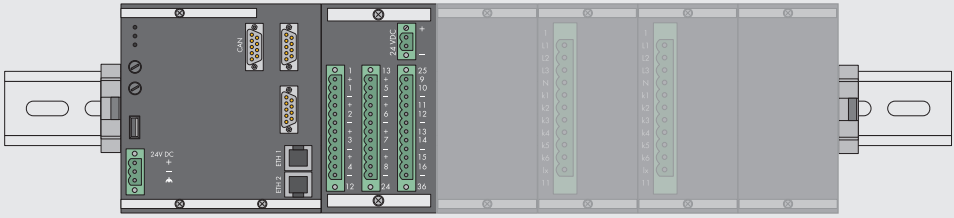
User Manual



SMA HYBRID CONTROLLER

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Status: Wednesday, October 30, 2024

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Table of Contents

1 Information on this Document 5
1.1 Validity 5
1.2 Target Group 5
1.3 Content and Structure of this Document 5
1.4 Levels of Warning Messages 5
1.5 Symbols in the Document 6
1.6 Typographies in the document 6
1.7 Designations in the Document 6
1.8 Explanation of Used Terms 7
1.9 Additional Information 7

2 Safety 8
2.1 Intended Use 8
2.2 IMPORTANT SAFETY INFORMATION 9

3 User Interface 13
3.1 Requirements for the user interface display 13
3.2 Design of the User Interface 14
3.3 Buttons in the header 15
3.4 User Groups and User Rights 16
3.5 Home Page for User Group "User" 17
3.6 Home Page for User Group "Installer" 18
3.7 Configuration Wizard 18
3.7.1 Structure of the Configuration Wizard 18
3.7.2 Buttons in the Configuration Wizard 20

4 Operation 21
4.1 Setting the User Interface Language 21
4.2 Logging In and Out of the User Interface 21
4.3 Changing Passwords 23
4.4 Setting the System Time and Location 23
4.5 Setting up access via the Internet 24
4.6 Internal Communication Network 25
4.6.1 Assigning IP Addresses for Internal Communication Network 25
4.6.2 Setting the IP addresses on the Hybrid Controller 27
4.7 Setting up communication with the SCADA system 27
4.8 Retrieving Display Values 27
4.9 Configuring the Operating Mode 28

4.10 Setting Parameters for System Control ... 29
4.11 Black start ... 30
4.11.1 Sequence of a black start with Hybrid Controller ... 30
4.11.2 Run black start with Hybrid Controller ... 31
4.12 Handling System Settings ... 33
4.12.1 Adjusting the System Settings ... 33
4.12.2 Ending System Settings ... 34
4.12.3 Saving System Settings ... 35
4.12.4 Loading System Settings ... 35
4.12.5 Deleting System Settings ... 36
4.12.6 Enabling devices ... 37
4.12.7 Disabling devices ... 37
4.13 System History ... 38
4.13.1 Overview of the Data Structure ... 38
4.13.2 Maximum Availability of System History ... 38
4.13.3 Viewing System History Data ... 39
4.13.4 Setting storage intervals ... 39
4.14 Time planning ... 39
4.14.1 Requirements for an XML file for time planning ... 39
4.14.2 Valid function types in an XML file ... 42
4.14.3 Creating time plans ... 46
4.14.4 Activating/deactivating time plans ... 47
4.15 Resetting the Product ... 48

5 Starting and Stopping the System ... 50
5.1 Starting the Hybrid Controller ... 50
5.2 Stopping the Hybrid Controller ... 50
5.3 Restarting the Hybrid Controller ... 51

6 Troubleshooting ... 52
6.1 Processing Event Messages ... 52
6.2 Miniature circuit breaker / Relay in Power Plant Manager ... 54
6.3 Error on Hybrid Controller ... 54
6.4 Only for Power Plant Manager: Checking the voltage on the internal buffer module ... 55

7 Only for Power Plant Manager: Cleaning ... 57

8 Contact ... 58

1 Information on this Document

1.1 Validity

This document is valid for:

- HYBRID CONTROLLER (SMA Hybrid Controller integrated in the SMA Power Plant Manager) as of firmware version 02.19.06.R
- HYBRID-CONTROLLER (SMA Hybrid Controller as assembly unit on DIN rail) as of firmware version 02.19.06.R

1.2 Target Group

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

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

1.3 Content and Structure of this Document

This document includes the configuration, operation and troubleshooting of the product.

You will find the latest version of this document and further information on the product in PDF format at www.SMA-Solar.com.

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

1.4 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.

1.5 Symbols in the Document

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

1.6 Typographies in the document

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

1.7 Designations in the Document

Complete designation	Designation in this document
SMA Hybrid Controller	Hybrid Controller, product
SMA Hybrid Controller as assembly unit on DIN rail	Assembly unit
SMA Power Plant Manager	Power Plant Manager, PPM
SMA Solar Technology AG	SMA
Sunny Tripower, Sunny Central	PV inverter
Sunny Tripower Storage, Sunny Central Storage	Battery inverter

1.8 Explanation of Used Terms

Term	Explanation
Genset	Electric generator with combustion engine
Genset controller	System for the regulation and control of electric generators with combustion engine
Hybrid system	System for the control of energy flows based on a programmable logic controller (e.g. SMA Hybrid Controller or Power Plant Manager) Various energy sources can be integrated into a hybrid system (e.g. PV power plant, genset or battery-storage system).

1.9 Additional Information

Additional information is available at www.SMA-Solar.com.

Title and information content	Type of information	Hyperlinks
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical Information	CyberSecurity-TI-en-xx.pdf CyberSecurity-TI-de-xx.pdf
"SMA HYBRID CONTROLLER - Parameters and Display Values" Device-specific overview of all parameters and measured values and their setting options	Technical Information	Parameter-HyCon-TI-en-xx Parameter-HyCon-TI-de-xx
"Use of Gensets in hybrid systems with SMA Hybrid Controller" Communication interface requirements and Genset Controller configuration	Technical Information	HyCon-Gensets-TI-en-xx HyCon-Gensets-TI-de-xx
SMA POWER PLANT MANAGER Description regarding installation, commissioning and decommissioning	Installation Manual	PPM-10-IA-en-xx PPM-10-IA-de-xx PPM-10-IA-es-xx PPM-10-IA-fr-xx PPM-10-IA-hu-xx PPM-10-IA-it-xx

2 Safety

2.1 Intended Use

Together with SMA inverters, the SMA Hybrid Controller is a system solution for the installation of PV power plants and hybrid systems on the basis of gensets or electrical storage systems. The Hybrid Controller continuously monitors the power output of the SMA inverters as well as the operating state of all gensets and loads in the local utility grid. On this basis, the Hybrid Controller controls the SMA inverters and adjusts its output power, where necessary.

When supplying micro-grids with energy, the Hybrid Controller additionally takes on different grid management functions as well as the operating reserve provision in large interconnected systems.

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

Only use gensets that adhere to the reverse-power and overload limits of the Hybrid Controller.

The power management and communication interface of the gensets must be compatible with the Hybrid Controller for optimal operation. Therefore, the combined use of the Hybrid Controller and the gensets must be coordinated with SMA (see technical information "Use of Gensets in hybrid systems with SMA Hybrid Controller").

The inverter data must only be retrieved via the Hybrid Controller. During commissioning, the correct setup of the system network is documented. Unauthorized configuration changes of the system network after commissioning will result in any warranty or warranty claims becoming null and void.

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

The Hybrid Controller has a Modbus/TCP and CAN interface for communicating with peripheral devices. Ensure that all communication between the Hybrid Controller and the gensets takes place via either the Modbus/TCP interface or the CAN interface.

The products by SMA Solar Technology AG are not suitable for use in

- Medical devices, in particular products for supplying life-support systems and machines,
- Aircraft, the operation of aircraft, the supply of critical airport infrastructure and airport systems,
- Rail vehicles, the operation and supply of rail vehicles and their critical infrastructure.

The above list is not exhaustive. Contact us if you are unsure whether products by SMA Solar Technology AG are suitable for your application.

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.

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

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

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

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

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

The type label must remain permanently attached to the product.

2.2 IMPORTANT SAFETY INFORMATION

Keep the manual for future reference.

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

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

⚠ DANGER

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

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

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

⚠ WARNING

Danger to life due to electric shock when supposedly de-energized components or cables are touched after a black start

If a black start is triggered by the product, switched-off energy sources, such as battery inverters or gensets, can be switched on again. By switching energy sources on again, supposedly de-energized parts or cables may be live. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Disconnect the energy sources in the system from voltage sources and make sure it cannot be reconnected before working on the device.
- Observe the safety information in terms of energy sources during all work on the system (see manufacturer documentation).

⚠ 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 injury due to weight of product

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

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

NOTICE

Damage to the enclosure seal in subfreezing conditions

If you open the product when temperatures are below freezing, the enclosure seals can be damaged. Moisture can penetrate the product and damage it.

- Only open the product if the ambient temperature is not below 0 °C.
- If a layer of ice has formed on the enclosure seal when temperatures are below freezing, remove it prior to opening the product (e.g. by melting the ice with warm air).

NOTICE

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

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

- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- The product must not be opened in case of splashing water (e.g. from an irrigation system).
- Do not open the product during a dust storm or precipitation.
- Close the product in case of interruption of work or after finishing work.
- Only operate the product when it is closed.
- Only use the supplied cable glands when inserting cables.

NOTICE

Damage to the product due to condensation

If the product is moved from a cold environment to a warm environment, condensation may form in the product. This can damage the product or impair its functionality.

- When there are large temperature differences, wait until the product has reached room temperature to connect the voltage supply.
- Make sure the product is dry.

NOTICE

Property damage due to unauthorized access to the system

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

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

NOTICE

Damage to the product due to cleaning agents

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

- Clean the product and all its components only with a cloth moistened with clear water.

