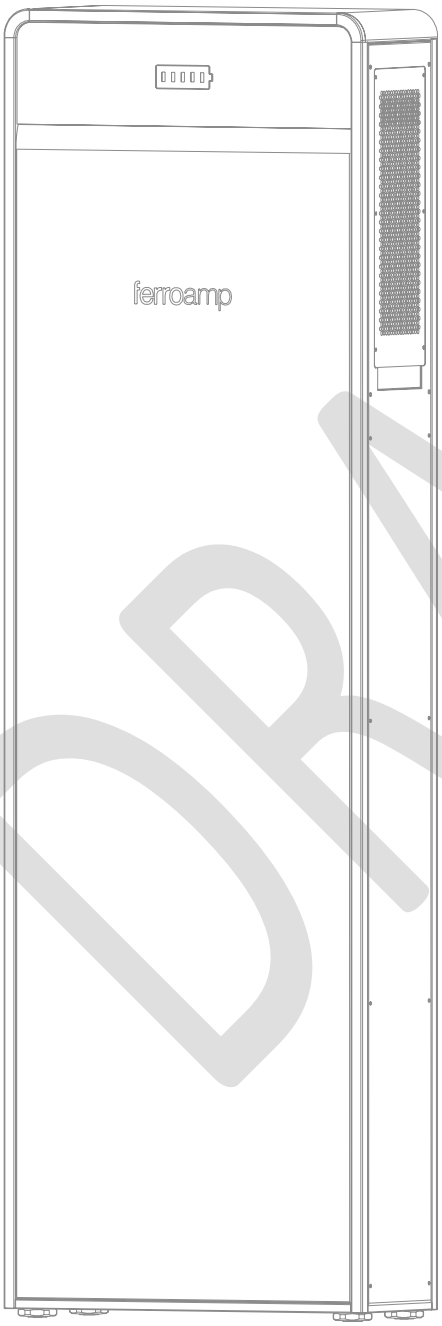
ferroamp

PSM 10/12/15 SERIES

INSTALLATION MANUAL

Ver.1.06 Jan. 2021
esoltech AB



SUNWODA ENERGY esol

WARNING

- Read through the instruction manual before installation.
- Electrical installation shall be done by professional such as electrician or authorized personnel in accordance with electrical standards and safety precautions.
- Simple assembly required for specific component shipping (ESO); consult your supplier for additional assembly support.
- Do not open the enclosure of the electrical components. Warranty is void if unauthorized modification is made.
- Plug in the jumper brick (for 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 ACE technology.

Abbreviations

ACE	Adaptive Current Equalization
BAT	Battery Module (batt.)
BMS	Battery Management System
CAN	Controller Area Network
CHG	Charge
COM	Communication (comm.)
ESO	Energy Storage Optimizer
LED	Light Emission Diode
PSM	Power Storage Module
SSO	Solar String Optimizer
SOC	Status of Charge

ferroamp
Ferroamp Elektronik AB (FERRO.ST) 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 (300207.SZ) established in 1997, a manufacture powerhouse with the headquarter in Shenzhen, China.

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

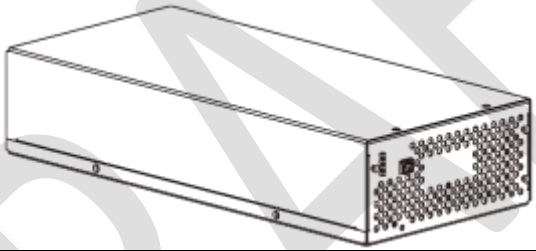
TABLE OF CONTENTS

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

System components:

Battery module		*4 pcs (PSM10)* *5 pcs (PSM12)* *6 pcs (PSM15)*
Battery controller		*1 pcs*
Energy Storage Optimizer (ESO)		*1 pcs (up to 6kW)* *2 pcs (up to 12kW)*
The Cabinet	see picture on the cover page	
Accessories box	see the list of accessories	

List of accessories:

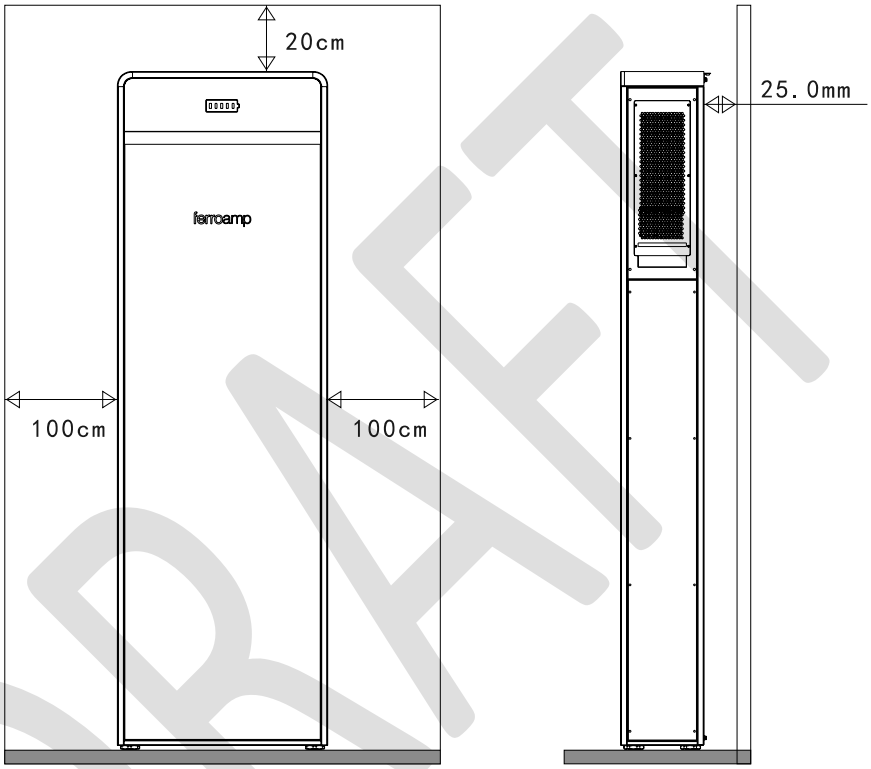
Item no.	Description	quantity	note
1	Installation manual	1	This manual
2	Wall mounting expansion bolt	2	M6 x 60mm
3	Power Cable: ESO - Battery controller PG	1	UL1015 12AWG Red 1500mm
4	Power Cable: ESO - Battery controller NG	1	UL1015 12AWG Black 1500mm
5	Power Cable 230VAC - Battery controller	1	IEC53 RVV 300/500V Black (3 threads) 4000mm
6	Comm. cable: from ESO to Battery controller	1	RJ45 Grey 2000mm
7	Grounding cable (PE) for ESO	1	UL1015 10AWG Yellow-Green 320mm
8	LED Cable	1	UL1007 24AWG (6 threads) 400mm
9	Power Cable for Battery Module	5	UL1015 10AWG Blue 100mm - 590mm
10	Power Cable for Battery Module (PSM 12/15)	7	UL1015 10AWG Blue 100mm - 590mm
11	Comm. Cable for Battery Module	5	UL1007 24AWG (5 threads) 100mm - 1300mm
12	Comm. Cable for Battery Module (PSM 12/15)	7	UL1007 24AWG (5 threads) 100mm - 1300mm
13	Cable tie	30	plastic 150mm
14	Cable tie basis	10	3M (adhesive) White 28,3 *28.3mm
15	Bolts	2	M6 x 14mm

* Available online from https://github.com/PSM-support/Instruction-manual

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:

- Ambient temperature is 3 – 45 deg. (recommended 25 deg.);
- Relative humidity ranges 0-95%;
- Adequate clearance (illustrated below) for 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 is to be fixed.

- **Figure A:** A wall mounting assembly is preinstalled at location 1. The assembly can be attached to location 1, 2 or 3 on the cabinet.
- **Figure B:** Fix the wall mounting piece to the wall.
- **Figure C:** Fasten the fixing bolts (M6) to secure the cabinet.

Please refer to Section 2.3 for the feet adjustment.

