Chapter 1 Introduction of EV-FT-12 BMS

1.1 Product Structure

With the distributed two-level management system, EV-FT-12 electric vehicle BMS (hereinafter called EV-FT-12 system) is composed of Battery cluster-management unit (BCU) and multiple Battery monitor unit (BMU), display screen (LCD), insulation detection module (LDM), heavy-current control system (HCS), current sensor (CS) and wiring harness.

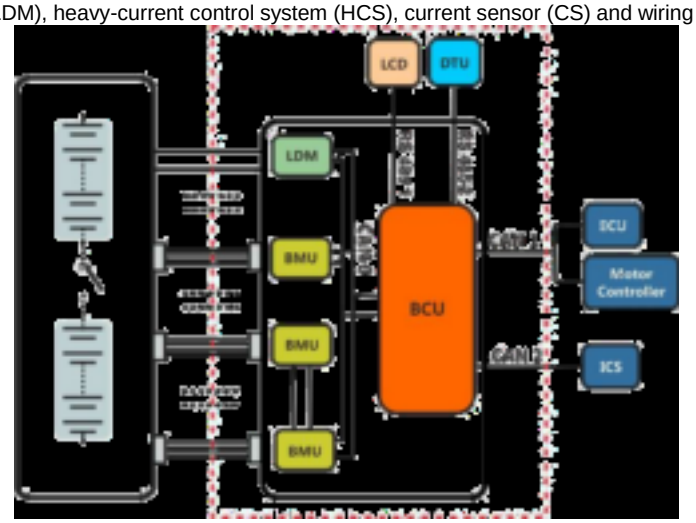


图 1-1 产品结构

1.2 System Configuration

Figure 1-2 System Configuration

1.3 Brief Introduction of Function

In EV-FT-12 system, BCU module carries out real-time communications with multiple BMU modules and LDM (insulation detection module) through CAN bus to gain system parameters, such as single cell voltage, box temperature and insulation

resistance and so on, collects charging and discharging current through current sensor, calculates SOC dynamically and displays related data through touch screen. BCU manages system after gaining comprehensive information of battery pack through calculation and analysis, respectively interacts with ECU, motor controller and charger and so on intelligently through independently CAN bus and can realize the secondary protection of charging and discharging through relay control to meet diversified safety control demands of customers, ensuring stable and effective operation of system.

1.4 Technical Specifications

Type	Specification	Remarks
Voltage collection range	0～5V	
Voltage collection accuracy	≤±5mV	
Accuracy of total voltage	≤0.2%	
Current collection accuracy	≤±1%	500A current sensor
Error of SOC estimation	≤5%	
Temperature collection accuracy	≤±1 ℃	-30～75℃
Temperature collection range	-40～125℃	
Balance current	≥1A（normal temperature）	2 channels of balance can be switched on at the same time
Power consumption of BMU operation	≤1W	One BMU module,均衡不开启
Power consumption of BCU operation	≤2.8W	
Working input voltage	DC 12/24V	
System operating temperature	-30～75℃	
Storage temperature	-40～85℃	
Weight	BCU:480±5g BMU:640±5g	One module
Charging control mode	CAN communication, active/passive output	Depend on actual conditions
Discharging control mode	CAN communication, active/passive output	Depend on actual conditions

1.5 Battery cluster-management unit (BCU)

- **BCU function**
  - SOC estimation: use Joint EKF algorithm to estimate SOC of battery pack dynamically
  - Current detection: carry out real-time detection of current in charging and discharging circuits through Hall current sensor.
  - Communication function: externally installed 3 CAN interfaces, which can be used to communicate with BMU, complete vehicle controller and charger and so on to exchange voltage, temperature, fault code, control command and other information.
  - Alarm and protection: when there is fault as over-charge, over-discharge and so on, BCU can perform the corresponding alarm and protection according to fault status and display it on LCD screen.

- System expanding: BCU supports multiple channels of active/passive node output and can realize two-level control management through CAN communication and relay to ensure effective isolation of strong and weak current and meet diversified safety control demands of customers.
- Data storage: support 8G data storage capacity and can record all performance parameters of long-term operation of power battery pack and dispatching and fault events of battery module.
- System self-check: the system checks itself and BMU working status after power on to ensure normal working of system.
- Remote management: BCU is equipped with wireless communication interface, which can realize four-remote function through external DTU module.
- System upgrade: program downloading interface is installed externally, which can be used to upgrade system within 30 seconds.

Parameters of BCU module

Item	Performance
Working voltage	DC 12V/24V
Current detection range	±500A（Optional）
Current detection accuracy	≤±1%
Error of SOC estimation	≤5%
Display	Total voltage, total current, maximum and minimum voltages and serial numbers, voltage of single battery, box temperature, charging and discharging status, over-charge alarm prompt, under-charge alarm prompt, over-discharge alarm prompt, over-temperature alarm prompt and insulativity alarm prompt, etc.
Alarm	Grade I alarm: prompted alarm information appears on display screen and no control measures are taken: ● Single cell voltage ≤3.0V; ● 100Ω/V≤ insulativity ≤500Ω/V Grade II alarm: prompted alarm information appears on display screen and there is bumming; disconnect charging and discharging circuits: ● Single cell voltage ≤2.5V or single cell voltage ≥3.9V; delay: 5-30S; ● Box temperature ≥75℃; ● Insulativity ≤100Ω/V
Charging control mode	Use CAN bus and relay to control: ● When the cell voltage of single battery ≥3.65V, carry out CAN communication with charger and the current value gradually decreases according to smooth curve. ● When the cell voltage of single battery ≥3.9V, disconnect charger output after 30S delay. ● When the cell voltage of single battery ＜3.4V, charger can be used again for continue charging. ● When the box temperature ≥75℃, charger is abnormal or charging circuit is disconnected.
Discharging control	Use CAN and high-voltage relay to control: ● when cell voltage of single battery ≤3.0V, ,communicate with motor controller by CAN communication to reduce motor output power. ● When the cell voltage of single battery ≤2.5V, disconnect motor power output after 5～10S delay. ● When single core voltage > 2.6 V festival, the motor controller can continue to output power. ● When battery box temperature ≥75℃, disconnect discharging circuit.。

Note: *all protection parameters in table can be configured.

1.6 Battery monitor unit (BMU)

■ BMU function

BMU connects with battery pack through voltage detection wire, collects voltage of 16 strings of battery cell at most and can equalize battery according to battery single cell voltage.

When the voltage of some single cell battery in battery box reaches to 2.8V and battery voltage difference is between 10mv-800mv, the balance function will start automatically. Each battery detection unit can switch on 2 channels of balance at the same time at most. BMU collects box module temperature through 4 temperature sensors at most and can actively manage cooling and heating according to temperature status to ensure battery application capacity and prolong battery service life.

The working power supply of BMU has to be provided by the external 12V (9V～18V self-adaption) or 24V (18V～36V self adaption) DC power source. BMU transmits the collected battery voltage, box temperature and other information to Battery cluster-management unit through CAN bus.

- Detection of single cell voltage: realize the real-time detection of each single cell voltage through isolated collection of series single cell voltage.
- Temperature detection: put 1~4 temperature sensors in box of battery module to realize the real-time detection of box temperature.
- CAN communication: transmit the voltage, box temperature and other information of each single cell in battery pack to BCU through CAN bus.
- Balance function: balance management can be performed to battery cell according to agreed balance management control strategy to improve the consistency of single battery cell and application performance of battery pack.
- Heat management: BMU can manage the cooling and heating status of battery actively according to battery box temperature to ensure battery application capacity and prolong battery service life.

System upgrade: program downloading interface is installed externally, which can be used to upgrade system within 30 seconds.

■ Parameters of BMU module

Item	Parameter	Remarks
Maximum quantity of collection string	16 strings	
Working voltage	DC9V~32V	
Voltage collection range	0～5V	
Collection accuracy of single cell voltage	≤±5mV	
Temperature collection range	-40～125℃	
Temperature detection accuracy	≤±1 ℃	-30～75℃
Communication interface	CAN	
Voltage sampling period	200ms	16S
Cooling/heating current	≤1.2A	Peak value 5A

1.7 Insulation Detection Module (LDM)

- **LDM function**

LDM is used to detect whether the battery pack has electricity leakage on vehicle body. LDM receives the command from BCU through serial bus and transmits the detected data information to BCU, which then will deliver LDM status to display screen.

Method to judge whether the battery leaks electricity onto vehicle body: respectively detect whether the insulativity between positive/negative pole of vehicle-mounted battery and body shell is more than 100Ω/V.

Insulativity	System Status	Display Screen
Insulativity≥100Ω/V	Normal system display	(No icon)
Total pressure testing abnormalities	System alarm I	Bus abnormal
Insulativity≤100Ω/V	System alarm II	Display insulation leakage (Red)system cuts off circuit.

1.8 Heavy-current Control System (HCS)

Heavy-current control system includes heavy-current control module, charging and discharging control circuits and pre-charge circuit, etc.

- **HCS function**
  - Charge and discharge control: charging/discharging of battery is controlled through switching on/off high-voltage relay to prevent over-charge and over-discharge of battery; besides, the function of relay contact detection is also equipped to prevent sticky point of relay in circuit.
  - Pre-charge circuit: before switching on the discharging high-voltage relay of main circuit, it is necessary to switch on the pre-charge circuit firstly to charge capacitance. Then, switch on the high-voltage relay of main circuit when the voltage at both terminals of capacitance has reached to setting threshold value to ensure the reliability of high-voltage relay of main circuit.
  - CAN and RS485 communication: use CAN or RS485 bus to communicate with BCU, upload relay status and other information and receive the control command from BCU.

- **Table of Relay Model Selection**

Item	Code	Detailed Parameters
Relay Model	01	EV200AAANA
	02	400V/10A
	03	400V/80A
	04	400V/120A

■ **Model Selection Table of Power and Resistance of Heavy-current Module**

Item	Code	Detailed Parameters
Power Model	00	50W
	01	75W
	02	100W
	04	300W
Resistance Model	01	50Ω
	02	75Ω
	03	100Ω
	07	240Ω

1.9 Current Sensor (CS)

■ **CS function**

The current of this system is detected with Hall open-loop current sensor with optional range 50A～1000A.

