48V Lithium-ion Battery module for telecommunication

User Manual

（V1.0）

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1. Brief introduction

Communication LFP battery module is a high-tech product.The product has many merits, mainly including: integration, miniaturization, light-weight, intelligent centralism monitoring, the battery maintenance and management, unattended, standardization installation and easy operation, at the same time, environment friendly. Now the product has been widely used as backup power in telecommunication field such as access network equipment, far-end telephone exchange, mobile telecommunication equipment, transmission facility, satellite earth station and microwave communication equipment, etc. At present, LFP backup battery telecommunication series products have been put into mass production and are widely used at home and abroad.

2. Product features

(1) The battery positive electrode is made of LFP, which has long cycling life and good safety.

(2) The battery module adopts the high-performance BMS, which has the protective functions of current, voltage and temperature etc..

(3) The monitoring unit automatically measures charging and discharging current, voltage, surface temperature of the cells and ambient temperature.

(4) The system can seamlessly turn on after the public electricity fails. When the discharge voltage is below the warning parameter set-up in advance, the battery will automatically send the warning signal. When discharge voltage is below the protect parameter, the battery will automatically turn off.

(5) The battery module has fine electromagnetic compatibility.

(6) Fully intelligent design, equipped with centralized monitoring module and telemeters, telesignalisation, remote regulating, remote control function, realizes intelligent management, and can correspond with the far-end central monitoring center.

(7) The organic combination of the power source control technology and the computer can monitor and control various parameters and state in real time.

(8) Adopting the self-cooling method, the system has extremely low noise.

3. Product advantages

(1) Realize the work directly under the primary DC telecommunication switching power supply system with the constant charge and discharge working mode.

(2) LFP backup battery module is the high-tech product manufactured by Group, with proprietary intellectual property rights, the product fills in the domestic blank,and the key technical indexes is in the lead level of the world.

(3) LFP backup battery module is the first bulk production in domestic, and is widely used in the telecommunication filed, with the longest market time, biggest market quantity and good market reaction.

(4) In order to satisfy Telecom Operator's new demands on the power-supply system, developed the integrative backup battery module solution based on LFP battery, BMS, DC switch power module or ups (uninterrupted power system).

(5) Higher gravimetric specific energy, during installing, there is no extra demand for space and bearing compared with VRLA battery, greatly reducing the cost of the area rented.

(6) Good temperature characteristics : working environment temperature can reach -20～+60℃(recommended temperature：+15～+35℃), which greatly reduces power consumption cost.

(7) LFP battery has excellent rate discharge performance, which enables LFP battery with small capacity to meet large current discharge requirements.

(8) Flexible allocation: muti-LFP battery modules in parallel, make large capacity LFP battery module become true, not only enhance the output power of the system, but also prolong the backup time of the battery module.

4. Product types and technical parameters

Table 4-1 48V series of product specifications and models

Model	Nominal voltage (DC V)	Nominal capacity (Ah)	Maximum load current (A)	Dimension (mm) (width×depth×height)	Remarks
48V50Ah	48	50	50	442×400×133 (3U)	parallel system
48V100Ah	48	100	100	442×440×133 (3U)	parallel system
48V150Ah	48	150	100	442×540×190 (4.3U)	parallel system
48V200Ah	48	200	100	442×480×245 (5.5U)	parallel system

Note: size deviation is ±3mm.

Remarks： The size of the table above is only for the battery module, excluding cabinet, rack, rain box, etc. In order to ensure the safety, reliability and stability of high-capacity LFP battery parallel

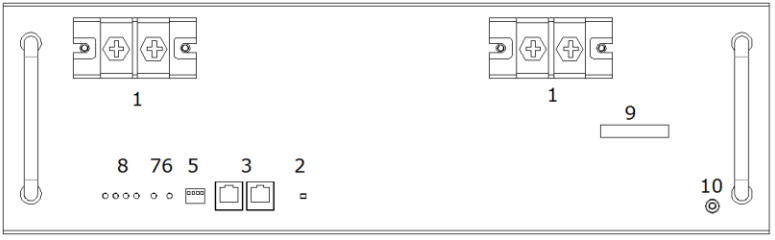
system, the expected capacity must be consistent with the actual capacity.

