

**4-8S Intelligent Protection Board for
Lithium Battery**

Operation and Maintenance Instructions

(HT-8S1A100/HT-8S1A200/HT-8S2A200)

Heltec Energy

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1. Introduction

The intelligent protection board of lithium battery is a management system specially designed for large-capacity series lithium battery packs. which has the functions of voltage acquisition, high current active balance, overcharge, over discharge, over current and over temperature protection, coulomb counter, Bluetooth communication, GPS remote, etc. It can be applied to lithium iron phosphate, ternary lithium and other battery types.

Based on the energy transfer active balance technology with independent intellectual property rights, the protection board can achieve the maximum continuous 2A balance current. High current active balance technology can guarantee the battery consistency, improve the battery life and delay the battery aging to the greatest extent.

The protection board has a supporting mobile app, supporting Android and IOS operating systems. The app can be connected to the protection board via Bluetooth to check the battery working status, modify the working parameters of the protection board, control the switch of charging and discharging, etc. The protection panel is small in size, simple in operation and full in function, which can be widely used in battery pack of small sightseeing bus, scooter, shared car, high-power energy storage, base station standby power supply, solar power station and other products.

2. Main Technical Parameters

2.1 Main Technical Indicators

Table 1. Main technical indicators of protection board

Technical Index	Product Model		
	HT-8S1A100	HT-8S1A200	HT-8S2A200
Number of battery strings (ternary lithium)	3-8S		
Number of battery strings (LifePO4)	4-8S		
Number of battery strings (LTO)	6-8S		

Balance mode	Active Balance		
Balancing current (MAX)	1A	2A	2A
Main circuit conduction internal resistance	0.3mΩ		
Continuous discharge current	100A	200A	
Maximum discharge current	200A	350A	
Charging over-current protection (adjustable)	10-100A	10-200A	
Other interfaces (customized)	RS485 or CAN		
Entry cable	Same port		
Single voltage range	1~5 V		
Voltage acquisition accuracy	±5 mV		
Overcharge protection voltage	1.2~4.35 V adjustable		
Overcharge release voltage	1.2~4.35 V adjustable		
Discharge time of charging over-current	2~120S adjustable		
Over discharge protection voltage	1.2~4.35 V adjustable		
Over discharge recovery voltage	1.2~4.35 V adjustable		
Number of temperature detection	3		
Temperature protection	yes		
Short circuit protection	yes		
Coulomb meter	yes		
Bluetooth function	Support Android and IOS		
Heating function	Can be customized		

2.2 Application Environment

- a) Operating temperature range: - 20 °C ~ 70 °C;
- b) Power requirements: 10 ~ 100V.
- c) Power consumption: 25mA @ 40V in balanced state and 20mA @ 400V in

unbalanced state.

3. Connector and Interface Description

3.1 Connector and LED Position Description

The positions of two types of protection board connectors and LED lights are shown in Figure 1.