■ **Model Selection Table of CS**

Item	Code	Detailed Parameters
Current Type	01	50A
	02	100A
	04	200A
	05	300A
	07	500A
	10	1000A

1.10 Display Screen (LCD)

■ **LDM function**

The display screen is human-machine interface for displaying system operation status. All its models are designed according to industrial standard and suitable for applying in various conditions. The display interface of LCD can display all operation parameters and faults of system.

■ **Status description of LCD**

The operation indicator of display screen includes three ones: power supply (PWR), running (RUN) and communication (COM). When the display screen is powered on, the power indicator (PWR) is normally on; if the running indicator (RUN) is normally on in yellow, it stands for normal running of display screen; if the running indicator (RUN) is not on, it means that the display screen has fault; when the display screen has connected with BMS, the communication indicator (COM) flashes in yellow.

Figure 1-3 Running Status Indicator

◆ The following table shows the display status of three LED indicators under various conditions:

Equipment Status		Green LED (PWR)	Yellow LED (RUN)	Yellow LED (COM)
No power supply		○	○	○
Power on, no communication	3.5'' screen	●	●	●
	5.7'' screen	●	●	○
Communicate with connected equipment		●	●	※
○ LED off ● LED on ※ Flash				

■ **Display description of LCD**

The integrated interface information of display screen is as shown in the figure below:

Figure 1-4 Figure of LCD Display Interface

■ **Model Selection Table of LCD**

Item	Code	Detailed Parameters	
LCD Model	01	Display screen	3.5''
	02	Display screen	5.7''

Chapter 2 Installation of System

2.1 Installation Dimension and Weight of Product

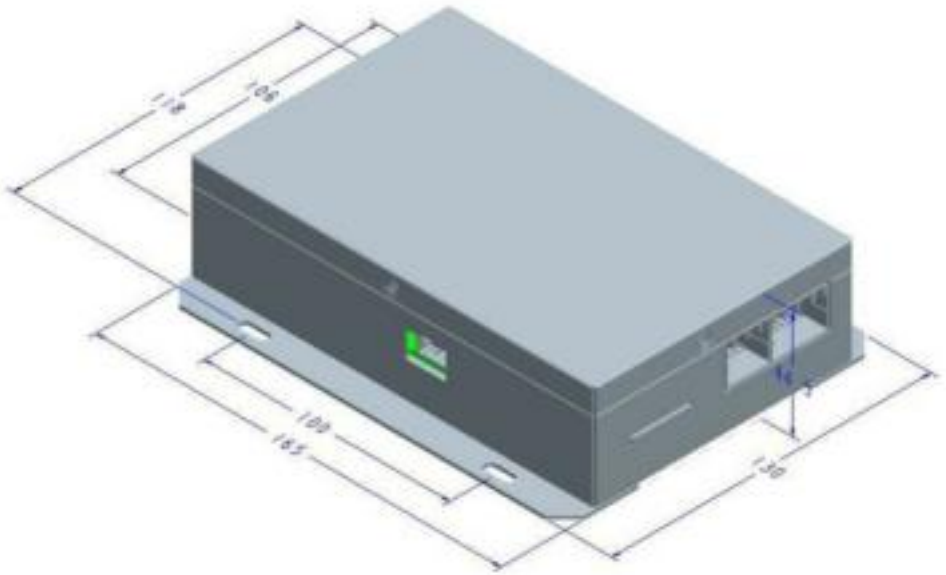
Product Type	Overall and Installation Dimensions (unit: mm)							Weight	
	W	H	D	W1	H1	D1	d	(KG)	
BCU	165	106	43	100	50			M4	0.64

BMU	124	91	40	100	40	M4	0.48	
LDM	165	120.5	25	105.5	85	15	4.5	1.05
HCS	260	240	100	130	225	26	6	—
LCD	96	81	47	90	75	5	4	0.186
	177	140	40	160.6	130.5	6	4	0.5

Note: W, H and D are dimensions of external structure; W1, H1 and D1 are installation dimensions of internal structure; d is width of mounting hole.

2.2 chematic Diagram of Overall Dimensions

- **Battery cluster-management unit (BCU)**



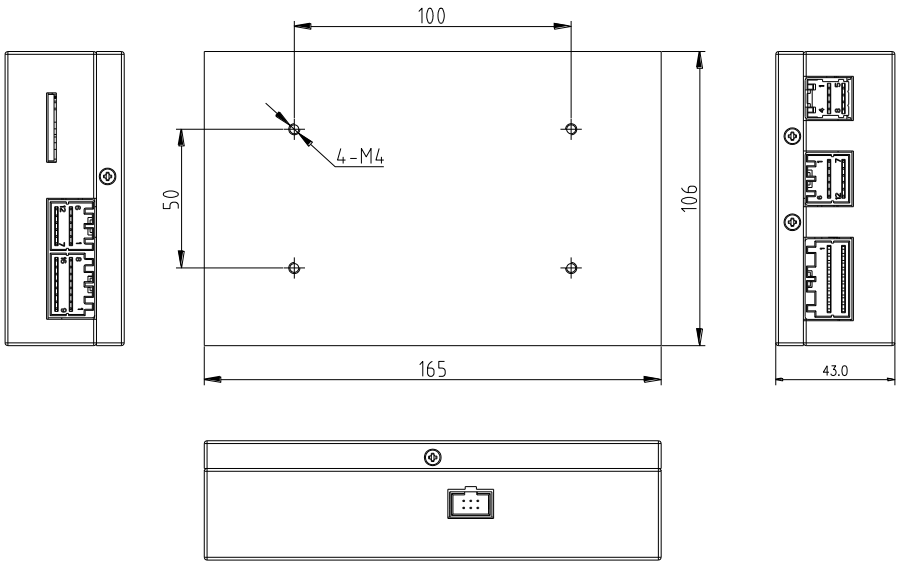


图 2-1 BCU Overall Dimension

- **Battery monitor unit（BMU）**

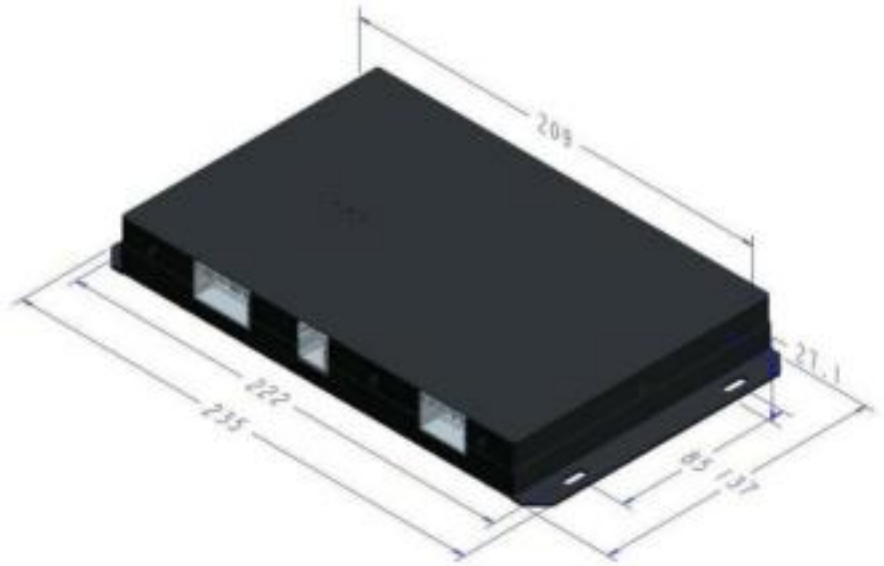


图 2-2 BMU Dimension

- **Insulation Detection Module（LDM）**

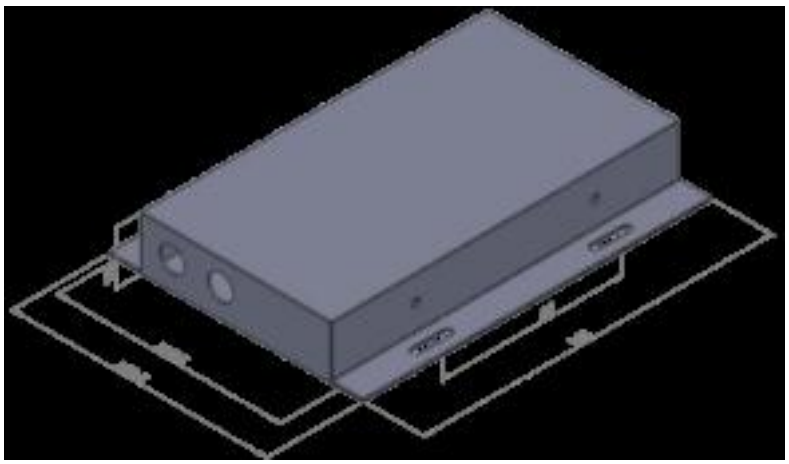
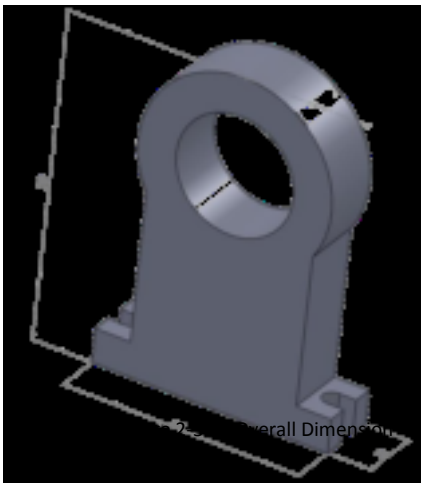


