

Smart Active BMS for Lithium Battery Operation and Maintenance Instructions

8~17S/8~20S/8~24S

40A/60A/80A/100A/120A/150A/200A

Heltec Energy

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1. Overview

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

The main technical indicators of the protection board are shown in below tables.

Table 1. Technical Indicators of 40A Protection Board

Technical Index	SKU		
	HT-817S04A40	HT-820S04A40	HT-824S04A40
Number of battery strings (NCM)	7~17	7~20	7~24
Number of battery strings (LFP)	8~17	8~20	8~24
Number of battery strings (LTO)	14~17	14~20	14~24

Balance mode	Active balance
Equalizing current	0.4A
Main circuit internal resistance	2.8mΩ
Continuous discharge current	40A
Maximum discharge current	60A (for 60S); 80A (instantaneous)
Charging overcurrent	10~40A
RS485	Supported (can only choose one of the two)
CAN	
Display interface	Yes
Entry cable	Same Port
Single voltage range	1~5V
Voltage acquisition	±3mV
Overcharge protection voltage	1. 2~4. 35V adjustable
Overcharge release voltage	1. 2~4. 35V adjustable
Discharge time of charging	2~120S adjustable
Number of temperature	3
Temperature protection	Yes
Short circuit protection	Yes
Coulomb meter	Yes
Bluetooth function	Support Android and IOS
GPS remote (optional)	RS485/GPS (can only choose one of the two)
Over discharge protection voltage	1.2 ~4.35V adjustable
Over discharge protection voltage	1.2 ~4.35V adjustable

Table 2. Technical Indicators of 60A/80A Protection Board

Technical Index	SKU					
	HT-817S 06A60	HT-820S 06A60	HT-824S 06A60	HT-817S 06A80	HT-820S 06A80	HT-824S 06A80
Number of battery strings (NCM)	7~17	7~20	7~24	7~17	7~20	7~24
Number of battery strings (LFP)	8~17	8~20	8~24	8~17	8~20	8~24
Number of battery strings (LTO)	14~17	14 ~20	14 ~24	14 ~17	14 ~20	14 ~24
Balance mode	Active Balance					
Equalizing current	0.6A					
Main circuit internal resistance	1.53 mΩ			1.2 mΩ		
Continuous discharge current	60A			80A		
Maximum discharge	100A			150A		

current		
Charging overcurrent	10 ~60 A	10 ~80 A
RS485	Supported (can only choose one of the two)	
CAN		
Display interface	Yes	
Entry cable	Same Port	
Single voltage range	1~5V	
Voltage acquisition	±3mV	
Overcharge protection voltage	1. 2~4. 35V adjustable	
Overcharge release voltage	1. 2~4. 35V adjustable	
Discharge time of charging	2~120S adjustable	
Number of temperature	3	
Temperature protection	Yes	
Short circuit protection	Yes	
Coulomb meter	Yes	
Bluetooth function	Support Android and IOS	
GPS remote (optional)	RS485/GPS (can only choose one of the two)	
Over discharge protection voltage	1.2 ~4.35V adjustable	
Over discharge protection voltage	1.2 ~4.35V adjustable	

Table 3. Technical Indicators of 100A/120A Protection Board

Technical Index	SKU			
	HT-820S 06A100	HT-824S 06A100	HT-820S 06A120	HT-824S 06A120
Number of battery strings (NCM)	7~20	7~24	7~20	7~24
Number of battery strings (LFP)	8~20	8~24	8~20	8~24
Number of battery strings (LTO)	14 ~20	14 ~24	14 ~20	14 ~24
Balance mode	Active Balance			
Equalizing current	0.6A			
Main circuit internal resistance	1 mΩ		0.9 mΩ	
Continuous discharge current	100A		120A	
Maximum discharge current	200A		240A	
Charging overcurrent	10~100A			
RS485 / CAN	Supported (can only choose one of the two)			
Display interface	Yes			
Entry cable	Same Port			

Single voltage range	1~5V
Voltage acquisition	±3mV
Overcharge protection voltage	1. 2~4. 35V adjustable
Overcharge release voltage	1. 2~4. 35V adjustable
Discharge time of charging	2~120S adjustable
Number of temperature	3
Temperature protection	Yes
Short circuit protection	Yes
Coulomb meter	Yes
Bluetooth function	Support Android and IOS
GPS remote (optional)	RS485/GPS (can only choose one of the two)
Over discharge protection voltage	1.2 ~4.35V adjustable
Over discharge protection voltage	1.2 ~4.35V adjustable

Table 4. Technical Indicators of 150A/200A Protection Board

Technical Index	SKU						
	HT-820S 06A150	HT-824S 06A150	HT-820S 1A150	HT-824S 1A150	HT-824S 2A150	HT-820S 2A200	HT-824S 2A200
Number of battery strings (NCM)	7~20	7~24	7~20	7~24	7~24	7~20	7~24
Number of battery strings (LFP)	8~20	8~24	8~20	8~24	8~24	8~20	8~24
Number of battery strings (LTO)	14 ~20	14 ~24	14 ~20	14 ~24	14 ~24	14 ~20	14 ~24
Balance mode	Active Balance						
Equalizing current	0.6A		1A		2A		
Main circuit internal resistance	0.65 mΩ						
Continuous discharge current	150A					200A	
Maximum discharge current	300A					350A	
Charging overcurrent	10~150A					10~200A	
RS485 / CAN	Supported (can only choose one of the two)						
Display interface	Yes						

Entry cable	Same Port
Single voltage range	1~5V
Voltage acquisition	±3mV
Overcharge protection voltage	1. 2~4. 35V adjustable
Overcharge release voltage	1. 2~4. 35V adjustable
Discharge time of charging	2~120S adjustable
Number of temperature	3
Temperature protection	Yes
Short circuit protection	Yes
Coulomb meter	Yes
Bluetooth function	Support Android and IOS
GPS remote (optional)	RS485/GPS (can only choose one of the two)
Over discharge protection voltage	1.2 ~4.35V adjustable
Over discharge protection voltage	1.2 ~4.35V adjustable

2.2 Application Environment

- a. Operating temperature range: -30°C~ 70°C;
- b. Power requirements: 20~100V.
- c. Power consumption: 8mA @ 100V in balanced state and 7mA@100V in imbalanced 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 below figures.

