LiFePO4 Battery System
for Households

3058-010011-02

User Manual

LiFePO4

Battery System for Households
VMBF Series

Contents

1. About This Manual

The manual mainly describes the product information, guidelines for installation, operation, and maintenance. The manual cannot include complete information about the solar photovoltaic-energy storage hybrid system.

How to Use This Manual

Read the manual and other related documents before performing any operation on the battery. Documents must be stored carefully and be always available.

Content may be updated or modified periodically due to product update iterations. The manual is subject to change without prior notice.

1.1 Safety Introductions

Reminding

1) It is very important and necessary to read the user manual carefully (in the accessories) before installing or using battery. Failure to do so or to follow any of the instructions or warnings in this document can result in electrical shock, serious injury, or death, or can damage battery, potentially rendering it inoperable.
2) If the battery is stored for long time, it is required to charge them every six months, and the SOC should be no less than 50%.
3) Battery needs to be recharged within 48 hours after fully discharged.
4) Do not expose cable outside.
5) All the battery terminals must be disconnected for maintenance.
6) Please contact the supplier within 24 hours if there is something abnormal.
7) Do not use cleaning solvents to clean battery.
8) Do not expose battery to flammable or harsh chemicals or vapors.
9) Do not paint any part of Battery, include any internal or external components.
10) Do not connect battery with PV solar wiring directly.
11) The warranty claims are excluded for direct or indirect damage due to items above.
12) Any foreign object is prohibited to insert into any part of battery.

Warning

1.1.1 Before Connecting

1) After unpacking, please check product and packing list first, if product is damaged or lack of parts, please contact with the local retailer.
2) Before installation, be sure to cut off the grid power and make sure the battery is in the turned-off mode.
3) Wiring must be correct, do not mistake the positive and negative cables, and ensure no short circuit with the external device.
4) It is prohibited to connect the battery and AC power directly.
5) Battery system must be well grounded and the resistance must be less than 1Ω.
6) Please ensured the electrical parameters of battery system are compatible to related equipment.
7) Keep the battery away from water and fire.

1.2 In Using

1) If the battery system needs to be moved or repaired, the power must be cut off and the battery is completely shut down.
2) It is prohibited to connect the battery with different type of Battery.
3) It is prohibited to put the batteries working with faulty or incompatible inverter.
4) It is prohibited to disassemble the battery.
5) In case of fire, only dry fire extinguishers can be used. Liquid fire extinguishers are forbidden.
6) Please do not open, repair, or disassemble the battery except staffs from VAMI or authorized by VAMI. We do not undertake any consequences or related responsibility which because of violation of safety operation or violating of design, production, and equipment safety standards.

2. Introduction

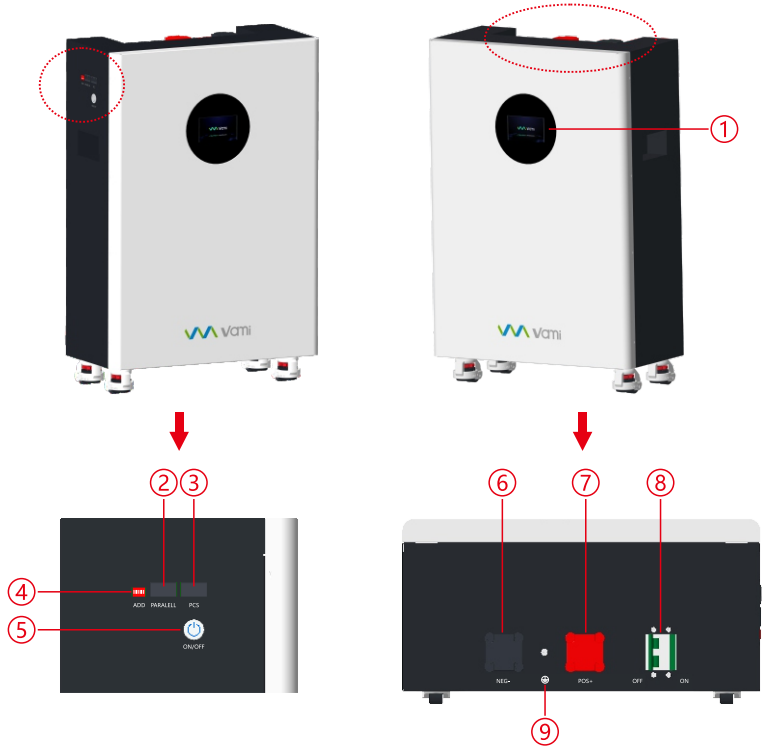
2.1 Product Features

1) The whole module is non-toxic, non-polluting, and environmentally friendly.
2) Cathode material is made from LiFePO4 with safety performance and long cycle life.
3) Battery management system (BMS)has protection functions including over-discharge, over-charge, over-current and high & low temperature.
4) Flexible configuration, multiple battery modules can be in parallel for expanding capacity and power.

5) Adopted self-cooling mode rapidly reduced system entire noise.
6) The module has less self-discharge, up to 6 months without charging it on shelf, no memory effect, excellent performance of shallow charge and discharge.
7) High-power density: flat design, wall-mounted and floor-mount, saving installation space.