NOTICE

Damage of gensets due to overload of the system network

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

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

3 User Interface

3.1 Requirements for the user interface display

- ☐ A computer for displaying the user interface must be available.
- ☐ The computer must be connected to the Hybrid Controller via Ethernet.
- ☐ A web browser must be installed on the computer.
- ☐ JavaScript must be enabled in the web browser.
- ☐ In the operating system and in the web browser, anti-aliasing must be activated.
- ☐ The IP address of the Hybrid Controller sent from the DHCP server to the local network of the PV system operator must be known.
- ☐ The respective latest version of one of the following web browsers must be installed on the smart device: Chrome, Edge, Firefox or Safari.
- ☐ Minimum display resolution: 800 x 600 pixels
- ☐ Recommended display resolution (as of): 1280 x 1024 pixels

3.2 Design of the User Interface

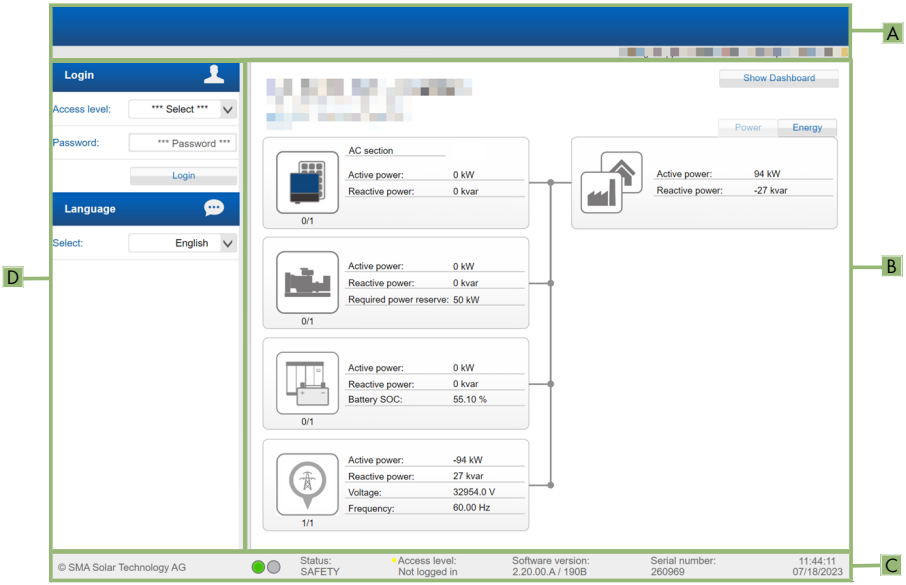


Figure 1: User interface (example)

Position	Designation	Explanation
A	Header	Allows access to the main functions of the user interface. Indicates the current path, e.g. **Home > Settings > Network Settings**.
B	Content area	Depending on the selected page, display values, adjustable parameters or a combination of display values and adjustable parameters are shown in the content area. Additional buttons are available on individual pages.

Position	Designation	Explanation
C	Status bar	Displays the following information: • Display of the operating state via **Status**: – **BOOT**: The product is starting. – **INIT**: The product is initializing. – **WAIT**: The product is establishing communication with the other devices. In this operating state, no setpoints for active and reactive power are transferred. – **STANDBY**: The product is in standby mode. – **MANUAL**: The product is in manual mode. The setpoint values for the active and reactive power of the PV power plant are set via the user interface. – **OPERATE**: The product is in automatic mode and specifies the setpoints for the active and reactive power of the PV power plant. If the product is connected to a SCADA system, it will use the setpoints from the SCADA system in automatic mode. – **SAFETY**: The product has switched to a safe state following an error. The PV power can be reduced compared with operation in automatic mode. – **ERROR**: There is an error in the product. Automatic operation is interrupted. • **Access level**: User group that you are logged in with • **Software version**: Current software version of the product • **Serial Number**: serial number of the device • Date and time
D	Page and menu selection	Access to the various pages and menus of the user interface

Also see:

• Buttons in the header ⇒ page 15

3.3 Buttons in the header

Symbol	Designation	Description
	Home	Use this symbol to access the home page.
	Return	Use this symbol to go back to the previous page.

Symbol	Designation	Description
	Plant[1)]	An overview of the display values can be shown via this symbol (for additional information on the display values, see Technical Information "Parameters and Measured Values").
	Control[1)]	Use this symbol to set various parameters relating to system control (for additional information on the parameters, see Technical Information "Parameters and Measured Values").
	Wizard[1)]	Use this symbol to select the configuration wizard and edit the system settings (for additional information on the parameters, see Technical Information "Parameters and Measured Values").
	Export[1)]	Use this symbol to select the following functions: • Save current system settings • Load saved system settings • Delete saved system settings
	Logout	Use this symbol to log out of the system.

Also see:

- Saving System Settings ⇒ page 35
- Loading System Settings ⇒ page 35
- Deleting System Settings ⇒ page 36

3.4 User Groups and User Rights

User rights	User group	
	User	Installer
Retrieve display values of the entire system and its subsystems, e.g. the gensets, the PV power plant or the load controller(see Section 4.8, page 27)	✓	✓
Set parameters of the entire system (see Section 4.12.1, page 33)	–	✓
Ending system settings(see Section 4.12.2, page 34)	–	✓
Save system settings (see Section 4.12.3, page 35)	–	✓
Loading system settings (see Section 4.12.4, page 35)	–	✓
Deleting system settings (see Section 4.12.5, page 36)	–	✓
Activating/deactivating devices (see Section 4.12.7, page 37)	–	✓

[1)] To use this button you must be logged in as an Installer.

User rights	User group	
	User	Installer
Set control functions of the entire system and the subsystems (see Section 4.10, page 29)	–	✓
Retrieve data for acquisition of measured values (see Section 4.13, page 38)	✓	✓
Retrieve event and error messages (see Section 4.13, page 38)	–	✓

3.5 Home Page for User Group "User"

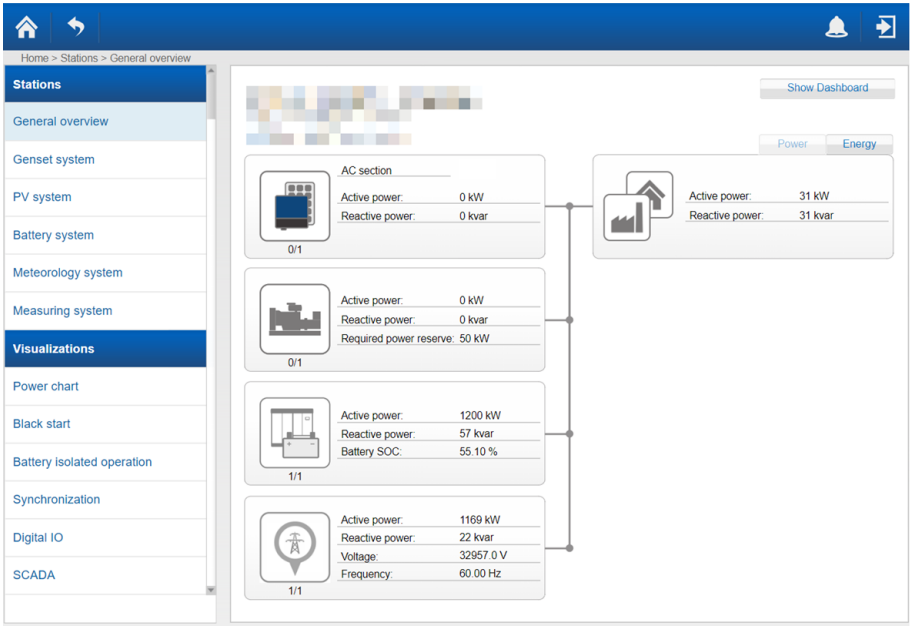


Figure 2: Home page for user group **User** (example)

The home page shows an overview of the display values for the user group User (for additional information on the display values, see Technical Information "Parameters and Measured Values").

3.6 Home Page for User Group "Installer"

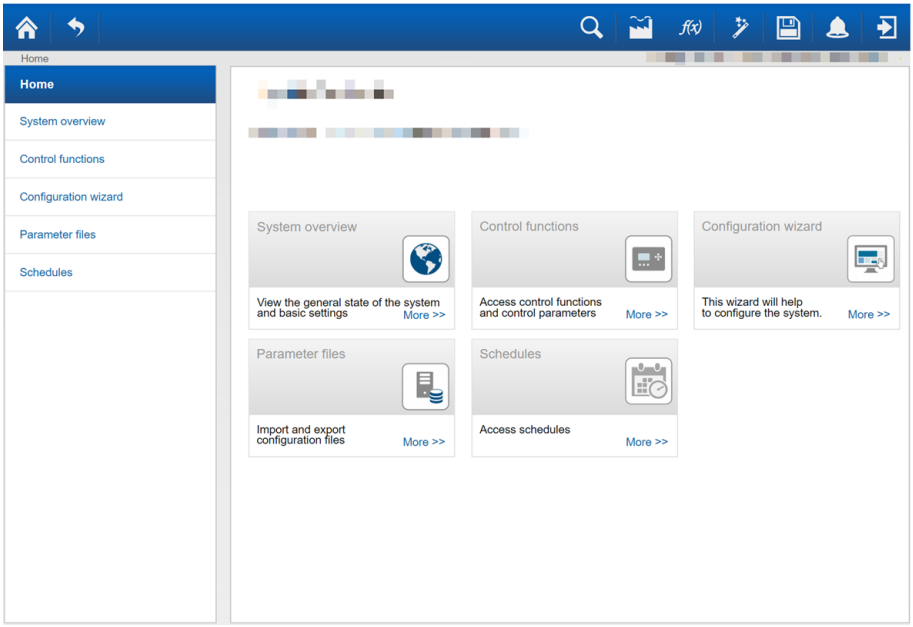


Figure 3: Home page for user group **Installer** (example)

Button	Description
System Overview	Access to the display values (see Technical Information "Parameters and Measured Values")
Control Functions	Access to the control system (see Technical Information "Parameters and Measured Values")
Configuration Wizard	Access to the system settings (see Technical Information "Parameters and Measured Values")
Parameter Files	Save current system settings and load/delete saved system settings (see Section 4.12, page 33)
Schedules	Access to temporal setting of different functions and parameters from system control (see Section 4.14, page 39)

3.7 Configuration Wizard

3.7.1 Structure of the Configuration Wizard

To use the configuration wizard you must be logged in as an **Installer**.

