RECHARGEABLE LITHIUM ION BATTERY

PRODUCT SPECIFICATION

MODEL NO.: VHR TL48150LFP

DESCRIPTION: 48V 150Ah LITHIUM ION(LFP) BATTERY

Revision History

VERSION NO.	DATE	DESCRIPTION	APPROVAL
VER-01	12th June, 2018	First Edition (EN)	

Content

1. General Information

1.1. Scope

This specification defines the product specification of the rechargeable Lithium Ion Battery supplied by Zhejiang Hengrui Technology Co., Ltd.

1.2. Applications

Telecom BTS power backup, Small or Medium-Sized Renewable Energy Storage System

1.3. Product Classification

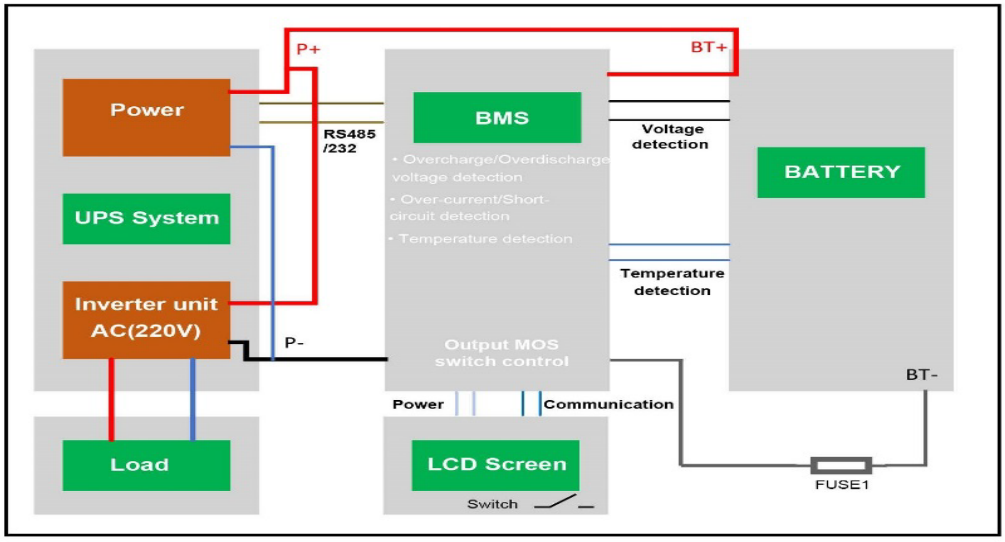
19" Standard Cabinet Suited Rechargeable Lithium Ion ($LiFePO_4$) Battery Pack.

1.4. Model No.

VHR TL48150LFP

1.5. Working Principal and Working Status

The 48V Lithium Ion Battery Pack is mainly working as 48VDC backup power source, and it consists of 15 cells of Lithium Iron Phosphate Battery Cells connected in series and telecom specialized high performance and high reliability Battery Management System (BMS). The battery's +/- output terminals are connected to the +/- terminals of rectifier. When the mains supply is normal, telecom equipment is powered by mains through rectifier and battery pack is also charged through rectifier; When the mains supply is outage, the 48V lithium ion battery pack is supplying power to telecom equipment without any time-delay to ensure telecom equipment is powered without any interruptions, until mains supply resumed or protective power cut-off by BMS due to over-discharge protection activated automatically.