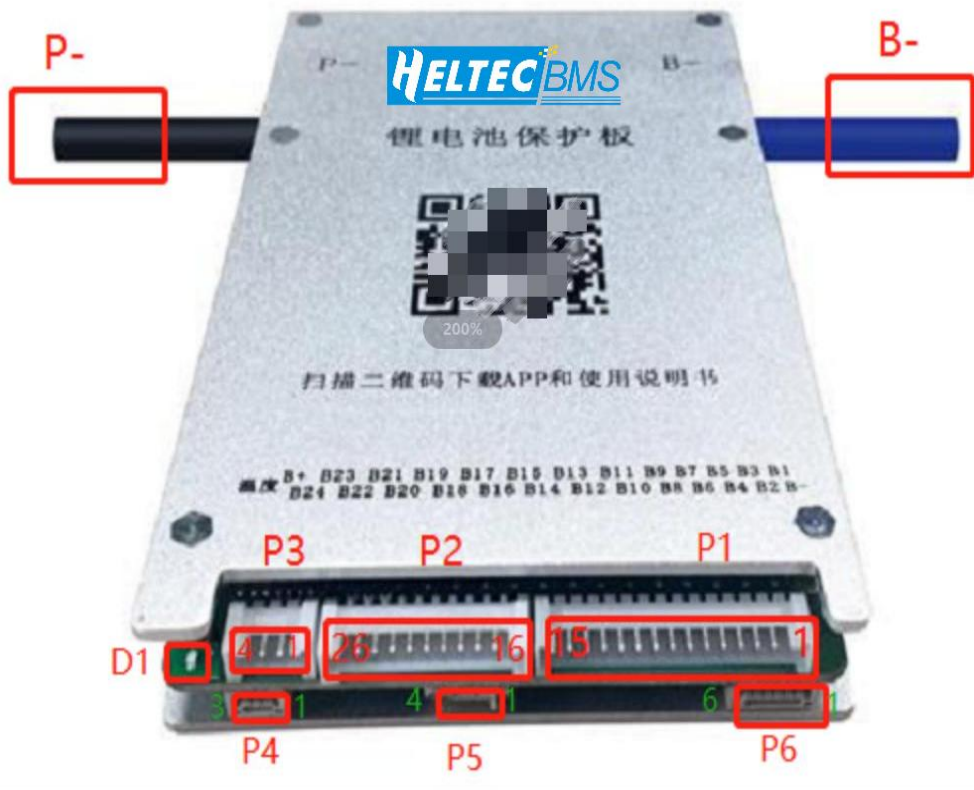


Figure 1. HT-824S04A40 connectors and LED Lights



Figure 2. HT-820S04A40 (HT-817S04A40) connectors and LED Lights



Figure 3. HT-820S06A100/ HT-820S06A120/ HT-820S06A150/
HT-820S1A150/ HT-820S2A200/ HT-824S06A100/ HT-824S06A120/
HT-824S06A150/ HT-824S1A150/ HT-824S2A150/ HT-824S2A200
Connector and LED Lights

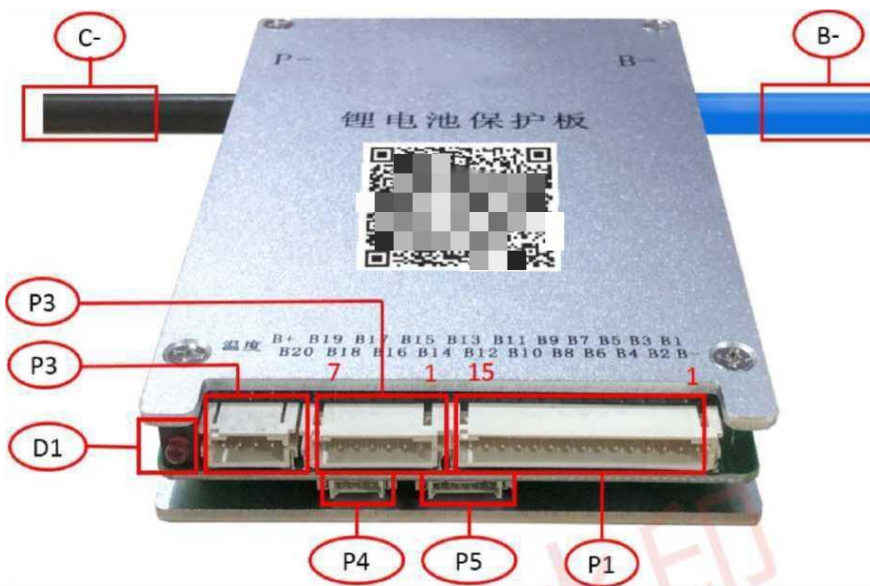


Figure 4. HT-817S06A60/ HT-817S06A80/ HT-820S06A60/ HT-820S06A80/
HT-824S06A60/ HT-824S06A80 Connector and LED Lights

3.2 Connector and Interface Description

Table 5. HT-824S04A40 Connector and LED Lights Definition

Connector	Interface Name	Pin No.	HT-824S04A40	
			Name	Definition
P1	Equalization and acquisition interface	1	B-	Total battery negative
		2	B1	Cell 1 Positive
		3	B2	Cell 2 Positive
		4	B3	Cell 3 Positive
		5	B4	Cell 4 Positive
		6	B5	Cell 5 Positive
		7	B6	Cell 6 Positive
		8	B7	Cell 7 Positive
		9	B8	Cell 8 Positive
		10	B9	Cell 9 Positive
		11	B10	Cell 10 Positive
		12	B11	Cell 11 Positive
		13	B12	Cell 12 Positive
		14	B13	Cell 13 Positive
P2		15	B14	Cell 14 Positive
		16	B15	Cell 15 Positive
		17	B16	Cell 16 Positive
		18	B17	Cell 17 Positive
		19	B18	Cell 18 Positive
		20	B19	Cell 19 Positive
		21	B20	Cell 20 Positive
		22	B21	Cell 21 Positive
		23	B22	Cell 22 Positive
		24	B23	Cell 23 Positive
		25	B24	Cell 24 Positive (charge positive)
		26	B+	Protection board power positive (To total battery positive)
P3	Temperature Interface	1	T1A	1 st temperature sensor A pin
		2	T1B	1 st temperature sensor B pin
		3	T2A	2 nd temperature sensor A pin
		4	T2B	2 nd temperature sensor B pin
P4	Connector Interface	1	D_N	RS485-B
		2	D_P	RS485-A
		3	GND	Signal ground
P5	GPS Interface	1	VGPS	Power output , the voltage is close to B+
		2	TX	UART_TX, 3.3V
		3	RX	UART_RX, 3.3V