图 2-3□LDM Dimension

- **Display Screen（LCD）**

图 2-4 Overall Dimension of 5.7'' LCD

- **Current Sensor(CS)**



- **Heavy-current Control Box**

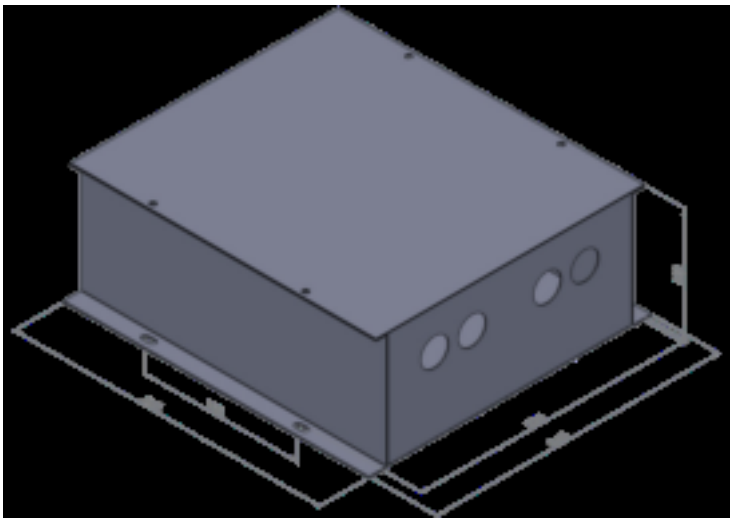
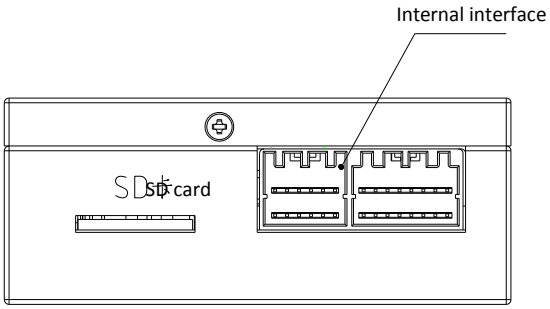


Figure 2-6 Overall Dimension of Heavy-current Control Box

2.3 Interface Description

- **BCU interface**

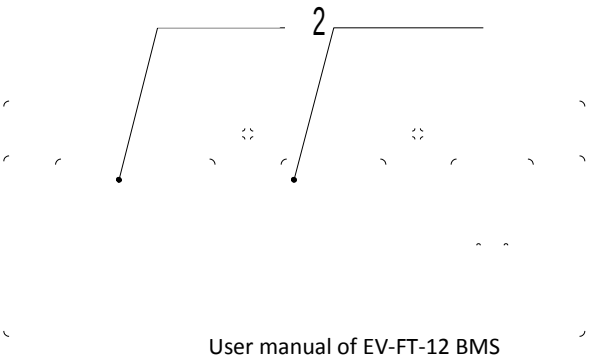


1 1

1 2

Figure 2-7 Front Interface of BCU

Communication and switching output interface



User manual of EV-FT-12 BMS

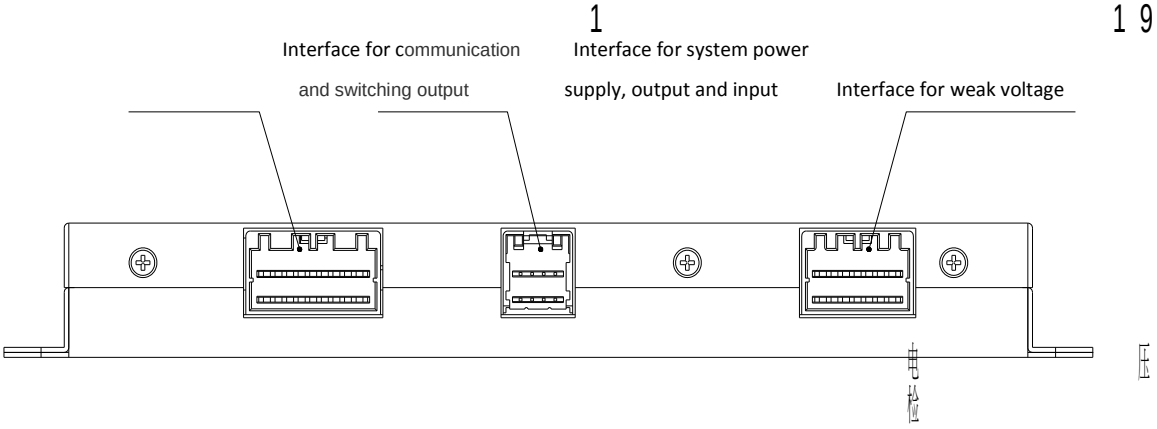


Fig 2-8□ Back Interface of BCU

- **BMU interface**

Interface for relay,ower supply
and CAN communication

Interface for voltage detection Interface for temperature detection

Figure 2-9 Front Interface of BMU

- **LDM interface**

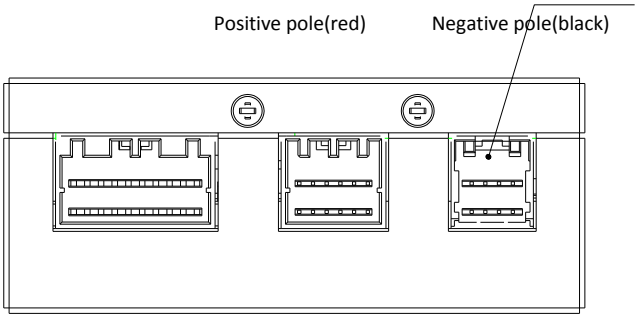
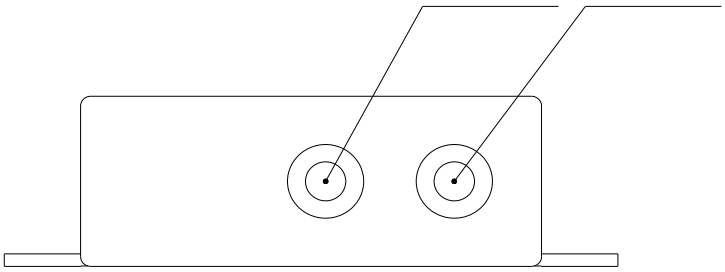


