



Fuel cell inverter

HYDRO BOY 1124 / 1324

Technical Description



Table of Contents

1	Notes on this manual	7
1.1	Validity	7
1.2	Target Group	7
1.3	Symbols Used	7
2	Safety	8
2.1	Appropriate Usage	8
2.2	Safety Instructions	9
3	Unpacking	10
3.1	Packing List	10
3.2	Identifying the Hydro Boy	11
3.3	Mounting the Fan	12
4	Mounting	13
4.1	Selecting the Mounting Location	13
4.1.1	Dimensions and Weight	13
4.1.2	Ambient Conditions	14
4.2	Mounting the Hydro Boy	15
5	Electrical Connection	16
5.1	Overview of the Connection Area	16
5.2	Connecting the Public Grid (AC)	17
5.3	Connecting the Fuel Cell (DC)	22
6	Communication	24
6.1	RS232 and RS485	24
6.2	CAN Communication	24
6.2.1	CAN Termination	24
6.2.2	"Heartbeat" Function	25
6.2.3	CAN Protocol	25

6.2.4	Error Memory	28
7	(Initial) Start-Up	30
8	Opening and Closing.....	31
8.1	Opening the Hydro Boy	31
8.2	Closing the Hydro Boy	31
9	Display Messages	32
9.1	Activating the Display Illumination	32
9.2	Display Messages in the Startup Phase	32
9.3	Display Messages during Operation	32
9.3.1	StatusMessages	33
9.4	Error Messages.....	33
10	Blinking Codes	37
10.1	Operating Modes.....	37
10.1.1	All LEDs are on	37
10.1.2	All LEDs are off	37
10.1.3	The green LED is blinking slowly	38
10.1.4	Green LED glows continuously	38
10.1.5	The green LED is blinking quickly	38
10.1.6	The green LED goes out briefly	39
10.2	Failures	39
10.2.1	The red LED glows continuously	39
10.2.2	The yellow LED glows continuously.....	40
10.2.3	The yellow LED blinks twice.....	40
10.2.4	The yellow LED blinks 3 times	41
10.2.5	The yellow LED blinks 4 times	42
10.2.6	The yellow LED blinks five times	42
11	Maintenance and Care	43

- 12 Decommissioning 44**
- 12.1 Disassembling the Hydro Boy 44
- 12.2 Packing the Hydro Boy 44
- 12.3 Storing the Hydro Boy 44
- 12.4 Disposing of the Hydro Boy 44
- 13 Troubleshooting 45**
- 13.1 Checking/Replacing Varistors 45
- 14 Operating Parameters 46**
- 14.1 Parameter Settings for Germany 48
- 14.2 Country-specific Parameter Settings 49
- 15 Technical Data 50**
- 16 Contact 52**

1 Notes on this manual

This manual describes how to mount, install, commission, operate, and maintain the Hydro Boy 1124 / 1324 (HB 1124 / HB 1324). Ensure that the Hydro Boy manual is stored in a location easily accessible at all times.

1.1 Validity

The manual applies to the firmware version BFR 7.15, SRR 1.37, and higher.

1.2 Target Group

This manual is intended for installers and users.

1.3 Symbols Used

The following types of safety instructions and general information appear in this manual 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 serious injury.

NOTICE!

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



Information

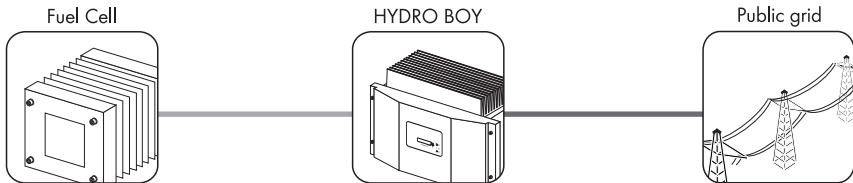
Information provides tips that are valuable for the optimal installation and operation of your product.

2 Safety

2.1 Appropriate Usage

The Hydro Boy is an inverter that converts the DC current from fuel cell systems or fuel cell stacks to AC current and feeds it into the available public grid. The Hydro Boy is particularly suitable for common PEM fuel cells of well-known manufacturers. However, there is no general restriction prohibiting it from use with other fuel cell technologies.

Principle of a fuel cell system with Hydro Boy



The Hydro Boy may only be operated with fuel cell systems or stacks whose performance data comply with the technical data of the Hydro Boy.

The Hydro Boy does not assume control of the fuel cell system. The operator must take special preventive measures in case the Hydro Boy disconnects itself from the grid (in case of a fault or grid failure). In this case, the fuel cell can no longer deliver its output to the Hydro Boy.

Make absolutely certain that when the Hydro Boy is idle (Hydro Boy does not extract any power from the fuel cell), the input voltage on the Hydro Boy does not exceed the maximum specified value.

Due to its design, the input current of the Hydro Boy features a high ripple level during feeding operation. Make sure that this high ripple level does not permanently damage the connected fuel cell, or that the number of operating hours of the fuel cell is reduced by this.

2.2 Safety Instructions

**DANGER!**

Danger to life due to high voltages in the Hydro Boy.

- All work on the Hydro Boy must be carried out by a qualified electrician.

**CAUTION!**

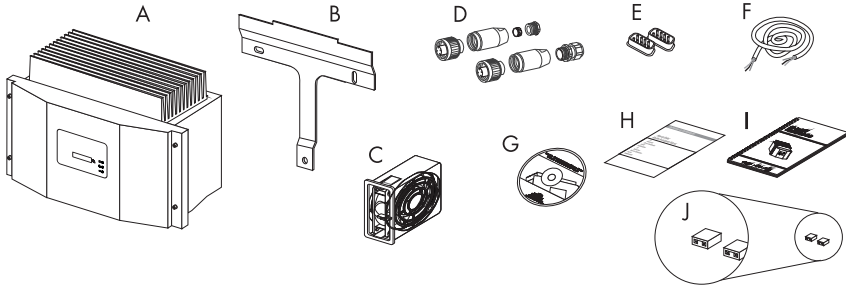
Danger of burn injuries due to hot housing parts.

- Do not touch the housing of the Hydro Boy during operation.

3 Unpacking

3.1 Packing List

Check the packing list for completeness and the device for visible external damage, such as cracks in the housing or in the display of the Hydro Boy. If anything is missing or damaged, contact your dealer.



Object	Quantity	Description
A	1	Hydro Boy
B	1	Wall mounting bracket
C	1	Fan (only with HB 1324)
D	2	Socket element (PG 13.5 and PG 16)
E	2	Termination resistor
F	1	Data transfer cable
G	1	CD-Rom (Sunny Data Control)
H	1	EC Declaration of Conformity
I	1	Technical Description
J	2	Jumper

3.2 Identifying the Hydro Boy

You can identify the Hydro Boy using the device type and the series number on the type label. The type label is on the right side of the housing.

SMA Solar Technology AG www.SMA.de

HYDRO BOY
Fuel Cell inverter * Made in Germany

Type
HB 1124

Serial No.
1600001261

Device type
Series number

	V _{DC max}	60 V
	V _{DC}	20 - 55 V
	I _{DC max}	56 A
	V _{AC nom}	230 V
	f _{AC nom}	50/60 Hz
	P _{AC nom}	1100 W
	I _{AC nom}	4,8 A
	cos φ	1

VDE 0126-1-1 (2.06)

indoor

1600001261

3.3 Mounting the Fan

An additional fan must be installed on a Hydro Boy (HB 1324) to operate it at a constant power of over 1200 W (DC), or at an ambient temperature at the installation location of over 40 °C.

Proceed as follows to install the fan on the Hydro Boy:

1. Position the provided fan in the center of the cooling fins of the Hydro Boy. Leave approximately 14 cm of space on the right and left side.
 2. Insert the fan in the first and twelfth cooling fin on the front of the Hydro Boy housing. The fan housing must rest on the cooling fins.
 3. Insert the fan plug in the socket on the front of the cooling fins. The plug will audibly snap into place.
- The fan is now mounted on the Hydro Boy.

4 Mounting

4.1 Selecting the Mounting Location



DANGER!