		4	GND	Power/Signal ground
P6	Display Interface	1	VCC	Display screen power output
		2	A	Display screen RS485 positive signal
		3	B	Display screen RS485 negative signal
		4	GND	negative pole of power supply
		5	K+	Activate signal positive terminal
		6	K-	Activate signal negative terminal
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-	Connect the negative terminal of the battery			

Table 6. HT-820S04A40 (HT-817S04A40) Connector and LED Lights Definition

Connector	Interface Name	Pin No.	HT-824S04A40	
			Name	Definition
P1	Equalization and acquisition interface	1	B-	Total battery negative
		2	B1	Cell 1 Positive
		3	B2	Cell 2 Positive
		4	B3	Cell 3 Positive
		5	B4	Cell 4 Positive
		6	B5	Cell 5 Positive
		7	B6	Cell 6 Positive
		8	B7	Cell 7 Positive
		9	B8	Cell 8 Positive
		10	B9	Cell 9 Positive
		11	B10	Cell 10 Positive
		12	B11	Cell 11 Positive
		13	B12	Cell 12 Positive
		14	B13	Cell 13 Positive
P2		15	B14	Cell 14 Positive
		16	B15	Cell 15 Positive
		17	B16	Cell 16 Positive
		18	B17	Cell 17 Positive
		19	B18	Cell 18 Positive
		20	B19	Cell 19 Positive
		21	B20	Cell 20 Positive
		22	B+	Protection board power positive (To total battery positive)
P3	Temperature Interface	1	T1A	1 st temperature sensor A pin
		2	T1B	1 st temperature sensor B pin
		3	T2A	2 nd temperature sensor A pin

		4	T2B	2 nd temperature sensor B pin
P4	Connector Interface	1	D_N	RS485-B
		2	D_P	RS485-A
		3	GND	Signal ground
		1	VGPS	Power output , the voltage is close to B+
P5	GPS Interface	2	TX	UART_TX, 3.3V
		3	RX	UART_RX, 3.3V
		4	GND	Power/Signal ground
		1	VCC	Display screen power output
P6	Display Interface	2	A	Display screen RS485 positive signal
		3	B	Display screen RS485 negative signal
		4	GND	negative pole of power supply
		5	K+	Activate signal positive terminal
		6	K-	Activate signal negative terminal
		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-	Connect the negative terminal of the battery			

Table 7. All 60A/80A/100A/120A/150A/200A BMS

Connector and LED Lights Definition

Connector	Interface Name	Pin No.	All 60A/80A/100A/120A/150A/200A BMS	
			Name	Definition
P1	Equalization and acquisition interface	1	B-	Total battery negative
		2	B1	Cell 1 Positive
		3	B2	Cell 2 Positive
		4	B3	Cell 3 Positive
		5	B4	Cell 4 Positive
		6	B5	Cell 5 Positive
		7	B6	Cell 6 Positive
		8	B7	Cell 7 Positive
		9	B8	Cell 8 Positive
		10	B9	Cell 9 Positive
		11	B10	Cell 10 Positive
		12	B11	Cell 11 Positive
		13	B12	Cell 12 Positive
		14	B13	Cell 13 Positive
P2		15	B14	Cell 14 Positive
		16	B15	Cell 15 Positive
		17	B16	Cell 16 Positive

		18	B17	Cell 17 Positive
		19	B18	Cell 18 Positive
		20	B19	Cell 19 Positive
		21	B20	Cell 20 Positive
		22	B21	Cell 21 Positive
		23	B22	Cell 22 Positive
		24	B23	Cell 23 Positive
		25	B24	Cell 24 Positive (charge positive)
		26	B+	Protection board power positive (To total battery positive)
P3	Temperature Interface	1	T1A	1 st temperature sensor A pin
		2	T1B	1 st temperature sensor B pin
		3	T2A	2 nd temperature sensor A pin
		4	T2B	2 nd temperature sensor B pin
P4	Connector Interface	1	D_N	CAN_L/RS485-N (optional)
		2	D_P	CAN_H/RS485-P (optional)
		3	GND	Signal ground
P5	GPS Interface	1	VGPS	Power output , the voltage is close to B+
		2	TX	UART_TX, 3.3V
		3	RX	UART_RX, 3.3V
		4	GND	Power/Signal ground
P6	Display Interface	1	VCC	Display screen power output
		2	A	Display screen RS485 positive signal
		3	B	Display screen RS485 negative signal
		4	GND	negative pole of power supply
		5	K+	Activate signal positive terminal
		6	K-	Activate signal negative terminal
P7	Heating Interface (optional for only 100A and up BMS)	1	HT-	Heating negative
		2	HT-	Heating negative
		3	HT-	Heating negative
		4	HT-	Heating negative
		5	HT-	Heating negative
		6	CD+	Charge indication input positive terminal
		7	CD-	Charge indication input negative terminal
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-	Connect the negative terminal of the battery			

3.3 Product Appearance

Smart Active BMS appearance are shown in below figures.



Figure 5. Smart Active BMS 100A/120A/150A/200A Product Appearance



Figure 6. Smart Active BMS 40A/60A/80A Product Appearance

3.4 Product Size

The size of HT-817S04A40/ HT-820S04A40 protection board is 110.4mm*73mm*17.6mm, dimensions are shown in Figure 7.