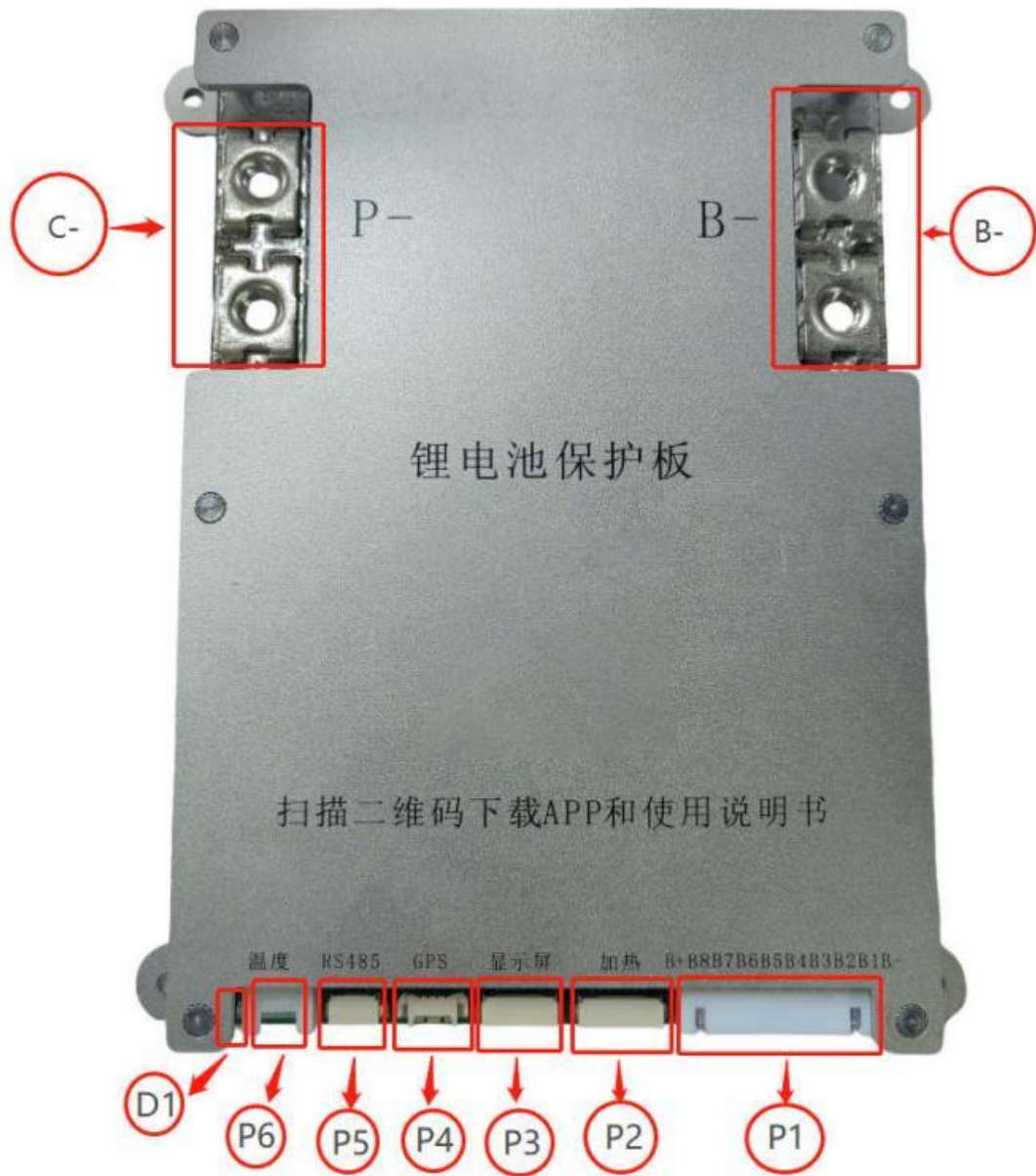


Figure 1.

3.2 Connector and LED Definition Description

Table 2. Connector Definition

Connector	Pin No.	HT-8S1A100/HT-8S1A200		HT-8S2A200	
		Name	Definition	Name	Definition
P1	1	B-	Total negative	B-	Total negative
	2	B1	Cell 1 Positive	B1	Cell 1 Positive
	3	B2	Cell 2 Positive	B2	Cell 2 Positive
	4	B3	Cell 3 Positive	B3	Cell 3 Positive
	5	B4	Cell 4 Positive	B4	Cell 4 Positive
	6	B5	Cell 5 Positive	B5	Cell 5 Positive
	7	B6	Cell 6 Positive	B6	Cell 6 Positive
	8	B7	Cell 7 Positive	B7	Cell 7 Positive
	9	B8	Cell 8 Positive	B8	Cell 8 Positive
	10	B+	Power	B+	Power
P2	Heating interface				
P3	Display interface				
P4	GPS interface				
P5	RS485/CAN interface (choose one of two)				
P6	1	T1A	Pin A , the 1st temperature sensor		
	2	T1B	Pin B, the 1st temperature sensor		
	3	T2A	Pin A , the 2nd temperature sensor		
	4	T2B	Pin B , the 2nd temperature sensor		
D1	Bluetooth connection indicator. When the protection board is connected to Bluetooth, the indicator is always on. When disconnected, the indicator blinks.				
C-	Connect external load or charger negative				
B-	Connected to electric core negative				

3.3 Product Appearance

The product appearance is shown in figure 2.



Figure 2.

3.4 Size

The size of HT-8S1A100/HT-8S1A200/HT-8S2A200 is: 153*126*17.6 mm. The outline dimension drawing is shown in figure 3.

