Accessories for stand-alone gird inverter

SMART LOAD 6000

Technical Description

SL6000-TEN081820 | 98-2001320 | Version 2.0

EN

Table of Contents

1 Notes on this Manual

This manual describes the installation, commissioning and maintenance of the Smart Load.

1.1 Validity

This manual applies to firmware version FwVer 2.03 and higher.

You can access the firmware version of the Smart Load 6000 (SL 6000) using a communication connection.

1.2 Target Group

This manual is intended for the installer and the user.

1.3 Storage of the Manual

Store all manuals in the direct vicinity of the system so that they are accessible at all times.

1.4 Symbols Used

The following types of safety instructions and general information appear in this document as described below:

DANGER!

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

WARNING!

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

CAUTION!

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

NOTICE!

NOTICE indicates a situation that can result in property damage if not avoided.

Information

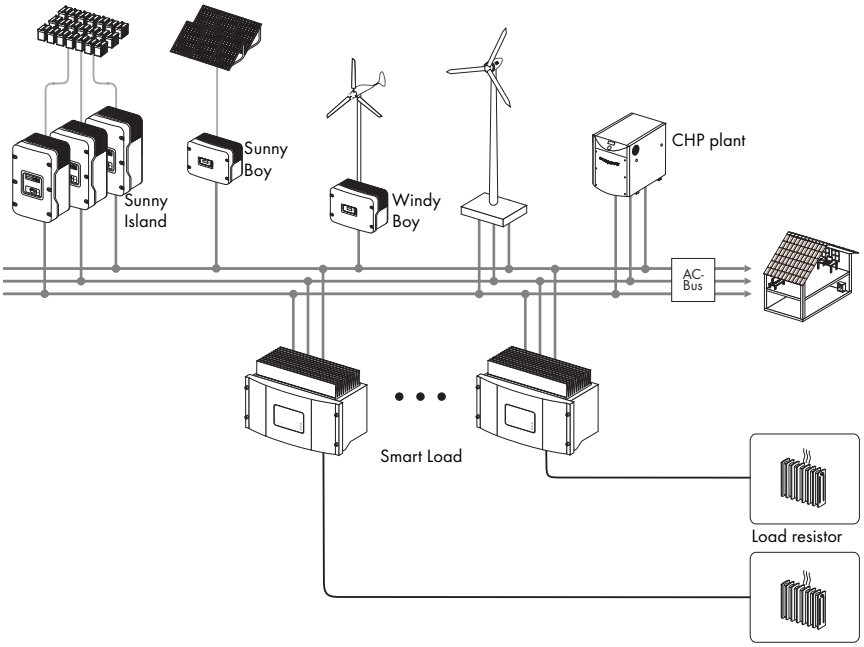
Information provides tips that are valuable for the optimal installation and operation of your product.

2 Safety

2.1 Appropriate Usage

The Smart Load is an electronic load for stand-alone grid systems equipped with Sunny Island. It identifies the grid frequency and determines whether an energy excess is present. The Smart Load converts the excess energy into heat using an external resistor or heating cartridge. You can also externally specify the nominal value of the power to be output.

Principle of a stand-alone grid system equipped with Smart Load



The Smart Load has a nominal power of 6 kW. The single or three-phase AC input voltage is 230 V or 3 x 230 V. One load resistor with a power consumption of 6 kW or 3 load resistors with a power consumption of 2 kW can be connected to the DC side of the Smart Load. The DC voltage is 230 V.

The Smart Load is suitable for Sunny Island stand-alone grid systems whose nominal voltage is 230 V or 3 x 230 V. The frequency can be 50 Hz or 60 Hz. Observe the limits specified by the manufacturer.

The Smart Load is only suitable for original SMA accessories or accessories recommended by SMA.

Appropriate usage also includes observing all the documentation.

2.2 General Safety Instructions

DANGER!

Danger to life due to high voltages in the Smart Load.

- All work on the Smart Load must be carried out by a qualified electrician.

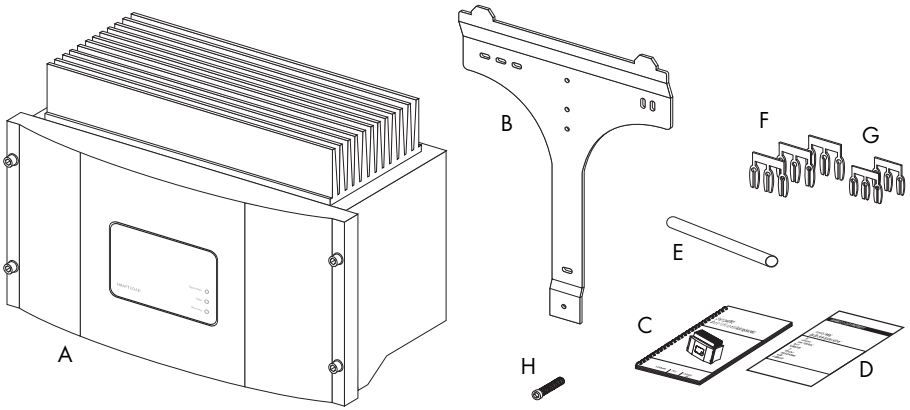
CAUTION!

Danger of burn injuries due to hot housing parts.

- Do not touch the housing during operation.

