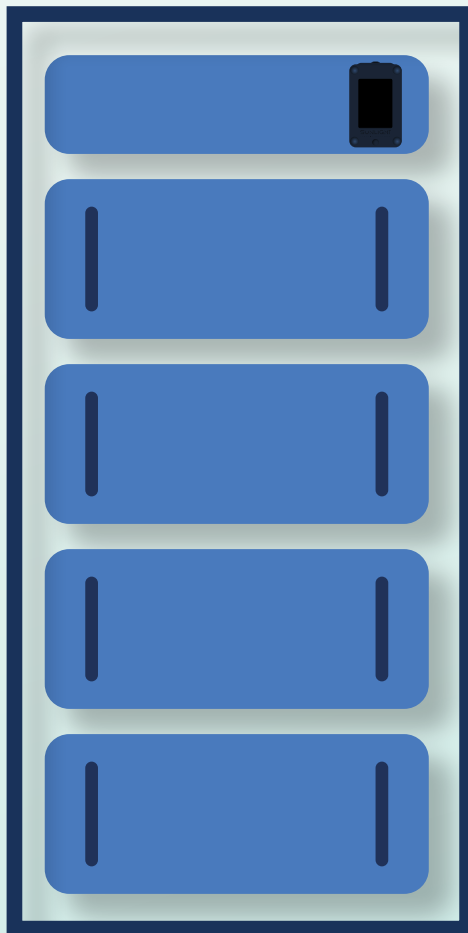


■ Operation, Safety and Installation Manual
of **Li.ONES** Batteries 51.2V Systems





Operation, Safety and Installation Manual of **Li.ONESS** Batteries 51.2V Systems

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Please keep this manual in the area of use. All users should be familiar with the following instructions.

1. Introduction

1.1 Purpose of this Manual

The purpose of this document is to present the installation process for Li.ONESS 51.2V systems. It provides all necessary information for the installation of:

- Li.ONESS Battery Modules (51.2V/100Ah - 5.1kWh)
- Electrical connections among Li.ONESS battery modules
- Communication connection between Li.ONESS battery modules (CAN RJ45 connectors)
- Telecommunication Box setup
- Communication with inverter / charger

1.2 Scope

The following parts are included in the scope of the supply:

- Li.ONESS Lithium-Ion battery system
- Documentation (Operating, Safety and Installation Instructions)
- External multi-functional display (Telecommunication Box)

After unpacking the parts, please examine them for possible damage. If any damage is found, please do not use the product; if in doubt, please contact the manufacturer.

1.3 Precautions

BEFORE UNPACKING, STORING, HANDLING, INSTALLING, OPERATING THE BATTERY SYSTEM READ THE FOLLOWING INFORMATION THOROUGHLY!

It is important to read, understand and strictly follow the instructions in this manual.

If the following precautions are not fully understood, or if local conditions are not covered, contact your nearest Systems Sunlight sales/service representative for clarification, or call the corporate office number listed on the back of this manual and ask for Sunlight Service. Also, refer to all applicable federal, state and local regulations and industry standards.

1.4 Product Description

A Li.ONESS battery system consists of the following main parts:

- The battery modules, which consist of series-connected cells enclosed at a metallic tray. The modules are connected in series and/or parallel depending on the voltage and the capacity of each battery.
- The BMS (MAB, CMU, PBT - where applicable)
- Contactors
- Fuses
- The metallic tray
- Shunt Box (external)
- The user interface control panel
- Display and telecommunication box with Sunlight cloud (GLocal)

The purpose of the battery is to deliver electric power to AC loads, respecting the following key principles:

- Protection from short circuits and inappropriate charging.
- Protection from over and under voltage.
- Protection from over charging and discharging.
- Protection from over and under temperature.

1.5 Environmental working conditions

- **Charging Temperature range:** 0°C to +55°C (+32°F to +131°F).

- **Discharging Temperature range:** -20°C to +55°C (-4°F to +131°F).
- **Recommended Operating range:** 15°C to +30°C (+59°F to +86°F).
- **Relative humidity:** 15% - 90% @ 25 ±5°C (+77°F ±9°F).
- **Atmospheric pressure:** 86KPa~106KPa @ 25 ±5°C (+77°F ±9°F).

1.6 Storage

- Standard Storage Temperature (more than 1 month) 0°C to +35°C (+32°F to +95°F).
- Absolute Storage Temperature Short term (less than 1 month): -20°C +55°C (-4°F to +131°F).
- Storage Humidity: <70%RH
- Store the battery in the state of 50% - 65% SoC. Stored batteries should be fully charged (100%) and discharged at ~60% every four months.
- Store Li.ONESS batteries in separate storage area, in case of mixed storage of other goods. Keep 2.5m (98.42in) distance between the batteries and the other goods.
- Limited quantities shall be stored in each area, for example, for a 100 m² (1076.39ft²) area the quantity should not be larger than 10 euro-pallets or an equivalent of 10 m³ (13.08yd³) of batteries.
- The safety team of the storage area shall define the required safety measures.

1.7 Li.ONESS operational conditions

The Energy Storage System (ESS) operates at temperature from -20 to +55°C (-4°F to +131°F) with maximum humidity of 85%.

Rooms that do not meet the above temperature characteristics must have controlled air-condition support.

The Energy Storage System must not be directly exposed to sunlight.

1.8 Certifications

- Battery Module level: UN38.3
- Cell level: IEC62619-2017, UN 38.3 and UL 1642

1.9 Product Life

The product life is specified at the warranty documentation.

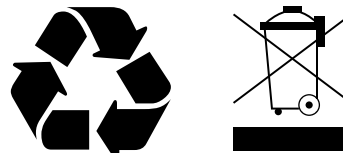
1.10 Disposal

Lithium-Ion batteries are subject to disposal and recycling regulations that vary by country and region. Always check and follow your applicable regulations before disposing of any battery.

Dispose of the Li-ion battery in accordance with local, state and federal laws and regulations.

Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles. Batteries may be returned to the manufacturer if no disposal and recycling regulations are in place.

Do not mix with other (industrial) waste.



1.11 Acronyms

- ESS – Energy Storage System
- Li.ONESS – Sunlight Lithium ESS
- BMS – Battery Management System
- MAB – Master Board
- CMU – Cell Management Unit
- PBT – Parallel Battery Topology PCB
- SOC – State of Charge
- SOH – State of Health
- P.U. – Power Unit
- PBT Unit – Parallel Battery Topology unit

1.12 Installation Tools

- 13mm Torch wrench (Connection Poles)
- PH2 Insulated Cross head screwdriver (Sliding Rails on U-rail)
- SW10 Insulated socket wrench (modules on U-rail)
- 12mm German polygon (Sliding rails)

Note

This document does not replace the inverter's manufacturer instructions. All settings that refer to the inverter can only be found at manufacturer's website.

2. Safety Related Topics

The instructions in this document may only be performed by qualified technical specialists. The technical specialist must have at least the following qualifications:

- Training at the installation of electrical equipment.
- Training at the installation and operation of Electrical equipment and batteries.
- Training at handling hazard materials such as Lithium batteries during transportation, storage and commissioning.

Personnel assembling Li.ONESS modules should adhere to the following recommendations:

- All jewelry should be removed to prevent short circuiting the battery.
- Appropriate personal protective equipment should be worn.
- Work surfaces should be non-conductive.
- Loose wires should not be stripped until they are ready for termination.
- Li.ONESS modules cannot be lift by hand during installation process.