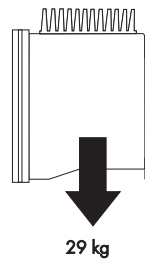
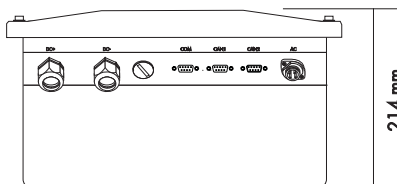
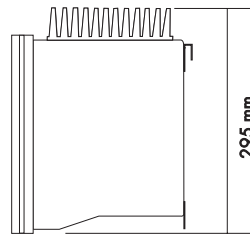
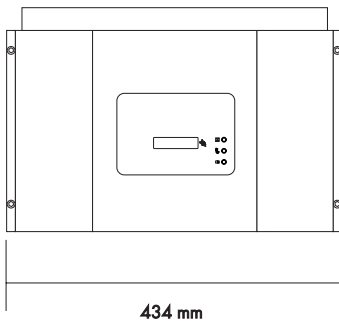
Danger to life due to fire or explosion.

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

Do not install the Hydro Boy

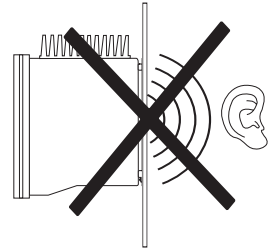
- on flammable construction materials,
- in areas where highly flammable materials are stored,
- or in potentially explosive areas!

4.1.1 Dimensions and Weight



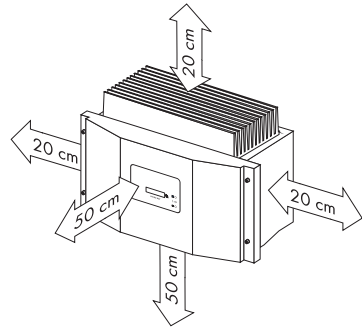
4.1.2 Ambient Conditions

- The installation location and installation method must be suitable for the weight and dimensions.
- Mounting on a solid surface.
- The mounting location must be accessible at all times.
- It must be easy to remove the Hydro Boy from the mounting location at all times.
- The ambient temperature should be between $-25\text{ }^{\circ}\text{C}$ and $+60\text{ }^{\circ}\text{C}$ to ensure optimum operation.
- Do not expose the Hydro Boy to direct sunlight to avoid a power reduction due to excessive heating.
- In living areas, do not install the unit on plasterboard walls, etc. so as to avoid audible vibrations. The Hydro Boy may make noises when in use which may be perceived as a nuisance in a living area.

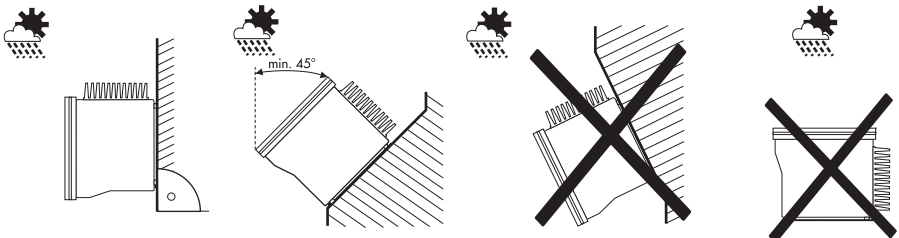


- Observe the following safety clearances to walls, other devices or other objects to ensure sufficient heat dissipation.

If several Hydro Boys are installed next to each other, the clearances between the individual devices must be increased.



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



4.2 Mounting the Hydro Boy

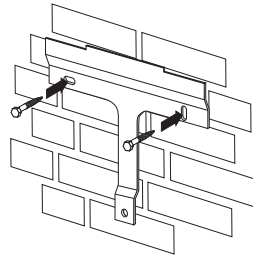


CAUTION!

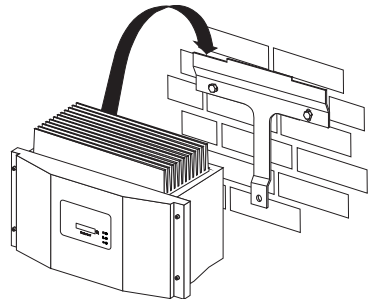
Risk of injury due to the heavy weight of the Hydro Boy.

- Note that the Hydro Boy weighs 29 kg.

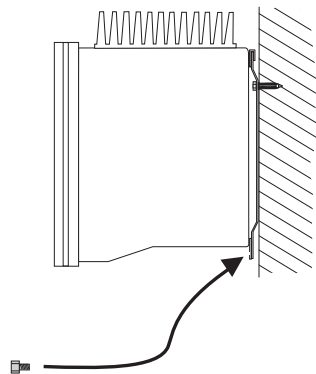
1. Use the wall mounting bracket as a drilling template, and mark the position of the drill holes.
2. Secure the wall mounting bracket using suitable screws and washers.



3. Attach the Hydro Boy by inserting its upper mounting slots into the wall mounting bracket.



4. Secure the Hydro Boy in position by installing a M6x10 screw.



5. Check that the unit is securely in place.

5 Electrical Connection

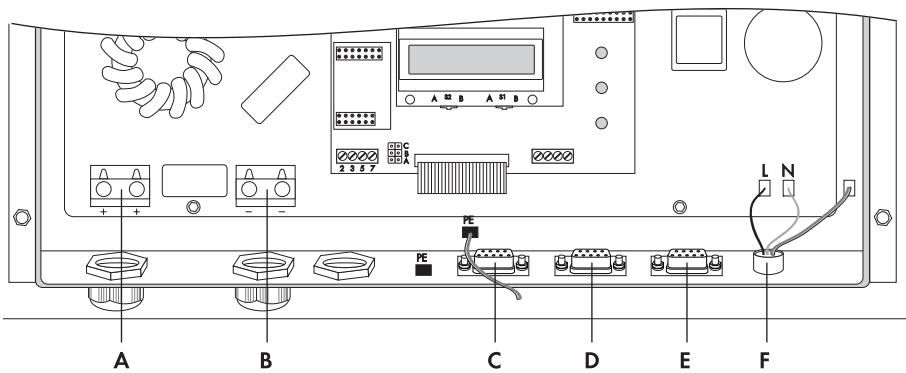
NOTICE!

Static discharges can damage the Hydro Boy.

Internal components of the Hydro Boy can be irreparably damaged by static discharge.

- Ground yourself before you touch a component.

5.1 Overview of the Connection Area



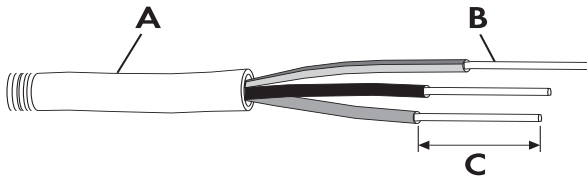
Object	Description
A	Connection terminal for "DC+" cable of the fuel cell
B	Connection terminal for "DC-" cable of the fuel cell
C	"COM" connection socket for RS232 or RS485 communication
D	"CAN1" connection socket for CAN communication
E	"CAN2" connection socket for CAN communication
F	AC socket for grid connection

5.2 Connecting the Public Grid (AC)

Connection regulations

- Observe the connection regulations of your grid operator.
- The Hydro Boy must have a three-cable connection to the grid (PE, N, L).
- The grid connection terminals on the AC connection socket included in the accessories kit can take cables with a cross-section of up to 2.5 mm². If you would like to connect a cable with a diameter of 9 to 13.5 mm, you must use the PG 13.5 connection socket provided. When connecting a cable with a diameter of 13.5 to 17 mm, the PG 16 connection socket provided must be used.

Cable requirements



Object	Description
A	Outer diameter: 9 - 17 mm
B	Cable cross section: max. 2.5 mm ²
C	Stripping length : approx. 12 mm



PE conductor

The PE conductor must be 5 cm longer than the N and L conductors.

Cable design

AC grid impedance should not exceed 1 Ohm. This is required for the correct operation of impedance monitoring.

The cable cross-section should be sized using the "Sunny Design" design program (www.SMA.de/en) so that line losses do not exceed 1 % at nominal power.

The maximum cable lengths, depending on the cable cross-section, are shown in the following table. Do not exceed the maximum cable length.

Cable cross-section	Max. cable length
1.5 mm ²	21 m
2.5 mm ²	35 m

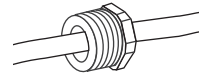
Connection procedure for the PG 13.5 AC connection socket

1. Test the grid voltage and compare it with the permitted voltage range (see section 15 „Technical Data“ (50)).

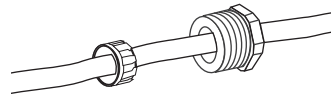
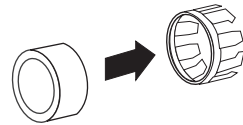
! DANGER!
Danger to life due to high voltages in the Hydro Boy.