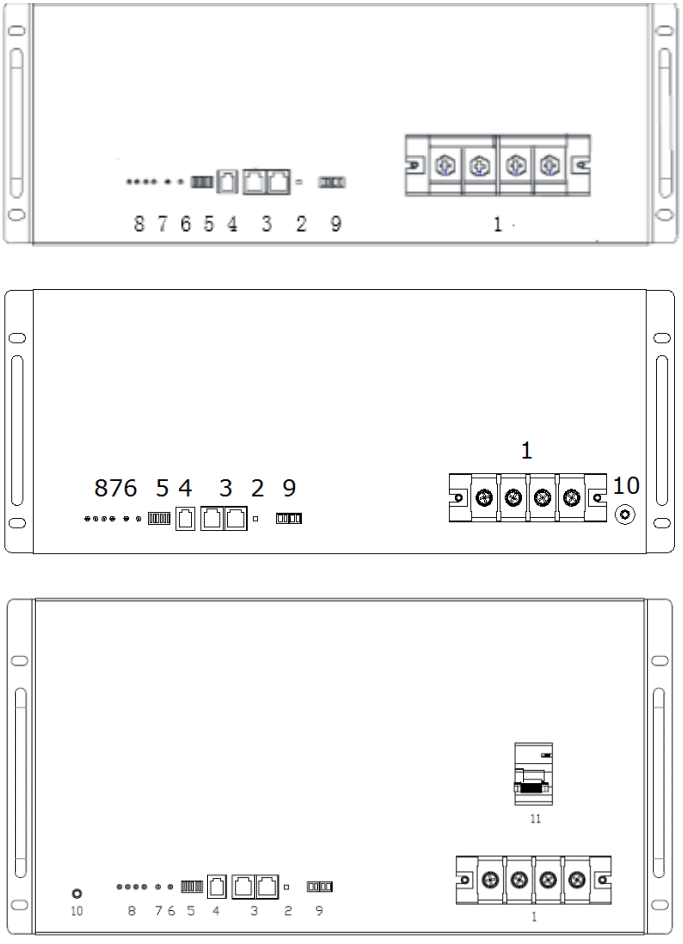
5. Environmental requirements

- Ambient temperature：-20～+60℃（suggested temperature：+15~+35℃）;
- Storage temperature：-40～+70℃（suggested temperature：+15~+35℃）;
- Relative humidity：5%～85%RH;
- Hight：not exceeding 4000m;
- No conductive dust and corrosive gas place.

6. System panel functions

6.1 System panel Schematic drawing





Pic. 6-1 Schematic drawing of the module panel

6.2 Battery output terminal

The number of "1" in Pic. 6-1 show the output terminal of the battery module. It adopts one 4 pin terminal.

Table 6-1 different output configurations of the battery modules

Battery model	**Battery capacity**	**Screw specification**	**Wiring request**	**Line nose**
48V100Ah	100Ah	--	≥10mm ²	OT10-6/SC16-8
More than 100Ah	--	--	≥10mm ²	OT10-6/SC16-8

6.3 Reset key

The number of "2" in Pic. 6-1 represents "RESET" key. When the system runs into abnormal status, one can use the key to reset the system to ensure the stability of the system. At the same time, in order to facilitate the use in different application scenarios, booting, shutdown and reset functions are integrated into this key. Specific definitions are shown in the Tabke 6-2 below.

Table 6-2 booting/shutdown, reset keys' definitions

No.	Functions	Definitions	Remarks
1	booting/ activation	When battery is dormant, press this key and hold for 3s, then the battery is activated and the LED indicator lights up in turn. The battery is turned into the normal working status.	
2	shutdown/ dormancy	When battery is in standby or working status, press this key and hold for 3s, the LED indicator lights up in turn. The battery is turned into the dormant status.	

3	Reset	When the battery is in standby or working condition, the battery is reset and the internal data will be restored to the factory status after pressing this key and holding for 6s.	

6.4 Communication interface

6.4.1 Cascade communication interface

The number of "3" in Pic. 6-1 represents RS485 communication ports which communicate with upper computer and the other modules in the cascade connection among the modules. The ports adopt two 8P8C straight PCB welding telephone sockets (round pin). The module panel is configured with two RS485 ports, which are serial ports physically. When the battery modules are cascaded, the communication address 000001 is defined as the master module, and the others are defined as the slave module. The slave module can communicate with the master module through the RS485. The master module manages the data of each battery in the cascade system. RS485 definition is shown in Table 6-3.

Table 6-3 The pins definition of the RS485 port

Pin	Definitions
1	RS485-B
2	RS485-A

6.4.2 Upper connection communication interface

The number of "4" in Pic. 6-1 represents RS232 communication port, its default baud rate is 9600bps. RS232 port adopts 6P4C straight PCB welding telephone socket (round pin). Through the RS232 port,

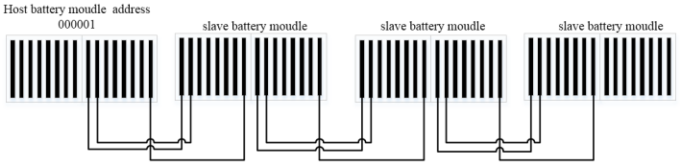
the master battery module can communicate with the upper computer. When the modules are cascaded, only the master module can communicate with the upper computer and upload data, status and information of all of the battery module in the cascade system, which achieves central monitoring and management, and realizes several remote functions. RS232 communication interface definition is shown in Table 6-4.