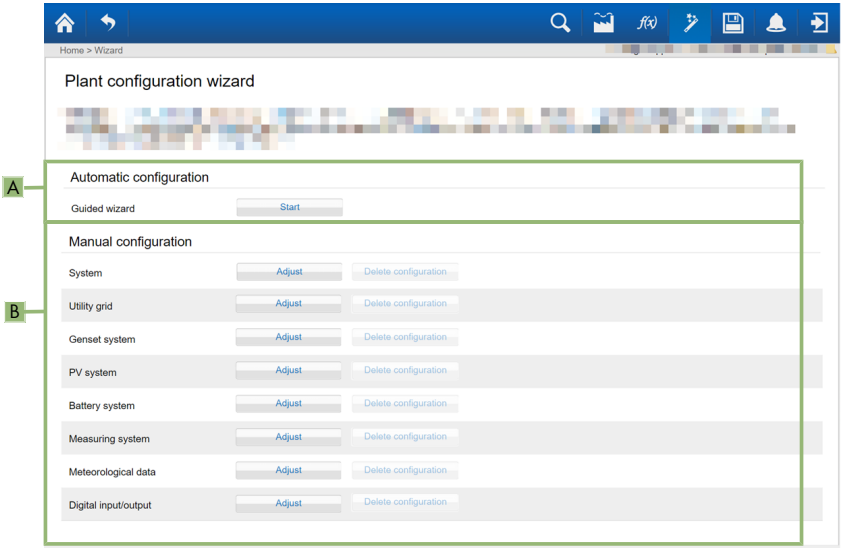


Figure 4: Home page of the configuration wizard (example)

Position	Designation	Explanation
A	Automatic configuration	The automatic configuration wizard guides you through the configuration of the entire system. During initial commissioning, the automatic configuration wizard must be run completely. In the **Manual configuration** area the completion status for each subsystem is displayed in %. Once the completion status has reached 100% for all subsystems, automatic configuration is completed.
B	Manual configuration	After initial commissioning, use the manual configuration wizard to carry out settings on individual subsystems (for additional information on the parameters, see Technical Information "Parameters and Measured Values": • **System**: Entire system • **UtilityGrid**: Utility grid • **Genset system**: Gensets • **PV system**: PV power plant • **Battery system**: Storage system • **Measurement system**: Measurement devices • **Meteorological data**: Temperature and irradiation sensors • **Digital input/output**: Digital inputs and outputs

3.7.2 Buttons in the Configuration Wizard

To use the configuration wizard you must be logged in as an **Installer**.

Button	Description
Add new item	Add device type, e.g. a type of inverter
Adjust	Adjust configuration of a subsystem
Apply	Save system settings This saves all system settings in the active dialog. If you exit the active dialog without saving the system settings, any system settings made since the last save will be discarded.
Continue Wizard	Continue to the next dialog
Delete config.	Delete configuration of a subsystem
Discard	Discard system settings Any system settings made in the active dialog and not saved by pressing the **Apply** button will be discarded.
Done	Close the active dialog and switch to the overview of current system settings
Remove item	Remove device type, e.g. a type of inverter
Start	Start automatic configuration wizard

4 Operation

4.1 Setting the User Interface Language

1. Enter the IP address of the Hybrid Controller (e.g. **172.16.1.21**) in the address bar of the web browser and press Enter.
2. Select your language in the **Language** area from the **Select** drop-down list.
3. Select the [**Apply**] button.
4. Log into the user interface.

4.2 Logging In and Out of the User Interface

Requirements:

☐ The IP address of the Hybrid Controller (defined during commissioning) and the subnet mask must be known.

☐ The computer used to display the user interface must have an IP address located in the same subnet as the IP address of the Hybrid Controller.



Assignment of the IP addresses for the Hybrid Controller and the computer with the user interface

If the IP address of the Hybrid Controller is set to **172.16.1.21** (default setting), the IP address for the computer with the user interface could be e.g. **172.16.1.200**. It is important that the subnet sections of both IP addresses **172.16** tally. The subnet mask is **255.255.0.0**.

NOTICE

Property damage due to unauthorized access to adjustable parameters

All adjustable parameters are protected by the password of the user group **Installer**. Providing the password to unauthorized persons can lead to incorrect parameters being input, resulting in damage to devices and system malfunctions.

- Only give the password for the user group **Installer** to qualified persons.

Procedure:

- Only during commissioning: Log in with the standard password.
- Log in with the changed password:
- Log out.
- Disable lock screen.

Log in with the standard password:

1. Enter the IP address of the Hybrid Controller (e.g. **172.16.1.21**) in the address bar of the web browser and press Enter.
2. Select the **Installer** user group from the **Access Level** drop-down list in the **Login** area.
3. Enter the standard password **1111** and press Enter.

4. Select the button [**Login**].
   ☑ The prompt for changing the standard password for the **Installer** user group is displayed.
5. Enter a password of your choice for the **Installer** user group and press Enter.
6. Repeat the entry of the password you chose yourself and press Enter.
7. Press the button [**Change password**].
   ☑ The prompt for changing the standard password for the **User** user group is displayed.
8. Enter the standard password **0000** and press Enter.
9. Enter a password of your choice for the **User** user group and press Enter.
10. Repeat the entry of the password you chose yourself and press Enter.
11. Press the button [**Change password**].

Log in with the changed password:

1. Enter the IP address of the Hybrid Controller (e.g. **172.16.1.21**) in the address bar of the web browser and press Enter.
2. Select the **User** or **Installer** user group from the **Access Level** drop-down list in the **Login** area.
3. Enter the password you chose yourself for the **User** or **Installer** user group and press Enter.
4. Select the button [**Login**].
5. If the message **Login error - Maximum user sessions reached** appears, the maximum number of logins for the selected user group has been reached. To resume the login, answer the question **Would you like to send a force log in request?** with **Yes**. This notifies users that are already logged in of your request. You will then receive a message regarding the success or failure of your request.
6. If the message **Login error - User level or password incorrect** appears, the password entry was not correct.
7. **Lock time if the password is entered incorrectly**
   When the password is entered incorrectly the first time, a lock time takes effect, which increases with each additional wrong entry. The password can only be entered again after the lock time has expired.
   - Enter the correct password after the lock time has expired.
8. If you do not remember the correct password, contact Service.

Logout

A maximum of 5 **Users**and 1 **Installer** can be logged into the user interface simultaneously. Users are not automatically logged out by closing the web browser. Therefore we recommend always logging out of the user interface prior to closing the web browser.

Automatic logout:

If a user has not shown any activity on the user interface for more than 30 minutes, this user will be warned that he is about to be logged out automatically. If this warning is not acknowledged within 10 seconds, the user is automatically logged out.

Procedure:

- Click the logout link in the header.

Disable lock screen

If a user has not shown any activity on the user interface for more than 10 minutes, a lock screen will be activated. The lock screen shows current performance diagrams of the hybrid system.

Procedure:

- To disable the lock screen, move the cursor over the screen and select button.
  ☑ The page of the user interface last selected is displayed.

4.3 Changing Passwords

Requirements:

☐ To change the password for the user group **User**, you must be logged in as **User**.

☐ To change the password for the user group **Installer**, you must be logged in as **Installer**.

Procedure:

1. Only if you are logged in as Installer, select the **System overview** menu via the page and menu selection.
2. Go to **Home > Settings > Password settings** via the page and menu selection. To do this, select the down arrow button on the scroll bar next to the page and menu selection.
3. Type the current password in the **Current password:** input field and press the Enter key.
4. Type the new password in the **New password:** input field and press the Enter key.
5. Enter the current password in the **Please repeat new password:** input field and press the Enter key.
6. Select the [**Apply**] button.

4.4 Setting the System Time and Location

1. Only if you are logged in as **Installer**, select the **System Overview** menu via the page and menu selection.
2. Go to **Home > Settings > Time and geographical location** via the page and menu selection (for further information on the parameters, see Technical Information "Parameters and Measured Values").
3. Enable the **Use SNTP client** checkbox in the **Time** area. Set the **Address of SNTP server** and **Time interval** parameters to the preferred values also.
4. To set the system time manually, disable the **Use SNTP client** checkbox and set the **Date** and **Time** parameters to the preferred values.
5. In order to set use as an SNTP server for other devices, activate the **Start SNTP server** checkbox.
6. Select the [**Apply**] button.
7. Set the **GeoCoordLat** and **GeoCoordlong** parameters to the preferred values in the **Geographical location** area.

Also see:

- Adjusting the System Settings ⇒ page 33

4.5 Setting up access via the Internet

In order to provide quick assistance in the event of a disturbance, the SMA Service requires access to the operating data of the Hybrid Controller. Access to the operating data enables a detailed analysis of the existing error and therefore speeds up troubleshooting.

The product is prepared to establish a secure VPN connection to Service. The VPN connection is based on the IPsec protocol and is established by the product-internal router. To allow smooth operation, access from the local network of the PV system operator to the product is only permitted for the following applications:

- FTPS interface to the product via port 22 of the TCP protocol
- Web browser for the user interface via port 443 of the TCP protocol
- Interface of the product to the SCADA system via port 502 of the TCP protocol

The product-internal router enables these applications by means of port forwarding via the system router (system router: router in the PV system operator's local network with access to the Internet).

i Ensure data security in networks

When accessing via the Internet, there is a risk that unauthorized users may access and manipulate the data or devices in your system. Appropriate protective measures can include the following:

- Set up a firewall.
- Close unnecessary network ports.
- Only enable remote access via VPN tunnel.
- Do not set up port forwarding at the communication port in use.

Requirement for VPN connection:

☐ The system router must enable exclusive access for the product-internal router via ports 500 and 4500 of the UDP protocol for IP address 194.176.121.155 of the SMA Solar Technology AG.

NOTICE

Damage of gensets due to overload of the system network

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

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

Procedure:

1. Configure the system router in such a way that the secure VPN connection is enabled for Service.
2. Make sure that the product-internal router has established an Internet connection.
3. Inform Service.

☑ Service will check whether the product-internal router has established a VPN connection.

4.6 Internal Communication Network

4.6.1 Assigning IP Addresses for Internal Communication Network

The Hybrid Controller controls and monitors the connected devices, such as gensets and inverters, via the internal communication network. The IP addresses must be assigned statically to ensure efficient communication. The recommendations of this section should be taken into account.