- Switch off the line circuit breaker and secure it to prevent it from being reactivated.
- Make sure that no voltage is present in the device.

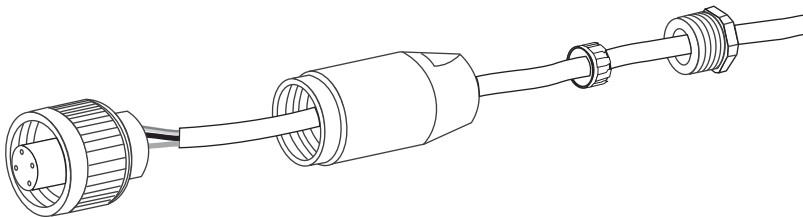
2. Slide the pressure screw over the AC cable.



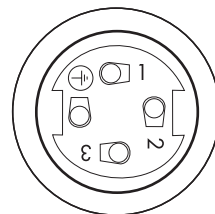
3. Press the seal ring into the fastening case and slide it over the AC cable.



4. Slide the threaded sleeve over the AC cable.



5. Insert the protective earth PE (green-yellow) in the screw terminal with the ground symbol on the socket element and tighten the screw.
6. Insert the neutral conductor N (blue) in screw terminal 1 on the socket element and tighten the screw.
7. Insert the live wire L (brown or black) in screw terminal 2 and tighten the screw.
8. Do not use screw terminal 3.

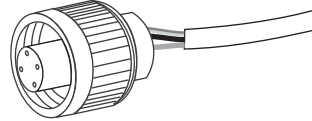


**DANGER!**

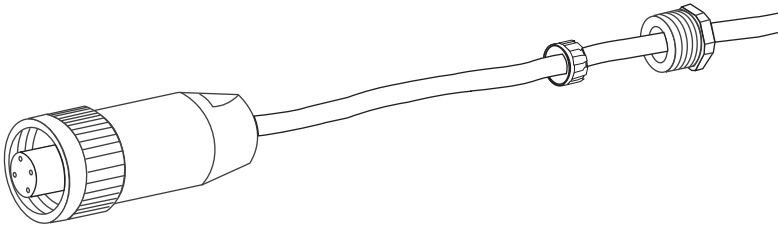
Danger to life due to high voltages in the Hydro Boy..

When laying the AC cable, the PE conductor and the other conductors can be extracted from the socket element after they have been connected.

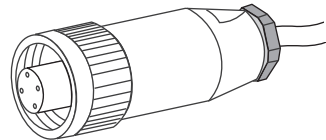
- Make sure the connection wires are securely connected.
- Do not bend the AC cable once it has been connected.
- Do not subject the socket element to heavy loads.



9. Screw the threaded sleeve onto the socket element.



10. Screw the pressure screw tightly onto the threaded sleeve. The fastening case with the seal ring is pressed into the threaded sleeve and can no longer be seen.



11. Close the socket element with the cap supplied in the accessories kit if the Hydro Boy is not being connected immediately.
12. Remove the protecting cap of the flange plug on the Hydro Boy.
13. Connect the AC connection socket to the flange plug on the Hydro Boy.
14. Firmly tighten the threaded ring on the AC connection socket onto the flange plug. The threaded ring is used to seal and provide strain relief for the AC connection socket.

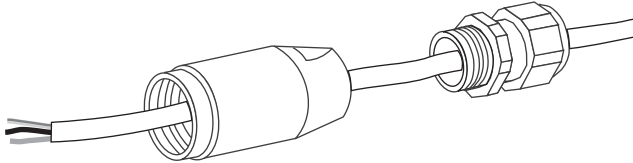
**DANGER!**

Danger to life due to high voltages in the Hydro Boy.

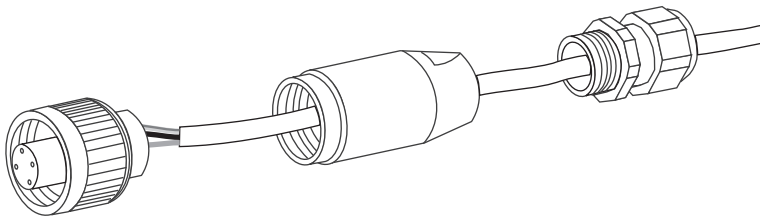
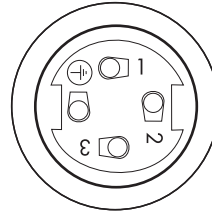
- Only switch on the line circuit breaker after all cables on the Hydro Boy have been connected.

Connection procedure for the PG 16 AC connection socket

1. Slide the PG16 cable gland with the pressure screw over the AC cable.
2. Slide the threaded sleeve over the AC cable.



3. Insert the protective earth PE (green-yellow) in the screw terminal with the ground symbol on the socket element and tighten the screw.
4. Insert the neutral conductor N (blue) in screw terminal 1 on the socket element and tighten the screw.
5. Insert the live wire L (brown or black) in screw terminal 2 and tighten the screw.
6. Do not use screw terminal 3.

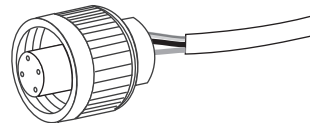


DANGER!

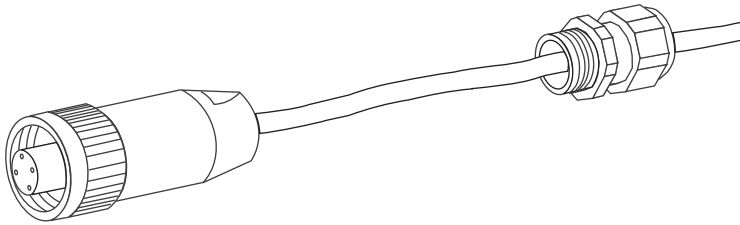
Danger to life due to high voltages in the Hydro Boy.

When laying the AC cable, the PE conductor and the other conductors can be extracted from the socket element after they have been connected.

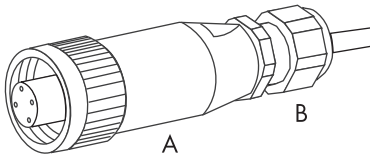
- Make sure the connection wires are securely connected.
- Do not bend the AC cable once it has been connected.
- Do not subject the socket element to heavy loads.



7. Screw the threaded sleeve onto the socket element.



8. Screw the PG16 cable gland with the pressure screw (B) tightly onto the threaded sleeve (A).



9. Close the socket element with the cap supplied in the accessories kit if the Hydro Boy is not being connected immediately.
10. Remove the protecting cap of the flange plug on the Hydro Boy.
11. Connect the AC connection socket to the flange plug on the Hydro Boy.
12. Firmly tighten the threaded ring on the AC connection socket onto the flange plug. The threaded ring is used to seal and provide strain relief for the AC connection socket.

**DANGER!**

Danger to life due to high voltages in the Hydro Boy.

- Only switch on the line circuit breaker after all cables on the Hydro Boy have been connected.

5.3 Connecting the Fuel Cell (DC)

The following thresholds at the DC input of the Hydro Boy must not be exceeded:

- Max. input voltage: 60 V (DC)
- Max. input current: 56 A (DC)

Cable Requirements

For the connection of the fuel cell, use a cable with a cross-section of 25 mm². The cable must be suitable for ambient temperatures of up to 110 °C.



Notice!

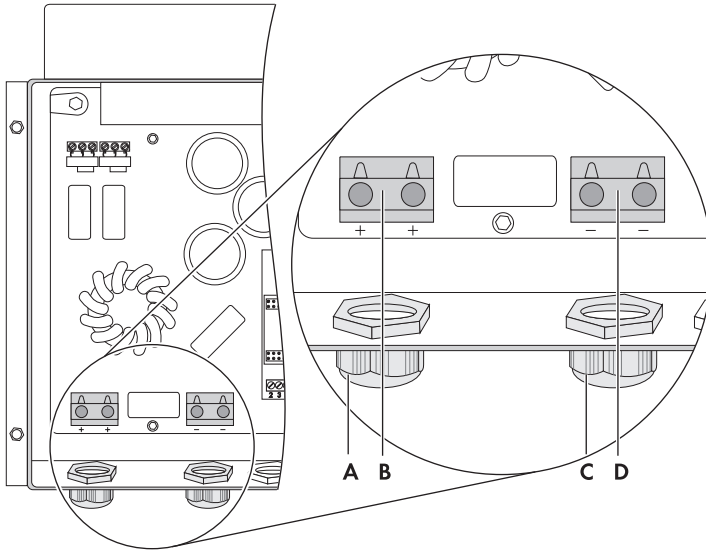
Damage of the DC cable due to overheating.

