FROG ENGINEERING

FE-3U-100Ah-LiFePO4

Telecommunication LiFePO4 Battery

Pack Product Manual

（V1.0）

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Thanks for choosing FE-3U-100Ah-LiFePO4 telecommunication LiFePO4 battery pack. Please read the manual carefully and strictly observe it for battery application. Please keep the manual in good condition.

Content

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1. Operation manual

Warning: FE-3U-100Ah-LiFePO4 is a 48VDC power supply system. Please pay attention during operation.

 Before connection

1) First please check whether the product's condition and packing list after unpacking;

2) Cut off the external power supply before installation, and ensure that the product is shut down;

3) Do correct wiring. Do not mistake the positive and negative terminals cable, ensure that there is no short circuit with external equipment;

4) Direct connection with AC power supply is not allowed;

5) Well grounded with resistance less than 100mΩ;

6) Ensure that the electrical parameters of the product are compatible with the relevant equipment;

7) Stay away from water or fire.

 During use

1) Cut off power and battery for transportation or maintenance ;

2) Do not connect with other different types of batteries;

3) Do not work with faulty or incompatible equipment;

4) Do not disassemble the product;

5) In the event of fire, use a lithium battery fire extinguishing device that meets the requirements of national standards.

6) Do not open, repair or disassemble the product without authorization.

 Tips:

1) Please read this manual carefully before installation.

2) The product is suitable for 48 VDC telecommunication switch power supply battery. Please do not use it for other applications;

3) Do not turn on system switch when it is not used, in case of electricity consumption;

4) Charge the product at least once every 6 months for long-term storage. SOC shall be more than 90% for every charge;

5) Charge the product within 12 hours after it triggers low voltage protection;

6) The rated voltage of the product is 48V. Please pay attention to personal safety;

7) Disconnect all the battery terminals before maintenance.

2. Product introduction

FE-3U-100Ah-LiFePO4 is LiFePO4 battery pack based on innovative lithium battery technology. It is especially designed for telecommunication base station with advanced features of long life, wide range of charging voltage, fast charging, and intelligent management.

2.1 Appearance

⚠ Note: the picture is only for reference. Please be subject to actual product.

2.2 Features

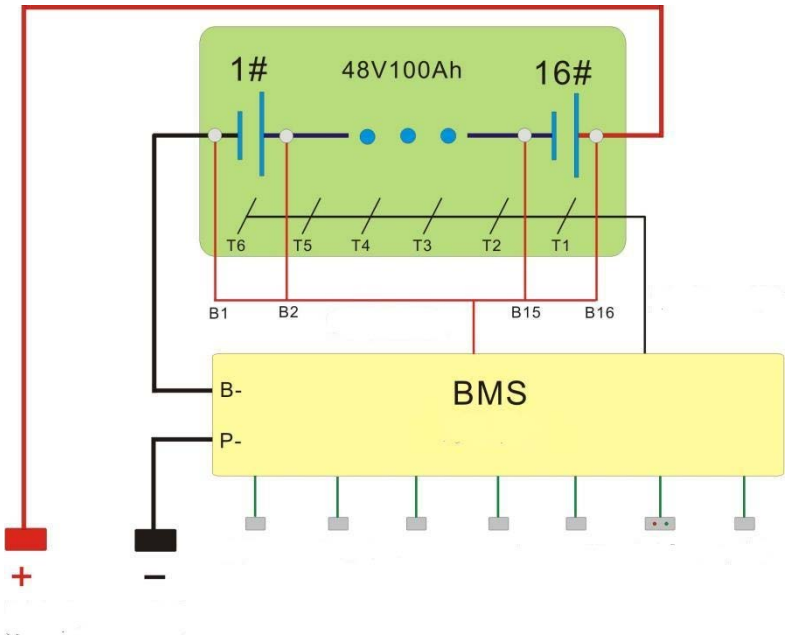
- New type of LiFePO4 battery, safe, reliable, long life cycle;
- More than 3000 cycles, longer for floating working condition;

- Environmentally friendly raw material, production and use;
- 3.2V/100Ah cell;
- Safety valve which has two kinds of protection functions
- High energy density, stable discharge platform
- Integrated design with 16 cells in series, BMS and 19'' standard cabinet;
- Embedded installation size conforms to EIA and ETSI; also suitable for earthquake proof iron rack installation;
- Small size and weight;
- Modular design. Capacity can be expanded by multiple parallel connection;
- Support high discharge rate, high efficiency, and meet with discharging with big current for small capacity configuration;
- Good environmental adaptability and wide operation tempt range. No need of air conditioner or increase AC constant temperature for base station. Construction and electricity costs are reduced significantly;
- Intelligent gap charging and discharging function is adopted to reduce the power costs of base station effectively;
- All-around alarm protection functions (overcharge, over-discharge, short circuit, overload, over-current, high temperature, low temperature, balancing, dormancy);
- Intelligent design, with functions of telemetry, remote communication and remote control. Remote communication can be achieved through dynamic ring monitoring system;
- RS232 and double RS485, which can be well connected with the master computer and other equipment;
- LED light indication, a clear view of the whole operation;
- Front panel, simple and convenient for operation and maintenance;
- Good electromagnetic compatibility, compatible with standard rectifier;
- Capable of direct replacement with lead acid battery switch power system by only adjusting parameters such as charging/discharging voltage;
- Very suitable for resident electricity Class 2 and 3.