3 Unpacking

3.1 Packing List



Object	Number	Description
A	1	Smart Load
B	1	wall mounting bracket
C	1	technical Description
D	1	EC Declaration of Conformity
E	1	silicone tube
F	3	large bridging strips (for AC and resistor connections)
G	2	small bridging strips (for choke connection)
H	1	screw M6 x 12

3.2 Checking for Transport Damage

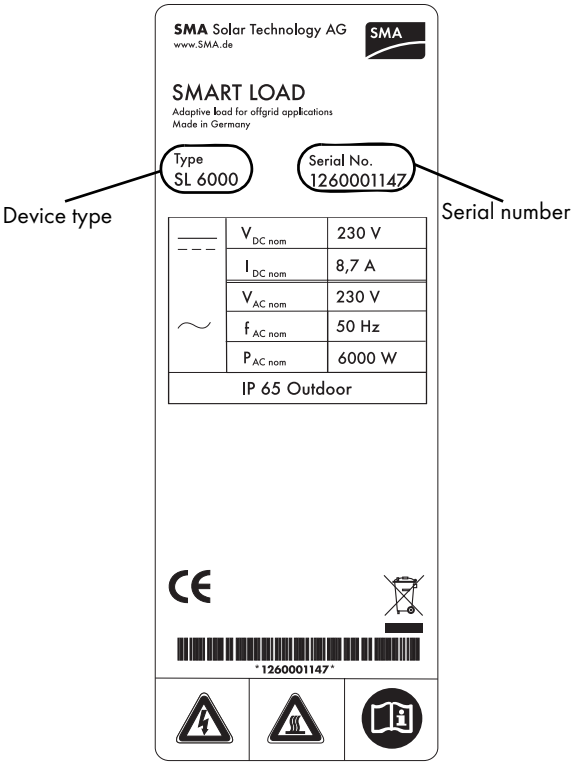
Before installing, make sure that all parts are included in the delivery.

- Carefully check the packaging and the Smart Load for any signs of damage.

If something is missing or the Smart Load has been damaged during transport, contact your dealer immediately.

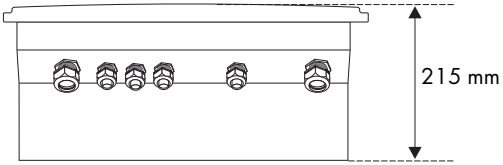
3.3 Identification of the Smart Load

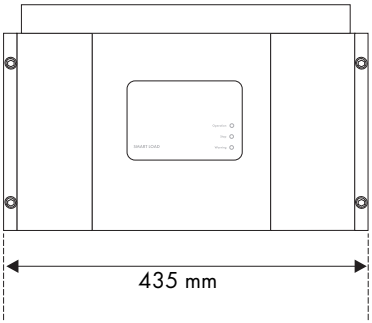
You can identify the Smart Load by the type label. The type label is on the right side of the housing.

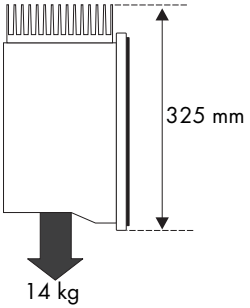


4 Mounting

4.1 Dimensions and Weight







4.2 Selecting the Mounting Location

DANGER!

Danger to life due to fire or explosion.

Despite careful construction, a fire can occur with electrical devices.

Do not install the Smart Load

- on flammable construction materials,
- in areas where highly flammable materials are stored,
- in potentially explosive areas!

CAUTION!

Danger of burn injuries due to hot housing parts.

- Mount the Smart Load in such a way that it cannot be touched inadvertently during operation.

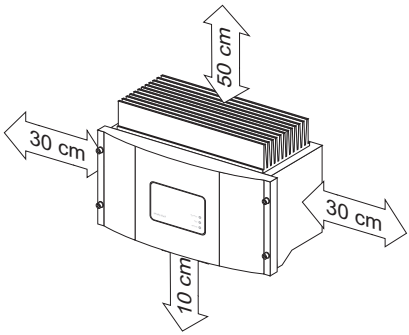
4.2.1 Ambient Conditions

- The mounting location must be accessible at all times.
- An ambient temperature between -25 °C and +50 °C ensures optimum operation.
- Do not expose the device to direct sunlight.
- The mounting location must be suitable for the weight and dimensions of the Smart Load.
- Mount the device on solid surfaces only.

4.2.2 Safety Clearances

When mounting the Smart Load, make sure to observe the following safety clearances to ensure sufficient heat dissipation.

Direction	Safety clearance
Sides	30 cm
Top	50 cm
Bottom	10 cm

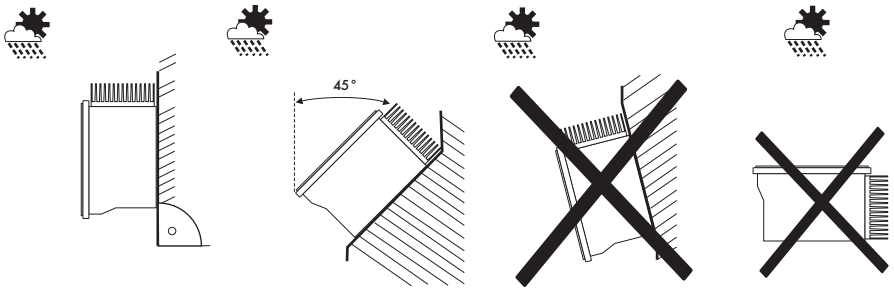


Multiple Smart Loads installed in areas with high ambient temperatures

If necessary, increase the clearances between the individual Smart Loads and ensure that there is sufficient ventilation. This ensures sufficient cooling.

