



AYAA TECHNOLOGY CO., LTD

# Datasheet

SF25-6S45AT-Y01-Vx.0

## BMS Product Specification

|                       |                                                   |
|-----------------------|---------------------------------------------------|
| Customer Name         |                                                   |
| Product Name          | SF25-6S45AT-Y01-Vx.0                              |
| Product Model         | SU06M45TC000                                      |
| Product Specification | NMC Li-ion 4S, Common-port, Chg 30A Dchg 45A, CAN |
| Output Mode           | Power MOSFET                                      |
| Product Technology    | PCBA with conformal coating                       |
| Date                  | 2023.10.24                                        |
| Period of Validity    | 2024.10.24                                        |

Revision Vx.0 / 2023.10.24

|                                                 | Registered | Checked | Approved |
|-------------------------------------------------|------------|---------|----------|
| Signature by Shenzhen Ayaa Technology Co., Ltd. |            |         |          |
| Signature by Customer                           |            |         |          |

Product Modified Record List

| NO. | Date       | Problem and Solution         | Principal     |
|-----|------------|------------------------------|---------------|
| 1   | 2023.10.24 | Hardware Vx.0, first version | Weiqiang Dong |



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# 1 Purpose

This technical specification serves as the input for the supplier to design, produce, inspect, and control quality. It also serves as the basis for the purchaser to conduct procurement, acceptance, and quality liability determination.

## 2 Reference Standards

Table 1 Reference and standards adopted

| NO. | Standard/File No. | Standard/File Name                                                      | Remarks |
|-----|-------------------|-------------------------------------------------------------------------|---------|
| 1   | GB 191-2008       | Packaging and storage marking signs                                     |         |
| 2   | GB/T 1804         | General tolerances                                                      |         |
| 3   | GB 31241-2014     | Safety requirements for Li-ion cells/batteries for portable electronics |         |
| 4   | GB/T 2423-2008    | Environmental testing for electric and electronic products              |         |

## 3 Terms and Abbreviations

The terms and definitions in GB31241-2014 apply. The following also apply:

Table 2 Terms and abbreviations

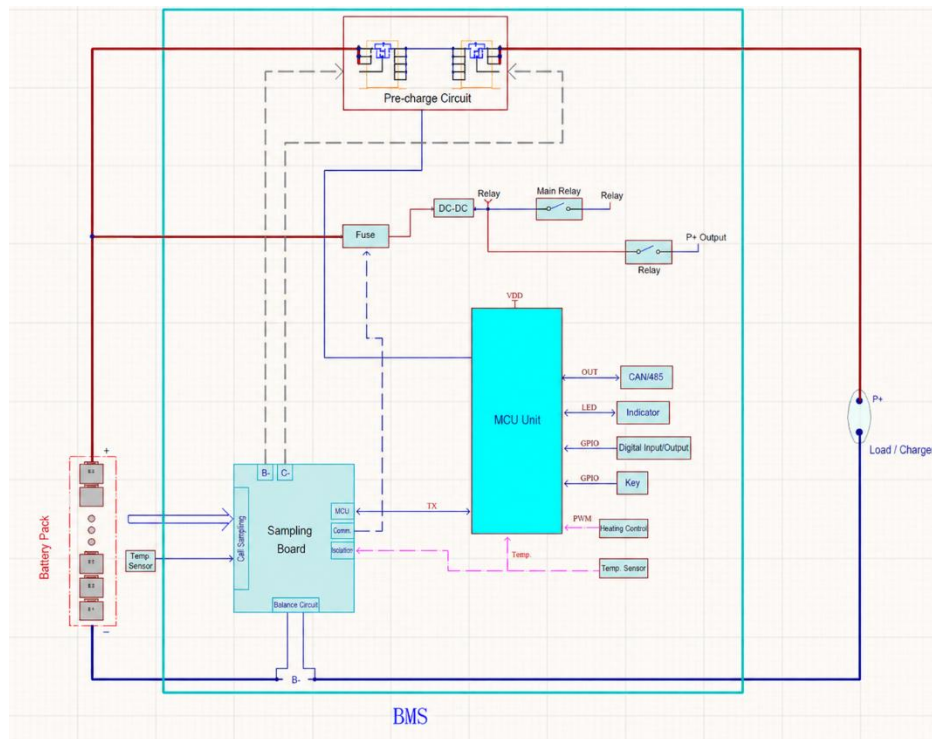
| NO. | Term/Abbreviation               | Description                                                                                                                                                                                                                                                 |
|-----|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | BMS (Battery Management System) | Electronic device controlling battery electrical/thermal performance and providing communication. Integrates cell voltage, current, temperature acquisition, SOC/SOH estimation, balancing, charge/discharge control, communication, and safety protection. |
| 2   | Battery Pack                    | Energy storage device including cells/modules, electronic components, HV/LV circuits, cooling, and mechanical assembly.                                                                                                                                     |