2.3 Working principle and status

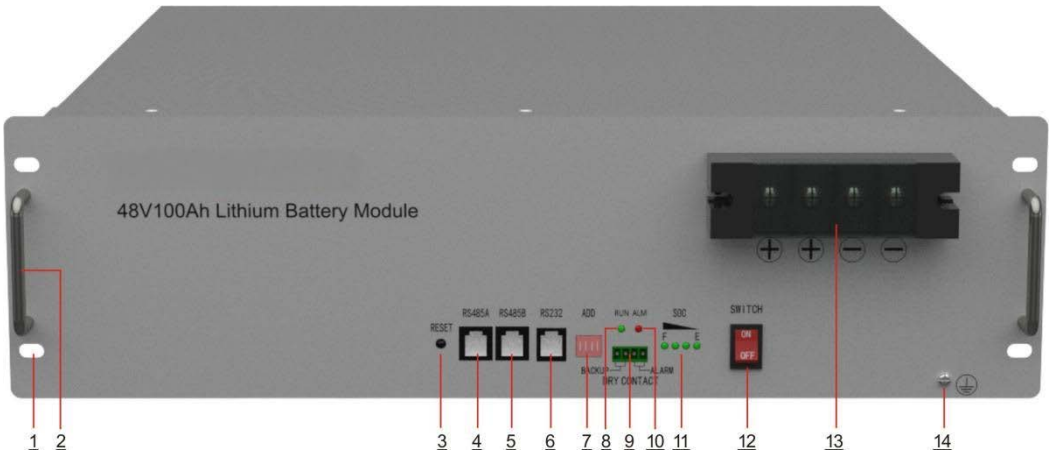
It is 48V backup power for telecommunication equipment, made up of 3.2V 100AH LiFePO4 cells in 16S and battery management system. It is connect by positive and negative ports of upfront panel and that of telecommunication switch power supply. Switch power supply offers power to telecommunication device and charge the product when electric supply is normal. When it is out of power, the product offers uninterrupted power to the telecommunication equipment until electricity is back to normal or BMS turns to over discharging protection and cut off the battery.

System schematic diagram:



Working status conversion diagram:

2.4 Panel


48V100Ah Lithium Battery Module
RESET
RS485A
RS485B
RS232
ADD
RUN ALM
SOC
SWITCH
ON
OFF
BACKUP
ALARM
DRY CONTACT
1
2
3
4
5
6
7
8
9
10
11
12
13
14

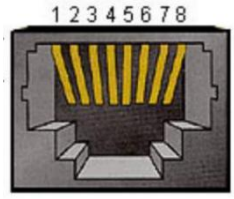
Panel port description:

1) Hanger: for installation and fixing fixed. It can be installed in a 19'' standard cabinet or in an earthquake proof iron rack.

2) Handle: easy for transportation and installment.

3) Reset: reset and wake up the product when it is abnormal or dormant to ensure steady operation of system.

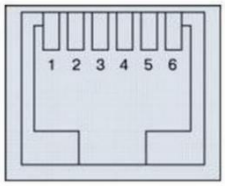
4) RS485A: cascade communication port A; RS485 communication way is adopted for cascade connection.



Pin	Definition
1、8	RS485-B
2、7	RS485-A
3、6	GND
4、5	NC

5) RS485B: cascade communication port B; RS485 communication way is adopted for cascade connection.

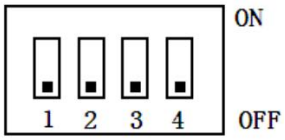
6) RS232: up communication port. Uploading data uses RS232 communication way, data including system parameter, status and alarming information.



Pin	Definition
1、2、6	NC
3	TX
4	RX

5	GND

7) ADD: to set address allocation for parallel connection of multiple products.



ADD	Dial switch location			
	#1	#2	#3	#4
0	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	OFF	ON	ON	OFF
7	ON	ON	ON	OFF
8	OFF	OFF	OFF	ON
9	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON
11	ON	ON	OFF	ON
12	OFF	OFF	ON	ON
13	ON	OFF	ON	ON
14	OFF	ON	ON	ON
15	ON	ON	ON	ON

8) Run: green LED lamp, pls see the LED working status as follows.

9) Dry contact: two-route dry contact, left one not activated, right one is always on, closed when alarm.

10) ALM: red LED lamp, pls see the LED working status as follows.

11) SOC： 4 green LED lamps to indicate SOC of battery pack.

SOC LED				Capacity
L4●	L3●	L2●	L1●	
OFF	OFF	OFF	ON	0 ~ 25%
OFF	OFF	ON	ON	25 ~ 50%
OFF	ON	ON	ON	50 ~ 75%
ON	ON	ON	ON	75 ~ 100%

<LED working status display>

Status	Normal/ALM/Protection	RUN	ALM	SOC LED			
		●	●	●	●	●	●
OFF	Dominant	OFF	OFF	OFF	OFF	OFF	OFF
Standby	Normal	Always on	OFF	Display according to SOC			
	ALM	Always on	Flash				
Charge	Normal	Always on	OFF	Display according to SOC(LED lamp with the most SOC flashes)			
	ALM	Always on	Flash				
	Charge protection	Always on	OFF	Always on			
	Tempt, over current and invalid protection	OFF	Always on	OFF			
Discharge	Normal	Flash	OFF	Display according to SOC			
	ALM	Flash	Flash				
	Undervoltage protection	Always on	OFF	OFF			
	Tempt, over current, reverse connection and invalid protection	OFF	Always on	OFF			
Invalid		OFF	Always on	OFF			
Current limit		Always on	OFF	Display according to SOC			

12) Switch: BMS switch. BMS is dormant when it is closed and meanwhile cut off charging and discharging MOS tube. Recover work when it is turned on.

