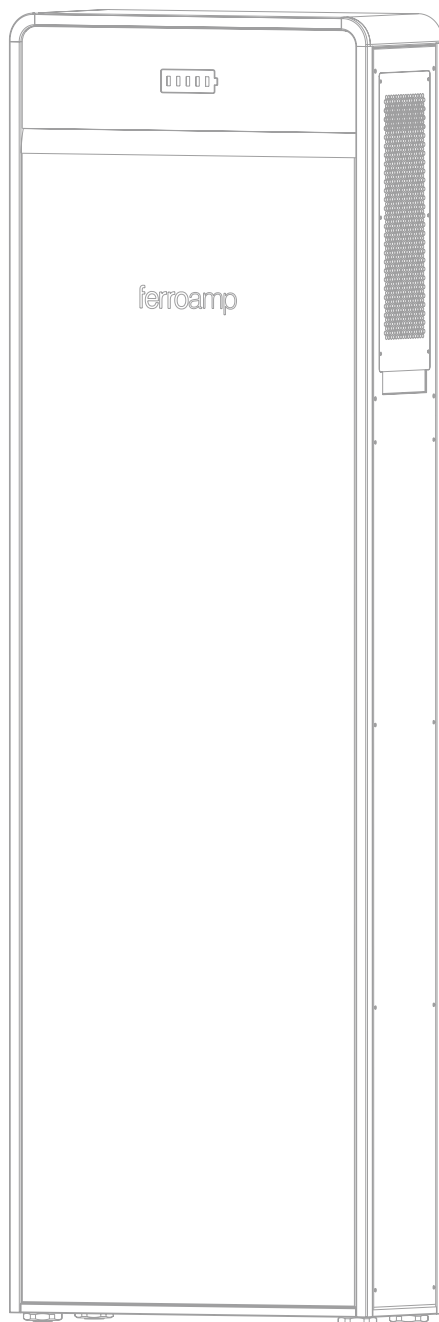

PSM 10/12/15 SERIES

INSTALLATION MANUAL

Ver.1.05 Dec. 2019

esoltech AB



WARNING

- Read through the instruction manual before installation.
- Electrical installation shall be performed by an authorized electrician in accordance with electrical standards and safety precautions
- Some component may need to be assembled before installation.
- Do not open the enclosure of the electrical components. Warranty is void if the products has been modified.
- Plug in the jumper brick (battery modules) only when the system is ready to power up.

The FerroAmp PSM 10/12/15 series high performance energy storage system is designed to be installed and operated together with the EnergyHub system with the patented Adaptive Current Equalization (ACE) technology.

ferroamp

Ferroamp Elektronik AB is a research-driven platform company that builds smart integrated energy system for home and industry. The FerroAmp ACE technology is patented under PCT WO2012050501 (A1).

Sunwoda Energy

Sunwoda Energy Solution Co., Ltd is a professional energy storage solution provider with 20 years' know-how in battery industry. Sunwoda Energy is a subsidiary of the listed Sunwoda Electronic Co., Ltd (SZ 300207) established in 1997, a manufacture powerhouse with the headquarter in Shenzhen, China.

esol

ESOLtech AB, a Stockholm-based company focused on energy storage technology.

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1. LIST OF COMPONENTS

The PSM 10/12/15 series high performance energy storage system comes with the following components:

- Cabinet
- Battery modules
- Battery controller modules
- Energy Storage Optimizer (ESO)
- Accessories box

Knowing your system components:

Battery module <i>4 pcs (PSM10)</i> <i>5 pcs (PSM12)</i> <i>6 pcs (PSM15)</i>	
Battery controller module <i>1 pcs</i>	
Energy storage optimizer <i>1 pcs (4-6kW, PSM10-15)</i> <i>2 pcs (8-12kW, PSM10-15)</i>	
The Cabinet	see picture on the cover page
The Accessories box	see the list of accessories

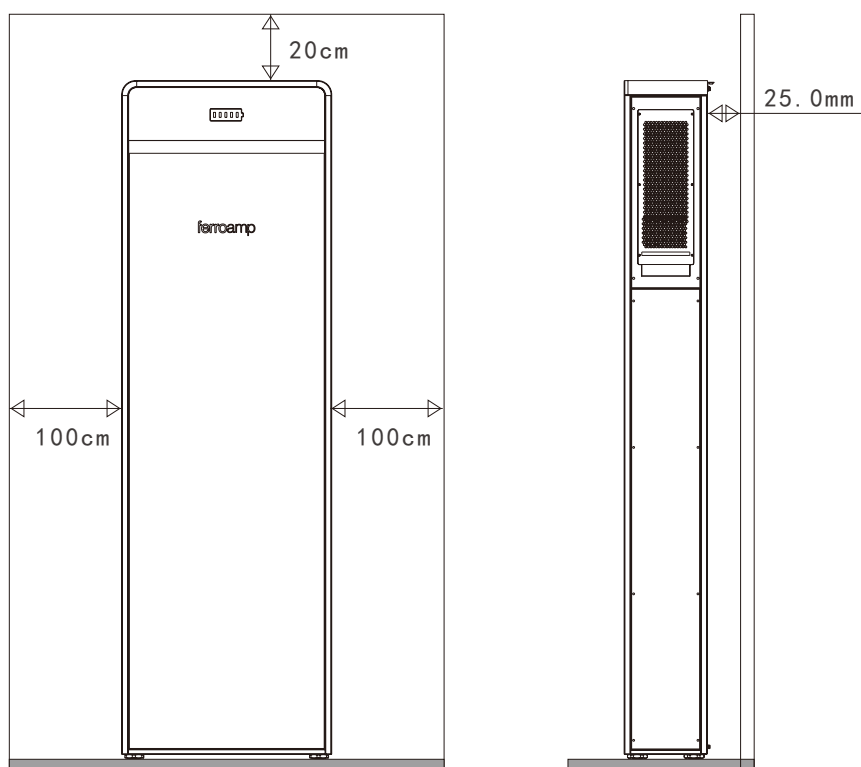
List of accessories:

Item no.	Description	quantity	note
1	Installation manual	1	This manual
2	Battery Module Comm. Cable	7	
3	Battery Module Power cable	7	
4	Battery Module Jumper Brick (in battery packing)	1 (per module)	
5	Battery Module Mounting bolts (in battery packing)	2 (per module)	M6
6	Wall mounting bolts	2	
7	Wall mounting assembly (in cabinet packing)	1	
8	Wall mounting assembly bolts (in cabinet packing)	2	
9	Power Cable ESO - Battery controller	2	
10	Battery controller Power cable 230VAC	1	
11	Comm. cable: from ESO to Battery controller	1	RJ45
12	Grounding cable (PE) for ESO	1	
13	ESO Adaptor (in ESO packing)	1	
14	ESO Adaptor fixing bolts (in ESO packing)	5	M3
15	ESO front panel (in ESO packing)	1	
16	ESO front panel fixing bolts (in ESO packing)	8	M2
17	ESO Mounting bolts (in ESO packing)	4 + 1 (for PE)	M6

2. CABINET ASSEMBLY

The cabinet is pre-assembled. The PSM cabinet is designed to be installed and used indoor only. Before installation, please make sure that:

- the ambient temperature is 0 – 45 deg. (recommended 25 deg.);
- the relative humidity ranges 0-95%;
- there is enough space around the cabinet to enable a safe installation.



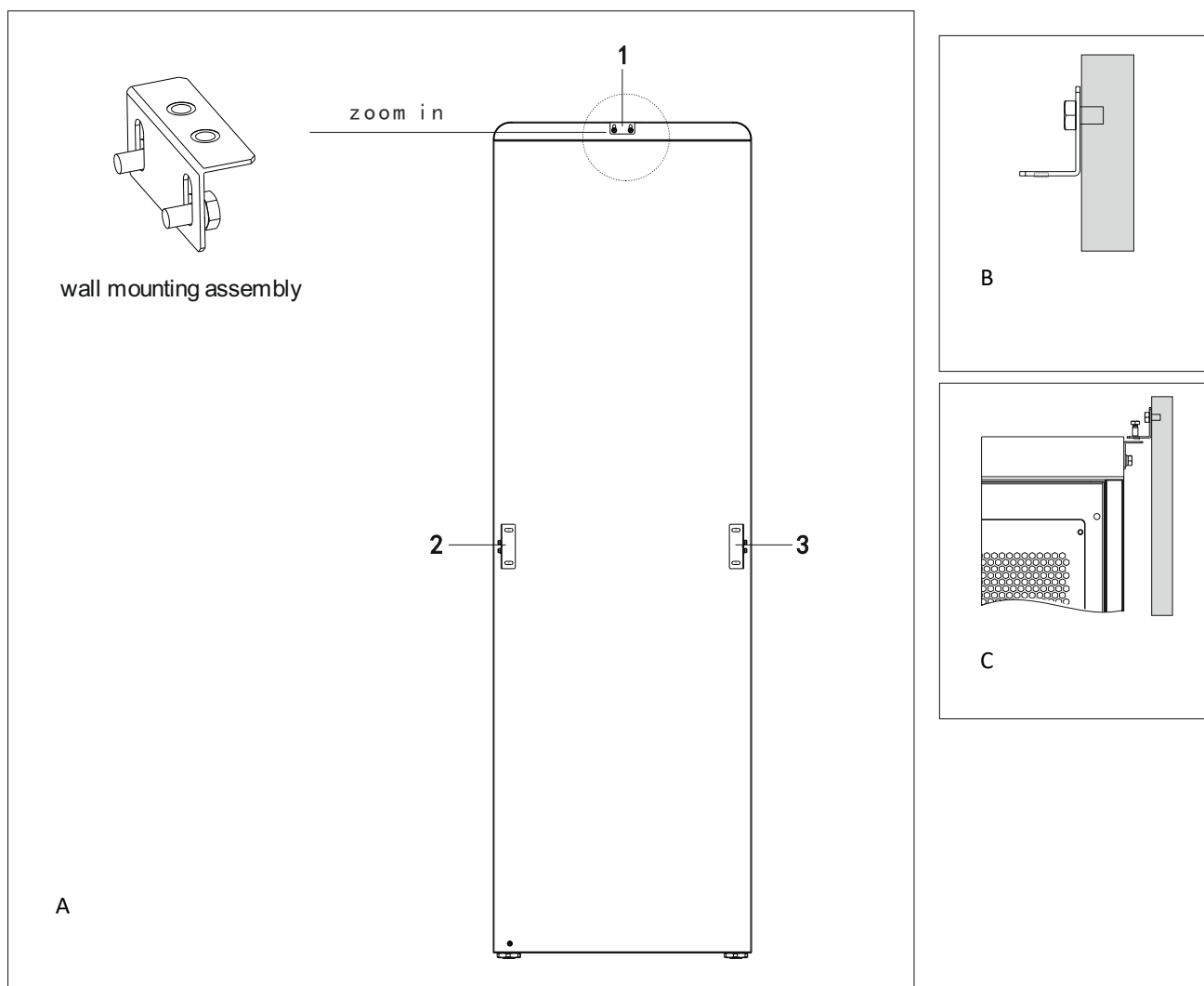
Note: the measurement in the diagram is not to the scale

2.1 WALL MOUNTING

Clear the wall. Measure the distance from the floor to the spot on the wall where mounting assembly shall be fixed.

