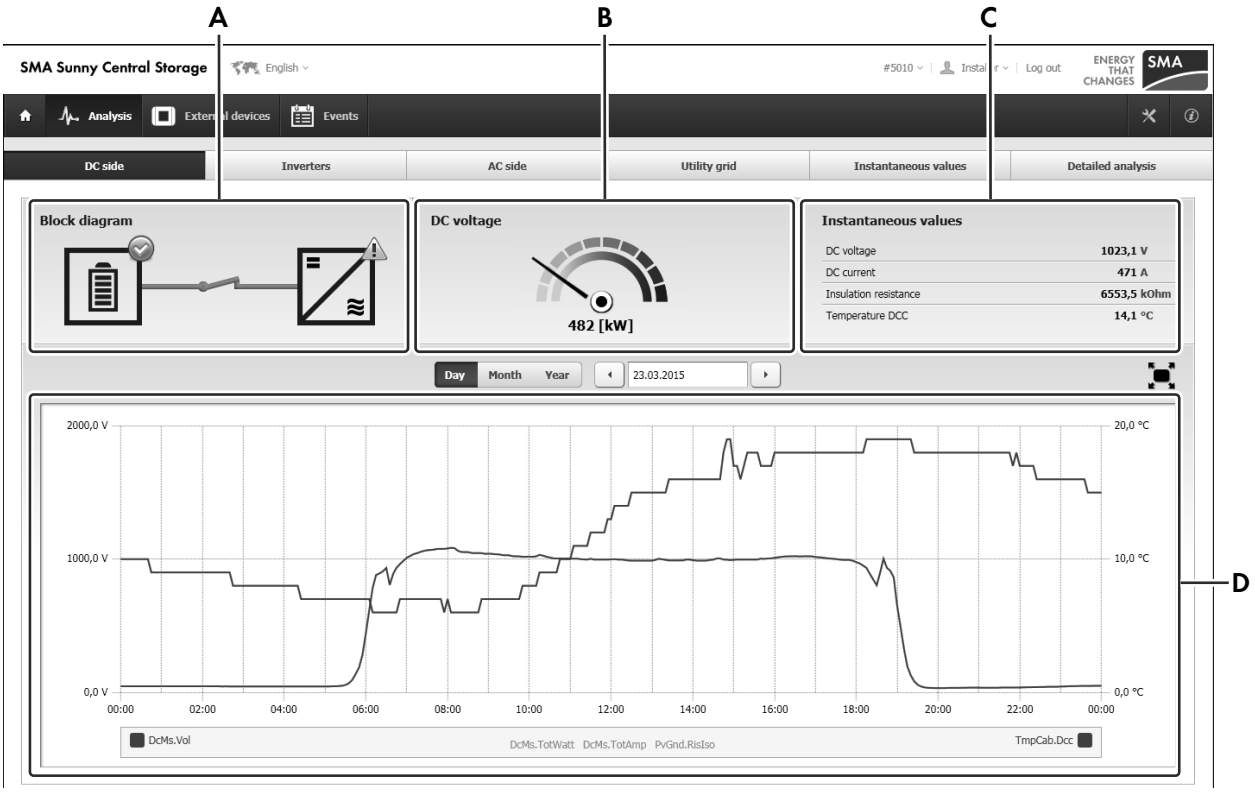


Figure 23: Page **DC side** of the user interface (example)

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

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

5.4.4 Inverter

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

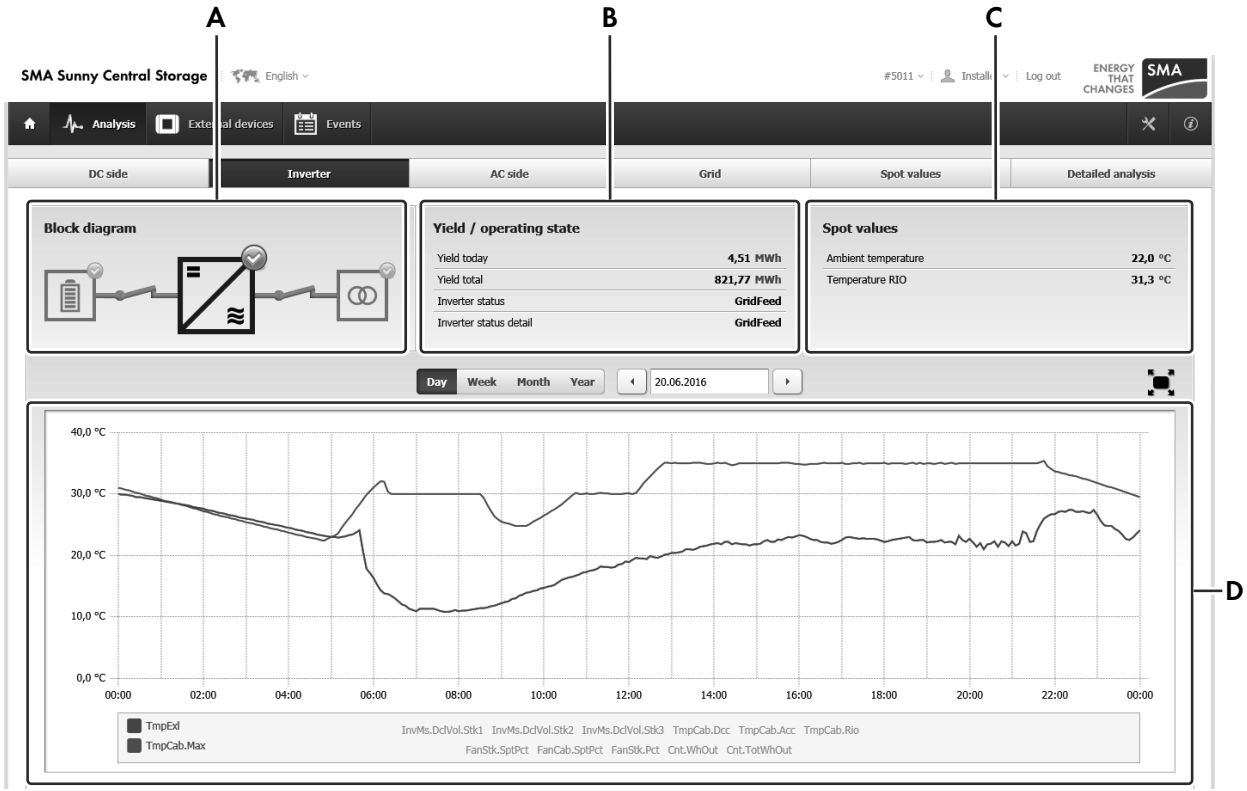


Figure 24: **Inverter page** of the user interface (example)

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

5.4.5 AC Side

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

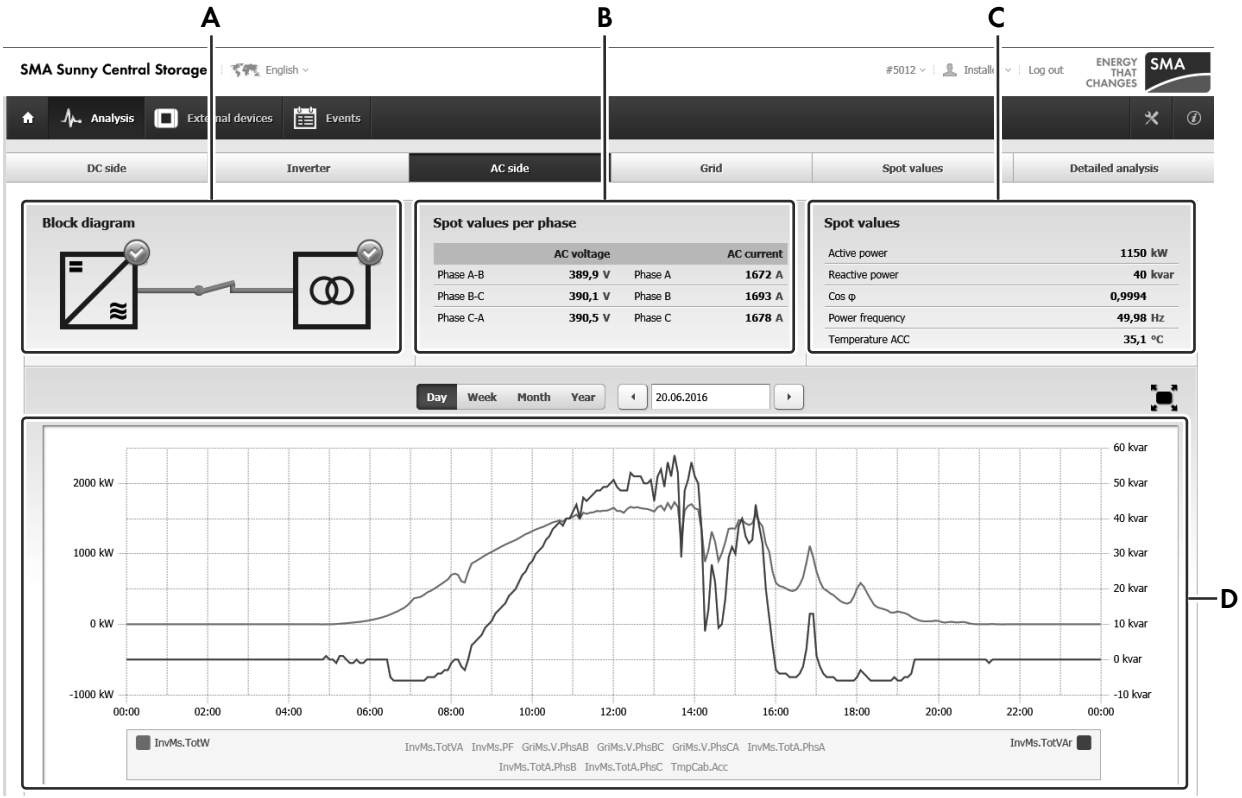


Figure 25: Page **AC side** of the user interface (example)

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.

5.4.6 Utility Grid

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

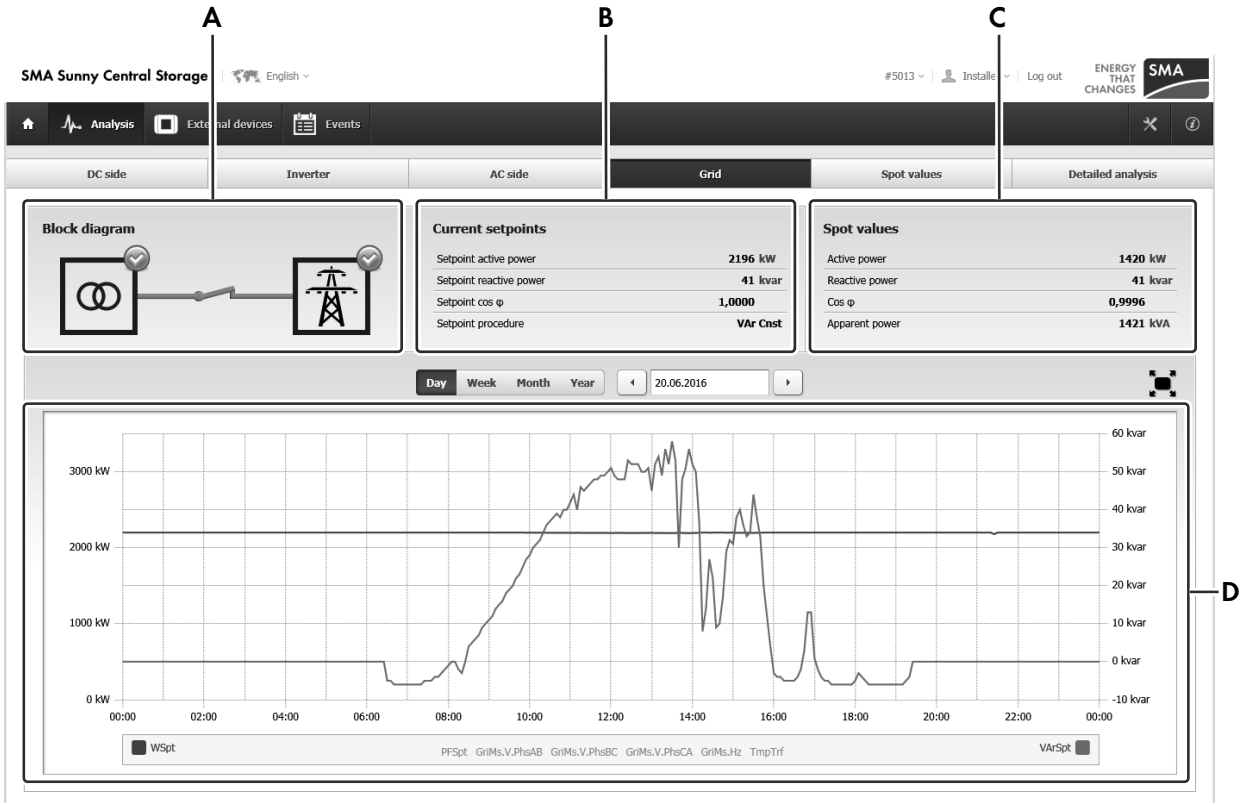


Figure 26: Page **Utility grid** of the user interface (example)

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.

5.4.7 Instantaneous Values

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

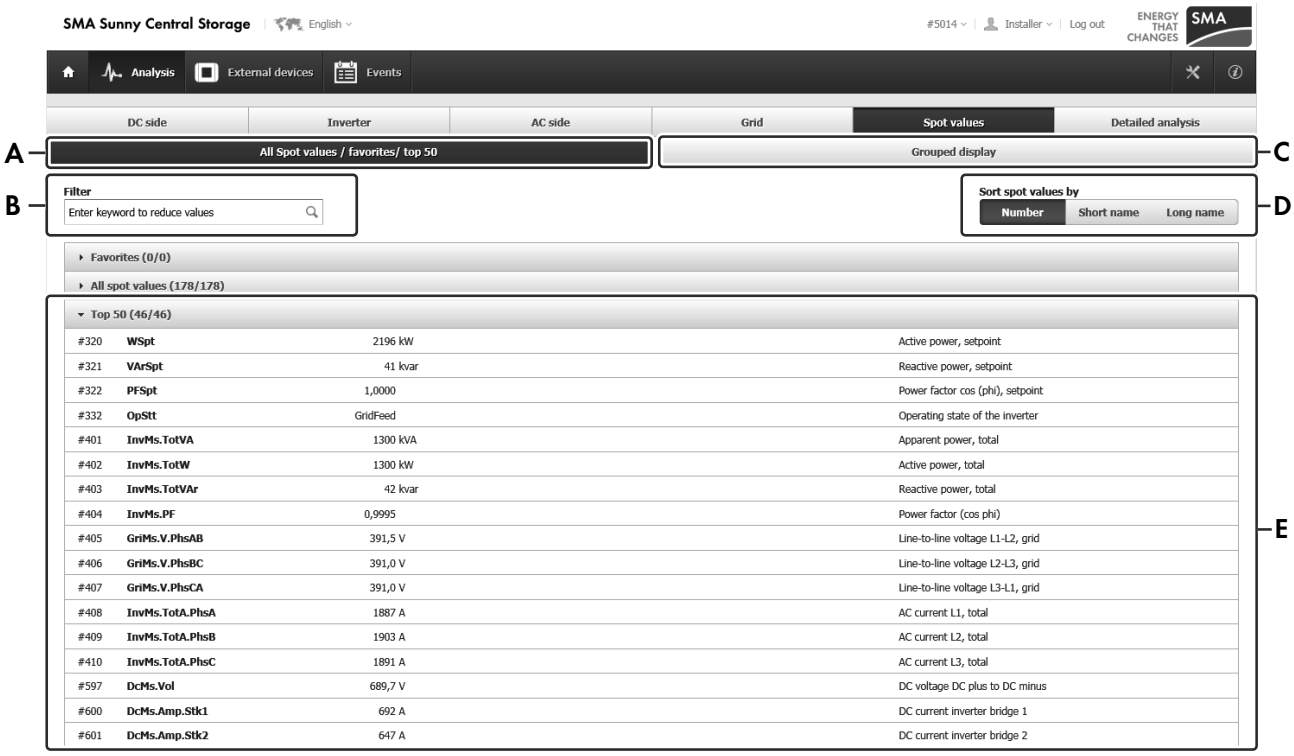


Figure 27: Page **Instantaneous values** of the user interface (example)

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

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

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

Detailed View of Instantaneous Values

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

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

5.4.8 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.

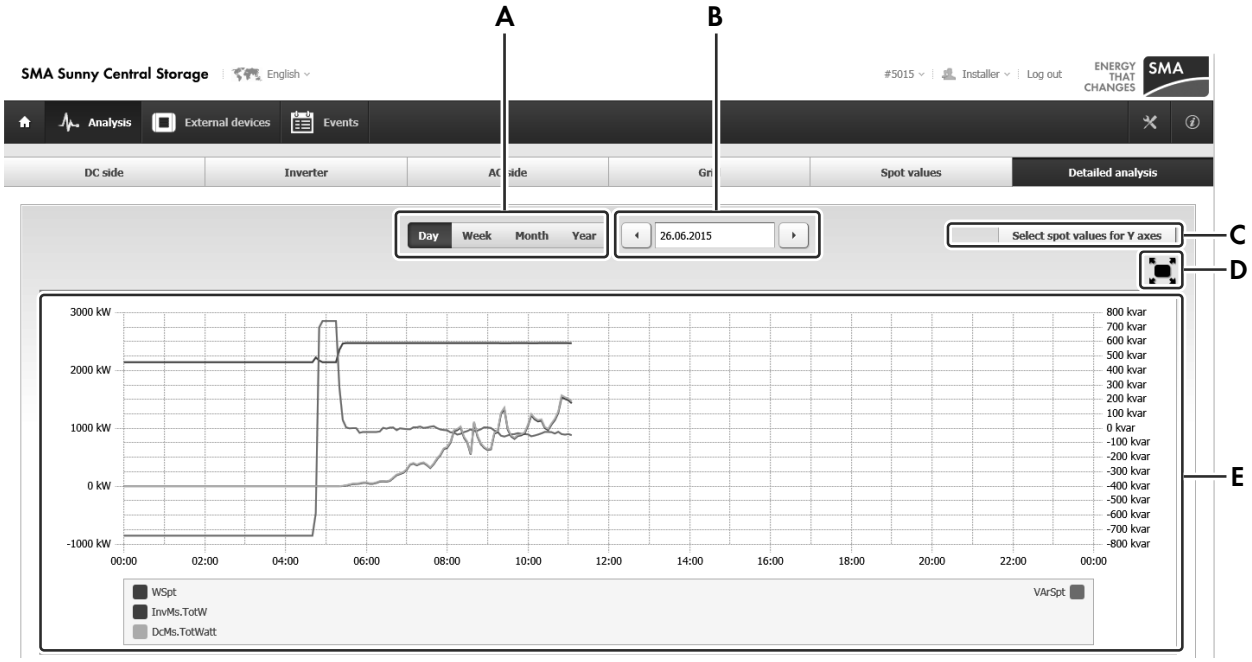


Figure 28: Page **Detail analysis** of the user interface (example)

Position	Explanation
A	Selection of the displayed time period • Day - Display of the selected day from 00:00 a.m. to 11:59 p.m. • Month - Display of the selected month Dates are always displayed from 1 to 31 to avoid any confusion. • Year - Display of the selected year
B	Selecting the period to be displayed You can select the date or the time period either by using the arrow buttons next to the date field or by making a direct entry in the date field.

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.

5.5 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.

5.6 Events

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

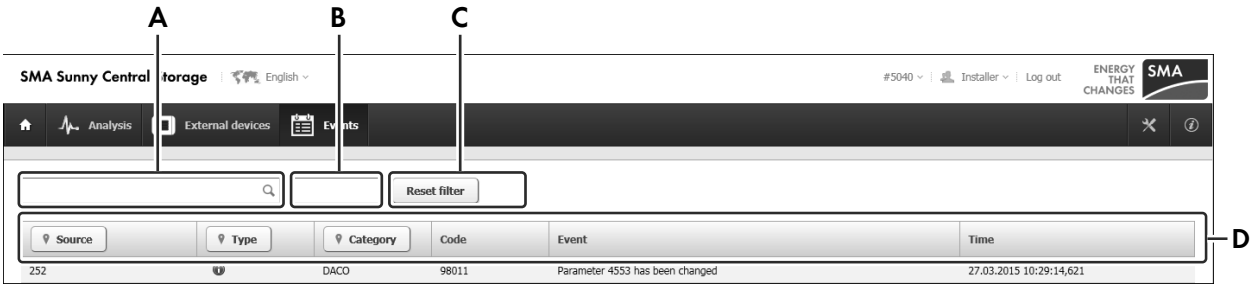


Figure 29: Events dialog

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

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

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

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

Category of events

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

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

5.7 Diagnosis

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

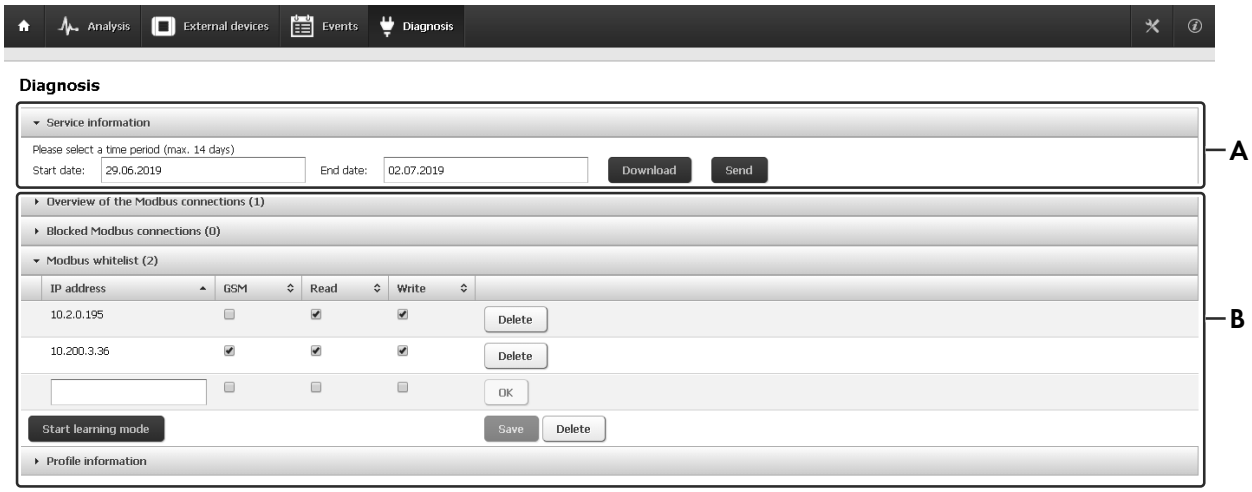


Figure 30: Page Diagnosis of the user interface (example)

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

5.8 Configuration Options

5.8.1 Parameters

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

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

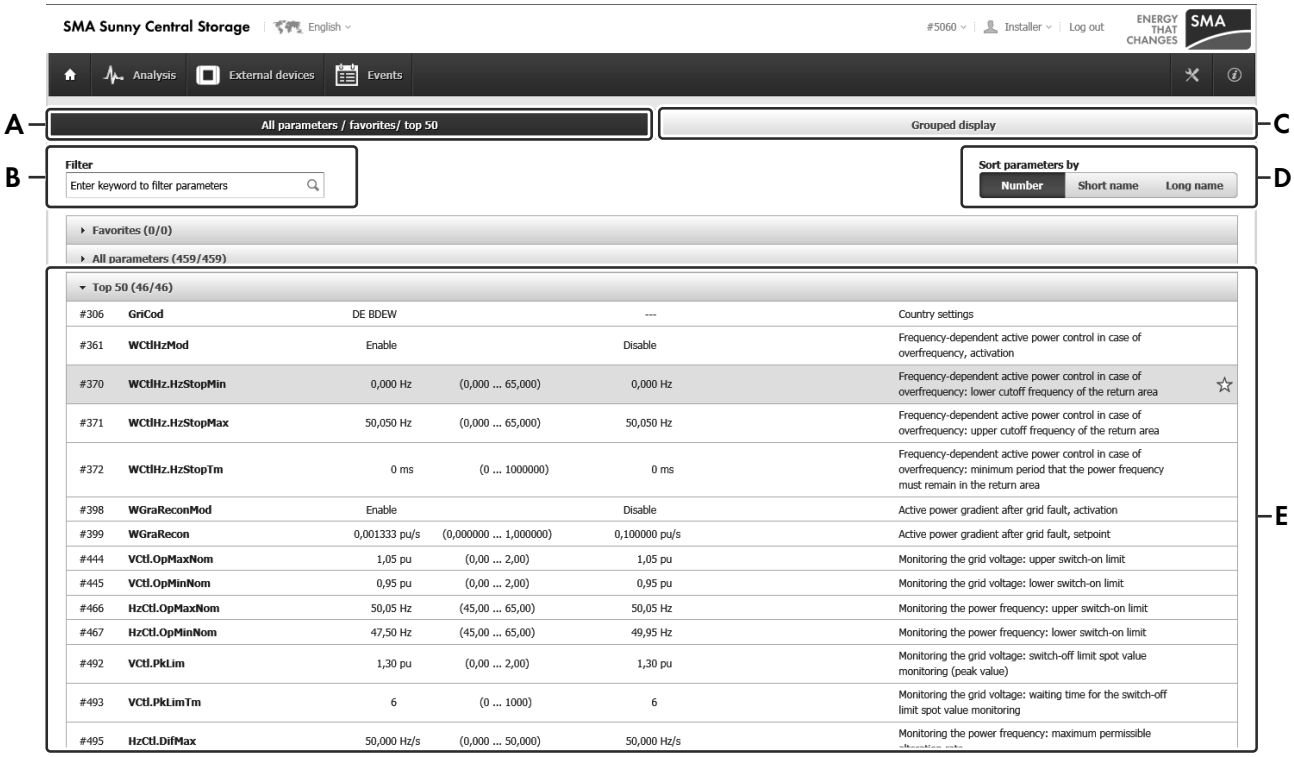


Figure 31: Page **Parameters** of the user interface

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

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

5.8.2 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.

5.8.3 Import

5.8.3.1 Import Concept

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

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

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

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

5.8.3.2 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.

5.8.4 Export

5.8.4.1 Export Concept

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

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

5.8.4.2 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.

5.8.5 File Manager

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

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

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

5.8.6 Setup Assistant

5.8.6.1 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.

5.8.6.2 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.

5.8.7 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.

5.9 Information

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

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

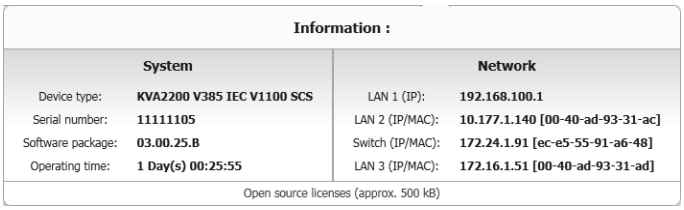


Figure 32: Dialog box **Information** (example)

6 Transport and Mounting

6.1 Safety during Transport and Mounting

⚠ WARNING

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

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

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 1.5%.
- 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.

- Wash the station with clear water within 3 days after it arrives at the construction site. This will inhibit the corrosion process. By processing and painting the affected areas further corrosion can be prevented.

6.2 Requirements for Transport and Mounting

6.2.1 Design of Entire System

Closed electrical operating area

The overall system includes all components of the system. For safety reasons, the entire system must be installed in a closed electrical operating area.

- The entire system must be enclosed by a fence.
- Access must be restricted by a door or gate in the fence and it must only be possible to open it with a key or other tool.
- The closed electrical operating area must be clearly marked with warning messages in accordance with country-specific requirements.
- Ensure that unauthorized persons have no access to the entire system.
- The components of the entire system may only be switched and operated by trained and qualified persons.

6.2.2 External dimensions and weights

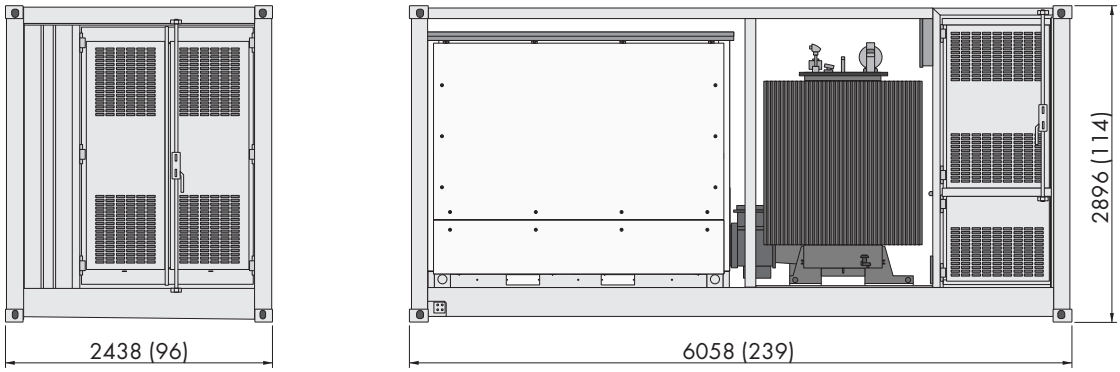


Figure 33: Dimensions of the MV Power Station(Dimensions in mm (in))

Width	Height	Depth	Weight
6058 mm (238.5 in)	2896 mm (114 in)	2438 mm (96 in)	< 18 t (39683 lb)

6.2.3 Minimum Clearances

Observe the following minimum clearances to ensure trouble-free operation of the MV Power Station. 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. Non-observance of the minimum clearances may result in the use of additional devices or greater amount of time and labor. The additional costs incurred will be invoiced also in case of a warranty claim.

The minimum clearances must be ensured for servicing. To avoid corrosion, the MV Power Station must be installed above ground level. If an elevated installation is required, this must be approved in advance by SMA Technology AG. If the MV Power Station is elevated, a mobile platform must be provided for service operations. The platform must comply with OSHA.

Shorter minimum clearances for servicing

The minimum clearances for servicing around the station can be reduced to 2500 mm (98.4 in) if the following conditions are met:

☐ A spot for a crane from which all stations can be reached must be available.

☐ Access roads and areas must be accessible and passable for service vehicles (e.g. forklift or crane truck).

☐ The unloading site for the crane and trucks must be firm, dry and horizontal.

- ☐ The crane must have sufficient load-carrying capacity according to the operating conditions (medium-voltage transformer, medium-voltage switchgear including crane pallet fork, converter choke, inverter with crane traverse, station with crane traverse).
- ☐ For smaller loads, suitable lifting gear (e.g. pallet truck and forklift) must be available on site.
- ☐ To transport smaller loads to the MV Power Station, the areas between the stations must be accessible by pallet truck and forklift.

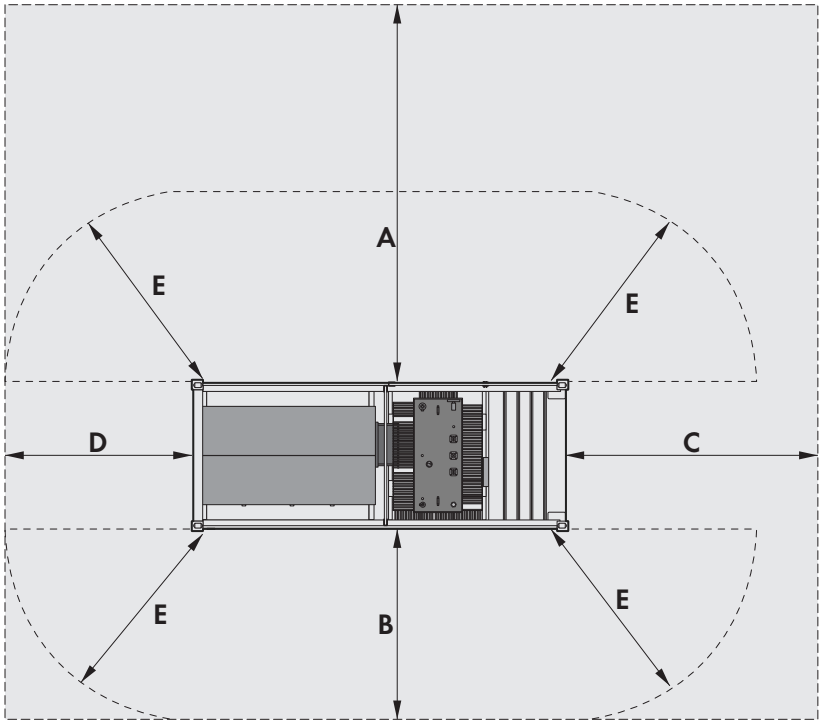


Figure 34: Minimum clearances

Position	Minimum clearance for servicing	Minimum clearance for trouble-free operation
A	6000 mm (236.2 in)	2500 mm (98.4 in)
B	3000 mm (118.1 in)	2500 mm (98.4 in)
C	4000 mm (157.5 in)	2500 mm (98.4 in)
D	3000 mm (118.1 in)	2500 mm (98.4 in)
Internal arc pressure safety areas to be observed during MV switchgear switching operations		
E	Minimum clearance for inflammable materials: 1000 mm (40 in) Minimum clearance for personnel: 3000 mm (119 in)[21)]	

[21)] The work area intended for switching in front of the medium-voltage switchgear is excluded

In the event of arc faults in the medium-voltage switchgear, pressure and hot plasma escape to the medium-voltage transformer. At the same time, the safety area for arc pressure relief system must not be blocked. The MV Power Station has the arc fault qualification IAC A according to IEC 62271-202. The arc pressure relief system must be checked against the local regulations during installation.

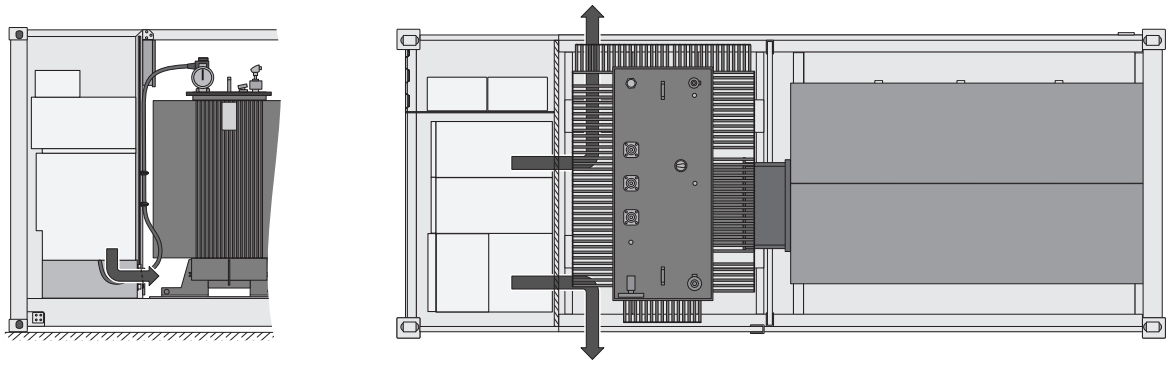


Figure 35: Internal arc pressure at the MV Power Station

6.2.4 Foundation

6.2.4.1 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 is recommended.
- 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.

6.2.4.2 Pea gravel ground

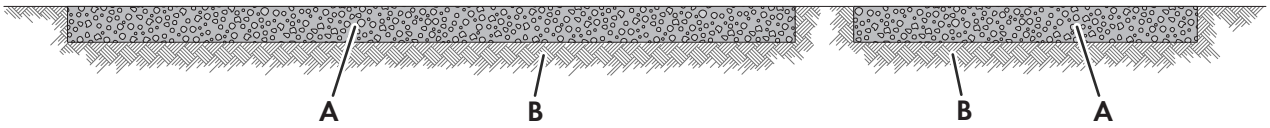


Figure 36: Structure of the support surface

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

The subgrade must meet the following minimum requirements:

☐ The load capacity of the subgrade must be given.

☐ Minimum clearances for servicing operations must be observed(see Section 6.2.3, page 63).

☐ Access roads and areas must be accessible and passable, without any obstructions, for service vehicles (e.g. forklift or crane truck).

6.2.4.3 Weight load on the support points

To ensure the stability and safe standing of the MV Power Station, the station container must stand on at least 4 support points on the outer feet and on 2 support points under the MV transformer. The weight load for each support point depends, among other things, on the height tolerance of the foundation. The weight loads must be determined on a project-specific basis.

It is recommended that the support points each be designed for 5400 kg.

6.2.4.4 Mounting options

Foundation properties:

- ☐ The design of the foundation and selection of building materials (e.g. type of concrete and reinforcement) depends on the soil conditions. The foundation is to be defined by the customer based on the given requirements (weights and tolerances) and ambient conditions.
- ☐ The foundation must be mounted on solid ground.
- ☐ The foundation must be suitable for the weight of the product.
- ☐ The burial depth of the foundation must satisfy the structural requirements.
- ☐ The height tolerance between the individual foundations must not exceed 3 mm. Deviations must be compensated.
- ☐ The middle foundation must be designed 45 mm (1.77 in) ±1.5 mm higher than the outer foundation. Shim plates can be used to compensate for the height difference.
- ☐ In order that the opening for the cable is not covered, the foundation may not protrude more than 240 mm from the outer edge below the station.
- ☐ The professional welding of the station on steel foundations is permitted. The customer is responsible for taking the appropriate corrosion protection measures. Claims regarding rust at the welding points cannot be made.
- ☐ When designing the foundations, safety factors must be taken into account according to local conditions or country-specific regulations.
- ☐ For the "Oil Containment" order option, the foundation must not obstruct the oil filter.
- ☐ A visual inspection of the underside of the oil spill containment must be possible in order to detect leaks at an early stage.

The design of the foundation is the responsibility of the customer. The MV Power Station can also be placed on posts driven into the ground. The weight distribution depends on the number and position of the piles and must be designed accordingly.

Mounting option with pile foundation

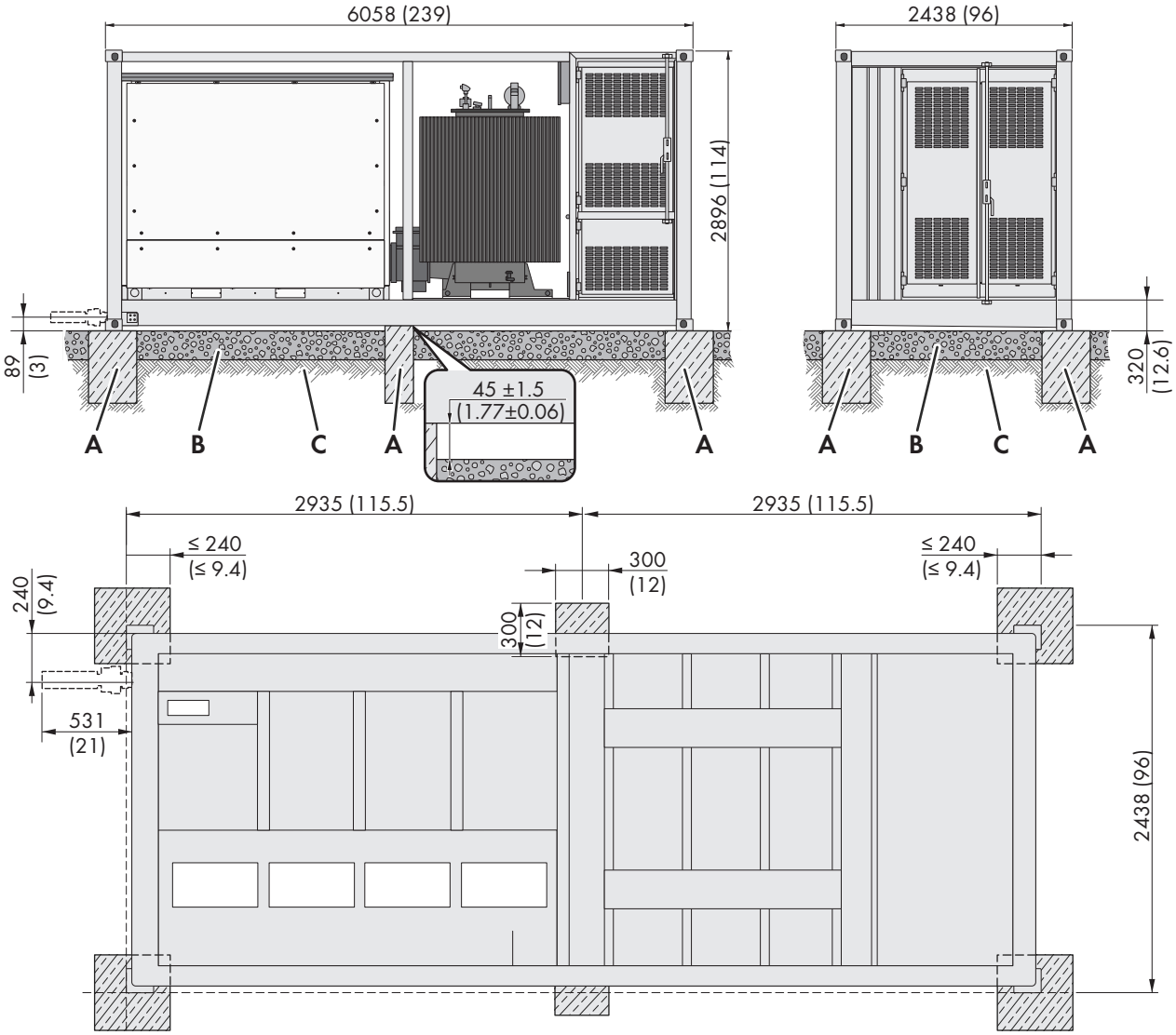


Figure 37: Mounting option with pile foundation (Dimensions in mm (in))

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

Mounting option with strip foundations

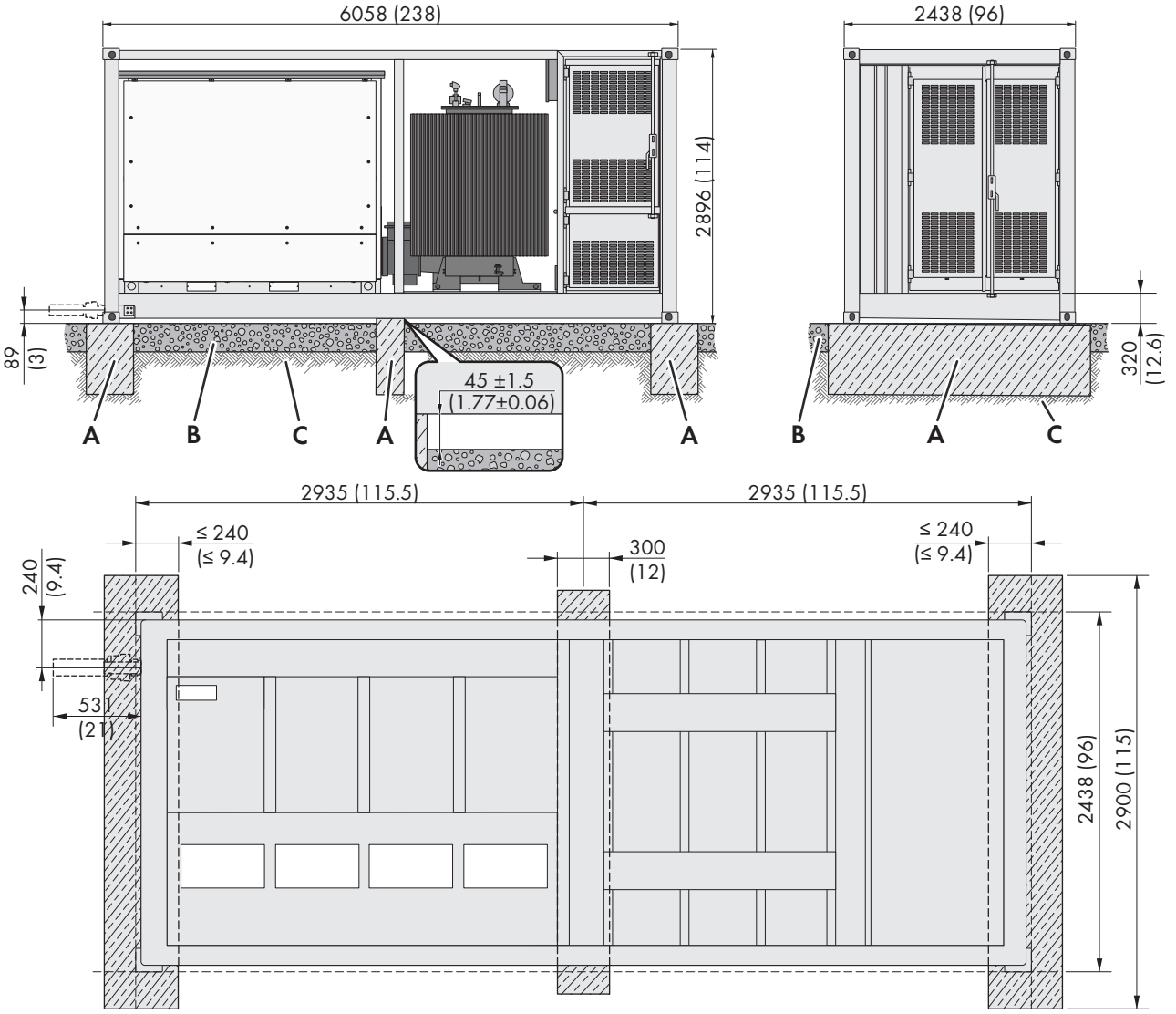


Figure 38: Mounting option with strip foundations (Dimensions in mm (in))

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

6.2.5 Overview of Openings in the Base Plate of the MV Power Station

The MV Power Station is fitted with base plates through which the cables are inserted. The cables should be protected between the foundation and the MV Power Station. Cable protection measures are customer responsibility.

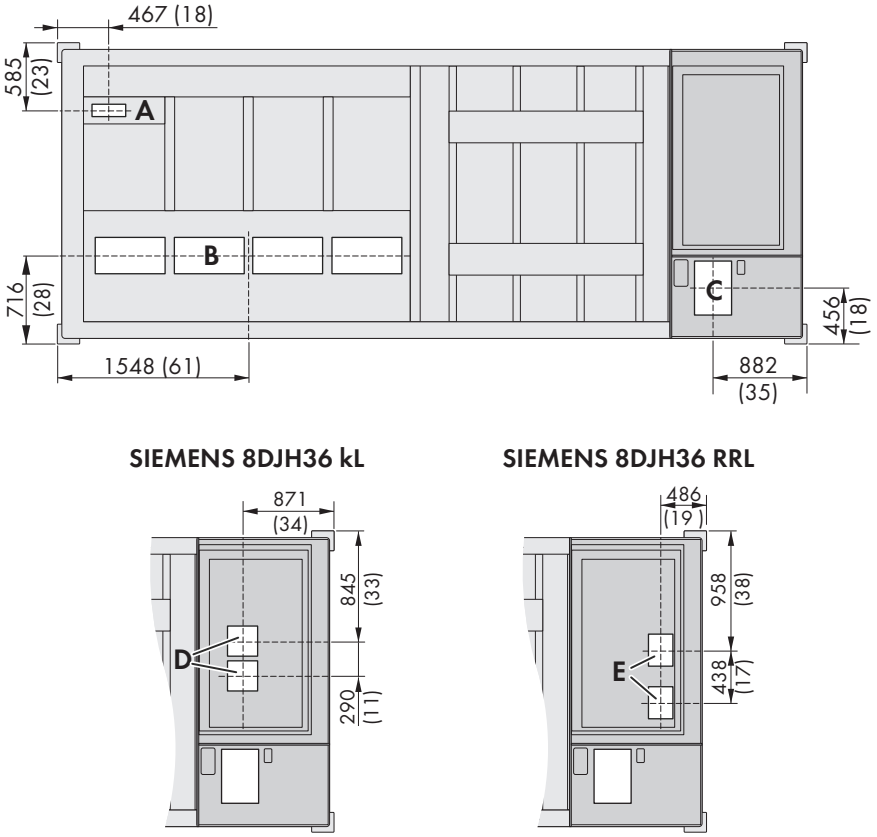


Figure 39: Position of the openings (Dimensions in mm (in))

Position	Designation	Recommended dimensions Width x depth
A	Opening underneath the inverter for insertion of the cables for communication, control, and monitoring With the order option "Cable Entry Kit", the opening is fitted with 2 sliding panels.	210 mm x 95 mm (8.27 in x 3.74 in)
B	Opening underneath the inverter for insertion of the DC cables With the order option "Cable Entry Kit", the opening is fitted with 4 sliding panels.	Left: 560 mm x 386 mm (22.04 in x 15.19 in) Center: 578 mm x 386 mm (22.75 in x 15.19 in) Right: 544 mm x 386 mm (21.41 in x 15.19 in)
C	Opening for insertion of the cables for communication and of the connection cables in the low-voltage room With the order option "Cable Entry Kit", the opening is fitted with 2 sliding panels.	300 mm x 430 mm (11.81 in x 16.93 in)

Position	Designation	Recommended dimensions Width x depth
D	Opening for insertion of AC cables without medium-voltage switchgear With the order option "Cable Entry Kit", the openings are fitted with cable support sleeves.	255 mm x 255 mm (10.03 in x 10.03 in)
E	Openings underneath the MV switchgear for insertion of the AC cables With the order option "Cable Entry Kit", the openings are fitted with cable support sleeves.	255 mm x 255 mm (10.03 in x 10.03 in)
F	Openings underneath the MV switchgear for insertion of the AC cables with order option "1 MVSG for 2 MVT" With the order option "Cable Entry Kit", the openings are fitted with cable support sleeves.	255 mm x 255 mm (10.03 in x 10.03 in)

6.2.6 Requirements for Transport Routes and Means of Transport

Requirements for transport routes and means of transport

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

- ☐ The access road must be accessible for servicing during the entire service life of the product.
- ☐ The maximum permissible gradient of the access road is 10%.
- ☐ During unloading, a distance of at least 2 m (6.5 ft) 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.
- ☐ In order to avoid hard impacts during transport by truck, the driving speed must be adapted to the road conditions.
- ☐ The unloading site for the crane and truck must be firm, dry and horizontal.
- ☐ The external temperature during transport must be greater that -25°C (-13°F).
- ☐ There must be no obstacles above the unloading site (e.g., live overhead power lines).

6.2.7 Center of Gravity Marker

The center of gravity of the product is not in the middle. Take this into consideration during transport of the product. The center of gravity depends on the order option.

The center of gravity is marked on the product.

Figure 40: Center of gravity symbol

6.3 Transporting the 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.
- Do not lift at damaged load-bearing parts.
- 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.

- Attach the lifting lugs to the lower corner castings only.
- Work may only be carried out in accordance with this document.

Requirements:

☐ The crane and hoist must be suitable for the weight.

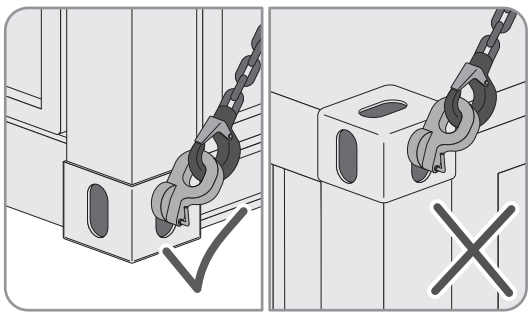
☐ The hoist must be properly connected to the crane.

☐ The factory-fitted transport lock on the devices of the MV Power Station must be in place.

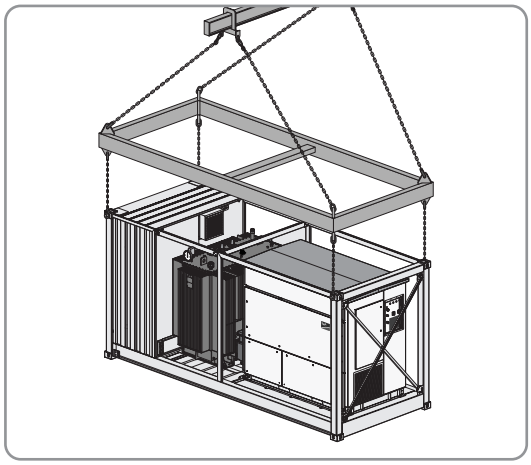
☐ All doors of the MV Power Station must be closed.

Procedure:

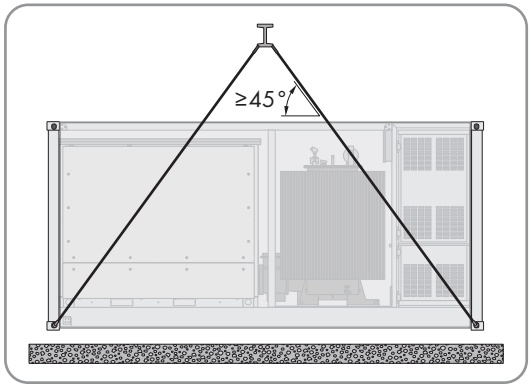
1. If the MV Power Station is to be transported by the lower corner castings, transport the MV Power Station with container cross beam and chain slings. To do so, attach the chain slings to the 4 lower corner castings on the MV Power Station with lifting lugs and protect the MV Power Station enclosure from mechanical damage caused by the hoist. If required, the lifting lugs can be ordered from SMA (material number: 104672-00.01).



2. For the "Sea Freight" order option: If the MV Power Station is to be transported by the upper corner castings, use a hoist frame to attach the chain slings to the upper corner castings. Make sure that the corners of the hoist frame are exactly above the corner castings of the station. This avoids horizontal forces on the station frame.



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



5. If the MV Power Station is not level when raised, lower it back down to the ground.
6. 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.
7. Raise the MV Power Station slightly.
8. Transport the MV Power Station to its final position as close to the ground as possible.
9. Set the MV Power Station down. While doing so, make sure to protect the MV Power Station from vibrations to prevent damages to the station frame. The support surface must be suitable for the weight of the MV Power Station in accordance with the requirements (see Section 6.2.2, page 63).

6.4 Transport by truck or ship

The dimensions of the MV Power Station correspond to those of an ISO container (High Cube Container). It can be transported by truck or ship. A truck with 16 m (629.9 in) length, 2.7 m (106.3 in) width, 5 m (196.85 in) height, and with a total weight of 50 t is capable of transporting up to 2 MV Power Stations. Transport by railroad is not permitted.

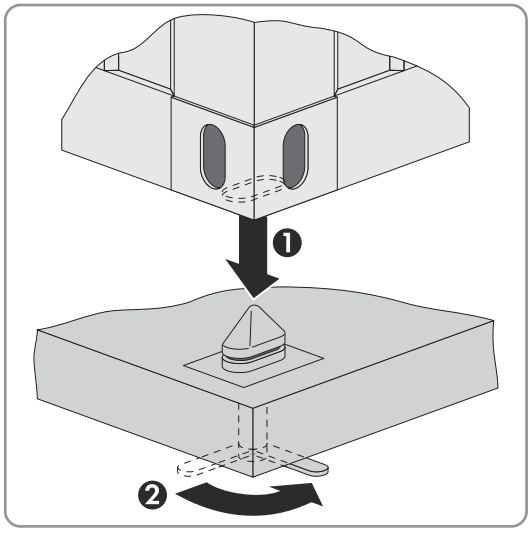
Transport and unloading may cause damage to the surface (hot-dip galvanizing of the station frame or paint of the low or medium-voltage cabinet). Damage to the surface does not impair the function, but must be repaired after 3 weeks at the latest (see Section 11.2.2, page 168).

The transport packaging was not assessed by UL.

For transportation by truck or ship, the MV Power Station must be secured at least at all 4 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.

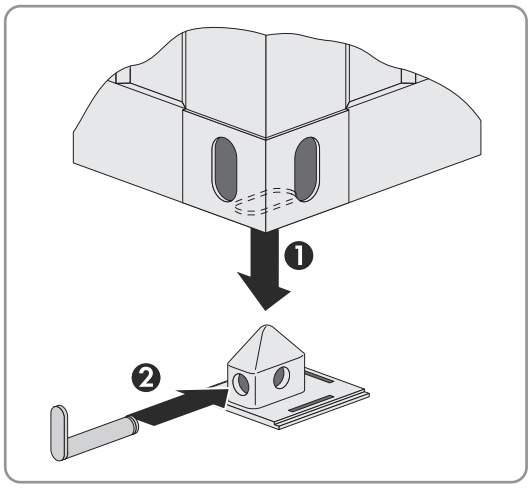
Twistlock

– 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.



- After the MV Power Station has arrived at the construction site, the transport checklist must be completed and sent to the SMA project manager. The transport checklist can be requested from the SMA project manager.

6.5 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 Desiccant bag in the inverter

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

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

Storage more than 2 months

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

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:

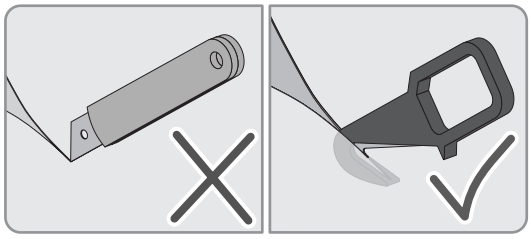
- Do not place the MV Power Station on an unstable, uneven surface.
- Once the MV Power Station has been set down on the surface, do not attempt to adjust its position by pulling or pushing.
- For the order option "Sea Freight", the foil must be removed.
- Prior to storage, ensure that the doors of the MV Power Station are tightly closed.

6.6 Removing the Foil

With the order option "Sea freight", the MV Power Station is covered with a protective foil made of polyethylene. This foil must be removed after 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.
3. Wash the station with clear water within 3 days after it arrives at the construction site. This will inhibit the corrosion process.

