

TAI ZHOU JOYDO ENERGY TECHNOLOGY CO., LTD

SPECIFICATION FOR APPROVAL

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| PRODUCT NAME |  |
| CUSTOMER MATERIAL CODE |  |

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| --- | --- | --- | --- |
| CUSTOMER |  | DATE | 2017.12.11 |
| DESCRIPTION | 14~24 series lithium ion battery management system |

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|  | TAI ZHOU JOYDO ENERGY TECHNOLOGY CO., LTD |
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1. Statement
* This file describes the functions and parameters of battery management system (BMS) which were designed and manufactured by Taizhou Joydo energy technology co., LTD.. The user should read this document and comply with the relevant industry standards before the operation of this product. The Company shall not be responsible for damage caused by improper operation or beyond the conditions of use specified in this specification.
* Due to the updating and upgrading of products, this document may modify the contents without informing the customers. If you want to know the latest product information or technical parameters, please contact our business department.
1. Overview
* Highly integrated platform within the single voltage, current, temperature management.
* Designed for lithium battery packs, can support 24 strings of batteries and 4 groups of temperature-sensitive test mostly.
* BMS is composed of data acquisition circuit board and balanced circuit board, with the maximum size of 190mm\*67mm\*26mm (L\*W\*H). The data acquisition circuit board is responsible for the collection of single voltage, temperature measurement and external communication. The balance circuit board is responsible for the single voltage balance, discharge control and charge control.
* Support CAN and RS485 communications:
	+ Specific communication protocol can be modified according to user needs.
	+ The monitoring data of BMS and the states of battery pack can be viewed through the communication instruction.
	+ BMS can communicate with vehicle controller, instrument system and handheld diagnostic instrument intelligently.
* Perfect protection function:
* Over-voltage protection
* Under-voltage protection.
* Over-current protection.
* Overload protection.
* Short-circuit protection.
* Over-temperature protection.
* Temperature difference protection.
* Charging low temperature protection.
* Discharging low temperature protection.
* Precharge.
* With the industry's leading intelligent balance management, accurate sampling current calculate SOC, the precision up to 5%.
* High precision voltage, current and temperature measurement.
* High-rate capacity design ensures the stability of the product under high current charge or discharge.
* With electric door lock wake, the static power consumption is 12uA, and the equalizing current is up to 1A.
* The charge and discharge control loop and the balanced circuit board are designed with aluminum plate, and the heat dissipation is better.
1. Limit Parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Items** | **Symbol** | **Unit** | **Upper limit** | **Lower limit** |
| **Supply voltage** | VBP-VBN | V | 99 | 38 |
| **Charger voltage** | VBP-VPN | V | 99.7 | 38.7 |
| **Input voltage** | VCELL(N)-VCELL(N-1) | V | 5.0 | 0.1V |
| **Maximum charging current** | I(BN-->PN) | A | 15 | / |
| **Maximum discharging current (10s)** | I30s (PN-->BN) | A | 100 | / |
| **Maximum discharging current (continuous)** | I(PN-->BN) | A | 50 | / |
| **Ambient temperature** |  | ℃ | 45 | -20 |

1. Battery Management System Technical Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Technical Item** | **Technical Parameters** | **Remarks** |
| 1 | SOC precision (0%~20%) | 2% |  |
| 2 | SOC precision (80%~100%) | 2% |  |
| 3 | SOC precision (20%~80%) | 6% |  |
| 4 | Monolithic voltage detection accuracy | 3mV | -20℃~85℃ |
| 5 | Accuracy of current detection (>0.1A,<5A) | 0.01A | -20℃~85℃ |
| 6 | Accuracy of current detection (>5A,<20A) | 0.5% | -20℃~85℃ |
| 7 | Accuracy of current detection (>20A) | 0.2% | -20℃~85℃ |
| 8 | Accuracy of temperature detection (-40~120) | 1℃ | -30℃~85℃ |
| 9 | BMS shut down power consumption (max) | 110uA |  |
| 10 | Number of management cells | 14~24s |  |
| 11 | Continuous discharging current | 50A |  |
| 12 | Peak discharging current (1min) | 80A |  |
| 13 | Short circuit protection current | 200A |  |
| 14 | Continuous charging current | 12A |  |
| 15 | Charging protection current | 15A |  |
| 16 | Discharging protection current | 80A |  |
| 17 | Discharging over-current protection delay | 60S |  |
| 18 | Balanced start-up voltage difference (charging equalization) | >15mV | The charging current or the maximum cell voltage is greater than 4.0V |
| 19 | Balanced stop voltage difference | <15mV |  |
| 20 | Charging low temperature protection | 0℃ |  |
| 21 | Relieve low temperature protection | 5℃ |  |
| 22 | Charging high temperature protection | 57℃ |  |
| 23 | Relieve high temperature charging protection | 52℃ |  |
| 24 | Discharging high temperature protection | 72℃ |  |
| 25 | Relieve discharging high temperature protection | 57℃ |  |
| 26 | Discharging low temperature protection | -15℃ |  |
| 27 | Relieve discharging low temperature protection | -10℃ |  |
| 28 | Discharging cell minimum voltage protection | 3000mV |  |
| 29 | Relieve discharging cell voltage protection | 3100mV |  |
| 30 | Charging cell maximum voltage protection | 4150mV |  |
| 31 | Relieve charging cell voltage protection | 4050mV |  |
| 32 | Equalizing current | 0.5A |  |
| 33 | All faults are relieved | Power on the BMS again |  |

