



深圳市聚扬电源有限公司
Shenzhen Max Power Co.,ltd
User manual

Lithium-ion Battery Module

User Manual





V1.0



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1. Cautions

Category	Safety precautions
 Installation!	<p>Turn off the power between the main device and the battery before installing the battery.</p> <p>It is forbidden to wear watch, bracelet, bracelet, ring or other conductive objects during operation.</p> <p>Do not connect the positive and negative electrodes of the battery in reverse</p> <p>It is forbidden to place tools or metal objects on the battery. Tools with insulated handle are allowed to use.</p> <p>Do not use metal objects (such as wires) to connect the positive and negative terminal of the battery directly.</p> <p>Small sparks appear might be happened at the connector when connection work, which will not damage people and equipment.</p>
 Storage!	<p>Please do not strike the battery, such as needling, hammering or trampling.</p> <p>Do not store the battery in a high temperature environment, such as putting the battery into the fire or heating the battery.</p> <p>Do not place the battery in a humid environment, such as putting the battery in water.</p> <p>Please do not disassemble the battery or change the battery structure.</p>
 Charge and discharge!	<p>Do not use unqualified equipment for charging and discharging, please follow the correct instructions.</p> <p>Please do not charge or discharge the hot, deformed or leaking batteries in the equipment.</p> <p>Do not discharge the battery continuously in case of low capacity.</p>
 Operation!	<p>Do not mix use different batteries, such as batteries from different manufacturers, types, models or service life.</p> <p>A supplementary recharge work shall be conducted if storage period is more than 3 months; a capacity verification test must be carried out if storage period is more than 6 months; the battery should be re inspected nd can be used only after they are qualified if a storage period is more than 1 year</p> <p>Install and use the battery according to the correct operation procedures.</p> <p>It is forbidden to connect the power supply or loads that do not meet the</p>



	power level to the battery. The system still has power even if the EB is off, Avoid electric shock or short circuit when using
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This Battery is recommended if frequent discharge is expected during service. Long service life and Deep cycle service.

Requirement for batteries in series: Recommended total system voltage limit is no higher than 48V(4 nos is series), consult our technical support for guide if voltage exceeds the limit.

Requirement for batteries in parallel: Less than four strings in parallel is recommended, if more than four strings, please consult our technical support for guide. All battery voltage should be same when connect in parallel(the error is less than 0.1V)

Aging factor, consider the aging, no less than 5% margin is needed when sizing.

Battery capacity goes high after put into service, an initial capacity of 95% is acceptable.

2. Shipment, delivery and storage

Choose adequate means for shipment, delivery and handle, for the weight of a battery is heavy. Don't roll and throw a battery pack.

Avoiding of upside- down.

Be careful and not damage the terminals and valve plugs.

Avoiding of short circuit a battery, since it's fully charged.

Store batteries at dry, clean, well-ventilated are. Batteries can be stored at 0~35℃ for 6 months with recharge. Recharge the batteries once if storage period exceeds 6 months. Suggest 50% SOC storage

Self-discharge during shipment and storage increase due to higher temperature and poor ventilation.

Keep ventilation well and away from heat, flame and spark.

Disconnecting batteries from a load and charging system when store the batteries.

Recharge the batteries as per table two during storage.

3. Environment requirements

Recommended temperature range, LFP batteries: Charge 0~+45℃, discharge -20~+60℃, storage -20~+40℃; And please check the data-sheet for the maximum range.

Keep away from flame, heat, spark.

Keep away from sunlight and heat sources.

Keep away from moisture, water. If batteries be used under ground or in water, pls choose us special design batteries.

Not use a battery in a sealed enclosure.

Relative humidity: 5% - 95% RH;

4. Requirement of application conditions

Requirement for batteries in series: Recommended total system voltage limit is no higher than 48V, consult our technical support for guide if voltage exceeds the limit.

Requirement for batteries in parallel: Less than four strings in parallel is recommended, if more than four strings, please consult our technical support for guide.

Battery temperature: Temperature difference between no more than 3°C.

Batteries cannot be installed on bottom, installation position be selected to avoid cell inside suspended, consult our technical support when need.

Clearance: Keep a clearance of 20mm at least between batteries for better heat dissipation.

Float charging parameters (25°C) : Initial current limit \leq 0.5C, voltage setting 3.4~3.45V/cell

Equalization charge parameters (25°C) : Initial current limit \leq 0.5C, voltage 3.5~3.6V/cell

The favorite ambient temperature for long battery service life is 25 \pm 5°C, battery service life shorten when the temperature increase above 25°C.

Not mix up batteries from different types, different production date, different manufacturers, different size, different models in a group. Consult our technical support for guide when such case happens.

Replacement of battery: Consult our technical support for guide when such case happens.

Warranty may be invalid if above requirements are not followed.

5. Installation and service

5.1 Inspection upon unpacking

Handling:

Avoiding pull or push on terminals, to prevent damage of terminals and sealing of terminas.