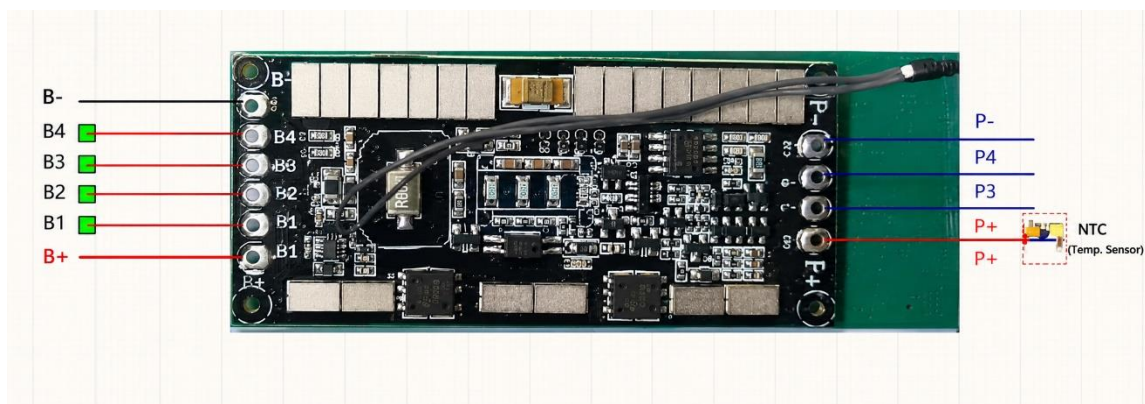
## 4 Overview

This BMS product is developed for medium- and low-voltage lithium battery packs, suitable for mainstream 3.2V and 3.7V lithium batteries. The main control board and power output board are available in integrated and separate types. The power output board supports max continuous 45A charge/discharge. The system integrates cell voltage monitoring, cell balancing, overcharge/over-discharge protection, temperature monitoring, charge/discharge control, thermal management, and data communication, ensuring safe and stable operation. High-precision SOC/SOH algorithms improve health management and extend service life.

## 5 Product Working Principle



(Figure 1 Product Framework Diagram)



This BMS system has an integrated main control and power output structure. The main control performs battery status acquisition (voltage, current, temperature), SOC calculation, data storage, communication, and charge/discharge logic control. The power output executes charging/discharging on/off actions.



Two operation modes: (1) Normal mode: after power-on, BMS detects battery status in real time and executes charging/discharging, protection, and communication. (2) Deep sleep mode: when any cell voltage drops below over-discharge protection value, BMS enters deep sleep after 1 min delay; charger signal can wake up BMS.

## 6 Function Description

### 6.1 Voltage Detection, Balancing and Protection

Includes total voltage and cell voltage detection. According to configured undervoltage/overvoltage/balancing thresholds, the system performs cell voltage balancing and overcharge/over-discharge alarm and protection.

### 6.2 Current Detection and Protection

Includes bidirectional charge/discharge current detection. According to configured overcurrent/short-circuit parameters, performs overcurrent alarm and short-circuit protection.

### 6.3 Temperature Detection and Protection

Supports multi-channel temperature detection and power component overheat detection. Monitors operation in high/low temperature environments and performs temperature alarms and protection.

### 6.4 Battery SOC Calculation

SOC is a core parameter. The system uses an optimized Kalman filter method, controlling SOC error within 5% with automatic calibration capability.

### 6.5 Data Communication

The system has a communication interface supporting PC software connection for viewing real-time status and configuring parameters.

### 6.6 Charge/Discharge Control

In normal mode, charging is enabled; discharging enables on power-on button. On abnormality (overcharge/discharge, over-temp, over-current, short circuit), charging/discharging closes immediately. After delay or fault removal, functions re-enable. In deep sleep mode, discharging is prohibited; charging is enabled; charger connection wakes up BMS.

### 6.7 Sleep and Wake-up

Two low-power modes: (1) Normal sleep: BMS enters sleep after set static time; charger/button signal wakes to normal mode. (2) Deep sleep: when any cell voltage < over-discharge protection, BMS enters deep sleep after 1 min; charger signal wakes BMS.

## 7 Product Technical Specifications

*Table 3 Product technical specifications*



## 7.1 Single cell parameters

|   | Parameter                                   | Min | Typical           | Max | Deviation | Unit |
|---|---------------------------------------------|-----|-------------------|-----|-----------|------|
| 1 | Single cell overcharge protection voltage   |     | 4.28              |     | ±0.025    | V    |
| 2 | Single cell overcharge protection delay     |     | 3                 |     | ±1        | S    |
| 3 | Single cell overcharge release voltage      |     | 4.15              |     | ±0.025    | V    |
| 4 | Single cell undervoltage protection voltage |     | 2.75<br>(warning) |     | ±0.025    | V    |
| 5 | Single cell undervoltage protection delay   |     | 3                 |     | ±1        | S    |
| 6 | Single cell undervoltage release voltage    |     | 3                 |     | ±0.025    | V    |
| 7 | Balancing start voltage                     |     | 4                 |     | ±0.02     | V    |
| 8 | Balancing start voltage difference          |     | 0.05              |     | ±0.02     | V    |
| 9 | Balancing current                           |     | 5                 |     | ±10       | mA   |

Note: Avoid using large charge/discharge cabinets for charging-related protection tests.