Product Working Principal

1.6. Electrical Specification

No.	Item	Specification	Remarks
1.6.1	Nominal Capacity	150Ah	Standard discharge (1) capacity after standard charge (2)
1.6.2	Nominal Voltage	48.0V	Configuration: 15 cells in series. Voltage of single cell is 3.2V.
1.6.3	Charge Voltage	54.0V	@ 25 ± 3℃
1.6.4	Voltage at End of Discharge	40.0V	@ 25 ± 3℃
1.6.5	Floating Voltage	51.0V	@ 25 ± 3℃
1.6.6	Maximum Continuous Charge Current (CC Threshold)	150A	@ 25 ± 3℃
1.6.7	Over Current Protection for Charge	155A ± 3A	N.A.
1.6.8	Over Voltage Protection	3.80V/cell	N.A.
1.6.9	Maximum Continuous Discharge Current	150A	@ 25 ± 3℃
1.6.10	Over Current Protection for Discharge	155A ± 3A	N.A.
1.6.11	Under Voltage Protection	2.50V/cell	N.A.
1.6.12	Operation Allowable Temperature Range	Charge: 0～60°C	N.A.
		Discharge: -20～60°C	N.A.
1.6.13	Continuous Discharge Power	1.4KW	50%SOC
1.6.14	Continuous Charge Power	1.4KW	N.A.
1.6.15	Self-discharge Rate/Month	≤4%	@ 25 ± 3℃,50%SOC
1.6.16	Cycle Life(cycles)	≥5000	@ 25 ± 3℃,80%DOD, 0.2C/0.2C
1.6.17	Operation Allowable Humidity Range	≤95% RH	Operation
		≤85% RH	Storage
1.6.18	Recommended Storage temperature	0～40°C	Max. 6 month
1.6.19	Weight	<60kg	N.A.

(1) Standard discharge : Constant current discharge(0.2CA) till the discharge end Voltage (40.0V) at 25 ± 3℃.

(2) Standard charge : 54.0V ± 0.05V constant voltage and(0.2CA) current limited charge, for 2.0 hours at 25 ± 3℃

(3) Suggest charge method: At the ambient temperature 30℃ ± 5℃, Set charger voltage to 54.0V

a. Charge the battery with 75A(0.5C) until any cell reach 3.65V, to step b;

b. Charge the battery with 30A(0.2C) until any cell reach 3.65V, to step c;

c. Charge the battery with 18A(0.12C) until any rest cell reach 3.65V, charge finish.

1.7. Basic Parameter

Item	Settable (Yes or No)	Detailed Information	Default Setting Value	Remark
Charge Current Limit	No	Limited Charge Current Value	155A	Acceptability range :105 ± 2A
	Yes	Method of Charge Current Limit	Overcharge current activates current limit	N.A.
Sleep Voltage	Yes	Sleep Voltage Set Value	3.30 V	Acceptability range : 3.3 ± 0.02V
BMS Power consumption	No	Internal Circuit Power Consumption at Mode 1 – Fan is not activated or for natural cooling model with heat radiator	≤ 40 mA	N.A.
	No	Internal circuit power consumption during sleep	≤ 500 uA	
Charge Balancing	Yes	Balancing Activation Voltage Value	3.40 V	N.A.
	Yes	Balancing Activation Voltage Difference Value	20 mV	
	No	Balancing current	60 mA	
Full Charge Setting	Yes	Constant voltage value	54 ± 0.3V	During constant voltage charging, when the overall voltage is greater than the constant voltage and the current is less than the constant current value, the BMS will assume that the battery capacity is fully charged and the charging MOSFET will be cut off.
	Yes	Constant current value	3.75A	
Standby Time	No	Interval days of forced recovery charge after overcharge	0	In order to ensure the battery capacity, after the battery over-voltage protection, the battery will

				be forced to resume charging after a fixed time; when the time is configured to 0, this function does not work.
Under-voltage OFF Time	No	Discharge MOS turn-on interval time after undervoltage	0	In order to be compatible with the traditional lead-acid charger charging method, the BMS periodically closes the discharge MOSFET for about 7.5 seconds after undervoltage protection, so that the charger detects the battery voltage and turns on the charging. The interval period of the closed discharge MOSFET can be set. When configured to 0, this function does not work.
Capacity Setting	Yes	Full capacity setting	150Ah	N.A.
	Yes	Residual capacity setting	113Ah	

