编号：JK/JK-B5A25S-60P.09
版本：8.0

Smart BMS with Active-Balancer

（JK-B2A25S-RP）

Specification and operation manual

JKBMS Technology Co., Ltd

Product warranty clause

Name ： Battery Active-Balancer

Warranty period ： One Year

First of all, thank you for purchasing the Battery Active-Balancer from Chengdu Jikong technology co., LTD.

Chengdu Jikong technology co., LTD. Provides quality warranty for the hardware products and accessories sold by our company. The warranty period is as shown above.During the warranty period, the company shall have the right to choose to repair or replace the whole set of products after receiving the notice of the product failure and verification.The whole set of replacement products may be new or close to new.

1. Chengdu jikong technology co., ltd. guarantees that the products are fully tested.
2. Chengdu jikong technology co., LTD does not guarantee that the products can be used without interruption during the product repair process.However, the company shall ensure that faulty products are repaired within a reasonable time.
3. The warranty period starts from the date of product delivery or the date of installation by chengdu jikong technology co., LTD.If the company's products are not installed within

   30 days after the date of shipment due to the user's schedule or delay, the warranty period of the products shall be calculated from the 31st day after the date of shipment.
4. Chengdu jikong technology co., ltd. shall not provide free warranty for any product failure or damage caused by :(a) improper use or improper maintenance;(b) software, accessories, components or other items not provided by chengdu jikong technology co., LTD.;(c) unauthorized removal, modification and misuse;(d) use in excess of the scope specified in the technical specifications of the product;(e) improper transport, handling and storage;(f) failure or damage caused by other non-mass causes (e.g. earthquake, war, traffic accident, etc.).

To the extent permitted by law, the above warranty is the only express warranty and there are no other warranties, whether written or oral.Expressly disclaims any implied warranty or commercial terms.

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1 Overview

JK-B5A25S-60P Battery Management System is a battery management system tailored for large capacity series lithium battery packs. It is suitable for 8-25 series battery packs and has battery protection, voltage collection and voltage balancing functions.

The balancing function of the system uses the super capacitor as the medium to achieve active energy transfer balancing. The system works with battery protection functions such as overcharge, overdischarge and short-circuit protection, and transfers energy with a balanced current of up to 5A. The balanced current does not depend on the voltage difference of the individual batteries in series in the battery pack. Voltage collection range 1V~5V, accuracy (+3mV). External communication interface can choose RS485 bus, CAN bus, GPS interface or LCD interface. It can be used for all types of batteries on the market, such as lithium iron phosphate, lithium ternary, Titanic acid, lithium lead.

The system is equipped with Bluetooth communication function and mobile APP software. It can check the voltage of single battery, view balance status, modify settings parameters and other operations through Bluetooth connected device system. It can be used in battery PACK of small sightseeing car, surrogate car, forklift, shared car, high power storage, base station backup power, solar power station and other products, as well as in batteries.Balance maintenance, repair and other occasions.

2 Main technical parameters

2.1 Features

◆ support 3 ~ 25 strings of battery pack;

◆ overcharge, over discharge voltage protection and overcurrent protection parameters can be set through app, with short-circuit protection function;

◆ real time and active equalization, the equalization current is 2a, and the voltage difference between batteries after balancing is ≤ 5mv;

◆ reserve charge / discharge switch control interface (12V) and configure 500A current shunt (75mV);

- ◆ reserved buzzer interface (12V);
- ◆ support 3 temperature probes;
- ◆ monomer voltage range 1V ~ 5V, accuracy ± 5mv;
- ◆ coulometer function;
- ◆ suitable for high-capacity ternary, lithium iron, lithium titanate and other lithium batteries;
- ◆ Bluetooth communication function, equipped with app, which can view the battery status in real time;
- ◆ support external interface RS485, can bus and GPS interface;
- ◆ low voltage shutdown function to prevent battery damage

2.2 a) Operating temperature range: - 20 ℃ ~ 70 ℃;

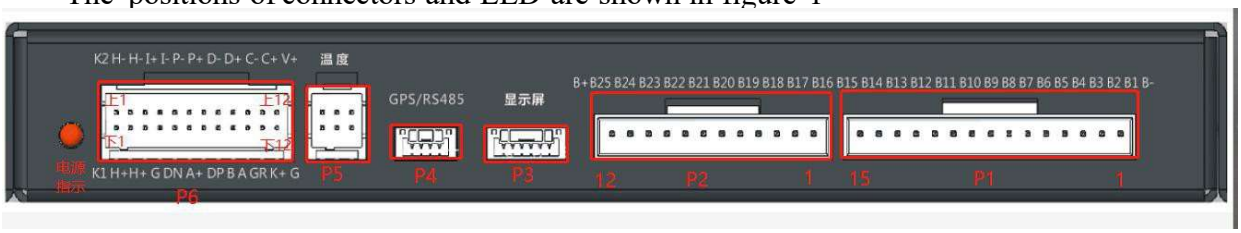
b) Power requirements: 16V ~ 100V, which can be powered by battery or external power supply.

c) Power consumption: the maximum power consumption of the protection board is 1.5W (excluding relay power consumption), and the shutdown power consumption is 20MW.

