Installation & Operation Manual

Energy Storage System (ESS)

Storion-T50/T100 (Indoor)

V01

IMPRINT

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Version Information

Version	Date	Content
V01	Sept. 8th, 2018	First edition, off-grid version

Content

1. Introduction

1.1 Brief Introduction

This manual applies for Storion-T50/T100 Li-ion battery energy storage system, mainly includes:

(1) Safety introduction

Introduces the product use, operating notes and qualification of operators of T50/T100 Li-ion battery energy storage system.

(2) Product description

Describes product appearance, product characteristics, system composition and major functions of T50/T100 Li-ion battery energy storage system.

(3) System installation

Introduces the installation of T50/T100, including attentions.

(4) Operation

Introduces the operation of T50/T100 system.

(5) Routine maintenance

Introduces items in maintenance of T50/T100 kWh Li-ion battery energy storage system, including attentions.

(6) Trouble-shooting

Introduces the faults of T50/T100 Li-ion battery energy storage system, reasons to faults, and processing method.

1.2 Explanation of Terms

(1) Lithium iron phosphate cell (LiFePO4)

Basic unit constituted by electric poles and electrolytes; Each cell is independent and closed.

Notes: Paralleled cell cannot be regarded as an independent cell, even packed again.

(2) Lithium iron phosphate pack

Combination made up of battery monitoring circuit, battery equalization circuit, electrical connectors, communication interfaces, thermal management devices and multiple Lithium iron phosphate cells.

Notes: For packs from same company, all the details such as physical size,

working performance and interface specification should be consistent in order that all the packs are interchangeable).

(3) Battery management system

Electronic equipment collection for monitoring the operating information of cells, packs and system units (such as voltage, current, temperature, protective parameter of batteries), evaluating the state of charge (SOC), the state of health (SOH) and cumulative processed energy, protecting batteries for safety, etc.

(4) Battery system unit

A combination of batteries through series parallel combination inside and a battery management system (BMS) in which accesses to DC side of a bidirectional converter.

(5) Storage unit

A combination of a bidirectional converter and a battery system unit, which can be used as an independent load or be controlled directly by monitoring system.

2. Safety Instructions

2.1 Manual Keeping

This manual contains important information about operating the system. Before operating, please read it very carefully.

The PCS should be operated in strict accordance with the description in the manual, in case that it causes damage or loss to equipment, personnel and property.

This manual should be kept carefully for maintenance and reparation.

2.2 Operator Requirements

The operators should get a professional qualification, or trained.

The operators should be familiar with the whole storage system, including compositions and working principles of the system.

The operators should be familiar with the Product Instruction.

While maintaining, it must be ensured that two operators are in the field, and they cannot operate until all of the equipments are powered off and fully discharged.

It is strictly prohibited for any maintenance when equipments are on or charged.

2.3 Protection of Warning Sign

The warning sign contains important information for the system to operate safely, and it is strictly prohibited to be torn or damaged.

Ensure that the warning sign is always clear.

The signs should be replaced immediately when damaged.

2.4 Setting of Warning Sign for Safety

While instructing, maintaining and repairing, in case of preventing unrelated personnel nearby to cause incorrect operation or accident, the opinions below should be followed:

Obvious signs should be set at front switch and rear-level switch in case of accidents caused by false switching.

Warning signs or tapes should be set near operating areas.

Keys of the system must be pulled out after maintenance or operation.

2.5 Live Line Measurement

High voltage in the container which may cause vital electric shock when touching by accident.

Equipment protection must be taken in live line measurements (e.g.: insulation gloves).

The measuring equipment should be connected and used correctly to ensure personnel safety. When measuring, at least two workers are needed.

2.6 Measuring Equipment

For ensuring the electrical parameters to match requirements, related measuring equipment are required when the system is being connected or tested.

Ensure that the connection and use matches specification in case of electric arc or shock.

2.7 Electrostatic Protection

Contact or improper operation of the printed circuit board or other ESD sensitive components may result in damage to the device. Unnecessary contact should be avoided.

2.8 Moisture Protection

It is very likely that moisture may cause damages to the system.

Do not open the container door if the humidity is larger than 95%.

Repair or maintaining activities in wet conditions should be avoided or limited.

2.9 Operation After Power Failure

The battery system belongs to energy storage system, which maintains fatal high voltage even when the DC side is disconnected. Therefore, touching the output of the battery is strictly prohibited.

The PCS maintains fatal voltage even when both the DC or AC side are disconnected, so it must be tested by the multimeter for safety before operation.

2.10 Minimum Personal Protection Equipment

For the safety of operators to the system, personal protective equipments are required. During the operation, following protective equipments are required:

No.	Item	Notes
1	Work clothes	
2	Protective shoes	
3	Protective glasses	

When doing maintenance works such as checking cables or wires, measuring voltage, replacing small electrical parts or cleaning modules and brackets, as minimum the following protective equipments are required:

No.	Item	Notes
1	Work clothes	
2	Protective shoes	
3	Protective glasses	
4	Insulated gloves	For touching live parts

Note: All metal tools during maintenance should be insulated.

When replacing modules, the following protective equipments are required:

No.	Item	Notes
1	Work clothes	
2	Protective shoes	
3	Protective glasses	
4	Insulated gloves	For touching live parts

Note: When replacing modules, the stacking machine should be used carefully in case that the modules may fall down. All workmen are suggested to wear high-safety and high strength protective shoes to protect their feet.

3. Product Description

The AlphaESS Storion-T50/T100 energy storage system is an off-grid system. The excessive energy generated by the PV will be stored in the batteries. The stored energy can be used when the PV is not generating enough energy. When connected with a generator, if there is neither enough PV supply nor enough stored energy, the loads will be automatically powered by generator through STS (Smart Transform Switch).The overall system connection diagram is as follows:

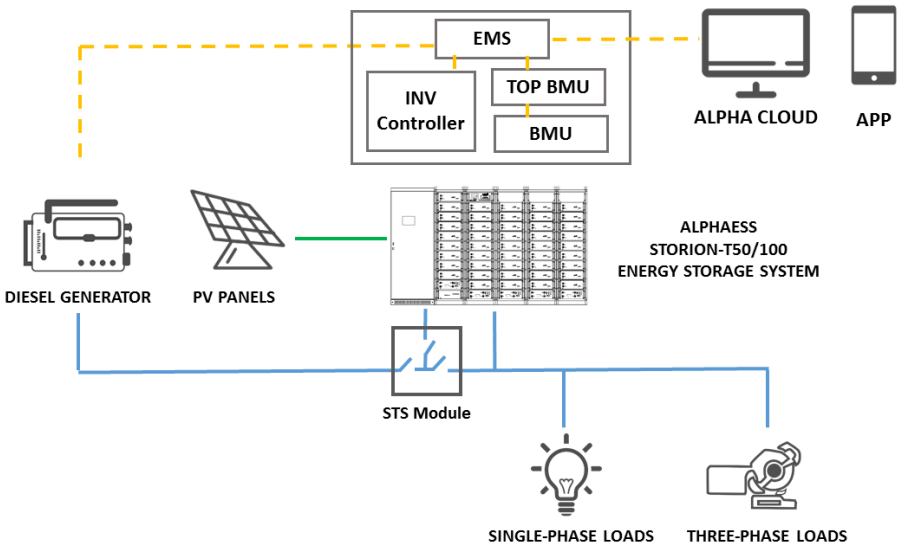


Figure 3.1 Applications of the system

3.1 Appearance of the Product

Figure 3.2 shows the appearance of the system.

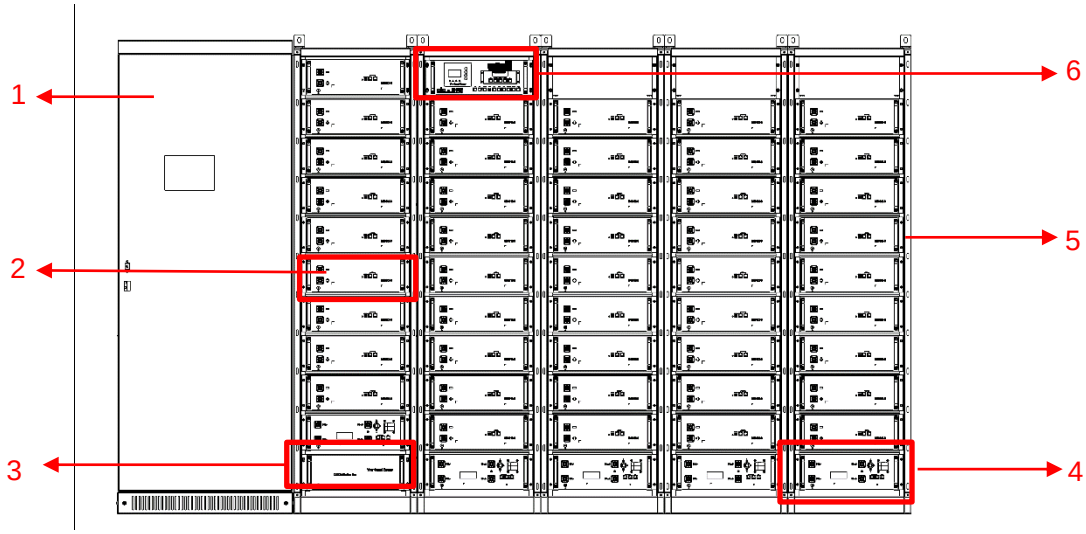


Figure 3.2 T50/T100 without container

Table 1 T50/100 System composition

Item	Components
1	Storion-T50/100-INV
2	M48112-S
3	Junction Box
4	HV900112 Box
5	Battery Rack
6	TOP BMU Box

3.2 Product Characteristics

LiFePO4 batteries produced by AlphaESS have longer lifespan and higher reliability, which is able to satisfy the application of energy storage systems.

The system is highly modular designed, and it is easier to assemble, transport and maintain.

The system has a three-level BMS and is readily allowed for system expansion.

The system adopts full time balancing technology so that the consistency of batteries and modules can be well ensured.

The system is designed as a removable container which is compact in structure, flexible, convenient for installation and testing, suitable to the working environment, and is able to satisfy different kinds of applications.

The system has current balance technology between strings in case of circulating current or unbalanced power.

The system has relatively developed thermal management technology so that the consistency of the system environment can be ensured.

The system has both remote monitor function and local control function.

The system realizes flexible scheduling of electric power system through communication among BMS, PCS and monitoring system.

The system realizes emergency fire protection by using the automatic alarming and fire extinguishing system

3.3 Parameters of Components

3.3.1. PCS

3.3.1.1 Product Instruction

Storion-T50/T100-INV is a hybrid inverter. It has DC/DC and DC/AC modules. It can transform the DC electricity from PV panels into three-phase AC electricity to supply loads. The DC/DC

module can charge batteries by using the electricity generated by PV panels. The DC/AC module is bidirectional so that the battery can also be charged by the grid through the inverter.