6.7 Mounting the MV Power Station

The MV Power Station can be mounted and attached on point strip foundations (see Section 6.2.4, page 65). 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 doors of all cabinets must be closed during operation.

Requirements:

☐ The pea gravel ground and foundation must be prepared.

☐ The requirements for the foundation must be complied with.

☐ Empty conduits for the cables must be laid under the support surface.

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.

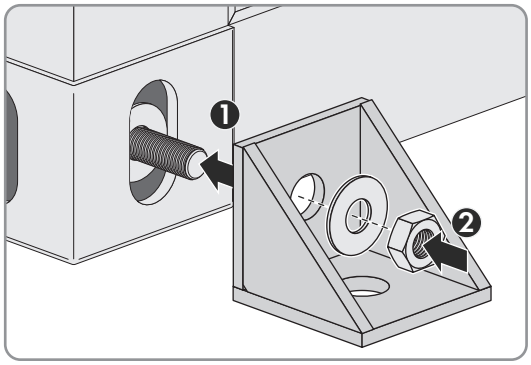
Procedure:

1. Transport the MV Power Station to the mounting location (see Section 6.3, page 71).

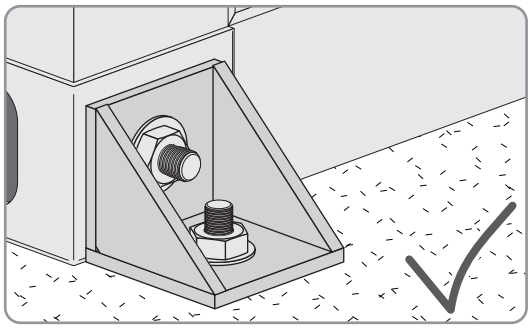
2. Set the MV Power Station down on the support surface. While doing so, make sure to protect the MV Power Station from vibrations to prevent damages to the station frame. Use the base plates to compensate any unevenness. The unevenness must be less than 1.5% (see Section 6.2.4, page 65).
3. Ensure that the height difference of 45 mm ±1.5 mm below the MV transformer is evened out (see Section 6.2.4, page 65). This prevents the station frame from bending.

Procedure for order option "Earthquake and Storm Package":

1. Provide an extra area of 130 mm x 135 mm for the corners of the station container.
2. Attach the side twistlocks at the 4 corners of station container. Take the 4 kg weight of the side twistlocks into account. Use the new supplied M24 x 90 screws, M24 flat nut and anchor plate for this.



3. Drill holes for the screw anchors (diameter of side twistlock: 32 mm).
4. Attach the side twistlocks to the foundation with bolts.



5. Install the Hurricane Kit as stated in the documentation.

7 Installation

7.1 Safety during Installation

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ DANGER

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

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

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

⚠ DANGER

Danger to life 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 and components that are normally ungrounded may be grounded. The PV field is not grounded when the inverter is disconnected or during the measurement of the insulation resistance. Touching live parts will result in death or serious injury due to electric shock.

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

⚠ WARNING

Danger to life due to arc fault caused by damaged connection busbars

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

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

⚠ WARNING

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

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

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.

7.2 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
Carry out preparatory work	Section 7.3, page 79
Inserting the cables	Section 13.5, page 198
Install the grounding at the MV Power Station	Section 7.5.3, page 85
Connecting the DC cables	Section 7.6, page 87
Connecting the AC cables	Section 7.7, page 91
Connecting the cables for communication, control and monitoring	Section 7.8, page 97
Connecting the cable for the supply voltage	Section 7.9, page 106

Task	See
Connecting the cable to customer installation location of the Inverter	Section 7.11.2, page 114
Mounting the inverter panels	Section 13.3.1.1, page 191

7.3 Preparatory Work

7.3.1 Removing the Supporting Struts for Order Option "Sea Freight"

For the order option "Sea Freight", supporting struts protect the MV Power Station from the inverter and the medium-voltage compartment. The supporting struts must be removed after installation.

⚠ CAUTION

Risk of injury when lifting the supporting struts or if they are dropped

When removing the supporting struts, there is a risk of injury if the supporting struts are lifted incorrectly or dropped. Weight of each supporting strut: maximum 15 kg (33 lb).

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

NOTICE

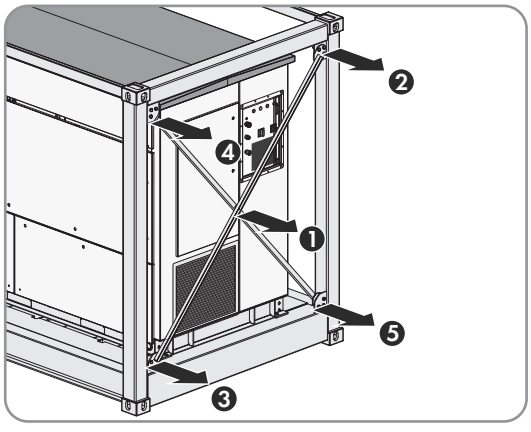
Damage to the product due to non-removal of transport lock

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.

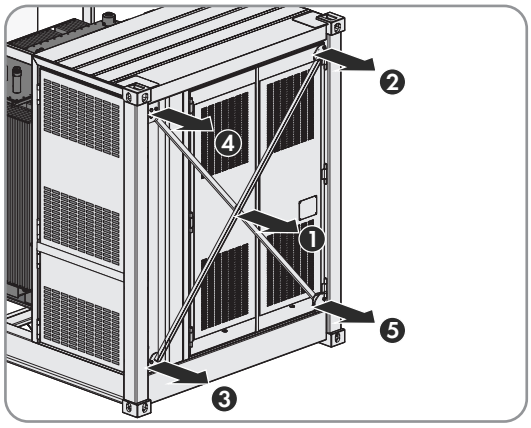
- Ensure that all adhesive foils are removed from doors and openings.

Procedure:

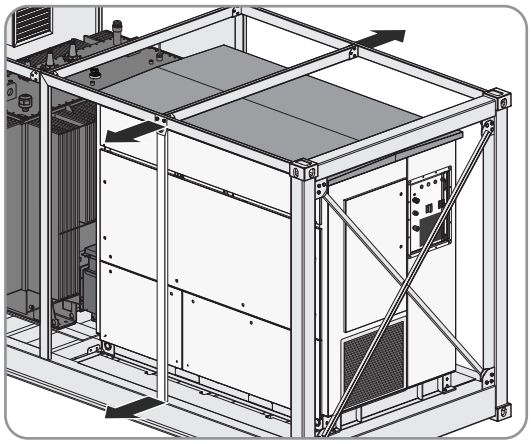
1. Remove the screws of the supporting struts (M22 external hexagon screw) in front of the inverter. When doing so, follow the sequence shown.



2. Remove the screws (M22 external hexagon screw) of the supporting struts and at least 16 screws of the right bracket corner (M16 hex socket) in front of the medium-voltage cabinet. When doing so, follow the sequence shown.



3. Remove the 6 upper screws and the 3 screws (M12 hex socket) for each side supporting strut in front of the inverter.



4. To protect the MV Power Station against corrosion, screw all the bolts into the remaining mounting holes again. When doing so, grease the holes to prevent corrosion. If screws are missing, they must be replaced.
5. Remove all adhesive foils from doors and openings.

7.3.2 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:

1. Loosen and remove all tie-down straps from the frame.
2. Loosen and remove the 4 tie-down straps from the medium-voltage transformer.
3. For the order option "Road Transport" with "MVT Grids" / "Grids Special", loosen and remove all tie-down straps from the rack.

7.3.3 Removing the transport locks on the medium-voltage transformer

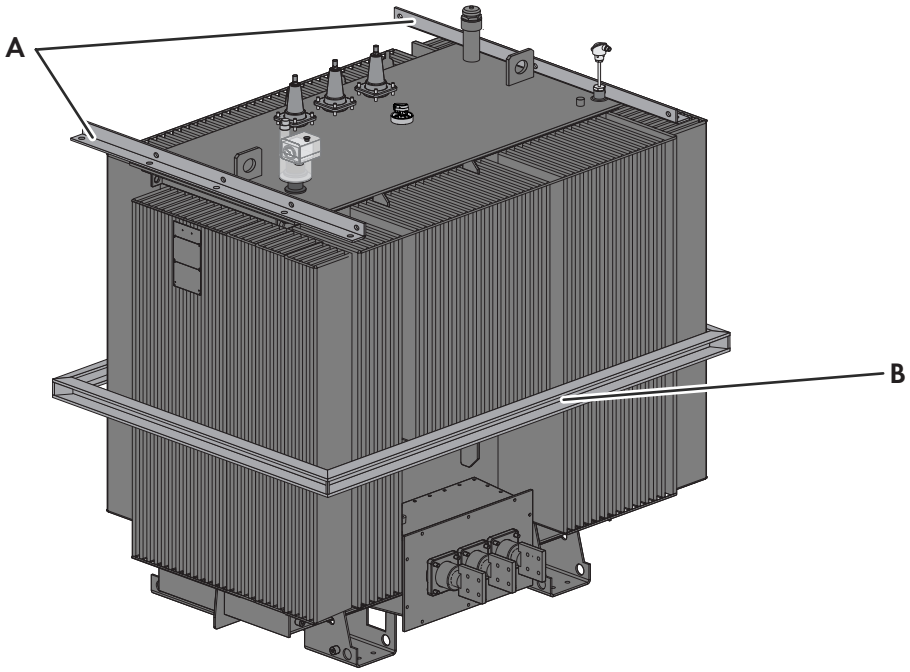


Figure 41: Position of the transport locks on the medium-voltage transformer

Position	Designation
A	L profile supports
B	Fin protection[22)]

Procedure:

1. At least 2 people are necessary to remove the frame surrounding the fins on the medium-voltage transformer. To do this, support the frame firmly and slowly loosen the bolts on the corners.
2. Remove the individual frame supports. Do not damage the paint when doing this.
3. Remove the 2 L-profile supports on the medium-voltage transformer. To do this, loosen the bolts and remove the supports.
4. Turn the bolts into the holes again. This will prevent the formation of rust.
5. Store one set of the transport locks for service actions.
6. If necessary, repair any paint damage using the primer and paint supplied in accordance with the instructions included.

[22)] Depending on the supplier of the medium-voltage transformer

7.3.4 Replacing the Desiccant Bag in the Inverter

Desiccant bags absorb moisture formed during transport.

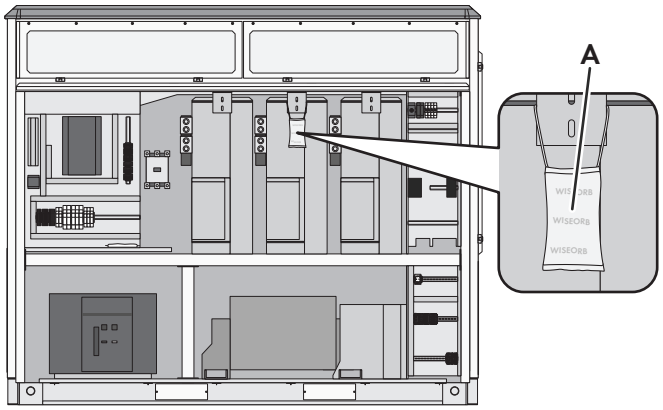


Figure 42: Position of the desiccant bags

Position	Designation
A	Desiccant bag

Desiccant bag in the inverter

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

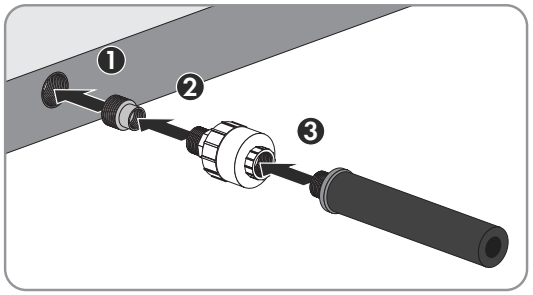
The commissioning is delayed by one day if the desiccant bag has not been replaced in the 24 hours prior to commissioning. Additional travel costs for SMA service personnel must be paid by the customer.

Procedure:

1. Remove and dispose 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.

7.3.5 Mounting the oil filter

1. Unscrew the screw filler plugs from the oil drain of the station.
2. Screw the pre-filter together with the oil filter and mount it on the reducer. Use Teflon tape for sealing.



7.3.6 Preparing the Cable Entry

Cable entries are fitted underneath the inverter and the medium-voltage switchgear and in the low-voltage cabinet.

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.

7.4 Cable Requirements Overview

Position	Torque	Cable cross-section	Cable typ	Rated temperature
Terminal block for external supply via low-voltage transformer	–	25 mm² to 95 mm² (3/0 AWG to 4/0 AWG)	Copper or aluminum	90°C (194°F)
Medium-voltage switchgear	< 50 Nm[23)]	≤ 630 mm² (1250 kcmil)[23)]	Copper or aluminum	90°C (194°F)
Terminal for grounding	80 Nm	≥ 185 mm² (350 kcmil) [24)]	Copper	[25)]
		≥ 300 mm² (600 kcmil) [24)]	Aluminum	
Terminal for the DC cables	60 Nm	≤ 400 mm² (800 kcmil)	Copper or aluminum	90°C (194°F)

You can find additional information in the relevant sections.

7.5 Grounding

7.5.1 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 recommend 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 inverter is grounded via the station frame. The installer is responsible for the grounding of the station frame according to Section 250 of the *National Electrical Code®*, ANSI/NFPA 70.

The AC output circuits are isolated from the enclosure. The AC system must be grounded during installation if required by the Canadian Electrical Code, Part I.

The installer is responsible for the grounding of the PV modules according to Section 690.41 to 690.47 of the *National Electrical Code®* ANSI/NFPA 70.

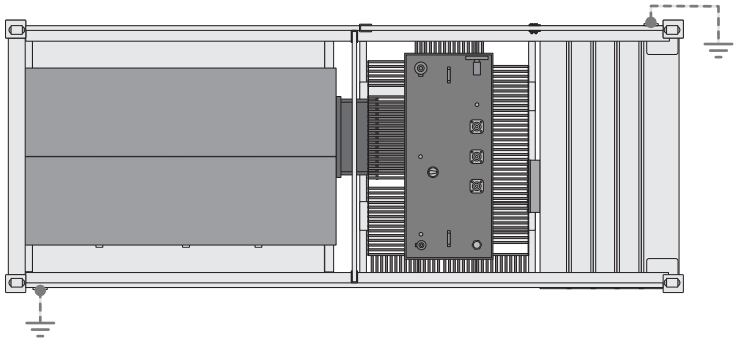


Figure 43: Grounding concept (example)

[23)] Dependent on the connection type and the cables used

[24)] Dependent on grounding concept

[25)] Dependent on ambient conditions

Double grounding of the MV Power Station

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

7.5.2 Requirements for the Grounding Arrangement

Cable Requirements for the Grounding Connection:

- ☐ All cables must be suitable for temperatures of up 90°C (194°F) and must be in accordance with the national standards and directives.
- ☐ All cables must be suitable for outdoor applications. They must be resistant to solar irradiation and, if necessary, oil.
- ☐ Use copper or aluminum cables only.
- ☐ The cable cross-sections of the grounding conductor connections depend on the installed overcurrent protective device. Calculating the required cross-sections depends on the national standards and directives.
- ☐ The grounding of the system must be designed in accordance with the national standards and directives and is the responsibility of the installer.

Requirements for the cable connection with terminal lugs:

- ☐ All terminal lugs used must be suitable for temperatures of up 90°C (194°F) and must be in accordance with the national standards and directives.
- ☐ The maximum material thickness of the terminal lugs must be observed:
  - When connecting with 1 terminal lug: 22.5 mm (0.89 in)
  - When connecting with 2 terminal lugs: 11.25 mm (0.44 in)
- ☐ 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:

- ☐ 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: 185 mm^2 (350 kcmil)
  - For aluminum cable, at least: 300 mm^2 (600 kcmil)
- ☐ Depending on the design of the equipment, an additional grounding must be planned for a YNd11 / YNy0 transformer.

7.5.3 Installing the Grounding at the MV Power Station

The ground electrode must be connected to the grounding terminals of the product. 2 grounding terminals with 4 connection options each are available for the connection. Using terminal lugs with 2 mounting holes is recommended.

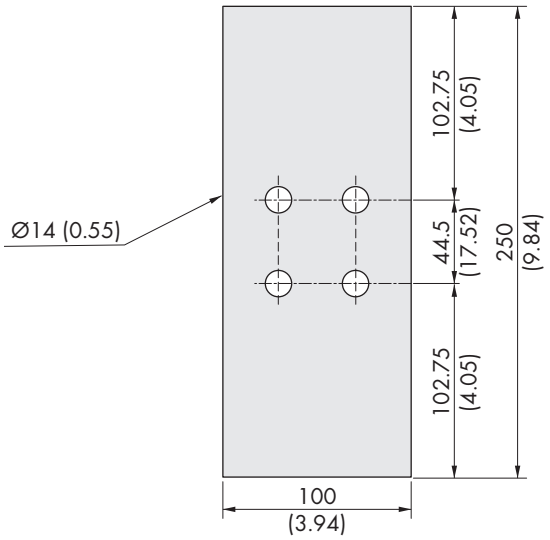


Figure 44: Dimensions of the grounding connections (Dimensions in mm (in))

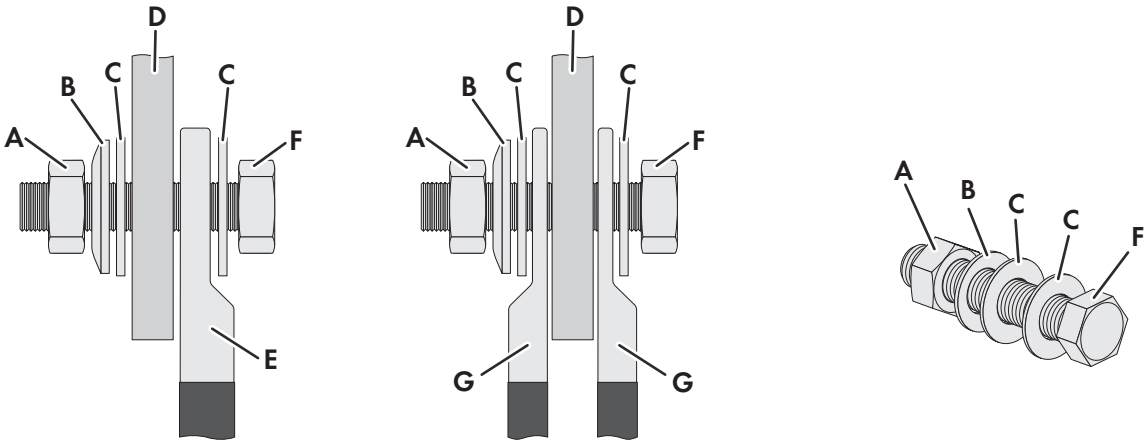


Figure 45: Assembly of the bolted connection

Position	Designation
A	Nut
B	Spring washer
C	Fender washer
D	Grounding terminal of MV Power Station
E	One- or two-hole terminal lug
F	Bolt

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

- ☐ Bolts M12
- ☐ Spring washer M12
- ☐ Fender washers M12

☐ Nuts M12

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

☐ Ground electrodes of the PV system suitable for the grounding concept of the PV system

☐ Clean cloth

☐ Ethanol cleaning agent

☐ Terminal lugs to match the cable cross-section used

☐ Non-woven abrasive

Procedure:

1. Install the ground electrodes in accordance with the applicable regulations.
2. Ensure that the required grounding resistance is reached.
3. If insulated grounding cables are used, strip the insulation off the cables.
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. Clean the contact surfaces with the non-woven abrasive and, if necessary, remove flash rust until they have a light metallic sheen. At the same time, ensure that the coated contact surfaces are not damaged.
7. Remove metal dust using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces again after cleaning.
8. Connect the grounding cable for the ground electrode to the grounding connections of the MV Power Station. Keep in mind that additional grounding cables depending on country-specific regulations may be connected here when disconnecting the medium-voltage transformer from voltage sources.
9. Connect the grounding cables to the ground electrodes of the PV system.

7.5.4 YNd11 / YNy0 transformer grounding

The MV Power Station is equipped with a YNd11 or YNy0 transformer depending on the order option. The medium-voltage transformer may additionally be grounded. Cable clamps are available to attach the grounding cable.

For the order option "Grids MVT Room", "Grids and Rodent Protection", "Grids Special" and "Grids Special and Rodent Prot." there is a gap of 100 mm (4 in) below the grid door for feeding the grounding cables through.

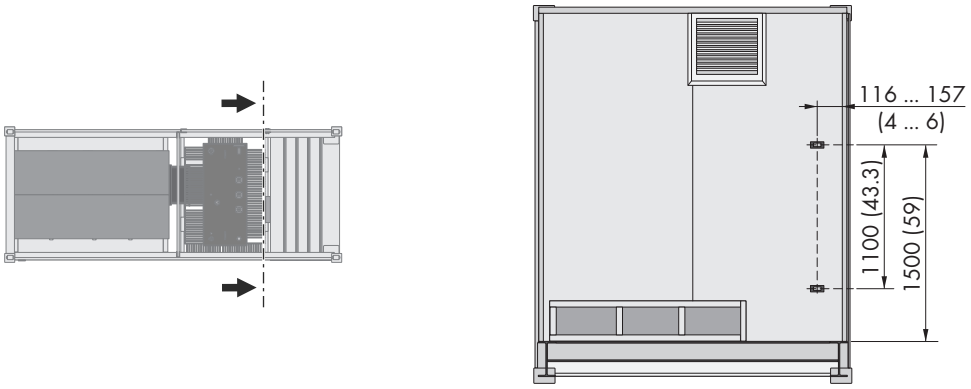


Figure 46: Position of cable clamps

Cable requirements:

☐ Cable diameters: 35 mm (1.4 in) to 54 mm (2.1 in)

☐ The grounding cable must be suitable for outdoor applications.

☐ The grounding cable must be connected to the ground electrode and must not be connected to the ground terminal of the MV Power Station.

- ☐ The dielectric strength of the grounding cable must be rated in accordance with the utility grid and the grounding type.
- ☐ The grounding cable must be rated for the maximum short-circuit current to be expected.
- ☐ The MV transformer is equipped with outer cone, type E bushings (Interface 13, see IEEE Standard 386, Image 15). Appropriate touch-proof connectors for outdoor use must be used.
- ☐ If the medium-voltage transformer is not grounded, a voltage-free cap must be installed on the feed-through.

Procedure:

1. Connect the grounding cable to the neutral conductor feed-through on the medium-voltage transformer. When doing so, observe the maximum bending radius of 400 mm and the torque (see manufacturer's documentation). Furthermore, the feed-through must be protected against UV radiation.
2. Secure the grounding cable using the cable clamps. When doing so, ensure that no forces are applied to the feed-through.

7.6 DC Connection

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

Cable Requirements for the DC Connection

- ☐ All cables must be suitable for temperatures of up to +90°C (+194 °F). They must comply with the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.2 No. 107.1-16.
- ☐ Use copper or aluminum cables only.
- ☐ The wire size has to be based on the ampacities given in Table 310.15(B) (16) of the *National Electrical Code*®, ANSI/ NFPA 70 or the *Canadian Electrical Code*® CSA C22.2 No. 107.1-16. and the derating factor of no less than 125 percent of the RMS or DC current that the circuit carries during rated conditions.
- ☐ Maximum cable cross-section per DC cable: 400 mm² (800 kcmil).
- ☐ For the order option "Cable Entry Kit", maximum outer diameter of the DC cables: 40 mm (1.57 in)
- ☐ The dielectric strength must be dimensioned for the maximum permanent DC voltage.
  - Minimum dielectric strength for Sunny Central Storage 2200: 1100 V
  - Minimum dielectric strength for Sunny Central Storage 2475: 1100 V
  - Minimum dielectric strength for Sunny Central Storage 2200-US: 1000 V
  - Minimum dielectric strength for Sunny Central Storage 2475-US: 1000 V
  - Minimum dielectric strength for Sunny Central Storage 2900-US: 1100 V
- ☐ Parallel connected DC cables must have the same characteristics in order to prevent uneven current distribution.
- ☐ Higher ground voltages can occur in the event of an insulation error until the inverter is switched off. The battery-side components must be insulated for the voltage that occurs in the event of a fault.
  - Voltage to ground for Sunny Central Storage 2200: ±1800 V
  - Voltage to ground for Sunny Central Storage 2475: ±1800 V
  - Voltage to ground for Sunny Central Storage 2900: ±1800 V
  - Voltage to ground: ±2400 V

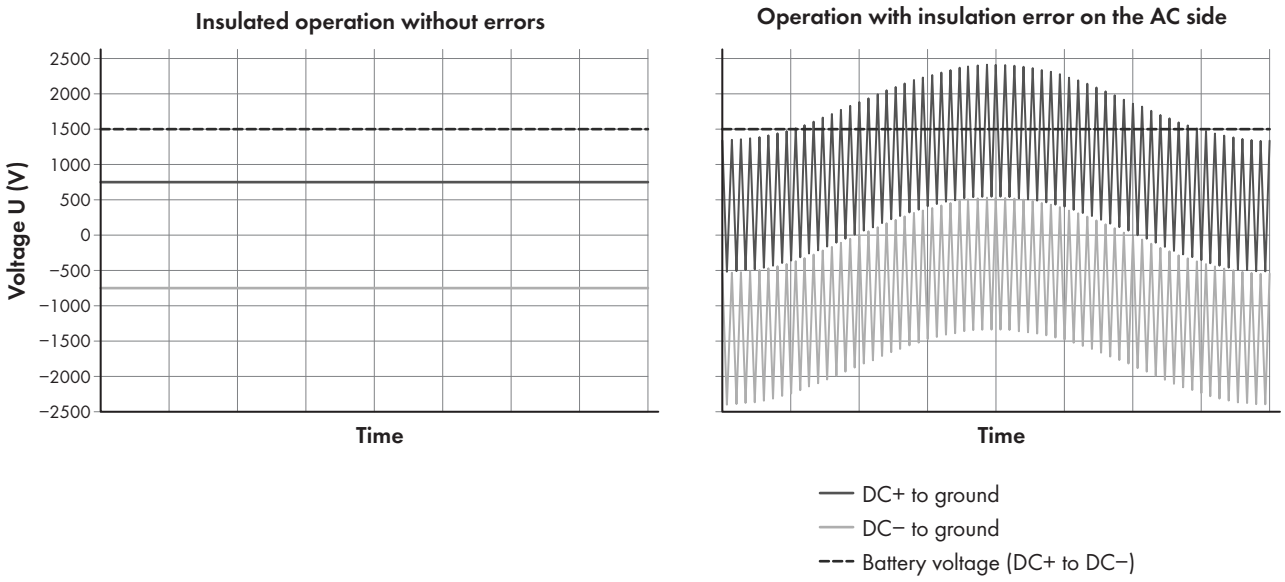


Figure 47: DC-side voltages on the inverter (example)

Requirements for the cable connection with terminal lugs:

- ☐ All terminal lugs used must be suitable for temperatures of up to +90°C (+194 °F) and have a valid UL approval.
- ☐ If not all DC inputs are used, the DC cables must be distributed symmetrically via the DC connection brackets.
- ☐ The maximum material thickness of the terminal lugs must be observed:
  - When connecting with 1 terminal lug: 22.5 mm (0.89 in)
  - When connecting with 2 terminal lugs: 11.25 mm (0.44 in)
- ☐ Using UL certified crimp-type terminal lugs with 2 mounting holes (diameter: 13 mm (0.5 in)) is recommended.
  - Minimum clearance between the holes: 40 mm (1.57 in)
  - Maximum clearance between the holes: 50 mm (1.95 in)
  - Recommended clearance between the holes: 45 mm (1.77 in)
- ☐ Both holes have to be used if two-hole terminal lugs are fitted.
- ☐ If terminal lugs with just 1 mounting hole are used, it must be ensured that the cables always lead downwards and do not twist. Cables laid in a different way reduce the clearance and creepage distances.
- ☐ All connections must be made in accordance with the *National Electrical Code®*, ANSI/NFPA 70.
- ☐ The terminal lug width must be larger than the diameter of the washers (32 mm (1.25 in)). 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 1 terminal lug may be connected per side of each terminal.
- ☐ The bolted connection must be made according to this document.
- ☐ The specified torques must always be complied with.

Requirements for laying in conduits:

- ☐ The conduits must be rain tight and moisture proof.
- ☐ The conduits must meet the requirements of UL 514B.

7.6.2 Battery-storage system requirements

- ☐ The battery must include a fuse switch-disconnector or circuit breaker for a safe disconnection. It is able to safely switch off the battery's short-circuit current in the event of an error.
- ☐ Only batteries approved by SMA Solar Technology AG must be used.

- ☐ The battery's entire voltage range must be completely within the permissible DC input voltage range of the inverter.
- ☐ The maximum permissible DC input voltage of the inverter must not be exceeded.
- ☐ The design of the DC cable between the battery and the inverter must ensure that the DC time constant $\tau < 1$ ms is complied with ($\tau = L/R$).
- ☐ To promote a symmetrical power flow, all DC cables must have the same length.
- ☐ In each case, cables of both polarities (DC+ and DC-) should be routed next to each other in pairs.
- ☐ For communication with the inverter, the battery system must be equipped with an Ethernet port.
- ☐ Higher ground voltages can occur in the event of an insulation error until the inverter is switched off. The insulation of the DC cables must have an appropriate dielectric strength.
  - Voltage to ground: ±2400 V

7.6.3 DC connection area

7.6.3.1 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.
- ☐ To ensure NEC compliance, the disconnection point must be within sight of the inverter.

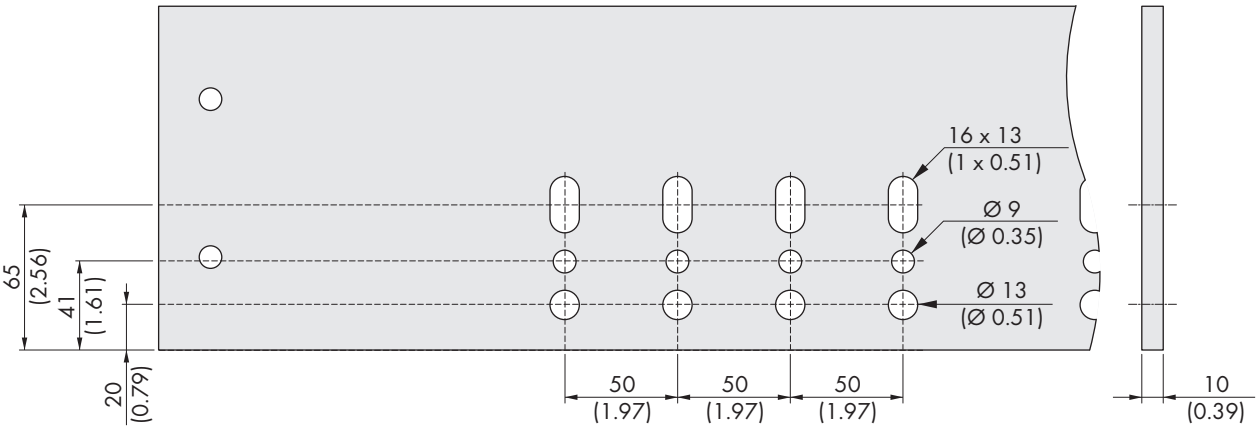


Figure 48: Dimensions of the DC busbar(Dimensions in mm (in))

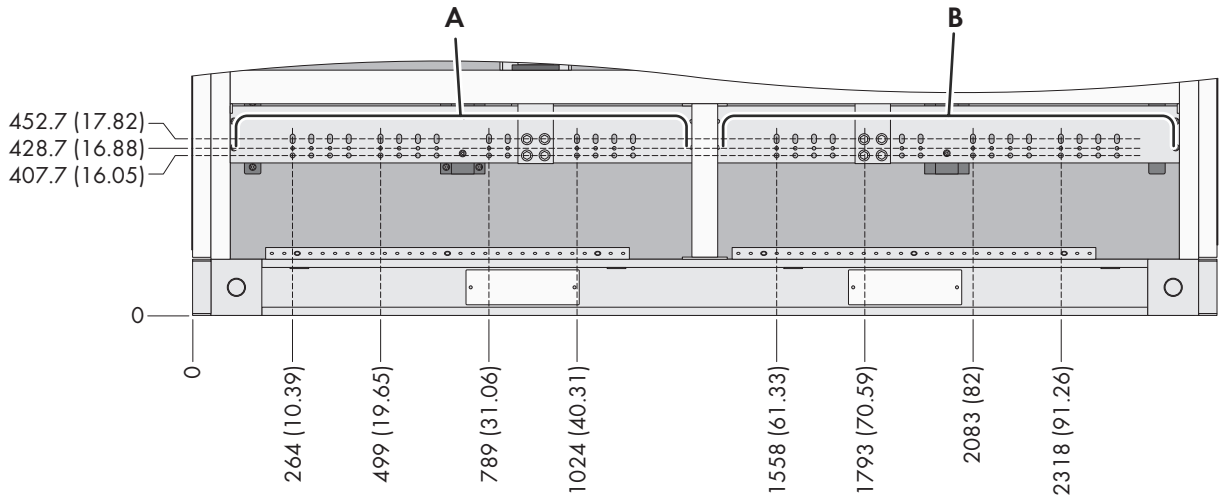


Figure 49: Position and dimensions of the DC busbar (Dimensions in mm (in))

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

7.6.4 Connecting the DC Cables

The terminal lugs must be connected according to the recommended bolted connection Design of the Bolted Connections.

Polarities of the connection points

The polarities of the connection points are marked with labels.

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

- ☐ Clean cloth
- ☐ Ethanol cleaning agent

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

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

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).
2. Strip the cable insulation.
3. Crimp the cables with the terminal lugs according to the manufacturer's technical specifications and our recommendations (see Section 17.8, page 279).
4. Clean the contact surfaces of the terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
5. Connect the DC cables to the connection busbars (torque: 60 Nm (44.3 ft-lb)). A symmetrical distribution of the DC cables is to be ensured. The polarity of the DC connecting rails is marked with labels.

7.7 AC Connection

7.7.1 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 medium-voltage transformer and the layout of the system. They 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 drilled.
- ☐ The holes must be closed with enclosing cable bushings (e.g. rubber grommets) to prevent animals from entering.
- ☐ For the cable length, the distance from the bottom of the MV Power Station to the medium voltage connections must be considered. The maximum distance depends on the medium-voltage switchgear used.
- ☐ Replace and adapt the strain reliefs of the MV switchgear if the diameter of the used cables is smaller than 36 mm (1.4 in) or greater than 52 mm (2 in).
- ☐ Outer-cone angle plugs of type E (Interface 13, see IEEE Standard 386, Image 15) and the required rated voltage must be used.
- ☐ The connection plugs must be suitable for mounting aluminum or copper cable terminal lugs.
- ☐ Follow the manufacturer's instructions when installing the connection plugs.
- ☐ The connection plugs and the cables must be mounted without tension or pressure.
- ☐ When laying the cables, allow for settling in the floor area. Before connecting the connection plugs, the ground must be compacted.
- ☐ Depending on the connector type, the cable cross-section of the line conductor can be as high as 630 mm² (1250 kcmil).
- ☐ If three-core cables are to be used, the conductors must be separated before insertion into the MV Power Station.

Types of cable connectors at Siemens 8DJH36 RRL:

Manufacturer	Type	Cable cross-section
Nexans	M784TB/G	35 mm² to 630 mm² (300 kcmil to 1250 kcmil)
	750LR	
	775LR	
Raychem	ELB-35	53.5 mm² to 630 mm² (1/0 kcmil to 1250 kcmil)

Types of cable connectors at Siemens 8DJH36 RRL with the order option "Deeper Covers":

Manufacturer	Cable type 1	Linking piece	Cable type 2	Optional surge arrester	Cable cross-section
1 cables per line conductor					
Nexans	M784TB/G	-	-	800SA-58-10-xxx	35 mm to 630 mm
TE Connectivity	ELB-35	-	-	-	53.5 mm to 633.4 mm
Cooper	BOL-T	-	-	-	50 mm to 630 mm
3M	5835-E	-	-	-	53.5 mm to 633.4 mm

Manufacturer	Cable type 1	Linking piece	Cable type 2	Optional surge arrester	Cable cross-section
Elastimold	755LR-WOX	-	-	-	50 mm to 500 mm
Richards	63LC	-	-	-	53.5 mm to 633.4 mm
	93LC				
2 cables per line conductor					
Nexans	M784TB/G	M804PB-58G	M784TB/G	-	35 mm to 630 mm

Types of cable connectors at Siemens 8DJH36 kL:

Manufacturer	Cable type 1	Linking piece	Cable type 2	Optional surge arrester	Cable cross-section
1 cables per line conductor					
Nexans	M784TB/G	-	-	800SA-58-10-xxx	35 mm to 630 mm
TE Connectivity	ELB-35	Linking piece	-	ELB-35-600 ARSTR-xx	53.5 mm to 633.4 mm
Cooper	BOL-T	DCP635x	-	M.O.V.E. DCEA635Mxx	50 mm to 630 mm
3M	5835-E	-	-	-	53.5 mm to 633.4 mm
Elastimold	755LR-WOX	750CP	-	755ESA-xx	50 mm to 500 mm
Richards	63LC	-	-	63RSA	53.5 mm to 633.4 mm
	93LC				
2 cables per line conductor					
Nexans	M784TB/G	M804PB-58G	M784TB/G	800SA-58-10-xxx	35 mm to 630 mm
TE Connectivity	ELB-35	Linking piece	ELB-35	-	53.5 mm to 633.4 mm
Cooper	BOL-T	DCP635x	BOL-T	-	50 mm to 630 mm
Elastimold	755LR-WOX	750CP	755LR-WOX	-	50 mm to 500 mm
Richards	63LC	63C...	63LC	-	53.5 mm to 633.4 mm
	93LC	93C...	93LC		

7.7.2 Installing the AC Connection on the Medium-Voltage Switchgear

Overview of the connection area of the MV switchgear

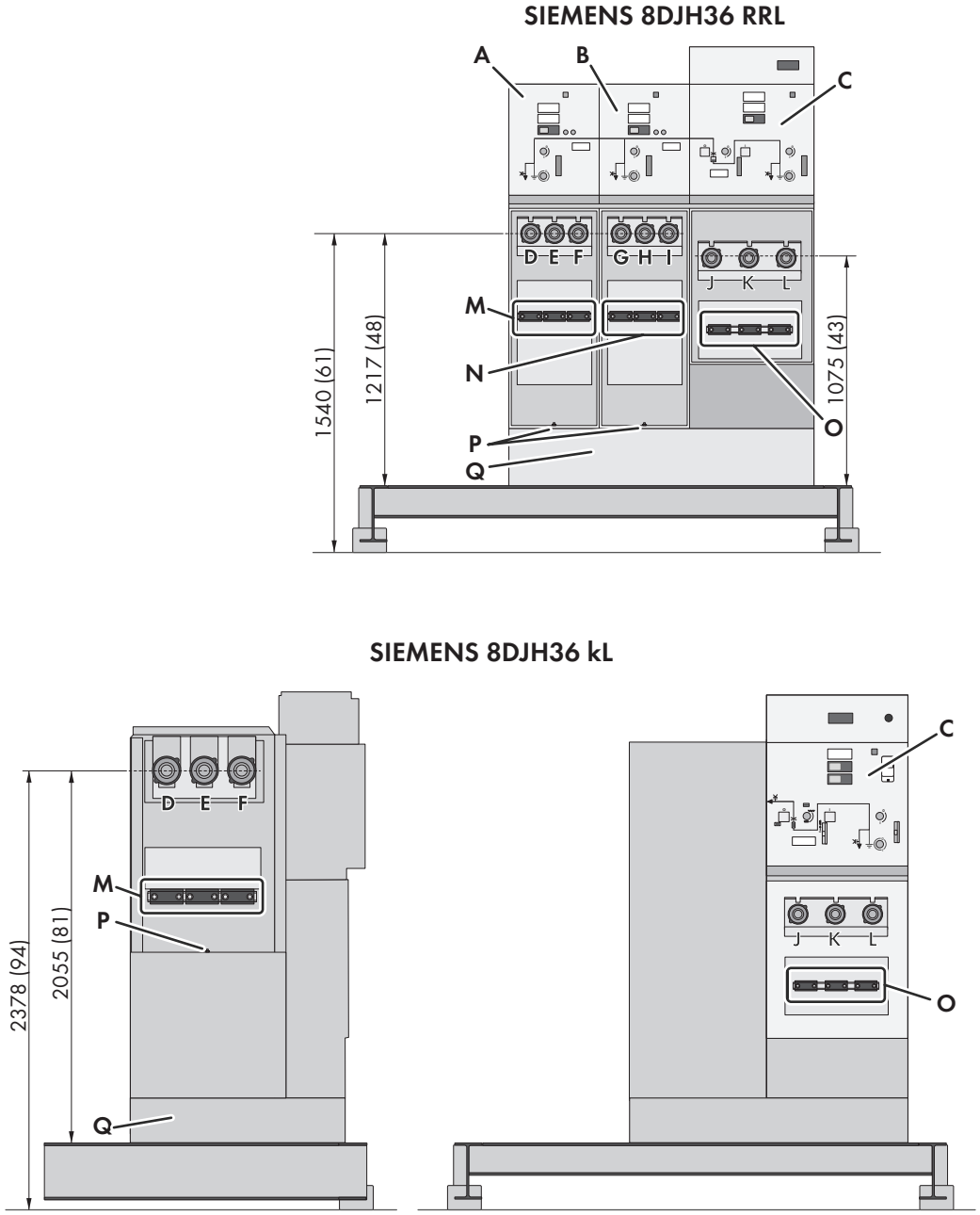


Figure 50: Connection area of medium-voltage switchgear (example) (Dimensions in mm (in))

Position	Designation
A	Cable compartment 1
B	Cable compartment 2
C	Transformer compartment
D	Line conductor L1 from cable compartment 1
E	Line conductor L2 from cable compartment 1
F	Line conductor L3 from cable compartment 1

Position	Designation
G	Line conductor L1 from cable compartment 2
H	Line conductor L2 from cable compartment 2
I	Line conductor L3 from cable compartment 2
J	Line conductor L1 from transformer compartment
K	Line conductor L2 from transformer compartment
L	Line conductor L3 from transformer compartment
M	Cable support rail cable compartment 1[26]
N	Cable support rail cable compartment 2[26]
O	Cable support rail from transformer compartment[27]
P	Grounding busbar for connecting AC cable shielding
Q	Kick plate

Strain-relief clamps

Select strain-relief clamps that are appropriate for the cable cross-section. To adjust the diameters for the cables, the strain-relief clamps contain 2 rubber inserts.

Strain-relief clamp	Size	Order number
Strain-relief clamp[28]	30 mm to 49 mm	114893-00.01
Strain-relief clamp with a small clamping range (on order)	19 mm to 35 mm	108992-00.01
Strain-relief clamp with medium clamping range	44 mm to 72 mm	123446-00.01
Strain-relief clamp with high clamping range	60 mm to 87 mm	200712-00.01

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 13.5, page 198).

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

☐ 3 cable connectors per cable panel, type E (Interface 13, see IEEE Standard 386, Image 15), rated voltage in accordance with the medium-voltage switchgear (see documentation of medium-voltage switchgear manufacturer)

☐ For the "1 MVSG for 2 MVT" order option: Connector (depending on the cable cross-section M800PB-58 / M804PB-58) for connection to the transformer compartment of the medium-voltage switchgear of another MV Power Station

[26] 3 (6 with kL) strain-relief clamps per cable panel are mounted on the cable support rail for attaching the cables. The equipment for connection of 2 cables per line conductor can be provided by SMA upon request.

[27] With the order option "1 MVSG for 2 MVT"

[28] On the 3-field medium-voltage switchgear, 3 strain-relief clamps are installed per cable panel at the factory. On the kL medium-voltage switchgear, 6 strain-relief clamps for attaching the cables are included in the scope of delivery.

Procedure:

1. Disassemble the protection plates for the "UL-Listed" version of the medium-voltage switchgear.
2. Disassemble the kick plate of the medium-voltage switchgear.
3. For the order option without "Cable Entry Kit": Remove the base plates of the cable entries. Drill holes in the base plates.
4. For the order option with "Cable Entry Kit": Remove the plates of the Cable Entry Kit. For each cable panel, there are 6 rubber bushings for cable diameters from 27 mm to 50 mm.
5. Thread the cables with cable glands or rubber bushings through the holes in the plate. Ensure that the cable glands or rubber bushings cleanly enclose and seal the cables. This prevents animals from entering the product and allows for a proper internal arc pressure.
6. Remove the strain-relief clamps from the cable support rail.
7. Attach the cables to the cable support rail using the strain-relief clamps. Ensure that the cables run straight down, the strain-relief clamps safely enclose the cable and the cable has no play. This helps prevent mechanical strain on the outer cone bushings of the medium-voltage switchgear. Ensure that the AC cable shielding is not mounted in the strain-relief clamp.
8. For the order option "1 MVSG for 2 MVT", pull the pre-installed current transformers for each line conductor over the individual cables and the summation current transformer around all cables. When doing this, route the grounded shield through the current transformers.
9. Connect the cables to the medium-voltage switchgear (see documentation for the medium-voltage switchgear and cable connector manufacturers). The torque specifications of the cable plug manufacturer must be adhered to in order to prevent the emission of SF6 gas.
10. Connect the shielding of the AC cables to the grounding busbar.
11. For the order option with "Cable Entry Kit": Attach the plates of the Cable Entry Kit.
12. For the order option without "Cable Entry Kit": Attach the base plates of the cable entries.
13. Close all unused outer cone bushings of a cable panel with voltage-resistant filler plugs.
14. Mount the kick plate of the medium-voltage switchgear.
15. Remount the protection plates for the "UL-Listed" version of the medium-voltage switchgear.
16. If necessary, install additional surge arresters. Mounting the surge arresters in the transfer station is recommended. When doing this, follow the manufacturer's instructions.

Further details are to be found in the circuit diagram.

7.7.3 Installing the AC Connection at the Medium-Voltage Transformer

If the MV Power Station was ordered without a medium-voltage switchgear (for example, with order option "1 MVSG for 2 MVT"), the AC cables must be connected to the medium-voltage transformer.

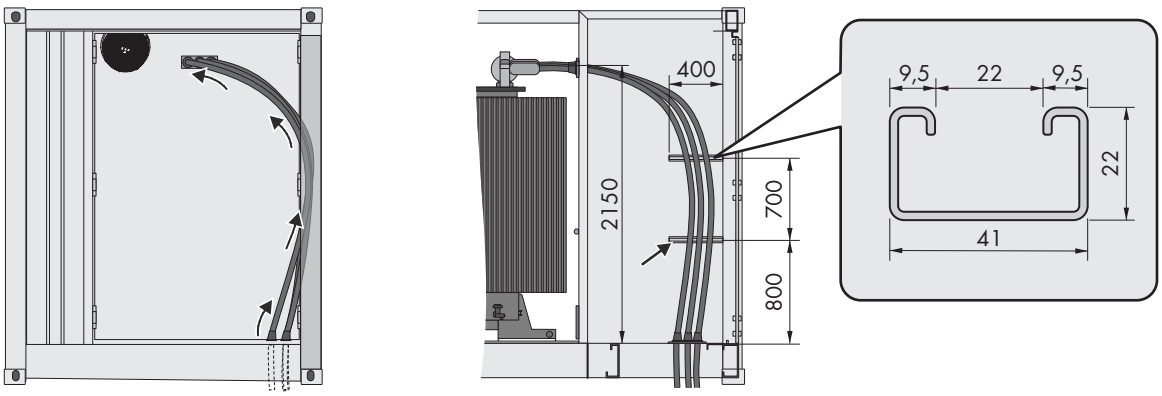


Figure 51: Cable route when connecting to medium-voltage transformer

Requirement:

- ☐ The MV transformer is equipped with outer cone, type E bushings (Interface 13, see IEEE Standard 386, Image 15). Appropriate touch-proof connectors for outdoor use must be used.
- ☐ All cables and connection plugs must be UV-resistant.
- ☐ The requirements for the protective settings and maximum short-circuit times must be observed (see Section 9.22, page 142).
- ☐ The openings for the cables are designed for diameters from 27 mm to 50 mm (2 in).
- ☐ The strain reliefs for securing the cables are not included in the product scope of delivery, however, can be ordered from us (material number: 114893-00.01).
- ☐ Screws and sliding nuts to match the C-profile (see figure above) for installing the cable clamps to the cable support rails must be provided.

Procedure:

1. For the order option with "Cable Entry Kit": Remove the plates of the Cable Entry Kits. Thread the cables with rubber bushings through the holes in the plate. When doing so, ensure that the rubber bushings cleanly enclose and seal the cables. This prevents animals from entering the product.
2. For the option without "Cable Entry Kit": Drill holes in the base plates. Thread the cables with cable glands or rubber bushings through the holes in the base plate. Ensure that the cable glands or rubber bushings cleanly enclose and seal the cables. This prevents animals from entering the product.
3. Connect the AC cables to the medium-voltage transformer (see manufacturer's documentation). To prevent oil leaks, do not damage the fins of the medium-voltage transformer when doing this (e.g., by stepping on or leaning against conductors). Comply with the maximum torque for the connection to the medium-voltage transformer.
4. Hold the AC cables onto the wall of the container by using cable clamps (maximum bending radius: 720 mm). Ensure that no tension of compression or force is exerted on the outer cone bushings of the medium-voltage transformer.
5. To protect the medium-voltage transformer from overload, short circuit and ground fault: For the order option without "MV Switchgear", use medium-voltage switchgear with a circuit breaker and transformer protection device that has the appropriate functionality.
6. To enable transformer protection with the protective devices installed on the medium-voltage transformer (oil level, gas and pressure), establish a connection from terminal **-X791:1/2** in the station subdistribution to the trip coil of the upstream medium-voltage switchgear. In case of error, the MV Power Station sends a signal to terminal **-X791:1/2** with a triggering voltage of 230 VAC.
7. For the order option "1 MVSG for 2 MVT" for communication between both stations, establish a connection from terminal **-X791:1/2** of the station without medium-voltage switchgear to terminal **X796:1/2** of the station with medium-voltage switchgear. Use a cable with at least the following cross-section: 1.5 mm^2.

Further details are to be found in the circuit diagram.

7.8 Cables for communication, control and monitoring

7.8.1 Connecting the Cable in the Inverter

7.8.1.1 Connect the battery's communication cable

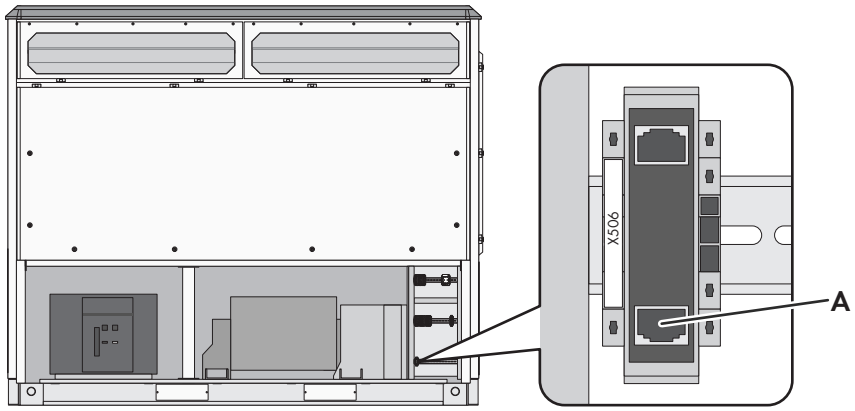


Figure 52: Position of the connection for battery communication

Position	Designation
A	Connection for battery communication

Ethernet cable requirements:

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

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Plug the cable into the network port **-X506** for the internal interface **LAN 1 Port 2**.
4. Attach the cable to the cable support rail using a cable tie. This will prevent the cable from being pulled out inadvertently.
5. Mount the panels (see Section 13.3.1.1, page 191).

7.8.1.2 Connecting the Cable for External Fast-Stop Function

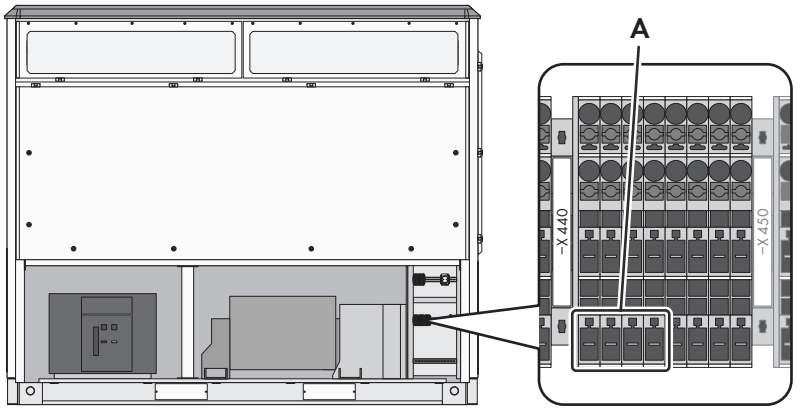


Figure 53: Position of the terminal block for external fast stop function

Position	Designation
A	Terminal block

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm² (26 AWG to 12 AWG)
- ☐ Single-wire cable: 0.14 mm² to 4.0 mm² (26 AWG to 14 AWG)
- ☐ Number of conductors: 2
- ☐ Maximum cable length: 30 m (98 ft)

Requirements:

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

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Remove the female connector **-X441** from the terminals **1** and **2** of the terminal block **-X440**.
4. Remove the bridge from the female connector **-X441**.
5. Connect 24 V_{out} to the female connector **-X441:1** and 24 V_{in} to the female connector **-X441:2** in accordance with the circuit diagram (see Section 13.4.2, page 197).
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 13.3.1.1, page 191).

7.8.1.3 Connecting cable for reporting an insulation error

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

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

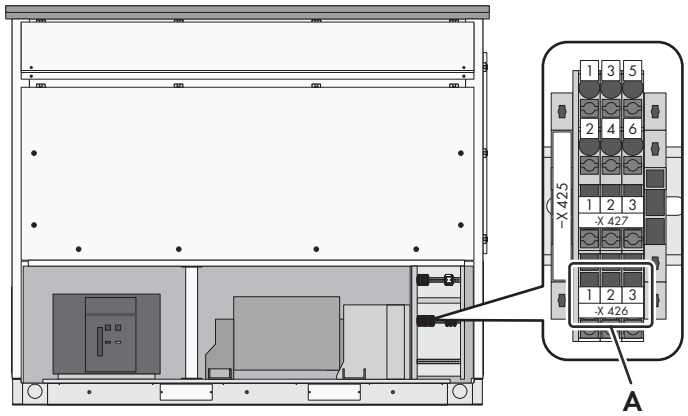


Figure 54: Position of the terminal block for reporting an insulation error

Position	Designation
A	Terminal block

Requirement:

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

Cable requirements:

☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm² (26 AWG to 12 AWG)

☐ Single-wire cable: 0.14 mm² to 4.0 mm² (26 AWG to 14 AWG)

☐ Number of conductors: 2

Querying the insulation error via break contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Remove the female connectors **-X427:1** and **-X427:2** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X427:1,2** according to the circuit diagram (see Section 13.4.2, page 197).
5. Plug the female connectors **-X427:1** and **-X427:2** into the terminal block **-X425:2** and **-X425:4**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.3.1.1, page 191).

Querying the insulation error via make contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Remove the female connectors **-X427:1** and **-X427:3** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X427:1,3** according to the circuit diagram (see Section 13.4.2, page 197).
5. Plug the female connectors **-X427:1** and **-X427:3** into the terminal block **-X425:2** and **-X425:6**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.3.1.1, page 191).

7.8.1.4 Connecting cable for reporting an insulation warning

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

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

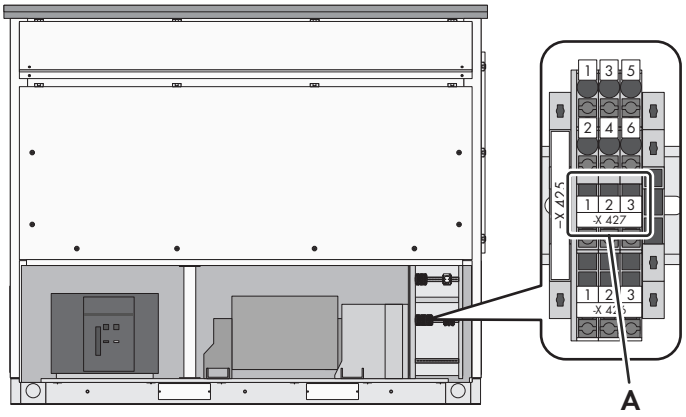


Figure 55: Position of the terminal block for reporting an insulation warning

Position	Designation
A	Terminal block

Requirement:

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

Cable requirements:

☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm² (26 AWG to 12 AWG)

☐ Single-wire cable: 0.14 mm² to 4.0 mm² (26 AWG to 14 AWG)

☐ Number of conductors: 2

Querying the insulation warning via break contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Remove the female connectors **-X426:1** and **-X426:2** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X426:1,2** according to the circuit diagram (see Section 13.4.2, page 197).
5. Plug the female connectors **-X426:1** and **-X426:2** into the terminal block **-X425:1** and **-X425:3**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.3.1.1, page 191).