Table 6-4 The pins definition of the RS232 port

Pin	Definitions
1,2,6	NC
3	TX
4	RX
5	GND

6.4.3 Communication wire

Pic. 6-2 shows the cascade communication wire connections of RS485.



Pic. 6-2 The cascade communication wire connections of RS485

6.5 Dial switch

The number of “5” in Pic. 6-1 represents the six-bit of dial switch, it can define the address of the module in cascade from 0 to 15. The default address of dial code switch is 000000 (that is, the address is "0").

If the number of battery modules in the cascade system is greater than 15, the address code of the battery module should be set through the software of the upper computer.

6.6 LED signal introduction

（1）Capacity signal light（SOC, green）

capacity signal light: 4 green lights, each light indicates 25% capacity. When capacity is 100%, 4 lights are all on; when capacity is 75% ,the first light on the left extinguishs, and the other 3 lights are on; when capacity is 50%, 2 lights on the left extinguish, and 2 lights on the right are on; when capacity is 25%, 3 lights on the left extinguish, and the first light on the right is on.

（2）System running indicator light（RUN, green）

RUN light, green, is always on during charging, and is on and off for 0.5 second separately during discharging.

（3）Alarm indicator light（ALM, red）

ALM light, red, it's on when the system breaks down. The definition of specific indicator light is shown in Table 6-5:

Table 6-5 LED signal difinitions

System status	Operation status	RUN	ALM	LED				Remark
		●	●	●	●	●	●	
Shut down	Dormancy	off	off	off	off	off	off	All are off
Standby	Normal	flash 1 time	off	off	off	off	off	Standby
	Alarm	flash 3 times	flash 3 times	off	off	off	off	Alarm and Run flash 3 times
Charge	Normal	on	off	Indicating according to actual capacity				According to capacity, flash 2 times

	Over voltage protect	on	off	on	on	on	on	RUN light: Bri when the power online, be standby when the power is offline
	Over current protect	off	on	off	off	off	off	Stop charging and discharging and force to sleep after no operation for 24 hours
Discharge	Normal	flash 3 times	off	Indicating according to actual capacity				According to capacity, it's on all the time
	Alarm	flash 3 times	flash 3 times					
	Over current, short circuit, reverse connection protection	off	on	off	off	off	off	Stop charging and discharging and force to sleep after no operation for 24 hours
	Low voltage protection	off	off	off	off	off	off	Stop discharging
Temperature	normal	According to normal state to signal						---
	Alarm during charging	on	flash 3 times	Indicating according to actual capacity				According to capacity to flash 2 times
	Alarm during discharging	Flash 3 times	flash 3 times	Indicating according to actual capacity				According to capacity, it's on all the time
	Protection	off	on	off	off	off	off	Stop charging and discharging and force to sleep after no operation for 24 hours

Table 6-6 LED flash mode definitions

Flash mode	on	off
flash 1 time	0.25s	3.75s
flash 2 times	0.5s	0.5s
flash 3 times	0.5s	1.5s

6.7 Dry contact

The number of "9" in Pic. 6-1 represents the dry contact, which is an interface through which the battery module sends the alarm or protection signals. When the BMS has a protection or warning signal, the dry contact sends a switch signal through the corresponding interface.

Table 6-7 Two Dry contact definitions

DRY	Definition	Status	
DRY1	BMS is power off or unable to start by itself	abnormal: Off	normal: On
DRY2	BMS failure(charging MOS failure, discharging MOS failure, NTC failure), cell failure(low voltage, big difference among the cell voltages)	abnormal: Off	normal: On

Table 6-8 Seven Dry contact definitions

DRY	Definition	Status	
DRY1	Soc 20%-when SOC is lower than 20%，dry contact alarm	abnormal: Off	normal: On
DRY2	Security feature enabled-Anti-theft function on Dry contact in alarm	abnormal: Off	normal: On

DRY3	Under voltage alarm and protection	abnormal: Off	normal: On
DRY4	Charge discharge current alarm and protection、Short circuit protection、Reverse connection protection	abnormal: Off	normal: On
DRY5	High and low temperature alarm and protection of charge and discharge	abnormal: Off	normal: On
DRY6	Alarm occurs（No action in case of charging current limit）	abnormal: Off	normal: On
DRY7	Protection and failure（No action in case of charging current limit）	abnormal: Off	normal: On

Note: Dry contact is off when BMS is in dormancy.

6.8 Grounding terminal

The number of "10" in Pic. 6-1 represents the grounding terminal, which is used to connect to the ground. With the ground terminal, the module can protect itself when an abnormal fault occurs from itself and the other equipments.

6.9 Air switch

The number of "11" in Pic. 6-1 represents the air switch, which is used to disconnect the battery module and the other equipment when the battery module is short-circuited or in over-current condition.