1.8. Protection Parameter Setting

Item	Default State	Settable (Yes or No)	Detail Information	Default Setting Value	Remark
Cell Over-charge Protection	on	Yes	Over-charge voltage detection value of Cell	3.80 V	Acceptability range：3.80 ± 0.02V
	on	Yes	Over-charge detection delay time of Cell	1000 ms	Acceptability range：1000 ~ 2500 ms
	on	Yes	Over-charge recovery voltage of Cell	3.34V	Acceptability range：3.34 ± 0.02V
Cell Over-discharge Protection	on	Yes	Over-discharge voltage detection value of Cell	2.50 V	Acceptability range：2.50 ± 0.02V
	on	Yes	Over-discharge detection delay time of Cell	1000 ms	Acceptability range：1000 ~ 2500 ms
	on	Yes	Over-discharge recovery voltage of Cell	3.10V	Acceptability range：3.10 ± 0.02V
Battery	on	Yes	Over-charge voltage	57 V	Acceptability range：

Module Over-charge Protection			detection value of Module		57.0 ± 0.3V
	on	Yes	Over-charge detection delay time of Module	1000 ms	Acceptability range：1000 ~ 2500 ms
	on	Yes	Overcharge recovery voltage of Module	50.1V	Acceptability range：50.1 ± 0.3V
Battery Module Over-discharge Protection	on	Yes	Over-discharge voltage detection value of Module	37.5 V	Acceptability range：37.5 ± 0.3V
	on	Yes	Over-discharge detection delay time of Module	1000 ms	Acceptability range：1000 ~ 2500 ms
	on	Yes	Over-discharge recovery voltage of Module	46.5V	Acceptability range：46.5 ± 0.3V
Over-current Protection	on	Yes	Charging overcurrent protection current 1	155 A	Acceptability range：155 ± 3A
	on	Yes	Charging overcurrent detection delay time 1	4000 ms	Acceptability range：3000 ~ 5500 ms
	on	Yes	Charging overcurrent protection current 2	188A	Acceptability range：188 ± 3A
	on	Yes	Charging overcurrent detection delay time 2	100ms	Acceptability range：100 ~ 500 ms
	on	Yes	Discharging overcurrent protection current 1	155 A	Acceptability range：155 ± 3A
	on	Yes	Discharging overcurrent detection delay time 1	6000 ms	Acceptability range：5000 ~ 7500 ms
	on	Yes	Discharging overcurrent protection current 2	188 A	Acceptability range：188 ± 3A
	on	Yes	Discharging overcurrent detection delay time 2	500 ms	Acceptability range：450 ~ 650 ms
Short-circuit Protection	on	No	Short-circuit detection current	300 ± 10A	N.A.
	on	-	Protection conditions	Load short circuit	N.A.
	on	Yes	Short circuit protection delay time	≤ 500 us	N.A.
	on	-	Protection recovery condition	Reset or recharge after load disconnection	N.A.
Temperature Protection	on	Yes	Charging high temperature protection	70 ℃	Acceptability range：70 ± 2 ℃
	on	Yes	Charging high temperature recovery	65 ℃	Acceptability range：

					65 ± 2 ℃
	on	Yes	Discharging high temperature protection	60 ℃	Acceptability range： 60 ± 2 ℃
	on	Yes	Discharging high temperature recovery	45℃	Acceptability range： 45 ± 2 ℃
	on	Yes	Charging low temperature protection	0 ℃	Acceptability range： 0 ± 2 ℃
	on	Yes	Charging low temperature recovery	5 ℃	Acceptability range： 5 ± 2 ℃
	on	Yes	Discharging low temperature protection	-20℃	Acceptability range： -20 ± 2 ℃
	on	Yes	Discharging low temperature recovery	-10 ℃	Acceptability range： -10 ± 2 ℃

1.9. Functions and Features

1.9.1 Voltage detection and protection function

The Product has the functions of cell and module voltage detection, over voltage, under voltage alarm and protection. The cell voltage detection accuracy is less than ± 15mV under normal temperature static conditions.

1.9.2 Current detection and protection function

The Product has the functions of charge and discharge current detection, alarming and protection. The charging current is shown as a positive current and the discharge current is shown as a negative current. The current sampling accuracy is less than ± 2% under normal temperature conditions.