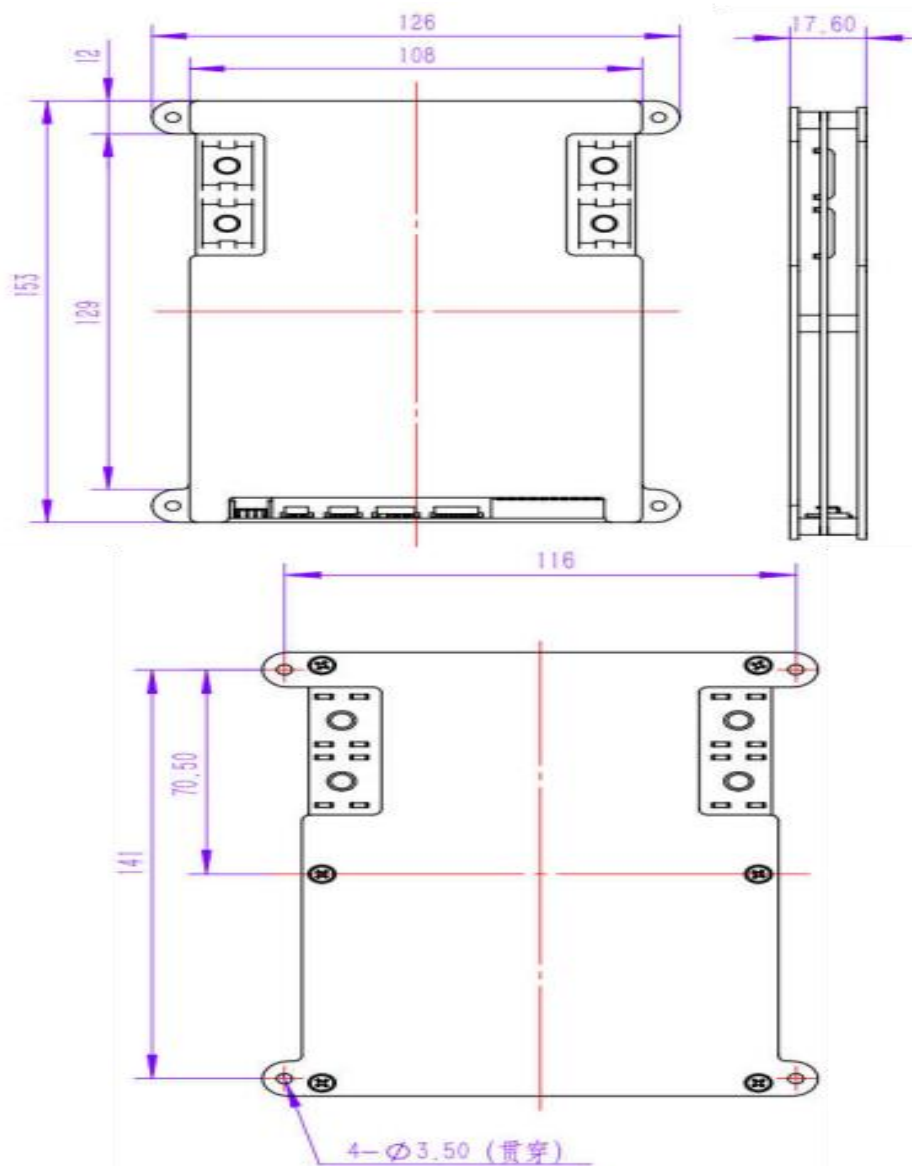


Figure 3. Outline Dimension Drawing of HT-8S1A100/HT-8S1A200/HT-8S2A200

3.5 Weight

The weight of HT-8S1A100/HT-8S1A200/HT-8S2A200 protection board is about 349g.

4. Installation Methods and Precautions

4.1 Unpacking Inspection and Precautions

- a) The packing box and protection board shall be handled with care and not

inverted as far as possible;

b) Before unpacking, pay attention to whether the package is in good condition, such as whether there are impact marks, damage, etc.

4.2 Wiring Diagram

The HT-8S1A100/HT-8S1A200/HT-8S2A200 intelligent lithium battery protection board is suitable for 4-8 series of lithium battery packs and the battery pack wiring method is different for different numbers of batteries.

For a battery pack with 8 strings in series, the installation and wiring method is shown in figure 4.