6.10 Gyro anti-theft function(optional)

The BMS has a gyro anti-theft function, which can be controlled by the host computer software to. By default, the gyro anti-theft is activated by charging method.

The BMS PC software can set the gyro anti-theft function activation mode. When use charging activation to activate the gyro anti-theft function, the BMS detects that the charging current is greater than 5A, and the time more than 30s, BMS automatically activates the gyro anti-theft function.

After the gyroscope is fixed, the initial position state of the gyroscope can be set by the PC software. When the gyroscope module has an angular offset of more than 30 ° in any direction, After a period of time delay (default 3s), BMS turn off the discharge MOSFET, and lock the battery. The battery can be charged normally but cannot discharge any more.

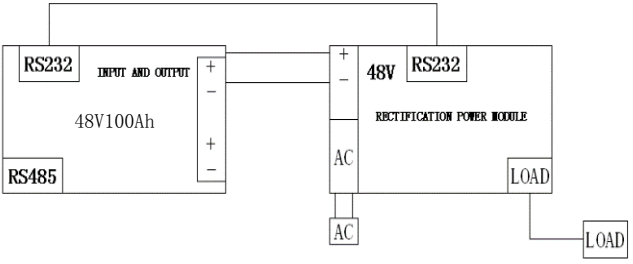
The locked battery can be unlocked by the host computer software. If the gyroscope returns to the initial position after unlocking, the battery can be charged and discharged normally. If the gyroscope module is still offset from the initial position by 30 °, the BMS will still delay for a period of time (default 3s). and then turn off the discharge MOSFET, cut off the output and lock the battery. The battery can be charged normally but cannot discharge.

7.System working principle and parameters

7.1 System working principle

48V100Ah LFP back up battery module working principle is shown in Pic. 7-1. The rectifier inputs AC220V power source, and output DC -48V. Under normal grid conditions, the rectifier supplies the

working current for the load and at the same time charges the battery module. When grid is off, the battery module supplies direct current for the load, which achieves uninterrupted power supply. When the battery module voltage is extremely low, the BMS will automatically cut off power supply to extend the battery life.



Pic. 7-1Working principle diagram of LFP battery module

7.2 Charge parameters

Table 7-1 Charge parameters

Model	Charge voltage（DC V）			Charge current（A）
	Minimum	Typical value	Maximum	
48V100Ah(15S)	53.2	56.4	57.5	Charge current,≤1C_3
48V100Ah(16S)	56.4	57.6	60.4	

7.3 Discharge parameters

Table 7-2 Charge parameters

Model	Discharge voltage（DCV）			Discharge current（A）	
	Minimum	Typical value	Maximum	Typical value	Maximum

48V100Ah(15S)	40	48.0	53.0	$0.2C_3$	$1C_3$
48V100Ah(16S)	41.6	51.0	55.0	$0.2C_3$	$1C_3$

7.4 System protection function and parameters

Table 7-3 Protection functions and parameters

Number	Protection project		Default value	
			15 string system	16 string system
1	system total voltage high protection and recover	Alarm value	54.00V	57.00V
		Alarm recovery value	52.50V	56.00V
		Protection value	57.00V	57.75V
		Protection Recovery value	50.1V	53.5V
			Discharge current, total voltage＜50.1V	
2	System total voltage low protection and recover	Alarm value	42V	42V
		Alarm recovery value	43.2V	43.2V
		Protection value	40V	40V
		Protection Recovery value	Charge current recovery, total voltage＞43.2V	
3	Short-circuit protection	Protection value	Protection and alarn	
4	Cell voltage low protection and recover	Alarm value	2.5V	
		Alarm recovery value	3.0V	
		Protection value	2.0V	
		Protection Recovery value	Charge current recovery, cell voltage＞2.7V	
5	Cell voltage high protection and recover	Alarm value	3.7V	
		Alarm recovery value	3.65V	
		Protection value	3.85V	
		Protection Recovery value	Discharge current recovery, cell voltage＜3.34V	
6	Charge over current protection	Alarm value	$1.05C_3A$	
		Alarm recovery value	$1.0C_3A$	
		Protection value	$1.1C_3A$	

	(no charge limited current)	Protection Recovery value	Discharge or manual reset
7	Discharge over current protection	Alarm value	1.05C_3A
		Alarm recovery value	1.0C_3A
		Protection value	1.1C_3A
		Protection Recovery value	Charge or manual reset
8	Cell high temperature protection and recover	Charge high temperature protection value	65℃
		Charge high temperature recovery value	60℃
		Discharge high temperature protection value	70℃
		Discharge high temperature recovery value	65℃
9	Cell low temperature protection and recover	Charge low temperature protection value	-10℃
		Charge low temperature recovery value	-5℃
		Discharge low temperature protection value	-25℃
		Discharge low temperature recovery value	-20℃
10	The environment temperature protection and recovery	High temperature alarm value	65℃
		Low temperature alarm value	-20℃
		High temperature protection value	70℃
		High temperature recovery value	65℃
		Low temperature protection value	-25℃