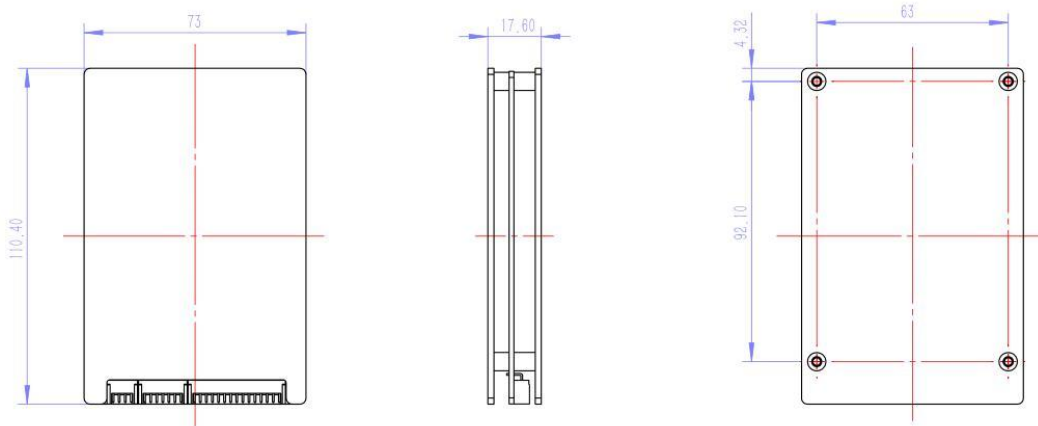


Figure 7. Outline Dimension Diagram of HT-817S04A40/ HT-820S04A40

The size of HT-824S04A40 protection board is 116mm*83mm*17.6mm, dimensions are shown in Figure 8.

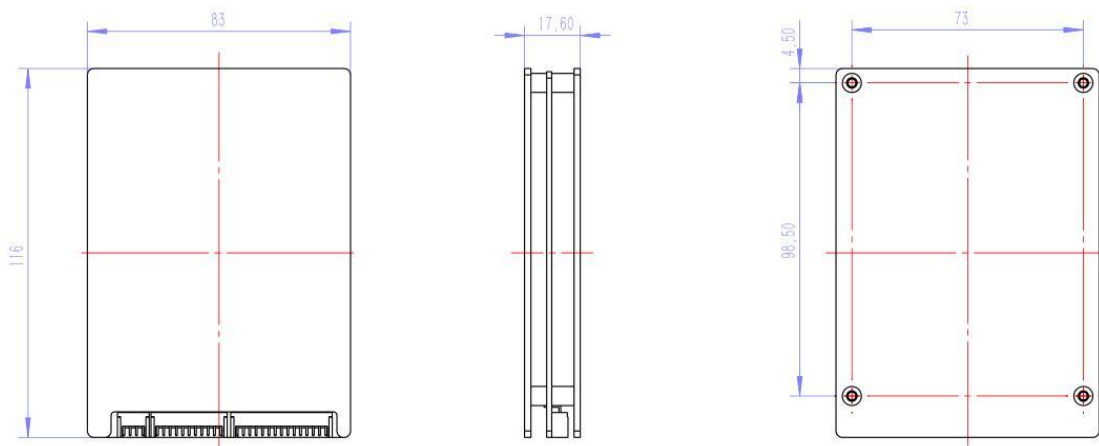


Figure 8. Outline Dimension Diagram of HT-824S04A40

The size of HT-817S06A60/ HT-820S06A60/ HT-824S06A60/ HT-817S06A80/ HT-820S06A80/ HT-824S06A80 protection board is 136mm* 83mm*17.6mm, dimensions are shown in Figure 9.

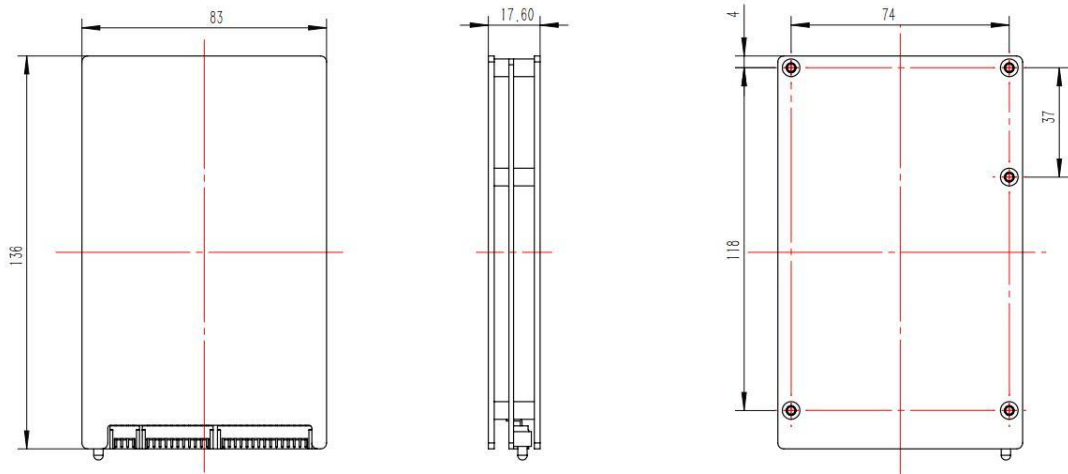


Figure 9. Outline Dimension Diagram of 60A/80A Smart Active BMS

The size of HT-820S06A100/ HT-820S06A120/ HT-820S06A150/ HT-820S1A150/ HT-820S2A200/ HT-824S06A100/ HT-824S06A120/ HT-824S06A150/ HT-824S1A150/ HT-824S2A150/ HT-824S2A200 protection board is 162mm*102mm*20.4mm, dimensions are shown in Figure 10.