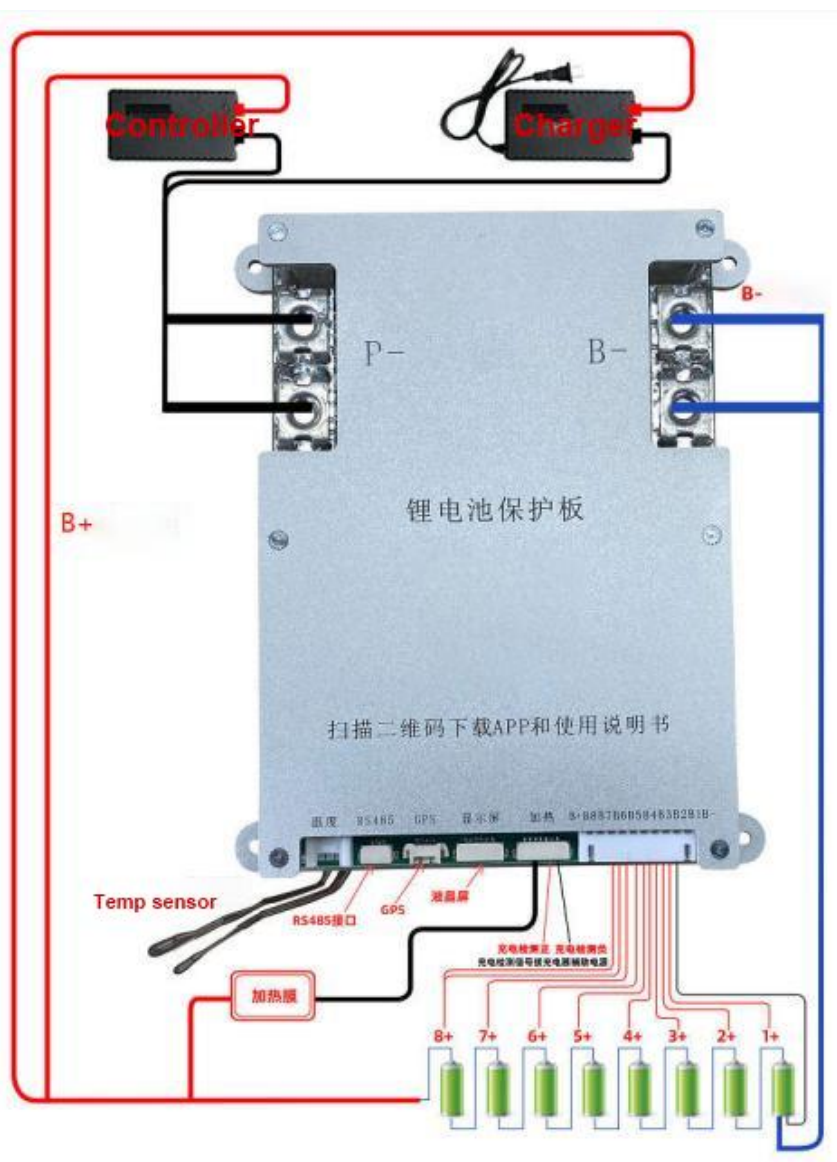


Figure 4.

4.3 App Installation

By scanning the QR code shown below, you can obtain the Android mobile app that matches the product.



5. Use and Operation

5.1 Preparation and Inspection Before Use

Before turning on the protection board, please confirm whether the balance line is connected normally and whether "C-" and "B-" are connected correctly. Check whether the protection board is securely fixed to the battery core, and then you can switch on the protection board after confirming that it is correct. Otherwise, it may cause serious consequences such as abnormal operation and even burnout.

5.2 Power On of Protection Board

After confirming that the above operations are correct, you can power on the protection board. The protection board does not have a power-on control switch, and is designed to be in a charging activation mode. **(Meet the condition: the voltage of the charger is 5V higher than that of the battery)** That is, after the battery is assembled, a charger needs to be connected to start the protection board.

5.3 App Operating Instructions

5.3.1 Equipment Operation

a) Equipment Connection

First turn on the mobile phone's Bluetooth, and then open the APP.

Click the icon in the upper left corner to scan the device. After the scan is completed, **click the name of the device to be connected**, such as "JK-B1A24S". The APP will prompt for a password when connecting for the first time. The default password of the device is "1234". The APP will automatically record the password after the device is connected. There is no need to enter the password for the next connection. It will automatically connect after starting the APP, The password input interface is shown in Figure 5 and Figure 6.

