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# Central inverter **SUNNY CENTRAL** 400HE/500HE/630HE

**Operating Manual** 



SC4-63HE-BE-BEN103280 | 98-4008280 | Version 8.0

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# 1 Notes on this Manual

### Validity

This manual applies to the following device types with a Sunny Central Control, from firmware version 2.08:

- 400HE (SC 400HE-11) as of production version D4
- 500HE (SC 500HE-11) as of production version D4
- 630HE (SC 630HE-11) as of production version D4

### **Target Group**

This manual is intended for skilled workers. Only qualified personnel are allowed to perform the tasks set forth in this manual (see section 2.3 "Target Group Qualification", page 13).

### **Additional Information**

Additional information is available at www.SMA.de/en:

Document title	Document type
Installation conditions for Sunny Central HE-11	Technical information
Medium-voltage transformers - Important requirements for the medium-voltage transformers for Sunny Centrals of the HE or CP range.	Technical information
COM-B - Communication distribution box for large-scale PV plants with Sunny Central, Sunny Mini Central or Sunny Tripower	Technical information
Sunny Main Box - Connecting the DC cabling for PV inverters	Technical information

### Symbols

Symbol	Explanation
	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a situation that can result in property damage if not avoided.
i	Indicates information that is important for a specific topic or objective, but is not safety-relevant.
	Indicates a requirement for meeting a specific goal.
☑	Desired result.
×	Undesired result. Followed by a solution on how to achieve the desired result.

### Typography

Typography	Usage	Example
"light"	<ul> <li>Display messages</li> <li>Parameter</li> <li>Terminals</li> <li>Slots</li> </ul>	• The inverter switches into the "Waiting" operating state.
bold	<ul> <li>Elements which you should select</li> <li>Elements which you should enter</li> </ul>	Set parameter "FanTest" to 1.

### Nomenclature

In this manual, the Sunny Central of the HE series is referred to as Sunny Central or inverter.

# 2 Safety

# 2.1 Intended Use

The inverter converts DC current generated in PV modules into grid-compliant AC current. Here, the maximum permissible DC input voltage must not be exceeded.

Inverters of the HE series may only be operated in connection with a suitable transformer.

Settings that affect grid management may not be switched off or changed without first obtaining approval from the distribution grid operator.



Figure 1: Principle of a grid-connected PV plant with a Sunny Central

Object	Description
А	PV modules
В	Sunny String-Monitor
С	Sunny Central
D	Medium-voltage transformer (e.g., Transformer Compact Station)
E	Power distribution grid

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# 2.2 Safety Instructions

### **Electrical Risk**

### Risk of electric shock when touching conductive parts

High voltages that can cause electrical shocks are present in the inverter. Work on the inverter is only allowed if the power is disconnected and in compliance with the guidelines that apply at the installation location.

- Disconnect the following components:
  - Grid voltage for grid feeding
  - Internal power supply
  - DC voltage from the PV array
  - Additional external voltages (e.g., control signals of a control room)
- Ensure that the device cannot be reconnected.
- Ensure that no voltage is present.
- Ground and short-circuit.
- Cover or safeguard any adjacent live components.

### Electric shock through capacitors not fully discharged

Hazardous voltages may still be present in the inverter even if the main AC and DC switches are switched off.

• Wait at least 10 minutes after switching off the inverter.

### Electric shock caused by damage on the inverter

The operation of a damaged inverter can lead to serious or lethal injuries through electric shock.

- Operate the inverter only in technically proper and operationally safe status.
- Operate the inverter only when there is no visible damage and check regularly for visible damage.
- Ensure that all external safety features are freely accessible at all times and that they function correctly.
- Regularly check for correct functioning.

### Electric shock caused by ground fault

In case of a ground fault, assume that grounded plant components are still live.

• Ensure that no voltage present before touching.

### Electric shock resulting from a failure to comply with safety requirements

Failure to follow this manual and the operating or safety instructions it contains may lead to severe injury from electric shock.

• Only perform work as described in this manual. Observe all safety instructions.

- Establish all electrical connections according to the circuit diagram.
- Safely store the documentation within the immediate area of the inverter. It must be accessible to service and maintenance personnel at all times.

#### Electrostatic discharge can damage electronic components

Electrostatic discharge can destroy components.

- During work on the inverter and handling of the components, observe the ESD protection regulations and wear protective gloves.
- Discharge electrostatic charges through contact with unvarnished, grounded enclosure parts (e.g., on the PE connection of the doors). Only then it is safe to touch any electronic components.

#### Burns

Some components, such as fuses, can become hot during operation.

• Wear safety gloves when working on the inverter.

### **Inverter Damage**

Tampering with the device may result in plant damage.

• Do not operate the inverter while the door is open.

If the key remains in the door lock, the inverter can be opened by unauthorized persons.

- Remove the key from the door locks and from the key switch.
- Keep the keys in a safe place.

Penetrating moisture can damage the inverter.

• Do not open the inverter when it is raining or in case of humidity greater than 95%.

Electrostatic discharge can destroy components.

- During work on the inverter and handling of the components, observe the ESD protection regulations and wear protective gloves.
- Discharge electrostatic charges through contact with unvarnished, grounded enclosure parts (e.g., on the PE connection of the doors). Only then it is safe to touch any electronic components.

Only operate the Sunny Central in regions with a radio frequency band of 80 MHz ... 1 000 MHz. Warning signs must be easily readable at all times and must be replaced in the event of damage.

# 2.3 Target Group Qualification

All work on the inverter may only be carried out by qualified technical personnel. Qualified means that the personnel has the relevant training for the tasks.

For commissioning and operating the inverter, the personnel must be familiar with the installation manual and the user manual. In particular, the safety notes must be observed.

# 3 Product Description

# 3.1 Sunny Central



Figure 2: Sunny Central 630HE (example)

Position	Description
А	DC cabinet
В	Inverter cabinet
С	AC cabinet
D	Sunny Central Control
E	Indicator lights
F	Key Switch
G	Emergency stop with key

Because the Sunny Central can be controlled using a Power Reducer Box or the Sunny Central Control, it meets the requirements of the distribution grid operator.

Stop "Stop" "Start" switch switch Wait Exceed grid V<sub>pv</sub>>V<sub>pvStart</sub> and T>T<sub>Start</sub> Fault limits Grid monitoring Grid monitoring No faults time reached Exceed grid Startup Fault limits MPP load operation Fault  $P_{_{pv}} < P_{_{pvStop}}$  and  $T > T_{_{stop}}$ "Stop" switch Fault Shutdown Shutdown

The inverter cycles through various states during operation:

Figure 3: Sunny Central operating states

### Stop

The Sunny Central is switched off. If the key switch is set to "Start", the Sunny Central changes to the "Waiting" operating state.

### Waiting

The Sunny Central is in the "Waiting" operating state. If the input voltage  $V_{PV}$  is higher than the start voltage "VpvStart", the Sunny Central waits until the time specified in the "T-Start" parameter ends. The value for "VpvStart" is shown on the Sunny Central Control's display. If the input voltage  $V_{PV}$  does not fall below the start voltage "VpvStart" during this time, the Sunny Central checks whether the AC grid is connected. If power is available from an AC grid, the AC contactor closes and the Sunny Central switches to grid monitoring.

### **Grid Monitoring**

The Sunny Central is in the grid monitoring "operating state". The inverter checks whether the grid limits of the medium-voltage grid are maintained during the monitoring time "GriGrdMonTm". If the grid limits are maintained during this time, the Sunny Central changes to the "Startup" operating state.

If the grid limits are exceeded during the monitoring time "GriGrdMonTm", the Sunny Central switches to the "Waiting" operating state.

### Startup

The Sunny Central is in the "Startup" operating state. The Sunny Central moves to its initial operating point and begins the feed-in process.

### **MPP Load Operation**

In the MPP operating state, the Sunny Central feeds power into the grid and operates permanently at the Maximum Power Point (MPP). If the measured power  $P_{PV}$  during the time interval "TStop" is smaller than "PpvStop" or the key switch is set to "Stop", the Sunny Central switches to the "Shutdown" operating state.

### Shutdown

The Sunny Central is in the "Shutdown" operating state. If the key switch is set to "Stop", the Sunny Central switches to the "Stop" operating state. In all other cases, it switches to the "Waiting" operating state.

### Failure

If a failure occurs during operation, the Sunny Central switches off and the failure is shown on the display (see section 7 "Troubleshooting", page 75).

# 3.2 Indicator Lights

If a failure occurs, the indicator lights show the current status of the inverter. The indicator lights are controlled by the Sunny Central Control.

If the yellow indicator light is on, the inverter is in "Warning" state. The inverter disconnects, but the failure must be rectified to ensure optimum operation over the long term.

If the red indicator light is on, the inverter is in "Warning" state and there is a massive error. The inverter has switched off automatically. The error must be rectified and acknowledged.

# 3.3 Key Switch

The key switch is used to switch the Sunny Central on and off.

### "Start" switch position

After turning the switch to the "Start" position, the Sunny Central changes from the "Stop" operating state to the "Waiting" operating state. If there is sufficient irradiation and a valid grid connection, the Sunny Central switches to feed in operation. If there is insufficient irradiation and, in turn, the input voltage is too low, the Sunny Central remains in "Waiting" operating state.

### "Stop" switch position

If the key switch is turned to "Stop" when the Sunny Central is in the "Waiting" operating state, a motor drive automatically shuts off the main DC switch and the Sunny Central goes into the "Stop" operating state.

If the key switch is turned to "Stop" when the Sunny Central is in "MPP Load Operation" state, the Sunny Central switches to the "Shutdown" operating state. Once shutdown is complete, a motor drive automatically switches off the main DC switch and the Sunny Central goes into the "Stop" operating state.

# 3.4 Emergency Stop

The emergency stop button allows the user to immediately disconnect the Sunny Central from the grid and the PV array in case of emergency.

### Tripping the emergency stop function

The emergency stop function may only be tripped if there is imminent danger.

Pressing the emergency stop button does not quickly discharge the capacitors.

Pressing the emergency stop button opens the DC contactor, switches off the inverter bridge and disconnects the inverter from the AC grid.

# 3.5 Sunny Central Control

The Sunny Central Control is the Sunny Central's control unit. It allows users to change parameters, display operating states and to output error messages.



Figure 4: The Sunny Central Control's control panel

Position	Description	Function
А		4-line display
В	ESC	Cancels/exits function/input
		Answers question with "No"
		• Returns to the previous menu
		<ul> <li>Switches from the standard view into the main menu or from the main menu into the standard view</li> </ul>
С	Arrow up	Moves to line above
		Increases value
D	Arrow down	Moves to line below
		Lowers value
E	ENTER	• Selects the function from the menu
		Selects a value
		Confirms changes
		Answers question with "Yes"

# 3.6 Sunny Central Control Menu Structure

Operating Data	Faults	Current Faults DSP Error Code BFR Error Stack Fail No. Stack Failure Err Meas. DC
	Plant Status	State Inverter Status
	Energy Yield	E-Total E-Today
	Data Files	Meas. Interval Daily Values Mess. Channels
	Other	h-On Working Time
		Startup counter
		Fault counter
		Alert counter
		DCSchaltCnt
		Availability
Spot Values	PV	Рру
		Vpv
		lpv
	Grid	Pac
		Fac
		lac
		Vac Phase 1-2
		Vac Phase 2-3
		Vac Phase 3-1
		Qac
		Sac
	Red.effect.pow	P-WSpt
		P-WmodFailStt

Figure 5: Sunny Central Control menu structure (part 1)

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C 1)/ 1		0)/// 5 .	
Spot Values	Outp.react.pow.	Q-VArSpt	
		Q-VArModFailStt	
		PF-PFSpt	
		PF-PFExtSpt	
	Grid decoupling	GriGrdStt	
	Other	T-Heat Sink C	
		Mppsearchcount	
		Team-Status	
		R-Insul	
		TmpInt C	
		TmpExt C	
		ExtSolP	
		ExtSolQ	
Long-Term Data	Meas Chn		
Long-term Data	Energy Vield		
	Diant Status		
	Faults		
Device Set-up	Password		
	System	Language	
		Date/Time	
		Inverter Type	
		Firmware	
		BFR SW Vers.	

Figure 6: Sunny Central Control menu structure (part 2)

Device Set-up	Parameters	ParamFunktion Red effect pow	
		Outo react now	
		Grid decoupling	
		Grid connection	
		Mpp Limit. Val.	
		Mpp Tracking	
		Start requirement	
		Shut-down requ.	
		Grid Monitor	
		Other	
	Interfaces	Communication	
		Analog In	
		Digital In	
		Digital Out	
	Data archives	Data Recording	
		Meas. Interval	
		Max. Storage	
		Chan. Select.	
	SMUs	Devices	
		Parameter	
		Measured Values	
		Failure	
	NET/EMAIL	NET	
		Remote-Info	

Figure 7: Sunny Central Control menu structure (part 3)

### i Team operation displays

None of the Sunny Central's team operation displays are supported.

### 3.7 Overview of the Analog Inputs

In the Sunny Central, it is possible to install 2 analog sensors (ExtSollrr, ExtGlolrr) on the Sunny Central Control via a special connecting terminal plate. The Sunny Central Control also has 4 signal inputs. The external temperature sensor TempExtC is installed at the factory.

The sensors can be configured individually.

The electrical connection of the sensors is described in the Sunny Central's installation manual.

Input	Description		
ExtSolIrr	External irradiation sensor		
ExtGloIrr	Pyranometer (measurement of global solar irradiation)		
ExtAlarm	External alarm input, e.g., for monitoring the functioning of the medium-voltage transformer		
ExtSolP	External target value of active power		
ExtSolQ	External target value for reactive power		
TempExtC	External temperature sensor PT 100 (is factory-installed in the Sunny Central)		

### **Overview of the Analog Inputs**

# 3.8 Insulation Monitoring

# 3.8.1 How Insulation Monitoring Works

Insulation monitoring consists of equipment that ensures plant protection in electrical devices. There are different types of insulation monitoring:

• In grounded grids

Insulation monitoring is performed via a residual current monitoring device. If an insulation failure occurs, the residual currents will be detected and interrupted.

