AYAA TECHNOLOGY CO., LTD

Datasheet

EF-002 Drone BMS

Product Specification

EF-002-Vx1.0

Battery Management System (BMS)

Customer	
Product Name	EF-002
Model No.	SU18M240TCB00
Output Mode	Power MOSFET
Technology	PCBA with Conformal Coating
Issue Date	2026.01.11
Revision	Vx.1.0

Prepared	Checked	Reviewed	Approved
Xiaolong Huang	Dong		Feiqiang Chen

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1. Product Introduction

The EF-002 Vx1.0 is a software-based BMS specifically designed for 18-series lithium battery packs with B- output control. It is compatible with various battery chemistries, including lithium-ion (Li-ion), lithium polymer (LiPo), lithium iron phosphate (LiFePO4), sodium-ion, and lithium manganese oxide (LMO). The BMS supports CAN communication for data transmission, enabling the host computer to read, monitor, and modify electrical parameters in real time.

2. Function Block Diagram

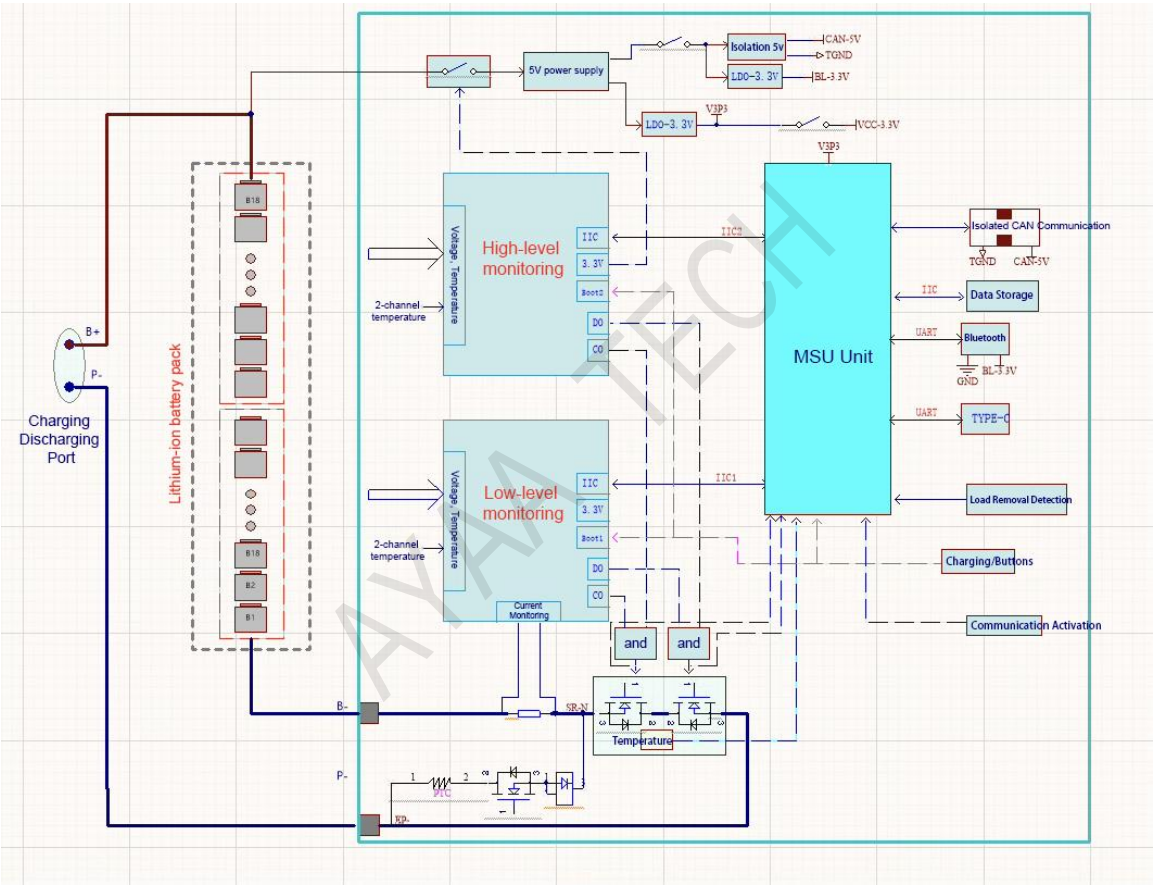


Figure 2-1: BMS Function Block Diagram

3. Configuration

Function	Configuration
Number of Series Cells	18S
Discharge Continuous Current	240A
Charge Continuous Current	120A
RS485 Communication	Isolated RS485
TYPE-C Communication	Standard Option (without 120Ω resistor)
CAN Communication(Isolated)	Standard Option (without 120Ω resistor)
NTC Channels	4 battery temperature probes + 1 MOS temperature probe
Heating Function	Standard Option
Balancing	Passive balancing
Bluetooth Module	Standard Option
Power Switch	Standard Option
Battery Series Connection	/
Battery Parallel Connection	Supported
Charging Current Limit	/
Secondary Protection	/
LCD Display	/
Data Logging	Standard Option

LED Indicator	Standard Option
Pre-discharge Function	Standard Option
GPS Interface	/
RTC Function	Standard Option

Note: Non-isolated communication interfaces do not support direct communication with chargers or loads.