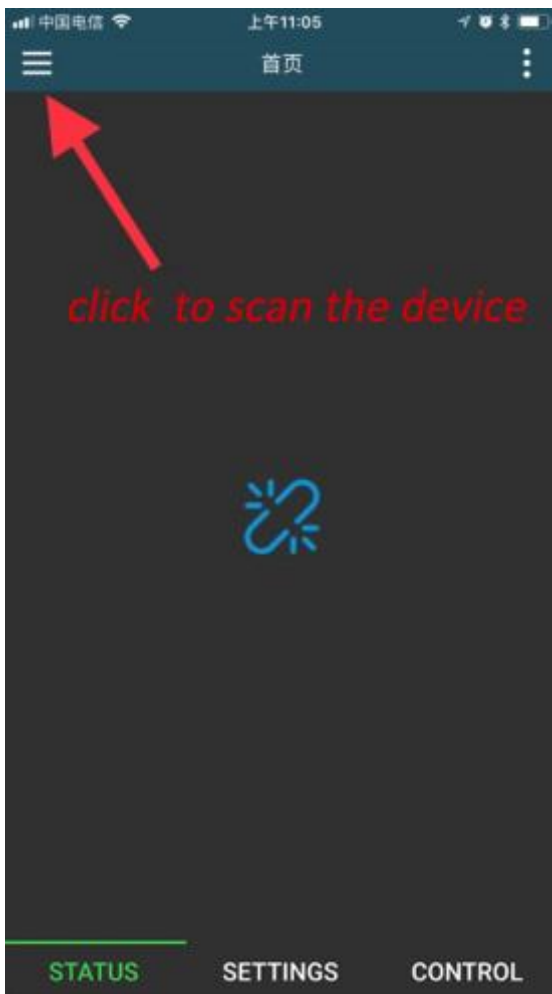


Figure 5. Device Scan

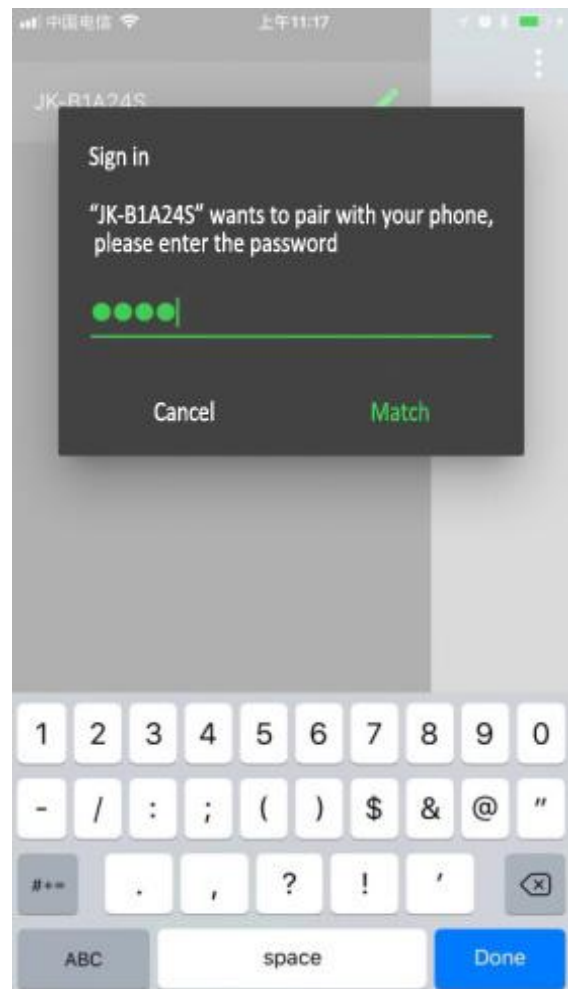


Figure 6. Password Input

b) Change Name and Password

After the device is connected, click the "pen type" icon on the right side of the device list to modify the device name and password.

The interface for modifying the device name is shown in Figure 7. Note that the device name only supports English or numbers.

The password change interface is shown in Figure 8. To change the device password, you must first enter the old password of the device. Only when the current password is correct can you enter the new password entry option. After entering the new password twice, click 'OK' to complete the device password modification.



Figure 7. Name Modification



Figure 8. Password Modification

5.3.2 Status View

The real-time status interface is shown as below.



Figure 9. The Real-time Status

The real-time status page is divided into 3 areas.

Area 1 in the figure is battery comprehensive information column. The parameters are defined as follows:

a) Time

The time indicates the total running time from the time the protection board is turned on until now.

b) Charging

Indicates the opening status of the current protection board charging MOS. When "on" is displayed, it means that the current protection board charging MOS is on and the battery is allowed to charge; when "off" is displayed, it means that the current protection board charging MOS is off and the battery is not allowed to charge.

c) Discharge

Indicates the open status of the current protection board discharge MOS. When "on" is displayed, it means that the current protection board discharge MOS is on and the battery is allowed to discharge; when "off" is displayed, it means that the current protection board discharge MOS is off and the battery is not allowed to discharge.

d) Balance

Indicates the on / off status of the protection board. When "On" is displayed, the protection board will automatically balance after the balance starting conditions are met; when "Off" is displayed, it means that the balance is off, and the protection board will not balance the battery.

e) Voltage

The voltage area displays the current total voltage of the battery in real time, and the total voltage is the sum of all unit voltages.

f) Current

The current area displays the total current of the current battery in real time. When the battery is charging, the current is positive, and when the battery is discharging, the current is negative.

g) Battery Power

Represents the total power of the current battery output or input. Its value is the product of the current battery voltage and the absolute value of the battery current.

h) Remain Battery

Represents the percentage of current battery power remaining.

i) Battery Capacity

Represents the actual battery capacity calculated by the current protection board based on the high-precision SOC. The unit is Ah. **(The value needs to be updated after the battery has completed a full discharge and charge cycle)**

j) Remain Capacity

Remaining capacity indicates the remaining capacity of the current battery, unit: Ah.

k) Cycle Capacity

The cycle capacity indicates the cumulative discharge capacity of the battery, and the unit is Ah.

l) Cycle Count

The Cycle Count indicates the number of charge saturation times of the current battery, the unit is: times.

m) Ave. Cell Vol.