1.9.3 Temperature detection and protection function

With the function of cell and environment temperature detection, when the temperature is too high or too low the product will start up alarming and protection function. The temperature sampling accuracy is less than ± 2°C within the operating temperature range. Four battery temperature detection points and one ambient temperature detection point (maximum 16 battery temperature detection points) are supported by default.

1.9.4 Short-circuit protection function

With short-circuit protection function, the short circuit delay time can be set by the host computer. The short circuit current should be less than 1200A.

1.9.5 Battery capacity calculation function

Cell algorithm: About the use of soc and soh, soc uses the basic elements of the Ampere integration and OCV method. The Ampere integration method and voltage, by the adjustment of the algorithm, with higher precision data and Independent clock system, ensures reasonable display during a single cycle. And the SOC estimation accuracy is ≤ ± 8%.

1.9.6 Balance function

When the battery pack is charged, if the cell voltage reaches the equalization turn-on voltage, and the maximum voltage difference is greater than the equalization voltage difference, the cell that meets the condition turns on the equalization function. Battery supports up to 6 channels simultaneously to turn on equalization. The maximum equalization current is about 75Ma.

1.9.7 LED indication function

6 LED indicators are used to indicate the battery's status. 4 green indicators are used for showing battery SOC, 1 red indicator is used for showing failure indication, 1 green operating indicator is used for showing battery's operation status, i.e. standby, charging, discharging, etc.

1.9.8 Sleep and wake-up functions

NO.	Sleep condition	Wake-up condition	Remark
1	In the idle state (no charge, discharge, no communication), the lowest voltage of any cell is lower than the set sleep voltage (can be set), after 30 minutes, enter normal sleep.	Charge and discharge, communication, reset button, soft switch, LCD	The battery with a soft switch and LCD can be waked up.
2	When the minimum cell voltage is lower than the cell over-discharge protection value (can be set) or the total voltage is lower than the overall over-discharge protection value (can be set), and after 1 minute, the under-voltage sleep is entered.	Charge, reset button, soft switch	The battery with a soft switch can be waked up.
3	Battery will enter to normal sleep after keeping idle state (no charge and discharge, no communication) for 24 hours.	Charge and discharge, communication, reset button, soft switch, LCD	The battery with a soft switch and LCD can be waked up.
4	Forcing sleep through the host computer or soft switch	Reset button, soft switch	N.A.

LCD Sleep and wake-up：Press the MENU button on the LCD to wake up.

1.9.9 Communication function

1. It can communicate with the computer or host through RS485, upload and save the collected information.
2. Supporting CAN bus communication (optional).
3. Supporting 2G/3G/4G communication (optional).
4. Supporting Bluetooth communication (optional).

1.9.10 Host computer control function

1) Through the host computer to set the protection parameters such as overvoltage, undervoltage, overcurrent, overtemperature, under temperature, short circuit, as well as balance, sleep, capacity, and other functional parameters and various alarm parameters.
2) Supporting monitoring of battery pack related information, battery status information, etc.
3) Supporting storing and exporting related data
4) Supporting writing barcode
5) Remote Control and Telemetering

1.9.11 Serial port upgrade function

The management system can be upgraded via the RS485 interface.

1.9.12 Communication Protocols

Default setting protocol with baud rate 19200, and other protocols are also supported.

1.9.13 Charge current limiting function

After the current limiting module is assembled and enabled by the host computer, the charging current limiting function can be implemented. The current limiting mode is current limiting after charging and overcurrent; the current limiting value is 10 ± 1A.

1.9.14 Anti-reverse function

Battery has Anti-reverse circuit. After the system is powered on, the protection board will be burnt due to the reverse connection of the battery during parallel installation.

1.9.15 Parallel communication function

The parallel communication function can be realized through the RS485 interface, and it can support up to 6-digit DIP switches (typically 4-digit DIP switches) for setting addresses when communicating in parallel. After parallel connection, the battery pack data can be monitored cyclically through the parallel version of the host computer.