2.1 Electrical Shocks and Burns

Multi-cell battery systems can attain high voltage and/or currents. **Do NOT** touch uninsulated batteries, connectors or terminals. To prevent serious electrical shock & burn, use **EXTREME CAUTION** when working with the Li.ONESS system.

- Always wear protective clothing and use nonconductive or insulated tools when working with ANY battery system.
- Remove all jewelry that could produce a short circuit.

BEFORE working on the system:

1. Disconnect ALL loads and power sources to the battery. Use appropriate lockout/tagout procedures.
2. If working on an assembled battery system, sectionalize (interrupt the battery in sections) into safe working voltage levels.
3. Check the battery system grounding. Grounding of the battery system is NOT recommended.

However, rack grounding is recommended.

IF BATTERY SYSTEM IS UNGROUNDED (system is NOT grounded):

1. If an unintentional ground develops within the system, an increased shock hazard exists between the terminals and ground.
2. If a second unintentional ground develops within the already unintentionally grounded system, a short circuit may occur and cause explosion or fire.

Therefore, should you be required to work on a grounded battery system, make sure that you use the correct safety precautions, equipment and clothing.

IMPORTANT: If you have ANY question concerning safety when working with the battery system, contact your local Systems Sunlight sales/service representative to clarify any of the noted safety precautions.

2.2 Battery Shipment Inspection

General

Precautions have been taken to pack the cells/ battery modules for shipment to ensure its safe arrival. However, upon receipt, you should inspect for evidence of damage that may have occurred during transit.

Visible External Damage

IMMEDIATELY upon delivery (while the carrier representative is still on-site), inventory all materials against the Bill of Lading and inspect for visible external damage.

Check material quantities received against the Bill of Lading, including the number of battery pallets and the number of accessory boxes.

Note any:

- Damage to packing material

If damage is noted:

1. Make a descriptive notation on the delivery receipt before signing
2. Request an inspection by the carrier
3. File a damage report

Concealed Damage

Within 15 days of receipt (or as soon as practical), unpack and check for concealed damage. Take precautions against a shock hazard.

Inspection by a representative of the carrier and file a claim for concealed damage.

Check the received materials against the detailed packing list to verify receipt of all materials in the quantities specified.

DELAY IN NOTIFYING THE CARRIER MAY RESULT IN LOSS OF YOUR RIGHT TO REIMBURSEMENT FOR DAMAGES

Refer to the Bill of Lading, if, when performing the parts inventory, you are unsure about the appearance of a part.

If you have questions concerning potential damages, contact your local Sunlight sales/service representative, or, call the corporate office number.

2.3 Li.ONESS Battery's Safety System dimensioning

The Battery pack (Cells), Conductors, Fuses, Shunt resistor, BMS are within battery's safety limits.

The following is identified as outside of the battery's safety boundary and is not Systems Sunlight responsibility to perform a safety assessment:

- Inverter / Charger
- Human error
- External sources of short circuit

Wireless connection to GLOCAL is not part of the safety boundary.

2.4 Safety Instructions



1. Before using the Sunlight Li.ONESS system, read all instructions and cautionary markings on the Batteries, and all appropriate sections of this manual.
2. Li.ONESS systems must be fully charged before commissioning. Failure to do so will void the Warranty.
3. Use of accessories not recommended or sold

by Systems Sunlight may result in a risk of fire, electric shock, or injury to persons and will void the Warranty.

4. The battery must be installed and operated as detailed in the Installation Manual and any other product documentation.
5. Do not operate battery with damaged cables or plugs – Inform Systems Sunlight immediately.
6. Do not operate battery if it has received a sharp blow, been dropped, or otherwise damaged during shipping or otherwise. Inform Systems Sunlight immediately.
7. Do not disassemble battery in case of inappropriate operation. Incorrect reassembly may result in a risk of fire, electric shock or injury to persons. Inform Systems Sunlight immediately.
8. Use only the recommended inverter/chargers.
9. Do not expose inverter/charger to rain or snow.
10. Check polarity of the connections of the inverter/charger and the battery.
11. Service only by Systems Sunlight's authorized personnel.
12. Do not disassemble, crush, modify or heat the battery.
13. Keep the battery away from fire.
14. Do not expose the battery to temperatures >60°C.
15. Do not short circuit terminals.
16. Do not immerse, throw or wet battery in any liquid.
17. During usage and storage, if any peculiar smell, heat or any other abnormal phenomenon occur to the battery, please shut down the battery immediately.
18. If, during operation, the battery emits an unusual smell, develop heat, or behave abnormally, the battery should be isolated from air by any measures (except using water), such as using carbon dioxide fire extinguisher and dry powder fire extinguisher. The battery should be treated after smoke dispersing. Contact Systems Sunlight if any of these problems are observed.
19. The customer has the option to return the battery for disposal upon agreement with Systems Sunlight.

3. Labelling

A label with main information is fitted to each battery (Picture 1).

SUNLIGHT LI.ONESS		SUNLIGHT POWER IS KNOWLEDGE	
			
Battery Type	LFP ESS 51.2V 15.3kWh OPTA-M-PBT-A-R32-D		
Battery Designation	IFpP30/135/185[(2P16S)4P]M/-20+55/95		
Technology	LiFePO ₄	Serial Number	10143214
Nominal Voltage (V)	51.2	Product Code	0314620
Nominal Capacity (Ah) / Nominal Energy (kWh)	300 / 15.3	Drawing No.	-
Weight (Kg)	310	Production Date	18/11/2020
Customer Code	-		
Designed and assembled by SYSTEMS SUNLIGHT S.A. Neo Olvio, 672 00 Xanthi, Greece, EU www.systems-sunlight.com customer.service@sunlight.gr			
			

Warning: Do not short circuit terminals. Do not reverse the terminal polarity. Do not disassemble, crush, modify or heat the battery. Do not expose the battery to temperatures > 60°C. Do not immerse, throw or wet battery in any liquid. Keep the battery away from fire. Must be disposed of properly. Be sure to use only with charger provided by Systems Sunlight S.A. Service only by Systems Sunlight's authorized personnel. Follow Manufacturer's instructions.

Picture 1: Example of Battery label

Note: The label must not be removed.

4. Datasheet

Specifications		Lion ESS 48V/100
Cell Type		LFP
Nominal Voltage (V)		51.2
Capacity (Ah)		100
Voltage Range (V)		50.9 - 55.1
Energy (kWh)		5.12
BMS		Active
Standard Discharge 25°C	Max. Constant Current	75A
	Cut-off voltage	50.9V
Standard Charge 25°C	Charge Voltage	55.1V
	Max. Constant Current	75A
Dimensions (L*W*H in mm)		465*653*228
Weight (Approximate)		77 ±0.3Kg
Communication Ports		CAN 2.0
Round Trip Efficiency (%)		> 98%
Calendar Life 25°C		> 10 Years
Cycle Life (0.2C, 25°C)		4500 Cycles @ 80% DOD
Operating Temperature		Charging: 0°C to +55°C (+32°F to +131°F)
		Discharging: -20°C to 55°C (-4°F to +131°F)
Storage Temperature (Recommended Range)		0°C to 35°C (+32°F to +95°F)
Storage Time		1 Year