2.2 Product Overview

This section details the front and side panel of the interface functions.
VMBF51280 Product Interface



1. Display Screen	6. Battery Negative
2. Parallel Port	7. Battery Poaitive
3. PCS Port	8. Micro Circuit Breaker
4. DIP Switch	9. Grounding Bolt
5. Power Button	

2.2.1 DIP switch SW1-SW5 Description

DIP switch SW1-SW4 Description						
SW1	SW2	SW3	SW4	Remarks	DIP switch SW5 Description	
0	0	0	0	ID=16,communication address is 0x10	SW5	Remarks
1	0	0	0	ID=1,communication address is 0x01	1	means connect 120Ω resistor
0	1	0	0	ID=2,communication address is 0x02		
1	1	0	0	ID=3,communication address is 0x03	0	means disconnect 120Ω resistor
0	0	1	0	ID=4,communication address is 0x04		
1	0	1	0	ID=5,communication address is 0x05		
0	1	1	0	ID=6,communication address is 0x06		
1	1	1	0	ID=7,communication address is 0x07		
0	0	0	1	ID=8,communication address is 0x08		
1	0	0	1	ID=9,communication address is 0x09		
0	1	0	1	ID=10,communication address is 0x0A		
1	1	0	1	ID=11,communication address is 0x0B		
0	0	1	1	ID=12,communication address is 0x0C		
1	0	1	1	ID=13,communication address is 0x0D		
0	1	1	1	ID=14,communication address is 0x0E		
1	1	1	1	ID=15,communication address is 0x0F		

1. When multiple battery packs communicate, the first and the last battery pack SW5 needs to be in the ON status, otherwise the communication may have interference.
2. When the battery pack ID is set to 1-16, it means that the parallel operation is required, and it isnecessary to detect whether the parallel condition is satisfied.
3. The parallel condition is that the difference between the battery voltage of the local battery and all the battery pack voltages is <3V, otherwise wait until the condition is satisfied.

2.2.2 Connect the communication line between battery and inverter

(1) PCS Port Definition

Definition of PCS Port Pin

No.	PCS Port Pin
1	RS485-BPCS
2	RS485-APCS
3	–
4	CANHPCS
5	CANLPCS
6	COM_GND
7	RS485-APCS
8	RS485-BPCS

(2) Parallel Port Definition

Definition of IN Port Pin

No.	PCS Port Pin
1	RS485-BPCS
2	RS485-APCS
3	+5V_COM
4	CANH
5	CANL
6	COM_GND
7	–
8	–

Grounding bolt

For the battery connecting to the PE.

Grounding wire

The grounding wire is connected to the grounding bolt, and its function is to lead the electricity on the possibly live metal shell to the earth, so as to avoid the electric shock accident.

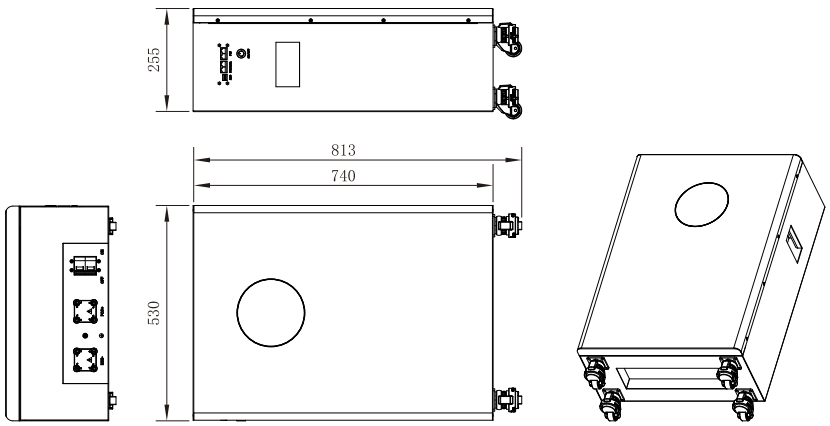
Micro Circuit Breaker

In the circuit for switching, breaking and bearing the rated working current, and can be in the line overload, short circuit in the case of reliable protection.

BMS function:

Protection and Alarm	Management and Monitor
Charge/Discharge End	Intelligent Protect Mode
Charge Over Voltage	Intelligent Charge Mode
Discharge Under Voltage	Protect, Charge Current Limit
Charge/Discharge Over Current	Intelligent Protect Mode
High/Low Temperature(cell/BMS)	Intelligent Protect Mode
Short Circuit	Protect

2.3 Product Size



2.4 Technical Data

Main Parameter		VMBF51280	VMBF51314
Battery Chemistry		LiFePO4	
Capacity (Ah)		280	314
Scalability		Max.16 pcs pack in parallel	
Nominal Voltage (V)		51.2	
Operating Voltage(V)		43.2~57.6	
Energy (kWh)		14.336	16.06
Usable Energy (kWh)[1]		12.9	14.47
Charge/Discharge Current (A)	Recommend [2]	150	
	Max. [2]	200	
	Peak(2mins,25℃)	250	
Other Parameter			
Heater [3]		×	×
Recommend Depth of Discharge		80%	
Dimension (W/H/D, mm)		530*815*255	
Weight Approximate(kg)		124	126
IP Rating of enclosure		IP20	
Working Temperature		Charge:0℃ ~ 55℃ Discharge:-20℃ ~ 60℃	
Storage Temperature		0℃~40℃	
Humidity		5%~95%	
Altitude		≤2000m	
Cycle Life		≥6000 (25°C+2°C,0.5C/0.5C,80%DOD,70%EOL)	
Installation		Floor-Mounted	
Communication Port		CAN2.0, RS485	
Certification		UN38.3, IEC62619, CE	

[1] DC Usable Energy, test conditions: 80% DOD, 0.5C charge & discharge at 25°C. System usable energy may vary due to system configuration parameters.