Description: Battery management system can be customized according to customer’s needs.

1. BMS Functional Description

## Number of measured cells

* The monitoring number of the cells is 14~24s, and the actual monitoring quantity can be adjusted according to the user's requirement.

## The state of BMS

* BMS has two states: working state, power off state.
* In power off state, the SCM system is powered off, without power consumption, the voltage acquisition chip is in a dormant state and the power consumption is 4uA. In this state, BMS cuts off the output, so it cannot detect the voltage of cell, the temperature, the current, and discharge. In the state of power failure, the charger can be plugged in to wake up and recharge normally.
* The BMS is awakened by an external charger or wake-up switch, and all functions of the BMS are normal after waking up. The charger has no output or wake-up switch off, and the BMS enters the state of power off.

## Overcharge protection and its recovery

* When the maximum cell voltage is higher than the maximum protection voltage of the charging cell, the BMS enters into the overcharge protection state and cuts off the charging MOS after the delay of 3 to 5 seconds.
* When the maximum cell voltage is less than the removing protection voltage of the charging cell, the BMS exits the overcharge protection state and reopens the charging MOS.

## Over-discharge protection and its recovery

* When the minimum cell voltage is less than the minimum protection voltage of the discharge cell, the BMS enters into the over-discharge protection state to cut off the discharging MOS after the delay of 3 to 5 seconds.
* When the minimum cell voltage is higher than the removing protection voltage of the charging cell, the BMS exits the over-discharge protection state and reopens the discharging MOS after the delay of 3 to 5 seconds.

## Over current, short circuit protection and their recovery

* When the discharging current is higher than the discharging protection current, the BMS enters into the over-current protection state and cut off the discharging MOS after the delay of 60 seconds.
* When there is a short circuit fault, the BMS enters into the short circuit protection and cut off the discharging MOS after the delay of 70 to 400 microseconds.
* When over-current and short circuit protection occur, the BMS needs to be restarted to recover.

## Over-temperature protection and its recovery

* The BMS has high-temperature charging protection and low-temperature charging protection. When the temperature is higher than the charging high-temperature protection temperature, the BMS enters the charging high-temperature protection state and cuts off the charging MOS after the delay of 10 seconds. When the temperature is less than the charging temperature protection temperature, the BMS enters into charging low temperature protection and cut off charging MOS after the delay of 10 seconds.
* BMS has discharging high temperature protection and discharging low temperature protection. When the temperature is higher than the discharging high temperature protection temperature, the BMS enters into the discharging high temperature protection state and shuts off the discharging MOS after the delay of 10 seconds. When the temperature is lower than the discharging temperature protection temperature, the BMS enters into the low-temperature discharging protection and cut off the discharging MOS after the delay of 10 seconds.
* When over-temperature protection occurs, the BMS needs to be powered off and then restored after power-on again.

## Equilibrium function

* BMS adopts passive equilibrium with resistance discharge, and the equilibrium current is 600mA. The starting condition of the equilibrium function is the charging current, the maximum cell voltage and the lowest cell voltage difference is greater than 20mV, and the maximum cell voltage is greater than 4.0V.

## Contactor control and heating control

* BMS has 2-way drive control output, which is used for contactor control or heating control. The specific control strategy should be adjusted according to the user's needs.

## Communication function

* BMS has RS485 and CAN communication functions, the specific communication protocol can be modified according to user’s needs.

## SOC analysis

* During charging or discharging, BMS will monitor the current and voltage to adjust SOC information in real time. The process is based on the integral method and assisted by learning functions.
1. Battery Management System’s Structure

## 1． The shape and structure of BMS

 BMS is composed of data acquisition circuit board and balanced circuit board, with the maximum size of 190mm\*67mm\*26mm (L\*W\*H). The data acquisition circuit board is responsible for the collection of single voltage, temperature measurement and external communication. The balance circuit board is responsible for the single voltage balance, discharge control and charge control.



Fig.1 16 ~ 24s lithium-ion battery management system

Fig.1 is a lithium-ion battery management system, where the data acquisition circuit board and the equalizer circuit board are stacked structures. The data acquisition circuit board is stacked on the equalizer circuit board through the connector (double row pin).



