



High-capacity Sodium-ion battery

Model: FHBS-7_6LV-01
(48V 160Ah 7680Wh)





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1 Scope

This specification applies to the Sodium-ion Battery module of 7.68 kWh

2 Model

FHBL-07_6LV-01

3 Battery specification

No.	Items	Specifications	Remark
1	Standard discharge Capacity	160Ah	Standard discharging method
2	Rated discharge Capacity	160Ah	Standard discharging method
3	Battery Nominal Voltage	48V	1Sx1P
4	Standard charge current	80A	0.5C
5	Max. charge current	160A	1C
6	Charge cut-off voltage	60.8V	
7	Standard discharge current	80A	0.5C
8	Max. discharge current	160A	1C
9	Instantaneous Max. discharge current	480A	3C (≤5s)
10	Discharge cut-off voltage	24V	
11	Internal Impedance	≤ 120 mΩ	ESR @ 1KHz after standard charge
12	Operation Temperature	0°C~+55°C	Charge
		-40°C~+60°C	Discharge
13	Weight	100±0.5kg	
14	Long term storage temperature	Less than 1 month: -20~40°C	Recommended to charge every 3 months when not is use.
		Less than 6 months: 15~35°C	

4 Battery/cell performance test criteria

4.1 Appearance visual inspection

The battery appearance should be free of cracks, bursts, rust stains, stains, leakage and other defects.

4.2 Environmental test condition

Unless otherwise specified, all tests stated in this document are conducted at below test conditions.

- Temperature: 20°C~25°C
- Relative Humidity: 60%±25%



4.3 Cell electrical characteristics

No.	Item	Test Method and Condition	Criteria
1	0.2C Discharge	After fully charging the cell with standard method, rest it for 0.5 hours, then discharge at 0.2C to 24V. Repeat the test up to three times or stop once requirements are met.	0.2C Discharge Capacity \geq 100Ah
2	Cycle Life	At 25 \pm 2°C, charge the cell at 0.5C. When the voltage reaches 60.8V, switch to constant voltage until the current is \leq 0.05C, then stop charging. After resting for 0.5 hours, discharge at 0.5C to 24V and repeat the cycle.	6000 Cycles \geq 80%
3	Rate Discharge	Charge the cell with standard charge mode, rest for 0.5h, then discharge with 1C until the voltage is 24V.	1C Discharge Capacity \geq 96%C min
4	High Temperature Discharge	After standard charging at 25 \pm 2°C, place the cell in a 55 \pm 2°C temperature and humidity chamber for 2 hours, then discharge at 0.5C to 24V.	55°C Discharge Capacity \geq 96%C min
5	Low Temperature Discharge	After standard charging at 25 \pm 2°C, place the cell in a -20 \pm 2°C temperature and humidity chamber for 2 hours, then discharge at 0.5C to 24V.	-20°C Discharge Capacity \geq 80%C min
6	Ultra-low Temperature Discharge	After standard charging at 25 \pm 2°C, place the cell in a -40 \pm 2°C temperature and humidity chamber for 8 hours, then discharge at 0.5C to 24V.	-40°C Discharge Capacity \geq 60%C min

4.4 Mechanical characteristics

No.	Items	Test Method and Condition	Criteria
1	Vibration test	Secure the fully charged battery cell on a vibration platform. Vibrate the cell along the X, Y, and Z axes for 30 minutes each, with an amplitude of 1.6mm. The vibration frequency should range from 10Hz to 55Hz, increasing by 1Hz per minute.	No leakage, No fire, No explosion
2	Crush test	Fully charge the battery under standard charging conditions. Place it between two flat metal plates and apply a continuous pressure of 13 kN (17.2 MPa). Stop when the hydraulic cylinder reaches the specified pressure of 13 kN (17.2 MPa).	No fire, No explosion
3	High and low temperature shock	Charge the battery cell fully at 0.5C under 25 \pm 2°C conditions. Place it in a -40°C environment for 1 hour, then in an 85°C environment for 1 hour. Repeat this cycle 32 times. After the test, remove the sample and let it sit at 25 \pm 2°C for 6 hours.	No leakage, No fire, No explosion