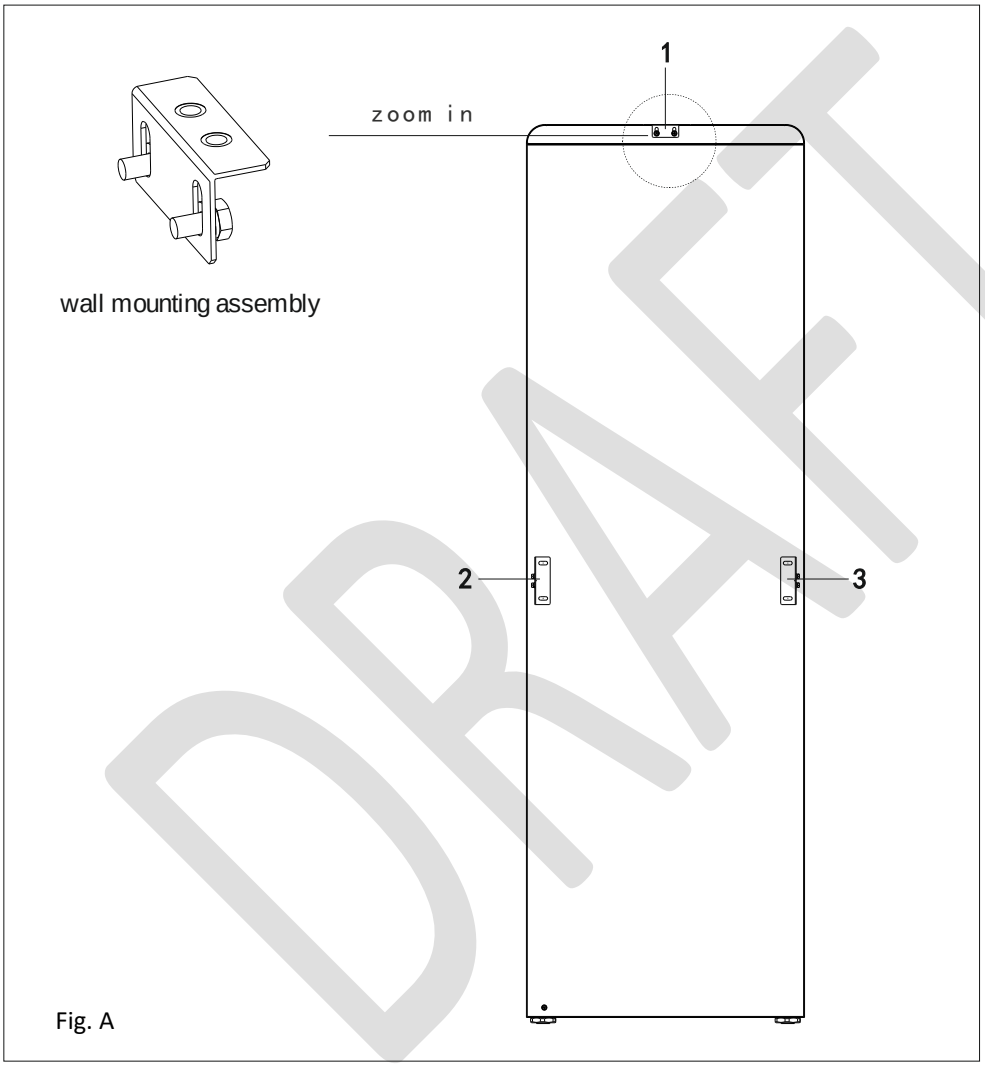


Fig. A

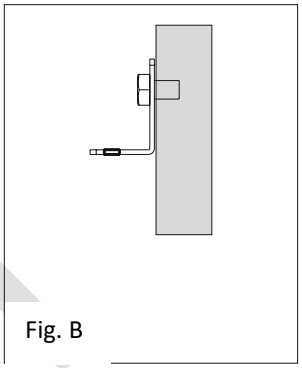


Fig. B

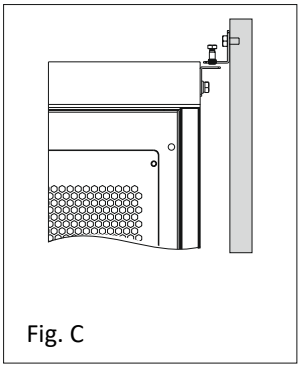
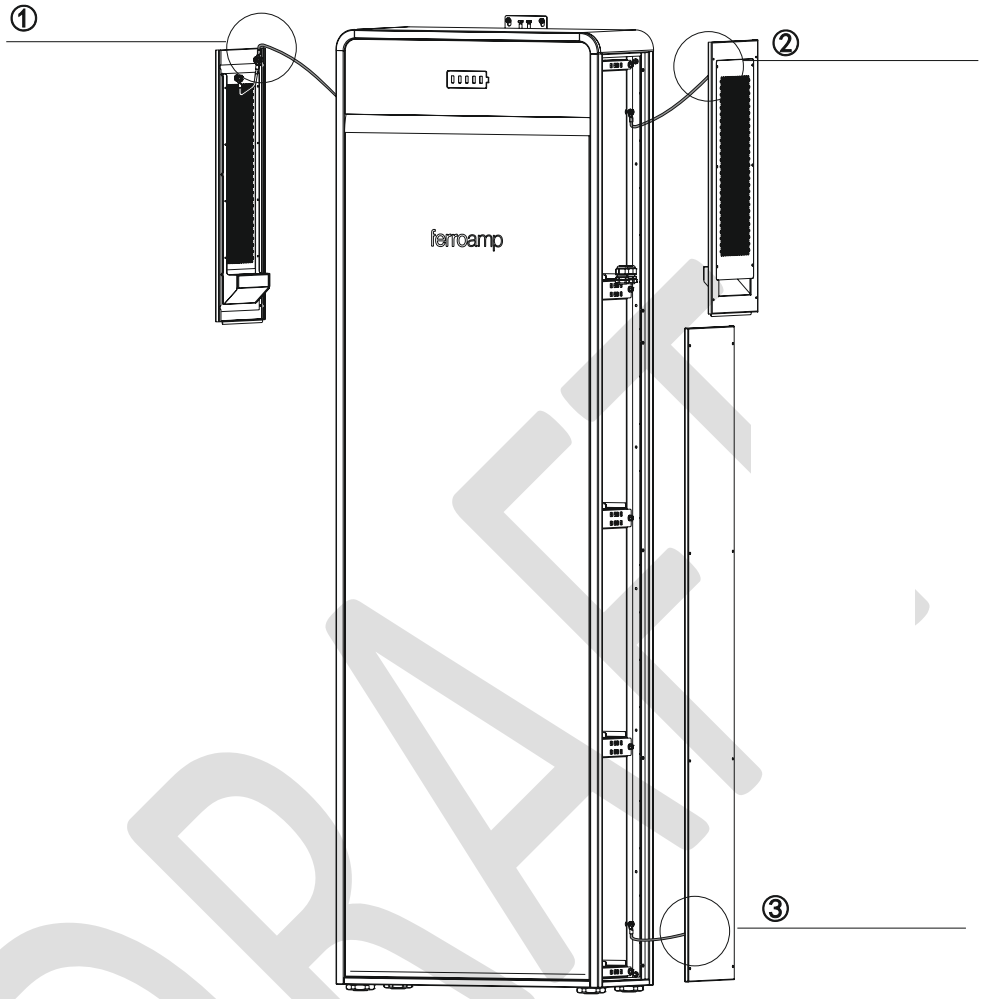


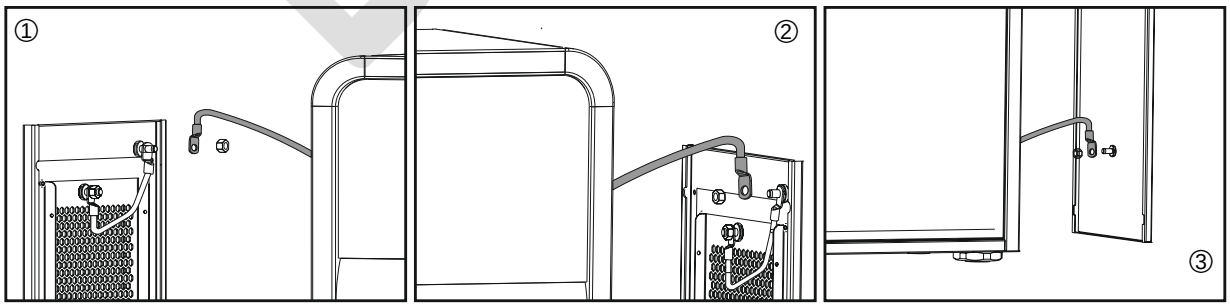
Fig. C

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.

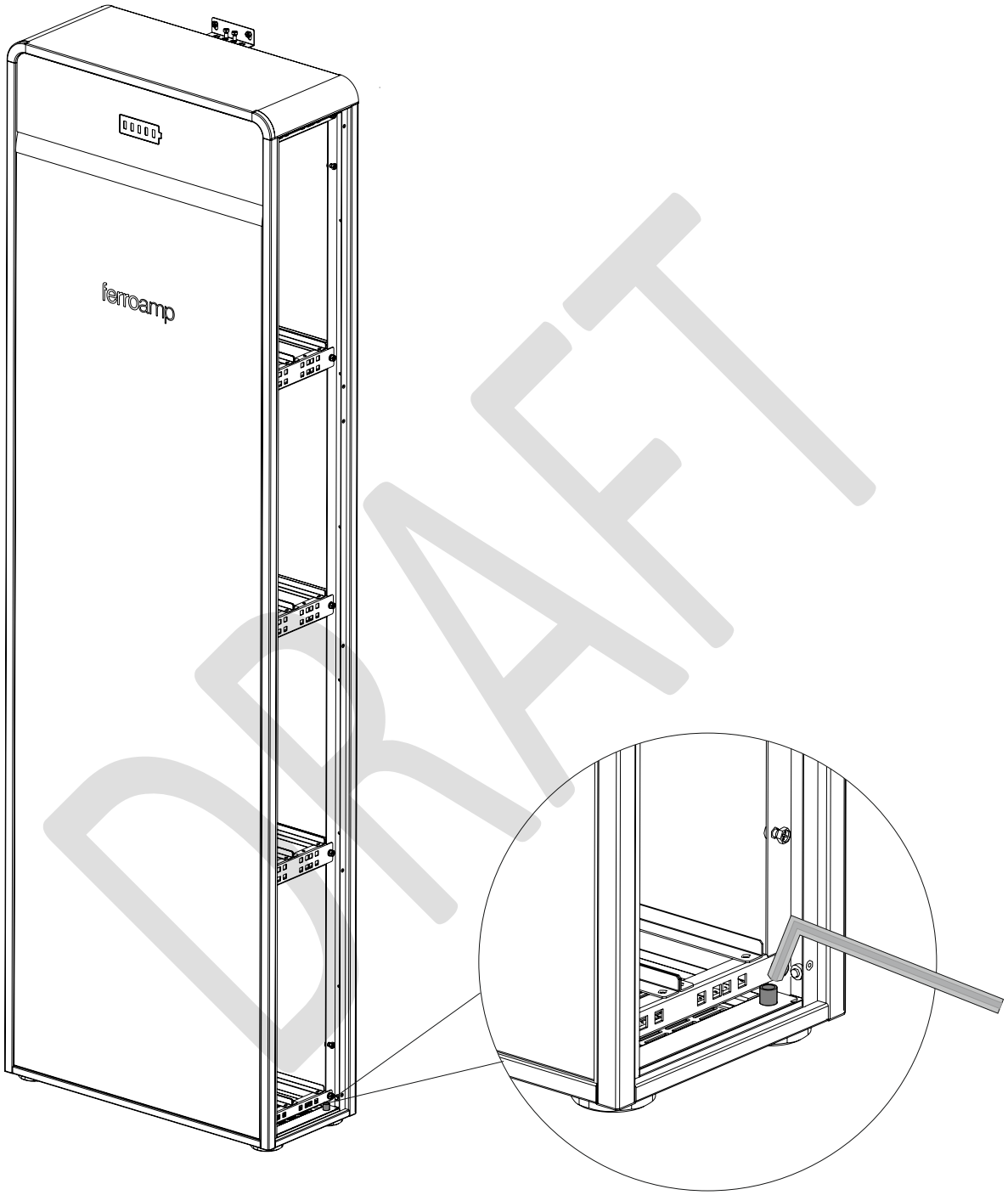


The diagram shows the upper side panels and one of the lower side panels are removed. Detach the grounding cable for installation clearance. The following shows the details of removing the grounding cables.



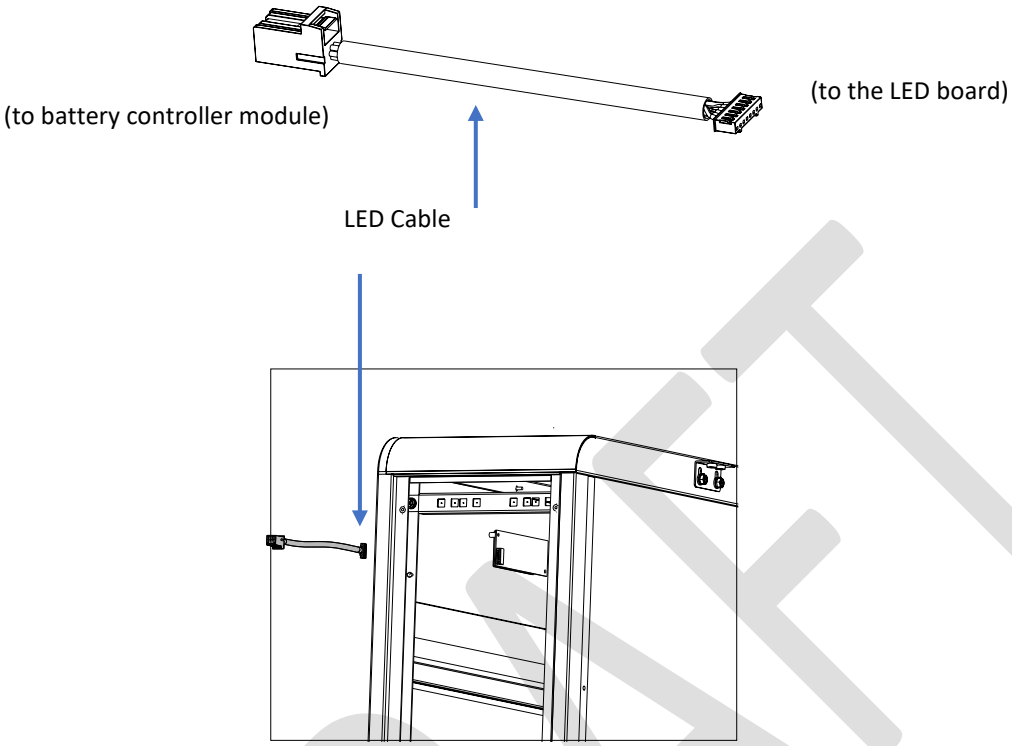
2.3 ADJUSTING THE FEET

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.