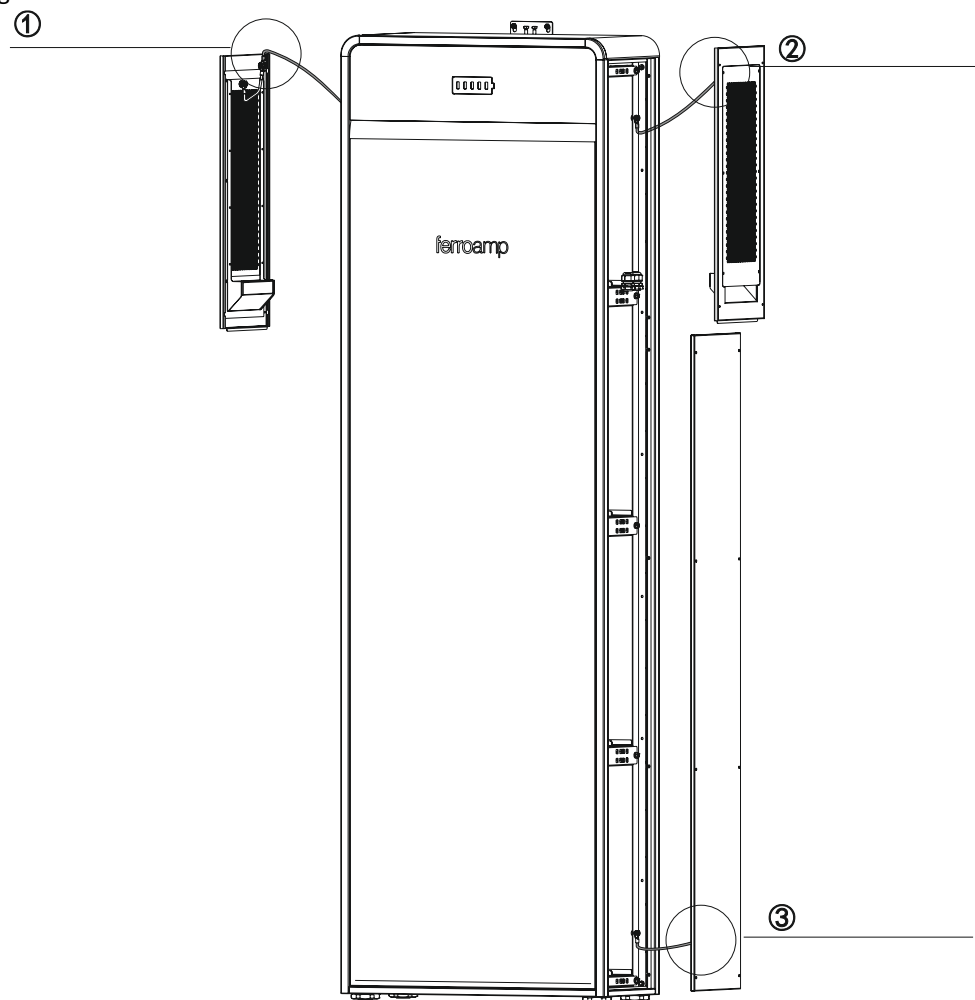
- **Figure A:** The wall mounting assembly can be attached to 3 locations on the cabinet. The assembly is preinstalled at location 1.
- **Figure B:** Fix the wall mounting piece to the wall.
- **Figure C:** Fasten the fixing bolts to make sure the cabinet is secured.

Please refer to Section 2.3 for the feet adjustment.

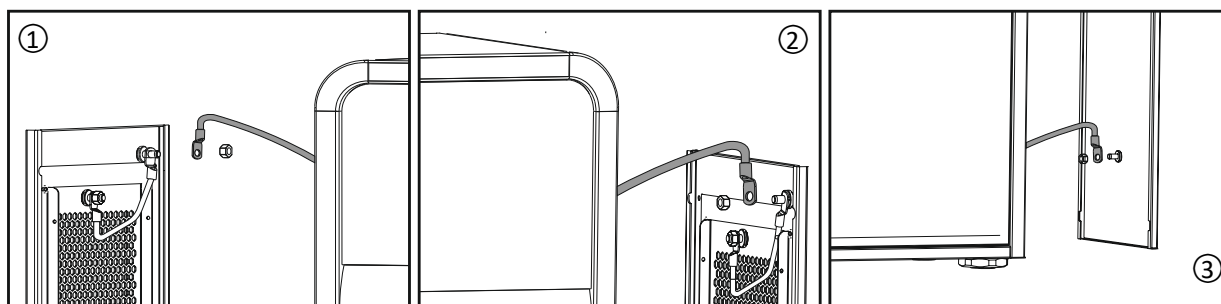


2.2 REMOVING THE SIDE PANELS

The cabinet has a symmetric design meaning that the panels on the left-hand-side are identical and exchangeable to the ones on the right.

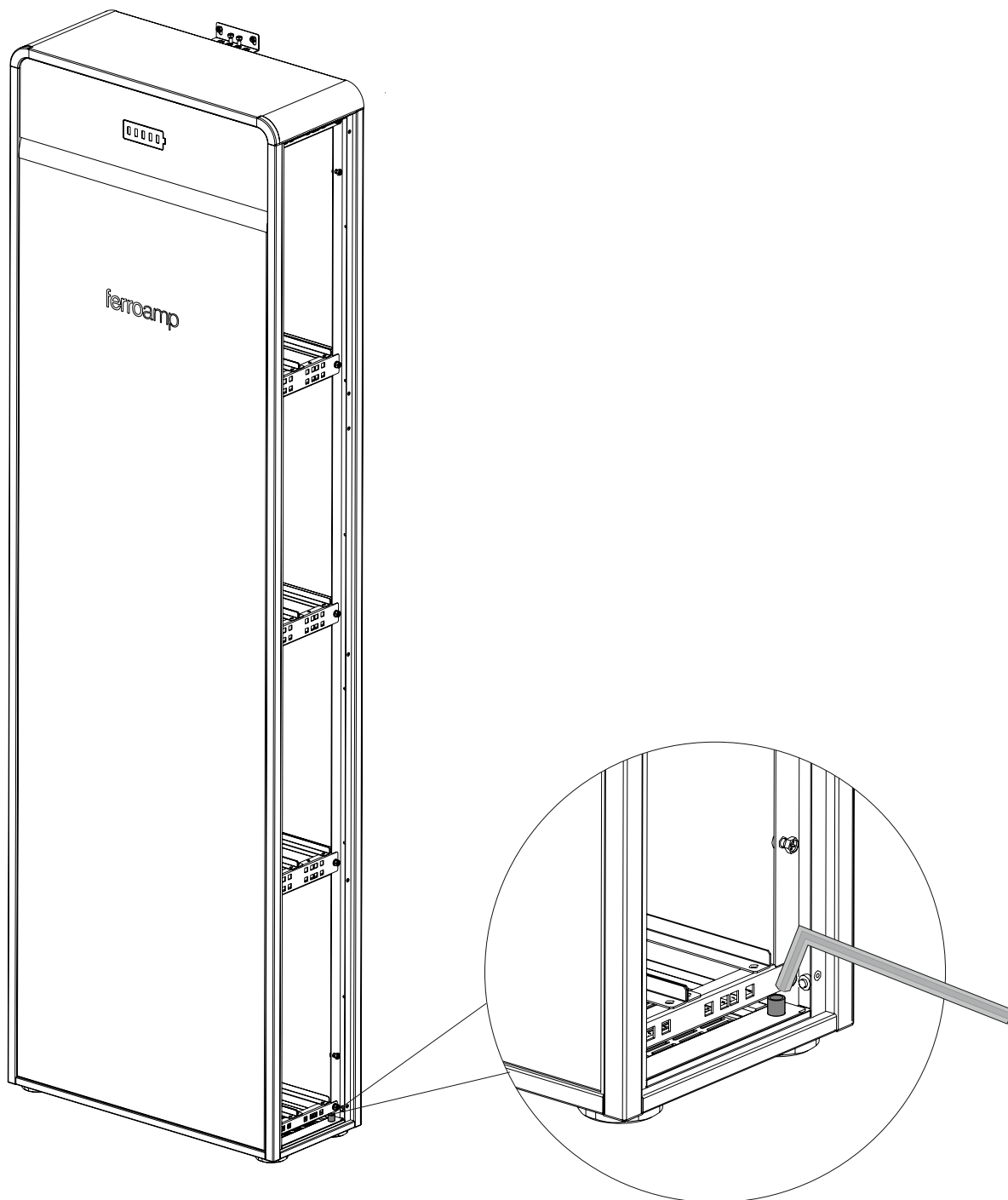


The diagram shows the upper side panels and one of the lower side panels are removed. Detach the grounding cable for installation clearance. The following shows the details of removing the grounding cables.



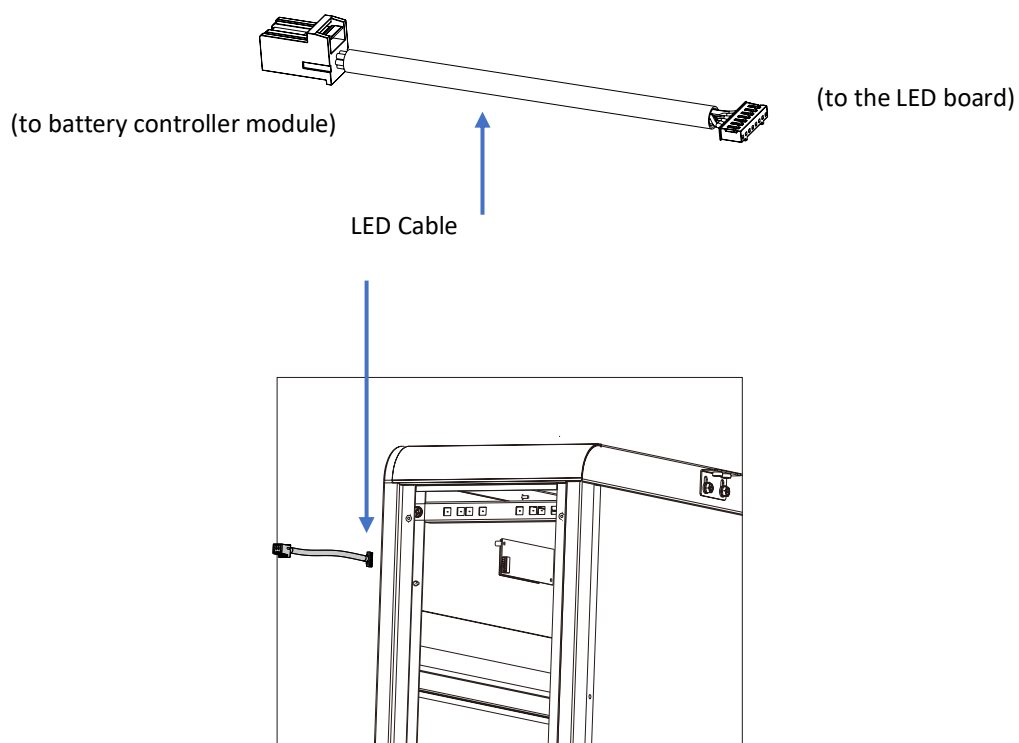
2.3 ADJUSTING THE FEET

There are 4 adjustable feet and are accessible after removing the side panels. Using a hex key (5mm, insex) to adjust the height of the feet.

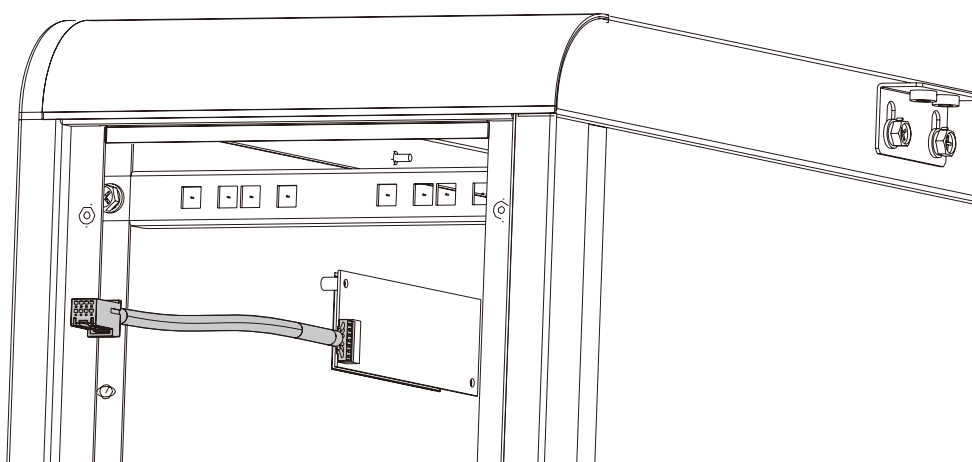


2.4 CABLE FOR LED PANEL

Connect the LED cable to the LED connector socket inside the cabinet as indicated below:



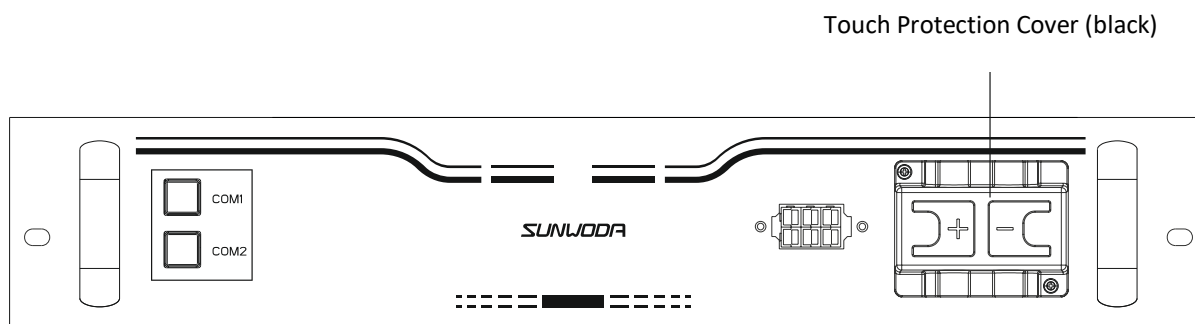
There is only one direction the cable can be inserted firmly. The following picture shows finished LED cable connection. The other end of the cable is to be connected to the battery controller module (**See also Section 3.2**).