4. Parameter Settings

4.1 Basic Parameters

Parameter	Specification
Battery Pack Configuration	18S Ternary Lithium Battery
Port Type	Common charge/discharge port
Charging Voltage	4.35V per cell
Cell Voltage Range	3.30V - 4.35V
Continuous Charging Current	120A
Continuous Discharging Current	240A
CAN Baud Rate / ID	1 Mbps / ID: 1
TYPE-C Baud Rate / ID	115200 bps / ID: 1
BLE Baud Rate / ID	115200 bps / ID: 1
Operating Current Consumption	<= 30 mA
Sleep Current Consumption	<= 2 mA
Sleep Condition	No current, no communication, no protection active
Deep Sleep Current Consumption	<= 100 uA
Deep Sleep Condition	Cell under-voltage state
Operating Temperature	-30 C to +70 C
Board Dimensions (L x W x H)	218.9 mm (L)x 123.2 mm(W) x 25 mm (+/-1 mm)(H)

4.2 Main Parameters

4.2.1 Cell Parameter

Category	Specification			
	MIN	**TYP**	**MAX**	**Unit**

Single Cell Over-Charge Protection	Over-charge Voltage Protection	4.33	4.35	4.37	V
	Over-Charge Voltage Protection Delay Time	/	1000	2000	mS
	Over-Charge Voltage Protection Release	3.18	4.20	4.22	V
Single Cell Over-Discharge Protection	Over-Discharge Voltage Protection	3.20**(Warning only if current > 10A)**	3.30**(Warning only if current > 10A)**	3.50**(Warning only if current > 10A)**	V
	Over-Discharge Voltage Protection Delay Time	/	1000	2000	mS
	Over-Discharge Voltage Protection Release	3.48	3.5	3.52	V

4.2.2 Cell Balancing Parameters

Category		MIN	TYP	MAX	Unit
Balancing Voltage	Balancing Start Voltage	3.78	3.8	3.82	V
	Balancing Start Voltage Different	0.03	0.05	0.07	V
	Balancing Current	30	50	70	mA
	Balancing Mode	Passive Balancing			

4.2.3 Current Protection Parameters

Category		MIN	TYP	MAX	Unit
Over-Charge Current Protection	Over-Current Charge Protection	130	140	150	A
	Over-Current Charge Protection Delay Time	2000	3000	4000	mS

	Over-Current Charge Protection Release	Auto-recovery after 30s delay			
Over-Discharge Current Protection	1st Level Over-Discharge Current	240(Warning only; no cutoff)	250(Warning only; no cutoff)	260(Warning only; no cutoff)	A
	1st Level Over-Discharge Current Delay	9	10	11	S
	2nd Level Over-Discharge Current	950	1000	1050	A
	2nd Level Over-Discharge Current Delay	1000	1050	A	
	Over-Dischartge Current Release	1	1.2	1.4	S

4.2.4 Short-Circuit Protection Parameters

Category		MIN	TYP	MAX	Unit
Short-Circuit Protection	Short-Circuit Protection Current	1000	1065	1200	A
	Short-Circuit Protection Delay	/	70	400	uS
	Short-Circuit Protection Release	Auto-recovery after 30s delay			

Note: The minimum and maximum short-circuit current values define the effective protection range. Currents below the minimum or above the maximum may cause the short-circuit protection to fail. Please evaluate the actual short-circuit current or add series resistance before conducting short-circuit tests.

4.2.5 Cell Temperature Protection Parameters

Category		MIN	TYP	MAX	Unit
Charging Temperature Protection	Charging High-Temperature Protection	63	68	73	℃

	Charging High-Temperature Recovery	60	65	70	℃
	Charging Low-Temperature Protection	0	5	10	℃
	Charging Low-Temperature Recovery	5	10	15	℃
Discharging Temperature Protection	Discharging High-Temperature Protection	85 (Warning only; no cutoff)	90 (Warning only; no cutoff)	95 (Warning only; no cutoff)	℃
	Discharging High-Temperature Recovery	75	80	85	℃
	Discharging Low-Temperature Protection	-25 (Warning only; no cutoff)	-20 (Warning only; no cutoff)	-15 (Warning only; no cutoff)	℃
	Discharging Low-Temperature Recovery	-15	-10	-5	℃

4.2.6 MOS Temperature Protection Parameters

Category		MIN	TYP	MAX	Unit
MOS High-Temperature Protection	**Temperature Protection Value**	85 **(Warning only; no cutoff)**	90 **(Warning only; no cutoff)**	95 **(Warning only; no cutoff)**	℃
	Temperature Protection Release	75	80	85	℃