4.2.3 Position

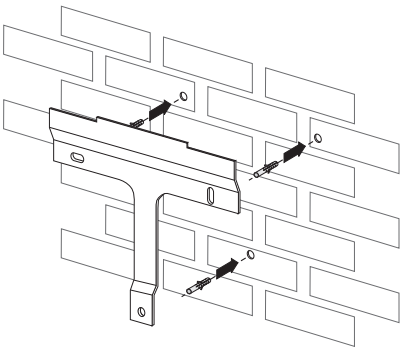
- Install at eye level to allow operating modes to be read at all times.
- Vertical installation or tilted backwards by max. 45 °.



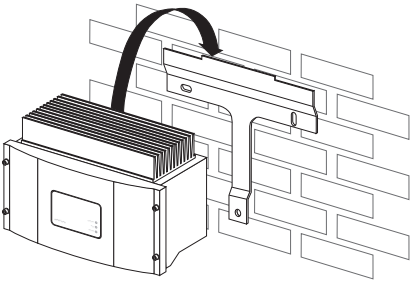
- Never install the device with a forward tilt.
- Do not install horizontally.

4.3 Mounting the Smart Load

1. Use the wall mounting bracket as a drilling template and mark the position of the drill holes.
2. Use fastening material suitable for the surface. Tighten the wall mounting bracket.

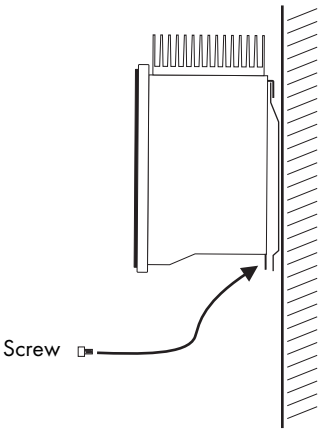


3. Hang the Smart Load onto the wall mounting bracket so that it can no longer be moved sideways.



4. Tighten the Smart Load using the provided M6 screw on the underside of the housing.

   The screw secures the Smart Load against being raised.



5. Ensure that the Smart Load is securely in place.

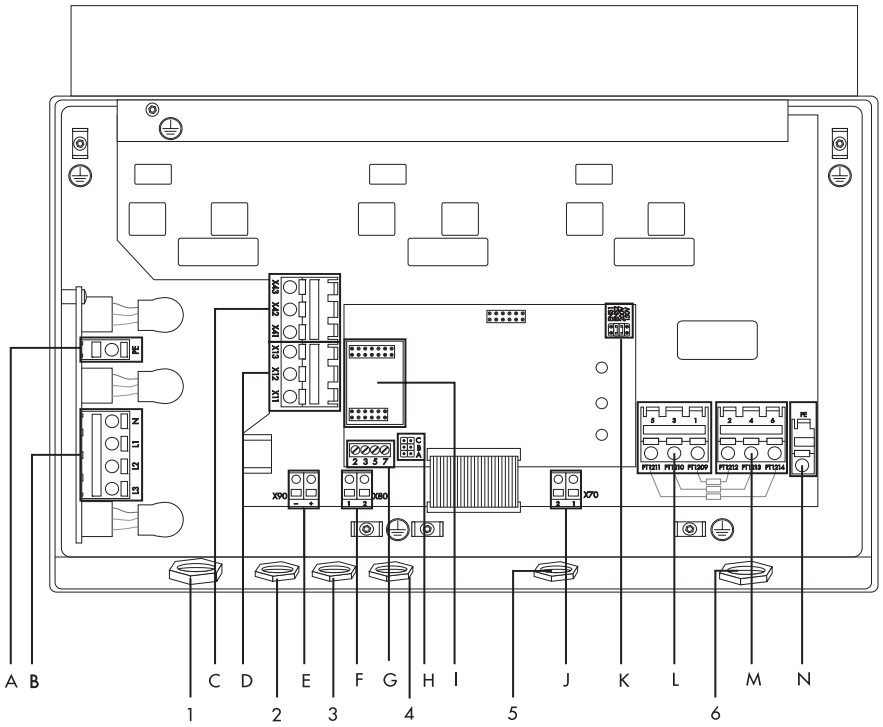
5 Electrical Connection

NOTICE!

Electrostatic discharges can damage the Smart Load.

- Ground yourself before touching a component inside the Smart Load. Touching the inside of the Smart Load's housing.

5.1 Overview of the Connection Area



Object	Description
A	PE connection terminal for AC connection
B	AC connection terminals
C	choke connection area
D	choke connection area

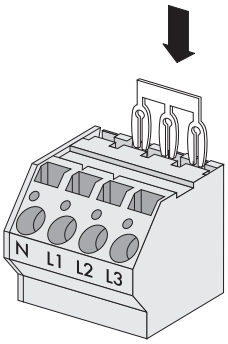
Object	Description
E	connection terminals for external specified power output
F	connection terminal for operational interruptor
G	Screw terminals for connection of the communication cable
H	jumper slot for communication
I	interface port
J	floating input for operation display
K	jumper slot for switching the grid frequency
L	connection terminal for resistor
M	connection terminal for resistor
N	PE connection terminal for grounding the load resistor
1	cable opening for AC connection
2	cable gland for external specified power output
3	cable opening for operational interruptor
4	cable opening for communication
5	cable opening for operation display
6	cable opening for DC connection (resistor)