4.5 Safety performance

No.	Items	Test Method and Condition	Criteria
1	Low pressure	Each fully charged cell is placed in a vacuum chamber, at an ambient temperature of 20~25°C. Once the chamber has been sealed, its internal pressure is gradually reduced to a pressure equal to or less than 11.6 kPa (this simulates an altitude of 15240 m) held at that value for 6 h.	No leakage, No fire, No explosion

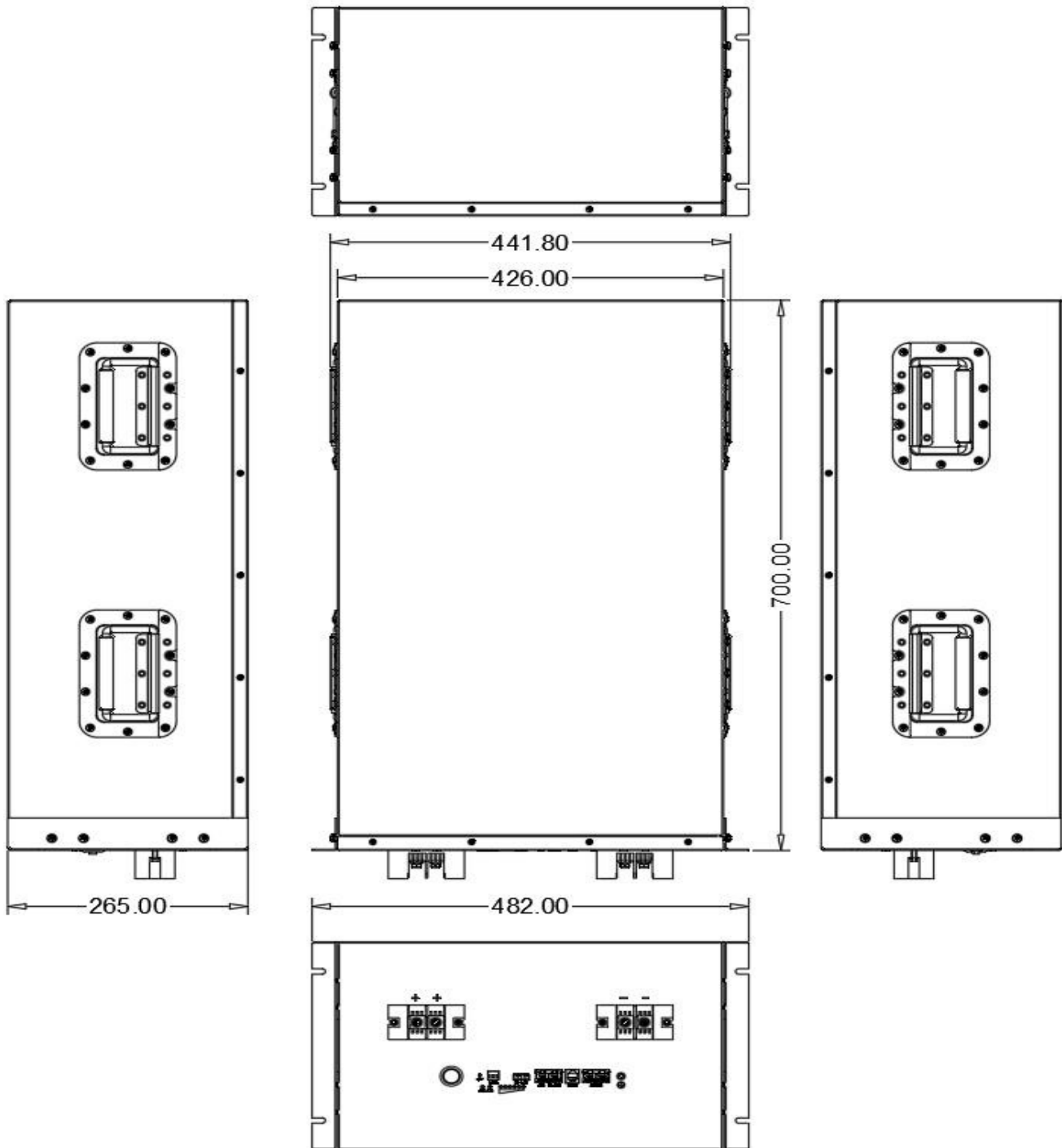


2	Over charge test	After standard charge, continue to charge with a constant voltage 72V, holding 8h.	No leakage, No fire, No explosion
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4.6 Unit voltage