## 7.2 Battery pack parameters

|   | Parameter                                    | Min | Typical        | Max | Deviation | Unit |
|---|----------------------------------------------|-----|----------------|-----|-----------|------|
| 1 | Battery pack charge max voltage              |     | 25.68          |     | ±1.0      | V    |
| 2 | Battery pack overvoltage protection delay    |     | 5              |     | ±1        | S    |
| 3 | Battery pack undervoltage protection         |     | 16.5 (warning) |     | ±1.0      | V    |
| 4 | Battery pack undervoltage protection delay   |     | 5              |     | ±1        | S    |
| 5 | Battery pack undervoltage protection release |     | 18             |     | ±1.0      | V    |

## 7.3 Battery temperature protection

|   | Parameter                                | Min              | Typical | Max             | Deviation | Unit |
|---|------------------------------------------|------------------|---------|-----------------|-----------|------|
| 1 | Charge temperature protection            | -5               |         | 65              | ±3        | °C   |
| 2 | Charge temperature protection release    | 0                |         | 55              | ±3        | °C   |
| 3 | Discharge temperature protection         | -20<br>(warning) |         | 70<br>(warning) | ±3        | °C   |
| 4 | Discharge temperature protection release | -10              |         | 60              | ±3        | °C   |
| 5 | Battery temperature monitoring points    |                  | 1       |                 |           | ch   |



|   | Parameter                                | Min | Typical                | Max | Deviation | Unit |
|---|------------------------------------------|-----|------------------------|-----|-----------|------|
| 6 | Power switch overtemp protection         |     | 90 (discharge warning) |     | ±3        | °C   |
| 7 | Power switch overtemp protection delay   |     | 10                     |     | ±1        | S    |
| 8 | Power switch overtemp protection release |     | 80                     |     | ±3        | °C   |

## 7.4 Board-level parameters

|   | Parameter                             | Min                                                                 | Typical      | Max | Deviation | Unit |
|---|---------------------------------------|---------------------------------------------------------------------|--------------|-----|-----------|------|
| 1 | Rated charge current                  |                                                                     | 30           |     | ±5        | A    |
| 2 | Charge overcurrent protection         |                                                                     | 45           |     | ±5        | A    |
| 3 | Charge overcurrent protection delay   |                                                                     | 5            |     | ±1        | S    |
| 4 | Charge overcurrent protection release | Delayed 30S recovery<br>(3 consecutive protections: remove charger) |              |     |           |      |
| 5 | Rated discharge current               |                                                                     | 45           |     | ±5        | A    |
| 6 | Peak discharge current                |                                                                     | 50           |     | ±5        | A    |
| 7 | Peak discharge duration               |                                                                     | 10           |     | ±1        | S    |
| 8 | Level 1 discharge overcurrent         |                                                                     | 67 (warning) |     | ±10       | A    |



|    | Parameter                                | Min                                                                                                                                     | Typical | Max | Deviation | Unit |
|----|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|---------|-----|-----------|------|
| 9  | Level 1 discharge overcurrent delay      |                                                                                                                                         | 1       |     | ±1        | S    |
| 10 | Level 2 discharge overcurrent            |                                                                                                                                         | 88      |     | ±10       | A    |
| 11 | Level 2 discharge overcurrent delay      |                                                                                                                                         | 320     |     | ±100      | mS   |
| 12 | Discharge overcurrent release            | Remove load to recover                                                                                                                  |         |     |           |      |
| 13 | Short circuit protection value           |                                                                                                                                         | 360     |     | ±20       | A    |
| 14 | Short circuit protection delay           |                                                                                                                                         | 200     |     | ±100      | uS   |
| 15 | Short circuit protection release         | Remove load to recover                                                                                                                  |         |     |           |      |
| 16 | Short circuit note                       | Theoretical value; too small/large may cause protection failure or device damage. Evaluate actual short-circuit current before testing. |         |     |           |      |
| 17 | Normal operation power consumption       |                                                                                                                                         | 10      |     | ±5        | mA   |
| 18 | Normal sleep power consumption           |                                                                                                                                         | 2       |     | ±1        | mA   |
| 19 | Over-discharge standby power consumption |                                                                                                                                         | 2       | 100 | ±10       | uA   |
| 20 | Working temperature range                | -20                                                                                                                                     |         | 70  |           | °C   |



|   | Parameter                       | Value                                    |
|---|---------------------------------|------------------------------------------|
| 1 | Storage temperature             | -40 ~ 85°C                               |
| 2 | Charge/discharge interface type | Common-port                              |
| 3 | Communication interface         | CAN: Baud rate 1000bps, BMS ID: 20       |
| 4 | Button function                 | 1 onboard button, wake up BMS from sleep |
| 5 | Board dimensions (L x W x H)    | ≤68 x 30 x 8 mm                          |
| 6 | Installation method             | Internal, M2 screws                      |