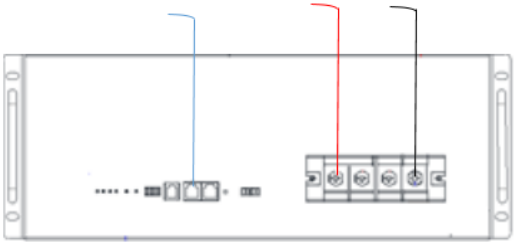
		Low temperature recovery value	-20℃

Note : The table above is the default parameters, specific setting parameters may be changed, please refer to our actual product parameters.

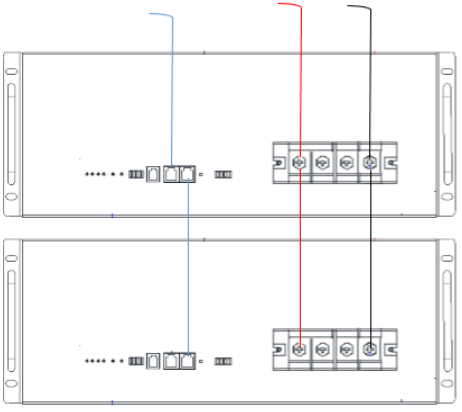
8. System installation, uses and maintenance

8.1 System installation

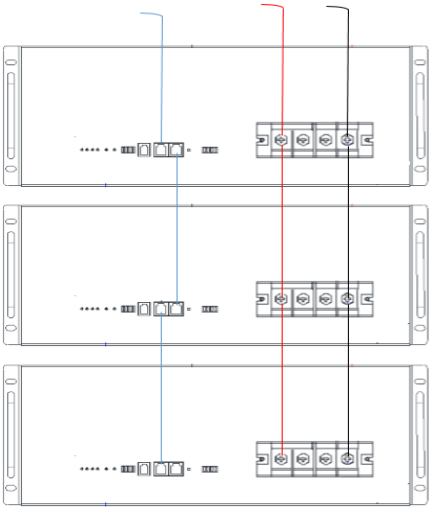
8.1.1 19 "standard rack embedded installation



Pic. 8-1 48100 installation drawing



Pic. 8-2 48200 installation drawing



Pic. 8-3 48300 installation drawing

(1) 19″ rack mounting is recommended to be used for installation with four M6 botls on both sides of the cabinet to fix the module on the rack. Wall Mounting installation is also can be used.

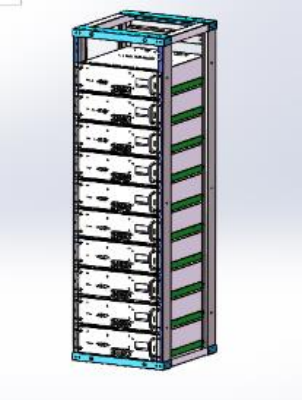
(2) The grounding terminal at the hangers on the chassis panel shall be grounded with a yellow-green soft wire of more than 4mm^2 and good grounding should be ensured.

(3) As is shown in Pic. 8-1, 8-2, 8-3, when the 48V100Ah battery module is connected in parallel to form a large capacity battery, firstly, the positive terminals of each battery module are connected with the red cable above 10mm^2, and then the negative terminals of each battery

module are connected with the black cable above 10mm^2 to form a battery system. Finally, the battery system can be connected to the switch power supply or equipment.

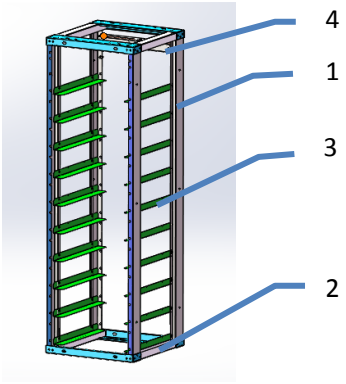
8.1.2 Scaffolding installation

Communication LFP battery module can be made into 48V series product specifications and models in parallel, as shown in Table 4-1. As shown in Pic. 8-4, the "+" and "-" terminals on the busbar of the combined stand of the LFP battery module are connected with the "+" and "-" terminals on the wiring terminal of the LFP battery module respectively with the red and black wires above 16mm^2 to form the LFP battery system.