Figure 2-10 Front Interface of LDM



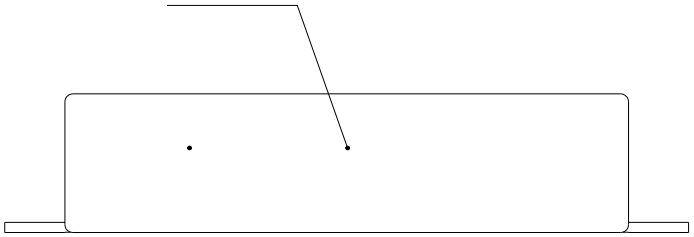


Figure 2-11 Back Interface of LDM

- **5.7” LDC interface**

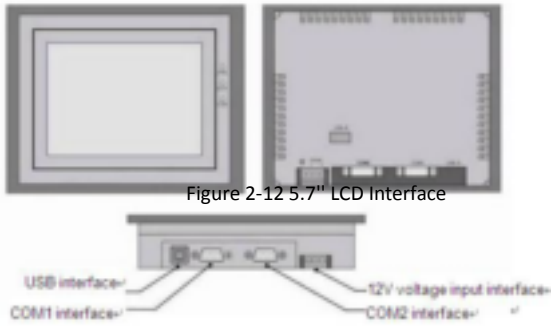


Figure 2-12 5.7'' LCD Interface

- **CS interface**

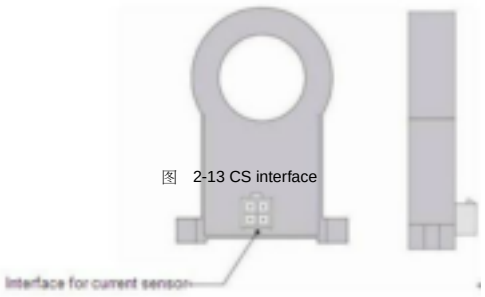


图 2-13 CS interface

2.4 Wiring Diagram of System

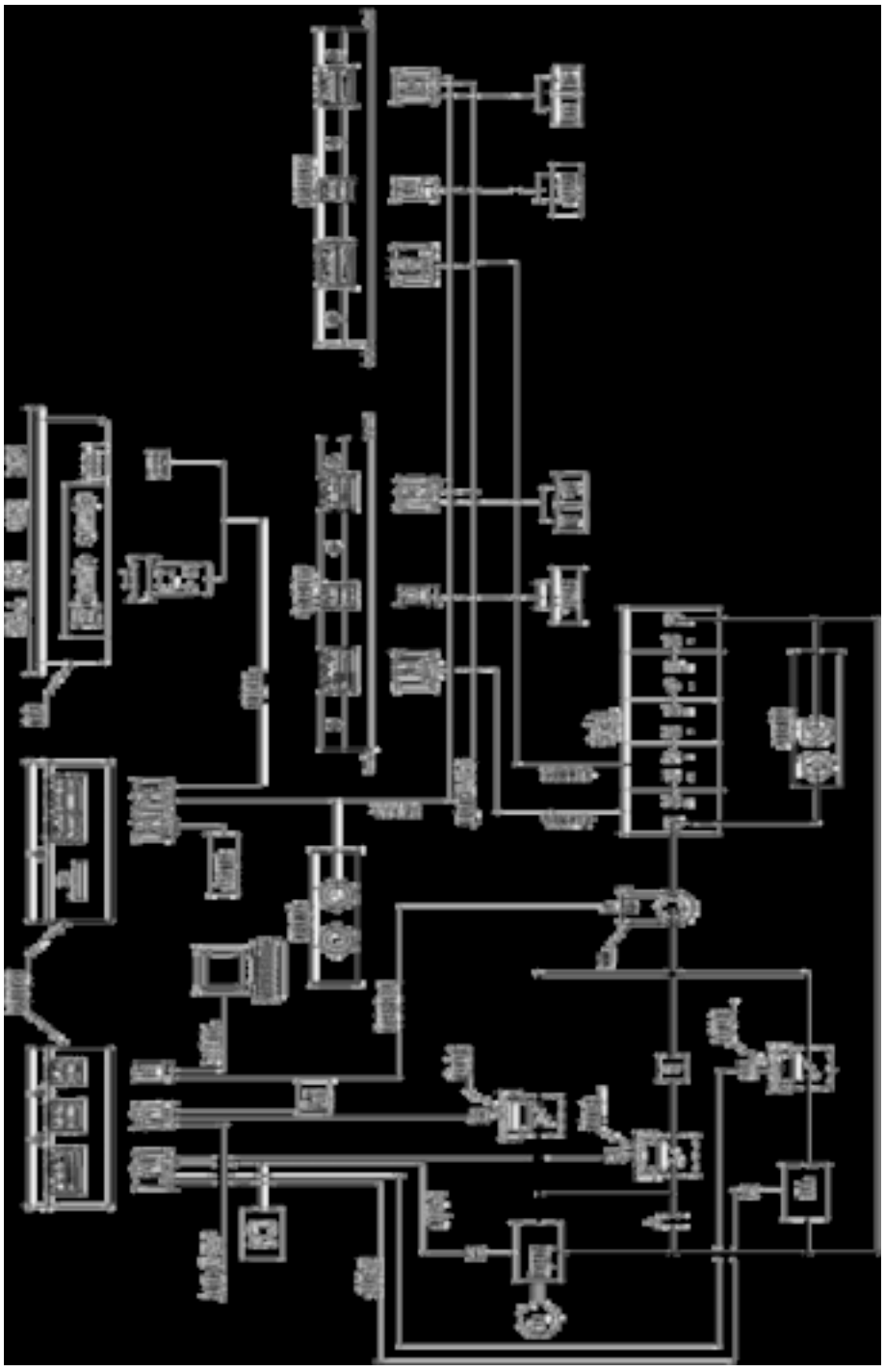


Figure 2-14 Schematic Diagram of Installation

Note: * products of different models may have some difference in functions and settings. The installation method of

special connecting lines and adaptors will be provided by our company separately.

2.5 Wiring Description of BMU

- **Connection of voltage detection wiring harness (take 16 strings for example)**
  - B1+ connects with positive pole (red line) of first battery;
  - B1-~B15- connect with negative pole (black line) of each battery in series successively;
  - B16- connects with negative pole (green line) of the last battery.

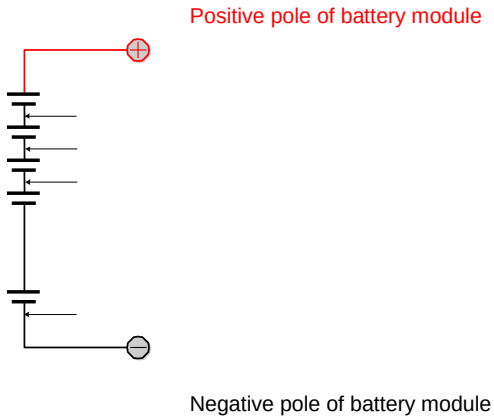


Figure 2-15 Schematic Diagram of Connection between Voltage Detection Wiring Harness and Battery

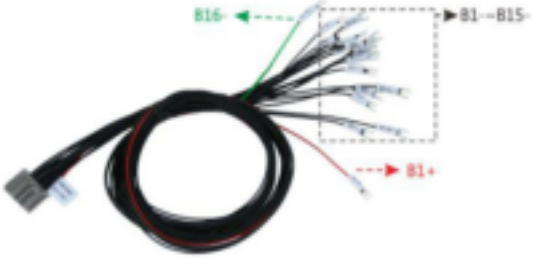


Figure 2-16 Example Diagram of Connection between Voltage Detection Wiring Harness and Battery

Caution: the connection order of voltage detection wiring harness cannot be wrong. Otherwise, the voltage collection may be incorrect, equalizing circuit may be burnt out and battery may be damaged.

- **Fix temperature sensor onto battery pack**

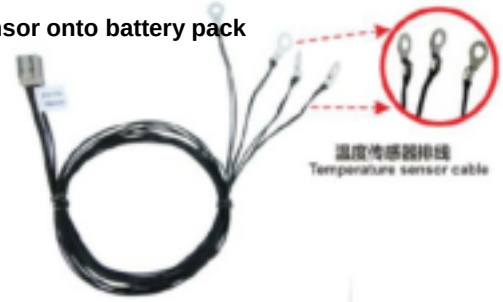


Figure 2-17 Example Diagram of Temperature Sensor Connection

- **Connect voltage detection cable harness and temperature detection cable to BMU**

Figure 2-18 Example Diagram for Connection of Voltage Detection Cable Harness and Temperature Detection Cable

- **Connection of CAN Communication Cable**

CAN communication cable is the communication medium between BMU and BCM. The system adopts 3-core shielding line to be communication cable. MOLEX12pin connector assembly and AMP 6PIN automobile connector (cellular type and pin type) are used for joint。

The BMU farthest away from BCU connects to No. 2 line and others connect to No. 1 line.

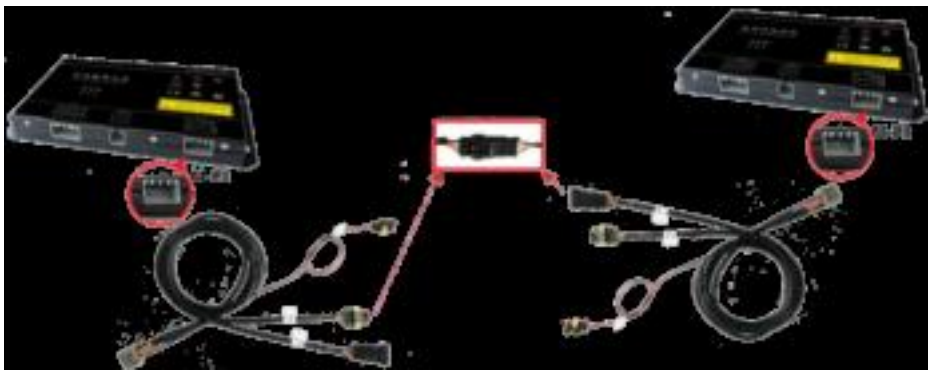


Figure 2-19 Example Diagram for Connection of Communication cables among BMUs

- **Connect the BCU power line, red line to connect power positive, black line across the connect power**

Figure 2-20 Example Diagram for Connection of BMU power line

2.6 Wiring Description of BCU

- **Connect communication cable s between BCU and BMU**

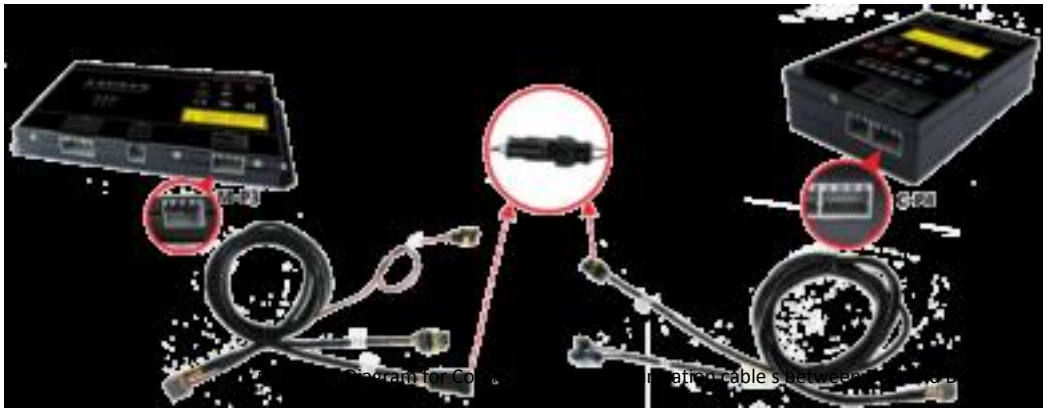


Figure 2-21 Schematic Diagram for Connection of Communication cable s between BCU and BMU

- **Connect current sensor**

The current sensor is strung onto the circuit cable of output positive/negative pole of battery pack and has two kinds of wiring modes, as shown in the figure below (pay attention to the arrow on current sensor).

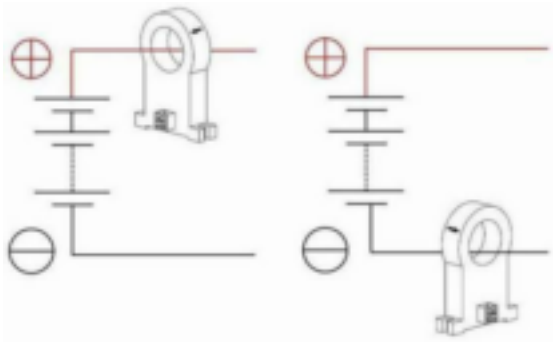


Figure 2-22 Schematic Diagram for Connection of Current Sensor Installation

Connection method 1 Connection method 2

Figure 2-22 Example Diagram for Connection of Current Sensor

■ **Connect the control cable of charge/discharge relay (red line connects with positive pole of relay coil and black one with negative pole of relay coil).**

Figure 2-24 Example Diagram for Connection of Relay Control Cable

■ **Connect CAN communication cables of charger and complete vehicle system/motor controller. (For 3-core shielding line: red is H, yellow is L and black is GND)**

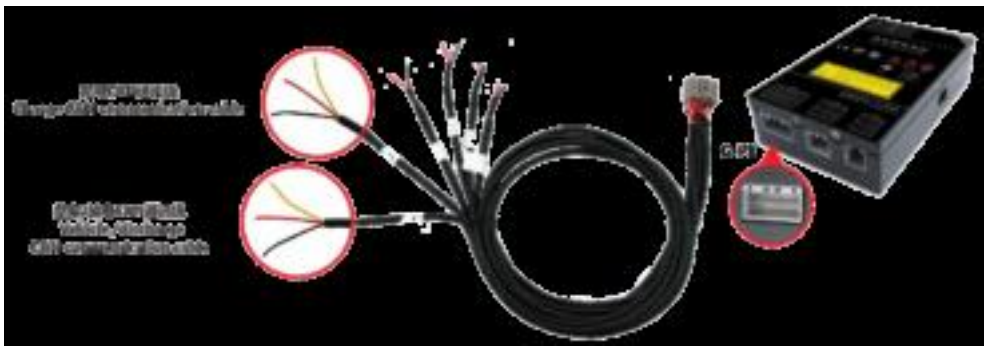


Figure 2-25 Example Diagram for Connection of CAN Communication Cable

⚠ **Caution: 1. Confirm that the connection of "H" and "L" of CAN bus is correct. Otherwise, CAN bus cannot communicate with other devices.**

2. Confirm that the matched resistance of CAN bus is correct. Otherwise, CAN bus cannot communicate with other

devices.