IP address of programmable logic controller in Hybrid Controller

The IP address of the first LAN interface of the programmable logic controller in the Hybrid Controller is factory set to **172.16.1.21** and the subnet mask to **255.255.0.0**. The IP address of the second LAN interface of the programmable logic controller in the Hybrid Controller is factory set to **192.168.100.21** and the subnet mask to **255.255.255.0**. The IP address of the optional router in the Hybrid Controller is **172.16.1.11**. All IP addresses proposed in this section are based on these settings.

- If the IP addresses of the Hybrid Controller are changed, check all other IP addresses in the internal communication network.
- Ensure that the IP addresses of the Hybrid Controller and all other devices are in the same subnet.

Block A of IP address

Block A of the IP address is a prefix. It must be set to **172**.

Block B of IP address

Block B of the IP address is the system number. It must be set to **16**. If **16** is not available for Block B in local network of the system operator, the setting of the system number must be changed in the Hybrid Controller.

Block C of IP address

Block C of the IP address contains the station number. Stations summarize the devices at a single location and enable you to see at a glance where each device is to be found. The following station numbers are recommended:

Number	Designation
1	Hybrid Controller
3	Genset controller
10 to 19	Measuring points that are not assigned to a station

Number	Designation
100 to 120	Sunny Central Storage
200 to 240	PV inverters (Sunny Tripower, Sunny Central CP XT)
xxx	Devices that are assigned to any station

Block D of IP address

Block D of the IP address contains the device number. The following format should be adhered to:

Station		Device	
Number	Designation	Number	Designation
1	Hybrid Controller	11	Router in the Hybrid Controller
		21	Programmable logic controller in the Hybrid Controller
3	Genset controller	1 to 70	Genset controller
10 to 19	Measuring points that are not assigned to a station	71 to 79	Power analyzers (e.g. Data Acquisition Module)
100 to 120	Sunny Central Storage	51	Communication unit SC-COM for the first Sunny Central Storage
		52	Communication unit SC-COM for the second Sunny Central Storage
		111	Communication interface of the Battery System Controller
200 to 240	PV inverters (Sunny Tripower, Sunny Central CP XT)	1 to 70	String inverters
		41 to 50	SMA Inverter Manager Sunny Central Storage
		51 to 52	Central inverter
xxx	Devices that are assigned to any station	71 to 79	Power analyzers (e.g. Data Acquisition Module)
		81 to 89	Temperature and irradiation sensors
		91 to 99	Managed switches
		250 to 254	Communication devices (e.g. SMA Data Manager M or SMA Data Manager L)

Assignment of IP Addresses in Internal Communication Network of Hybrid System

Station	Device	IP address
Hybrid Controller	Router in the Hybrid Controller	172.16.1.11
	Programmable logic controller in the Hybrid Controller	172.16.1.21
Genset controller	1. Genset Controller	172.16.3.1
	2. Genset Controller	172.16.3.2
PV inverter	1. PV inverter (e.g. Sunny Tripower)	172.16.200.1
	2. PV inverter (e.g. Sunny Tripower)	172.16.200.2

4.6.2 Setting the IP addresses on the Hybrid Controller

The Hybrid Controller controls and monitors the connected devices, such as gensets and inverters, via the internal communication network. The IP addresses must be assigned statically to ensure efficient communication (see Section 4.6.1, page 25).

Requirements:

☐ You must be logged in as Installer.

Procedure:

1. Choose the menu **System overview** via the page and menu selection.
2. Go to **Home > Settings > Network settings** via the page and menu selection.
3. Set the IP addresses at **Ethernet adapter 1** for the internal communication network of the hybrid system.
4. Optionally for the additional internal communication network of the hybrid system, set the IP address under **Ethernet adapter 2**.
5. Set the IP addresses at **IP address DNS server** and **IP address gateway** for the external communication network.

4.7 Setting up communication with the SCADA system

1. Only if you are logged in as **Installer**, select the **System overview** menu via the page and menu selection.
2. Go to **Home > Settings > SCADA settings** via the page and menu selection.
3. Set the parameters how you would like them (for additional information on the parameters, see Technical Information "SMA HYBRID CONTROLLER - Cooperation with SCADA System").
4. Select the [**Apply**] button.

4.8 Retrieving Display Values

1. Only if you are logged in as Installer, select the **System overview** menu via the page and menu selection.
2. Choose the path via the page and menu selection, e.g., **Home > Settings > PV system** for the display values for the PV inverter (for further information on the display values, see Technical Information "Measured Values and Parameters").

4.9 Configuring the Operating Mode

NOTICE

Damage to the PV inverters, gensets, or loads caused by the input of incorrect setpoints

In **Manual** mode, the setpoints for the PV inverters and the reserve power to be kept by the gensets are specified via the user interface. If the specifications are incorrect, the technical thresholds of the PV inverters, gensets, or loads can be exceeded. An exceeding of technical thresholds can lead to damage of the PV power plant, gensets or loads.

- For continuous operation of the Hybrid Controller, always use the **Automatic** operating mode.
- Only activate the **Manual** operating mode in temporary and exceptional situations (e.g., when carrying out maintenance).
- Verify that when **Manual** operating mode is active that at least two persons are monitoring the technical thresholds for PV inverters, gensets, and loads.

If the Hybrid Controller remains in the operating mode **Manual** for five minutes and no user is logged in, the Hybrid Controller switches automatically to the operating state **Standby** via the **SLOW STOP** mode.

Requirements:

☐ You must be logged in as Installer.

Procedure:

1. Choose the menu **System overview** via the page and menu selection.
2. Go to **Home > Operations > Control Mode** via the page and menu selection.
3. Select the [**Activate**] button in the **Activate automatic mode** bar to activate **Automatic** mode.
4. To activate **Manual** mode, select the [**Activate**] button in the **Activate manual mode** bar.
5. To deactivate **Manual** mode, activate **Automatic** mode or select the logout button in the header.

4.10 Setting Parameters for System Control

NOTICE

Property damage due to power supply failure caused by unexpected stop of a genset due to reverse power protection

To ensure that a genset is protected from backfeed damage, reverse power protection must be enabled and configured in the Hybrid Controller and the genset. The parameters on the Hybrid Controller and the genset must be configured so that the reverse power protection is always triggered at the Hybrid Controller first. If the reverse power protection first triggers in the genset, this results in an unexpected stop of the genset which cannot be foreseen by the Hybrid Controller. Unexpected stop of a genset can lead to a total power supply failure.

- Only use gensets with reverse power protection which fulfill the reverse power limits of the Hybrid Controller (see installation manual of the product).
- Ensure that the reverse power protection of the gensets is always active during operation.
- Adjust the reverse power protection parameters to ensure that reverse power protection always triggers first at the Hybrid Controller and only then at the genset.

NOTICE

Destruction of gensets due to overload caused by insufficient reserve power

If the current reserve power of the gensets is insufficient, switch off the loads or connect additional gensets. This increases the reserve power of the gensets.

- Prior to stopping the Hybrid Controller, always check whether the current reserve power of the gensets is sufficient to cover the requirement of the loads.
- If the power management and the communication interface of the genset are not compatible with the Hybrid Controller, power management must be deactivated on the Hybrid Controller. In this case, the gensets must be monitored to ensure that sufficient genset reserve power is retained.
- Make sure that the setpoints for power management on the Hybrid Controller and the gensets are set to the same value.

NOTICE

Property damage due to power outage caused by power fluctuations in the PV power plant

If the communication between the Hybrid Controller and the inverters is interrupted, the inverters will operate according to their fallback settings. When communication is restored, power fluctuations may occur if the fallback settings of the inverters deviate from the fallback settings of the Hybrid Controller. These power fluctuations can result in failure of the power supply.

- Ensure that the fallback settings of the inverters match the fallback settings of the Hybrid Controller.

Procedure:

1. Log in as **Installer**.

2. Select the path via the page and menu selection, e.g. for controlling the grid feed-in **Home > Control Functions > Utility grid > Feed-in protection**.
3. To change parameters with an entry field, enter new values and press Enter after each entry. By pressing Enter, the entered value is adopted in the user interface.
4. To change parameters with a checkbox, activate the required checkbox.
5. To change parameters with a drop-down list, select the desired value in the appropriate drop-down list.
6. If the border of the input field flashes red, check the input and set the parameter to a valid value. To do this, repeat the previous step.
7. To discard current parameter settings, select the [**Discard**] button.
8. To adopt current parameter settings in the control, select the [**Apply**] button.
9. Only applies for settings regarding MPP estimate for PV power plants: Ensure that the settings of the **MppNormOpCellTemp** and **MppPwrTempCoeff** parameters of the **MPP Estimation** function corresponds to the technical data of the PV modules (for further information on the see Technical Information "Parameters and Measured Values").

4.11 Black start

4.11.1 Sequence of a black start with Hybrid Controller

A black start is the process of ramping up a power plant without existing power supply and restoring the power supply. This is of particular relevance during a total blackout or in case of stand-alone grids.

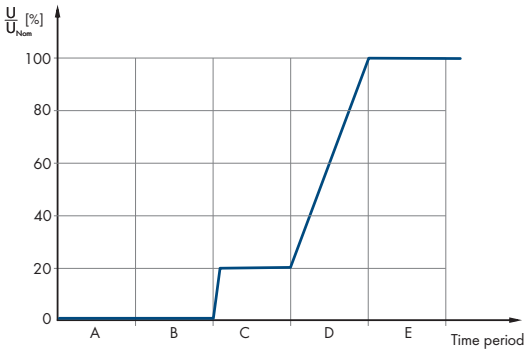


Figure 5: Sequence of a black start with Hybrid Controller

Time period	Explanation
A	All energy sources and loads in the stand-alone grid are switched off. All medium-voltage components (medium-voltage transformers and medium-voltage switchgear) are connected to the stand-alone grid in a de-energized state. Hybrid Controller receives the command for a black start.