3 Connector and interface

3.1 connectors and LED

The positions of connectors and LED are shown in figure 1



3.2 Connector definition and LED definition are shown in table 1.

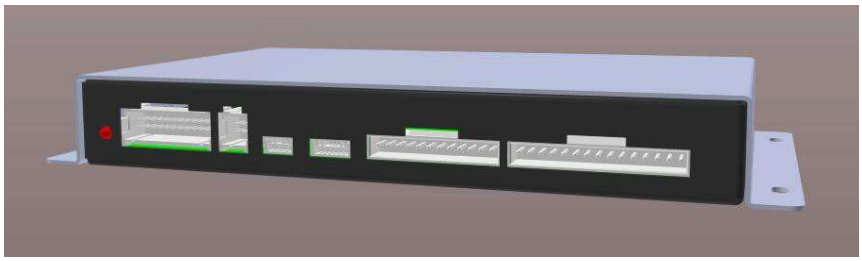
table 1 connector definitions

connector	Pi8	Name	Description
P1	1	B-	battery negative
	2	B1	The 1st string of battery cathode
	3	B2	The 2st string of battery cathode
	4	B3	The 3st string of battery cathode
	5	B4	The 4st string of battery cathode
	6	B5	The 5st string of battery cathode
	7	B6	The 6st string of battery cathode

connector	Pi8	Name	Description
	8	B7	The 7st string of battery cathode
	9	B8	The 8st string of battery cathode
	10	B9	The 9st string of battery cathode
	11	B10	The 10st string of battery cathode
	12	B11	The 11st string of battery cathode
	13	B12	The 12st string of battery cathode
	14	B13	The 13st string of battery cathode
	15	B14	The 14st string of battery cathode
P2	1	B15	The 15st string of battery cathode
	2	B16	The 16st string of battery cathode
	3	B17	The 17st string of battery cathode
	4	B18	The 18st string of battery cathode
	5	B19	The 19st string of battery cathode
	6	B20	The 20st string of battery cathode
	7	B21	The 21st string of battery cathode
	8	B22	The 22st string of battery cathode
	9	B23	The 23st string of battery cathode
	10	B24	The 24st string of battery cathode
	11	B25	The 25st string of battery cathode
	12	B+	battery positive
P3	Display interface		
P4	GPS interface		
P5	up 1	T1	Thermal sensor 1 positive
	up 2	T2	Thermal sensor 2 positive
	up 3	T3	Thermal sensor 3 positive
	Down1	GP	Thermal sensor ground
	Down2	GP	Thermal sensor ground
	Down3	GP	Thermal sensor ground
P6	up 1	K2	Reserved pin
	up 2	Heat-	Heating switch negative
	up 3	Heat-	Heating switch negative
	up 4	I+	Diverter positive
	up 5	I-	Diverter negative
	up 6	P-	Precharge switch negative
	up 7	P+	Precharge switch positive
	up 8	D-	Discharge switch negative
	up 9	D+	Discharge switch positive

connector	Pi8	Name	Description
	up 10	C-	Charge switch negative
	up 11	C+	Charging switch positive
	up 12	V+	Protection board power supply positive
	Down1	K1	Reserved pin
	Down2	Heat+	Heating switch positive
	Down3	Heat+	Heating switch positive
	Down4	GND	Negative power supply of protection board
	Down5	ACC-	Ignition switch-
	Down6	ACC+	Ignition switch+
	Down7	K-	Charge detection-
	Down8	B/L	485_ B/CAN_ 50. Default CAN_ L
	Down9	A/H	485_ A/CAN_ H. Default CAN_ L
	Down10	GND-TR	RS485/CAN ground
	Down11	K+	Charging switch positive
	Down12	GND	Negative power supply of protection board
LED		LED	Power indicator

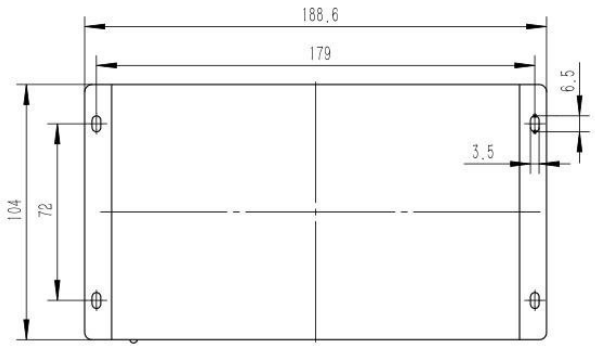
3.3 The product appearance is shown in Below

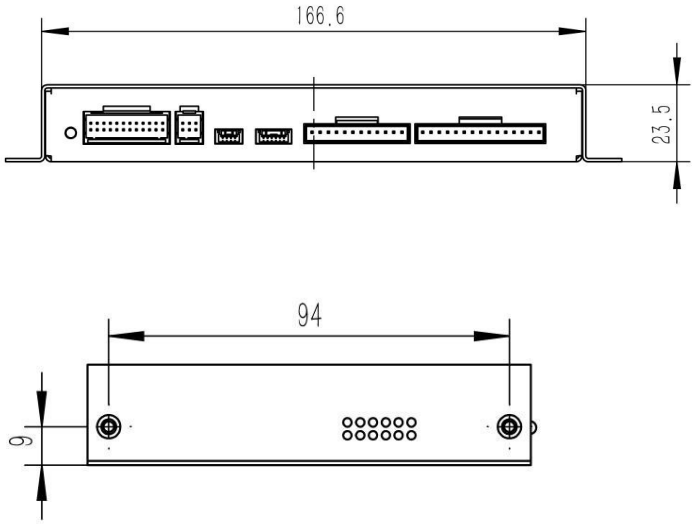


错误!未找到引用源。 appearance

3.4 Size

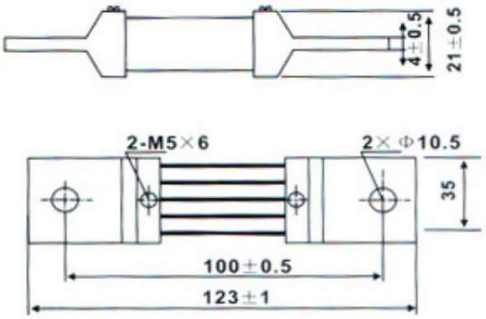
The size of balancer is 188.6mm×94mm×23.5mm,and its appearance and size of mounting hole are shown in figure 2





3.5 Splitter

The shunt uses a maximum of 500A current with a full range of 75mv pressure



3.6 Weight

The balancer weighs about 700g.