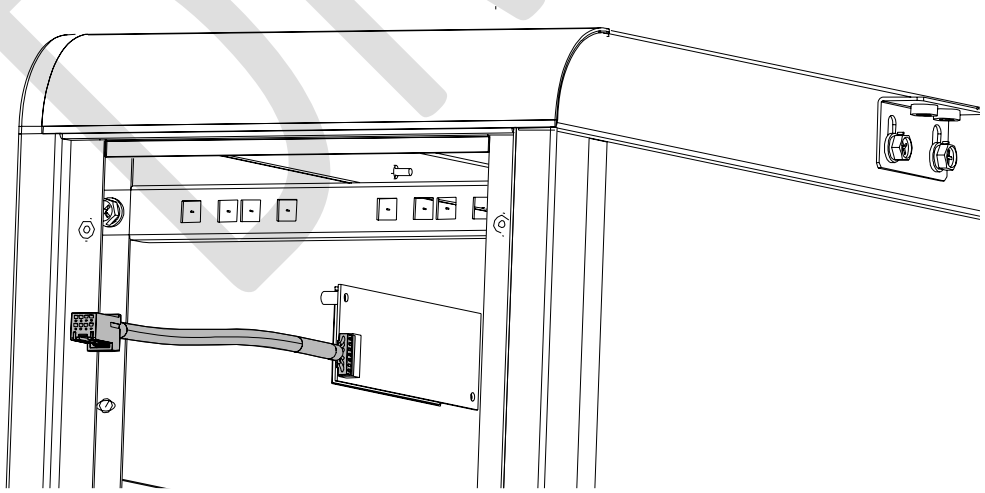


2.4 CABLE FOR LED PANEL

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



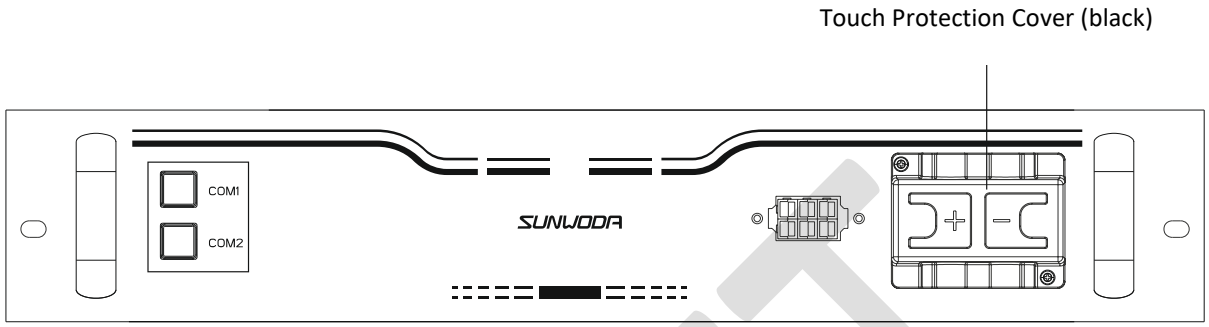
There is only one direction the cable can be inserted firmly. The following picture shows inserted LED cable connector. The other end of the cable is to be connected to the battery controller module **(See also Section 3.2)**.



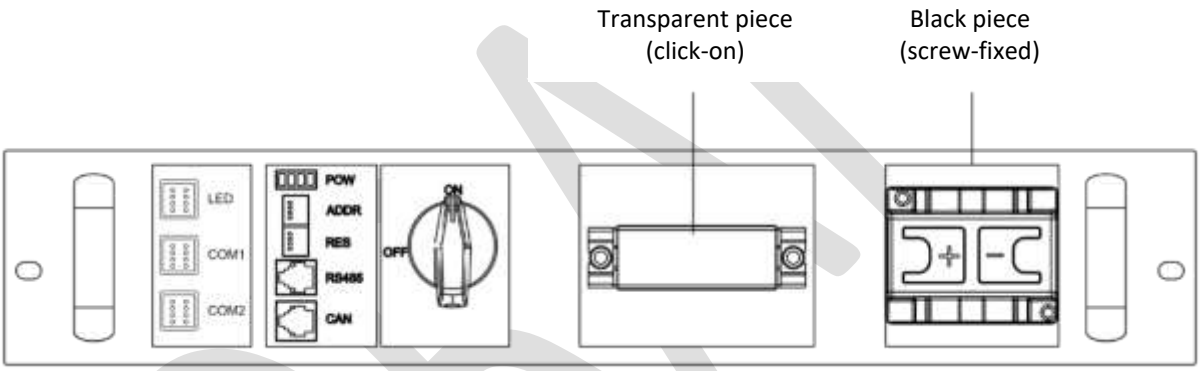
3. BATTERY AND CONTROLLER MODULES

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

Battery module:



Battery controller module:

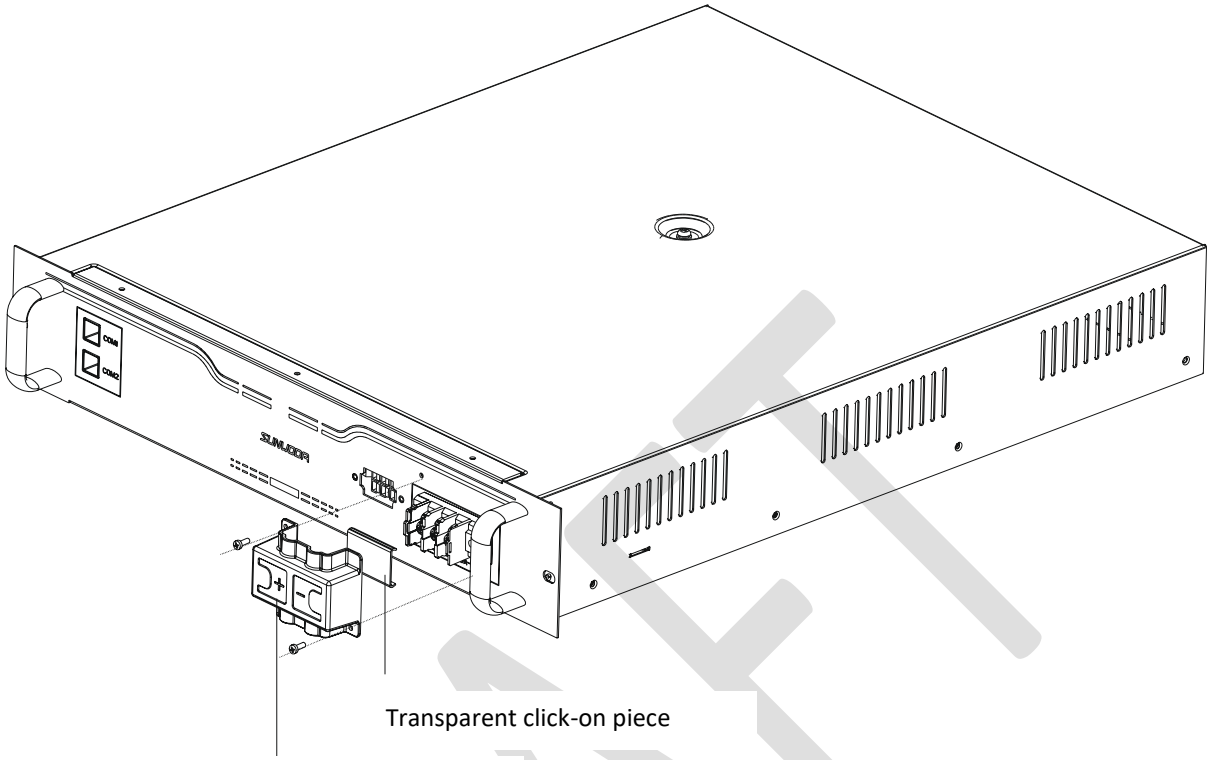


The PSM system is shipped with one battery controller module and 4 - 6 battery modules depending on system configuration.

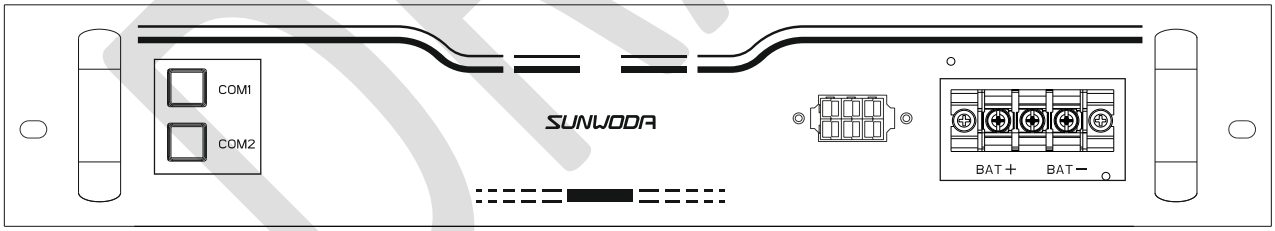
Remove the preinstalled Black protection cover before inserting the unit into the cabinet.

3.1 Touch Protection Cover

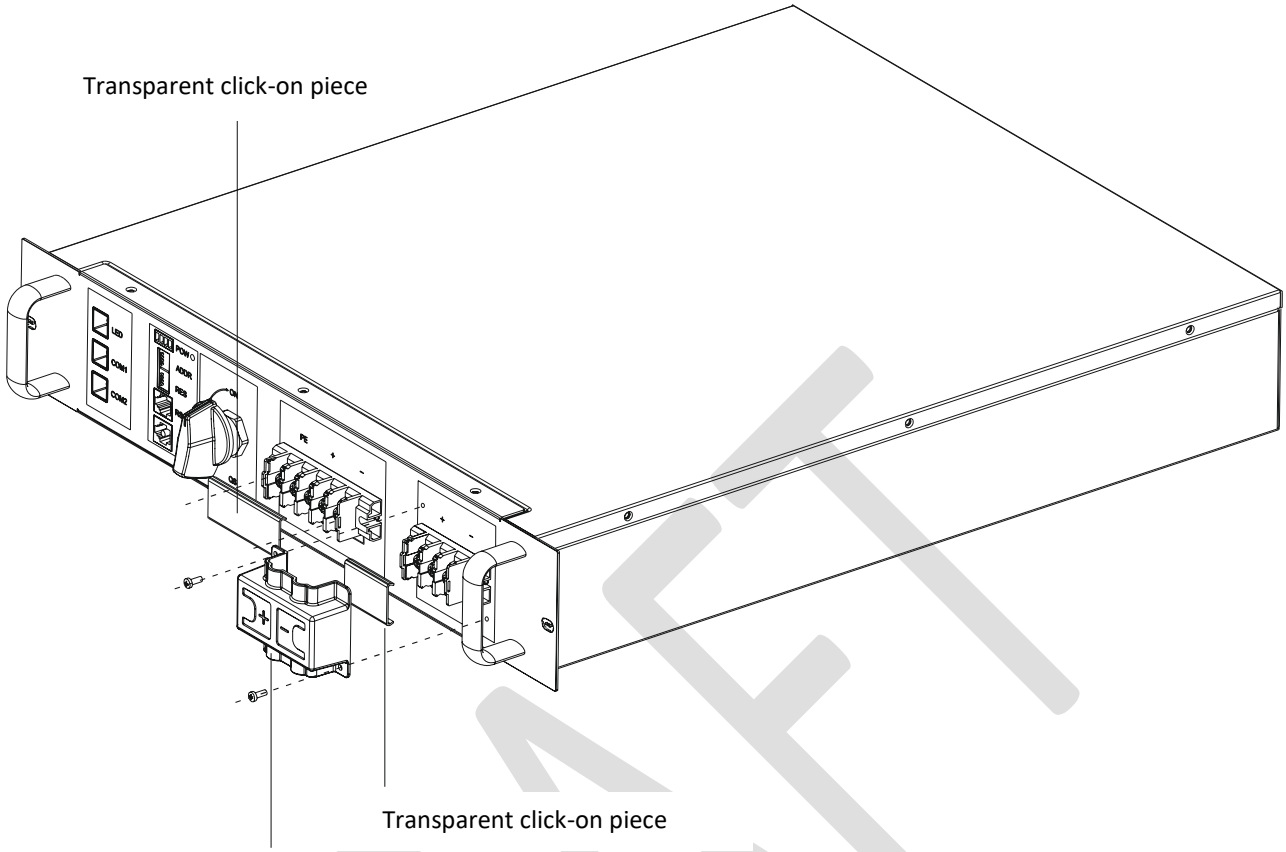
For battery module:



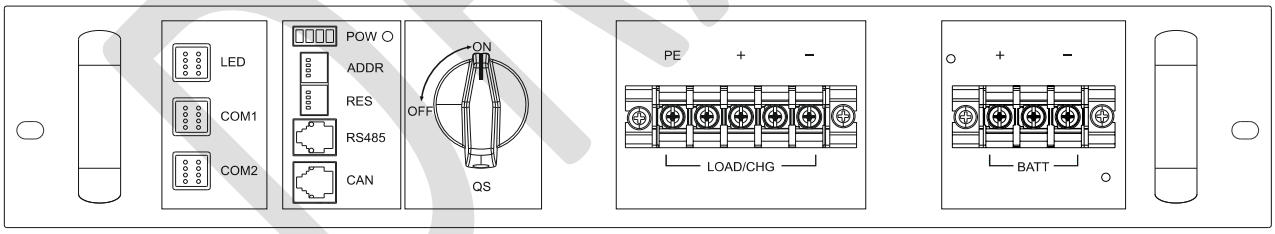
The battery module with the protection covers removed:



For the battery controller module:

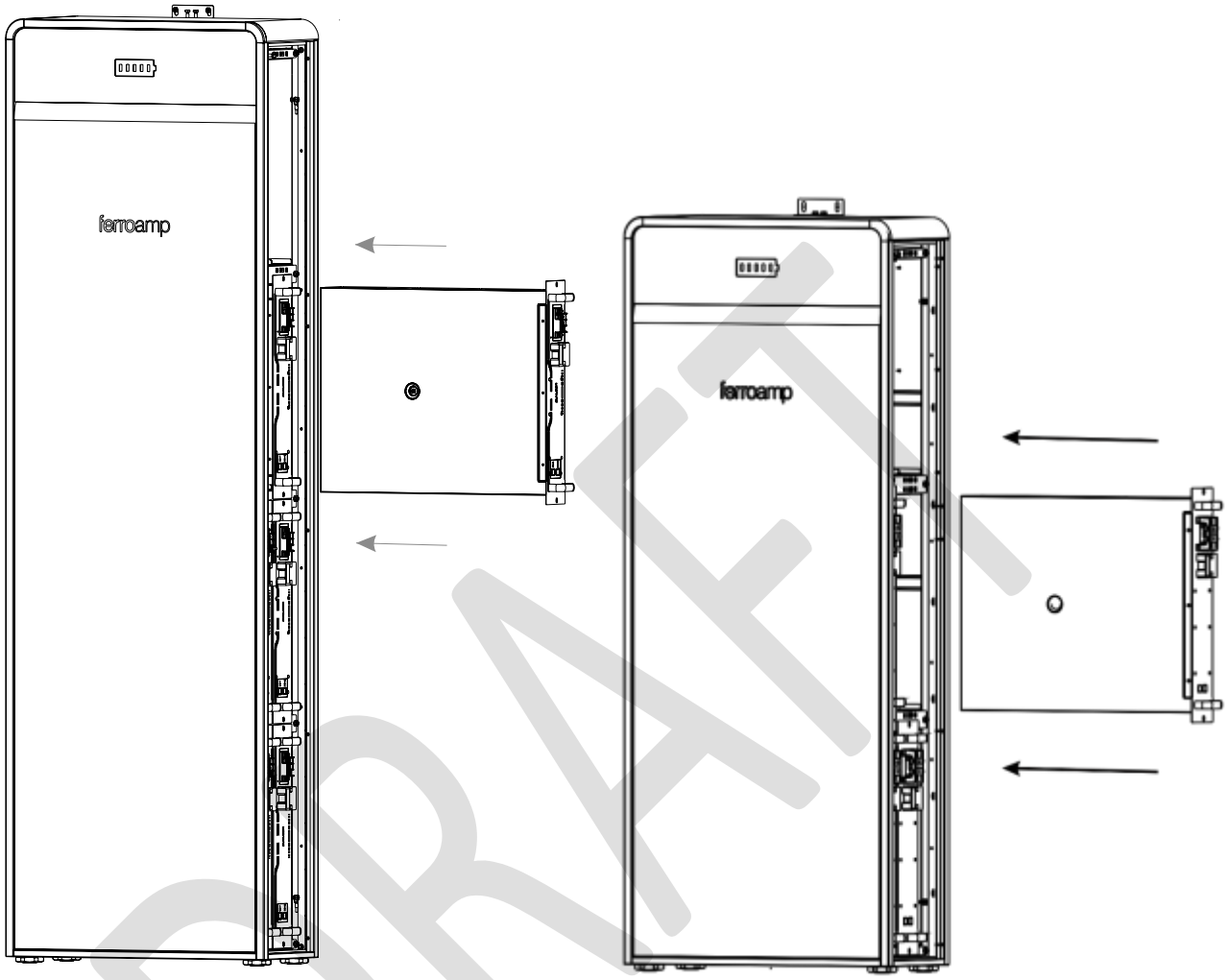


The battery controller module with the protection covers removed.



3.2 INSERT THE BATTERY MODULES

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



Left: PSM12/15 with 5 or 6 batt. **Right**: PSM10 with 4 batt.

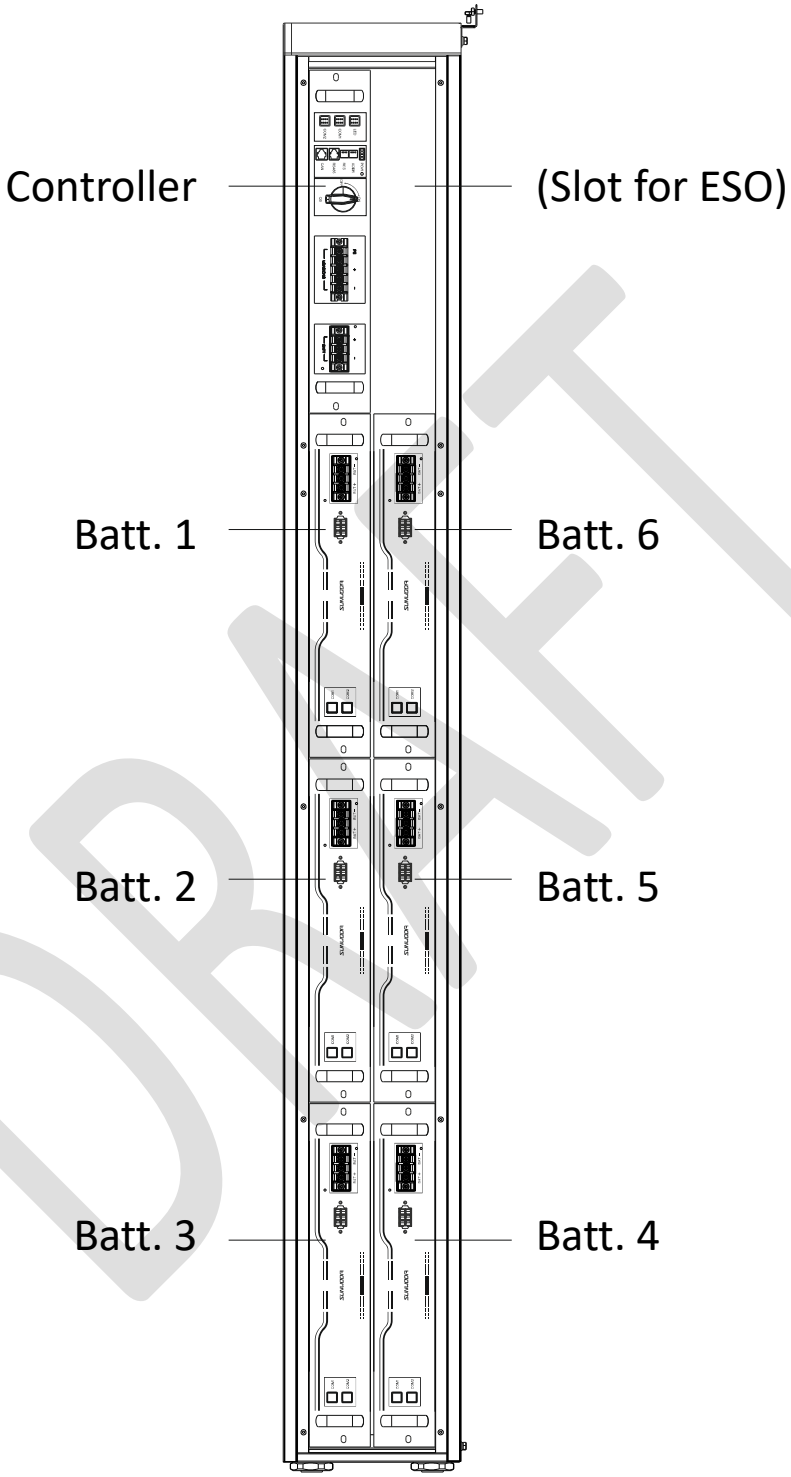
Make sure all the bolts for the inserted module fastened before installing the next one.

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**.