Querying the insulation warning via make contact

1. Ensure that all poles are de-energized.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Remove the female connectors **-X426:1** and **-X426:3** from the terminal block **-X425**.
4. Connect the cable on the female connector **-X426:1,3** according to the circuit diagram (see Section 13.4.2, page 197).
5. Plug the female connectors **-X426:1** and **-X426:3** into the terminal block **-X425:1** and **-X425:5**.

6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.3.1.1, page 191).

7.8.1.5 Connecting cable for the status of the DC switch

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

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

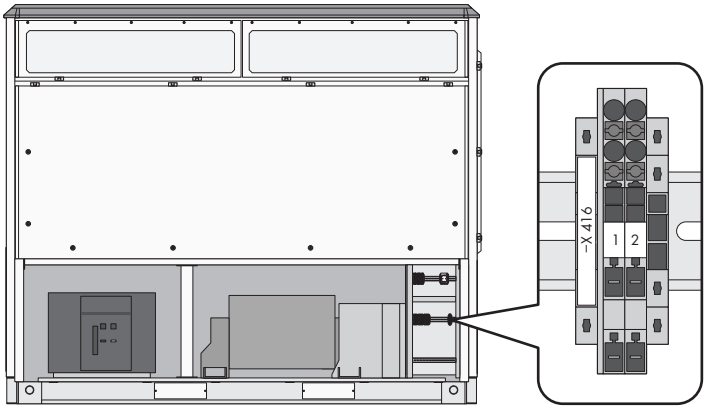


Figure 56: Position of the connecting terminal plate for the switching-state light repeater of the DC switch

Requirement:

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

Cable requirements:

☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm² (26 AWG to 12 AWG)

☐ Single-wire cable: 0.14 mm² to 4.0 mm² (26 AWG to 14 AWG)

☐ Number of conductors: 2

☐ Maximum cable length: 30 m (98 ft)

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Connect the cable to the terminals **-X416:1** and **-X416:2** in accordance with the circuit diagram (see Section 13.4.2, page 197).
4. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 13.3.1.1, page 191).

7.8.1.6 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.

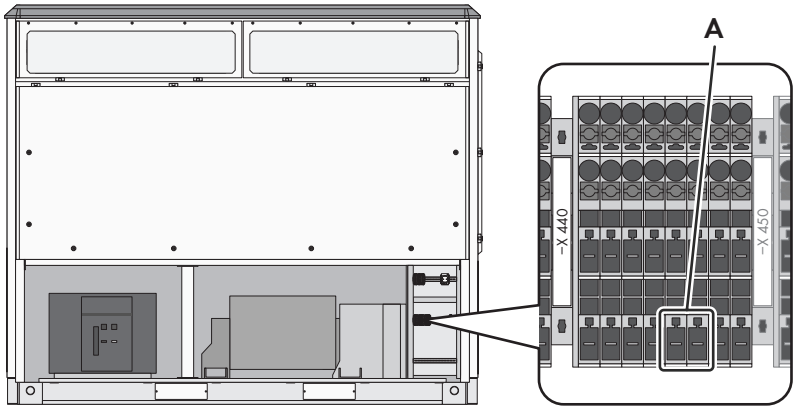


Figure 57: Position of the terminal block for external standby

Position	Designation
A	Terminal block

Requirements:

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

☐ The contact must be closed for operation.

Cable requirements:

☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm² (26 AWG to 12 AWG)

☐ Single-wire cable: 0.14 mm² to 4.0 mm² (26 AWG to 14 AWG)

☐ Number of conductors: 2

☐ Maximum cable length: 30 m (98 ft)

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Remove the female connector **-X442** from the terminals **5** and **7** of the terminal block **-X440**.
4. Connect the cable to the female connector **-X442** in accordance with the circuit diagram (see Section 13.4.2, page 197).
5. Plug the female connector **-X442** into the terminals **5** and **7** in the terminal block **-X440**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 13.3.1.1, page 191).

7.8.1.7 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
- 4 analog and 8 digital inputs

O/I modules used

Industrial fiber media converters of MOXA are being used.

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

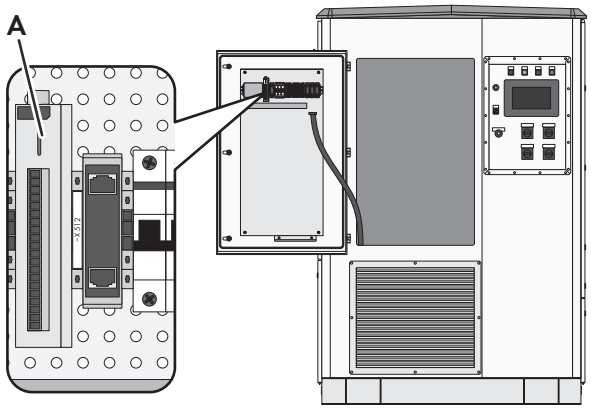


Figure 58: Position of the Remote I/O module

Position	Designation
A	Remote I/O module

Ethernet cable requirements:

☐ The cable must be shielded.

☐ The insulated conductors must be twisted pairs.

☐ The cable must be at least of category 5 (CAT 5).

Cable requirements for digital/analog connections:

☐ Maximum cable cross-section 0.75 mm² (AWG 20)

Requirements for terminals:

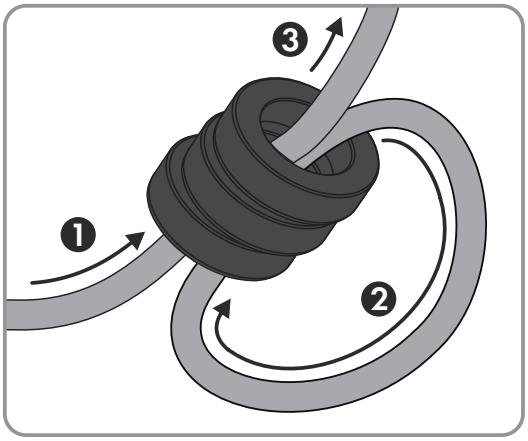
☐ A surge protection is recommended for the Ethernet cable.

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

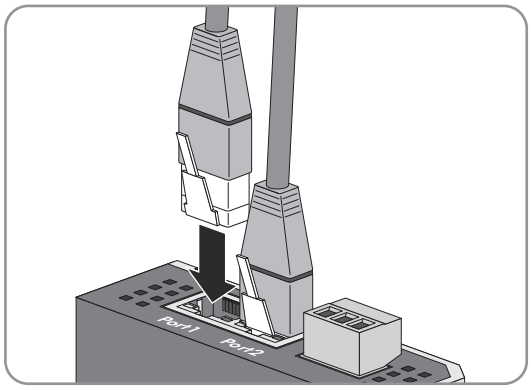
☐ 3 ferrites (material number: 124886-00.01)

Procedure:

1. Insert the cables into the inverter (see Section 13.5.2, page 199).
2. Lead the Ethernet cables through the 3 ferrites from the scope of delivery, form a ring with the cables and lead the cables through the ferrites again.



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



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

7.8.1.8 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

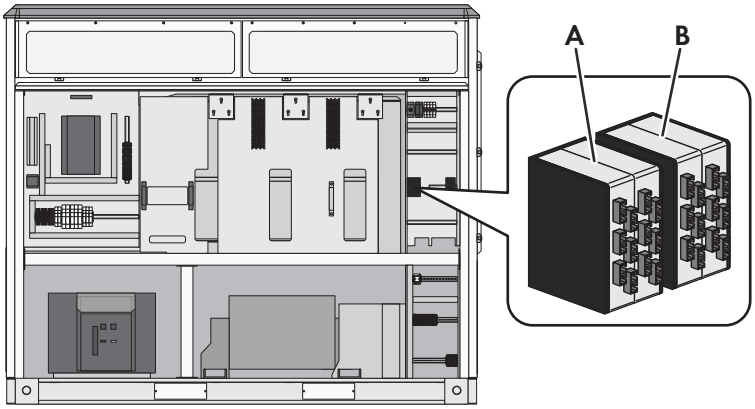


Figure 59: Position of the splice box of the communication via optical fiber backbone ring

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

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

Optical fiber requirements in single mode:

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

Optical fiber requirements in multi mode:

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

NOTICE

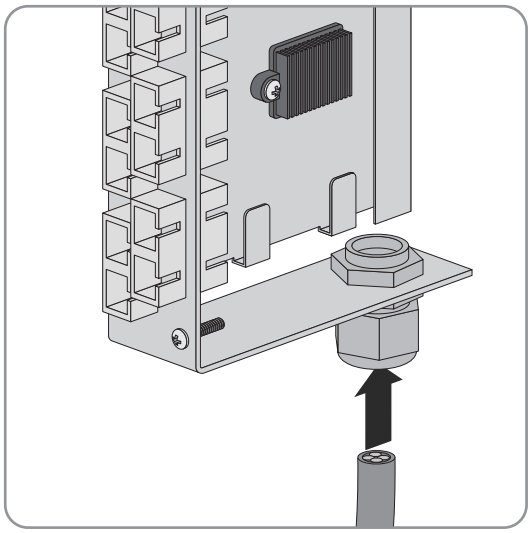
Damage to optical fibers due to too tight bend radii

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

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

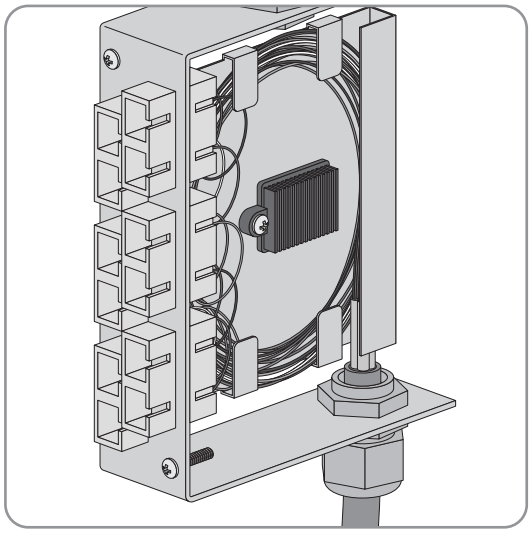
Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Open the hatch in front of the AC area of the product (see Section 13.2, page 189).
4. Insert the optical fibers with received signal and with transmitting signal through the electronics connection area and the cable gland to the splice box inside the inverter (see Section 13.5.2, page 199).
5. Loosen the upper and lower screw on the front of the splice box.
6. Pull the insert forwards out of the splice box and remove.
7. Insert the optical fiber with the receiving signal from below through the cable gland into the splice box of the corresponding communication ring.



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

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



12. Slide the insert into the enclosure of the splice box.
13. Tighten the upper and lower screw at the front of the splice boxes.
14. Attach the optical fibers to the cable support rail using a cable tie. This ensures that the optical fibers cannot be pulled out inadvertently.
15. Seal the enclosure openings with silicone
16. Close the hatch in front of the AC area of the product (see Section 13.2, page 189).
17. Mount the panels (see Section 13.3.1.1, page 191).

7.8.1.9 Connect the cable for the feedback contact and the trigger of the fast-stop function in the MV Power Station.

In addition to the feedback contact of the fast-stop key switch -S2 (terminal -X412:1/2 in the inverter), a feedback contact is available in the station subdistribution of the MV Power Station. This allows additional devices to be integrated into the fast-stop sequence.

Procedure:

1. Open the low-voltage cabinet.
2. Ensure that no voltage is present.
3. Connect the cable for the feedback contact to terminal **-X800:1/2** in the station subdistribution.
4. Connect the cable for the external trigger with potential-free contact to terminal **-X801:1/2** in the station subdistribution.
5. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Close the low-voltage cabinet.

7.9 Supply voltage

7.9.1 Connecting External Supply Voltage for Motor-Driven Circuit Breaker of Medium-Voltage Switchgear

If the MV Power Station is used with the remote control of the motor-driven circuit breaker of the medium-voltage switchgear (order option "Remote Control"), 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 120 V to 230 V / ±10 % at 60 Hz.

☐ The maximum power consumption is 100 W for 15 seconds when tensioning the spring and < 350 W for 1 second when switching on and off via remote control.

Procedure:

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

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

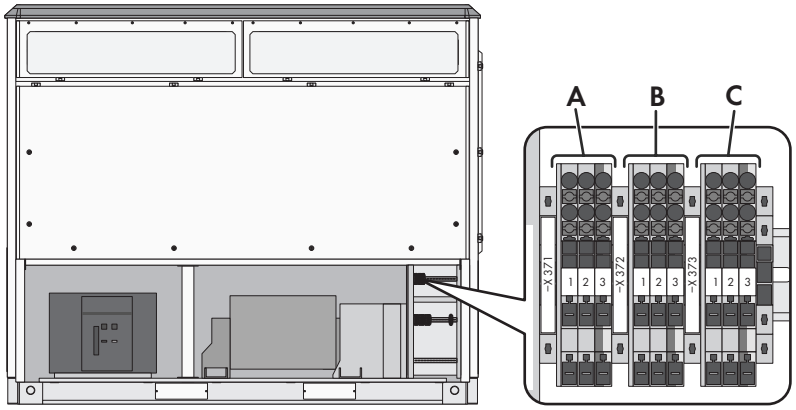


Figure 60: Position of the terminal blocks for external loads

Position	Designation
A	Connecting terminal plate **-X371**
B	Connecting terminal plate **-X372**
C	Terminal block **-X373** (for connection to the station subdistribution)

The outlet **-X374** for external loads is located in the customer installation location.

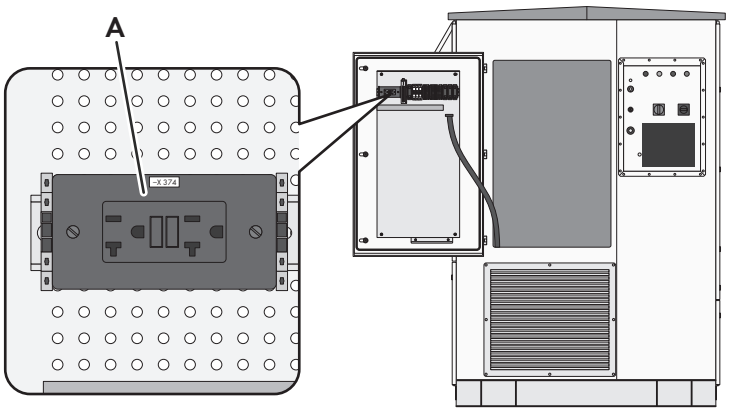


Figure 61: Position of the outlets for external loads

Position	Designation
A	Outlet **-X374**

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: 1440 VA.

☐ The customer devices must be designed for the permissible voltage. The permissible voltage is: 120 V.

☐ The customer devices must be suitable for the connection to the circuit breaker. The circuit breaker type is: B25 A.

Requirements for the connection of customer devices to the terminal block -X371 to -X372:

☐ 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 permissible voltage is: 120 V/± 20 %.

☐ The customer devices must be suitable for the connection to the circuit breaker. The circuit breaker type is: B25 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 mm² to 2.5 mm² (26 AWG to 14 AWG)

☐ Single-wire cable: 4 mm² (AWG 12)

☐ Number of conductors: 3

Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Connect the cable to the female connector **-X371** in accordance with the circuit diagram (see Section 13.4.2, page 197).
4. Plug the female connector into the terminals **1**, **2** and **3** in the terminal block **-X371**.
5. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
6. Connect the cable to the female connector **-X372** in accordance with the circuit diagram (see Section 13.4.2, page 197).
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. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
10. Mount the panels (see Section 13.3.1.1, page 191).

7.9.3 Connecting the Cables for Supply Voltage of Customer-Supplied Devices

Cable requirements for customer-supplied devices:

The customer is responsible for selecting the cable cross-sections which depend on the power of the customer-supplied devices and the cable routing.

- ☐ The following cable cross-section is recommended for clamps by PHOENIX CONTACT GMBH & CO. KG, model PTPOWER 95: 2.5 mm² to 35 mm² (14 AWG to 2 AWG)
- ☐ For clamps from Wago Kontakttechnik GMBH and CO. KG Model Power Cage Clamp 285-135, the following cable cross-section is recommended: 6 mm² to 35 mm² (10 AWG to 2 AWG)
- ☐ For the length of the cables, a maximum height of 1000 mm (40 in) from the corner of the station container or 670 mm (26.37 in) from the bottom of the MV Power Station to the terminals must be taken into account.
- ☐ The insulation of the conductors must be designed for a temperature of at least75°C (+167°F).
- ☐ The ampacity of the conductors must be designed for the maximum temperature at the connection point of 60°C (140°F).
- ☐ Depending on the low-voltage transformer, the terminals X480:5 to X480:8 are available for the connection:

Low-voltage transformer	Fusing
10 kVA	15 A
20 kVA	30 A
30 kVA	40 A
40 kVA	60 A
50 kVA	70 A
60 kVA	80 A

Procedure:

1. Ensure that no voltage is present.
2. Open the doors of the low-voltage cabinet to the low-voltage transformer (see Section 13.1, page 189).
3. For the order option without "Cable Entry Kit": Remove the base plate to insert the connection cables in the low-voltage room. Drill holes in the base plate.
4. For the order option with "Cable Entry Kit": Remove the plates of the Cable Entry Kit.
5. Thread the cables with cable glands or rubber bushings through the holes in the base plate. Ensure that the cable glands or rubber bushings cleanly enclose and seal the cables. This prevents animals from entering the product.
6. Connect the cables in accordance with the circuit diagram.
7. Mount the base plate of the cable entries.
8. Close the doors of the low-voltage cabinet to the low-voltage transformer (see Section 13.1, page 189).

7.10 External supply voltage

7.10.1 Connecting Single-Phase External Supply Voltage of Inverter

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

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

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

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

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

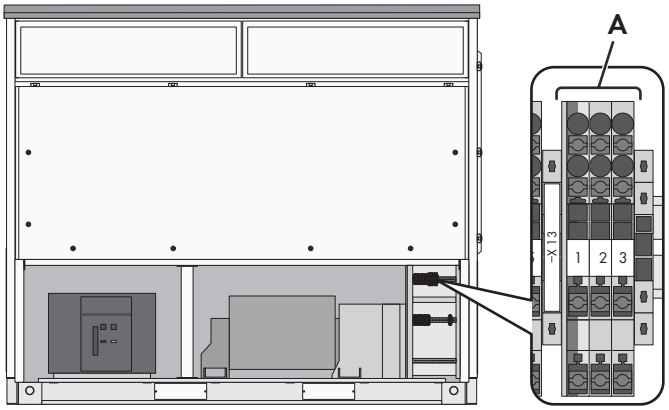


Figure 62: Position of terminals for external voltage supply

Position	Designation
A	Terminal block

Requirements for the external voltage and fusing:

☐ Line-to-line voltage 230 V (L/N/PE) / 120 V (L/N/PE) (depending on option), 50 Hz / 60 Hz

☐ The external voltage source must supply a power of at least 2.0 kVA.

☐ The upstream fuses for external disconnection must be designed selectively by the customer. The nearest protective device in the inverter is a circuit breaker with characteristic B16A.

☐ The input short-circuit current must be limited to 10 kA.

Requirement for cable routing:

☐ The electrical connection must be carried out in accordance with overvoltage category III.

☐ The cables must be routed in such a way that direct lightning coupling is not possible.

Cable requirements:

☐ Multi-wire cable with bootlace ferrules: 1.5 mm² to 10 mm² (16 AWG to 8 AWG)

☐ Single-wire cable: 1.5 mm² to 16 mm² (16 AWG to 6 AWG)

☐ Number of conductors: 3

NOTICE

Inverter damage due to incorrect supply voltage at terminal

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

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

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Connect the insulated conductors for **L1**, **N** and **PE** to the female connector-**X13** according to the circuit diagram (see Section 13.4.2, page 197).
4. Attach the cable to the cable support rail using cable ties. This will prevent the cable from being pulled out inadvertently.
5. Mount the panels (see Section 13.3.1.1, page 191).

7.10.2 Connecting Three-Phase External Supply Voltage of Inverter

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

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

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

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

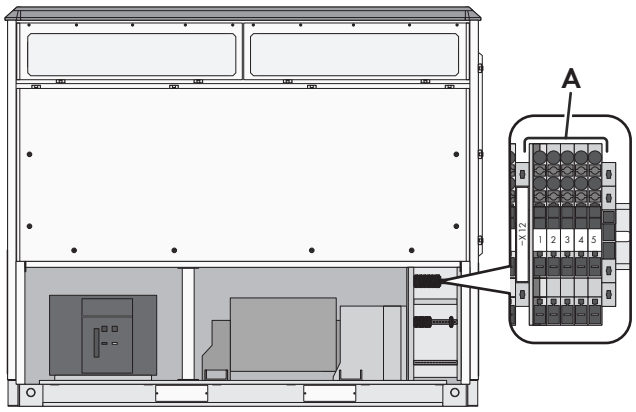


Figure 63: Position of terminals for external voltage supply

Position	Designation
A	Terminal block

Requirements for the external low-voltage transformer and fusing:

☐ An external auxiliary power supply is only permitted when a transformer with a Dyn vector group is used.

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

Requirement for cable routing:

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

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 1.5 mm² to 6 mm² (16 AWG to 10 AWG)
- ☐ Single-wire cable: 1.5 mm² to 10 mm² (16 AWG to 8 AWG)
- ☐ Number of conductors: 5

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Connect the insulated conductors for **L1**, **L2**, **L3**, **N** and **PE** to the female conductor **-X12** according to the circuit diagram (see Section 13.4.2, page 197).
4. Attach the cable to the cable support rail using cable ties. This will prevent the cable from being pulled out inadvertently.
5. Mount the panels (see Section 13.3.1.1, page 191).

7.11 Customer installation location of the inverter

7.11.1 Connecting the Cable for Supply Voltage to Customer Installation Location

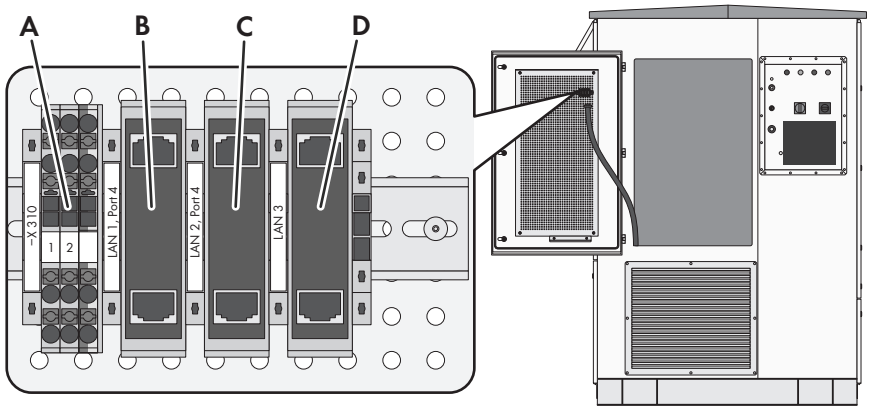


Figure 64: Position of the connections at the customer installation location

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

Position	Designation
C	Ethernet interface for connecting customer communication devices **LAN 2 Port 4**[29]
D	Internal Ethernet interface **LAN 3**

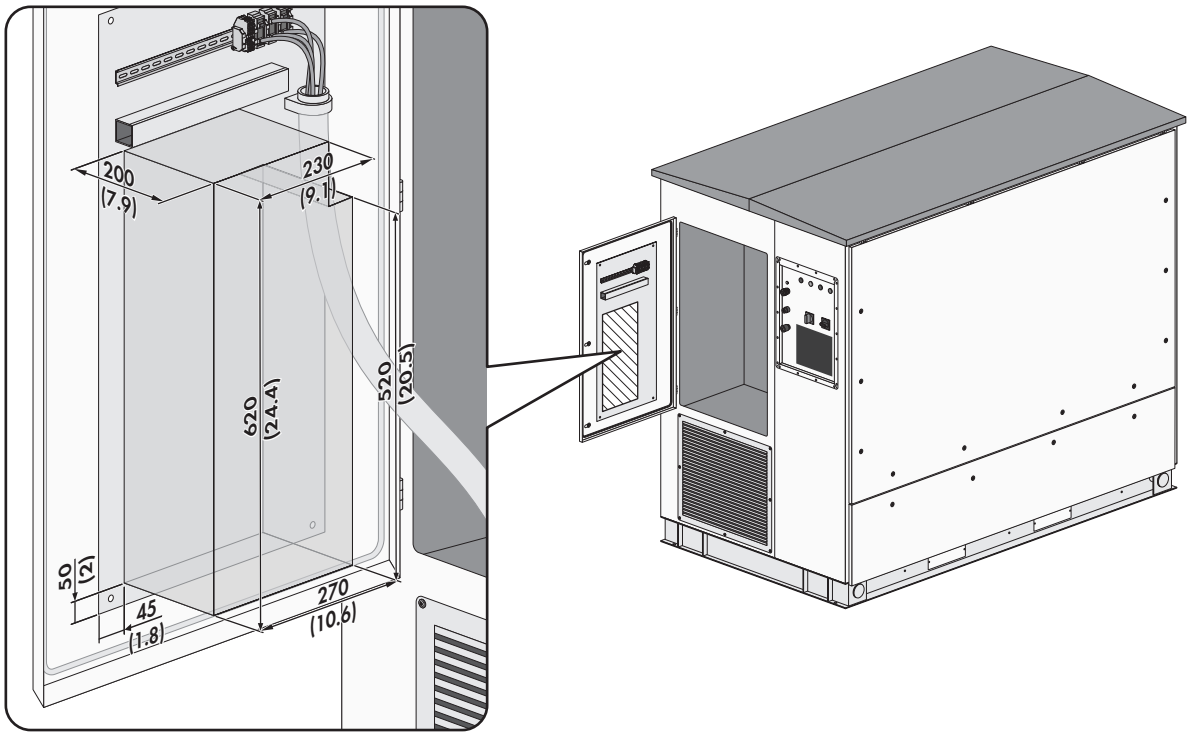


Figure 65: Area for customer devices in the customer installation location (Dimensions in mm (in))

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: 120 V.
- ☐ Voltage fluctuations that occur at the grid-connection point are transmitted to terminal block **-X310** in the same proportion. The customer devices must be designed for these voltage fluctuations.
- ☐ The device-internal voltage supply is not buffered. To avoid switch off of customer devices during supply voltage failures (e.g., grid failures), a buffered power supply unit must be used by the customer.
- ☐ The total weight of all customer devices may not be exceeded. The total weight is: 20 kg (44 lb).
- ☐ Customer devices may be mounted on the mounting plate. An area of 270 mm x 620 mm x 200 mm (10.6 in x 24.4 in x 7.8 in) is available for this. The area may not be exceeded.
- ☐ The customer devices must be designed for a temperature of 60°C (140°F) in normal operation.

Requirements for cable routing:

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

Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 0.14 mm² to 2.5 mm² (26 AWG to 12 AWG)
- ☐ Single-wire cable: maximum 0.14 mm² to 4.0 mm² (26 AWG to 14 AWG)
- ☐ Number of conductors: 3

[29] The Ethernet interface in the inverter is not available. A connection to the customer installation location in the low-voltage cabinet has been prepared with a network cable at the factory.

Procedure:

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

7.11.2 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

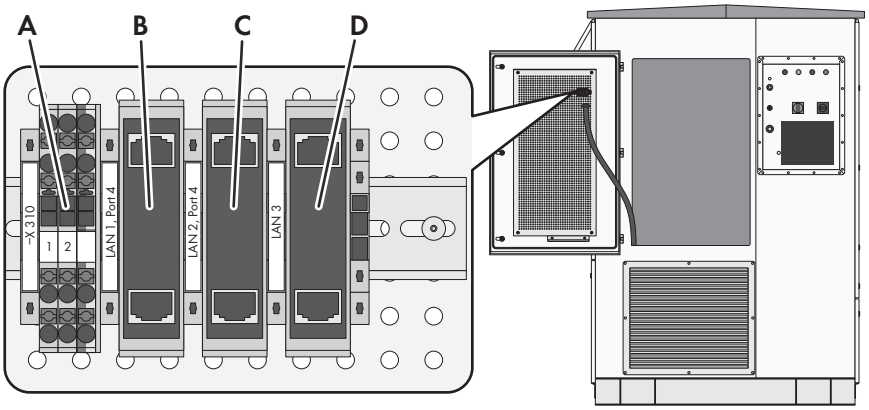


Figure 66: Position of the connections at the customer installation location

Position	Designation
A	Connecting terminal plate for voltage supply at customer installation location **-X310**
B	Interface for the optional remote I/O module **LAN 1 Port 4**
C	Ethernet interface for connecting customer communication devices **LAN 2 Port 4**[30)]
D	Internal Ethernet interface **LAN 3**

[30)] The Ethernet interface in the inverter is not available. A connection to the customer installation location in the low-voltage cabinet has been prepared with a network cable at the factory.

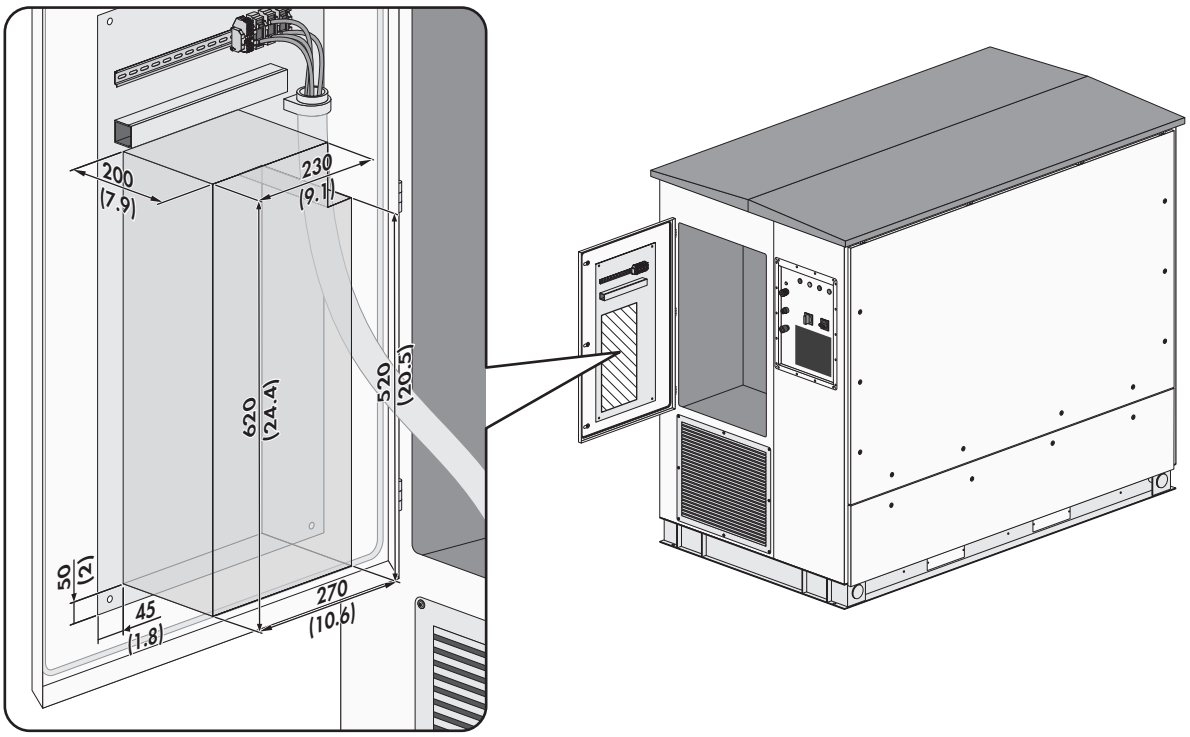


Figure 67: Area for customer devices in the customer installation location (Dimensions in mm (in))

Requirements for cable routing:

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

Ethernet cable requirements:

☐ The cable must be shielded.

☐ The insulated conductors must be twisted pairs.

☐ The cable must be at least of category 5 (CAT 5).

Requirements for wired communication:

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

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).
2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Insert the cables into the inverter (see Section 13.5.2, page 199).
4. Plug the cable into the network port **LAN 2 Port 4**.
5. Attach the cables to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 13.3.1.1, page 191).

7.12 Sealing the Cable Entries

Requirement:

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

Procedure:

1. Close and fasten the base plates underneath the station subdistribution. Ensure that the enclosure openings close tightly. This prevents animals from entering the product.

2. Screw the rubber gaskets onto the MV switchgear base plate.
3. Insert the base plates under the inverter. The base plates must be aligned as close as possible to each other.
4. Tighten the base plates. Ensure that the enclosure openings close tightly.
5. Seal all cable entries properly.

7.13 Requirements for Commissioning

General requirements:

- ☐ All foils and packaging must have been removed.
- ☐ All components must be in clean and purified condition.
- ☐ None of the devices must display any damage.
- ☐ Paintwork damage on the product must be repaired.
- ☐ The base of the product must not show any deformations.
- ☐ All devices must be correctly installed.
- ☐ All devices must be properly grounded.
- ☐ All transport locks and desiccant bags must be removed.
- ☐ All devices must be properly closed and sealed.
- ☐ All doors and locks must function properly.
- ☐ All labels and signs must be in place.
- ☐ Air inlets must be opened.
- ☐ All cables leading to the MV Power Station must be correctly routed, connected and attached to the cable support rail.
- ☐ Replace the desiccant bags in the inverter with new desiccant bags from the scope of delivery 24 hours prior to commissioning. This will protect the electronic components against moisture. Moisture can delay commissioning and additional travel costs for SMA service personnel must be paid by the customer.
- ☐ An ambient temperature above 0°C is recommended for commissioning.
- ☐ For the order option "Sea Freight", the supporting struts in front of the inverter and the medium-voltage compartment must be removed.

DC side:

- ☐ All DC cables must be correctly connected to the inverter. The installer is responsible for the execution of the bolted connection.
- ☐ The battery must have been checked.
- ☐ All cables of the battery must be correctly connected to the inverter.
- ☐ The DC load must have been checked.
- ☐ The polarity of all DC cables must have been 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 of the inverter must be opened.
- ☐ The medium-voltage transformer must be connected to the utility grid.

- ☐ The medium-voltage transformer must not show any oil leakage.
- ☐ The pressure gauge for the SF6 gas on the medium-voltage switchgear gas must be in the green range.
- ☐ 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.
- ☐ It is recommended to assign the IP address 192.168.100.36 to the battery. This makes easy commissioning possible.

Documentation:

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

i Development of odors after commissioning

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

8 Disconnecting and Reconnecting

8.1 Safety When Disconnecting and Reconnecting Voltage Sources

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ DANGER

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

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

- Install the inverter in a closed electrical operating area.
- Always close and lock the inverter.
- After switching off the converter, wait at least 15 minutes before opening the converter to allow the capacitors to discharge completely.

⚠ DANGER

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

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

- 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 battery storage system

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

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the 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.
- Install the product in a closed electrical operating area.

⚠ WARNING

Danger to life due to arc fault caused by fault in the medium-voltage switchgear

If there is a fault in the medium-voltage switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. In the event of arc faults in the medium-voltage switchgear, the pressure escapes to the rear into the medium-voltage transformer compartment.

- Only perform work on the medium-voltage switchgear when it is in a voltage-free state.
- Prior to commissioning and operating the medium-voltage switchgear, close the front panels of the base below the medium-voltage switchgear.
- When performing switching operations, make sure that the hatch of the arc fault opening can be easily opened and is not covered by objects (e.g., ice, vegetation).
- When performing switching operations, open the doors of the medium-voltage cabinet and attach the doors to the designated positions.
- All work and switching operations on the medium-voltage switchgear must only be performed by qualified persons wearing adequate personal protective equipment.
- All other persons 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.
- Do not touch or access the roof of the medium-voltage switchgear when medium voltage is connected.

⚠ WARNING

Danger to life due to electric shock when switching the MV switchgear when the level of SF6 gas is too low

When the level of SF6 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 SF6 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.

8.2 Connection Point Overview

8.2.1 Power Connection Points

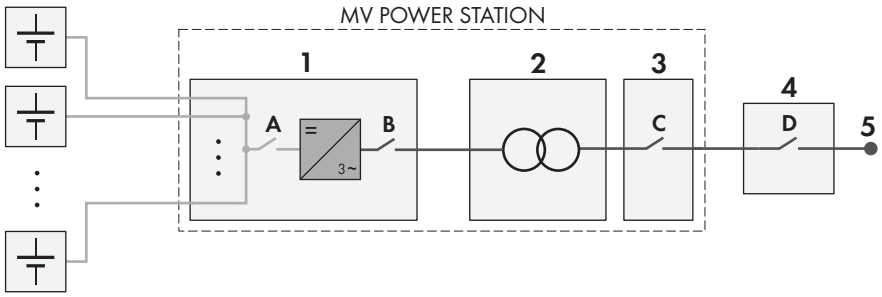


Figure 68: Overview of the power connection points

Position	Designation
1	Inverter
2	Medium-voltage transformer
3	MV switchgear
4	Superordinate MV switchgear (string, ring or transfer station)
5	Utility grid
A	Inverter DC switchgear
B	Inverter AC disconnection unit
C	Medium-voltage switch
D	Transfer station disconnection device

8.2.2 Connection Points for Supply Voltage

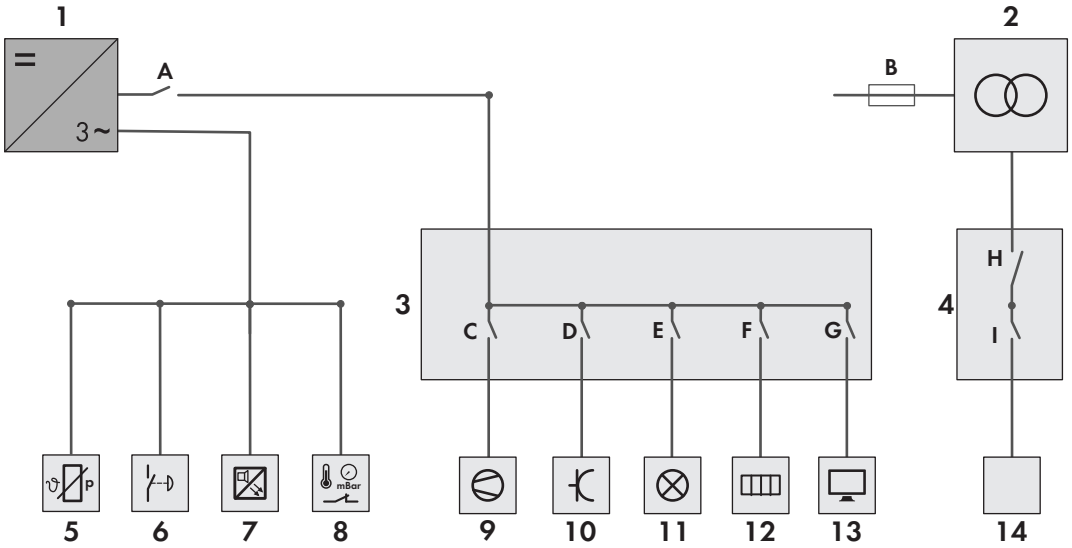


Figure 69: Connection points for supply voltage (example)

Position	Designation
1	Inverter
2	Low-voltage transformer of MV Power Station[31)]
3	Station subdistribution
4	Separate subdistribution for the low-voltage transformer[31)]
5	PT100
6	Fast-stop switch[31)]
7	Heat detector[31)]
8	Protective devices for pressure and oil level[31)]
9	Fan[31)]
10	Socket[31)]
11	Lighting for low-voltage and medium-voltage cabinet[31)]
12	Heating[31)]
13	Monitoring and communication[31)]
14	Customer devices[31)]
A	Fuse switch **-F70** of the inverter
B	Fuse holder with thermal fuse of the low-voltage transformer[31)]
C	Miniature circuit breaker for the fan[31)]
D	Miniature circuit breaker for the socket[31)]
E	Miniature circuit breaker for the lighting[31)]

[31)] Optional

Position	Designation
F	Miniature circuit breaker for the heating[31)]
G	Miniature circuit breaker for monitoring and communication[31)]
H	Miniature circuit breaker **-F101**
I	Miniature circuit breakers for tracker motors[31)] The number of the installed miniature circuit breakers depends on the low-voltage transformer used.

Further details are to be found in the circuit diagram.

8.3 Disconnecting the Battery Storage System

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

☑ Entering the operating area is permitted.

8.4 Disconnecting the Supply Voltages of the Station Subdistribution

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

⚠ DANGER

Danger to life due to applied voltages in the low-voltage cabinet

The components of the low-voltage cabinet are supplied by the inverter as well as by the medium-voltage transformer. Even after the inverter has been disconnected from voltage sources, there are still high voltages applied to the terminals to the low-voltage transformer. Touching live components results in death or serious injury due to electric shock.

- Before carrying out any work on the station subdistribution or on the low-voltage transformer, disconnect the inverter and the medium-voltage transformer from voltage sources.

Procedure:

1. To disconnect the lighting from the supply voltage, switch off the **-F32** miniature circuit breaker.
2. To disconnect the fan from the supply voltage, switch off the **-F34** miniature circuit breaker.
3. If the supply voltage for the components of the MV Power Station is to be disconnected, switch off the fuse switch **-F70** in the inverter or disconnect the inverter from voltage sources (see Section 8.5, page 123)

8.5 Disconnecting the Inverter

8.5.1 Switching off the Inverter

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

8.5.2 Disconnecting the Inverter from the Power Transmission Path on the AC Side

Apply the Lock Out Tag Out (LOTO) procedure

Lock all switches and designate in accordance with the site-specific OSHA LOTO procedure.

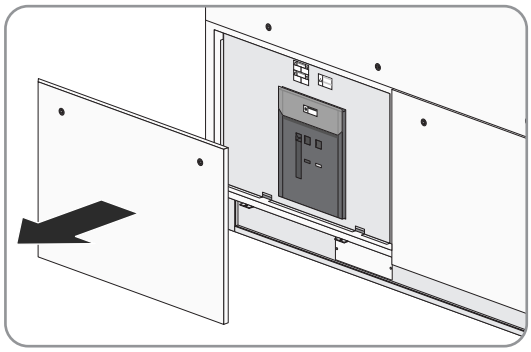
Additionally required material (not included in the scope of delivery):

☐ 1 padlock. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in) .

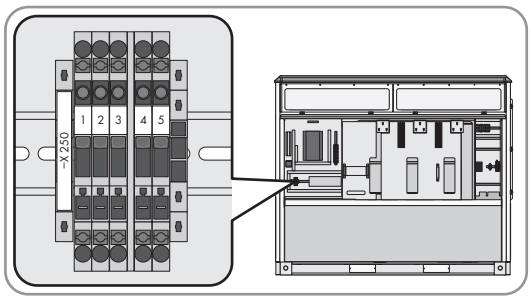
☐ Depends on variant: 1 padlock for AC disconnection unit. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in)

Procedure:

1. Switch off the inverter (see Section 8.5.1, page 123).
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. Ensure that 15 minutes have passed after switching off the load-break switch **-Q61**.
6. Disassemble the outer panel of the AC switch module (see Section 13.3.1.1, page 191).



7. Verify that the switch state display of the AC disconnection unit is in the **OPEN** position.
8. Ensure that the AC disconnection unit cannot be reconnected. Use the key supplied or a padlock, depending on the version of the AC disconnection unit.
9. Mount the outer panel of the AC switch module (see Section 13.3.1.1, page 191).
10. Open the hatch on the AC side of the inverter (see Section 13.2, page 189).
11. Ensure that no voltage is present on the **-X250** terminal.



8.5.3 Disconnecting the Inverter from the Power Transmission Path on the DC Side

Apply the Lock Out Tag Out (LOTO) procedure

Lock all switches and designate in accordance with the site-specific OSHA LOTO procedure.

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

- 1 padlock. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in)

Procedure:

1. Switch off the inverter (see Section 8.5.1, page 123).
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. Disconnect all-pole the battery at the external fuse switch-disconnector or circuit breaker and secure against reconnection.
7. Check whether the switch between the DC side and the inverter is open on the touch display. If the switch between the DC side and the inverter is closed, ensure that all switch-points upstream have been activated.
8. Open the hatch (see Section 13.2, page 189).
9. Ensure that no voltage is present for each DC input.

8.5.4 Disconnecting the Supply Voltage at the Inverter from Voltage Sources

i Apply the Lock Out Tag Out (LOTO) procedure

Lock all switches and designate in accordance with the site-specific OSHA LOTO procedure.

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

☐ 4 padlocks. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in)

Switching Off the Supply Voltage

1. Switch off the inverter (see Section 8.5.1, page 123)
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.

Switching Off the Auxiliary Energy 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. Pull the bracket out of the switch lever.
3. 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 the inverter (see Section 8.5.1, page 123)
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 Switchgear

1. Switch off the inverter (see Section 8.5.1, page 123)
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.

8.6 Disconnecting the Medium-Voltage Transformer

The tap changer of the medium-voltage transformer must not be operated at oil and ambient temperatures under -10°C (14°F).

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

- ☐ At least 1 padlock Diameter of the bracket: 5 mm to 8 mm (0.2 in to 0.3 in) , quantity depending on the type of the medium-voltage switchgear
- ☐ Voltage measuring device with a dielectric strength of at least 2.6 kV

Procedure:

1. Ensure that the inverter is disconnected from all voltage sources (see Section 8.5, page 123).
2. Make sure that the safety clearances around the MV Power Station are complied with (see Section 6.2.3, page 63).
3. Ensure that the medium-voltage cabinet doors are secured (see Section 13.1, page 189).
4. Switch off the circuit breaker of the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
5. Switch off the disconnect of the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
6. Check that there is no voltage present by using the voltage indicator located on the transformer panel.
7. Connect the circuit breaker for the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
8. Check switch positions at the sight glasses of the medium-voltage switchgear.
9. Lock the circuit breaker, and if necessary the grounding switch, of the medium-voltage switchgear using a padlock. This secures the medium-voltage switchgear from accidentally being switched on again (see manufacturer's documentation).
10. Disconnect any additional external voltage.
11. Ensure that there is no voltage present on the undervoltage side of the medium-voltage transformer.
12. Cover or isolate any adjacent live components.

8.7 Disconnecting the MV Power Station

Only when the entire MV Power Station has been disconnected and the medium-voltage side of the MV Power Station has been grounded and short-circuited, will you be able to work on the devices of the MV Power Station without risk.

Procedure:

1. Ensure that the minimum clearances of all MV Power Stations of the complete system are complied with (see Section 6.2.3, page 63).
2. Disconnect any additional external supply voltages.
3. Disconnect the inverter (see Section 8.5, page 123).
4. Disconnect the supply voltage of the station subdistribution (see Section 8.4, page 123).

5. Disconnect the medium-voltage transformer (see Section 8.6, page 126).
6. Depending on the medium-voltage switchgear, switch off the cable panel (see manufacturer's documentation).
7. Disconnect the MV Power Station from the utility grid at the superordinate medium-voltage switchgear (refer to manufacturer documentation). Always observe the 5 safety rules.
8. In the case of a three-field medium-voltage switchgear, ground the cable panel (see manufacturer's documentation)
9. In the case of a 1-field medium-voltage switchgear, ground the upstream and downstream medium-voltage switchgear (see manufacturer's documentation).
10. Cover or isolate any adjacent live components.

8.8 Reconnecting the MV Power Station

The MV Power Station must not be started at temperatures lower than -25°C (-13°F).

Procedure:

1. Ensure that the minimum clearances of all MV Power Stations of the complete system are complied with (see Section 6.2.3, page 63).
2. Depending on the medium-voltage switchgear, remove the grounding from the cable panel of the medium-voltage switchgear (see manufacturer's documentation) or remove the grounding of the upstream and downstream medium-voltage switchgear.
3. Reconnect the MV Power Station from the utility grid at the higher-level medium-voltage switchgear (see manufacturer's documentation).
4. Depending on the medium-voltage switchgear, switch on the cable panel of the medium-voltage switchgear (see manufacturer's documentation).
5. Reconnect the medium-voltage transformer (see Section 8.9, page 127).
6. Reconnect the supply voltage of the station subdistribution (see Section 8.11, page 129).
7. Reconnect the inverter (see Section 8.10, page 128).
8. Reconnect any additional external supply voltages.

8.9 Reconnecting the Medium-Voltage Transformer

The tap changer of the medium-voltage transformer must not be switched at oil and ambient temperatures under -10°C (14°F).

Procedure:

1. Make sure that the safety clearances around the MV Power Station are complied with (see Section 6.2.3, page 63).
2. Ensure that the medium-voltage cabinet doors are secured (see Section 13.1, page 189).
3. If necessary, disconnect the grounding system on the low-voltage side of the medium-voltage transformer.
4. Remove the grounding from the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).
5. Switch on the transformer panel of the medium-voltage switchgear (see manufacturer's documentation).

8.10 Reconnecting the Inverter

8.10.1 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 13.3.1.1, page 191).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 13.2, page 189).

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 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.

8.10.2 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 13.3.1.1, page 191).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 13.2, page 189).

Procedure:

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.

8.10.3 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 13.3.1.1, page 191).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 13.2, page 189).

Procedure:

1. Remove protection against reconnection at the AC disconnection unit.
2. Mount the outer panel of the AC switch module (see Section 13.3.1.1, page 191).
3. Remove the padlock from the bracket of the load-break switch **-Q63**.
4. Turn the DC load-break switch **-Q63** to the **ON** position.

8.10.4 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 13.3.1.1, page 191).
- Before reconnecting, make sure that the protective covers are mounted.
- Before reconnecting, make sure that the hatches are closed (see Section 13.2, page 189).

Procedure:

- Turn the key switch **-S1** to **Start**.

8.11 Reconnecting the Supply Voltage of the Station Subdistribution

1. If needed, reconnect the inverter for the supply voltage of the MV Power Station components and switch on the miniature circuit breaker **-F70** in the inverter.
2. Switch on the miniature circuit breaker **-F32** for lighting.
3. Switch on the miniature circuit breaker for the optional fan **-F34**.

8.12 Reconnect the battery storage system

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

9 Operation

The information in the following sections affect the inverters only. Information on the operation of further optional devices of the MV Power Station, such as the medium-voltage switchgear can be found in the documentation of the respective device.

9.1 Safety during Operation

⚠ WARNING

Danger to life due to arc fault caused by fault in the medium-voltage switchgear

If there is a fault in the medium-voltage switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. In the event of arc faults in the medium-voltage switchgear, the pressure escapes to the rear into the medium-voltage transformer compartment.

- Only perform work on the medium-voltage switchgear when it is in a voltage-free state.
- Prior to commissioning and operating the medium-voltage switchgear, close the front panels of the base below the medium-voltage switchgear.
- When performing switching operations, make sure that the hatch of the arc fault opening can be easily opened and is not covered by objects (e.g., ice, vegetation).
- When performing switching operations, open the doors of the medium-voltage cabinet and attach the doors to the designated positions.
- All work and switching operations on the medium-voltage switchgear must only be performed by qualified persons wearing adequate personal protective equipment.
- All other persons 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.
- Do not touch or access the roof of the medium-voltage switchgear when medium voltage is connected.

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 **WCtlCom** for active power limitation and the mode **VArCtlCom** for reactive power control are selected in the inverter.

NOTICE

Unwanted product behavior following a Firmware update

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

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

9.2 Localization of the User Interface

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

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

Procedure:

1. Select [**Localize**] in the drop-down menu.
2. Adjust the desired localizations.
3. Select [**Login**].

9.3 Selecting the Language

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

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

Procedure:

1. Log into the user interface (see Section 13.6, page 203).
2. In the user info line select English and select the desired language from the drop-down list.

9.4 Setting the System Time

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. Select the area with date and time in the status info line.
3. Enter the current time.
4. Select [**Save**] to save the time change.

9.5 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.

9.6 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 13.6, page 203).
2. Select the role of the user group for which the password is to be changed.
3. Enter the new password: The new password must have at least 8 characters, including at least one lowercase letter, one uppercase letter and one number. The following 4 special characters can be used optionally: **! _ ? -** [**Save**] can only be selected when the password meets the requirements.
4. To confirm, enter the new password again.
5. Click on [**Save**].

9.7 Resetting Passwords

Resetting the "User" user group password

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. Enter the link https://<IP-Adresse>/SunnyCentral/public/#/Security in the browser line.
   ☑ The page [**Password security**] opens.
3. Select the button [**Reset password**] in the "User" user group.
   ☑ The password for the "User" user group is reset to the standard password. Before leaving this page, the password must be changed
4. Change the standard password to a secure password.

Resetting the "Installer" user group password

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

Procedure:

1. To reset the password, contact Service (see Section 18, page 284).
2. Once the password has been reset, change the standard password to a secure password immediately.

9.8 Display of Measured Values

9.8.1 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 13.6, page 203).
2. Select **Analyze** in the main navigation.
3. Select the page with the desired component.
4. Select the desired time period for the display in the lower part of the content area. For reasons of better comparison, all months are displayed with 31 days. Tip: You can also change the display time period after selection of the instantaneous values for display.
5. Select the instantaneous values to be displayed from the instantaneous values below the diagram. Data with the same units are automatically assigned to one Y axis and the horizontal gridlines are adjusted to fit the data.
6. Select the instantaneous values to be displayed from the list which now appears. The instantaneous values can be assigned to the left or right Y axis.
7. To delete data from the display, select the instantaneous value again. The corresponding curve will be removed from the diagram.
8. To display data with other units, select the data on the left or right Y axis again. The curves will be deleted from the diagram and you can select other data.

9.8.2 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 2 different units displayed on two Y axes.

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

Procedure:

1. Log into the user interface (see Section 13.6, page 203).
2. Select **Analyze** in the main navigation.
3. Select the page [**Detail analysis**].
4. Select the desired time period for the display in the upper part of the content area. For reasons of better comparison, all months are displayed with 31 days. Tip: You can also change the display time period after selection of the instantaneous values for display.
5. To select the instantaneous values for the diagram, select [**Select instantaneous values for Y axes**].
6. To select the instantaneous values for the left Y axis, select the corresponding instantaneous values in the left column of the drop-down box.
7. To select instantaneous values for the right Y-axis, select the corresponding instantaneous values in the right-hand column of the selection box. Tip: If both axes are assigned a unit, all instantaneous values with a different unit are grayed out.
8. Select [**OK**] to create the diagram.
9. To delete data from the display, select the instantaneous value in the legend. The corresponding curve will be removed from the diagram.
10. To display data with other units, select [**Select instantaneous values for left Y axes**] again and select the data of the Y axis again. The curves will be deleted from the diagram and you can select other data.

9.8.3 Displaying Measured Values of the External Devices

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. In the main navigation select [**External devices**].
3. In the list of the external devices, select the row of the device for which the measured values are to be displayed.
4. Select the button [**All instantaneous values**].
5. To return to the overview of all external devices, select the button **[Back**].

9.9 Enabling Communication via FTP Server

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

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

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:

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. In the parameter **FtpSrv.Mode**, select the type of access to the FTP server.

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

9.10 Setting up communication with the battery

Direct communication between inverter and battery

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

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

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

Procedure:

1. Call up the parameter overview (see Section 13.7, page 203).
2. Set the parameter **Bsc.BatEna** to **DISABLED**.

9.11 Configuring External Devices

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

Procedure:

1. Log into the user interface as an installer (see Section 13.6, page 203).

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

9.12 Search Function

9.12.1 Search based on the ID Number

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

Procedure:

1. Log into the user interface (see Section 13.6, page 203).
2. Enter the required ID number of the page, parameter or instantaneous value in the user info line in the field **#XXXX**.

9.12.2 Targeted Search

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

Procedure:

1. Call up parameter overview (see Section 13.7, page 203) or instantaneous value overview (see Section 13.8, page 203).
2. In the field **Search parameter** or **Search instantaneous value**, enter the searched parameter or instantaneous value. You can search for long names, short names, numbers or parts of it.

☑ As you make your entry in the search field, the list of parameters or instantaneous values will be reduced to the matching entries.

☑ In the tabs of the subnavigations, the number of filtered parameters and instantaneous values is displayed.

9.13 Creating Favorites

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

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

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

Procedure:

1. Call up the overview for parameters or instantaneous values (see Section 13, page 189).
2. In the line of the parameter or instantaneous value, select the favorite identifier ★.

9.14 Using Parameters to Activate and Deactivate the Inverter Standby

1. Call up the parameter overview (see Section 13.7, page 203).

2. To set the inverter to operating state "Standby", set the parameter **RemRdy** to **DISABLED**.
3. To restart the inverter, set the parameter **RemRdy** to **ENABLED**.

9.15 Setting the operating mode

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

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

Procedure:

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

Operating mode	Description
Battery standby	The inverter switches to the operating state "Stop". The battery's DC switching device remains closed.
Inverter standby	The inverter switches to the operating state "Standby". The battery's DC switching device remains closed. This reduces the battery's standby consumption.
Power control	The inverter switches to the operating state "GridFeed". The setpoint of the active power is set in the parameter **Bsc.WSptMan** or, if there is an external signal generator, via the Modbus protocol. The active power setpoint currently used can be read off in the instantaneous value **WSpt**. The setpoint of the reactive power is set in the parameter **Bsc.VArSptMan** or, if there is an external signal generator, via the Modbus protocol. The reactive power setpoint currently used can be read off in the instantaneous value **VArSpt**. When the parameter **GriMng.VArMod** is set to **PFCtlCom**, the power factor can be preset via the parameter **Bsc.PFSptMan**. The reactive power setpoint currently used can be read off in the instantaneous value **PFSpt**.

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

9.16 Import file

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

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

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

Procedure:

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. Select in the main navigation and select **Import** from the drop-down list.
3. Select the required data type for import from the list.
4. To import a file to the cache, select [**Copy file from external device**].
5. If the file can be imported from a connected medium, select the desired file from the list. The file source is indicated in the first column of the list.
6. If the file is to be read from a local directory of the computer used, select [**Browse...**] and then select the desired file in the directory.
7. To upload the file to the internal cache, select the desired file from the list.
8. To execute the file in the appropriate application, select the desired file from the list.