13) Wire bank: 4P port(2P positive and 2P negative), carry a maximum current of 300A.

14) Grounded: port for grounding.

2.5 Specification

Please set the parameter of switch power in strict accordance with the specification before use. The specification can't be modified randomly otherwise the performance will be affected seriously.

Basic parameter

Model	FE-3U-100Ah-LiFePO4
Cell type	LiFePO4
Rated voltage	-48V
Nominal capacity	100Ah
Cell	3.2V/100Ah
Battery pack mode	16S cell+ BMS + standard cabinet or iron rack
Battery pack size	482×480×133（mm）(WxDxH)
Weight	48.0±1.0 kg
Charging tempt	0～65℃
Discharging tempt	-20～65℃
Storage tempt	-20～65℃
Relative Humidity	5% to 95%
Max. Operating Altitude	4000m (Each 200m increases in altitude will decrease the working temperature by 1°C from 2000m to 4000m)
Working atmospheric pressure	70kpa-106kpa
Noises	0 db

Charging parameter

Charging mode	Balancing charging, intermittent charging, continuous floating charge
Total voltage range	56.8V～57.6V(general 56.8V)
Cell voltage range	3.55V～3.60V(general3.55V)
Total floating charging voltage	54.4V～55.2V(general54.4V)

range	
Cell floating charging voltage range	3.40V ~ 3.45V(general3.40V)
Charging current range	0A ~ 100A（general 10A ~ 30A）
Over current alarm range	0A ~ 50A（general50A）
Over current protection range	0A ~ 100A（general > 60A）
Over current protection recovery	< 55A（can be set）
Charging limit	10A（Default ON ）
Cell over voltage alarm	3.60V（can be set）
Cell over voltage alarm recovery	3.50V（can be set）
Cell over voltage protection	3.70V（can be set）
Cell over voltage protection recovery	3.40V（can be set）
Cell over voltage test delay time	1.0S-1.5S（can be set）
Over current test delay time	1.0S-1.5S（can be set）
Total over voltage alarm	57.6V （can be set）
Total over voltage alarm recovery	54.0V（can be set）
Total over voltage protection	59.0V（can be set）
Total over voltage protection recovery	56.0V（can be set）
Total over voltage test delay time	1.0S-1.5S（can be set）
Intermittent charging condition	Average cell voltage < 3.4V，SOC < 80%（can be set）
Fully charged condition of intermittent charging	Average cell voltage > 3.5V，charging current < 4A（can be set）

Discharging parameter

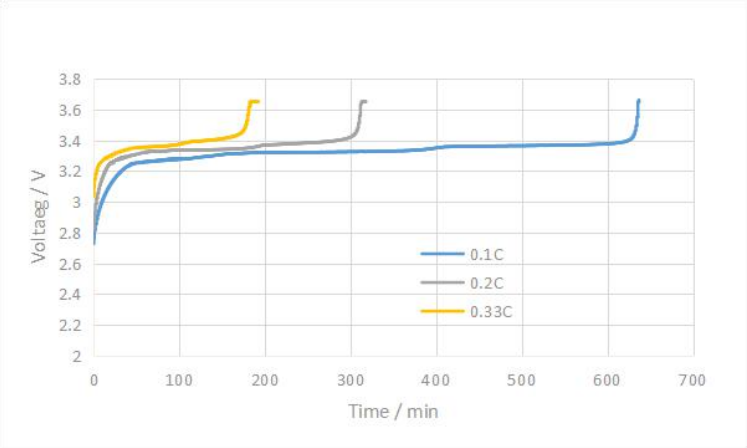
Discharging current	0A ~ 100A
Over current alarm	> 95A（can be set）
Over current alarm recovery	< 91A（can be set）
Over current protection	> 100A（can be set）
Over current protection recovery	< 95A（can be set）
Cell under voltage alarm	2.90V（can be set）
Cell under voltage alarm recovery	3.10V（can be set）
Cell under voltage protection	2.70V（can be set）
Cell under voltage protection recovery	3.00V（can be set）
Cell over discharge test delay time	1.0S-1.5S（can be set）
Over current test delay time	1.0S-1.5S（can be set）
Total under voltage alarm	48.0V（can be set）
Total under voltage alarm recovery	49.6V（can be set）
Total under voltage protection	43.2V（can be set）
Total under voltage protection recovery	47.2V（can be set）
Total over discharge test delay time	1.0S-1.5S（can be set）
Low SOC alarm	10% SOC（can be set）
Low SOC alarm recovery	20% SOC（can be set）