3.3.1.2 Appearance Instruction

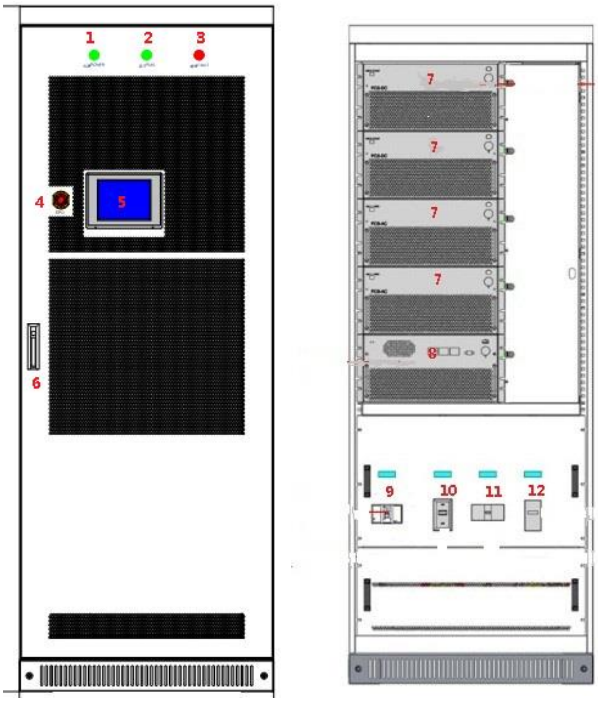


Figure 3.3 Appearance of the PCS

Table 2 Composition of the PCS

No.	Description	No.	Description
1	Power indicator	7	PCS module
2	Normal indicator	8	STS module
3	Fault indicator	9	PV DC switch
4	Scram button	10	Battery switch
5	Display screen	11	Back-UP switch
6	Handle	12	AC grid (or generator) switch

3.3.1.3 Technical Parameters

Table 3 Technical parameters of the PCS

No.	Item	Storion-T50-INV	Storion-T100-INV
	AC Side Data (off-grid)		
1	Nominal Output Power	50 kW	100 kW
2	Output Overload Capacity	55 kW	110 kW
3	Rated Voltage	400 V	

4	Voltage Range	400 V ± 10 %	
5	Max. AC Output Current	72 A	144 A
6	AC Connection	3-phase and 4-wire system (including transformer)	
7	Rated Frequency	50 Hz / 60 Hz	
8	Frequency Range	50 Hz / 60 Hz ± 2.5 Hz	
9	THDU @ Nominal Power	< 2 %	
10	Power Factor	-1 ~ +1	
	DC Data (Battery Side)		
11	DC Voltage Range	250 – 520 V	
12	One-Way Maximum Input Current	150 A	300 A
13	Max. DC Power	50 kW	100 kW
	PV Side Data		
14	PV Voltage Range	520 – 900 V	
15	PV DC. Max Current (in case of completely consumption)	220 A	440 A
17	Max. PV Power	110 kW	220 kW
	General Data		
18	Max Efficiency	98%	
19	Dimensions (W x H x L)	800 x 2160 x 800 mm	
20	Weight	520 kg	750 kg
21	Altitude	3000 m	
22	Ingress Protection	IP20	
23	Noise	< 70 dB	
24	Operation Temperature	-25 ℃ ~ +50 ℃	
25	Cooling Concept	Forced Air	
26	Humidity	0~95% (Non-Condensing)	
27	Communication Interfaces	Ethernet, RS485, CAN2.0	

3.3.1.4 Emergence Stop Switch

The converter stops working immediately after pushing the button.

If you want to restart the converter, please execute in the following order:

a) Conduct counter clockwise rotation on the emergency stop switch and then loosen the locking status.

b) Push the AC breaker into “OFF” position, pull up the emergence button and then turn the AC breaker “ON”.

c) Launch the machine and operate it as required

3.3.2. Battery System

Table 4 Battery system parameters

Item	Description	Parameter	Remark
1	Nominal discharge power	50 kW / 100 kW	
2	Energy storage capacity	According to the project situation	Ambient temperature is 30℃, measured at DC side
3	Continuous discharge current	1C (continuous)	
4	Direct voltage	250 ~ 520 V	
5	Communication interface	RS485, CAN2.0	

3.3.2.1 M48112-S

Figure 3.4 Battery appearance

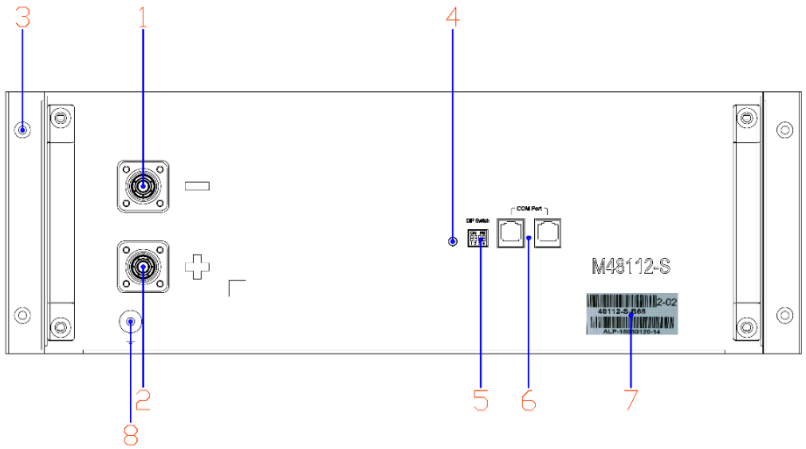


Figure 3.5 Battery front cover

Table 5 Battery interface definition:

No.	Description	No.	Description
1	Battery negative pole	5	Dip switch
2	Battery positive pole	6	COM port (CAN) x 2
3	Earthing point x 4	7	Information label
4	LED light	8	Earthing point (reserved)

Table 6 Battery technical parameters:

No.	Item	Technical parameter	Remarks
1	Battery model	M48112-S	
2	Assembly method	16S2P	
3	Nominal voltage	51.2 V	
4	Voltage range	48～58 V	
5	Nominal capacity	112 Ah	Max. charge / discharge current 1C
6	Nominal stored energy	5.734 kWh	
7	Work power consumption	0.4752 W	
8	Dormant power consumption	1.52 mW	Battery dormant state
9	Max. charge/discharge current	112 A	Constant current mode
10	DC internal resistance	＜20 mΩ	Factory default
11	Transportation/storage temperature range	-20 ~ 45 ℃	
12	Charge work temperature range	0～50 ℃	
13	Discharge work temperature range	-10～50 ℃	
14	Communication mode	CAN	
15	Weight	70 ± 2.0 kg	
16	Size (W x D x H)	494.6 x 615.3 x 162.6 (±5) mm	
17	Humidity	15%～85%	

The dip switch of M48112-s defines the serial number. Please see the detailed description in the following table.

Table 7 Dip switch definition of M48112-S

Serial Number	Dip Switch	Serial Number	Dip Switch	Serial Number	Dip Switch
1		4		7	
2		5		8	
3		6		9	

3.3.2.2 HV900112

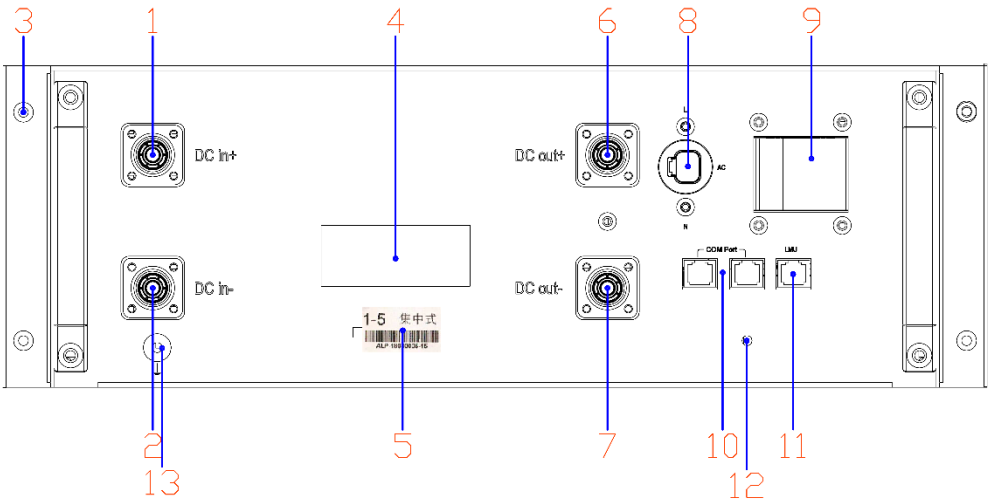


Figure 3.6 HV900112 front cover

Table 8 HV900112 interface definition:

No.	Description	No.	Description
1	DCin+	7	DCout-
2	DCin-	8	AC input (auxiliary power)
3	Earthing point x 4	9	AC Air switch (auxiliary power)
4	Moulded case circuit breaker	10	BMU COM port (CAN) x 2
5	Information label	11	LMU COM port (CAN)

6	DCout+	12	LED light
		13	Earthing point (reserved)

HV900112 technical parameters:

No.	Item	Technical parameter	Remarks
1	High-voltage control box	HV900112	
2	Working voltage range	200 ~ 900 V	
3	Rated current	112 A	
4	Dimensions (W x D x H)	494.6 x 552.6 x 162 ± 5mm	
5	Weight	20 kg	
6	Power consumption	<10 W	

3.3.2.3 Top BMU Box (with EMS)

Through the TOP BMU Box with EMS, the functions such as remote monitoring, remote upgrade etc. can be realized.

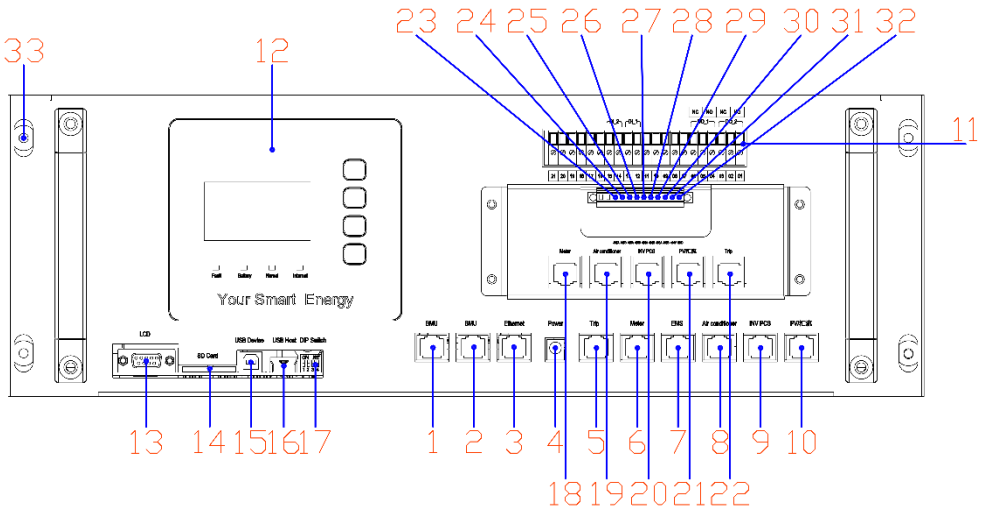


Figure 3.7 Front cover of TOP BMU box with EMS

Table 9 Top BMU box with EMS interface definition:

No.	Description	No.	Description
1	BMU COM port	17	DIP switch
2	BMU COM port	18	Meter COM port (reserved for RS485)
3	Ethernet	19	Air conditioner COM port((reserved for RS485)
4	Reserve power supply	20	INV PCS COM port (reserved for RS485)