9.17 Exporting Files

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

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

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

Procedure:

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. In the main navigation, select and select **Export** from the drop-down list.
3. Select **Service information**.
4. Select [**Create service information**].
5. Set the desired time period.
6. Select [**Generate**].

9.18 Adjusting Network Ports

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

Unauthorized access to the inverter

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

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

Procedure:

1. Call up the parameter overview (see Section 13.7, page 203).
2. In the parameter **Netw.StdGw.IpAdr**, enter the IP address of the standard gateway via which the inverter can be accessed.
3. Enter the IP address of the DNS server in the parameter **Netw.Dns.SrvIpAdr**.
4. If you want to use a proxy authentication, activate the parameter **Netw.Proxy.AuthEna**.
5. Enter the port of the proxy server in the parameter **Netw.Proxy.Port**. The default setting is **8080**.
6. Enter the address of the proxy server in the parameter **Netw.Proxy.Adr**.
7. Enter the user names and password of your proxy server in the parameters **Netw.Proxy.Usr** and **Netw.Proxy.Pwd**.

9.19 Setting and Testing the FTP Push Function

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

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

Requirement:

☐ A local FTP server must have been configured.

General FTP settings

1. Call up the parameter overview (see Section 13.7, page 203).
2. In the parameter **Ftpush.SrvAdr** enter the DNS name or the IP address of the FTP server.
3. In the parameter **Ftpush.SrvPort**, enter the port of the FTP server.
4. In the parameter **Ftpush.SrvUsr**, enter the user name if a login is required on the FTP server.
5. In the parameter **Ftpush.SrvPwd**, enter the password if a login is required on the FTP server.
6. In the parameter **Ftpush.SrvDir**, enter the directory where the files should be saved.
7. To execute a connection test immediately, select the button [**Execute action**] in the **Ftpush.Tst** parameter.
8. To execute an upload immediately, select the button [**Execute action**] in the **Ftpush.Upld** parameter.
9. To execute a cyclic upload, in the drop-down list select the desired frequency in the **Ftpush.UpldCyc** parameter.

Additional SFTP settings

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

Procedure:

1. If necessary, ensure that the certificate is in RSA private key format Open the file in a text editor. Check that the file begins with the line **—–BEGIN RSA PRIVATE KEY—–** and ends with the line **—–END RSA PRIVATE KEY—–**. If the format is not correct, contact your server operator.
2. Import the certificate of your server operator (see Section 9.16, page 137).
3. Activate the certificate for transfer via the parameter **Ftpush.Cert.Ena**.
4. Enter the password that you received from your server operator in the parameter **Ftpush.Cert.Pass** if the certificate is password-protected.

9.20 Secure Transmission of Control Commands

9.20.1 Information for a Secure Transmission of Control Commands

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

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

Different rights can be assigned to the individual IP addresses:

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

9.20.2 Starting the automatic capture of the accepted IP addresses

In learning mode, the inverter captures the IP addresses of the computers that access the inverter. The learning mode starts automatically after commissioning and the first connection setup via Modbus to the inverter and lasts 24 hours. The IP addresses are added to a so called whitelist stored in the inverter. The inverter also stores whether a device had read or write access or sent GMS commands. A device that has read-only access during learn mode may read-only access the inverter even after the learn mode is completed. The access rights for the individual IP addresses can be changed manually (see Section 9.20.3, page 140).

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

Procedure:

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. Select **Diagnosis**.
3. Select the button [**Start learning mode**].

9.20.3 Entering accepted IP addresses via the user interface

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

Procedure:

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. Select **Diagnosis**.
3. To add new IP addresses to the GMS whitelist, enter the accepted IP address in the **IP address** field in the **Modbus Whitelist** area.
4. To add blocked IP addresses to the whitelist, click on the **Add** button in the **Blocked Modbus connections** area.
5. To adjust the rights of individual IP addresses, assign the required rights in the **Modbus whitelist** area.
6. Select the button [**Save**]. Tip: Unsaved changes are lost when you exit the page.

9.21 Transferring of operating data

9.21.1 Saving operating data of inverters manually

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

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

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

Installing the SMA Remote Download Tool

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

Procedure:

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

Saving operating data of inverters

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

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

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

Procedure:

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

9.21.2 Set up automatic backup of operating data

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

Procedure:

1. Call up the parameter overview (see Section 13.7, page 203).
2. Set the parameter **Fmspush.UpldCyc** to **Daily**.

9.22 Setting the MV Switchgear Protective Device

Tripping time of circuit breaker panel of medium-voltage switchgear

The grounding inside the MV Power Station is laid out in such a way that the troubleshooting time of the circuit breaker panel is less than 170 ms in the event of a short circuit. Depending on the order option, the grounding of the medium-voltage switchgear is designed for a short-circuit current with a tripping time of maximum 20 kA / 1 s or 25 kA / 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 a maximum of 40 ms in order to avoid damages to the grounding device and injury to persons. **t>>** is factory set to 0 ms.

The inrush current of the medium-voltage transformer must be considered to guarantee a smooth operation. The inrush-current curve can be made available by SMA 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.

9.23 Preparing Update of Firmware Version

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

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

Requirement:

☐ There is a Product Change Information from SMA about a new firmware version.

☐ The IP addresses of the inverters are known.

Procedure:

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

9.24 Recording network traffic

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

Procedure:

1. Log into the user interface as an installer (see Section 13.6, page 203).
2. In the main navigation, select [**Diagnosis**].

3. Select [**Start TcpDump**] in the **Network diagnosis** area.
4. Select the network from which the data traffic is to be recorded.
5. If the data traffic of a specific external device is to be recorded, select the appropriate device from the drop-down menu **Devices**.
6. Select [**Execute**].
7. To stop the recording, select [**Stop TcpDump**].
8. To download the data for evaluation, select [**Download**].

10 Troubleshooting

10.1 Safety during Troubleshooting

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ DANGER

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

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

- Observe all safety information when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- If you cannot remedy the disturbance with the help of this document, contact the Service (see Section 18, page 284).

⚠ WARNING

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

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

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the 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.
- Install the product in a closed electrical operating area.

⚠ WARNING

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

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

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

⚠ WARNING

Hearing impairment due to high-frequency noises of the product

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

- Wear hearing protection.

⚠ CAUTION

Risk of burns due to hot components

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

10.2 Troubleshooting the MV Power Station

Error	Cause and corrective measures
Supply voltage is not present (e.g. for lighting).	The main breaker has tripped. **Corrective measures:** • Ensure that the main breaker is intact. • Ensure that the miniature circuit breaker **-F70** in the inverter is switched on.
The low-voltage transformer (if available) is not supplying voltage.	The primary side thermal fuse has tripped. **Corrective measures:** • Ensure that the size of the thermal fuse on the primary side of the low-voltage transformer is set correctly. • Replace the thermal fuse.
	The low-voltage transformer is defective. **Corrective measures:** • Replace the low-voltage transformer. Contact us regarding this (see Section 18, page 284).
	The EMC filtering device is defective. **Corrective measures:** • Replace the EMC filtering device. Contact us regarding this (see Section 18, page 284).
	The cabling is damaged. **Corrective measures:** • Replace defective cables.

Error	Cause and corrective measures
The lighting is not working.	The lamps are defective. **Corrective measures:** • Replace the lamp.
	The miniature circuit breaker has tripped. **Corrective measures:** • Check whether apparent damage is visible in the corresponding electrical circuit. If any damage is present, remove it. • Switch the miniature circuit breaker back on.
	The supply voltage of the MV Power Station has failed. **Corrective measures:** • Ensure that the supply voltage is present (see "Supply voltage is not present" error).
	The door contact switch is defective. **Corrective measures:** • Replace the door contact switch. Contact us regarding this (see Section 18, page 284).
The fan does not start up.	The required temperature has not been reached. **Corrective measures:** • To check whether the fans are working, note the position of thermostat **-S1**. Turn down the thermostat. This starts the fans. • Reset the thermostat to the initial value.
	The miniature circuit breaker has tripped. **Corrective measures:** • Check whether apparent damage is visible in the corresponding electrical circuit. If any damage is present, remove it. • Switch the miniature circuit breaker back on.
	The fan is defective. **Corrective measures:** • Replace the fan. Contact us regarding this (see Section 18, page 284).
	The supply voltage of the MV Power Station has failed. **Corrective measures:** • Ensure that the supply voltage is present (see "Supply voltage is not present" error).
	The cabling is damaged. **Corrective measures:** • Replace defective cables.

Error	Cause and corrective measures
Medium-voltage transformer cannot be connected.	The medium-voltage transformer is defective. **Corrective measures:** • Replace the medium-voltage transformer. Contact us regarding this (see Section 18, page 284).
	The oil sight gauge shows a low oil level. **Corrective measures:** • Check the medium-voltage transformer for leakage. • Ensure that no air is in the medium-voltage transformer. • Please contact us (see Section 18, page 284).
	The medium-voltage transformer is too warm. **Corrective measures:** • Read off the temperature of the medium-voltage transformer from the inverter. • Let the medium-voltage transformer cool down. • If the error reoccurs, contact the Service (see Section 18, page 284).
	The relay in the station subdistribution is not working properly. **Corrective measures:** • Ensure that the relay in the station subdistribution is correctly functioning. • Replace defective cables.
The medium-voltage switchgear switches off.	The temperature in the low-voltage cabinet is very high. **Corrective measures:** • If present, check the fans. • Check ventilation grids and filter pads and clean or replace if needed.
	The protective device of the medium-voltage transformer has triggered. **Corrective measures:** • Check the protective device of the medium-voltage transformer. • Please contact us (see Section 18, page 284). Reconnection without analyzing the cause of the error can result in the destruction of the medium-voltage transformer and is not permitted.
	If present, the fast stop was activated. **Corrective measures:** • Deactivate the fast stop and connect the medium-voltage switchgear again.
	If present, the heat detector has triggered. **Corrective measures:** • Check the low-voltage and medium-voltage cabinet for heat and fire. If needed, please contact us (see Section 18, page 284).

Error	Cause and corrective measures
The inverter switches off with an error. The pressure indicator shows positive or negative pressure or the oil sight gauge shows low oil level.	• Please contact us (see Section 18, page 284).
There is oil on or below the medium-voltage transformer.	• Do not continue to operate the medium-voltage transformer. • Please contact us (see Section 18, page 284).
	The medium-voltage transformer has traces of oil on the seals. **Corrective measures:** • Clean the medium-voltage transformer. • If more oil leaks out, contact us (see Section 18, page 284).
	There is a leakage at the transformer boiler of the medium-voltage transformer. • Please contact us (see Section 18, page 284).
The pressure-relief valve has triggered.	• Do not continue to operate the medium-voltage transformer. • Please contact us (see Section 18, page 284).

10.3 Troubleshooting in the Inverter

10.3.1 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 13.7, page 203).
2. To activate the alarm via e-mail, set the parameter **Alrm.Mail.Ena** to **On**.
3. Enter the address or IP address of the relevant SMTP server in the parameter **Alrm.Smtp.Adr**.
4. Enter the port of the relevant SMTP server in the parameter **Alrm.Smtp.Port**.
5. Enter the user name for the SMTP authentication in the parameter **Alrm.Smtp.Usr**.
6. Enter the password for the SMTP authentication in the parameter **Alrm.Smtp.Pwd**.
7. Enter the required encryption in the parameter **Alrm.Smtp.Cry**.
8. Enter the e-mail address to which e-mails are to be sent in the parameter **Alrm.Smtp.Recp**.
9. If you do not wish the sender of the e-mail to contain the address of the SMTP server, enter the desired address in the parameter **Alrm.Smtp.TxAdr**.
10. To create a test e-mail, select the parameter **Alrm.Smtp.Tst** and click the button [**Execute action**]. A test e-mail will be sent to the specified e-mail address.
11. If no test e-mail has arrived, check whether the test e-mail is in the spam folder and make sure that the network settings of the communication unit and the settings of the SMTP server are correct.

10.3.2 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.

Display current error message

1. Call up the instantaneous value overview (see Section 13.8, page 203).
2. Read off the current disturbance in the instantaneous value **ErrNo**.
3. Read off the location of the current cause of disturbance in the instantaneous value **ErrLcn**.

Display all error messages

1. Call up the event overview (see Section 13.9, page 203). All events will be displayed in chronological order.
2. To find warnings and error messages faster, select Typ. This will filter the events.

10.3.3 Acknowledging Disturbance Messages

10.3.3.1 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.

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

Procedure:

1. Call up the parameter overview (see Section 13.7, page 203).
2. To acknowledge the current error, set the parameter **ErrClr** to **Ackn** for each error respectively. Click on [**Save**] to confirm the change of the parameter.
3. To acknowledge any further errors, set the parameter **ErrClr** to **Ackn** again. The current error can be found in the instantaneous value **ErrNo**.

10.3.3.2 Acknowledging Safety-Relevant Errors via the User Interface

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

Dealing with disturbances

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

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

Requirement:

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

Procedure:

1. Call up the parameter overview (see Section 13.7, page 203).
2. To acknowledge a safety-relevant error, select the error source to be acknowledged in the parameter **ErrClr.ProErr**.

3. Adopt changes of the parameter with [**Save**].
   ☑ The safety-relevant error will be set as a regular error.
4. To acknowledge the error before the waiting time has expired, set the parameter **ErrClr** to **Ackn**.
5. Adopt changes of the parameter with [**Save**].

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

When acknowledging disturbances via the key switch **-S1**, any pending safety-relevant disturbances will also be acknowledged (see Section 10.3.4.2, page 153).

Dealing with disturbances

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

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

Procedure:

1. Before entering the battery storage system, disconnect the battery storage system from voltage sources (see Section 8.3, page 123).
2. Turn the start-stop key switch **-S1** to **Stop**.
3. Turn the start-stop key switch **-S1** to **Start**.
4. Turn the start-stop key switch **-S1** back to **Stop** within ten seconds.
5. Turn the start-stop key switch **-S1** back to **Start** again within ten seconds. This will acknowledge the disturbance from the last switching procedure and the disturbance message will be deleted from the fault memory.

10.3.4 Remedial Action in Case of Disturbances

10.3.4.1 Troubleshooting for non-feeding of the inverter

It can occur under certain circumstances that the inverter does not feed into the utility grid or the battery does not charge. The cause for not feeding in is displayed in the instantaneous value **PwrOffReas**.

Only when all error causes have been corrected can the inverter change back over to feed-in operation.

Value of the instantaneous value	Possible causes and remedies
No Power Off Reason	There are no disturbances. • Wait for a short period for a reaction.
Error: Error	An error has occurred. • View the cause of the error in the **ErrNo** instantaneous value. • Check the cause of the error, where necessary eliminate the error and acknowledge via the parameter **ErrClr** (see Section 10.3.3.1, page 150).
Stop: Battery System Controller	The internal unit for approving battery operation prevents the grid feed-in. • Set the parameter **Bsc.SCSOpCmdMan** to the required operating mode.
Stop: Key Switch	The inverter has been switched to the "Stop" operating state with the **-S1** start-stop key switch. • Turn the key switch **-S1** to the **Start** position.
Stop: Parameter InvOpMod	The inverter has been switched to the "Stop" operating state via the parameter **InvOpMod**. • Set the parameter **InvOpMod** to **Operation**.

Value of the instantaneous value	Possible causes and remedies
Stop: Stop External X440:3	The inverter has been switched to the "Stop" operating state via the external stop function. • If a signal was not issued via the external stop input, check the input **-X440:3**. To do so, measure the voltage and check the cable where necessary.
Stop: Scada or PPC, Modbus	The inverter has been switched to the "Stop" operating state via the Modbus protocol. • Switch the inverter back to the "GridFeed" operating state via a Modbus signal.
Standby: Scada or PPC, Modbus	The inverter has been switched to the "Standby" operating state via the Modbus protocol. • Switch the inverter back to the "GridFeed" operating state via a Modbus signal.
Standby: AC Synchronization	The inverter cannot be synchronized with the utility grid and switches to the "Standby" operating state. • Check the AC voltage at the inverter.
Standby: External Grid Error	An external network error has been reported via the Modbus protocol and the inverter has switched to the "Standby" operating state. • Switch the inverter back to the "Start" operating state via a Modbus signal and acknowledge the error via a Modbus signal. Here, the status of the utility grid is transmitted via one channel and a special acknowledgement of the network error is transmitted via a second channel to avoid communication errors.
Standby: Power Monitoring Module	The inverter has been switched to the "Standby" operating state due to missing default values for the power regulation and the corresponding configuration in the parameters **BatCtl.ComFlb.BatEna** and **BatCtl.ComFlb.AuxCtlEna** (see Section 14.4.6, page 225).
Standby: Parameter RemRdy	The inverter has been switched to the "Standby" operating state via the parameter **RemRdy**. • Set the parameter **RemRdy** to **Enable**.
Standby: Standby External X440:7	The inverter has been switched to the "Standby" operating state via the external standby function. • If a signal was not issued via the external standby input, check the input **-X440:7**. To do so, measure the voltage and check the cable where necessary.

Value of the instantaneous value	Possible causes and remedies
Wait AC	The grid limits entered in the parameters **VCtl.xxx** or **HzCtl. xxx** have been violated and the inverter has disconnected from the utility grid. • Check the waiting time for reconnection to the grid in the parameter **WaitGriTm**. • Check the settings for the grid limits in the parameters **VCtl.xxx** (see Section 14.2.2.2, page 212) or **HzCtl.xxx** (see Section 14.2.2.1, page 210). The voltage of the utility grid does not satisfy the requirements for connection to the utility grid. • Check the amplitude of the voltage in the utility grid. • Check the frequency of the voltage in the utility grid. • Check the line conductor of the voltage in the utility grid.
Wait DC: DC Voltage	The DC voltage at the inverter is too low or too high. • Wait or adjust the DC voltage.
Wait DC: Bender	The insulation monitoring device is measuring the insulation resistance. The time period of the measurement is defined in the parameter **PvGnd.AcIsoMonTm**. • Wait until the measurement of the insulation resistance has been completed.
Self Test active	The inverter is performing a self test. • Wait until the self test has been completed.
IO Test active	The inverter is in test mode. Please contact (see Section 18, page 284).

10.3.4.2 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 2 levels assigned to each disturbance which influence the display and system behavior. Only in the case of certain disturbances will the inverter behavior differ depending on the level. The level is increased from 1 to 2 if the disturbance occurs 5 times within 2 hours or without interruption for 2 hours.

If a disturbance occurs, an "incoming" disturbance entry is generated in the event overview. This entry includes the device in which the disturbance was detected, a warning symbol, the exact location of the error source within the assembly, an error number, a description of the disturbance and the time when the disturbance occurred.

The cause of the disturbance must be determined and remedied before you acknowledge the disturbance.

Once the disturbance has been acknowledged, the inverter checks whether the cause of the disturbance is eliminated. If the cause of the disturbance still exists after the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance." If the disturbance is no longer present, the disturbance is entered in the event list as "outgoing."

Inverter behavior in the disturbance levels 1 and 2:

- **Waiting time**

  In case of an error, the inverter switches to the operating state "Disturbance" and opens the AC disconnection unit and DC switchgear. The inverter does not feed into the grid for the defined waiting time.

  The waiting time specifies how long the inverter will be prevented from feeding into the utility grid. Once the waiting time has elapsed, the inverter checks whether the cause of the disturbance has been remedied.

  If the cause of the disturbance still exists after the waiting time has expired or the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance."

- **Waiting for acknowledgement**

  The inverter switches to the operating state "Disturbance" and opens the AC disconnection unit and DC switchgear. The inverter does not feed in until the disturbance is acknowledged.

- **Day change**

  The inverter switches to the operating state "Disturbance" and opens the AC disconnection unit and DC switchgear. The inverter does not feed in.

  The disturbance is automatically reset after a day change, or it can be acknowledged once the cause has been eliminated.

- **Warning**

  A warning does not affect inverter behavior.

In order to ensure the safe use of the inverter, safety-relevant errors are safeguarded via an additional error acknowledgement. This additional error acknowledgement is necessary for the following errors:

Error cause	Error number occurring
Triggering of the GFDI	3502
Detection of a stand-alone grid	405
Detection of a line conductor fault	802
Insulation monitoring device alarm	3501
Detection of a frequency error	502, 503

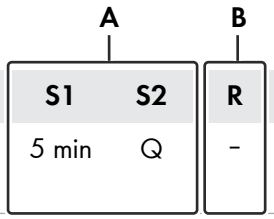
The parameter **ErrClr.ProErr** must be set for the additional acknowledgement of a safety-relevant error. This will allow the error to be acknowledged via the parameter **ErrClr** in just the same was as any other error.

The disturbance will be displayed in the event report as an outgoing event once the cause of the disturbance has been remedied and the waiting time has expired or the error has been acknowledged. In order that previous disturbances can be viewed even after they have been acknowledged on the user interface, an event report is saved. 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 1 minute. While the control system is booting, the regular waiting times for grid monitoring are complied with.

10.3.4.3 Content and structure of the error tables

You will find the following information in the error tables in the following sections:



Error no.	Explanation	S1	S2	R	Corrective measures
9009	Fast stop tripped by processor assembly.	5 min	Q	–	• Eliminate error and switch fast stop back on.

Figure 70: Explanation of the error table (example)

Position	Explanation
A	Behavior of the inverter: disturbance level S1, disturbance level S2 • s / min: waiting time • D: day change • Q: waiting for acknowledgement • W: warning
B	Reset

10.3.4.4 Error Numbers 01xx to 13xx – Disturbance at the AC Connection

After a grid failure, the inverter monitors the utility grid for a specific period before reconnecting.

When the inverter monitors the utility grid after a grid error, the grid monitoring time is complied with.

Certain errors, such as grid errors, cause the inverter to shut down. In this case, the instantaneous value **WaitGriTm** indicates the time for which the inverter monitors the utility grid before reconnecting. This grid monitoring time can be defined in parameter **GriErrTm**.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
0104	Grid voltage is too high. Overvoltage detected by standard monitoring.	30 s	30 s	–	• Check the grid voltage. • Check grid connections. • Check stability of the utility grid. • Make sure the external fuses work properly. • Make sure the AC cable connections are tight. • Check the configured grid limits.
0204	Grid voltage is too low. Undervoltage detected by standard monitoring.	30 s	30 s	–	
0205	An error has occurred for the grid synchronization.	W	W	–	–
0404	A frequency change in the utility grid greater than permitted has been detected.	30 s	30 s	–	• Check power frequency. • Check stability of the utility grid.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
0405	The inverter has disconnected from the utility grid because a stand-alone grid has formed.	30 s	30 s	–	• Check the grid voltage. • Check stability of the utility grid.
0502	Power frequency is too low. Power frequency disturbance detected by standard monitoring.	30 s	30 s	–	• Check power frequency. • Check the display of the grid monitoring relay. • Make sure the fuses in the load circuit function properly. • Check the configured grid limits.
0503	Power frequency is too high. Power frequency disturbance detected by standard monitoring.	30 s	30 s	–	
0802	One line conductor of the utility grid has failed.	5 min	Q	–	• Check the grid voltage. • Check grid connections. • Check stability of the utility grid. • Make sure the external fuses work properly. • Make sure the AC cable connections are tight. • Check the configured grid limits.
0803	The supply voltage for the assemblies has failed.	5 min	Q	–	• Contact Service.
1304	The rotating magnetic field of the utility grid is incorrect.	Q	Q	–	• Check the phase assignment. • Contact Service.
1417	The inverter load is not symmetrical.	30 s	30 s	–	–

10.3.4.5 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	–	• Check the DC source.
3501	Error: The insulation monitoring device has measured a too low grounding resistance.	30 min	Q	–	• Check the DC source for ground faults.
3502	The GFDI has tripped.	30 min	30 min	–	

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
3511	Warning: a ground fault has occurred. The inverter remains in feed-in operation.	W	W	–	• Check the DC source.
3517	At the moment insulation measurement is being performed. The inverter is in standby mode.	W	W	–	–
3518	The GFDI is thermally overloaded.	5 min	Q	–	• Check the DC source.
3521	The DC voltage to ground is too high. The insulation measurement was canceled.	15 min	D	–	• Check the DC source.
3522	The insulation resistance is too low.	5 min	5 min	–	• Check the DC source.
3601	Warning: In isolated operation, leakage current to ground has occurred at the PV modules or the limiting value defined in the **Gfdi.FltEnWarnLim** parameter has been reached.	W	W	–	• Check the grounding and equipotential bonding of the PV modules. • Check the circuitry and PV system design. • Check parameter **Gfdi.FltEnWarnLim**.
3602	Warning: In grounded operation, leakage current to ground has occurred at the PV modules or the limiting value defined in the **Gfdi.FltEnWarnLim** parameter has been reached.	W	W	–	• Check the grounding and equipotential bonding of the PV modules. • Check the circuitry and PV system design. • Check parameter **Gfdi.FltEnWarnLim**.
3803	An incidence of overcurrent at the DC input has occurred.	1 min	D	–	• Check the DC source.
4003	Reverse currents detected in the DC source or DC connection polarity reversed.	Q	Q	–	• Check the DC source for short circuits. • Check the circuitry and PV system design. • Check the DC terminals for correct polarity. • Check the functionality of the DC input.
4401	Error in the backfeed power module	W	W	–	• Check the backfeed power module

10.3.4.6 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 mi n	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 mi n	Q	–	• Contact Service.
6422	Inverter bridge in undefined state	30 s	5 min	–	• Contact Service.
6423	Error: Temperature of the medium-voltage transformer is too high. Disconnection limit exceeded. Inverter stops feed-in operation.	Q	Q	–	• Check the medium-voltage transformer.
6426	Overvoltage at the DC input.	30 s	5 min	–	• Check the battery.
6440	Hermetic protection (oil level) of the medium voltage transformer is no longer given.	Q	Q	–	• Check the medium-voltage transformer.
6443	A general error has occurred.	30 s	5 min	–	• Contact Service.
6456	Pre-charging circuit of DC link is defective.	5 min	5 min	–	• Contact Service.
6479	Data of coding plug is inconsistent.	Q	Q	–	• Contact Service.
6480	Coding plug is not plugged in or not readable.	Q	Q	–	• Contact Service.

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 medium voltage transformer is no longer given.	30 s	5 min	–	• Check the medium-voltage transformer.
6487	A ground fault has occurred on the AC side.	Q	Q	–	• Contact Service.
6494	Light repeater of the insulation monitoring is defective.	W	W	–	• Check the light repeater and replace it if necessary.
6495	The insulation monitoring device has detected a device fault.	5 min	5 min	–	If the fault 3501 is also displayed, a ground fault may have occurred while the battery was disconnected. • Check the external insulation resistance. • Contact Service.
6496	The driver control of the GFDI has reported an error.	5 min	D		• Contact Service.
6497	The voltage supply is faulty.	W	W	–	• Contact Service.
6498	The circuit breaker for heating and interior fan has tripped.	30 s	30 s	–	• Check the circuit breaker.
6499	An overload at the pre-charging contactor of the sinusoidal filter capacitor was detected.	30 s	Q	–	• Contact Service.
6502	Temperature of inverter bridge is too high.	30 s	30 s	–	• Check function of the fans. • Clean the fans. • Clean clogged fan inlets and ventilation plates.
6506	Warning: Temperature of the medium-voltage transformer is too high.	30 s	30 s	–	• Check the medium-voltage transformer.
6508	Intake temperature is to high.	30 s	30 s	–	–
6512	Intake temperature is to low.	30 s	30 s	–	–
6515	Temperature inside the inverter is too high.	30 s	30 s	–	–

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6517	Error: temperature at the sine-wave filter choke is too high. Disconnection limit exceeded. Inverter stops feed-in operation.	5 min	Q	–	• Contact Service.
6518	The temperature at the AC busbars is too high.	Q	Q	–	• Check the torque on the AC connection on the inverter. • Check the design of the AC connection on the inverter.
6519	Temperature in the interior of the inverter is undershot.	30 s	30 s	–	–
6520	Warning: Temperature in the interior of the inverter is low. The inverter might be disconnected.	W	W	–	–
6607	Maximum static charge current (DcAmpOpMin) of battery exceeded.	Q	Q	–	• Check the battery.
6608	Maximum static discharge current (DcAmpOpMax) of battery exceeded.	Q	Q	–	• Check the battery.
6609	Minimum static discharge voltage (DcVolOpMin) of the battery undershot.	Q	Q	–	• Check the battery.
6610	Maximum static charge voltage (DcVolOpMax) of the battery exceeded.	Q	Q	–	• Check the battery.
6625	The current on the inverter bridge is too high and is therefore limited to the maximum current.	1 min	1 min	–	• Contact Service.
6626	Maximum dynamic charge current (DcAmpDynMin) of battery exceeded.	W	W	–	• Check the battery.
6627	Maximum dynamic discharge current (DcAmpDynMax) of battery exceeded.	W	W	–	• Check the battery.
6628	Minimum dynamic discharge voltage (DcVolDynMin) of the battery undershot.	W	W	–	• Check the battery.
6629	Maximum dynamic charge voltage (DcVolDynMax) of the battery exceeded.	W	W	–	• Check the battery.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6634	The short-term overcurrent protection has triggered.	30 s	30 s	–	–
6635	The inverter was in the state "Grid-forming-FRT" for too long.	1 min	Q	–	–
6636	The inverter was in current limitation mode for too long during the black start procedure.	5 min	Q	–	–
7002	Cable break or short circuit at inverter temperature sensor	W	W	–	• Check the wiring of the temperature sensor. • Contact Service.
7004		W	W	–	
7005		W	W	–	
7016		W	W	–	
7501	Interior fan is defective.	W	W	–	• Check function of the fans. • Clean the fans. • Contact Service.
7502		W	W	–	
7503	Inverter bridge fan is defective.	W	W	–	
7505	Medium-voltage transformer fan is defective.	W	W	–	
7600	Internal communication error has occurred or communication is interrupted.	30 s	5 min	–	• Contact Service.
7601		30 s	180 min	–	• Contact Service.
7602		30 s	30 s	–	• Contact Service.
7605		30 s	5 min	–	• Contact Service.
7620		30 s	180 min	–	• Contact Service.
7621		30 s	180 min	–	• Contact Service.
7700	An error at the internal switches has occurred.	30 s	Q	–	• Contact Service.
7704	An error has occurred at the DC switchgear.	30 s	Q	–	• Contact Service.
7707	An error has occurred at the AC disconnection unit.	30 s	Q	–	• Contact Service.
7708	Faulty switching status of Remote GFDI.	5 min	D	–	• Contact Service.
7709	90% of the switch cycles of the DC switching devices have been reached.	–	–	–	–

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
7710	100% of the switching cycles of the DC switching devices have been reached. The electrical endurance of the DC switching devices has been reached, the DC switching devices must be replaced.	30 s	30 s	–	• Contact Service.
7721	The DC link could not be charged sufficiently.	5 min	Q	–	• Contact Service.
7722	IO test aborted due to voltage at the inverter (AC, DC).	5 min	Q	–	• Contact Service.
7723	No response from the Remote GFDI to the switching commands.	15 min	Q	–	• Contact Service.
7724	The number of switch cycles of the DC switching devices at high current is almost reached.	–	–	–	• Contact Service.
7725	The number of switch cycles of the DC switching devices at high current has been reached. The electrical endurance of the DC switching devices has been reached, the DC switching devices must be replaced.	30 s	30 s	–	• Contact Service.
7801	The surge arrester is defective or the back-up fuse of the surge arrester has tripped.	5 min	Q	–	• Check the surge arrester. • Check the back-up fuse of the surge arrester.
7804	A defined number of brief overvoltage events have occurred or the surge arrester has triggered. Overvoltage protection **F26** must not be switched on again. Prior to switching on the overvoltage protection **-F26** again, the assemblies must be replaced by SMA Service.	–	–		• Contact Service.
8402	High ripple currents have occurred due to defective sine-wave filter capacitors.	30 s	30 s	–	• Contact Service.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
8712	Warning: failure of power setpoints transmitted via communication. The inverter behavior depends on the parameter settings **GriMng.ComFltFlbWMod** and **GriMng.ComFltFlbVArMod**: • **Last setpoint**: The inverter feeds in with the last valid value. • **W**: The inverter feeds in with the substitute value given for the selected procedure. Once valid setpoints are available again, these will be used.	W	W	–	• Contact Service.
8713	Failure of power setpoints transmitted via communication. Inverter stops feed-in operation. The inverter behavior depends on the parameter settings **GriMng.ComFltFlbWMod** and **GriMng.ComFltFlbVArMod**: • **Standby**: The inverter switches to the operating state "Standby." The AC disconnection unit and the DC switchgear remain closed. • **Error**: Standby: The inverter switches to the operating state "Error." The AC disconnection unit and the DC switchgear are opened and the inverter disconnects from the utility grid.	1 min	1 min	–	• Contact Service.
8715	Communication between inverters failed.	W	W	–	• Check communication of both inverters. • Contact Service.
9009	Fast stop tripped by processor assembly.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9017	Fast stop was manually tripped.	30 s	5 min	–	-
9019	A fast stop has been tripped for an unknown reason	30 s	5 min	–	• Check the fast stop cabling. • Eliminate error and switch fast stop back on.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
9023	Fast stop tripped by DC overcurrent.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9024	Fast stop tripped by Remote GFDI.	5 min	Q	–	• Check the fast stop cabling. • Eliminate error and switch fast stop back on.
9025	Fast stop manually tripped at key switch **-S2**.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9026	Fast stop tripped by the external fast stop.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9027	Fast stop tripped by AC overcurrent.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9028	Fast stop was tripped by AC disconnection unit.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9029	Fast stop has tripped.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9030	Fast stop tripped by the external watchdog.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9031	Fast stop tripped by redundant monitoring of the processor assembly.	5 min	Q	–	• Eliminate error and switch fast stop back on.
9104	An error has occurred at the control clock timing.	30 s	5 min	–	• Contact Service.
9307	The battery management system has reported a fault.	30 s	30 s	–	• Contact Service.
9308	Failure of communication with the battery. The inverter behavior depends on the parameter settings **BatCtl.ComFlb.FlbMod**.	W	W	–	• Check communication. • Contact Service.
9346	The battery is not configured.	W	W	–	• Check the battery's communication.
9347	The battery reports an event.	W	W	–	• Check the battery.
9348	Failure of communication with the external control. The inverter behavior depends on the parameter settings **BatCtl.ComFlb.FlbMod**.	W	W	–	• Check communication. • Contact Service.
9349	The state of charge limits are too narrow. Hysteresis is not used.	W	W	–	• Check the parameters of the state of charge limit (see Section 14.4.8, page 228).

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
9350	Timeout when the battery status is changing	W	W	–	• Check the battery.
9501	The Remote GFDI fuse has tripped.	15 min	Q	x	• Contact Service.

11 Maintenance

11.1 Safety during Maintenance

⚠ DANGER

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

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

- Do not touch non-insulated parts or cables.
- Observe all safety information on components associated with the product.
- Disconnect the 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ DANGER

Danger to life from electric shock 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

These maintenance instructions are intended for use by qualified personnel only.

To reduce the risk of electric shock, do not perform maintenance work other than that described in this document unless you are qualified to do so.

⚠ WARNING

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

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

- Ensure that the insulation resistance of the storage system exceeds the minimum value. The minimum value of the insulation resistance is: 14 kΩ.
- All work on the product must be carried out by qualified persons only.
- Before entering the battery storage system, switch the system with the ground fault detection system (Remote GFDI) to insulated operation.
- After entering the battery storage system, immediately ensure that the inverter does not display an insulation error.
- Disconnect the 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.
- Install the product in a closed electrical operating area.

⚠ WARNING

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

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

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

⚠ WARNING

Hearing impairment due to high-frequency noises of the product

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

- Wear hearing protection.

⚠ 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.

11.2 Servicing Schedule

11.2.1 Information on Maintenance

Observance of the maintenance intervals ensures trouble-free operation.

i Correct performance of maintenance work

All maintenance work must be performed as described in this document. Deviations from procedures or failure to comply with the maintenance intervals will lead to any guarantee- or warranty claims becoming null and void.

i Consumables and maintenance materials

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

i Spare parts

Only original parts or parts recommended by SMA Solar Technology AG are to be used as spare parts when replacing components.

Spare parts can be identified via the reference designation and the circuit diagram. The spare-parts list includes the article numbers of each spare part. For information on a specific article number, contact us (see Section 18, page 284).

11.2.2 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.

Position	Color	Color scheme
Enclosure of the inverter	RAL 9016	Traffic white
Medium-voltage transformer	RAL 7033 / 7035	Cement gray / light gray
Low and medium-voltage cabinet	RAL 7004	Signal gray
Rack	Zinc paint (e.g., WÜRTH Zink 300)	Hot-dip galvanized

- ☐ For the paints for medium-voltage transformers, low- and medium-voltage cabinets, observe the following information according to the order option:

	"Environment: Standard"	"Environment: Harsh"
Basic requirement	Suitable as corrosion protection for C3H as per ISO 12944-5:2019	Suitable as corrosion protection for C5H as per ISO 12944-5:2019
Color structure / color composition	1-K (one-component)	2-K (two-component)
Temperature resistance	130°C (266°F)	130°C (266°F)
Layer thickness	240 µm to 260 µm	320 µm
Number of coating layers	1 to 2	2 to 3

Maintenance under voltage-free conditions:

Task	Interval	See
Maintain the key switches and seals.	12 months	Section 11.3.1.2, page 175
Perform visual inspection of the MV Power Station.	12 months[32)]	Section 11.3.1.3, page 176
Perform visual inspection of the inverter.	C5M: 6 months[33)] C4M: 12 months C3H: 24 months	Section 11.3.1.3, page 176
Clean the interior.	12 months[32)]	Section 11.3.1.5, page 176
Save the operating data of the inverter.[34)]	12 months[35)]	Section 9.21.1, page 140

[32)] If the product is subject to adverse ambient conditions, SMA recommends that the maintenance interval be reduced in accordance with the ambient conditions.

[33)] The length of the maintenance interval affects the term of protection of the coating system.

[34)] Supply voltage must be present.

[35)] In order to reduce the data transmission time, the interval should be shortened.

Task	Interval	See
Check the surfaces for rust damage. If necessary, remove the rust and paint over with primer and the respective color. If necessary, touch up the station frame by applying zinc paint. The proportion of zinc dust as a pigment should be greater than 90% of the weight. Make sure that any traces of corrosion have been removed and that the support surface is free of grease and oil. The zinc paint must overlap the hot-dip galvanizing. The thickness of coating in the area to be touched up should be at least 100 µm. Zinc sprays are not allowed.	12 months[32)]	–
In case of salt spray, remove the salt from the surface of the product regularly to prevent rust damage.	12 months[32)]	–
Check the latches, door stops and hinges.	24 months	Section 11.3.1.4, page 176
Check the labels of the MV Power Station.	24 months[32)]	Section 11.3.1.6, page 177
Check the inverter label.	24 months[32)]	Section 11.3.2.2, page 181
Check that the grounding connections are securely in place. Check the grounding connections for discoloration and corrosion. If necessary, repair any corrosion damage and grease.	24 months[32)]	–
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	–

11.2.3 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.	12 months	Section 11.3.2.1, page 178
Check the fuse of the DC surge arrester for continuity.	24 months	Section 11.3.2.3, page 181
Check the fans.	24 months	Section 11.3.2.4, page 182
Check the functioning of the indicator lights.	24 months	Section 11.3.2.5, page 182
Maintain the DC load-break switch.	24 months[36)]	Manufacturer documentation (see Section 1.7, page 13)

[36)] In deviation to the maintenance interval of 12 months specified by ABB, the maintenance interval stated in this documentation applies.

Maintenance work	Interval	See
Clean the AC disconnection unit.	24 months[36]	Manufacturer documentation (see Section 1.7, page 13)
Maintain the AC circuit breaker.	4 years / after a short circuit[37]	Manufacturer documentation (see Section 1.7, page 13)
Replace the fuse of the DC surge arrester.	Once triggered	Section 11.3.2.6, page 183
Replace the lithium-ion rechargeable battery.[38]	10 years	–
Replace the Industrial Compact Flash card.[38]	10 years or after an error message	–
Replace the interior fan.[38]	14 years	–
Replace the inverter bridge fan.[38]	14 years	–
Replace the remote GFDI fuse.	4 years	–
Replace the DC fuses.	After a fault	Replacing the DC Fuses

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

Task	Interval
Clean the busbar and feed-throughs.	12 months[39]
Check whether the ventilation grids are free from pollution and deposits and clean if needed.	24 months[39]

11.2.5 Servicing Schedule for Work in the Medium-Voltage Cabinet

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 applied:

Task	Interval
Check the function of the fans. To do this, turn the thermostat lower than the ambient temperature until the fan starts. After the test, set the thermostat to the original value again.	12 months
For the order option "Environment: Harsh" or "Ambient Temperature: -35°C to +55°C": 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 10 washes. Filter pads can be ordered from us (material number: 113059-00.01).	12 months[40]
Check the heat detector (see manufacturer's documentation).	12 months

[37] In deviation to the maintenance interval of 3 years specified by ABB, the maintenance interval stated in this documentation applies.

[38] Repair work that must only be performed by SMA Service.

[39] If the product is subject to adverse ambient conditions, SMA recommends that the maintenance interval be reduced in accordance with the ambient conditions.

[40] If the product is subject to adverse ambient conditions, SMA recommends that the maintenance interval be reduced in accordance with the ambient conditions.

Task	Interval
Check whether the ventilation grid function is given.	24 months[40)]
Clean the medium-voltage cabinet.	24 months[40)]
Clean the ventilation shaft of the fan and the ventilation grids on the doors.	24 months[40)]
Ensure that the grounding contacts are securely in place and show no discoloration or corrosion.	24 months
Check the function of the lighting.	24 months
Check the function of the doors and hinges and lubricate them.	24 months
Replace the heat detector	10 years

11.2.6 Servicing Schedule for Work in the Low-Voltage Cabinet

Task	Interval
Check the surge arrester and, if necessary, remove it: For L1, L2, L3 - grounding conductor: 116725-00.01 per phase and 62-951002 for module For N - grounding conductor: 116746-00.01 and 62-900200.01 for module	12 months, after thunderstorms or noticeable voltage surges in the utility grid
For the order option "Environment: Harsh" or "Ambient Temperature: -35°C to +55°C": 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 10 washes. Filter pads can be ordered from us (material number: 113059-00.01).	12 months[41)]
Check function of the heaters. To do this, turn the thermostat higher than the ambient temperature until the heaters start. After the test, set the thermostat to the original value again.	12 months
Check the function of the residual-current device.	12 months
Check that the protective covers of the fuses are securely in place and correct, if necessary.	24 months
Ensure that the grounding connections are securely in place and show no discoloration or corrosion.	24 months
Check the function of the relay in the safety loop.	24 months
Clean the inside of the enclosure.	24 months[41)]

11.2.7 Servicing Schedule for Work on the Medium-Voltage Transformer

Maintenance under voltage-free conditions:

Task	Interval	See
Check the oil temperature in the instantaneous value **6107**.	12 months	Section 13.8, page 203

41) If the product is subject to adverse ambient conditions, SMA recommends that the maintenance interval be reduced in accordance with the ambient conditions.

Task	Interval	See
Check low-voltage and medium-voltage cable entries for discolorations and damages.	24 months	Section 11.3.3.4, page 184
Check electrical connections for dirt and signs of electric arcs.	24 months	Section 11.3.3.5, page 184
Check the cooling surfaces for dirt and damages.	24 months	Section 11.3.3.1, page 183
Check maintenance seal and security seals for damage.	24 months	Section 11.3.3.3, page 184
Check the torques of grounding connections.	24 months	Section 11.3.3.6, page 184
Check function of the tap changer.	24 months	Section 11.3.3.8, page 185
Check the oil level.	24 months	Section 11.3.3.9, page 186
Check the medium-voltage transformer for paint damage and rust. Remove any rust patches and repaint (if necessary).	24 months	–
Check all seals of the medium-voltage transformer for leakage. In case of leakage, contact us (see Section 18, page 284).	24 months	Manufacturer documentation
Take an oil sample and have it tested.	Recommended after a failure when, for example, the hermetic protection device has tripped.	Contact us.
Check the medium-voltage transformer for abnormal noises during operation.	Where necessary	–

Further information can be found in the manufacturer documentation.

11.2.8 Maintenance plan for work on the medium-voltage switchgear

Task	Interval	See
Checking Gas Fill Level in Medium-Voltage Switchgear	Prior to each switching procedure:	Section 11.3.4.1, page 186
Carry out the visual inspection of the general condition (cleanliness, no corrosion, etc.). If required, clean the enclosure and repair corroded surfaces.	24 months[42)]	–
Check the lid of electric-arc opening.	24 months and prior to each switching operation.	Section 11.3.4.2, page 186
Check grounding connections.	24 months	Section 11.3.4.4, page 186
Check the functionality of the switch.	24 months	Section 11.3.4.5, page 186
Check the motor-drive function.[43)]	24 months	Manufacturer documentation

[42)] If the product is subject to adverse ambient conditions, SMA recommends that the maintenance interval be reduced in accordance with the ambient conditions.

[43)] depending on the order option

Task	Interval	See
Check the locking of the cable cover in ungrounded condition.	24 months	Manufacturer documentation
Check functionality of the over-current protection device.[44)]	4 years	-
Check electrical connections.	6 years	Section 11.3.4.3, page 186
Check the accessory for completeness and its current state.	6 years	Manufacturer documentation
Check that switch position indicators are aligned.	6 years	Section 11.3.4.6, page 187
Replace the battery (Saft Type LS 17500, 3.6 V) of the overcurrent protection devices IKI 30E and IKI 35.	15 years	Manufacturer documentation

Further information can be found in the manufacturer documentation.

11.2.9 Servicing Schedule for Work on the Oil Spill Containment

The MV Power Station is equipped with an oil spill containment depending on the order option.

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 organic oil for KNAN transformers	58-940200.01
Oil filter for mineral oil for ONAN transformers	58-940100.01
Pre-filter	58-940000.01
Filter media for the pre-filter	65-171800.01

Task	Interval
Check the oil spill containment underneath the medium-voltage transformer and the inverter and clean it if necessary. To clean the oil spill containment, remove the base plates (10 x M6 hex socket) in front of the inverter. Remove any leaves and dirt. If there is oil leakage, use a pump placed at the lowest point of the oil spill containment.	12 months[45)]
Check prefilter and oil filter and clean if necessary.	12 months[45)]
Check the oil spill containment underneath the medium-voltage transformer and the inverter regularly for leakages. If necessary, eliminate leakages.	24 months[45)]
Check the oil spill containment underneath the medium-voltage transformer and inverter regularly for water to prevent frost damage. Remove water, if necessary.	24 months[45)]

[44)] This task must only be performed by qualified protection tester.

[45)] If the product is subject to adverse ambient conditions, SMA recommends that the maintenance interval be reduced in accordance with the ambient conditions.

Task	Interval
Remove pre-filter.	36 months
Replace oil filter when, normally, clean and clear water flows through the filter.	5 years or if oil filter has come into contact with oil.

11.3 Maintenance Work

11.3.1 General Maintenance Work

The general maintenance work must be performed on all components of the product according to the required intervals (see Section 11.2.1, page 168). The first maintenance work must be done no later than 12 months after delivery of the MV Power Station.

11.3.1.1 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. In case of salt spray, the salt must be removed from the product surface on a regular basis to prevent rust damage.

NOTICE

Damage due to environmental disturbances

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

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

Maintenance within one week after the environmental incident

1. Check the product surface for damages(see Section 11.3.1.3, page 176).
2. Check ventilation grids and air duct for pollution and deposits. If dust or other deposits cover the air inlets and outlets, clean the ventilation grids and air duct (see Section 11.3.2.1, page 178).

Maintenance within four weeks after the environmental incident

1. Check the product behavior for errors. If errors occur more frequently than before the environmental incident, contact us.
2. Check the product behavior for derating. If the product is in derating mode more frequently than before the environmental incident, clean the ventilation grids and the air duct again (see Section 11.3.2.1, page 178).

11.3.1.2 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

Procedure:

1. Check whether the seals in the sealing area of the enclosure opening show any signs of damage. If seals are damaged, contact us (see Section 18, page 284).
2. Apply talcum, petroleum jelly or wax to seals. This will prevent frost damage.
3. If the product is installed in regions in which temperatures below freezing occur, protect the key switch from icing-up with non-greasy antifreeze agent.

11.3.1.3 Performing the Visual Inspection

1. Ensure that no voltage is present on all poles (see Section 8, page 118).
2. Check all surfaces for dirt. Remove dirt (if necessary).
3. 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.
4. Ensure that there are no objects in front of or behind the MV transformer compartment which will endanger operational safety in the event of arc faults and which prevent arc fault diversion.
5. Ensure that all cable entries are intact and that the cables are not damaged (e.g., due to animal bites).
6. Ensure that the ventilation and exhaust air vents are not obstructed.
7. Ensure that there are no objects around the product which prevent the cooling air from circulating.
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. medium-voltage transformer, low-voltage transformer and low-voltage transformer) are present, complete and legible. Replace the type label if it is not legible. Contact us (see Section 18, page 284).
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 18, page 284).

11.3.1.4 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

Procedure:

1. Ensure that no voltage is present on all poles (see Section 8.5, page 123).
2. 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.
3. Check whether the stops hold the doors in place. If the stops cannot hold the doors in place, contact us(see Section 18, page 284).
4. Check whether the door hinges move easily. If the door hinges do not move easily, lubricate the hinges.
5. Lubricate all moving parts and movement points.
6. Tighten any loose screws with the appropriate torque.
7. If the product is installed in regions where below-freezing temperatures occur, apply the non-greasing antifreeze to the profile cylinders of the door locks and the key switch in order to protect them from icing up.

11.3.1.5 Cleaning the Interior

1. Ensure that no voltage is present on all poles (see Section 8.5, page 123).
2. Remove dirt and dust from all interiors and from all devices.

3. Check the interior for leaks. If leaks are present, fix them.
4. Remove moisture.

11.3.1.6 Checking the Labels of the MV Power Station

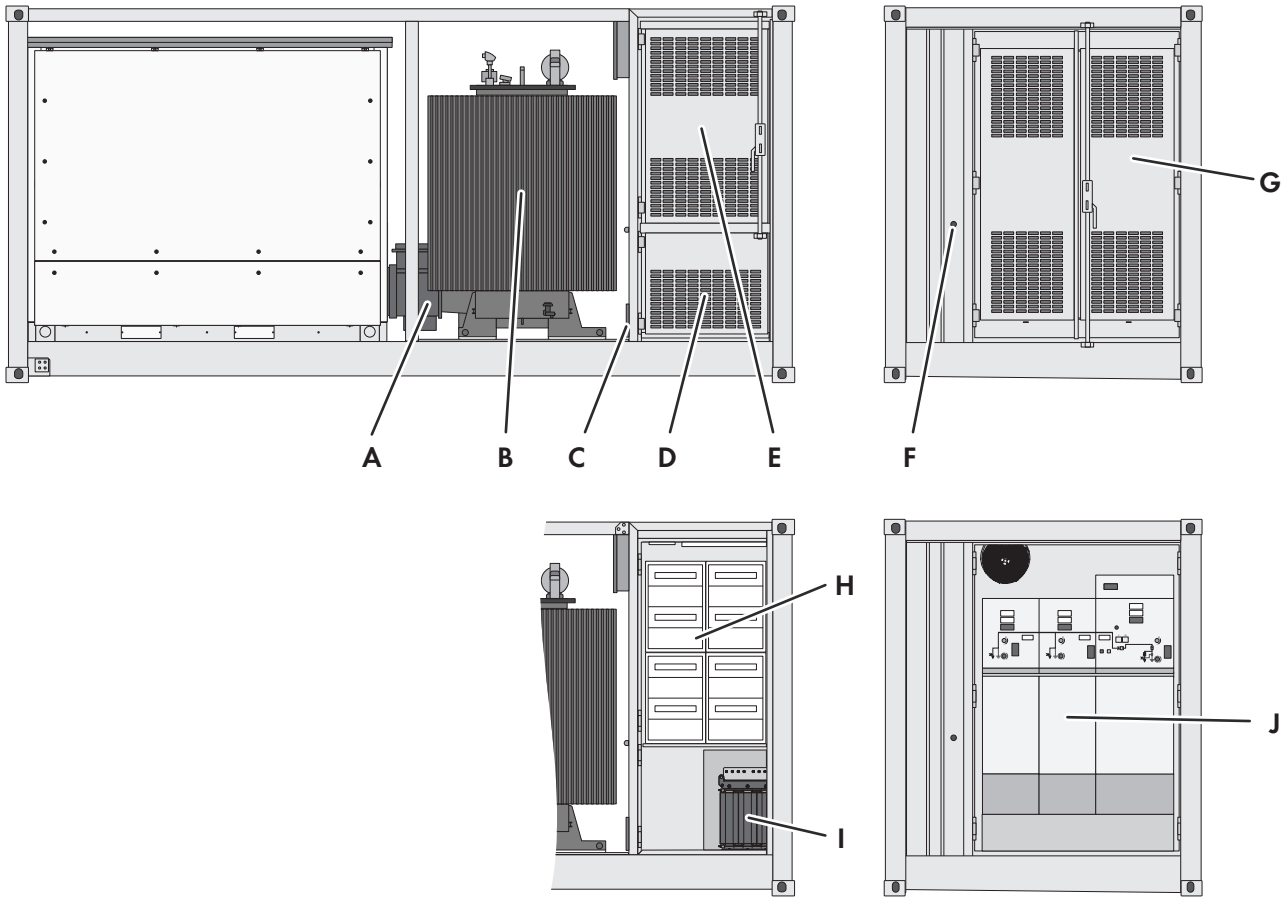


Figure 71: Position of the warning labels on the MV Power Station

Position	Order number
A	118639-00.01 (en/es) | 119289-00.01 (en/fr) 118637-00.02 (en/es) | 119291-00.01 (en/fr) 118613-00.01 (en/es) | 119287-00.01 (en/fr)
B	On both sides of the medium-voltage transformer: 118639-00.01 (en/es) | 19289-00.01 (en/fr) 118637-00.02 (en/es) | 119291-00.01 (en/fr)
C	On the lid of the arc pressure relief system: 118647-00.01 (en/es) | 119290-00.01 (en/fr)
D	On the door to the low-voltage transformer: Only applies to Canada: 104305-00.01 118836-00.01 (en/es) | 119298-00.01 (en/fr) For the order option "Ambient Temperature: -40°C to +45°C": 123085-00.01 (en/fr)

Position	Order number
E	On door of low-voltage cabinet: 118614-00.01 (en/es) | 119288-00.01 (en/fr)
F	Via the fast-stop switch: 119020-00.01 (en) | 119187-00.01
G	118639-00.01 (en/es) | 119289-00.01 (en/fr) For the order option "Ambient Temperature: -40°C to +45°C": 123085-00.01 (en/fr) Only for Canada on the left side: 121825-00.01 (en/fr)
H	On the station subdistribution: 118611-00.01 (en/es) | 119285-00.01 (en/fr)
I	On the low-voltage transformer: 118637-00.01 (en/es) | 119291-00.01 (en/fr) 118639-00.01 (en/es) | 119289-00.01 (en/fr) Next to the fuse holder for the low-voltage transformer: 118614-00.01 (en/es) | 119288-00.01 (en/fr) 119687-00.01 On the left wall: 119021-00.01 (en/es) | 119293-00.01 (en/fr) For the order option "Ambient Temperature: -40°C to +45°C" near the heater: 118637-00.02 (en/es) | 119291-00.01 (en/fr) Only for Canada on the left side: 121823-00.01 (en/fr) | 121824-00.01 (en/fr)
J	118615-00.01 (en/es) | 119292-00.01 (en/fr) 118612-00.01 (en/es) |119286-00.01 (en/fr) 118637-00.02 (en/es) | 119291-00.01 (en/fr) Only applies to Canada: 121827-00.01 (en/fr) | 121826-00.01 (en/fr)

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 18, page 284).

11.3.2 Maintenance Work on the Inverter

11.3.2.1 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

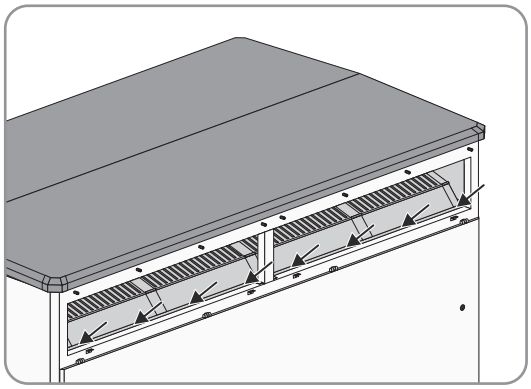
Risk of injury when mounting and removing the fans

One fan weighs 25 kg (55 lb). Injuries may occur if the fan is lifted incorrectly or if the fan falls during mounting or removal.

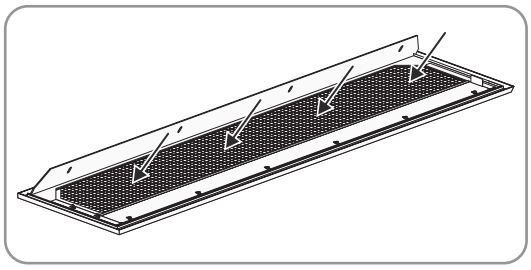
- Mount and remove the fan with all due care.
- Wear personal protective equipment for all work on the product.