• In ungrounded grids

An insulation monitoring device constantly determines the insulation resistance using an active measurement procedure. If the insulation resistance falls below a certain threshold, an insulation warning will be displayed on the indicator light and Sunny Central Control. This allows measures to be taken to prevent errors, for example, personal injury caused by leakage current or plant failure. If the insulation resistance falls below a limiting value, then the plant can switch itself off. A parameter can be configured to switch off the unit when an error occurs.

# 3.8.2 GFDI

Depending on the order, the insulation monitoring in the Sunny Central is carried out via a ground fault detection interruption, abbreviated GFDI. This process is used to ground one pole of the PV array.

A high-performance miniature circuit-breaker with adjustable trip current with K characteristics is used as a GFDI. It is integrated in the inverter and connected between an input busbar and the protective conductor bar.



Figure 8: GFDI in the Sunny Central

#### Ground fault on ungrounded pole

If a ground fault occurs at the PV array pole that is not grounded, the residual current flows through the GFDI and back to the grounded pole, thus tripping the GFDI. This interrupts the residual current and the PV array is not grounded via the ground fault.

If the GFDI is tripped, the monitoring device switches off the inverter and the insulation error needs to be corrected.

#### Ground fault on grounded pole

The GFDI is bypassed when a ground fault occurs in the grounded pole of the PV array. The ground fault on the grounded pole cannot be reliably detected. If the Sunny Central is equipped with an additional insulation monitoring device, this type of error will be detected.

# 3.8.3 Remote GFDI

Depending on the order, the insulation monitoring in the Sunny Central is carried out via a ground fault detection interruption with a remote tripped, abbreviated "remote GFDI". This process is used to ground one pole of the PV array. Remote GFDI also enables automatic error processing. This prevents downtimes and service calls due to temporary insulation errors, such as condensation on the modules.

A high-performance miniature circuit-breaker with adjustable trip current with K characteristics is used as a remote GFDI. It is integrated in the inverter and connected between an input busbar and the protective conductor bar.



Figure 9: Remote GFDI in the Sunny Central

If the remote GFDI is tripped, a motor will close it after a starting command. The starting command can also be given via a remote tripping. This allows the inverter to switch back to feed-in operation after the delay.

The Sunny Central's default setting allows up to 3 attempts to start the remote GFDI per day.

If the remote GFDI is tripped three times in one day, the software assumes that there is a "permanent insulation fault" and the inverter no longer goes into operation. In this case, the insulation should be checked by an electrically skilled person and repaired if necessary. The fault should then be confirmed.

# 3.8.4 Soft Grounding

Depending on the order, the insulation in the Sunny Central is monitored via soft grounding. This process grounds one pole of the PV array through a resistor.



Figure 10: Soft grounding in the Sunny Central

With soft grounding, the insulation is monitored by measuring the voltage between the grounded pole and PE. To do this, the software analyzes the DC voltage " $V_{PV}$ + to PE" on the positive pole or " $V_{PV}$ - to PE" on the negative pole when grounded.

If the amount of voltage measured exceeds a certain threshold, the grounding of the PV array is disconnected and the residual current is interrupted. This threshold is adjustable.

If a soft grounding error occurs, the insulation should be checked by an electrically skilled person and repaired if necessary. The insulation protection must be reactivated using the reset button in the device.

# 3.8.5 Insulation Monitoring Device

The insulation monitoring device monitors the inverter's insulation resistance. The user can configure the monitoring to the PV modules used.



Figure 11: Insulation monitoring ISO-PV-3 in the Sunny Central

Object	Description
А	Display
В	Control buttons
С	LEDs

A measuring circuit and a relay with a changeover contact are integrated in the insulation monitoring device.

The insulation monitoring device is connected between the PV voltage and the PE conductor. The measuring circuit closes when an insulation error occurs. If the ALARM1 value falls below a specific threshold, the measuring circuit trips a warning and LED1 turns on.

The measuring circuit generates a failure message and the inverter switches off when the ALARM2 value falls below a specific threshold. LED2 turns on.

#### Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV device supplied by Bender GmbH and Co. KG.

# 3.9 External Grid Monitoring Relay

Depending on the order, the Sunny Central is also equipped with a separate grid monitoring relay instead of the integrated grid monitoring feature.

The external monitoring relay monitors the grid, detects breaches of the grid limits and transmits an error message to the Sunny Central. The set grid limits in the external monitoring relay always have priority over the settings in the Sunny Central Control.



Figure 12: External grid monitoring relay in the Sunny Central

Position	Description
A	2-line display
В	Control buttons
С	Side input and control dial

#### External grid monitoring relay used

The Multi Function Relay Protection MFR 11 device from the Woodward Gavenor Company is used as an external monitoring relay.

# 3.10 Grid Management

### 3.10.1 Requirements

In Germany, PV plants with more than 100 kWp connected power must be integrated into the feed-in and grid management. First and foremost, the distribution grid operator must be able to limit the power of the PV plant by remote control and temporarily reduce it to zero in critical cases. The relevant control commands of the distribution grid operator must therefore be transmitted to the Sunny Central quickly and reliably for implementation.



# 3.10.2 Low Voltage Ride Through (LVRT)

The LVRT function interrupts feeding in for a maximum of 1.2 seconds and starts monitoring if the grid fails.

As soon as the grid voltage begins to rise again, the Sunny Central supports the grid by feeding in at maximum level. In case of longer grid failures, grid monitoring comes into effect, and the Sunny Central disconnects itself from the grid.

The limiting values for monitoring the grid are specified by the electric utility company and/or state regulations.

If you wish to deactivate the LVRT option, please consult the SMA Serviceline.

# 3.10.3 Active Power Limitation

Five methods are available for limiting the active power regardless of power frequency. The limit can be defined using a parameter and supplied by the distribution grid operator via an external signal.

In addition to these methods, the active power can also be limited according to the power frequency.

# 3.10.4 Reactive Power Setpoint

The Sunny Central can provide reactive power. There are 10 methods available for specifying the target value.

The reactive power can be supplied as follows:

- by entering fixed parameters on the Sunny Central Control
- by external signals from the distribution grid operator
- by adjustable characteristic curves in the Sunny Central Control

# 3.11 Active Island Detection

The active island detection function detects the formation of island grids during a grid failure and disconnects the Sunny Central from the grid.

Island grids are created when the medium-voltage grid fails and the Sunny Central is feeding a specific power output at the same time and there is a load and on the grid with a a load of the same size. In such a stand-alone grid, the Sunny Central measures its own voltage, which is equal to the grid voltage. As a result, the grid monitoring cannot detect any faults and the Sunny Central does not disconnect from the grid.

To enable the active island function, contact the SMA Serviceline.

# 3.12 NET Piggy-Back

The NET Piggy-Back is an additional module for the Sunny Central Control. The NET Piggy-Back allows you to directly e-mail the operating data of your PV plant from the Sunny Central Control to any e-mail address.

Refer to the NET Piggy-Back documentation to connect the NET Piggy-Back.

# 3.13 Serial Number and Device Type

The serial number (Serial No.) and device type (Type) of the Sunny Central are listed on the type label. The type label is located on the inside of the door in the DC cabinet.



Figure 13: Position of the type label

In addition, the serial number (A) is located on the front side of the Sunny Central.

You can view the device type on the Sunny Central Control under **Device Set-up** > **System** > **Inverter Type**.

# 4 Sunny Central Control

# 4.1 Display Layout

The Sunny Central Control display has 4 lines.



Figure 14: Display layout

Position	Explanation
А	Parameter and measurement channel display
	The menu item in which you currently are is displayed in brackets [ ] (example fig. 14: [Device Set-up]).
В	Area for the display symbols

### **Description of Display Symbols**

The following symbols are shown on the Sunny Central Control display.

Symbol	Description
4	This symbol indicates that there are additional menu items below.
÷	This symbol indicates that there are additional menu items above.
*	This symbol indicates that there are additional menu items above and below.
÷	This symbol indicates which menu item you have currently selected. You can switch into this menu item using the [ ↑ ] or [ ↓ ] button.
-#-	This symbol indicates that a value can be changed.
-⊪ Flashes	After a value is changed and confirmed with [ENTER], the arrow flashes. It flashes to indicate that the value was changed and requests confirmation. Press [ENTER] again to confirm and apply the change. [ESC] resets the change.
ž	The Sunny Central Control processes data.

### **Standard View Display**

If there are warnings or failures, the message is alternatively displayed with the highest priority and the standard view.

### Main Menu Display

From the main menu, you can reach all areas of the Sunny Central Control and all settings.

All of the navigation paths are described below with the main menu as the starting point.

ESUN	NY CENTRAL	]
E I	CONTROL	3
Time	:	
Date	:	
гм	nin Manu	7
E M.	ain Menu	]
[ M. Oper	ain Menu ratin9 Dat:	]
[ M. Oper Spor	ain Menu ratin9 Dat. t Values	]

### **Display Messages during Initialization**

After the Sunny Central has been switched on, the Sunny Central Control starts initializing. Initialization involves a sequence of 3 display messages.

After initialization, the Sunny Central displays the measured values and instantaneous values shown.

Mode MPF	Mode	MPP	Mode	MPP
Pac 85.7kU	Ppu	89 <b>.</b> 27k₩	fac	50.04Hz
E-Today 357.5kWH	Upu	5570	Vac	230 <b>.</b> 51V
E-Total2512.3kW	IPV	160.26A	Iac	124 <b>.</b> 04A

• You can switch between the 3 views with the [  $\uparrow$  ] and [  $\downarrow$  ] buttons or [ENTER].

# 4.2 Password and System Settings

### 4.2.1 Adjusting the Display Contrast

You can adjust the display contrast in any menu.

- To increase the contrast, press [ESC] + [ ↑ ].
- To lower the contrast, press [ESC] + [ ↓ ].

# 4.2.2 Entering the Password

Safety-relevant Sunny Central parameters can only be adjusted upon entry of a password. The SMA Serviceline provides you with the password (see section 10 "Contact", page 102).

- 1. Select Device Set-up > Password.
- 2. Select individual parts of the password with the [ $\uparrow$ ] or [ $\downarrow$ ] buttons and confirm the respective set value with [ENTER].
  - $\blacksquare$  After confirmation, the entered values are displayed as stars.
  - ☑ Sunny Central Control beeps 3 times.
  - ★ Sunny Central Control does not beep?

The wrong password was entered.

• Reenter the password.

# 4.2.3 Locking the Sunny Central Control

The Sunny Central's safety-relevant parameters may not be available during normal operation. Lock the Sunny Central Control after changing the parameters.

**Tip:** Password protection will automatically resume at midnight, or upon a restarting Sunny Central Control.

- 1. Select Device Set-up > Password.
- 2. Enter the incorrect password or no password at all and confirm with [ENTER].

# 4.2.4 Setting the Language

You can choose between German, English and Spanish.

- 1. Select Device Set-up > System > Language.
- 2. Select the desired language with the [  $\uparrow$  ] or [  $\downarrow$  ] button.
- 3. Press [ENTER] twice.

# 4.2.5 Changing the Date and Time

The Sunny Central Control's default settings for date and time correspond to the Central European time zone (CET).

- 1. Select Device Set-up > System > Date/Time.
- Select the displayed date with the arrow buttons and confirm by pressing [ENTER].
   ☑ The area to be changed flashes.
- 3. Set the day and year with the arrow buttons and confirm each setting with [ENTER]. Complete the entry by pressing [ENTER] again.

 $\blacksquare$  The desired date is set.

- 4. Select the displayed time with the arrow buttons and confirm by pressing [ENTER].
- 5. Set the hours and minutes with the arrow buttons and confirm each setting with [ENTER]. Complete the entry by pressing [ENTER] again.
  - $\blacksquare$  The desired time is now set.

# 4.2.6 Display Firmware Version

• Select Device Set-up > System > Firmware.



# 4.3 Measured Data

# 4.3.1 Measured Data via Sunny Data Control

The data is compiled in a channel record.

# 4.3.2 Requesting Measured Data from the Sunny Central Control

- 1. Select Long-Term Data > Meas. Chn. > SC...SCXXX.
  - ☑ The Sunny Central Control displays the measurement channels selected for the display (see section 8 "Sunny Central Control Measurement Channels", page 89).
- 2. Select measurement channel.
- 3. Select the date and confirm by pressing [ENTER].

# 4.3.3 Displaying the Daily Energy Yield Values

- 1. Select Long-Term Data > Energy Yield. The daily values are compiled monthly.
- 2. Select the month and confirm by pressing [ENTER].

# 4.3.4 Deleting the Daily Energy Yield Values

- Select Device Set-up > Parameters > Param.-Function.
   The display flashes.
- 2. Select Del. Daily Value and confirm by pressing [ENTER].

## 4.3.5 Adding Other Measurement Channels to Long-Term Data List

The Sunny Central Control displays 14 measurement channels in the default settings.

- Select Device Set-up > Data archives > Chan. Select. > SC...SCCXXX.
  - ☑ The Sunny Central Control displays all measurement channels (see section 8 "Sunny Central Control Measurement Channels", page 89). The measurement channels displayed in the menu Long-Te



channels displayed in the menu **Long-Term Data** > **Meas. Chn.** > **SC...SCXXX** are marked by a dot.

- Select the measurement channel and confirm by pressing [ENTER]. In the future, the measurement channel is then displayed under Long-Term Data > Meas. Chn. > SC...SCXXX.
  - ☑ A dot appears before the selected measurement channel and it is added to the long-term data list.
- 3. After exiting the menu, confirm the security prompt twice with [ENTER].

Another measurement channel is added to the long-term data list.

# 4.3.6 Resetting the Long-Term Data List of the Measurement Channels to the Factory Setting

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- Select Device Set-up > Parameters > Param.-Function.
   ☑ The display flashes.
- Select default chan. and confirm by pressing [ENTER].
   ☑ The line stops flashes.
- 4. Press [ENTER].

# 4.3.7 Deleting Measured Data

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- Reset the display of the measurement channels to the factory setting (see section 4.3.6 "Resetting the Long-Term Data List of the Measurement Channels to the Factory Setting", page 34).
- Select Device Set-up > Parameters > Param.-Function.
   ☑ The line flashes.
- Select Del. Meas. Data
   ☑ The line stops flashes.
- 5. Press [ENTER].