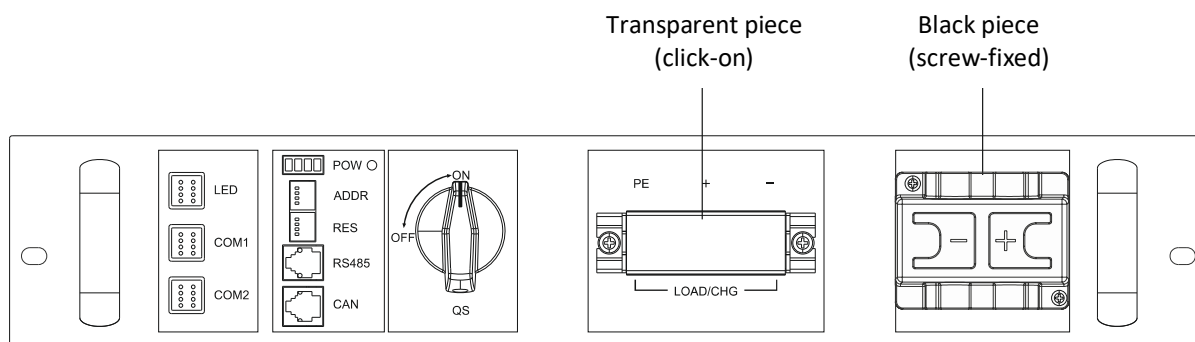
3. BATTERY AND CONTROLLER MODULES

Both the battery module and the battery controller box are shipped with protection covers preinstalled.

Battery module:



Battery controller module:

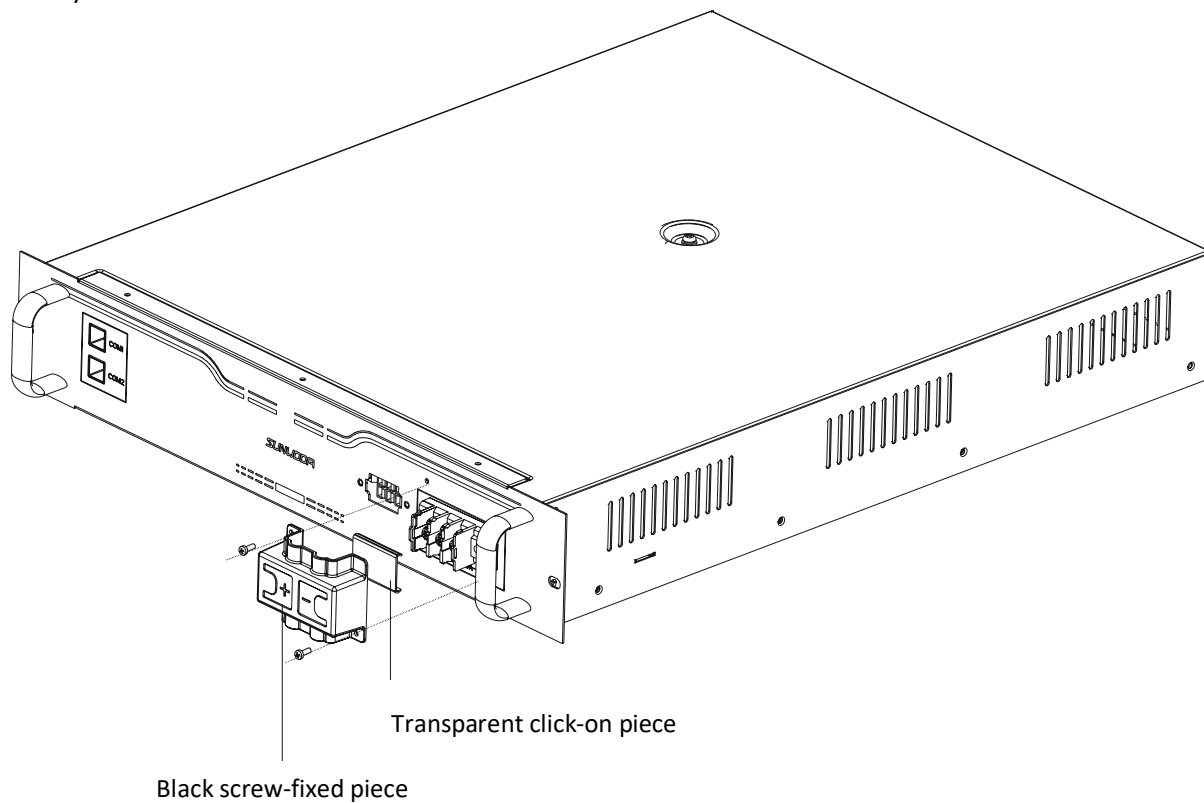


The PSM system is shipped with one battery controller module and 4 - 6 battery modules depending on system configuration.

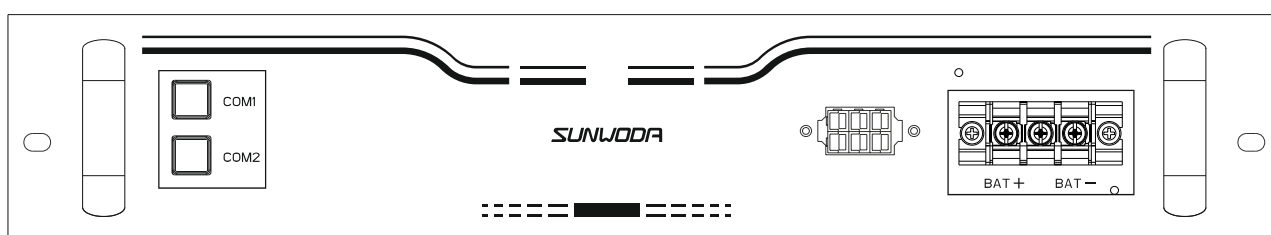
Remove the preinstalled protection cover before inserting the unit into the cabinet.

3.1 TOUCH PROTECTION COVER

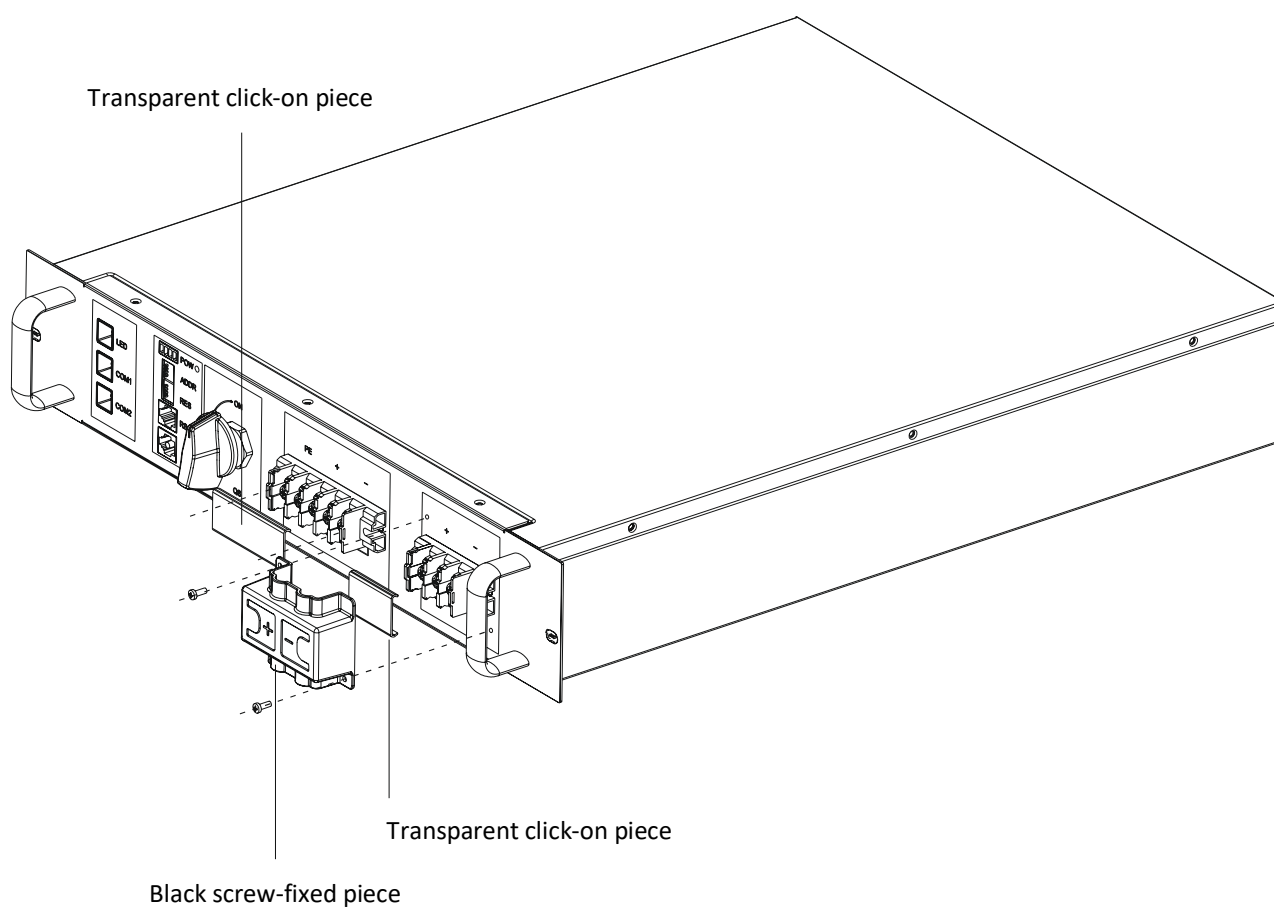
For battery module:



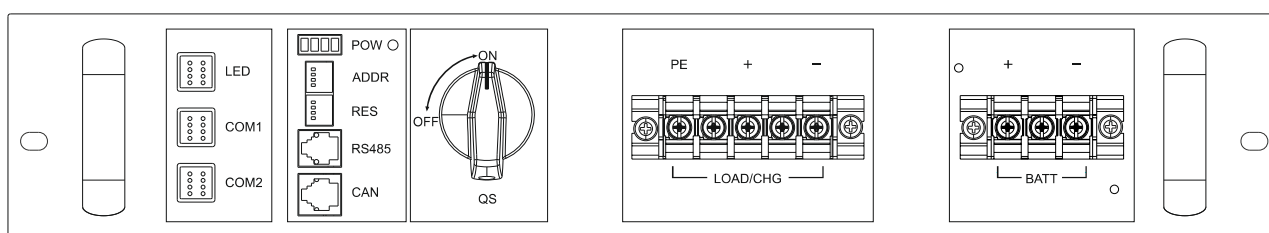
The battery module with the protection covers removed:



For the battery controller module:

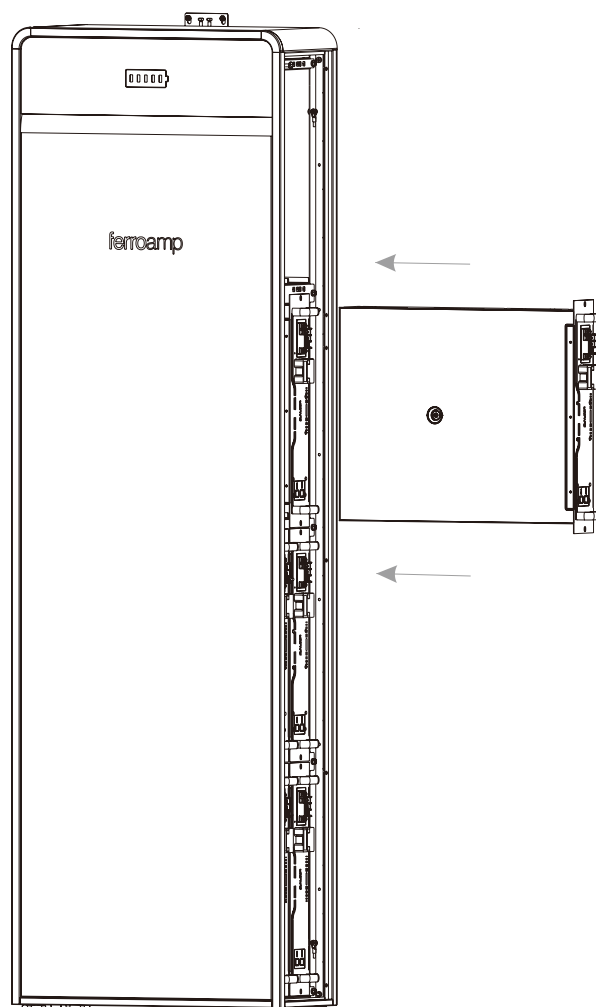


The battery controller module with the protection covers removed.