Time period	Explanation
B	The Hybrid Controller checks whether all energy sources in the system are switched off and if the hybrid system is in a de-energized state. Once the de-energized state has been confirmed, the Hybrid Controller starts the first battery inverter capable of black start. Initially, the battery inverter provides a start AC voltage for the stand-alone grid. This start AC voltage can be configured, but usually is 20 percent of the nominal output voltage of the battery inverter.
C	At this voltage level, the Hybrid Controller connects all other battery inverters capable of black start.
D	The Hybrid Controller then controls all battery inverters capable of black start in such a way that the inverters raise their output voltage evenly to 100% of the nominal voltage. The time of the voltage ramp can also be configured. If the start AC voltage has already been set to 100%, no voltage ramp becomes effective during period D.
E	All battery inverters capable of black start feed in with 100% of their nominal voltage. The black start is complete. The Hybrid Controller can relay the completion of the black start via a digital output. Other energy sources and loads can now be connected one by one.

4.11.2 Run black start with Hybrid Controller

NOTICE

Damage to equipment and electrical loads through high compensating currents

Unplanned electrical loads and energy sources switching on and off can occur during a black start. These switching processes can cause high compensating currents. Equipment and loads can become damaged due to these compensating currents.

- Disconnect the energy sources and loads from the utility grid before the black start. To do so, proceed as described in this section.
- When doing any work involving a black start, follow the local guidelines on turning on low- and medium-voltage and the system-specific start-up sequence.

Requirements:

☐ At least one battery inverter must be capable of doing a black start. The battery inverter must include the options "External auxiliary power supply" and "Grid-forming inverter with DC pre-charge" to be able to do this (see the inverter's manual).

☐ The black start function must be activated in the Hybrid Controller's firmware (optional software).

Procedure:

- Prepare for black start.
- Run black start.

Preparing for black start

1. Ensure that the gensets and all other grid-forming energy sources are switched off and that they cannot be reconnected. This should prevent accidental feed-in by a genset or another energy source.
2. If a utility grid or other neighboring utility grids are present, disconnect all grid connections and secure them against being switched back on. This should prevent accidental feed-in by another utility grid.
3. Ensure that all loads that react sensitively to low grid voltage are disconnected from the grid.
4. Open the Hybrid Controller user interface and log in as an Installer (see Section 4.2, page 21).
5. Follow the path **Home > Control Functions > Battery Isolated Operation > Black start** and set the parameters for the black start (see Section 4.10, page 29).
6. Check whether the grid voltage is 0 V. If the grid voltage is not 0 V, check the status of all energy sources. Power down and shut off all energy sources that are still active.
7. If the Hybrid Controller is in the **ERROR** operating state, check whether error messages are displayed (see Section 6.1, page 52).
8. If error messages are displayed, find the cause of the error and fix it. Now confirm the error messages.
9. Wait until Hybrid Controller is in operating state **SAFETY**.
   ☑ Hybrid Controller is able to run the black start.
10. If the Hybrid Controller does not go into operating state **SAFETY**, contact Service.

Running black start

1. Switch on the transformers on the inverter and the gensets. This enables a slow magnetization of the transformers during the black start. This prevents voltage fluctuations which could lead to a disruption to the black start.
2. Open the path **Home > Visualization > Battery Isolated Operation** and select the [**Initiate black start**] button.
   ☑ Hybrid Controller runs the black start and, in the process, automatically starts the black start-capable battery inverter. This can take up to 30 seconds.
   ☑ If the message **An error occurred during the black-start process** appears, the black start will cancel automatically.
3. If the black start was interrupted automatically, ensure that the preparations for the black start were made correctly.
4. If the black start has been correctly prepared, confirm the **An error occurred during the black start process** message (see Section 6.1, page 52).
5. If this black start is cancelled again, contact Service.
6. To cancel the black start manually, click on the [**Abort black start**] button.
7. Ensure that all loads that were disconnected from the grid before the black start have been switched back on.

8. Ensure that all grid areas that were disconnected before the black start have been switched back on.
9. Ensure that the gensets and all other grid-forming energy sources are switched back on.

4.12 Handling System Settings

4.12.1 Adjusting the System Settings

Always adjust the system settings according to the following procedure.

NOTICE

Property damage due to unauthorized access to adjustable parameters

All adjustable parameters are protected by the password of the user group **Installer**. Providing the password to unauthorized persons can lead to incorrect parameters being input, resulting in damage to devices and system malfunctions.

- Only give the password for the user group **Installer** to qualified persons.

NOTICE

Destruction of gensets due to overload caused by insufficient reserve power

If the current reserve power of the gensets is insufficient, switch off the loads or connect additional gensets. This increases the reserve power of the gensets.

- Prior to stopping the Hybrid Controller, always check whether the current reserve power of the gensets is sufficient to cover the requirement of the loads.
- If the power management and the communication interface of the genset are not compatible with the Hybrid Controller, power management must be deactivated on the Hybrid Controller. In this case, the gensets must be monitored to ensure that sufficient genset reserve power is retained.
- Make sure that the setpoints for power management on the Hybrid Controller and the gensets are set to the same value.

NOTICE

System disruption due to faulty or missing support from the gensets

To successfully operate Hybrid Controller and the gensets, the parameter settings on the gensets and in Hybrid Controller must be adjusted to one another. If parameter settings contradict one another, the gensets may no longer be able to be correctly controlled during operation, and might also no longer start. Faulty or missing support from the gensets can cause a system failure.

- Always follow the specifications in this document when setting parameters for the gensets in Hybrid Controller.
- Always follow the specifications from the manufacturer's documentation when setting parameters for the gensets in the genset controllers.
- Have all the parameter settings for the genset checked during commissioning: By SMA Solar Technology AG Service employees or by qualified persons who were trained in the commissioning of PV diesel hybrid systems by SMA Solar Technology AG.

Procedure:

1. Log in as **Installer**.
2. Select the configuration wizard via the page and menu selection.
3. In the bar with the desired sub-system, select the [**Adjust**] button.
4. To change parameters with an entry field, enter new values and press Enter after each entry. By pressing Enter, the entered value is adopted in the user interface.
5. To change parameters with a checkbox, activate the required checkbox.
6. To change parameters with a drop-down list, select the desired value in the appropriate drop-down list.
7. If the border of the input field flashes red, check the input and set the parameter to a valid value. To do this, repeat the previous step.
8. To discard current parameter settings, select the [**Discard**] button.
9. To adopt current parameter settings in the control, select the [**Apply**] button.
10. If the selected page has a [**Continue wizard**] button, select this button. This opens another page with detailed settings.
11. Select the [**Done**] button.
12. If a storage system is installed, select the path **Home > Control Functions > PV & Battery > State of charge** and activate monitoring for the state of charge limits **Upper SOC operating limit** and **Lower SOC operating limit** (for additional information, see Technical Information "Parameters and Measured Values").
13. End the system settings (see Section 4.12.2, page 34).

Also see:

- Contact ⇒ page 58

4.12.2 Ending System Settings

The system settings can only be changed in operating state **STANDBY** or **ERROR**. The operating state **STANDBY** can be reached by stopping the system.

Requirements:

☐ You must be logged into the user interface as **Installer**.

☐ All the setting desired settings regarding the parameters must be finished and confirmed with the [**Done**] button.

Procedure:

1. Save the current settings in a parameter file (see Section 4.12.3, page 35).
2. Restart Hybrid Controller with the saved parameter file (see Section 5.3, page 51). This accepts the current settings for ongoing operation. The restart process takes approx. 2 minutes.

4.12.3 Saving System Settings

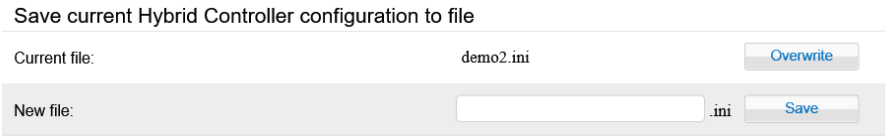


Figure 6: Saving system settings

The system settings are saved in parameter files. You can overwrite the current parameter file or create a new parameter file.

The system settings of Hybrid Controller can only be saved, loaded or deleted when the Hybrid Controller is in the **STANDBY** or **ERROR** operating state.

Prerequisite:

☐ You must be logged into the user interface as **Installer**.

Maximum number of parameter files

It is possible to save up to ten different system settings in parameter files.

- Once this number has been reached, delete parameter files you no longer need (see Section 4.12.5, page 36).

Procedure:

1. Go to **Parameter files > Load/Save configuration database** via page and menu selection.
2. To overwrite the current parameter file, select the [**Overwrite**] button in the **Current file** bar.
3. To add a new parameter file, enter the preferred file name in the **New file** bar and press Enter.
   ☑ By pressing Enter, the entered value is adopted in the user interface.
4. Select the [**Save**] button.

4.12.4 Loading System Settings

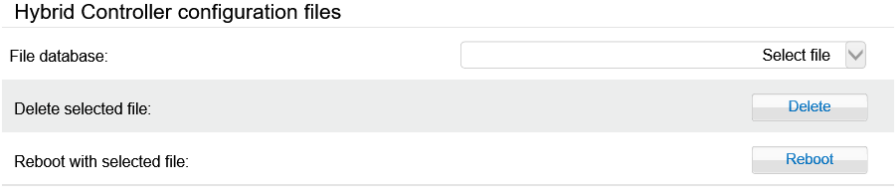


Figure 7: Loading or deleting system settings

The system settings of Hybrid Controller can only be saved, loaded or deleted when the Hybrid Controller is in the **STANDBY** or **ERROR** operating state.

After a software update, the Hybrid Controller restores automatically the system settings from the file that has been saved last. Due to the newly added parameters in the new software version, the Hybrid Controller remains in the operating state **ERROR** and signals the error **2069** until the system settings are saved again and the system has been restarted.

The new parameters, which have been added through an update, can be found in the respective release notes that are included in the software update package.

Requirements:

☐ You must be logged into the user interface as **Installer**.

☐ The Hybrid Controller and PV power plant must have been stopped (see Section 5.2, page 50).

NOTICE

Power supply failure when the Hybrid Controller is restarted

Before restarting the Hybrid Controller, the Hybrid Controller and PV power plant must be stopped. It can take a few minutes for the Hybrid Controller and PV power plant to stop because the PV inverters have to reduce their output power slowly. If the PV inverters are still feeding energy to the grid when the Hybrid Controller is restarted, this may cause failure of the power supply.