4.2.7 Total Voltage Protection Parameters

Category		MIN	TYP	MAX	Unit
	Overall Over-Charge Protection Voltage	78.51	78.66	78.81	V

Total Over-Charge Protection Voltage	**Overall Over-Charge Protection Delay**	/	1000	2000	mS
	Overall Over-Charge Protection Release Voltage	77.94	78.30	78.66	V
Total Over-Discharge Protection Voltage	**Overall Over-Discharge Protection Voltage**	59.20**(Warning only if current > 10A)**	59.40**(Warning only if current > 10A)**	59.60**(Warning only if current > 10A)**	V
	Overall Over-Discharge Protection Delay	/	1000	2000	mS
	Overall Over-Discharge Protection Release Voltage	62.64	63.00	63.36	V

4.2.8 Heating Management Parameters

Category		MIN	TYP	MAX	Unit
Heating Management	**Heating Start Temperature**	-	0	-	℃
	Heating Stop Temperature	-	10	-	℃
	Heating Current	10			A
	Heating Method	Charging-based heating			

5. Bill of Critical Materials

No.	Component	Manufacturer	Package	Qty
1	GD32F103RCT6	GigaDevice	LQFP-64	1
2	BQ7693003DBTR	Texas Instruments (TI)	TSSOP-44	2

Note: To ensure supply chain security, we maintain qualified alternative components of equivalent quality and specifications for all BMS materials, particularly critical components. If certification requirements prohibit component substitution, or if client approval is required prior to any change, please notify our sales team to resubmit sample proposals and confirm the specification.

6. Product Diagrams and Dimensions

6.1 Product Photos and Interfaces

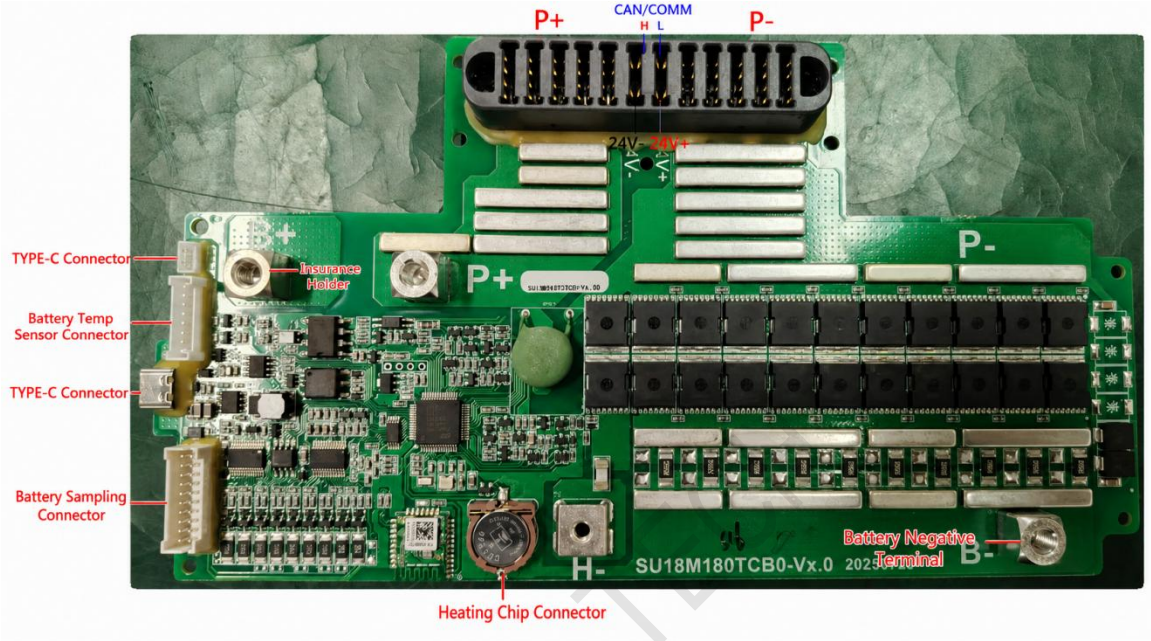


Figure 6-1: Product Photo - Component Side

6.2 Cell Voltage Sampling Interface (J1)

No.	PIN	Pin Function	No.	PIN	Pin Function
1	B9	Cell 9 positive	2	B+	Cell 18 positive (pack positive)
3	B8	Cell 8 positive	4	B18	Cell 18 positive
5	B7	Cell 7 positive	6	B17	Cell 17 positive
7	B6	Cell 6 positive	8	B16	Cell 16 positive
9	B5	Cell 5 positive	10	B15	Cell 15 positive
11	B4	Cell 4 positive	12	B14	Cell 14 positive
13	B3	Cell 3 positive	14	B13	Cell 13 positive
15	B2	Cell 2 positive	16	B12	Cell 12 positive