5.2 Connecting the Stand-alone Grid System

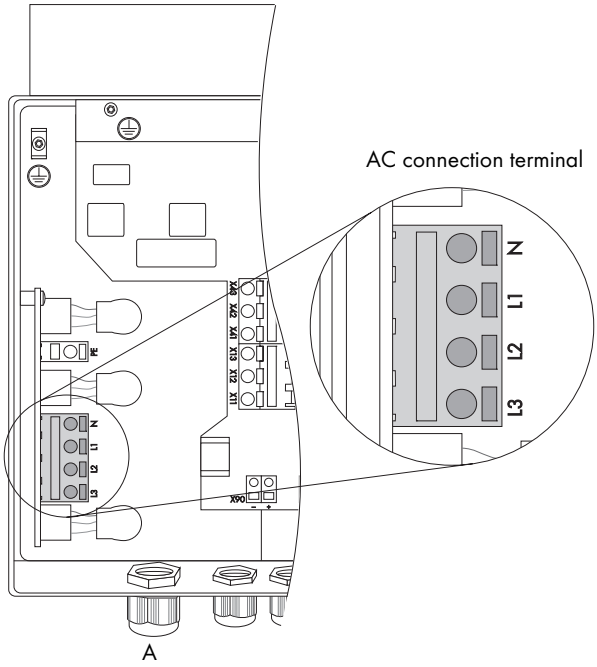
The Smart Load can be installed in single or three-phase, AC-coupled stand-alone grids whose nominal voltage is 230 V or 3 x 230 V having a frequency of 50 Hz or 60 Hz.

Connection Procedure

1. **DANGER!**
   Danger to life caused by voltages in the AC stand-alone grid.
   - Disconnect the stand-alone grid system.
   - Ensure that no voltage is present in the system.
2. Unscrew the M25 metric-thread cable screw connection's lock nut (A), and slide it over AC cable.
3. Thread the AC cable through the cable screw connection and connect PE to the "PE" connection terminal.

If...	Then...
Three-phase operation...	Connect L1, L2, L3 and N to the AC connection terminal according to the label.
Single-phase operation...	Bridge L1, L2 and L3 using the bridging strip provided (use large bridging strip). Connect L to the "L1" connection terminal. Connect N to the "N" connection terminal. 

4. Tighten the lock nut on the cable screw connection.



DANGER!

Danger to life due to high voltages in the Smart Load.

- Only start the stand-alone grid system after all work has been completed.

5.3 Connecting the Resistor

Load resistor

- The resistance value must be between 19 Ω and 26 Ω.
- The load resistor must be suitable for 230 V DC voltage.
- Only use resistors that are suitable for pulsed DC voltages.

Load resistors with a power consumption of 6 kW can be purchased from SMA.

If...	Then...
Three-phase operation...	• Connect 3 load resistors with a power consumption of 2 kW, see "Connection procedure for three load resistors" (Page 20).
Single-phase operation...	• Connect 1 load resistor with a power consumption of 6 kW, see "Connection procedure for one load resistor" (Page 21). or • Connect 3 load resistors with a power consumption of 2 kW, see "Connection procedure for three load resistors" (Page 20).

Cabling notes

The load resistor should be connected using a cable with the following properties:

- Shielded
- Cable length: maximum 20 m
- Cross section: at least 1.5 mm^2

Exceeding the resistance value

If the resistance value of 26 Ω is exceeded, achieving the nominal power of the Smart Load can no longer be ensured.

NOTICE!

An incorrect resistance value will irreparably damage the Smart Load.

- Ensure that the resistance value is never below 19 Ω.

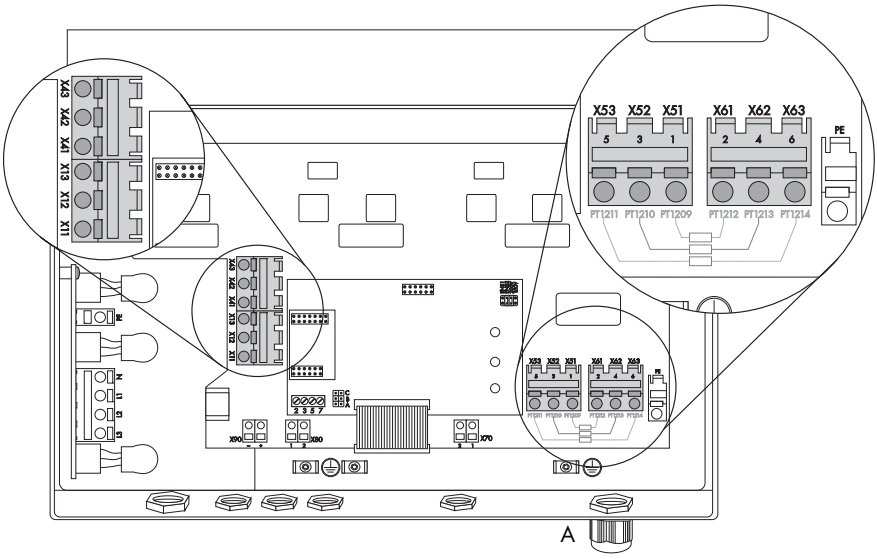
NOTICE!

A short circuit will irreparably damage the Smart Load.

- Always connect three load resistors, with a power consumption of 2 kW each, for a 3-phase AC connection.

Connection procedure for three load resistors

1. Unscrew the M25 metric-thread cable screw connection's lock nut (A) and slide it over the load resistor cable.
2. Pull the load resistor cable through the cable screw connection.
3. Ground the shield using the EMC cable screw connection.
4. Ground the housing of the load resistor by connecting it to the "PE" connection terminal.
5. Connect the first load resistor to "X51"and "X61". Connect the second load resistor to "X52" and "X62". Connect the third load resistor to "X53" and "X63".
6. Tighten the lock nut on the cable screw connection.
7. Ensure that the load resistors are connected properly.