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 (28 lb)).
5. Vacuum the edge under the ventilation grid and clean it with a brush.



6. Vacuum the ventilation grid and clean them with a brush.

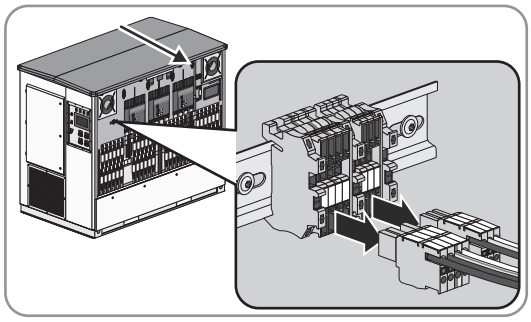


7. Check the ventilation grid for visible damage. If ventilation grids are damaged, contact us (see Section 18, page 284).
8. Vacuum the air duct from the outside or clean it with a brush.
9. If moisture is present in the air duct, remove it with a damp cloth.
10. Fold the ventilation grids upwards and tighten the screws (torque: 8 Nm to 10 Nm (70.8 in-lb to 88.5 in-lb)).

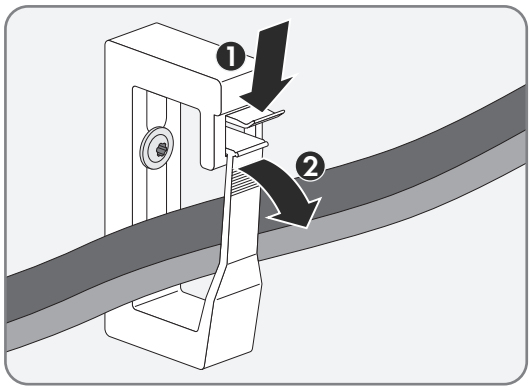
Cleaning the fans and air duct

1. Open the hatch on the DC side of the inverter (see Section 13.2, page 189).

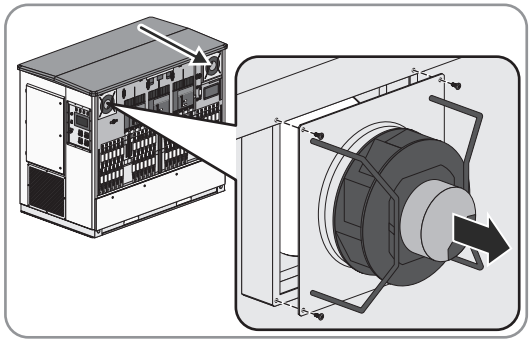
2. Disassemble both fans. To do this, loosen the connectors of the fans **-X341**, **-X741**, **-X342**, **-X742**.



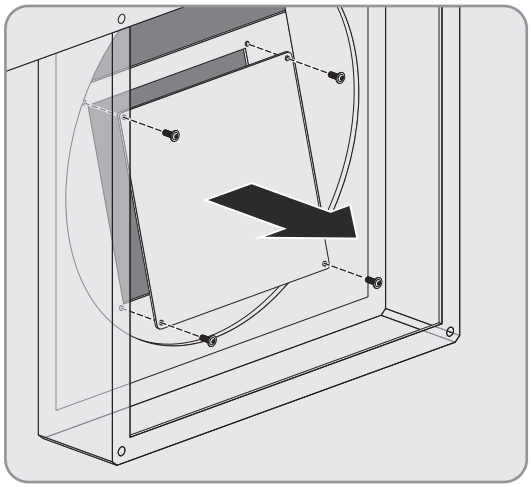
3. Open the cable brackets and pull the connectors of the fans out of the cable brackets.



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



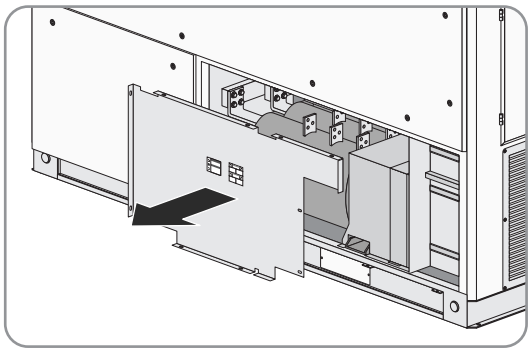
5. Remove the inspection hatches. To do so, unfasten the screws of the inspection hatches.



6. Check whether there are any dust deposits in the air duct behind the inspection hatches. Use an angled telescopic mirror for this. If there are any dust deposits in the air duct behind the inspection hatches, remove the dust deposits. Use a vacuum cleaner for this.
7. Remount the inspection hatches. To do so, tighten the screws of the inspection hatches (torque: 8 Nm to 10 Nm (70.8 in-lb to 88.5 in-lb)).
8. Position the fans over the bolting points and tighten the screws (torque: 8 Nm to 10 Nm (70.8 in-lb to 88.5 in-lb)).
9. Place the connectors of the fans into the cable brackets and close the cable brackets.
10. Connect the connectors of the fans to the terminals **-X341**, **-X741**, **-X342**, **-X742**.

Cleaning the sine-wave filter

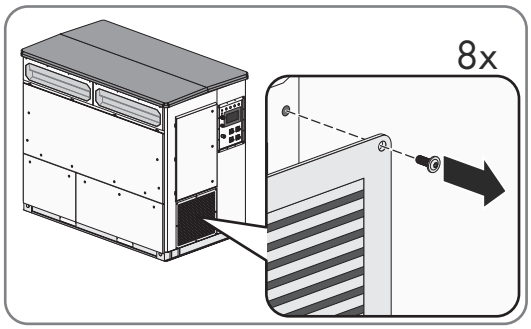
1. Remove the cover in front of the sine-wave filter capacitors (see Section 13.3.1.2, page 194).
2. Remove any dust deposits from the area around the sine-wave filter capacitors.
3. Mount the cover in front of the sine-wave filter capacitors (see Section 13.3.1.2, page 194).
4. Disassemble the panels (see Section 13.3.1.1, page 191).
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 (70.8 in-lb to 88.5 in-lb)).

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 (70.8 in-lb to 88.5 in-lb)).

11.3.2.2 Checking the Labels

11.3.2.3 Checking the DC Surge Arrester Fuse for Continuity

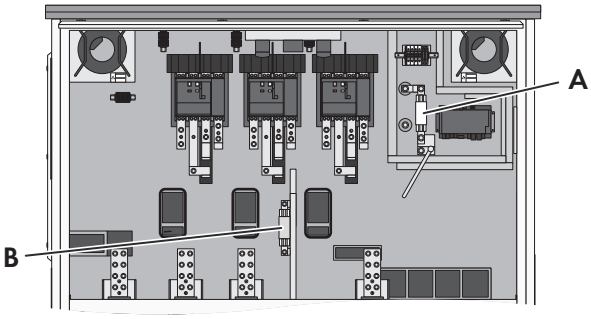


Figure 72: DC surge arrester fuse

Position	Designation
A	DC surge arrester fuse, 125 A

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).
2. Open the hatch (see Section 13.2, page 189).
3. Disassemble the protective cover in front of the DC fuses and the electronics area Disassembling and Mounting the Protective Covers on the Inverter.
4. Perform a continuity check on the fuse. If there is no continuity in the fuse, contact us (see Section 18, page 284).
5. Mount the protective cover in front of the DC fuses and the electronics area Disassembling and Mounting the Protective Covers on the Inverter.
6. Close the hatch (see Section 13.2, page 189).

11.3.2.4 Checking the Fans

NOTICE

Damage to the product due to test operation at low temperatures

Test operation at low temperatures leads to a cold start of the fan. This can damage the fan.

- Only carry out the test operation of the fans at temperatures above -25°C (-13°F).

Procedure:

1. Call up the parameter overview (see Section 13.7, page 203).
2. Set the parameter **InvOpMod** to **Operation**.
3. Set the parameter **InvTstMod** to **Fan**. If the fans do not start running, contact the Service (see Section 18, page 284).
4. Set the parameter **InvTstMod** to **No test**.
5. Set the parameter **InvOpMod** to **Stop**.

11.3.2.5 Checking the Functioning of the Light Repeaters

1. Call up the parameter overview (see Section 13.7, page 203).
2. Set the parameter **InvOpMod** to **Operation**.
3. Set the parameter **InvTstMod** to **Signal lamp**.
4. Check whether the light repeaters flash briefly. If the indicator lights do not flash, contact us (see Section 18, page 284).
5. Set the parameter **InvTstMod** to **No test**.
6. Set the parameter **InvOpMod** to **Stop**.

11.3.2.6 Replacing the Fuse of the DC Surge Arrester

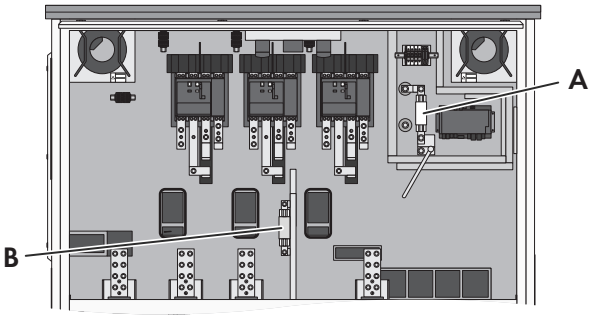


Figure 73: DC surge arrester fuse

Position	Designation
A	DC surge arrester fuse, 125 A

Additionally required material:

☐ Replacement fuse. The replacement fuse can be ordered under the material number 61-01565.

Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).
2. Open the hatch (see Section 13.2, page 189).
3. Disassemble the protective cover in front of the DC fuses and the electronics area Disassembling and Mounting the Protective Covers on the Inverter.
4. Remove the alarm contact of the DC surge arrester.
5. Remove the defective fuse. Use an LV/HRC fuse extractor.
6. Insert the replacement fuse. Use an LV/HRC fuse extractor.
7. Mount the alarm contact of the DC surge arrester.
8. Mount the protective cover in front of the DC fuses and the electronics area Disassembling and Mounting the Protective Covers on the Inverter.
9. Close the hatches (see Section 13.2, page 189).

11.3.3 Maintenance Work on the Medium-Voltage Transformer

In addition, obey the instructions in the manufacturer's documentation.

11.3.3.1 Checking the Cooling Surfaces for Dirt and Damages

1. Ensure that the MV transformer and the inverter are disconnected from all voltage sources (see Section 8, page 118).
2. Clean the cooling surfaces of the medium-voltage transformer.
3. Check the cooling surfaces of the medium-voltage transformer for damage. If the cooling surfaces are damaged, contact us (see Section 18, page 284).

11.3.3.2 Checking the transformer tank for damage

1. Remove dirt and dust from the surface of the MV transformer. Do not use any high-concentration cleaning agents for this.
2. Check the surface of the MV transformer for oil traces and cracks. If the surfaces has any oil traces and cracks, please contact us (see Section 18, page 284).

11.3.3.3 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 inverter are disconnected from all voltage sources (see Section 8, page 118).
2. Check the security seals on the oil filler neck and oil drain valve.
3. If the maintenance seals or security seals are damaged, contact us (see Section 18, page 284).

11.3.3.4 Checking Low-Voltage and Medium-Voltage Cable Entries for Discolorations and Damages

1. Ensure that the MV transformer and the inverter are disconnected from all voltage sources (see Section 8, page 118).
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 18, page 284).

11.3.3.5 Checking Electrical Connections for Dirt and Signs of Electric Arcs

1. Ensure that the MV transformer and the inverter are disconnected from all voltage sources (see Section 8, page 118).
2. Check electrical connections for dirt. Remove dirt (if necessary). To prevent oil leaks, do not damage the fins of the medium-voltage transformer when doing this (e.g., by stepping on or leaning against conductors).
3. Check electrical connections for signs of electric arcs. If the electrical connections show any discolorations, deformations or scorch marks, contact us (see Section 18, page 284).

11.3.3.6 Checking the Torque of Grounding Connections

1. Ensure that the MV transformer and the inverter are disconnected from all voltage sources (see Section 8, page 118).
2. Check the torque of the grounding connections on the MV transformer (60 Nm) and if necessary retighten the bolted grounding connection and grease.

11.3.3.7 Checking the Function of the Control Elements of the Protective Devices

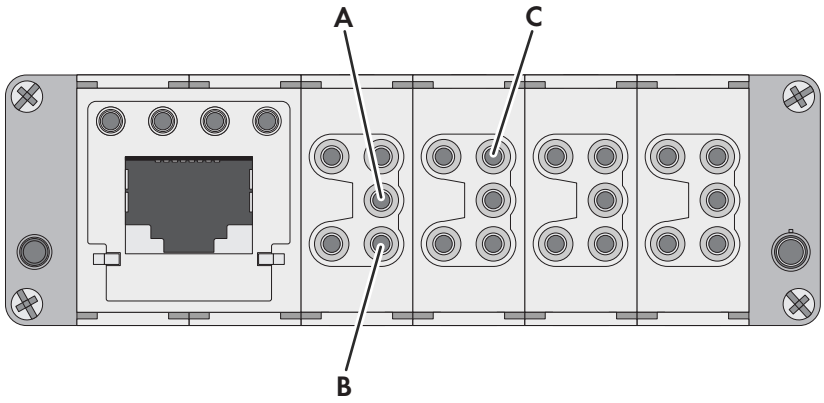


Figure 74: Assignment of the transformer protection plug on the medium-voltage transformer side

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 inverter are disconnected from all voltage sources (see Section 8, page 118).
2. Open the brackets on the transformer protection plug. Then, remove the plug.
3. Ensure through measurement on the transformer protection plug between the terminals **X4:3** and **X4:5** that the contact is closed.
4. Pull the float of the oil level indicator down with a magnet.
5. 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 (see Section 18, page 284).

11.3.3.8 Checking the function of the tap changer

1. Ensure that the MV transformer and the inverter are disconnected from all voltage sources (see Section 8, page 118).
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).

11.3.3.9 Checking Oil Level and Oil Pressure

Depending on the order option, the oil level and oil pressure of different devices must be determined.

1. Ensure that the MV transformer and the inverter are disconnected from all voltage sources (see Section 8, page 118).
2. Ensure that the oil level indicator is in the green zone. If the oil level is outside the green range, please contact us (see Section 18, page 284).
3. Check whether the pressure is within the range indicated on the type label. If the pressure is higher than indicated, contact us (see Section 18, page 284).

11.3.4 Maintenance Work in Medium-Voltage Switchgear

In addition, obey the instructions in the manufacturer's documentation.

11.3.4.1 Checking Gas Fill Level in Medium-Voltage Switchgear

The level of SF6 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 SF6 gas is too low, contact us (see Section 18, page 284).

11.3.4.2 Checking the Internal Arc Pressure Relief

1. Ensure that the MV Power Station is disconnected (see Section 8, page 118).
2. Ensure that there are no objects in front of or behind the MV transformer compartment which will endanger operational safety in the event of arc faults and which prevent arc fault diversion.

11.3.4.3 Checking Electrical Connections

1. Ensure that the MV Power Station is disconnected (see Section 8, page 118).
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). Always adhere to the torque specifications.
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 18, page 284).

11.3.4.4 Checking Grounding Connections

1. Ensure that the MV Power Station is disconnected (see Section 8, page 118).
2. Make sure that the grounding contacts of the station 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 18, page 284).
3. Grease the grounding connections.

11.3.4.5 Checking Functionality of the Circuit Breaker

This procedure does not check the disconnection via the transformer protective relay. This test is done by checking the functionality of the over-current protection device (see Section 11.2.8, page 173).

Procedure:

1. Ensure that the MV Power Station is disconnected (see Section 8, page 118).

2. For the "Remote Control " option, set the Local/Remote switch on the medium-voltage switchgear to **Local**.
3. Check the functioning of the circuit breaker of the medium-voltage switchgear by performing 1 to 2 switching cycles. If the circuit breakers do not function correctly, contact us (see Section 18, page 284).

11.3.4.6 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 medium-voltage switchgear in the specified order. Check thereby the display of the switch position before and after each switching operation.
3. If the display of the switch position is not correct, the medium-voltage switchgear is defective. Please contact (see Section 18, page 284).

11.3.5 Maintenance Work at the Low-Voltage Connection between Inverter and MV Transformer

11.3.5.1 Checking the Protective Cover of the Low-Voltage Connection

1. Ensure that the MV transformer and the inverter are disconnected from all voltage sources (see Section 8, page 118).
2. Open the protective grid in front of the medium-voltage transformer.
3. Open the inspection lid. Use a wrench for this.
4. Check the low-voltage connection for dirt, damage and corrosion. If the protective cover is damaged or corroded, contact us.
5. Remove dirt (if necessary).
6. Reattach the inspection lid of the protective cover (torque: 8 Nm (71 in-lb)).
7. Close the protective grid in front of the medium-voltage transformer.

11.3.6 Completing Maintenance Work

Requirement:

☐ All maintenance work must be completed.

Procedure:

1. Ensure that the MV Power Station is disconnected (see Section 8, page 118).
2. Close all inverter lids (see Section 13.2, page 189).
3. Mount the MV switchgear covering plates in front of the cable panels and the transformer panel.
4. Insert the transformer protection plug into the inverter and lay down the bracket attached to the plug.

12 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.
- Do not lift at damaged load-bearing parts.
- 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.

i 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 SF6 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 SF6 gas used in MV switchgears can be extracted completely and then sent for recycling.

We can support you (see Section 18, page 284) in implementing the measures necessary for the disposal and recycling of the system.

13 Periodic Actions

13.1 Opening and Closing the Doors

Opening doors

To access the medium-voltage switchgear, the station subdistribution or the low-voltage transformer and to perform maintenance work, you must unlock and open the doors of the product.

To lock the doors, it is recommended to use padlocks (diameter of the shackle: < 8 mm (0.3 in)). Alternatively, suitable lock cylinders (EMKA 1109-U1-N) can be installed instead of the filler plugs.

Procedure:

1. Unlock the doors.
2. Pull the door levers slightly forward and turn them 45° counterclockwise.
3. At the door to the low-voltage transformer, use a square key to open the sash lock on the right side of the door.
4. To lock the doors in place, open the doors to 90°.

Closing doors

1. Lift the bracket to unlock the locking mechanism.
2. Close the doors.
3. At the door to the low-voltage transformer, use a square key to close the sash lock on the right side of the door.
4. Turn the door levers 45° clockwise and press them lightly.
5. Lock the doors.

13.2 Opening and Closing the Hatches

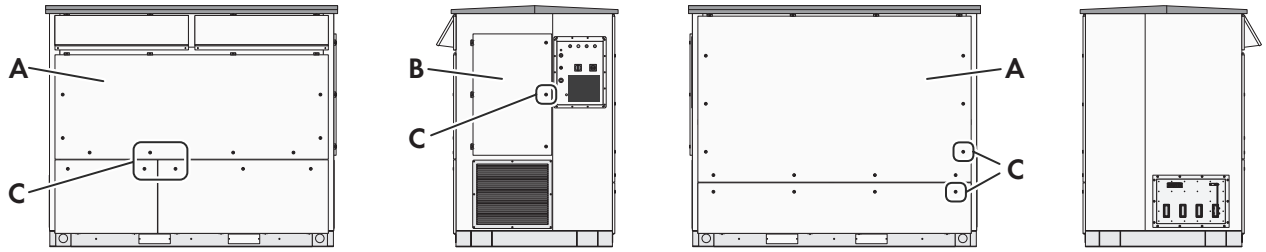


Figure 75: Overview of the hatches

Position	Designation
A	Hatch with gas springs
B	Door
C	Optional locking mechanism for padlock security

Additionally required material for the option "Enclosure lockable" (not included in the scope of delivery):

☐ 6 padlocks, horizontal shackle clearance: 13 mm (0.5 in)

⚠ 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING

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

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

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

⚠ WARNING

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

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

Open hatches

1. Remove the two outer locking screws (width across flats: 18 mm) from the hatch in front of the DC area of the inverter and keep them.
2. If locking mechanisms are secured with padlocks, remove the corresponding padlock if necessary.
3. Open the hatch locks and the doors with a square key wrench. Press gently on the hatch and remember that the hatches with gas springs open to an intermediate position of 60°.
4. Press the hatch upwards to the required position. Observe the maximum opening angle.

Close hatches

1. Press the hatch down.
2. Close the locking mechanism of the hatches and the door with a square key wrench. Lightly press against the hatch or door.
3. If necessary, attach the removed padlocks to the locking mechanisms.
4. At the hatch in front of the DC area of the inverter, insert the locking screws (width across flats: 18 mm) into the outer mounting holes and tighten them (torque: 8 Nm to 10 Nm (70.8 in-lb to 88.5 in-lb)).

13.3 Mounting and Disassembly Work

13.3.1 Mounting and Disassembly Work in the Inverter

13.3.1.1 Disassembling and Mounting the Panels

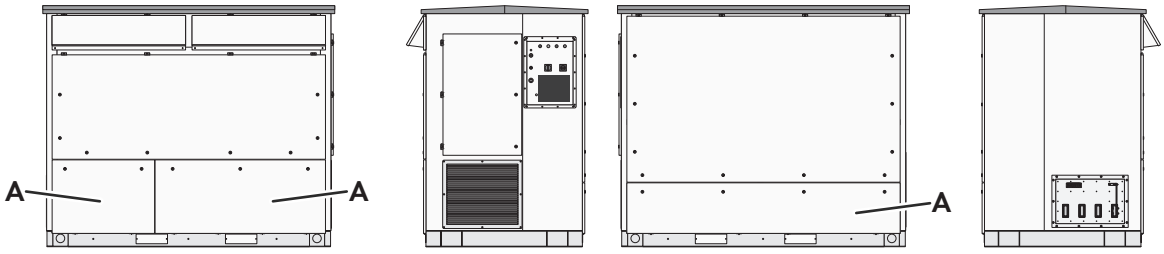


Figure 76: Overview of the panels

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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING

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

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

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

⚠ WARNING

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

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

NOTICE

Property damage due to rupture of grounding conductors

The components are connected to the product via grounding conductors. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Make sure not to damage the grounding conductors during disassembly.

Disassembling the panels

1. If panels are secured with padlocks, remove the corresponding padlock if necessary.
2. Open the locks with a square key wrench.
3. Detach the grounding straps from the panels.
4. 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 (70.8 in-lb to 88.5 in-lb)).
2. Ensure that the grounding straps are firmly in place.
3. Mount the panels.
4. Close the locks with a square key wrench.
5. If necessary, attach the removed padlocks to the panels.

13.3.1.2 Disassembling and Mounting Cover in Front of the Sine-Wave Filter Capacitors

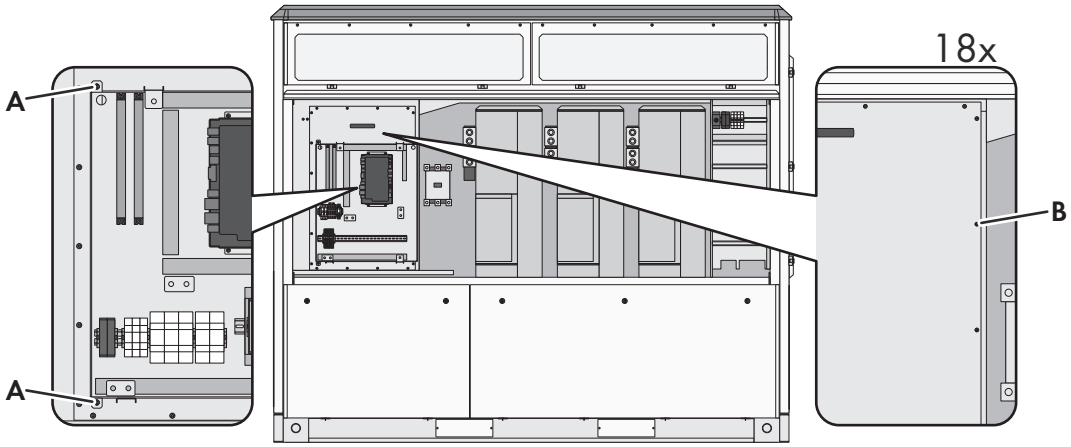


Figure 77: Position of the screw connections of the mounting plate and cover in front of the sine-wave filter capacitors

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 8.1, page 118).
- After switching off the converter, wait at least 15 minutes before opening the converter 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 product, there may still be lethal voltages present in cables. Touching live components can result in death or serious injury due to electric shock.

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

⚠ WARNING

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

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

Disassembling the Cover in Front of the Sine-Wave Filter Capacitors

1. Open the hatch (see Section 13.2, page 189).
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 (70.8 in-lb to 88.5 in-lb)).
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 (42.5 in-lb to 63.7 in-lb)).
5. Close the hatch (see Section 13.2, page 189).

13.4 Clamp Connections

13.4.1 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING

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

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

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

⚠ WARNING

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

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

Procedure:

1. Ensure that no voltage is present.
2. Dismantle the cable outside the product. This prevents contamination in the product.
3. Strip the insulation of the insulated conductors. Insulation stripping length: 6 mm to 7 mm (0.236 in to 0.275 in).
4. Connect the cable in accordance with the circuit diagram. To do this, insert the screwdriver into the square opening of the terminal block. This unlocks the opening for the insulated conductors of the terminal block.
5. Pull the screwdriver out of the terminal block.
6. Ensure that the cable is securely in place.

13.4.2 Connecting Cables to the Female Connectors

⚠ 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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING

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

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

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

⚠ WARNING

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

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

Procedure:

1. Ensure that no voltage is present.
2. Dismantle the cable outside the product. This prevents contamination in the product.
3. Strip the insulation of the insulated conductors. Insulation stripping length: 6 mm to 7 mm (0.236 in to 0.275 in).
4. Connect the cable in accordance with the circuit diagram. To do this, insert the screwdriver into the square opening of the terminal block. This unlocks the opening for the insulated conductors of the terminal block.
5. Pull the screwdriver out of the terminal block.
6. Ensure that the cable is securely in place.

13.5 Cable Entry

13.5.1 Inserting the Cables through the Base Plates

13.5.1.1 Inserting Cables through the Base Plates of the Inverters

1. Cut the cables to the required length. Allow for some reserve.

2. For the order option with "Cable Entry Kit": Remove the plates of the Cable Entry Kit. Thread the cables with rubber bushings through the holes in the plate. When doing so, ensure that the rubber bushings cleanly enclose and seal the cables. This prevents animals from entering the product. Remount the Cable Entry Kit.
3. For the order option without "Cable Entry Kit": Remove the base plates of the cable entries. Drill holes in the base plates. Route the cables through the opening in the base of the MV Power Station into the DC connection area of the inverter. Thread the cables with cable glands or rubber bushings through the holes in the base plate. Ensure that the cable glands or rubber bushings cleanly enclose and seal the cables. This prevents animals from entering the product.
4. Route the data cables separately from the power cables.

13.5.1.2 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.

⚠ WARNING

Danger to life due to arc faults 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. In the event of arc faults in the MV switchgear, the pressure escapes to the rear into the MV transformer compartment. Incorrectly installed cable protection can prevent arc fault diversion. This can result in death or serious injury.

- Mount the base plate and rubber bushings such that gases cannot escape downwards.
- Do not place any objects in front of or behind the MV transformer compartment.

Procedure:

1. Cut the cables to the required length. Allow for some reserve.
2. Lead the cables into the MV switchgear.

13.5.2 Insert the cable into the inverter.

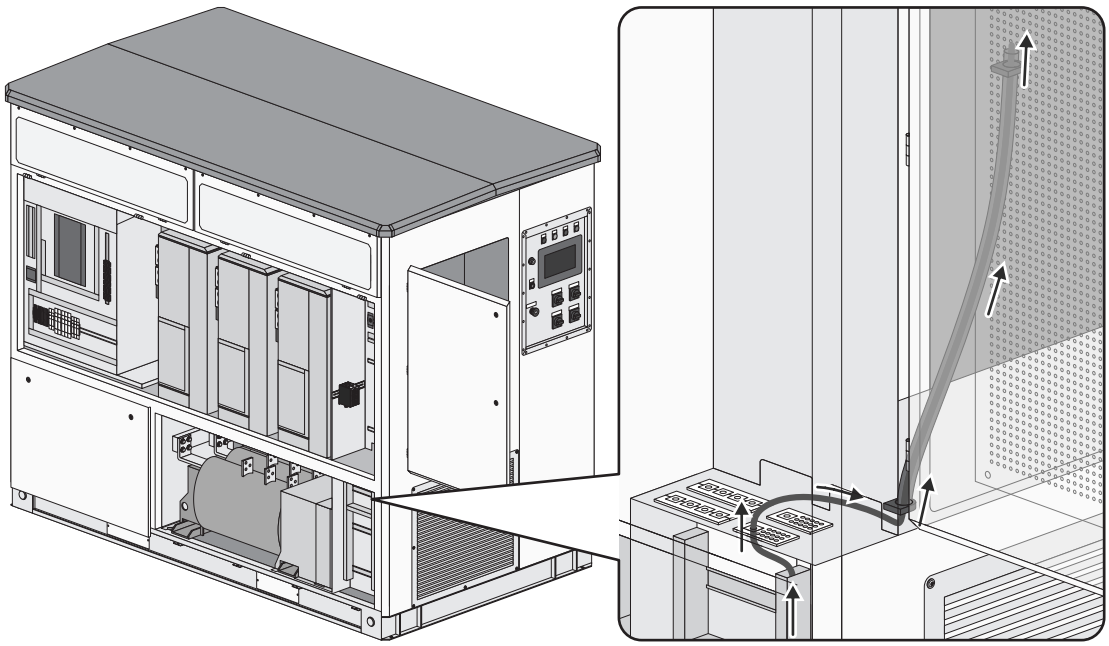


Figure 78: Cable route from the base to the customer installation location

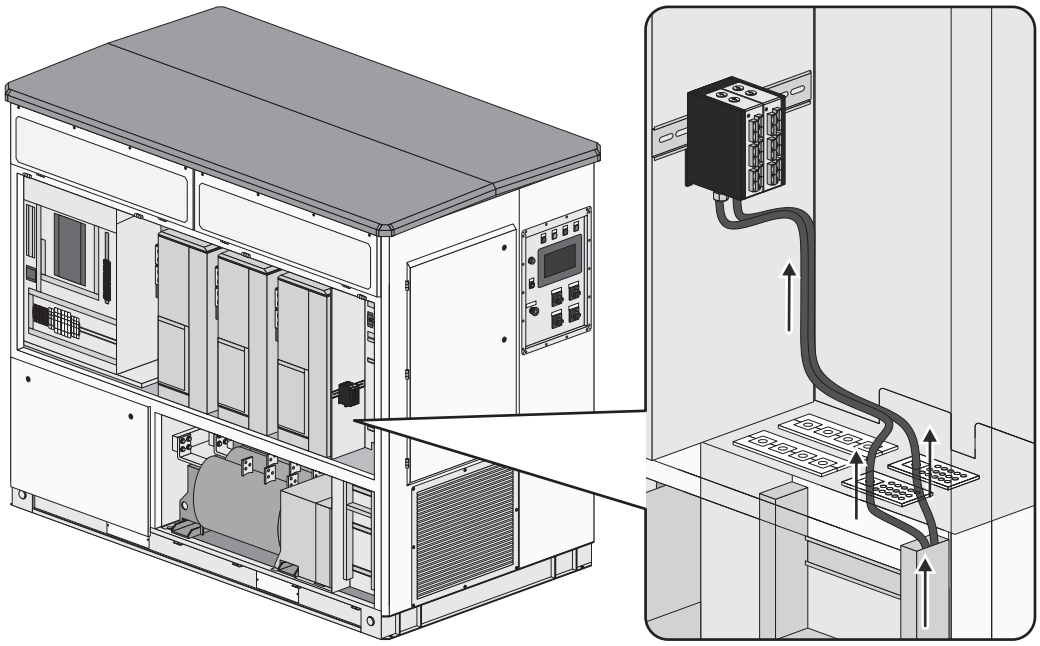


Figure 79: Cable route from the base to the splice box

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 converter, wait at least 15 minutes before opening the converter 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 on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC/NFPA 70, and NFPA 70E.
- Observe all safety information on the product and in the documentation.
- The product must not be operated with open covers or doors.
- Cover or isolate all live components.

⚠ WARNING

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

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

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

⚠ WARNING

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

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

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

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

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

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

⚠ CAUTION

Risk of injury when using unsuitable tools

Using unsuitable tools can result in injuries.

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

NOTICE

Property damage due to rupture of grounding conductors

The components are connected to the product via grounding conductors. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Make sure not to damage the grounding conductors during disassembly.

NOTICE

Damage to optical fibers due to too tight bend radii

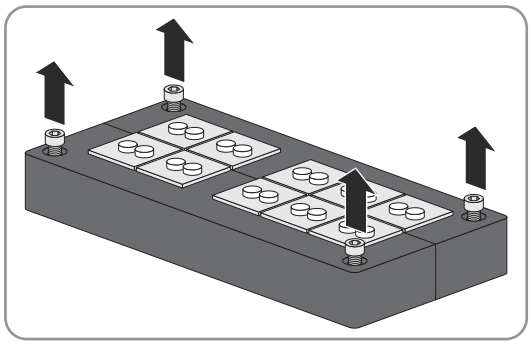
Excessive bending or kinking will drop below of the permissible bend radii. When dropping below the permissible bend radii, the optical fibers may be damaged.

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

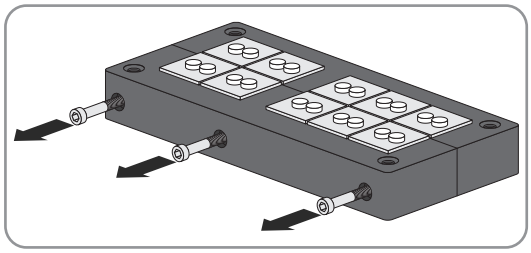
Procedure:

1. Ensure that all poles of the inverter are disconnected from all voltage sources (see Section 8.5, page 123).

2. Disassemble the panels (see Section 13.3.1.1, page 191).
3. Open the hatches (see Section 13.2, page 189).
4. Open the cable channels.
5. Remove the screws at the top of the sealing plate.



6. Remove the sealing plate.
7. Loosen the screws at the side of the sealing plate.



8. Remove the required number of rubber seals from the sealing plate. Make sure that the diameter of the rubber seals corresponds to the diameter of the cables to be inserted. Use the additional rubber seals included in the scope of delivery, if necessary.
9. Remove the sealing plugs from those rubber seals through which the cables are to be led.
10. Lead the cables through the rubber seals.
11. Insert the rubber seals in the sealing plate avoiding any distortion. This will ensure the tightness of the seal.
12. Cables should be sealed using suitable means such that the IP65 degree of protection is maintained even after installation.
13. Tighten the screws at the side of the sealing plate (3 Nm).
14. Screw the sealing plate to the floor of the interface cabinet (1 Nm).
15. Lay the cables in the cable channel.
16. Close the cable channel.
17. For cables to the customer installation location, route the cables through the opening to the door and through the conduit to the customer installation location.
18. For cables to the splice box:
    - Loosen the 2 outer screws at the front of the splice box. There is no need to remove the screws as they are being held by plastic washers.
    - Remove the gray insert.
    - Unscrew the filler plug and nut.
    - Mount the enclosed cable gland and the nut previously removed.
    - Lead the cables to the splice box.
    - Guide the cable gland over the cable.
    - Insert the cable through the cable gland into the splice box.
    - Tighten the cable gland.
27. Seal the enclosure opening used with proper material to comply with the degree of protection IP65.

28. Mount the panels (see Section 13.3.1.1, page 191).
29. Close the hatches (see Section 13.2, page 189).

13.6 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 **Login** page, not only the relevant login fields but also the instantaneous values for power, daily yield, previous-day yield and total yield are displayed.

To protect the system from unauthorized access, access to the user interface is blocked after ten unsuccessful login attempts. You will have to wait an hour before you can log in again.

Procedure:

1. Call up the user interface with the corresponding IP address. The IP address of the service interface is 192.168.100.1.
2. **Web browser signals a security vulnerability**
   After the IP address has been entered, a message might appear indicating that the connection to the user interface of the product is not secure. SMA Solar Technology AG guarantees the security of the user interface.
   - Continue loading the user interface.
3. Select your login role from the drop-down list in the field **Login**.
4. Enter the password in the field **Password**.
5. Select [**Login**].

13.7 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.

13.8 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.

13.9 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.

14 Function Description

14.1 Operating States of the Inverter

14.1.1 Overview of the Operating States

The inverter cycles through various states during operation. The current operating state can be displayed in the instantaneous value **OpStt**.

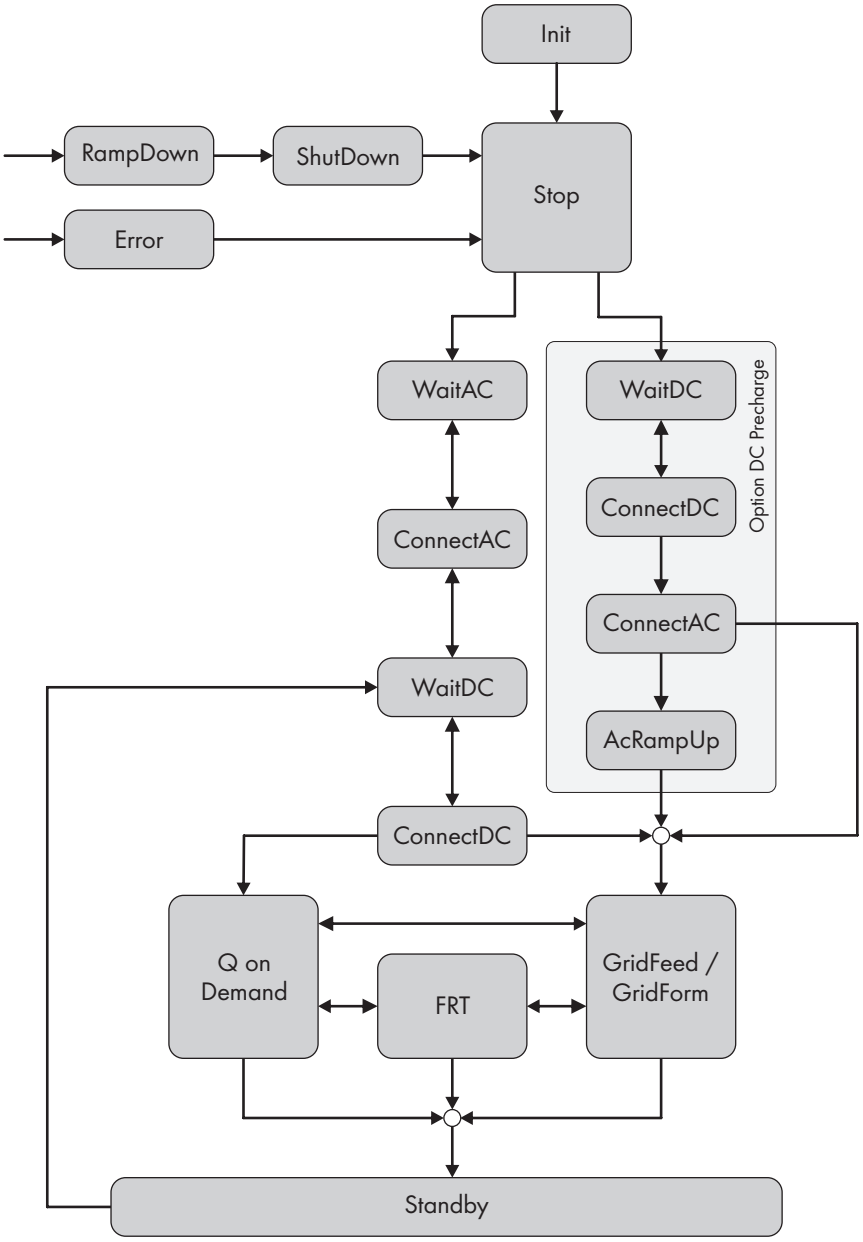


Figure 80: Principal overview of the operating states

The overview shows the names of the operating states as they appear on the user interface.

14.1.2 Stop

The inverter is switched off. The DC switchgear and the AC disconnection unit are switched off.

If the start-stop key switch **-S1** is set to **Start**, the inverter waits for an external start command. Depending on the configuration, the inverter can be started manually via the user interface or by an external signal. The inverter then switches to the "WaitAC" operating state.

Inverters that are equipped with the option "DC precharge", can either be started with AC voltage or with DC voltage. If the option **AC start** is selected in the parameter **Bsc.InvStrMod**, the inverter starts with AC voltage and switches to the operating state "WaitAC". If the option **DC start** is selected in the parameter **Bsc.InvStrMod**, the inverter starts with DC voltage and switches to the operating state "WaitDCStart".

14.1.3 Init

The inverter is prepared for operation and the functioning of all components is tested.

14.1.4 Starting the Inverter from the AC Grid

14.1.4.1 WaitAC

In the operating state "WaitAC", the inverter monitors the grid limits for the time defined in the parameter **GriErrTm**. The remaining time is displayed in the instantaneous value **WaitGriTm**. If no grid error occurs during the grid monitoring time, the inverter switches to the operating state "ConnectAC".

If the grid limits are exceeded during the grid monitoring time, the inverter remains in the operating state "WaitAC" and will restart grid monitoring.

14.1.4.2 ConnectAC

A valid AC grid is present in the operating state "ConnectAC" and the inverter connects to the utility grid. The inverter switches the AC disconnection unit on.

14.1.4.3 WaitDC

In the operating state "WaitDC", the inverter monitors the applied input voltage U_{DC} and compares it with the DC voltage necessary for operation. When the battery is ready for operation and the input voltage meets the requirements, the inverter switches to the operating state "ConnectDC".

If the battery is not yet ready for operation at this time and therefore does not provide a stable DC voltage, precharging may be aborted because the precharging contactor has closed. If the start-up process occurs using DC precharging, this will delay a possible restart of the inverter. The inverter interrupts the start-up process for 10 minutes to allow the precharge capacitors to cool down. The value **WaitDC: DC precharge period** is shown in the instantaneous value **PwrOffReas**.

Ensure that the system operates without communication between the inverter and the battery

If the inverter is used without its own communication to the battery, the system must coordinate the operation of the inverter and the battery. Initiate the start-up process of the inverter only when the battery is fully ready for use.

14.1.4.4 ConnectDC

When in the operating state "Connect DC", the inverter changes to the operating state "GridFeed" or into "Q on Demand" operation. For the operating state "GridFeed", the inverter connects the DC switchgear. If the battery is not ready for operation and the relevant setpoints for the reactive power control have been set, the inverter can provide reactive power in "Q on Demand" operation.

14.1.5 Starting the Inverter from the DC Grid

14.1.5.1 WaitDC

During the "WaitDC" operating state, the inverter checks the DC voltage of the battery with the "DC precharge" option. When the minimum battery voltage has been reached and the maximum battery voltage is not exceeded, the inverter switches to the "ConnectDC" operating state.

14.1.5.2 ConnectDC

During the "ConnectDC" operating state, the inverter checks the DC precharge waiting period with the "DC precharge" option. **WaitDc: DC precharge waiting period** is shown in the instantaneous value **PwrOffReas**. After the DC precharge waiting period has expired, the DC precharge contactor closes, the DC link is precharged by the battery, the inverter connects the DC switching device, and changes to the "ConnectAC" operating state.

14.1.5.3 ConnectAC from the DC grid

In the operating state "ConnectAC", the inverter checks whether an AC grid is present.

When at least 20% of the nominal AC voltage are connected, the inverter synchronizes to the AC grid, switches on the AC disconnection unit and changes to the "GridForm" operating state.

If the inverter started with a black start and thus there is no AC grid present, the inverter switches on the AC disconnection unit and changes to the "ACRampUp" operating state.

14.1.5.4 AcRampUp

During the operating state "ACRampUp", the inverter increases the AC voltage of the inverter to the specified setpoint. Switching to the operating state "GridFeed" occurs when the current voltage exceeds the parameter **VCtl.OpMinNom** and thus is within the operational operating limits.

14.1.6 GridFeed

In the operating state "GridFeed", the inverter feeds in active power and reactive power in accordance with the requirements or charges the battery.

If a grid-voltage dip occurs in the utility grid, the inverter switches from the operating state "GridFeed" to the operating state "FRT".

If the start/stop key switch **-S1** has been set to **Stop**, the inverter switches to the operating state "RampDown".

14.1.7 GridForm

In the operating state "GridForm", the inverter regulates the AC output voltage in accordance with the setpoint specifications. The parameters for this operating state are coordinated with the SMA application engineers for each specific project.

14.1.8 Q on Demand

In the operating state "Q on Demand", the inverter can provide reactive power if necessary or if the battery is not ready for operation. This function is independent of normal feed-in operation. In the operating state "Q on Demand", only limited dynamic grid support is available.

If the setpoint for controlling reactive power changes, the inverter does not return to the operating state "GridFeed".

14.1.9 Standby

To reduce switching losses, the inverter can be switched to the "Standby" state. The AC disconnection unit and the DC switchgear remain closed. The inverter remains in the "Standby" state until the setpoint for this state is reset.

The parameter **StbySfCapacMod** can be used to set whether the capacitor contactor is opened in the "Standby" operating state. This setting is system-specific.

Set value	Explanation
Standby without capacitor	The capacitor contactor is opened. The sinusoidal filter capacitor is then disconnected from the utility grid. No additional reactive power is drawn from the utility grid.
Standby with capacitor	The capacitor contactor is not opened. As a result, the inverter draws reactive power from the utility grid. Depending on the requirements of the grid operator, the purchase of reactive power can lead to additional costs or the compensation of the reactive power may be required. With this setting and when the feed-in conditions are met, the inverter can switch faster to the operating state "GridFeed". This also prolongs the electrical endurance of the capacitor contactor due to lower number of switch cycles. In addition, possible switching overvoltages are prevented.

The parameter **DcSw.OpnStbyEna** can be used to set whether the DC switchgear is opened in the "Standby" operating state. This setting is system-specific.

Set value	Explanation
Enable	The DC switchgear is opened during the "Standby" operating state. This disconnects the batteries from the inverter. The AC disconnection unit remains closed.
Disable	The DC switchgear remains closed during the "Standby" operating state. The batteries remain connected to the inverter.

To enable the inverter to return to the "GridFeed" operating state, the inverter switches to the "WaitDC" operating state and checks the conditions for closing the DC switchgear.

14.1.10 RampDown

If the start/stop key switch **-S1** has been set to **Stop**, the inverter reduces its power to below 100 kVA, disconnects from the utility grid and opens the AC disconnection unit and the DC switchgear. Then the inverter switches to the operating state "ShutDown".

14.1.11 ShutDown

Once the inverter has disconnected from the utility grid in the operating state "RampDown", all capacitors are discharged. Then the inverter switches to the operating state "Stop".

14.1.12 Error

If an error has occurred in the inverter or the medium-voltage transformer or the fast stop key switch **-S2** was pressed, the AC disconnection unit and the DC switchgear are opened immediately, the inverter disconnects from the utility grid and switches to a safe state. In this state, the capacitors remain charged.

When the inverter switches to the operating state "Error" following an error, the error must be acknowledged. Then the inverter switches to the operating state "Stop". Depending on the type of error, the error must be rectified and acknowledged manually or the error will automatically be acknowledged after an error-dependent time period.

When the inverter switches to the operating state "Error" after the fast stop key switch **-S2** was pressed, the fast stop key switch **-S2** must be switched on again manually. Then the inverter switches to the operating state "Stop".

14.1.13 Selftest

To guarantee the safety of the inverter, the inverter must cycle through a diagnostic test periodically. For this, the inverter must cycle through the operating state **Stop** within a year. In this test, the AC and DC side safety devices are checked to ensure that they function correctly.

The instantaneous value **DiagRmgTm** shows how many days remain until the next self-test to be performed. The instantaneous value is counted to **0** and reset automatically as soon as the self-test has been completed or the inverter has entered the **Stop** operating state.

The diagnostic test is performed at a reduced feed-in power and takes approximately 15 seconds.

14.1.14 FRT

If a disturbance occurs in the utility grid whilst in the "GridFeed" operating state, the inverter switches to the "FRT" operating state and supports the utility grid via dynamic grid support in accordance with the grid operator requirements. There are three types of grid support:

Mode	Explanation
Complete dynamic grid support	The inverter feeds in reactive current during the grid failure.

Mode	Explanation
Limited dynamic grid support	The inverter interrupts feed-in operation during the grid failure.
Continuation of the requested feed-in operation	The inverter continues feeding into the utility grid with the currently specified set-points.

If a disturbance occurs in the utility grid while in "Q on Demand" operation, the inverter switches to the operating state "FRT" and discontinues feeding in. Once the grid error is no longer present, reactive power is supplied immediately.

14.2 Safety Functions of the Inverter

14.2.1 Manual Shutdown Functions

14.2.1.1 Overview of Manual Shutdown Functions

The inverter can be shut down via various functions. As soon as one of the functions is activated, the inverter remains in the given mode. Only when all functions have been switched to operation can the inverter switch over to feed-in operation.

Function	Inverter behavior	Inverter bridge	AC disconnection unit	DC load-break switch
Key switch	After actuating the key switch, the inverter switches to the operating state "Stop". In this case, the inverter disconnects from the utility grid, opens the AC disconnection unit and the DC switchgear, and discharges the capacitors.			
Fast-stop key switch	After actuating the key switch of the fast stop, the inverter switches to the operating state "Stop". In this case, the inverter disconnects from the utility grid and opens the AC disconnection unit and the DC switchgear.			
Parameters	The inverter can be switched to the operating state "Standby" via the parameter **RemRdy**. In this case, the inverter bridges are opened and feed-in is interrupted. The AC disconnection unit and the DC switchgear remain closed.			
	The inverter can be switched to the "Stop" operating state via the parameter **InvOpMod**. When this happens, the AC disconnection unit and the DC switchgear open. Depending on the configuration of the parameter **Bsc.SrcSel**, the inverter can be deactivated manually via the user interface or externally. For this purpose, the parameter **Bsc.SCSOpCmdMan** or **AuxCtl.SCSOpCmd** must be set to **Stop**. Only the inverter switches off here. The AC disconnection unit and the DC switchgear remain open.			

Function	Inverter behavior	Inverter bridge	AC disconnection unit	DC load-break switch
External standby	The inverter can be switched to the operating state "Standby" via an external signal. In this case, the inverter bridges are opened and feed-in is interrupted. The AC disconnection unit and the DC switchgear remain closed.			
External stop	The inverter can be switched to the "Stop" operating state via a digital signal. When this happens, the AC disconnection unit and the DC switchgear open.			
External fast stop	The fast-stop function can be tripped on the inverter via a digital signal. The inverter switches immediately to the operating state "Stop". In this case, the inverter disconnects from the utility grid and opens the AC disconnection unit and the DC switchgear.			
	If the digital signal is applied again the inverter runs through the waiting period defined in the country data set, closes the AC disconnection unit, loads the DC link and then closes the DC switchgear. As a result, the inverter is reconnected with the utility grid and can feed-in.			

14.2.1.2 Mode of Operation of the External Fast Stop

The inverter is equipped by default with a fast stop input at terminal **-X440:1,3**.

The following options are available for configuring the external fast stop:

- **External fast stop is deactivated**

  The terminals of the active fast stop are bridged. The fast stop function is thus deactivated. The terminals were bridged during production.

- **External fast stop is operated with internal or external 24 V supply**

  An external switch (break contact) is connected to the inverter terminals via the internal supply voltage or the external 24 V supply of the inverter. When the switch is closed, the relay is activated and the inverter feeds into the grid. If the fast stop is tripped, the switch opens and the relay is deactivated. The inverter is stopped and no longer feeds into the utility grid.

If the external fast stop is tripped, the AC disconnection and the DC switchgear are opened. The external fast stop does not result in rapid discharge of the capacitors.

Tripping the fast stop

The fast stop must only be released if there is immediate danger. Tripping of the fast stop does not entail fast discharge of the capacitors. If the inverter is to be switched off and properly shut down via an external signal, the remote shutdown input is to be used.

No warranty claims can be submitted for damages to the inverter or yield losses caused by activating the fast stop for no reason.

14.2.1.3 Mode of Operation of the External Standby

The inverter is equipped by default with an external standby input at terminal **-X440:5,7**.

This function lets you switch the inverter to the "Standby" operating state from a control room, for example. The AC disconnection unit and the DC switchgear of the inverter remain closed. This makes a switch to the operating state "GridFeed" possible in less than one second if the standby signal has been reset.

If 0 V is present at the external standby, the inverter continues to operate in the current operating state. If the external standby has been triggered, 24 V are applied to terminal **-X440:5,7** and the inverter switches from the current operating state to the operating state "Standby".

14.2.2 Automatic Shutdown Functions

14.2.2.1 Monitoring the Power Frequency

The inverter continuously checks the power frequency. This enables the inverter to disconnect from the utility grid in case of overfrequency or underfrequency.

If the power frequency rises above or falls below the configured thresholds, the inverter waits for the time defined in the corresponding parameter and disconnects from the utility grid.

You can set the thresholds and the delay time in the parameters. For frequency monitoring, 6 limits for overfrequency and six limits for underfrequency can be configured.

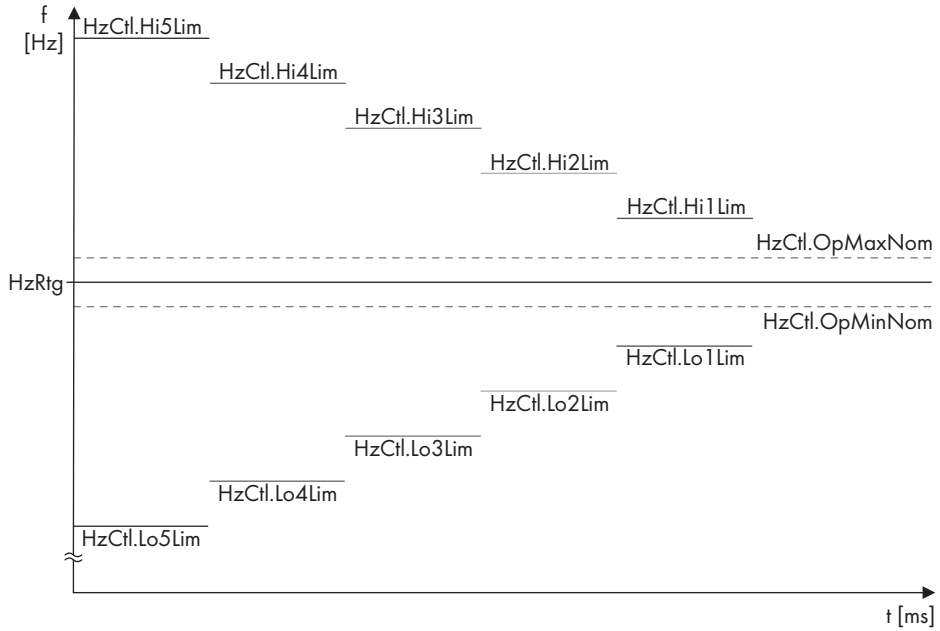


Figure 81: Monitoring of the power frequency

Parameters	Explanation	Default value
HzCtl.OpMaxNom	Frequency threshold for the upper connection limit of frequency monitoring	60.50 Hz
HzCtl.OpMinNom	Frequency threshold for the lower connection limit of frequency monitoring	59.30 Hz
HzCtl.Hi1Lim	First threshold for overfrequency	65.00 Hz
HzCtl.Hi1LimTm	Time lapse for the first threshold for overfrequency	160 ms
HzCtl.Hi#Lim	Threshold of the second to fifth level for overfrequency	65.00 Hz[46)]
HzCtl.Hi#LimTm	Time lapse for the second to fifth threshold for overfrequency	10000 ms[46)]
HzCtl.Lo1Lim	First threshold for underfrequency	57.00 Hz

[46)] In this parameterization, the thresholds are deactivated.

Parameters	Explanation	Default value
HzCtl.Lo1LimTm	Time lapse for the first threshold for underfrequency	160 ms
HzCtl.Lo2Lim	Threshold of the second level for underfrequency	57.00 Hz
HzCtl.Lo2LimTm	Tripping time for the second threshold for underfrequency	160 ms
HzCtl.Lo#LimTm	Threshold of the third to fifth level for underfrequency	55.00 Hz[46)]
HzCtl.Lo#LimTm	Time lapse for the third to fifth threshold for underfrequency	10000 ms[46)]

Monitoring of the grid frequency for overfrequency and underfrequency in accordance with UL1741 /IEEE 1547

Termination of the operating license if setting values are changed

The limiting values for the grid frequency are configured in accordance with UL1741 SA / IEEE 1547. If inverter grid monitoring is to be performed in accordance with UL1741 SA / IEEE 1547, the parameters relevant for the standard must be left unchanged.

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.

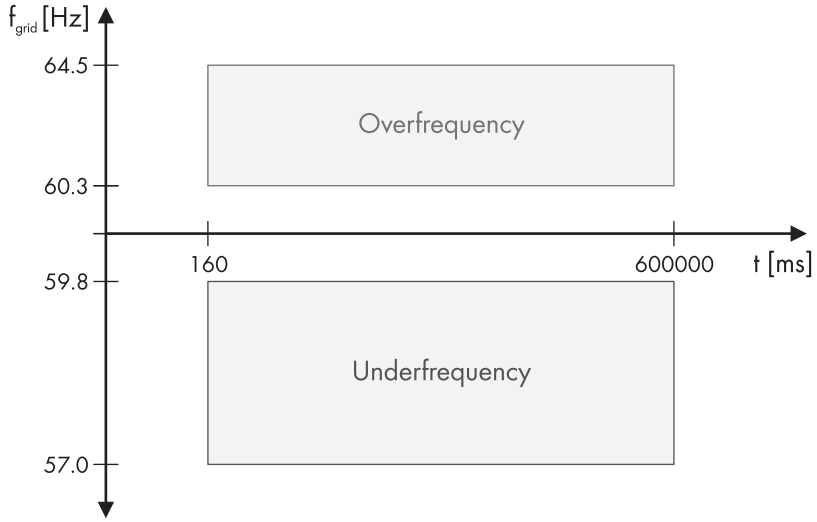


Figure 82: Range of power frequency monitoring in accordance with IEEE 1547

Implementation of power frequency monitoring in accordance with IEEE 1547 is two-tiered: there are 2 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.