17	B1	Cell 1 positive	18	B11	Cell 11 positive
19	B0	Cell 1 negative (pack negative)	20	B10	Cell 10 positive

6.3 Temperature Sampling Interface (J2)

No.	PIN	Pin Function	No.	PIN	Pin Function
1	T4-	Temperature sensor 4 negative	2	T4+	Temperature sensor 4 positive
3	T3-	Temperature sensor 3 negative	4	T3+	Temperature sensor 3 positive
5	T2-	Temperature sensor 2 negative	6	T2+	Temperature sensor 2 positive
7	T1-	Temperature sensor 1 negative	8	T1+	Temperature sensor 1 positive

6.4 Communication Interface

No.	PIN	Pin Function
1	GND	TYPE-C Ground
2	D-	TYPE-C Data Negative
3	D+	TYPE-C Data Positive
4	5V	TYPE-C 5V Power

6.5 Product Dimensions

Board Dimensions: 218.9 mm (L) x 123.2 mm (W) x 25 mm (H), tolerance +/-1 mm.

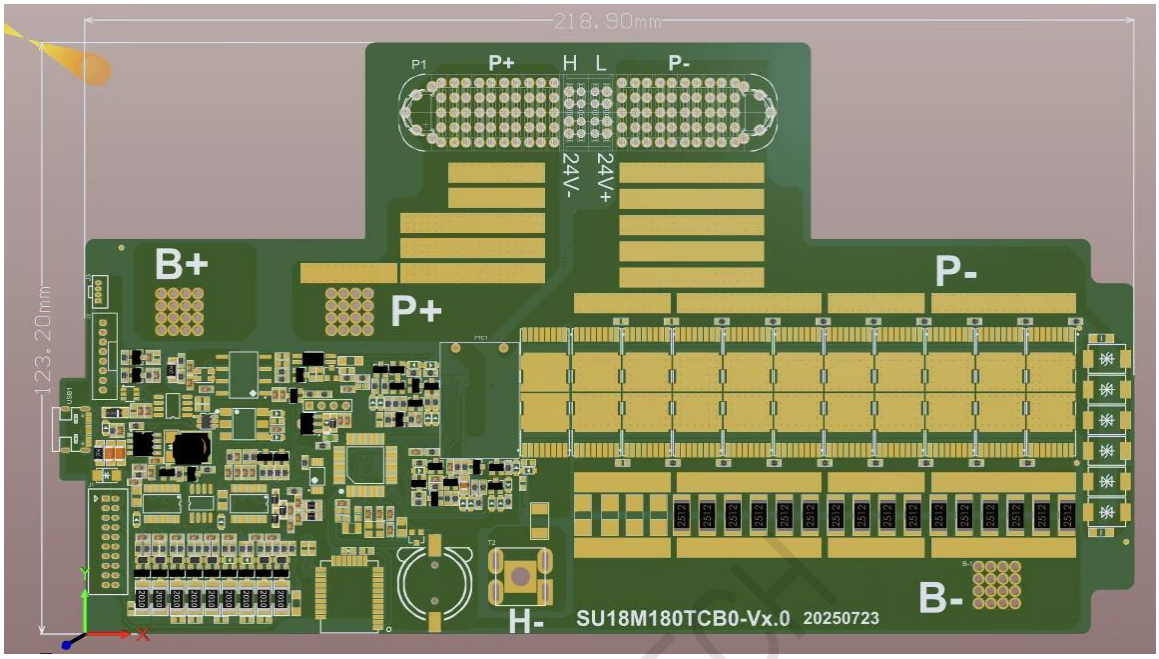


Figure 6-5: Product Photo - PCB Dimensions (218.9 mm x 123.2 mm)