5. Li.ONESS System Layout



Picture 2: Li.ONESS system

5.1 LionESS Parts

5.1.1 Power Unit / PBT Unit



Picture 3a Power Unit Version



Picture 3b PBT Unit (Where applicable)

5.1.2 LionESS Battery Module



Picture 4 LionESS Module

5.1.3 Shunt Box



Picture 5 Shunt Box

5.1.5 Battery Cabinet



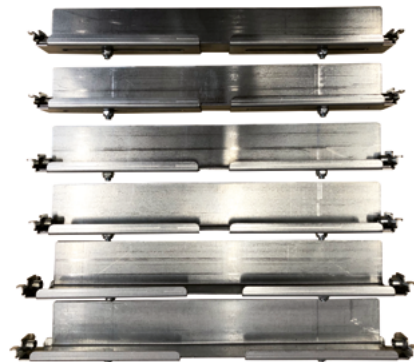
Picture 7 Cabinet

5.1.4 Connection Parts



Picture 6 Connection parts

5.1.6 Sliding Rails

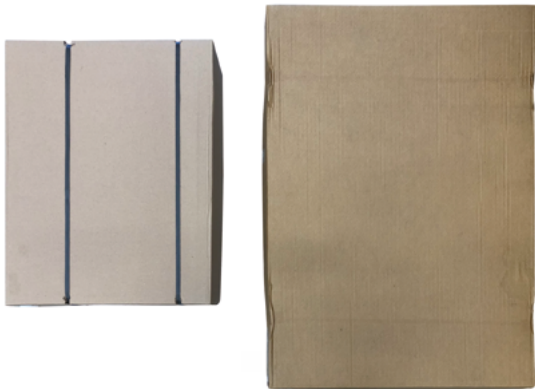


Picture 8 Sliding rails

6. Installation Procedure

6.1 Battery Cabinet

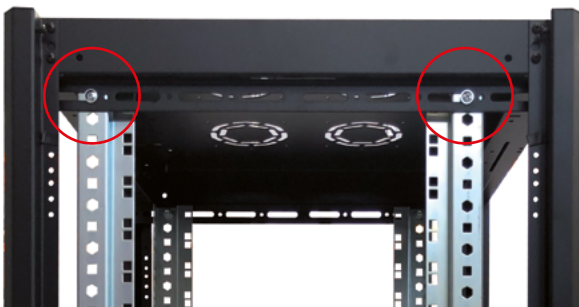
Battery cabinet installation manual can be found inside the carton box.



Picture 9: ESS cabinet consists of two carton boxes

6.1.1 Battery Cabinet assembly

- The manufacturer's installation manual included will provide all necessary information for the proper cabinet assembly.
- When the assembly is complete, you will find below the relative distance of the vertical U-Rails inside cabinet.



Picture 10: Vertical U-Rail assembly distance

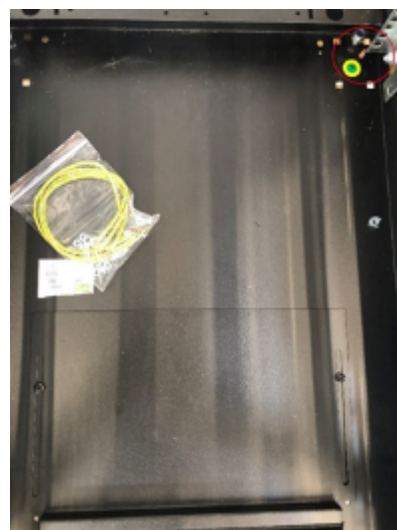
6.1.2 Battery Cabinet Sliding rails assembly

- Place the battery cabinet at the final installation position
- Set all four (4) standing cluster set points to balance the battery cabinet with the floor
- Open battery cabinet door using the key provided. It is attached at the front door panel.
- Remove the perforated door as shown in the following picture



Picture 11: Hinge for removing door

- Connect the earth cable at one of the earthing bolts provided



Picture 12: Cabinet ground connection point

- Install the provided set of sliding rails to vertical U-Rail (PH2 screwdriver) starting from the bottom as shown at the following picture



Picture 13 Sliding rails assembly

- The vertical distance from the first (bottom) set of sliding rails to the second is 6U as shown at the following picture



Picture 14 Sliding rails assembly distance

After completing the battery cabinet assembly, the battery cabinet will have the following layout



Picture 15 Battery cabinet final assembly

Note: The height distance of all sliding rail sets is 6U starting from the bottom of the U-rail

- Install the cage nuts M6 at the vertical U-rails for all ESS modules. The distance is one square starting from sliding rail and the next one at fourth square moving upwards as shown below



Picture 16 Cage nuts for ESS modules installation

6.2 Li.ONESS System installation

Notes

- During installation, the Li.ONESS modules cannot be lifted by using the front panel handles.
- Telescopic lift can be used for lifting / leveling the Li.ONESS modules before inserting it to the sliding rail set
- One Li.ONESS module must be inserted at a time, starting from the bottom of the battery cabinet

As an example, the assembly of a 20kWh Li.ONESS system is presented:

- Insert the **Li.ONESS Module No 4** starting from the bottom sliding rail set as shown below



Picture 17 Battery cabinet final assembly

- Insert the next **Li.ONESS Module No 3** to the second sliding rail set as shown below



Picture 18 Li.ONESS Module No 3

- Insert the **Li.ONESS Module No 2** to the third sliding rail set



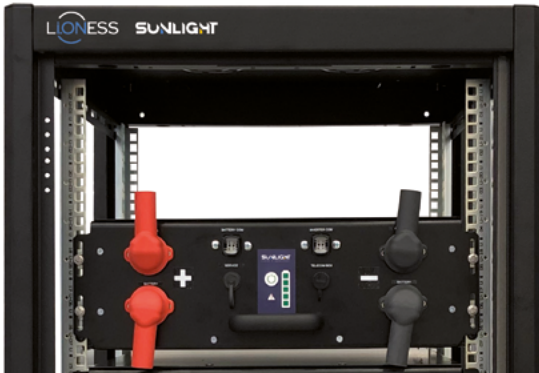
Picture 19 Li.ONESS Module No 2

- Insert the final **Li.ONESS Module No 1** to the fourth sliding set of rails



Picture 20 Li.ONESS Module No 1

- Insert the Power Unit (P.U.) or PBT Unit (where applicable) at the final set of sliding rails as shown below



Picture 21a Li.ONESS P.U. installation



Picture 21b Li.ONESS P.U. installation

- After the installation of all the modules and Power / PBT unit the system layout is shown below



Picture 22 Li.ONESS System installed at battery cabinet

- Screw the M5x12mm bolts using SW10 hexagonal screwdriver



Picture 23 Li.ONESS modules tighten on vertical U-rail

6.3 Electrical connections

- Connect the positive (+) **RED** connection cables provided starting from **Li.ONESS Module No 4** and move upwards to **Li.ONESS Module No 3, No 2 and No 1** respectively.

Be careful to connect all the positive (+) **RED** cables to the positive (+) **RED** poles

- Connect the negative (-) **BLACK** connection cables provided starting from **Li.ONESS Module No 4** and move upwards to **Li.ONESS Module No 3, No 2 and No 1** respectively.