## 4.4 Parameters

# 4.4.1 Changing Parameters

### Sunny Central does not function properly due to incorrect settings

If the parameter settings are incorrect, the proper functioning of the Sunny Central cannot be ensured.

 Modify the parameters marked with \* in the parameter overview only after consulting SMA Solar Technology AG (see section 9 "Parameters", page 91).

After work has been carried out on the Sunny Central Control, it must be relocked to prevent third parties from making unauthorized changes to the parameters (see section 4.2.3 "Locking the Sunny Central Control", page 32).

### **i** Parameter protection for grid parameters

All values in the grid decoupling and grid connection parameter areas are relevant for the grid safety and may only be changed in the "Stop" operating state.

This parameters may only be changed with the approval of SMA Solar Technology AG.

There are three ways to change parameters:

- At the site with a laptop via the service interface and the Sunny Data Control software (see Sunny Data Control user manual).
- From a PC via remote access with Sunny Data Control or via the Sunny WebBox (see Sunny WebBox user manual). Not all parameters can be modified by remote access.
- At the Sunny Central with the Sunny Central Control.

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- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > Parameters.

☑ The menu with the available parameter groups opens (see section 9 "Parameters", page 91).

- Using the [↓] button, select the parameter group in which a parameter is to be changed.
- Using the [↓] button, select the parameter to be changed.
- 5. Take note of the parameter's preset value.
- 6. Exit the menu with [ESC].

Parameters ] Г Param. -Function Mpp Limit. Val. Mpp Tracking Start requiremt Shut-down requ. Grid Monitor. Other

### 4.4.2 Saving Parameters

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > Parameters > save parameter.
- 3. Press [ENTER] twice.

### 4.4.3 Resetting Parameters

- Select Device Set-up > Parameters.
   ✓ The menu with the available parameter group opens (see section 9 "Parameters", page 91).
- 2. Using the  $[\downarrow]$  button, select the parameter group to be changed.
- 3. Using the  $[\downarrow]$  button, select the parameter to be changed.
- 4. Enter the parameter's original value.
- 5. Confirm the change with [ENTER].
# 4.5 Sending Data

## 4.5.1 Activating E-mail Reports

Reports are only sent by e-mail if the corresponding function is activated.

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > NET/EMAIL > Remote-Info.

🗹 Remote info menu appears.



3. Press [ENTER].

☑ Line below "EMAIL" flashes.

- 4. Select **...activated** with the  $[\downarrow]$  button.
- 5. Press [ENTER] twice.

## 4.5.2 Selecting the Report Types to Send

### Report types and setting options

Report	Description	Adjustable
Plant info	Report on the present values of your plant, e.g., E-Total, E-Today.	<ul> <li>no report</li> <li>daily report (recommended)</li> </ul>
Warnings	Report on the generated warning messages (see section 7.3 "Warnings", page 77).	<ul> <li>no report</li> <li>hourly report</li> <li>daily report (recommended)</li> </ul>

Report	Description	Adjustable
Errors	Report on the generated errors (see section 7.4 "Interferences", page 80).	<ul> <li>no report</li> <li>hourly report (recommended)</li> <li>daily report</li> </ul>
Event	Report on the generated events (see section 7.5 "Events", page 87). In addition to the report, you can have the events displayed on the Sunny Central Control in the menu under <b>Long-Term Data &gt; Plant Status</b> .	<ul> <li>no report</li> <li>hourly report</li> <li>daily report (recommended)</li> </ul>
Send at	Here, the time is set at which the daily report should be sent. SMA Solar Technology AG recommends setting the time to 10:15 pm.	• Time

### "Plant-Info" report

Display	Description
DEVICE	Name of the Sunny Central
SERIAL NUMBER	Serial number of the Sunny Central
E-total	Total energy which the Sunny Central has fed into the grid during its operating time
E-today	Energy which the Sunny Central fed into the grid on this day

## "Error, warnings, events" report

Display	Description	
DEVICE	Name of the Sunny Central	
SERIAL NUMBER	Serial number of the Sunny Central	
DATE	Date of the error, the warning or the event	
TIME	Time at which the error, warning or event was detected	
MESSAGE	Number of the failure, warning or name of the event	
	• ">" before the message: the message occurred at the time specified	
	<ul> <li>"&lt;" before the message: the message was corrected at the time specified</li> </ul>	

1. Enter password (see section 4.2.2 "Entering the Password", page 32).

- 2. Select Device Set-up > NET/EMAIL > Remote-Info.
- 3. Select Events.

4. Select which reports are to be sent and confirm with [ENTER].

☑ Selected line flashes.

- 5. Select when the reports are to be sent with [  $\downarrow$  ].
- 6. Press [ENTER] twice.

C	EVENTS ]
Plant	-Info
dai	ly report
Warni	n9s
…dai	ly report
Error	s
hou	rly report
Send	at
2	0:00

# 4.5.3 Entering or Changing an E-mail Address

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > NET/EMAIL > Remote-Info.
- 3. Select Recipient.
- 4. In the line "FIRMA XYZ-SOLA", enter the company name and confirm with [ENTER].
- 5. Enter your name in the "HERRN MUSTERMANN" line and confirm with [ENTER].
- 6. Enter your e-mail address in the "EMAIL TO" line and confirm with [ENTER].
- To send reports to other addresses, enter 2 other e-mail addressed in the "EMAIL CC1" and "EMAIL CC2" lines and confirm each with [ENTER].

[ RECIPIENT ]
Company/Name
…FIRMA XYZ-SOLA
HERRN MUSTERMA
EMAIL TO
EMAIL CC1
EMAIL CC2
L

# 4.5.4 Sending Reports

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > NET/EMAIL > Remote-Info.
- 3. Select Test-Report.

☑ The Sunny Central Control shows "Start" on the display.

4. Press [ENTER].

☑ The test report is sent.

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★ Does the error 0016 appear on the display?

The test report was not sent.

• The meaning of the error code in the bottom line is described in the NET Piggy-Back user manual.

```
FI-Status
.....Fault
[0016]
```

# 4.6 Analog Sensors and External Signals

# 4.6.1 Calculating Gain and Offset of External Sensors

To obtain specific measurement results from the external sensors, you have to calculate the gain and offset of each sensor in advance.

## Gain

The gain is obtained by dividing the value range by the measuring range.

### Gain = value range/measuring range

## Offset

The offset is calculated by subtracting the product of the gain factor and the lower end of the measuring range from the lower end of the display range.

### Offset = lower end of value range - (gain factor x lower end of measuring range)

## Calculation

M is a measured value in a range between Mu and Mo

W is the value displayed in a range between Wu and Wo

Gain:	$V = (W_0 - W_U) / (M_0 - M_U)$
Offset:	$O = W_U - (V \times M_U)$
Display on the Sunny Central Control:	$W = (V \times M) + O$

### **Explanation of the Symbols Used**

М	Measured value	Мо	Upper end of measuring range
Mυ	Lower end of measuring range	0	Offset
G	Gain	W	Value
Wo	Upper end of value range	Wu	Lower end of value range

### **Example Calculation for Pyranometer**

A pyranometer has an output voltage of 0 to 10 V, which corresponds to an irradiation of  $0 \text{ W/m}^2 \dots 1\ 350 \text{ W/m}^2$ . Mu = 0 V Mo = 10 V Wu = 0 W/m<sup>2</sup> Wo = 1\ 350 W/m<sup>2</sup> **Calculation V** G = (1\ 350 - 0) / (10 - 0) = 135 **Calculation O** O = 0 - (135 x 0) = 0 W/m<sup>2</sup> Example for M = 5 V **Calculation** W = 135 x 5 + 0 = 675

### **Example Calculation for Temperature Sensor**

A temperature sensor with a converter puts out 4 to 20 mA, which corresponds to a temperature range of -30 °C ... +80 °C.

$$\begin{split} \mathsf{Mu} &= 4 \text{ mA} \\ \mathsf{Mo} &= 20 \text{ mA} \\ \mathsf{Wu} &= -30 \,^{\circ}\text{C} \\ \mathsf{Wo} &= +80 \,^{\circ}\text{C} \\ \textbf{Calculation V} \quad \mathsf{V} &= (80 - (-30)) / (20 - 4) = 6.875 \\ \textbf{Calculation O} \quad \mathsf{O} &= (-30) - (6.875 \times 4) = -57.5 \,^{\circ}\text{C} \\ \text{Example for if } \mathsf{M} &= 4 \,\text{mA} \end{split}$$

**Calculation**  $W = 4 \times 6.875 + (-57.5) = -30$ 

# 4.6.2 Configuring ExtSolIrr and ExtGloIrr Analog Sensors

### **Requirement:**

- □ Values for gain and offset are calculated for the required sensor (see section 4.6.1 "Calculating Gain and Offset of External Sensors", page 40).
- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > Interfaces > Analog In.
- 3. Select the required analog input.

A detailed view of the required analog input is displayed.

- 4. Select ctrl (analog input) and set to "on" to activate the analog input for the sensor and confirm twice with [ENTER].
- 5. Under **Fkt (analog input)**, select the measuring range for the analog sensor and confirm twice with [ENTER].

- 6. Enter the calculated value for gain and confirm with [ENTER] until the line stops flashing.
- 7. Enter the calculated value for offset and confirm with [ENTER] until the line stops flashing.
- After exiting the menu, confirm the security prompt twice with [ENTER].
   ☑ The sensor is configured.

# 4.6.3 Displaying the Sensor's Spot Values

- 1. Select Spot Values > Other.
- 2. Select the required sensor.

☑ The present value is displayed under the sensor name.

# 4.6.4 Setting the External Alarm

The analog input "ExtAlarm" is preconfigured for the connection of an external alarm.

If you have activated the e-mail report "Warnings", you will receive an e-mail immediately after the alarm is tripped (see section 4.5.2 "Selecting the Report Types to Send", page 37).

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > Interfaces > Analog In > ExtAlarm.
- 3. Set the **ctrl ExtAlarm** parameter to the required value.

Adjustable	Meaning
Deactivated	The sensor is deactivated.
Active high	The alarm is tripped if there is 24 V on the alarm input terminal.
Active low	The alarm is tripped if there is 0 V on the alarm input terminal.

4. After existing the menu with the security prompt, confirm twice with [ENTER].

# 4.7 Active Power Limitation

# 4.7.1 Frequency-independent Active Power Limitation Procedure

The Sunny Central can limit its active power if requested by the distribution grid operator. You can use the "P-WMod" parameter to set the procedure for limiting active power (see section 9.2 "Red.effect.pow.", page 92). You use the parameter to configure how the distribution grid operator's parameters should be received and implemented. The default value for this parameter is "Off".

Active power limitation independent of power line frequency can be realized through 6 different procedures:

Procedure	Description	
Off	Active power is limited to the device's rated output power "Pmax".	
WCtlCom	The active power limitation is received by the Sunny WebBox via the Power Reducer Box and then forwarded to the Sunny Central.	
WCnst	The active power limitation is entered as an absolute value using the "P-W" parameter.	
WCnstNom	The active power limitation is entered as a percentage value using the "P-WNom" parameter.	
WCnstNomAnIn	Active power limitation is set at the input terminals using an analog signal for specifying the target value.	

### i Parameter Protection

This parameter may only be changed in the "Stop" operating state. The entry will not be accepted in other operating states.

### Active Power Limitation Procedure and Associated Parameter Setting

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- Select Device Set-up > Parameters > Red.effect.pow. > P-WMod.
   ✓ Line below "P-WMod" flashes.
- 3. Select the required procedure for limiting the active power.
- 4. Press [ENTER] twice.

I The required procedure for limiting the active power is set.

- 5. If necessary, select the parameter associated with the procedure with the [  $\downarrow$  ] key and press [ENTER].
- 6. Set the parameter.
- 7. Press [ENTER] twice.

# 4.7.2 "Off" Procedure

Feed-in power is limited to the "Pmax" parameter.

The "Pmax" parameter defines the inverter power at the feed-in point and is adjusted to the local conditions during commissioning. The "Pmax" parameter can only be changed in the "Stop" operating state and after entering the installer password.

Used parameters Pmax

# 4.7.3 "WCtlCom" Procedure

The target value for the active power limitation is received by the Sunny Central Control via the Power Reducer Box and then forwarded to the Sunny Central. If the Sunny Central has received no signal for 5 minutes, the "P-WModFailStt" error message will be displayed.

Used parameters none

## 4.7.4 "WCnst" Procedure

The active power limitation is entered as an absolute value using the "P-W" parameter.

The "P-W" parameter defines the active power to be fed in. The "P-W" parameter can be changed during feed in operation. The "P-W" parameter must always be smaller than the "Pmax" parameter.

Used parameters P-W

## 4.7.5 "WCnstNom" Procedure

Active power limitation is set as a percentage value using the "P-WNom" parameter. The percentage value refers to the "Pmax" parameter.

The "P-WNom" parameter indicates the percentage of maximum possible power to be fed in. The "P-WNom" parameter can be changed during feed-in operation.

Used parameters P-WNom

# 4.7.6 "WCnstNomAnIn" Procedure

Active power limitation is set at the input terminals using an analog signal for specifying the target value (see the enclosed inverter installation manual). This is usually accomplished by using a radio ripple control receiver.

The current of the connected signal determines the rated active power.

The analog measured values must be between 4 mA ... 19 mA. If the analog signal is smaller than 2 mA, the error message "P-WModFailStt" will be displayed.

Signal	Power limit	Description
< 2 mA	Last valid value and/or "Pmax" after restart	Signal is in the invalid range
2 mA 4 mA	0	No power is fed into the grid.
4 mA 19 mA	0 Pmax	Fed-in energy is determined using a characteristic curve
> 19 mA	Pmax	Fed-in energy is Pmax

The analog value is converted to a target value for power limitation. Here, the "Pmax" parameter is the end point of the linear characteristic curve.

Used parameters none

## 4.7.7 Displaying Error Messages and Warnings for Active Power Limitation

The "P-WModFailStt" channel displays the error messages or warnings associated with active power limitation.

Displaying the "P-WModFailStt" Channel

• Display spot value of the "P-WModFailStt" channel on the Sunny Central Control user interface (see section 9.2 "Red.effect.pow.", page 92).