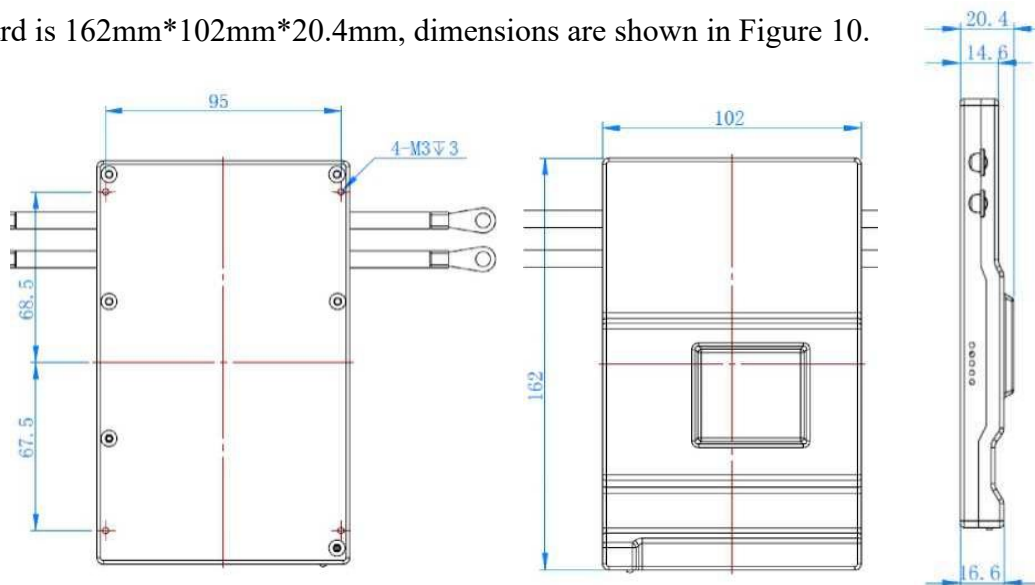


Figure 10. Outline Dimension Diagram of 100A/120A/150A/200A Smart Active BMS

3.5 Weight

The weight of 0.6A 60A/80A Smart Active BMS is about 260g.

The weight of 0.6A 100A Smart Active BMS is about 360g.

The weight of 0.6A 120A Smart Active BMS is about 390g.

The weight of 0.6A 150A Smart Active BMS is about 420g.

The weight of 1A/2A 150A/200A Smart Active BMS is about 430g.

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 Wring Diagram Examples

The intelligent lithium battery protection board is suitable for 7~24 series of lithium battery packs and the battery pack wiring method is different for different numbers of batteries. Please take below figures as reference.