5	Dry contact COM port	21	PV junction COM port (reserved for RS485)
6	Meter COM port	22	Dry contact COM port (reserved for RS485)
7	EMS COM port	23	Meter RS485A port
8	Air conditioner COM port	24	Meter RS485B port
9	PCS COM port	25	Air conditioner RS485A port
10	PV junction COM port	26	Air conditioner RS485B port
11	Dry contact port	27	PCS RS485A port
12	EMS display screen	28	PCS RS485B port
13	DB9 COM	29	PV Junction RS485A port
14	Storage card	30	PV Junction RS485B port
15	Burning port	31	Dry contact +24V
16	COM pin board	32	Dry contact earthing point
		33	Earthing point x 4

Table 10 Technical parameters:

No.	Item	Technical parameter
1	Dimensions（W x D x H)	490.6 x 323 x 161 ± 5 mm
2	COM	RS-485×4; Ethernet 10/100/1000Mbps×1
3	Internal storage	CD card, 16 GB
4	Events diary	Recent one-month happenings
5	Work voltage	24 V
6	Power consumption	<10 W

3.3.2.4 Junction box

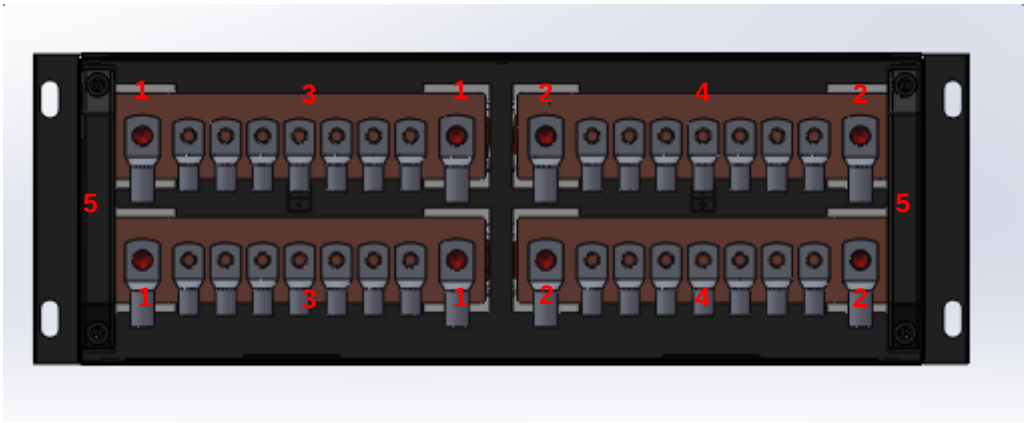


Figure 3.8 Inside of the junction box

Table 11 Wiring definition of the junction box:

No.	Description	No.	Description
1	DC IN INV-	4	DC OUT+
2	DC IN INV+	5	Handle
3	DC OUT-		

Table 12 Technical parameters:

No.	Description	Technical parameter
1	Dimensions (W*D*H)	490.5 x 205 x 162 mm
2	Weight	7 kg

4. Installation

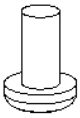
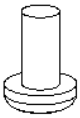
4.1 Installation Precautions

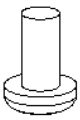
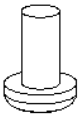
The following sites are not allowed for installation:

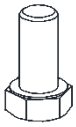
- Sites which are salty and where humid air can penetrate.
- Flooded areas.
- Earthquake areas –additional security measures are required here.
- Sites that are higher than 3000 meters above the sea level.
- Sites that are in an explosive or potentially explosive atmosphere.
- Sites with extreme changes of ambient temperature.
- Sites with highly flammable materials or gases.

4.2 Parts List

Table 13 Parts List

M48112-S			
			
1 X Power Cable 130 mm, Black-Red, BAT-BAT	1 X Communication Cable 280 mm, BAT-BAT	4 X M6*16	4 X M6 Gouding Serrated Washer
Hv900112			
			
1 X Communication Cable 300 mm, BAT-HV Box	1 X Communication Cable 680 mm, HV Box - HV Box	4 X M6*16	4 X M6 Gouding Serrated Washer

			
1 X Power Cable 2500 mm, Black-Black, BAT-HV	1 X Power Cable 130 mm, Red-Red, BAT-HV	AC Auxiliary Power Cable	1 X Terminal Resistance
TOP BMU Box			
			
1 X Communication Cable 2500 mm, TOP BMU-HV BOX	1 X Terminal Resistance	4 x M6*16	4 x M6 Gouding Serrated Washer
Junction Box (if required)			
			
1 X 4500 mm Power Cable Black-Black, Junction Box-INV	1 X 4500 mm Power Cable Red-Red, Junction Box-INV	4 x M6*16	4 x M6 Gouding Serrated Washer
Rack			
			
1 x 4500 mm Power Cable, Black-Black, For HV Box - Junction Box (If Junction Box Required); Or For HV Box - INV (If Junction Box Not Required)	1 x 4500 mm Power Cable, Red-Red,For HV Box – Junction, (If Junction Box Required); Or For HV Box – INV,(If Junction Box Not Required)	1 x Communication Cable 7500 mm EMS-INV	1 x M6 Nut

			
4 X M12 Hex Nut	4 X M12*25 Hex Screw		

4.3 Installation

4.3.1. PCS Installation

4.3.1.1 Removal

When removing the T50/T100-INV, a forklift can be used to remove the whole case. Users can lift the device bottom with a forklift or remove the inverter cabinet through the lifting hole on its top with a crane. It can be transported alone.

Figure 4.1 Moving method for inverter

Don't insert the module into the cabinet and move them together! Before the cabinet is moved, pull out the module and move the cabinet alone.

4.3.1.2 Operation Space

The installation space of the PCS should have a proper distance from its peripheral walls so as to ensure that the machine door can be opened and closed conveniently and there will be sufficient space for module insertion and extraction, normal heat dissipation and user's operation.

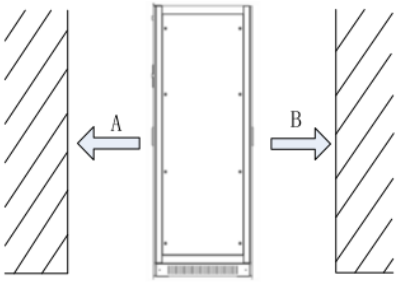


Figure 4.2 Installation space

A≥1,000mm, make sure that the front door of the cabinet can be fully opened and there is sufficient space for cold air to enter. Users can conveniently insert and extract the module and operate the breaker.

B≥1,000mm, make sure that the rear door of the cabinet can be fully opened. Ventilation and heat dissipation should be ensured. Users can also have sufficient space for product maintenance.

4.3.1.3 Cabinet Installation

After the cabinet is removed to the installation position with a forklift or a tool. The cabinet should be adjusted and removed to the designed position. Then open the internal door of cabinet, and fix the cabinet with M13 screws, as shown in Figure 4.3.

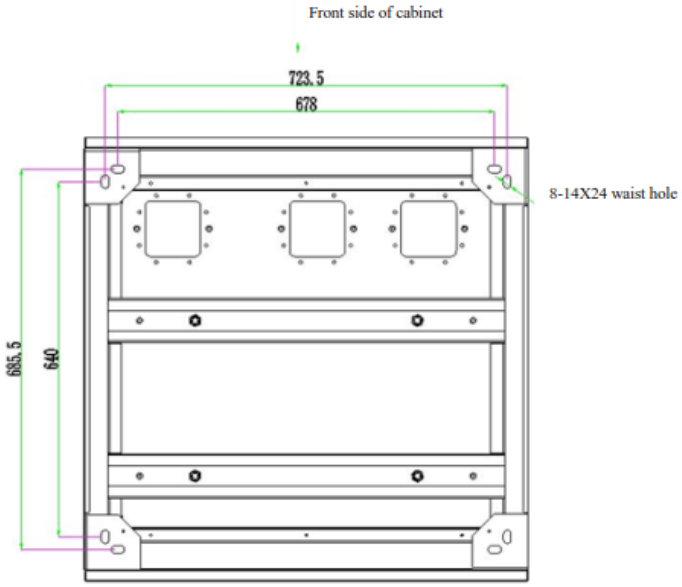


Figure 4.3 Diagram of the cabinet base

When the cabinet needs to be fixed on the steel channel, Φ14 holes can be made in the steel channel. Fix the cabinet to the steel channel with screws, as shown in Figure 4.4.

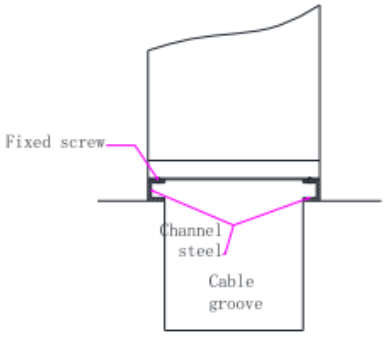


Figure 4.4 Fix the cabinet to the steel channel

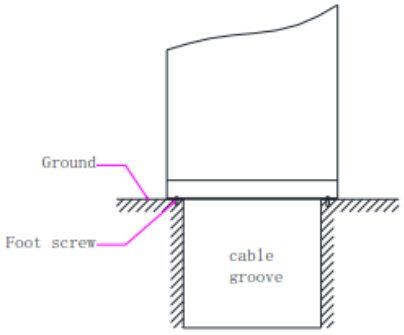


Figure 4.5 Fix the cabinet to the concrete floor

When the cabinet is fixed to the concrete floor, make holes on the floor and fix the cabinet to the concrete floor with expansion screws, as shown in Figure 4.5.

4.3.1.4 Inverter Grounding

The modules in the Bi-directional Hybrid Storage Inverter can realize grounding connection with the cabinet through hangers.

As for cabinet grounding, the cabinet bottom is installed with grounded cooper bars. During wiring, refer to the following table for cable diameter. The grounding resistance should be less than 4Ω.

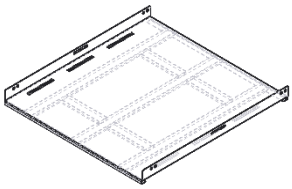
Rated power	PE line section recommendation
50 kW	≥16 mm²
100 kW	≥25 mm²

4.3.2. Battery System Installation

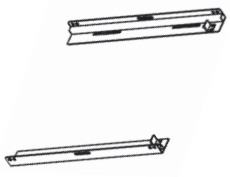
4.3.2.1 Battery Rack Installation

a. Open the battery rack package(s).

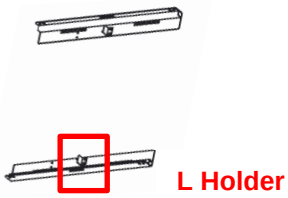
The tray is for the battery, the holder 1 is for HV900112 and the holder 2 is for junction box or TOP BMU box as the below figures show. The locations of them can be exchanged.



Tray



Holder 1



Holder 2

Note: the location of L holder on holder 2 is flexible. The front location is for the junction box and the rear location is for TOP BMU box.

b. If there are only one or two clusters, the junction box is not required, and the same is true of cluster racks. Just place the rack(s) in the suitable place(s) by using a crane or forklift.