4 Installation method and precautions

4.1 Unpacking inspection

Unpacking inspection and precautions are as follows:

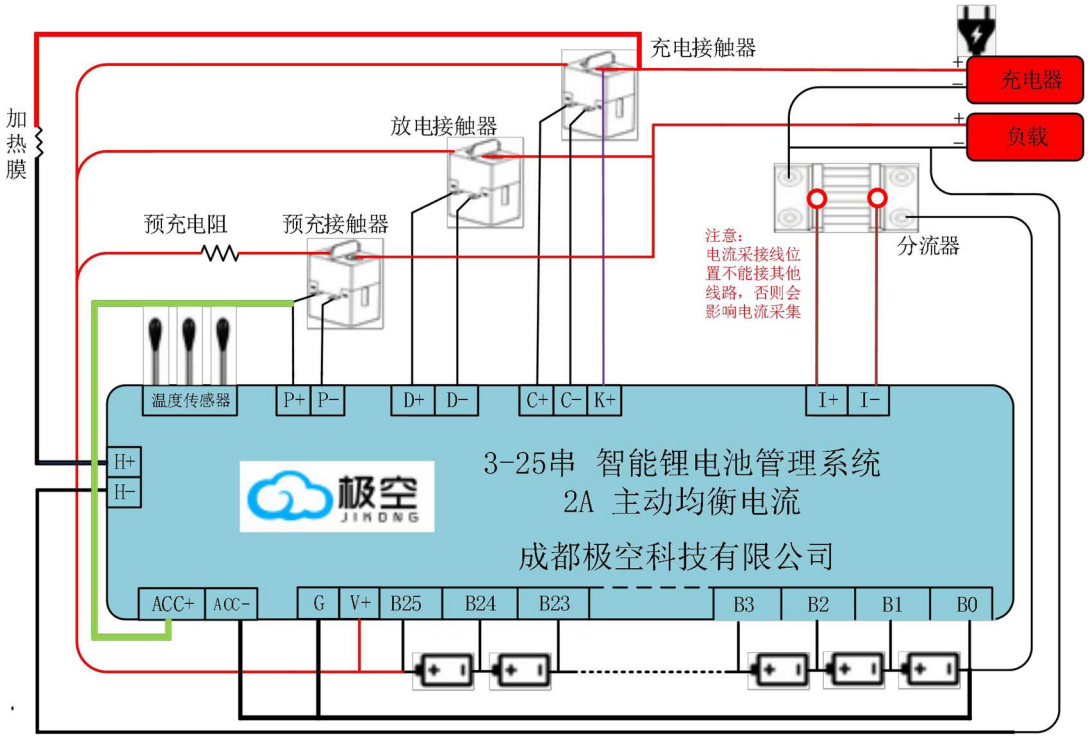
a) Handle the packing box and equalizer with care and try not to put them upside down;

b) Before unpacking, pay attention to whether the package is intact, such as whether there is impact trace, damage, etc;

c) Take sufficient anti-static measures, such as wearing anti-static clothes, anti-static gloves and anti-static wrist strap. After full discharge, open the anti-static bag, take out the equalizer and check whether the appearance of the equalizer is intact.

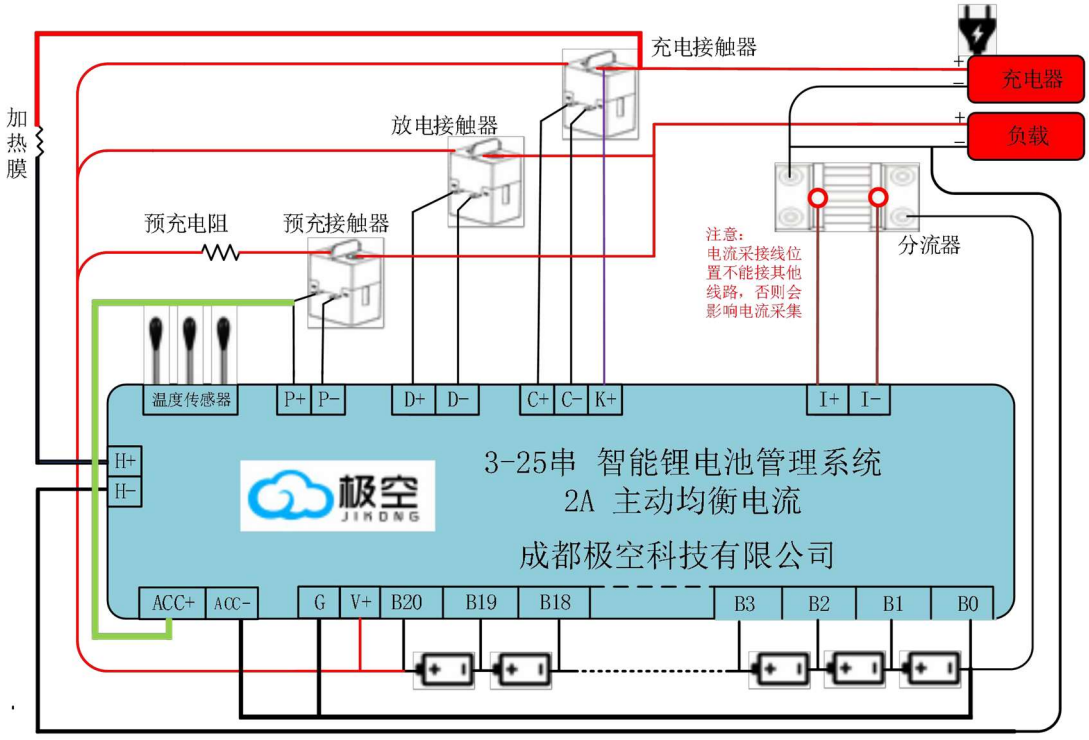
4.2 Installation of a single balancer

JK-B5A25S-60P Battery Management System is suitable for 8-25 series battery packs. The connection mode of 25 series battery pack system is shown in Figure 4.