Be careful to connect all the negative (-) **BLACK** cables to the negative (-) **BLACK** poles

- The Battery system after the electrical cable connection will be shown below



Picture 24 Li.ONESS system electrical connection

6.4 CAN Communication connections

- Install the **CAN** communication cables (Molex connector / or RJ45 where applicable) with the following sequence:

Li.ONESS System with Power Unit

- **P.U. BATTERY COM** (left side RJ45 connector) connected to **Li.ONESS Module No 1 BATTERY COM IN** (Left side RJ45 connector)



Picture 25 Li.ONESS P.U communication connection to Li.ONESS Module 1

Li.ONESS System with PBT Unit (Where applicable)

- **PBT Unit BATTERY COM** (left side RJ45 connector) connected to **Li.ONESS Module No 1 BATTERY COM IN** (Left side RJ45 connector)



Picture 26 Li.ONESS PBT Unit communication connection to Li.ONESS Module 1

- **Li.ONESS Module No 1** BATTERY COM (Right side RJ45 connector) connected to **Li.ONESS Module No 2** BATTERY COM IN (Left side RJ45 connector) and so on until all modules have been connected as seen in picture 27.



Picture 27 Li.ONESS system, CAN communication connection

- The **Shunt box** will be connected to the **PBT** unit as described below:
 - The front side Negative (-) Black connection post will be connected to the negative (-) Black post of the first **Li.ONESS** module.
 - The 4-pin Molex connector of the Shunt Box will be connected to the Current Measurement Molex connector located at the right-hand side of the PBT unit.
 - The back side Negative (-) Black connection post will

be connected to the negative (-) Black connection point of the inverter / charger

Notes

- The Shunt box will be installed at maximum of 3m from the inverter/charger.
- The installation point will be located at the end of the **NEGATIVE (-)** Bus bar closer to the inverter side in order to measure the total system's battery current.



Picture 28 Shunt Box connection

7. Battery use information

7.1 General instructions

- Do not leave the battery in a SOC $\leq 50\%$ for more than 3 months.
- Charging is not allowed at temperatures $\leq 0^{\circ}\text{C}$ ($+32^{\circ}\text{F}$). The BMS will automatically reduce the permitted charging current in low temperatures (0°C to $+10^{\circ}\text{C}$ / $+32^{\circ}\text{F}$ to $+50^{\circ}\text{F}$) and completely stop any charging current at temperatures $\leq 0^{\circ}\text{C}$ (32°F).

7.2 Battery Function

- Charging is performed automatically using Inverter/Charger that is connected to the Li.ONESS Power Unit / PBT unit (where applicable), within specified temperature limits (0°C to $+45^{\circ}\text{C}$ / $+32^{\circ}\text{F}$ to $+113^{\circ}\text{F}$), only to a defined voltage limit, with a current which is supplied from the charger and regulated from the BMS. The limits for Voltage, Temperature and Current are set in the BMS without the intervention of the user.
- Discharging is performed within specified temperature limits (-10°C to $+45^{\circ}\text{C}$ / $+14^{\circ}\text{F}$ to $+113^{\circ}\text{F}$), only to a defined voltage limit, with a current defined from the needs of the load. The limits for Voltage, Temperature and Current are set in the BMS without the intervention of the user.

Each Li.ONESS system is designed to meet the power and energy requirements for a specific application.

- The battery's operational limits are fully controlled from the BMS which consists of three types of electronic boards (the MAB, the CMU and the secondary safety boards), contactors and switches.

The BMS protects the battery from the following dangerous failure modes:

- Over - Under voltage
- Over - charge / discharge
- Over - Under temperature
- Over - current IN and OUT

MAB board is the central board and one is placed at each battery. In this board all monitored signals from the sensors mounted on the battery (temperature sensors, shunt resistor) and the signals from the CMU boards (cell voltages and temperatures) are gathered.

MAB is responsible for:

- The management of the auto power off (only for EOL voltage limit)
- The communication with the Inverter/Charger
- The communication with the Li.ONESS battery modules
- The communication with all the CAN BUS attached devices

Furthermore, MAB has digital I/Os which can give to BMS more functions such as heating, cooling etc. in case it is required.

- Connection to GLOCAL (Systems Sunlight Cloud Platform), through GSM or Wi-Fi, to monitor the performance and editing of the settings (if it is needed / requested).

CMU boards monitor the cell voltage, temperature, insulation resistance and they also perform the cells' balancing.

PBT boards are responsible to control the contactor installed at each Li.ONESS module.

The PBT functionality gives the ability to disconnect one or more parallel connected Li.ONESS battery modules (in case of failure) from the system without losing the complete Li.ONESS system.

The disconnection of a parallel module can be performed manually via the BMS tool or remotely by Systems Sunlight or by the customer via the cloud.

Example

If there is a faulty Li.ONESS battery module (i.e. communication error, low performance cell, etc.) the system will raise an alarm on Systems Sunlight's cloud platform (GLOCAL). E-mail notification will be sent directly to Systems

Sunlight S.A. and the customer.

At this stage, the user/distributor can deactivate the Li.ONESS battery module manually via the cloud (or the BMS tool) without the need of a site visit. No other hardware modification / disconnection should be made.

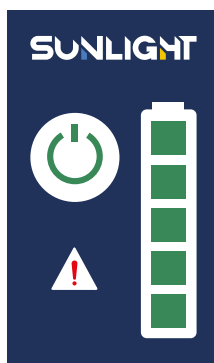
The faulty module can be totally disconnected remotely, allowing the Li.ONESS system to continue operating with reduced capacity. The hardware disconnection of the faulty module can be done on a later stage of normal operation of the battery.

Replacement of the faulty module with an operational one (or the same repaired) can be done following the steps above (chapter 5).

7.3 Control Panel Operation

There is one control panel located at the Power Unit (P.U) / PBT Unit (where applicable) of the Li.ONESS system.

The control panel (pic. 29) has five (5) green LEDs which are used to show the SoC of the Li.ONESS system in normal operation. It also informs the user for the error messages which are displayed by flashing certain LEDs depending on the type of error (see Table 2). It has, also, an Error LED (!) which in case of error message, turns red and finally an ON/OFF button.



Picture 29 Small control panel

ON / OFF button: When the battery is active (ON) and in standby mode, press the ON / OFF switch to turn OFF the battery. When the battery is in operation (charging or discharging) and the

current $>10A$ (charge) or $<-10A$ (discharge) the battery cannot be turned off by pressing only the ON /OFF button.

Alarms displaying: On the control panel, there are shown the errors and warnings that could possibly occur to the Li.ONESS system battery during the operation. The flashing speed and the combinations of the LEDs is defining the occurred alarm.

The sequence of the flashing speed of the LEDs is shown below:

- Fast: flashing LED 125 msec ON, 125 msec OFF
 - Normal: flashing LED 250 msec ON, 250 msec OFF
 - Slow: flashing LED 500 msec ON, 500 msec OFF
 - Where the LED is off, the cell of the table is blank
- In the following table (Table 2) is shown the definition of the occurred alarm in accordance with the flashing LED's sequence and the alarm clear mode.

If an error does not allow the battery to operate, contact with Systems Sunlight S.A. for further assistance.

Note

All the alarms are also appearing at the display of the communication box.