3.2 INSERT THE BATTERY MODULES

The battery shall be inserted **one by one from the bottom** of the cabinet.



The figure above illustrates only **PSM15 (6 batt.)**.

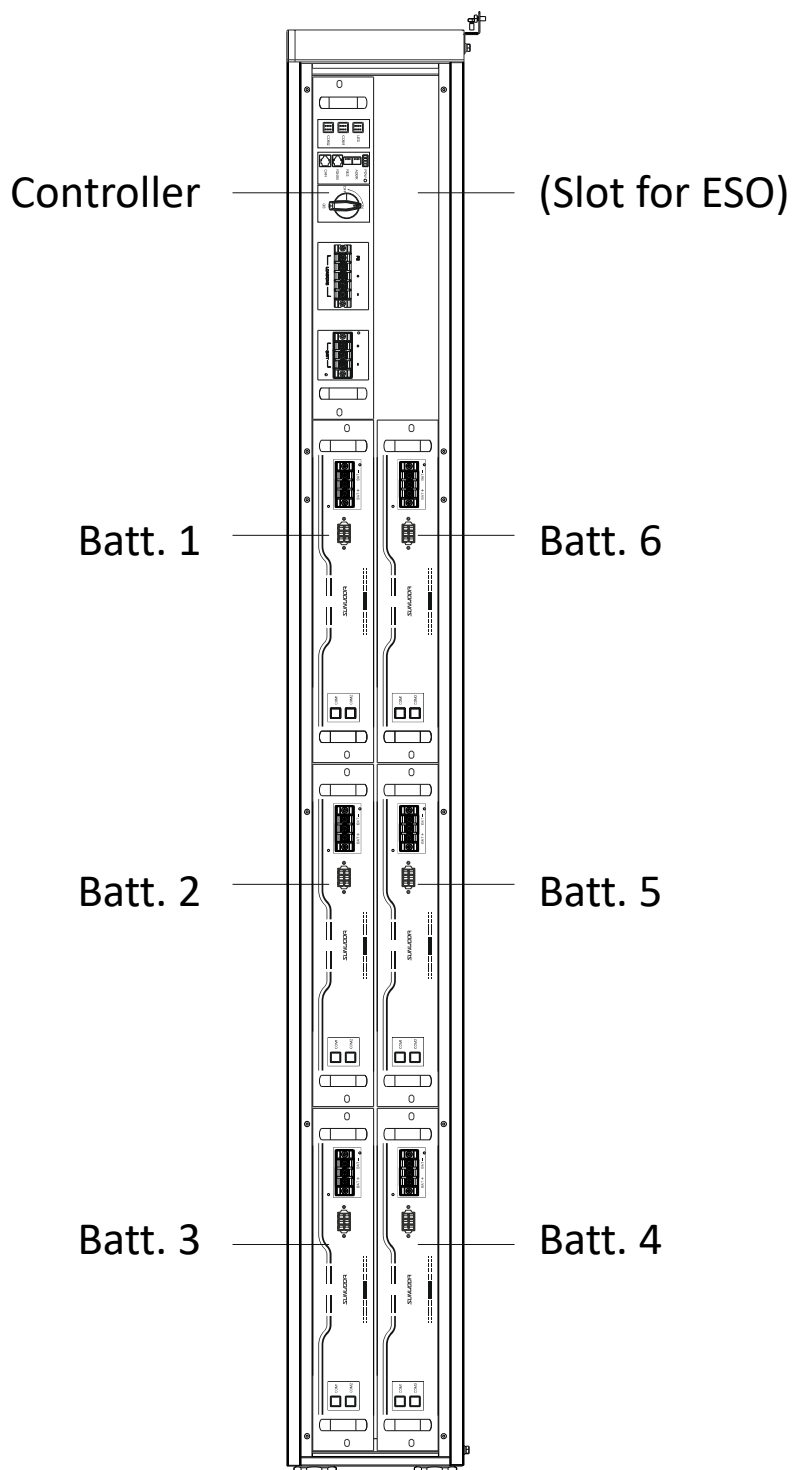
Make sure all the bolts for the inserted module fastened before installing the next one.

Install the controller module after all the battery modules are done.

Pay special attention not to block the Cable for LED panel (**Section 2.4**) whose connection is to be done in **Section 3.3**.

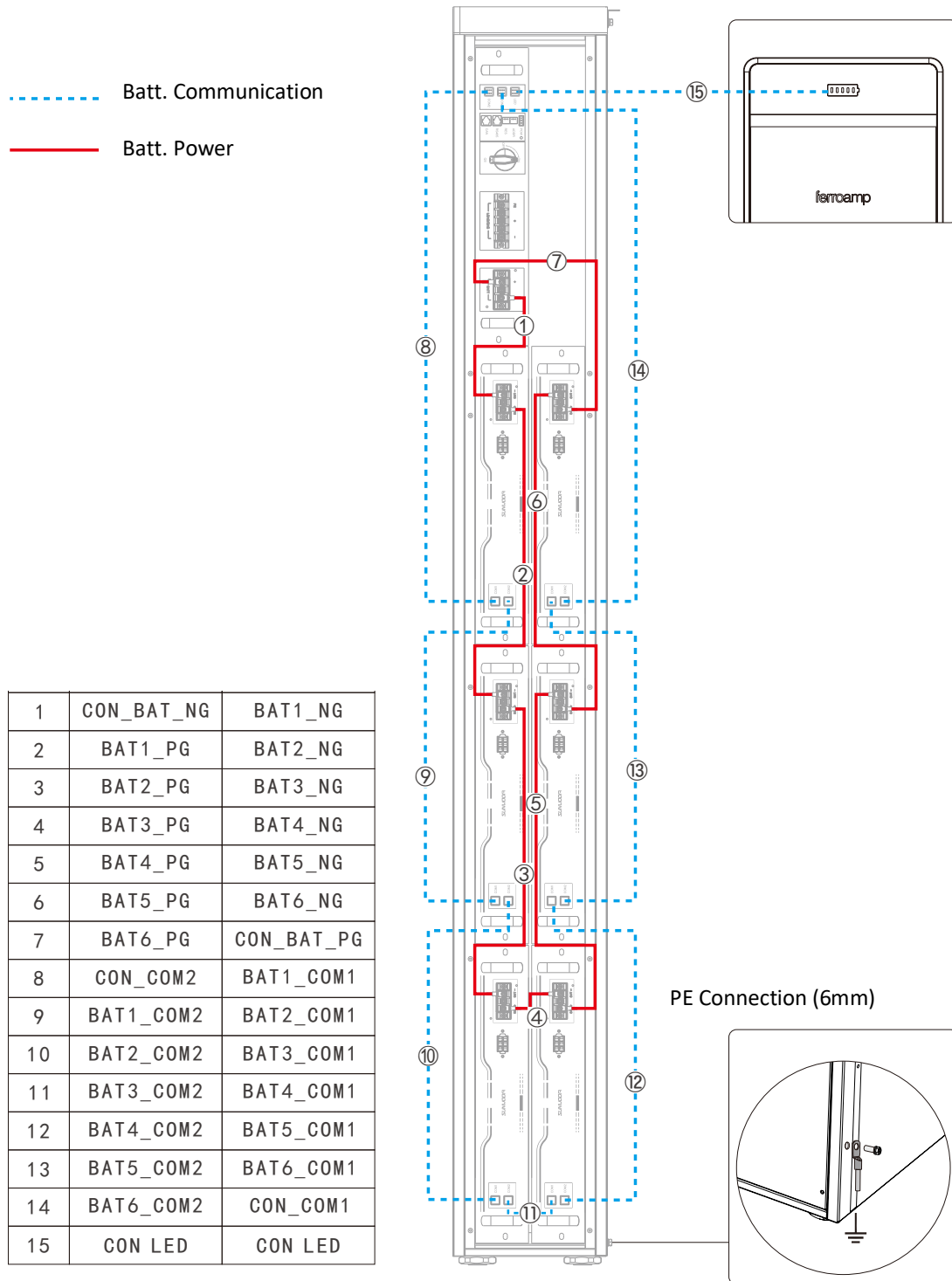
The following is a side view of the system (15kWh) after insertion of the battery and controller modules. **PSM12,5** and **PSM 10** are illustrated respectively in 3.3.

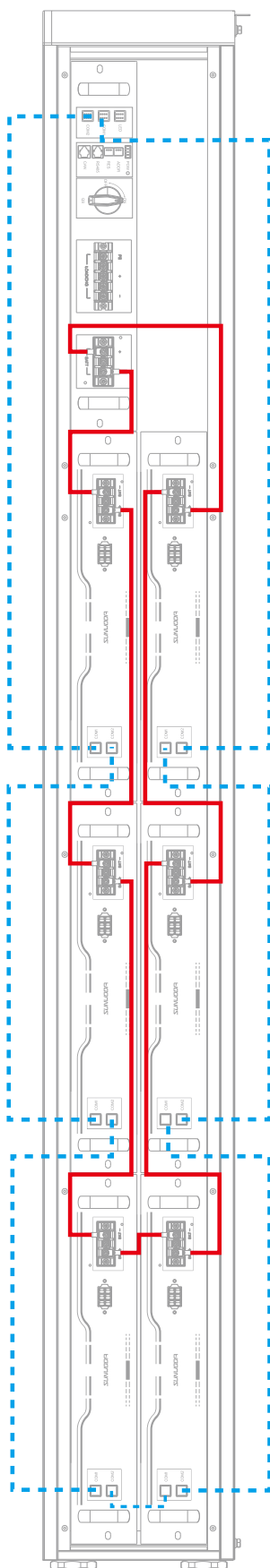
Make sure all the bolts (M6) fastened before proceeding for safety installation.



3.3 CABLE INSTALLATION

3.3.1 Connection overview and the numbering of the cables (PSM15):



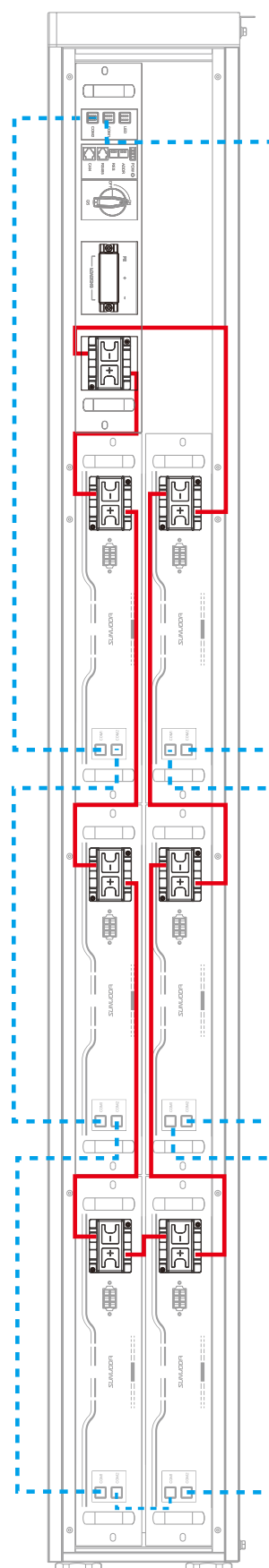


Sort the cables according to the list above and install the cables according to the numbering:

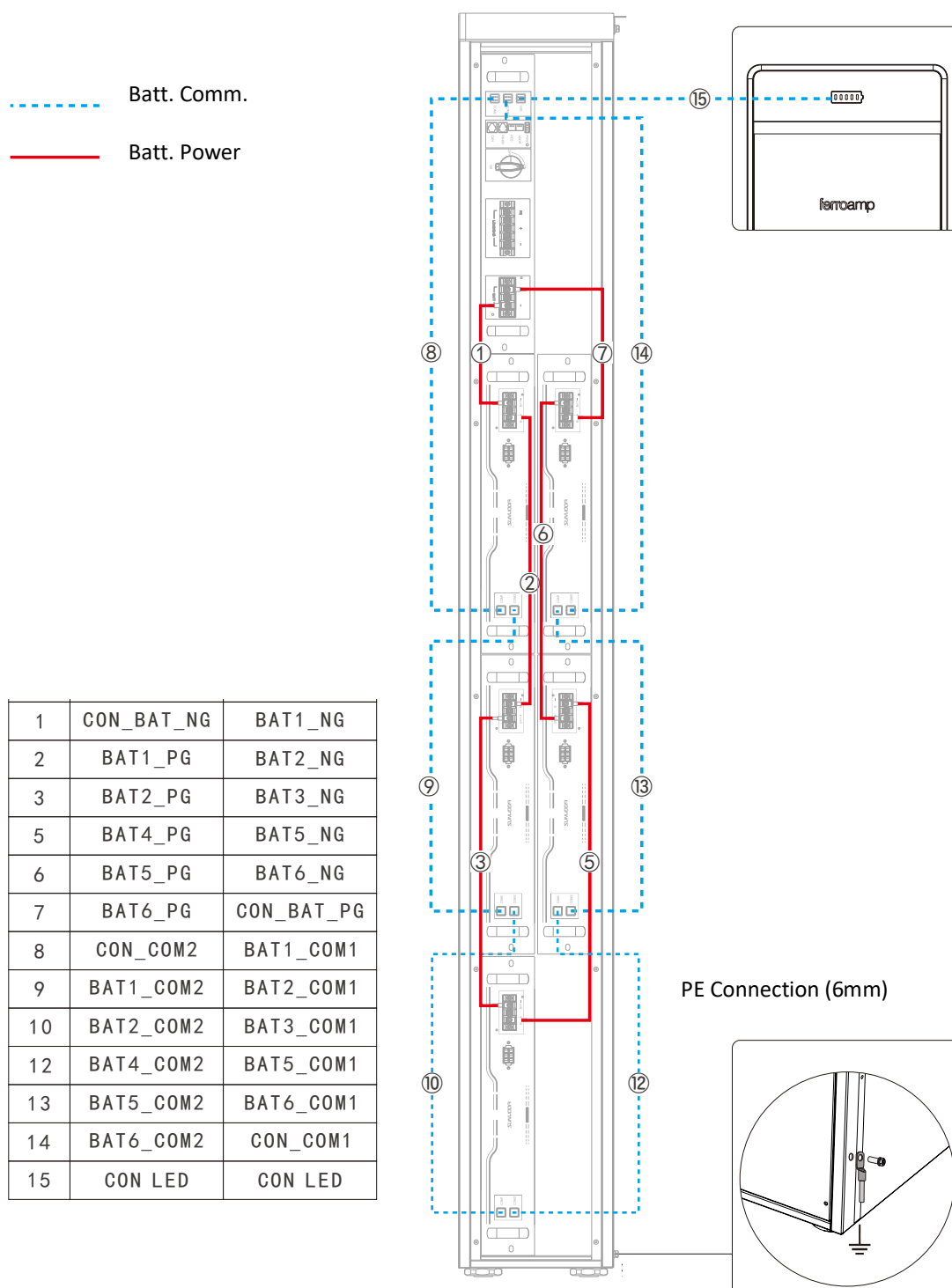
- The power cables (solid) first, then
- The communication cables (dashed)

Note: the **cable connector is labeled** with the exact port to be connected and shall not be reversed.

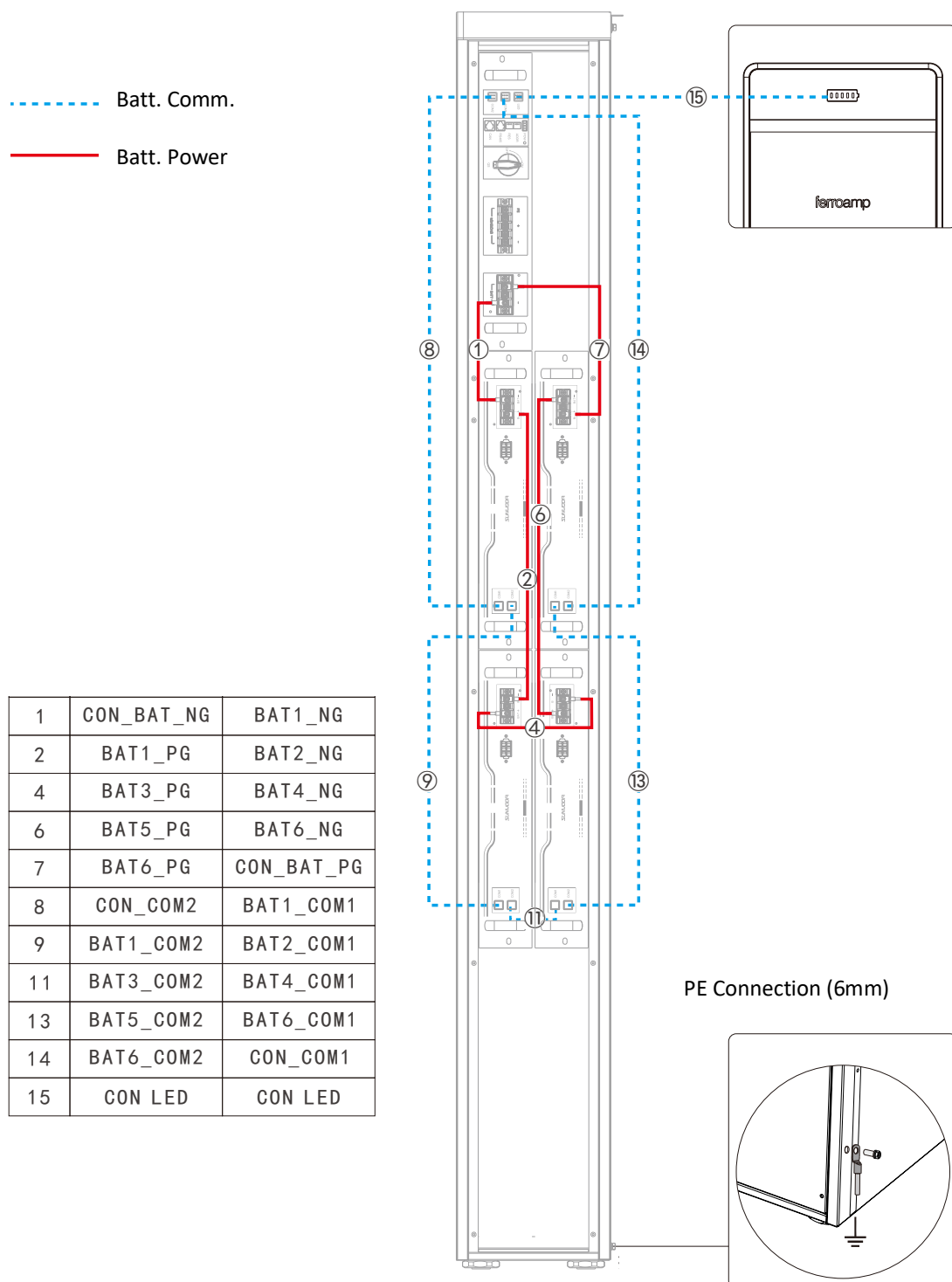
Install the battery module touch protection covers (**Section 3.1**) back; the system shall then resemble the figure on right-hand side.



3.3.2 Connection overview and the numbering of the cables (PSM12.5):



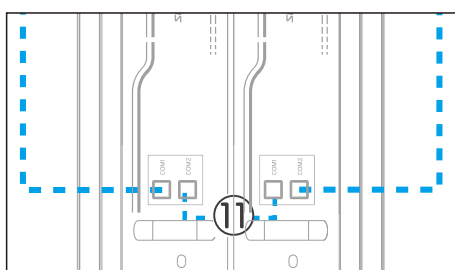
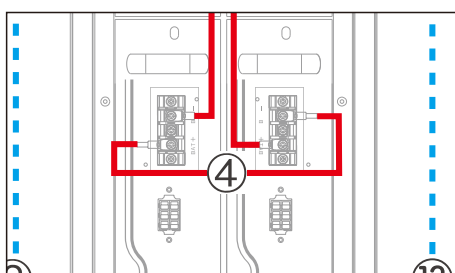
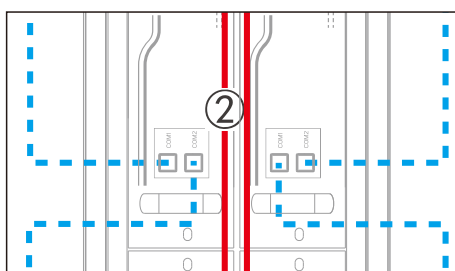
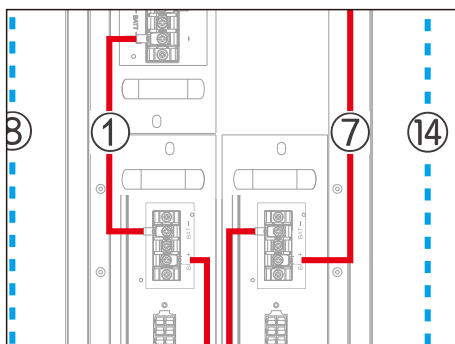
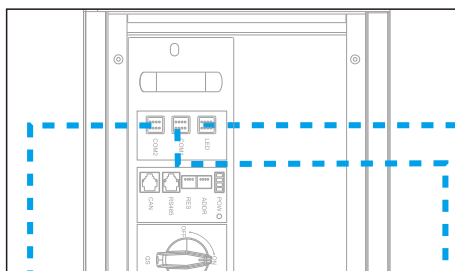
3.3.3 Connection overview and the numbering of the cables (PSM10, applies also for 1550mm cabinet)



Note:

For **2050 mm** cabinet installation, empty slots are left at the bottom (as illustrated above);
For **1550 mm** cabinet installation, **no empty slots**.

Zoomed in:



4. ESO MODULE

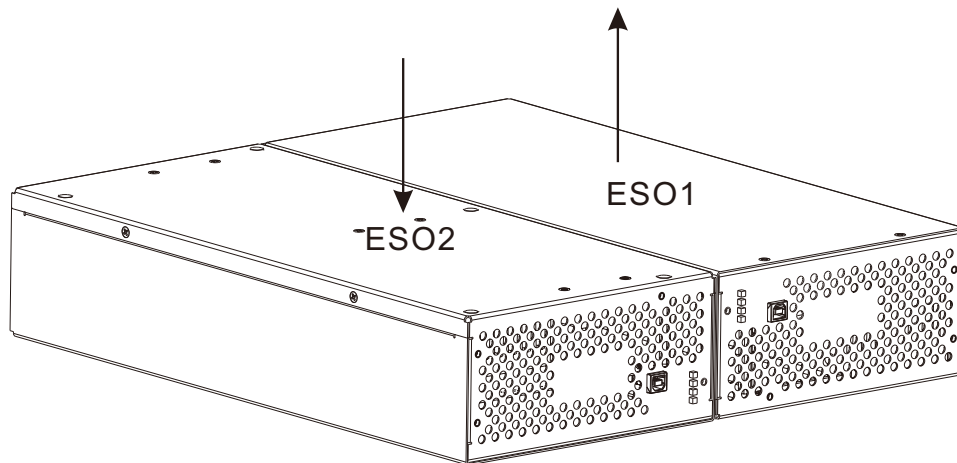
Depending on the system configuration, one or two ESO modules are shipped alongside with your PSM system. The ESO module is normally shipped in a cardboard package without pre-assembly. Each ESO module resembles a rectangular metal box.

Please skip to 4.2 if ESO is shipped pre-assembled.

4.1 ESO ASSEMBLY

The following instruction applies to the two-ESO system with a nominal power of 12kW.

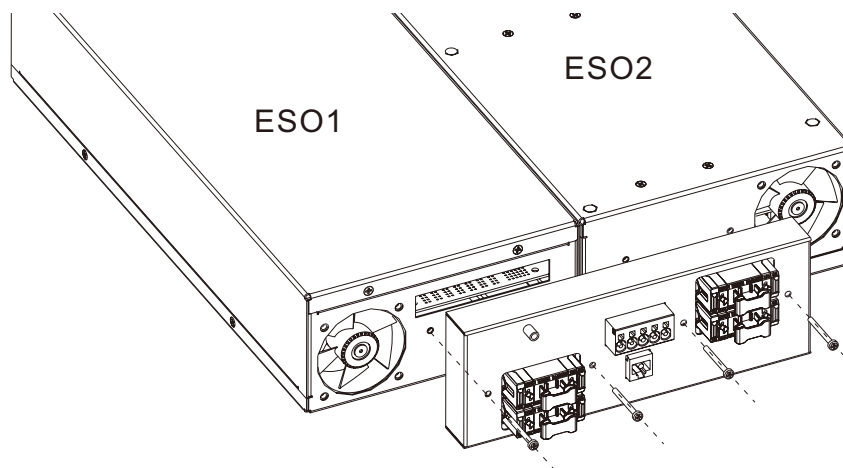
Lay the two ESO modules side by side on a flat surface. Make sure the second one (ESO2) have the bottom metal enclosure facing upward as indicated in the picture below.



Note that the weld nuts are visible from the ESO bottom metal enclosure.