Display	Description	Measure
Off	No procedure for limiting active power has been chosen.	None
ОК	A procedure for limiting active power has been chosen and there are no errors.	None
ComFail	The "WCtlCom" procedure has been chosen and the expected signal with a valid active power limitation has been absent for at least 5 minutes.	<ul> <li>Check whether Sunny Central Control is working.</li> <li>Check whether the Sunny Central Control can be accessed from outside and is displaying the data of the inverter.</li> <li>Check whether the cables between the Sunny Central Control and the inverters are OK.</li> <li>Check whether the cables inside the Sunny Central Control are OK.</li> </ul>
AnInFail	The "WCnstNomAnIn" procedure has been chosen and the value measured at the analog input is less than 2 mA.	Check the analog input.

## 4.7.8 Active Power Limitation Depending on Power Frequency

In addition to the procedures for limiting active power that can be chosen using the "P-WMod" parameter, active power can be limited depending on the power frequency.

When limiting active power dependent on power frequency, the Sunny Central constantly checks the connected power frequency.



Figure 15: Behavior of the Sunny Central when exceeding the "P-HzStr" frequency limit

If the power frequency exceeds a certain limit "P-HzStr" defined by you as shown in point A, the Sunny Central will save the current feed-in power  $P_{cur}$ . The reduced feed-in power is calculated based on this saved value. The reduction of the feed-in power is defined through the "P-WGra" parameter. This parameter indicates by which percentage of the saved power  $P_{cur}$  output will be reduced per Hz if the power frequency continues to rise.

If the power frequency decreases again as shown in point B, the last reached feed-in power will remain valid. Only if the power falls below the "P-HzStop" parameter defined by you as shown in point C, can the fed-in power be increased again. The saved value "Pcur" will be rendered invalid.

Should the power frequency exceed the power line limit, the Sunny Central will shut down and switch over to the "Waiting" operating state. The Sunny Central will remain in the "Waiting" operating state until all feed-in conditions are fulfilled again.

 Calculating the power limit:

 Formula: P<sub>lim</sub> = P<sub>cur</sub> - ( (f<sub>power</sub> - P.HzStr) \* P.WGra \* P<sub>cur</sub> )

 P<sub>lim</sub>
 Power limit
 P<sub>cur</sub> Current power

 f<sub>power</sub>
 Power frequency
 P.HzStr
 Selected frequency limit which will lead to reduction of feed-in power

 P.WGra
 Gradient for reducing active power
 P.WGra
 Gradient for reducing active power

### Example:

A Sunny Central with 500 kW is feeding 350 kW ( $P_{cur}$ ) into the power distribution grid. The frequency will reach up to 51.2 Hz.

The difference between the current power frequency and P-HzStr (51.2 Hz - 50.2 Hz) multiplied by the gradient "P-WGra" (40%/Hz) results in an active power reduction of 40% in the last available power P<sub>cur</sub> (350 kW). This results in a power limitation of 140 kW and a maximum active power of 210 kW.

Calculation:

210 kW = 350 kW - ( (51.2 Hz - 50.2 Hz) \* 40%/Hz \* 350 kW )

Used parameters	P-HzStr
	P-HzStop
	P-WGra

## 4.7.9 Displaying the Status of the Active Power Limitation

The "P-WModStt" spot value displays the status of the active power limitation.

### Displaying the Spot Value "P-WModStt"

### Select Spot Values > Red.effect.pow. > P-WModStt.

Display	Description
Off	No procedure for limiting active power has been chosen.
WMax	Active power is limited by the specified maximum limit. This limit is based on Pmax.
Hz	Active power is limited by a frequency increase.
Tmp	Active power is limited due to temperature derating.
AmpPv	Active power is limited via PV power limitation.

# 4.8 Reactive Power Regulation

# 4.8.1 Procedure for Regulating Reactive Power

The Sunny Central can supply reactive power if required by the distribution grid operator. The distribution grid operator defines the used procedures and target values for this.

The "Q-VArMod" parameter is used to select the procedure for regulating reactive power. You use the parameter to configure how the utility operator's parameters should be received and implemented.

Procedure	Description
Off	The reactive power target value is limited to 0 kVAr.
VArCtlCom	The reactive power target value is received by the Sunny WebBox through the Power Reducer Box and forwarded to the Sunny Central.
PFCtlCom	The reactive power target value is received by the Sunny WebBox through the Power Reducer Box and forwarded to the Sunny Central. A power factor is transmitted as a target value.
VArCnst	The "Q-VAr" parameter is used to set the reactive power target value (in kVAr).
VArCnstNom	The "Q-VArNom" parameter is used to set the reactive power target value (in %).
VArCnstNomAnIn	The reactive power target value is imported through an analog input. The analog value is converted into a reactive power target value.
PFCnst	The reactive power target value is set using a power factor.
PFCnstAnIn	The reactive power target value is imported through the analog input for specifying target values. The analog value is converted into a power factor.
PFCtIW	The power factor is set depending on the feed-in power. The dependency is depicted by a parameterizable curve.
VArCtlVol	Reactive power is set depending on the grid voltage. The parameterization of this function depends on the medium voltage.

There are 11 different procedures for regulating reactive power:

## **i** Parameter protection

This parameter may only be changed in the "Stop" operating state. The entry will not be accepted in other operating states.

### Procedure for Regulating Reactive Power and Setting Associated Parameters

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- Device Set-up > Parameters > Red.effect.pow. Select > P-WMod.
   ✓ Line below "P-WMod" flashes.
- 3. Select the required procedure for limiting the active power.
- 4. Press [ENTER] twice.

I The required procedure for limiting the active power is set.

- 5. If necessary, select the parameter pertaining to the procedure with the [  $\downarrow$  ] key and press [ENTER].
- 6. Set the parameter.
- 7. Press [ENTER] twice.

## 4.8.2 "Off" Procedure

The reactive power target value is limited to 0 kVAr. This target value cannot be influenced.

Used parameters none

## 4.8.3 "VArCtlCom" Procedure

The reactive power target value is received by the Sunny Central Control through the Power Reducer Box and forwarded to the Sunny Central. The target value is detected as a percentage and converted to kVAr inside the device.

If the Sunny Central has received no signal for 5 minutes, the "P-ModFailStt" error message will be displayed.

Used parameters none

## 4.8.4 "PFCtlCom" Procedure

The reactive power target value is received by the Sunny Central Control through the Power Reducer Box and forwarded to the Sunny Central. A power factor is transmitted as a predefined target value.

If the Sunny Central has received no signal for 5 minutes, the "P-ModFailStt" error message will be displayed.

Used parameters none

# 4.8.5 "VArCnst" Procedure

The reactive power target value is set using the "Q-VAr" parameter. The "Q-VAr" parameter must be smaller or equal to "Qmax".

Used parameters Q-VAr

## 4.8.6 "VArCnstNom" Procedure

The "Q-VArNom" parameter is used to set the reactive power target value (in %). The "Q-VArNom" parameter refers to "Pmax". If the calculated total reactive power exceeds the predefined "Qmax" value, "Qmax" will be provided by the device.

Used parameters Q-VArNom

# 4.8.7 "VArCnstNomAnIn" Procedure

The reactive power target value is set at the input terminals using an analog signal for specifying the target value (see enclosed installation manual). This is usually accomplished by using a radio ripple control receiver.

The analog value is converted into a reactive power target value. The current of the connected signal determines the target value.

The analog measured values must be between 4 mA ... 19 mA. If the analog signal is smaller than 2 mA, the error message "Q-VarModFailStt" is displayed.

Signal	Power limit	Description
< 2 mA	Last valid value, or 0 after reboot	Signal is in the invalid range
2 mA 4 mA	– Pmax	The maximum amount of negatively excited reactive power is fed in.
4 mA	– Pmax	Starting point of the curve Maximum amount of negatively excited reactive power is fed in.
11.5 mA	0	Zero-crossing of the curve No reactive power is fed in.
> 19 mA	+Pmax	End point of the curve Maximum amount of positively excited reactive power is fed in.

The analog value is converted to a target value for power limitation. Here, the "Pmax" parameter is the end point of the linear characteristic curve.

If the value of "P<sub>max</sub>" exceeds the value of "Qmax", the characteristic curve for the value "Qmax" is limited to "Qmax" and has a linear progression from -Pmax to -Qmax and from +Qmax to +Pmax.

Used parameters none

## 4.8.8 "PFCnst" Procedure

The reactive power setpoint is set using the "PF-PF" and "PF-PFExt" parameters. The "PF-PF" parameters indicate the displacment power factor  $\cos \phi$  and the "PF-PFExt" parameter indicates the degree of excitation.

Used parameters	PF-PF
	PF-PFExt

## 4.8.9 "PFCnstAnIn" Procedure

The reactive power target value is set at the input terminals using an analog signal for specifying the target value (see enclosed installation manual). This is usually accomplished by using a radio ripple control receiver.

The analog value is converted into a power factor. The current of the connected signal determines the target value.

The analog measured values must be between 4 mA ... 19 mA. If the analog signal is smaller than 2 mA, the error message "Q-VArModFailStt" is displayed.

Signal	Power limit	Description
< 2 mA	Last valid value, or 1 after reboot	Signal is in the invalid range
2 mA 4 mA	PFAbsMin <b>/ underexcited</b>	The maximum amount of negatively excited reactive power is fed in.
4 mA	PFAbsMin <b>/ underexcited</b>	Starting point of the curve Maximum amount of negatively excited reactive power is fed in.
11.5 mA	1	Zero-crossing of the curve No reactive power is fed in.
> 19 mA	PFAbsMin <b>/ overexcited</b>	End point of the curve Maximum amount of positively excited reactive power is fed in.

The analog value is converted to the power factor target value. Here, the "PFAbsMin" parameter is the start and end point of the linear characteristic curve.

### Used parameters

# 4.8.10 "PFCtlW" Procedure

For the "PFCtIW" procedure, the power factor is set depending on the feed-in power. The dependency is depicted by a parameterizable curve. The parameters of the curve may be set to either make it rise or fall. The starting and end points of the characteristic curve can be set via parameters.



Figure 16: Curve for reducing reactive power depending on active power

On the basis of a linear characteristic curve with an upper and lower limit, a power factor can be regulated dependent on the active power fed in at the time. The starting and end points of the characteristic curve can be set via parameters. The course of the characteristic curve is determined by the setting of the starting and end points.

### **Used** parameters

PF-PFStr PF-PFExtStr PF-PFStop PF-PFExtStop PF-WStr PF-WStop

# 4.8.11 "VArCtlVol" Procedure

## **i** Parameter protection

Contact the SMA Serviceline before selecting or parameterizing this procedure.

Reactive power is set depending on the grid voltage. The reactive power target value is adjusted in stages.



Figure 17: Curve for reducing reactive power depending on grid voltage

If the grid voltage and the parameterizable voltage difference "Q-VDif" change for the configurable duration of "Q-VDifTm", the reactive power target value is adapted to the "Q-VArGra" value. The parameterization of this function depends on the medium voltage.

### Used parameters

Q-VDif Q-VArGra Q-VDifTm Q-VRtgOfsNom

# 4.8.12 Displaying Error Messages and Warnings for the Reactive Power Setpoint

The "Q-VArModFailStt" channel shows the error messages or warnings associated with the reactive power setpoint

## Displaying the "Q-VArModFailStt" channel

# Select Spot Values > Outp.react.pow. > Q-VArModFailStt.

Display	Description	Measure
Off	No procedure for specifying the reactive power setpoint has been chosen.	None
ОК	A procedure for specifying the reactive power setpoint has been chosen and there are no errors.	None
ComFail	The "VArCtlCom" or "PFCtlCom" procedure has been chosen and the expected signal with a valid reactive power setpoint has been absent for at least 5 minutes.	<ul> <li>Check whether Sunny Central Control is working.</li> <li>Check whether the Sunny Central Control can be accessed from outside and is displaying the data of the inverter.</li> <li>Check whether the cables between the Sunny Central Control and the inverters are OK.</li> <li>Check whether the cables inside the Sunny Central Control are OK.</li> </ul>
AnInFail	The "VArCnstNomAnIn" or "PFCnstNomAnIn" procedure has been chosen and the value measured at the analog input is less than 2 mA.	Check the analog input.

# 4.9 Grid Monitoring

## 4.9.1 How Grid Monitoring Works

The Sunny Central monitors the power distribution grid to make sure it stays within a definable range of limiting values. If these limiting values are exceeded for a set time period, the Sunny Central will disconnect itself from the grid for safety reasons.

The following limiting values are monitored:

- Voltage loss protection
- Voltage increase protection
- Frequency loss protection
- Frequency increase protection

A tripping delay time for how long the grid failure must be present before the Sunny Central disconnects from the grid can be set for each limiting value.

# 4.9.2 Grid Monitoring for Grid Voltage

You can manually specify the limiting values and tripping time. For voltage monitoring, 2 limits can be set for both overvoltage and undervoltage.



Figure 18: Temporal behavior of the Sunny Central when exceeding the grid limits

Object	Parameter	Description
А	VCtlhLimTm	Delay time for grid limit level 2
В	VCtlhhLimTm	Delay time for grid limit level 1

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Object	Parameter	Description
С		Startup/MPP load operation
D		Grid monitoring
E		Failure
1	VCtlhhLim	Grid limit level 2
2	VCtlhLim	Grid limit level 1
3		Connection limit
4		Grid limit level 1 is breached, timer starts
5		Grid limit level 2 is breached, timer starts
6		Grid limit level 2 for delay time level 2 is breached $\rightarrow$ grid disconnection
7		Grid limit level 1 for delay time level 1 is breached → grid disconnection (already occurred on level 2)
8		Connection conditions fulfilled monitoring time starts
9		Grid within valid range during monitoring time grid connection

Similar to the behavior during grid overvoltage, the Sunny Central responds when the voltage falls below the "VCtIlLim" parameter (undervoltage threshold 1) and the "VCtIlLim" parameter (undervoltage threshold 2).

1. Enter password (see section 4.2.2 "Entering the Password", page 32).

### 2. Select Device Set-up > Parameters > Grid decoupling > Voltage.

- 3. Using the [ ↓ ] button, select the parameter to be changed.
- 4. Enter the parameter and confirm with [ENTER] until the line stops flashing.
- 5. Enter the calculated value for offset and confirm with [ENTER] until the line stops flashing.
- 6. After exiting the menu, confirm the security prompt twice with [ENTER].