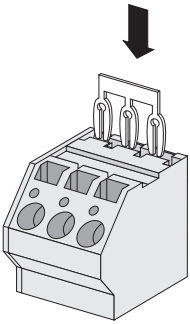
DANGER!

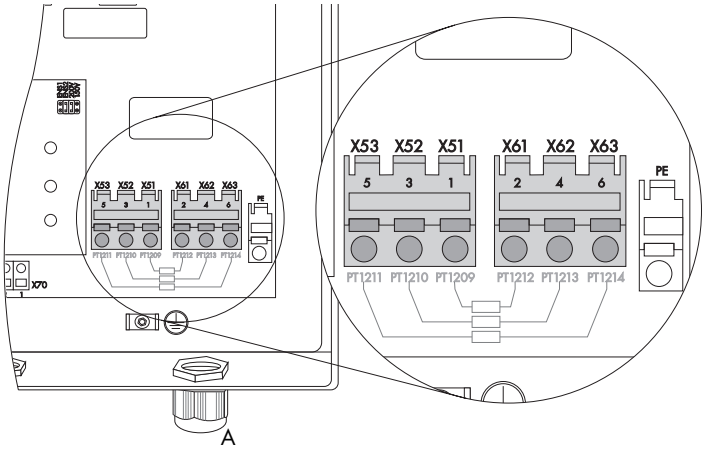
Danger to life due to high voltages in the Smart Load.

- Only start the stand-alone grid system after all cables have been connected.

Connection procedure for one load resistor

1. Unscrew the M25 metric-thread cable screw connection's lock nut (A) and slide it over the load resistor cable.
2. Remove the dummy plug from the cable screw connection.
3. Pull the load resistor cable through the cable screw connection into the inside of the Smart Load.
4. Ground the shield using the EMC cable screw connection.
5. Ground the housing of the load resistor by connecting it to the "PE" connection terminal.
6. Connect the cables to "X52" and "X62".
7. Bridge the X51, X52 and X53 terminals using the bridging strip provided (large bridging strip).
8. Bridge the X61, X62 and X63 terminals using the bridging strip provided (large bridging strip).
9. Bridge the X41, X42 and X43 terminals using the bridging strip provided (small bridging strip).
10. Bridge the X11, X12 and X13 terminals using the bridging strip provided (small bridging strip).
11. Tighten the lock nut on the cable screw connection.
12. Ensure that the load resistors are connected properly.





DANGER!

Danger to life due to high voltages in the Smart Load.

- Only start the stand-alone grid system after all work has been completed.

5.4 Communication

5.4.1 RS232 and RS485

SMA communication devices use RS232 and RS485 communication interfaces. In addition, a PC equipped with suitable software can be connected to the Smart Load.

See the communication device documentation for a detailed wiring diagram.

Connection Procedure

1.

NOTICE!

Electrostatic discharges can damage the communication interface.

- Ground yourself before touching the communication interface. touching the inside of the Smart Load's housing.

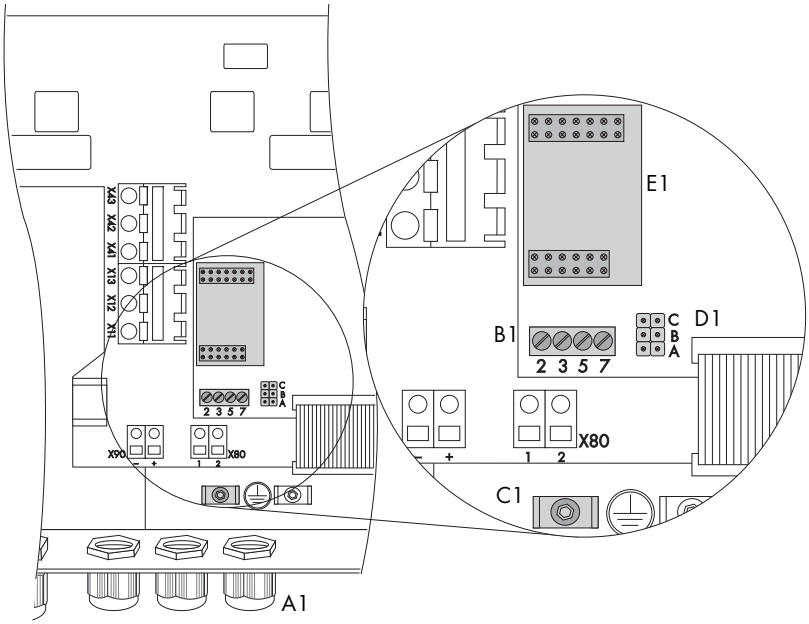
2. Loosen the lock nut of the PG screw fitting (A1) and slide it over the communication cable.
3. Remove the dummy plug from the cable screw connection.
4. Pull the communication cable through the cable screw connection.
5. Pull the silicone tube provided over the communication cable of the communication device. Cut the silicone tube to the required length.
6. Lay the cable directly to the screw terminal (B1).
7. Ground the communication cable with the PC connection (C1).
8.

NOTICE!

Connecting the receiver incorrectly can damage the devices.

- Connect the communication cables of the screw terminal strip as described in the connection diagram of the communication device.

9. Note down the conductor color coding for the respective pin numbers
   - Pin 2 color:_____
   - Pin 3 color:_____
   - Pin 5 color:_____
   - Pin 7 color:_____
10. Tighten the lock nut on the cable screw connection.
11. Connect the jumpers (D1) if the connection diagram of the communication device indicates this as necessary. Details on the jumper functions can be found in the communication device documentation.
12. Unpack the communication interface and connect it on the board (E1).



DANGER!

Danger to life due to high voltages in the Smart Load.