Install the ESO adaptor:

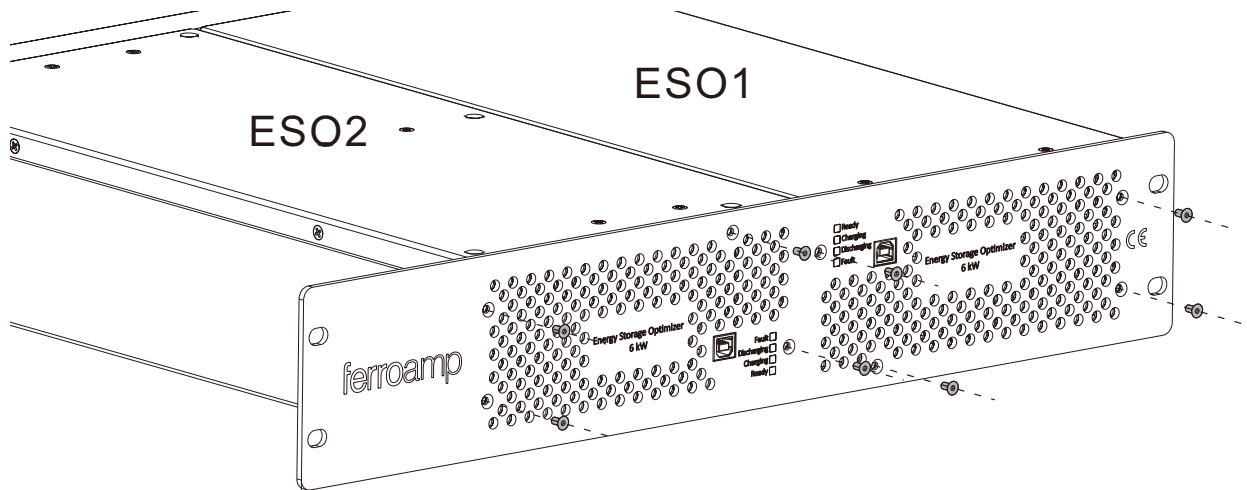
- firmly insert the adaptor into the sockets
- fasten the screws (4 pcs)



Note: do not lift the ESO off the supporting surface during the assembly

Install the ESO front plate.

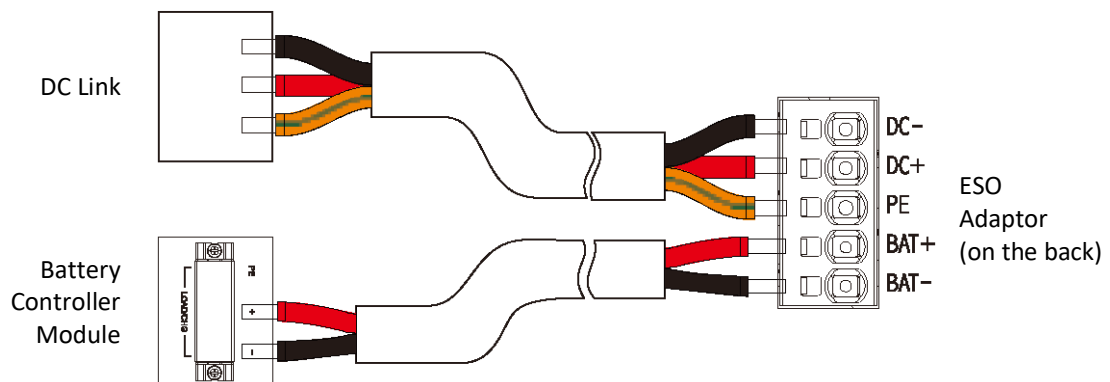
- Carefully align the ESO front plate to the
- Pay specially attention to the LED prismatic piece
- Fasten the screws (8 pcs)



4.2 CABLE INSTALLATION

Power cables

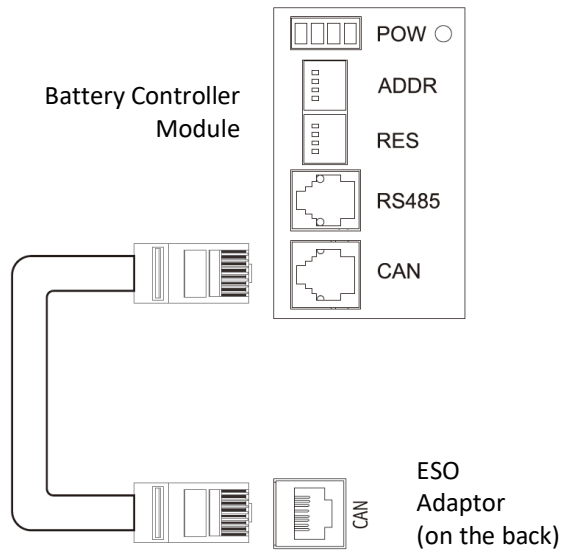
The following diagram shows the power cable connecting the ESO to the battery controller module and to the DC-link.



We recommend to prepare the DC-Link cable before inserting ESO into the cabinet. The external cable installation is covered in **Section 5**.

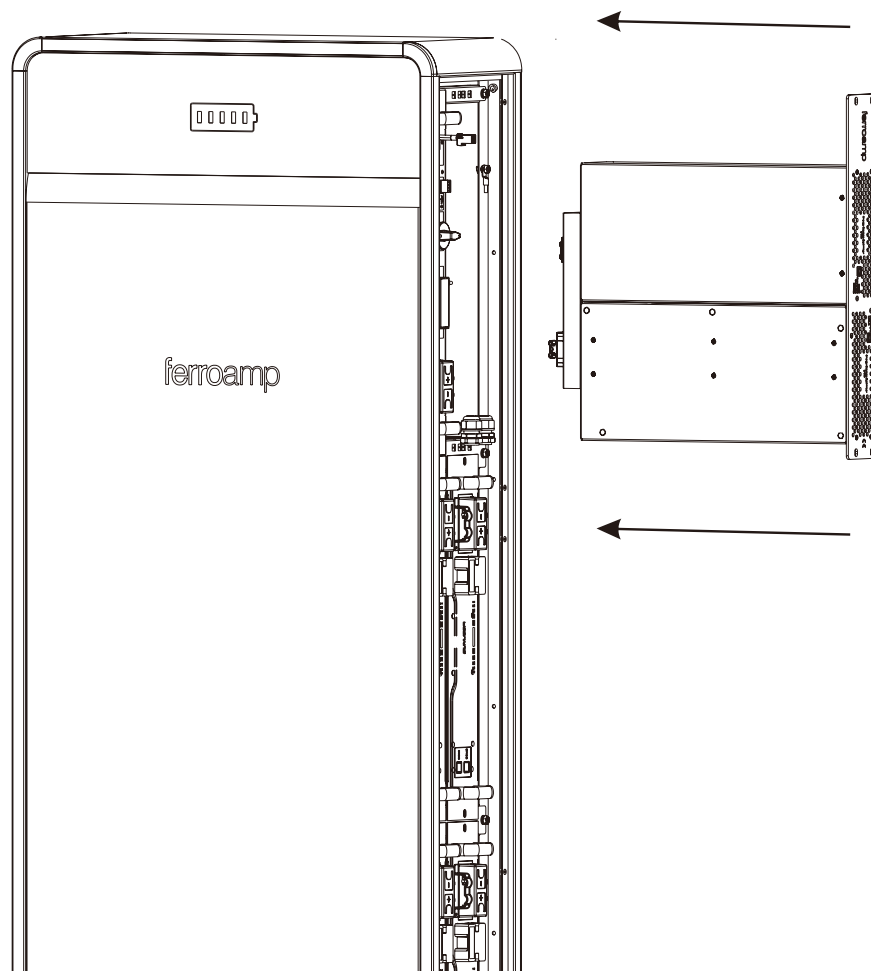
Communication cable

The communication between ESO and the battery controller module is through a standard RJ45 cable (ethernet cable). The connection is showed as below.



4.3 INSERT THE ESO

Insert the assembled ESO sideways and fasten the bolts.

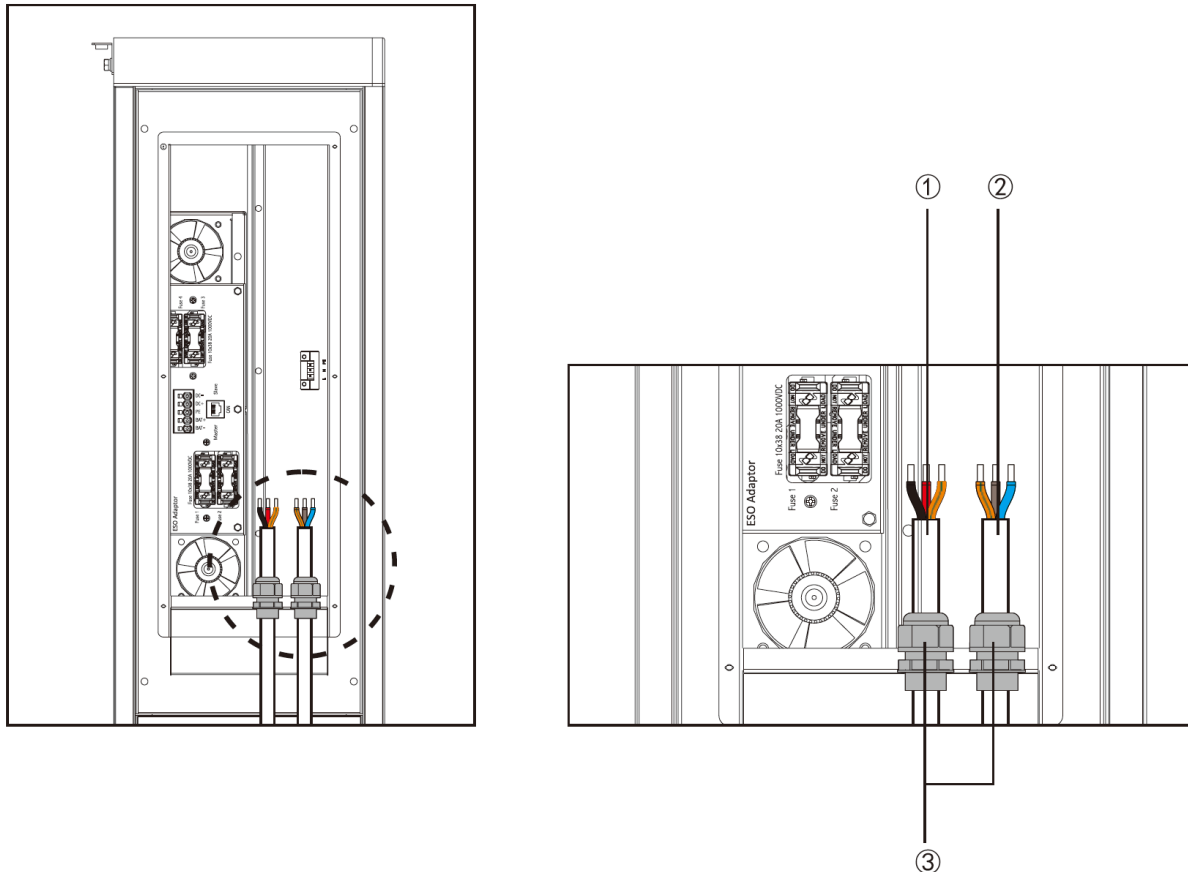


5. EXTERNAL CABLE

PSM system requires two external cables:

- One DC-Link cable (DC+,DC-, PE) connecting to the DC junction box, powered by EnergyHub
- One AC cable (L,N,PE) powering the controller module (single phase, 230V)

The following diagram shows a typical external cable installation.