If there are more than three racks, place the first rack beside the PCS, which is different from others as Figure 4.6 shows.

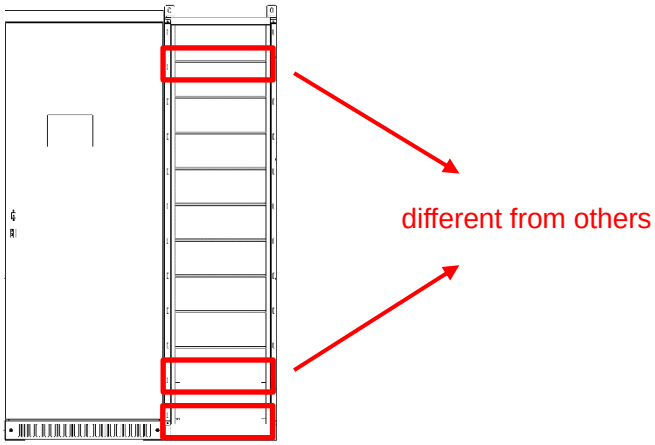
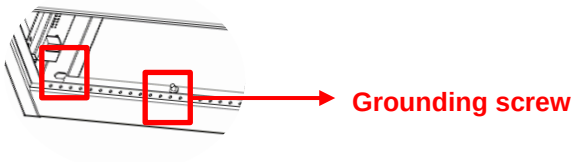


Figure 4.6 First rack appearance

c. Place other racks as Figure 4.7 shows.

d. Fix the rack foundation(s) with hex screws and nuts if the fixing is required, which you can find in the rack parts list. The customer shall prepaid for some materials, such as a cable to connect your own grounding cooper bar to the grounding screws of the rack bottom by using the grounding nut M6 from the rack parts list.



e. Fix the back fixing spot by using a ladder to prevent incline.

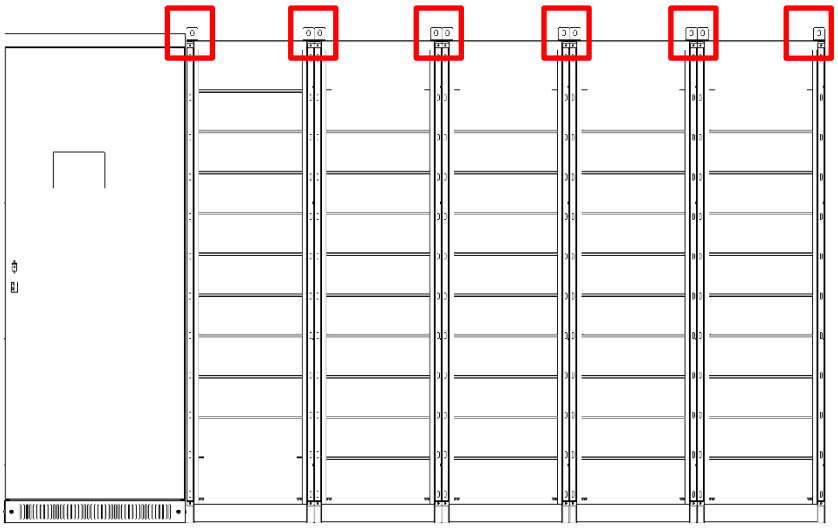


Figure 4.7 PCS and racks installation

4.3.2.2 Control Box Installation

Open the HV900112 package(s) and the TOP BMU box package (if TOP BMU is required).

- If the junction box is required

a. Put the TOP BMU box on the top of the second rack as Figure 4.8 shows.

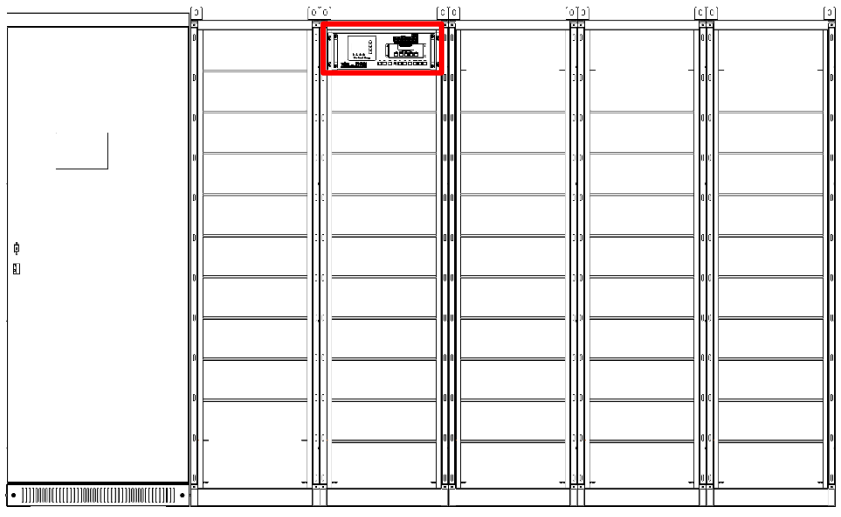


Figure 4.8 TOP BMU box installation

b. Put all the HV900112 boxes in the right places as Figure 4.9 shows.

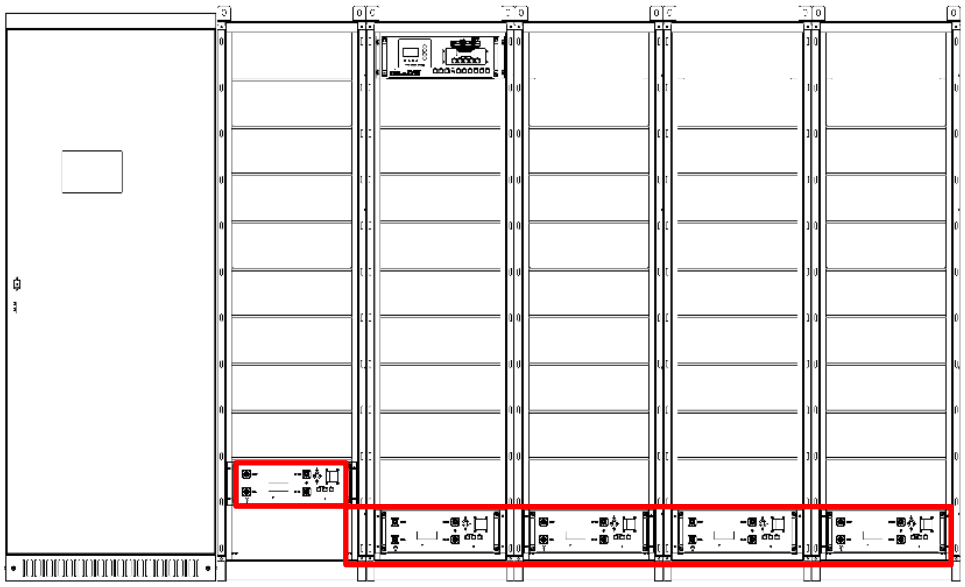


Figure 4.9 HV900112 boxes installation

- If the junction box is not required, just put the HV900112(s) in the bottom of the rack(s).

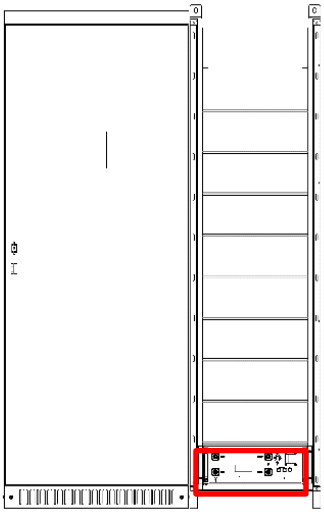
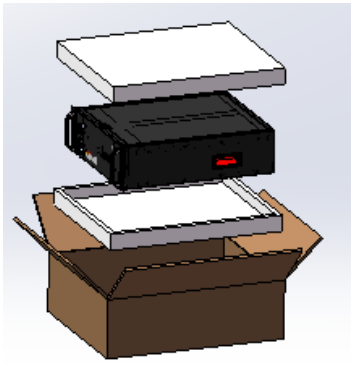
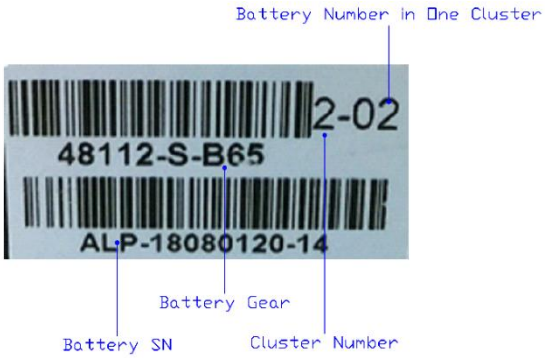


Figure 4.10 One cluster with HV900112

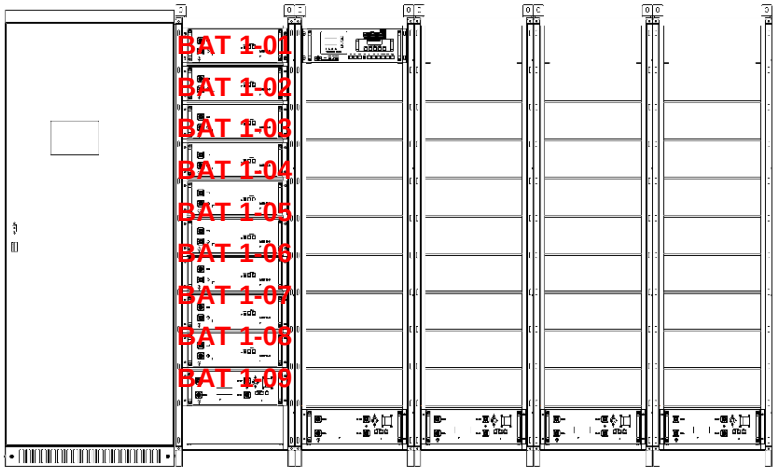
4.3.2.3 Battery Installation



Step 1: Open all the battery packages.



Step 2: Check the Battery No. and cluster No. on the battery cover.



Step 3: Put the same cluster of batteries on the same rack with the serial number of 01 to 09 from top to bottom as the above figure shows. The dip switch defines the serial number, see Table 7.

NOTE: All the cluster battery gear No. shall be the same.

In one cluster the dip switch of the battery should be different from ohers.

When you are installing the battery, pleasecto avoid scratches because of the heavy battery.

Step 4: After completing one rack, please check whether the installed batteries have the same cluster No. and the same battery gear No.

Step 5: If there are more than one rack, please repeat step 3 and 4 to install the other battery racks as Figure 4.11 shows.