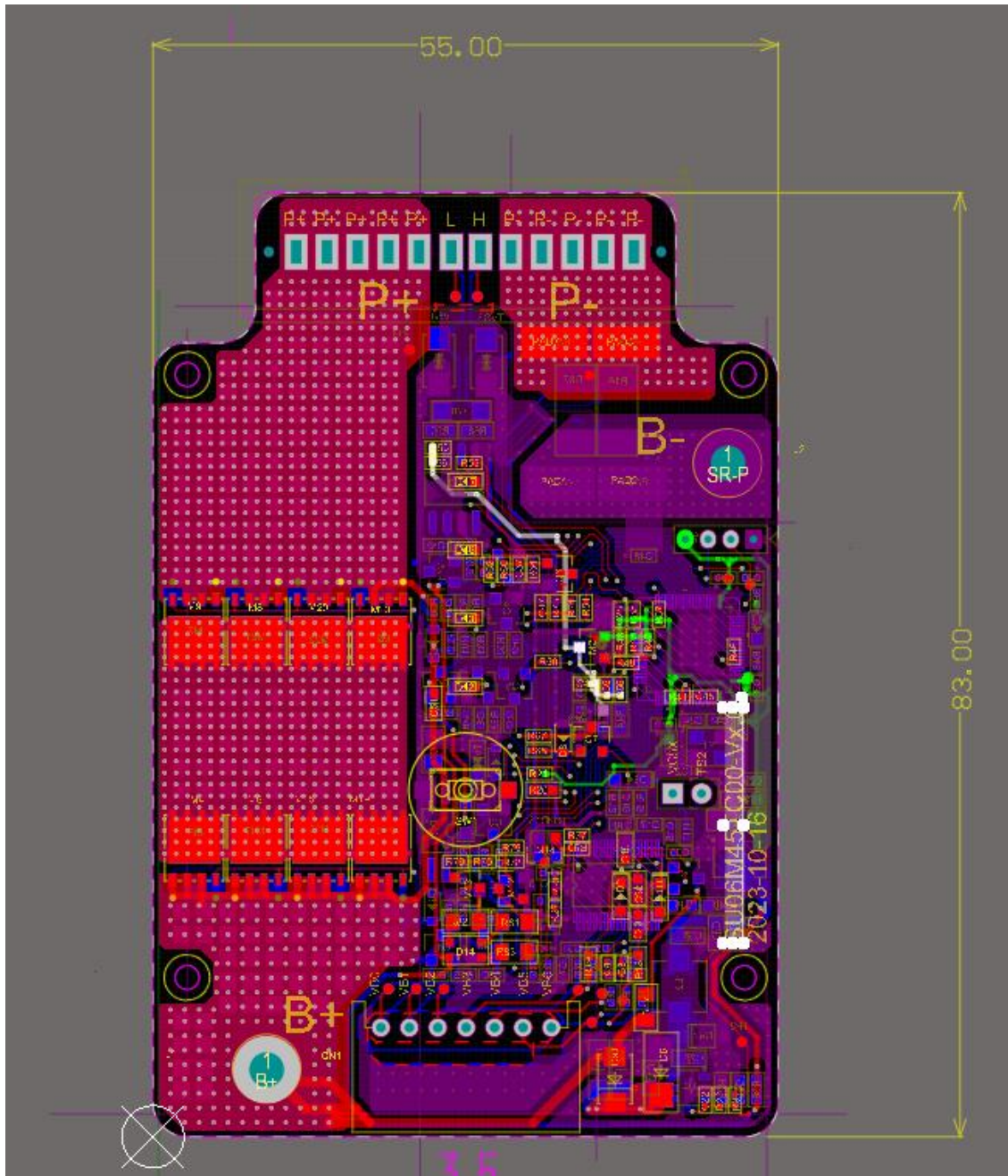


## 8 Product Installation and Use

### 8.1 Electrical Wiring Diagram

#### 8.1.1 Charge/Discharge Test Wiring Diagram

(Figure 2 Charge/Discharge Test Wiring Diagram)



Important note: Since the motor controller has freewheeling protection devices, the BMS board is not equipped with high-power freewheeling diodes. When using large charge/discharge test cabinets for discharge tests, connect a freewheeling protection diode (recommended: 200V/100A Schottky diode) in parallel at the test cabinet output. Otherwise, induced voltage may damage BMS power devices. Similarly, avoid using large cabinets for charging-related protection tests.

### **8.1.2 Electrical Wiring Sequence (power-off in reverse)**

Step 1: Connect 1 B- power wire, temperature and communication wires.

Step 2: Connect low-voltage acquisition wires first, then high-voltage wires in order.