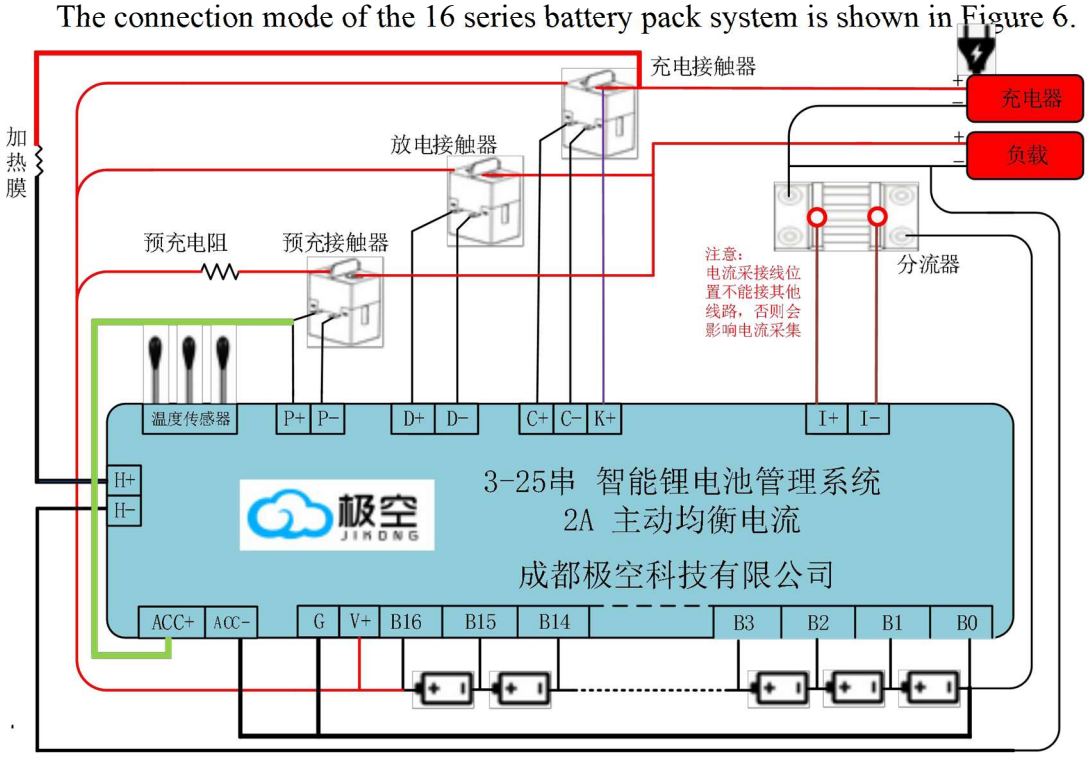
Wiring mode of serial battery pack system

The connection mode of the 20 series battery pack system is shown in Figure 5.



The 20 Strial battry wiring diagram is shown。

The connection mode of the 16 series battery pack system is shown in Figure 6.



Strial battery wiring diagram shows

4.3 The APP install

By scanning the QR code shown in figure 7, you can get the mobile APP matching the product.

5 Operation guide

5.1 使 Preparation and inspection before use

Before turning on the power supply, please make sure again that the cable connection is correct, that the power supply provided to the battery management system is within the required

range, that the device is properly placed, that the circuit board is short-circuited, and so on, that the power supply of the battery management system can only be connected after making sure that it is correct, otherwise it may cause serious consequences such as abnormal work or even burning down.

5.2 Balancer start to work

The JK-B5A25S-60P battery management system does not have an on-power control switch. When the charging interface of the device is powered on, the device automatically turns on and works.

5.3 APP operation guide

5.3.1 Device operation in APP

A) Device connection

First turn on Bluetooth on your mobile phone, then turn on APP, as shown in Figure 9.

Click on the icon in the upper left corner to scan the device. The first time you connect to the APP, you will be prompted to enter the password. The default password of the device is "1234". APP will record the password automatically after the device is connected. No password is needed for the next connection. After opening the APP, you will connect automatically. The password input interface is shown in Figure 10.