No.	Items	Condition	Criteria
1	UN38.3 SoC for during transportation	Status of the cell as of ex-factory	Battery should be shipped in 42V~ 48V Charging voltage range.

5 Battery Pack dimensions





6 Protection board parameters

6.1 Technical specification

No.	Test	Factory parameters	Resettable	Remarks	
1	Single cell overcharge protection	Single-cell overcharge alarm voltage	3800 mV	Yes	
		Single-cell overcharged 1 protection voltage	3900 mV	Yes	
		Single-cell overcharge 2 protection voltage	4000 mV	Yes	
		Single-cell overcharge 1 protection delay	1.0 s	Yes	
		Single-cell overcharge 2 protection delay	1.0 s	Yes	
	Single cell Over voltage Protection release	Single-cell overcharge protection and release voltage	3700 mV	Yes	
		Discharge release	Discharge current >1000 mA		
		Capacity release	SOC<96%	Yes	
2	Single cell over discharge protection	Single unit over discharge alarm voltage	1850 mV	Yes	
		Single unit over discharge 1 protection voltage	1600 mV	Yes	
		Single unit over discharge 2 protection voltage	1500 mV	Yes	
		Single cell over-discharge 1 protection delay	1.0 s	Yes	
		Single cell over-discharge 2 protection delay	1.0s	Yes	
	Single cell over discharge protection release	Single cell over discharge protection and release voltage	2100 mV	Yes	
		Release when charged	Charging current >1000 mA		
		Single cell over discharge protection release delay	3.0 s	Yes	
3	Battery pack overcharge protection	Battery pack overcharge alarm voltage	60.8 V	Yes	
		Battery pack overcharge protection voltage	62.4 V	Yes	
		Battery pack overcharge protection delay	1.0 s	Yes	
	Battery pack over charge release	Over charge protection release voltage	59.2 V	Yes	
		Capacity release	SOC <96%	Yes	
		Discharge release	Yes	Yes	



	Battery pack over discharge protection	Battery pack over discharge alarm voltage	29.6 V	Yes	
		Battery pack over discharge protection voltage	25.6 V	Yes	
		Battery pack over discharge protection delay	1.0 s	Yes	
	Battery pack over discharge protection release	Battery pack over discharge protection release voltage	33.6 V	Yes	
		Charging to release	Charging current >1000 mA		
4	Charging over-current protection	Charge over-current alarm value	155 A	Yes	If it occurs 3 times in a row, the state will be locked and will not be automatically released. Discharging is required to release it.
		Charge over-current protection value	160 A	Yes	
		Charge over-current protection delay	1.0 s	Yes	
	Charging over-current protection release	Automatic release	Automatic release after 30 s	Yes	
		Discharge to release	Discharge current > 1000mA		
5	Discharge overflow alarm	Discharge over-current alarm value	155A	Yes	If it occurs 3 times in a row, the state will be locked and will not be automatically released. Charging is required to release it.
	Discharge over-current protection	Discharge over-current 1 protection current	160 A	Yes	
6	Discharge over-current protection	Discharge over-current 2 protection current	300 A	Yes	If it occurs 3 times in a row, the state will be locked and will not be automatically released. Charging is required to release it.
	Discharge over-flow delay	Discharge over-current 1 protection delay	3 s	Yes	
		Discharge over-current 2 protection delay	160 ms	Yes	
	Discharge over-current protection release	Automatic release	30 s	Yes	
		Charge to release	Charging current >1000 mA		
	short-circuit protection	Short circuit protection current	400 A	Yes	
		Short circuit protection delay	100 us	Yes	
		Short circuit protection release	30 s	Yes	
			Charging current >1000 mA		
		The MOS over-temperature protection temperature	110°C	Yes	
MOS protection release temperature		80°C	Yes		
Charge low temperature alarm temperature		-5°C	Yes		
Charge with low-temperature protection temperature		-10°C	Yes		
Charge with low temperature protection release temperature		-5°C	Yes		