 $\blacksquare$  Grid monitoring is configured.

# 4.9.3 Grid Monitoring for Power Frequency

You can manually specify the limiting values and tripping time. For frequency monitoring, three separate limits can be set for both overvoltage and undervoltage. For the frequency, 3 limits can be set respectively.

For example, you can set activation to occur after 1 second if there is an overfrequency of 50.5 Hz or even after 0.1 seconds if the overfrequency reaches 51.5 Hz.



Figure 19: Tripping characteristics and time-dependant performance illustrated based on the frequency monitoring

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > Parameters > Grid decoupling > Grid frequency.
- 3. Using the [ $\downarrow$ ] button, select the parameter to be changed.
- 4. Enter the parameter and confirm with [ENTER] until the line stops flashing.
- 5. Enter the calculated value for offset and confirm with [ENTER] until the line stops flashing.
- After exiting the menu, confirm the security prompt twice with [ENTER].
   ☑ Grid monitoring is configured.

## 4.9.4 Grid Connection after Correction of Error

If a grid fault in the inverter has been corrected, the inverter will only switch on when the grid voltage meets a set of conditions.

For example, the grid voltage must stay within the set limiting values for grid connection (e.g., parameter "VCtlOpMinNom") for the duration of the grid monitoring time "GriGrdMonTm".

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# 4.9.5 Setting the Medium Voltage

The medium voltage of the inverter must match with the medium voltage of the MV grid.

It is important that the transmission ratio of the external medium-voltage transformer is adjusted at the same time. The undervoltage side is already preset according to the specific device.

The default value of the parameter "VRtg" is specified in the parameter list (see section 9.4 "Grid Decoupling / Voltage", page 96).

- 1. Select Device Set-up > Parameters > Grid decoupling > Voltage > VRtg.
- 2. Select the parameter "VRtg" and confirm by pressing [ENTER].
- 3. Select Device Set-up > Parameters > Grid decoupling > Voltage > TrfVolExlHi.
- 4. Select the parameter "TrfVoIExIHi" and confirm by pressing [ENTER].

# 4.9.6 Configuring the Decoupling Protection Ramp

After a grid fault, the Sunny Central restarts at a maximum 10% of nominal power per minute using a decoupling protection ramp. You have the option of switching this decoupling protection ramp on or off.

If you switch the decoupling protection ramp off, the Sunny Central quickly returns to maximum power.

If you wish to deactivate the decoupling protection ramp, consult the SMA Serviceline.

# 5 Insulation Monitoring

## 5.1 Switching the Remote GFDI on

The remote GFDI can be switched back on using the Sunny WebBox, Sunny Data Control and by operating the Sunny Central Control. Up to 3 attempts to activate it can be made each day.

## Switching the Sunny Central Control back on

- 1. Enter password (see section 4.2.2 "Entering the Password", page 32).
- 2. Select Device Set-up > Parameters > Other > SC\_Remote GFDI.
- 3. Select "on" with the [ $\downarrow$ ] button and confirm twice by pressing [ENTER].

# 5.2 Insulation Monitoring Device

## 5.2.1 Overview of Display and Control Elements



Figure 20: Insulation monitoring control panel

Position	Description	Function
А	[INFO] button	Querying standard information
	[ESC] button	Back (menu function), confirm parameter change
В	[TEST] button	Call up self-test
	Up button	Changes parameter, moves up in the menu Increases a parameter

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Position	Description	Function
С	[RESET] button	Deletes saved insulation error alarms
	Down button	Changes parameter, moves down in the menu
		Lowers a parameter
D	[MENU] button	Call up menu system
	[ENTER] button	Confirms parameter change
E	Alarm LED 1 turns on	Insulation error, first warning threshold is reached
F	Alarm LED 2 turns on	Insulation error, second warning threshold is reached
G	Device fault LED turns on	iso-PV is faulty
Н	2-line display for standard and menu operation	

# 5.2.2 Switching between the Main Menu and Standard Operation

- Press the [MENU] button to switch to the main menu from standard operation. You can enter various submenus from the main menu.
- To return to standard operation, press [RESET].

# 5.2.3 Selecting used PV Modules

There are various measurement profiles available for the insulation monitoring. Select the measurement profile that is suitable for your PV modules.

Module types	Measurement profile
PV modules with crystalline cells	AMP3
PV modules with thin-film cells	AMP4
Other PV modules	AMP

- 1. Access main menu.
- 2. Select the ISO ADVANCED menu and then select the Measure menu.
- 3. Select the measurement profile that matches the PV modules and confirm by pressing [ENTER].

# 5.3 Combining GFDI and Insulation Monitoring Device

The insulation monitoring device with GFDI does not provide protection from injury. By combining the GFDI and insulation monitoring device options, you can manually switch the PV array from grounded operation to insulated operation. To ensure that there is no insulation error on the grounded pole, an insulation measurement is carried out. After switching to insulated operation, the insulation monitoring device checks each pole of the PV array for potential insulation errors.

Switching to insulated operation, for example, is required for any maintenance or service work on or near the PV array such as cutting the grass.

## Switching from Grounded to Insulated Operation

- 1. Turn the key switch on the inverter to "Stop".
- 2. Wait 5 minutes.
- 3. Open the inverter.
- 4. Manually switch off the GFDI miniature circuit-breaker.
- 5. Close the inverter.
- 6. Turn the key switch on the inverter to "Start".
  - ☑ The insulation monitoring device starts collecting data. Normally a ground fault will be reported first. The error message disappears once the insulation monitoring device detects the correct insulation resistance after approx. 5 minutes.

## Switching from Insulated to Grounded Operation

- 1. Turn the key switch on the inverter to "Stop".
- 2. Wait 5 minutes.
- 3. Open the inverter.
- 4. Manually switch on the GFDI miniature circuit-breaker.
- 5. Close the inverter.
- 6. Turn the key switch on the inverter to "Start".

 $\blacksquare$  The inverter starts to work in grounded operation.

# 6 External Grid Monitoring Relay

# 6.1 Overview of Display and Control Elements



Figure 21: Grid monitoring relay control panel

Object	Description	Function		
А	Star	Display of star voltages (line to line neutral conductor)		
В	Triangle	Display of line-to-line voltages		
С	LCD	2-line LCD		
D	Clear	Confirms alarm message		
	Cursor	Moves one position to the right		
E	Menu	Selects menu		
	Digit	Increases selected digit		
F	Display	Switches to next display		
	Select	Confirms change		
G	Alarm	An alarm has occurred		
Н	Operating	Automatic mode		

# 6.2 Display Messages

The following information is displayed depending on the set mode:

Automatic mode	Operating parameter display
Configuration mode	Individual parameter display

## Display in Automatic Mode, Upper Line: Measured Values

You can use the [Display  $\downarrow$  ] button to switch through the first line of the display.

Display				Description
L1/L12	L2/L23	L3/L31	[]	The "Star" LED lights up and the "Triangle" LED is off.
230	230	230	U	The star voltages (V <sub>L1-N</sub> , V <sub>L2-N</sub> and V <sub>L3-N</sub> ) of the four- wire system are displayed.
Hz	Revei	rsible Displc	ау	
L1/L12	L2/L23	L3/L31	[]	The "Star" LED is off and the "Triangle" LED lights up.
400	400	400	U	The line-to-line voltages ( $V_{L1-L2}$ , $V_{L2-L3}$ and $V_{L3-L1}$ ) of the
				3-conductor grid are displayed.
Hz	Reve	rsible Displo	ау	

## Display in Automatic Mode, Lower Line: Measured Values

You can use the [Menu] button to switch through the messages displayed in the lower line.

Display	Description
L1/L12         L2/L23         L3/L31         []           00,00         XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	The frequency [Hz] is displayed on the left in the lower line.

## Display in Automatic Mode, Lower Line: Alarm Display

You can use the [Menu] button to switch through the alarm messages which have occurred.

Alarm messages are depicted in the lower line of the display on the right.

L1/L12	L2/L23	L3/L31	[	]
·				-
00,00	99999		:/':	: _

Alarm text	Description
Overvoltage 1	The limiting value for the 1st level of the overvoltage monitoring has been exceeded.
Overvoltage 2	The limiting value for the 2nd level of the overvoltage monitoring has been exceeded.
Undervoltage 1	The limiting value for the 1st level of the undervoltage monitoring has been deceeded.
Undervoltage 2	The limiting value for the 2nd level of the undervoltage monitoring has been deceeded.
Overfreq. 1	The limiting value for the 1 st level of the overfrequency monitoring has been exceeded.
Overfreq. 2	The limiting value for the 2nd level of the overfrequency monitoring has been exceeded.
Underfreq. 1	The value is below the limiting value for the 1st level of the underfrequency monitoring.
Underfreq. 2	The value is below the limiting value for the 2nd level of the underfrequency monitoring.

In the following table, you will find a list of all of the alarm messages that the device can display.

## **Confirming Alarm**

The grid monitoring relay signals an error/alarm by means of the "Alarm" LED.

You confirm an alarm by pressing the [Clear] button.

The error status is distinguished as follows:

### • The error is still present:

You will not be able to confirm the error for as long as it is still present. The flashing "Alarm" LED on the control panel indicates that the alarm is still present.

### • The error is no longer present:

If the present error has been rectified, then the flashing "Alarm" LED will switch to continuous illumination. The relay is configured in such a way that the error display is automatically reset after clearance of the error and expiration of a reset time.

# 6.3 Configuration

## 6.3.1 Switching into Configuration Mode

You may not perform any configurations unless the Sunny Central is not in operation!

L1/L12 L2/L23 L3/L31 []	"Select" input mode
Adjust Settings: SELECT (ANWAHL) Hz Reversible Display	Pressing the [Select] button activates the input mode. It allows you not only to view the following screens but also to modify them within the specified limits. You can move the following screens forward by one screen by pressing the [Select] button.
	If you have configured a parameter to "OFF", then the associated screens will not be displayed and you will also not be able to edit them. You can move the display forward to the next parameter by pressing the [Select] button.

# 6.3.2 Displaying the Basic Settings

Proceed as follows to display the basic settings of the monitoring relay:

- Press the [Menu] and [Clear] button at the same time.
   The grid monitoring relay menu is displayed.
- 2. Navigate to the "Software version" or "Language" menu with the [Display  $\downarrow$  ] button.

$\checkmark$	The following	displays	appear	depending	on the	menu	selected.
--------------	---------------	----------	--------	-----------	--------	------	-----------

L1/L12 L2/L23 L3/L31 [] Softwareversion X.XXX Hz Reversible Display	Software version
L1/L12 L2/L23 L3/L31 [] SPRACHE/LANGUAGE Hz Reversible Display	Language selection German/English

# 6.3.3 Access for Configuration

## **Password Protection**

Safety-relevant Sunny Central parameters can only be adjusted when a code number is entered. Our service team will provide you with the code number (see section 10 "Contact", page 102).

After this code number has been entered, you will be able to view and modify all parameters.

You can change the code number as you wish. Store the code number at a safe location so that no unauthorized persons can change the parameters.

## 

### Danger to life through changing the internal safety specifications of the Sunny Central.

- Only electrically skilled persons are permitted to make changes to parameters.
- The parameters may only be changed in consultation with the SMA Serviceline.

## Entering the code number

Proceed as follows to enter the password:

1. Press the [Menu] and [Clear] button at the same time.

☑ The grid monitoring relay menu is displayed.

2. Navigate to the "Enter code number" menu with the [Display ↓ ] button.



Once the code level has been set, it will not be changed, even after repeated entry into configuration mode. If an incorrect code number is entered, then the device is locked.

If the supply voltage is uninterruptedly present at the relay for 2 hours, the device locks automatically.

The configuration screen "Enter code number" appears only if the configuration screen "Password protection" is set to "ON".

## Changing the password

L1/L12 L2/L23 L3/L31 [] Define level 1 code 0000 Hz Reversible Display	Establish password for code level 1 The code level 1 enables the parameter area for the installer.
L1/L12 L2/L23 L3/L31 [] Define level 2 code 0000 Hz Reversible Display	Establish password for code level 2 The code level 2 enables the parameter area for the service personnel.

## 6.3.4 Entering Parameters

Section 4.9 "Grid Monitoring", page 55 contains information on how the grid is monitored according to frequency and voltage and which parameters must be set.

After the codeword has been entered successfully, the following menus can be displayed with the [  $\mathsf{Display} \downarrow$  ] button:

## **Voltage Measurement**



### Voltage converter configuration

L1/L12 L2/L23 L3/L31 []	Secondary voltage converter
[Volt.transformer]	50 V to 125 V; default 100 V
secondary 000V	Preset, depending on the device, <b>do not alter.</b>
Hz Reversible Display	
L1/L12 L2/L23 L3/L31 []	Primary voltage converter
Volt.transformer	0.1 kV to 65 kV; default: 20 kV
Volt.transformer primary 00.000kV	<b>0.1 kV to 65 kV; default: 20 kV</b> The primary voltage in kV is set here. This parameter is
Volt.transformer Primary 00.000kV Hz Reversible Display	<b>0.1 kV to 65 kV; default: 20 kV</b> The primary voltage in kV is set here. This parameter is used for displaying the system voltage; <b>enter the</b>

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Adjust the setting for the "primary voltage converter" in accordance with the level of the medium voltage at your system. This setting has no effect on monitoring, but only on the display of voltage readings.

If you exit a menu in which a parameter was previously changed, the change is automatically saved.

# 6.3.5 Monitoring

The relay can monitor either the string voltages (four-conductor grid) or the line-to-line voltages (threeconductor grid). In the case of medium voltage systems, it is usually the line-to-line voltages which are monitored.

1	L1/L12	L2/L23 L3/L31 []	Monitoring for
	Volt.	Monitoring	Four-conductor/three-conductor grid; do not alter
	Hz	Reversible Display	

This parameter will no longer be displayed if you have set the parameter "Voltage measurement" to three-conductor grid.