7. Wiring Harness

7.1 Cell Voltage Sampling Cable: PHSD-2x10Y / UL3266-24AWG / 700 mm / HZSW03

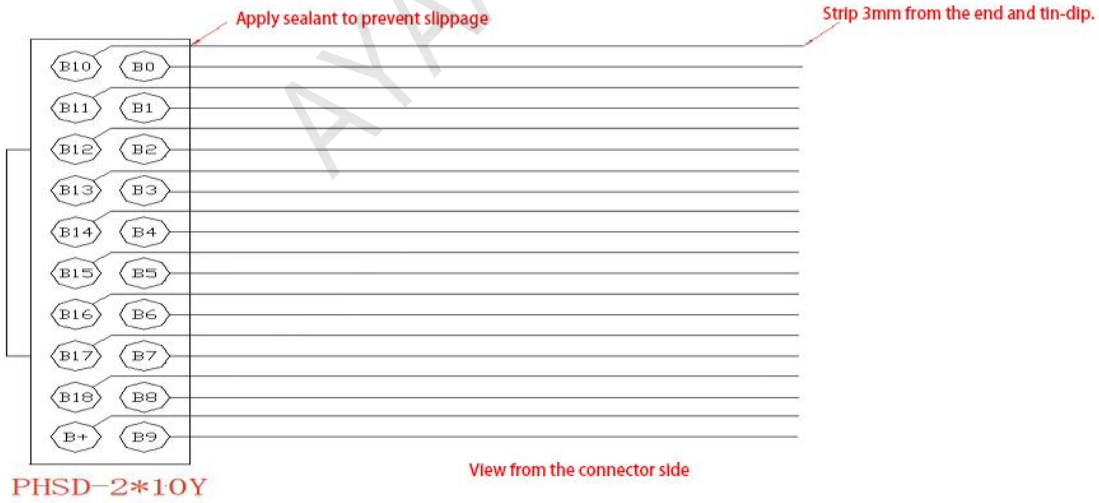


Figure 7-1: 18S Voltage Sampling Harness Definition (PHSD-2x10Y)

Figure 7-1: 14S Voltage Sampling Harness - Pin Assignment Detail

7.2 Temperature Cable: PHB-4Y / UL3266-24AWG / 700 mm / HZSW03 / with 3950-10K-1% NTC

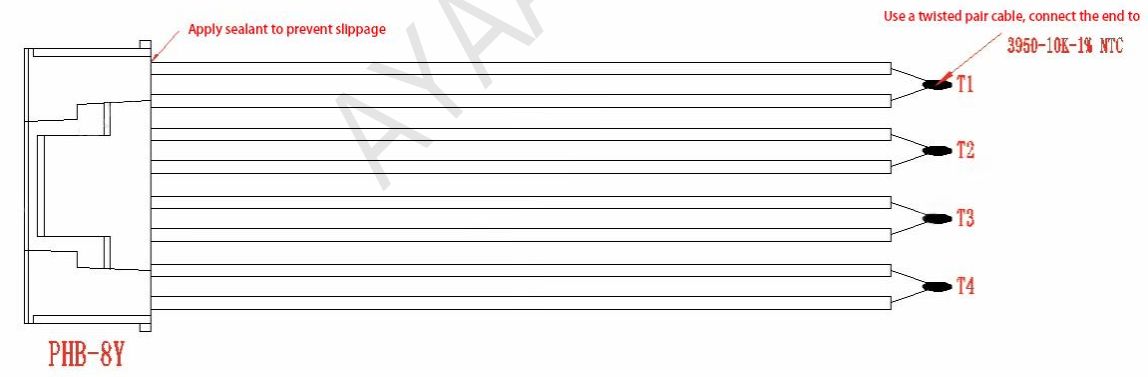


Figure 7-2: Temperature Sampling Harness Definition (PHB-4Y)