- Only start the stand-alone grid system after all work has been completed.

5.4.2 Operation Display

You can connect an external load (e.g. energy saving lamp) to the Smart Load. It displays whether the Smart Load is operating (green LED illuminates) and whether power is being output (green LED flashes).

Connect the operation display to the floating relay contact X70.

NOTICE!

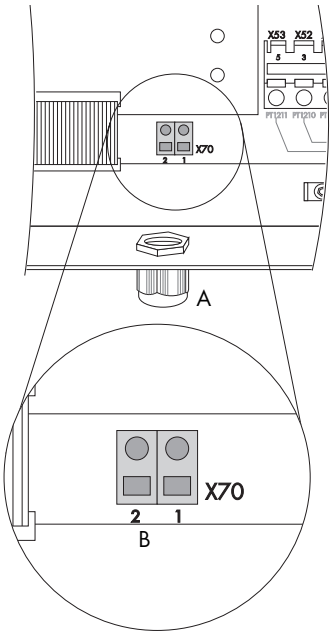
High currents will irreparably damage the Smart Load

Observe the maximum voltage, current and power on the relay contact X70:

- V_{AC} = 230 V
- $I_{AC\ max}$ = 0.5 A
- $P_{AC\ max}$ = 115 W

Connection Procedure

1. Loosen the lock nut of the PG screw fitting (A) and slide it over the cable of the load.
2. Remove the dummy plug from the cable screw connection.
3. Pull the cable of the load through the cable screw connection into the inside of the Smart Load and connect the cables to the connection terminal "X70" (B).
4. Tighten the lock nut on the cable screw connection.



DANGER!

Danger to life due to high voltages in the Smart Load.

- Only start the stand-alone grid system after all cables have been connected.

5.5 Additional Connections

5.5.1 Operational Interruption

You can switch the Smart Load on and off using an external contact.

NOTICE!

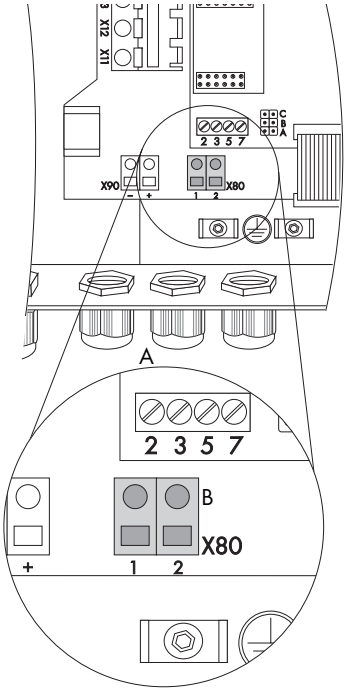
High voltages and currents will irreparably damage the Smart Load

Observe the maximum voltage and current of the contact:

- V_{DC} = 10 V
- I_{DC} = 0.5 mA

Connection Procedure

1. Loosen the lock nut of the PG screw fitting (A) and slide it over the cable of the load.
2. Remove the dummy plug from the cable screw connection.
3. Thread the contact cable through the cable screw connection and connect the cables to the connection terminal "X80" (B).
4. Tighten the lock nut on the cable screw connection.



DANGER!

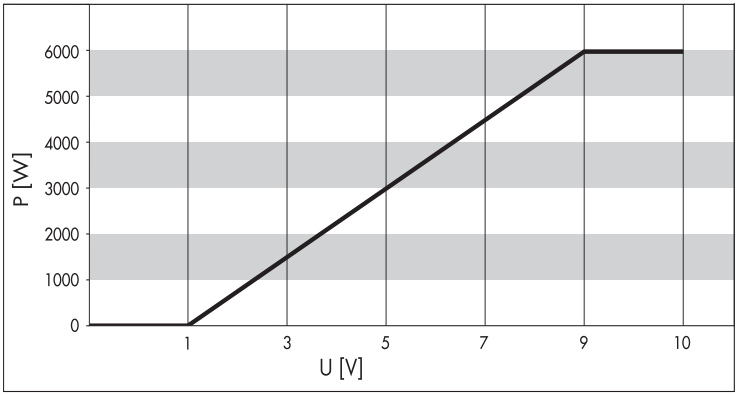
Danger to life due to high voltages in the Smart Load.

- Only start the stand-alone grid system after all work has been completed.

5.5.2 External Specified Power Output

You can set the level of the power to be regulated using an external DC source. The control range is 1 V - 9 V.

- 1 V = 0 % power output
- 9 V = 100 % power output

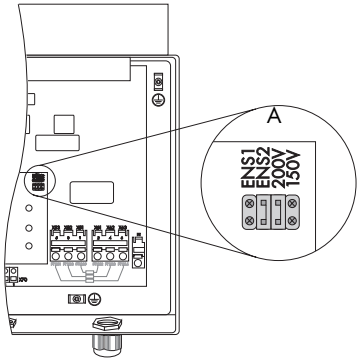


Connection Procedure

Ensure that the polarity is correct

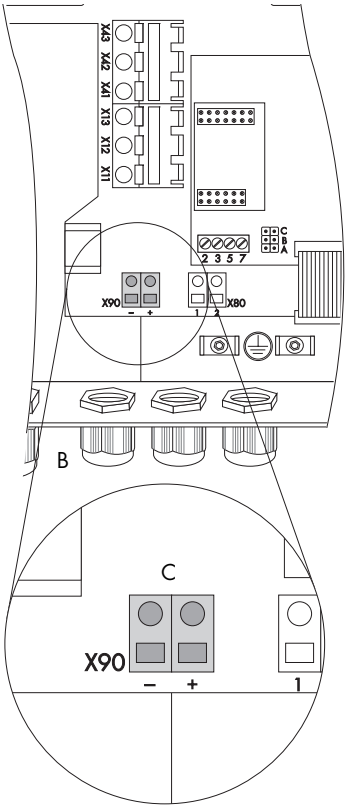
The power output control depends on the polarity. This function does not work if the connection is incorrect.