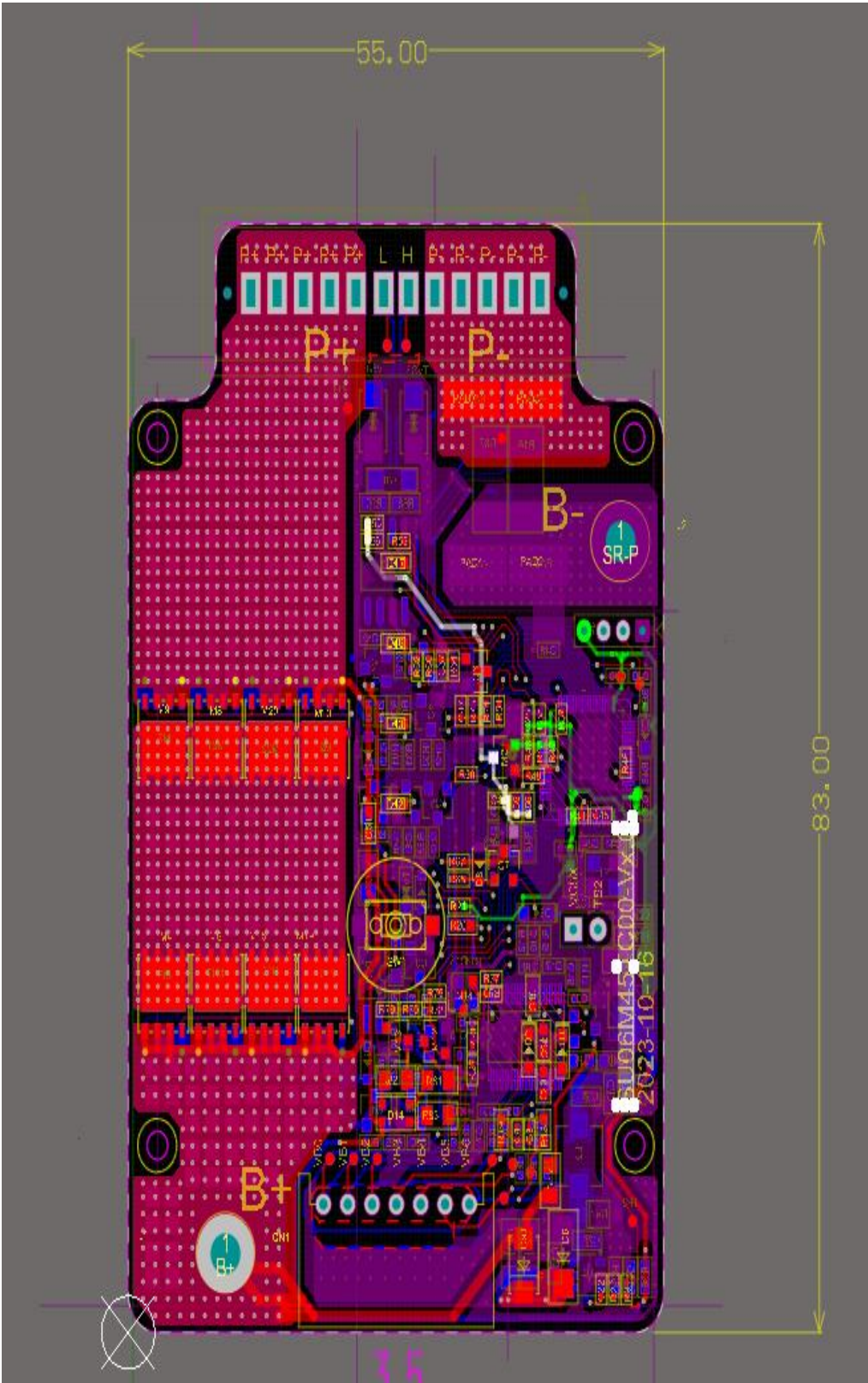
Step 3: Connect 1 P- power wire to load or charger negative.

Step 4: Connect load or charger positive to battery pack P+ terminal.

Note: After undervoltage, charger ON&CRG combined signal is needed to activate BMS.



8.2 PCB Board Layout and Dimension Diagram



(Figure 3 PCB Layout and Dimension Diagram)



### 8.3 BMS Board Interface Definition

Voltage acquisition interface:

| Pin | Definition | Description     | Pin | Definition | Description     |
|-----|------------|-----------------|-----|------------|-----------------|
| 1   | VB0        | Cell 1 negative | 2   | VB1        | Cell 1 positive |
| 3   | VB2        | Cell 2 positive | 4   | VB3        | Cell 3 positive |
| 5   | VB4        | Cell 4 positive | 6   | VB5        | Cell 5 positive |
| 7   | VB6        | Cell 6 positive | 8   |            |                 |

Output communication interface:

| Pin | Definition | Description                    | Pin  | Definition | Description                    |
|-----|------------|--------------------------------|------|------------|--------------------------------|
| 1-5 | P-         | Charge/discharge port negative | 6    | L          | CAN H                          |
| 7   | L+         | CAN L                          | 8-12 | P+         | Charge/discharge port positive |