Pic. 8-4 （n×100）Ah Communication LFP battery system（n is the quantity of 48V100Ah battery modules）

Main parts of the frame are shown in Pic. 8-5

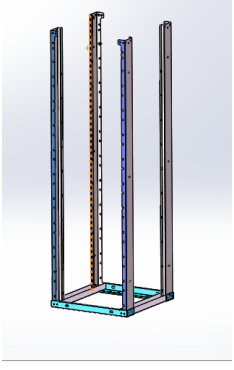


Pic. 8-5 Main parts of the frame

No.	Part Name	Quantity
1	vertical column	4
2	frame fixator	2
3	Slide way	According to the order
4	Busbar	1 set

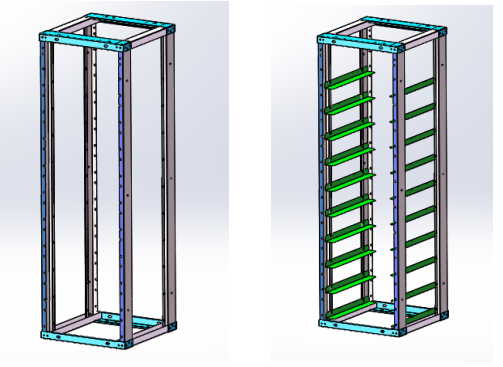
The installation processes are listed below：

Firstly, install the four vertical columns 1 into the frame fixator 2 as shown in Pic. 8-6.



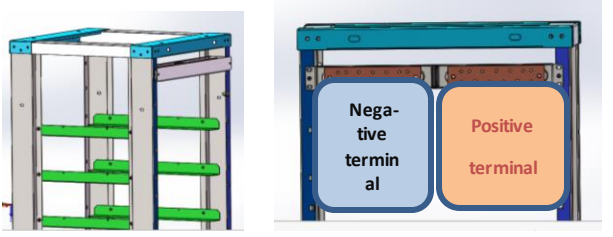
Pic. 8-6 Installation Step 1

Secondly, install another frame fixator on the four vertical columns. Install the guide rail in the area where the riveted nut is pressed on the side of the column as shown in Pic. 8-7.



Pic. 8-7 Installation Step 2

Thirdly, install the bus bar on the rack for the connection and wiring of the cable as shown in Pic. 8-8.



Pic. 8-8 Installation Step 3

Finally, install the battery on the rack and fasten the lug.

8.1.3 Installation of equipment cabinet type

Installation of rack type is a kind of indoor battery module designed for the high demand of dust prevention situation. The system consists of a 19 inches standard cabinet, battery module, bus-bar and

connecting wire, etc. The height of the 19 inches standard cabinet can be configured according to the number of the battery. The steps of installation are just below:

(1) use more than 10 mm ²red and black soft cables to connect battery module's +, - to the copper bus bar which is connected in parallel in the equipment cabinet , red cable connects “+”, and black cable connects “-“;

(2) Arrange every battery modules on the equipment cabinet tray, use M6 bolts to fix all the hangers of the battery modules on the holders of equipment cabinet;

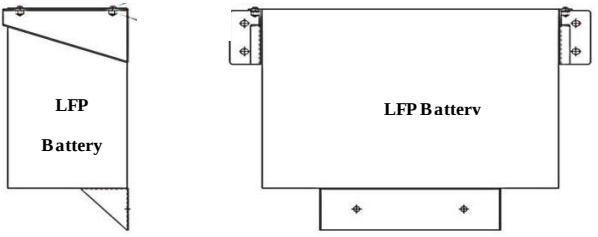
(3) Grounding from the grounding hole on battery module's panel with 4mm^2 yellow-green soft cable to ensure good grounding;

(4) Using two cables to connnect the cabinet bus bars and those of switch power supply or equipment's.

8.1.4 Installation of wall mounting type

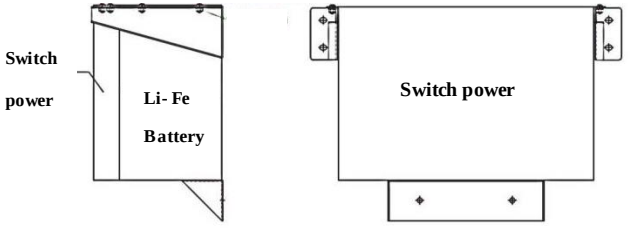
(1) installation of battery module

As the Pic. 8-9 shows, use four M8 expansion screws to fix two hangers on the wall, the distance between them is 445mm, and use two M8 expansion screws to fix the triangle shelf under the battery to support the battery.

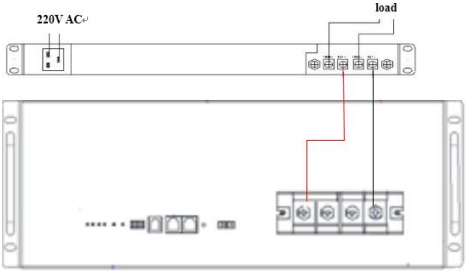


(2) DC integral installation

As the Pic. 8-10 shows, the hangers are fixed on the wall with four M8 expansion screw, the distance between them is 445mm. Fix switch power supply and battery module on the hanger's bayonet nuts with M6 bolts separately, and keep their panels upwards, then use two M8 expansion screws to fix the triangle shelf under them as Pic. 8-10 and 8-11 show.