7.3 TYPE-C Communication Cable: 1.25-4Y dual-head / UL3266-28AWG / 500 mm / DGHY03

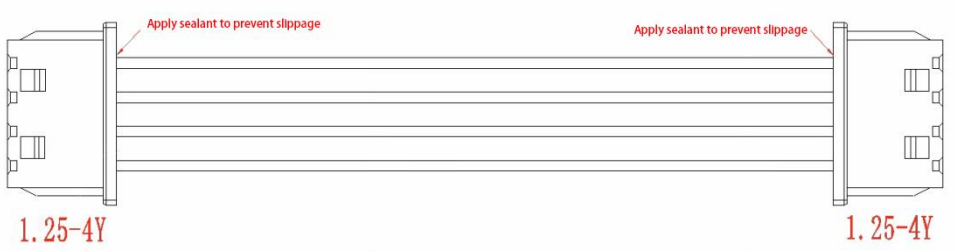


Figure 7-3: TYPE-C Communication Cable Definition

8. Installation Instructions

8.1 Charge / Discharge Wiring Diagram

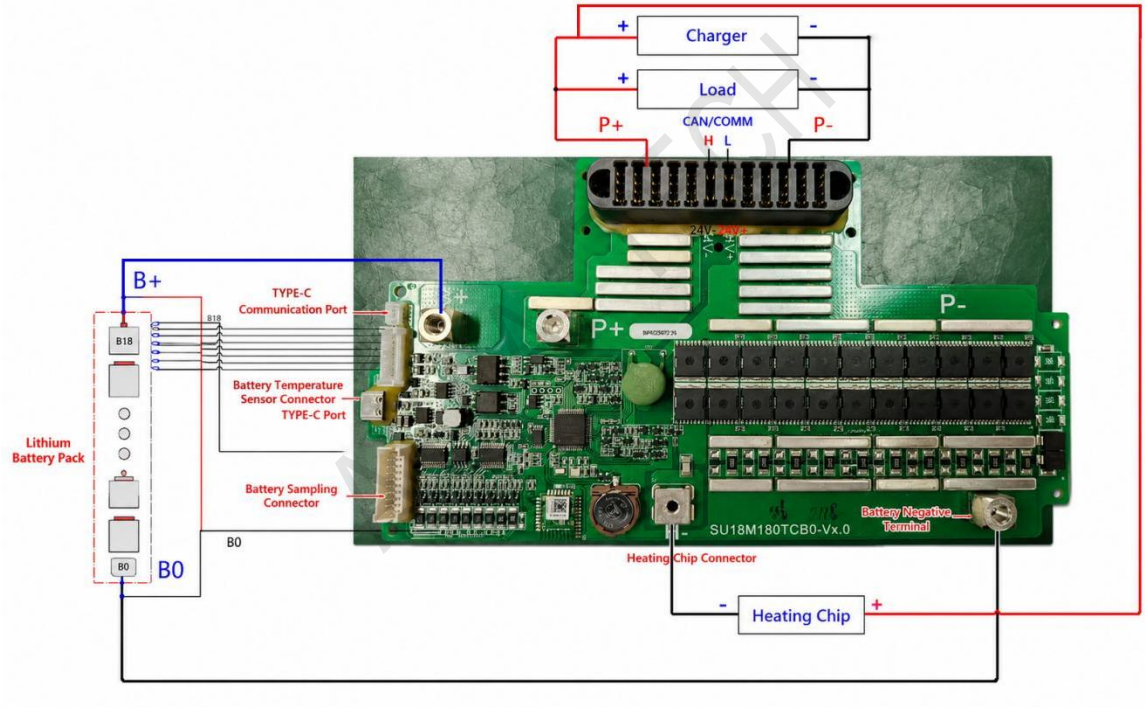


Figure 8-1: System Charge/Discharge Wiring Diagram

8.2 Connection Sequence

- Power-Up Sequence:

  Step 1: Connect the main board B- terminal to the battery pack negative terminal.

  Step 2: Connect the temperature sensor cable, RS485 communication cable, and start signal cable.

Step 3: Connect the cell voltage sampling cable.

Step 4: Connect the P- power wire to the load negative or charger negative, or connect the C- wire to the charger negative.

Step 5: After verifying all connections are correct, briefly short-circuit K+ and K- for 1 second, then release. The BMS will power on and perform a self-test. If the status LED blinks once per second, the system is operating normally. If the LED blinks three times per second, an alarm condition exists.

- Power-Down Sequence:

  Step 1: Disconnect the charger and load.

  Step 2: Disconnect the voltage sampling cable.

  Step 3: Disconnect all communication cables.

  Step 4: Disconnect the main board B- terminal.

Note on Welded Connections: If the voltage sampling cable is soldered directly:
A) Pre-tin both the BMS solder pads and the cable ends before live soldering to minimize heat exposure.
B) Solder in sequence: B1 > B2 > ... > B+. Verify all connections before powering on.
C) Avoid contacting surrounding components and PCB traces during soldering.

8.3 Temperature Sensor Installation

The onboard temperature sensors are used to monitor battery pack temperature. During installation, place the sensor probe firmly against a single cell located in the middle of the battery pack to ensure measurement at the area of highest thermal concentration.

8.4 Electrical Wiring Instructions

When connecting the BMS to the battery pack, first connect the overall pack negative terminal to the BMS B- terminal, ensuring reliable grounding. The impedance of the power line from the pack negative to the BMS B- terminal should be kept within 0.1 mOhm to ensure accurate current detection during high-current charge/discharge operations.

For charge/discharge tests exceeding 50A, both B- and P- power cables on the main board must be fully connected to ensure overcurrent capability and even current distribution across all power devices.

8.5 BMS Unpacking Inspection & Precautions

Before unpacking, inspect the packaging for signs of impact or damage. Handle the packaging and BMS with care; avoid placing the unit upside down.

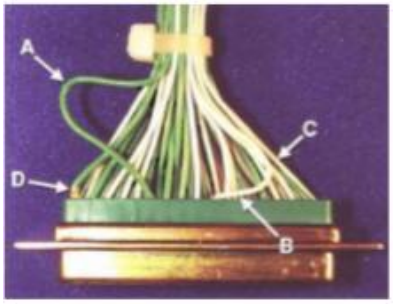
Before installing the BMS, ensure all battery cells are properly matched. Excessively high or low voltage will trigger BMS alarms and prevent normal operation. If any cell is over-charged or over-discharged, adjust it to the normal voltage range before connecting the BMS.