1. Reconnect jumper (A) from 200 V slot to 150 V slot.



2. Loosen the lock nut of the PG screw fitting (B) and slide it over the cable of the voltage source.
3. Remove the dummy plug from the cable screw connection.
4. Thread the cable of the voltage source through the cable screw connection and connect the cables to the connection terminal "X90" (C).

   Ensure the polarity of the cables is correct.
5. Tighten the lock nut on the cable screw connection.



DANGER!

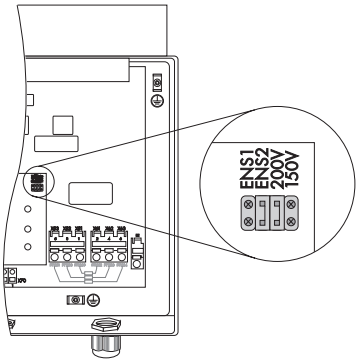
Danger to life due to high voltages in the Smart Load.

- Only start the stand-alone grid system after all work has been completed.

6 Switching the Grid Frequency

In order to operate the Smart Load in Sunny Island systems with a 60 Hz grid, the jumper must be disconnected from jumper slot "ENS 2" and be connected to slot "ENS 1".

Grid	Jumper slot
50 Hz grid	ENS 2
60 Hz grid	ENS 1



7 Commissioning

Check the following requirements before commissioning:

- Secure fit on wall mounting bracket
- Correct connection of the AC cable (grid)
- Connection of DC cable (load resistor, any additional connections) is complete
- All housing openings are sealed
- All screw fittings are tight
- The lid is securely screwed in place

Commissioning procedure

1. Commission the AC feed-in generators.
2. An illuminated green LED on the Smart Load indicates fault-free operation.

8 Opening and Closing

8.1 Opening the Smart Load

NOTICE!

Electrostatic discharges can damage the Smart Load.

- Ground yourself before touching a component inside the Smart Load. touching the inside of the Smart Load's housing.

1. **DANGER!**

   Danger to life due to high voltages in the Smart Load.

   - Disconnect the stand-alone grid system.
   - Ensure that no voltage is present in the system.
2. Wait until the LEDs and, if applicable, the operation display of the Smart Load have gone out.
3. Unscrew all four lid screws and set them aside.
4. Pull the lid slightly forward.
5. Disconnect the PE connection from the lid.
6. Remove the lid and set it aside.

8.2 Closing the Smart Load

1. Establish the PE connection to the lid.
2. Fasten the lid to the housing using four screws.
3. Commission the Smart Load as described in section 7 "Commissioning" (Page 29).

9 Maintenance and Cleaning

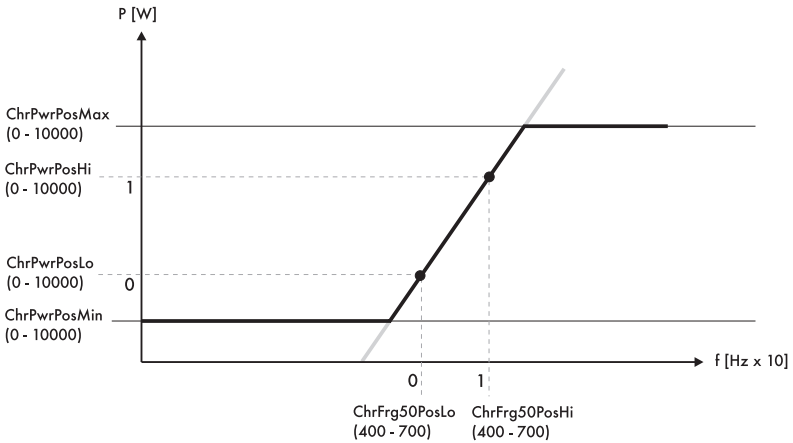
9.1 Cleaning the Cooling Fins

It is only necessary to clean the cooling fins if the Smart Load's heat dissipation is restricted by dirt.

- Clean the cooling fins using a suitable brush.