Avoiding upside-down, impact, throw of batteries.

Avoiding metal rope, wire for handing, to prevent short-circuit of batteries.

Inspection: Package and appearance of batteries should be no sign of damage.

Counting out: batteries number, connectors and hardware are correct.

Refer to installation drawing and manual for guide.

5.2 Cautions before installing

Batteries voltage should be in normal range.

Insulation pad should be set under the batteries.

Begin installing only after no abnormality be found.

The position should be away from heat sources, such as a transformer.

The position should be away from spark sources, such as a fuse.

Clean or polish the terminals before connection of batteries.

Be careful to prevent the short circuit of battery positive and negative terminals by metal items.

Make sure the connection of batteries is correct before connecting the batteries to equipment. Connect the positive end of batteries to positive output terminal of the charger (the equipment), connect the negative end of the batteries to negative output terminal of the charger, otherwise damage of charger (equipment) or injure of body may occur.

Use a torque wrench for adequate tightness of the connection. Recommended torque value is as table one.

Table one Torque setting

Item	Terminal size	Value
1	M5	6.2N*m
1	M6	8.5N*m
2	M8	12.4N*m

The safe current value of our standard cable connectors for long duration is as follow

Cable 70mm², 220A/cable.

Cable 50mm², 170A/cable.

Cable 35mm², 130A/cable.

State clearly if working current is higher than above value and we will specify correct connectors for the application.

5.3 Connecting of batteries

Use isolated tools for the connecting.

- ✧ Connect batteries first, then connect batteries to charger and load.

Connect batteries in a string first, then connect strings in parallel.

Clearance between batteries no less than 20mm for better heat dissipation.

After connecting the cables with battery terminals, antirust such as vaseline may be applied onto the junction points.

Measure the total voltage of battery group before connect to power.

5.4 How to use the batteries

5.4.1 Recharging

Recharge the batteries before put into service to makeup the self-discharge during shipment and storage.

If no service for a long period of time, recharge the batteries on schedule.

Refer to table two for recharge schedule

Table two Storage temp. and recharge schedule

Temp. range	Recharge interval	Recharge parameters
Less than 20°C	Every 9 months	a) Constant voltage 3.5V/cell, initial current 0.1C(A), for12hours.
20°C ~ 30°C	Every 6 months	b) Constant voltage 3.5V/cell, initial current 0.25C(A) for 6 hours.



30°C~40°C	Every 3 months	c) Constant current 0.1C (A) for 12hours.
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Note: C means nominal capacity of the battery.

For example: The nominal capacity of LF12100 is 100AH, 0.1C (A) =0.1X100=10A.

Charge voltage: 12V battery3.6X4=14.4V

5.4.2 Capacity test and end of discharge

Performance

Standard Test Condition

The battery shall be evaluated within 1 month from the arrival date. Unless otherwise stated in these specifications, the following test shall be carried out in an ambient temperature of 20±5°C, relative humidity of 65±20%. Discharge capacity when the battery is discharged at 20A to 10V after being standard charged. Five cycles are permitted for this test. The test shall be terminated at the end of the first cycle which meets the requirement.

Testing Instrument or Apparatus

Dimension Measuring Instrument

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm specified.

Voltmeter and Ammeter

Voltmeters and ammeters shall be equal or more precision instruments of 10KΩ/V and 0.01Ω.

Impedance Meter

Impedance shall be measured by a sinusoidal alternating current method (1kHz LCR meter)

Standard Charge

Standard charge means charging for 6hours using 14.4V/0.2CA charger

Standard Discharge

Standard discharge means discharging at 0.2CA down to 10V

Electrical Performance

Item	Condition	Specification
Open-Circuit Voltage	The open-circuit voltage shall be measured within 24hours after standard charge	≥13.3V
Battery Capacity	The discharge time at 20A shall be measured after standard charge at 20±5°C and rest 30mins	≥100%
Cycle Life	At the temperature of 20 ± 5 °C, charge with 20A to the charge voltage, and then keep the charge voltage until the charging current is ≤ 0.02C; Rest for 1 hour, discharge with 20A to the cut- off voltage; Rest for another 1 hour. Cycle 2000 times according to the above steps and record the discharge time.	≥80%
Charge(capacity) retention	The discharge time at 20A shall be measured after standard charge and then storage at 20±5°C for 28 days.	≥94%
Temperature Characteristic1	After standard charging at 20±5°C, laying the battery at 55°C for 2 hour, then discharge at 20A to 10V, record the discharge	≥96%



	time.	
Temperature Characteristic2	After standard charging at 20±5℃, laying the battery at -10℃ for 4hour, then discharge at 20A to 10V, record the discharge time.	≥80%