8.6 Wiring Harness Management

8.6.1 B-, P-, B+, P+, H+, H- power cables are separate output lines. Do NOT bundle them with signal cables.

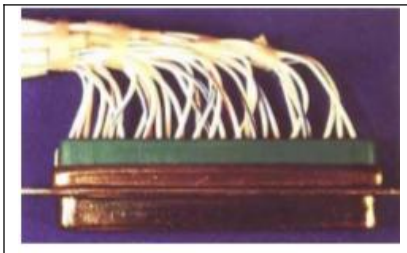
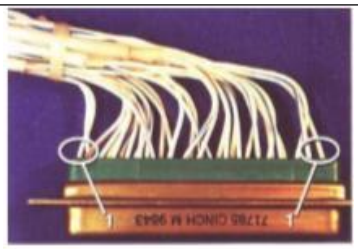
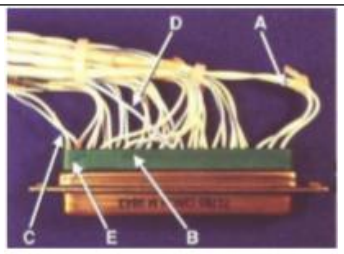
8.6.2 External communication cables (RS485, CAN, 12V activation signal, low-voltage switch signal) must be routed separately from local cables (BLE, GPS, voltage sampling, temperature sampling, display, LED indicator board).

8.6.3 Straight Wiring: The harness tie point should be positioned at a length equivalent to the connector width. The harness exit should be perpendicular to the connector surface with sufficient distance to prevent wire stress.

Objective (Figure A): The wiring harness exit is perpendicular to the connector's surface; there's enough distance between the tie point of the harness and the connector to prevent any stress on the wires.	Acceptable (Figure B): The wiring harness exit is almost perpendicular to the connector; the harness is free from stress.	Not Acceptable (Figure C,A): The length of the wiring harness is too long; The wiring harness exit forms a sharp angle with the connector's surface (Figure C, B); The harness is under stress (with no room for movement whatsoever).
 A (Location 1 is a high-stress zone.)	 B	 C

8.6.4 Lateral Wiring: The harness bend point should be at 1/3 of the connector width. The harness should be perpendicular to the connector before any bending, and free from stress.

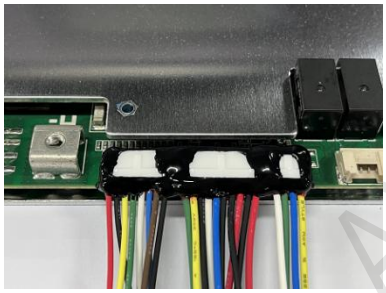
Objective (Figure A): The wire harness should be perpendicular to the connector before any bending; The harness should be free from stress; The harness shouldn't experience stress from any ties.	Acceptable (Figure B): The wire harness exit is nearly perpendicular to the face of the connector.	Not Acceptable (Figure C): • The wire harness is excessively long (A). • A sharp angle is formed between the wire harness exit and the connector (B). • The wire harness has tension or stress (lacks slack or free movement) (C, D).

		
A	B (Location 1 is a high-stress zone.)	C

8.6.5 Wire Harness Fixation: Secure the harness to the enclosure or mounting plate using clips or cable ties. Wiring should be neat, stable, and free from hanging, interference, stress, or friction damage. Fixation points must be within 30-50 mm from each connector, with no more than 200 mm between fixation points. Fixation points should be within 80 mm of corner edges.

8.7 Connector Securing with Adhesive

After wiring harness installation, ensure the connector latch is fully engaged. Apply flame-retardant red or yellow structural adhesive at the junction between the harness connector housing and the BMS connector, as well as around the latch. Adhesive should be applied to both sides of the connector.



8.8 Bluetooth / GPS Module Installation

The Bluetooth/GPS module is a standalone unit. To ensure optimal signal strength, the Bluetooth/GPS antenna must not be shielded or obstructed by any metal enclosure.

8.9 Assembly Precautions

Avoid electrostatic discharge (ESD) during assembly and operation. Do not touch conductive areas of the PCB with bare hands. Ensure soldering irons and power tools are properly grounded.

Avoid applying mechanical stress to the PCB during assembly and operation to prevent damage to electronic components and potential board failure.

Important Note: Since motor controllers typically include freewheeling protection devices, the BMS board does not incorporate high-power freewheeling diodes. When using large-scale

charge/discharge test cabinets, a freewheeling protection diode (recommended: 200V/100A Schottky diode) should be connected across the test cabinet output to prevent inductive voltage spikes during discharge cutoff. Failure to do so may damage power components on the BMS board.

9. Disclaimer

Failure to follow the specified procedures may damage BMS components and render the protection board unable to safeguard the battery pack. The user assumes full responsibility for any consequences resulting from non-compliance with the installation and operating instructions.

10. Fault Diagnosis

NO	(Fault Phenomenon)	(Troubleshooting)
1	Smoke or burnt smell when plugging in the voltage collection harness	1. Immediately disconnect the voltage sampling harness and verify that the cell-end wiring follows the correct sequence: B0, B1, B2, ... to the last cell. Sequence errors, open solder joints, or cold solder joints are not permitted. 2. For BMS boards with multiple voltage sampling interfaces, verify that the low-position harness is connected first, followed by the high-position harness. When disconnecting, remove the high-position harness first, then the low-position. 3. Check for exposed wires causing short circuits or solder beads fallen onto the board.
2	BMS does not power on	1. Check if the status LED is illuminated. If not, try pressing the power switch or charging to activate the BMS. A 1-second blink indicates normal operation; a 200 ms fast blink indicates an alarm or protection condition (connect communication or BLE app to diagnose); a flash every 10 seconds indicates sleep mode (charge or discharge to wake). 2. If the LED is constantly on, the unit may have accidentally entered firmware upgrade mode. Perform a firmware re-upgrade to resolve.