Cables that are not suitable for ambient temperatures of up to 110 °C may be damaged due to overheating with respect to the maximum temperatures inside the Hydro Boy.

- Use cables of the type "H07G-K" or similar for the connection of the fuel cell.

Connection procedure for the fuel cell

1. Check the connection cable of the fuel cell for correct polarity and that the maximum input voltage of the Hydro Boy is not exceeded.
2. Open the Hydro Boy. Remove the lid screws and the lid.
3. Unscrew the lock nut from the cable screw connection (A), and slide it over the "DC+" cable of the fuel cell.
4. Pull the "DC+" cable of the fuel cell through the cable screw connection into the inside of the Hydro Boy, and connect it to the "DC+" connection terminal (B).
5. Unscrew the lock nut from the cable screw connection (C), and slide it over the "DC-" cable of the fuel cell.
6. Pull the "DC-" cable of the fuel cell through the cable screw connection into the inside of the Hydro Boy, and connect it to the "DC-" connection terminal (D).
7. Tighten the lock nut of the cable screw connection.



6 Communication

6.1 RS232 and RS485

The Hydro Boy can communicate with a PC through a RS232 or RS485 interface. When using the RS232 interface, the cable between the PC and Hydro Boy can have a maximum length of 15 m.

Requirements

- The communication interface is installed in the Hydro Boy
- Sunny Data Control is installed correctly
- Use the interface converter if the PC is equipped with a USB port

Procedure for connecting the device to a PC

1. Connect the provided data transfer cable to the "COM" port of the Hydro Boy.
 2. Connect Hydro Boy to the PC using the data transfer cable.
- The Hydro Boy is connected to the PC, and can be commissioned as described in section 7 „(Initial) Start-Up“ (30).

6.2 CAN Communication



CAN interface

The CAN interface design is not safely isolated.

The Hydro Boy is equipped with a CAN interface that, for example, allows it to communicate with a PC. Specific formats and functions have been defined for the CAN data transfer. They are explained in more detail in the following sections. A CAN bus baud rate of 500 kBit/s is used.

Connection layout of the CAN interface on the "CAN1" and "CAN2" connection socket

CAN High	Pin 7
CAN Low	Pin 2
CAN GND	Pin 3

6.2.1 CAN Termination

The CAN bus system must be terminated using a termination resistor. If the CAN bus system is incorrectly or not terminated, the Hydro Boy may only operate at a limited capacity or not at all.

If only one connection is occupied, the unused connection must be fitted with a termination resistor. The termination resistors are included in the delivery.

If the CAN communication is not used, both connections must be fitted with termination resistors.

6.2.2 "Heartbeat" Function

If, for example, the PC does not receive any values from the Hydro Boy within the time period defined in the "Timeout CAN" parameter, the Hydro Boy is switched off.

If you do not want to use the "Heartbeat" function, the "Timeout CAN" parameter must be set to 0.

Proceed as described in section 7 „(Initial) Start-Up“ (30) to restart the Hydro Boy.

6.2.3 CAN Protocol

The CAN protocol contains the CAN identifier used and the cyclically transmitted PDOs (Process Data Objects). The process data (a PDO (tx) in each case) is cyclically transmitted with varying contents. A telegram with an ascending ID is transmitted during the next cycle. The process is repeated after the last telegram.

PDO telegrams (tx)

Designation	Identifier (HEX)	Description
ID_CAN_SERVICE_BFR_PDO_TX	0x90	DC data, E-total
	0x91	AC data, H_mode
	0x92	Error code, operating mode, temperature
	0x93	Zac, dZac, Fac, Riso

Up to four data fields are transferred in one PDO (tx) (parameters are transferred in Motorola format).

CAN ID	Word 1		Word 2		Word 3		Word 4	
	BYTE 1	BYTE 2	BYTE 3	BYTE 4	BYTE 5	BYTE 6	BYTE 7	BYTE 8
ID_CAN_SERVICE_BFR_PDO_TX	PARA_NR#1		PARA_NR#2		PARA_NR#3		PARA_NR#4	

Definition of PDO (tx)

Designation	Parameter	Data range / unit	Scaling	Data type / description
0x90	CBS_DATA_SET1			
	UDC	0 - 1000 V	*10	WORD input voltage (example: 455 = 45.5 V)
	IDC	0 - 100 A	*10	WORD input current (example: 102 = 10.2 A)
	PDC	0 - 3000 W	-	WORD input power
	E_Total	0 - 65535 kWh	-	WORD accumulated energy fed into the grid
0x91	CBS_DATA_SET2			
	UAC	0 - 300 V	*10	WORD output voltage (example: 2375 = 237.5 A)
	IAC	0 - 15000 mA	-	WORD output current
	PAC	0 - 3000 W	-	WORD output power
	H_ON	0 - 65535	-	WORD operating hours
0x92	CBS_DATA_SET3			
	E_Code	-	-	WORD error code
	STATUS	-	-	WORD operating mode
	TEMP_TKK	0 - 120 °C	-	WORD temperature (example 35 = 35 °C)
	ERRORSTACK	0 - 255	-	HIGH BYTE error number
	HB MODE	Enabling type (0 - 1)	-	LOW BYTE HB in feeding operation
0x93	CBS_DATA_SET4			
	ZAC	0 - 30000 mOhm	-	
	dZac	-5000 - +5000 mOhm	-	(The CAN measured value is transferred using an offset of +5000 mW, i.e. the display range is between 0 and 10000 mOhm)
	FAC	0 - 100	*100	WORD grid frequency
	Riso	0 - 3000 kOhm		Insulation resistance in kOhm.

PDO telegrams (rx)

Designation	Identifier (HEX)	Description
ID_CAN_SERVICE_BFR_PDO_RX	0x80	PDO from control computer

A maximum of four parameters can be set in a PDO (rx).

CAN ID	Word 1		Word 2		Word 3		Word 4	
	BYTE 1	BYTE 2	BYTE 3	BYTE 4	BYTE 5	BYTE 6	BYTE 7	BYTE 8
ID_CAN_SERVICE_BFR_PDO_RX	PARA_NR#1		ENABLING		PARA_VAL#		GET_ERROR	RESERVE1

Definition

The "ENABLING" parameter must be sent in each telegram. The "Heartbeat" is sent using this parameter.

The following parameter numbers (PARA_NO#) are currently supported:

Designation	Value	Description
None	0	-
DCVtgStr	1	Start voltage DC (in volts)
DCCurSt_Pt	4	Current ramp (in mA/s * 10)
DCCurStpt	6	Nominal current value (in mA/s * 10)
DCVtgMin	41	Min. DC voltage
PwrMax	11	Max. AC output (in W)
DCVtgMax	15	Voltage limit (UDC, max)
ImplsoMin	22	Insulation resistance (in kOhm)
ComTm	47	CAN Timeout (in s)

Depending on the capacity at which the processor is operating, the cycle time can slightly vary (several ms). The thresholds and the parameters set in the Sunny Data Control are valid for all parameters. The software ignores invalid thresholds.

6.2.4 Error Memory

A FIFO error memory with a maximum of 16 entries is implemented in the Hydro Boy. The memory can be sequentially read out using CAN.

The errors are consecutively saved along with the corresponding error number in the memory. If more than 16 errors occur within a query period, the oldest messages are overwritten.

Entering errors

If an error from the error table occurs, the software enters the error number in the error stack at the location where the writing pointer is located. The error is incremented so that it points to the next position. The reading pointer is not incremented. If the writing pointer points to the last position in the stack, the writing pointer will be set to the first position upon the next error entry.

Reading out errors

If a 1 is sent by the PDO (rx) using the "GET_ERROR" parameter, the next valid error number on the PDO (tx) (CBS_DATA_SET3) is defined in the "ERRORSTACK" channel and can be evaluated. The signal in the PDO is displayed as long as a 1 is sent using "GET_ERROR".