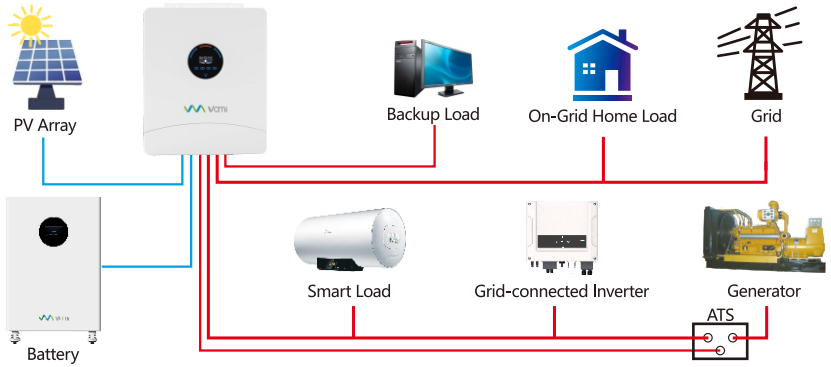
[2] The current is affected by temperature and SOC.

[3] Heater Temperature Range: ON: discharge: below 0°C, charge: below 5°C; OFF: Above 10°C.

2.5 Product application solutions

The following illustration shows basic application of this battery.
It also includes following devices to have a complete running system.
- Generator or Utility
- PV modules
- Inverters (Charge & Discharge)

Consult with your system integrator for other possible system architectures depending on your requirements.



The picture is only an effect picture, please refer to the actual product, the final interpretation right belongs to VAMI.

3. Parts List

Check the equipment before installation. Please make sure nothing is damaged in the package. You should have received the items in the following package.

NO	NAME	SPECIFICATION	PICTURE
❶	Communication line 2	Used for communication among batteries	
❷	Cables	Used for battery parallel connection	
❸	Guarantee card	Guarantee card	
❹	User manual	User manual	

4. Preparations for Installation

4.1 Explanation of Symbol

4.2 Tools

These tools are required to install the battery.

No.	Items	Usage	Appearance
1	Phillips Screwdriver or Bit	To fasten battery and assemblies	
2	Box Cutter	Opening boxes	
3	Insulated Torque Wrench	Installing cables and busbars	
4	Insulated Sockets	Installing cables and busbars	
5	Battery Tester	Measure battery module's voltage	

NOTE:

Use properly insulated tools to prevent accident tale electric shock or short circuits.
If insulated tools are not available, cover the entire exposed metal surfaces of the available tools, except their tips, with electrical tape.

4.3 Safety Gear

It is recommended to wear the following safety gear when dealing with the battery pack.

Safety gloves

Safety goggles

Safety shoes

5. Mounting instructions

5.1 Installation Precaution

Please make sure the installation site meets below conditions:

◆Not in direct sunlight.
◆Not in areas where highly flammable materials are stored.
◆Not in potential explosive areas.
◆Not in the cool air directly.
◆Not higher than altitude of about 2000 meters above sea level.
◆Not in environment of humidity.

5.2 Installation Location

Make sure that the installation location meets the following conditions:

✧The area is completely water proof.
✧The wall is flat and level.
✧There are no flammable or explosive materials.
✧The ambient temperature is within the range from -20°C to 50°C.
✧The temperature and humidity are maintained at a constant level.
✧There is minimal dust and dirt in the area.
✧The distance from heat source is more than 2 meters.
✧The distance from air outlet of inverter is more than 0.5 meters.
✧Do not cover or wrap the battery case or cabinet.
✧Do not place at a children or pet touchable area.
✧The installation area shall avoid of direct sunlight.
✧There are no mandatory ventilation requirements for battery module, but please avoid of installation in confined area. The aeration shall avoid of high salinity, humidity, or temperature.

CAUTION

If the ambient temperature is outside the operating range, the battery pack stops operating to protect itself. The optimal temperature range for the battery pack to operate is 15°C to 35°C. Frequent exposure to harsh temperatures may deteriorate the performance and life of the battery pack.

5.3 Mounting the Battery

CAUTION

Remember that this battery is heavy! Please be careful when lilting out from the package.

CAUTION

Note the allowable installation modes:

5.3.1 Cable Connection

Single Battery Connection

	NOTICE ▪ Before connect the cable with the inverter, the worker must confirm the output switch of the inverter has been turn off, to prevent the risk of fire or electric shock.
	⚠ CAUTION ▪ Before connection, make sure to close the battery. ▪ Please follow the instructions to protect the module BMS against damage. ▪ DO NOT deviate from the sequence of steps below. ▪ Exercise extreme caution prevent the terminals from contacting anything except their intended mounting points. ▪ Terminals and their connected wires have either positive or negative polarity (Positive: +; Negative: -). The polarity of a terminal or a wire connected to the terminal is on the front of each module. Exercise extreme caution to prevent the terminals and/or wires with opposite polarity from contacting with each other. ▪ The maximum voltage of the battery is no more than 60V, which is higher than the safe voltage of 36V. Therefore, we still recommend that the battery terminals or other exposed parts should not be directly touched during the

NOTICE

- When tightening the screws, make sure they are at a straight angle from the battery module terminals to avoid damage to the nuts inside.
- Assemble the screws using a Phillips-head within the fastening torque of less than 8.0 Nm (81.5 kgf▪cm).