SN	error type	LED 20%	LED 40%	LED 60%	LED 80%	LED 100%
1	Cell over voltage				Fast	Fast
2	Cell end of life voltage			Fast		Fast
3	Cell under voltage			Fast	Fast	Fast
4	Cell over temperature		Fast			Fast
5	Cell under temperature		Fast		Fast	Fast
6	System over temperature		Fast	Fast		Fast
7	System under temperature		Fast	Fast	Fast	Fast
8	Cell temperature sensor open (all sensors of the cell)				Normal	Fast
9	Cell temperature sensor short (all sensors of the cell)			Normal		Fast
10	System temperature sensor open (MAB NTC sensor)			Normal	Normal	Fast
11	System temperature sensor short (MAB NTC sensor)		Normal			Fast
12	Short circuit		Normal		Normal	Fast
13	Over current		Normal	Normal		Fast
14	Discharge current		Normal	Normal	Normal	Fast
15	Charge current max				Normal	Normal
16	Charge contactor AUX contact			Normal		Normal
17	Load contactor AUX contact			Normal	Normal	Normal
18	Safety contactor AUX contact		Normal			Normal
19	Load/safety contactor failed		Normal		Normal	Normal
20	CMU communication		Normal	Normal		Normal
21	Insulation resistance low		Normal	Normal	Normal	Normal
22	Insulation resistance hardware error				Slow	Fast
23	Battery voltage measurement difference			Slow		Fast
24	Cell high voltage			Slow	Slow	Fast
25	Cell low voltage		Slow			Fast
26	Cell high temperature		Slow		Slow	Fast
27	Cell low temperature		Slow	Slow		Fast
28	System high temperature		Slow	Slow	Slow	Fast
29	System low temperature				Slow	Normal
30	Cell temperature sensor open (the other is operational)			Slow		Normal
31	Cell temperature sensor short (the other is operational)			Slow	Slow	Normal
32	Regeneration current		Slow			Normal
33	High cell resistance		Slow		Slow	Normal
34	High pack resistance		Slow	Slow		Normal
35	Low state of charge		Slow	Slow	Slow	Normal
36	Absolute maximum battery voltage				Slow	Slow
37	Absolute minimum battery voltage			Slow		Slow
38	Startup battery low voltage			Slow	Slow	Slow
39	System temperature values difference		Slow			Slow
40	SD card error		Slow		Slow	Slow
41	Real Time Clock error		Slow	Slow		Slow

Table 2 Error types & Flashing LEDs' sequence

SN	error type	Alarm type	Action	Alarm clears when:
1	Cell over voltage	Error	open discharge contactor	Alarm cause removed
2	Cell end of life voltage	Error	open discharge/charge contactors	On/off Button pressed
3	Cell under voltage	Error	open charge contactor	On/off Button pressed
4	Cell over temperature	Error	open discharge/charge contactors	Alarm cause removed
5	Cell under temperature	Error	open discharge/charge contactors	Alarm cause removed
6	System over temperature	Error	open discharge/charge contactors	Alarm cause removed
7	System under temperature	Error	open discharge/charge contactors	Alarm cause removed
8	Cell temperature sensor open (all sensors of the cell)	Error	open discharge/charge contactors	Alarm cause removed
9	Cell temperature sensor short (all sensors of the cell)	Error	open discharge/charge contactors	Alarm cause removed
10	System temperature sensor open (MAB NTC sensor)	Error	open discharge/charge contactors	Alarm cause removed
11	System temperature sensor short (MAB NTC sensor)	Error	open discharge/charge contactors	Alarm cause removed
12	Short circuit	Error	open discharge/charge contactors	On/off Button pressed
13	Over current	Error	open discharge/charge contactors	Alarm clear mode after 5 seconds of deactivation of contactors and if alarm cause is removed
14	Discharge current	Error	open discharge contactor	same as above
15	Charge current max	Error	open charge contactor	On/off Button pressed
16	Charge contactor AUX contact	Error	open charge contactor	On/off Button pressed
17	Load contactor AUX contact	Error	open discharge/charge contactors	On/off Button pressed
18	Safety contactor AUX contact	Error	open discharge/charge contactors	On/off Button pressed
19	Load/safety contactor failed	Error	open discharge/charge contactors	On/off Button pressed
20	CMU communication	Error	open discharge/charge contactors	Alarm cause removed
21	Insulation resistance low	Error	open discharge/charge contactors	Alarm cause removed
22	Insulation resistance hardware error	Error	open discharge/charge contactors	Alarm cause removed
23	Battery voltage measurement difference	Error	open discharge/charge contactors	Alarm cause removed
24	Cell high voltage	Warning	no contactors opening	Alarm cause removed
25	Cell low voltage	Warning	no contactors opening	Alarm cause removed
26	Cell high temperature	Warning	no contactors opening	Alarm cause removed
27	Cell low temperature	Warning	no contactors opening	Alarm cause removed
28	System high temperature	Warning	no contactors opening	Alarm cause removed
29	System low temperature	Warning	no contactors opening	Alarm cause removed
30	Cell temperature sensor open (the other is operational)	Warning	no contactors opening	Alarm cause removed
31	Cell temperature sensor short (the other is operational)	Warning	no contactors opening	Alarm cause removed
32	Regeneration current	Error	no contactors opening	Alarm cause removed
33	High cell resistance	Error	open discharge contactor	Alarm clear mode after 5 seconds of deactivation of contactors and if alarm cause is removed
34	High pack resistance	Warning	no contactors opening	Alarm cause removed
35	Low state of charge	Warning	no contactors opening	Alarm cause removed
36	Absolute maximum battery voltage	Error	open discharge/charge contactors	Alarm cause removed
37	Absolute minimum battery voltage	Error	open discharge/charge contactors	Alarm cause removed
38	Startup battery low voltage	Error	open discharge/charge contactors	Alarm cause removed
39	System temperature values difference	Warning	no contactors opening	Alarm cause removed
40	SD card error	Warning	no contactors opening	Alarm cause removed
41	Real Time Clock error	Warning	no contactors opening	Alarm cause removed

Table 3 Error types, Action & Alarm Clearance

7.4 Display and communication box

The Li.ONESS batteries are equipped with the Compact Display Telecommunication Box (Picture 4).

7.4.1 Functions and use of the Compact Display by Sunlight:

This display is connected permanently to the battery via a 7pin cable.



Picture 30 Compact display connection to PBT Unit

The functionality of the Compact Display Box is described below:

- i. Communicates with the battery via Wi-Fi and displays all the critical parameters of the battery (i.e. alarms, temperature, battery voltage, battery current, and SoC).
- ii. Switching ON / OFF the battery from the display and communication box. (To switch off the battery the ON / OFF button must be pressed continuously for two (2) seconds in both cases)
- iii. Sends to GLocal via Wi-Fi or 2G, 3G, 4G, (whatever is available at the user's premises) all the parameters which are visible on the user's display.

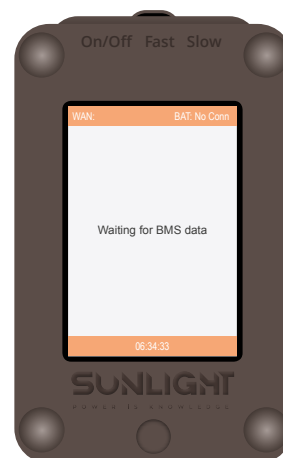
7.4.2 Getting started with the Compact Display Telecommunication Box

- i. Switch on the Li.ONESS battery by pressing the On/Off button of the control panel or from the On/Off button of the display (Picture 31).