After the control system has read out and/or evaluated the error, a 0 can be sent. In the next PDO (CBS_DATA_SET3), the "ERRORSTACK" channel displays a 0.

The software of the Hydro Boy increments the reading pointer of the error memory after the error has been read out. If the memory contains another error, it can be read out. If the error memory is empty, a 0 is returned. Now, the reading pointer is no longer incremented. The error memory is empty after it has been switched off. It cannot be saved.

Error code

Description	Value	Designation
No error	0	-
Measurement difference between BFR and SRR regarding grid voltage	1	NUW-UAC
Measurement difference between BFR and SRR regarding grid frequency	2	NUW-FAC
Measurement difference between BFR and SRR regarding grid impedance	3	NUW-ZAC
Error during relay test	4	K1-Trenn
Average value of the grid voltage is too high	5	U-St-Schutz
The EEPROM cannot be accessed	6	EEPROM dbh
Error during memory test	7	ROM
The EEPROM cannot be accessed (parameter)	13	EeRestore
V/I offset adjustment failed	18	OFFSET
The EEPROM cannot be accessed	19	EEPROM
Communication between both computers is interrupted	20	Bfr-Srr
Error during relay test	21	K1-Schliess
Error in the program flow monitoring	22	Watchdog
Input voltage is above permitted maximum value	24	UdcMax

Description	Value	Designation
Insulation resistance, value outside tolerance	25	Riso
Heartbeat remained off longer than the time set under the "CAN-ComTime" parameter	26	Timeout CAN
BFR grid frequency voltage, value outside tolerance	28	Uac-Bfr
BFR grid impedance measurement, value outside tolerance	29	Fac-Bfr
BFR grid impedance measurement, value outside tolerance	30	Zac-Bfr
BFR grid impedance measurement, value outside tolerance	31	dZac-Bfr
Device-internal overcurrent	56	Imax
Power transistor lock	57	Shut-Down
SRR grid voltage measurement, value outside tolerance	59	Uac-Srr
SRR grid frequency measurement, value outside tolerance	60	Fac-Srr
SRR grid impedance measurement, value outside tolerance	61	Zac-Srr
SRR grid impedance measurement, value outside tolerance	62	dZac-Srr
Communication between both computers is interrupted	63	NUW-Timeout

Operating mode

Designation	Value (HEX)	Description
Z_BFR_INIT	0xFFFF	Initialization status
Z_BFR_STOP	0x0001	Stop status
Z_BFR_OFFS	0x0002	Offset Calibration status
Z_BFR_WARTEN	0x0004	Waiting status
Z_BFR_TEST_NUW	0x0008	Grid monitoring text status
Z_BFR_KONST_U	0x0010	I-Const status (constant current mode)
Z_BFR_U-KONST	0x0020	U-Const status (constant voltage mode)
Z_BFR_DERATING	0x0040	Derating status
Z_BFR_STOERUNG	0x0080	Failure status
Z_BFR_FEHLER	0x0100	Error status

7 (Initial) Start-Up

Check the following requirements before (initial) start-up:

- Secure fit on wall mounting bracket
- Full connection of the DC cables (fuel cell)
- Correct connection of the AC cable (public grid)
- Correct termination of CAN communication
- All housing openings are sealed
- The housing lid is securely screwed in place
- Connection to the PC via RS232 or RS485

Procedure for (initial) start-up

1. Switch on line circuit breaker and start fuel cell.
 2. Detect Hydro Boy using the provided Sunny Data Control software as described in the Sunny Data Control documentation.
 3. Select type of communication (RS485 or RS232).
 4. Set the baud rate to 1200.
 5. Set the "EnOp" parameter to 1.
The Hydro Boy now begins to operate. An illuminated green LED signals fault-free feeding operation.
 6. Set the "DCCurChgSp" parameter to the required value.
 7. Set the "DCCurSt_Pt" parameter to the required value.
- (Initial) start-up is complete.

8 Opening and Closing

8.1 Opening the Hydro Boy

**DANGER!**

Danger to life due to high voltages in the Hydro Boy.

- Switch off the line circuit breaker and secure it to prevent it from being reactivated.
- Make sure that no voltage is present in the device.

**DANGER!**

Danger to life due to high voltages in the Sunny Boy.

- Wait 5 minutes for the capacitors to discharge.

1. Unscrew the lid screws and set them aside.
2. Pull the lid slightly forward.
3. Disconnect the PE connection from the lid.
4. Remove the lid and set it aside.

8.2 Closing the Hydro Boy

1. Establish the PE connection to the lid.
2. Close the Hydro Boy. Fasten the lid to the housing using four screws.
3. Switch on the line circuit breaker.
4. Look at the LED display to check whether the Hydro Boy is in a fault-free operating status.


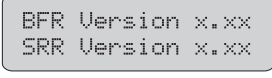
9 Display Messages

9.1 Activating the Display Illumination

The background illumination is switched on by tapping on the lid. Tapping again switches the display to the next message.

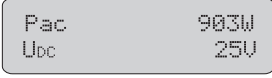
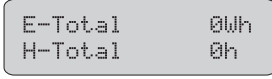
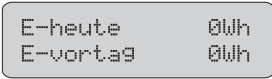
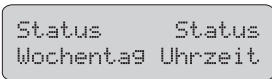
After 2 minutes, the illumination switches off automatically.

9.2 Display Messages in the Startup Phase

Display screen	Description
	Inverter name Device type
	Firmware version of the operation control unit (BFR) Firmware version of the current control unit (SRR)

9.3 Display Messages during Operation

The display shows the most important operation data of the Hydro Boy in a continuous cycle. The following diagrams serve to clarify the messages. Every message is displayed for 5 seconds. Then the cycle begins again.

Display screen	Description
	Current feed-in power Fuel cell voltage
	Energy generated by the Hydro Boy (total) Operating hours (total)
	Energy generated today Energy generated yesterday
	Status Weekday Time

9.3.1 StatusMessages

Display screen	Meaning	Description
Stop	Stop	
Offset	Calibration	Self-test and if necessary, calibration of measurement electronics
Wait	Waiting	The Hydro Boy checks whether the initial conditions necessary for feeding electricity into the grid are satisfied (e.g. start voltage, start time) and then begins monitoring the grid.
GridMon	Grid monitoring	
DCCurMod	Constant current operation	Standard grid feeding mode. The Hydro Boy controls the DC input current according to the nominal current value, which can be specified using the "DCCurStPt" parameter.
DCVtgMod	Constant voltage mode	If the DC input current falls below the value specified using the "DCVtgMin" parameter, the input current is no longer controlled, but rather the input voltage. This is intended to prevent the input voltage from dropping further.
Disturbance	Disturbance	Is displayed if a fault occurs.
Failure	Error	Is displayed if an error occurs.

9.4 Error Messages

Name	Cause / description	Remedy
F-Bfr-Srr	Communication error Error during the data transfer between both processors	If the error occurs frequently, contact SMA Serviceline.
F-dZac-Srr	Grid impedance error The grid impedance changes so that the permitted threshold is exceeded.	-
F-dZac-Srr	Grid impedance error Excessive grid impedance.	-
F-EEPROM	Memory error Transmission error when reading or writing EEPROM	If the error occurs frequently, contact SMA Serviceline.
F-EEPROM dBh	Memory error Data loss due to faulty memory (EEPROM)	If the error occurs frequently, contact SMA Serviceline.

Name	Cause / description	Remedy
F-EeRestore	Memory error Faulty dataset was restored.	If the error occurs frequently, contact SMA Serviceline.
F-Fac-Bfr F-Fac-Srr	Grid frequency disturbance The grid frequency is outside the permitted range. For safety reasons, the Hydro Boy disconnects itself from the grid.	If possible, test the grid frequency and the frequency of major fluctuations. If repeated deviations occur and this is causing these errors, ask the grid operator if he agrees to a modification of the operating parameters. Discuss the proposed parameters with the SMA Serviceline.
F-Imax	Overcurrent Device-internal overcurrent.	If the error occurs frequently, contact SMA Serviceline.
F-K1-Close F-K1-Open	Relay error Relay test failed.	If the error occurs frequently, contact SMA Serviceline.
F-NUW-FAC	Communication error The frequency measurement in the device-internal processors does not match.	If the error occurs frequently, contact SMA Serviceline.
F-NUW-Timeout	Communication error Communication fault between the two device-internal processors.	If the error occurs frequently, contact SMA Serviceline.
F-NUW-UAC	Communication error The voltage measurement in the device-internal processors does not match.	If the error occurs frequently, contact SMA Serviceline.
F-NUW-ZAC	Communication error Die impedance measurement of the device-internal processors does not match.	If the error occurs frequently, contact SMA Serviceline.
F-OFFSET	OFFSET error OFFSET test failed.	If the error occurs frequently, contact SMA Serviceline.