IMPORTANT

- The power terminals, such as “+,” “-,” of the module are covered with the protecting cover to guard against a short circuit (Shown in Figure 5-1).
- You must remove the insulation cover prior to connecting and reattach the insulation cover immediately after connecting.

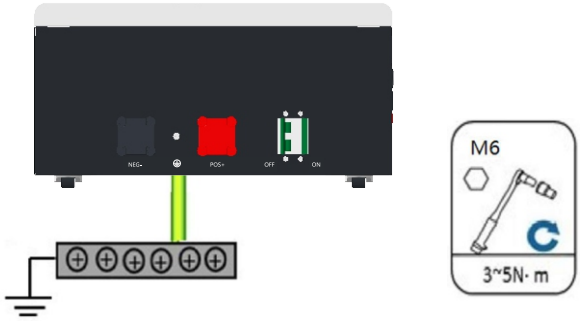


Figure 5-1: Install the Grounding Wire

Step 1 Wear the protective gloves.

Step 2 Install the battery ground cable.

Step 3 Install negative and positive power cables for the battery.

1) Remove the protective cover from the battery power wiring terminal.
2) Connect the negative power cable to the battery.
3) Connect the positive power cable to the battery.
4) Install the other end of the battery power cables at a battery route and the corresponding busbar in the power system.
5) Reinstall the protective cover on the battery power wiring terminals.

Connect the inverter:

1) Remove the protecting cover.
2) Take-down positive fixing bolt by the Insulated sockets and connect the positive output cable between the battery positive terminal of the battery and the inverter. After connecting the battery, fastening bolt immediately to avoid dropping.

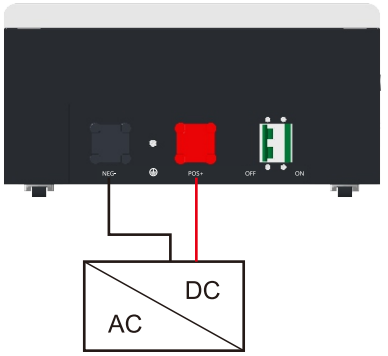


Figure 5-2: Single Battery Connection

3) Take-down negative fixing bolt by the Insulated sockets and connect the negative output cable between the battery negative terminal of the battery and the inverter. After connecting the battery, fastening bolt immediately to avoid dropping.
4) Install the protecting cover.
5) Sort the cables and fasten the battery cables to the perforated bracket with cable ties.
6) Communication Line Connection

As shown in Figure 5-3, when monitoring the battery by the computer, connect the USB convert RS485 BOX communication line between battery and computer.