7	Temperature protection	Charging with high temperature alarm temperature	55°C	Yes	
		Charging with high temperature protection temperature	60°C	Yes	
		Charging with high temperature protection release temperature	55°C	Yes	
		Discharge at low-temperature alarm temperature	-35°C	Yes	
		Discharge at low-temperature protection temperature	-40°C	Yes	
		Discharge low temperature protection release temperature	-35°C	Yes	
		Discharge high temperature alarm temperature	50°C	Yes	
		Discharge at a high-temperature protection temperature	60°C	Yes	
		Discharge high temperature protection release temperature	55°C	Yes	
8	Consumption current	Self-consuming current at operation	≤25 mA		
		Shutdown mode current	≤300 uA		
9	Balancing function	Balancing turn on voltage	3600 mV	Yes	
		Turn on voltage difference	30 mV	Yes	
		Turn off voltage difference	20 mV	Yes	
		Low battery alarm threshold	SOC < 10%	Yes	
10	Capacity default settings	Full capacity setting	[0-160]Ah	Yes	

6.2 LED indication

Battery status		Electricity showing on LED (From low to high)						ALM	RUN	Remark
Shut down		1	2	3	4	5	6	7	8	
Charge	0%-15% capacity	★							★	Power LED lamp (1 ^ 6) from low to high in the ON-state
	16%-31% capacity	●	★						★	Power LED lamp (2 ^ 6) from low to high in ON-state
	32%-47% capacity	●	●	★					★	Power LED lamp (3 ^ 6) from low to high in the ON-state
	48%-63% capacity	●	●	●	★				★	Power LED lamp (4 ^ 6) from low to high in the ON-state
	64%-79% capacity	●	●	●	●	★			★	Power LED lamp (5 ^ 6) from low to high in the ON-state



	80%-100% capacity	●	●	●	●	●	★		★	Power LED lamp 6 flashes
	100% capacity	●	●	●	●	●	●		★	Charging end
Discharge	1%-15% capacity	●							★	ALM ★ low power alarm default 10%
	16%-31% capacity	●	●						★	
	32%-47% capacity	●	●	●					★	
	48%-63% capacity	●	●	●	●				★	
	64%-79% capacity	●	●	●	●	●			★	
	80%-100% capacity	●	●	●	●	●	●		★	
	0% capacity	★						★	★	ALM ★ low power alarm default 10%
In parallel standby state	1%-15% capacity	●							★	
	16%-31% capacity	●	●						★	
	32%-47% capacity	●	●	●					★	The main circuit is not closed
	48%-63% capacity	●	●	●	●				★	The main circuit is not closed
	64%-79% capacity	●	●	●	●	●			★	The main circuit is not closed
	80%-100% capacity	●	●	●	●	●	●		★	The main circuit is not closed
Reporting emergency	Low power alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	Warrant alarm			/	/	/	/	★	★	Both unit and group are included according to the current SOC indication
	Over voltage alarm	/	/	/	/	/	/		★	Contains the cell over-voltage and the whole group of over voltage
	Charge excessive alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	Discharge overflow alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	Charging low temperature alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	Charging high	/	/	/	/	/	/	★	★	As per the current SOC



	temperature alarm									instructions
	Discharge low temperature alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	Discharge high temperature alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	MOS tube high temperature alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	Fan failure alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
	Cell imbalance alarm	/	/	/	/	/	/	★	★	As per the current SOC instructions
Protection	Under voltage protection	/	/	●				●	★	Contains the monomer under voltage and the whole group under voltage
	Over voltage crowbar	/	/	/	/	/	/		★	Including the monomer over voltage and the whole group over voltage according to the current SOC indication
	Charging over-current protection	/	/		●			●	★	
	Discharge over current protection	/	/			●		●	★	
	Charging low temperature protection	/	/	●	●			●	★	
	Charging high temperature protection	/	/	●		●		●	★	
	Discharge low temperature protection	/	/	●			●	●	★	
	Discharge high temperature protection	/	/		●	●		●	★	
	High-temperature protection for the MOS tube	/	/		●		●	●	★	
	Discharge short circuit protection	/	/	●	●		●	●	★	
Hitch	Charging MOS failure fault							●		
	Discharge MOS	/	/							