- **Connect the power supply cord of BCU (red line connects with positive pole of power supply and black one with negative pole).**

Figure 2- 26 Example Diagram for Connection of BCU Power Cord

2.7 Wiring Description of LDM

- **Connect communication cables between LDM and BCU**。

Figure 2-27 Example Diagram for Connection of Communication Cables between LDM and BCU

- **Connect LDM to the master positive pole and master negative pole of battery pack; and make LDM shell contact with vehicle body and keep well conducting between them (LDM shell grounded).**

Figure 2-27 Example Diagram for Connection of Communication Cables between LDM and battery positive and negative terminals

Caution: LDM shell must well contact with vehicle body. Otherwise, functions of LDM will be invalid!

Dangerous: it is necessary to wear insulation gloves when connecting positive/negative pole wire of detection. Otherwise, electric shock may be caused!

2.8 Wiring Description of LCD

- **Wiring description of display screen**

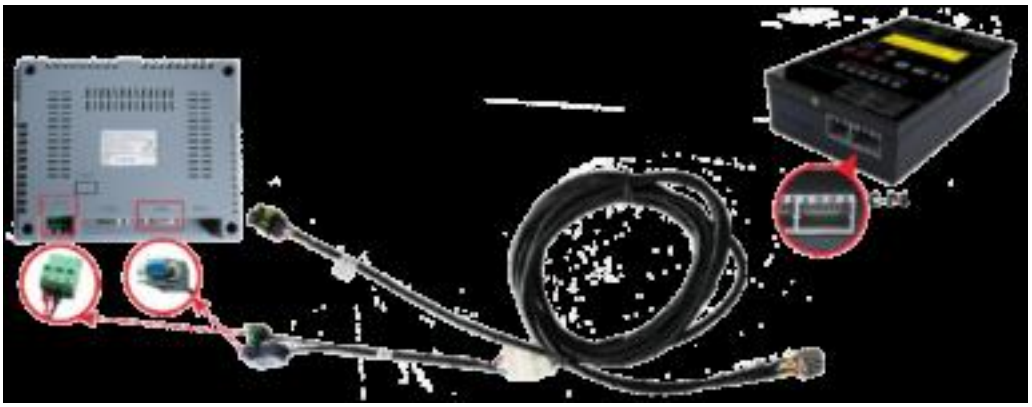


Figure 2-29 Example Diagram for Connection of LCD and BCU（take 5.7" one for example）

Caution: 1. the communication cable interface (DB9 connector) of LCD connects to COM1 communication interface of LCD. If it is connected to COM2 interface, the LCD communication will be interrupted!

2. The connection of positive and negative poles of LCD power cannot be reversed. Otherwise, LCD will be burnt out!

3. LCD is powered by DC24V. The positive pole connects with 24V+ and negative one with 24V-!

2.9 Installation Conditions and Requirements

- Avoid installing the system under the condition with oil mist, metallic dust and much dust.

- Avoid installing the system under the condition with harmful gas and fluid or corrosive, flammable and explosive gas.
- Reserve appropriate installation dimensions.
- Cable installation shall be kept away from sharp objects.
- Try best to keep away from conditions with strong electromagnetic interference.
- Parameters of all parts related to his system shall be confirmed by our company.

Chapter 3 Wiring of System

3.1 Type of Cable

No.	Name	Specification	Remarks
1	**Voltage detection cable**	0.5 high temperature wire： one end is MOLEX28PIN connector assembly; the other end is 1.5-8 cold pressed terminal.	Size of cold pressed terminal is determined according to the actual demand of customer.
2	**Temperature detection cable**	2×0.5 high temperature wire: one end is MOLEX28PIN connector assembly; the other end is temperature sensor.	
3	**Heating relay control line**	2×0.5 power line: one end is MOLEX16PIN connector assembly; the other end is null.	
	Refrigeration relay control line	2×0.5 power line: one end is MOLEX16PIN connector assembly; the other end is null.	
	BMU power line 1	2×0.5 power line: one end is MOLEX16PIN connector assembly; the other end is3PINAMP pin-type connector assembly.	Power supply into BMU
	Communication cable among modules	3×0.5 shielding line: one end is MOLEX16PIN connector assembly; the other end is AMP3PIN connector assembly (cellular type and pin type).	Communication among BMUs
4	**BMU power line** 2	6×1.0 high temperature wire +2×0.5 power line one end is 30A connection assembly; the other end is AMP2PIN cellular connector assembly.	AMP cellular connector assembly. is equal to the number of BMU quantity. Main line connect with several AMP2PIN cellular connector.
5	**Power line**	2×0.5 power line： one end is MOLEX12PIN connector assembly; the other end is null.	

	Discharge relay cable	2×0.5 power line: one end is MOLEX12PIN connector assembly; the other end is null.	
	Input signal cable	2×0.5 power line: one end is MOLEX12PIN connector assembly; the other end is null.	
6	**CAN cable of whole car**	3*0.5 shielding line: one end is MOLEX20PIN connector assembly; the other end is null.	
	Charge CAN cable	3*0.5 shielding line: one end is MOLEX20PIN connector assembly; the other end is null.	
	Charge relay cable	2×0.5 power line: one end is MOLEX20PIN connector assembly; the other end is null.	
	Pre-charge relay cable	2×0.5 power line: one end is MOLEX20PIN connector assembly; the other end is null.	
	Charge switching signal cable	2×0.5 power line: one end is MOLEX20PIN connector assembly; the other end is null.	
	Discharge switching signal cable	2×0.5 power line: one end is MOLEX20PIN connector assembly; the other end is null.	
7	**Connecting wire of current sensor**	4×0.5 shielding line: one end is MOLEX8PIN connector assembly; the other end is 5569 (2×2) cellular terminal.	
	USB communication cable	4×0.5 shielding line: one end is MOLEX8PIN connector assembly; the other end is USB interface.	
8	**Communication cable between BCU and BMU**	3×0.5 shielding line: one end is MOLEX28PIN connector assembly; the other end is AMP3PIN cellular connector assembly.	

	Screen communication cable	5×0.3 shielding line: one end is MOLEX28PIN connector assembly; the other end is DB9 terminal (cellular) and 2PIN plug.	
	LDM communication cable	3×0.5 shielding line and 2*0.5 power cord: one end is MOLEX28PIN connector assembly; the other end is AMP6PIN pin-type connector assembly.	

Note: *1. the cable length is determined through consultation between customer and our company.

***2. The type of charge and discharge cables is determined according to requirement of customers.**

***3. For wiring mode, please refer to instructions for system installation.**

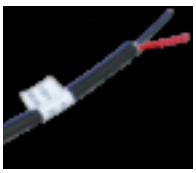
***4. If special cables are needed, please contact technical support center of our company.**

***5. In the above listed cable type, based on standard system, according to the demand of customer and system application different occasions, will different with objects.**

3.2 Diagram of Cables

- Following pictures show common cables produced by our company：

Diagram	Name	Application	Interface
	Voltage detection cable	Connect with battery and BMU, detect voltage	
	Temperature detection cable	Detect temperature information of battery	
	Heating relay control line	Control external heating equipment	

	Refrigeration relay control line	Control external refrigeration equipment	
	BMU power line 1	Power input BMU	
	Communication cable among modules	Communication among all BMUS	
	BMU power line 2	Connection external power supply and BMU	
	Power cord (red “+”, black "-")	Supply power for BCU	
	Discharge relay cable	Connect with control cables of discharge relay and BCU	
	Input signal cable	Input level Signal for BCU	
	Complete vehicle CAN cable	Connect with motor controller/complete vehicle controller	

	Charge CAN cable	Connect with charger	
	Charge relay cable	Connect with control cables of charge relay and BCU	
	Pre-charge relay cable	Connect with control cables of pre-charge relay and BCU	
	Charge switching cable	Output charge switching signal to charger	
	Discharge switching cable	Output discharge switching signal to motor controller or others	
	Current sensor cable	Connect with BCU and current sensor	
	USB communication cable	Download saved data	
	BMU and BCU communication cable	Communication cables between BMU and BCU	

	Screen communication cable	Communication between BCU and LCD, and power cord	
	Insulation communication cable	Communication between BCU and LDM, and power cord	

3.3 Cable Quantity

In the following table, a set of EV-FT-12 system is taken for example to explain cable quantity required by product. One of products takes one BCU and N (≤16) BMUs for example to explain the quantity of each cable, as shown in the table below.