1.9.16 Data Storage

Battery supports no less than 500 battery status data storage functions, protects all data and regular historical data during all state transitions, and stores 1 historical data every hour.

1.9.17 Optimized electrical structure

The battery can be arranged vertically in the design/use of electrical structure to enhance the stability of the battery cells；Electrical structure has made more strengthening on heat transfer and heat dissipation.

1.9.18 Pre-charge function (optional)

BMS has pre-charge function. For those applications with inverters and other power electronics connected to battery, considering large capacitors are used at charger side, pre-charge strategy can be set in BMS as per specific conditions.

1.9.19 Dry contact (optional)

2 circuits of dry contacts output are supported, and they are in normal-close mode. Dry Contact 1: Battery failure; Dry Contact 2: BMS failure.

1.9.20 Active output (optional)

2 circuits of active output are supported to control external warming-up and fans, etc. Warming-up power can reach up to 50W (warming up power is from battery self)

1.9.21 Buzzer (optional)

Buzzer alarming is supported.

1.9.22 LCD Display Screen (optional)

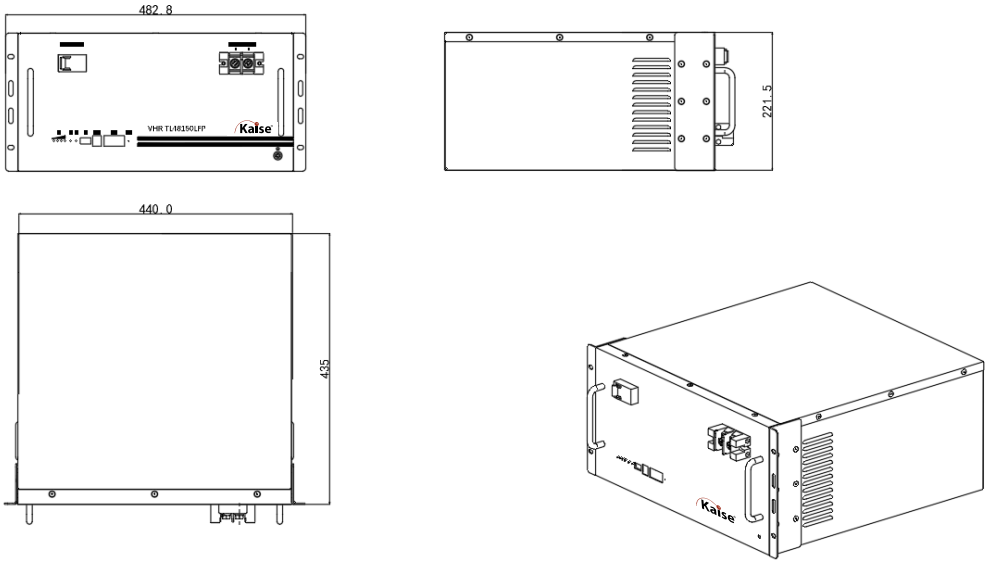
LCD display screen is provided as option.

2. Appearance and Dimension

2.1. Appearance

There shall be no defects (deep scratch, crack, rust, discoloration, leakage, and so on), which may adversely affect the commercial value of the module.