failure fault				●			●		
Voltage front-end sampling fault	/	/			●		●		
Voltage front-end line break fault	/	/				●	●		
Temperature front-end sampling fault	/	/	●	●			●		
Temperature front break fault	/	/	●		●		●		
Current front-end sampling fault	/	/	●			●	●		
The battery cell is seriously unbalanced and faulty	/	/		●	●		●		
Parameter configuration error failure	/	/		●		●	●		
Parallel failure of equipment	/	/			●	●	●		
Pre-charging road failure	/	/	●	●	●		●		
Communication failure	/	/	●	●		●	●		
Charger failure	/	/	●		●	●	●		
Fault superposition			●	●	●	●	●		Two or more faults occur simultaneously

Note: ● refers to always bright, ★ refers to shining, the flashing frequency of the indicator light is 1Hz

6.3 Button description

1. **With self-locking button:** Press the button to power on, release the button to power off.
2. **Without self-locking button:** Press and hold for 3 seconds to power on or off.
 - When the BMS is in sleep mode, pressing and holding the button for 3 seconds activates the BMS, and the LED indicator lights up sequentially from "RUN," each for 0.5 seconds.
 - When the BMS is active, pressing and holding the button for 3 seconds activates sleep mode of the BMS, and the LED indicator lights up sequentially from the lowest battery level light, each for 0.5 seconds.



- When the BMS is active, pressing and holding the button for 6 seconds resets the BMS, and all LEDs light up simultaneously for 1.5 seconds.

After the BMS is reset, the parameters and functions set through the host computer remain. If you need to restore to default parameters, this can be done via the host computer's "Restore Default Values" option. However, operational records and stored data (such as battery level, cycle count, protection records, etc.) remain unchanged.

6.4 Sleep and wake up

6.4.1 Sleep

The system will enter low power mode when any of the following conditions are met:

- Individual or overall over-discharge protection remains active for 30 seconds.
- The button is pressed for 3 seconds and then released.
- The lowest individual cell voltage falls below the sleep voltage threshold (default 3000mV) and stays below that value for the sleep delay time (default 1 minute), while no communication, protection, balancing, or current is present.
- The system has been in standby for more than 24 hours (no communication, no charging/discharging, no AC power).
- The system is forced to shut down via the host software.

Before entering sleep mode, ensure that no charger is connected, as this will prevent the system from entering low power mode.

6.4.2 Wake up

When the system is in low power mode, it will exit low power mode and enter normal operation mode when any of the following conditions are met:

- The charger is connected, and the charger output voltage is greater than 48V.
- The button is pressed for 3 seconds and then released.
- A communication line is connected, and the host software is activated (Note: this method cannot wake up the protection board if the system is in sleep mode due to over-discharge protection).

Note:

After over-discharge protection (either individual or overall) and the Battery was into low power mode, the system will wake up every 4 hours to activate the charge/discharge MOS. If charging is possible, it will exit sleep mode and enter normal charging. If the system cannot charge after 10 consecutive automatic wake-up attempts, it will stop the automatic waking up.

When the system is set up to charging, if the recovery voltage is not reached within 2 days/48 hours (standby time setting), it will forcibly resume charging until charging ends again.