Name	Cause / description	Remedy
F-Riso	Insulation resistance is below the preset threshold.	<ul style="list-style-type: none"> Check and if necessary, replace varistors as described in section 6.1 "Checking/Replacing Varistors" (39).
F-ROM	Memory error ROM test failed.	If the error occurs frequently, contact SMA Serviceline.
F-Shut-Down	Hardware error Device-internal hardware error.	If the error occurs frequently, contact SMA Serviceline.
F-Timeout CAN	Communication error Data transfer on CAN bus interrupted.	If the error occurs frequently, contact SMA Serviceline.
F-Vac-Bfr F-Vac-Srr	Grid voltage error The grid voltage is outside the permitted range.	<ul style="list-style-type: none"> Check the grid voltage and grid connection. <p>If the grid voltage lies outside the permissible range because of local grid conditions, ask the grid operator if the voltages can be adjusted at the feed-in point, or if he agrees to changes in the values of the monitored operation limits.</p> <p>If the grid voltage is within the acceptable range, but the error is still displayed, contact the SMA Serviceline.</p>
F-VdcMax	DC overvoltage The DC input voltage at the Hydro Boy is too high.	<ul style="list-style-type: none"> Disconnect the Hydro Boy from the fuel cell immediately! Otherwise, the Hydro Boy may be irreparably damaged. <p>Check the DC voltage for compliance with the maximum input voltage of the Hydro Boy before you reconnect the fuel cell to the Hydro Boy.</p>

Name	Cause / description	Remedy
F-U-St-Schutz	<p>Voltage increase protection</p> <p>The average grid voltage over 10 minutes is no longer within the permissible range.</p> <p>This can be caused by either of the following:</p> <ul style="list-style-type: none"> • The grid voltage at the connection point of the Hydro Boy is too high. • The grid impedance at the connection point of the Hydro Boy is too high. 	<ul style="list-style-type: none"> • Test the grid voltage at the connection point of the Hydro Boy. <p>If the grid voltage lies outside the permissible range because of local grid conditions, ask the grid operator if the voltages can be adjusted at the feed-in point, or if he agrees to changes in the values of the monitored operation limits.</p> <p>If the grid voltage is within the acceptable range, but the error is still displayed, contact the SMA Serviceline.</p>
F-Watchdog	<p>Software error</p> <p>The device-internal monitoring "Watchdog" was triggered.</p>	-
F-Zac-Bfr F-Zac-Srr	<p>Grid impedance error</p> <p>Excessive grid impedance.</p>	-

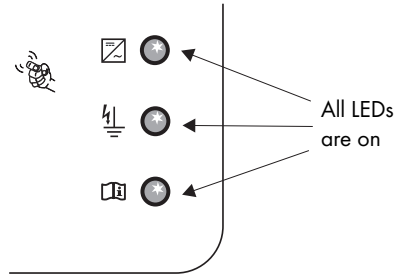
10 Blinking Codes

10.1 Operating Modes

10.1.1 All LEDs are on

Initialization

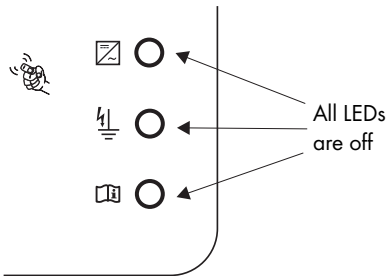
The Hydro Boy's on-board computer is currently in the initialization phase. The on-board power supply is present, but there is not sufficient energy for feeding the grid and data communication is also not yet possible.



10.1.2 All LEDs are off

No power

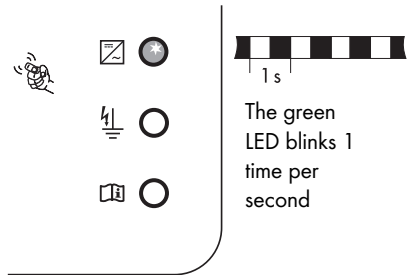
The Hydro Boy is off.



10.1.3 The green LED is blinking slowly

Waiting, grid monitoring

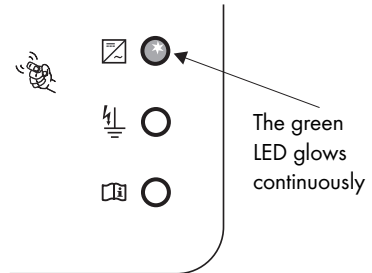
The Hydro Boy checks whether the initial conditions necessary for feeding electricity into the grid are satisfied (e.g. start voltage, start time) and then begins monitoring the grid.



10.1.4 Green LED glows continuously

Grid feeding

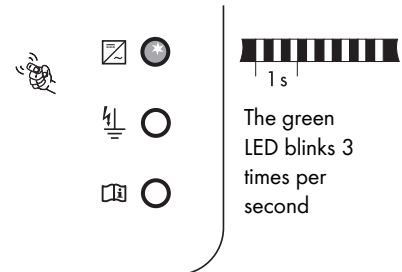
The Hydro Boy has passed the self-test of the measurement electronics and grid monitoring, and is now in normal grid-feed operation.



10.1.5 The green LED is blinking quickly

Stop

The Hydro Boy is in Stop mode. Among other functions, the measurement electronics are calibrated, then the device switches to "Waiting" mode. The "Stop" operating mode can also be manually set by the system operator via the Sunny Data Control. In this case, the inverter remains in "Stop" mode until a new operating mode has been set.



10.1.6 The green LED goes out briefly

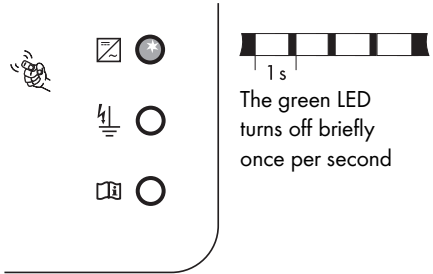
Derating

The "Derating" operating mode is a normal operating mode, which may occur occasionally and can have several causes:

- Temperature derating

The temperature monitoring of the Hydro Boy has reduced the output power to prevent the device from overheating. The Hydro Boy enters into "Temperature derating" mode.

If the Hydro Boy frequently switches to this operating mode, you should check the heat dissipation, and install the Hydro Boy in a more suitable position with better ventilation.



10.2 Failures

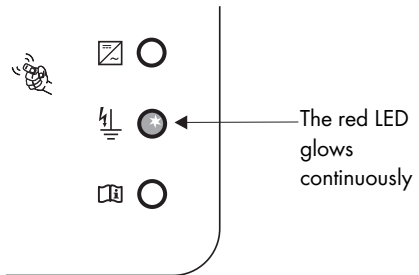
10.2.1 The red LED glows continuously

Varistor is defective

The red LED on the Hydro Boy glows continuously. With this blinking code, it is not relevant whether the green or yellow LEDs are glowing or blinking.

The insulation resistance is below the preset threshold.

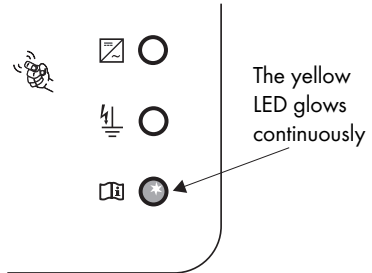
One of the thermally monitored varistors on the DC input side may be defective and require replacement due to overcurrent or aging.



10.2.2 The yellow LED glows continuously

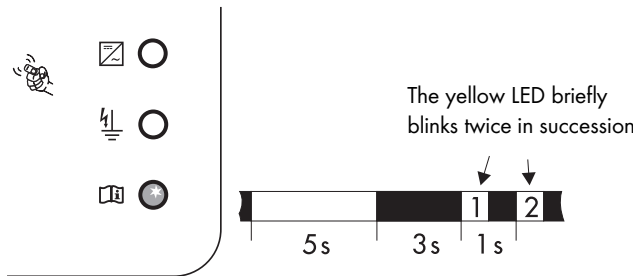
Permanent disable

In the event of a recurring fault, the Hydro Boy switches to "Permanent Disable" mode, and ceases grid feeding. A fault may exist that cannot be resolved on-site. You can attempt to rectify the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data Control). If this is unsuccessful, contact the SMA Serviceline to discuss further action to solve the problem.