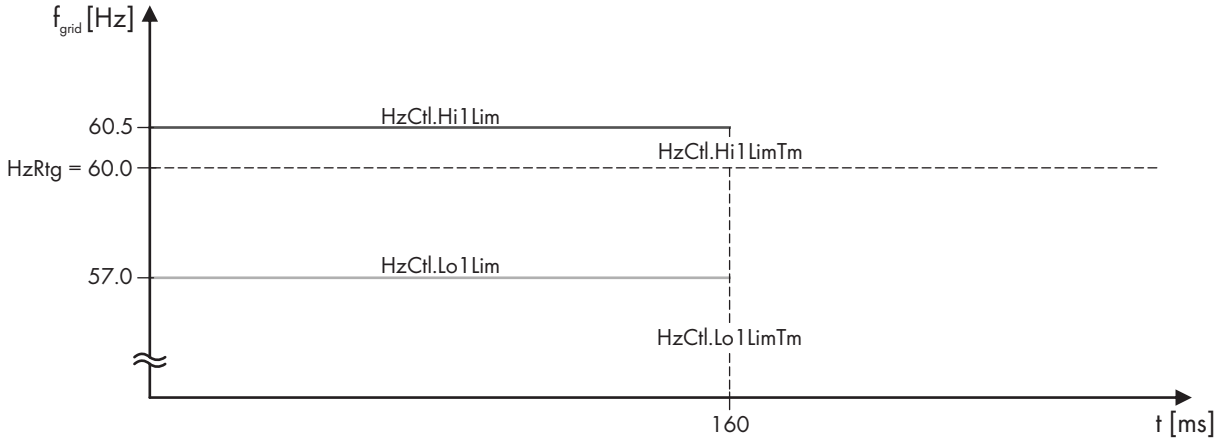


Figure 83: Parameters for monitoring the power frequency in accordance with IEEE 1547

Parameters	Explanation	Default value
HzCtl.Hi1Lim	First threshold for overfrequency	60.5 Hz
HzCtl.Hi1LimTm	Time lapse for the first threshold for overfrequency	160 ms
HzCtl.Lo1Lim	First threshold for underfrequency	57.0 Hz
HzCtl.Lo1LimTm	Time lapse for the first threshold for underfrequency	160 ms

14.2.2.2 Monitoring the Grid Voltage

The inverter continuously checks the grid voltage. This enables the inverter to disconnect from the utility grid in case or 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 5 limits for overvoltage and five limits for undervoltage.

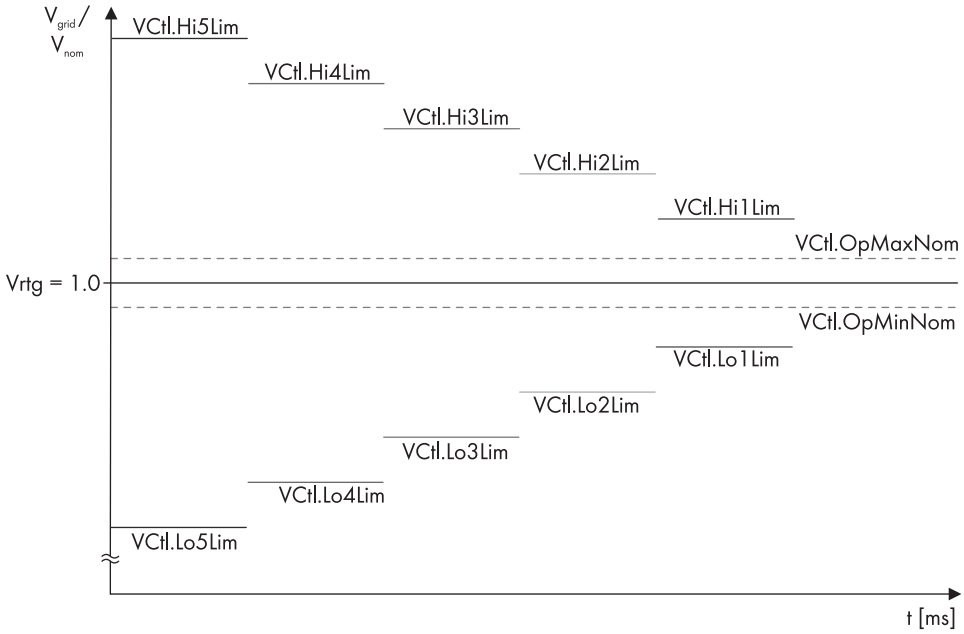


Figure 84: Monitoring of the grid voltage

Parameters	Explanation	Default value of the country data set "Hz 60"
VCtl.OpMaxNom	Voltage threshold for the upper connection limit of voltage monitoring	1.10
VCtl.OpMinNom	Voltage threshold for the lower connection limit of voltage monitoring	0.88
VCtl.Hi1Lim	First threshold for overvoltage	1.10
VCtl.Hi1LimTm	Time lapse for the first threshold for overvoltage	1000 ms
VCtl.Hi2Lim	Threshold of the second level for overvoltage	1.2
VCtl.Hi2LimTm	Time lapse for the second threshold for overvoltage	160 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	0.88
VCtl.Lo1LimTm	Time lapse for the first threshold for undervoltage	2000 ms
VCtl.Lo2Lim	Threshold of the second level for undervoltage	0.50
VCtl.Lo2LimTm	Time lapse for the second threshold for undervoltage	160 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 UL1741 / IEEE 1547

Termination of the operating license if setting values are changed

The limiting values for the grid frequency are configured in accordance with UL1741 SA / IEEE 1547. If inverter grid monitoring is to be performed in accordance with UL1741 SA / IEEE 1547, the parameters relevant for the standard must be left unchanged.

In accordance with IEEE 1547, the grid voltage is monitored for over and undervoltage.

If the grid voltage exceeds or falls short of a defined voltage threshold, the inverter must disconnect from the utility grid within a defined time interval. In this case, the voltage thresholds as defined by relevant standards and the disconnection times form a window in which the individual parameters of the inverter must be located.

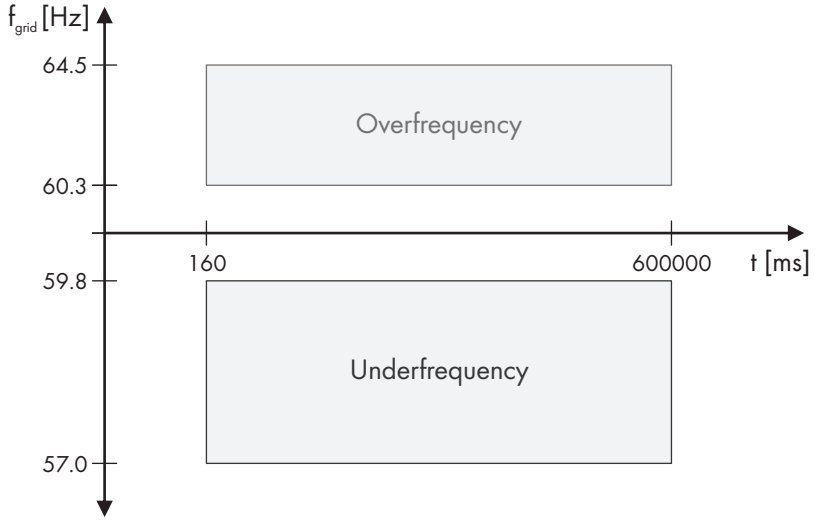


Figure 85: Range of grid voltage monitoring in accordance with IEEE 1547

Implementation of voltage monitoring is two-tiered: there are 2 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.

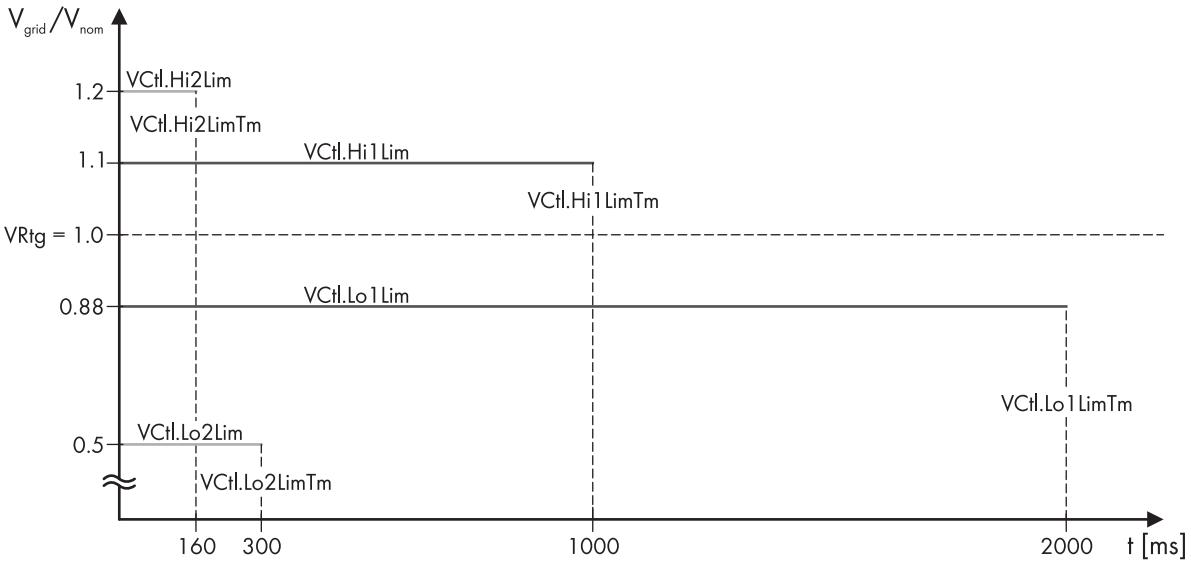


Figure 86: Parameters for monitoring the grid voltage in accordance with IEEE 1547

Parameters	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	160 ms

14.2.2.3 Transformer Protection

Protective functions of the MV transformer are connected to the inverter via a plug.

The inverter provides a 24 V_{DC} signal. This signal can be used to supply the analog sensor and the change-over contact. The transformer protection is only active if the supply voltage is applied to the inverter.

Transformer protection is implemented by individual signal generators. If the signal generators are properly connected to the inverter, the inverter is switched off in the event of an MV transformer error.

The inverter switches immediately to the operating state "RampDown" in the event of a wire break.

The following functions can be monitored separately:

Oil temperature monitoring

The inverter can monitor the oil temperature of the MV transformer via an analog sensor on the MV transformer. Two temperature levels are monitored: a warning temperature and a switch-off temperature.

The inverter also offers the option of supplying the oil temperature of the MV transformer to the communication interface. The temperature signals can be called up via Modbus protocol at the communication interface.

Monitoring of boiler pressure

- **With change-over contact**

  If the pressure in the MV transformer boiler 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 pressure thresholds depend on the MV transformer used and must be set for each individual project.

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. Depending on the type of the MV transformer and the protective device, gas formation in the MV transformer can also 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".

14.2.2.4 Active Islanding Detection

The islanding detection function detects the formation of stand-alone grids and disconnects the inverter from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power.

With active islanding detection, the inverter continuously checks the stability of the utility grid. If the utility grid is intact, this has no impact on the utility grid. Only if a stand-alone grid has formed will the inverter disconnect from the utility grid.

To enable the active islanding detection function, contact us (see Section 18, page 284).

14.2.2.5 Passive Islanding Detection

Depending on the order option, the inverter may be equipped with passive islanding detection. The islanding detection function detects the formation of stand-alone grids and disconnects the inverter from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power.

Unlike active islanding detection, with passive islanding detection the utility grid is not actively influenced, but simply passively monitored. This involves monitoring the speed of the frequency change.

If the power frequency changes by a certain amount in a certain time, a stand-alone grid is detected and the inverter disconnects from the utility grid. The magnitude of the frequency change and the time lapse in which this change must take place can be configured via parameters on the inverter.

The "passive islanding detection" function is not UL-certified.

14.2.2.6 External Islanding Detection

If the overall system is equipped with an external anti-islanding detection system with transfer trip, the formation of stand-alone grids can be detected at the plant level. If a stand-alone grid has formed, a signal is transmitted to the fast stop input of the inverter. A suitable cable must be connected at the fast stop input at terminal **-X440:1,3** of the inverter during installation.

During normal operation conditions, a 24 V signal is transmitted to the fast stop input of the inverter. If a stand-alone grid has formed, the signal switches to 0 V and the inverter switches to "Error" and is disconnected from the utility grid.

In order to switch back the inverter to the operating state "GridFeed", ensure that the external anti-islanding detection system generates the 24 V signal.

14.2.2.7 Low-Temperature Shutdown

The intake temperature is monitored in the inverter so that it can be shut down if the operating temperature range is infringed. Furthermore, there are thermostats in the low-voltage cabinet and the medium-voltage cabinet that activate the heaters or trigger a safety shutdown of the medium-voltage switchgear if the temperatures are low.

Commissioning and recommissioning must not be done at temperatures below -25°C (-13°F). Doing this despite a low temperature does not guarantee safe operation of the MV Power Station. Furthermore, the tap changer of the medium-voltage transformer must not be operated at oil and ambient temperatures under -10°C (14°F).

Temperature range -25°C (-13°F) to +45°C / +55°C

If the intake temperature falls below -25°C (-13°F), the inverter switches to the operating state "Stop" in order to protect the electronic components. As soon as the intake temperature increases to -20°C (-4°F), the inverter resumes feed-in operation.

Temperature range -40°C (-40°F) to +45°C

i Switch the heaters on only when an AC utility grid is available

The heaters can only switch on when the AC utility grid is available. In the event of a grid failure at low intake temperatures, the inverter is in danger of cooling down. If the AC utility grid is not available again within a short time and the interior temperature drops below -25°C (-13°F), the inverter switches to the operating state "Error". Furthermore, this can cause a safety shutdown of the medium-voltage switchgear.

For the order option "Ambient Temperature: -40°C to +45°C", the MV Power Station is equipped with 1 heater each in the medium and low-voltage cabinet, 1 thermostat in the medium-voltage cabinet, and 1 hygrostat in the low-voltage cabinet. In the medium-voltage cabinet there is 1 thermostat for safe shutdown. If the ambient temperature drops below -33°C (-27.4°F) for a long, the medium-voltage switchgear switches off. Do not open the doors at ambient temperatures below -25°C (-13°F). If temperatures remain below -33°C (-27.4°F) for a long time, or if the doors are opened, this can cause a safety shutdown of the medium-voltage switchgear.

The internal temperature in the inverter and the humidity in the medium-voltage cabinet are monitored in addition to the intake temperature.

Temperature range -35°C (-31°F) to +55°C

For the order option "Ambient Temperature: -35°C to +55°C", the MV Power Station is equipped with 1 thermostat and 1 heater in the right area of the station subdistribution. For the order option with a low-voltage transformer, there is also 1 thermostat and 3 heaters in the upper left and right areas of the station subdistribution. In the medium-voltage compartment there is 1 thermostat for safe shutdown. If the ambient temperature drops below -33°C for a long time, the medium-voltage switchgear switches off.

The heaters in the station subdistribution provide a temperature over -25°C (-13°F). The components in the low-voltage cabinet are designed for temperatures of -35°C (-31°F). Do not open the doors at ambient temperatures below -25°C (-13°F). If temperatures remain below -33°C (-27.4°F) for a long time, or if the doors are opened, this can cause a safety shutdown of the medium-voltage switchgear.

Inverter behavior

At an intake temperature up to -40°C (-40°F), the inverter continues to operate in the current operating state as long as the internal temperature of the inverter is above -25°C (-13°F). To keep the interior temperature above -25°C (-13°F), auxiliary heaters are activated in the inverter, the medium-voltage cabinet and the low-voltage cabinet. In addition, the operational waste heat generated by the components is used to heat the interior. If the humidity in the medium-voltage cabinet exceeds 90%, the heaters in the medium-voltage and low-voltage cabinets are activated.

If the inverter is switched to the operating state "Stop", it can no longer generate operational waste heat. The heaters stay switched on. However, due to the lack of operational waste heat from the components, the inverter is in danger of cooling down and triggering a undertemperature fault. If the inverter is set to the operating state "Stop" or "Standby" at low intake temperatures, it can be set back to feed-in operation within a limited time. This is possible as long as the interior temperature is above -25°C (-13°F). We therefore recommend that the inverter be set to the operating state "Stop" or "Standby" at intake temperatures below -25°C (-13°F) only in exceptional situations.

If the interior temperature of the inverter falls below -25°C (-13°F), the inverter switches to the operating state "Error" in order to protect the electronic components. The MV Power Station remains connected to the utility grid and the heaters in the low and medium-voltage cabinets are still supplied with power. If the internal temperature increases to at least –22°C, the inverter automatically switches to the previously selected operating state.

If the intake temperature falls below -40°C (-40°F), the inverter switches to the operating state "Error" independently of the interior temperature in order to protect the electronic components. If the intake temperature increases to at least -35°C (-31°F) and the interior temperature to at least -22°C (-7°F), the inverter automatically switches to the previously selected operating state.

If the interior temperature in the medium-voltage cabinet sinks below -33°C (-27.4°F), the medium-voltage switchgear transformer field and the circuit breaker in the inverter are safely shut off.

The self-consumption of the inverter is an additional 10 kW due to the additional heaters in the inverter and in the sub-distribution of the station.

14.2.2.8 Disconnecting at High Temperatures at the AC Connection

The connection busbars between the inverter and MV transformer must not exceed the maximum temperature. The maximum temperature is: 120°C (248°F). 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°C (257°F), 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.

14.2.2.9 Reducing the Feed-In Power when there are High Temperatures in the Inverter

The temperature inside the inverter is continuously monitored.

The inverter reduces the feed-in power when a fan in the inverter fails and the temperature in the inverter increases. Disturbance **7501**, **7502** or **7503** is displayed. The **DrtCabTmp** instantaneous value displays whether the inverter is reducing the feed-in power due to excessive temperature inside the inverter.

If the temperature in the inverter exceeds the maximum interior temperature, the inverter switches off and the fault **6515** is displayed.

14.2.2.10 Reduction of the Output Power Depending on Altitude of Installation and Ambient Temperature

The inverter monitors the ambient temperature in order to reduce the feed-in power as protection for the electronic assemblies of the inverter where necessary. Here, the temperature at which the reduction of the feed-in power started is dependent on the altitude of installation of the inverter.

The load profile of the medium-voltage transformer shifts by -2.5°C per 1000 m:

Installation altitude	Reduction of the feed-in power depending on ambient temperature			
1000 m	100% at -25 C	100% at +35 C	90% at +40°C / +50 C[47)]	0% at +45°C / +55°C[47)]
2000 m	100% at -25 C	100% at +32.5 C	90% at +37.5°C / +47.5°C[47)]	0% at +42.5°C / +52.5°C[47)]

[47)] Depending on the order option "Ambient Temperature"

14.2.3 Ground-Fault Monitoring and Insulation Monitoring

14.2.3.1 Mode of Operation

In a grounded power system

The ground-fault monitoring is implemented by means of a residual-current monitoring device. If a ground fault occurs, the residual currents are detected and interrupted.

- **Ground fault on the ungrounded terminal**

  If a ground fault occurs on the ungrounded pole of the battery, the normally ungrounded pole is grounded non-specifically by the ground fault and a residual current flows to the grounded pole. This residual current flows through the ground-fault monitoring device, e.g. the Remote GFDI, and triggers it.

- **Ground fault on the grounded terminal**

  The ground-fault monitoring device is bypassed when a ground fault occurs on the grounded pole. A ground fault on the grounded terminal cannot be reliably detected. If an undetected ground fault occurs on the grounded terminal, this will pose a safety risk. A further ground fault occurring on the ungrounded terminal will lead to high residual currents that cannot be interrupted by the ground-fault monitoring unit.

i Residual current monitoring in grounded systems

In order to ensure the residual current monitoring function in grounded systems, the insulation must be checked at regular intervals. The NEC 2014 (Section 690.5 (A)) and the TS 62548 © IEC:2013(E) regulations require the periodic measuring of the insulation resistance for the reliable detection of ground faults even in grounded systems. An additional insulation monitoring device is necessary for this.

- The operator of the power system must find out whether these standards apply to the power system and whether an additional insulation monitoring device is necessary.

In the non-grounded battery storage system

An insulation monitoring device constantly determines the insulation resistance using an active measurement procedure. As soon as the insulation resistance falls below the warning threshold specified in the insulation monitoring device, an insulation warning will be displayed. As a result, preventative measures can be taken before errors such as personal injury due to leakage currents or system failure occur. If the insulation resistance falls below the configured warning threshold, the inverter switches off.

14.2.3.2 Insulation Monitoring Device

In non-grounded battery storage systems, the insulation monitoring device monitors the battery storage system's insulation resistance.

In the operating state "GridFeed", the insulation resistance of the entire system, from the battery to the MV transformer, is measured.

If the inverter is in the operating states "Stop" or "WaitDC", only the insulation resistance from the battery to the inverter is measured.

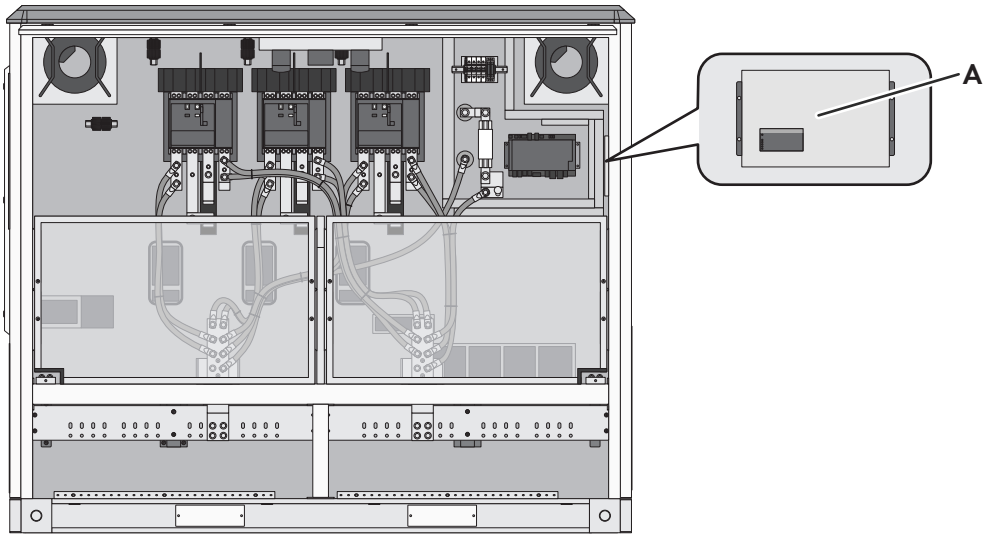


Figure 87: Position of the insulation monitoring device

Position	Designation
A	Insulation monitoring device

The insulation monitoring device is connected between the DC voltage and the grounding conductor.

If the insulation resistance falls below the threshold specified in the parameter **PvGnd.RisIsoWarnLim**, a warning is generated. The measuring circuit closes and the LED **ALARM1** on the insulation monitoring device glows. The inverter displays the disturbance message **3601** and continues feeding in. The orange light repeater at the inverter's control panel flashes.

If the insulation resistance falls below the threshold specified in the parameter **PvGnd.RisIsoErrLim**, an insulation error is generated. The measuring circuit closes and the LEDs **ALARM1** and **ALARM2** on the insulation monitoring device glow. The inverter displays the disturbance message **3501** and switches to the operating state "Error". The red light repeater at the inverter's control panel is lit.

Type of insulation monitoring device used

The insulation monitoring device used is the ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

14.2.3.3 Remote GFDI and Insulation Monitoring Device

With the order option "Remote GFDI and Insulation Monitoring," it is possible to check the insulation via the integrated insulation monitoring device. Here, in the morning upon start-up of the inverter, or after the control voltage of the inverter has been switched off, the Remote GFDI will be opened and an insulation measurement will be performed.

When the Remote GFDI is closed, the battery is grounded. In this state, the insulation resistance cannot be determined.

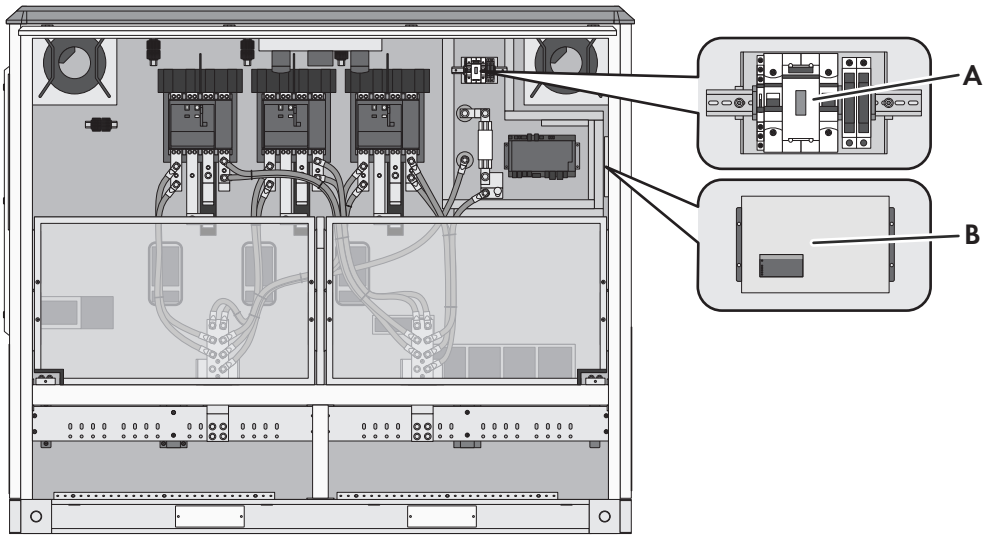


Figure 88: Position of Remote GFDI and insulation monitoring device

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.

Type of insulation monitoring device used

The insulation monitoring device used is the ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

14.3 Safety Functions of the MV Power Station

14.3.1 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 individual devices for temperature, pressure and oil level. The fast-stop function can also be tripped by an external signal. For this, a potential-free make contact can be connected at terminal **-X801:1/2** in the station subdistribution. This enables a customer's own devices to be integrated into safety chain. In addition, the terminal **-X800:1/2** is available in the station subdistribution as a feedback contact for the fast-stop switch of the MV Power Station and fast-stop key switch -S2 of the inverter.

By triggering the safety chain, the fast stop signal is sent to the inverter and the MV switchgear is switched off.

14.3.2 Monitoring the ambient temperatures

With the order option "Ambient Temperature: -40°C to +45°C", the MV Power Station is equipped with 2 heaters in the medium and low-voltage cabinet, 1 thermostats in the medium-voltage cabinet, and 1 hygrostat in the low-voltage cabinet. The heaters are activated at a temperature lower than -15°C (+5°F) or at a humidity above 90%. If the interior temperature in the medium-voltage cabinet sinks below -33°C (-27.4°F), e.g., when opening the doors, the transformer field of the medium-voltage switchgear and the circuit breaker in the inverter are safely shut off.

For the order option "Ambient Temperature: -35°C to +55°C", the MV Power Station is also equipped with 1 thermostat and 1 heater on the right in the lower area of the station subdistribution. For the order option with a low-voltage transformer, there is also 1 thermostat and 3 heaters in the upper left and right areas of the station subdistribution. In the medium-voltage compartment there is 1 thermostat for safe shutdown. If the ambient temperature drops below -33°C (-27.4°F) for a long, the medium-voltage switchgear and inverter switch off.

14.4 Power Control

14.4.1 Power Control in the Battery Storage System

The battery storage system supports the stability of the utility grid by controlling the power fed in. The inverter can process various setpoints for the control:

- Parameters that are entered via the user interface
- Setpoints that are delivered via Modbus protocol
- Output values calculated in the inverter for controlling the inverter
- Adjusted substitute values for further operation in the event of a communication error

Using these values, the inverter can calculate setpoints for the active power and the reactive power to be fed in and the inverter can then feed in the appropriate power. These values are constantly being compared with the nominal values set in the inverter for active power, reactive power and apparent power and limited to them.

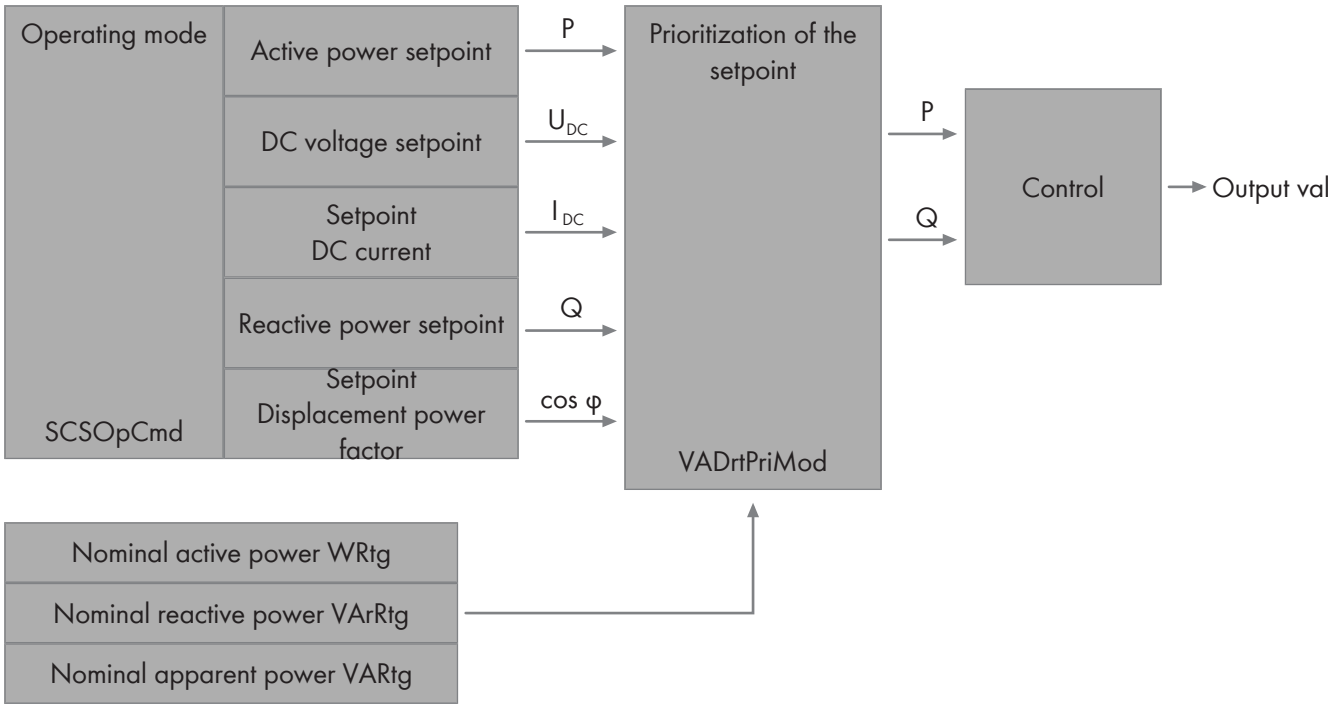


Figure 89: Principle of Power Control

In order to meet the requirements of the electric utility company, it can be adjusted in the parameter **VArDrtPrioMod** whether the reduction of the active power or the control of the reactive power should have priority.

14.4.2 Principle of Active Power Control

The output value for the active power control is calculated using two setpoints.

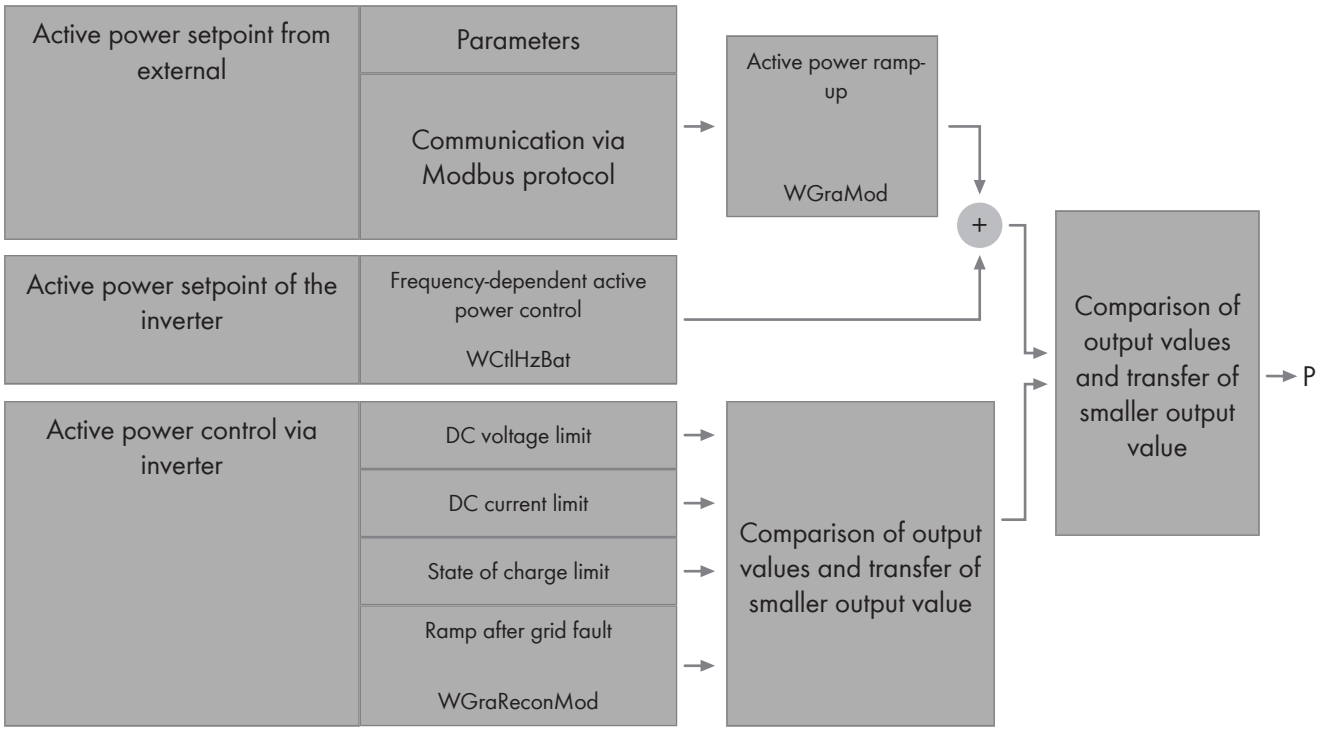


Figure 90: Principle of Active Power Limitation

The inverter processes the external setpoints when the intervals between data transmissions in the Modbus protocol are greater than 50 ms. It is recommended that the transmission interval be set as high as possible.

The inverter can start the specified active power feed-in using a ramp. This means that the inverter gradually increases the ratio of feed-in power per second by the value set in the parameter **WGra**. The ramp is activated and deactivated in the **WGraMod** parameter.

At the same time, the inverter processes the setpoints that were set on the inverter for the frequency-dependent active power limitation via the parameter **WCtlHzBatMod**.

To ensure that the inverter does not feed in any active power, the reactive power must also be set to 0 kVAr in addition to the 0 kW setpoint for the active power. Otherwise, the inverter will still feed in about 9 kW, which may result in contract penalties.

Following a grid error, the inverter starts to feed-in power with the ramp set up in the parameter **WGraRecon**.

The inverter control internally compares the setpoints for reducing the active power and generates the control value for the active power reduction using the smaller value.

14.4.3 Principle of Reactive Power Control

The output value for the reactive power control is calculated using two output values.

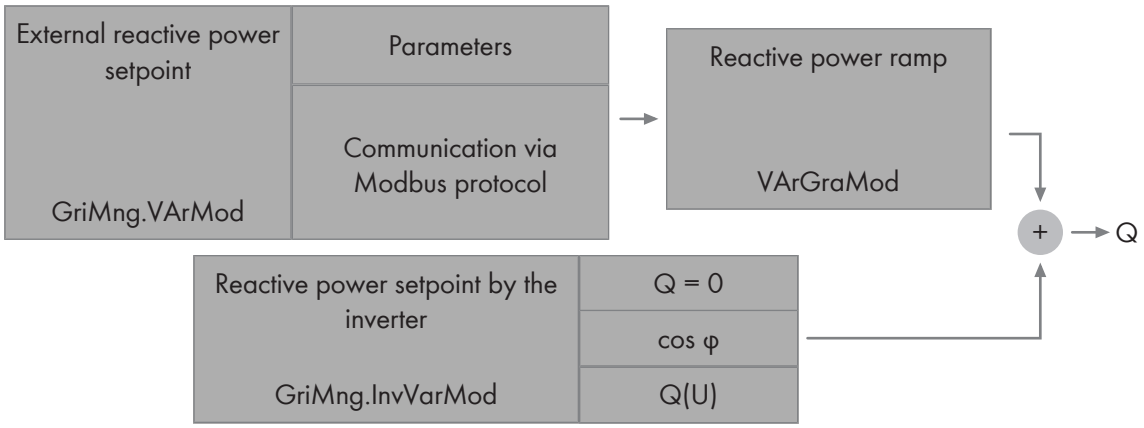


Figure 91: Principle of Reactive Power Control

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:

- **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

A reactive power value or the displacement power factor can each be transmitted.

The certification of the inverter according to UL1741 SA is valid for a displacement factor of up to 0.8 or a reactive power setpoint of up to 60%.

The inverter processes the external setpoints when the intervals between data transmissions in the Modbus protocol are greater than 50 ms. It is recommended that the transmission interval be set as high as possible.

When the setpoints are defined via the Modbus protocol, the reactive power is expressed as a percentage depending on the maximum reactive power. After resetting the parameters to the default setting, ensure that the specifications via the Modbus protocol continue to match the previous or expected specifications.

If an inverter is to be integrated into an existing SCADA system, the settings of all components of the SCADA system must be adjusted. For this, there are two options:

- Adjust the parameter **VArRtg** of the new inverter to the settings of the existing inverters
- Adjust the SCADA system:
  - When the maximum value for the reactive power is changed, simulate the grid stability at the AC connecting rails of the inverter.
  - When the maximum value for the reactive power feed-in is changed, simulate the grid stability of the power plant at the grid-connection point.
  - Ensure that the MV transformer is designed for the permanent reactive power feed-in with a new maximum value.
  - Adjust the reactive power setpoints.

The inverter can feed the specified reactive power into the utility grid using a ramp. This means that the inverter gradually increases the reactive power by the value set in the **VArGra** parameter. The ramp is activated and deactivated in the **VArGraMod** parameter.

At the same time, the inverter processes the specifications set directly on the inverter for reactive power control via the parameter **GriMng.InvVArMod**. The following setpoints can be set via this parameter:

- **Off** - The inverter does not generate internal setpoints for the reactive power.

- **VArCtlVol** - The inverter controls the reactive power as a function of the voltage(see Section 14.5.4, page 234). The internal setpoints are added up with the external setpoints. The reactive power can also be controlled externally via voltage setpoint (see Section 14.4.4, page 225).
- **PFCtlW** - The inverter controls the reactive power via the displacement power factor as a function of the active power.

The inverter control adds up both reactive power setpoints and feeds the sum of the reactive power into the utility grid.

In order to use parameter **GriMng.InvVArMod**, please contact us.

14.4.4 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 **Bsc.SrcSel**. The following setpoint sources can be set via this parameter:

- **Manual control** - The inverter controls the reactive power via the parameter **Bsc.VolNomSptMan**, which is entered via the user interface.
- **External control** - Grid voltage setpoints are transmitted via Modbus protocol

The inverter processes the external setpoints when the intervals between data transmissions in the Modbus protocol are greater than 50 ms. It is recommended that the transmission interval be set as high as possible.

14.4.5 Inverter Behavior with Low Power Setpoints

If the specifications for active and reactive power are below 0.1% of the rated power, the inverter monitors the specifications of the electric utility company for the time defined in parameter **PwrSpt2StbyTm**. If the specifications continue to be below 0.1% after this time has expired, the inverter changes its operating state.

It must be ensured that the time defined in parameter **PwrSpt2StbyTm** is greater than the time demanded by the power gradients **WGra**, **WGraFlb**, **VArGra** and **VArGra** for reducing the power. If the time is too short, the inverter cannot reduce the power to 0.

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 **PwrStp2StbyTm**. 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.

14.4.6 Inverter Behavior in Case of Communication Disturbances

Standard behavior in the event of a communication disturbance during operation

Via the parameter **Bsc.SrcSel**, the inverter can be set to receive the control setpoints via Modbus protocol. If these setpoints for the active and reactive power control or the battery's parameters cannot be transmitted correctly via Modbus protocol, the error detection function controls the inverter's behavior.

There are three possible causes for communication failure:

Cause	Explanation
External communication	The communication between SCADA system and inverter is disturbed.
	Communication between battery and inverter is disturbed.
Internal communication	Internal communication in the inverter is disturbed.

Since an external communication failure caused by various sources can be viewed to be critical in different ways, a tolerance time is taken into account by the inverter. The tolerance time for SCADA system communication failures can be set with the parameter **BatClt.ComFlb.AuxCtlTmLim**. The tolerance time for battery communication failures can be set with the parameter **BatClt.ComFlb.BatTmLim**.

The inverter automatically takes the shorter period of the tolerance time into account during an internal communication failure.

The inverter goes into fallback mode only after the expiration of the tolerance time mentioned above.

The status of error detection is displayed in the instantaneous value **BatCtl.ComFlb.FlbStt**.

Indication	Status of the inverter
Ok	The inverter is operating in automatic mode.
Fallback	The inverter has detected a communication failure and is in fallback mode for a defined period of time.
Error	The inverter is in the operating state "Error" due to a communication error. Possible sources of error: • The battery communication is disrupted. • The SCADA communication is disrupted. • The communication to SCADA system and battery is disrupted.

The inverter automatically activates the error detection for the battery and external signal generators separately from each other. The status of the respective setting is shown in the parameters **BatCtl.ComFlb.BatEna** or **BatCtl.ComFlb.AuxCtlEna**. If one of the two external communication paths is disrupted, the signals of the other communication path are still used.

If the time period set in the parameter **BatCtl.ComFlt.FlbTmLim** has expired after entering the fallback mode, the inverter switches to the operating state "Error" and no longer feeds into the utility grid. If the parameter **BatCtl.ComFlt.FlbTmLim** has been set to 0 seconds, the inverter immediately switches to the operating state "Error".

If the inverter again receives valid setpoints via the Modbus protocol, the inverter voids the communication error and switches back to normal operation.

The inverter's behavior in the absence of setpoints is set in the parameter **BatCtl.ComFlb.FlbMod**:

Setting	Behavior in the event of communication disturbances
Error	The inverter switches to the operating state "Error". The AC disconnection unit and the DC switchgear are opened and the inverter disconnects from the utility grid and battery.
Standby	The inverter switches to the operating state "Standby". The AC disconnection unit and the DC switchgear remain closed.

Setting	Behavior in the event of communication disturbances
Predefined	The inverter switches to a predefined operating state. The inverter's behavior is set by the following parameters: • **BatCtl.ComFlb.CtlMod**: Selection of the operating mode – **Power Control**: The active power is controlled by the value set in the parameter **BatCtl.ComFlb.WSpt**. – **DC Voltage Control**: The DC voltage is controlled by the value set in the parameter **BatCtl.ComFlb.DclVolSpt**. – **Last Control Mode**: Use last control mode. • **BatCtl.ComFlb.WSpt**: Specify the active power in the absence of setpoints. • **BatCtl.ComFlb.VArSpt**: Specify the reactive power in the absence of setpoints. • **BatCtl.ComFlb.PFSpt**: Specify the power factor in the absence of setpoints. • **BatCtl.ComFlb.DclVolSpt**: Specify the DC voltage in the absence of setpoints. • **BatCtl.ComFlb.VolNomSpt**: Specify the nominal voltage in the absence of setpoints.
Last setpoint	The inverter uses the last known specified setpoint. If setpoints could not be transmitted via communication (e.g. after switching the inverter on), a last known value is missing and the inverter remains in the operating state "Standby".

Alongside the behavior specification via the parameter **BatCtl.ComFlb.FlbMod** during a communication failure, the parameter **WCtlHzBatMod** is set depending on how the frequency-dependent active power is controlled during disturbed communication (see Section 14.5.3, page 232).

Enhanced behavior in the event of a communication disturbance during operation

In comparison to standard behavior, enhanced behavior can be activated in the parameter **GriMng.ExtdFlbEna**.

In this case, the inverter detects a communication error after the time set in the parameter **GriMng.ComFltTmLim** and issues the warning **9348**. In addition, the state **Timeout, 30 sec** is displayed in the instantaneous value **GriMng.ExtdFlbStt**. A check is made for 30 seconds to see if the communication error occurs again.

- The communication remains interrupted:

  If communication is still interrupted after this period (30 seconds) has elapsed, the inverter switches to the fallback state in accordance with the configured setpoints. After the time defined in the parameter **GriMng.ComFltFlbTmLim** has elapsed, the inverter switches to the operating state "Error". It no longer feeds into the utility grid, and it issues the error message **6136**. The state **Fallback and error** is displayed in the instantaneous value **GriMng.ExtdFlbStt**. Before the inverter can return to the operating state "GridFeed", the communication error must be resolved and the error must be confirmed manually via the parameter **GriMng.ExtdFlbErrClr**.

- The communication error is resolved within the 30 seconds but it occurs again.

  If the communication error is resolved within this period (30 seconds), the inverter will monitor the communication for the next 60 minutes. The state **Timeout, 1 hour** is displayed in the instantaneous value **GriMng.ExtdFlbStt**.

  If communication is interrupted again during this time, the inverter switches to the fallback state in accordance with the configured setpoints. After the time defined in the parameter **GriMng.ComFltFlbTmLim** has elapsed, the inverter switches to the operating state "Error". It no longer feeds into the utility grid, and it issues the error message **6136**. The state **Fallback and error** is displayed in the instantaneous value **GriMng.ExtdFlbStt**. Before the inverter can return to the operating state "GridFeed", the communication error must be resolved and the error must be confirmed manually via the parameter **GriMng.ExtdFlbErrClr**.

- The communication error is resolved within the 30 seconds and it does not occur again.

  If no further communication error occurs during this time, the communication error is considered to be resolved. If a communication error occurs again, the inverter monitors the communication error again for 30 seconds. The state **Timeout, inactive** is displayed in the instantaneous value **GriMng.ExtdFlbStt**.

This behavior during a lack of communication is required in Australia.

14.4.7 Static and dynamic DC limits of the battery

To protect the battery, DC current and DC voltage can be limited. If a static DC limit is overshot or undershot, the inverter switches off after a specified period of time. The time in terms of exceeding the voltage limit is specified in the parameter **BatCtl.DcVolOpLimTm**. The time in terms of exceeding the current limit is specified in the parameter **BatCtl.DcAmpOpLimTm**.

Depending on the battery type, the current and voltage must be limited according to the dynamic DC limits. If the dynamic DC limits are reached, the inverter goes into derating. The instantaneous value **DrtStt** displays the states **Bat.DcAmp** or **Bat.DcVol**.

The actual DC limits are calculated on the basis of the battery's thresholds and the internal thresholds. The narrower threshold is used.

Parameters	Explanation
DcVolOpMax	Maximum static charge voltage, overshooting leads to deactivation of the inverter
DcVolOpMin	Minimum static discharge voltage, undershooting leads to deactivation of the inverter
DcVolDynMax	Maximum dynamic charge voltage, overshooting leads to derating
DcVolDynMin	Minimum dynamic discharge voltage, undershooting leads to derating
DcAmpOpMax	Maximum static discharge current, overshooting leads to deactivation of the inverter
DcAmpOpMin	Maximum static charge current, undershooting leads to deactivation of the inverter
DcAmpDynMax	Maximum dynamic discharge current, overshooting leads to derating
DcAmpDynMin	Maximum dynamic charge current, undershooting leads to derating

14.4.8 State of charge limit of the battery

The state of charge limit controls the dynamic DC limits or the active power depending on the battery's charge state. If the state of charge limits are overshot or undershot, the inverter stops charging or discharging the battery. In this way, an overcharge or deep discharge of the battery is prevented.

To prevent large current or power leaps at the state of charge limits, a transition area can be defined.

Depending on the resolution of the battery's state of charge that is transmitted, power leaps may occur. This can be avoided by estimating the state of charge. In stead of the battery's state of charge that is sent, a state of charge is then calculated based on the nominal battery capacity, the measured DC current, the transmitted state of charge and the set resolution.

Parameter	Explanation
Bsc.SOCLimEna	Activates the state of charge limit
Bsc.SOCLimMod	Operating mode of the state of charge limit • **DC Amp derating**: Limits the DC current (recommended setting) • **AC power derating**: Limits the active power
Bsc.SOCOpMax / AuxCtl.SOCOpMax	Maximum state of charge

Parameter	Explanation
Bsc.SOCOpMin / AuxCtl.SOCOpMin	Minimum state of charge
Bsc.SOCOpHys	Width of the transition area at the state of charge limits
Bsc.SOCestEna	Activates estimation of the state of charge
Bsc.SOCRes	Resolution of the state of charge

14.4.9 Zero power correction

Through the self-consumption of the inverter, at a power specification of 0 kW on the AC side, power will continue to be drawn from the battery. This leads to a small but possibly unwanted electric discharge of the battery. By offsetting the zero power correction, the power required for self-consumption is drawn from the AC utility grid. This avoids electric discharges and premature ageing of the battery. Where necessary, the offset of the zero power correction can be adjusted during commissioning.

Parameters	Description
Bsc.ZPO.ZeroPwrAtOfsEna	Activates the zero power correction
Bsc.ZPO.ZeroPwrAtOfs	Offset of the zero power correction

14.5 Grid Management Services

14.5.1 Start-Up Behavior

14.5.1.1 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.

14.5.1.2 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 **WGraRecon**.

14.5.1.3 Switching the inverter after a protective device was triggered

In accordance with AR-N 4120, after a protective device has been triggered, the inverter is not allowed to switch to feed-in operation until it receives permission from the control gear for the PV farm. This ensures that the defined grid limits for voltage and frequency are maintained both at the control gear for the PV farm and at the point of interconnection to the grid.

The function is deactivated by default. To activate this function, the parameter **ExlConnEna** must be set to **Enable**.

As soon as the defined values for the grid limits are reached at the point of interconnection, the parameter **ExlConn** is set to the value **Enable** by the control gear for the PV farm via Modbus and transmitted to the inverter. This will enable the inverter to switch back to feed-in operation as soon as the defined grid limits are met at the inverter inputs. If the parameter **ExlConn** is set to **Disable** after this, the inverter continues to remain in the current operating state. The inverter waits again for the value **Enable** of the parameter **ExlConn** only if a protective device is triggered again.

14.5.2 Dynamic Grid Support (FRT)

The inverter is a grid support interactive inverter. The inverter was tested in accordance with the UL 1741 SA (2016-09-07) to be compliant with the source requirements documents of the states available at the time. For connecting the inverter to the utility grid, no additional grid monitoring equipment is necessary. You can find the implementation of UL 1741 SA in the Technical Information "Grid Support Utility Interactive Inverters for Sunny Central-US and Sunny Central Storage-US" at www.SMA-Solar.com.

14.5.2.1 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.

In the event of dynamic grid support, the inverter uses the last calculated values for the active and reactive power. If this results in a decreasing voltage, it is no longer possible to feed in at rated power. The power setpoints are normalized to **VolNomSpt**.

i Q on Demand and dynamic grid support

In the operating state "Q on Demand", limited dynamic grid support is available.

The inverter behavior can be set via the parameter **Frt.Mod**.

Parameter	Description
Disable	Dynamic grid support is deactivated.
Full	Complete dynamic grid support is activated.
Partial	Limited dynamic grid support is activated.
Active Current Constant	The inverter supplies reactive power without reducing the active current fed in and without exceeding the nominal current.
Momentary Cessation	The limited dynamic grid support is activated while the apparent current is reduced simultaneously. Dynamic grid support is activated to to fulfill the UL 1741 SA and Rule 21.
Maximum Active Current	Unlike with full dynamic grid support, the inverter increases the active power to the maximum regardless of the pre-fault condition, without limiting the reactive current for full dynamic grid support.

The grid limits and deactivation delays vary depending on the country standard and can be set via parameters.

14.5.2.2 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.

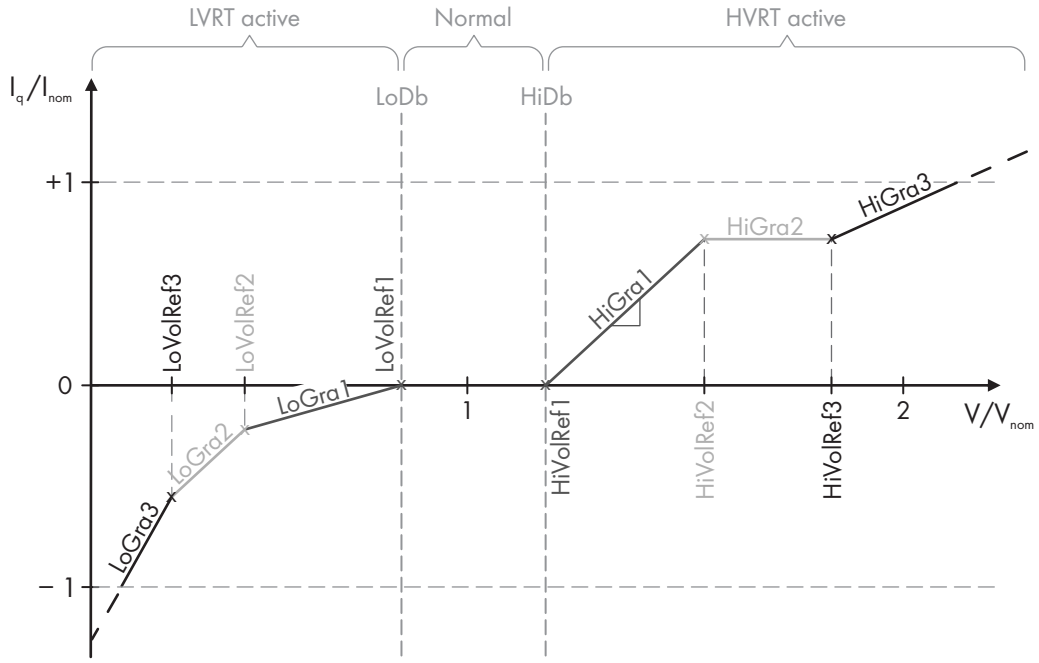


Figure 92: Characteristic curve of full dynamic grid support

Two ranges each with different gradients can be defined for undervoltage and overvoltage in the characteristic curve.

Parameter	Description
Frt.LoDb	Lower threshold for the voltage band in which dynamic grid support is not required
Frt.HiDb	Upper threshold for the voltage band in which dynamic grid support is not required
Frt.WaitTmLo	Minimum duration for which grid support is active once grid voltage has returned to the voltage band
Frt.WaitTmHi	Maximum duration for which grid support is active once grid voltage has returned to the voltage band
Frt.LoVolRef1	First reference value of undervoltage up to which the corresponding gradient is effective
Frt.LoVolRef2	Second reference value of undervoltage up to which the corresponding gradient is effective
Frt.LoVolRef3	Third reference value of undervoltage up to which the corresponding gradient is effective
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

Parameter	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.VolFilMod	Definition of the reference value during grid support: The voltage refers to the nominal voltage. The voltage refers to a filtered value of the measured voltage.

If active current or reactive current has to be limited during grid support, please contact us.

14.5.2.3 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 **Frt.WaitTmLo** and **Frt.WaitTmHi**.

14.5.3 Active power control depending on grid frequency: procedure WCtlHzBat

With frequency-dependent active power control, the inverter continually checks the connected power frequency and changes the power in accordance with the frequency deviations. This function is activated via the parameter **WCtlHzBatMod**. Using the parameter **BatCtl.ComFlb.WCtlHzBatMod**, the function can be activated or deactivated separately in the event of a communication interruption. To control the behavior of the inverter in the event of power frequency deviations, a characteristic curve with eight support points is configurable. These support points can be adjusted on the user interface via the parameters **WCtlHzBat.Hzn** for the X axis, and via the parameters **WCtlHzBat.Wn** for the Y axis.

The frequency of the support point is entered as absolute value in Hz on the X axis.

The ratio of the power change in relation to the nominal power of the inverter must be entered on the Y axis in percent. The power change will be added to the current setpoint.

Parameter **HzNomSpt** can be used if the fixed point of the characteristic curve is to be adjusted during operation. This allows the entire characteristic curve to be moved on the X axis. This parameter can be configured in manual operation on the user interface in parameter **Bsc.HzNomSpt*Man***. In automatic operation, the parameter **HzNomSpt** can be configured via the Modbus interface. Keep in mind that the support points 5 to 8 must describe the behavior above the nominal frequency and the support points 1 to 4 the behavior below the nominal frequency. The X values must be set continuously rising and the Y values continuously falling.