6.5 DIP switch setting

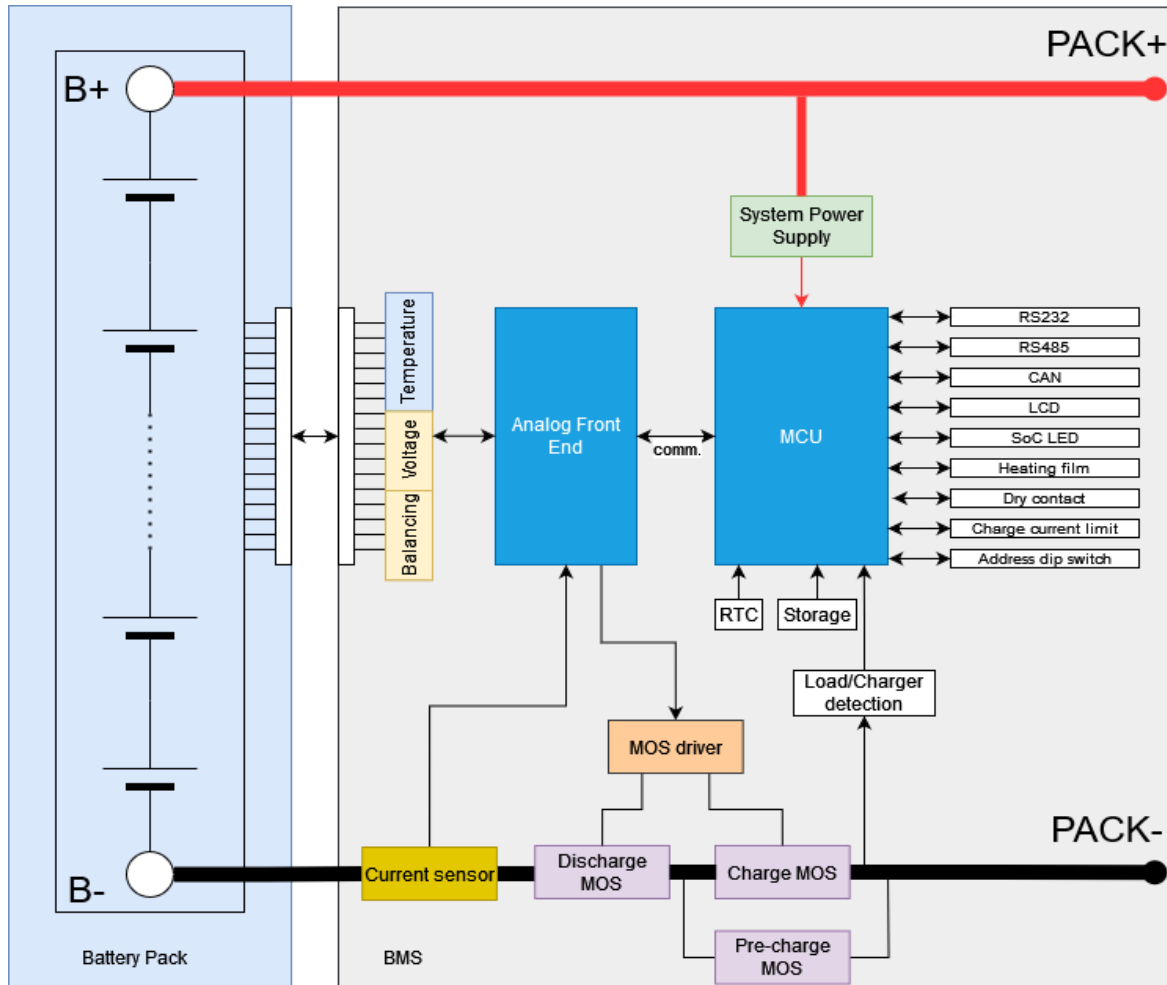
The customer can choose whether to use the dip switch. If the dip switch is not used, the system will automatically detect the presence of other devices and allocate addresses, selecting the device with the smallest address as the master.