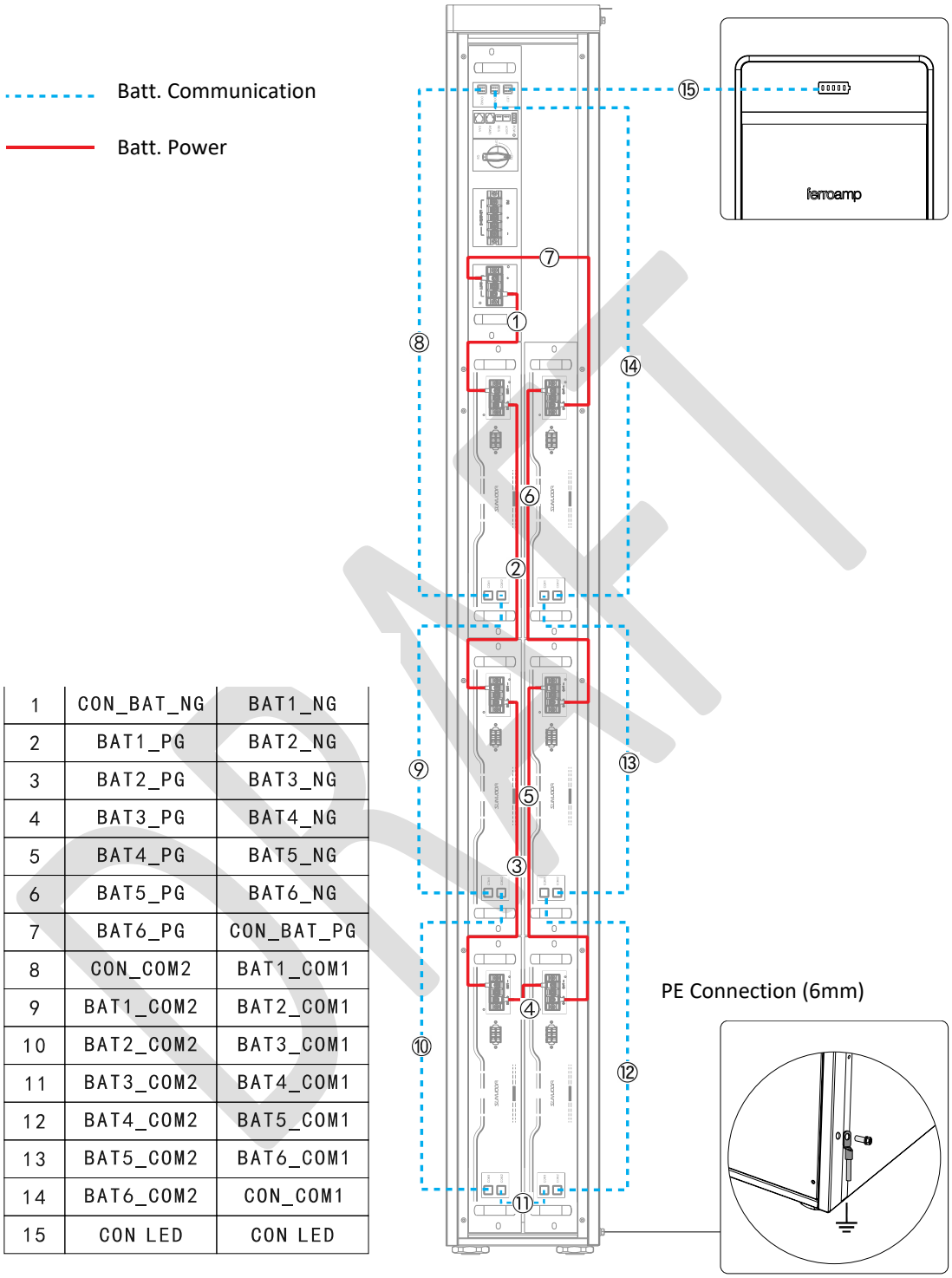
The following is a side view of the system (15kWh) after insertion of the battery and controller modules. **PSM12** and **PSM 10** are illustrated respectively in **3.3**.

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

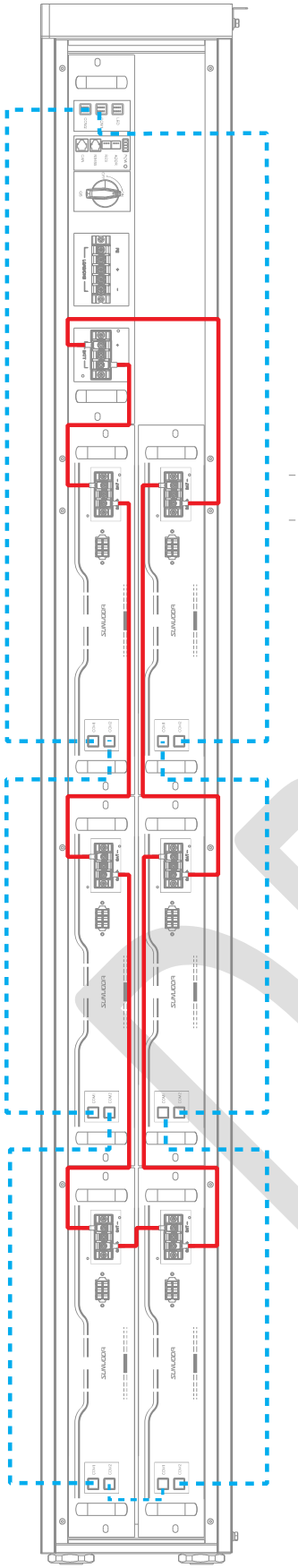


3.3 Cable Installation

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



1	CON_BAT_NG	BAT1_NG
2	BAT1_PG	BAT2_NG
3	BAT2_PG	BAT3_NG
4	BAT3_PG	BAT4_NG
5	BAT4_PG	BAT5_NG
6	BAT5_PG	BAT6_NG
7	BAT6_PG	CON_BAT_PG
8	CON_COM2	BAT1_COM1
9	BAT1_COM2	BAT2_COM1
10	BAT2_COM2	BAT3_COM1
11	BAT3_COM2	BAT4_COM1
12	BAT4_COM2	BAT5_COM1
13	BAT5_COM2	BAT6_COM1
14	BAT6_COM2	CON_COM1
15	CON LED	CON LED

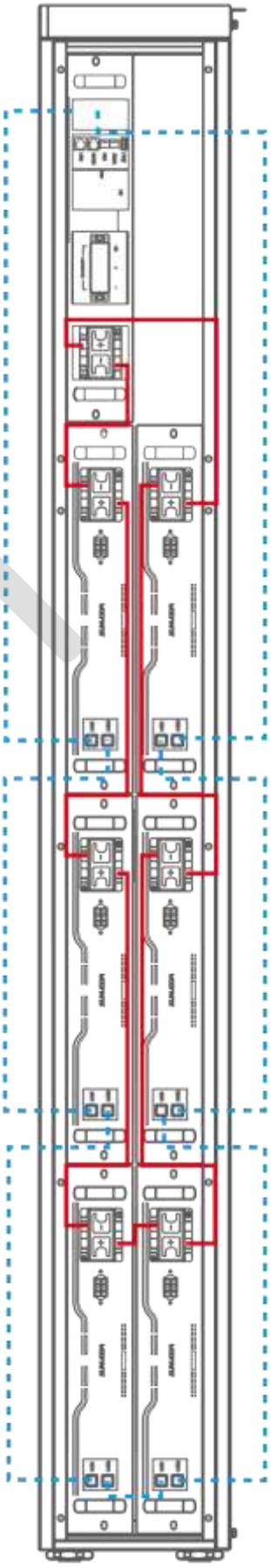


Sort the cables according to the list above and install the cables according to the numbering:

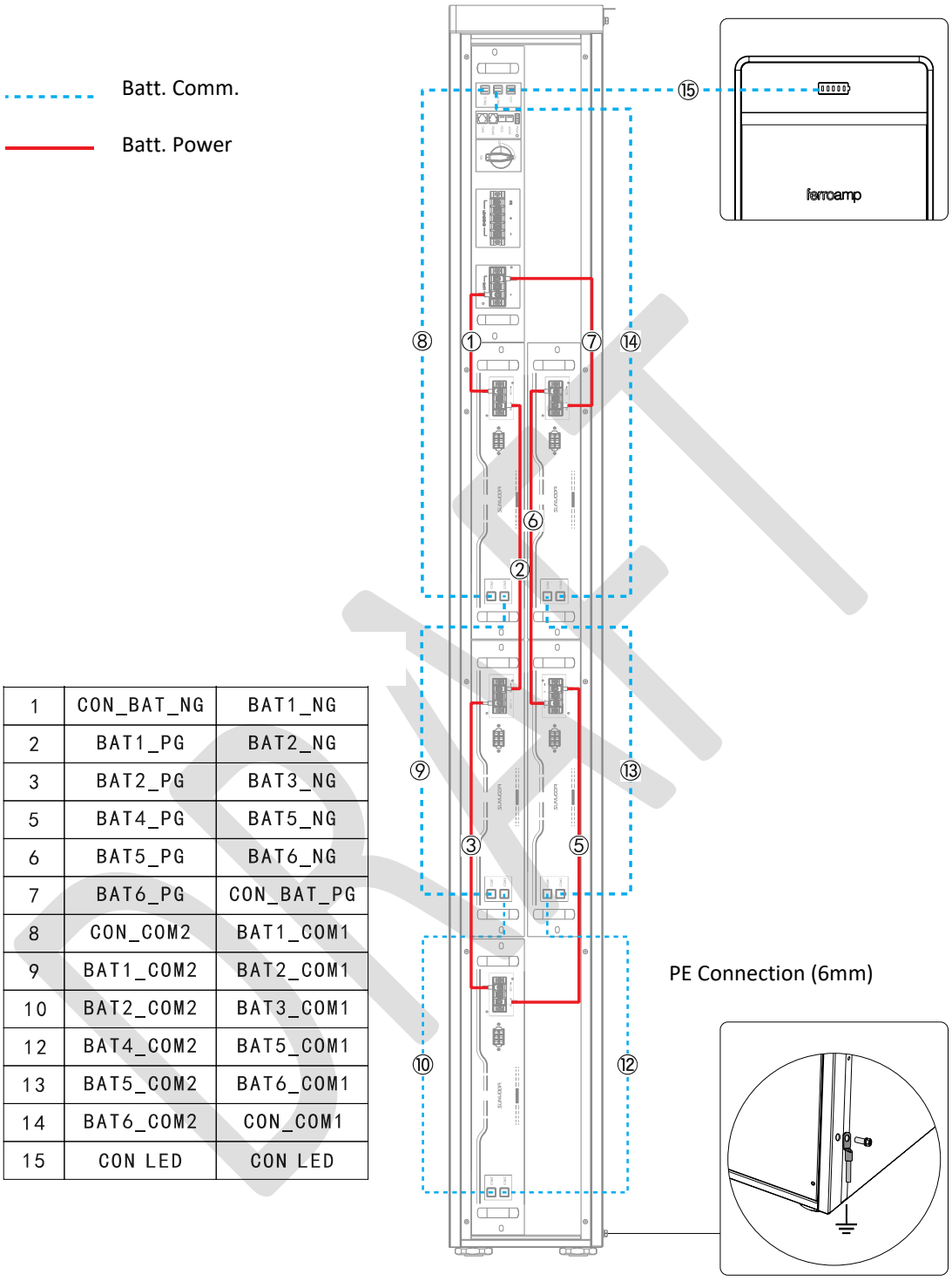
- The power cables (solid) first, then
- The communication cables (dashed)

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.