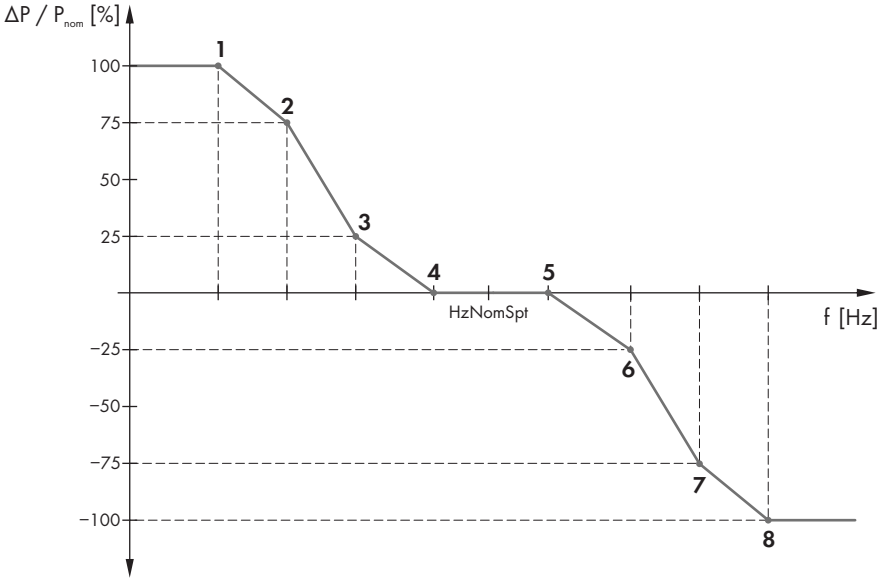


Figure 93: Active power control depending on grid frequency (example)

Example: Configuring the characteristic curve for overfrequency:

If the limits for the power reduction in the event of overfrequency are to be 50.2 Hz and 51 Hz, the support points 5 and 8 have to be set as follows:

Support point 5 - the point above which the power is to be reduced:

- x: 100.4% (equates to 50.2 Hz with the nominal frequency of 50 Hz)
- y: 0% (as yet no power change)

Support point 8 - the point at which the inverter must reduce the power by 100%:

- x: 102% (equates to 51 Hz with the nominal frequency of 50 Hz)
- y: –100% (power reduction)

Support points 6 and 7 can be used to make the characteristic curve steeper (see example diagram between support points 6 and 7) or flatter (see example diagram between support points 5 and 6 or 7 and 8).

Overview of the relevant parameters

Parameters	Description
WCtlHzBatMod	Activation of the active power control depending on grid frequency
WCtlHzBat.Hz*n*	Grid frequency at support point *n* for the frequency-dependent active power control
WCtlHzBat.W*n*	Active power setpoint at support point *n* to be attained at the end of the given radio spectrum
HzNomSpt	The mid-point of the characteristic curve writable via Modbus interface, or readable on the user interface.

Parameters	Description
Bsc.HzNomSptMan	Mid-point of the characteristic curve in manual operation
BatCtl.ComFlb.WCtlHzBatMod	Activation of the function in case of a communication failure

14.5.4 Reactive Power Control as a Function of Grid Voltage: VArCtlVol Mode

The reactive power is controlled as a function of the grid voltage. By supplying reactive power, the inverter performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve. The characteristic curve can be flexibly configured by parameterizing the slope and a type of deadband through two voltage points.

Figure 94: Characteristic curve of the voltage-dependent reactive power control

A quotient is derived from the ratio of grid voltage to nominal voltage.

When the grid voltage is equal to the defined nominal voltage, the reactive power feed-in is zero. If the grid voltage changes and exceeds or falls short of a defined threshold, the inverter reacts according to the voltage/reactive power characteristic curve by adjusting its reactive power feed-in. For each voltage quotient three thresholds can be configured, and the gradients of the reactive power adjustment for decreasing or increasing grid voltage can be defined individually for each threshold.

Overview of the relevant parameters

Parameter	Description
VArCtlVol.LoVolRef1HiVolRef1	Voltage quotient at which reactive power feed-in is zero
VArCtlVol.HiVolRef2/HiVolRef3	Threshold of the voltage quotient at increased grid voltage
VArCtlVol.HiGra1/HiGra2/HiGra3	Gradient of reactive power adjustment of the given voltage band at increased grid voltage
VArCtlVol.LoVolRef2/LoVolRef3	Threshold of the voltage quotient at reduced grid voltage

Parameter	Description
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.

14.5.5 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 φ(P) characteristic curve.

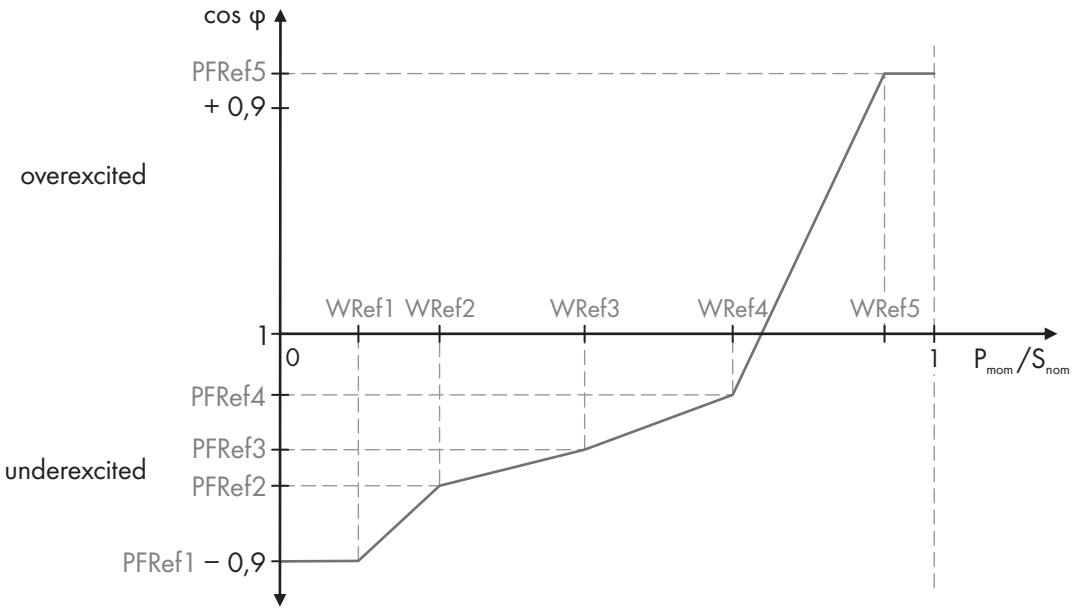


Figure 95: Reactive power control as a function of active power (example)

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 φ values of the following parameters must be set to the cos φ 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
PFCtlW.VolDsaTm	Waiting time for which the deactivation voltage must be present before reactive power control is deactivated

Parameter	Description
PFCtlW.WRef1	First reference point of the active power on the characteristic curve
PFCtlW.PFRef1	First reference point of the displacement power factor on the characteristic curve
PFCtlW.WRef2	Second reference point of the active power on the characteristic curve
PFCtlW.PFRef2	Second reference point of the displacement power factor on the characteristic curve
PFCtlW.WRef3	Third reference point of the active power on the characteristic curve
PFCtlW.PFRef3	Third reference point of the displacement power factor on the characteristic curve
PFCtlW.WRef4	Fourth reference point of the active power on the characteristic curve
PFCtlW.PFRef4	Fourth reference point of the displacement power factor on the characteristic curve
PFCtlW.WRef5	Fifth reference point of the active power on the characteristic curve
PFCtlW.PFRef5	Fifth reference point of the displacement power factor on the characteristic curve

14.6 Communication

14.6.1 Communication Network in the MV Power Station

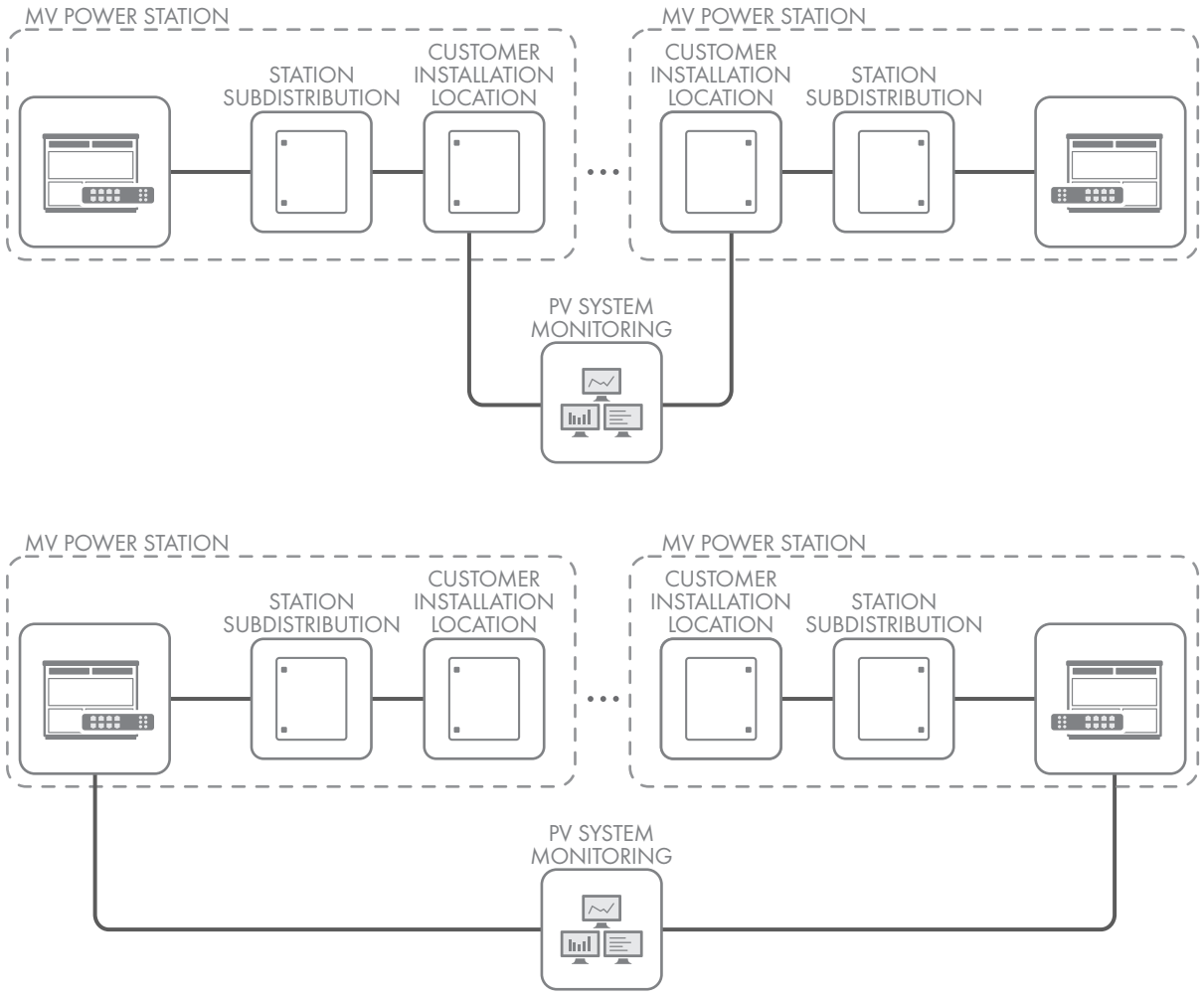


Figure 96: Communication network in the MV Power Station

Depending on the order option of the inverter, the terminal for the communication network is located in the inverter or in 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.

A connection from the managed switch of the inverter to the customer installation location of the MV Power Station has been factory-set via **LAN 2 port 4**.

14.6.2 Communication network in case of order option "Monitoring"

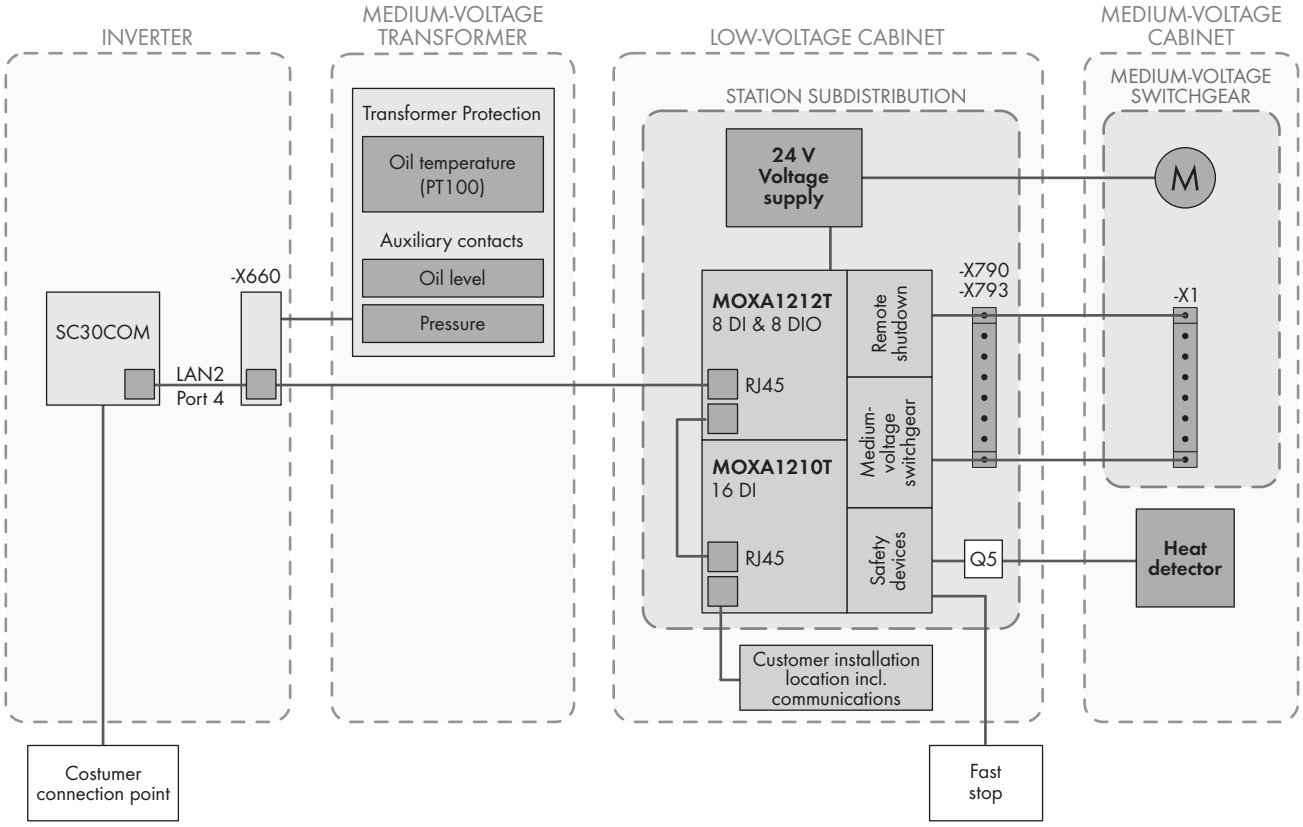


Figure 97: Communication network of the MV Power Station

The type and number of MOXA modules in the station subdistribution depends on the order option:

Order option	Type MOXA 1	Type MOXA 2
Monitoring MVSG	MOXA 1210T	-
Monitoring MVSG + Remote Control	MOXA 1210T	MOXA 1212T
Monitoring MVSG + Remote Control + Safety Equipment	MOXA 1210T	MOXA 1210T
Monitoring MVSG + Safety Equipment	MOXA 1210T	MOXA 1210T
Monitoring Safety Equipment	-	MOXA 1210T

For the order option "Monitoring MVSG + Remote Control", the disconnect signal must be sent directly to the MOXA module. Since communication with the inverter is interrupted after the medium-voltage switchgear is switched off, a separate voltage supply must be provided.

15 Instantaneous Values and Parameters

15.1 Instantaneous Values

No.	Name	Value/range
320	WSpt	-5000 kW to +5000 kW
321	VArSpt	-5000 kVAr to +5000 kVAr
322	PFSpt	-1.0000 to +1.0000
327	Rio.KeySw	On | Off
328	ErrStt	Ok | Error
332	OpStt	Unknown | Bootloader | Defect | Init | Stop | Error | Update | Reset | WaitAC | ConnectAC | WaitDC | ConnectDC | GridFeed | FRT | Standby | QonDemand | RampDown | ShutDown | Selftest | Ctl | Vloop | IOTest | DCSource | CtlExt | ChkGri | Cwg | CwgMpp | RLC | GridForm | AcRampUp | BatOnly
401	InvMs.TotVA	–
402	InvMs.TotW	–
403	InvMs.TotVAr	–
404	InvMs.PF	–
405	GriMs.V.PhsAB	–
406	GriMs.V.PhsBC	–
407	GriMs.V.PhsCA	–
408	InvMs.TotA.PhsA	–
409	InvMs.TotA.PhsB	–
410	InvMs.TotA.PhsC	–
506	TrfPro.TmpTrp	Ok | Error
6382	Rio.Din.FloatCtl.Warn	True | False
6383	Rio.Din.FloatCtl.Err	True | False
7029	TrfPro.Pres	Ok | Error
7170	TrfPro.GasOilLev	Ok | Error
665	VAMaxSpt	–
666	AMaxSpt	–
673	DrtIgbtTmp	Off | On
674	DrtCabTmp	Off | On

No.	Name	Value/range
690	DrtExlStt	No VAMax Derating | Derating VAMax MVPS Communication | Derating VAMax External Temperature | Derating VAMax Transformer Temperature
675	FanCtl.Stt	FanAll Min | TmpCtl | FanCoupling | TmpCtl Cab and FanStk Min | TmpCtl Igbt and FanCab Max | TmpCtl Cab and FanStk Max | FanAll Max | TmpWrn Choke | Heater Ctl -40degC | Heater Ctl DeHyd | Heater Ctl All | Fan Test | DifPres Test | TmpCtl Cab Off | TmpCtl Igbt Off | TmpCtl All Off | Heater Ctl All and TmpCtl Off | TmpCtl Choke
597	DcMs.Vol	–
598	DcMs.Vol.PosGnd	–
599	DcMs.Vol.NegGnd	–
600	DcMs.Amp.Stk1	–
601	DcMs.Amp.Stk2	–
602	DcMs.Amp.Stk3	–
603	DcMs.TotWatt	–
604	DcMs.Watt.Stk1	–
605	DcMs.Watt.Stk2	–
606	DcMs.Watt.Stk3	–
607	GriMs.Hz	–
608	GriMs.RotDir	clockwise | anticlockwise
609	GriMs.PllOpStt	Off | Search | Locked
611	DcSw1Stt	Open | Closed
614	WaitGriTm	–
615	WaitGriRsReas	–
616	InvMs.DclVol.Stk1	–
617	InvMs.DclVol.Stk2	–
618	InvMs.DclVol.Stk3	–
721	DcSw2Stt	Open | Closed
722	DcSw3Stt	Open | Closed
750	TmpCab.Dcc	–
751	TmpCab.Acc	–
752	TmpCab.Rio	–
753	TmpStk1.Pcb	–

No.	Name	Value/range
754	TmpStk2.Pcb	–
755	TmpStk3.Pcb	–
756	TmpStk1.Igbt	–
757	TmpStk2.Igbt	–
758	TmpStk3.Igbt	–
759	TmpExl	–
823	ErrNo	–
830	DrtStt	Stk.DcAmpLim | Frt | AmpGra | AMax | VAMax | WCtlLoHz | WCtlHz | WGraRecon | WGra | WMax | WMaxExt | VecLen | Bat.DcAmp | Bat.DcVol | WGraStr | WCtlHzBat | WCtlVol | Mvps.WRvLim | VArPrio | WSptMax | WSptMin
6203	Eps.Stt	INIT | IDLE | SKIP_FRT | EPS | WAIT_STOP | WAIT_RESET
6084	FanStk.Pct	–
6085	FanCab.Pct1	–
6086	FanCab.Pct2	–
6099	TmpStk.PcbMax	–
6100	TmpStk.IgbtMax	–
6107	TmpTrf	–
6131	TmpChoke.Sns	–
6146	DcMs.TotAmp	–
6202	AcSwStt	Open | Closed
6365	GriMs.NspOpStt	Off | Search | Locked
6425	InvMs.A.Stk1.PhsA	–
6427	InvMs.A.Stk1.PhsB	–
6429	InvMs.A.Stk1.PhsC	–
6431	InvMs.A.Stk2.PhsA	–
6433	InvMs.A.Stk2.PhsB	–
6435	InvMs.A.Stk2.PhsC	–
6437	InvMs.A.Stk3.PhsA	–
6439	InvMs.A.Stk3.PhsB	–
6441	InvMs.A.Stk3.PhsC	–
6610	DevInf.ChkSum.AccFpga	–

No.	Name	Value/range
6611	DevInf.ChkSum.DccCpu	–
6613	DevInf.ChkSum.ContCpu2	–
6614	DevInf.ChkSum.DstFpga2	–
6644	PvGnd.RisIso	–
6706	GfdiSwStt	Open | Closed
6707	PreChaSwStt	Open | Closed
6708	CapacSwStt	Open | Closed
6718	InvMs.V.PhsAB	–
6719	InvMs.V.PhsBC	–
6720	InvMs.V.PhsCA	–
6763	DevInf.SerNo	–
6764	InvMs.Eff	–
7118	Cnt.TotAcWhOut	–
6767	Cnt.AcWhOut	–
7119	Cnt.TotDcWhIn	–
6771	Cnt.DcWhIn	–
7120	Cnt.TotVArhOvExt	–
7121	Cnt.TotVArhUnExt	–
6777	Cnt.TotOpTm	–
6779	Cnt.TotFeedTm	–
6791	Cnt.FanStkTm	–
6793	Cnt.FanCab1Tm	–
6795	Cnt.FanCab2Tm	–
6797	Cnt.HtCabTm	–
6799	Cnt.HtLoExlTmpTm	–
6801	Cnt.AcSw	–
6803	Cnt.DcSw1	–
6805	Cnt.DcSw2	–
6807	Cnt.DcSw3	–
6809	Cnt.PreChaSw	–
6811	Cnt.CapacSw	–

No.	Name	Value/range
6813	Cnt.GfdiTr	–
6815	Cnt.GfdiSw	–
6819	TmpStk.IgbtSpt	–
6864	InvMs.TotEff	–
6968	ErrLcn	–
7000	VolNomSpt	0.0000 pu to 1.1500 pu
7073	Cnt.YstdAcWhOut	–
7081	Cnt.DrtTmExl	–
7083	Cnt.DrtTmInvCfg	–
7114	ErrRmgTm	–
7182	Cnt.TotAcWhIn	–
7180	Cnt.AcWhIn	–
7218	Eps.RmgTm	–
7221	PwrOffReas	No Power Off Reason | Error: Critical Error, ProErr active | Error | Init: Wait Buffer Voltage | Stop: Key Switch | Stop: Parameter 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 19 | WaitAc | WaitDc: DC Voltage | WaitDc: Bender | WaitDc: DC precharge waiting period | Selftest active | IO Test active | Reserve 26 | Low Power Set Point | Battery
7233	GriMs.Vol.PsNom	–
7242	DcMs.Vol.Max	0.0 V to 2000.0 V
7249	PresTrf	–
7253	PresTrf.ErrStt	Ok | Error
7276	DcAmpSpt	-10000 A to +10000 A
7277	HzNomSpt	40.000 Hz to 70.000 Hz
7359	InvTyp	PV | Battery | PV and Battery
7304	BatCtl.ComFlb.FlbStt	Ok | Battery Communication Timeout | Auxiliary Control Communication Timeout | Battery and Auxiliary Communication Timeout | Battery Control Communication Timeout | Error
7300	Cnt.TotDcWhOut	–
7302	Cnt.DcWhOut	–

No.	Name	Value/range
7343	Bat.ErrBits	–
7345	Bat.WarnBits	–
7346	Bat.InfBits	–
7488	DclVolSpt	0 V to 2000 V
7569	Mvps.ChkComStt	No test | Test okay | Test not okay
7571	Cnt.FanMvpsTm	–
7168	TrfPro.TmpWrn	Ok | Error
7616	CapPreChaSwStt	Open | Closed
7632	WAval	–
7633	VArAval	–
7675	InvMs.DclVol	–
7716	DiagRmgTm	–
7719	DcPreChaSwStt	Open | Closed
7769	DevInf.ChkSum.GfdiCpu	–
7986	Gfdi.AmpPrc	–
7988	Gfdi.AmpErr	–
8045	ActErrNo1	–
8046	ActErrTxt1	–
8047	ActErrLcn1	–
8048	ActErrNo2	–
8049	ActErrTxt2	–
8050	ActErrLcn2	–
8051	ActErrNo3	–
8052	ActErrTxt3	–
8053	ActErrLcn3	–
8054	ActErrNo4	–
8055	ActErrTxt4	–
8056	ActErrLcn4	–
8057	ActErrNo5	–
8058	ActErrTxt5	–
8059	ActErrLcn5	–

No.	Name	Value/range
8060	ActErrNo6	–
8061	ActErrTxt6	–
8062	ActErrLcn6	–
8063	ActErrNo7	–
8064	ActErrTxt7	–
8065	ActErrLcn7	–
8066	ActErrNo8	–
8067	ActErrTxt8	–
8068	ActErrLcn8	–
8069	ActErrNo9	–
8070	ActErrTxt9	–
8071	ActErrLcn9	–
8072	ActErrNo10	–
8073	ActErrTxt10	–
8074	ActErrLcn10	–
8077	TmpStk.Chip	–
8078	TmpStk.Diode	–
8079	TmpStk.TmpAct	–
8140	Cnt.DcSwOvAmp1	–
8142	Cnt.DcSwOvAmp2	–
8144	Cnt.DcSwOvAmp3	–
8253	WSptMin	-5000 kW to +5000 kW
8271	VArExlSpt.RefVal	–
8272	WExlSpt.RefVal	–
8537	WSptMax	-5000 kW to +5000 kW
8570	WGraSpt	–
8574	VArGraSpt	–
8601	Cnt.ChopStd	–
8603	Cnt.ChopCrt	–
8969	GriForm.OvAmpStt	Disabled | None | Normal | Short
8970	GriForm.OvAmp.AmpMaxFrtAval	–

No.	Name	Value/range
8971	GriForm.OvAmp.AmpMaxAval	–
8972	Cnt.GriForm.OvAmp	–
8974	Cnt.GriForm.OvAmpSec1	–
8976	Cnt.GriForm.OvAmpSec2	–
8978	Cnt.GriForm.OvAmpSec3	–
8993	GriMng.ExtdFlbStt	Ok | Timeout, inactive | Timeout, 1 hour | Timeout, 30 seconds | Fallback and error

15.2 Parameters

No.	Name	Value/range	Default value
306	GriCod	DE BDEW | US IEEE1547 | US ERCOT | US HECO | US NERC | US WECC | US IESO CAISO | US PGE CAISO | 50Hz | 60Hz | FR | GR | IN | TH | IL | US PRC024 W | US PRC024 E | US PRC024 ERCOT | US MA NE ISO | CL | US Rule 21 | IT CEI 0-16 | AE | JP 50Hz | JP 60Hz | IL-HV | ES | Off-Grid 50Hz | Off-Grid 60Hz | KR | AU | VDE-AR-N 4110 | VDE-AR-N 4120 | VDE-AR-N 4110 SCS | VDE-AR-N 4120 SCS | US IEEE1547:2018 | US IEEE1547:2018 SCS | US IEEE1547:2018 + NERC | US IEEE1547:2018 + NERC SCS | ES TED749 | GB G99 | PT Portaria 73 | Custom	–
310	HzRtg	40.00 Hz to 70.00 Hz	country-specific
709	Aid.Mod	Enable | Disable	country-specific
318	WRtg	1 kW to 5000 kW	device-specific
319	VArRtg	1 kVAr to 5000 kVAr	device-specific
323	VARtg	1 kVA to 5000 kVA	device-specific
730	VADrtPriMod	VAr | W	VAr
329	InvOpMod	Stop | Operation	Stop
331	RemRdy	Enabled | Disabled	Enabled
361	WCtlHzMod	Enable | Disable	country-specific
362	WCtlHz.DrgIndMod	Enable | Disable	country-specific
363	WCtlHz.RefMod	W | WNom | VANom	W
364	WCtlHz.Hz1	0.000 Hz to 70.000 Hz	country-specific

No.	Name	Value/range	Default value
365	WCtlHz.Hz2	0.000 Hz to 70.000 Hz	country-specific
366	WCtlHz.Hz3	0.000 Hz to 70.000 Hz	65.000 Hz
708	WCtlHz.Hz4	0.000 Hz to 70.000 Hz	65.000 Hz
367	WCtlHz.HzGra1	0.0000 pu/Hz to 10.0000 pu/Hz	country-specific
368	WCtlHz.HzGra2	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
369	WCtlHz.HzGra3	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
370	WCtlHz.HzStopMin	0.000 Hz to 70.000 Hz	0.000 Hz
371	WCtlHz.HzStopMax	0.000 Hz to 70.000 Hz	country-specific
372	WCtlHz.HzStopTm	0 ms to 1000000 ms	0 ms
373	WCtlHz.WGraPosEna	0 to 1	0
374	WCtlHz.WGraNegEna	0 to 1	0
375	WCtlHz.WGraPos	0.0000000 pu/s to 10.0000000 pu/s	country-specific
376	WCtlHz.WGraNeg	0.0000000 pu/s to 10.0000000 pu/s	country-specific
377	WCtlHz.HzQtlIntv	0.000 Hz to 0.100 Hz	0.000 Hz
398	WGraReconMod	Enable | Disable	country-specific
399	WGraRecon	0.000000 pu/s to 1.000000 pu/s	country-specific
424	Frt.LoDb	0.00 pu to 1.00 pu	country-specific
425	Frt.HiDb	1.00 pu to 1.50 pu	country-specific
426	Frt.WaitTmHi	0.02 s to 20.00 s	country-specific
427	Frt.LoVolRef1	0.00 pu to 1.00 pu	1.00 pu
428	Frt.LoVolRef2	0.00 pu to 1.00 pu	country-specific
429	Frt.LoVolRef3	0.00 pu to 1.00 pu	0.00 pu
430	Frt.LoGra1	0.00 to 10.00	country-specific
431	Frt.LoGra2	0.00 to 10.00	2.00
432	Frt.LoGra3	0.00 to 10.00	0.00
433	Frt.HiVolRef1	1.00 pu to 2.00 pu	1.00 pu
434	Frt.HiVolRef2	1.00 pu to 2.00 pu	country-specific
435	Frt.HiVolRef3	1.00 pu to 2.00 pu	country-specific
436	Frt.HiGra1	0.00 to 10.00	country-specific
437	Frt.HiGra2	0.00 to 10.00	country-specific
438	Frt.HiGra3	0.00 to 10.00	country-specific

No.	Name	Value/range	Default value
439	Frt.VolDFilTm	0.0 s to 600.0 s	country-specific
440	Frt.AmpQFilTm	0.0 s to 600.0 s	country-specific
441	Frt.AmpDGra	0.00 pu/s to 100.00 pu/s	country-specific
444	VCtl.OpMaxNom	0.000 pu to 2.000 pu	country-specific
445	VCtl.OpMinNom	0.000 pu to 2.000 pu	country-specific
446	VCtl.Hi1Lim	0.00 pu to 2.00 pu	country-specific
447	VCtl.Hi2Lim	0.00 pu to 2.00 pu	country-specific
448	VCtl.Hi3Lim	0.00 pu to 2.00 pu	country-specific
449	VCtl.Hi4Lim	0.00 pu to 2.00 pu	country-specific
450	VCtl.Hi5Lim	0.00 pu to 2.00 pu	country-specific
451	VCtl.Hi1LimTm	0 ms to 1000000 ms	country-specific
452	VCtl.Hi2LimTm	0 ms to 1000000 ms	country-specific
453	VCtl.Hi3LimTm	0 ms to 1000000 ms	country-specific
454	VCtl.Hi4LimTm	0 ms to 1000000 ms	country-specific
455	VCtl.Hi5LimTm	0 ms to 1000000 ms	country-specific
456	VCtl.Lo1Lim	0.00 pu to 2.00 pu	country-specific
457	VCtl.Lo2Lim	0.00 pu to 2.00 pu	country-specific
458	VCtl.Lo3Lim	0.00 pu to 2.00 pu	country-specific
459	VCtl.Lo4Lim	0.00 pu to 2.00 pu	country-specific
460	VCtl.Lo5Lim	0.00 pu to 2.00 pu	country-specific
461	VCtl.Lo1LimTm	0 ms to 1000000 ms	country-specific
462	VCtl.Lo2LimTm	0 ms to 1000000 ms	country-specific
463	VCtl.Lo3LimTm	0 ms to 1000000 ms	country-specific
464	VCtl.Lo4LimTm	0 ms to 1000000 ms	country-specific
465	VCtl.Lo5LimTm	0 ms to 1000000 ms	10000 ms
466	HzCtl.OpMaxNom	40.00 Hz to 70.00 Hz	country-specific
467	HzCtl.OpMinNom	40.00 Hz to 70.00 Hz	country-specific
468	HzCtl.Hi1Lim	40.00 Hz to 70.00 Hz	country-specific
469	HzCtl.Hi2Lim	40.00 Hz to 70.00 Hz	country-specific
470	HzCtl.Hi3Lim	40.00 Hz to 70.00 Hz	country-specific
471	HzCtl.Hi4Lim	40.00 Hz to 70.00 Hz	country-specific

No.	Name	Value/range	Default value
472	HzCtl.Hi5Lim	40.00 Hz to 70.00 Hz	country-specific
473	HzCtl.Hi6Lim	40.00 Hz to 70.00 Hz	country-specific
474	HzCtl.Hi1LimTm	0 ms to 1000000 ms	country-specific
475	HzCtl.Hi2LimTm	0 ms to 1000000 ms	country-specific
476	HzCtl.Hi3LimTm	0 ms to 1000000 ms	country-specific
477	HzCtl.Hi4LimTm	0 ms to 1000000 ms	country-specific
478	HzCtl.Hi5LimTm	0 ms to 1000000 ms	10000 ms
479	HzCtl.Hi6LimTm	0 ms to 1000000 ms	10000 ms
480	HzCtl.Lo1Lim	40.00 Hz to 70.00 Hz	country-specific
481	HzCtl.Lo2Lim	40.00 Hz to 70.00 Hz	country-specific
574	HzCtl.Lo3Lim	40.00 Hz to 70.00 Hz	country-specific
483	HzCtl.Lo4Lim	40.00 Hz to 70.00 Hz	country-specific
484	HzCtl.Lo5Lim	40.00 Hz to 70.00 Hz	country-specific
485	HzCtl.Lo6Lim	40.00 Hz to 70.00 Hz	country-specific
486	HzCtl.Lo1LimTm	0 ms to 10000000 ms	country-specific
487	HzCtl.Lo2LimTm	0 ms to 10000000 ms	country-specific
488	HzCtl.Lo3LimTm	0 ms to 10000000 ms	country-specific
489	HzCtl.Lo4LimTm	0 ms to 10000000 ms	country-specific
490	HzCtl.Lo5LimTm	0 ms to 10000000 ms	country-specific
491	HzCtl.Lo6LimTm	0 ms to 10000000 ms	10000 ms
492	VCtl.PkLim	0.00 pu to 2.00 pu	1.30 pu
493	VCtl.PkLimTm	0 to 1000	6
494	VCtl.Hyst	-0.100 pu to +0.100 pu	0.002 pu
495	HzCtl.DifMax	0.000 Hz/s to 50.000 Hz/s	50.000 Hz/s
496	HzCtl.DifMaxTm	0 ms to 1000000 ms	10000 ms
497	GriErrTm	0 s to 3600 s	country-specific
733	ErrClr	Ackn	–
718	Frt.Mod	Disable | Full | Partial | Active Current Constant | Momentary Cessation | Maximum Active Current	country-specific
725	WGraMod	Enable | Disable	Enable
726	WGra	0.000000 pu/s to 100.000000 pu/s	0.200000 pu/s

No.	Name	Value/range	Default value
727	VArGraMod	Enable | Disable	Enable
728	VArGra	0.000 pu/s to 100.000 pu/s	0.100 pu/s
6029	PFCtlW.WRef1	-1.00 pu to +1.00 pu	0.00 pu
6030	PFCtlW.WRef2	-1.00 pu to +1.00 pu	1.00 pu
6031	PFCtlW.WRef3	-1.00 pu to +1.00 pu	1.00 pu
6032	PFCtlW.WRef4	-1.00 pu to +1.00 pu	1.00 pu
6033	PFCtlW.WRef5	-1.00 pu to +1.00 pu	1.00 pu
6034	PFCtlW.PFRef1	-1.00 to +1.00	-0.90
6035	PFCtlW.PFRef2	-1.00 to +1.00	0.90
6036	PFCtlW.PFRef3	-1.00 to +1.00	1.00
6037	PFCtlW.PFRef4	-1.00 to +1.00	1.00
6038	PFCtlW.PFRef5	-1.00 to +1.00	1.00
6040	PFCtlW.VolMod	0 to 1	0
6041	PFCtlW.VolDsaPF	-1.00 pu to +1.00 pu	1.00 pu
6042	PFCtlW.VolEnaVol	0.000 pu to 2.000 pu	1.050 pu
6043	PFCtlW.VolDsaVol	0.000 pu to 2.000 pu	1.000 pu
6044	PFCtlW.VolEnaTm	0 ms to 1000000 ms	1000 ms
6045	PFCtlW.VolDsaTm	0 ms to 1000000 ms	1000 ms
6047	VArCtlVol.VolOfs	-10.0000 pu to +10.0000 pu	0.0000 pu
6048	VArCtlVol.LoVolRef1HiVolRef1	0.000 pu to 2.000 pu	1.000 pu
6050	VArCtlVol.LoVolRef2	0.000 pu to 2.000 pu	0.945 pu
6051	VArCtlVol.LoVolRef3	0.000 pu to 2.000 pu	0.000 pu
6052	VArCtlVol.HiVolRef2	0.000 pu to 2.000 pu	1.055 pu
6053	VArCtlVol.HiVolRef3	0.000 pu to 2.000 pu	2.000 pu
6054	VArCtlVol.LoGra1	0.00 pu to 100.00 pu	0.00 pu
6055	VArCtlVol.HiGra1	0.00 pu to 100.00 pu	0.00 pu
6056	VArCtlVol.LoGra2	0.00 pu to 100.00 pu	15.00 pu
6057	VArCtlVol.HiGra2	0.00 pu to 100.00 pu	15.00 pu
6058	VArCtlVol.LoGra3	0.00 pu to 100.00 pu	0.00 pu
6059	VArCtlVol.HiGra3	0.00 pu to 100.00 pu	0.00 pu
6060	VArCtlVol.VArSptFilTm	0.000 s to 1000.000 s	0.500 s

No.	Name	Value/range	Default value
6061	VArCtlVol.WMod	0 to 1	0
6062	VArCtlVol.WEnaW	0.00 pu to 1.00 pu	0.50 pu
6063	VArCtlVol.WDsaW	0.00 pu to 1.00 pu	0.50 pu
6064	VArCtlVol.WEnaTm	0 ms to 1000000 ms	1000 ms
6065	VArCtlVol.WDsaTm	0 ms to 1000000 ms	1000 ms
6073	GriMng.ComFltFlbTmLim	0 s to 86400 s	3600 s
6071	GriMng.ComFltFlbWMod	Error | Standby | WSptFlb | Last setpoint	Error
6080	GriMng.VArMod	VArCtlAnIn | PFCtlAnIn | VArCtlCom | PFCtl-Com | AutoCom | VArCtlMan | PFCtlMan | Off	VArCtlMan
6088	GriMng.InvVArMod	Off | VArCtlVol | VArCtlVolPi | PFCtlW | VArCtlW	Off
6091	AmpGraMod	Enable | Disable	Disable
6092	AmpRtg	1 A to 10000 A	3350 A
6093	AmpGra	0.0001 pu/s to 100.0000 pu/s	0.0500 pu/s
6095	VolRtg	1 V to 1000 V	385 V
6109	Frt.VolFilMod	PT1 filtered grid voltage | VolRtg	PT1 filtered grid volt-age
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 | Re-mote Gfdi UL | Remote Gfdi and Bender | Remote Gfdi and Bender UL | Bender | Float Controller and Bender | Float Controller | Disable	Remote Gfdi
6335	DclVolLim	0 V to 2000 V	country-specific

No.	Name	Value/range	Default value
6582	WCtlHz.CfgMod	HzGra | W	country-specific
6584	WCtlHz.W2	0.000 pu to 1.000 pu	0.000 pu
6586	WCtlHz.W3	0.000 pu to 1.000 pu	0.000 pu
6588	WCtlHz.W4	0.000 pu to 1.000 pu	0.000 pu
6640	PvGnd.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	0.000 s to 1000.000 s	0.500 s
6710	Pld.Mod	Enable | Disable	Disable
6817	Cnt.Rs	Select counter to reset | All counter | Cnt.TotAcWhOut + Cnt.TotDcWhIn | Cnt.AcWhOut + Cnt.DcWhIn | Cnt.YstdAcWhOut | Cnt.TotDcWhOut + Cnt.TotAcWhIn | Cnt.DcWhOut + Cnt.AcWhIn | Cnt.TotVArOvExt | Cnt.TotVArUnExt | Cnt.TotOpTm | Cnt.TotFeedTm | Cnt.DwnTm | Cnt.FanStkTm | Cnt.FanCab1Tm | Cnt.FanCab2Tm | Cnt.FanMvpsTm | Cnt.HtCabTm | Cnt.HtLoExlTmpTm | Cnt.AcSw | Cnt.PreChaSw | Cnt.CapacSw | Cnt.GfdiSw | Cnt.GfdiTr | Cnt.Dcs.TotDcWhIn + Cnt.Dcs.TotDcWhOut | Cnt.Dcs.DcWhIn + Cnt.Dcs.DcWhOut	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

No.	Name	Value/range	Default value
6934	WCtlLoHz.Hz4	0.000 Hz to 70.000 Hz	0.000 Hz
6936	WCtlLoHz.HzGra1	0.0000 pu/Hz to 10.0000 pu/Hz	0.3373 pu/Hz
6938	WCtlLoHz.HzGra2	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
6940	WCtlLoHz.HzGra3	0.0000 pu/Hz to 10.0000 pu/Hz	0.0000 pu/Hz
6942	WCtlLoHz.HzStopMin	0.000 Hz to 70.000 Hz	country-specific
6944	WCtlLoHz.HzStopMax	0.000 Hz to 100.000 Hz	65.000 Hz
6946	WCtlLoHz.HzStopTm	0 ms to 1000000 ms	0 ms
6948	WCtlLoHz.WGraPosEna	0 to 1	1
6950	WCtlLoHz.WGraNegEna	0 to 1	1
6952	WCtlLoHz.WGraPos	0.0000 pu/s to 10.0000 pu/s	1.0000 pu/s
6954	WCtlLoHz.WGraNeg	0.0000 pu/s to 10.0000 pu/s	1.0000 pu/s
6956	WCtlLoHz.HzQtlIntv	0.000 Hz to 1.000 Hz	0.000 Hz
6958	WCtlLoHz.CfgMod	HzGra | W	HzGra
6960	WCtlLoHz.W2	1.000 pu to 100.000 pu	country-specific
6962	WCtlLoHz.W3	1.000 pu to 100.000 pu	country-specific
6964	WCtlLoHz.W4	1.000 pu to 100.000 pu	10.000 pu
6989	AuxSply.AutoProtMod	Enable | Disable	Enable
6991	AuxSply.OvVolLim	0.00 pu to 2.00 pu	1.20 pu
6993	AuxSply.ConOpnTm	0 ms to 100000 ms	1 ms
6995	AuxSply.ConClsTm	0 ms to 100000 ms	500 ms
7048	PvGnd.AcIsoMonTm	0.0 s to 86400.0 s	0.0 s
7085	AuxSply.UnVolLim	0.00 pu to 2.00 pu	0.75 pu
7211	ErrClr.ProErr	Gfdi | Aid | Pld | IsoBender | Frq | VCtl.LoLim | VCtl.HiLim | VCtl.PkLim | All	–
7212	ProErr	0 to 1073741823	0
7214	PvGnd.WaitDcIsoMonTm	5.0 s to 86400.0 s	2000.0 s
7216	Eps.Tm	0 to 2592000	0
7231	PwrSpt2StbyTm	0.1 s to 4294960.0 s	30.0 s
7239	InvTstMod	No test | Fan | Signal lamp | MVTrf Fan | Service test	No test
7278	BatCtl.ComFlb.FlbMod	Error | Standby | Predefined | Last setpoint	Last setpoint

No.	Name	Value/range	Default value
7280	BatCtl.ComFlb.CtlMod	Power Control | DC Voltage Control | Last Control Mode	Last Control Mode
7282	BatCtl.ComFlb.DcAmpSpt	-10000 A to +10000 A	0 A
7284	BatCtl.ComFlb.DclVolSpt	0 V to 2000 V	750 V
7286	BatCtl.ComFlb.WSpt	-5000 kW to +5000 kW	0 kW
7288	BatCtl.ComFlb.VArSpt	-5000 kVAr to +5000 kVAr	0 kVAr
7298	BatCtl.ComFlb.FlbTmLim	0 s to 86400 s	300 s
7311	WCtlHzBat.Hz1	0.000 Hz to 70.000 Hz	44.000 Hz
7313	WCtlHzBat.Hz2	0.000 Hz to 70.000 Hz	46.000 Hz
7315	WCtlHzBat.Hz3	0.000 Hz to 70.000 Hz	48.000 Hz
7317	WCtlHzBat.Hz4	0.000 Hz to 70.000 Hz	49.500 Hz
7319	WCtlHzBat.Hz5	0.000 Hz to 70.000 Hz	50.500 Hz
7321	WCtlHzBat.Hz6	0.000 Hz to 70.000 Hz	52.000 Hz
7323	WCtlHzBat.Hz7	0.000 Hz to 70.000 Hz	54.000 Hz
7325	WCtlHzBat.Hz8	0.000 Hz to 70.000 Hz	56.000 Hz
7327	WCtlHzBat.W1	-1.000 pu to +1.000 pu	1.000 pu
7329	WCtlHzBat.W2	-1.000 pu to +1.000 pu	0.700 pu
7331	WCtlHzBat.W3	-1.000 pu to +1.000 pu	0.200 pu
7333	WCtlHzBat.W4	-1.000 pu to +1.000 pu	0.000 pu
7335	WCtlHzBat.W5	-1.000 pu to +1.000 pu	0.000 pu
7337	WCtlHzBat.W6	-1.000 pu to +1.000 pu	-0.200 pu
7339	WCtlHzBat.W7	-1.000 pu to +1.000 pu	-0.700 pu
7341	WCtlHzBat.W8	-1.000 pu to +1.000 pu	-1.000 pu
7352	BatCtl.ComFlb.AuxCtlEna	Off | On	–
7353	BatCtl.ComFlb.BatEna	Off | On	–
7406	Hw.MvpsMod	Disable (Single Inverter) | MVPS SMA Double | MVPS Customer Double | MVPS SMA Single	Disable (Single Inverter)
7413	BatCtl.ComFlb.HzNomSpt	40.00 Hz to 70.00 Hz	50.00 Hz
7415	BatCtl.ComFlb.VolNomSpt	0.8500 pu to 1.1500 pu	1.0000 pu
7463	GriMng.ComFltFlbRstrWMod	Error | Standby | WSptFlb	Error
7469	InstFunc	Systemreset Acc, Dcc, Rio, Cont	—

No.	Name	Value/range	Default value
7523	WGraStr	0.001000 pu/s to 100.000000 pu/s	100.000000 pu/s
7525	VArCtlVol.EnaTm	0 ms to 100000 ms	0 ms
7527	WCtlHz.EnaTm	0 ms to 100000 ms	0 ms
7536	BatCtl.ComFlb.WCtlHzBatMod	Enable | Disable	Disable
7534	WCtlHzBatMod	Enable | Disable	Disable
7576	GriForm.AcCtl.DrpHz	-10.000D1P_UNIT_HZ_PER_PU to +10.000D1P_UNIT_HZ_PER_PU	-1,000D1P_UNIT_HZ_PER_PU
7577	GriForm.AcCtl.DrpVol	0.000 to 1.000	0.030
7646	HzNomSptLim	0.000 Hz to 20.000 Hz	2.000 Hz
7671	BatCtl.ComFlb.PFSpt	-1.0000 to +1.0000	1.0000
7682	PvGnd.OpnRemGfdi	Enable | Disable	Disable
7684	HzCtl.OpMaxNomRecon	40.00 Hz to 70.00 Hz	50.05 Hz
7686	VArRtgQoD	1 kVAr to 5000 kVAr	device-specific
7712	DclVolSptGra	0.0 V/s to 100000.0 V/s	50.0 V/s
7714	DcAmpSptGra	0 A/s to 1000000 A/s	500 A/s
7892	Frt.WaitTmLo	0.02 s to 20.00 s	country-specific
7894	Frt.HystEna	Enable | Disable	Disable
7896	Frt.LoDbHyst	0.00 pu to 1.00 pu	0.92 pu
7898	Frt.HiDbHyst	1.00 pu to 1.50 pu	1.08 pu
7900	Frt.ExpryEna	Enable | Disable	Disable
7902	Frt.LoDbExpry	0.00 pu to 1.00 pu	0.90 pu
7904	Frt.HiDbExpry	1.00 pu to 1.50 pu	1.10 pu
7906	Frt.ExpryTm	0.00 s to 10000.00 s	60.00 s
7908	Frt.ExpryEndTm	0.00 s to 10000.00 s	1.00 s
7913	StbySfCapacMod	Standby with capacitor | Standby without capacitor	Standby without capacitor
7929	Gfdi.FltEnWarnLim	0% to 100%	80 %
7931	Gfdi.CurLim	0.00 A to 32.00 A	device-specific
7997	GriForm.Frt.Mod	Disable | Full (Virt. Impedance)	Full (Virt. Impedance)
8001	GriForm.Frt.AmpCtlEna	Enable | Disable	Enable
8090	Frt.AmpQLim	0.00 pu to 2.00 pu	2.00 pu
8094	FrtStep.HiDb	1.00 pu to 1.50 pu	1.05 pu

No.	Name	Value/range	Default value
8096	FrtStep.LoDb	0.00 pu to 1.00 pu	0.95 pu
8098	FrtStep.ExpryTm	0.00 s to 10000.00 s	5.00 s
8100	FrtStep.Ena	Enable | Disable	Disable
8102	FrtStep.VolFilTm	0.0 s to 600.0 s	1.0 s
8146	DcSwNormWrn	0 to 100000	9000
8148	DcSwNormErr	0 to 100000	10000
8150	DcSwOvAmpErr	0 to 100	device-specific
8156	WCtlVol.Ena	Enable | Disable	Disable
8158	WCtlVol.CrvNumPt	1 to 4	2
8160	WCtlVol.Vol1	0.0000 pu to 2.0000 pu	1.1000 pu
8162	WCtlVol.Vol2	0.0000 pu to 2.0000 pu	1.2000 pu
8164	WCtlVol.Vol3	0.0000 pu to 2.0000 pu	2.0000 pu
8166	WCtlVol.Vol4	0.0000 pu to 2.0000 pu	2.0000 pu
8168	WCtlVol.W1	-200.00% to +200.00%	100.00 %
8170	WCtlVol.W2	-200.00% to +200.00%	0.00 %
8172	WCtlVol.W3	-200.00% to +200.00%	0.00 %
8174	WCtlVol.W4	-200.00% to +200.00%	0.00 %
8176	WCtlVol.WRefMod	WNom | W actual | WSnptMax	WNom
8178	WCtlVol.WFilEna	Enable | Disable	Enable
8180	WCtlVol.WFilTm	0.000 s to 600.000 s	1.000 s
8182	WCtlVol.WGraEna	Enable | Disable	Disable
8184	WCtlVol.WGraPos	0.000%/s to 1000.000%/s	100.000%/s
8186	WCtlVol.WGraNeg	0.000%/s to 1000.000%/s	100.000%/s
8188	WCtlVol.ActDlTm	0.000 s to 600.000 s	0.000 s
8259	VArCtlVol.VolFilTm	0.00 s to 5000.00 s	0.50 s
8261	VArCtlVol.VolNomSptMod	VolNomSpt | InvMs.Vol.PsNom | InvMs.Vol.PsNom init. meas.	VolNomSpt
8276	VArCtlW.CrvNumPt	0 to 8	4
8278	VArCtlW.W1	-100.00% to +100.00%	50.00 %
8280	VArCtlW.W2	-100.00% to +100.00%	60.00 %
8282	VArCtlW.W3	-100.00% to +100.00%	90.00 %
8284	VArCtlW.W4	-100.00% to +100.00%	100.00 %

No.	Name	Value/range	Default value
8286	VArCtlW.W5	-100.00% to +100.00%	100.00 %
8288	VArCtlW.W6	-100.00% to +100.00%	100.00 %
8290	VArCtlW.W7	-100.00% to +100.00%	100.00 %
8292	VArCtlW.W8	-100.00% to +100.00%	100.00 %
8294	VArCtlW.VAr1	-100.00% to +100.00%	0.00 %
8296	VArCtlW.VAr2	-100.00% to +100.00%	-5.00 %
8298	VArCtlW.VAr3	-100.00% to +100.00%	-33.00 %
8300	VArCtlW.VAr4	-100.00% to +100.00%	-33.00 %
8302	VArCtlW.VAr5	-100.00% to +100.00%	-33.00 %
8304	VArCtlW.VAr6	-100.00% to +100.00%	-33.00 %
8306	VArCtlW.VAr7	-100.00% to +100.00%	-33.00 %
8308	VArCtlW.VAr8	-100.00% to +100.00%	-33.00 %
8310	VArCtlW.VArRefMod	WNom | VArNom	VArNom
8312	VArCtlW.VArFilEna	Enable | Disable	Enable
8314	VArCtlW.VArGraEna	Enable | Disable	Disable
8316	VArCtlW.VArDynEna	Enable | Disable	Disable
8318	VArCtlW.VArFilTm	0.010 s to 1000.000 s	10.000 s
8320	VArCtlW.VArGraPos	1.000%/s to 10000.000%/s	100.000%/s
8322	VArCtlW.VArGraNeg	1.000%/s to 10000.000%/s	100.000%/s
8324	GriMng.VArLimVolMod	Off | Curve	Off
8326	VArLimVolCrv.Vol1	0.0000 pu to 2.0000 pu	0.9400 pu
8328	VArLimVolCrv.Vol2	0.0000 pu to 2.0000 pu	0.9600 pu
8330	VArLimVolCrv.Vol3	0.0000 pu to 2.0000 pu	1.0400 pu
8332	VArLimVolCrv.Vol4	0.0000 pu to 2.0000 pu	1.0600 pu
8334	VArLimVolCrv.VAr1	-100.00% to +100.00%	33.00 %
8336	VArLimVolCrv.VAr2	-100.00% to +100.00%	0.00 %
8338	VArLimVolCrv.VAr3	-100.00% to +100.00%	0.00 %
8340	VArLimVolCrv.VAr4	-100.00% to +100.00%	-33.00 %
8342	VArLimVolCrv.VArRefMod	WNom | VArNom	VArNom
8346	VArLimVolCrv.VArFilEna	Enable | Disable	Enable
8348	VArLimVolCrv.VArGraEna	Enable | Disable	Disable

No.	Name	Value/range	Default value
8350	VArLimVolCrv.VArDynEna	Enable | Disable	Disable
8352	VArLimVolCrv.VArFilTm	0.010 s to 1000.000 s	10.000 s
8354	VArLimVolCrv.VArGraPos	1.000%/s to 10000.000%/s	1200.000%/s
8356	VArLimVolCrv.VArGraNeg	1.000%/s to 10000.000%/s	1200.000%/s
8386	WSptMinMan	-5000 kW to +5000 kW	device-specific
8388	WSptMinFlb	-5000 kW to +5000 kW	device-specific
8390	GriMng.WMinMod	WMinCtlCom | WMinCtlMan	WMinCtlMan
8416	VArFilMod	Enable | Disable	Disable
8418	VArFilTm	0.000 s to 100.000 s	0.500 s
8420	WFilMod	Enable | Disable	Disable
8422	WFilTm	0.000 s to 100.000 s	0.500 s
8451	WCtlHzLoHi.HzOv1	0.000 Hz to 70.000 Hz	50.200 Hz
8453	WCtlHzLoHi.HzOv2	0.000 Hz to 70.000 Hz	65.000 Hz
8455	WCtlHzLoHi.HzOv3	0.000 Hz to 70.000 Hz	65.000 Hz
8457	WCtlHzLoHi.HzOvGra1	-1000.000 %/Hz to 0.000 %/Hz	-40.000%/Hz
8459	WCtlHzLoHi.HzOvGra2	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8461	WCtlHzLoHi.HzOvGra3	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8463	WCtlHzLoHi.HzUn1	0.000 Hz to 70.000 Hz	49.800 Hz
8465	WCtlHzLoHi.HzUn2	0.000 Hz to 70.000 Hz	45.000 Hz
8467	WCtlHzLoHi.HzUn3	0.000 Hz to 70.000 Hz	45.000 Hz
8469	WCtlHzLoHi.HzUnGra1	-1000.000 %/Hz to 0.000 %/Hz	-40.000%/Hz
8471	WCtlHzLoHi.HzUnGra2	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8473	WCtlHzLoHi.HzUnGra3	-1000.000 %/Hz to 0.000 %/Hz	0.000%/Hz
8475	WCtlHzLoHi.HzStopMax	0.000 Hz to 70.000 Hz	50.200 Hz
8477	WCtlHzLoHi.HzStopMin	0.000 Hz to 70.000 Hz	49.800 Hz
8479	WCtlHzLoHi.WSptFilTm	0.001 s to 100.000 s	0.001 s
8481	WCtlHzLoHi.WGra	0 %/min to 600000 %/min	9 %/min
8483	WCtlHzLoHi.OvGraWRefMod	WNom | W actual | WSnptMax	WNom
8485	WCtlHzLoHi.UnGraWRefMod	WNom | W actual | WSnptMax	WNom
8487	WCtlHzLoHi.DrgIndOvEna	Enable | Disable	Disable
8489	WCtlHzLoHi.DrgIndUnEna	Enable | Disable	Disable