Figure 8. Device scan

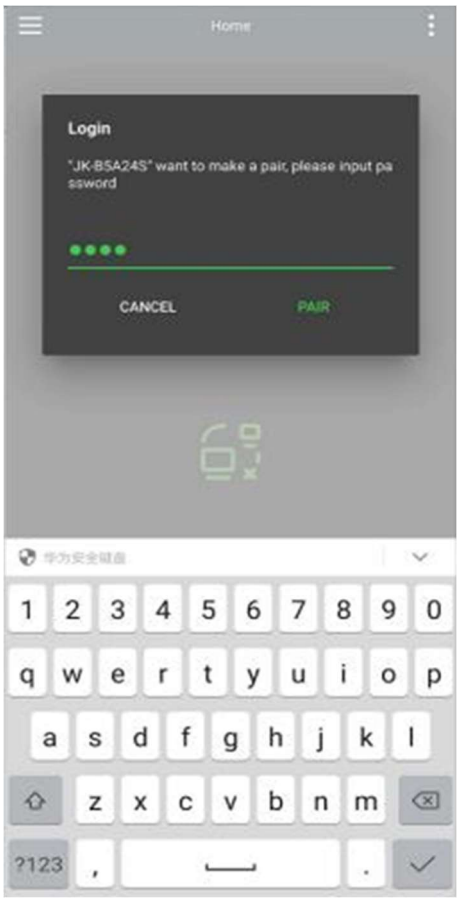


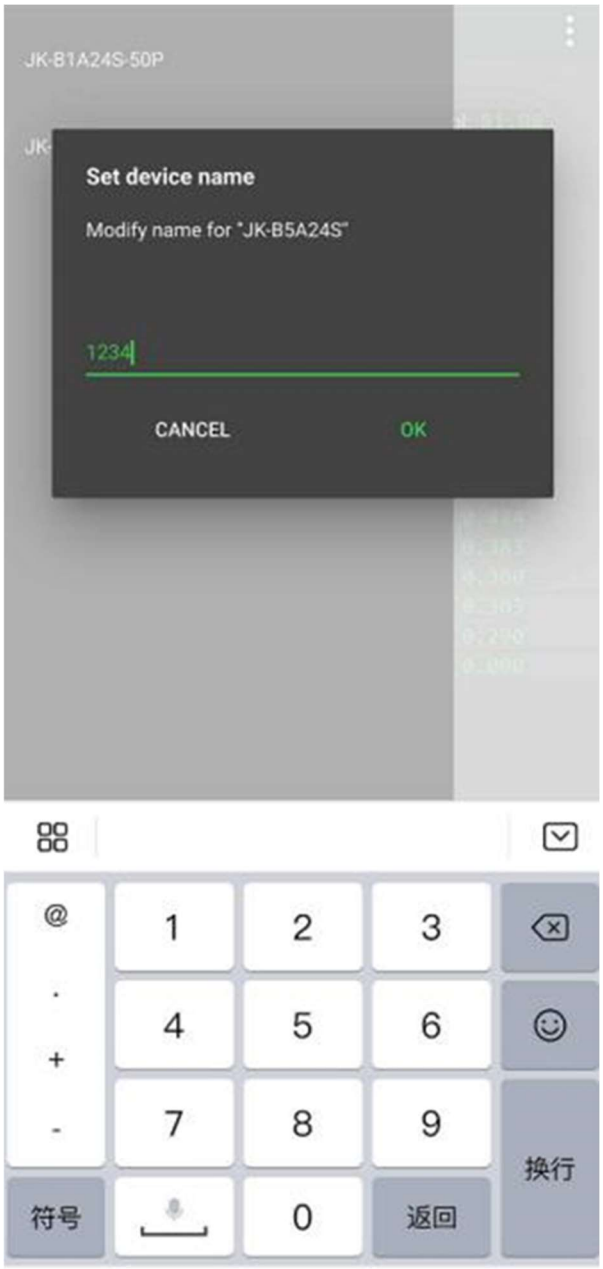
Figure 9 Enter the password

B) Modify password and name

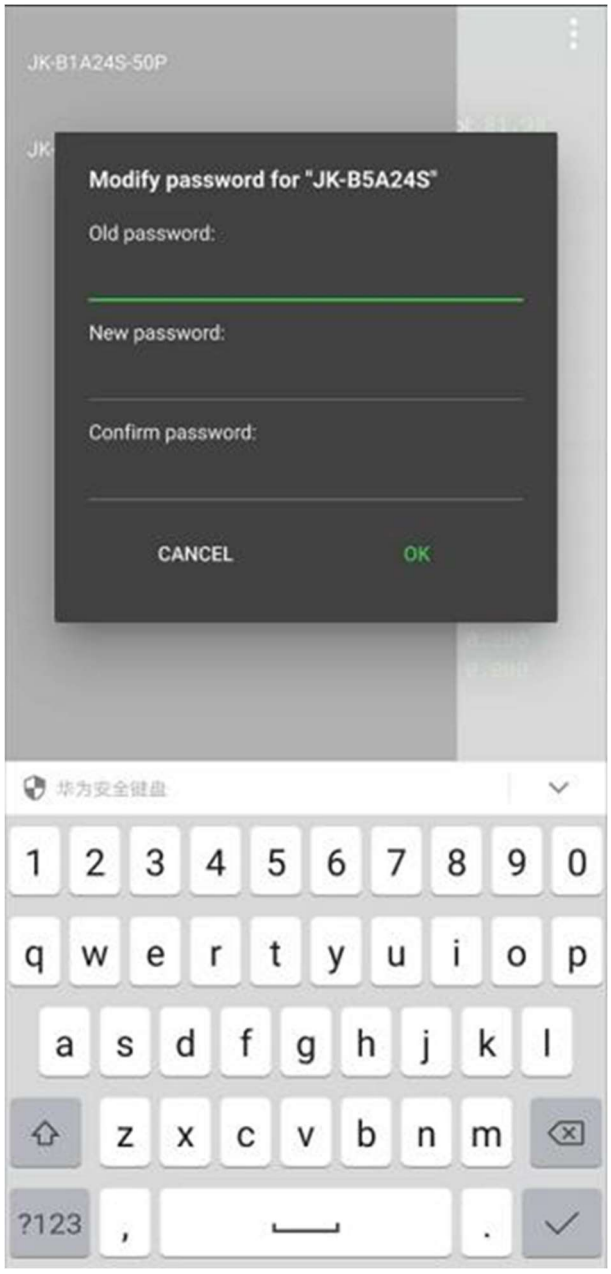
You can change the device name and password by clicking the pen Icon to the right of the device list after the device is connected.

Modify the device name interface as shown in Figure 10. Note that the device name only supports English or numbers, not Chinese names and Chinese characters.

The password modification interface is shown in Figure 11. To modify the device password, you must first enter the old password of the device, and only if the current password is correct can you enter the option of entering a new password. After entering the new password twice, select Confirm to complete the device password modification.