Other parameter

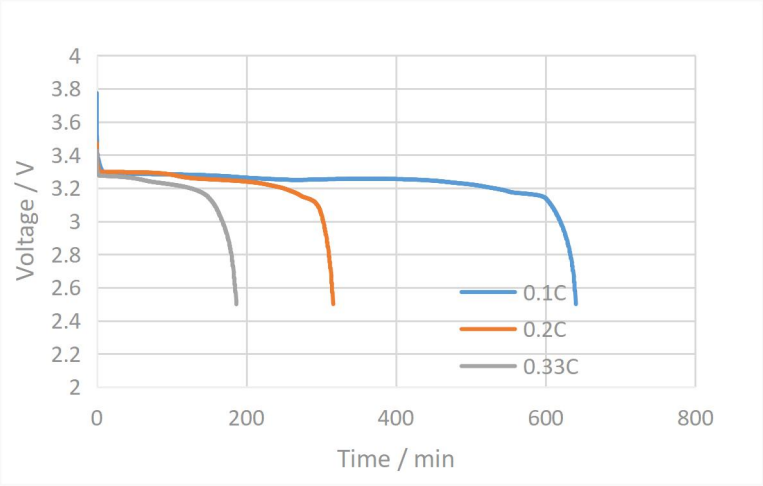
Balancing opening voltage	3.50V（can be set）
Balancing opening voltage difference	20mV（can be set）
Balancing current	75mA
Short circuit protection current	> 3C
Short circuit protection delay	≤500us

Short circuit recover method	Load disconnecting, automatic or manual recovery
BMS working current	≤30mA
BMS dormant current	≤500μA
Storage capacity	> 500
Over tempt alarm	50℃（can be set）
Over tempt alarm recovery	40℃（can be set）
Over tempt protection	60℃（can be set）
Over tempt protection recovery	50℃（can be set）
Low tempt alarm	0℃（can be set）
Low tempt alarm recovery	5℃（can be set）
Low tempt protection	-20℃（can be set）
Low tempt protection recovery	-10℃（can be set）
Voltage display accuracy	±10mV
Current display accuracy	1.2%
SOC display accuracy	2.5%
Tempt display accuracy	1℃
Tempt collecting number	6（4 for battery，1 for environment，1 for PCB）
Up connection communication	RS232，RJ11
Cascade connection communication	Double RS485, RJ45

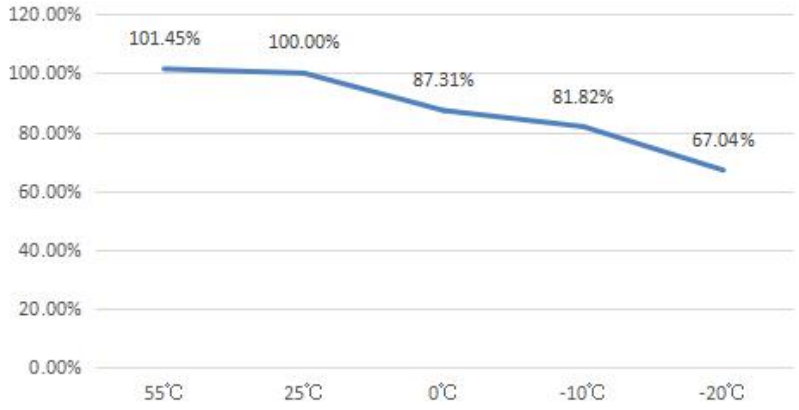
Charging Curve @ Different Charge Current, 25°C



Discharging Curve @ Different Discharge Current, 25°C



Capacity curve at different temperature



3. Installation

Warning

1) Installation, calibration and maintenance shall be operated by trained staff. Please read carefully and understand the safety precautions and operation procedures before installation and use. The relevant safety regulations shall be strictly observed during installation process in case of any personal injury or product damage caused by illegal operations.

2) Please check whether the switch power matches or not.

3) Please check whether the switch power and the product are shut down again.

4) Please check whether the connection cable has the corresponding insulation protection. Exposed metal wires shall be strictly not allowed.

5) Ensure the product and switch power are well grounded.

Dimension:

3.1 Equipment and tool

The following are needed for installation.

laptop

screwdriver

cocket wrench

wire stripping plier

crimping plier

multimeter

clamp meter

diagonal cutting plier

insulation tape

steel tape

Warning:

Appropriate insulation tools are used to prevent unexpected electric shock or short circuit.

If there is no insulation tool, cover the existing tool with insulation tape except the terminal.

It is recommended to wear the following safety item during the operation.

insulation glove

google

safety shoes

3.2 Cleansing

Dust and iron scrap shall be removed before installation and starting the product to ensure the product and environment are neat.

3.3 Installation regulation

1) At least 2 persons are need on site.

2) First check the packaging, product specification and model.

3) Check the material list after packaging.

4) The product shall be taken out carefully, in case of collision, scratch, and other damages.

5) Insulation shall be handled for metal tools in case of short circuit due to tool drop and other accidents.

6) Wiring and connection wires shall be checked before installation.

7) Before installation, check the connection wire's diameter whether it meets the maximum current requirements of the equipment operation.

8) Correct wiring, reasonable layout, and neat and orderly condition; moisture-proof and anti-corrosion measures shall be taken.

9) Wire connection and grounded wire shall be correct and reliable.

10) The screws, bolts and wiring shall be checked one by one after installation is completed.

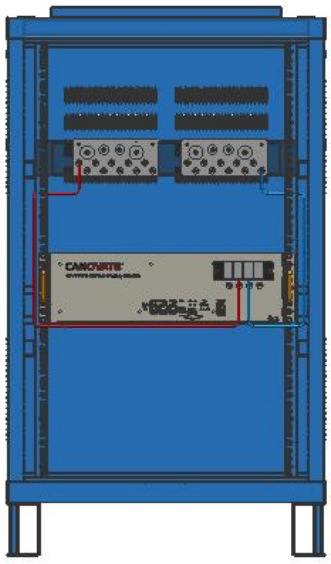
11) The product shall be turned off when electricity is not connected.