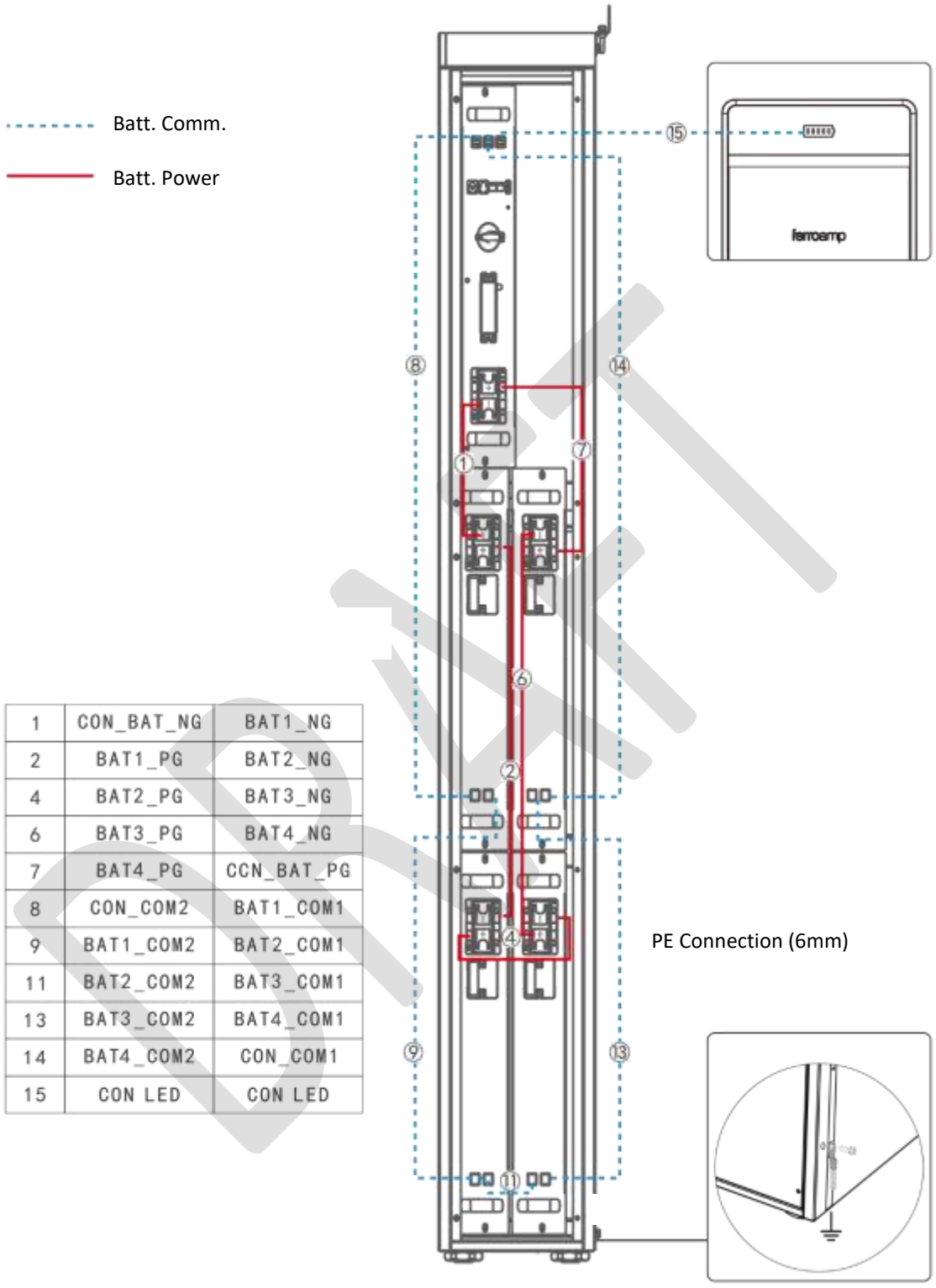


3.3.2 Connection overview and the numbering of the cables (**PSM12.5 – 5 Batt.**):



1	CON_BAT_NG	BAT1_NG
2	BAT1_PG	BAT2_NG
3	BAT2_PG	BAT3_NG
5	BAT4_PG	BAT5_NG
6	BAT5_PG	BAT6_NG
7	BAT6_PG	CON_BAT_PG
8	CON_COM2	BAT1_COM1
9	BAT1_COM2	BAT2_COM1
10	BAT2_COM2	BAT3_COM1
12	BAT4_COM2	BAT5_COM1
13	BAT5_COM2	BAT6_COM1
14	BAT6_COM2	CON_COM1
15	CON LED	CON LED

3.3.3 Connection overview and the numbering of the cables (**PSM10)**

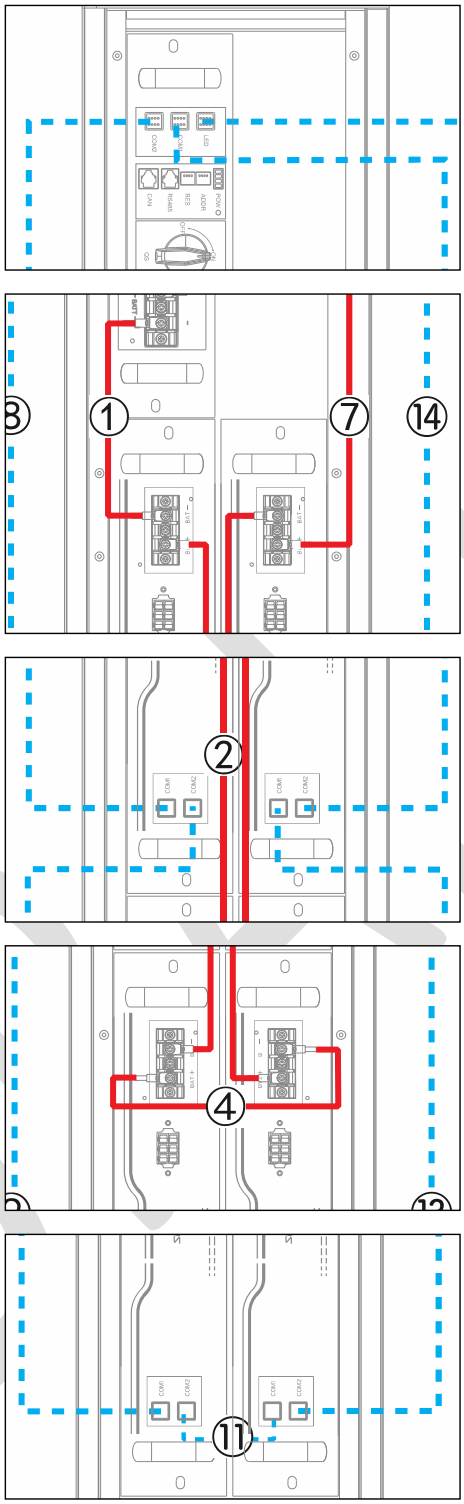


1	CON_BAT_NG	BAT1_NG
2	BAT1_PG	BAT2_NG
4	BAT2_PG	BAT3_NG
6	BAT3_PG	BAT4_NG
7	BAT4_PG	CCN_BAT_PG
8	CON_COM2	BAT1_COM1
9	BAT1_COM2	BAT2_COM1
11	BAT2_COM2	BAT3_COM1
13	BAT3_COM2	BAT4_COM1
14	BAT4_COM2	CON_COM1
15	CON LED	CON LED

Note:

For **2050 mm** cabinet installation, 2 empty slots are left at the bottom;

Zoomed in:



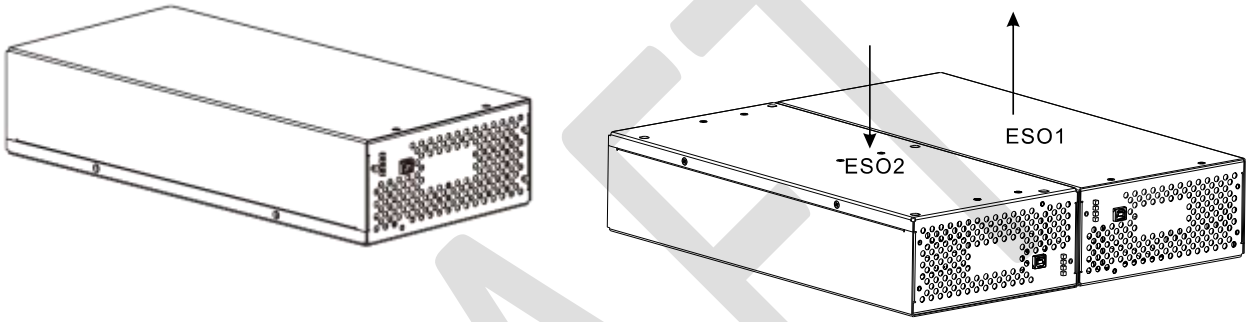
4. ESO MODULE

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.

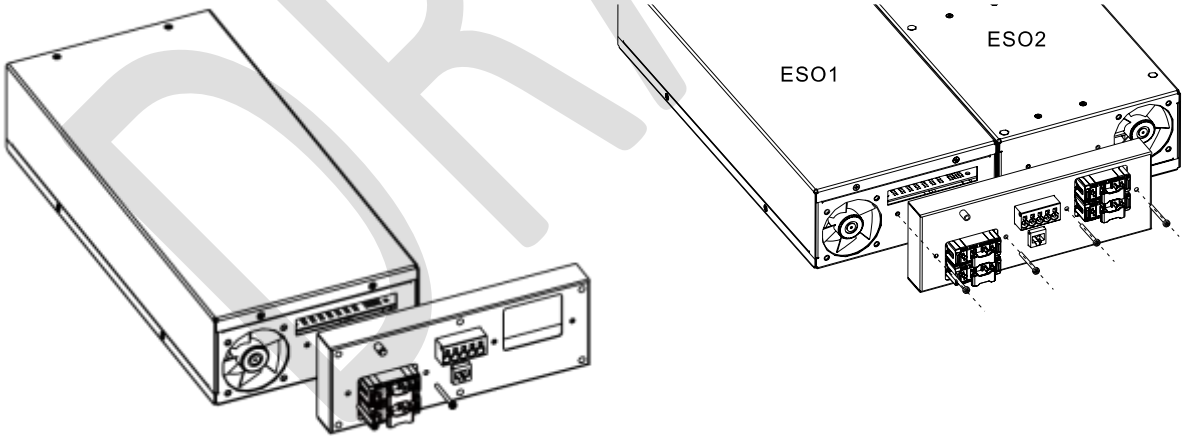
4.1 ESO ASSEMBLY

4.1.1 Lay the ESO modules on a flat surface. For 2 ESO system, lay them side by side and 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.