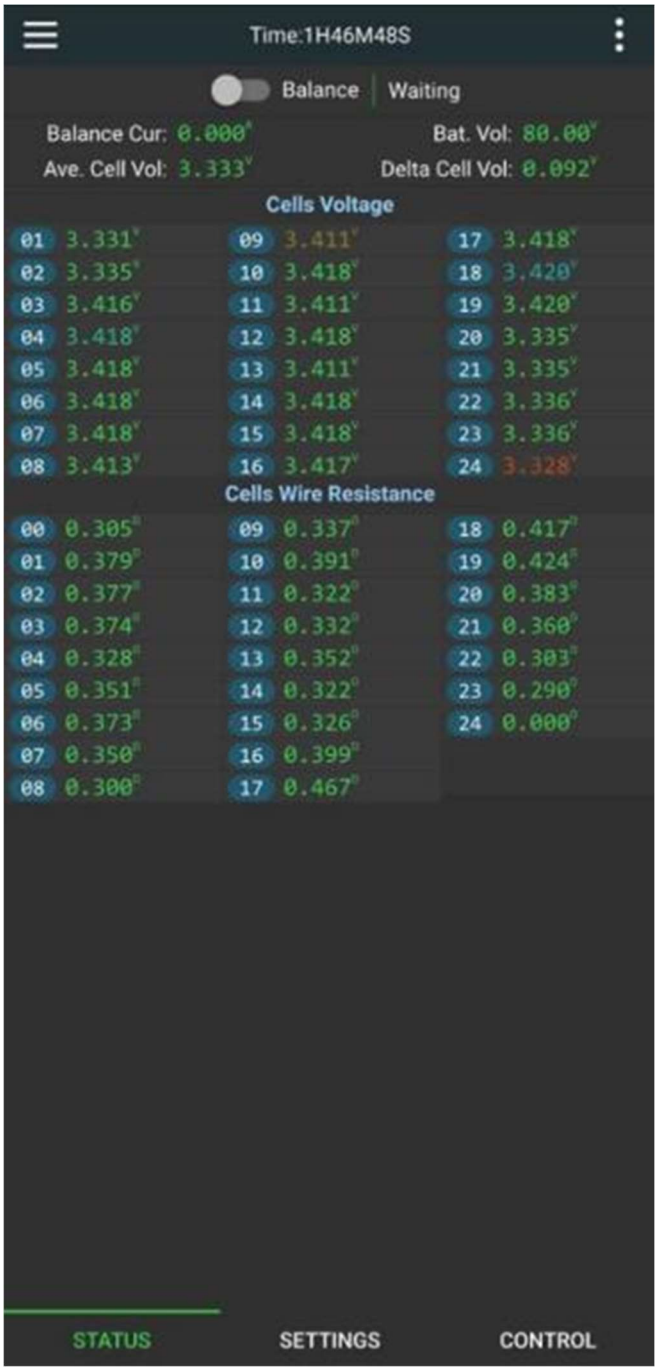
Name modification



Password modification

5.3.2 Status View

The real-time status interface is shown in Figure 12.



On the Real-Time Status page, you can view information such as switch status, charging current, discharge current, temperature display, protection alarm, individual voltage, total battery voltage, maximum pressure difference, average single voltage, balanced status, balanced current, balanced line resistance, etc.

5.3.3 参数设置 Parameter Settings

If you need to modify the working parameters of the protection panel, you must first click the Authorization Settings button and enter the parameter settings password. Set permissions to validate parameters. The parameter setting password factory defaults to **"123456"**. The parameters of the BMS can only be modified after the parameters are entered correctly and the password is set. The

parameter setting password and the device Bluetooth connection password are independent of each other.

On the Parameter Settings page, the working parameters of the BMS can be modified, and each parameter is interpreted as follows.

a) One-click Lifepo4

One-click Lifepo4 button can change all working parameters of the BMS to Lifepo4 battery parameters. The default values of Lifepo4 parameters are listed in the appendix. These should be adjusted for your specific battery cell specifications for proper operation.

b) One-click lithium iron

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One-click lithium iron can modify all the working parameters of the BMS to triple battery parameters. The default values of triple lithium parameters are listed in the appendix. These should be adjusted for your specific battery cell specifications for proper operation.

c) One-click Lithium Titanate

One-click Lithium Titanate, all working parameters of the BMS can be modified to the Lithium Titanate battery parameters. The default values of the Lithium Titanate parameters are listed in the appendix. These should be adjusted for your specific battery cell specifications for proper operation.

d) Number of monomers

Number of units Indicates the number of cells in the current battery. Please set this value accurately before use, otherwise the BMS will not work properly.

e) Battery capacity

Battery capacity This value is the designed capacity of the battery.

f) Trigger Balanced Pressure Differential

When the Active Balancing switch is turned on, and when the maximum voltage difference of the battery pack exceeds this value and the current monomer voltage exceeds the balancing start voltage, Active Balancing starts until the voltage difference is lower than this value or the monomer voltage is lower than the Active Balancing start voltage. For example, set the Active Balancing trigger pressure difference to 0.010V, start Active Balancing when the battery pack pressure difference is greater than 0.010V, and end Active Balancing when it is lower than 0.01V. (It is recommended to set the balance trigger pressure difference of 0.005V for batteries above 50AH and 0.01V for batteries below 50AH).

g) Voltage Calibration

The voltage calibration function can be used to calibrate the accuracy of the BMS voltage collection. When errors are found between the total voltage collected by the BMS and the total voltage of the battery, the BMS can be calibrated using the voltage calibration function. The calibration method is to get the actual voltage from the Battery Terminals with charge / discharge OFF then enter the "actual" total battery voltage and click on the Settings button after the voltage calibration to complete the calibration. Remember to turn charge/discharge back on.

h) Current Calibration

The current calibration function can be used to calibrate the accuracy of current collection from the BMS. When errors are found between the total current collected by the BMS and the actual current of the battery, the current calibration function can be used to calibrate the BMS. The calibration method is to fill in the current measured total battery current and click on the Settings button after the current calibration to complete the calibration.

i) Single Under-voltage Protection, Single Under-voltage Recovery

j)

"Single under-voltage protection" refers to the cut-off voltage of the cells. When any single Cell within the battery pack is lower than this value, a "single under-voltage alarm" is generated, and the BMS turns off the discharging MOS. At this time, the battery cannot be discharged and can only be charged. When the alarm is generated, only after all the individual voltage values exceed the value of "single voltage recovery", the BMS removes the "single under-voltage alarm" and turns on the discharge MOS.

j) Monomer Overcharge Voltage", "Monomer Overcharge Recovery"

Single Overcharge Voltage refers to the saturated voltage of the battery. As long as any single Cell voltage within the battery pack exceeds this value,'Single Overcharge Alarm' will be generated, and the BMS will turn off the charging MOS. At this time, the battery can not be charged but can only be discharged. When the alarm is generated, only after all the individual voltage values are lower than the "single overcharge recovery" value, the BMS removes the "single overcharge alarm" and turns on the charging MOS at the same time. While not being able to charge, the Active Balancing will transfer the higher voltage cell to a lower voltage cell.

k) Auto Shutdown Voltage

The automatic shut-off voltage indicates the lowest voltage at which the BMS operates. When the lowest cell voltage in the battery pack reaches this value, the BMS shuts down. This value must be lower than "Single under-voltage protection"

l) Maximum Charging Current", "Charging Over-current Delay", "Charging Over-current Release"

When charging the battery pack, the current exceeds the "maximum charging current" and the duration exceeds the "charging Over-current delay", the BMS generates the "charging Over-current alarm" and turns off the charging MOS. After the alarm is generated, after the "charging Over-current relief" time, the BMS relieves the charging Over-current alarm and turns on the charging MOS again.