12) Charge the product before use it formally. Over discharge shall be avoided.

3.4 Standard cabinet Installment and parallel connection method

1) Standard cabinet installation is the product placed in the 19’’ standard cabinet. With 4 bolts M6 * 15 and square nuts, it is fixed to to the square column through 4 mounting holes of hanger.

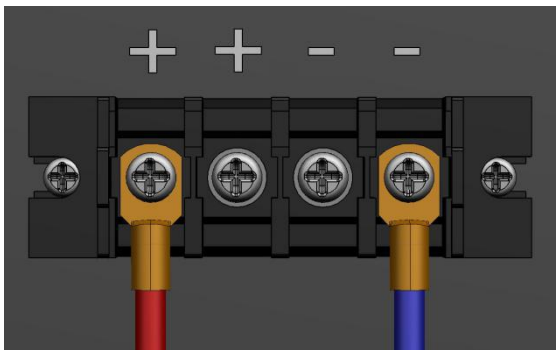
Installation schematic diagram:



2) The front panel has wire bank of total positive and total negative terminals, which are connected with switch power. Flame retardant wire shall meet requirements of the maximum current. One end of the cable is connected to wire bank with the screw.

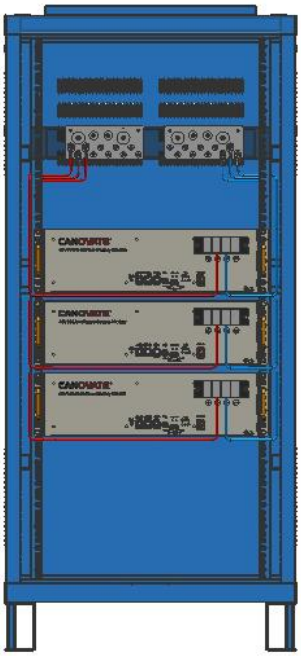
Torque 2.5 N.m is recommended. The other end of the wire is connected with the positive bus bar and battery switch(or fuse) respectively. Finally cover with transparent polycarbonate (PC) insulation protection cap.

Wire bank connection schematic diagram:



3) If there is need to upgrade the backup power support time, multiple products can be connected in parallel to increase the total capacity. Take 48V 300Ah standard cabinet product for example, put 3 sets of FE-3U-100Ah-LiFePO4 in a standard cabinet, set the first FE-3U-100Ah-LiFePO4 to 100000, the second to 010000, the third to 110000. Then connect the RS485B port of the first FE-3U-100Ah-LiFePO4 to that of the second FE-3U-100Ah-LiFePO4 with 8 core twisted-pair wires. Connect the RS485A port of the first FE-3U-100Ah-LiFePO4 to that of the second FE-3U-100Ah-LiFePO4 with 8 core twisted-pair wires. Then connect RS485A port of the first FE-3U-100Ah-LiFePO4 with TRS485/RS232 or RS485/USB. Communication is made normally. The total number of 3 battery packs can be set on the homepage of the master computer software, and the automatic round selection mode can be selected. Connect "+" of 4P wire bank of 3 products to the positive bus bar with 3 flame retardant wires, and then connect "-" of 4P wire bank of 3 products to the negative bus bar with 3 flame retardant wires. 48V 300Ah parallel connection is completed for use.

48V 300Ah parallel connection schematic diagram:



4. Application

4.1 Step

1) Open the system switch after installation and the product enter standby status. The running lamp is always on and SOC lamp indicates the remaining electricity.

2) Product is in charging status when telecommunication switch power is loading. The running lamp flashes and SOC lamp indicates the current electricity. The SOC lamps are fully green after fully charged and then product turns to standby status. The running lamp is always on.

3) When electricity is out, it enters discharging status without delay and offer power to the telecommunication equipment. The running lamp is always on and SOC lamp flashes and indicate the current electricity. The product turns to charging status when electricity recovers. Otherwise, it is discharged until protection is turned on. Output is automatically cut off and then it turns to dormant status.

4.2 Dormant and wake-up functions

1) The product has dormant function to minimize the consumption of BMS on the battery pack. The BMS current consumption is <30mA under normal working

conditions, and the BMS current consumption is <500μA in the dormant status There are three kinds of dormant modes: automatic dormancy, forced dormancy by system switch and forced dormancy by master computer.

a. When the lowest cell is lower than dormant voltage(in general 3.30V, can be set on the master computer), or there is no continuous charging and discharging current and master computer doesn't communicate, BMS will enter the automatic dormant status;

b. BMS enters the automatic dormant status after turning off switch.

c. Click forced dormancy on the master computer.

2) The product has wake-up functions with the following conditions:

a. charging, discharging or resetting.

b. turning on system switch.

c. clicking communication recovery on the master computer.

4.3 Charging

 It has 3 charging methods, balancing charging, intermittent charging and constant online floating charging.

1) Balancing charging

a. This charging method is suitable for the site with relatively large power configuration and large module redundancy, which can be charged in a fixed current and fixed time, and the charging speed is faster. BMS provides balancing charging function and fix the voltage discreteness of series connection battery pack which is caused by battery itself, avoid any battery pack performance worsen or damage due to over charging or discharging of several batteries, and to make sure all the battery voltages are in a reasonable range.