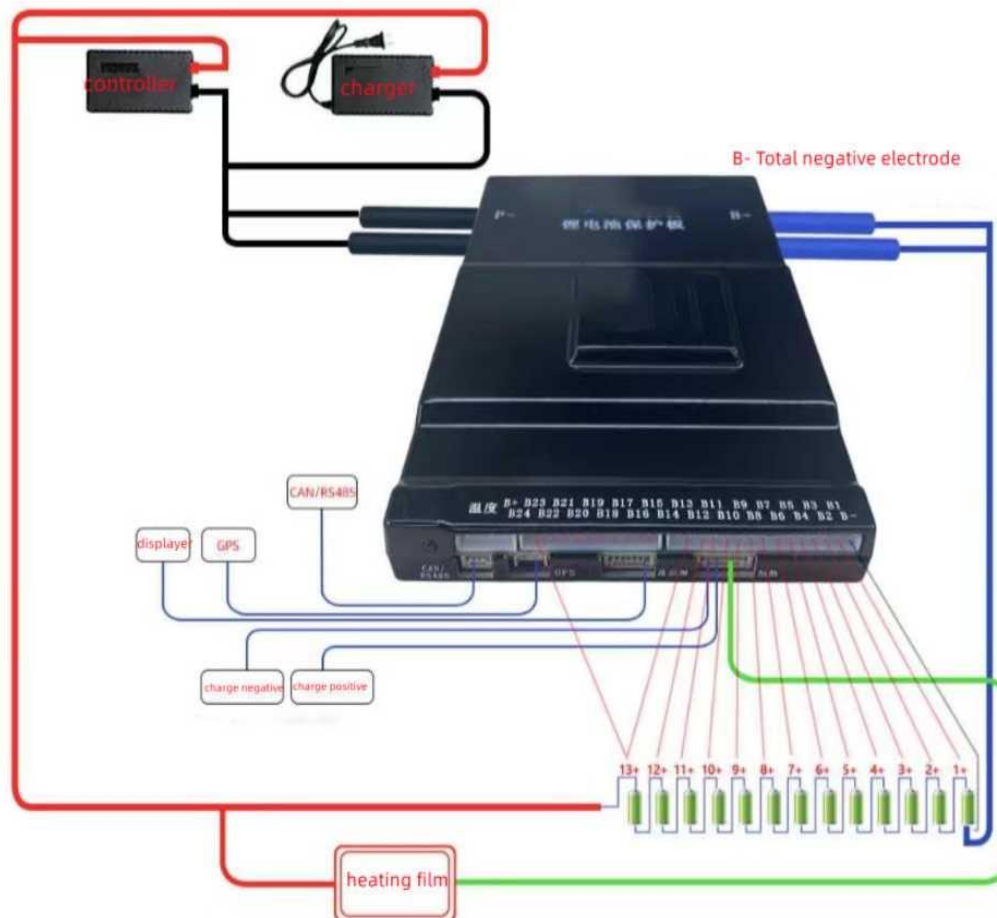


Figure 11. Heating Function Wiring Diagram

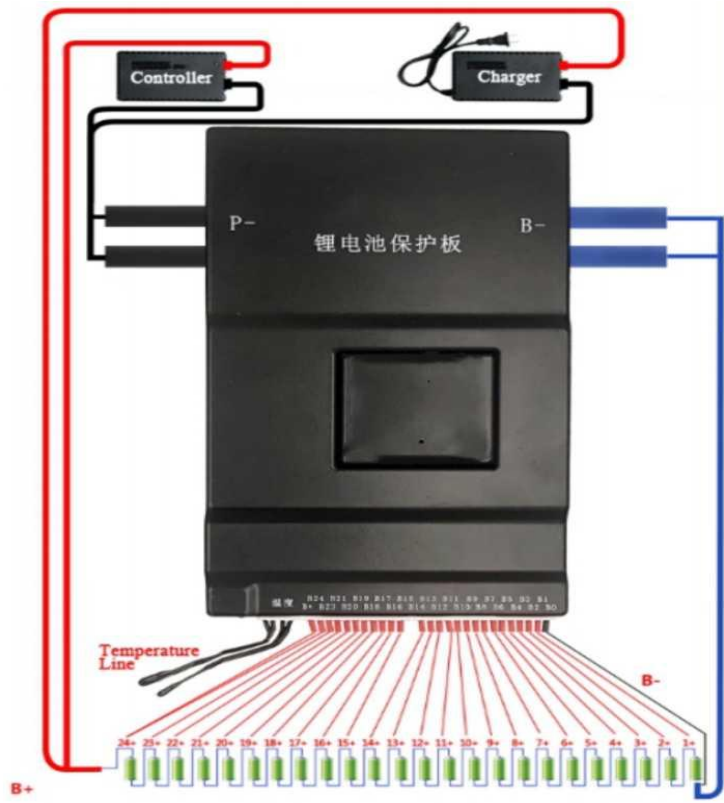


Figure 12. 24S Battery Wiring Diagram

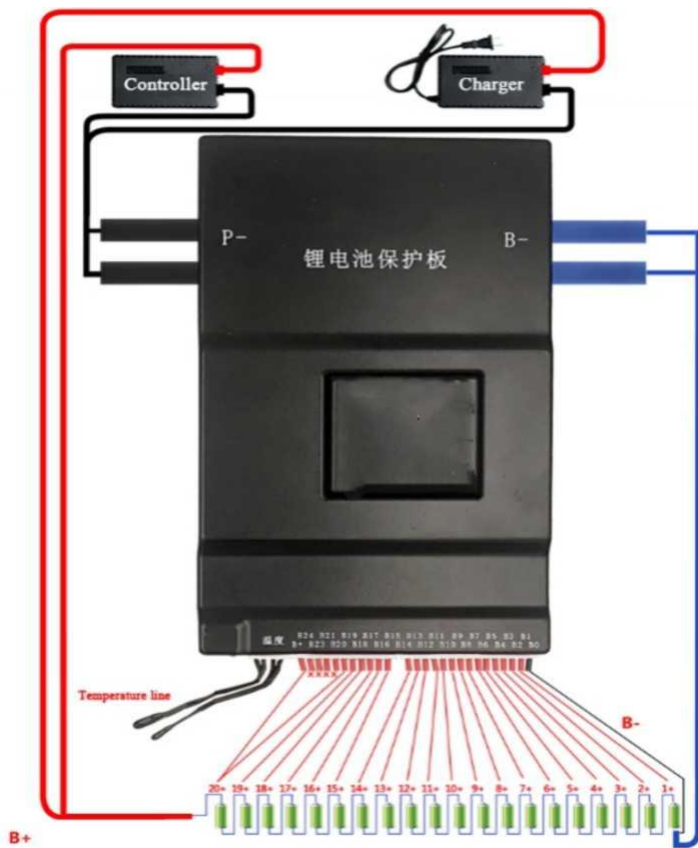


Figure 13. 20S Battery Wiring Diagram

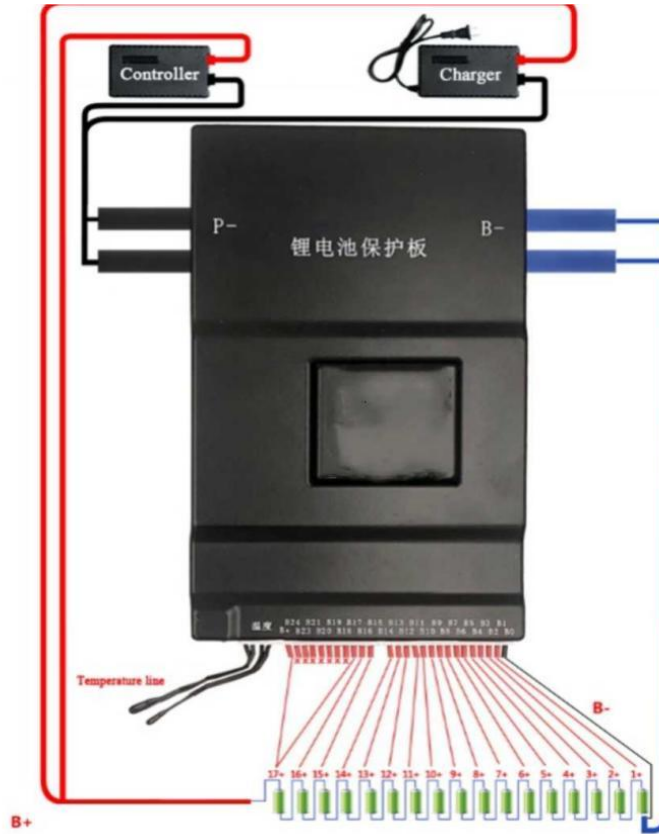


Figure 14. 17S Battery Wiring Diagram