Name	Qty.	Unit	Remarks
Voltage detection cable	N	Set	Quantity of each set of voltage detect cable is equal to that of determined BUM.
Temperature detection cable	N	Set	There are 3 temperature sensors on each set of cable.
Heating relay control line	N	Set	Optional
Refrigeration relay control line	N	Set	Optional
BMU power line 1	N	Set	BMU power input
Communication cable among modules	N	Set	Communication cables among BMUs
BMU power line 2	1	Set	Each system of BMU corresponding a connection of the external power source supply bus
Power line	1	Set	BCU power input
BMU and BCU communication cable	1	Set	
Connecting wire of current sensor	1	Pcs	
Screen communication	1	Set	

cable			
Discharge switching cable	1	Pcs	
Discharge CAN cable	1	Pcs	The corresponding discharge mode and harness corresponding to one cable are selected by customers.
Discharge relay cable	1	Pcs	
Charge relay cable	1	Pcs	
Charge CAN cable	1	Pcs	The corresponding discharge mode and harness corresponding to one cable are selected by customers.
Charge switching cable	1	Pcs	
Pre-charge relay cable	1	Pcs	Optional
USB communication cable	1	Pcs	Optional
Input signal cable	1	Pcs	Optional
Insulation communication cable	1	Pcs	Optional

Chapter 4 LCD Application and Parameter Setting

4.1 Explanation of Parameters

Total capacity	Capacity of battery pack after being fully charged; Usually, it is initially configured to nominal capacity of battery pack.
Surplus capacity	Currently surplus ampere-hours of battery pack; it is set according to parameters provided by battery manufacturer.
Maximum charging voltage	Set maximum allowed charging voltage of charger through CAN communication.
Maximum charging current	Set maximum allowed charging current of charger through CAN communication.
Over-charge protection voltage	Set the maximum voltage threshold value that single cell battery can raise during charging. Carry out over-charge protection to battery and alarm when it is more than this value.
Over-charge protection release	Set to cancel the voltage threshold value of overcharge protection, i.e. to cancel over-charge protection and alarm when the maximum voltage of single cell battery drops to the value lower than threshold value.
Under-voltage alarm voltage	Set threshold value of alarm for low voltage of battery single cell, which is used to prompt low power of battery.
Under-voltage alarm release	Set to cancel the voltage threshold value of under-voltage alarm, i.e. to cancel under-voltage alarm when the minimum voltage of single cell battery recovers to the value more than this parameter.
Over-discharge protection voltage	Set the minimum voltage threshold that battery can drop to during discharging. Carry out over-discharge protection to battery when the voltage is lower than the value.
Over-discharge protection release	Set to cancel the parameter of battery over-discharge protection, i.e. to cancel battery over-discharge protection when the minimum voltage of single cell battery recovers to the value more than this parameter.
Over-temperature protection temperature	Set allowed maximum operating temperature of battery pack. Carry out battery over-temperature protection and alarm when the temperature is higher than the value.
Over-temperature protection release	Set the temperature threshold of over-temperature alarm release, i.e. to cancel over-temperature protection and alarm when the maximum temperature of battery drops to the value lower than the threshold.

4.2 Main Interface of LCD

Figure 4-1 Main Interface of Terminal User

Remarks: It displays in gray when alarm information is normal; it displays in red and flashes when there is alarm.

（2） For advanced user

Figure 4-2 Main Interface of Senior User

Remarks: at this moment, click “battery information” to pop up the window Compared with terminal user interface, statistical information and configuration information are newly increased in senior user interface.

4.3 User Permission

The touch screen has the function to set user permission. The terminal user can only browse general information. For senior user, statistical information and configuration information of battery are increased. When the touch screen is powered on, the default user is terminal user.

- **Steps for modification of user permission**
  - Step 1: click “Menu” to pop up the window as shown in figure 4.3.1.
  - Step 2: click “User Information” to pop up the window as shown in figure 4.3.2.
  - Step 3: click “Modify” and enter password to change user name.

    If the entered password is 1111, the user is terminal user. If the entered password is 5555, the user is senior user.
  - Step 4: click "Return". The main interface can alter automatically according to user name.

Figure 4-4 User Information

4.3 User Permission

The touch screen has the function to set user permission. The terminal user can only browse general information. For senior user, statistical information and configuration information of battery are increased. When the touch screen is powered on, the default user is terminal user.

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    If the entered password is 1111, the user is terminal user. If the entered password is 5555, the user is senior user.
  - Step 4: click "Return". The main interface can alter automatically according to user name.

Figure 4-4 User Information

4.4 Display of Battery Single Cell Information

The system will enter the corresponding interface after clicking “Single Cell Information”, as shown in the following figure 4-5.

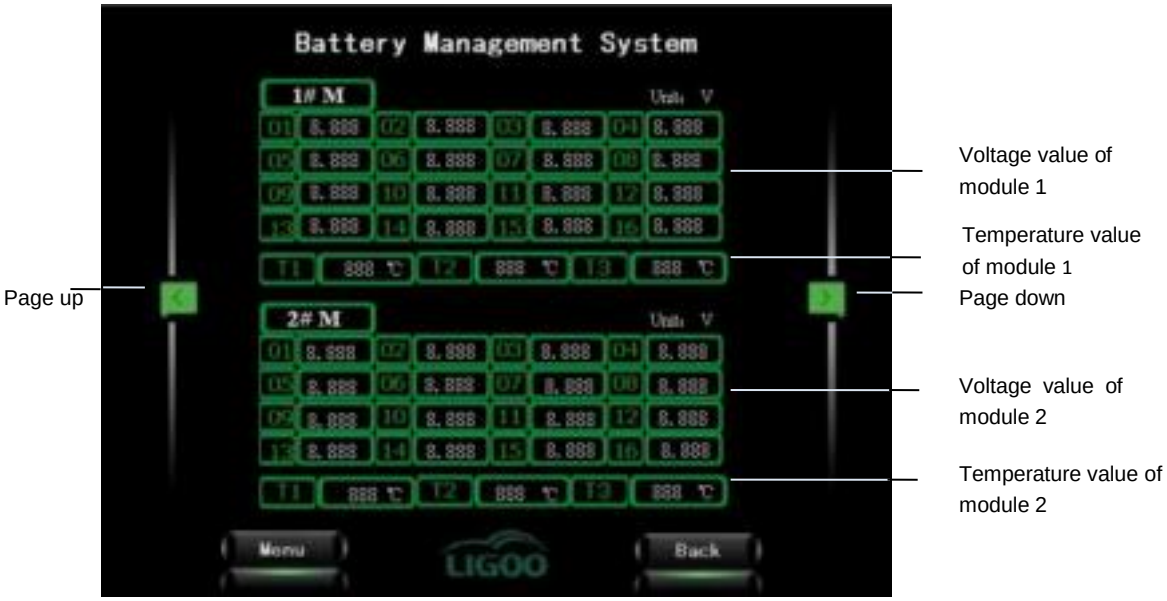


Figure 4-5 Single Cell Information

Remarks: above figure gives the corresponding information of modules 1 and 2. Each module includes the information of 16 single cell voltages and 3 module temperatures.

4.5 Di splay of Charger Information

The system enters into corresponding charger interface after clicking “Charger”.

Figure 4-6 Charger Information

Remarks: the interface displays some information of charger. Receive the corresponding messages of charger through CAN communication and display them on the touch screen.

- **Explanation of parameters**
  - Online status: communication status of charger; it displays online when charger is communicating with BMS; otherwise, it is offline; the default status is offline.
  - Starting status: indicate whether the charger has started to charge; it indicates starting after starting to charge; otherwise, it is stopping; the default status is normal.
  - Hardware fault: malfunction of charger itself, default to normal.
  - Input voltage: indicate the status of charger input voltage, default to normal.
  - Temperature status: indicate the temperature status of charger, default to normal.
  - Output current: indicate present charging current of charger.
  - Output current: indicate present charging voltage of charger.

4.6 Display of Battery Statistical Information

The information is mainly used for analysis of battery performance and application status.

- Step 1: change user information to senior user.
- Step 2: click “Battery Information”.
- Step 3: click “Statistical Information”.

4.7 Configuration Interface

In order to evaluate all parameters of battery accurately, it is necessary to re-configure BMS before its initial running. The configurable content includes: total capacity of battery pack (nominal capacity), current surplus capacity of battery pack, maximum charging voltage, maximum charging current, over-charge voltage of single cell battery, over-charge release voltage of single cell battery, under-voltage protection voltage of single cell battery, under-voltage release voltage of single cell battery, over-discharge protection voltage of single cell battery, over-discharge release voltage of single cell battery, over-temperature protection temperature and over-temperature release temperature.

- **Steps of parameter configuration:**

- Step 1: change user information to senior user.
- Step 2: click “Configure Information” of main interface. The system displays a configuration interface as shown in figure 4.7.1.
- Step 3: click “Read” to read the default configuration parameters of host. The system doesn’t support automatic reading of configuration parameter. Therefore, it is required to click "Read" after entering the configuration interface.
- Step 4: click the corresponding parameter column to modify the corresponding parameter.
- Step 5: Click “Write in” to enter the password 8888. Configuration parameters are related to the running status of system. Therefore, they cannot be altered at will. After clicking, if you didn’t operate step 3 previously, the dialog box for reading will pop up. If you have operated step 3, system will pop up a dialog box for write-in confirmation. The configuration parameter can be read before writing in.
- Step 6: When writing into the dialog box, click "Write in" and wait for 5 seconds around. It means that the setting operation has been finished when the COM indicator light flashes normally. If the indicator displays abnormally, you can click “Write in” again and then click “Return”.

Figure 4-8 Configuration Information

Remarks: the relationship between configuration parameters is as follows:

1. over-charge voltage > over-charge release > under-voltage release > under-voltage voltage > over-discharge release > over-discharge protection
2. Over-temperature release < over-temperature protection
3. Surplus capacity < total capacity

- **Recover configuration parameters to default value:**
  - Step 1: click the button “Restore Default”. The dialog box to inquire whether confirm the restoration pops up.
  - Step 2: Click “OK” in the popped-up dialog box. Then, the configuration information restores to default value.
  - Step 3: click "Write in" to write default value into BMS.

Chapter 5 Application of Upper Computer Software

5.1 BCU data show Upper Computer Software

5.1.1 Function of Upper Computer Software

- Communication with BCU through designated model CAN-USB converter
- Analyze the data information transmitted by all modules and then display voltage, temperature and configuration value and so on.
- Configure information for each module through upper computer
- Can request data automatically

5.1.2 Software Installation

- System requirement: all systems above WinXP (Vista or Win 7 is better)
- Software running: operate EXE file directly.

5.1.3 Application of BCU Upper Computer

BCU can be tested and configured independently through using upper computer software

1. Main interface

Fig. 5-1 System Login Form

- Choose applicable communication (optional) according to communication protocol between BMS and upper computer

software

- Default value of equipment index number is “0”(appointed CAN-USB converter)
- Default value of CAN channel is “0”(appointed CAN-USB converter)
- Choose suitable CAN Baud rate according to communication protocol between BMS and upper computer software
- Choose the language
- Click “Yes”and enter BCU interface after connecting with BMS

Remark: It will show following information if BMS and upper computer software is not connected.

Fig. 5-2 System Login Form

2. BCU Interface

Fig. 5-3 BCU Interface

BCU interface will display the systems' working condition information.