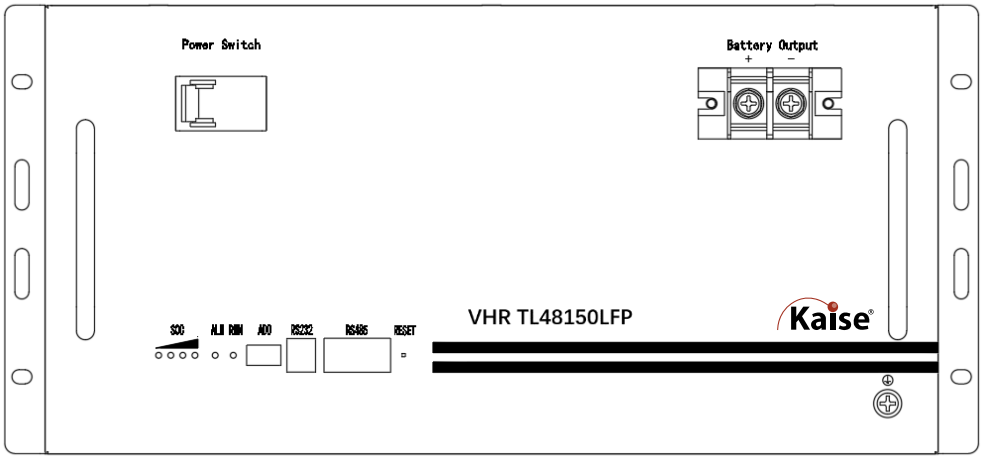
2.2. Dimension



Model No.	Nominal Voltage	Nominal Capacity	Dimension (W X D X H, mm)	Weight	Terminal			Remarks
					Material	Install way	Type	
VHR TL48150LFP	48V	150Ah	Width: 440.0mm (±2) Depth: 430.0mm (±2) Height: 221.5mm (±2)	Approx. 60kg	Steel	Threaded insert	M6	5U

2.3. Interface

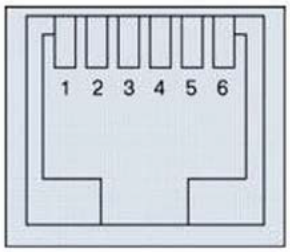
2.3.1 Drawing of Front Panel and Interface Description



No.	Name	Description	Remark
1	SOC	Capacity status	Details refer to “3.3.3 Indicators Illustration”
2	ALM	Red alarm light	Details refer to “3.3.3 Indicators Illustration”
3	RUN	Status of device running	Details refer to “3.3.3 Indicators Illustration”
4	ADD	Communication switch dip	Reserved
5	RS-232	RJ-11 for RS232 Communication and firmware update	Details refer to “3.3.2 Communication Interface Description”
6	RS-485	RJ-45 for RS485 Communication	2 X RS485 are internally parallel. Details refer to “3.3.2 Communication Interface Description”
7	RESET	Reset button	N.A.
8	MCB	Micro circuit breaker	125A
9	Fan Cooling Hole	Integrate with cooling fan	N.A.
10	Battery Output	Nominal 48V output	Positive/Negative
11	For Maintenance	For maintenance	N.A.
12	Earth	Earth	N.A.

2.3.2 Communication Interfaces Description

A) RS232 adopts 6Pin straight PCB welding socket (RJ11) to provide RS-232 protocol, the Pin assignment of RJ11 is defined as follow:



RS232

RJ11 Pin Assignment	
RJ11 Pin	**Definition Description**
1	GND (Grounding)
2	SWCLK
3	BMS transmits, Computer receives
4	BMS receives, Computer transmits
5	RS232_GND
6	SWDIO

B) RS485 adopts 8Pin straight PCB welding socket (RJ45) to provide RS-485 protocol, the pin assignment of RJ45 is defined as follow:

RS485

RJ45 Pin Definition	
RJ45 Pin	**Definition Description**
7	RS485_B
4	RS485_A
8	GND (Grounding)
1/2/3/5/6	NC

3.3.3 Indicators Illustration

A) SOC Indication

●	●	●	●	**SOC**
☼	☼	☼	☼	75% ~ 100%
☼	☼	☼	○	50% ~ 75%
☼	☼	○	○	25% ~ 50%
☼	○	○	○	0% ~ 25%

Remarks: ☼ represents LED light on, ○ represents LED light off

B) Other LED Indication

Pack Status	**Protect /Alarm /Normal**	**RUN**	**ALM**	**SOC LED**				**Description**
		●	●	●	●	●	●	——
Power down/Sleep	——	OFF	OFF	OFF	OFF	OFF	OFF	——
Standby	Normal	Flash 1	OFF	According to the SOC				——
Charge	Normal	Flash 2	OFF	According to the SOC				——
Discharge	Normal	ON	OFF	According to the SOC				——