### 8.4 BMS Physical Diagram

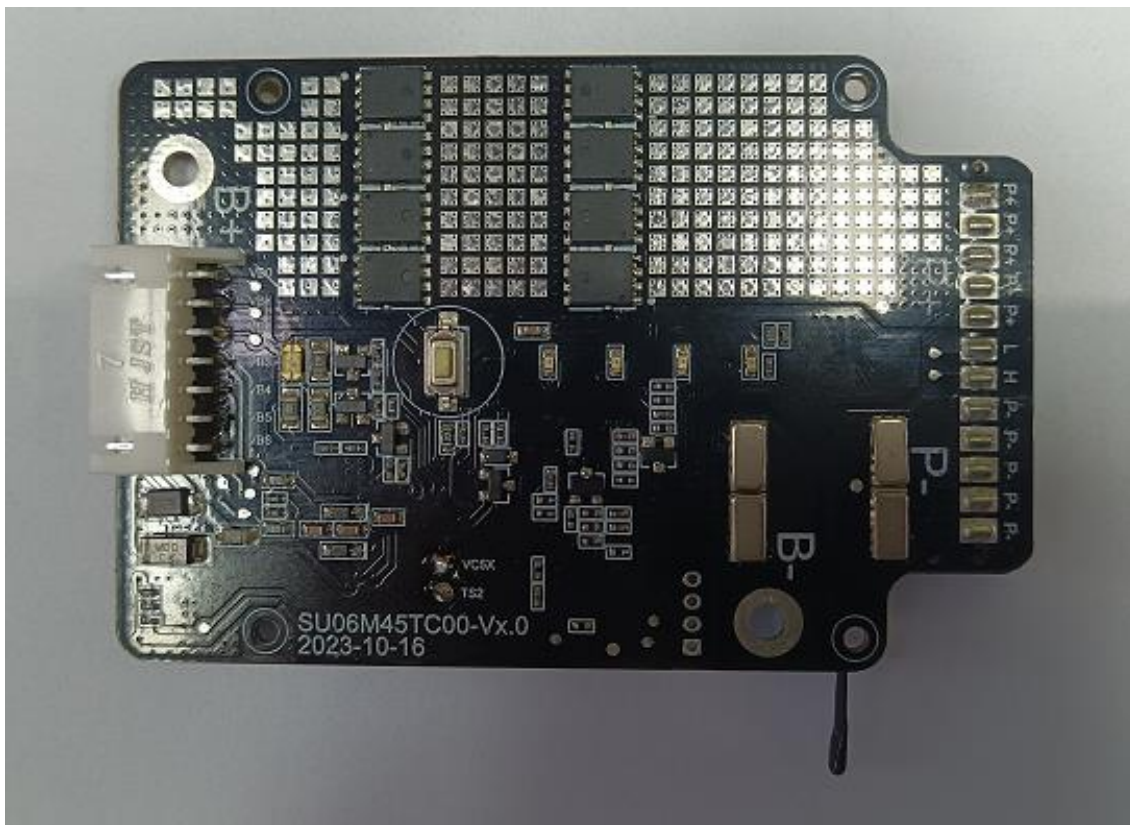




Figure A (1 is the High-Stress Area)



## 9 Product Usage Precautions

### 9.1 Temperature Sensor Installation

The on-board temperature sensor monitors battery pack temperature. Attach the probe tightly to the cell in the middle of the battery pack to measure the most concentrated temperature area.

### 9.2 Bluetooth/GPS Module Installation

The Bluetooth/GPS module is independent. To ensure signal strength, the antenna must not be shielded by metal housing or blocked.

### 9.3 Electrical Wiring Instructions

When connecting BMS to battery pack, first connect the battery pack total negative to B- power wire for reliable grounding. The impedance from battery pack total negative to BMS B- terminal should be within  $0.1\text{m}\Omega$  to ensure voltage detection accuracy during high-current operation.

### 9.4 Assembly Precautions

#### 9.4.1 ESD Protection

Prevent electrostatic discharge during assembly and use. Do not touch conductive parts of the circuit board. Soldering irons and electric tools must be well grounded.

#### 9.4.2 Mechanical Stress

Avoid mechanical stress on the circuit board to prevent damage to electronic components and board failure.

#### 9.4.3 Hot Swap Prohibition

Bluetooth/GPS modules and LCD screens must not be hot-swapped to avoid damaging the BMS board.

#### 9.4.4 BMS Board Wiring Specification

BMS board wiring shall follow these requirements:

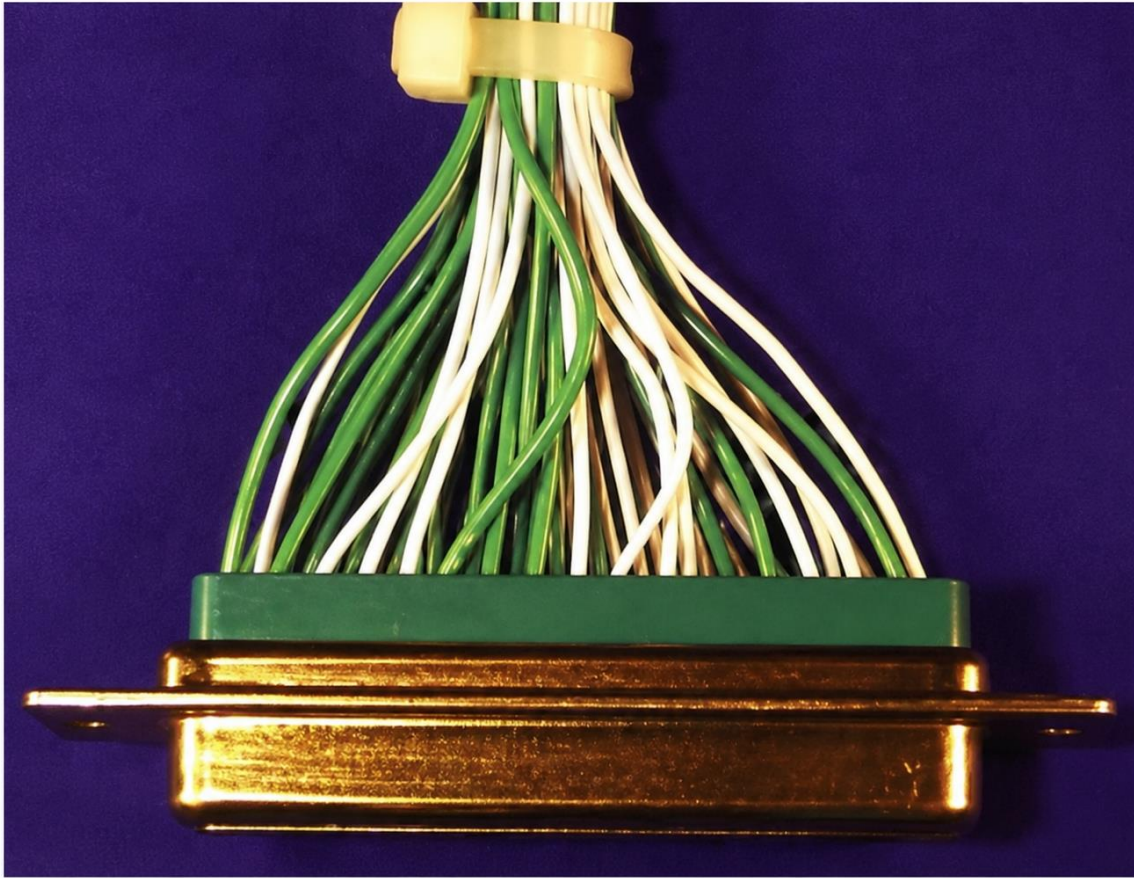
A. Straight wiring: Wire bundle tying point at connector width position

Target (Figure A): Wire exit perpendicular to connector; sufficient distance to prevent stress.