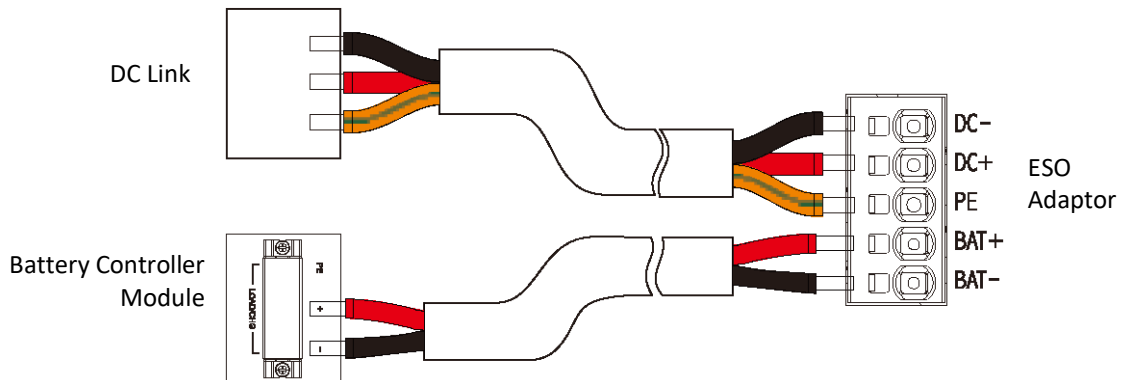


Side view of the upper part cabinet with side panel removed:

- (1) DC-Link cable
- (2) AC230 cable
- (3) cable gland (to be fastened after the installation)

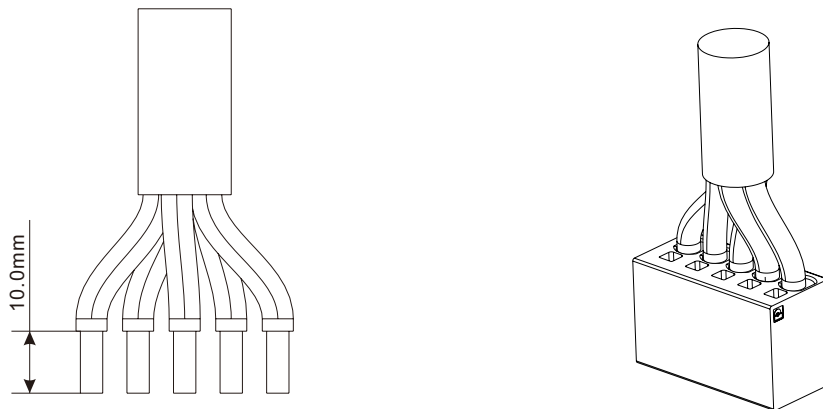
5.1 DC-LINK CABLE

The ESO comes with a **Phoenix Contact 5P socket** on the back of ESO adaptor for easier cable installation. The socket is seen on the righthand side in the diagram below.



To connect the cable:

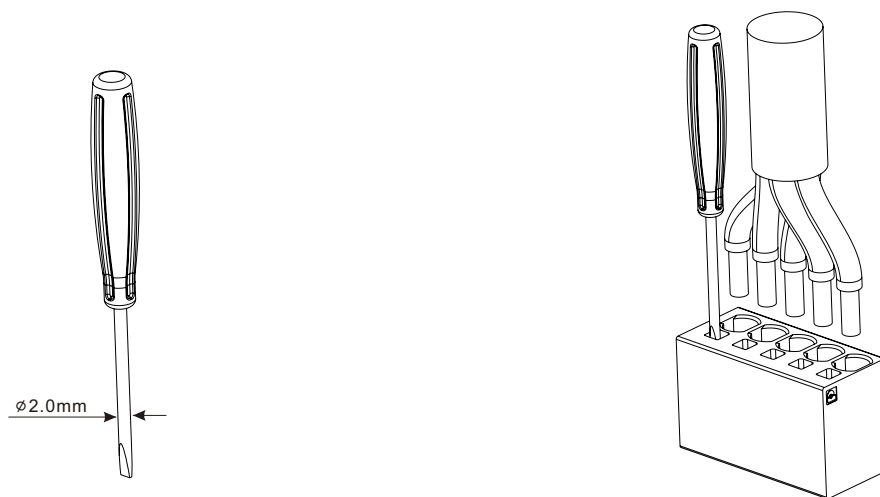
- Prepare the cable according to the following diagram.
- Install one cable at a time, apply force evenly and gently in the direction towards the cable socket, make sure each cable is fully inserted.
- Once fully inserted, the cable is locked inside the socket.



Note: if properly inserted, the installed cable cannot be removed without using a tool. Properly installed cable looks like the one in the right above.

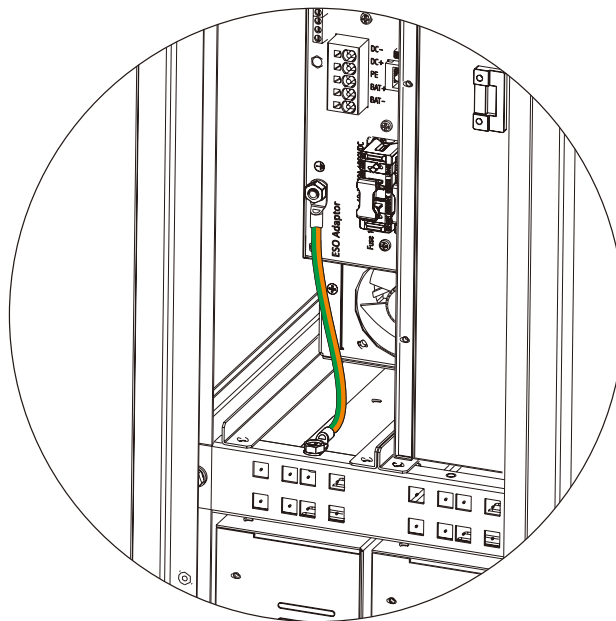
To remove an installed cable:

- use a flat-blade screwdriver (2mm)
- firmly insert the flat-blade into the locking-releasing hole next to the cable socket (diagram below)
- Pull out one cable at a time until all cables are fully detached



The PE cable

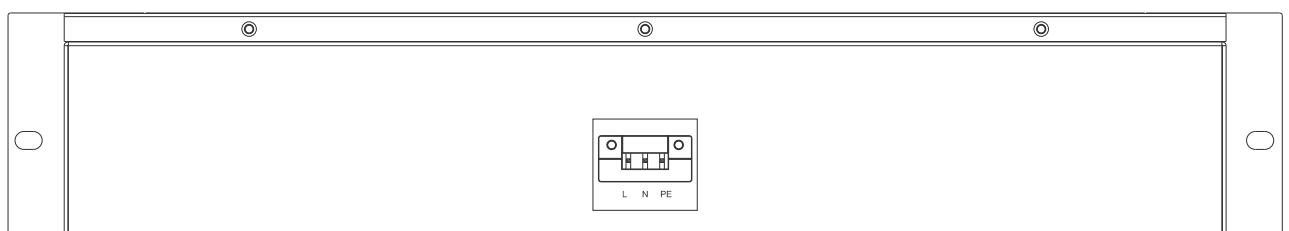
Connect the PE cable to metal bar inside the cabinet.



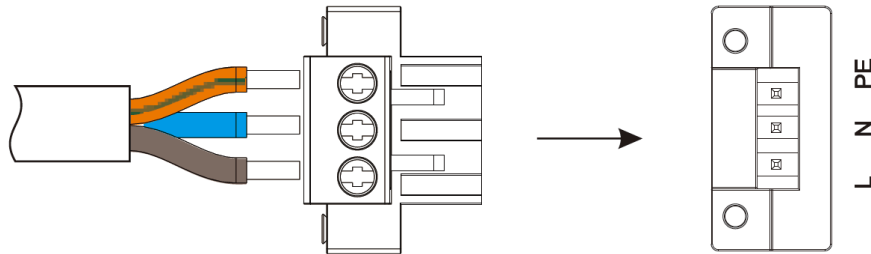
5.2 AC CABLE

(Only for controller model H100030H-P02)

The module comes with a cable terminal block in the box. The back of the controller looks like below.



- Build the cable / peel off the insulation (approx. 1.0 cm)
- Insert the cable into the terminal block* as indicated (figure below)
- Plug in the terminal block and fasten the screws (flat-blade 2mm)



Note*: an alternative terminal block (PLTB2.5-BF-SP) with a push-release mechanism instead of fastening bolt may also be found in the package

Please consult electrician for the AC power cabling.

5.3 CABLE GLAND

Check all the external cabling before tightening the cable gland.

Make sure no tension is built when fastening the cable gland.

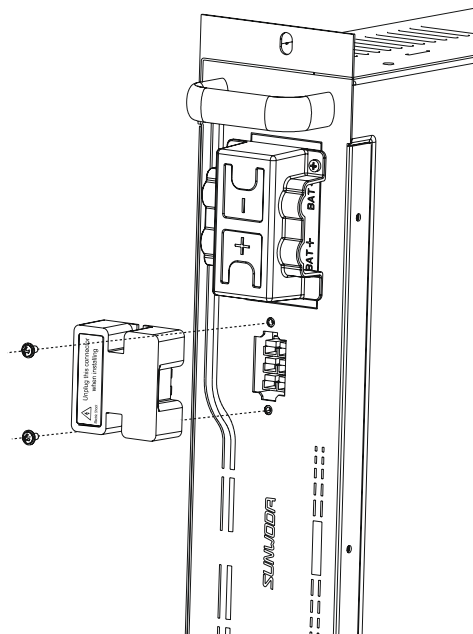
6. FINAL CHECK AND FINISHING UP

Consider using the checklist in Section 7.4 Trouble shooting / installation checklist.

6.1 JUMPER BRICKS

Both the battery and the controller module come with jumper bricks for safety consideration.

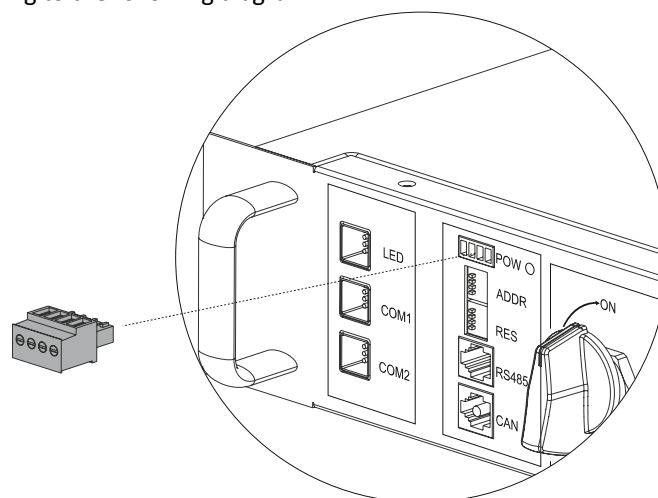
The battery is physically cut off from the internal circuit if the jumper brick is removed. Install the batter jumper brick according to the following diagram.



Make sure all the screws are properly fastened.

The battery controller comes with a green jumper that needs to be installed. The power to the controller is cut off if the jumper is removed.

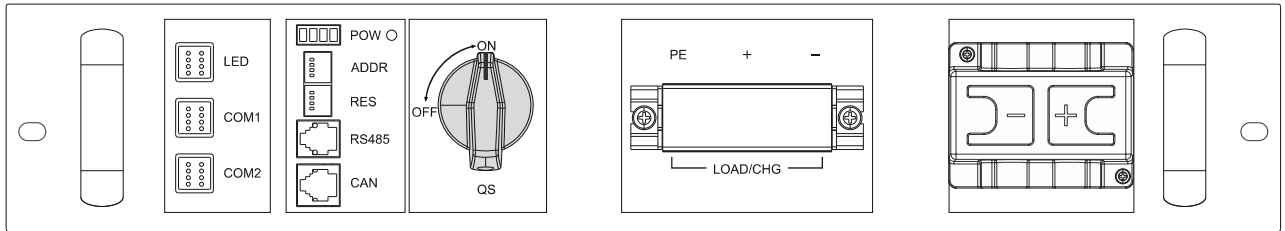
Insert the jumper according to the following diagram



PSM 10/12/15 Series installation manual

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The battery controller has no power output if the QS breaker is switched off. The QS breaker should be switched **ON** before powering up. It is prohibited to operate the QS during charging or discharging.



Make sure all the jumpers, switches done properly according to instructed.

6.2 FINISHING UP

Put back all the side panels in reverse order they were removed. Make sure all the screws are properly fastened.

Note: the PSM system does not come with any switch.

The LED lights up when the controller module (**H100030H-P02**) is powered from AC230. You may hear click which indicates the system initiates self-diagnosis. Your PSM system is now ready.

Contact your system administrator for a proper setting of the PSM in your FerroAmp Portal system.

After a proper configuration, the PSM system will be displayed as a battery in your Portal. The PSM is automatically controlled by the EnergyHub.