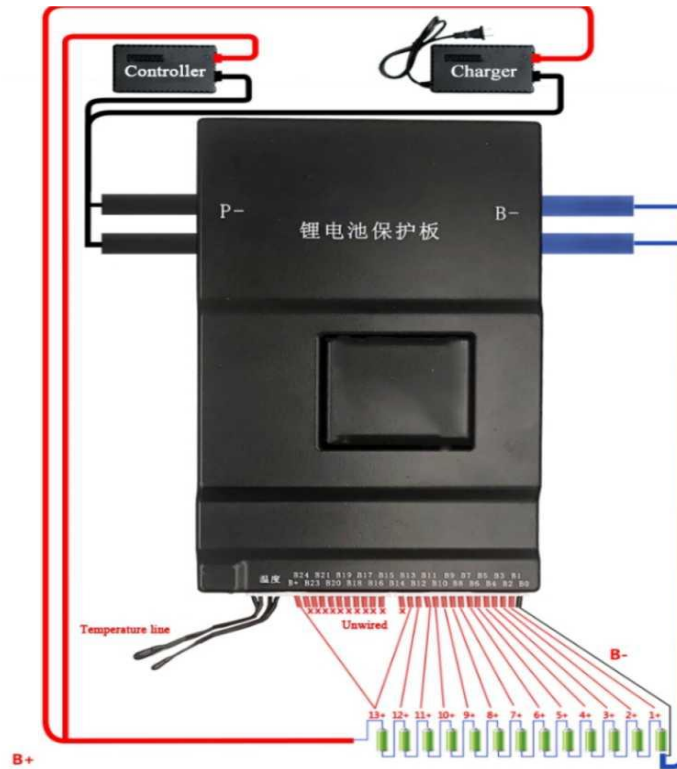


Figure 15. 13S Battery Wiring Diagram

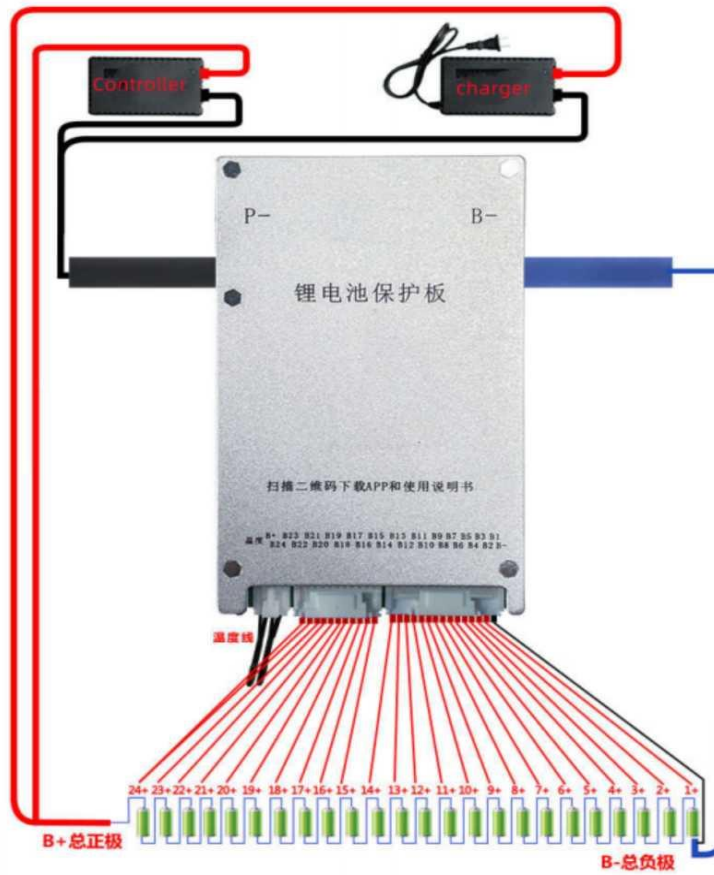


Figure 16. 24S Battery Wiring Diagram(2)

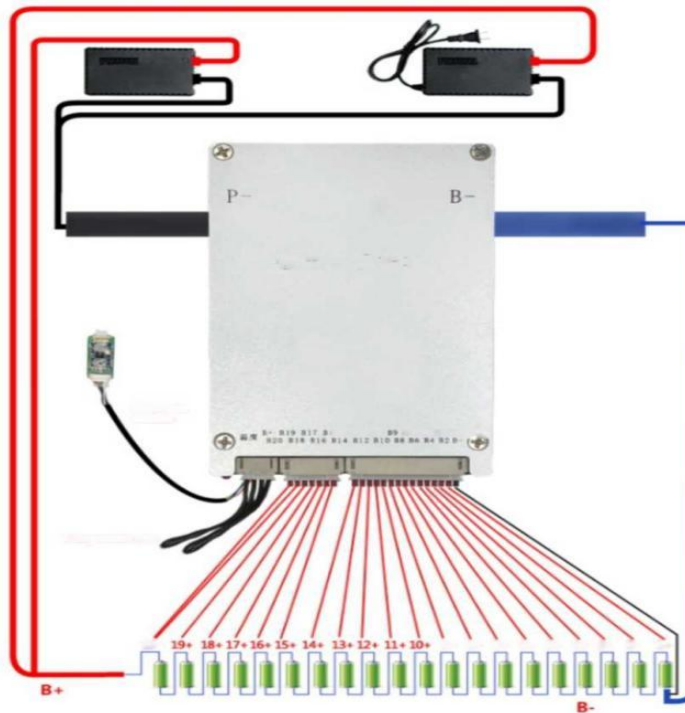


Figure 17. 20S Battery Wiring Diagram(2)

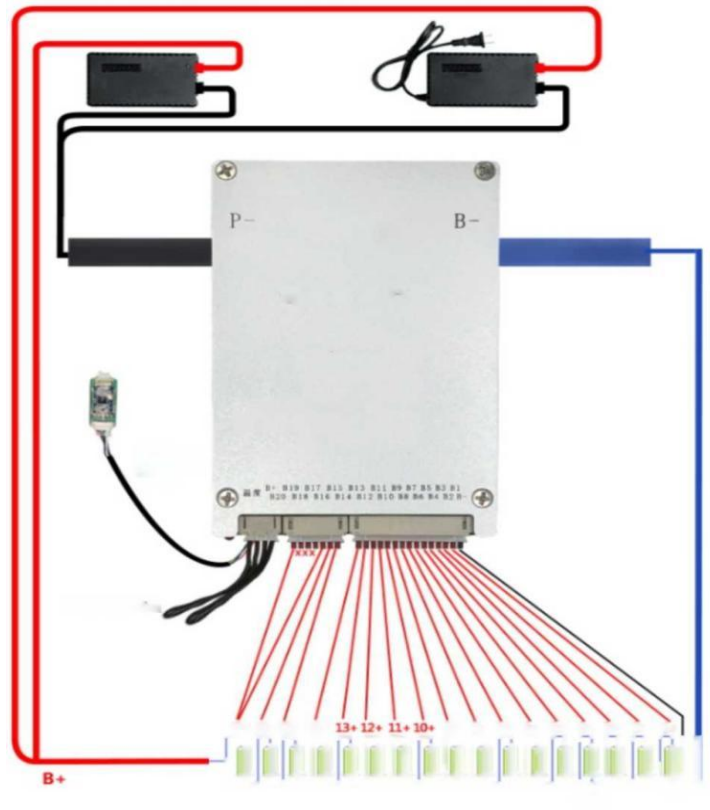


Figure 18. 17S Battery Wiring Diagram(2)