3.BMU Interface

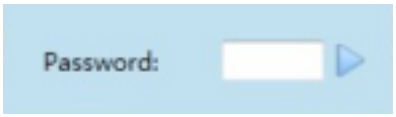
Fig. 5-4 BMU Interface

BMU interface will display the collection voltage and temperature information of each module.

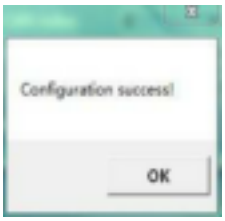
4. Configuration Information Interface

Fig. 5-5 Configuration Information Interface

- Enter configuration information interface and click “Read”, it will display each parameter of system
- Input parameter if need any modification.
- Click “Configuration” and enter password (default password is 8888) ,then press “Enter”to confirm. (refer to following picture)



- System will display the information of “configuration success”or “configuration failure”.



Remark: If entering wrong password, it will display like following picture.

5.2.1 Function of Upper Computer Software

5.2 Function of BMU Configuration Upper Computer software

- Communicate with BMU,BCU, data storage module and leakage detecting module.
- Analysis data from modules, shown the voltage, temperature and configuration value etc.
- Configure information for BMU module through upper computer
- Can request data automatically

5.2.2 Software Installation

- System requirement: all systems above Win98
- Software running: operate EXE file directly.

5.2.3 Application of Upper Computer

BMU can be tested and configured independently through using upper computer software

1. Main interface

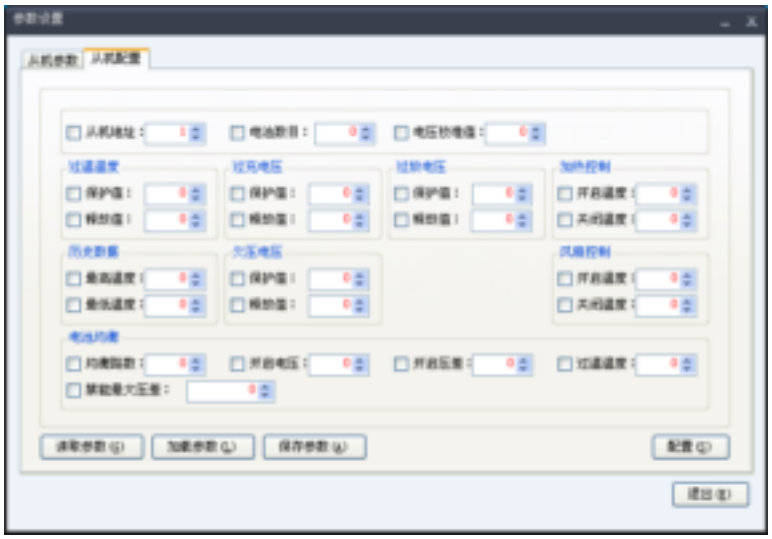


Fig 5-6 Main interface of BMU configuration parameters

“BMU configuration "the default configuration parameters in the list below：

1	BMU address	Configuration according to the practical situation. Scope:1~255
2	Battery number	Configuration according to the practical situation. Scope:1~16 strings
3	Voltage calibration value	Configuration according to the practical situation. Scope:-5000~5000mV
4	Over Temperature value	Protection value：60℃
		Release value:40℃
5	Over charging voltage	Protection value：3850mV
		Release value:3400mV
6	Over discharge voltage	Protection value：2600mV
		Release value:2800mV
7	Heating control	Starting temperature：Configuration according to the practical situation
		Off temperature :Configuration according to the practical situation
8	History data	Maximum temperature: Factory configuration is25℃
		Minimum temperature：Factory configuration is 25℃
9	Undervoltage value	Protection value：2900mV
		Release value:3000mV
10	Fan control	Starting temperature:60℃
		Off temperature:40℃
11	Battery balancing	Balancing ways:2
		Starting voltage：2800mV
		Starting differential pressure：10mV
		Over temperature：60℃
		Disable maximum differential pressure：800mV

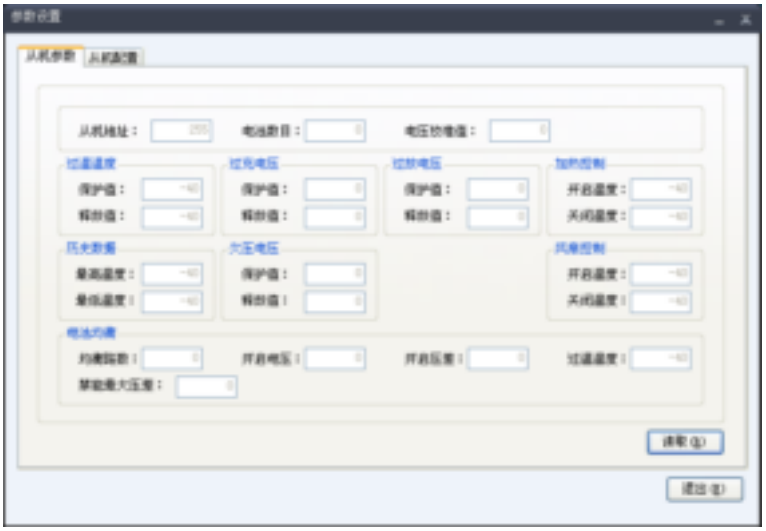


Fig5-7 Upper computer software configuration display interface 3

2. Configuration parameters method

◆ Operation PC software. Enter the PC connection interface 1, connect USB-CAN translator.

Fig 5-8 PC connection interface 1

◆ Click “Connect(C)” to enter equipment connection interface 2(Fig 5-9). Select the corresponding device number, the channel number and baud rate, click "connection (O)".

Fig 5-9 Equipment connection interface 2

◆ After entering the equipment connection interface3,slect”FT-BMU(S)”,to enter PC configuration display interface1.

Fig5-10 Upper computer software connection interface 3

◆ Parameter setting

Click “Parameter setting(O)” enter parameter settings interface, slect “BMU setting”, click “Loading parameters (L)” to lead parameters configuration files or fill in the data need configuration and selected in front of the check box, then click “setting(S)”.

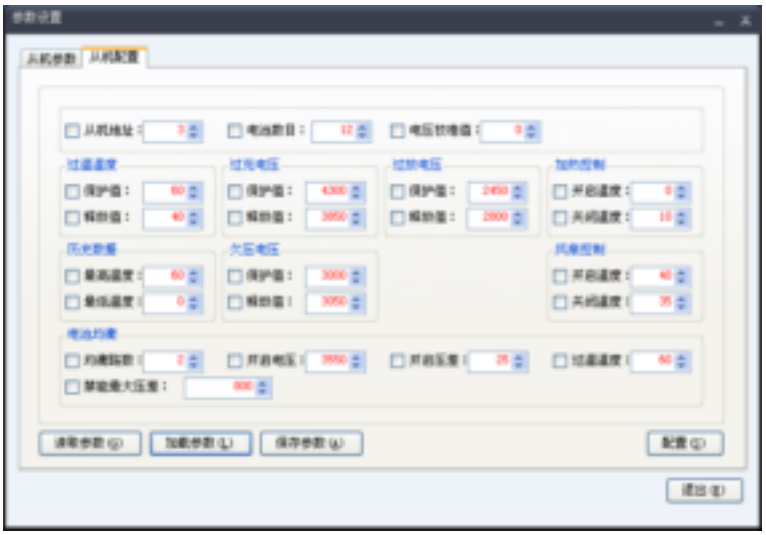


Fig 5-11 Parameter setting interface

You can also click “Getting parameter(G)” to get all the parameters of BMU and adjust according to requirement.

When batch configuration, click “Save parameters(A)” to create files like “BMU_03_2011_09_01_02_44.lgpara”.Then load again.

After finishing the configuration, click “Getting parameter(G)” or back to “BMU parameter” clicking “Read(R)” to check the modified parameter.

After finishing the configuration, click “Exit(E)” to back to main interface. Click “Getting(G)” to get the parameters of BMU. Select “automatic acquisition” then setting the interval time, click “Getting(G)” again, you could periodically obtain information from BMU.

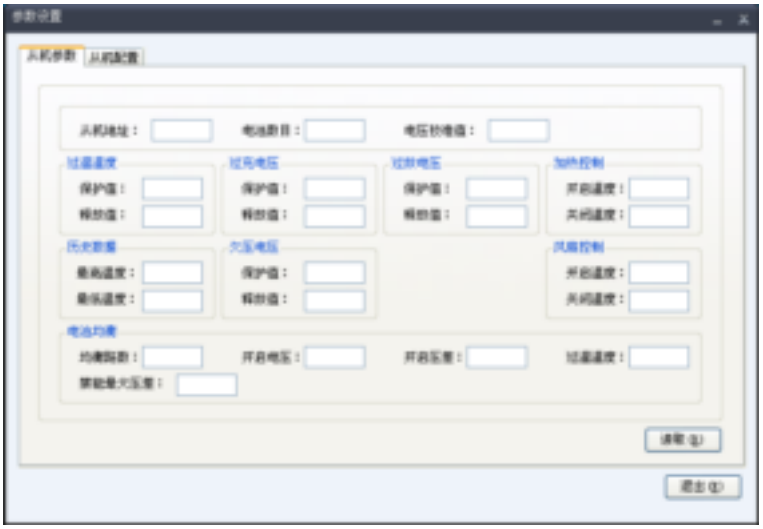


图 5-12 Upper computer software configuration display interface 2

5.3 LDM Upper Computer

Leakage detecting module can be independently testing by upper computer. Procedure is as follows:

- Step 1:Positive and negative of LDM respectively connect the battery total positive and negative.
- Step 2: Connect LDM and PC through USB-RS485 adapter.
- Step 3:Power supply for LDM is DC12V or DC24V。
- Step 4:Open upper computer software(fig 5-13 Initialize setting),“端口”slect“COM1”(free configuration according to the upper machine interface).“波特率”选择“9600”，“校验位”选择“None”，“数据位”选择“8”，“停止位”选择“1”，然后单击界面中“打开串口”。

Fig 5-13 Initialize setting

- Step 5：After connecting the power line, click “read”,to read the display value.