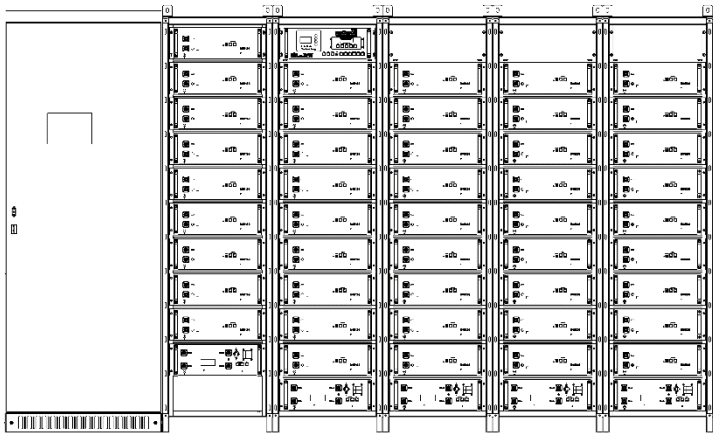


Figure 4.11 All batteries installation

4.4 Wiring

4.4.1. Battery Side Wiring

4.4.1.1 Communication Cables Connection

a. Please refer to the following figure, connect the communication cables among batteries of each cluster. These cables are in each battery parts list.

b. Take the terminal resistance in the HV900112 parts list and insert it into the top battery COM port of each battery cluster. You can see the detailed information Figure 4.13.

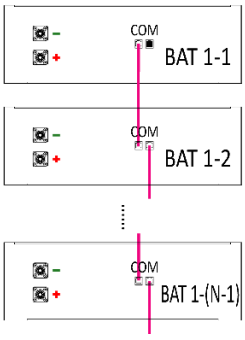


Figure 4.12 Communication cables connection in one cluster

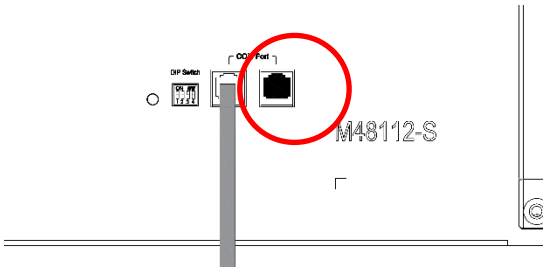


Figure 4.13 Terminal resistance in the top battery of each cluster

c. Connect the bottom battery of each cluster to V900112 (LMU Port) by using the communication cables from HV900112 parts list.

d Connect HV900112 (COM Port) in the nearest cluster from TOP BMU and TOP BMU box (COM Port, Port 1 or 2) by using the communication cable from TOP BMU part list. Then connect HV900112 (COM port) one by one by using cable from HV900112 parts list, please see Figure 4.14.

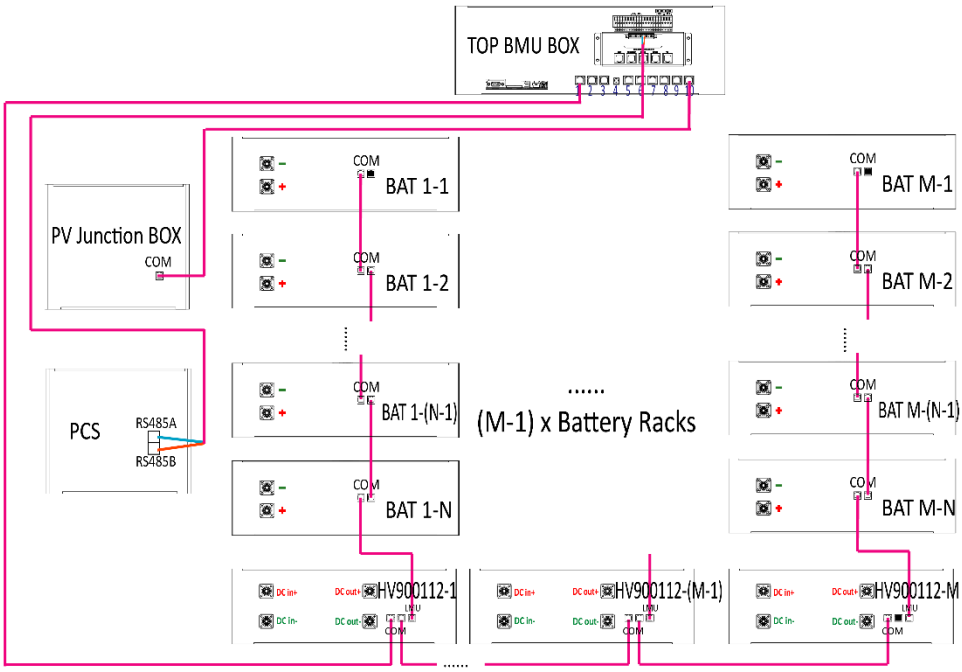


Figure 4.14 Battery side communication cables connection

e To connect the PCS and EMS please open the PCS cabinet front door and remove the shield of the right side. You can see the communication interface on the right down position. Then please connect TOP BMU box (Port 27 -485A and Port 28 - 485B) to the PCS (Port 9 - 485A and Port 10 - 485B) by using the RS485 cable from the rack parts list as Figure 4.15 shows.

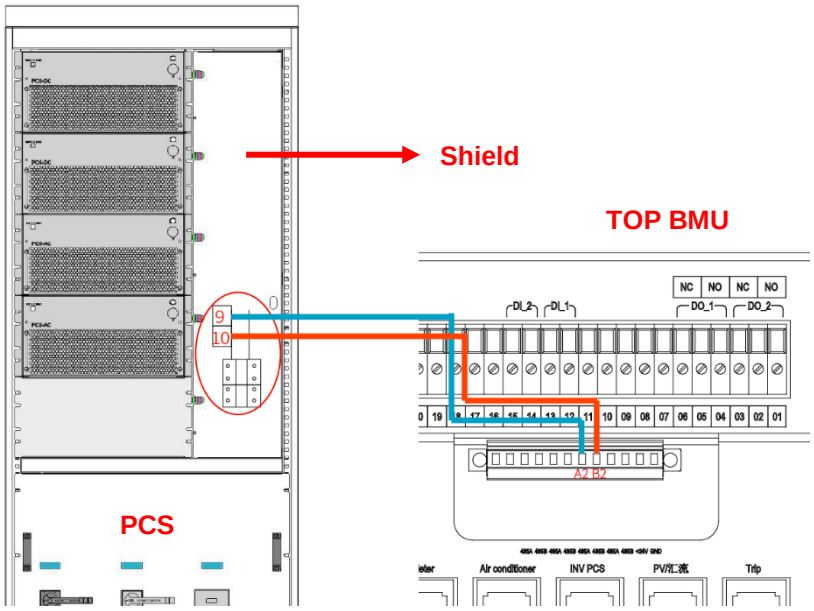


Figure 4.15 Conection between EMS and PCS

The terminal strip ports of PCS are defined as in Table 14 shown.

Table 14 Definition of terminal strip ports of PCS

Item	Terminal	Notes
Input Signal Loop		
1	IN1	BMS Fault Signal
2	IN1 GND	
3	IN4	On/Off-grid Switch Node 1
4	IN4 GND	
5	IN5	On/Off-grid Switch Node 2
6	IN5 GND	
External Communication Loop		
7	CAN H	From External BMS
8	CAN L	
9	485 A	To External RS485
10	485 B	
External Aux Power Input		
11	L	From External AUX Power
12	N	

f. Connect the PV junction port of TOP BMU box (Port 10) and the COM port of PV junction box by using a normal net cable (AlphaESS doesn't provide it).

g. The last COM port of HV900112, which has no cable to connect, should be inserted with the terminal residence from HV900112 parts list. You can see the detailed information Figure 4.16.

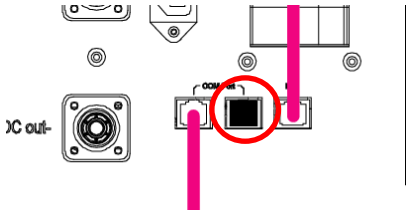


Figure 4.16 Terminal resistance in one of the HV900112

4.4.1.2 Power Cables Connection

- If there are only one or two clusters, you don't need the junction box. The battery DC positive and negative port of HV900112 can be directly connected to the BAT+ and BAT- of PCS as Figure 4.17 shows.

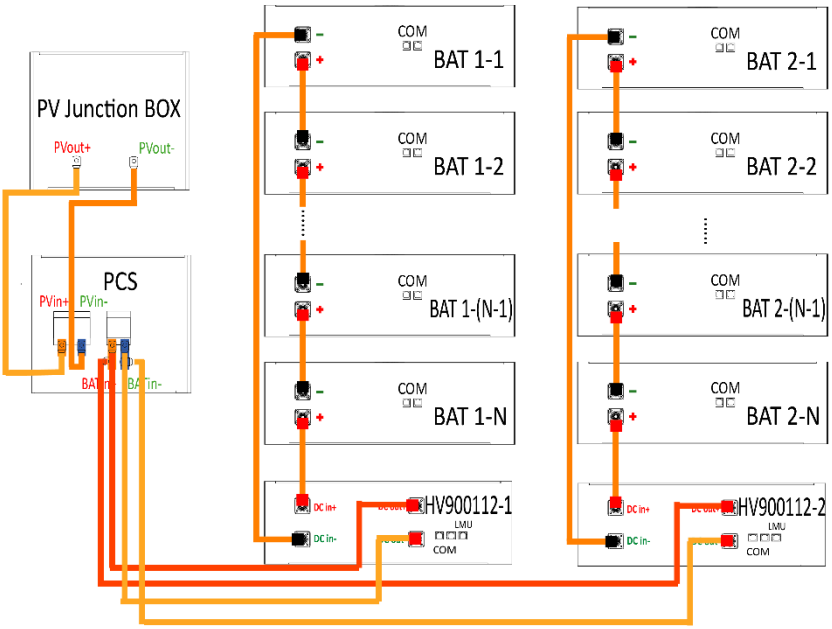


Figure 4.17 Battery side-power cables connection without junction box

- If you use the junction box, place the relevant power cables to junction box at the first, as shown in Figure 4.18. Then put the junction box in to the rack as shown in Figure 4.19.

The cables should be connected vertically with the copper bars in the junction box.