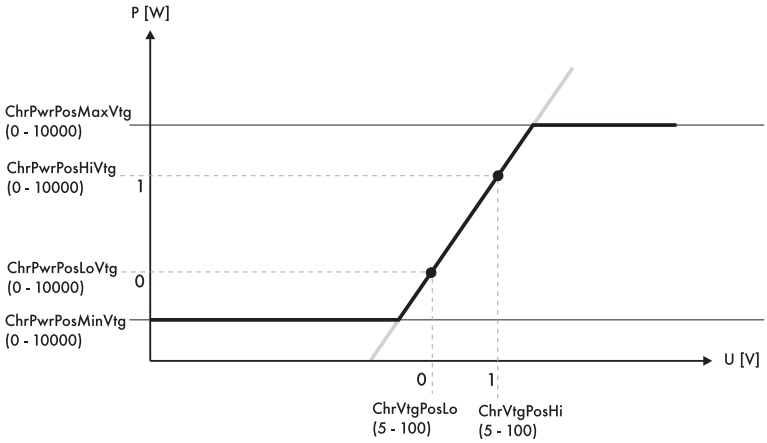
10 Parameter List

10.1 Adjustable Parameters

No.	Parameter	Range	Default value	Unit	Description
3	ErrWtTms	600 - 3600	600	seconds	error criterion: length of time for which the system remains in error status.
4	EvtWtTms	10 - 300	30	seconds	waiting time in the event of a failure
6	MinACVtg	150 - 290	180	volt	minimum effective input voltage value
7	MaxACVtg	150 - 290	270	volt	Maximum effective input voltage value
Frequency power curve 					
10	ChrPwrPosLo	0 - 10000	0	watt	P/f defined curve P at point 0
11	ChrPwrPosHi	0 - 10000	6000	watt	P/f defined curve P at point 1
12	ChrFrq50PosLo	400 - 700	510	hertz[a)]	P/f defined curve f at point 0
13	ChrFrq50PosHi	400 - 700	520	hertz[a)]	P/f defined curve f at point 1
14	ChrFrq60PosLo	400 - 700	610	hertz[a)]	P/f defined curve f at point 0
15	ChrFrq60PosHi	400 - 700	620	hertz[a)]	P/f defined curve f at point 1

a) multiplied by the factor 10

No.	Parameter	Range	Default value	Unit	Description
16	ChrPwrPosMin	0 - 10000	0	watt	P/f defined curve - minimum output power
17	ChrPwrPosMax	0 - 10000	6000	watt	P/f defined curve - maximum output power
18	PWMMan	0 - 100	0	percent %	Pulse-width modulation level in manual mode
19	RlyHystTms	1 - 3600	3	seconds	Hysteresis time between activation and deactivation of the operating message
21	dFreqNg	1 - 5	5	hertz	The measured frequency may only be a maximum of delta below the nominal frequency 50/60 Hz
22	dFreqPs	1 - 5	5	hertz	The measured frequency may only be a maximum of delta above the nominal frequency 50/60 Hz
External power output specified by DC source					
24	ChrPwrPosMin Vtg	0 - 10000	0	watt	P/U analog defined curve - minimum output power
25	ChrPwrPosMax Vtg	0 - 10000	6000	watt	P/U analog defined curve - maximum output power



No.	Parameter	Range	Default value	Unit	Description
26	ChrPwrPosLoVtg	0 - 10000	0	watt	P/U analog curve P at point 0
27	ChrPwrPosLoHiVtg	0 - 10000	6000	watt	P/U analog curve P at point 1
28	ChrVtgPosLo	5 - 100	10	volt [a)]	P/U analog curve U at point 0
29	ChrVtgPosHi	5 - 100	90	volt[a)]	P/U analog curve U at point 1
30	FrqFilCnst	7 - 15	11	-	frequency filter constant filtering the frequency measurement values

a) multiplied by the factor 10

11 Troubleshooting

11.1 LEDs

Green LED	Red LED	Yellow LED	Meaning	Remedy
-	-	-	device off	Commission the Smart Load as described in section 7 "Commissioning" (Page 29).
is illuminated	is illuminated	is illuminated	initialization	-
is illuminated	-	-	ready for operation (no power output)	-
flashes	-	-	operating (power output)	-
-	-	is illuminated	device fault	Contact SMA Technical Service Line (see section 14 "Contact" (Page 38)).
-	is illuminated	-	operation interruption (through external contact)	Switch off the external switch.
is illuminated or flashes	-	is illuminated	no or reduced power output	Check DC installation. Connect load resistor as described in section 5.3 "Connecting the Resistor" (Page 19).

12 Decommissioning

12.1 Disassembly

1. Open the Smart Load as described in section 8.1 "Opening the Smart Load" (Page 30).
2. Disconnect the AC cable from the Smart Load.
3. Disconnect the load resistor from the Smart Load.
4. Remove the communication cable from the Smart Load.
5. If necessary, disconnect additional connections from the Smart Load.
6. Close the Smart Load. Establish the PE connection to the lid and tighten the lid on the Smart Load using four screws.
7. Remove the Smart Load.

12.2 Packaging

If possible, pack the Smart Load in the original packaging. If this is no longer available, you can also use an equivalent box that fulfills the following requirements:

- Suitable for loads of up to 14 kg
- With handle system
- Can be closed fully

12.3 Storage

Store the Smart Load in a dry place where the ambient temperature is always between -25 °C and +50 °C.

12.4 Disposal

Dispose of the Smart Load at the end of its service life in accordance with the disposal regulations for electronic waste which apply at the installation site at that time. Alternatively, send it back to SMA with shipping paid by sender, and labeled "ZUR ENTSORGUNG" ("for disposal").

13 Technical Data

	SL 6000
AC Input	
Nominal input voltage	230 V (1-phase) / 3 x 230 V with N conductor (3-phase)
System frequency	45 ... 55 Hz, 55 ... 65 Hz
Input voltage range	3 x 180 ... 270 V
DC output	
Output voltage	3 x 0 ... 230 V
Output power	3 x 0 ... 2 kW
Connections for	3 resistors with a power consumption of 2 kW or 1 resistor with a power consumption of 6 kW
General Information	
Dimensions (w x h x d) in mm	435 x 325 x 215
Weight	14 kg
Ambient temperature	–25 °C ... +50 °C
Protection class according to DIN EN 60529	IP 65
EC Declaration of Conformity	enclosed, download area www.SMA.de

14 Contact

If you have technical problems concerning our products, contact the SMA Technical Service Line. We require the following information in order to provide you with the necessary assistance:

- Serial number of the Smart Load
- Number of additional Smart Loads
- Communication method

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- Operating the product whilst ignoring relevant, statutory safety regulations in the deployment location
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- Altering the product or supplied software without authority
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