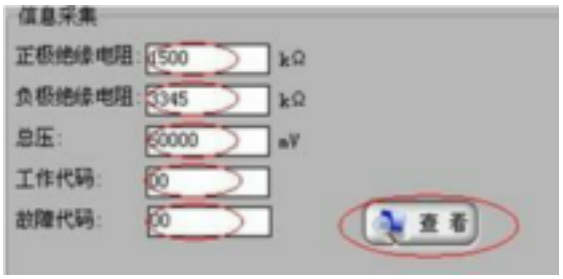


Fig 5-14 Parameters to check

Insulation monitoring the condition of normal detection:

- Positive insulation resistance:>1MΩ。
- Negative insulation resistance:>1MΩ。
- Total voltage：effective when above 100V
- Fault code：00 means normal operation;01 means offline state;02 means leakage state。
- Working code：00。

Chapter 6 Fault Diagnosis

6.1 List of Fault and Alarm Information

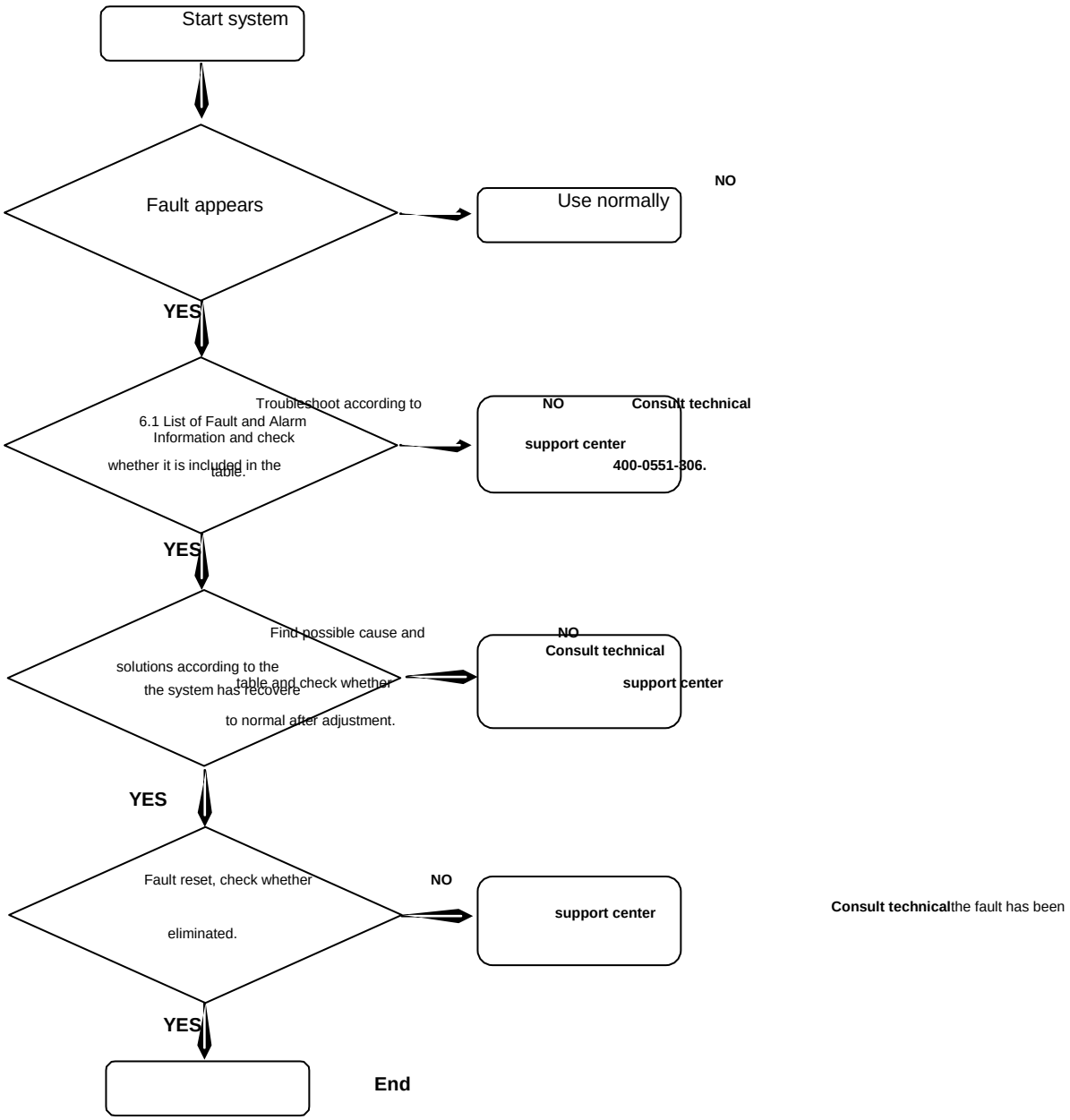
EV-FT-1 BMS has perfect management functions, which can prolong the service life of battery. Some fault tips may appear during application. Please carry out analysis, judge causes and eliminate fault according to the following table.

(If system damaged or meet problems that cannot be solved, please contact the technical support center (400-0551-306) of our company to obtain solutions.)

No.	Fault Description	Possible Cause	Solutions
1	System doesn't work.	1. working voltage incorrect 2. no power supply 3. DC power supply damaged	1. Check whether the working voltage is within normal voltage range. 2. Supply power for system. 3. Maintained by professional technicist.
2	Buzzer alarms and LCD displays fault.	1. Over-charge, over-discharge or under-voltage 2. over-temperature 3. communication interrupted	1. Check parameter setting of battery protection. 2. Disconnect charger or stop supplying power for battery. 3. Check communication interface.
3	Buzzer alarms. But LCD has no fault display.	1. Temperature difference at temperature detection point is too large. 2. SOC too low	1. Stop charging and discharging and restart after temperature recovery. 2. Charge battery or correct configuration manually.
4	LCD displays error communication.	Incorrect connection of communication cable	Check whether the power interface of LCD is loose or has fallen off.
5	LDC displays voltage=0 (multiple batteries or two consecutive batteries)	Incorrect connection of voltage cable	Check whether the voltage detection cable harness is connected in good stations.
6	The maximum temperature indicates -40℃.	Incorrect connection of temperature sensor	Check and reconnect temperature sensor.
7	Voltage display of partial batteries is abnormal.	Incorrect connection of voltage collection cable for the corresponding battery	Check and reconnect voltage collection cable.
8	Current displays positive when discharging and displays negative when charging.	Incorrect installation direction of current sensor	Change the direction and re-install current sensor.
9	No current display	Incorrect connection of current sensor	Check whether the current sensor is connected in good stations.
10	There is current display when system is static.	"Current digital calibration" is not set.	Refer to "explanation of configuration parameters".
11	Current display is incorrect when system is operated.	Incorrect matching of current sensor	Check whether the current sensor is original configuration of system.
12	LCD doesn't work.	No power supply voltage	1. Check whether the host has supplied power. 2. Check whether the power cord between host and LCD is connected correctly.
13	Charging current ＜ maximum current of charger	Maximum charging current is set too low.	Reset parameter of maximum charging current.
14	Cannot protect over-charge or over-discharge	Incorrect parameter setting	Reset parameter
15	SD card cannot write in.	SD card write-in is protected.	Switch off SD card write-in protection.

Remark: for detailed fault icons of LCD, please refer to LCD introduction part.

6.2 Procedure of Fault Diagnosis



Chapter 7 Daily Maintenance

Factors as service environment (such as temperature, humidity, dust and interference and so on), aging and abrasion of internal components and so on will increase the fault occurrence rate of system. It is necessary to carry out daily maintenance to decrease fault occurrence rate and prolong system service life.

Caution:

- Only trained professional operators can disassemble and replace the internal components.
- It is necessary to switch off the power supply before checking and maintaining.
- Prevent metal or other matters being left in system. Otherwise, system may be short circuited and damaged

Daily maintenance	Service environment	● In order to improve the function realization and prolong the service life of system, it is necessary to keep good installation environment. Generally, it is required to avoid direct high light for long time or other radiation and prevent water, other fluid, dust or dirt and so on from entering.
	BCU and BMU modules	● Check input voltage and input current with voltmeter and ampere meter to see whether they are within normal range. You can refer to description of system parameters. The output voltage and output current also can be checked with voltmeter and ampere meter to see whether they are within rated range. It is possible to perform intuitive judgment through touching, smelling and visual inspection to prevent these factors influencing its functions.
	LCD	● It is necessary to clean LCD frequently to keep it clean. Don't crash or abrade it. Otherwise, the sight line will be interfered, which will cause incorrect judgment.
Component replacement	Different components have different service life. The service life of components is influenced by environment and application conditions. Keeping good operating environment is good for the improvement of component service life.	● Wires of various plugs (e.g. air plug), PIN connector and serial port easily fall off from their welding spot, causing open circuit. Please replace them in time if there is any damage. It is necessary to cut off power supply before replacement. ● DC-DC is easily short circuited or damaged under high voltage. Please replace it in time if there is any damage. It is necessary to cut off power supply before replacement. ● Various wires are easily of short circuit or open circuit due to vehicle vibration, aging or falling off of plug from welding point. Please replace them in time if there is any damage. It is necessary to cut off power supply before replacement.
Regular maintenance	● Check whether any connector assembly is loose. If yes, please fix it. ● Check whether any cable is worn. If yes, replace it in time. ● Check the communication between BCU and BMU. If the communication is abnormal, please check it by yourself according to appendix. If the problem still cannot be solved, please contact technical support center of our company in time. ● Check module collection accuracy; mainly refer to voltage accuracy and temperature accuracy. It is necessary to check whether the voltage is within normal range with special instrument when measuring voltage. Also, use special instrument to detect whether the battery temperature is consistent with the value displaying on console. Please check it by yourself according to appendix if there is any abnormality. If the problem still cannot be solved, please contact technical support center of our company in time. ● Regularly check whether LCD display is normal. Please check it by yourself according to appendix if there is any abnormality. If the problem still cannot be solved, please contact technical support center of our company in time. ● Regularly check whether any module is loose. If yes, please tighten it in time.	