7. MORE INFORMATION

7.1 MEANING OF CABINET LED

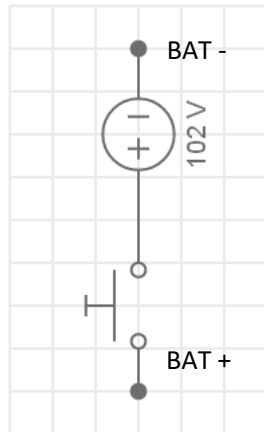
LED indicator interpretation

(★ is flashing, ★★ is flashing quickly, ● is always on and the flashing frequency is 1Hz)

STATES DESCRIPTION		LED 1	LED 2	LED 3	LED 4	LED 5	REMARKS
Power off							Lights off
Self-inspection							LED flashing
Charging	SOC 0% - 20%	★					LED1-LED5 flashing
	SOC 21% - 40%	●	★				LED2-LED5 flashing
	SOC 41% - 60%	●	●	★			LED3-LED5 flashing
	SOC 61% - 80%	●	●	●	★		LED4-LED5 flashing
	SOC 81% - 100%	●	●	●	●	★	LED5 flashing
	Over vol. warning	★	●				
	Over temp. warning	★		●			
	Over current warning	★	●	●			
	Over vol. protection	★★	●				
	Over temp. protection	★★		●			
	Over current protection	★★	●	●			
Discharging	SOC 0% - 20%	●					
	SOC 21% - 40%	●	●				
	SOC 41% - 60%	●	●	●			
	SOC 61% - 80%	●	●	●	●		
	SOC 81% - 100%	●	●	●	●	●	
	Under vol. warning	★			●		
	Over temp. warning	★	●		●		
	Over current warning	★	●	●	●		
	Under vol. protection	★★			●		
	Over temp. protection	★★	●		●		
	Over current protection	★★	●	●	●		
Error		★	★	★	★	★	

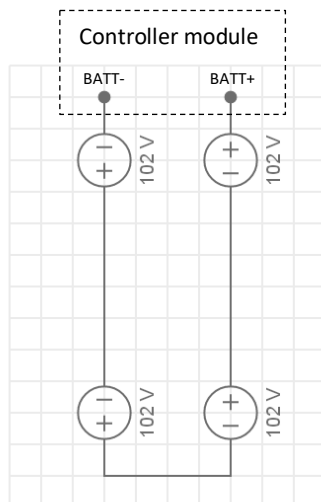
7.2 SYSTEM SCHEMATIC DIAGRAM

1. One battery module.

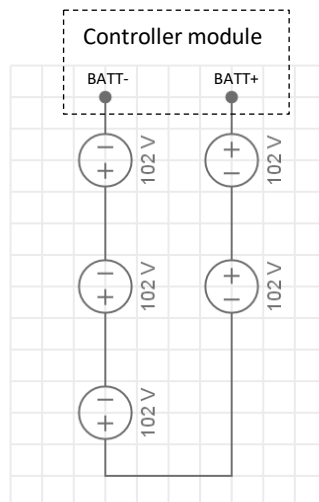


Note: the **jumper brick** is illustrated here as a “switch”; when inserted, the single battery module is **switched ON**. Refer to **6.1 JUMPER BRICKS** for detailed description. The open circuit voltage $V_{BAT+,BAT-}$ is 102 ~ 106V.

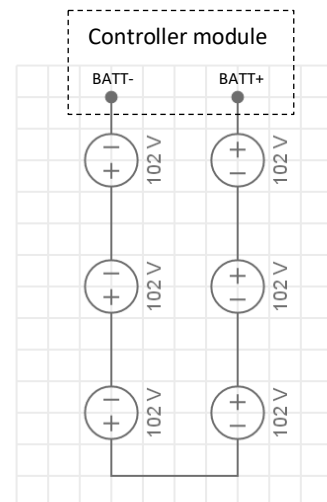
2. Schematic diagram showing power cables



PSM 10 (4 Batt.)

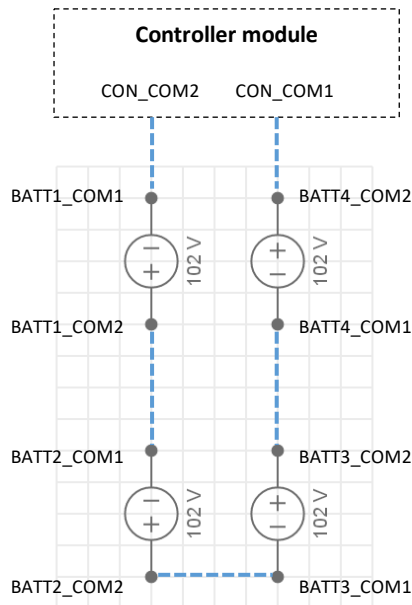


PSM 12,5 (5 Batt.)



PSM 15 (6 Batt.)

3. Schematic diagram showing communication cables



Note: the **cable connector is labeled** with the exact port to be connected and shall not be reversed.

Taking **PSM10** (4 batteries) for example, 5 comm. cable are installed between:

CON_COM2	-->	BATT_COM1
BATT1_COM2	-->	BATT2_COM1
BATT2_COM2	-->	BATT3_COM1
BATT3_COM2	-->	BATT4_COM1
BATT4_COM2	-->	CON_COM1

Properly installed comm. cables should resemble a “**close loop**”

7.3 TROUBLE SHOOTING GUIDE

Use a **CAT III** (690V or better) multimeter for measuring the total voltage of a battery string. Normally, the **Negative (COM)** probe is **black**, and the **Positive (DC V)** probe is **red**.

- Measure the voltage (BAT+ and BAT-) for **each battery** module
 - Insert the **jumper brick**
 - The measured module voltage $V_{BAT+,BAT-}$ shall be 102 ~ 106V
- Check the power cable polarity according to the system **schematic diagram**
 - Step by step measuring the battery voltage in series, the measurement should be done according to the following:

Negative (COM)	Positive (DC V)	Battery pcs.	Approx. Voltage (V)
BAT1-	BAT1+	1	102
BAT1-	BAT2+	2	204
BAT1-	BAT3+	3	306
BAT1-	BAT4+	4	408
BAT1-	BAT5+	5	510
BAT1-	BAT6+	6	612

if the measured voltage does not correspond to above, check the power **cable** as well as the safety **jumper brick**; repeat the measurement.

- If properly connected, the total measured voltage at the **controller module** (BATT +, BATT -) should be:

Negative (COM)	Positive (DC V)	PSM model	Approx. $V_{BATT+, BATT-}$
BATT-	BATT+	PSM 10	408 v
BATT-	BATT+	PSM 12,5	510 v
BATT-	BATT+	PSM 15	612 v

3. Check the protection earth (PE)

- Note: the PE is shared by the **controller module**, **ESO** (casing), the **cabinet** and **PE in the main junction box**. The electric potential should be equal when measured using a multimeter.
- It **prohibited** to connect PE with single phase neutral line (N) which will cause **isolation** fault thus result in system bootup failure.
- At normal operation condition (bootup completed), the PE is “floating” meaning:

$$V_{BATT+, PE} = V_{PE, BATT-}$$

Taking PSM 10 with 4 batteries for example, when measuring at the controller module output with a multimeter:

$$V_{BATT+, BATT-} \approx 408 V, V_{BATT+, PE} = V_{PE, BATT-} \approx 204 V$$

4. Check the CAN communication cable (COM1, COM2, CAN)

- **Proprietary cables** are used for CAN communication between adjacent modules and are always physically connecting from port **COM2** (on the first module) to **COM1** (next adjacent one). Follow **3.3 CABLE INSTALLATION** for detailed instruction. Refer also to the **Schematic diagram** showing **communication cable** in previous section.
- Standard RJ45 cable is used for **CAN** communication between controller module and the ESO.

*When connecting a CAN analyzer to the **CAN** port (RJ45) on the controller module for debugging, one will need to manually set **RES** dip1 to **ON** (CAN terminating resistor) because some CAN analyzer does NOT have internal terminating resistor thus results in CAN communication failure. It is OK to leave **RES** dip1 to **ON** even for normal operation condition.*

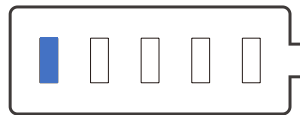
5. Power on the PSM system

- **CHECK the DC junction box first:** the DC junction box normally accommodates one DC breaker (MCB, 4-p 1000V) for DC-link and multiple fuse holders (1-p 1000V) for SSO (10A, solar panel) and ESO (20A, battery).

It is important to **connect only ESO** to the DC-Link for trouble shooting. Make sure DC power (Energy hub) is turned off before proceeding.

- First, power up the DC-link
 - Connect **ONLY** the ESO to the DC-link, it can be done by closing its fuse holders while leaving the SSO fuse holder (s) open; close the MCB breaker for DC-link, then

- Switch on the Energy hub, it will automatically detect modules connected to DC link and power them up;
- The LED on the ESO panel will light up indicating it is powered through the DC link
- The fault LED on the ESO panel will light up **red** indicating no communication to the battery controller module. This fault will be cleared as long as the battery is properly connected.
- Second, switch on the battery controller module
 - Make sure the main **breaker (QS)** is on and the **jumper** (green) on the front of the controller module is inserted. The controller model (H100030H-P02) will bootup immediately after powered through AC 230V.
 - The LED on the front panel will light up **one at a time from left to right** indicating self-diagnosis, during which time the user can hear multiple “**click**” indicating relay action inside the controller module.



- The PSM boot up sequence will take about 45 seconds; when finished, the ESO will automatically recognized the connected battery, and the LED on the ESO panel will light up **green**.
- On the PSM cabinet front panel, the left-most LED will **stay on** indicating SOC ~ 20%.
- **Note:** the controller module will automatically perform multiple diagnoses before trying to **pre-charge** then **close its main relays** (powered on):

output shortage	short circuit between controller module output to the ESO (LOAD/CHG +, -)
isolation	Step-wise impedance check: ○ Batt.+ to PE ○ Batt.- to PE ○ LOAD/CHG + to PE (briefly close pre-charge relay) ○ LOAD/CHG - to PE (open pre-charge relay, briefly close negative relay)
batt. voltage	the voltage at the controller battery string input (batt.) agrees with the number of battery modules installed in the system
communication	the CAN communication between controller module and each battery module is established
Cell level BMU	the cell level management unit (BMU, inside the battery module) functioning normal; the cell voltage is normal
temperature	the temperature sensors are functioning normal; the ambient temperature should be above zero

In case any error is detected during the bootup, the controller module will abort the sequence and all LED on the cabinet front panel starts **flashing**.

Please contact customer support for further support if the guide does not resolve the issue.

7.4 TROUBLE SHOOTING / INSTALLATION CHECKLIST

Mark "x" if the item is checked OK

What to check	Where to check	Mark
Power cables	Batt. module	
Jumper bricks	Batt. module	
Comm. Cable	Batt. module / Ctrl. module	
Protective earth (PE)	ESO / Junction box / Ctrl. module/ Cabinet	
DC-Link cable (DC+, DC-)	ESO / Junction box	
Power output (LOAD/CHG)	Ctrl. module (LOAD +, -) / ESO (BAT+, -)	
AC 230 cable	Ctrl. module	
QS switch	Ctrl. module	
Safety jumper (green)	Ctrl. module	
RJ45 (CAN)	Ctrl. module / ESO	

Manufacture supplied information

1. Battery Module

Model No. H102025M-S with High-voltage Control Module

2. Battery controller module

HV control module H100030H-P01 (off-grid)

HV control module H100030H-P02 (AC powered)

3. Ferroamp support

Technical support: support@ferroamp.se

Phone +46 (0)8-684 333 90, select 2

7.5 DATASHEET

	DC coupled energy storage		
PSM System Model *	PSM 10 / 4 (8)	PSM 12.5 / 5 (10)	PSM 15 / 12
Storage capacity, W _{NOM}	10 kWh	12.5 kWh	15 kWh
Maximum power rating, P _{MAX}	4 kW (8kW)	5 kW (10kW)	12 kW
Battery voltage, V _{NOM}	410 V	512 V	614 V
Maximum cont. battery charge current, I _{BAC}	20 A		
Maximum cont. battery discharge current, I _{BAD}	20 A		
Electrical roundtrip efficiency incl. DC/DC converter	93 % typical		
Cycle life	6000 cycles @ 80% DOD, EOL capacity 70%		
Cell chemistry	LiFePO4		
Maximum battery potential to ground	1000 Vpk		
Battery fuses	20 A, 1000 V, 10x38 mm gPV		
SOC precision	≤ 5 %		
Standby consumption incl. DC/DC converters	≤ 5 W (10 W)		≤ 10 W
Protection functions	Over voltage, over temperature, over current, isolation fault, pre-charge protection, short-circuit protection		
DC-nanogrid			
Number of included ESO DC/DC converters	1 (2)		2
DC bus voltage, V _{DC}	760 V (nominal)		
DC bus voltage range, V _{DC}	720 – 800		
Maximum DC bus current, I _{DC(max)}	10 A / 20 A	10 A / 20 A	20 A
DC bus connection	3-wire (DC+, DC-, PE)		
DC bus communication	Narrow band power line communication (PLC)		
Physical			
Dimensions H x W x D	1550 x 630 x 250 mm	2050 x 630 x 250 mm	
Weight	140 kg	Up to 210 kg	
Color	Black		
Installation			
Ambient temperature	0°C – 40°C		
Humidity	10 – 90% RH non condensing		
Degree of protection	IP 20		
BMS Power supply	230 VAC, max 40 W		
Compliance			
Battery safety	EN 62619, UN38.3		
LVD	EN 62477-1		
EMC	EN 61000-6-3, EN 61000-6-2		

* the data in parenthesis refers to model shipped with 2 ESOs