3	Battery pack does not discharge	1. In normal operation mode with no output, check if an external low-voltage switch is configured and try pressing it. Verify via BLE or host computer whether the discharge MOS status is set to '1' (on/discharge allowed) or '0' (off/discharge blocked). 2. No output in sleep mode is normal. Check for switch functionality and try wake-up via switch, charging, or discharging. 3. Check if the LED is fast-blinking at 200 ms, which indicates a protection condition. Connect communication or BLE app to diagnose voltage, current, or temperature abnormalities. 4. Verify whether recovery conditions have been met after a previous protection event.
4	Battery pack does not charge	1. Verify charger compatibility. For blind chargers, confirm output voltage >= pack full-charge voltage. 2. Protocol chargers may not be compatible with the BMS and may fail to charge. 3. Verify charger output voltage is approximately 1.2V higher than the current pack voltage. When the pack is nearly full, failure to charge or recognize the charger is normal. 4. Some BMS boards include a low-voltage switch that controls charging. Try pressing the external switch.

5	Voltage sampling harness overheating	1. Verify the connection sequence at the cell end is correct. Reversed high/low connections cause overheating and may damage board circuits and components. 2. Verify the number of harness strings matches the BMS factory configuration. Mismatched harnesses cause overheating and potential board damage.
6	One cell shows excessive voltage deviation with increasing current	1. Check if the bus bar connection between the affected cell and adjacent cells is firmly soldered. 2. Check if the voltage sampling wire of the affected cell is firmly soldered. 3. Check if the internal resistance of the bus bar connection is excessively high. Soft copper bus bars are strongly recommended for inter-group connections; avoid using power cables.
7	Power loss when connecting load or inverter	1. Check if battery voltage is too low, triggering over-discharge protection. 2. Check if load or inverter power exceeds the overcurrent protection threshold. 3. Check if the load device has large input capacitors triggering overcurrent or short-circuit protection.
8	Power loss during acceleration or hill climbing	1. Check if overcurrent protection is triggered. Connect host computer or BLE app to read alarms and optimize protection parameters. 2. Verify sufficient battery charge level; check for under-voltage protection activation. 3. Check if power cables are firmly soldered.

9	Bluetooth connection failure	1. Check if the BLE module name appears in the app search. If visible, the BMS is operating normally. If not, the BMS may be in sleep or under-voltage protection mode. 2. Check if the BLE module LED is flashing green (normal power). If not, verify connector wiring. 3. If the BLE LED is constantly on, the phone has paired. If data is displayed, the connection is normal. Constant on without data may indicate a settings error; try changing the ID to 1 or 20. 4. Verify phone Bluetooth is enabled. Refresh the search screen multiple times. Android devices require location services to be enabled.
10	CAN communication failure	1. Check the CAN adapter brand (Chuangxin Technology recommended). Other brands may have compatibility issues. 2. Verify driver installation via Device Manager when plugging/unplugging the USB CAN adapter. 3. Verify the CAN adapter DIP switch setting (typically one up, one down). 4. Verify BMS CAN-H and CAN-L wiring matches the adapter. Ensure screws make contact with the conductor, not just the insulation. 5. Prioritize connecting to the CAN1 port of the adapter. 6. Close any other CAN software or debug tools that may be occupying the CAN device. 7. Verify settings: Device = CANalyst-II, Baud Rate = per specification, BMS ID = per specification. Common baud rate/ID combinations: 125Kbps (ID 1 or 20), 250Kbps (ID 1 or 20), 500Kbps (ID 1 or 20),

		1000Kbps (ID 1 or 20).
11	RS485 communication failure	1. Verify driver installation via Device Manager when plugging/unplugging the USB RS485 adapter. 2. Verify BMS RS485-A and RS485-B wiring matches the adapter. 3. Close any other software that may be occupying the COM port. 4. Verify settings: correct COM port, baud rate per specification, BMS ID per specification. Common combinations: 9600 bps (ID 1 or 20), 115200 bps (ID 1 or 20).
12	UART communication failure	1. Verify driver installation via Device Manager when plugging/unplugging the USB UART adapter. 2. Verify BMS TXD, RXD, GND wiring matches the adapter. Typically TXD-to-TXD, RXD-to-RXD, but some models require cross-wiring. 3. Close any other software that may be occupying the COM port. 4. Verify settings: correct COM port, baud rate per specification, BMS ID per specification. Common combinations: 9600 bps (ID 1 or 20), 115200 bps (ID 1 or 20).