Charge / Discharge / Standby	Protect	According to the state of charge and discharge	Flash 2	According to the SOC	——
Charge / Discharge / Standby	Alarm	OFF	ON	OFF	——

C) LED Flash State

	Light	**Extinguish**
Flash1	0.25S	3.75S
Flash2	0.5S	0.5S
Flash3	0.5S	1.5S

3. Charge/Discharge Modes and Conditions

3.1. Charge Modes and Conditions

Cell Temperature	**Standard Charge**	**Fast Continuous Charge**	**Boost Charge(5s)**
＜0℃	No Charge Allowed	No Charge Allowed	No Charge Allowed
0℃~ 5℃	Charge Current: 0.1C	No Charge Allowed	No Charge Allowed
5℃~10℃	Charge Current: 0.1C	Charge Current: 0.2C	No Charge Allowed
10℃~25℃	Charge Current: 0.2C	Charge Current: 1.0C	No Charge Allowed
25℃~50℃	Charge Current: 0.5C	Charge Current: 0.75C	1C Charge is allowed when voltage is lower than 3.65V
50℃~60℃	Charge Current: 0.1C		
＞60℃	No Charge Allowed		

3.2. Discharge Modes and Conditions

Cell Temperature	**Standard Discharge**	**Rate Continuous Discharge**	**Boost Discharge(5s)**
＜-40℃	No Discharge Allowed	No Discharge Allowed	No Discharge Allowed
-40℃~-20℃	Discharge Current: 0.1C	No Charge Allowed	No Charge Allowed

-20℃~0℃	Discharge Current: 0.1C	Discharge Current: 0.5C	Discharge Current: 2.0C
0℃~60℃	Discharge Current: 0.2C	Discharge Current: 1.0C	Discharge Current: 3C
＞60℃	No Charge Allowed		

4. Tests

4.1. Measurement Apparatus

A) Dimension Measuring Instrument: The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm;

B) Voltmeter: Standard class specified in the national standard or more sensitive class having inner impedance not less than 10KΩ/V;

C) Impedance Meter: Impedance shall be measured by a sinusoidal alternating current method (500Vac 1 kHz LCR meter).

4.2. Testing Condition

Temperature: 25 ± 3℃;

Relative humidity: 60 ± 20%.

4.3. Test Description

No.	Test Item	Standard	Reference Standard
Basic performance test			
1	Appearance	The appearance of the battery box shall not be deformed, and the protective paint shall fall off. The surface shall be flat, dry and free of trauma.	Visual inspection
2	Dimension	Comply with Technical Design Requirement	Actual measurement
3	Weight		Actual measurement
General performance test			
1	Communication	Comply with Technical Design Requirement	Actual measurement
2	Relay opening and closing		Actual measurement
3	Charge and discharge test		Actual measurement
4	Insulation		Actual measurement

5	Creepage distance		According to the enterprise standard
6	Leakage		Actual measurement
7	Air leakage test		Actual measurement
Electrical performance test			
1	Nominal capacity and energy	Comply with Technical Design Requirement	According to the enterprise standard
2	High and low temperature charging performance		According to the enterprise standard
3	High and low temperature discharging performance		According to the enterprise standard
4	C-Rate charging performance		According to the enterprise standard
5	C-Rate discharging performance		According to the enterprise standard
6	Pulse charge and discharge test		According to the enterprise standard
7	Temperature rise		According to the enterprise standard
8	Charge retention and capacity recovery		According to the enterprise standard
9	Storage performance		According to the enterprise standard
10	Cyclic life test		According to the enterprise standard
11	Charge and discharge efficiency test		According to the enterprise standard
Safety Performance Test			
1	Vibration	Comply with the standard requirement	Refer to IEC, EN, UN, ISO
2	Mechanical shock		Refer to IEC, EN, UN, ISO
3	Drop		Refer to IEC, EN, UN, ISO
4	Nail penetration		Refer to IEC, EN, UN, ISO
5	Simulate impact		Refer to IEC, EN, UN, ISO
6	extrusion		Refer to IEC, EN, UN, ISO
7	Temperature impact		Refer to IEC, EN, UN, ISO
8	Temp and humidity cycle		Refer to IEC, EN, UN, ISO
9	Seawater immersion		Refer to IEC, EN, UN, ISO
10	External fire		Refer to IEC, EN, UN, ISO
11	Salt mist		Refer to IEC, EN, UN, ISO