The definition of dip switch refers to the following table

ADD	1#	2#	3#	4#	5#	6#	
0	OFF	OFF	OFF	OFF	reserved	reserved	Stepless connection, single machine use
1	ON	OFF	OFF	OFF			Set as the main PACK device address 1
3	ON	ON	OFF	OFF			device address 3
4	OFF	OFF	ON	OFF			device address 4
5	ON	OFF	ON	OFF			device address 5
6	OFF	ON	ON	OFF			device address 6
7	ON	ON	ON	OFF			device address 7
8	OFF	OFF	OFF	ON			device address 8
9	ON	OFF	OFF	ON			device address 9
10	OFF	ON	OFF	ON			device address 10
11	ON	ON	OFF	ON			device address 11
12	OFF	OFF	ON	ON			device address 12
13	ON	OFF	ON	ON			device address 13
14	OFF	ON	ON	ON			device address 14
15	ON	ON	ON	ON			device address 15

6.6 Circuit diagram



7 Handling of battery

Before using the battery, carefully read the instruction manual and the labels on the battery.

7.1 Battery short circuits are strictly prohibited.

Avoid battery short circuits. A short circuit generates a high current, causing the battery to heat up, leak electrolyte, release toxic gases, or even explode, posing significant danger. When the battery tabs come into contact with a conductive surface, a short circuit can occur. External short circuits can lead to overheating and battery damage. Using an appropriate protection circuit can safeguard the battery in case of accidental short circuits.



7.2 Disassembly is prohibited

The battery contains internal protection mechanisms and circuits to prevent hazards. Improper disassembly or assembly can damage these protections, potentially causing the battery to overheat, emit smoke, deform, or catch fire.

Do not disassemble the battery. Disassembly can cause an internal short circuit, leading to fire, explosion, harmful gases, or other issues.

Electrolyte is hazardous. If it comes into contact with skin or enters the eyes, rinse immediately with clean water and seek medical attention.

7.3 Do not dispose of batteries in fire

Do not incinerate the battery, as it may explode, posing a significant danger. This is strictly prohibited.

7.4 Do not immerse the battery in liquid

Please do not immerse the battery in liquids such as water, sea water, non-alcoholic beverages, juice, coffee or other beverages.

7.5 Battery cells replacement

The battery replacement shall be done only by either the battery supplier or device supplier and never be done by the user.

8 Period of warranty

The manufacturing warranty period is 1 year from the date of shipment. If the battery defect is caused by the manufacturing process rather than user abuse or misuse, the company is responsible for returning or replacing the battery.

9 Storage of the batteries

The batteries should be stored at room temperature, with a charge level of 30% to 50%. We recommend that batteries be charged at least once every 6 months to prevent over-discharging.

10 Remarks on lifetime

Since batteries rely on chemical reactions, their performance decreases over time, even if stored for an extended period without use. If the operating conditions such as charging, discharging, or ambient temperature, etc fall outside the specified range, then the battery's lifespan will be shorter or can cause leakage, potentially damaging equipment. If a battery cannot hold a charge for an extended period, even with proper charging methods, it should be replaced.



11 Note

Any other items which are not covered in this specification shall be agreed by both parties.

12 Cell specification

Items	Specifications		Remark
Standard discharge Capacity	160 Ah		Standard discharging method
Rated discharge Capacity	160 Ah		
Battery Nominal Voltage	3.0 V		
Standard charge current	80 A		0.5 C
Max. charge current	160 A		1 C
Charge cut-off voltage	3.8 V		
Standard discharge current	80 A		0.5 C
Max. discharge current	320 A		2 C
Instantaneous Max. discharge current	480 A		3C ($\leq 5s$)
Discharge cut-off voltage	1.5 V		
Internal Impedance	$\leq 0.65 \text{ m}\Omega$		ESR 1KHz after standard charge
Operating Temperature	0~10°C	$\leq 0.2C$	Continuous charging
	10~20°C	$\leq 0.5C$	
	20~30°C	$\leq 1C$	
	30~45°C	$\leq 1C$	
	45~55°C	$\leq 0.5C$	Continuous discharging
	-40°C~0°C	$\leq 0.5C$	
	0~15°C	$\leq 1C$	
	15~45°C	$\leq 2C$	
45~60°C	$\leq 1C$		
Storage Temperature	5°C~+45°C		Less than 1 month
	15°C~+35°C		Less than 6 months
Cell Weight	4.2±0.2kg		
Cycle life	≥ 6000 cycles		To 80% capacity (100% DoD)