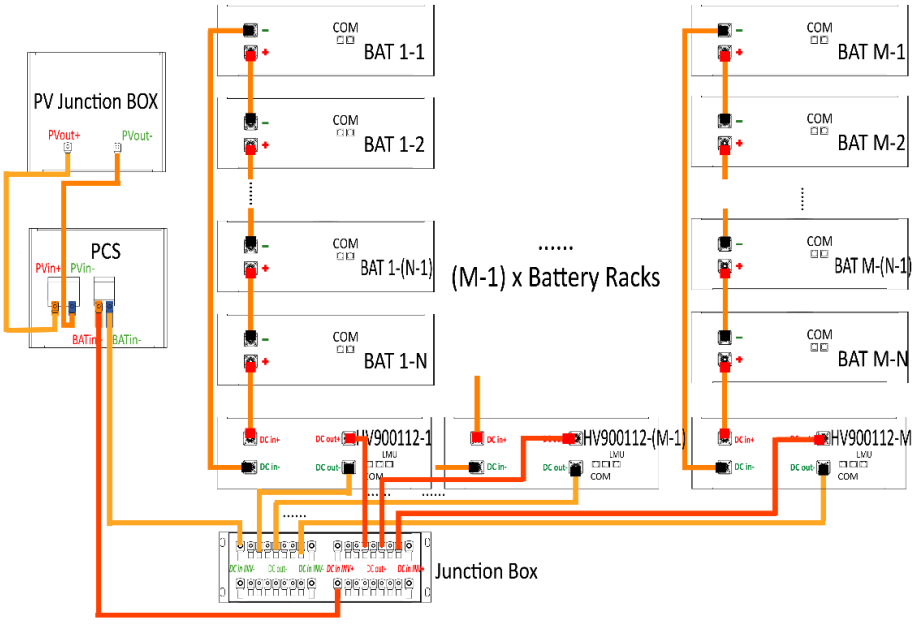


Figure 4.18 Battery side-power cables connection with junction box

After wiring the junction box, please fix it on the rack by using the screws and grounding serrated washers in junction box parts list

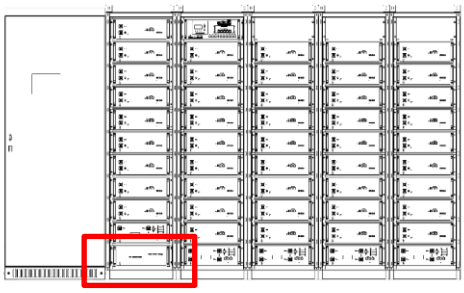
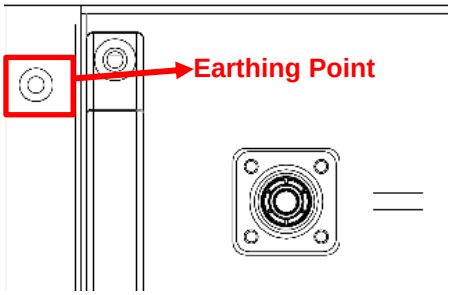


Figure 4.19 Placing junction box



After wiring the battery side, please fix each box with the four screws and four grounding serrated washers to the racks. These screws and grounding serrated washers are shipped in the corresponding batteries, HV900112, Top BMU box, junction box packages

4.4.2. Inverter Side-Wiring

The connection positions are in the bottom down position of the inverter cabinet. The cables shall be passed through the hole on the base of cabinet into the cable trench. Open the front door and remove the inner door, you can see the wiring copper bar. In view of the requirements of connecting cables, single or multiple cables with suitable diameter shall be selected.

It is suggested that the current in 1mm² wire should be ⩽3A.

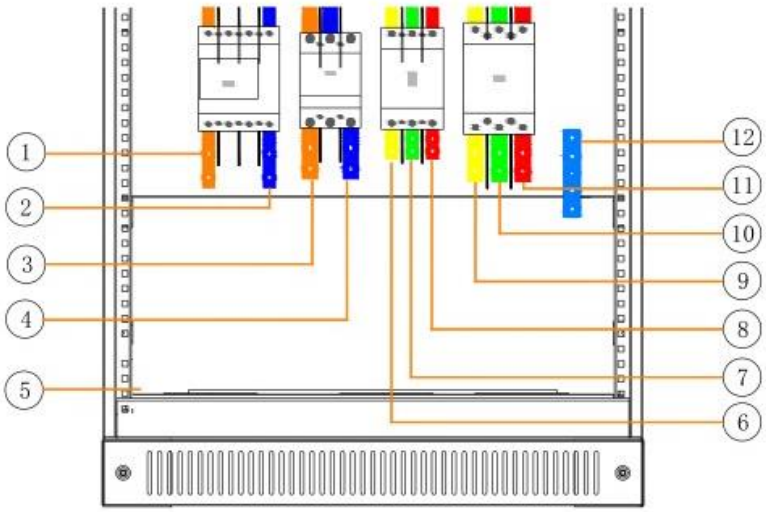


Figure 4.20 Inverter wiring diagram

Position	Description	Position	Description
1	PV DC input positive pole	7	Load output phase B
2	PV DC input negative pole	8	Load output phase C
3	Battery input positive pole	9	Diesel input phase A
4	Battery input negative pole	10	Diesel input phase B
5	Ground connect	11	Diesel input phase C
6	Load output phase A	12	Neutral connect

5. Operation

5.1 Switch on

5.1.1. Check Before Operation

Before operation, please check the equipment according to following procedures:

If no sign of damage is inspected visually outside the inverter module and all the battery switch, PV switch and load switch, diesel engine switch are in the "OFF" position, you will

a. check whether the DC input wiring of the energy storage system and the AC output wiring are normal and whether the earthing is good;

b. check whether the wire connection polarity is normal;

5.1.2. Power-on Procedures

The system shall be turned on in the correct sequence to avoid any damage.

A. Turn on the moulded case circuit breakers of HV900112 in each cluster respectively.

From left to right: OFF- triggered position–ON

Figure 5.1 Moulded case circuit breaker in switch-off status

B. Turn on the AC air switch of HV900112 in each cluster respectively. If there is an AC main switch, turn it on.

Figure 5.2 AC switch in switch-on status

C. After the power is on, the LED on the batteries and HV900112 starts flashing.

D. Two minutes later, turn on the battery and PV switches of the inverter by pushing up the switch handles. The green indicator of the inverter starts flashing. After 10 seconds, the red indicator is on.

Figure 5.3 PV switch and battery switch in switch-off satus

E. Click “login/out” to enter login interface, enter login password 123456789 and enter main interface of super client. Set in the PCS android display control mode as “remote control”.

Figure 5.4 PCS display setting

F. Turn on the load switch by pushing up switch handles. If a diesel generator is connected, turn on the generator switch.

Figure 5.5 Load switch and diesel switch in switch-off satus

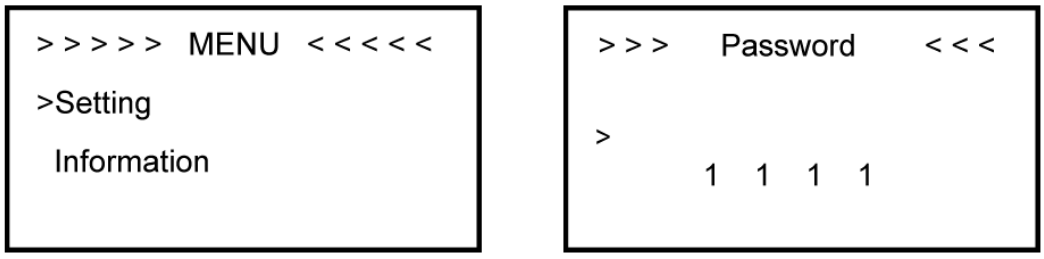
G. Normal system operation

After the system is powered on, it will be switched on automatically if there are no errors and warnings.

5.2 Switch off

Enter into EMS menu

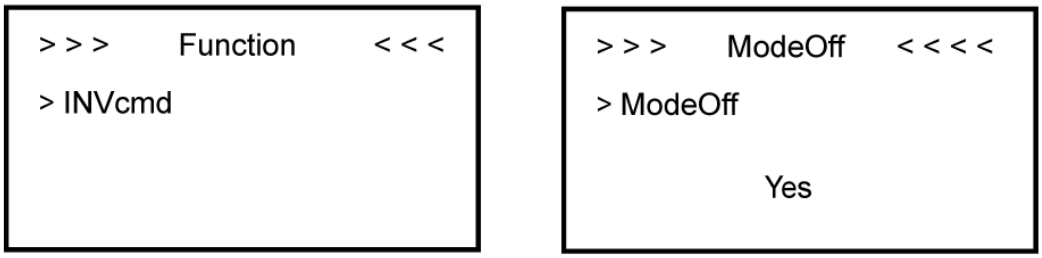
Main interface -> Setting -> Password (the initial password for installers is 1111)



(1) **(2)**

Enter Function menu -> INVcmd -> ModeOff -> yes

The system shall then be powered off.



(3) (4)

5.2.1. Power-off Procedures

The system shall be powered off according to following steps:

A. turn off two DC breakers of the inverter.

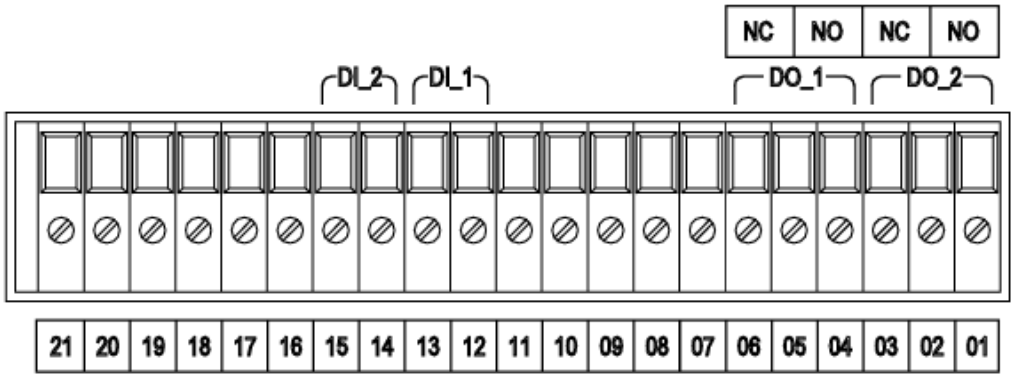
B. turn off two AC switches of the inverter.

C. turn off the AC air switch of HV900112 in each cluster.

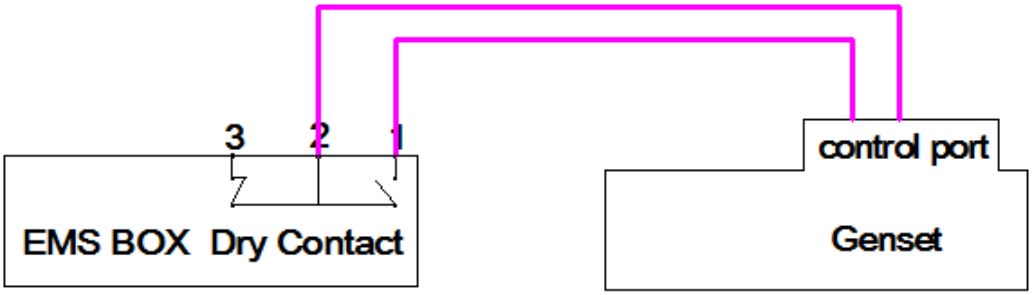
D. turn off the moulded case circuit breaker of HV900112 in each cluster.

Note: the system will be switched on automatically if it is still powered on after 5 min.

5.3 Dry Contact Description



1. Connect DO_2 to the dry contact of the diesel generator, port 2 and 3 (normally closed contact), 1 and 2 (normally open), you can connect the diesel dry contact to control the 2 and 3.
2. Connect DI_2 to the fire fighting dry contact, port 14 and 15 are respectively corresponding to the composite fire alarm of connecting fire fighting. (if required)
3. Please connect the diesel control dry contact as the below picture shows:



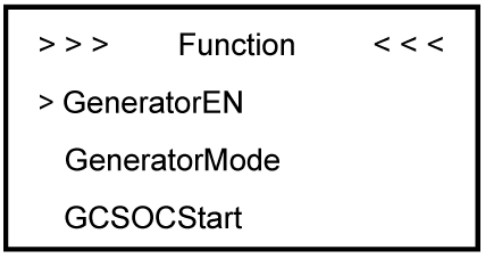
Note: normally open/closed contact which connects the Genset according to the genset controller.