The average cell voltage of the current battery, unit: V.

n) Delta Cell Vol.

The Delta Cell Vol. represents the difference between the highest battery voltage and the lowest battery voltage of the entire battery pack. The unit is V.

o) Balance Cur.

When the protection board turns on the balance function and reaches the balance condition, it displays the balance current in real time. Unit: A.

When the balance is performed, the status display area of the real-time status, blue represents a discharged battery, and red represents a charged battery.

When balance is in progress, the status display area of the real-time status, blue represents the discharged battery, and red represents the charged battery. The negative current of balance current indicates that the battery is discharging. At this time, the

blue flashes. The positive current of balance current indicates that the battery is charging. At this time, the red flashes.

Active balance technology is used in the protection board. The principle of balance is to take power from the high-voltage core, store it in the protection board, and then put it into the low-voltage core.

p) MOS Temp

Real time display of the temperature of current protection board power MOS, unit: °C.

q) Battery T1

Display "Na" when the temperature sensor 1 is not installed, and display the temperature of the temperature sensor 1 in real time when the temperature sensor is installed, unit: °C.

r) Battery T2

Display "NA" when the temperature sensor 2 is not installed, and display the temperature of the temperature sensor 2 in real time when the temperature sensor is installed, unit: °C.

In the figure, area 2 is the voltage area of single body. The voltage data of each cell in the battery pack is displayed in real time, in which red represents the cell with the lowest voltage and blue represents the cell with the highest voltage.

Area 3 in the figure is the area of cells wire resistance. The cells wire resistance is obtained by the self inspection of the protection board. The value is only a preliminary calculation to prevent wrong connection or poor contact. When the cells wire resistance exceeds a certain value, it will be displayed in yellow, and the balance cannot be turned on at this time.

5.3.3 Parameter Setting

The parameter setting page is shown as below.



Figure 10. Parameters Setting

In the parameter setting page, you can modify the working parameters of the protection board. The definitions of each parameter are as follows.

a) LIFEP04

This function button can modify all the working parameters of the protection board into the parameters of the iron-lithium battery. For the default values of the parameters, see Appendix.

b) Ternary lithium

This function button can modify all the working parameters of the protection board into the parameters of the iron-lithium battery. For the default values of the

parameters, see Appendix.

c) LTO

Function This button can modify all the working parameters of the protection board to the parameters of the lithium titanate battery. The default values of the parameters are shown in the Appendix.

d) Cells Count

The cells count represents the number of cells in the current battery. Before use, please set this value accurately, otherwise the protection board will not work properly.

e) Battery Capacity

This value is the design capacity of the battery.

f) Trigger Diff Volt

Triggered balance difference Voltage is the only parameter that controls balance. When the balance switch is on, when the maximum difference voltage of the battery pack exceeds this value, the balance starts, and the balance ends when the difference voltage is lower than this value. For example, the balance trigger voltage difference is set to 0.01V. When the battery pack voltage difference is greater than 0.01V, balance is started, and when the battery pack voltage difference is lower than 0.01V, the balance is ended. (It is recommended that the balance trigger difference voltage of the battery above 50Ah is 0.005V, and the balance trigger difference voltage of the battery below 50Ah is 0.01V)

g) Voltage Calibration

The voltage calibration function can be used to calibrate the accuracy of the equalizer voltage acquisition.

When there is an error between the total voltage collected by the protection board and the total voltage of the battery, you can use the voltage calibration function to calibrate the protection board. The calibration method is to fill in the total battery voltage that is currently measured, and then click "Small Plane" behind the voltage

calibration to complete the calibration.

h) "Cell UVP" and "Cell UVPR"

"Cell Low-voltage Protection" refers to the cut-off voltage of the battery cell. As long as the voltage of any cell in the battery pack is lower than this value, the "Cell Low-voltage Alarm" will be generated. At the same time, the protection board will turn off the discharge MOS, at this time, the battery can not discharge, but can only charge. When the alarm occurs, only after the voltage of all the cells exceeds the value of "Cell Voltage Recovery" the protection board releases the "Cell Low-voltage Alarm" and turns on the discharge MOS at the same time.

i) "Cell OVP", "Cell OVPR"

"Cell OVP" refers to the saturation voltage of the cell. As long as the voltage of any single cell in the battery pack exceeds this value, a "single overcharge alarm" will be generated. At the same time, the protection board will turn off the MOS for charging. At this time, the battery cannot be charged and can only be discharged. After the alarm is generated, only when the voltage value of all cell is lower than the value of "Cell OVPR", the protection board will release the "cell overcharge alarm" and open the charging MOS at the same time.

j) Power Off Vol.