4.1.2 Install the ESO adaptor:

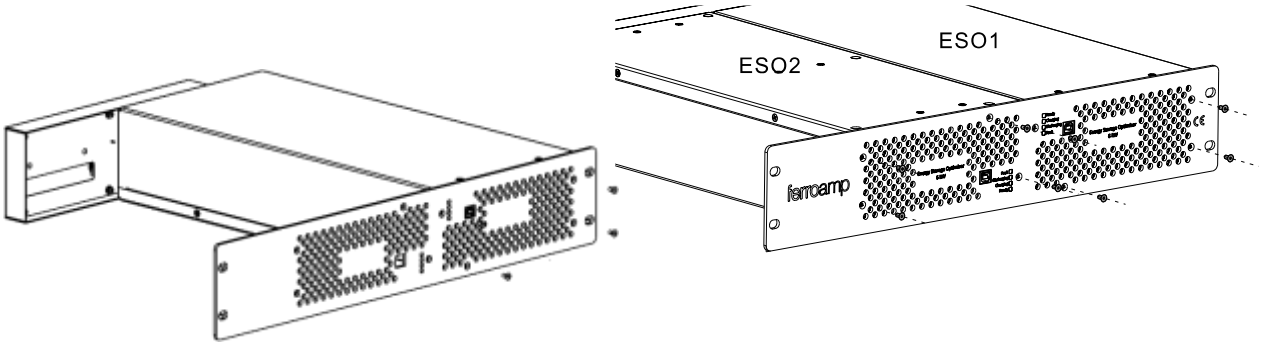


- firmly insert the adaptor into the sockets
- fasten the screws (2 pcs per ESO)

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

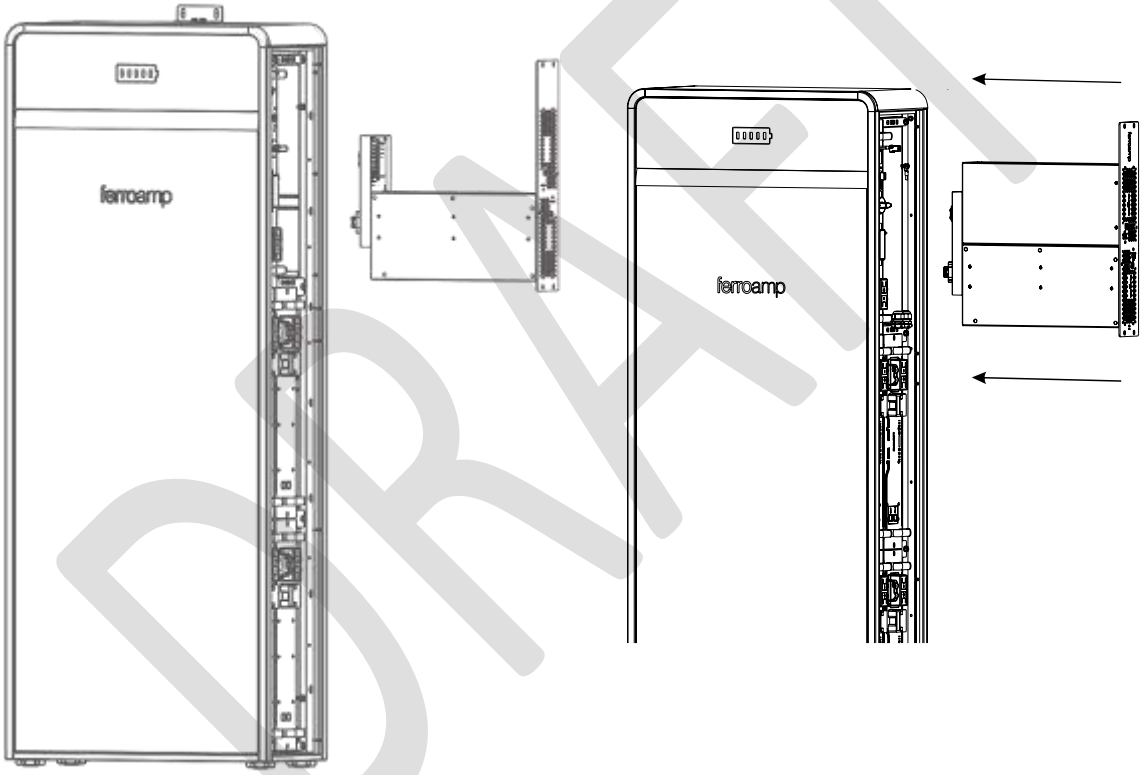
4.1.3 Install the ESO front plate.

- Carefully align the ESO front plate
- Pay specially attention to the LED prismatic piece
- Fasten the screws (4 pcs per ESO)



4.2 ESO INSERTION

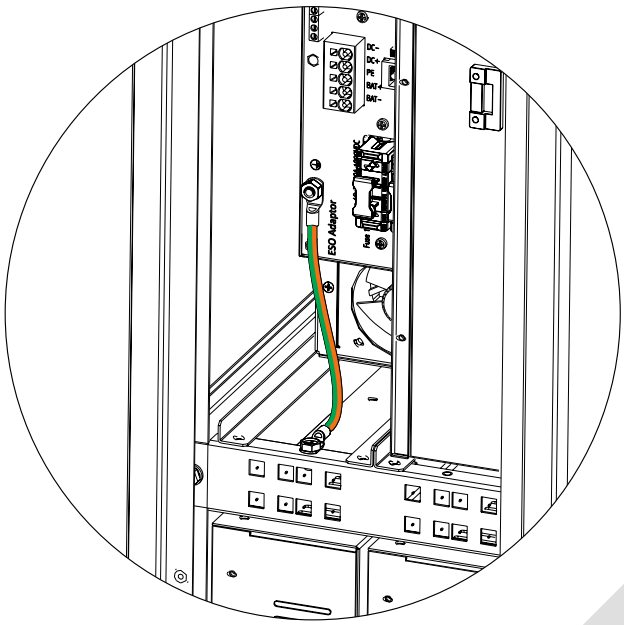
Insert the assembled ESO sideways and fasten the bolts (M6).

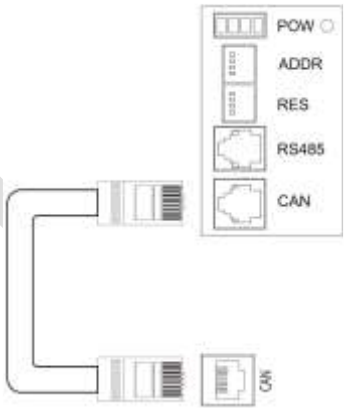


The ESO can be inserted from the either the left or the right side (illustrated) of the cabinet owing to its ***symmetric design*** **- the left and right side panels are interchangeable.**

4.3 ESO CABLES INSIDE THE CABINET

4.3.1 PE for ESO – from the back of the ESO to metal frame inside the cabinet.

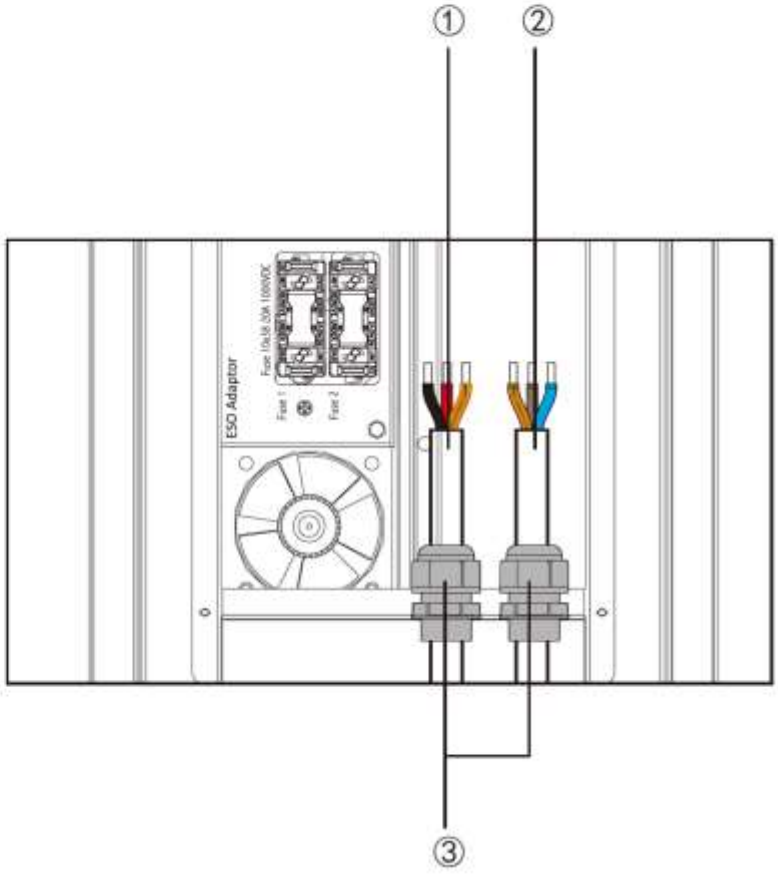




4.3.2 Communication cable (RJ45)
A standard RJ45 cable (Ethernet cable) is used for the communication between ESO and the battery controller (illustrated on the right).

5. EXTERNAL CABLES

5.1 SIDE VIEW WITH UPPER SIDE PANEL REMOVED:



(1) DC-Link cable
(DC+, DC-, PE) connecting to the DC junction box, powered from the Energy Hub

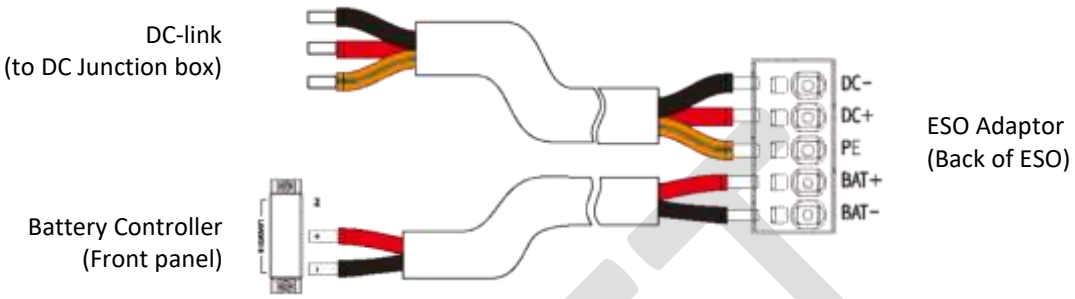
(2) AC230 cable
(L, N, PE) powering the controller module (single phase, 230V)

(3) Cable gland
To be fastened at closing up the side panel. Make sure no tension is built.

Make sure no tension is built when fastening the cable gland. Tighten the cable gland only when ready to close the side panel.

5.2 ESO Power cable connection

(1) Power Cable ESO - Battery controller (Red +, Black –)
(2) Power Cable from the ESO to DC-link (**not included***).

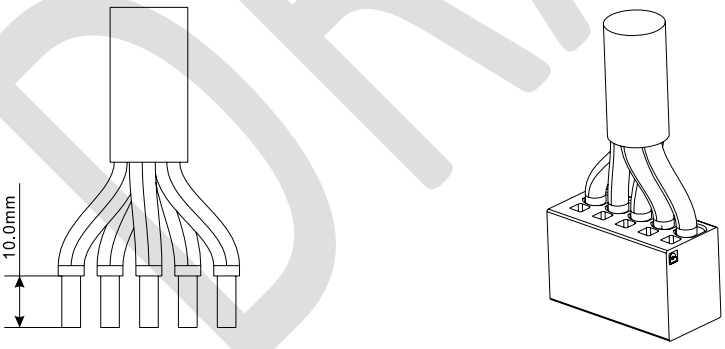


Note: For PSM15/12kW the DC link cable shall be rated at 20A

5.4 DC Link cable - Phoenix Contact 5P socket

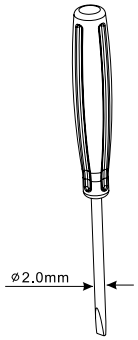
To connect:

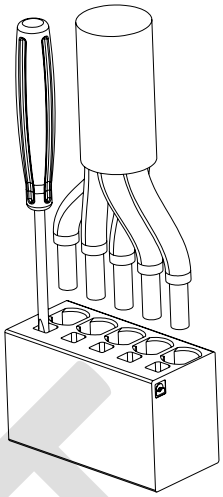
- Prepare the cable according to the following illustration. Insert one cable at a time, apply force evenly and gently in the direction towards the cable socket, make sure each cable is fully inserted.
- Once fully inserted, the cable is locked inside the socket.