Qualified (Figure B): Wire exit nearly perpendicular; no stress.

Unqualified: Wire too long (Figure C-A); acute angle exit (C-B); wire stress (C-C)





## Figure B

B. Side wiring: Wire bending point at 1/3 connector width position

Target (Figure A): Wire direction perpendicular to connector before bending; no stress.

Qualified (Figure B): Wire exit nearly perpendicular to connector surface.

Unqualified (Figure C): Wire too long (A); acute angle (B); stress (C, D)



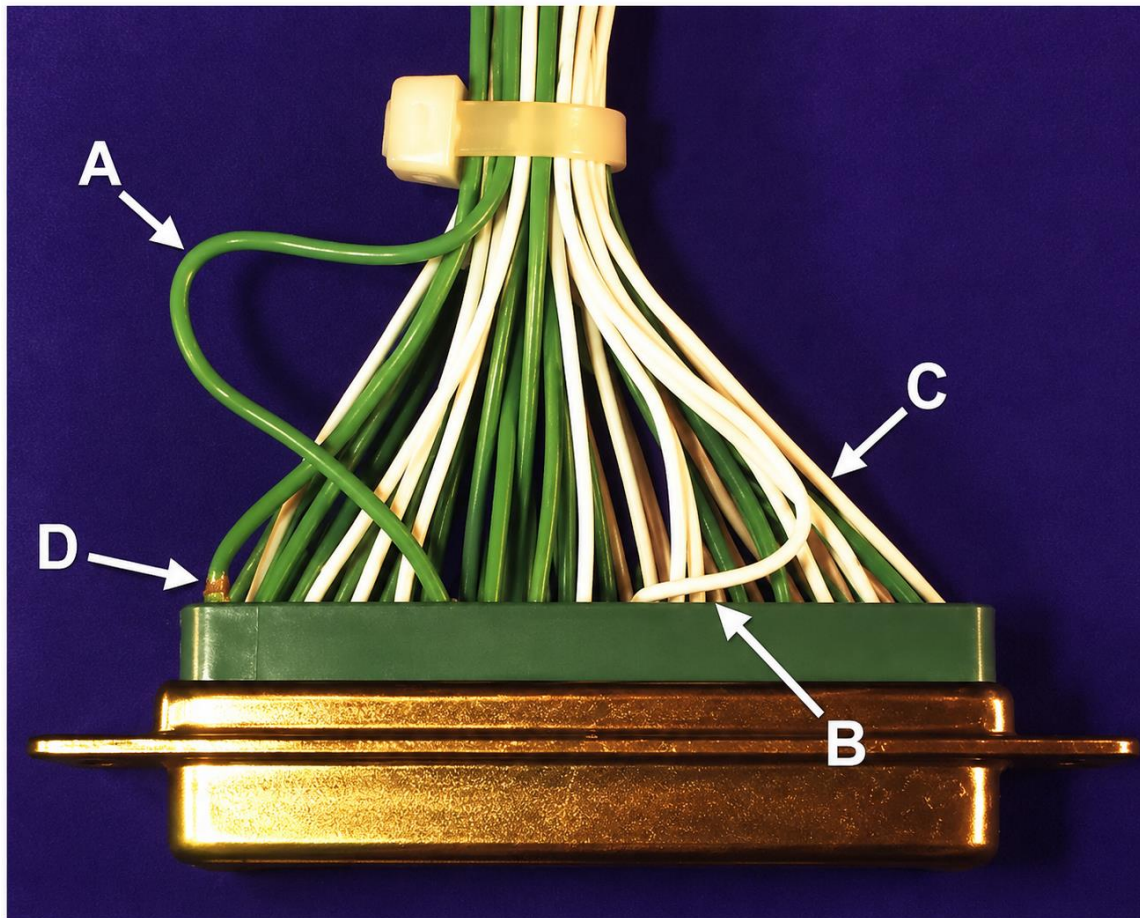


Figure C

C. Wire harness fixing:

Fix wire harnesses with clips or ties on box/mounting plate. Requirements: neat wiring, firm fixing, no sagging, no interference stress, no friction damage. Fixing points within 30-50mm of connector; spacing between points  $\leq 200\text{mm}$ ; points within 80mm at corners/edges.