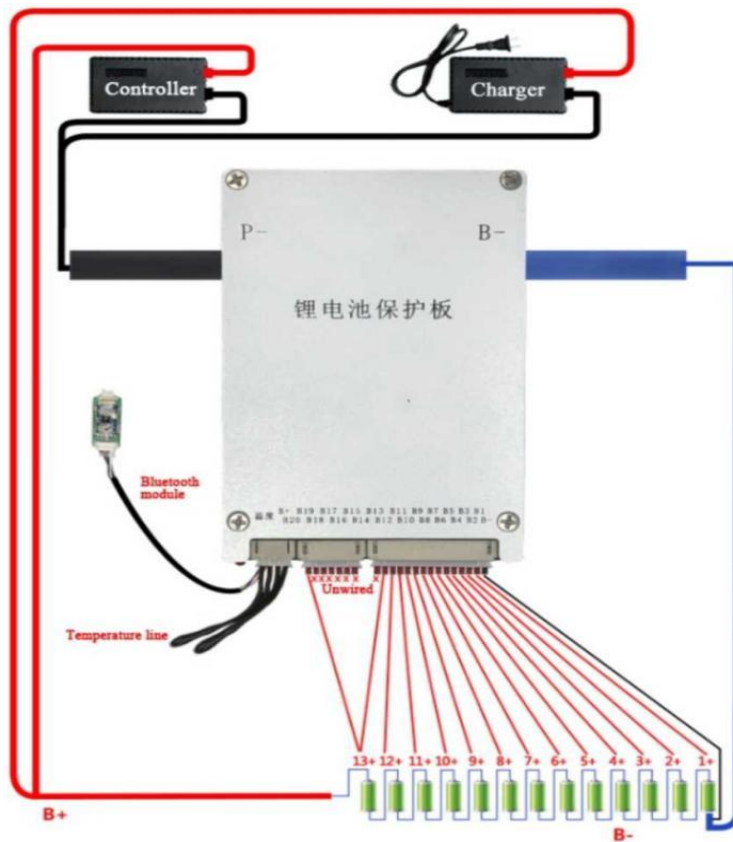


Figure 19. 13S Battery Wiring Diagram(2)

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 one charger is 5V higher than that of the battery**). That is, after the battery is assembled, the charger needs to be connected to start the protection board.

5.3 APP Operating Instructions

5.3.1 Equipment Operation

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



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 20 and Figure 21.

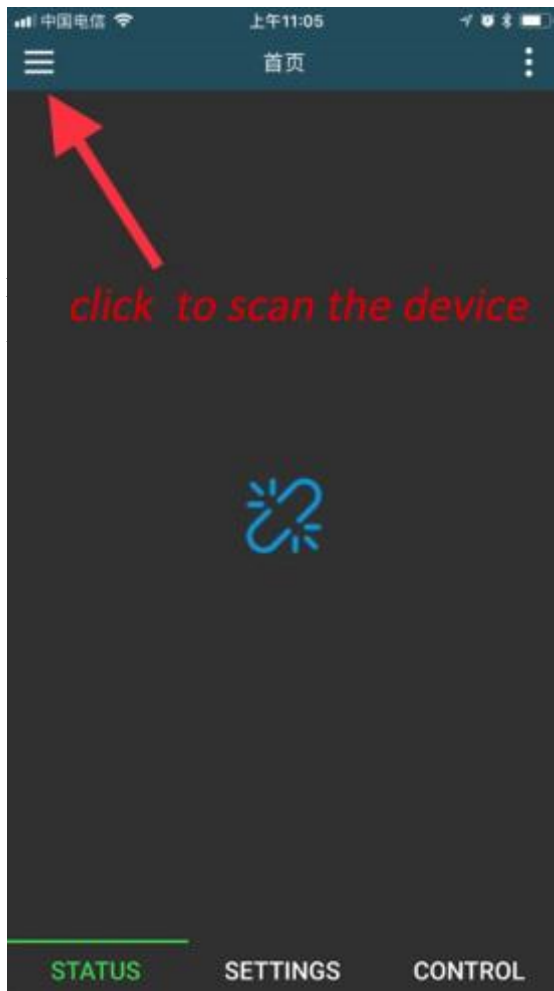


Figure 20. Device Scan

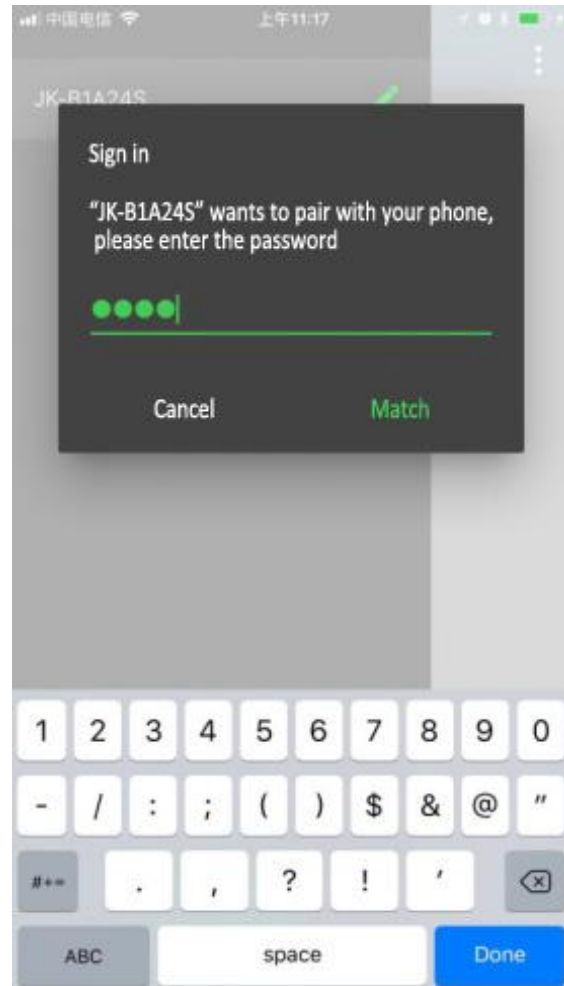


Figure 21. Password Input

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 22. Note that the device name only supports English or numbers.

The password change interface is shown in Figure 23. 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 22. Name Modification



Figure 23. Password Modification

5.3.2 Status View

The real-time status interface is shown as below.



Figure 24. 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 25. 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 be turned off to 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 26. 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.