P6:Temperature connector

P3:1~12s connector

P6

P1:13~24s connector

P5:Communication and key signal connector

Fig.2 structure dimension of data acquisition circuit board

Fig. 2 is the dimension of the data acquisition circuit board, the location of each connector and the function of the connector.

Copper stud CHIN-, connect charger’s negative electrode

 

Copper stud BAT-, connect battery pack’s negative electrode

Copper stud PACK-, connect load’s negative electrode

Fig.3 Equilibrium circuit board structure

Fig.3 is an equilibrium circuit board structure, the equilibrium circuit board with aluminum substrate design, fixed on the aluminum plate to enhance heat dissipation. Equilibrium circuit board has three copper studs, BAT- connect the negative electrode of battery pack, PACK- is the output of battery pack, connect the negative electrode of load, CHIN- is the interface of charger, connect the negative electrode of charger.

## 2． The external wiring of the BMS

2.1 Cell wiring

BMS can manage 14 to 24s cell voltage, which also can be determined according to customer needs. Once the managed system is determined, the BMS will not be used for the management of other cell quantities, otherwise it will be burned down. The following introduction for the management of different number of cells, pointed out the different way of wiring:



Fig.4 pin definition of P3 connector



Fig.5 pin definition of P1 connector

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Battery input** | **14S** | **15S** | **16S** | **17S** | **18S** | **19S** | **20S** | **21S** | **22S** | **23S** | **24S** |
| BC1\_0-BC1\_1 | Cell 1 | Cell1 | Cell1 | Cell1 | Cell1 | Cell1 | Cell1 | Cell1 | Cell1 | Cell1 | Cell1 |
| BC1\_1-BC1\_2 | Cell2 | Cell2 | Cell2 | Cell2 | Cell2 | Cell2 | Cell2 | Cell2 | Cell2 | Cell2 | Cell2 |
| BC1\_2-BC1\_3 | Cell3 | Cell3 | Cell3 | Cell3 | Cell3 | Cell3 | Cell3 | Cell3 | Cell3 | Cell3 | Cell3 |
| BC1\_3-BC1\_4 | Cell4 | Cell4 | Cell4 | Cell4 | Cell4 | Cell4 | Cell4 | Cell4 | Cell4 | Cell4 | Cell4 |
| BC1\_4-BC1\_5 | Cell5 | Cell5 | Cell5 | Cell5 | Cell5 | Cell5 | Cell5 | Cell5 | Cell5 | Cell5 | Cell5 |
| BC1\_5-BC1\_6 | Cell6 | Cell6 | Cell6 | Cell6 | Cell6 | Cell6 | Cell6 | Cell6 | Cell6 | Cell6 | Cell6 |
| BC1\_6-BC1\_7 | Cell7 | Cell7 | Cell7 | Cell7 | Cell7 | Cell7 | Cell7 | Cell7 | Cell7 | Cell7 | Cell7 |
| BC1\_7-BC1\_8 | \ | Cell8 | Cell8 | Cell8 | Cell8 | Cell8 | Cell8 | Cell8 | Cell8 | Cell8 | Cell8 |
| BC1\_8-BC1\_9 | \ | \ | \ | Cell9 | Cell9 | Cell9 | Cell9 | Cell9 | Cell9 | Cell9 | Cell9 |
| BC1\_9-BC1\_10 | \ | \ | \ | \ | \ | Cell10 | Cell10 | Cell10 | Cell10 | Cell10 | Cell10 |
| BC1\_10-BC1\_11 | \ | \ | \ | \ | \ | \ | \ | Cell11 | Cell11 | Cell11 | Cell11 |
| BC1\_11-BC1\_12 | \ | \ | \ | \ | \ | \ | \ | \ | \ | Cell12 | Cell12 |
| BC1\_12-BC2\_1 | Cell8 | Cell9 | Cell9 | Cell10 | Cell10 | Cell11 | Cell11 | Cell12 | Cell12 | Cell13 | Cell13 |
| BC2\_1-BC2\_2 | Cell9 | Cell10 | Cell10 | Cell11 | Cell11 | Cell12 | Cell12 | Cell13 | Cell13 | Cell14 | Cell14 |
| BC2\_2-BC2\_3 | Cell10 | Cell11 | Cell11 | Cell12 | Cell12 | Cell13 | Cell13 | Cell14 | Cell14 | Cell15 | Cell15 |
| BC2\_3-BC2\_4 | Cell11 | Cell12 | Cell12 | Cell13 | Cell13 | Cell14 | Cell14 | Cell15 | Cell15 | Cell16 | Cell16 |
| BC2\_4-BC2\_5 | Cell12 | Cell13 | Cell13 | Cell14 | Cell14 | Cell15 | Cell15 | Cell16 | Cell16 | Cell17 | Cell17 |
| BC2\_5-BC2\_6 | Cell13 | Cell14 | Cell14 | Cell15 | Cell15 | Cell16 | Cell16 | Cell17 | Cell17 | Cell18 | Cell18 |
| BC2\_6-BC2\_7 | Cell14 | Cell15 | Cell15 | Cell16 | Cell16 | Cell17 | Cell17 | Cell18 | Cell18 | Cell19 | Cell19 |
| BC2\_7-BC2\_8 | \ | \ | Cell16 | Cell17 | Cell17 | Cell18 | Cell18 | Cell19 | Cell19 | Cell20 | Cell20 |
| BC2\_8-BC2\_9 | \ | \ | \ | \ | Cell18 | Cell19 | Cell19 | Cell20 | Cell20 | Cell21 | Cell21 |
| BC2\_9-BC2\_10 | \ | \ | \ | \ | \ | \ | Cell20 | Cell21 | Cell21 | Cell22 | Cell22 |
| BC2\_10-BC2\_11 | \ | \ | \ | \ | \ | \ | \ | \ | Cell22 | Cell23 | Cell23 |
| BC2\_11-BC2\_12 | \ | \ | \ | \ | \ | \ | \ | \ | \ | \ | Cell24 |