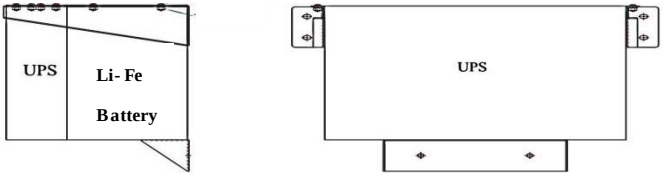
Pic. 8-10 The sketch of battery and rectifier installation on the wall



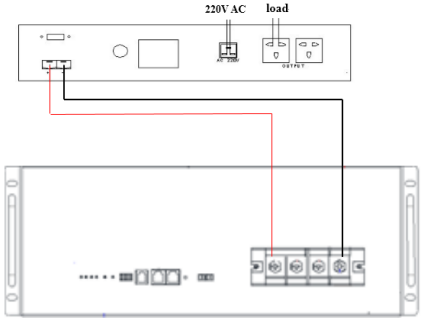
Pic. 8-11 The sketch of battery and rectifier wiring

(3) AC integral installation

As Pic. 8-12 shows, fix the hangers on the wall with four M8 expansion screws, the distance between them is 445mm. Fix UPS and battery module on the hanger's bayonet nuts with M6 bolts separately, and keep their panels upwards, then use two M8 expansion screws to fix the triangular shelf under them as Pic. 8-12 and 8-13 show.



Pic. 8-12 The sketch of battery and UPS mounted on the wall



Pic. 8-13 The sketch of battery and UPS wire connection

Notes：

(1) When the battery module is installed in parallel, the distance between the battery module must be no less than 20mm, and the distance between the battery module and UPS or switch power supply must be no less than 30mm to ensure effective heat dissipation of the battery module, and avoid affecting the battery life.

(2) After the completion of the wall mounting installation of battery module, dc integration system and ac integration system, a dust cover is needed to be put above the panel to prevent dust from obstructing fan and exhaust outlet of the equipement's after the system works for a long time.

8.2 System power on

Before the system is being installed, it is usually in the standby mode. After being installed, it can be put into normal operation through the ways below.

8.2.1 System Activation

The battery module remains dormant during storage, transportation, or after 24 hours without power input or output. After connecting rectifier and getting the proper input voltage, the battery module is activated and enters into normal operation status. It should be noted that when the battery module is dormant, the rectifier must let its anti-reverse protection function be cancelled, so that the battery module can be activated after ac recovers.

8.2.2 System Standby

If the external power source and load are removed, the battery module will actively enter the standby state, after the battery module is activated. In this status, the power consumption is very low, and the RUN light on the panel flashes to indicate that the battery module is in standby mode. After 24 hours, the battery module will automatically enter into the dormant status, the power consumption of which is much lower, and all of the indicator lights on the panel are completely off.

8.3 Warning explanation and processing

In case that the battery module fails, an alarm signal will be sent according to the fault itself. All faults have audible and visual alarm and text log. When warning, the red warning light on the monitoring unit is on, and a warning message is sent to the remote monitoring center. When an alarm occurs in the system, the remote monitoring center

receives the alarm information, and maintenance personnel should immediately check the corresponding module according to the alarm information, find out the fault and take actions.

8.3.1 Warnings and countermeasures for cases which influence module output

When abnormal conditions that influence module output occurs，such as single cell over charge, over current ,low voltage protection, temperature protection, etc, please process according to Table 8-1.

Table 8-1 Warnings and protections

Status	Alarm value	The warning instructed	Processing
Charge status	Cell over voltage	ALM on	Stop charging , Search breakdown reason
	Charge over current	ALM on	Stop charging , Search breakdown reason
	Charge temperature protection	ALM on	Stop charging
Discharge status	Discharge over current protection	ALM on	Stop discharging , Search breakdown reason
	Discharge temperature protection	ALM on	Stop discharging

	Total voltage low voltage protection	ALM off	Charge
	Cell low voltage protection	ALM off	Charge

8.3.2 Warnings and countermeasures for cases which don't influence module output

If the module or its single cell voltage is low, the module will send corresponding alarm signal. The maintenance personnel should check the module according to the alarm information, determine the fault type and location, and take corresponding countermeasures to ensure the system is in the best working status and prevent the fault extention. The phenomenon and countermeasures are shown in Table 8-2.

Table 8-2 Warnings without protection

Warning	Mos - FET action	Warning signal	Countermeasure
low module voltage warning	None	ALM flashes	Stop discharge
low Cell voltage warning	None	ALM flashes	Stop discharge

8.4 Communication breakdown

The protection status and system status can be read on upper computer software, which can help us to analyse the definite reason.