12	High altitude		Refer to IEC, EN, UN, ISO
13	Over-Temperature Protection		Refer to IEC, EN, UN, ISO
14	Short circuit Protection		Refer to IEC, EN, UN, ISO
15	Over-Charge Protection		Refer to IEC, EN, UN, ISO
16	Over-discharge Protection		Refer to IEC, EN, UN, ISO
BMS Test			
1	Sampling error (current, voltage, temperature, accuracy)	Comply with Technical Design Requirement	SOC estimation accuracy is tested under different voltage, current and temperature: 1. High-precision voltmeter, test monomer voltage and BMS acquisition voltage comparison; 2. Conduct charging and discharging test on the equipment and compare current data. 3. Infrared thermometer, testing temperature comparison between each temperature control point and the collected temperature of BMS;
2	SOC estimation accuracy	≤8%	In the charging and discharging process of the test capacity, the actual discharge capacity when the interception of SOC is 30%, 50% and 90%, and the discharge capacity/actual total capacity ratio is obtained to obtain the real SOC, and the SOC value is displayed by the host machine.
3	Temperature sampling quantity	No less than 8	Checking on host machine

5. Shipment

The battery should be packed in cartons under the condition of half capacity 20%-50% for shipment. The violent vibration, impaction or squeezing should be avoided in the transport process; neither is exposed in the sunlight nor rain. The batteries shall be shipped by normal transportation such as by road, by train, by ocean or by air.

6. Storage

The battery storage shall be in the clean and dry ventilation room at the temperature of 0～40°C and shall keep

out of fire or heat and avoid touching corrosion elements. The batteries shall be charged every 8 or 12 months (0 ~ 30℃ - 12month, 30 ~ 40℃ - 8 month) during storage.

7. Caution and Prohibition in Handling

Warning for using the rechargeable lithium ion battery. Mishandling of the battery may cause heat, fire and deterioration in performance. Please be noticed the following cautions.

Cautions

- Please read the user manual carefully before using the lithium ion battery.
- No human body shall direct contact the positive/negative poles at the same time if the battery's voltage exceeds 36V safety voltage.
- Please read the specific charging device's user manual carefully before charging.
- When the battery is not charged after long exposure to the charger, discontinue charging.
- Please check the positive (+) and negative (-) direction before connection.
- Battery must be stored in a dry area with low temperature (≤25°C) environment for long-term storage.
- Do not expose the battery in direct sunlight or heat.
- Do not use the battery in high static energy environment where the protection device can be damaged.
- When rust or smell is detected on first use, please return the product to the seller immediately.
- Keep the battery out of reach of children and pets.
- When battery life span shortens after long period of usage, please exchange to new battery.
- No metal objects (rings, watches, and other metal accessories, etc.) can be worn during the handling of battery.
- Charge time should not be longer than specified in the manual.
- Do not expose the battery out of the temperature range specified in the specification.

Prohibitions

- Do not use different charger to charge the battery.
- Do not charge with constant current higher than maximum charge current allowed.
- Do not disassemble or reconstruct the battery.
- Do not throw or cause impact.
- Do not pierce a hole in the battery with sharp objects, such as nail, knife, pencil, drill, etc.
- Do not mixing with other batteries.
- Do not solder on battery directly.
- Do not use old and new battery together in connection.
- Do not expose the battery to high heat, such as fire, etc.
- Do not put the battery into a microwave or high-pressure container.
- Do not use the battery in reverse.
- Do not connect positive (+) and negative (-) with conductive materials, such as metal, cables, etc.
- Do not immerge or wet battery with water or sea water.
- Do not bend the battery without prior permission from manufacturer.