Tab.1 the cell wiring of BMS

Note: BC1\_12 is not connected when the connected cell is less than or equal to 22S. It is short connected with low string cell’s positive electrode in the internal of BMS, and the BC2\_1 is connected to the positive electrode of this string.

2.2 Communication terminals wiring



Fig.6 pin definition of P5 connector

|  |  |  |  |
| --- | --- | --- | --- |
| **Connector name** | **Pin number** | **Pin definition** | **Description** |
| P5：Connector of key door and communication port(Fig.6) | PIN1 | GND12 | Communication place |
| PIN2 | B | RS485 interface B |
| PIN3 | A | RS485 interface A |
| PIN4 | +12V | Communication input +5V～12V |
| PIN5 | CANH | CAN communication |
| PIN6 | CANL | CAN communication |
| PIN7 | +12VOUT | +12V output, connect the relay input |
| PIN8 | RELAY2 | Relay output control |
| PIN9 | +12VOUT | +12V output, Connect the relay input |
| PIN10 | RELAY2 | Relay output control |
| PIN11 | KEY | BMS wake-up input, connect the positive electrode of battery pack |
| PIN12 | suspension | suspension |

2.3 Temperature terminal wiring



Fig.7 pin definition of P2 connector

|  |  |  |  |
| --- | --- | --- | --- |
| **Connector name** | **Pin number** | **Pin definition** | **Description** |
| P2：NTC resistance interface (Fig.7) | PIN1 | TEMP4 | Connect NTC R1 resistor’s *2* feet |
| PIN2 | GND2 |
| PIN3 | TEMP3 | Connect NTC R2 resistor’s 2 feet |
| PIN4 | GND2 |
| PIN5 | TEMP2 | Connect NTC R3 resistor’s 2 feet |
| PIN6 | GND1 |
| PIN7 | TEMP1 | Connect NTC R4 resistor’s 2 feet |
| PIN8 | GND1 |

1. The Installation and Debugging of BMS
2. When connecting the BMS to the battery pack, be sure to access it in the following order:
* First of all, the negative electrode of the battery pack should be connected to the baseplate copper pillar BAT-;
* Then access the sensor terminals P2 and P5 (no order);
* Access the cell acquisition wire terminal P3 (14PIN) and P1 (12PIN) in order;
* Finally, access communication terminal P5；
1. When removing the BMS from the battery pack, be sure to follow the following order:
* Unplug the communication terminal P9;
* Unplug the sensor terminal P6 and P5 (no order);
* Unplug the terminal P1 (12PIN) and P3 (14PIN) in order.
* Remove the negative electrode of the battery pack from the copper pillar BAT-.
1. **The Use, Maintenance and Attentions of BMS**

Please read and comply with the following regulations before using the battery management system. Improper use may cause damage to the battery pack, smoke, fire, etc.

1. Prohibited matters
* Do not place BMS in a burning, flooding (or other liquid), vacuum and high pressure environment.
* Do not store or use this product outside the environment specified in the specification.
* Do not disassemble, impact, puncture or any other means to destroy the original structure of the product.
1. Considerations
* Check the battery pack appearance before use without swelling, cracks.
* Make sure the BMS is matched with the battery pack parameters.
* When transporting, the packing method shall not be lower than the original packaging grade. And cannot appear such as violent shaking, falling, extrusion, high temperature, rain, inversion, etc.
1. Quality Guarantee Period
* Customers who use, store, transport according to the requirements of this specification have 1 year warranty from the delivery date if product’s appearance is not damaged or any other signs of human intention (intentional or unintentional).
* If any provision is made, the provision shall be deemed to be effective.