(1) When communication breakdown occurs in RS232, eliminate it according to the following steps:

a. Check communication port;

b. Press master pack “RESET” key for 3s;

c. For a parallel system, the master pack and slave pack can be exchanged to diagnose.

(2) When communication breakdown occurs in RS485, eliminate it according to following steps:

a. Check communication port;

b. Press slave pack “RESET” key;

c. Exchange slave module address settings to diagnose.

8.5 Protection breakdown

8.5.1 Over charge protection

When using the standard charging voltage, the single cell overvoltage will not appear usually, unless there is a large imbalance among the cells. If the voltage difference are very large, the protection will appear when there is cell overvoltage and the module voltage is still low, so it is necessary to check the cell voltage.

8.5.2 Current protection

When the module current is relatively small and current protection occurs, it is necessary to check the status indicator to check whether the connection cable is normal.

8.5.3 Other breakdown

If there is a protection alarm and the module cannot be charged or discharged, it is necessary to check the specific parameters such as voltage, temperature and system status indication to determine the fault cause.

8.6 Particular circumstance processing

8.6.1 Power outage

AC power outage is the most common situation in the module operation. When the power outage lasts for a short period of time, dc power supply will come from the LFP battery module.

8.6.2 Cataclysm accident

Catastrophic accidents include communications equipment failure caused by lightning, flooding, earthquake, fire and other disasters. The measure for these disasters which may seriously influence communications security is to prevent and control. The communication agency station should have the countermeasure and the corresponding manpower physical resource to prevent these disasters, at the same time should have the emergency act of administration and the significant accident emergency regulations.

8.7 Normal operation and maintenance of LFP battery

After installation and debugging project system, if public grid can not be accessed or the module is not activiated, please be sure to disconnect air Circuit Breaker, and quickly connect public grid to avoid the battery module failure.

8.8 Stable and reliable switch power supply

Please use switch power supply suitable for wide voltage fluctuation range, or switch power supply that meets the requirements of 110V and 220V dual standard. To avoid switch power supply outputs instable DC voltage in the poor condition, and use reliable quality and stable switch power supply.

9. Packaging transportion and storage

9.1 Packaging

The system adopts the overall packaging to prevent the product in the transportation and the storage from any noxious gas, chemistry pollution, the static electricity, moist and the mechanical damage. Packing case indication: product name, type module, production date, quantity and batch number.

9.2 Transportation

The products are suitable for vehicle, ship and aircraft transportation. During transportation, the products should avoid direct sunshine, and should be gently loaded and unloaded. The packaging box of the product is allowed to be transported by any means of transprtation. The battery should be lifted and put down gently to avoid throwing, tumbling and heavy pressure. Direct rain, snow and mechanical impact should be avoided during transportation.

9.3 Storage

The system shall be stored in a dry warehouse and shall not be exposed to sun or rain. There shall be no harmful gas, inflammable and explosive products and corrosive chemicals in the warehouse, avoiding mechanical shock, heavy pressure and strong magnetic field effect, and avoiding direct sunlight. The distance from the system and the heat source shall be no less than 2m, and the packaging box shall be at least 20cm high from the ground, and at least 50cm from the wall, window or air inlet. Under the conditions of these provisions, the products with storage period of more than 6 months need to be carried out a

supplementary charge, the products with storage period of more than 12 months must be reinspected to be qualified before delivery.

10. Environment protection request

Meet RoHS request. No cadmium, hydride, fluoride and asbestosnever, no vaporized organic compound coming out, and package materials can be recycled.

11. Safety iessues needing attention

(1) It is strictly forbidden to immerse the battery in water or rain, and keep the battery in a cool dry surrounding.

(2) Prohibit using and shelving the battery beside the high temperature source.

(3) Please use the module according to the charge and discharge parameters specified in this manual.

(4) Prohibit directly connecting the system with the power source plug.

(5) Forbid discarding the battery into fire or heater.

(6) Forbid breaking up the battery and its part.

(7) Forbid to rap, stomp and throw the battery.

(8) Even if the grid is cut off, the battery module still has the voltage output, please take care to avoid electric shock or short circuit when using battery module.

(9) In areas with poor environmental conditions, effective protective measures must be taken for battery module, such as good grouding, sunshading board, rain cabinet and dust screen, to avoid lightning, rain, snow, high temperature, dust damage battery module and impact battery life.

(10) For being used in high temperature areas, the battery must be used in cabinets with corresponding heat dissipation equipment (fans or air conditioners). In low temperature areas, the battery must be used in cabinets with corresponding heating equipment (heating plates or air conditioners). In coastal areas, the battery must be used in a cabinet with the corresponding salt spray protection capability.

(11) Unless otherwise specified, the charging and discharging current for the battery module and battery module is recommended to be set at $0.5C_3$.

(12) Please read the product manual carefully before installation and application.