5.4 Diesel Generator Control

Enter into EMS menu

Main interface -> Setting -> Password (the initial password for installers is 1111)

Enter function menu -> Generator allocation



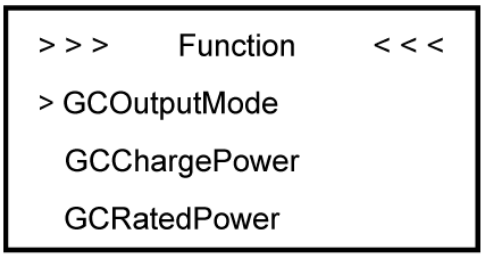


Table 15 Setting parameter for diesel generator control

No.	Parameter	Description
1	GeneratorEN	Yes-Diesel generator enabled No-Diesel generator disabled
2	GeneratorMode	Fix SOC mode
3	GCSOCStart	Lower limit of the configured SOC range
4	GCSOCEnd	Upper limit of the configured SOC range
5	GCOutputMode	Optional 6, 7 mode
6	GCChargePower	Battery charging power
7	GCRatedPower	Diesel generator output rated power

When the diesel generator is enabled, it will supply the load first.

1. When the SOC drops below the lower limit of the configured SOC range, the diesel generator will start; when it raises beyond the upper limit, the diesel generator will then be turned off.

2. Charging power mode

If the mode 6 – battery charging power mode is selected, the diesel generator will charge the batteries with configured power.

3. Diesel generator rated power mode

If the mode 7 – diesel generator output rated power mode is selected, the diesel generator will charge batteries with the rest of the power under the condition of satisfying load.

The rest power is $P_{rest} = P_{output} - P_{load}$.

You can also set the control mode on the website, see 5.5.3

5.5 Online Monitoring

5.5.1. Register

You have to create a new account on our webserver for normal monitoring. In addition, a part of our warranty is based on this connection to our webserver. The data before the registration would not be retained on the webserver.

So please use following steps:

Open the portal: www.alphaess.com.

Please fill in “Username”, “Password” and click “Login”, if you have registered.

If not, please register following these steps

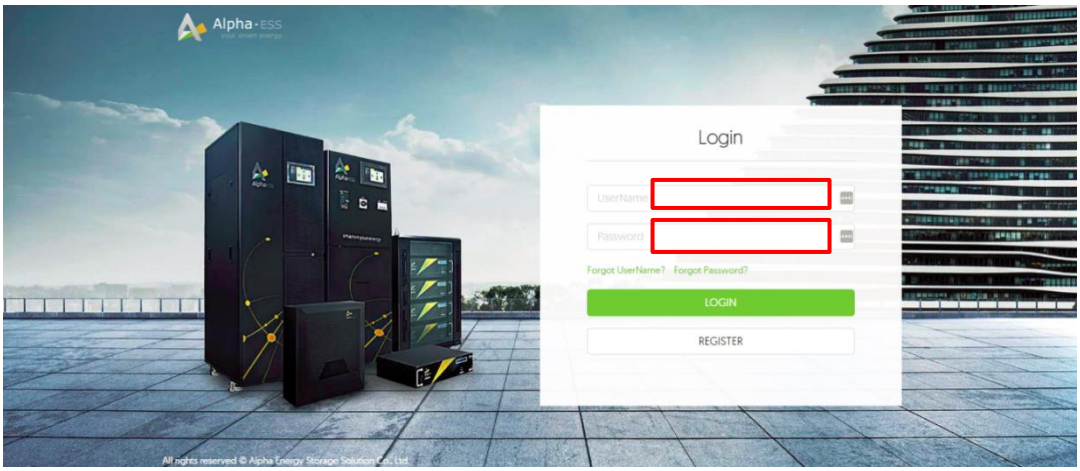


Figure 5.6 Monitoring login interface

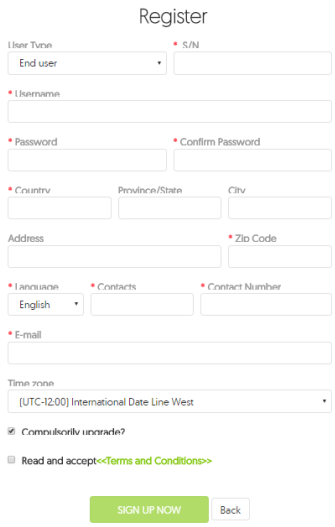


Figure 5.7 Register interface

In this form, all blanks marked with an asterisk must be filled out, you can choose End user or installer.

More detailed information can be obtained in Online Monitoring Webserver installation Manual.

5.5.2. Registering License

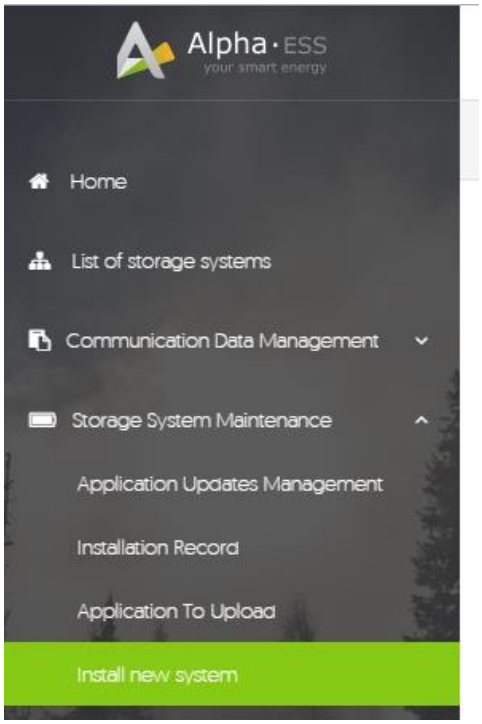


Figure 5.8 Menu for installer

Click Install new system to register the license No.

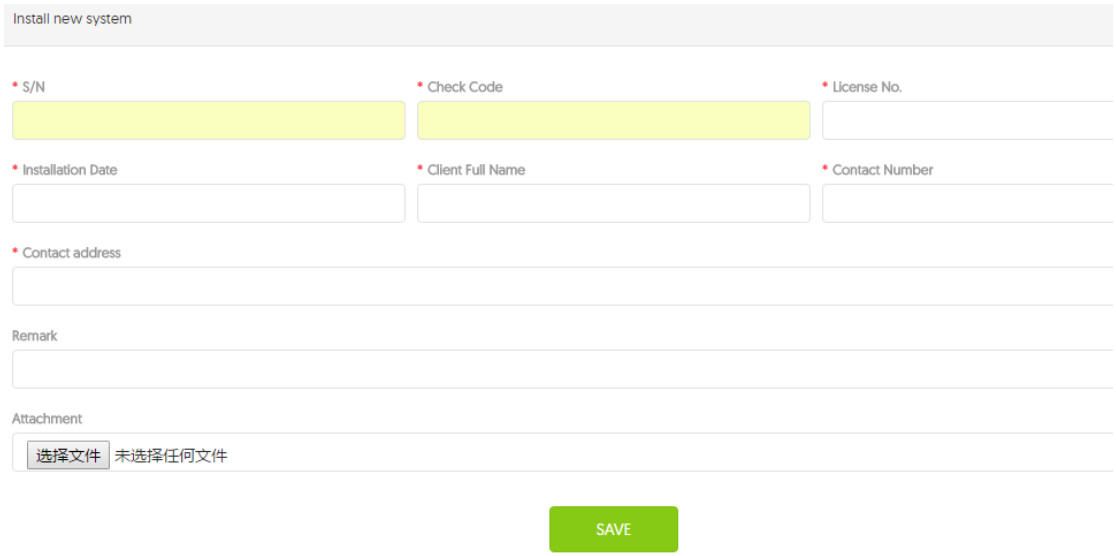
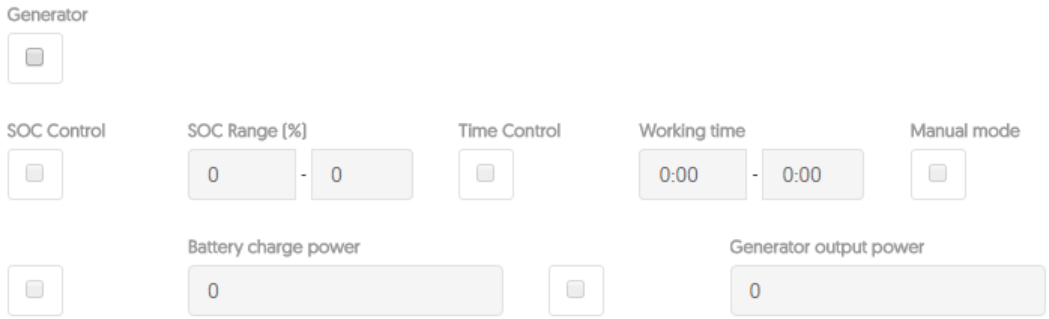


Figure 5.9 System registering interface

Input **S/N**, **Check Code**, **License No**., **Date**, **Name**, and **Contact No.** to complete the registering process.

5.5.3. Generator Control Setting On Server



You can set according to the actual conditions by customers.

There are two options, SOC control or time control.

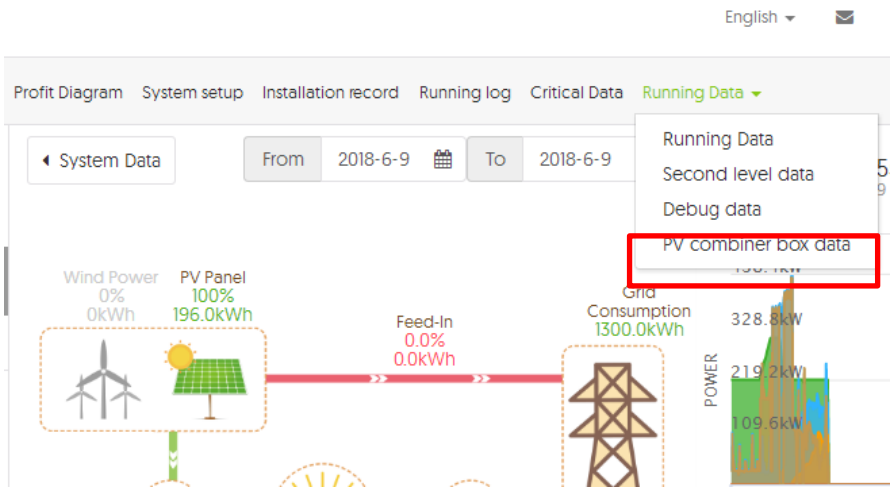
At the first, please click Generator to enable it.

- Choose SOC control to set SOC range. If the SOC drops below the lower limit of the configured SOC range, the diesel generator will start; when it raises beyond the upper limit, the diesel generator will then be turned off.
- If you set the battery charge power, it will charge the batteries with the configured battery charge power.
- If you set the Generator output power, it will charge the batteries with the rest of the power under the condition of satisfying load. The rest of the power is $P=P_{output} - P_{load}$.

- Choose time control, the diesel generator will start during the configured working time.

5.5.4. PV Junction Box Data Check

Click on stored energy system list -> input SN -> click operating data -> Check by choosing the required operating data type.



5.6 Emergency Stop

When the energy storage system is abnormal, you can press the emergency stop button "EPO" on the cabinet door, follow the step A to D in 5.2.1 to power it off.

In order to prevent personal casualty, if you want to repair or open the machine after power-off, please measure the voltage at the input port with the multimeter first. Before any relevant operation, please confirm that there is no grid electric supply!