# 6.3.6 Overvoltage Monitoring

L1/L12 L2/L23 L3/L31 []	Overvoltage monitoring ON/OFF
Overvoltage Monitoring ON	ON = overvoltage monitoring is activated. The following parameters of this function are displayed.
Hz Reversible Display	OFF = overvoltage monitoring is deactivated. The following parameters of this function will not be displayed.
Parameters for "Three conductor grid":	Threshold value for tripping at overvoltage in level 1.
L1/L12 L2/L23 L3/L31 [] Overvoltage 1 Delay 00.00s Hz Reversible Display	
	Delay time for threshold value with overvoltage in
Overvoltage 1 Delay 00.00s Hz Reversible Display	level 1

Parameters for "Three conductor grid":	Threshold value for tripping with overvoltage in level 2.
L1/L12 L2/L23 L3/L31 [] Overvolta9e 2	
U(ph-ph) >000U Hz Reversible Display	
L1/L12 L2/L23 L3/L31 [] Overvoltage 2 Delay 00.00s Hz Reversible Display	Delay time for threshold value with overvoltage in level 2
L1/L12 L2/L23 L3/L31 [] Overvoltage Hysteresis ØØV Hz Reversible Display	Hysteresis for the overvoltage monitoring. This must be exceeded before any reconnection is possible.

# 6.3.7 Undervoltage Monitoring

L1/L12 L2/L23 L3/L31 []	Undervoltage monitoring ON/OFF
Undervoltage Monitoring ON Hz Reversible Display	ON = undervoltage monitoring is activated. The following parameters of this function are displayed.
	OFF = Undervoltage monitoring is deactivated. The following parameters of this function will not be displayed.
Parameters for "Three conductor grid":	Threshold value for tripping at undervoltage in level 1.
L1/L12 L2/L23 L3/L31 [] Undervolta9e 1 U(ph-ph) <000U Hz Reversible Display	
L1/L12 L2/L23 L3/L31 [] Undervoltage 1 Delay 00.00s Hz Reversible Display	Delay time for threshold value at undervoltage in level 1
Parameters for "Three conductor grid":	Threshold value for tripping at undervoltage in level 2.
L1/L12 L2/L23 L3/L31 [] Undervolta9e 2 U(ph-ph) <000U Hz Reversible Display	

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# 6.3.8 Overfrequency Monitoring

L1/L12 L2/L23 L3/L31 []	Overfrequency monitoring ON/OFF
Overfrequency- Monitoring ON	ON = overfrequency monitoring is activated. The following parameters of this function are displayed.
Hz Reversible Display	OFF = overfrequency monitoring is deactivated. The following parameters of this function will not be displayed.
L1/L12 L2/L23 L3/L31 [] Overfrequency 1 f > 00.00Hz Hz Reversible Display	Threshold value for tripping at overfrequency level 1
L1/L12         L2/L23         L3/L31         []           Overfrequency         1           Delay         00.00s           Hz         Reversible Display	Delay time for threshold value at overfrequency in level 1
L1/L12 L2/L23 L3/L31 [] Overfrequency 2 f > 00.00Hz Hz Reversible Display	Threshold value for tripping at overfrequency level 2
L1/L12 L2/L23 L3/L31 [] Overfrequency 2 Delay 00.00s Hz Reversible Display	Delay time for threshold value at overfrequency in level 2

L1/L12 L2/L23 L3/L31 [] Overfrequency	Hysteresis for the overfrequency monitoring; this must be exceeded before any reconnection is possible.
Hysteres. 0.00Hz Hz Reversible Display	

# 6.3.9 Underfrequency Monitoring

L1/L12 L2/L23 L3/L31 []	Underfrequency monitoring ON / OFF
Underfrequency-	ON = underfrequency monitoring is activated. The
Monitoring ON	following parameters of this function are displayed.
Hz Reversible Display	OFF = underfrequency monitoring is deactivated. The following parameters of this function will not be
	displayed
	Threshold value for tripping at underfrequency level 1
Underfrequency 1	
f < 00.00Hz	
Hz Reversible Display	
L1/L12 L2/L23 L3/L31 []	Delay time for threshold value with underfrequency level 1
Dalay 00 00c	
Hz Reversible Display	
$\begin{bmatrix} 1/L12 & L2/L23 & L3/L31 \\ \end{bmatrix}$	Inresnoia value for fripping af underfrequency level 2.
Hz Reversible Display	
L1/L12 L2/L23 L3/L31 [] Underfrequency 2	Delay time for threshold value with underfrequency level 2
Delaч 00.00s	
Hz Reversible Display	
L1/L12 L2/L23 L3/L31 []	Hysteresis for the underfrequency; this must be
Underfrequency	exceeded before any reconnection is possible.
Hysteres. 0.00Hz	
Hz Reversible Display	

# 6.4 Relay Configuration

## Relay is Self-confirming

L1/L12 L2/L23 L3/L31 []	Relay self-confirming ON/OFF
Auto-clearing Display ON Hz Reversible Display	ON = relay self-confirming is activated. The relays will be reset automatically if the error condition is no longer detected. How the display of the alarm messages is handled depends on the setting in the " <b>Self-confirming messages</b> " screen.
	OFF = relay self-confirming is deactivated. The relays are reset by pressing the button.
	How the display of the alarm messages is handled depends on the setting in the " <b>Self-confirming messages</b> " screen. The following screens of this function will not be displayed.
L1/L12 L2/L23 L3/L31 []	Fall-back delay of the relays 0.02 to 99.98
Release delay XXXXXXX 00.00s Hz Reversible Display	The individual relays are resent when "Self-confirming relays" is activated and the monitored values have returned to within the permissible limits plus/minus hysteresis (in accordance with the monitoring) without interruption for at least the amount of time configured in this parameter. If the measured value exceeds/falls below the tripping value within this time frame, then the time measurement will be restarted. A fall-back delay can be configured for the following protective functions.

## **External Confirmation**

[] [] [] [] [] [] [] [] [] [] [] [] [] [	External confirmation of the relay via the digital input "Monitor/Remote Confirmation Blocking".
Clearing ON	Default: Off
Hz Reversible Display	This function is not supported.
## Self-confirming Messages

L1/L12 L2/L23 L3/L31 []	Self-confirming messages ON/OFF
Auto-clearin9 Display ON	ON = once the alarm status is not longer detected, the message in the display will be deleted.
Hz Reversible Display	OFF = once the alarm status is not longer detected, the alarm message on the display will remain in effect until it is confirmed manually. The following parameter of this function will not be displayed.
L1/L12 L2/L23 L3/L31 []	Fall-back delay messages 1 - 99 s/OFF
Clearing display after 00s Hz Reversible Display	Active alarm messages will be confirmed once the delay time configured here has expired. This delay time begins as soon as the measured value exceeds/falls below the limit value plus/minus the hysteresis.
L1/L12 L2/L23 L3/L31 []	Alter relay allocation YES/NO
Chan9e relay-	This parameter enables one to select whether the relay outputs can be configured or not.
Hz Reversible Display	YES = this relay can be configured with respect to function and allocation. The following parameters are displayed:
	NO = the relays are configured with the presettings. The following parameters are not displayed:
L1/L12 L2/L23 L3/L31 []	Allocate the protective functions to the Relays 0 to 3
to relay 0000 Hz Reversible Display	Each digit in this parameter is used for the allocation of a relay to a protective function. Up to 4 relay outputs can be allocated a protective function. The relay can be configured as follows:
	O = if no relay is to be allocated to the protective function, then a "O" must be configured. None of the relay outputs energizes or drops out when the corresponding protective function trips. If all 4 relay allocations are configured with a "O". A corresponding message will nevertheless be visible on the display.
	1/2/3 = Relay 1 (terminals 9/10), relay 2 (terminals $11/12/13$ ) and/or relay 3 (terminals $14/15/16$ ) can be allocated the protective function with all of the devices.

#### **Relay Function**

L1/L12 L2/L23 L3/L31 []	Function of relays 1, 2 and 3 A/R
Funct. relay 123 (R=releases) RRR Hz Reversible Display	The individual relays can be configured either as A = open-circuit current (normally open) or R = standby current (normally closed).
	A = the relay is configured as open-circuit current contact (normally open). The relay energizes only if the allocated protective function trips.
	R = the relay is configured as standby current contact (normally closed). The relay is always energized and opens only if the allocated protective function trips.
	<b>INFORMATION:</b> Relay 1 is configured to R (normally closed) and cannot be altered.

## Interface

A configuration interface is available for configuring the relay using a PC. A special interface cable (DPC) and software are required for this purpose. For more detailed information, read the relay manual. It accompanies the Sunny Central on CD or you can find it on the Internet at www.woodward.com.

# 7 Troubleshooting

## 7.1 Identifying Errors

## 

#### Danger to life due to high voltages in the Sunny Central. Death or serious burns.

Even in the case of an error, the Sunny Central can still carry high voltages.

- Only qualified technical personnel should perform any and all work described in this section. "Qualified" means that the personnel must possess training relevant to the activity performed.
- Work on the Sunny Central must only be carried out as described in this manual.
- All listed safety instructions must be observed.
- All the safety instructions in the Sunny Central installation manual must be observed!
- If the error cannot be rectified with the help of this manual, contact SMA Solar Technology AG as soon a possible.

If a failure occurs during operation, the Sunny Central will shut down and the failure will be displayed by the Sunny Central Control.

If several failures or warnings are present, the Sunny Central Control shows the failure which has the highest priority. It switches between the standard view and the error message.

A failure appears in the display as shown below:



Position	Description
А	Number of the failure or warning
В	Reason for the failure or warning

# 7.2 Types of Failures and Warnings

Туре	Description
Error type 1 (warning)	The Sunny Central does not switch itself off. Once the error is no
	longer present, the error message is reset automatically.
Error type 2 (failure)	The Sunny Central switches itself off. Once the error is no longer
	present, the error message is reset automatically, and the
	Sunny Central starts up again.
Error type 3 (failure)	The Sunny Central switches itself off. Error type 3 only arises if the
	Sunny Central is in feed-in operation when an error occurs. Once
	the error is no longer present, the error message is reset
	automatically, and the Sunny Central starts up again.
Error type 4 (failure)	The Sunny Central switches itself off. Rectify the cause of the error,
	and confirm the error at the Sunny Central Control, or with
	Sunny Data Control. Once you have confirmed the error, the
	Sunny Central starts up again.

The Sunny Central failures and warnings are subdivided into 4 types:

## 7.3 Warnings

No.	Description		
281	Error text:		
	Ground fault or SPD defect		
	Failure cause:		
	The warning alarm chain is interrupted (see circuit diagram).		
	• Back-up fuse(s) damaged on the grid side or array side (if present).		
	• The insulation resistance of the PV plant is lower than the set limiting	value.	
	<ul> <li>The transformer's biasing circuit breaker has tripped.</li> </ul>		
	• One of the redundant power supply units is defective.		
	Corrective measures:		
	Check fault signaling of the surge arresters and replace them if neces	ssary.	
Check the protectors' back-up fuse(s), and replace if necessary			
	<ul> <li>Check the insulation resistance of the PV plant.</li> </ul>		
	• In the event of an insulation fault, check strings under load-free conditions.		
<ul><li>Separate and connect individual strings to determine which string is for</li><li>Check the function of the ground fault monitoring system.</li></ul>		ı is faulty.	
	<ul> <li>Switch the biasing circuit breaker of the transformer back on.</li> </ul>		
<ul><li>Check the LEDs on the power supply unit and the monitoring module.</li><li>Contact the SMA Serviceline.</li></ul>			
283	Error text:	Error type 1	
	Temperature switch cabinet		
	Failure cause:		
	The limiting value (parameter TMin or TMax) for the permissible cabinet te been breached (too high or too low).	mperature has	
	Corrective measures:		
	Check function of cabinet cooling fans.		
Clean or replace dirty air filters.			
	Check ambient temperature, and adjust it if necessary.		

No.	Description	
284	Error text:	Error type 1
	Temperature sensor	
	Failure cause:	
	External or internal or temperature sensor is defective.	
	Corrective measure:	
	Check sensors.	_
380	Error text:	Error type 1
	SMU	
	Failure cause:	
	The string monitoring system has detected one or more faulty strings or sur	ge arresters.
	Corrective measures:	
	• In the menu "Device Set-up > SMUs > Devices > Measured Values", string currents can be read out to detect the faulty string.	the individual
	• More detailed information can be found in the Sunny String-Monitor	manual.
381	Error text:	Error type 1
	Ser. com. with SMU disturbed	
	Failure cause:	
	Communication disturbed between Sunny Central and the Sunny String-Monitors.	
	Corrective measures:	
	Check communication lines and terminals.	
	• More detailed information can be found in the Sunny String-Monitor	manual.
382	Error text:	Error type 1
	Thievery solar panel	
	Failure cause:	
	Signal loop for theft detection at the Sunny String-Monitor has been interrupted.	
	Corrective measures:	
	Check string currents.	
	Check signal loop.	
	• For further details, refer to the installation guide and user manual of Sunny String-Monitor or Sunny String-Monitor Cabinet.	the

No.	Description	
601	Error text:	Error type 1
	Defective default Effective power	
	Failure cause:	
	The current value present at the analog input is not within the permitted ra	nge.
	Corrective measures:	
	Check the analog input.	
602	Error text:	Error type 1
	Defective default Reactive power.	
	Failure cause:	
	The current value present at the analog input is not within the permitted ra	nge.
	Corrective measures:	
	Check the analog input.	
603	Error text:	Error type 1
	Disturbed communication Effective power	
	Failure cause:	
	Preset signal at the communication level is faulty.	
	Corrective measures:	
	Check the communication route.	
604	Error text:	Error type 1
	Disturbed communication Reactive power.	
	Failure cause:	
	Preset signal at the communication level is faulty.	
	Corrective measures:	
	Check the communication route.	
680	Error text:	Error type 1
	External Alarm was initiated	
	Failure cause:	
	Depending on the unit being monitored.	
	Corrective measures:	
	Check the unit connected on at external alarm input.	

No.	Description	
681	Text:	Error type 1
	Reduction of effective power activated	
	Description:	
	The Sunny Central momentarily reduces the active power by means of an external tar- value.	