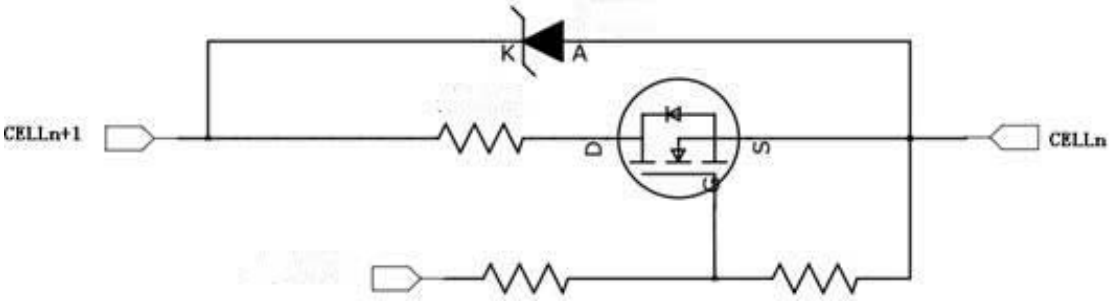
b. It uses intermittent balancing method, that is to say, control the number of cell which opening balancing and balancing cell opens and shuts down balancing circuit proportionally.

① Under the charge status, the cells which open balancing are in balancing discharge. Voltage collection accuracy will be affected. The time proportion can be allocated by the intermittent balancing method, so as to ensure the accuracy of voltage collection .

② The intermittent balancing can control the temperature rise effectively by controlling the number and hour of balancing, so as to ensure the reliability of balancing.

③ Adopting intermittent balancing helps keep the battery consistent.

Balancing circuit schematic diagram:



c. When the following conditions are met, cell balancing function is opened:

① The battery pack is in the charging status.

② The voltage of highest cell is higher than balancing opening voltage(normal is 3.50V, can be set)

③ The max voltage difference is more than balancing opening voltage difference(20mV, can be set).

d. When the following conditions are met, the cell balancing function is closed:

① The battery pack is not in the charging condition;

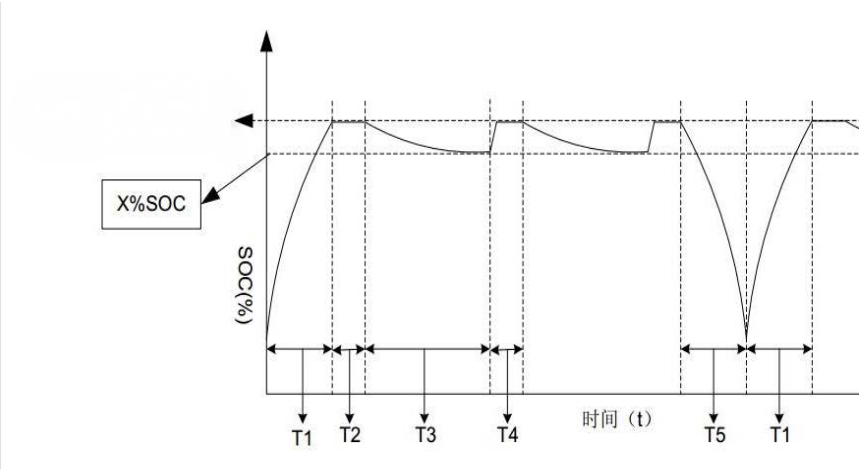
② The voltage of highest cell is lower than balancing opening voltage;

③ The max voltage difference is lower than balancing opening voltage difference.

2) Intermittent charging method

This charging method is suitable for the site with relatively small power configuration and relatively small module redundancy. When the capacity of the battery pack is lower than the set parameter value (factory setting: 90%SOC), BMS will turn on the battery charging function until the battery pack is fully charged. Note that there is a "charging recovery voltage" setting in the BMS parameter setting. If all battery voltages in the battery pack are lower than that voltage, the charging will also be started. So, if intermittent charging function is used, charging recovery voltage can't be set too high. Take LiFePO4 battery for example, the factory charging voltage is set to 3.4 V. When all the battery voltages are lower than 3.4 V, no matter the battery pack capacity is lower than the recovery of intermittent charging set value, BMS will restore to charge.

Intermittent charging is divided into four stages, as shown in the figure:



T1: Constant current-limiting voltage charging stage

The charging current remains the same and voltage keeps improving. It stops charging when the maximum voltage or battery pack terminal voltage is bigger than or equal to battery pack voltage.

T2: Constant voltage-limiting current charging stage

The maximum charging current is within the range of allowable charging current. When the maximum voltage is equal to the set value, charging current decreases automatically until it reaches the set value and then stop charging.

T3: Battery pack open-circuit static stage

The battery pack enters charging open-circuit static stage after constant current and voltage charging.Test the DC output terminal voltage of power system and make sure the circuit smooth. When DC power is cut, BMS will enter discharging status without delay.

T4: Intermittent supplement charging stage

The battery pack charging circuit is in the open-circuit static status until capacity decreases to 90% SOC of the initial capacity limited by battery charging voltage. Then BMS is back to supplement charging according to constant current and voltage charging way.