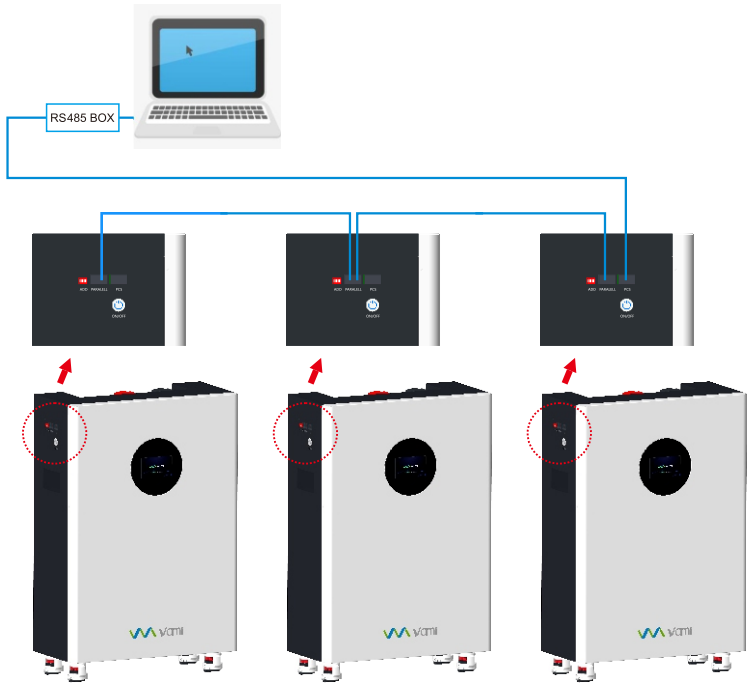


Figure 5-3: Communication Cable Connections between Battery and Computer

5.4 Batteries in parallel

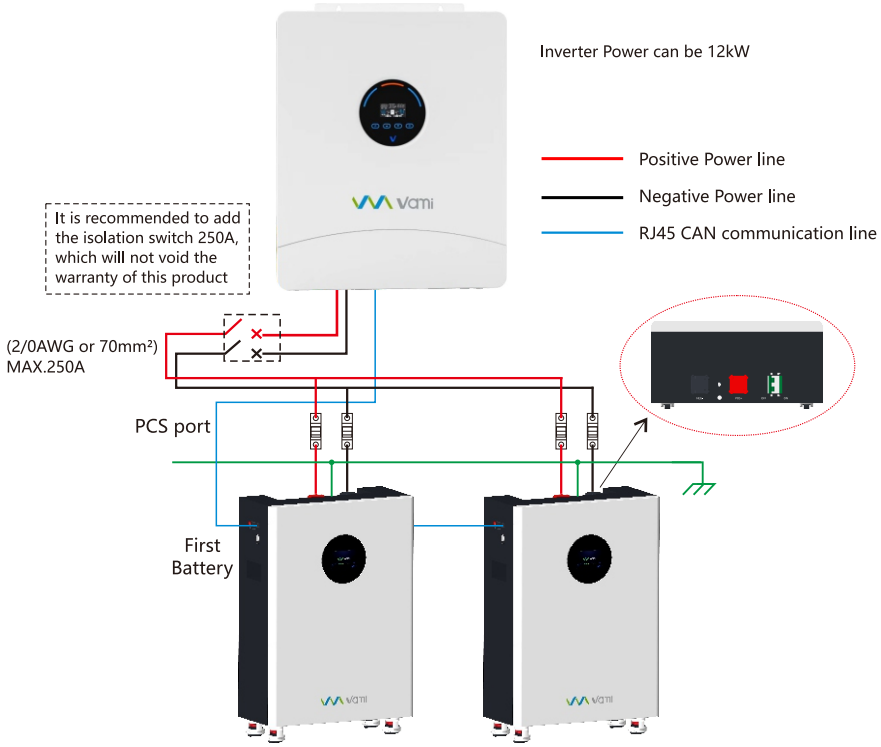
5.4.1 Parallel mode 1 (It is suitable for scenarios where the inverter power ≤ 12kW)

CAUTION

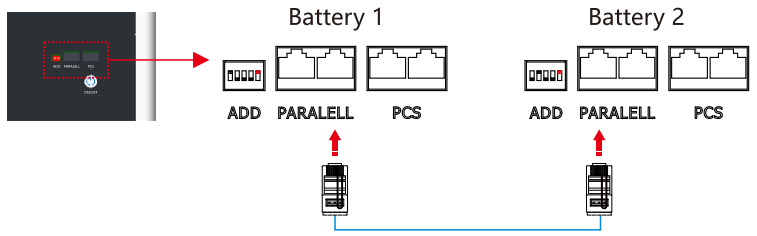
It should be noted that the maximum current of the first battery is 250A (inverter power must not exceed 12kW), exceeding 250A will cause heating of the connectors and cable, and in severe cases, it will cause a fire accident.

If the inverter power exceeds 12kW, the parallel mode must be used mode 2!

Schematic diagram of parallel connection of low-power system batteries:

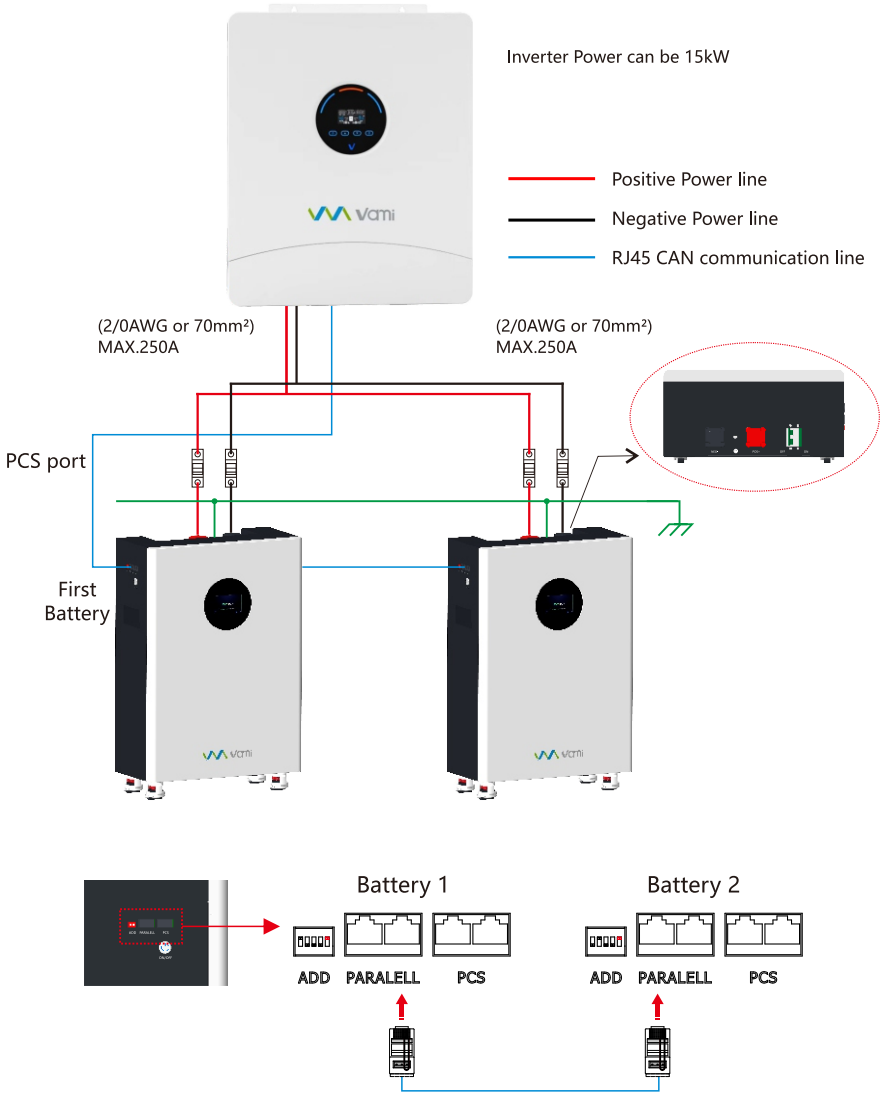


Note: Mode 2

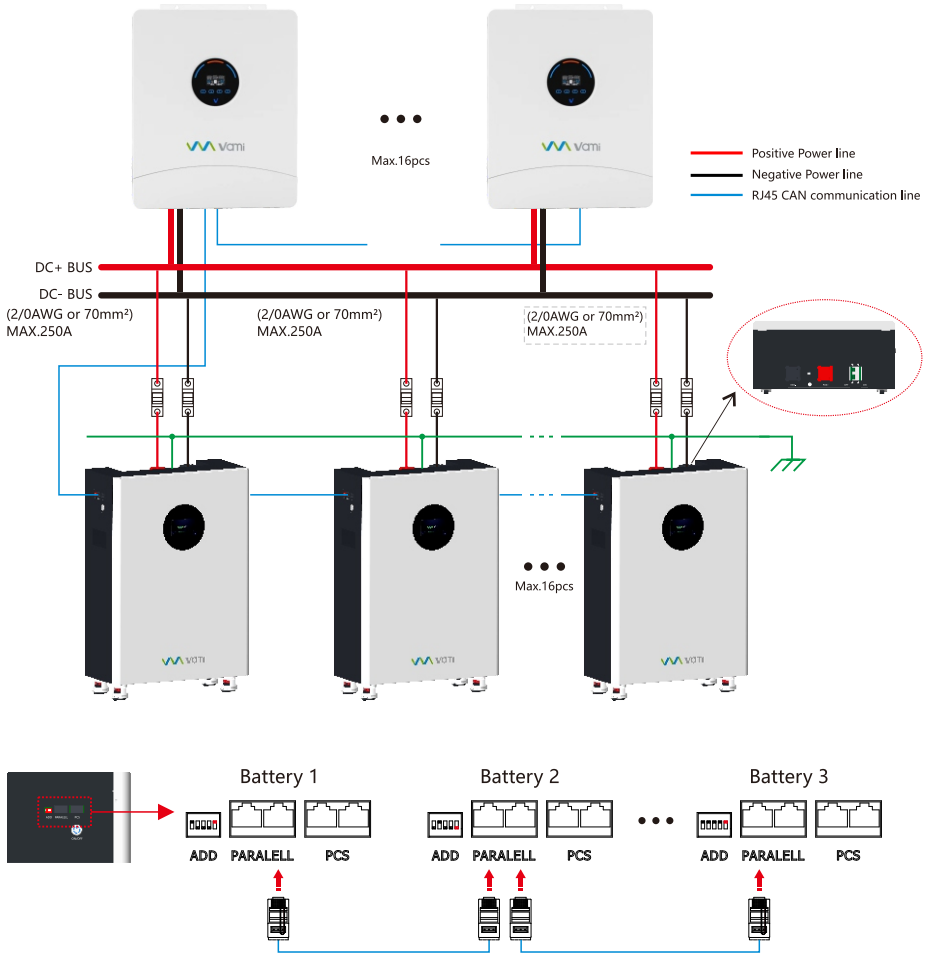


5.4.2 Parallel mode 2 (It is suitable for scenarios where the inverter power > 12kW)

Schematic diagram of parallel connection of high-power system batteries:



or larger capacity systems:



5.5 Visual inspection of the Connection

After connecting the battery, check for:

- Usage of positive and negative cables.
- Connection of the positive and negative terminals.
- All the bolts are tightened.
- Cables fixation and the appearance.
- The installation of the protecting cover.

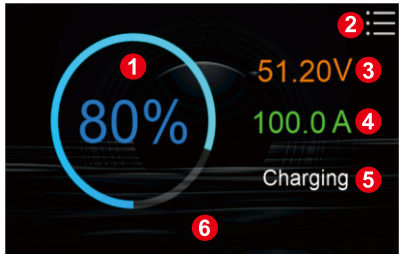
5.6 Activate the Product

A. Place the battery correctlyas shown in 5.3
B. Connect the wires according to the picture on 5.4.
C. Turn on all battery power in turn.
Start the Battery:
After installation, wiring, and configuration are completed, you must check all the connection. When the connections are correctly, and then press power button to activate the battery.

6. LCD Display

6.1 Main Screen

The LCD is touchscreen, below screen shows the overall information of the battery.



1.Battery SOC
2.Go to System Menu page
3.Battery pack voltage
4.Battery current
5.Battery charging or discharging status
6.Error message

NOTE: Swipe left or right to enter the System Menu page

6.2 System Menu

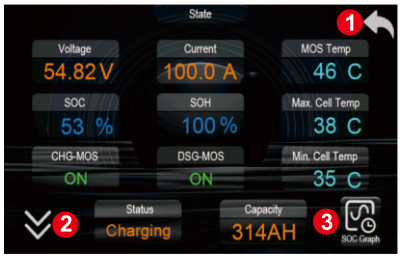
This page shows you the selections of Battery state,Setting and Othersudes battery state, Setting items and others .