For example, set the "maximum charging current" to 10A, "charging Over-current delay" to 10 seconds, and "charging Over-current relief" to 50 seconds. When the charging current exceeds

10A continuously for 10 seconds during the charging process, the BMS will generate a 'charging Over-current alarm', turn off the charging MOS at the same time, remove the 'charging Over-current alarm' 50 seconds after the alarm is generated, and turn on the charging MOS again.

m) Maximum Discharge Current", "Discharge Over-current Delay", "Discharge Over-current Release"

When the battery pack is discharged, and the current exceeds the "maximum discharge current" and the duration exceeds the "discharge Over-current delay", the BMS generates a "discharge Over-current alarm" and turns off the discharging MOS. After the alarm is generated, after the time of "discharge Over-current relief", the BMS relieves the "discharge Over-current alarm" and turns on the discharge MOS again.

Examples include setting maximum discharge current to 100A,'discharge Over-current delay to 10 seconds, and discharge Over-current relief' to 50 seconds. When the discharge current exceeds 100A continuously for 10 seconds during the discharge process, the BMS will produce a 'discharge Over-current alarm', turn off the discharge MOS at the same time, remove the 'discharge Over-current alarm' 50 seconds after the alarm is generated, and turn On the discharge MOS again.

n) Short Circuit Protection Release

When the short-circuit protection occurs, the short-circuit protection is removed after the time set by `Release of Short-Circuit Protection'.

o) balancing starting voltage

The balancing starting voltage is used to control the voltage stage of balancing. Balancing will be triggered when the cell voltage exceeds this value and the maximum voltage difference of the battery pack exceeds the balancing trigger voltage difference.

p) Maximum balancing current

The balancing current represents the continuous current of high-voltage battery discharge and low-voltage battery charging during the process of energy transfer. The maximum balancing current refers to the maximum current in the process of energy transfer, and the maximum balancing current should not exceed 0.1C. For example, 20Ah battery shall not exceed 20*0.1=2a.

q) Charging over temperature protection", "charging over temperature recovery"

During charging, when the battery temperature exceeds the value of "Charge Over Temperature Protection", the BMS generates a warning of "Charge Over Temperature Protection", and the BMS turns off the charging MOS. After the alarm is generated, and the temperature falls below "Charge Over Temperature Recovery", the BMS removes the warning of "Charge Over Temperature Protection" and turns on the charging MOS again.

r) "Charging Low Temperature Protection", "Charging Low Temperature Recovery"

During the charging process, when the battery temperature is below the value of "Charging Low Temperature Protection", the BMS generates a warning of "Charging Low Temperature Protection", and the BMS turns off the charging MOS. After the alarm is generated, and the temperature is higher than "Charging Low Temperature Recovery", the BMS removes the "Charging Low Temperature Protection" warning and restarts the charging MOS.

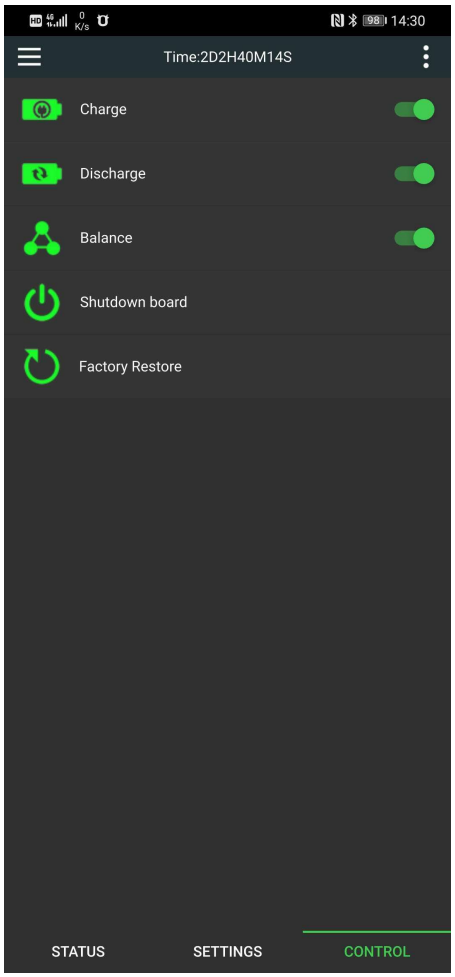
s) "MOS Over Temperature Protection", "MOS Over Temperature Recovery"

When the MOS temperature exceeds the value of "MOS over-temperature protection", the BMS generates a "MOS over-temperature alarm" and turns off the charging and discharging MOS at the same time, so the battery cannot be charged or discharged. After the alarm is generated, and the MOS temperature reaches lower than the value of "MOS Over Temperature Recovery", the BMS will release the "MOS Over Temperature Alarm" and turn on the charging and discharging MOS again (the MOS Over Temperature Protection Value is 75 degrees C and the MOS Over Temperature Recovery Value is 65 degrees C, (these are the factory default values and cannot be modified).

Note: Any parameter modification, please refer to the instruction manual, inappropriate parameters may make the BMS not work properly, or even damage the BMS. After any parameter modification, you need to click on the Settings button after the parameter to complete the parameter issue. When the BMS successfully receives the parameter, it will make a "drop" sound.

5.3.3 BMS control

The BMS control page is shown in Figure 40. The BMS control can switch the charging , discharging, and balancing functions of the BMS and restore the factory settings



5.3.3.1 BMS control page

6 6. Safety protection measures and precautions

Please read the operation manual carefully before use, and connecting the wires according to the wiring diagram of the corresponding string number, from the negative pole to the positive pole. After the balancing wire is connected, use a multi-meter again to confirm that it is correct before connecting the BMS.

The default password of the BMS is **"1234"**. After the mobile app is connected to the BMS, please modify the connection password in time to prevent others from connecting.

It is not allowed to refit the power line of the BMS without permission. Refitting the power line without permission will cause uneven Over-current of the BMS and damage the BMS.