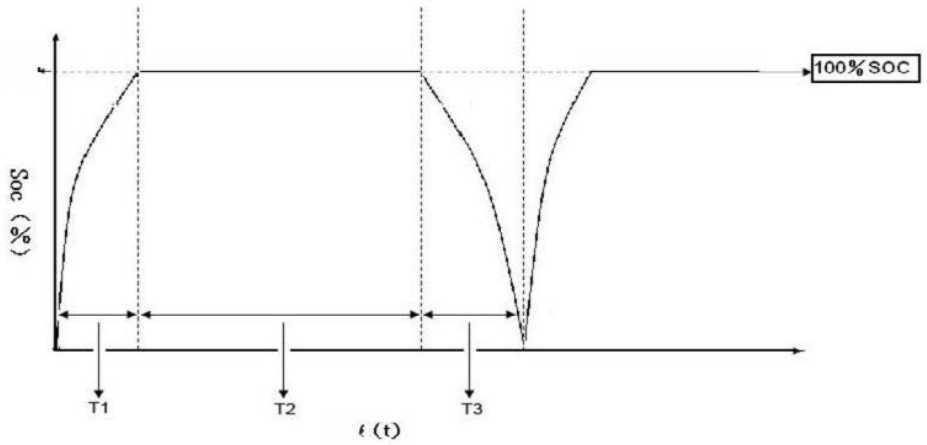
T5: Discharging process of battery pack

Battery pack supplies power according to loads. It stops discharging when the minimum voltage or battery pack terminal voltage meets the cut-of voltage.

3) Constant online floating charging

The charging way is suitable for station in which switch system only has floating charging function. It is also called trickle constant-voltage charging. It can be controlled by switch power. Set the maximum charging current to 54V to do the constant charging. Switch power only offers small current to supply the consumption of battery. The battery pack is always charged but not over charge. The charging circuit is managed by batteries' voltage. The charging voltage of battery and pack meets the requirements of charging voltage limitation until all the batteries are charged full. This charging way improves the pack's life.

Constant online floating charging schematic diagram:



T1: Constant current-limiting voltage charging stage

The charging current remains the same and voltage keeps improving. It stops charging when the maximum voltage or battery pack terminal voltage reaches the set floating voltage.

T2: Trickle-limiting voltage charging stage

Charging current remains trickle status. Voltage is the set floating voltage and do the constant charging.

T3: Discharging process of battery pack

Battery pack supplies power according to loads. It stops discharging when the minimum voltage or battery pack terminal voltage meets the cut-of voltage.

4) Limited charging current function

It has the charging current limiting function. BMS has 10A (0.1C) charging current limiting module. It can be opened or closed on the software. The default is open. The BMS charging MOS tube is shut down after charging current limiting module is turned on. If the switch power supply output current is lower than the current limit value, it is charged according to the switch power supply. If the switch power supply output current is higher than the current limit value, it is charged according to current limit value.

If the current limiting function is not enabled, the BMS charging MOS tube is turned on, and the switching power supply is charged by the charging MOS tube. The charging current value is the output current of the switching power supply, and the charging current can reach 100A (1C) at most. When the current exceeds the charge

over-current limit value of 100A (1C, BMS turns off the charging MOS and stops charging.

4.4 Storage and recording function

BMS has storage and recording function. It can record, protect, alarm, recover type and happening time, which includes single cell voltage, total voltage, charge and discharge capacity, charge and discharge current and temperature of error type and happening time. Beside, it can set and record battery parameter within a period of time, such as single cell voltage, total voltage, charge and discharge capacity, charge and discharge current and temperature. Storage capacity is no less than 500 lines. Storage time and interval can be set. The storage content is one by one. It can be read on the master computer and saved as excel.

4.5 Remote control function

It has RS232 and RS485 ports. It can control the product remotely after meeting relevant communication protocol. Master computer protocol can be offered and it is connected to monitoring system to reduce daily maintenance work.

It has the following monitoring functions：

Remote test: SOC, battery pack voltage, cell voltage, environment , battery pack temperature, PCB board temperature, battery pack charge current, battery pack discharge current and SOH.

Remote communication: battery pack charge and discharge status, battery pack over charge alarming, cell over charging alarm, battery pack under voltage alarm, cell under voltage alarm, over current charge alarm, over current discharge, polarity reverse connection alarm, environment/pack/PCB/high temperature alarm, environment/pack/PCB/low temperature alarm, low SOC alarm, pack temperature/voltage/current sensor failure alarm, pack failure alarm etc.

Remote control: current limit charge function, on/off, charging/discharging test, alarm switch, intermittent charging method.

4.6 Protection and alarm function

There are two kinds of safety protection functions, one positive protection(software) and the other negative protection(hardware). Safety protection and recovery data can be set on the master computer. 3 alarming ways are as follows: ① buzzer alarm; ② LED display alarm; ③ master computer alarm.

1) Charge over total voltage protection and recovery function

It has charge over total voltage protection and recovery function. When total charge voltage reaches the alarm value, BMS alarms. But it doesn’t affect normal charge. When the total voltage reaches protection value, BMS cuts the charge circuit and alarms, which ensures pack safety without affecting the normal discharge. When the

total voltage decreases to normal value, pack returns to charge status. The function can be turned on and shut down on the master computer.