The Power Off Vol. indicates the lowest working voltage of the protection board. When the highest voltage of the cell in the battery pack is lower than this value, the protection board is closed. The value must be lower than "unit low-voltage protection".

k) "Max Charge Curr.", "Charge OCP Delay", "Charge OCPR Time"

When charging the battery pack, if the current exceeds the "Max Charge Curr" and the duration exceeds the time of "Charge OCP Delay", the protection board will generate "charging over-current alarm" and turn off the charging MOS at the same time. After the alarm is generated, after the time of "Charge OCPR Time", the

protection board will release the charging over-current alarm and restart the charging MOS.

For example, set "Max Charge Curr." as 10A, "Charge OCP Delay" as 10s, "Charge OCPR Time" as 50s. In the charging process, if the charging current exceeds 10A continuously for 10 seconds, the protection board will generate "charging over-current alarm" and close the charging MOS. 50 seconds after the alarm is generated, the "charging over-current alarm" will be released. At the same time, the protection board will restart the charging MOS.

l) "Max Discharge Curr.", "Discharge OCP Delay", "Discharge OCPR Time"

When the battery pack is discharged, when the current exceeds the "Max Discharge Curr." and the duration exceeds the time of "Discharge OCP Delay", the protection board will generate a "discharge over-current alarm" and close the discharge MOS at the same time. After the alarm is generated, after the time of "Discharge OCPR Time", the protection board releases the "discharge over-current alarm" and turns on the discharge MOS again.

For example, set "Max Discharge Curr." as 100A, "Discharge OCP Delay" as 10s, "Discharge OCPR Time" as 50s. During the discharge process, if the discharge current exceeds 100A continuously for 10 seconds, the protection board will generate a "discharge over-current alarm" and turn off the discharge MOS. 50 seconds after the alarm is generated, the "discharge over-current alarm" will be released, and the protection board will restart the discharge MOS.

m) SCPR Time

When the short-circuit protection occurs, the short-circuit protection will be released after the set time of "SCPR Time".

n) Max Balance Cur.

The balance current represents the continuous current of high-voltage battery discharge and low-voltage battery charging in the process of energy transfer.

The maximum balance current is the maximum current in the process of energy

transfer, and the maximum balance current should not exceed 0.1C. For example: 20Ah battery shall not exceed $20 * 0.1 = 2A$.

o) "Charge OTP", "Charge OTPR"

During the charging process, when the battery temperature exceeds the value of "Charge OTP", the protection board will generate a "charging over temperature protection alarm", and the protection board will turn off charging MOS. After the alarm is generated, when the temperature is lower than "Charge OTPR", the "charging over temperature protection alarm" will be released, and restart the charging MOS.

p) "Charge UTP", "charge UTPR"

During the charging process, when the battery temperature is lower than the value of "Charge UTP", the protection board will generate a "low temperature protection for charging alarm" , and the protection board will turn off the MOS for charging. After the alarm is generated, when the temperature is higher than "charge UTPR", the protection board will release the warning of "low temperature protection of charging alarm" and restart the MOS of charging.

q) "MOS OTP", "MOS OTPR"

When the MOS temperature exceeds the value of "MOS OTP", the protection board will generate "MOS over temperature alarm" and close the charge discharge MOS at the same time. The battery cannot be charged or discharged. After the alarm is generated and the MOS temperature is lower than the value of "MOS OTPR", the protection board will release the "MOS over temperature alarm" and restart the charge and discharge MOS (the MOS over temperature protection value is 100 °C, the MOS over temperature recovery value is 80 °C, these two values are factory default values and cannot be modified).

Attention:

Any parameter modification, please refer to the manual, improper parameters may make the protection board can not work properly, or even burn the protection

board.

After any parameter is modified, you need to click "small aircraft" behind the parameter to complete parameter distribution. After the equalizer successfully receives the parameter, it will send out a "drip" sound.