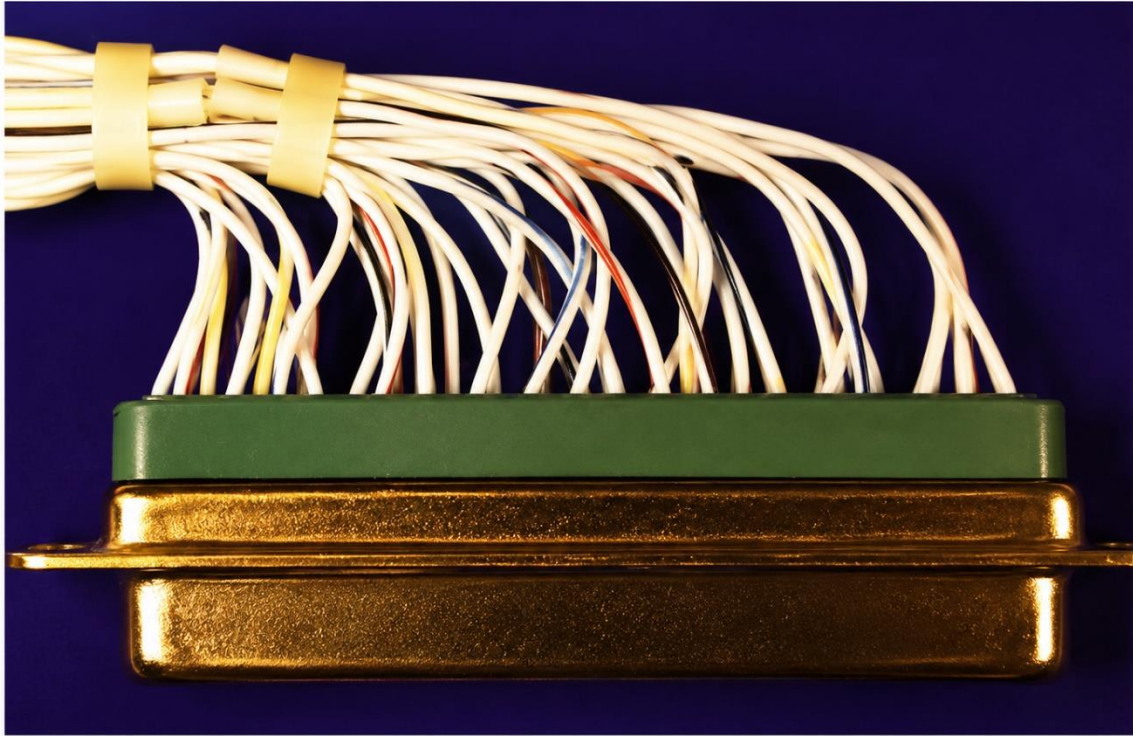
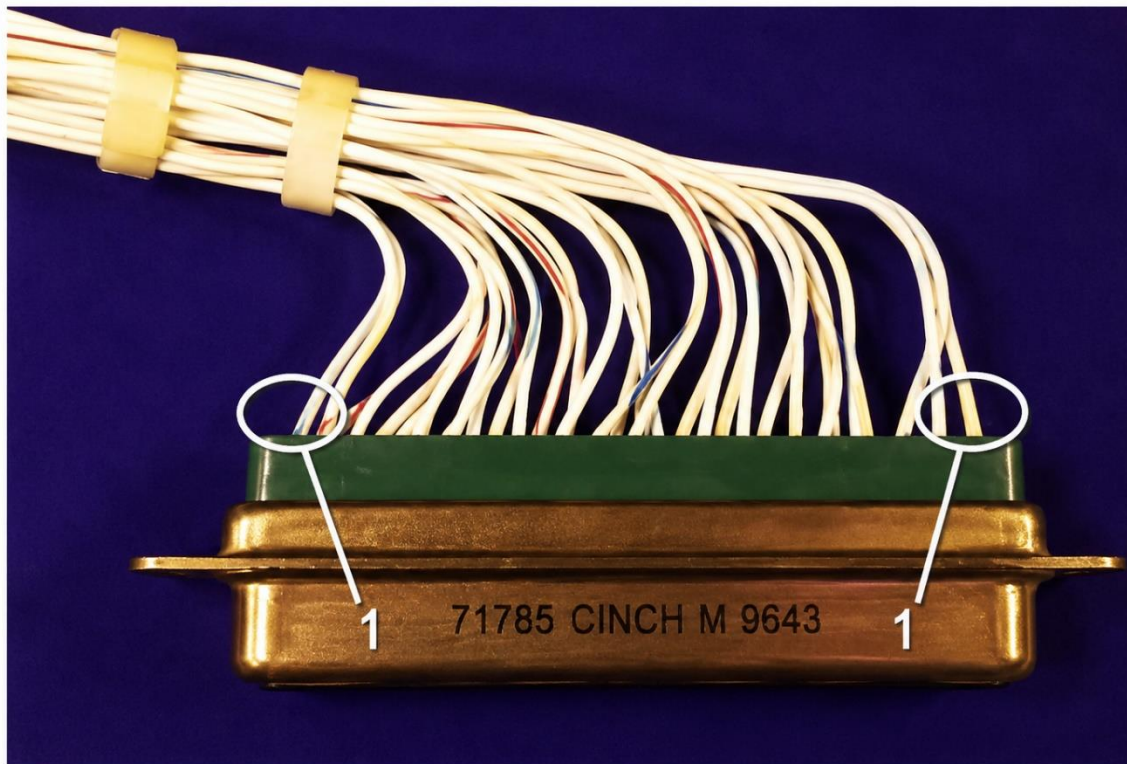


Figure A





**Figure B (1 is the High-Stress Area)**

After installation, ensure connector buckle is in place. Apply fixing glue at wire harness shell/BMS connector intersection and around buckle.