7 7. Transportation and storage

8 7.1. Transportation

8.1 The packed product is not directly affected by rain or snow and is subject to severe bumps. It can be transported by normal means of transport. Corrosives such as acids and bases are not allowed to be kept together during transportation.

9 7.2. storage

The packed products should be stored in a permanent warehouse with a temperature ranging from 0 35 and a relative humidity not exceeding 80%. The warehouse should be free from acid and alkali, corrosive gases, strong mechanical vibration and impact, and strong magnetic field.

Appendix1 Default Parameters for Lithium-Ion, Lithium Iron Phosphate, Lithium Titanate

NUM	PARA	LI-ION	LIFEPO4	UNIT
1	Single undervoltage protection	2.500	2.800	V
2	Recovery of unit undervoltage cutoff protection	2.650	3.200	V
3	Single overcharge voltage	3.65	4.2	V
4	Single overcharge protection recovery	3.6	4.1	V
5	Trigger equalizing differential pressure	0.01	0.01	V
6	Automatic shutdown voltage	2.5	2.799	V
7	Charging overcurrent protection current	100.0	100.0	A
8	Charging overcurrent protection delay	30	30	second
9	Release time of charging overcurrent protection	60	60	second
10	Discharge overcurrent protection current	400.0	400.0	A
11	Discharge overcurrent protection delay	30	30	second
12	Discharge overcurrent protection release time	60	60	second
13	Release time of short-circuit protection	60	60	second
14	Maximum equalizing current	5.0	5.0	A
15	Charging over temperature protection temperature	70	70	℃
16	Charging over temperature recovery temperature	60	60	℃
17	Discharge over temperature protection temperature	70	70	℃
18	Discharge overtemperature recovery temperature	60	60	℃
19	Charging low temperature protection temperature	-20	-20	℃
20	Charging low temperature recovery temperature	-10	-10	℃
21	MOS over temperature protection temperature	100	100	℃
22	MOS over temperature protection recovery temperature	80	80	℃
23	Monomer quantity	25	25	strings
24	Charging switch	off	off	-
25	Discharge switch	off	off	-
26	Equalizing switch	Equalizing	off	off
27	Battery capacity	400	400	AH

Be careful:
1. Factory default Li-ion parameters.
2 It is recommended that users only modify the number of individual strings and the capacity of individual. Then select one-click settings according to the battery type. If other parameters need to be modified, users are strongly advised to read the instructions to understand the meaning of each parameter before modifying them.
3. If you modify according to the above rules and prompt for errors, it is recommended that users update APP.

Noted:
1. For Android 12 and above systems, app needs to be allowed to obtain mobile GPS permission, and it is always allowed.
(this is the setting of Android 12 system. BMS will not always read the user's data.)

2. It is recommended that the customer update the app in time. The app will repair the bug within a week according to the customer's feedback, and it will also be updated according to the design reasons.

FAQ:

Error code

1**. Monomer over discharge alarm**
2. Monomer overcharge alarm
3. Overcurrent alarm
4. MOS over temperature alarm
5. CELL over temperature alarm
6. Short circuit alarm
7. Internal communication abnormal alarm
8. Alarm of excessive equalizing resistance
9. Drop string

Supplemental Appendix

System Calibration for proper BMS operations.

Calibrating the Voltages between your Solar Controller, Inverter/Charger, All-In-One *Must be Done.*

- This is essential so that everything is reading, sending/receiving the correct Voltages @ the Battery Terminals / DC Bus (for Parallel Banks of Batteries).

- When an SCC or Inverter/Charger etc is charging @ 25.6/51.2 You need to ensure that is WHAT the Batteries See. Otherwise, the differential "will" cause a Mismatch and generate an error (*1), either at the SCC or any Charge Device on the DC Bus (*2).
- The BMS is the MOST Precise @ measuring the Battery & the Cell Voltage States. This applies to a Single Battery or a Bank of Batteries.
- Not All SCC's or Charging Devices have a Compensation/Correction setting within them. Therefore you have to do the "Math" to compensate for that differential. Therefore you "must" take Voltage Measurements @ the SCC, Charger & Battery Terminals/Bus, then make adjustments to match your desired Charge Profile to prevent such incidents.
- A Digital Multimeter / Digital Volt/Ohm Meter with at least 2 Decimal Place voltage displays is Most Highly Recommended to do so. A Single Digit device is TOO INACCURATE for any Lithium Based Battery or cell.

(*1) This can result in Over/Under voltage reading triggering an error. IF over or under it can also create the "Runner Cell" situation where one or more cells within a Battery can run & defeat the Working Voltage Range (3.000-3.400) of the cells, triggering a BMS Fault. This is Very Common with new/fresh installations that are NOT Corrected & Balanced for Voltage.

(*2) Note that ALL DC-Lines will suffer some loss over the length of the wire run. These include every terminal, lug, bolt, switch, and even fuses & breakers collectively. While each individual "item" may not be large (unless there is a Fault), collectively they can add up quite quickly collectively. This is an "accuracy" requirement problem with using Lithium Based tech as opposed to Lead Acid which is more "brute force" and not as accurate due to the very Tight Voltage Curves in comparison to Lead-Acid.

Typical Faults creating large drops, with some basic problem avoidance solutions:

- Loose or dirty connections,
- Poor or weak crimped terminals,
- Overly long wiring, including wires of Different Lengths (+) & (-) should be as close to identical lengths as possible,
- Low-Grade or Incorrect wiring used for the application, load & demands,
- Quality wires (Fine Strand Pure Copper) tinned or not, along with Tinned Terminal lugs is always the best solution,
- All Connections to Lugs etc should be shrink wrapped with quality adhesive bound Shrink Wrap to prevent air/moisture infiltration over time that can cause corrosion & deterioration. Do NOT avoid using long enough shrink wrap.

Final Important Note:

It is extremely important to not that various devices like Solar Charge Controllers, Inverter/Chargers etc all have varying hardware, firmware and user interface software. This makes Calibration & Configuration more demanding for proper operations between all the variety of devices.