1.Return to Main page
2.Go to Battery State page
3.Go to Setting page
4.Go to Others page

NOTE:
1) Swipe left to return to Main page
2) Swipe right to enter the Parallel Data page

6.3 Battery State

This page displays battery pack voltage, current, soc/soh, temperature, mos state and battery capacity.

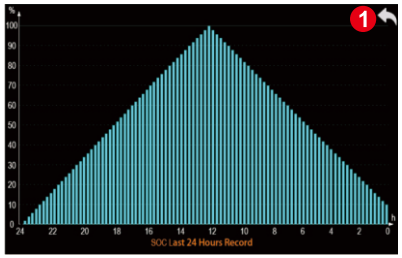


1.Return to System Menu page
2.Go to Parallel Data page
3.Go to SOC page

NOTE:
1) Swipe left to return to the System Menu page
2) Swipe right to enter the SOC Curve page

6.4 SOC Curve

This page shows you the SOC record of last 24 hours.

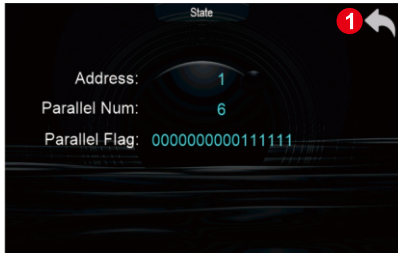


1.Return to Battery State page

NOTE:
1) Swipe left to return to the Battery Status page
2) Swipe right to enter the Parallel Data page

6.5 Parallel Data

This page shows you the detail of parallel system including local address and parallel status.

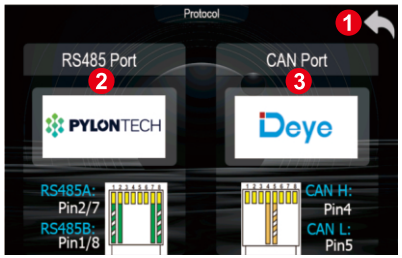


1.Return to Battery State page

NOTE:
1) Swipe left to return to the SOC Curve page
2) Swipe right to enter the Battery Status page

6.6 Protocol

This page shows you the protocol of RS485 port and CAN port.



1.Return to Battery State page

2.Go to RS485 Protocol Setting page

3.Go to CAN Protocol Setting page

NOTE: Swipe left or right to enter the System Menu page

6.6.1 RS485 Protocol Setting

This page can set the RS485 protocol. All available protocols are shown below.

6.6.2 CAN Protocol Setting

This page can set the CAN protocol. All available protocols are shown below.

1.Return to Protocol page

2.Indicates the selected protocol

3.Previous Page

4.Next page

NOTE:
After selecting the RS485 or CAN protocol, you must return to the Protocol page for the Settings to take effect.

6.7 Others Menu

This page shows you the operation of LCD brightness, firmware version and rated information of battery pack.

1.Return to System Menu page

2.Extinguishing screen

NOTE: Swipe left or right to enter the System Menu page

7. Inspection, Cleaning and Maintenance

7.1 General Information

- The battery product is not fully charged. It is recommended that the installation be completed within 3 months after arrival;
- During the maintenance process, do not re-install the battery in the battery product. Otherwise, the performance of the battery will be reduced;
- It is forbidden to dismantle any battery in the battery product, and it is forbidden to dissect the battery;
- After the battery product is over-discharged, it is recommended to charge the battery within 48 hours. The battery product can also be charged in parallel. After the battery product is connected in parallel, the charger only needs to connect the output port of any product battery.
- Never attempt to open or dismantle the battery! The inside of the battery does not contain serviceable parts.
- Disconnect the Li-Ion battery from all loads and charging devices before performing cleaning and maintenance activities
- Place the enclosed protective caps over the terminals before cleaning and maintenance activities to avoid the risk of contacting the terminals.

7.2 Inspection

- Inspect for loose or damaged wiring and contacts, cracks, deformations, leakage, or damage of any other kind. If damage to the battery is found, it must be replaced. Do not attempt to charge or use a damaged battery. Do not touch the liquid from a ruptured battery.

- Regularly check the battery' s state of charge. Lithium Iron Phosphate batteries will slowly self-discharge when not in use or whilst in storage.
- Consider replacing the battery with a new one if you note either of the following conditions:
- - The battery run time drops below 70% of the original run time.
- - The battery charge time increases significantly.

7.3 Cleaning

If necessary, clean the Li-Ion battery with a soft, dry cloth. Never use liquids, solvents, or abrasives to clean the Li-Ion battery.

7.4 Maintenance

The Li-Ion battery is maintenance free. Charge the battery to approximately > 80% of its capacity at least once every year to preserve the battery's capacity.