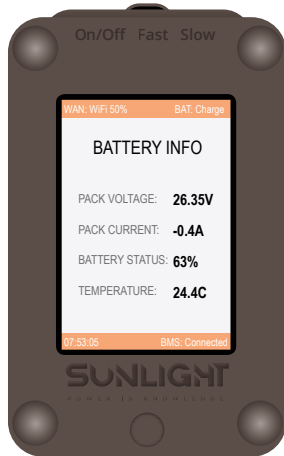
Picture 31 Compact display loading screen

After 1 minute the following screen will appear on the display (Picture 32).



Picture 32 Compact display loading screen No 2

After the successful communication establishment between the display and the battery, the following screen will be shown to the display (Picture 33):



Picture 33 Compact display operating screen

Picture 34 shows the active errors of the battery:



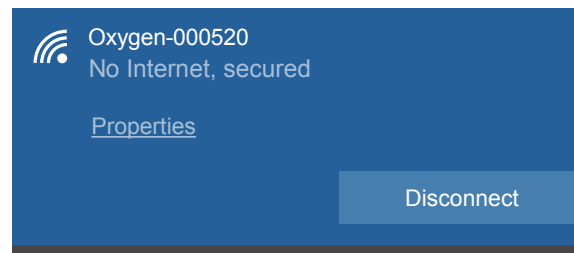
Picture 34 Indicative error

7.4.3 Enable the Wi-Fi of the display and communication box

The Li.ONESS system will start sending data to the Glocal (Sunlight cloud platform) after the activation of the Wi-Fi communication. The customer must connect to the display's Wi-Fi.

The following steps below describe the synchronization process.

Connect to the wireless network (Oxygen-000520) of the display with a Laptop.



Picture 35 Laptop Wireless network Tab

To login, insert the secure key which is the WPA key or the Wi-Fi password (depending on the label of the display) written in the label of the Display Telecommunication Box (see Picture 36).

Open the browser:

<http://192.168.254.254>

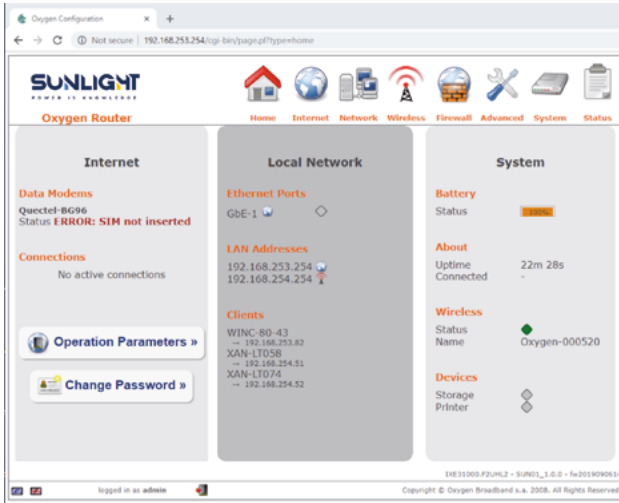
User: admin

Password: The password is written on the label of the box and depending on the label of the display, could be the password after "admin" or the password after "pass" (see Picture 40).

S/N	184017000133	admin : 6a2DjBMTUA
MAC	243F3000893C	serial : 105806000520
PASS	MTf3BX4b7R	mac : 001D1C0F00EE
WiFi	RYRAILKURR	wpa key : ENISHACCEE

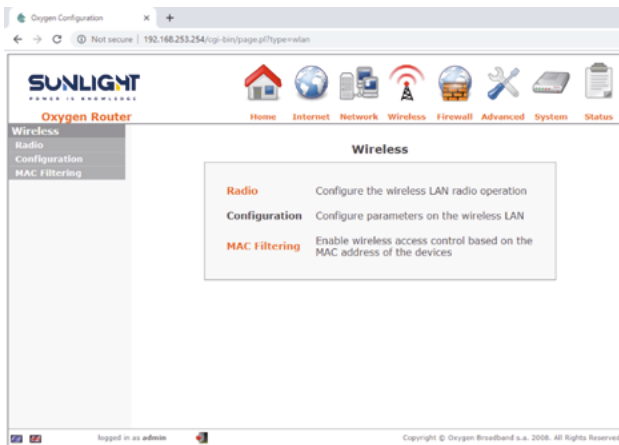
Picture 36 Different labels

After login, the home page appears (Picture 37), then press the Wireless button.

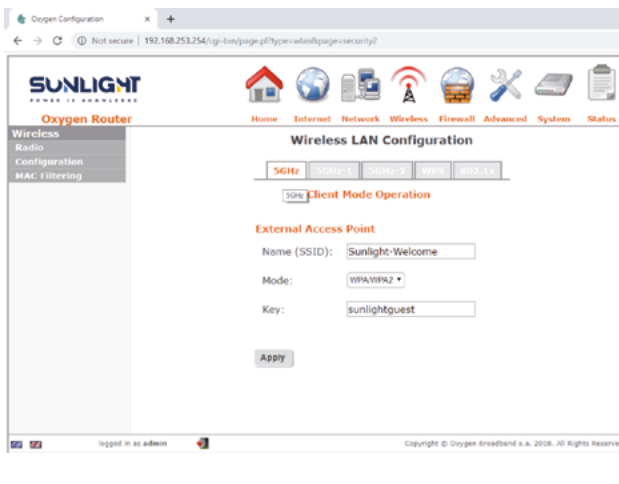


Picture 37

Choose the configuration field:



Picture 38



Picture 39

At the Wi-Fi field insert:

Name (SSID): the name of your Wi-Fi

Mode: The security mode of the Wi-Fi network normally is: WPA/WPA2
(In any case, it should be checked)

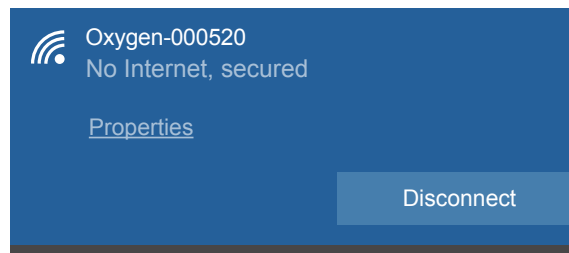
Key: Your Wi-Fi password
Click Apply

Disconnect from the wireless network (Oxygen-000520).

7.4.4 Firmware Upgrade of the Compact Display Telecommunication Box

It may be needed to update the firmware of the Compact Display Telecommunication Box. The steps are described below:

Connect to the wireless network (Oxygen-000520) of the Compact Display Telecommunication Box with a laptop. In order to login please insert the secure key, which is the WPA key written behind the Compact Display Telecommunication Box.



Picture 40

Open the browser:

<http://192.168.254.254>

User: admin

Password: The password is written on the label of the Compact Display Telecommunication Box and depending on the label of the Display, it could be the password after "admin" or the password after "pass" (see Picture 41).

S/N	184017000133	admin : 6a2DjBMTUA
MAC	243F3000893C	serial : 105806000520
PASS	MTf3BX4b7R	mac : 001D1C0F00EE
WiFi	RYRAILKURR	wpa key : ENISHACCEE

Picture 41

After login, the home page appears:

The screenshot shows the Oxygen Router home page. It features three main columns: Internet (Data Modems, Connections), Local Network (Ethernet Ports, LAN Addresses, Clients), and System (Battery, About, Wireless, Devices). The System section shows the battery status as 'Full' and the device name as 'Oxygen-000520'.