- Once the Hybrid Controller has stopped, wait until the PV inverters have reduced their output power to zero. This can take several minutes.

Procedure:

1. Go to **Parameter files > Load/Save configuration database** via page and menu selection.
2. Select a parameter file in the drop-down list **Configuration file**.
3. Click on the [**Reboot with selected file**] button.

4.12.5 Deleting System Settings

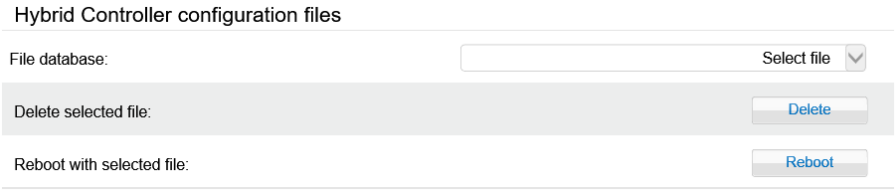


Figure 8: Loading or deleting system settings

The system settings of Hybrid Controller can only be saved, loaded or deleted when the Hybrid Controller is in the **STANDBY** or **ERROR** operating state.

Requirement:

☐ You must be logged into the user interface as **Installer**.

Procedure:

1. Choose the menu **Parameter Files** via the page and menu selection.
2. Choose the parameter file with the required system settings via the dropdown list **File database**.
3. In the bar **Delete selected file**, press [**Delete**].

4.12.6 Enabling devices

The system settings can only be changed in operating state **STANDBY** or **ERROR**. The operating state **STANDBY** can be reached by stopping the system.

Requirements:

☐ You must be logged in as **Installer**.

Procedure:

1. Select the menu **Configuration Wizard** via the page and menu selection.
2. In the **Measurement System** bar, click on the button [**Adjust**].
3. In the menu **Measurement devices general configuration**, first click on the button [**Apply**] and then on the button [**Continue wizard**]. This opens the menu **Measurement devices detailed configuration**.
4. In the **Assign measurement points** bar, click on the button [**Show devices**].
5. Select the appropriate subsystem via **Select a subsystem**.
6. To select one available device, enable the checkbox for this device in the **Select a measurement point** area.
7. To select all available devices, enable the **Select all** checkbox in the **Select a measurement point** area.
8. Click on the [**Add >>**] button.
9. Click on the [**Apply and close**] button.

4.12.7 Disabling devices

The system settings can only be changed in operating state **STANDBY** or **ERROR**. The operating state **STANDBY** can be reached by stopping the system.

Prerequisite:

☐ You must be logged in as **Installer**.

Procedure:

1. Select the menu **Configuration Wizard** via the page and menu selection.
2. In the **Measurement System** bar, click on the button [**Adjust**].
3. In the menu **Measurement devices general configuration**, first click on the button [**Apply**] and then on the button [**Continue wizard**]. This opens the menu **Measurement devices detailed configuration**.
4. In the **Assign measurement points** bar, click on the button [**Show devices**].

5. To select one available device, enable the checkbox for this device in the **Select a measurement point** area.
6. To select all available devices, enable the **Select all** checkbox in the **Select a measurement point** area.
7. Click on the [**<< Remove**] button.
8. Click on the [**Apply and close**] button.

4.13 System History

4.13.1 Overview of the Data Structure

The product records the system history and saves two files with different data each day:

- One file with data for fast acquisition of measured values
- One file with event and error messages

The files are saved in CSV format and recorded according to the following pattern:

File content	Name structure	Save interval	Path for open access	Read access for user group
Data for fast acquisition of measured values	LogDataFast_JJJJ-MM-TT.csv	Can be set[2)]	/cfc0/fsc/log/DataFast	**User** and **Installer**
Event and error messages	ErrEvtLog_JJJJ-MM-TT.csv	Cannot be set	/cfc0/fsc/log/ErrEvt	only **Installer**
System settings	–	Cannot be set	/cfc0/fsc/param	only **Installer**

Also see:

- Maximum Availability of System History ⇒ page 38

4.13.2 Maximum Availability of System History

The maximum number of days for the system history depends on the capacity of the memory card installed:

Capacity of memory card installed	Maximum Availability of System History
512 MB	100 days
1 GB	150 days
2 GB	200 days
4 GB	555 days

However, if there is not enough free space on the installed memory card, there will be correspondingly fewer days available for the system history

[2)] Value range: 1 s to 3600 s. Default value: 1 s.

Once the period for maximum availability of the system history has expired, the product begins to overwrite the files.

4.13.3 Viewing System History Data

Safety settings of FTP server

The FTP server in the Hybrid Controller is deactivated by default for safety reasons.

- To view the system history data, use FTPS or temporarily enable the FTP server via the HyC user interface.

Requirements:

☐ To access the files, a file management program (e.g., Windows Explorer) or web browser (e.g., Google Chrome) must be installed.

☐ The file management program or web browser must have an FTPS function.

☐ To open the files, a spreadsheet program or text editor must be installed.

Procedure:

1. Enter the IP address of the Hybrid Controller **ftps://172.16.1.21** in the address bar of the file management program or web browser.
2. Enter password.
3. Enter the required path.
4. Open the required file.

Also see:

- Overview of the Data Structure ⇒ page 38
- Logging In and Out of the User Interface ⇒ page 21

4.13.4 Setting storage intervals

1. Only if you are logged in as **Installer**, select the **System Overview** menu via the page and menu selection.
2. Open the **General Settings** menu via the page and menu selection.
3. Set the parameter **Log fast interval** to the storage time you would like.
4. Select the [**Apply**] button.

4.14 Time planning

4.14.1 Requirements for an XML file for time planning

Temporary settings for various functions and parameters from the system control for the Hybrid Controller can be stored as XML files. This makes it possible to plan these temporary settings in advance. Hybrid Controller can run the stored XML file and implement the time planning.

Maximum number of XML files

A maximum of 50 XML files to temporarily influence functions and parameters for the system control may be transmitted to Hybrid Controller.

Every XML file must meet the specifications for file names, file structure and the individual elements in the XML file described in this section.

Specifications for file names

The specifications for file names in the following table are mandatory for storing time plans as XML files. If Hybrid Controller contains XML file with file names that are different, Hybrid Controller will delete these XML files automatically.

File Name	Explanation
schedule_YYYY-MM-DD.xml	**Time plan for a calendar day:** A file named according to the naming scheme **schedule_YYYY-MM-DD** is intended for one-time use on a specific calendar day. The calendar day must always be indicated based on the naming scheme **YYYY-MM-DD**. A time plan for a specific calendar day will always be run and is independent from the specifications from the following time plans.
schedule_monday.xml schedule_tuesday.xml schedule_wednesday.xml schedule_thursday.xml schedule_friday.xml schedule_saturday.xml schedule_sunday.xml	**Time plan for a weekday:** If the name of the weekday is contained in the file name, this file is to be run each week on this day of the week. Hybrid Controller checks every day whether or not there is a time plan for the current calendar day. If there is no time plan for the current calendar day, then the time plan for the current day of the week will be run.
schedule_daily.xml	**Time plan to be run daily:** A file with the name **schedule_daily.xml** is intended to be run on a daily basis. Hybrid Controller checks every day whether or not there is a time plan for the current day of the week or for the current calendar day. If there is no time plan for the current day of the week or the current calendar day, then the time plan stored in the file **schedule_daily.xml** will be run.

Specifications on file structure and on the elements

Generally applicable rules for creating syntactically correct (well-formed) XML files must be observed in any case. The additional specifications for the file structure and for the individual elements of the XML file are mandatory for creating time plans as XML files. If Hybrid Controller contains XML files with an invalid file structure or with invalid elements, Hybrid Controller will save these as XML files, but will not run the time plans they contain.

```
<?xml version ="1.0"?>
<schedule xmlns="http://www.sma.de/fsc/schedule">
        <function id="1">
                <type>FFR</type>
                <start>00:00:00</start>
                <stop>16:00:00</stop>
                <parameters>
                </parameters>
        </function>
        <function id="2">
                <type>PowerBlockAt</type>
                <start>16:00:00</start>
                <stop>17:00:00</stop>
                <parameters>
                        <param name="ExtAtSpnt" value="49990" />
                </parameters>
        </function>
</schedule>
```

Figure 9: Structure of an XML file for a time plan in Hybrid Controller (indents and line breaks are allowed, but not necessary.)

Elements of the XML file	Explanation
<?xml version ="1.0"?>	Required element of the XML file
<schedule xmlns="http://www.sma.de/fsc/schedule">	Required element of the XML file
<function id="1">	This element starts the first time plan function within the XML file. Every time plan function must have its own identification number. A maximum of 16 time plan functions can be defined for each XML file.

Elements of the XML file	Explanation
<type>	Establishes the function type. Each function type corresponds to a function or a selection of parameters for the system control. The function type must be defined as valid by SMA Solar Technology AG (see Section 4.14.2, page 42). Hybrid Controller will not run XML files with invalid function types. The element **<type>** occurs exactly once in the time plan function.
<start>	Specifies the start time for the time plan function. The start time must be indicated according to the **hh:mm:ss** scheme. The element **<start>** occurs exactly once in the time plan function.
<stop>	Specifies the stop time for the time plan function. The stop time must be indicated according to the **hh:mm:ss** scheme. The element **<stop>** occurs exactly once in the time plan function.
<parameters>	The element **<parameters>** occurs exactly once in the time plan function and establishes the parameters that will be changed by the applicable function to a specific value. Each time plan function may influence a maximum of 16 parameters. Every parameter in the XML file must be defined as valid by SMA Solar Technology AG (see Section 4.14.2, page 42). Hybrid Controller will not run XML files with invalid parameters. Each parameter setting is described using a **param** tag. In the process, the following attributes must be set: • Name of the parameter: **name=** • Value to be set: **value=** Example for a parameter: The element **<param name="PwrAtChrMaxPc" value="40" />** has an effect that sets the parameter **PwrAtChrMaxPc** to the value **40**.
</schedule>	Required element of the XML file

4.14.2 Valid function types in an XML file

Temporary settings for various functions and parameters from the system control for the Hybrid Controller can be stored as XML files. This makes it possible to plan these temporary settings in advance. Hybrid Controller can run the stored XML file and implement the time planning.