5.4.3 Mechanical Performance

Item	Condition	Specification
Crush Test	A battery is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram with a 32mm diameter piston. The crushing is to be continued until a pressure reading of 17.2mmPa is reached on the hydraulic ram, applied force of 13kN. Once the maximum pressure has been obtained it is to be released.	No fire, No explosion
Drop Test	The battery has only two axes of symmetry in which case only two directions shall be tested. The battery is to be dropped from a height of 1 meter twice onto concrete ground.	No explosion, No fire, No smoke
Vibration	A full-charged battery is to be subjected to simple harmonic motion with an amplitude of 1.6mm total maximum excursion. The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz. The cell shall be vibrated for 30 minutes per axis o XYZ axes.	No explosion, No fire, No smoke

5.4.4 Cell Safety Performance

Item	Condition	Specification
Over charge	At 20±5℃, charging battery with constant current 1C to voltage 4V, then with constant voltage 4V till current decline to 0. Monitor the temperature	No explosion, No fire
Over discharge	At 20±5℃, according to the requirement of the standard of discharge after discharge to termination voltage, 30 mΩ external load discharge within 24 hours.	No explosion, No fire
Short-circuit	At 20±5℃, Standard charge, across the electrodes of the battery with a less than 50 m Ω wire connection, 6 hours	No explosion, No fire The temperature of the surface of the cell are lower than 150℃

Heating	Battery is heated in a circulating air oven at a rate of $5\pm 2^{\circ}\text{C}$ per mins to 130°C , an then placed 30 mins at 130°C	No explosion, no fire
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6. Maintenance

6.1 Cleaning

Keep batteries and battery room clean and dry.

Avoiding induce of static electricity during clean of batteries.

Use damp cloth for cleaning, don't use gasoline, alcohol and other organic solvents.

6.2 Check and maintenance

Perform following routine checks and keep records. Approx. 50-70% charged Shipment voltage: 13.2-13.6V。

6.2.1 Monthly checks

Items	Details	Benchmarks	Maintenance
① Total battery group voltage	Use multi-meter checking total voltage across positive and negative terminals	1.The value of measured and displayed on equipment should be close. 2. Voltage error after compensation should be less than $\pm 50\text{mV}$	Adjust the charging voltage to recommended range if there is a deviation; Repair the equipment if voltage can't be adjusted.
② Battery appearance	Bulge, leakage or damage	Appearance should be ok	Replace the battery if bulge, leakage or damage
	Dust, dirty	Clean	Cleaning
	Connectors, terminals	No rust	Clean and antirust dealing
③ Battery surface temperature	Use infrared thermometer measure surface temperature	Less than 35°C	Further check and analyse if high temperature found
④ Connections	Use torque wrench to check connection hardware	Refer to torque values	Re-tight if there is a loose connection

	Connector appearance	No rust	Clean or replace if rusted connectors found
⑤ Switch-over	Disconnect AC power, switch-over to UPS, or DC power	Switch-over is smooth	Further check if there is a problem

6.2.2 Quarterly check

Following items be checked except the monthly items.

Items	Details	Benchmarks	Maintenance
① Float voltage for each battery	Measure the voltage of each battery under floating, using a meter with four and half digits.	Voltage differences less than 2V: 90mV 6 V: 240mV 12 V:480mV	If there is a deviation, discharge the batteries and perform a equalizing charging, observe for one through two months under floating. Contact us if no improvement.
② Correct the low voltage batteries	1、 Charging the whole battery group, using equalizing voltage and discharge for one through three times. 2、 Use a charger to repair the individual battery	Voltage differences less than 2V: 90mV 6 V: 240mV 12 V:480mV	Replace the battery if can't be corrected.
③ Activated discharge	Perform a discharge-charge cycle, using lower level of equalizing charge voltage for the charge.	Discharge around 30% of the nominal capacity.	Perform the discharge-charge cycle if no power-off for six months.

2.3 Yearly check

Following items be checked except the quarterly items.

Items	Details	Benchmarks	Maintenance
① Check-up discharge	Disconnect the AC power and discharge the battery to a DOD of 30%~40%	The final voltage be greater 2.60V/cell.	Perform a equalizing charge if voltage less than 2.6V/cell. Observe for one through two months. Contact us if no improvement.
② Capacity test	Discharge battery at I_{10} current to 3.6V/cell	Remained capacity higher than 80%	Replace battery with low capacity

6.2.4 Requirements and cautions

- 1) .Insure personal and utilities safe during check operation.
- 2) .Follow the instructions of operation and keep records.
- 3) .Refer to recommended parameters of batteries.
- 4) .Wear preventative clothes, use insulated tools.
- 5) .Use calibrated tools and meters.

7. Replacement of batteries

7.1 Criteria

Batteries should be replaced if the capacity is lower than 80% of nominal capacity.

7.2 Time of replacement

Batteries are consumable and have a service life range. Batteries need to be replaced when reach the end of life, considering the application conditions, ambient temperature and etc, to insure the safety of power system. The used batteries should be disposed of properly, according to national laws and regulations.

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