Picture 42

Go to the System field and choose Firmware Upgrade:

The screenshot shows the 'System' configuration page. The 'Firmware Upgrade' option is selected in the left sidebar. The main content area lists various system settings such as Green Operation, SNMP, Syslog, Remote Admin, Users, Certificates, Time-plan, Change Password, Backup / Restore, Device Restart, and Firmware Upgrade.

Picture 43

In the field "Local Upgrade" choose the corresponding file (firmware) and press upgrade.

The screenshot shows the 'Upgrade System Firmware' page. It displays the current model (EKF31000_F21HH2), version (SUN01_1.0.0), and build (fw2019091111). Under the 'Local Upgrade' section, there is a 'Choose File' button and an 'Upgrade' button.

Picture 44

Wait for some minutes:

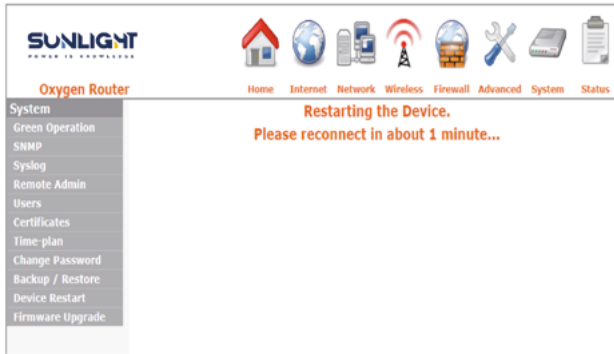
The screenshot shows the 'Firmware upgrade has started' page. A message states: 'The upgrade process can take five minutes or more. Please do not disconnect or shutdown the device as it may become unusable!'.

Picture 45

After finishing the upgrade procedure go again to System button and select Device Restart.

The screenshot shows a dialog box titled 'Restart the Device' with the question 'Do you want to restart the device?'. There are two options: 'Erase configuration (factory defaults)' and 'Restart'. An 'OK' button is visible at the bottom right.

Picture 46



Picture 47

7.5 Discharge Mode of Li.ONESS battery

If the battery is switched off the steps below must be followed:

- Switch on the battery by pressing the On/Off button of the control panel or the On/Off button of the Compact Display Telecommunication Box. Wait for the initialization of the BMS. The duration of the initialization can be up to 1 minute and it is depending on the storage period of the battery (sleep mode).
- Battery is ready for use.

NOTE: If the battery is not used, the battery will shut down automatically in approximately 4 hours.

8. Connection to GLocal

The connection to GLocal cloud platform is described to the corresponding manual.

9. Li.ONESS System Modularity

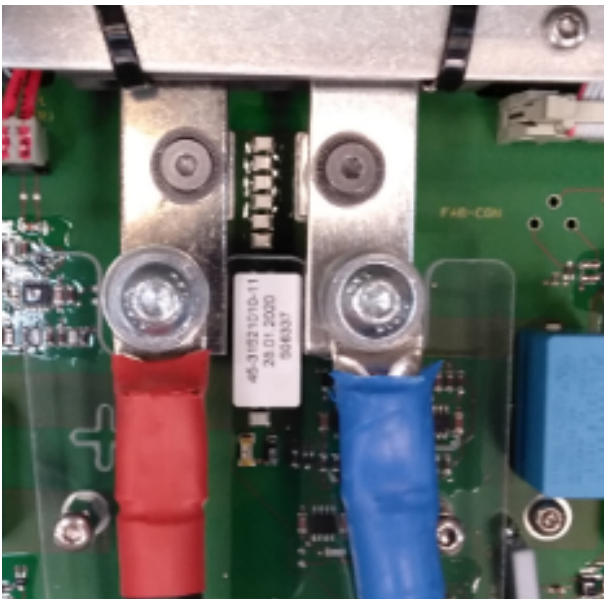
In case of the user who needs to insert new battery modules or a new rack in parallel connection respectively, the following procedure should be implemented.

1. In case of all battery modules are brand new and from the same batch, the steps are:
 - a. Measurement of each battery module's Voltage.
 - b. In case the numbers of modules are not pre-defined (i.e. 1-2 up to 13-14), the user should give CAN IDs to modules. For this purpose, a laptop, communication cables and a limited edition of SL BMS tool are necessary. It is a step by step procedure.
 - c. The connection of the necessary parts (M-PU up to 38.4kWh, 38.4kWh parallel rack + battery modules) should take place one by one. The modules are not active (OFF status via circuit breaker) during connection.
 - d. The user shall adjust the final parameters of system connecting a laptop on M-PU with the SL limited BMS-tool (i.e. Final capacity, number of strings, inverter model, etc.)
 - e. Circuit breakers (C/B) shall be turned on after the final programming and quality control.
2. In case that for example three modules have been used for 3 months and four new modules need to be connected in parallel (total system up to 38.4kWh), the steps are:
 - a. A dedicated equipment is necessary (charger CCCV, Master Unit), a laptop and the Limited version of SL BMS tool
 - b. All modules shall be charged up to 100% (Cut-Off voltage) separately
 - c. The voltage of each module shall be measured.
 - d. In case the numbers of modules are not pre-defined (i.e. 1-2 up to 13-14), the user shall give CAN IDs to the modules. For this purpose, a laptop, communication cables and a limited version of SL BMS tool is necessary. It is a step by step procedure.
 - e. The connection of the additional new modules to the system is completed. The modules are not active (OFF status via circuit breaker) during connections.
 - f. The user shall adjust the final parameters of system connecting a laptop on M-PU with the limited BMS-tool (i.e. Final capacity, number of strings, inverter model, etc.)
 - g. Circuit breakers (C/B) shall be turned on after the final programming and quality control.
 - h. The additional modules will be added at the penultimate position of the system (As a second to last module)

Annex 1 - SMA Sunny Island Inverter connection with Li.ONESS

Electrical connection

- Connect the positive (+) cable from Power unit (inverter) to SMA (+) DC terminal.
- Connect the negative (-) cable from Power unit (inverter) to SMA (-) DC terminal.



Picture A1.1 Battery Connection

Note

DO NOT CONNECT INVERTER WITH ANY OTHER EXTERNAL SOURCE (GRID, GENERATOR) OR ANY OTHER LOAD (AC1 and AC2 IS NOT CONNECTED ANYWHERE)

Communication connection



Picture A1.2 Communication cable of the battery with the inverter

After the installation of the power cables of the inverter, connect the module's communication cable to the inverter.