To remove an installed cable:

- Firmly insert the flat-blade (2mm) into the locking-releasing hole (illustrated below)
- Pull out one cable at a time until all cables are fully detached

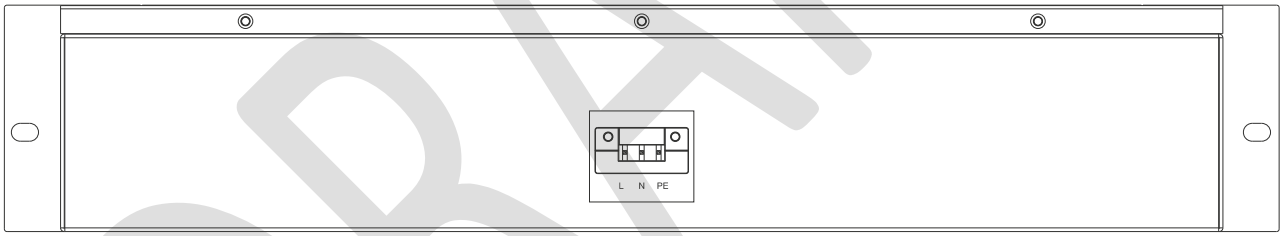




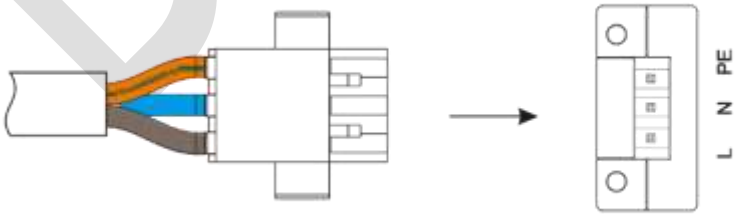
5.3 AC CABLE FOR BATTERY CONTROLLER

(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 below
- Plug in the terminal block and fasten the screws (flat-blade 2mm)



Please consult electrician for the AC power cabling.

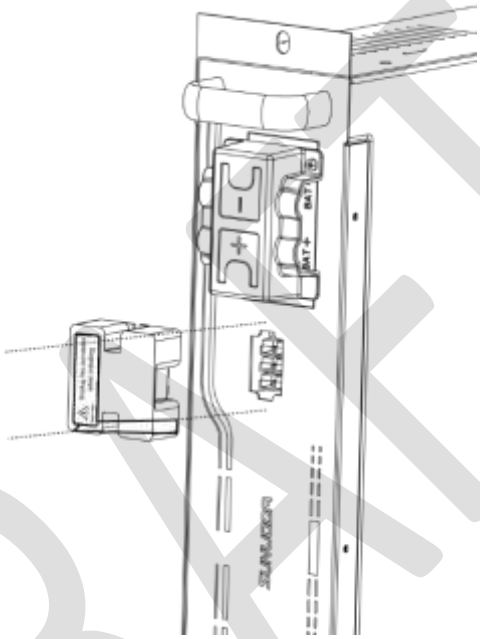
6. FINAL CHECK AND FINISHING UP

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

6.1 JUMPER BRICKS

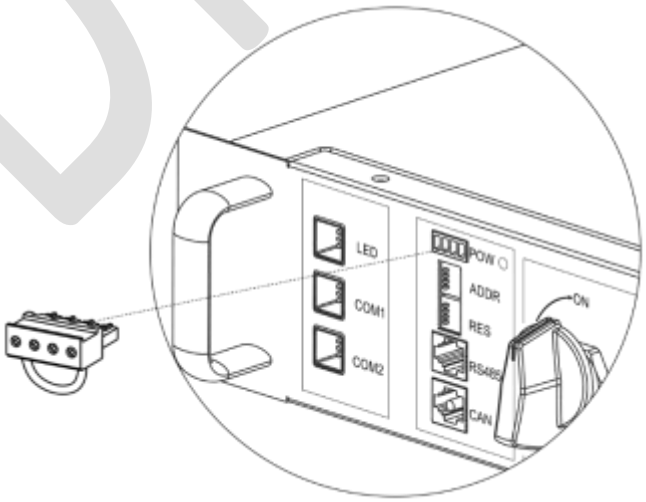
Both the battery and the controller module come with jumper bricks for safety consideration.

6.1.1 The battery is physically cut off from the internal circuit if the jumper brick is removed.

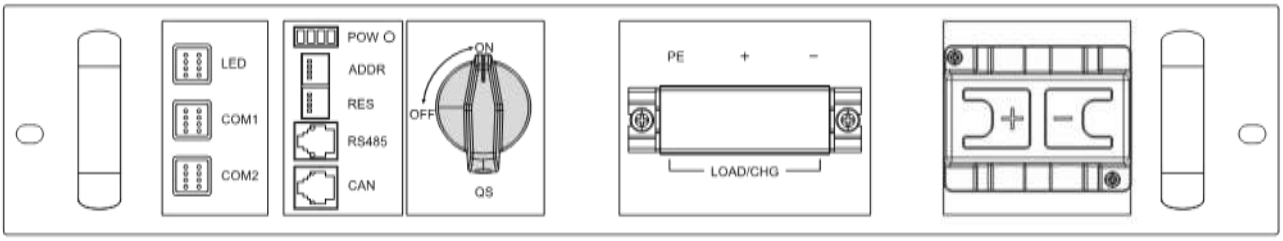


Insert jumper bricks only when the system is ready to boot up for the first time.

6.1.2 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 as illustrated below



The battery controller has no power output if the QS breaker is switched off. The QS switch 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.

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.

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

Contact your system administrator for appropriate configuration 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 from the EnergyHub.

7. MORE INFORMATION

7.1 MEANING OF CABINET LED

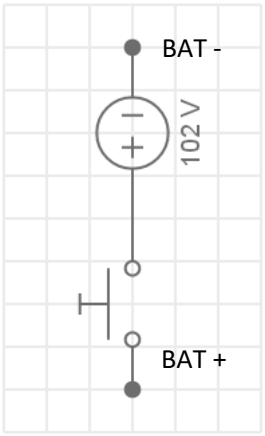
LED indicator interpretation

(★ 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		★	★	★	★	★	

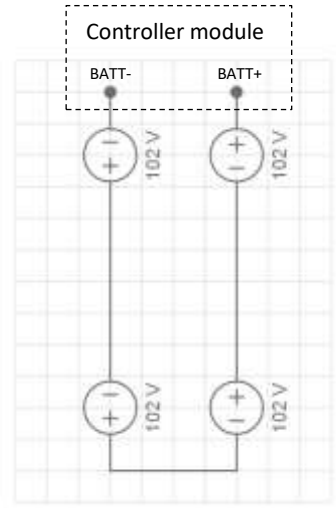
7.2 SYSTEM SCHEMATIC DIAGRAM

1. One battery module.

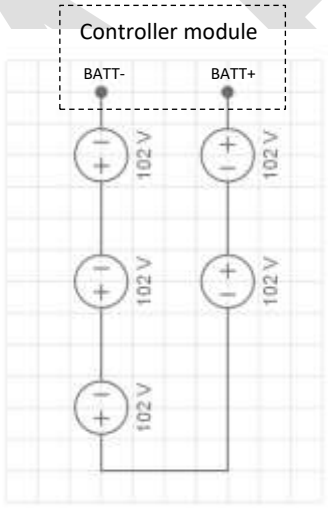


Note: the **jumper brick** is illustrated here as a "switch"; when inserted, the single battery module is **switched ON.**
Refer to **6.1 JUMPER BRICKS** for detailed description.
The open circuit voltage $V_{BAT+,BAT-}$ is 102 ~ 106V.

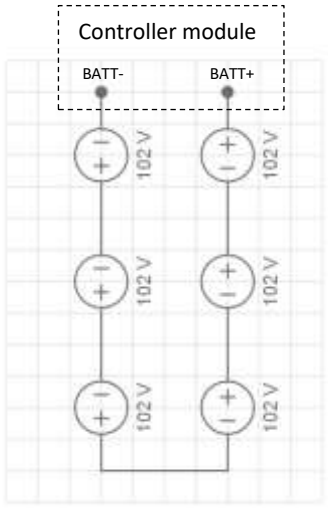
2. **Schematic diagram** showing **power cables**



PSM 10 (4 Batt.)

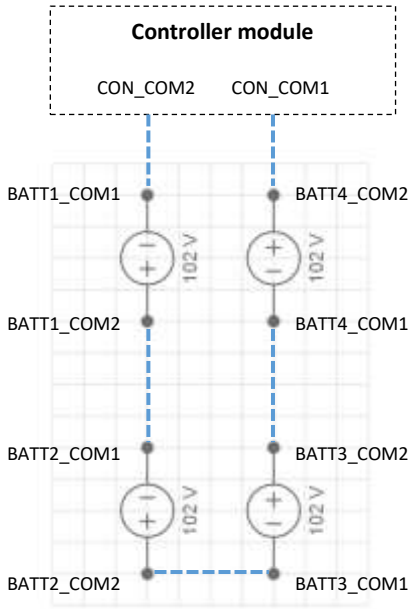


PSM 12,5 (5 Batt.)



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**"

7.2 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.**

1. 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

2. 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:

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

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

   - **Proprietary cables** (UL1007 24AWG - 5 threads) 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).

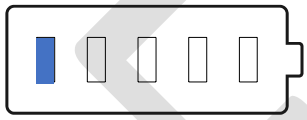
     Make sure DC Link power from the Energy hub is turned off before trouble shooting. It is important to **connect only ESO** to the DC-Link when trouble shooting.

   - 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 **switch (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 system shipped with 2 ESOs

7.6 Upgrading guide

Please check with your supplier / distributor for upgrading options available in your region.

Table 7.6 Viable configurations for PSM system

	3 batt.*	**4 batt.**	**5 batt.**	**6 batt.**
1 ESO	7.5 kWh / 3kW	10kWh / 4kW	12.5 kWh / 5kW	15 kWh / 6kW
2 ESO	7.5 kWh / 6kW	10kWh / 8kW	12.5 kWh / 10kW	15 kWh / 12kW
Cabinet size **	*1550 mm / 2050mm*	*1550 mm / 2050mm*	*2050 mm*	*2050 mm*

** Only offered as upgrading option for extra PSM cabinet purchase*

Electric power refers to the rate of energy, in term of kilowatt (**kW**) that can be withdrawn from a power source. Higher kW means more electronic devices can be powered at the same time. In other word, taking EV charging for example, more power means faster charging.

Electrical energy refers to the total amount of energy that is available measured as kilowatt hour (**kWh**). 1 kWh is calculated as to supply electricity to a 1-kW device for 1h.

7.6.1 Adding a second ESO

For PSM unit shipped with 1 ESO, a most cost-effective option for system power upgrade is to add a second ESO. An ESO is shipped inside canton box with screws (4 pcs M3x6mm, 2 pcs M3x30mm) for front plate and ESO adaptors assembly. Please refer to **Chap.4.1 ESO Assembly** for detailed instruction.

The ESO must be shut down before proceeding ESO upgrade.

Examine the Fuse box
Your existing DC junction box may come with pre-mounted 10A DC fuses. This is because the PSM shares the same junction box with SSO. After the upgrade make sure **20A DC fuses** are installed for the PSM.

7.6.2 Adding more battery modules

Consider the following before purchasing new battery modules:

> Age of the existing PSM system – professional analysis is needed for system older than 1.5y
> The cycle count of existing PSM battery modules

Battery balancing
Contact **ferroamp** helpdesk before adding more batteries to existing system. The helpdesk will initiate SOC calibration remotely then hold the existing PSM at 30% SOC before proceeding with the battery module upgrade.

Each new battery module has 30% SOC out of the box.

7.6.3 Additional upgrade options

Multiple PSM with different configurations (kW/kWh), e.g. PSM10kWh/4kW + PSM7.5kWh/3kW can work on the same DC-nanogrid. Consider adding a second PSM unit if needed.