No.	Name	Value/range	Default value
8491	WCtlHzLoHi.WSptDl	0 ms to 500 ms	0 ms
8493	WCtlHzLoHi.HzStopTm	0.000 s to 1000.000 s	0.000 s
8495	WCtlHzLoHiMod	Enable | Disable	Disable
8497	VArCtlVol.VolPsNomHiLim	1.0000 pu to 2.0000 pu	1.1000 pu
8499	VArCtlVol.VolPsNomLoLim	0.0000 pu to 1.0000 pu	0.9000 pu
8524	HzCtl.OpMinNomRecon	40.00 Hz to 70.00 Hz	country-specific
8526	VCtl.OpMaxNomRecon	0.00 pu to 2.00 pu	country-specific
8528	VCtl.OpMinNomRecon	0.000 pu to 2.000 pu	country-specific
8538	WSptMaxMan	-5000 kW to +5000 kW	device-specific
8540	WSptMaxFlb	-5000 kW to +5000 kW	device-specific
8542	GriMng.WMaxMod	WMaxCtlCom | WMaxCtlMan	WMaxCtlMan
8544	WSptMaxMinFilMod	Enable | Disable	Disable
8546	WSptMaxMinFilTm	0.000 s to 100.000 s	0.500 s
8548	WSptMaxMinGraMod	Enable | Disable	Enable
8550	WSptMaxMinGra	0.000000 pu/s to 100.000000 pu/s	0.200000 pu/s
8563	GriForm.VolSptGra	0.01 pu/s to 100.00 pu/s	5.00 pu/s
8565	GriForm.AcRmpUpVolGra	0.01 pu/s to 100.00 pu/s	5.00 pu/s
8568	WGraFlb	0.000000 pu/s to 100.000000 pu/s	country-specific
8572	VArGraFlb	0.000 pu/s to 100.000 pu/s	country-specific
8582	GriForm.HzSptGra	0.0001 Hz/s to 1000.0000 Hz/s	2.0000 Hz/s
8605	Chop.CrtMax	0 to 1000	50
8607	Frt.SepNsGraEna	Enable | Disable	Disable
8609	Frt.SepNsGra	0.00 to 10.00	2.00
8620	VArCtlVol.VArOfs	-1.0000 pu to +1.0000 pu	0.0000 pu
8630	AcCtl.AmpABCtlEna	Enable | Disable	Disable
8665	VCtl.PkLimBlkPwm.Ena	Enable | Disable	Disable
8667	VCtl.PkLimBlkPwm.PkLimAct	0.00 pu to 2.00 pu	1.25 pu
8669	VCtl.PkLimBlkPwm.PkLimActTm	0 to 3000	6
8671	VCtl.PkLimBlkPwm.PkLimDeact	0.00 pu to 2.00 pu	0.50 pu
8673	VCtl.PkLimBlkPwm.PkLimDeactTm	0 to 3000	6
8675	VCtl.PkLimBlkPwm.BlkOffDlTm	0 to 6000	300

No.	Name	Value/range	Default value
8677	AmpGraRmpDwn	0.0001 pu/s to 10.0000 pu/s	0.5000 pu/s
8679	InvPwrOnStpEna	Enable | Disable	Disable
8687	GriMng.ComFltTmLim	0.0 s to 86400.0 s	300.0 s
8689	BatCtl.ComFlb.BatTmLim	0.1 s to 86400.0 s	500.0 s
8691	BatCtl.ComFlb.AuxCtlTmLim	0.1 s to 86400.0 s	300.0 s
8843	VArCtlVol.CfgMod	Gra | VAr	Gra
8845	VArCtlVol.LoVAr2	-1.000 pu to +1.000 pu	0.000 pu
8847	VArCtlVol.HiVAr2	-1.000 pu to +1.000 pu	0.000 pu
8849	VArCtlVol.LoVAr3	-1.000 pu to +1.000 pu	0.440 pu
8851	VArCtlVol.HiVAr3	-1.000 pu to +1.000 pu	-0.440 pu
8945	ExlConnEna	Enable | Disable	Disable
8947	ExlConn	Enable | Disable	Disable
8957	DcSw.OpnStbyEna	Enable | Disable	Disable
8991	GriMng.ExtdFlbEna	Enable | Disable	Disable
8994	GriMng.ExtdFlbErrClr	Ackn	–
9036	VArCtlVol.VArRefMod	WNom | VArNom | VANom	VANom
4900	Alrm.Mail.Ena	–	–
4901	Alrm.Smtp.Adr	–	–
4902	Alrm.Smtp.Port	1 to 65535	25
4903	Alrm.Smtp.Usr	–	–
4904	Alrm.Smtp.Pwd	–	–
4905	Alrm.Smtp.Cry	None | SSL | StartTLS | TryTLS	–
4906	Alrm.Mail.Recp	–	–
4907	Alrm.Smtp.TxAdr	–	–
4908	Alrm.Mail.Tst	–	–
4910	Alrm.Email.Lang	english | german | greek | spanish | french | italian | czech | portuguese	english
3960	AuxCtl.SCSOpCmd	–	0
3961	AuxCtl.SOCOpMax	0 to 100	100
3962	AuxCtl.SOCOpMin	0 to 100	0
3959	Bat.OpMod.ReqCanc	–	0
3958	Bat.OpMod.ReqOk	–	0

No.	Name	Value/range	Default value
3921	Bsc.BatEna	–	1
3957	Bsc.BatOpTmLim	0 to 3600	60
3940	Bsc.BatStrProc	–	0
3926	Bsc.DcAmpDynMax	0 to 10000	4000
3927	Bsc.DcAmpDynMin	-10000 to 0	-4000
3928	Bsc.DcAmpOpMax	0 to 10000	5000
3929	Bsc.DcAmpOpMin	-10000 to 0	-5000
3930	Bsc.DcAmpSptMan	-10000 to +10000	0
3932	Bsc.DcVolDynMax	0 to 2000	1500
3933	Bsc.DcVolDynMin	0 to 2000	550
3934	Bsc.DcVolOpMax	0 to 2000	1600
3935	Bsc.DcVolOpMin	0 to 2000	500
3931	Bsc.DcVolSptMan	0 to 2000	850
3946	Bsc.ErrClrTime	0 to 1000000	0
3963	Bsc.ExtDcAmpLimEna	–	0
3923	Bsc.HzNomSptMan	45 to 70	50
3939	Bsc.InvEff	50 to 100	97
3941	Bsc.InvStrMod	–	0
3956	Bsc.NomCapStrg	0 to 1000000	1
3936	Bsc.PFSptMan	-1 to +1	1
3955	Bsc.RisInStrg	0 to 10000	50
3943	Bsc.SCSOpCmdMan	–	0
3949	Bsc.SOCLimEna	–	1
3951	Bsc.SOCOpHys	0 to 20	3
3952	Bsc.SOCOpMax	0 to 100	100
3953	Bsc.SOCOpMin	0 to 100	0
3954	Bsc.SOCRes	0 to 10	0.1
3948	Bsc.SOCestEna	–	1
3942	Bsc.SrcSel	–	1
3945	Bsc.VArSptMan	-5000 to +5000	0
3922	Bsc.VolNomSptMan	0 to 1.15	1

No.	Name	Value/range	Default value
3944	Bsc.WSptMan	-5000 to +5000	0
3924	Bsc.ZPO.ZeroPwrAtOfs	-20 to +20	-4
3925	Bsc.ZPO.ZeroPwrAtOfsEna	–	1
4969	FtpSrv.Mode	Off | Ftp only | secure FTP (FTPS) only | secure FTP (FTPS) + FTP	Off
4971	Ftpush.CertEna	–	0
4972	Ftpush.CertPass	–	–
4970	Ftpush.Mode	active FTP | passive FTP | SFTP | FTPS	active FTP
4950	Ftpush.SrvAdr	–	–
4954	Ftpush.SrvDir	–	–
4951	Ftpush.SrvPort	0 to 65535	21
4952	Ftpush.SrvUsr	–	–
4953	Ftpush.SrvPwd	–	–
4955	Ftpush.Upld	–	0
4956	Ftpush.UpldCyc	–	0
4962	Ftpush.Tst	–	0
4980	Fmspush.Upld	–	–
4981	Fmspush.UpldCyc	Off | Daily	Off
4987	Fmspush.Tst	–	–
4993	Fmspush.LastTm	–	–
4129	Netw.Dns.SrvIpAdr	–	–
4106	Netw.Hima.IpAdrCfg	–	–
4109	Netw.Lan2.DhcpSrvCfg	–	–
4112	Netw.Lan2.DhcpSrvEna	–	0
4104	Netw.Lan2.IpAdrCfg	–	–
4101	Netw.Lan2.ItfMod	Off | Static | DHCP Client	Static
4110	Netw.Lan3.DhcpSrvCfg	–	–
4113	Netw.Lan3.DhcpSrvEna	–	0
4105	Netw.Lan3.IpAdrCfg	–	–
4102	Netw.Lan3.ItfMod	Off | Static | DHCP Client	Static
4137	Netw.Nat.Ena	–	0
4143	Netw.Proxy.Adr	–	–

No.	Name	Value/range	Default value
4141	Netw.Proxy.AuthEna	–	0
4138	Netw.Proxy.FtpEna	–	0
4140	Netw.Proxy.MailEna	–	0
4142	Netw.Proxy.Port	–	8080
4145	Netw.Proxy.Pwd	–	–
4139	Netw.Proxy.SunnyPortalEna	–	0
4144	Netw.Proxy.Usr	–	–
4114	Netw.StdGw.IpAdr	–	172.24.1.1
4568	Portald.Act.Conn.Chk	–	0
4566	Portald.Act.Rgst.Dev	–	0
4565	Portald.Act.Rgst.Plnt	–	0
4571	Portald.Act.Rgst.Sub.Dev	–	0
4567	Portald.Act.Upld	–	0
4562	Portald.Conn.Lim.Tm	10 s to 60 s	10 s
4552	Portald.Plnt.Id	–	–
4569	Portald.Plnt.Lang	–	–
4551	Portald.Plnt.Nam	–	–
4563	Portald.Rx.Lim.Tm	30 s to 120 s	30 s
4564	Portald.Tx.Lim.Tm	30 s to 120 s	30 s
4553	Portald.Upld.Cyc	Off | 15min | 30min | 60min | 2h | 4h | 6h | 8h | 12h | 24h	Off
4561	Portald.Upld.Mod	HTTP | HTTPS (SSL)	HTTP
4570	Portald.Usr.Lang	–	–
4550	Portald.Usr.Mail	–	–
4233	Smgr.Ui.SysDecPt	, | .	,
4231	Smgr.Ui.SysDtFmt	DD.MM.YYYY | YYYY-MM-DD | MM/DD/YYYY	DD.MM.YYYY
4236	Smgr.Ui.SysInvNam	–	–
4230	Smgr.Ui.SysLang	english | german	english
4234	Smgr.Ui.SysStrOfWeek	sunday | monday	monday
4235	Smgr.Ui.SysThousandSep	. | , | –	–
4232	Smgr.Ui.SysTmFmt	HH:MM:SS | HH:MM:SS AM/PM	HH:MM:SS

No.	Name	Value/range	Default value
4500	Tm.Sys.SynMod	None | NTP	None
4502	Tm.Sys.Tm	–	–
4503	Tm.Sys.TmZn	–	–
4504	Tm.Ntp.SrvAdr	–	–
4505	Tm.Ntp.SynTm	15min | 30min | 60min | 2h | 4h | 6h | 8h | 12h | 24h	30 min

16 Technical Data

16.1 Inverter

16.1.1 Sunny Central Storage 2200-US

DC terminal	
DC voltage range	570 V to 950 V
Minimum / maximum DC voltage	545 V to 1100 V*
Maximum DC current at 25°C (+77°F)	3960 A
Maximum DC current at 50°C (+122°F)	3600 A
Maximum DC short-circuit current	6400 A
Maximum DC power at cos φ = 1	2235 kW
Maximum number of DC cables per DC input for each polarity	26
Maximum cable cross-section per DC cable	400 mm² (800 kcmil)

* With power derating

AC terminal	
Nominal AC power at 25°C (+77°F)	2200 kVA
AC power at 50 °C (+122 °F)	2000 kVA
Maximum output current $I_{AC, max}$	3300 A
Nominal AC current $I_{AC, nom}$	3000 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	385 V / 308 V to 462 V
AC power frequency / frequency range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Power factor at rated power / adjustable displacement power factor	1 / 0 overexcited to 0 underexcited*

* Depending on the DC voltage

Efficiency	
Maximum efficiency, measured without energy self-sufficiency	98.6 %
European weighted efficiency, measured without energy self-sufficiency	98.4 %
CEC weighted efficiency, measured without supply voltage*	98.0 %

* Test measurement similar to the PV inverter

Protective Devices	
Input-side disconnection point	DC Load-Break Switch
AC disconnection point	AC circuit breaker
DC overvoltage protection	Surge arrester, type I
Overcurrent protection device (according to NEC, ANSI/NFPA 70)	3600 A
Ground-fault monitoring / remote ground-fault monitoring	Optional / optional
Insulation monitoring	Standard features
Degree of protection (as per IEC 60529): electronics / air duct / connection area	IP65
Degree of protection (as per UL 50E)	Type 3R
General Data	
Width x height x depth	2780 mm x 2318 mm x 1588 mm (109.4 in x 91.3 in x 62.5 in)
Weight	< 3400 kg (< 7500 lb)
Maximum self-consumption (rated operation) / self-consumption (standby)	< 8100 W / < 300 W
Internal supply voltage / external supply voltage	Integrated 8.4 kVA transformer / optional
Noise emission with distance of 10 m / 50 m (33 ft / 164 ft)*	64.7 dB(A) / 50.6 dB(A)
Maximum permissible value for relative humidity (non-condensing)	0% to 95%
Max. permissible value for relative humidity (condensing)	> 95% to 100% (up to two months per year)
Maximum operating altitude up to MSL 2000 m	Standard features
Fresh air consumption	6500 m^3/h
* The noise emission can be reduced by using the optional silencing baffle.	
Equipment	
DC terminal	Terminal lug at each input
AC terminal	Track system
Communication	Ethernet, Ethernet/IP, Modbus TCP/IP
Color enclosure / roof	RAL 9016 / RAL 7004
Display	HMI touch display (10.1") (optional)
Supply transformer for external loads	optional 2.5 kVA

Equipment	
Certificates and approvals	UL 1741, UL 1741 SA*, IEEE 1547, UL 1998, UL 840 Category IV, IEC / EN 61000-6-4, IEC / EN 61000-6-2, EN 55022, CISPR 22:2008 modified class A, FCC Part 15 Class A

* For operation with power factor from 1 / 0.8 underexcited to 0.8 overexcited

16.1.2 Sunny Central Storage 2475-US

DC terminal	
DC voltage range	634 V to 1000 V
Minimum / maximum DC voltage	614 V to 1100 V*
Maximum DC current at 25°C (+77°F)	3960 A
Maximum DC current at 50°C (+122°F)	3600 A
Maximum DC short-circuit current	6400 A
Maximum DC power at cos φ = 1	2515 kW
Maximum number of DC cables per DC input for each polarity	26
Maximum cable cross-section per DC cable	400 mm² (800 kcmil)

* With power derating

AC terminal	
Nominal AC power at 25°C (+77°F)	2475 kVA
AC power at 50 °C (+122 °F)	2250 kVA
Maximum output current $I_{AC, max}$	3292 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / AC voltage range	434 V / 347 V to 520 V
AC power frequency / frequency range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Power factor at rated power / adjustable displacement power factor	1 / 0 overexcited to 0 underexcited*

* Depending on the DC voltage

Efficiency	
Maximum efficiency, measured without energy self-sufficiency	98.6 %
European weighted efficiency, measured without energy self-sufficiency	98.4 %

Efficiency	
CEC weighted efficiency, measured without supply voltage*	98.0 %
* Test measurement similar to the PV inverter	
Protective Devices	
Input-side disconnection point	DC Load-Break Switch
AC disconnection point	AC circuit breaker
DC overvoltage protection	Surge arrester, type I
Overcurrent protection device (according to IEC 62305-1)	3600 A
Ground-fault monitoring / remote ground-fault monitoring	Optional / optional
Insulation monitoring	Standard features
Degree of protection (as per IEC 60529): electronics / air duct / connection area	IP65 / IP34 / IP34
Degree of protection (as per UL 50E)	Type 3R
General Data	
Width x height x depth	2780 mm x 2318 mm x 1588 mm (109.4 in x 91.3 in x 62.5 in)
Weight	< 3400 kg (< 7500 lb)
Maximum self-consumption (rated operation) / self-consumption (standby)	< 8100 W / < 300 W
Internal supply voltage / external supply voltage	Integrated 8.4 kVA transformer / optional
Noise emission with distance of 10 m / 50 m (33 ft / 164 ft)*	64.7 dB(A) / 50.6 dB(A)
Maximum permissible value for relative humidity (non-condensing)	0% to 95%
Max. permissible value for relative humidity (condensing)	> 95% to 100% (up to two months per year)
Maximum operating altitude up to MSL 2000 m	Standard features
Fresh air consumption	6500 m^3/h
* The noise emission can be reduced by using the optional silencing baffle.	
Equipment	
DC terminal	Terminal lug at each input
AC terminal	Track system
Communication	Ethernet, Ethernet/IP, Modbus TCP/IP
Color enclosure / roof	RAL 9016 / RAL 7004

Equipment	
Display	HMI touch display (10.1") (optional)
Supply transformer for external loads	Optional 2.5 kVA
Certificates and approvals	UL 1741, UL 1741 SA*, IEEE 1547, UL 1998, UL 840 Category IV, IEC / EN 61000-6-4, IEC / EN 61000-6-2, EN 55022, CISPR 22:2008 modified class A, FCC Part 15 Class A

* For operation with power factor from 1 / 0.8 underexcited to 0.8 overexcited

16.1.3 Sunny Central Storage 2900-US

DC Connection	
DC voltage range	760 V to 1100 V
Minimum / maximum DC voltage	740 V to 1100 V[48)]
Maximum DC current at 25°C (+77°F)	3960 A
Maximum DC current at 50°C (+122°F)	3600 A
Maximum DC short-circuit current	6400 A
Maximum number of DC cables per DC input for each polarity	26
Maximum cable cross-section per DC cable	400 mm² (800 kcmil)
AC connection	
Nominal AC power at 1000 V_{DC} at 25°C / 40°C / 50°C (+77°F / 104°F / 122°F)	2940 kVA / 2780 kVA / 2670 kVA
Nominal AC power at 1100 V_{DC} at 25°C / 40°C / 50°C (+77°F / 104°F / 122°F)	2940 kVA / 2670 kVA / 2250 kVA
Maximum output current $I_{AC, max}$	3265 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range	520 V / 416 V to 624 V
AC power frequency / frequency range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz
Power factor at rated power / adjustable displacement power factor	1 / 0 overexcited to 0 underexcited[49)]
Efficiency	
Maximum efficiency, measured without energy self-sufficiency	98.6 %

48) With power derating

49) Depending on the DC voltage

Protective Devices	
Input-side disconnection point	DC Load-Break Switch
AC disconnection point	AC circuit breaker
DC overvoltage protection	Surge arrester, type I
Overcurrent protection device (according to IEC 62305-1)	3600 A
Ground-fault monitoring / remote ground-fault monitoring	Optional / optional
Insulation monitoring	Standard features
Degree of protection (as per IEC 60529): electronics / air duct / connection area	IP65 / IP34 / IP34
General Data	
Width x height x depth	2780 mm x 2318 mm x 1588 mm (109.4 in x 91.3 in x 62.5 in)
Weight	< 3400 kg
Maximum self-consumption (rated operation) / standby	< 8100 W / < 300 W
Internal supply voltage / external supply voltage	Integrated 8.4 kVA transformer / optional
Noise emission with distance 10 m / 50 m[50)]	64.7 dB(A) / 50.6 dB(A)
Maximum permissible value for relative humidity (non-condensing)	0% to 95%
Max. permissible value for relative humidity (condensing)	> 95% to 100% (up to two months per year)
Maximum operating altitude up to 2000 m	Standard features
Fresh air consumption	6500 m^3/h
Equipment	
DC terminal	Terminal lug at each input
AC Connection	Track system
Communication	Ethernet, Ethernet/IP, Modbus TCP/IP
Color enclosure / roof	RAL 9016 / RAL 7004
Display	HMI touch display (10.1") (optional)
Supply transformer for external loads	Optional 2.5 kVA
Certificates and approvals	CE, IEC / EN 62109-1, IEC / EN 62109-2, IEC / EN 61000-6-4, IEC / EN 61000-6-2, EN 55022

[50)] The noise emission can be reduced by using the optional silencing baffle.

16.2 MV Power Station

16.2.1 General Data

AC output	
Nominal AC voltage	12 kV to 34.5 kV
AC grid frequency	60 Hz
Transformer vector groups	Dy11 / YNd11[51] / YNy0[51]
Transformer cooling method	KNAN
Maximum total harmonic distortion	< 3 %
Power factor at rated power / adjustable displacement power factor	1 / 0.8 overexcited to 0.8 underexcited
Feed-in phases	3
General Data	
Width x height x depth (transport dimensions)	6058 mm x 2896 mm x 2438 mm (238.5 in x 114.0 in x 96.0 in)
Weight	< 18.0 t
Maximum Self-Consumption[52]	< 8.1 kW
Self-consumption at partial load[52]	< 1.8 kW
Average self-consumption [52]	< 2.0 kW
Standby consumption[52]	< 370 W
Max. permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above MSL	1000 m (3280 ft)
Maximum operating altitude above MSL for option "Installation at high altitudes"	2000 m (6561 ft)
Fresh air consumption[52]	6500 m^3/h
Medium-voltage and low-voltage compartment degree of protection according to IEC 60529	IP23D
Inverter electronics degree of protection	IP54
Degree of protection of the busbar conduit between the inverter and medium-voltage transformer	IP23D
Operating temperature range (standard)	-25 °C (-13 °F) to +45 °C (+113 °F)
Operating temperature range with the option "Ambient Temperature: -25°C to +55°C"	-25 °C (-13 °F) to +55 °C (+131 °F)

[51] Optional

[52] Information based on inverter

General Data	
Operating temperature range with the option "Ambient Temperature: −40°C to +45°C"	-37 °C (-35 °F) to +45 °C (+113 °F)
Operating temperature range with the option "Ambient Temperature: -35°C to +55°C"	-35 °C (-31 °F) to +55 °C (+131 °F)
Temperature range (storage)	–40 °C to +70 °C (–40 °F to +158 °F)
Standards and directives complied with	UL 847, IEEE 142, IEEE 80, IEEE 386, IEEE C57.12, C37.20.9, UL 1741 listed, CSC, UL 347

16.2.2 MV Power Station 2200

AC output	
Sunny Central Storage 1900: Power[53] at -25°C (-13°F)[54] to 25°C (77°F) / 40°C (104°F)[55]	1900 kVA / 1710 kVA
Sunny Central Storage 2200: Power[53] at -25°C (-13°F)[54] to 25°C (77°F) / 40°C (104°F)[55]	2200 kVA / 2000 kVA

16.2.3 MV Power Station 2475

AC Output	
Power[56] at -25°C (-13°F)[54] to 35°C (95°F) / 40°C (104°F)[55]	2475 kVA / 2250 kVA

AC Output	
Power[56] at -25°C (-13°F)[54] to 25°C (77°F) / 40°C (104°F)[55]	2475 kVA / 2250 kVA

16.2.4 MV Power Station 2900

AC Output	
Power[56] at -25°C (-13°F)[54] to 25°C (77°F) / 40°C (104°F)[55]	2940 kVA / 2670 kVA

[53] Information based on inverter; depending on the order option with 1000 m

[54] Optional -35°C (-31°F) or -37°C (-35°F)

[55] Optional 50°C (122°F)

[56] Information based on inverter; depending on the order option with 1000 m

17 Appendix

17.1 Overall System Requirements

- ☐ When designing the components of the battery storage system, you should take account of the maximum inrush current.
- ☐ During configuration, you should take account of the fact that the closed-loop control of the compensation plant on the MV side does not affect the closed-loop control of the inverter.
- ☐ When configuring the battery storage system, the relay times of the various medium-voltage switchgear must be coordinated with each other. This means that only PV systems, in which a disturbance has occurred, are disconnected from the utility grid.

17.2 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.

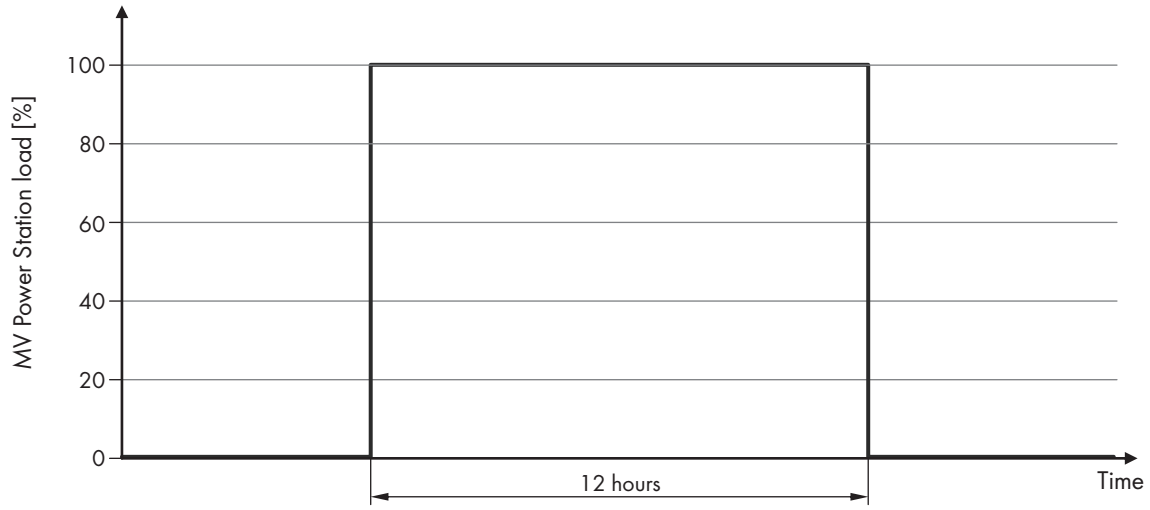


Figure 98: Maximum possible load profile of the MV Power Station without Q at Night

Depending on the order option, the MV Power Station can also be operated 24 hours with 100% station power.

17.3 Load Profile of the Low-Voltage Transformer

Depending on the order option, the MV Power Station is equipped with a low-voltage transformer with a nominal power of 10 kVA to 60 kVA. Above a nominal power of 30 kVA, the maximum continuous power over 24 hours per day is lower:

Nominal power	Continuous power
10 kVA	10 kVA
20 kVA	20 kVA
30 kVA	22 kVA
40 kVA	26 kVA
50 kVA	30 kVA
60 kVA	34 kVA

If the maximum nominal power of the low-voltage transformer is to be used, take intermittent operation into account. During intermittent operation, the low-voltage transformer supplies 6% of the power for 5 minutes. For example, a low-voltage transformer with 60 kVA has only 3.6 kVA available. To operate applications that only need power for a short time, the low-voltage transformer provides 100% of the power for 1 minute every 5 minutes. Thus, connected tracker motors can track the PV modules, for example.

To be able to have enough energy available to move the PV modules to a safe position in the event of a storm, the low-voltage transformer provides 100% of the power for 10 minutes after 6 intervals.

Time interval	Available power
1 minute (one-time start interval)	100 %
5 minutes (start of cyclical interval)	6 %
1 minute	100 %
5 minutes	6 %
1 minute	100 %
5 minutes	6 %
1 minute	100 %
5 minutes	6 %
1 minute	100 %
5 minutes	6 %
1 minute	100 %
5 minutes	6 %
10 minutes (end of cyclical interval)	100 %

17.4 Ambient Conditions

Requirements for the mounting location:

- ☐ The mounting location must be freely accessible at all times.
- ☐ The permissible maximum value for non-condensing relative humidity must not be exceeded. The permissible range is: 0% to 95%.
- ☐ The permissible maximum values for relative humidity must not be exceeded. The maximum values are as follows: 0% to 95% (annual average) and > 95% to 100% (up to two months per year).
- ☐ The fresh air consumption of the MV Power Station must be assured. The fresh air consumption is: 10000 m^3/h.
- ☐ The mounting location must be below the maximum installation altitude.
- ☐ The system must have a minimum clearance of 30 m (100 ft) 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: 2019 must be observed.
- ☐ The air quality for chemically active substances in accordance with ISO 12944-2: 2019 must be observed.
- ☐ If the inverter is deployed at locations with ambient conditions rating C5 according to ISO 12944-2 / ISO 9223, 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 standard	C5M / C4M / C3H (depending on the order option)
MV Power Station standard	C3 / 4S12 as per IEC 60721-3-4 (2019) or ISO 12944-2 / ISO 9223
MV Power Station Option Harsh	C5 / 4S13 as per IEC 60721-3-4 (2019) or ISO 12944-2 / ISO 9223

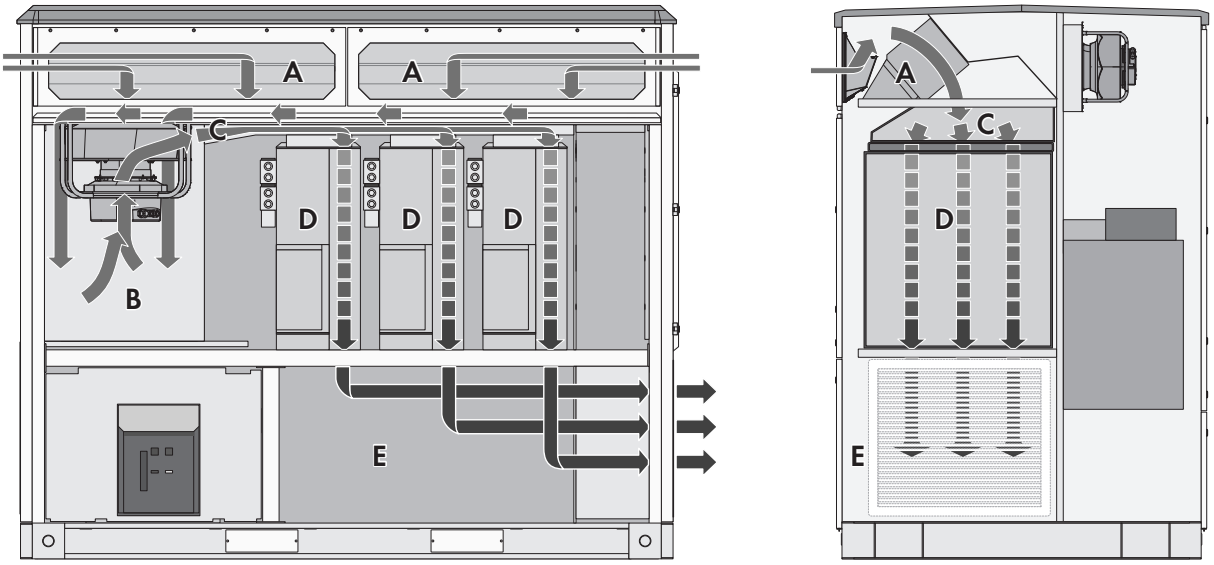
17.5 Air Circulation in the Inverter

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

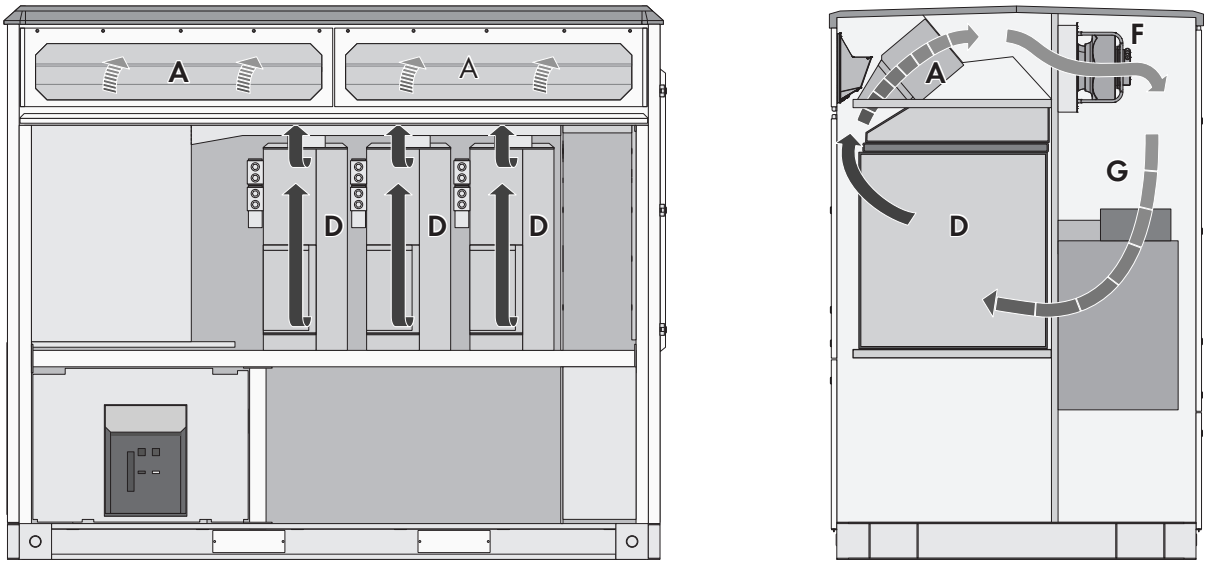


Figure 99: Air circulation in the inverter

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 trough 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 separates 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.

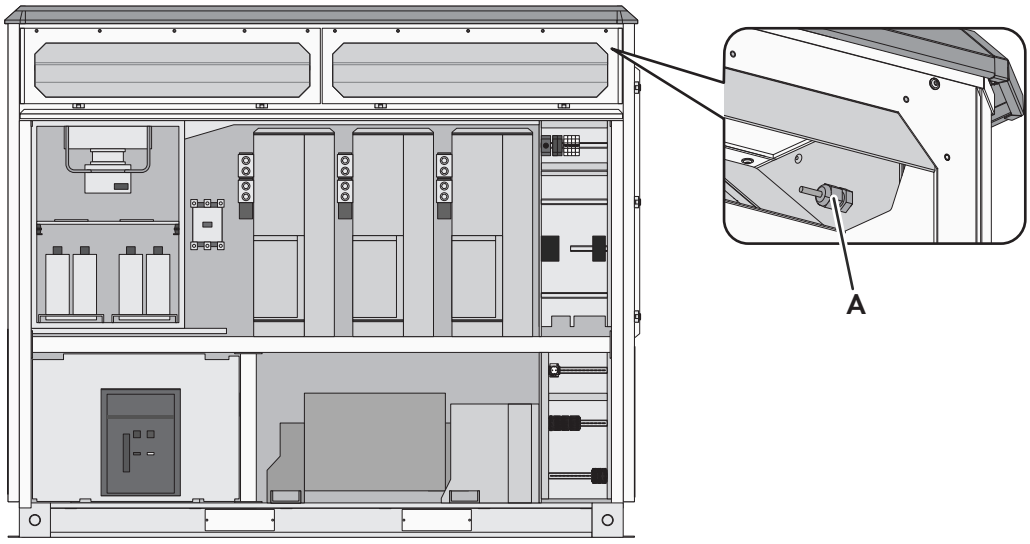


Figure 100: Position of the temperature sensor in the inverter

Position	Designation
A	Temperature sensor

The temperature of the air drawn in is measured in the area of the heat exchanger. Since a temperature exchange has already taken place, the temperature of the air drawn in no longer has the same value as the ambient temperature. The difference is generally 2 K to 4 K. This offset is compensated internally by the software. The difference in temperatures may be greater in the deactivated state as the heat from the sinusoidal filter choke rises and is measured by the sensor.

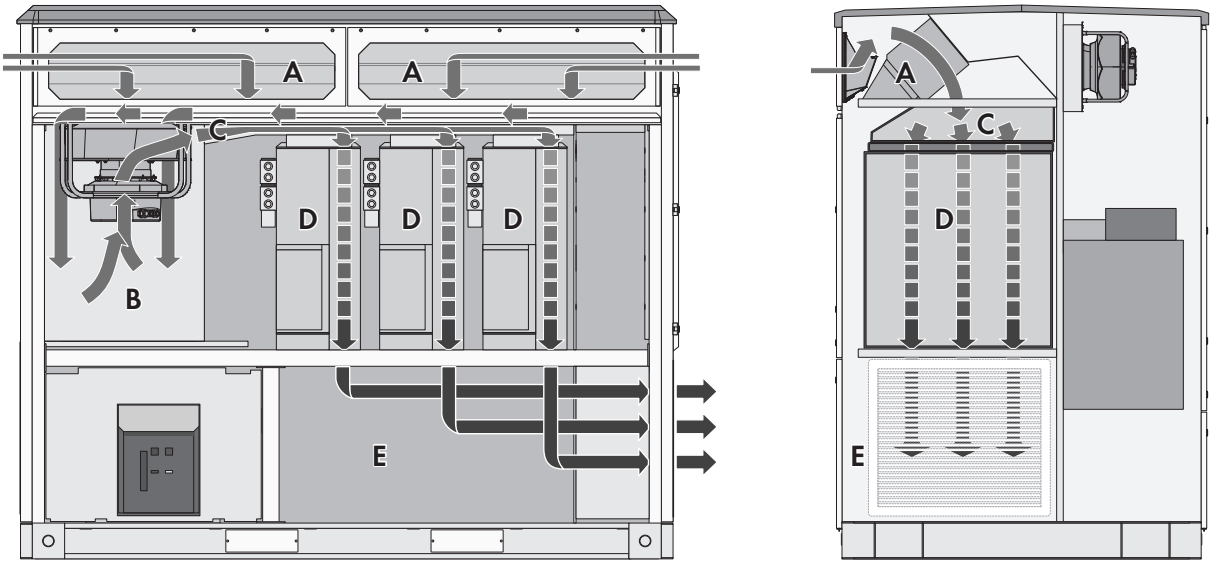
The temperature is measured with a PT100 temperature sensor.

The temperature in the inverter is controlled via two separate air circuits. In an air circuit, ambient air is drawn in, heated in the inverter and blown out again. The air circuit corresponds to the degree of protection IP34.

A second and parallel air circuit only circulates air inside the inverter. This air circuit corresponds to the degree of protection IP54. To meet the requirements of the degree of protection IP54, all transitions to other areas in the inverter must be sealed and protected against external influences.

The heat exchange between both air circuits takes place in the heat exchanger located in the roof of the inverter. The heat exchanger is constructed with separate ducts for the respective air ducts IP34 and IP54.

IP34



IP65

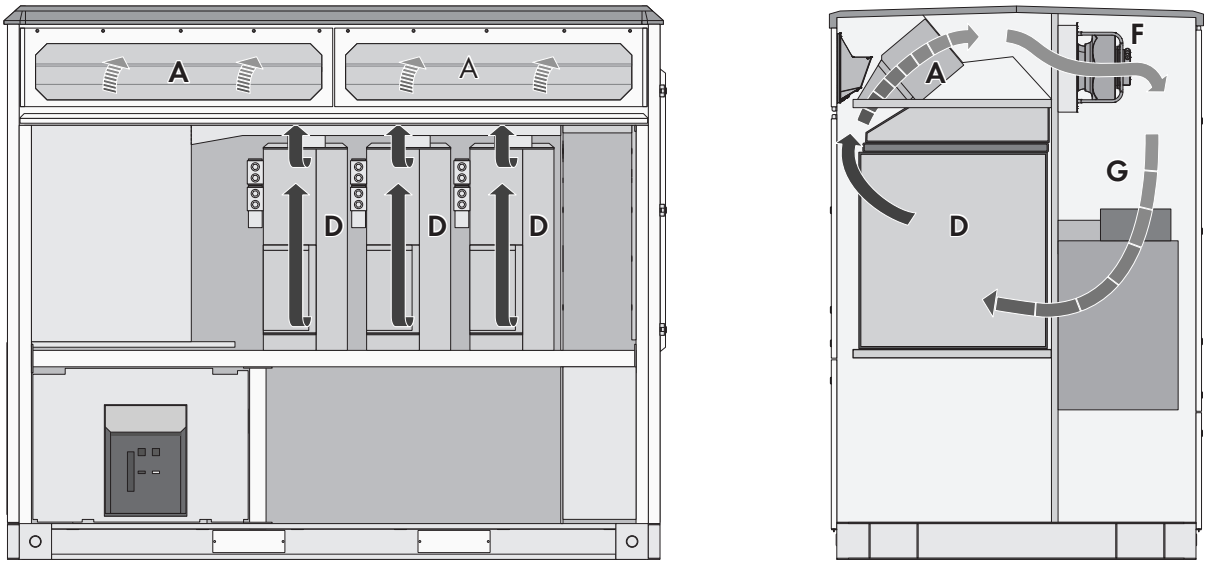


Figure 101: Air circulation in the inverter

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 trough 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 separates chambers in the inverter bridge. Each of the three chambers has a heat exchanger to efficiently cool the inverter bridges. Then the air flows through the area of the sine-wave filter choke and is finally expelled from the inverter laterally.

The air circuit with degree of protection IP54 does not come into contact with the ambient air. The air is cooled with help of the heat exchanger located in the roof of the inverter. This is done by flooding the warm air of the IP54 air circuit with the cooler ambient air of the IP34 air circuit so that the heat of the IP54 air circuit is transferred to the IP34 air circuit.

After the air inside the IP54 air circuit has been cooled down in the heat exchanger, it will be sucked in by the two fans of the DC area, transferred through the DC area and then through the chambers with the electronic components in the inverter bridges before it is cooled in the heat exchanger again.

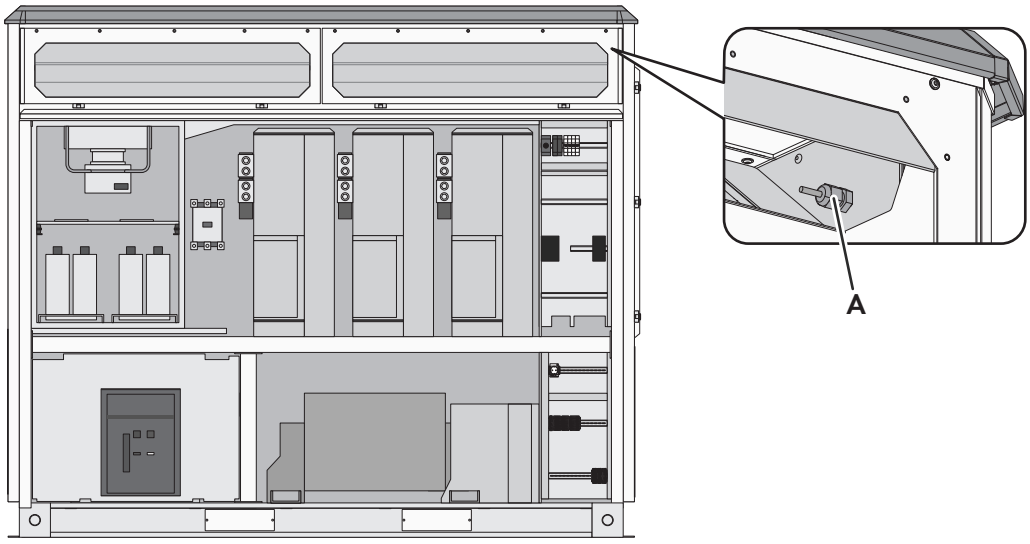


Figure 102: Position of the temperature sensor in the inverter

Position	Designation
A	Temperature sensor

The temperature of the air drawn in is measured in the area of the heat exchanger. Since a temperature exchange has already taken place, the temperature of the air drawn in no longer has the same value as the ambient temperature. The difference is generally 2 K to 4 K. This offset is compensated internally by the software. The difference in temperatures may be greater in the deactivated state as the heat from the sinusoidal filter choke rises and is measured by the sensor.

The temperature is measured with a PT100 temperature sensor.

17.6 Dependence of the nominal current on the ambient temperature

The ampacity of the busbar of the medium-voltage switchgear depends on 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 at 1000 m (3280 ft)
30°C (86°F)	630 A
35°C (95°F)	600 A
40°C (104°F)	565 A

Ambient temperature of the MV Power Station	Nominal current at 1000 m (3280 ft)
45°C (113°F)	530 A
50°C (122°F)	430 A
55°C (131°F)	0 A

At an ambient temperature above 55°C (131°F), operation is only permissible for a maximum of 3 hours per day.

For nominal currents at an installation height greater than 1000 m (3280 ft), please contact us.

17.7 Short-circuit currents at the terminals of the inverter

The values specified here are the electrical currents at the terminals of the inverter. The short-circuit currents on the medium-voltage side must be converted using the medium voltage transformer provided.

Short-circuit current	Electrical current	Time
Root-mean-square value (RMS) during first clock period	5434 A_{rms}	16.7 ms (1 cycle)
Maximum value within the time interval	12500 A_{peak}	7.7 ms
Maximum root-mean-square value (RMS) during 8.5 clock periods	4555 A_{rms}	141.7 ms (8.5 clock periods)

For more information refer to CSA 22.2 No. 107.1-2016 clause 14.4.2.4.

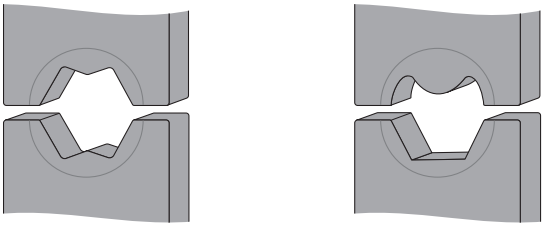
17.8 Recommendations for mounting the terminal lugs

Proper installation of the terminal lugs on the cable is required for a correct connection and faultless operation of the product. We recommend using crimped terminal lugs, as proper crimping means a higher conductivity of the connection and lower space requirements.

Observe the following factors:

☐ Type of crimping in relation to the cable cross-section and type of cable

WM crimp and 6-mandrel crimping are the types most frequently used.



☐ Use of a tool and material recommended by the terminal lug manufacturer

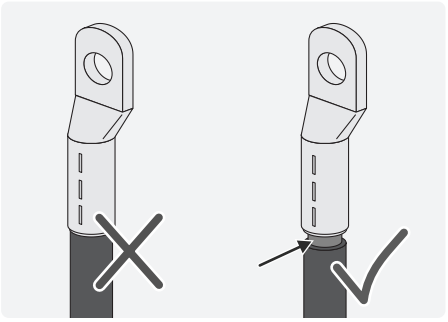
☐ Regular calibration of the tool

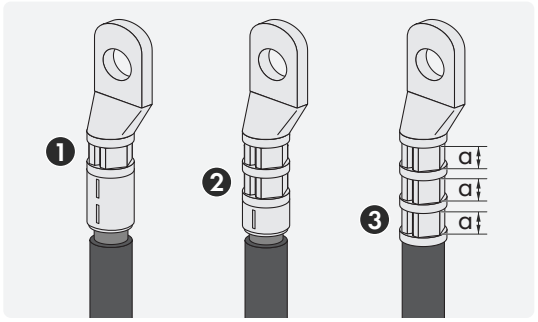
☐ Ensuring clean contact surfaces

In order to connect the terminal lug and cable without errors, we recommend observing the following points:

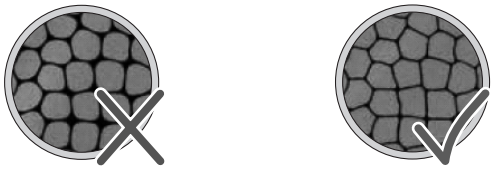
☐ The terminal lugs must not be attached to the insulation of the cable. Keep in mind that crimping makes the terminal lug 10% longer so that the insulation is accordingly further away.

The number and sequence of the crimps depends on the cross-section of the cable. Marking on the terminal lug shows the number of crimps required for the terminal lug used. Make sure that the crimps are not turned in relation to each other and that they are evenly spaced.





☐ The cable and terminal lug must be fully crimped to avoid gaps between the individual conductors. This reduces the contact resistance and prevents the contact from heating up, which can lead to damage.



17.9 Measurement accuracy

The inverter is not equipped with a calibrated meter. The values on the user interface can deviate from the actual values and must not be used as a basis for billing. The inverter's measured values are required for the system management and to control the current to be fed to the grid.

Deviation:

- Voltage measurement: ± 5 V
- Frequency measurement: ± 0.06 Hz
- Disconnect time: ± 0.1%

17.10 Structure of names for parameters and instantaneous values

The names of parameters and instantaneous values are allocated over the entire system according to a standardized concept. Accordingly, the names are made up of acronyms as defined in the standard IEC 61850.

In general, a name looks like this: **Modulecode.Namepart1.Namepart2**

- A name can consist of several parts each separated by a period. A name can consist of 3 parts.
- Parameters and instantaneous values only consisting of one part, pertain to the overall inverter.
- The name begins with the module code to which the parameter or instantaneous value refers. In this way, the parameters and instantaneous values that belong to a process or a hardware component, for example, are grouped.
- A part of a name can consist of several acronyms which together describe what the parameter or instantaneous value represents. The names are organized according to a tree structure.

The main module acronyms are explained below:

Module acronym	Description
Bat	Parameters for monitoring the battery
BatCtl	Parameter for controlling the battery
Bsc	Parameter of the battery system controller
Cnt	Energy meter for different instantaneous values
DcMs	Monitoring of the DC values

Module acronym	Description
Dcs	DC coupled storage system
Frt	Parameters for grid support
GriMng	Parameters for grid management services
GriMs	Monitoring of the utility grid
HzCtl	Parameters for monitoring the power frequency
InvMs	Monitoring of AC values
Mpp	Parameters for MPP tracking
PFCtlW	Parameters for power-dependent reactive power control
VArCtlVol	Parameters for voltage-dependent reactive power control
VCtl	Parameters for monitoring the grid voltage
WCtlHz	Parameters for frequency-dependent active power control

17.11 FTP-push protocols Used

The data collected from your PV system can be saved as an CSV file to a local FTP server. 4 different protocols can be used to transfer data with the FTP push function:

- **Active FTP**: The client opens a random port and sends the port number and its own IP address to the server. The communication with commands is only performed on the control port so that the communication partners can continue to communicate during data transmission. This protocol requires at least 2 separate connections.

  Port of FTP server: Port 21 (default setting)
- **Passive FTP**: The client sends a request to the server. The server then opens a port and sends the port number and IP address to the client. This method is used if the server is unable to connect to the client. This may be due to the fact that the client's network is shielded from external access by a firewall. This protocol operates only with 1 connection between client and server.

  Port of FTP server: Port 21 (default setting)
- **SFTP**: This protocol uses an SSH protocol for encrypted data communication. This protocol operates only with 1 connection between client and server.

  Port of FTP server: Port 22 (default setting)

  To use this protocol, a certificate of the server operator is used. In addition, this certificate can be protected by a password. The password and certificate are provided by the server operator.
- **FTPS**: This protocol uses SSL for encrypted data communication. Encryption with this protocol requires at least 2 separate connections.

  Port of FTP server: Port 21 (default setting)

17.12 Information on Data Storage

The internal memory of the inverter can store the following data:

Type of data	Memory size
Events	10000 entries in the ring buffer
Measured values	Max. 1000 data points per second

The communication interface is delivered with a permanently installed CF memory card. Updates, events, measured values and export files, for example, can be stored on the CF memory card. 2 GB are available for this.

17.13 Reaction Speed of the Modbus Control

In order to meet the specifications of the electric utility company, the inverter must observe a particular reaction speed when implementing control commands via Modbus.

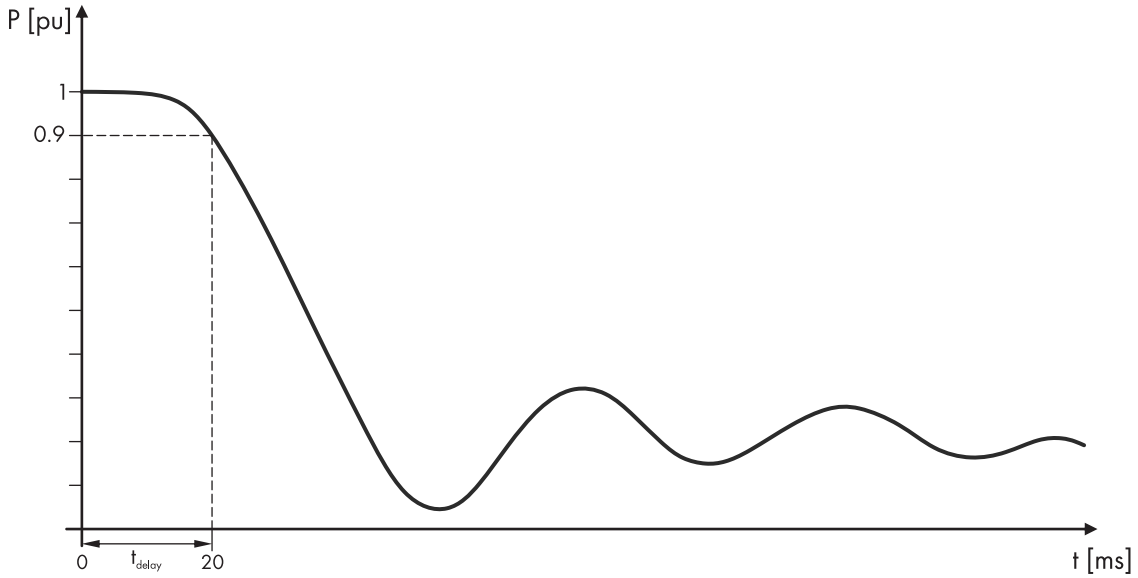


Figure 103: Reaction speed of the Modbus commands in the inverter

The reaction time T_{delay} is the time that the inverter requires to change the power on the AC side of the inverter by ten percent towards the new output value after having received a Modbus control command. The ten percent refer to the difference between the old and the new output value.

17.14 On-Site Services

The following provisions and services are not included in the product scope of delivery and must be provided:

- ☐ Crane for unloading the product at the construction site (can be supplied on request)
- ☐ Foundation for the product
- ☐ Shim plates to compensate for the height difference from the corners of the foundation to the middle foundation
- ☐ For the order option "Earthquake and Storm Package" suitable anchors in the foundation.
- ☐ Platforms or landings to overcome the step height. To prevent rust, the landings must not cover any parts of the MV Power Station.
- ☐ For the order option "Without MV Switchgear" without the order option "1 MVSG for 2 MVT": suitable protective relay for the medium-voltage transformer
- ☐ For the "1 MVSG for 2 MVT" order option: Connector (depending on the cable cross-section M800PB-58 / M804PB-58) for connection to the transformer compartment of the medium-voltage switchgear of another MV Power Station
- ☐ For connection of customer's own AC cables: Connectors with 35 kV, 600 A (Inferface 13, see IEEE Standard 386)
- ☐ Cable for the external fast-stop function
- ☐ Ladder
- ☐ Drainage channel for rainwater that has penetrated the oil filter
- ☐ Conduit for cable entry
- ☐ Overvoltage protection of the entire system

- ☐ Site 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 of the medium-voltage switchgear
- ☐ Zinc paint and spare paint to touch up transport damage
- ☐ Touch up paint damage according to the specification of SMA
- ☐ To protect the electronic components against moisture, the desiccant bag in the inverter must be replaced every 2 months after their arrival at the construction site or in storage until commissioning. If necessary, desiccant bags can be ordered from SMA Solar Technology AG using the following material number: 85-0081.
- ☐ Replace the desiccant bags in the inverter with new desiccant bags from the scope of delivery 24 hours prior to commissioning. This will protect the electronic components against moisture. Moisture can delay commissioning and additional travel costs for SMA service personnel must be paid by the customer.
- ☐ For safe commissioning, the requirements for mounting must be fulfilled.
- ☐ After maritime transport, wash the station with clear water within 3 days after it arrives at the construction site or is placed in storage.
- ☐ Cleaning of all components after completing the assembly and installation work before commissioning
- ☐ Removal of the supporting struts in front of the inverter and medium-voltage cabinet
- ☐ Removal of the supporting struts of the lower right bracket corner in front of the medium-voltage cabinet

If you have any questions, please contact us (see Section 18, page 284).

18 Contact

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

- Device type
- Serial numbers
- Firmware version
- Event message
- Type of communication
- Type and size of additional energy sources
- Optional equipment, e.g. communication products
- Detailed description of the problem

You can find your country's contact information at:

https://go.sma.de/service

ENERGY
THAT
CHANGES

SMA

www.SMA-Solar.com