# 7.4 Interferences

No.	Description	
104	Error text:	Error type 3
	No Grid Synchronization	
	Failure cause:	
	Left-hand rotating field or internal device fault.	
	Corrective measures:	
	Check (right-hand) rotating field.	
	• Check whether all internal fuses are switched on.	
	Contact the SMA Serviceline.	
105	Error text:	Error type 2
	Grid voltage too low	
	Failure cause:	
	Voltage on the AC side is below the permitted range.	
	Corrective measures:	
	Check grid connections.	
	Check grid stability.	
106	Error text:	Error type 2
	Grid voltage too high	
	Failure cause:	
	Voltage on the AC side is above the permitted range.	
	Corrective measures:	
	Check grid connections.	
	Check grid stability.	

No.	Description	
110	Error text:	Error type 2
	UVW-Range	
	Failure cause:	
	Voltage on phase L1, L2, or L3 outside the permitted range.	
	Corrective measures:	
	Check grid connections.	
	Check grid stability.	
111	Error text:	Error type 2
	Grid frequency too high or too low	
	Failure cause:	
	Grid limits were breached.	
	Corrective measures:	
	• Check the display of the grid monitoring relay.	
	Check the fuses in the load circuit.	
112	Error text:	Error type 2
	External Grid Monitoring tripped	
	Failure cause:	
	Voltage or frequency on the AC side is outside the permitted range.	
	Corrective measures:	
	Check the grid connections.	
	Check grid stability.	
	Check right-hand rotary field.	

No.	Description	
201	Error text:	Error type 2
	Ground fault or Overtemperature	
	Failure cause:	
	• The overtemperature failure chain is interrupted (refer to the circuit d	iagram).
	Switch cabinet overtemperature	
	Transformer overtemperature	
	Diode overtemperature	
	• The insulation resistance of the PV plant is lower than the set limiting value.	
	GFDI tripped	
	Corrective measures:	
	Check the cooling fans for proper function.	
	Clean or replace dirty air filters.	
	Ambient or cooling air temperature too high.	
	• Check the insulation resistance of the PV array.	
	<ul> <li>In the event of an insulation fault, separate and connect individual strin faulty one.</li> </ul>	ngs to detect the
	Check the function of the ground fault monitoring system.	
	<ul> <li>Check GFDI (see section 7 "Troubleshooting", page 75 and addition documentation in the download area of SMA Solar Technology AG www.SMA.de/en).</li> </ul>	nal at
206	Error text:	Error type 4
	Emergency shutdown activated	
	Failure cause:	
	The device's own emergency shut-off was activated.	
	Corrective measures:	
	Unlock emergency and confirm failure (see section 7.6 "Confirming Errors"	', page 88).
209	Error text:	Error type 4
	DC Short circuit	
	Failure cause:	
	An internal short circuit was detected on the DC side within the inverter. The was switched off.	DC main switch
	Corrective measures:	
	Check the Sunny Central from the outside.	
	• If possible, the Sunny Central should be externally disconnected.	
	Contact the SMA Serviceline.	

No.	Description		
210	Error text:	Error type 4	
	DC rev. current monitoring tripped		
	Failure cause:		
	Reverse currents detected in the PV array or DC connection polarity i	is reversed.	
	Corrective measures:		
	Check PV modules for short circuit.		
	<ul> <li>Check module wiring and plant design.</li> </ul>		
	<ul> <li>Make sure the DC terminals have the correct polarity.</li> </ul>		
	Contact the SMA Serviceline if the error occurs frequently.		
215	Error text:	Error type 2	
	Heat sink fan fault		
	Failure cause:		
	• Motor overload switch for the fan(s) cooling the power module has tripped.		
	• Overtemperature protection for the fan(s) cooling the power module has tripped.		
	<ul> <li>Ambient or cooling air temperatures too high.</li> </ul>		
	Corrective measures:		
	<ul> <li>Switch the motor overload switch back on.</li> </ul>		
	Check the cooling fans for proper function.		
	Clean soiled air inlet or heat sink.		
	Contact the SMA Serviceline if the error occurs frequently.		
217	Error text:	Error type 2	
	DC CB tripped or door switch open		
	Failure cause:		
	<ul> <li>The cabinet door was opened during operation.</li> </ul>		
	• The DC disconnector was tripped due to an internal fault.		
	• The reverse current monitoring system on the DC side has tripped.		
	Corrective measures:		
	Close the switch cabinet doors.		
	Check the function of the door switches.		
	• Check the function and activation of the emergency shut-off relay.		
	Check reverse current monitoring system.		
	Contact the SMA Serviceline.		

No.	Description	
220	Error text:	Error type 2
	Release- or Reset-Signal faulty	
	Failure cause:	
	The release signal or confirmation signal of the inverter bridge is faulty.	
	Corrective measures:	
	Contact the SMA Serviceline if the error persists.	
222	Error text:	Error type 2
	Ambient temperature	
	Failure cause:	
	The ambient temperature is higher than 51°C.	
	Corrective measure:	
	Check the cooling concept.	
	Check the fans.	
	Check the ambient conditions.	
	Check the sensor.	
281	Error text:	Error type 2
	Ground fault or SPD defect	
	Failure cause:	
	GFDI has tripped. There is a ground fault.	
	Corrective measure:	
	Check the PV plant for a ground fault.	
400	Error text:	Error type
	Internal failure of inverter bridge	2/3
	Failure cause:	
	emperature,	
	Corrective measures:	
	Contact the SMA Serviceline if the error occurs frequently.	

No.	Description				
402	Error text:	Error type 2			
	Ser. com. with inverter bridge disturbed				
	Failure cause:	•			
	• The RS485 communication between the inverter bridge and the Sunny is interrupted.	<sup>,</sup> Central Control			
	• The inverter bridge or the Sunny Central Control may be faulty.				
	Corrective measures:				
	Check the RS485 wiring.				
	Contact the SMA Serviceline if the error persists.				
408	Error text:	Error type 3			
	PV Overvoltage				
	Failure cause:				
	DC voltage is too high on the generator side.				
	Corrective measures:				
	Immediately disconnect the PV array from the Sunny Central! Dange the Sunny Central!	r of damage to			
	Check the DC voltage.				
	Check module wiring and plant design.				
	Information:				
	<ul> <li>If the failure poses a danger to the PV plant or the Sunny Central, the Sunny Central switches into the "Waiting" operating state for 30 minutes.</li> </ul>				
409	Error text:	Error type 3			
	IGBT Stack Temperature				
	Failure cause:				
	Heat sink temperature is too high (software).				
	Corrective measures:				
	• Check the function of the inverter bridge cooling fans.				
	• Clean soiled air inlet or heat sink.				
	Ambient or cooling air temperature too high.				
	Contact the SMA Serviceline if the error occurs frequently.				

No.	Description				
410	Error text:	Error type 3			
	IGBT Stack Error Sum				
	Failure cause:				
	Internal inverter bridge fault (e.g., DC overvoltage, overtemperature, defect overcurrent).	tive driver,			
	Corrective measures:				
	Contact the SMA Serviceline if the error occurs frequently.				
	• The unit can be switched back on in 30 minutes.	The unit can be switched back on in 30 minutes.			
	Information:				
	<ul> <li>If the failure poses a danger to the PV plant or the Sunny Central, the switches into the "Waiting" operating state for 30 minutes.</li> </ul>	e Sunny Central			
411	Error text:	Error type 3			
	IGBT-Overcurrent or UVW-Phase Error ADAPSCP				
	Failure cause:				
	Internal failure of the inverter bridge.				
	Corrective measures:				
	Contact the SMA Serviceline if the error occurs frequently.				
412	Error text:	Error type 3			
	Overcurrent				
	Failure cause:				
	Internal failure of the inverter bridge.				
	Corrective measures:				
	Contact the SMA Serviceline if the error occurs frequently.				
413	Error text:	Error type 4			
	Internal stack monitoring tripped				
	Failure cause:				
	Internal failure of the inverter bridge.				
	Corrective measures:				
	Contact the SMA Serviceline if the error occurs frequently.				
	<ul> <li>Up to three confirmations are possible, afterwards the unit must be reset via the key switch.</li> </ul>				

No.	Description			
420	Error text:	Error type 3		
	ADAPSCP Overtemperature			
	Failure cause:			
	Heat sink temperature is too high (hardware threshold)			
	Corrective measures:			
	Check the function of the inverter bridge cooling fans.			
	Clean soiled air inlet or heat sink.			
	Ambient or cooling air temperature too high.			
	Contact the SMA Serviceline if the error occurs frequently.			
421	Error text:	Error type 2		
	ADAPSCP Overvoltage DC Voltage link			
	Failure cause:			
	DC voltage is too high on the generator side (hardware threshold).			
	Corrective measures:			
	<ul> <li>Immediately disconnect the PV array from the Sunny Central! Dange the Sunny Central!</li> </ul>	r of damage to		
	Check the DC voltage.			
	Check module wiring and plant design.			
	Information:			
	• If the failure poses a danger to the PV plant or the Sunny Central, the switches into the "Waiting" operating state for 30 minutes.	e Sunny Central		

## 7.5 Events

Event	Explanation
> LVRT	Low Voltage Ride Through (LVRT) is active
> Net-Parameter	Grid parameters are set incorrectly
> NSM	Power limitation via grid management activated
< NSM	Power limitation via grid management deactivated
> FRQ-Derating	Frequency-dependent output limitation activated
< FRQ-Derating	Frequency-dependent output limitation deactivated

# 7.6 Confirming Errors

#### **Requirement:**

- □ The cause of the error is rectified.
- Select Operating Data > Faults > Current Faults Sunny Central.
   An active fault or warning is displayed with its date and time of occurrence.
- 2. Press [ENTER].

☑ The line flashes.

- Press the [↓] button.

   The word "quit" appears on the display.
- 4. Press [ENTER] twice.
  - ☑ The error is confirmed. The adjacent message shown appears on the display.

[ Actual Fault	s]
Quit-Function	
quit	
14/05 13:26.57	<b>,</b>
Alert 281	

# 8 Sunny Central Control Measurement Channels

All measurement channels are described in the following table. The measurement channels marked with \* are preset at the factory and are displayed in the Sunny Central Control under Long-Term Data > Meas. Chn. > SC...SCXXX.

Measurement channel	Description
+Diag DOut	The measurement channel does not become visible until after the installer password has been entered. Status of the digital output "+Diag DOut". Status: Okay, error.
+Diag Ext+24V	The measurement channel does not become visible until after the installer password has been entered. Status of the digital output "+Diag Ext+24V". Status: Okay, error.
Startup counter	Counter of the number of times the system has been started.
E-today	Energy which the Sunny Central fed into the grid on this day.
Error <sup>*</sup>	Sunny Central error.
E-total	Total energy which the Sunny Central has fed into the grid during its operating time.
ExtGloIrr	Analog input - external pyranometer, optional
ExtSolIrr	Analog input - external irradiation sensor, optional.
ExtAlarm	Analog input - external alarm input.
ExtSolP	Analog input - external target value specification of active power.
ExtSolQ	This measurement channel is displayed but not supported.
Fac	Power line frequency.
FI Code	Response code of the NET Piggy-Back.
FI Status	Status of connection to the NET Piggy-Back.
h-On	Total operating hours.
h-total	Total number of operating hours in feed-in operation.
lac	Grid output current.
lpv	DC input current.
Komm.FehlerSMU	Disturbed communication with Sunny String-Monitor No.
Meas. data	Counter of the number of times an entry is saved in the ring buffer.
Mean value Grp1	Mean value of the string currents of Sunny String-Monitor group 1 to
Mean value Grp2	Sunny String-Monitor group 3.
Mean value Grp3	

Measurement channel	Description
Mode	Sunny Central operating mode, e.g., MPP
Mppsearchcount	Counter of number of times the system switches to MPP Search mode
Pac*	Grid output power of the Sunny Central.
Pac smoothed	Smoothed feed-in power.
Ррч	DC input power of the Sunny Central.
P-WModStt <sup>*</sup>	Display of the activated active power limit.
Qac <sup>*</sup>	Reactive power.
regist. SMUs	Number of registered Sunny String-Monitors.
Reg. Insul <sup>*</sup>	Insulation resistance.
SMU Warncode	The channel "SMU Warncode" displays a number code "xxyy": xx: number of the faulty Sunny Central String-Monitor (1 to 40) yy: Error number 01 - 08: Channel number in the case of failure of string current monitoring 09 - 10: Failure of signaling contact monitoring.
Fault counter	Counter for the number of times a fault has occurred.
Team-Status	This measurement channel is not supported.
Temp. Kk <sup>*</sup>	Heat sink temperature.
TmpExt C <sup>*</sup>	Analog input of the external temperature sensor, optional.
TmpInt C	Analog input internal temperature sensor.
TStart Restzeit	The time remaining before the system starts up.
TWarte Restzei	The time remaining until the next time the system tries to start up.
Vac L1-L2 <sup>*</sup>	Grid output voltage L1-L2
Vac L2-L3	Grid output voltage L2-L3
Vac L3-L1	Grid output voltage L3-L1
Vpv <sup>*</sup>	DC input voltage of the Sunny Central.
Vpv0 <sup>*</sup>	Open-circuit voltage of the PV plant.
VpvSet	Target value DC input voltage.
Alert counter	Counter for the number of times a warning has occurred.

# 9 Parameters

## 9.1 Parameter Overview

The parameters of the Sunny Central are preset. If necessary, you can adjust some of the Sunny Central's parameters to the PV array and to the requirements of the grid management (see section 3.10 "Grid Management", page 27).

#### **i** Impaired functionality of Sunny Central due to altered parameters

Improperly altered parameters can partly or completely impair the functionality of the Sunny Central.

• The parameters marked with \* in the parameter overview may only be changed after consulting with SMA Solar Technology AG.

After work has been carried out on the Sunny Central Control, it must be relocked to prevent third parties from making unauthorized changes to the parameters (see section 4.2.3 "Locking the Sunny Central Control", page 32).