10.2.3 The yellow LED blinks twice

Grid side fault



The yellow fault LED lights up for 5 seconds when the fault occurs, and then begins emitting the blinking code. The LED goes off for 3 seconds and then blinks twice. The code is repeated 3 times. If the fault is still present, the fault display starts again from the beginning.

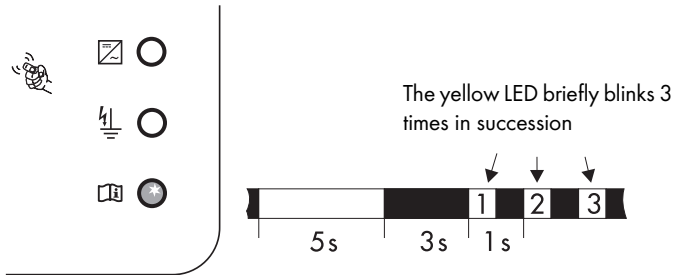
With this fault signal, the inverter indicates a grid fault which can have the following causes:

- Grid undervoltage ($UAC < "ACVtgMin"$)
- Grid overvoltage ($UAC > "ACVtgMax"$)
- Grid underfrequency
- Grid overfrequency
- Grid frequency change

Check if a general power outage has occurred (check the operation of other electrical loads), and check that the fuse in the feeding cable of the inverter is not damaged, and check if the line circuit breaker is switched on.

10.2.4 The yellow LED blinks 3 times

Grid impedance



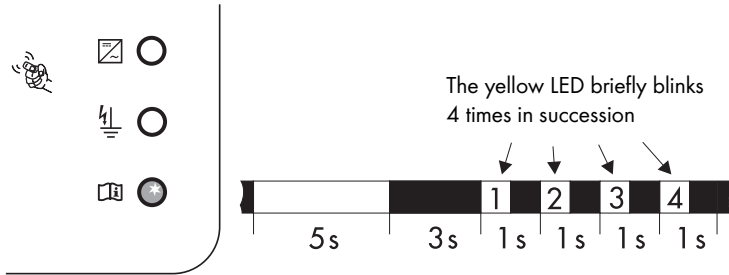
The yellow fault LED lights up for 5 seconds when the fault occurs, and then begins emitting the blinking code. The LED goes off for 3 seconds and then blinks 3 times. The code is repeated 3 times. If the fault is still present, the fault display starts again from the beginning.

The Hydro Boy has detected a fault due to impermissible grid impedance values. If the Hydro Boy frequently deactivates and displays the aforementioned fault during grid monitoring, this may be caused by excessive grid impedance.

A qualified electrician can usually fix this problem by increasing the cross-section of the power line. Tightening the terminal clamps on the connection cable may also help. Other measures can be taken to correct this fault, but they require the explicit agreement and cooperation of the grid operator.

10.2.5 The yellow LED blinks 4 times

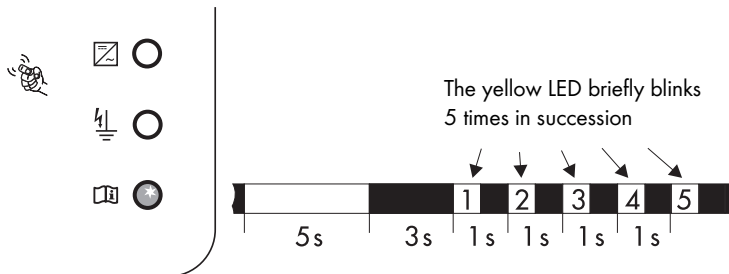
The maximum permissible input voltage range is exceeded



The yellow fault LED lights up for 5 seconds when the fault occurs, and then begins emitting the blinking code. The LED goes off for 3 seconds and then blinks 4 times. This code is emitted 3 times in succession. If the fault is still present, the fault display starts again from the beginning. The fuel cell voltage exceeds the permissible input voltage range of the Hydro Boy!

10.2.6 The yellow LED blinks five times

Device fault



The yellow fault LED lights up for 5 seconds when the fault occurs, and then begins emitting the blinking code. The LED goes off for 3 seconds and then blinks 5 times. The code is sent 3 times in succession. If the fault is still present, the fault display starts again from the beginning.

If this fault leads to a major impairment of normal operation, the Hydro Boy and the entire system installation should be checked by a qualified electrician.

11 Maintenance and Care

Cleaning the cooling fins

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

Clean the cooling fins using a suitable, soft brush.

12 Decommissioning

12.1 Disassembling the Hydro Boy

**CAUTION!**

Risk of injury due to the heavy weight of the Hydro Boy.

- Note that the Hydro Boy weighs 29 kg.

**DANGER!**

Danger to life due to high voltages in the Hydro Boy.

- Switch off all fuses and secure them to prevent them from being reactivated.

1. Wait until the LED on the Hydro Boy has gone out.
2. Remove the AC connection socket from the Hydro Boy.
3. Remove the communication cables from the Hydro Boy.
4. Open the Hydro Boy. Remove the lid screws and the lid.
5. Remove all cables from the Hydro Boy.
6. Close the Hydro Boy. Fasten the lid to the Hydro Boy using four screws.
7. Remove the Hydro Boy.

12.2 Packing the Hydro Boy

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

- With handle system
- Suitable for loads of up to 29 kg
- Can be closed fully

12.3 Storing the Hydro Boy

Store the Hydro Boy in a dry place where the ambient temperatures are always between $-25\text{ }^{\circ}\text{C}$ and $+60\text{ }^{\circ}\text{C}$.

12.4 Disposing of the Hydro Boy

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

13 Troubleshooting

13.1 Checking/Replacing Varistors

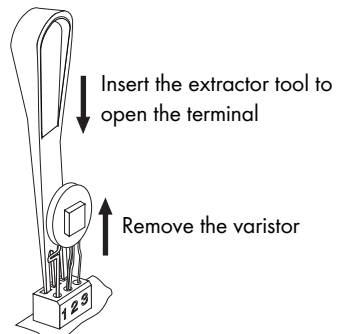
Varistors are wearing parts. Their functioning diminishes with age or following repeated responses as a result of overvoltages. If the red LED glows continuously, it is possible that one of the thermally monitored varistors has lost its protective function.

You can check these varistors in the following way:

1. Open the Hydro Boy as described in section 8.1 „Opening the Hydro Boy“ (31).
2. Use a multimeter to check all the varistors, and determine whether there is a conducting connection between connectors 2 and 3.

If...	Then...
There is a conducting connection...	There is probably another fault in the Hydro Boy. Contact the SMA Serviceline. Continue with point 4.
There is no conducting connection...	The respective varistor is defective and must be replaced. The varistors are specially manufactured for use in the Hydro Boy and are not commercially available. They must be ordered directly from SMA Solar Technology. To replace the part, proceed to step 3.

3. Replace all varistors with new ones as shown in this drawing. Varistor failure is generally due to influences which affect all varistors similarly (temperature, age, induced overvoltages). If you do not receive a special tool together with the replacement varistors, please contact SMA Solar Technology. However, the terminal contacts can be operated using a 3.5 mm wide screwdriver. Ensure the varistor is installed the right way round!




The pole with the small loop (crimp) must be fitted to terminal 1 when replacing the varistor.

4. Close the Hydro Boy as described in section 8.2 „Closing the Hydro Boy“ (31).

14 Operating Parameters

The different operating parameters control the functionality of the Hydro Boy. They can only be viewed and changed via a communication device or communication software. Some parameters can only be seen and changed by an installer (parameters marked in gray). The so-called "installer password" is required for this.

Parameters designated with * are safety-related grid monitoring parameters. To change the SMA grid guard parameters, you must enter your personal SMA grid guard password. Call the SMA Serviceline to obtain your personal SMA grid guard password.

	DANGER! Danger to life through changing the internal safety specifications of the Hydro Boy.
Unauthorized changes to the SMA grid guard parameters void the operation permission.	
<ul style="list-style-type: none"> SMA grid guard parameters may only be changed with the express authorization of the grid operator. 	