The following table contains the function types defined by SMA Solar Technology AG as valid. Each function type is assigned the functions and parameters that are currently approved for temporary influence. Additional functions and parameters can be added following consultation with SMA Solar Technology AG.

Function type	Function of system control	Parameter of system control
EFR[3)]	Enhanced Frequency Response	DoSocMgmtInFrqDb
		EnaRestoreSoc
		MaxPwrDelTm
		PwrAtChrMaxPc
		PwrAtDisMaxPc
		RecoveryTm
		SocOpLimHi
		SocOpLimLo
		SocMgmtPwrAtChrMaxPc
		SocMgmtPwrAtDisMaxPc
EgyShift[3)]	Energy Shifting	ChrFromPvSpntLimPc
		DisBatSpntLimPc
		MinDisTm
		RampRate
		TolerancePc
FFR[3)]	Firm Frequency Response	DbForm
		EnaRestoreSoc
		FrqDbHi
		FrqDbLo
		FrqSpnt
		PwrAtChrMaxPc
		PwrAtDisMaxPc
		PwrAtChrMaxTm
		PwrAtDisMaxTm
		RecoveryTm

[3)] The parameters of this function type can be set via XML files and via the user interface (for further information on these parameters, see Technical Information "Parameters and Measured Values").

Function type	Function of system control	Parameter of system control
GridFip	Feed-in Protection	FipMode
		GridReleaseAllPv
		GridReleaseAllPv
		PwrAtGridMinLoad
		SpntOfsAbs
PeakLoadShave[3)]	Peakload-Shaving	Trshld
PwrRt	Automatic Switching of Reactive Power Control Mode	PwrRtCtrlMode
		PwrRtCtrlModeAuto1
		PwrRtCtrlModeAuto2
SocCtrl[3)]	State of Charge	ChrFromGenTm
		HysPc
		PwrAtChrMaxPc
		PwrAtDisMaxPc
		SocLimHiPc
		SocLimLoPc
		UseFullPvPwr

Function type	Function of system control	Parameter of system control
Setpoints	External Setpoints	PwrAtAprSpnt
		PwrApLim
		PwrAtLimHi
		PwrAtLimLo
		PwrAtLoLimPrl
		PwrAtMpp
		PwrAtRateMax
		BatPwrAtSpnt
		PwrAtSpntOfs
		PwrAtUpLimPrl
		PwrRtLimHi
		PwrRtLimLo
		PwrRtRateMax
		PwrRtSpnt
		VtgSpnt
		CosPhiSpnt
		PwrAtLimSale
		CtrlModeCmd
		FrqSpnt
TargetDisEgy[4)]	-	PwrAtDisMaxPc

[4)] This function type is used for temporarily influencing the electrical power. The parameters of this function type can only be set using XML files.

4.14.3 Creating time plans

Executing time schedules at the wrong time because the system time differs from the time valid on site

When executing the time schedules, the product depends on its own system time. If this system time differs from the locally valid time, the time schedules stored in the product are executed at the wrong time.

- Set the product to automatic default of the system time via an SNTP server (see Section 4.4, page 23). This means that the system time automatically corresponds to the time valid on site.
- Ensure that the SNTP server is permanently available.
- If the SNTP server is not available permanently, set the system time manually to the time valid on site. Ensure that the system time and the time valid on site are checked regularly and that deviations are corrected.

Requirements:

☐ Software that is suitable for transfer of XML files under the FTPS protocol (e.g. WinSCP) must be present on the computer that will display the user interface.

☐ The password that is used for the user group **Installer** must be known.

☐ The time plans for temporarily influencing the system control must be stored as XML files.

☐ The XML files must be named and structured according to the specifications of this document (see Section 4.14.1, page 39).

☐ The XML files may only access the functions and parameters of the system control that are currently approved for temporary influence (see Section 4.14.2, page 42).

☐ A maximum of 50 XML files may be created.

Data to add Hybrid Controllers as new host in the FTPS software:

Query the FTPS software	Necessary input for Hybrid Controller
File protocol	FTPS
Encryption	Implicit encryption with TLS/SSL protocol TLS: Transport Layer Security SSL: Secure Sockets Layer
Host name	172.16.1.21 (IP address for the Hybrid Controller)
Port number	990
User name	Installer
Password	The password used for the user group **Installer**

Procedure:

1. Start the FTPS software.

2. Once you have started the FTPS software for the first time, make the Hybrid Controller the new host in the FTPS software. Enter the data specified in this section.
   ☑ The path **/cfc0/fsc/** appears in the user interface of the FTPS software. The folders **log**, **newfiles** and **schedulesoperator** are stored on this path.
3. Copy the XML files with time plans to be run daily and the XML files with time plans for a day of the week into the **schedulesoperator** folder.
4. Copy the XML files with time plans for a calendar day into the **newfiles** folder.
5. Log into the Hybrid Controller's user interface as **Installer**.
6. On the home page, select **Schedules**.
7. Select a menu via the page and menu selection **Available Schedule Files**.
8. Select [**Refresh**].

☑ All available XML files will be shown in the **Available Schedule Files** folder.

4.14.4 Activating/deactivating time plans

Hybrid Controller automatically considers the following XML files as active time plans:

- XML files with time plans to be run daily
- For every weekday within the next 48 hours: XML files with time plans to be run on a day of the week
- For every calendar day within the next 48 hours: XML files with time plans to be run on a calendar day

To deactivate XML files with time plans to be run daily and XML files with time plans to be run on a day of the week, you must overwrite these XML files according to the following process. XML files with time plans to be run on calendar days that have already passed will be deleted by Hybrid Controller automatically.



Example for deleting an XML file

The XML file **schedule_2019-01-12.xml** would have been an active time plan on January 12, 2019 and would have influenced the system control according to the functions established in the file. The XML file **schedule_2019-01-12.xml** would have been automatically deleted on January 13, 2019.

Executing time schedules at the wrong time because the system time differs from the time valid on site

When executing the time schedules, the product depends on its own system time. If this system time differs from the locally valid time, the time schedules stored in the product are executed at the wrong time.

- Set the product to automatic default of the system time via an SNTP server. ((see Section 4.4, page 23)). This means that the system time automatically corresponds to the time valid on site.
- Ensure that the SNTP server is permanently available.
- If the SNTP server is not available permanently, set the system time manually to the time valid on site. Ensure that the system time and the time valid on site are checked regularly and that deviations are corrected.

Procedure:

1. To activate a time plan, create this time plan as an XML file and transfer it to Hybrid Controller (see Section 4.14.3, page 46).
2. To deactivate a time plan, create an empty XML file with the file name of this time plan and transfer it to Hybrid Controller (see Section 4.14.3, page 46).
3. Log into the Hybrid Controller's user interface as **Installer**.
4. On the home page, select **Schedules**.
5. Select a menu via the page and menu selection **Available Schedule Files** and press [**Refresh**].
6. Select **Current Schedule** via the page and menu selection.

☑ All XML files with active time plans will be shown on the **Current Schedule** page.

4.15 Resetting the Product

Modes for resetting the product

Value	Explanation
Reset only control parameters	Only the parameters of the control functions are reset to default settings. The control function are in the **Home > Control Functions** menu.

Value	Explanation
Reset all parameters but not network and DigIO settings	All parameters of the Hybrid Controllers are reset except network settings: For network settings go to **Home > Settings > Network settings**. For settings of digital inputs and outputs go to **Home > Wizard > Digital inputs/outputs > General**.
Reset all parameters	All parameters of the Hybrid Controllers are reset.

Procedure:

1. Log in as **Installer**.
2. Go to **Home > Parameter files > Factory Reset** via page and menu selection.
3. Select the value for the preferred mode in the drop-down list **Reset mode**:
4. Click on the [**Reset**] button.
5. Click on the [**Proceed**] button.
6. Define a folder to store the new parameter file and click on the [**Save**] button.
7. Restart the product. In doing so, use the new parameter file (see Section 5.3, page 51).

5 Starting and Stopping the System

5.1 Starting the Hybrid Controller

1. Start the gensets (see system documentation).
2. On the Hybrid Controller, connect the supply voltage (see the installation manual of the product).
3. Connect the current and voltage measurement inputs (see the installation manual of the product).
4. Log into the user interface as **Installer**.
5. Select the **System overview** menu via the page and menu selection.
6. Go to **Home > Settings > General settings** via the page and menu selection and click on the [**Start**] button.
7. Connect the PV inverters on the DC main distributor to the AC grid (see inverter documentation).
   - ☑ The PV power plant synchronizes to the available AC grid. How long synchronization takes depends on the current solar irradiation on the PV modules and on the current power required by the loads.
   - ☑ The Hybrid Controller reports the event **Valid product licence found**: The Hybrid Controller is fully functional.
8. If the Hybrid Controller generates a warning **No product licence found**, **Product licence is not valid** or **Product licence is empty**, contact Service and request a valid software license.

5.2 Stopping the Hybrid Controller

NOTICE

Destruction of gensets due to overload caused by insufficient reserve power

If the current reserve power of the gensets is insufficient, switch off the loads or connect additional gensets. This increases the reserve power of the gensets.

- Prior to stopping the Hybrid Controller, always check whether the current reserve power of the gensets is sufficient to cover the requirement of the loads.
- If the power management and the communication interface of the genset are not compatible with the Hybrid Controller, power management must be deactivated on the Hybrid Controller. In this case, the gensets must be monitored to ensure that sufficient genset reserve power is retained.
- Make sure that the setpoints for power management on the Hybrid Controller and the gensets are set to the same value.

Requirements:

☐ You must be logged into the user interface as Installer.

Procedure:

1. Log into the user interface as **Installer**.

2. Go to **Home > Settings > General settings** via the page and menu selection.
3. In the **Start/Stop** bar, select the [**Stop HC**] button.
4. Wait until the Hybrid Controller has stopped the inverters. This can take several minutes.
   ☑ The **Hybrid Controller is off** message is displayed.
5. To disconnect the inverters from the AC grid, disconnect the inverters on the DC main distributor from voltage sources (see inverter documentation).

5.3 Restarting the Hybrid Controller

Requirements:

☐ You must be logged into the user interface as **Installer**.