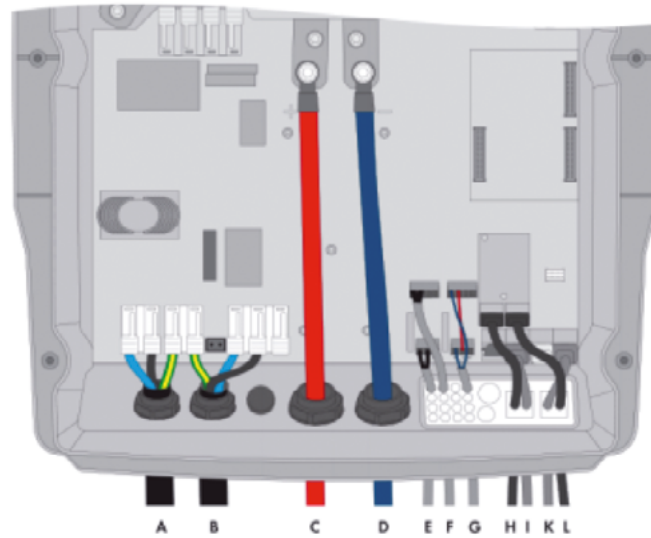


Picture A1.3 Inverter's Communication cable with Li.ONESS Power / PBT Unit (Battery Side)



Picture A1.4 Inverter's Communication cable with the battery (Inverter's side)

Regarding the connection of SMA the following connection took place:



Position	Designation	Description/Information
A	AC Power cable	Connection AC2 Gen/Grid terminals L, NTT, and PE Utility grid connection with a three-wire cable Conductor cross-section: 6 mm ² to 16 mm ²
B	Grounding conductor	Terminal AC1 Loads/SunnyBoys terminal PE Additional grounding if the conductor cross-section of the AC power cable is less than 10 mm ²
C	DC+ Cable	Battery connection
D	DC- Cable	Conductor cross-section: 50 mm ² to 95 mm ²
E	Control cable, generator	Sunny Island: Relay1 NO and Relay1C terminals Conductor cross-section: 0.2 mm ² to 2.5 mm ²
G	Control cable, load shedding	Sunny Island: Connect the control cable to the terminals Relay2 NO and BatVtgOut-. Inside the Sunny Island inverter, connect terminal Relay2C and BatVtgOut+. Conductor cross-section: 0.2 mm ² to 2.5 mm ²

The settings of the inverter refer to an off-grid battery system where the capacity of the battery is 80Ah. The inverter can charge the battery from the grid and can discharge the battery only with loads.

The user and installer have the same password on the IP address of the inverter:

Name: User and Installer

Password: Sunlight12!!

Annex 2 - Victron Inverter connection with Li.ONESS

Note

It is mandatory to use Victron's CCGX device to connect Sunlight's Li.ONESS

Electrical connection

- Connect the positive (+) cable from Power unit (inverter) to Victron (+) DC terminal.
- Connect the negative (-) cable from Power unit (inverter) to Victron (-) DC terminal.



Picture A2.1 DC Connection points

Note

DO NOT CONNECT INVERTER WITH ANY OTHER EXTERNAL SOURCE (GRID, GENERATOR) OR ANY OTHER LOAD (AC1 and AC2 IS NOT CONNECTED ANYWHERE)

The following connections are necessary for the correct operation of Sunlight's battery with Victron inverter (through CCGX device).

1. Connect the two cables (black and red) to the battery's terminal cables or inverter's DC cable (which come from the battery) in order to power up the CCGX color control display.

Power in V+ → Red Cable

8-70V DC GND → Black cable

2. Connect the Ve.Bus from the CCGX device to the Inverter's communication port Ve.Bus 1 or Ve.Bus 2 (both are the same) with a RJ-45 cable.
3. Connect the Ve.Can from CCGX device to the communication port INVERTER COM of the power unit with the modified RJ-45 cable.



Picture A2.2 Power Unit & CCGX display

- **VE.Bus** connects to Inverter at inverter
- **VE.Can** connects to Inverter Com at battery
- **Ethernet** connects to router
- **Power in V+** Power CCGX from the positive (+) battery terminal
- **8-70VDC GND** Power CCGX from the negative (-) battery terminal



Picture A2.3 CCGX display back view

Download and install VE Configuration tools from:

<https://www.victronenergy.com/supportanddownloads/software>

Connect your computer to a VE.Bus product. MK3-USB interface and RJ45 UTP cable are required. Computer with internet connection will automatically download correct driver. Update all components to latest firmware, follow instructions on:


https://www.victronenergy.com/live/updating_firmware:updating_ve.bus_products

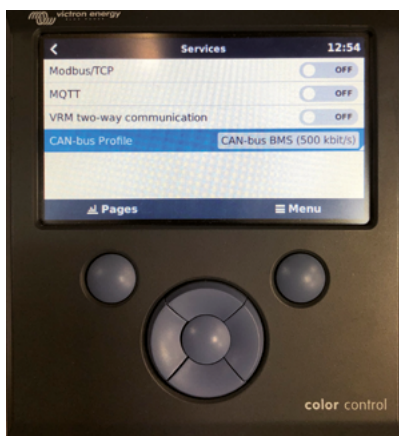
https://www.victronenergy.com/live/ccgx:firmware_updating Color Control settings:

It is also required to Update CCGX to 2.40 or higher.

CCGX Device Settings

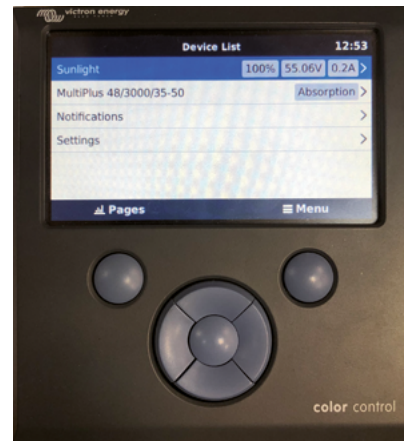
Before you operate the inverter with the **Li.ONESS**, you must complete the following steps, in order to successfully communicate with Sunlight's BMS:

1. From Device list go to Settings menu → Services → Can-bus Profile → Select Can-bus BMS (500 kbit/s) and apply the settings → 




Picture A2.4 CCGX display Services Tab

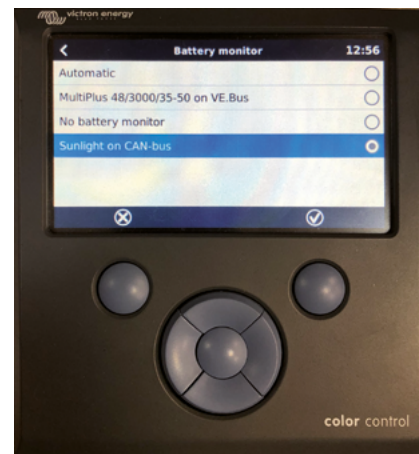
Then, go back to **Device list** and Sunlight's **Li.ONESS** will appear as shown at the following print screen



Picture A2.5 CCGX display Device list Tab

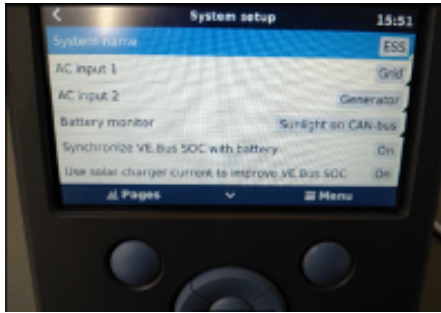
2. Return to Settings Tab and go to System Setup → Battery monitor → Sunlight on Can-bus and apply the settings with the following symbol → 

The Battery Monitor Tab selections are shown below



Picture A2.6 CCGX display Battery Monitor Tab

The selected settings can be seen in the System's Setup Tab as shown below



Picture A2.7 CCGX display System Setup Tab

In settings menu go to DVCC and apply the following settings:

This table shows the recommend settings for the use of Sunlight lithium battery with fixed charge control method:

DVCC	<input checked="" type="checkbox"/>
SVS - Shared voltage sense	<input type="checkbox"/>
STS - Shared temperature sense	<input type="checkbox"/>
Limit charge current	<input checked="" type="checkbox"/>
Maximum charge current	50A

Table A2.1 Sunlight's Settings Tab

Contact Us
www.systems-sunlight.com