Name	Description
ACVtgMin *	Lower (Uac-Min) and upper (Uac-Max) thresholds of the permissible AC voltage, before the grid monitoring system disconnects the device from the grid.
ACVtgMax *	
ACVtgProt *	Voltage increase protection (only relevant for Germany). The Hydro Boy can feed electricity into the public grid with up to 260 V AC. However, DIN VDE 0126-1-1 stipulates that the average AC voltage over 10 minutes must not exceed 253 V. If the average over 10 minutes exceeds the threshold of 253 V, the Hydro Boy disconnects itself from the grid. Once the average over 10 minutes returns to a value of less than 253 V, the Hydro Boy resumes grid feeding. If overvoltage protection is not required in the relevant grid area (outside Germany), it can be deactivated by presetting the LDVtgC parameter accordingly.
CurTstPls *	Setting the impulse for impedance monitoring. This parameter can only be changed if the Hydro Boy is deactivated (disconnection on the AC side), or has been set to "Stop" mode.
Default *	This parameter allows settings to be defined for countries without any predefined settings.
DCCurChgSp	Rate of change at which a new nominal DC current value is to be reached.
DCCurSt_Pt	Nominal DC current value
DCVtgMin	Parameter for setting the lower threshold of the DC voltage for switching from the "DCCur mode" into "DCVtg mode".
DCVtgStr	The DC voltage required before the Hydro Boy begins feeding power into the grid.
EnOp	Enabling signal for operation

Name	Description
E-Total	Total energy yield of the inverter. This change may be necessary when you exchange your Hydro Boy, and want to use the data from the old device.
Fac-Tavg	Averaging time of grid frequency measurement.
FanStrt	Starting temperature for fan (only for HB 1324)
FanStp	Stopping temperature for fan (only for HB 1324)
Firmware BFR	Firmware version of the operation control unit (BFR).
Firmware SSR	Firmware version of the current control unit (SRR).
FrqDifMax *	Maximum permissible deviation of the frequency from the previous value.
FrqDifNg *	Maximum frequency above and below the grid frequency, before the grid monitoring system disconnects the device from the grid.
FrqDifPos *	Maximum permissible positive change in impedance.
ImpDifMax *	Maximum permissible positive change in impedance.
FrqLim1	Only for off-grid mode: Frequency at which the output is to be adjusted.
FrqLim2	Only for off-grid mode: Frequency at which the output is adjusted to zero.
h_Total	Total operating hours of the Hydro Boy. This change may be necessary when you exchange your Hydro Boy, and want to use the data from the old device.
Inst.-Code	Parameters for stand-alone grid recognition can only be changed after entering the SMA grid guard password.
LDVtgC *	<p>Compensation for the voltage drop in the cabling.</p> <p>With this parameter, the voltage drop between the inverter and the grid connection point is taken into account. The 10-minute average voltage at the inverter connection must not exceed the sum of ACVtgRPro plus LDVtgC. The parameter LDVtgC is preset to 0 V for Germany. In grid areas in which the additional voltage increase protection (see parameter ACVtgRPro) is not required, the parameter LDVtgC is preset to 50 V. Thus, the voltage increase protection is deactivated for these grid areas ($253 \text{ V} + 50 \text{ V} = 303 \text{ V}$), and only the fast cut-off via the Uac-Max parameter intervenes.</p>
Modus	Operating mode of the Hydro Boy.
Plimit	Upper threshold for AC output power.
RippleCtrlFrq	Frequency of the local ripple control signal.
RippleCtrlLev	Level of the local ripple control signal.
RippleCtrlRcv	Enable signal for activating the ripple control signal detection.
Seriennummer	Series number of the Hydro Boy.
Stofnct	<p>Default parameter: returns all parameters to the factory settings.</p> <p>Reset Betriebsdaten: returns all user level parameters to the factory settings.</p> <p>Reset Fehler: resets a permanent fault.</p>

Name	Description
Storage	Permanent: modified parameters are stored in the EEPROM and can be used even when the Hydro Boy has been restarted. Volatile: prevents the parameters being stored in the EEPROM, the parameters are only stored until the next restart.
TStr *	The period the Hydro Boy waits after the Udc start value has been reached.
TStop	The period the Hydro Boy waits before disconnecting from the grid when Pac drops below the set value.
Uac-Tavg	Averaging time for measuring grid voltage.

14.1 Parameter Settings for Germany

Name	Unit	Value range	Factory settings
DCVtgStr	V	-	21.6
TStr*	s	5 - 300	10
TStp	s	1 - 3600	2
LDVtgC*	V	0 - 50	0
CurTstPls*	mA	0 - 7500	6000
ACVtgMin*	V	160 - 230	198
ACVtgMax*	V	230 - 300	260
FrgDifNg*	Hz	0.1 - 4.5	2.45
FrqDifPs*	Hz	0.1 - 4.5	0.19
FrqDifMax*	Hz/s	0.1 - 4	4
ImpDifMax*	mOhm	0 - 20000	600
E_Total	kWh	0 - 2000000	-
h_Total	h	0 - 200000	-
DCVtgMin	V	15 - 75	19.5
ACVtgProt*	V	230 - 300	253
Modus	-	-	DCCur-Modus
Stofnct	-	-	-
Default*	-	-	GER/VDE0126-1-1
Storage	-	permanent, volatile	permanent

14.2 Country-specific Parameter Settings

Name	Unit	Country settings			Off-Grid
		Germany	Other	Korea	
Default	-	GER/VDE0126-1-1	Other	Korea	Off-Grid
FrqDifMax	Hz/s	4	4	4	4
ImpDifMax	mOhm	600	20	20	600
FrqDifNg	Hz	2.45	0.19	0.3	4.5
FrqDifPs	Hz	0.19	0.19	0.3	4.5
CurTstPls	mA	6000	0	6000	0
TStr	s	10	10	300	10
ACVtgMin	V	198	198	194	180
ACVtgMax	V	260	260	242	260
LDVtgC	V	0	50	50	50

15 Technical Data

	HB 1124	HB 1324
Fuel Cell System Data		
Input voltage during operation	20 V - 55 V	
Max. input current [$I_{PV, max}$]	56 A	
Max. input open-circuit voltage [U_{PV0}]	60 V	
Connection of the DC input side	DC screw terminal	
Overvoltage protection	Thermally monitored varistors	
Voltage ripple [U_{ss}]	< 10 % of the input voltage	
Internal consumption during operation	< 4 W (waiting)	
Reverse polarity protection	Yes, via short-circuit diode	
Grid Connection Data		
Nominal output power [$P_{AC, nom}$] @ 30 °C	1100 W	1200 W
Nominal peak power [$P_{AC, max}$]	1200 W	1300 W
Nominal output current [$I_{AC, nom}$]	4.8 A	5.2 A
Harmonic distortion of output current (at $K_{Ugrid} < 2\%$, $P_{AC} > 0.5 P_{AC, nom}$) [K_{IAC}]	< 4 %	
Short circuit tolerance	grid-side via current regulation	
Operating range, grid voltage [U_{AC}]	160 - 300 V AC Germany: 198 - 253 / 260 V AC	
Operating range, grid frequency [f_{AC}]	45.5 - 54.5 Hz / 55.5 - 64.5 Hz Germany: 47.5 - 50.2 Hz	
All-pole disconnection unit (grid side)	automatic disconnection device (SMA grid guard 2), double implementation	
Phase shift (based on the currents fundamental frequency) [$\cos\phi_i$]	1	
Overvoltage category	III	
Test voltage (DC)	1.6 kV (1 s routine testing / 5 s type testing)	
Surge testing voltage	4 kV (serial interface: 6 kV)	
Internal consumption	0.1 W (deactivated)	

	HB 1124	HB 1324
General Data		
Dimensions (w x h x d) in mm	434 x 259 x 214	
Weight	29 kg	
Protection rating in accordance with DIN EN 60529	IP 42	IP 23
Altitude (operational)	2000 m above sea level	
EC Declaration of Conformity	enclosed, download area www.SMA.de/en	
External Interfaces		
Data transfer via separate data cable	CAN	
Data transfer via separate data cable	RS232, RS485 (galvanically isolated)	
Efficiency		
Max. efficiency	> 91 %	

16 Contact

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

- Series number of the Hydro Boy
- Type of the connected fuel cell
- Communication method

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