☐ The Hybrid Controller and PV power plant must have been stopped (see Section 5.2, page 50).

NOTICE

Power supply failure when the Hybrid Controller is restarted

Before restarting the Hybrid Controller, the Hybrid Controller and PV power plant must be stopped. It can take a few minutes for the Hybrid Controller and PV power plant to stop because the PV inverters have to reduce their output power slowly. If the PV inverters are still feeding energy to the grid when the Hybrid Controller is restarted, this may cause failure of the power supply.

- Once the Hybrid Controller has stopped, wait until the PV inverters have reduced their output power to zero. This can take several minutes.

Procedure:

1. Log into the user interface as **Installer**.
2. Select the **System overview** menu via the page and menu selection.
3. Go to **Home > Settings > General settings** via the page and menu selection.
4. Click on the [**Reboot**] button in the **Hybrid Controller system** area.
   ☑ The **Do you really want to reboot the HybridDo Controller** prompt appears.
5. Confirm the **Do you really want to reboot the Hybrid Controller** prompt by clicking [**Yes**].

6 Troubleshooting

6.1 Processing Event Messages

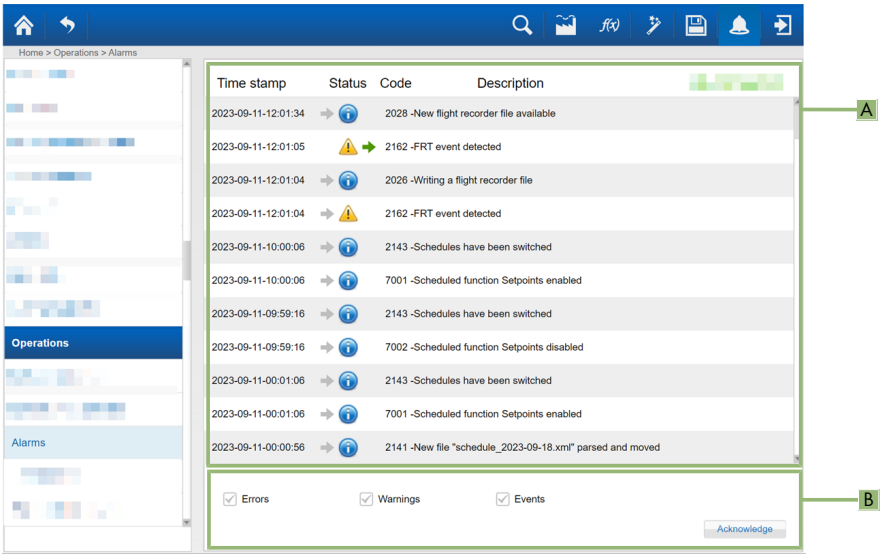


Figure 10: Event messages (A) and filter functions (B)

Event messages (A)

Name of the column	Description
Timestamp	Time at which the message was recorded:
Status	Information
	Warning If a warning occurs, automatic operation continues.
	Error If an error occurs, automatic operation stops.
	Warning or error no longer exists.
	Event, warning or error has occurred.
Code	Four-digit number of the reported event, warning or error
Description	Description of the reported event, warning or error

Filter functions (B)

Drop-down menus	Description
Errors / Warnings / Events	Status of event message

Using the scrollbar

If not all messages can be displayed on the user interface, a scrollbar appears on the **Alarm list** page. You can only use this scrollbar by means of the arrow keys.

- To call up messages recorded at an earlier time, press the up row key.
- To call up messages recorded at a later time, press the down arrow key.

Procedure:

1. Only if you are logged in as **Installer**, open the **System Overview** menu via the page and menu selection.
2. Choose **Operations > Alarms** via the page and menu selection.
3. Set filter functions. To do this, activate the checkboxes and deactivate the checkboxes that are not required.
4. If errors are reported, determine and eliminate the causes for each error.
5. When the causes of an error have been eliminated, acknowledge the corresponding error message. To do so, select the [**Acknowledge**] button.
6. Ascertain the causes of reported warnings and take corrective action.
7. To acknowledge reported warnings, select the [**Acknowledge**] button.

6.2 Miniature circuit breaker / Relay in Power Plant Manager

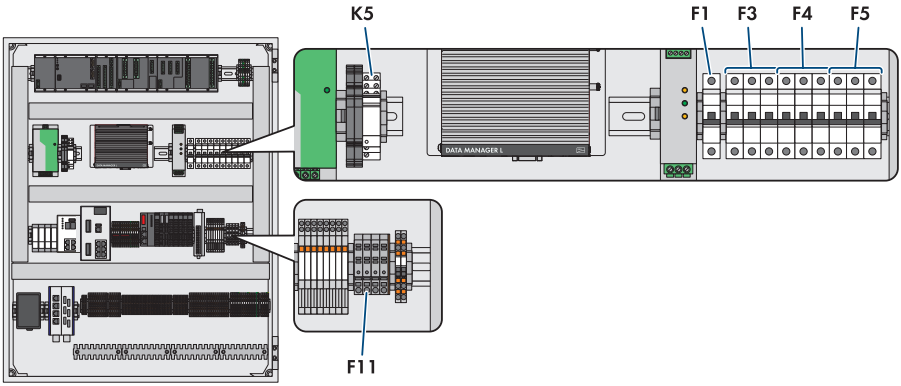


Figure 11: Position of miniature circuit breakers

Miniature circuit breaker / Relay	Explanation
Miniature circuit breaker **F1**	Circuit breaker for the connection for the external supply voltage
Miniature circuit breaker **F3** to **F5**	Circuit breaker for inputs to measure voltage in the internal measuring modules
Miniature circuit breaker **F11**	Fuse protection for 24 V supply of Hybrid Controller
Relay **K5**	Switching off the 24 V supply of the Hybrid Controller during a role switchover in a redundant PPM system

Also see:

- Error on Hybrid Controller ⇒ page 54

6.3 Error on Hybrid Controller

Problem	Cause and corrective measures
The inverters do not start although the Hybrid Controller is in **OPERATE** mode.	There may be an error in an inverter which must be acknowledged manually. • Ascertain and remove the cause of the error. • Log onto the user interface of the inverter as installer and acknowledge the error message.

Problem	Cause and corrective measures
Settings of parameters or data on the system history are not saved	It is possible that the Hybrid Controller's internal memory card is defective. A defective memory card can, as a worst-case scenario, prevent Hybrid Controller from restarting. **Corrective measures:** • If the problem persists, contact Service.
The voltage 0 V is persistently shown at a measuring point.	Miniature circuit breaker **F3**, **F4** or **F5** on the measuring module for the voltage measurement may be deactivated (see Section 6.2, page 54). **Corrective measures:** • Activate the miniature circuit breaker.
The Hybrid Controller's user interface is not available.	The external supply voltage may not be connected correctly. • Ensure that the external supply voltage is attached and turned on correctly. The miniature circuit breaker **F1** or **F11** may be deactivated. (see Section 6.2, page 54). • Activate the miniature circuit breaker. There may be an error in the internal supply voltage. • Check the voltage on the internal buffer module (see Section 6.4, page 55). Only in the redundancy system: During a role change in the redundancy system, relay K5 pulls in and drops out again after the switching operation. Relay K5 may be permanently pulled in. • Check the wiring.
The Hybrid Controller generates a warning: **2098: No product licence found**, **2099: Product licence is not valid**, or **2100: Product licence is empty** when starting or restarting.	The software license installed may be damaged or invalid for some other reason. • Contact Service.

6.4 Only for Power Plant Manager: Checking the voltage on the internal buffer module

If no indicator light lights up and the user interface cannot be activated, there may be an error in the internal voltage supply.

⚠ 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.
- Externally disconnect the cables for the current- and voltage measurement before inspecting the internal supply voltage.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.
- Always perform all work in accordance with the locally applicable standards, directives and laws.

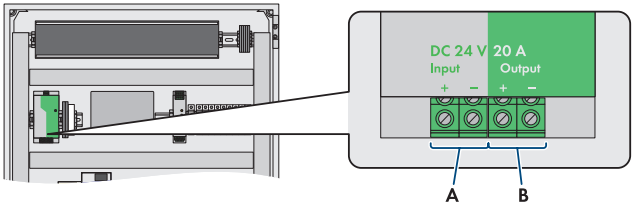


Figure 12: Input and output of the internal buffer module

Position	Explanation
A	Input of the internal buffer module with DC 24 V
B	Output of the internal buffer module with DC 24 V

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

☐ Suitable measuring device to measure the DC voltage

Requirements:

☐ The internal supply voltage must be attached and switched on correctly (see the installation manual for the Hybrid Controller).

☐ Circuit breaker **F1** in Hybrid Controller must be activated (see Section 6.2, page 54).

Procedure:

1. Open the product using the switch cabinet key.
2. Check whether the voltage at the input of the internal buffer module is DC 24 V.
3. If the voltage at the input of the internal buffer module is not DC 24 V, contact Service.
4. Check whether the voltage at the output of the internal buffer module is DC 24 V.
5. If the voltage at the output of the internal buffer module is not DC 24 V, contact Service.

7 Only for Power Plant Manager: Cleaning

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

- ☐ Abrasive cloth
- ☐ Degreaser
- ☐ Use touch-up stick in the appropriate RAL color to repair small-area surface damage.

Position	RAL color	Color
Enclosure	RAL 7035	Light gray

⚠ DANGER

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

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

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

NOTICE

Damage to the product due to cleaning agents

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

- Clean the product and all its components only with a cloth moistened with clear water.

Procedure:

1. Check whether the products shows any externally visible damage.
2. If the product has externally visible damage, take the product out of service (see the product's installation manual) and contact the Service.
3. Remove coarse dirt contamination from the outside of the enclosure with a soft brush or similar tool.
4. Remove dust from the outside of the enclosure using a moist cloth.
5. Check the enclosure for corrosion.
6. Fix the areas affected by corrosion. Slightly sand the surface, clean the area with a degreaser and paint the area. When doing so, adhere to the relevant instructions of the paint manufacturer.

8 Contact

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

- Device type
- Serial number
- Firmware version
- Event message
- Type of genset control unit used

You can find your country's contact information at:

https://go.sma.de/service

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