The upper cover plate cannot be opened until the DC-link capacitance inside the module discharges completely about 15 minutes (see warning label on the surface of module for details).

6. Routine Maintenance

6.1 Maintenance Plan

- check if wire connection loose
- check if cables aged/damaged
- check if cable insulating ribbon drop
- check if cable terminal screw loose, any overheat sign
- check if ground connection is well

6.1.1. Routine Inspection

Item	Details	Frequency	Training/qualification requirements	Minimum PPE (Personal protection equipment)	Notes
Foundation	Check the foundation for tilt or sink	Once 6 months	No tilt or sink	Work cloth; Protective shoes	
Footing	Check the earthing bar of the container for rusting.	Once 6 months	No rusting	Work cloth; Protective shoes	
Lighting power supply	Check the lighting supply; all the lights should work normally	Once 6 months	All the lights should work normally	Work cloth; Protective shoes	
Emergency lighting	Check the emergency lighting equipments; all the lights should work normally	Once 6 months	All emergency lights should work normally after power supply is down	Work cloth; Protective shoes	
Bracket surface	Check the brackets for rust or damage	Once 6 month	No rusting or damage	Work cloth; Protective shoes	
Bracket fixing	Check the fixing of brackets between brackets and ground of the container	Once 6 months	All bolts are tight	Work cloth; Protective shoes; Wrenches	

Module surface	Check the modules for rust or damage	Once 6 months	No rusting or damage	Work cloth; Protective shoes	
Module fixing	Check the fixing of modules between modules and brackets	Once 6 months	All bolts on module are tight	Work cloth; Protective shoes; Wrenches; Insulated gloves	
Module connection	Check the module serial and parallel connection	Once 6 months	All bolts of copper bars and cables are tight	Work cloth; Protective shoes; Wrenches; Insulated gloves	
Module grounding	Check the module for correct grounding	Once 6 months	The bolts on module surface should be electrically connected to the bracket surface and grounding bars(tested by a multimeter)	Work cloth; Protective shoes; Wrenches; Insulated gloves	
Module terminal	Check the terminals of modules for insulation protection	Once 6 months	All red and black covers should be complete	Work cloth; Protective shoes; Wrenches; Insulated gloves	
Circuit breaker	Check the on-off function and tripping function of circuit breakers	Once 6 months	The circuit breaker function should be OK; When breaker is off , no voltage is allowed	Work cloth; Protective shoes; Wrenches; Insulated gloves	
PCS display	Check the PCS screen	Once 6 months	All data on PCS including voltage, power and current is OK	Work cloth; Protective shoes;	
PCS inside temperature	Check inside temperature of PCS, including module temperature and cabinet temperature	Once 6 months	No alarming events on PCS	Work cloth; Protective shoes;	
PCS cable	Check the	Once 6	No overheating	Work cloth;	

	terminals of PCS cables for overheat marks	months	marks or burning marks	Protective shoes;	
PCS grounding	Check the PCS for correct grounding	Once 6 months	No rusting or damage	Work cloth; Protective shoes;	
PCS fixing	Check the fixings of PCS with container	Once 6 months	All fixing bolts should be tight	Work cloth; Protective shoes; Wrenches; Insulated gloves	

6.1.2. Routine Maintenance

Item		Equipment	Maintenance cycle	Training/qualification requirements
Battery system	Painting on brackets	Work clothes; Protective shoes; Anticorrosive paint	6 months	Corresponding color number
	Fixing on brackets	Work clothes; Protective shoes; Wrench	6 months	Fixing between brackets and container ground
	Grounding of brackets	Work clothes; Protective shoes; Screwdriver	3 months	Use multimeter to test grounding.
	Battery system cleaning	Work clothes; Protective shoes; Cloth	6 months	The brackets and modules should be clean
	Painting on modules	Work clothes; Protective shoes; Insulating paint	6 months	Corresponding color number
	Fixing on modules	Work clothes; Protective shoes; Wrench	3 months	Fixing between modules and brackets
	Connecting cooper bar	Work clothes; Protective	3 months	Serial copper bars

	fixing	shoes; Wrench		
	Insulation protection	Work clothes; Protective shoes;	3 months	Protecting cover on module poles
	Module tamper proof labels	Work clothes; Protective shoes;	3 months	Tamper proof labels
	Module grounding	Work clothes; Protective shoes; Wrench	3 months	Use multimeter to test grounding.
	Battery capacity calibration	Work clothes; Protective shoes;	6 months	Whole discharge-charge-discharge cycle
	Battery data analyze	Work clothes; Protective shoes;	6 months	Analyze BMS data recorded（by Alpha staff)
Junction box	Junction box cable terminal fixing	Work clothes; Protective shoes; Wrench	6 months	All bolts are tight
PCS	Operating status and environment of the system	Work clothes; Protective shoes;	6 months	Check whether the converter is damaged or deformed or not. Listen whether abnormal sound is available during the operation of converter. Check all varieties during the operation of converter. Check whether the major parts are Ok or not. Check the heating of converter`s case and use thermal imager to monitor the heating situation of the system. View whether the air inlet/outlet is normal or not. Check the humidity and dust around the converter and ensure the filters in air inlet are OK. Attention! Check the ventilation in

				the air inlet hole. If the module cannot be effectively cooled down, it may be damaged due to overheating.
	System clean	Work clothes; Protective shoes;	6 months or 12 months	Clean circuit board and components. Check the temperature and dust of the radiator. If necessary, use the compressed air from the fan to clean the module. Change the air strainer.
	The connection of power circuit	Work clothes; Protective shoes;	6 months	Check whether the power cable is losse and fasten it with the torque. Check whether there are damages on power cable and control cable, especially the cable skin contacts with the metal surface. Check whether the insulated ribbon is stripped from the electric cable's wiring terminal.
	Connection of terminal and winding displacement	Work clothes; Protective shoes;	6 months	Check whether the screw in control terminal is loose. If yes, use the screw driver to fasten. Check whether the main-circuit's terminal is loose or overheating on bolt. Visually check the connection of converter and the winding displacement.
	Maintenance and alteration of cooling fan	Work clothes; Protective shoes;	12 months	Check whether some cracks appear on the fan's blade. Listen whether there are some abnormal vibration sounds during the operation of fan. Please change the fan immediately if some faults occurred on the fan.
	Breaker maintenance	Work clothes; Protective shoes;	6 months or 12 months	Conduct routine inspection on the corrosion of metal components. (once half a year) Yearly inspection on the contactor

				(auxiliary switch or micro-switch) and ensure it good mechanical running. Check the operation parameters (especially voltage and insulation).
	Safety function	Work clothes; Protective shoes;	6 months or 12 months	Check the emergency stop switch and LCD Simulate power off and check whether communication signals are available during power off. Check the warning label. If necessary, please change it in time.

6.2 Notes

After all of the equipments are out of operation, the following notes should be paid attention to while maintaining:

- Related safety standards and specifications should be followed in operation and maintenance.
- Disconnect all the electrical connections so that the equipment would not be powered on.
- Wait at least 15 minutes after disconnection in case that the residual voltage of capacitors down to safe voltage. Use a multimeter to ensure the equipment is completely uncharged.
- The amount of maintenance staff should be not less than two while maintaining.
- The equipment should be repaired by professional staff and it is strictly forbidden for maintenance staff to open equipments on their own.
- Appropriate protective measures should be taken while maintaining, such as insulated gloves, shoes, and anti-noise ear plugs.
- Usually the location of the storage system is far away from urban areas. Related emergency rescue measures should be prepared in order to be implemented when necessary.
- Life is priceless. Make sure no one would get hurt first.
- When a fire happened in the container, just make sure the fire system is on (should be on), then leave the container as soon as possible. After running out, make sure all doors are closed. The fire extinguishing system would automatically work. Do not try to put the fire out manually.
- When a fire happened in the PCS container, just close the door and press the emergency button manually.
- When the fire is outside the containers, please make sure all doors are closed in case of smoke. Smoke may cause warnings of sensor, but it will not trigger fire system. If

the fire spreads into the container, the temperature sensor would work and the whole system would start.

- For single cell, it is better to be sank into water to block burning.
- The batteries need to be charged to 30%~50%SOC rate when the whole system is static (that is, the batteries has not been charged for two weeks or longer) for a long time, in case of over discharge.
- Please contact us in time if there are any conditions that could not be explained in the manual.

7. Troubleshooting

7.1 Battery and BMS Troubleshooting

7.1.1. Error Type

Alarm	Displayed in EMS	Processing method
Cell temperature different fault	Cell-Temp-Diff	Contact with Alpha service
Balancer fault	Balancer Err	Contact with Alpha service
Module charge over current fault	Chrg-Ov-Curr	Contact with Alpha service
Module discharge over current fault	Disch-Ov-Curr	Contact with Alpha service
Pole over temperature fault	Pole-Ov-Temp	Contact with Alpha service
Cell over volt fault	Cell-Ov-Volt	Contact with Alpha service
cell volt different fault	Cell-Volt-Diff	Contact with Alpha service
cell discharge under temperature fault	Disch-Low-Temp	Contact with Alpha service
Cell under volt fault	Cell-Low-Volt	Contact with Alpha service
Insulation resistan fault	IR_Fail	Cut off BMS at the first, then operate in power sequence when power the system
LMU Communication fault	Commu_fail_LMU	Check communication connection between batteries (LMU and LMU), battery and HV900112 (LMU and BMU)
Cell over temperature fault	Cell-Ov-Temp	Contact with Alpha service
BMU Communication fault	Commu_fail_BMU	Check communication cable between HV90012s (BMU and BMU), also HV900112 and TOP BMU Box (BMU and TOP BMU)
Cell charge under temperature fault	Chrg-Low-Temp	Contact with Alpha service
Wire beam fault	Wire-Harness-Err	Contact with Alpha service
Relay fault	relay Err	Cut off BMS
Temperature sensor fault	Temp-Sen-Err	Contact with Alpha service

7.1.2. Emergency Handling Plan

In order to prevent accidents such as electric shock, fire or explosion, the emergency switch should be pressed immediately to stop the equipments when abnormal sound, smell or sparks is found.

- Disconnect the AC breaker.
- Check the control power supply. If it is OK, return the power supply to find out the reason.

Please record every detail related to the fault, so we can analyze and solve the fault better. Any operation of equipments is strictly forbidden, please contact us as soon as possible.

When the batteries are on fire, do not try to put the fire out manually. That is dangerous because the special chemical property of lithium-ion batteries (though LiFePO4 is safer, there is possibility of danger). Water or other liquid is not recommended. Novec 1230, FM-200, or dioxide extinguisher are recommended. ABC extinguishers are not effective when the battery pack is on fire.

As battery cell contains little Oxygen inside and all cells have got explosion-proof valve, explosion hardly happens.

7.2 EMS Troubleshooting

Alarm	Displayed in EMS	Processing method
Inverter Disconnect	INV Lost	Check communication connection between EMS and inverter
Grid Meter Disconnect	Meter Lost	Check communication connection between EMS and grid meter
Battery Disconnect	BMS Lost	Check communication connection between EMS and battery system
PV Meter Disconnect	PV-Meter Lost	Check communication connection between EMS and grid meter
SD not inserted or SD writing error	SD lost	Replug SD card
Network card error	NetCard Err	Contact with Alpha