2) Discharge under total voltage protection and recovery function

It has discharge over voltage protection and recovery function. When total discharge voltage reaches the alarming value, BMS alarms. But it doesn't affect normal discharge. When the total voltage reaches protection value, BMS cuts the discharge circuit and alarms, which ensures pack safety without affecting the normal charge. BMS enters dormant status. When charge recovers, the total voltage rise to the recovery value, BMS removes under total voltage protection and the product returns to normal working state. The function can be turned on and shut down on the master computer.

3) Cell over voltage protection and recovery function

It has cell over voltage protection and recovery function. When charge voltage reaches the alarming voltage, BMS alarms. But it doesn't affect normal charge. When the single cell's voltage reaches protection value, BMS cuts the charge circuit and alarms, which ensures pack safety without affecting the normal discharge. When single cell's voltage decreases to normal value, BMS cancels single cell over voltage protection. It returns ton normal working status.

4) Cell under discharge voltage protection and recovery function

It has cell under voltage protection and recovery function. When discharge voltage reaches the alarming voltage, BMS alarms. But it doesn't affect normal discharge. When the single cell's voltage reaches protection value, BMS cuts the discharge circuit and alarms, which ensures pack safety without affecting the normal charge. BMS enters dormant status. When charge recovers, the single cell's voltage rise to the recovery value, BMS cancels single cell under voltage protection and the product returns to normal working state.

5) Short circuit protection

It has short circuit protection. When battery pack output is in short circuit, discharge current exceeds short-circuit protection current, BMS cuts the circuit and alarms, which ensures safety performance and has no influence on other devices. Under such

circumstances, charge and discharge is not allowed. Once external short circuit is canceled, BMS cancels the short circuit protection and it returns to normal working state(manual resetting is available to normal work).

6) Discharge over current(load) protection and recovery function

It has discharge over current(load) protection and recovery function. When discharge current exceeds alarm value, BMS alarms. But it doesn't affect normal discharge. When discharge current exceeds over current(load) value, BMS cuts the discharge circuit and alarms, which ensures pack safety performance. Pack returns to normal discharge after load is canceled or discharging current is decreased to set value. The function can be turned on and shut down on the master computer.

7) Charge over current protection

It has charge over current protection function. When charge current exceeds alarm value, BMS alarms. But it doesn't affect normal charge. When charge current reaches protection value, BMS cuts the charge circuit and alarms, which ensures pack safety performance. When charge current decreases to recovery value, BMS cancels over current protection and pack returns to normal charge. The function can be turned on and shut down on the master computer.

8) Over temperature protection and recovery function

It has over temperature protection and recovery function. When temperature reaches alarm value, BMS alarms. But it doesn't affect normal charge and discharge. When temperature reaches over temperature protection value, BMS cuts the circuit and alarms, which ensures pack safety performance. When temperature decreases to over temperature protection recovery value, BMS cancels over temperature protection and it returns to normal charge and discharge.

9) Low temperature protection and recovery function

It has low temperature protection and recovery function. When temperature reaches alarm value, BMS alarms. But it doesn't affect normal charge and discharge. When temperature reaches low temperature protection value, BMS cuts the circuit and alarms, which ensures pack safety performance. When temperature decreases to low

temperature protection recovery value, BMS cancels low temperature protection and it returns to normal charge and discharge.

5. Maintenance

5.1 Transport and storage

1) It shall be operated by qualified and authorized personnel.
2) Due to the weight of the battery system, please be careful during handling.

5.2 Common errors and solution

No.	Error description	Analysis	Solution
1	No DC output after starting	over low voltage, over discharging protection	Charge
2	Lamp off after starting	BMS dormant	Restart the reset switch
3	Insufficient SOC	under charging voltage	Adjust parameters of switch power such as balancing and floating charging voltage
4	Short power supply time	Not fully charged	Check parameters of switch power such as charging voltage and current
5	Unsteady output voltage after starting	BMS interrupted	Restart the reset switch
6	RS485 communication error	communication wire or address error	Check address switch, set port and circuit
7	RS232 communication error	communication wire error	Check port and circuit

5.3 General maintenance

 Danger: Maintenance must be done by qualified and authorized personnel.

 Danger: System power must be turned off during maintenance.

1) Voltage: Check voltage through monitoring system. For example: voltage of cell is unusually high or low.

2) SOC: Check SOC is normal through monitoring system.

3) Wire: Inspect all the wires visually. Check whether they are damaged, aging, and loose.

4) Balance: Balance the battery every 3 months (fully charged).

5) History check: Analyze history records for accidents (alarm and protection) and analyze the reasons.

6) Shutdown and maintenance: For partial problems, restart the product and check. It is recommended to restart system every 6 months.

5.4 Inspection&maintenance

Test discharge capacity of battery pack regularly. There are two discharge ways. One is through on-line discharge and the other is discharge capacity tester. Records shall be made.

5.5 Maintenance space requirement

1) If the product is mounted on a standard cabinet , it shall ensure that front-end operation and maintenance space shall not be less than 60cm, the front-end space shall not be less than 100cm and the upper and lower end space shall not be less than 15cm.

2) If the product is mounted on an earthquake iron rack, it shall ensure that the front-end operation and maintenance space shall not be less than 60cm, the front-end space shall not be less than 100cm and the upper and lower end space shall not be less than 10cm.

6. Packing list

No.	Description	Quantity(set)
1	LiFePO4 battery pack	1
2	Manual	1
3	Certificate	1
4	Accessory	1