Parameter group	Description
Red.effect.pow.	Parameter for active power limitation
Outp.react.pow.	Parameters for the reactive power setpoint
Grid decoupling	Parameters for separating the Sunny Central from the grid
Grid connection	Parameters for grid connection
Mpp Limit. Val.	Limiting values for MPP operation
MPP Tracking	Settings for MPP operation
Start requiremt	Parameters for startup of the Sunny Central
Shut-down requ.	Parameters for the controlled shutdown of the Sunny Central
Grid Monitor.	Parameters for grid conditions
Other	Various additional functions

The Sunny Central parameters are summarized in the following parameter groups:

# 9.2 Red.effect.pow.

Name	Description	Value / range	Explanation	Default value
P-WMod	Target value for active power limitation	Off	Limits active power to "Pmax"	Off
	procedure	WCtlCom	Limits active power via an external control unit, such as the Power Reducer Box	
		WCnst	Manually limits the active power (P-W) via the Sunny WebBox or Sunny Data Control	
		WCnstNom	Manually limits the active power P-WNom via the Sunny WebBox or Sunny Data Control	
		WCnstNomAnIn	Limits active power on the analog input "ExtSoIP"	
P-W	Limits the active power in kW	0 kW 1 000 kW	SC 400HE-11	440 kW
		0 kW 1 000 kW	SC 500HE-11	550 kW
		0 kW 1 000 kW	SC 630HE-11	700 kW
P-WNom	Limits the active power in %	0% 100%		100%
Pac nominal	Nominal active power of the Sunny Central	1 kW 1 000 kW	SC 400HE-11	440 kW
		1 kW 1 000 kW	SC 500HE-11	550 kW
		1 kW 1 000 kW	SC 630HE-11	700 kW
Smax <sup>*</sup>	Maximum apparent power that the	0 kVA 1 000 kVA	SC 400HE-11	440 kVA
	Sunny Central feeds into the grid during nominal	0 kVA 1 000 kVA	SC 500HE-11	550 kVA
	operation	0 kVA 1 000 kVA	SC 630HE-11	700 kVA

Name	Description	Value / range	Explanation	Default value
Pmax*	Limits the active power This is necessary, for	1 kW 1 000 kW	SC 400HE-11	440 kW
	example, if the feed-in power has to be limited at	1 kW 1 000 kW	SC 500HE-11	550 kW
	the grid node.	1 kW 1 000 kW	SC 630HE-11	700 kW
P-HzStop	Frequency for discontinuing active power limitation in case of overfrequency	40 Hz 70 Hz		50.05 Hz
P-HzStr	Start frequency for limiting active power in case of overfrequency	40 Hz 70 Hz		50.2 Hz
P-WGra	Accepts the active power as of "P-HzStr"	1%/Hz 100%/Hz		40 %/Hz

# 9.3 Outp.react.pow.

Name	Description	Value / range	Explanation	Default value
Q-VArMod <sup>*</sup>	Procedure for the reactive power setpoint	Off	Sets reactive power Q = 0 kVAr and power factor $\cos \varphi = 1$	Off
		VArCtlCom	Sets reactive power via Power Reducer Box	
		PFCtlCom	Power Reducer Box transmits power factor and excitation of the Sunny Central	
		VArCnst	Sets "Q-VAr" via Sunny WebBox or Sunny Data	
		VArCnstNom	Sets "Q-VAr-Nom" as a percentage, with respect to the nominal active power, via the Sunny WebBox or Sunny Data Control	

Name	Description	Value / range	Explanation	Default value
		VArCnstNomAnIn	Sets the reactive power using the signal on the analog input "ExtSolQ"	
		PFCnst	Manually limits the "PF-PF" and "PF-PPExt" via Sunny WebBox or Sunny Data Control	
		PFCnstAnIn	Sets power factor cos φ using the signal on the analog Input "ExtSolQ"	
		PFCtlW	Sets cos φ depending on the feed-in power	
		VArCtlVol	Sets the reactive power depending on the grid voltage	
Q-VAr	Reactive power in kVAr	- 1 000 kVAr 1 000 kVAr		0 kVAr
Q-VArNom	Reactive power setpoint in %	- 100% 100%		0%
Qlimit	Nominal reactive power	0 kVAr 1 000 kVAr	SC 400HE-11	205 kVAr
		0 kVAr 1 000 kVAr	SC 500HE-11	256 kVAr
		0 kVAr 1 000 kVAr	SC 630HE-11	325 kVAr
Qmax	Limits the reactive power	0 kVAr 1 000 kVAr		0 kVAr
PFAbsMin	Restricted range of the power factor cos φ	0.5 1		0.9
PF-PF	Power factor cos φ	0.5 1		1
PF-PFExt	Excitation of the power factor cos φ	Overexcited Underexcited	Overexcited Underexcited	Overexcited
PF-PFStr*	Power factor cos φ at the point "PF-WStr"	0.5 1		1
PF-PFExtStr <sup>*</sup>	Excitation of the power factor cos φ at the point "PF-WStr"	Overexcited Underexcited	Overexcited Underexcited	Underexcited

Name	Description	Value / range	Explanation	Default value
PF-PFStop <sup>*</sup>	Power factor cos φ at the point "PF-WStop"	0.5 1		1
PF-PFExtStop*	Excitation of the power	Overexcited	Overexcited	Overexcited
	factor cos φ at the point "PF-WStop"	Underexcited	Underexcited	
PF-WStr*	Feed-in power in % at the point "PF-WStr"	0% 90%		0%
PF-WStop*	Feed-in power in % at the point "PF-WStop"	10% 100%		100%
Q-VDif <sup>*</sup>	Reactive power depending on the nominal voltage "VRtg"	0.1% 10%		1%
Q-VArGra <sup>*</sup>	Reactive power target value in % of the nominal power "Pmax" at a voltage step "Q-VDif"	0% 100%		1%
Q-VDifTm <sup>*</sup>	Time span of a voltage step "Q-VDif" in which it must wait before the reactive power target value "Q-VArGra" changes	0 s 120 s		l s
Q-VRtgOfs Nom	Change in the nominal voltage for testing purposes in % based on "VRTg". It is only active when the "QVArMod" parameter is at "VArCtlCol".	-10% +10%		0%

 $^{\star}$  Only modify parameters after consultation with SMA Solar Technology AG.

# 9.4 Grid Decoupling / Voltage

Name	Description	Value / range	Explanation	Default value
VRtg	Nominal voltage of the power distribution grid	100 V 40 000 V		20 000 V
VCtlhLim	Threshold value for overvoltage in level 1	100% 150%		115%
VCtlhLimTm	Tripping time for threshold value during overvoltage in level 1	0 s 5 s		0.1 s
VCtlhhLim	Threshold value for overvoltage in level 2	100% 150%		130%
VCtlhhLimTm	Tripping time for threshold value during overvoltage in level 2	0 s 5 s		0.1 s
VCtllLim	Threshold value for undervoltage in level 1	0% 100%		80%
VCtllLimTm	Tripping time for threshold value during undervoltage in level 1	0 s 5 s		0.1 s
VCtIIILim	Threshold value for undervoltage in level 2	0% 100%		45%
VCtIIILimTm	Tripping time for threshold value during undervoltage in level 2	0 s 5 s		0.1 s
TrfVolExlHi	Line-to-line voltage on the overvoltage side of the external transformer		0 V 65 535 V	20 000 V
TrfVolExILo	Line-to-line voltage on the		SC 400HE-11	270 V
	undervoltage side of the		SC 500HE-11	270 V
	external transformer		SC 630HE-11	315 V

Name	Description	Value / range	Default
			value
HzRtg	Nominal frequency of the power distribution grid	40 Hz 62 Hz	50 Hz
HzCtlhhLim	Threshold value for overfrequency in level 2	50 Hz 70 Hz	55 Hz
HzCtlhhLimTm	Tripping time for overfrequency in level 2	0 s 5 s	0.1 s
HzCtlhLim	Threshold value for overfrequency in level 1	50 Hz 70 Hz	51.5 Hz
HzCtlhLimTm	Tripping time for overfrequency in level 1	0 s 5 s	0.1s
HzCtllLim	Threshold value for underfrequency level 1	40 Hz 60 Hz	47.5 Hz
HzCtllLimTm	Tripping time for underfrequency in level 1	0 s 600 s	0.1 s
HzCtlllLim	Threshold value for underfrequency in level 2	40 Hz 60 Hz	46 Hz
HzCtlllLimTm	Tripping time for underfrequency level 2	0 s 600 s	0.1 s
HzCtlMin	Threshold value for underfrequency level 3	40 Hz 60 Hz	44 Hz
HzCtlMinTm	Tripping time for underfrequency level 3	0 s 600 s	0.1 s

## 9.5 Grid Decoupling / Power Frequency

# 9.6 Grid Connection

Name	Description	Value / range	Default value
GriGrdMonTm	Time span in which the activation conditions must be satisfied so that the power distribution grid can be switched.	0 ms 600 ms	5 s
VCtlOpMinNom	Minimum grid voltage for switching on the power distribution grid. The parameter is based on the nominal voltage "VRtg".	0% 100%	95%
VCtlOpMaxNom	Maximum grid voltage for switching on the power distribution grid. The parameter is based on the nominal voltage "VRtg".	100% 200%	115%
HzCtlOpMin	Minimum power frequency for switching on the power distribution grid.	40 Hz 60 Hz	47.5 Hz
HzCtlOpMax	Maximum power frequency for switching on the power distribution grid.	50 Hz 70 Hz	50.05 Hz

## 9.7 Mpp Limit. Val.

Name	Description	Value / range	Explanation	Default value
VmppMin <sup>*</sup>	Minimum MPP voltage	75 V 600 V	SC 400HE-11	450 V
	required for the Sunny	75 V 600 V	SC 500HE-11	450 V
	Central to teed power into the power distribution grid.	75 V 600 V	SC 630HE-11	500 V
dVreference	Voltage window for	5 V 1 000 V		80 V
	switching into the operating mode "MPP-Search" The parameter comes into effect if the value falls below or exceeds the set voltage window twice.	5 V 1 000 V	Recommendation for thin-film PV modules	120 V
PsearchMpp <sup>*</sup>	Limiting value for searching for the MPP	0 W 25 000 W		15 000 W
	If the value is below the value "PsearchMpp", the inverter starts searching for the MPP again after the time "TsearchMpp" has expired.			
TsearchMpp <sup>*</sup>	Time for a new search for the MPP	60 s 3 600 s		600 s
	If the value is below the value "PsearchMpp" for the time "TsearchMpp", the inverter starts searching for the MPP.			

\*Only modify parameters after consultation with SMA Solar Technology AG.

# 9.8 Mpp Tracking

Name	Description	Value / range	Explanation	Default value
dVtrack	Increments of MPP settings	1 V 10 V		5 V
TcheckMpp <sup>*</sup>	Time span for MPP setting increments	5 s 60 s		10 s
Mpp Factor	Start value for MPP	0.2 1		0.80
	obtained by multiplying the MPP factor parameter by the open-circuit voltage.	0.2 1	Recommendation for thin-film PV modules	0.70
TrackCnt	Number of the MPP setting increments	5 20		7
	The inverter searches for the maximum power point during operation. It checks the voltage up to seven times in one direction, e.g., always towards the higher voltage. After the seventh time at the latest, it also searches below the last voltage in order to check whether the maximum power point has decreased. If, for example, the inverter finds a lower power point at the time of the third increase, it searches below the most recently checked voltage.			

\*Only modify parameters after consultation with SMA Solar Technology AG.

## 9.9 Start Requiremt

Name	Description	Value / range	Explanation	Default value
Operating Mode <sup>*</sup>	Condition for starting up the inverter	MPP	Maximum power point tracking	MPP
		VconstSet	Target value for constant voltage operation	
VconstSet	Target value for constant voltage operation	300 V 700 V		600 V
VpvStart	PV voltage that must be exceeded for the inverter to	300 V 1 000 V	SC 400HE-11	600 V
	switch into feed-in operation	300 V 1 000 V	SC 500HE-11	600 V
		300 V 1 000 V	SC 630HE-11	650 V
Tstart	Time span until the inverter switches from the "Waiting" operating state to "Startup"	1 s 600 s		90 s
Twait	Time span until the inverter tries to start up again after 3 failed attempts	0 s 18 000 s		600 s

 $^{\ast}$  Only modify these parameters after consultation with SMA Solar Technology AG.

# 9.10 Shut-down Requ.

Name	Description	Value / range	Default value
PpvStop <sup>*</sup>	PV power before the inverter switches into the "Waiting" operating state after time "TStop".	0 W 10 000 W	5 000 W
Tstop	Time span until the inverter switches into the "Startup" operating state if the array power "Ppv" < "PpvStop"	60 s 600 s	60 s

\*Only modify parameters after consultation with SMA Solar Technology AG.

## 9.11 Grid Monitor

Name	Description	Value / range	Explanation	Default value
PpvMinCheck <sup>*</sup>	Procedure for shut- down requirements	On	Inverter implements shut- down requirement limits.	On
		Off	The inverter continues to operate if the shutdown conditions have not yet been met.	
Grid disconnection	Activation of grid disconnection	On	Grid disconnection activated	On
		Off	Grid disconnection deactivated	

\*Only modify parameters after consultation with SMA Solar Technology AG.

## 9.12 Other

Name	Description	Value / range	Default value
E-Total Offset	Offset for the device's internal energy counter. It is advisable to change this parameter after replacing the Sunny Central Control.	0 kWh 429 496 000 kWh	0 kWh
TMax. cabinet <sup>*</sup>	Maximum temperature of the inverter cabinet. If "TMax. cabinet" is exceeded, the warning "cabinet Temp." will be generated.	30°C 70°C	60°C
TMin. cabinet <sup>*</sup>	Minimum temperature of the inverter cabinet. If the value is below "TMin. cabinet", the warning "cabinet Temp." will be generated.	-30°C 10°C	-20°C
TmpDrtStopMod	Settings for the temperature derating This parameter is used to activate or deactivate the temperature derating.	On Off	On
SC_RemoteGFDI <sup>*</sup>	Setting for Remote GFDI This parameter is used to activate or deactivate Remote GFDI.	On Off	Off

\*Only modify parameters after consultation with SMA Solar Technology AG.

# 10 Contact

If you have technical problems concerning our products, contact the SMA Serviceline.

SMA Solar Technology AG requires the following data in order to provide you with the necessary assistance:

- Type of Sunny Central
- Serial number of the Sunny Central
- Type and number of the modules connected
- Type of communication
- Fault or warning number displayed
- Display message of the Sunny Central Control

#### SMA Solar Technology AG

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