5.3.4 BMS Control

The BMS control page is shown in the figure 11. Through BMS control, the charging function, discharging function and balancing function of the protection board can be switched on and off, and the power supply of the protection board can be closed and factory Settings can be restored.



Figure 11. The BMS Control Page

6. Safety Protection Measures and Precautions

The protection board itself does not have high voltage, which will not cause electric shock to the body.

Please read the instruction manual carefully before use, connect according to the correct wiring diagram of different strings, and connect from the negative pole to the positive pole. After the balanced wire is connected, confirm it with a multi-meter again, and insert the protection board after confirmation.

It is not allowed to modify the power line of the protection board without permission. Unauthorized modification of the power line will cause the protection board to over-current and burn the protection board.

7. Transportation and Storage

7.1 Transport

The products after packing are not directly affected by the rain, snow and violent bump, it can be transported by normal means of transportation. It is not allowed to put together with acid, alkali and other corrosive substances during transportation.

7.2 Storage

The packed products shall be stored in a permanent warehouse with a temperature of 0 °C ~ 35 °C and a relative humidity of no more than 80%. There should be no acid, alkali and corrosive gas in the storeroom, no strong mechanism vibration and shock, and no strong magnetic field.

Appendix I. Default Parameter Settings

"one bond lithium iron", "one bond ternary" and "one bond lithium titanate" default parameters.

No.	Parameter	Lithium Iron Default	Lithium Ternary Default	Lithium Titanate Default	Unit
1	Cell Low-voltage Protection	2.9	2.6	1.8	V
2	Cell Low-voltage Protection Recovery	3.2	3.0	2.0	V
3	Cell Overcharge Voltage	4.2	3.6	2.7	V
4	Cell Overcharge Protection Recovery	4.1	3.4	2.4	V
5	Trigger Balance Differential Voltage	0.01	0.01	0.01	V
6	Power Off Voltage	2.8	2.5	1.7	V
7	Charge Over-Current Protection	30	30	30	S
8	Charge Over-Current Protection Recovery Time	60	60	60	S
9	Discharge Over-Current Protection Delay	30	30	30	S
10	Discharge Over Current Protection Recovery Time	60	60	60	S
11	Short Circuit Protection Recovery Time	60	60	60	S
12	Charge Over Temperature Protection	60	60	60	°C
13	Charging Over Temperature Protection Recovery	55	55	55	°C
14	Discharge Over Temperature Protection	60	60	60	°C
15	Discharge Over Temperature Protection Recovery	55	55	55	°C
16	Charging Low Temperature Protection	-20	-20	-20	°C
17	Charging Low Temperature Protection Recovery	-10	-10	-10	°C
18	MOS Over Temperature Protection	75	75	75	°C
19	MOS Over Temperature Protection Recovery	70	70	70	°C

Appendix II. Product Warranty Terms

Product Name: Smart Active BMS for Lithium Battery

Warranty Period: One Year

First of all, thank you for purchasing the Smart Active BMS for Lithium Battery launched by Chengdu Heltec Energy Technology Co., Ltd.

Chengdu Heltec Energy Technology Co., Ltd. provides quality warranty for the hardware products and accessories sold by the company. The warranty period is as shown above. If a malfunction occurs due to quality reasons during the warranty period, the company has the right to choose to repair or replace the entire product after receiving notification of the product malfunction and verification. The entire set of replacement products may be new or nearly new.

1. Chengdu Heltec Energy Technology Co., Ltd. guarantees that the products have been fully tested.

2. Chengdu Heltec Energy Technology Co., Ltd. does not guarantee that the product can be used without interruption during the product repair process. However, the company shall ensure that malfunctioning products are repaired within a reasonable period of time.

3. The product warranty period starts from the date of shipment of the product or the date of installation by Chengdu Heltec Energy Technology Co., Ltd. If the installation of the Company's product does not begin within 30 days after the date of shipment due to user schedules or delays, the product warranty period begins on the 31st day after the date of shipment.

4. Chengdu Heltec Energy Technology Co., Ltd. does not provide free warranty for product failure and damage caused by any of the following conditions:

- (a) Incorrect use or improper maintenance;
- (b) Software, accessories, components or other items not provided by Chengdu Heltec Energy Technology Co., Ltd.;
- (c) Unauthorized disassembly, modification and misuse;
- (d) Use beyond the scope specified in the product technical specifications;

(e) Improper transportation, handling and storage;

(f) Failure or damage caused by other non-quality reasons (such as earthquakes, wars, traffic accidents, etc.).

To the extent permitted by law, the above warranty terms are express and exclusive and there are no other warranties of any kind, whether written or oral. Any implied warranties and commercial terms are expressly disclaimed.