7.5 Storage

- The battery product should be stored in a dry, cool, and cool environment;
- Generally, the maximum storage period at room temperature is 6 months. When the battery is stored over 6 months, it is recommended to check the battery voltage. If the voltage is higher than 51.2V, it can continue to store the battery. In addition, it is needed to check the voltage at least once a month until the voltage is lower than 51.2V. When the voltage of the battery is lower than 51.2V, it must to be charged according to the charging strategy.
- The charging strategy is as follows: discharge the battery to the cutoff voltage with 0.2C current, and then charge with 0.2C current for about 3 hours. Keep the SOC of the battery at 40%-60% when stored;
- When the battery product is stored, the source of ignition or high temperature should be avoided and it should be kept away from explosive and flammable areas.

7.6 Troubleshooting

To determine the status of the battery system, users must use additional battery status monitoring software to examine the protection mode. Refer to the installation manual about using the monitoring software. Once the user knows the protection mode, refer to the following sections for solutions.

8. Fault Code Table

When fault event happens, battery will cut off output, and the LCD displays the fault code.

Fault Code	Fault information	Trouble shooting
E01	Battery Over Voltage	The battery voltage is abnormally high, Please stop charging , restart the battery, if the error happens again,contact after-sales service.
E02	Battery Low Voltage	The battery voltage is abnormally low,please charging.
E03	Over Charge Current	The charge current is too large. Reduce the charge current, if the error happens again,contact after-sales service.
E04	Over Discharge Current	The discharge current is too large. Reduce the load power, if the error happens again,contact after-sales service.
E05	Cell Over Voltage	The cell voltage is abnormally high, Please stop charging , restart the battery, if the error happens again,contact after-sales service.
E06	Cell Low Voltage	The cell voltage is abnormally low,please charging.
E07	Cell Over Temperature	The cell temperature is abnormally high, Please stop charging , Let stand for 1 hour, if the error happens again,contact after-sales service.
E08	Cell Low Temperature	The cell temperature is abnormally low, if the ambient temperature is not below -20 ℃, contact after-sales service.
E09	BMS Over Temperature	The BMS temperature is abnormally high, Please stop charging and discharging , Let stand for 1 hour, if the error happens again,contact after-sales service.
E10	BMS Low Temperature	The BMS temperature is abnormally low, if the ambient temperature is not below -20 ℃, contact after-sales service.
E12	Discharge soft start Fail	Restart the battery, if the error happens again, contact after-sales service.
E13	Parallel Commucation Fail	Communication failure, check parallel wiring and dip, restart the battery,if the error happens again, contact after-sales service.
E14	Cell Volt Different High	Restart the battery, if the error happens again, contact after-sales service.
E15	Cell Temp Different High	Restart the battery, if the error happens again, contact after-sales service.

By checking the above data and sending the data to the service personnel of our company, the service personnel of our company will reply the corresponding solution after receiving the data.

9. Battery recovery

Aluminum, copper, lithium, iron, and other metal materials are recovered from discarded LiFePO4 batteries by advanced hydrometallurgical process, and the comprehensive recovery efficiency can reach 80%. The specific process steps are as follows:

9.1 Recovery process and steps of cathode materials

Aluminum foil as collector is amphoteric metal. Firstly, it is dissolved in NaOH alkali solution to make aluminum enter the solution in the form of $NaAlO_2$. After filtration, the filtrate is neutralized with sulfuric acid solution and precipitated to obtain $Al(OH)_3$. When the pH value is above 9.0, most of the aluminum precipitates, and the obtained $Al(OH)_3$ can reach the level of chemical purity after analysis.

The filter residue is dissolved with sulfuric acid and hydrogen peroxide, so that lithium iron phosphate enters the solution in the form of $Fe_2(SO_4)_3$ and Li_2SO_4, and is separated from carbon black and carbon coated on the surface of lithium iron phosphate. After filtration and separation, the pH value of the filtrate is adjusted with NaOH and ammonia water. First, iron is precipitated with $Fe(OH)_3$, and the remaining solution is precipitated with saturated Na_2CO_3 solution at 90 ℃.

Since $FePO_4$ is slightly dissolved in nitric acid, the filter residue is dissolved with nitric acid and hydrogen peroxide, which directly precipitates $FePO_4$, separates impurities such as carbon black from acid solution, leaches $Fe(OH)_3$ from filter residue respectively, and precipitates Li_2CO_3 with saturated Na_2CO_3 solution at 90 ℃.

9.2 Recovery of anode materials

The recovery process of anode materials is relatively simple. After the separation of anode plates, the purity of copper can be more than 99%, which can be used for further refining electrolytic copper.

9.3 Recovery of diaphragm

The diaphragm material is mainly harmless, and has no recycling value.

9.4 List of recycling equipment

Automatic dismantling machine, pulverizes, wet gold pool, etc.

10. Transportation Requirements

The battery products should be transported after packaging and during the transportation process, severe vibration, impact, or extrusion should be prevented to prevent sun and rain. It can be transported using vehicles such as cars, trains, and ships.

Always check all applicable local, national, and international regulations before transporting a Lithium Iron Phosphate battery.

Transporting an end-of-life, damaged, or recalled battery may, in certain cases, be specially limited or prohibited.

The transport of the Li-Ion battery falls under hazard class UN3480, class 9. For transport over water, air and land, the battery falls within packaging group PI965 Section I.

Use Class 9 Miscellaneous Dangerous Goods and UN Identification labels for transportation of lithium-ion batteries which are assigned Class 9. Refer to relevant transportation documents.

Figure 9-1: Class 9 Miscellaneous Dangerous Goods and UN Identification Label