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Product Specification

LiFePO4 Battery 3,2V 6000mAh

Product Name	LiFePO4 Battery 3,2V 6000mAh
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CONTENTS

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1. Scope

This specification applies to rechargeable LFP battery with aluminium shell (3,2V; 6000mAh) and contains description, model, main performance, test conditions and precautions for the product. This product is suitable for power supply of electric bicycles and scooters, battery storage power stations (e.g. solar power stations) etc.

2. Description and model

2.1 Description: LiFePO4 Battery 3,2V 6000mAh
2.2 Model: 3,2V, 6000mAh

3. Drawing and dimensions

Parameter	Dimensions
Diameter	32 ± 0,1 mm
Height	70 ± 0,1 mm

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4. General technical parameters

No.	Item		Parameter	Remark
1	Average capacity		6Ah at 0,5C discharge	temperature (25 ± 2)°C; discharge current 0,5C; cut off 2,5V.
2	Minimum capacity		6Ah at 0,5C discharge	
3	Standard voltage		3,2V	Under 0,5 C cc-discharge
4	AC impedance resistance		≤ 10mΩ	30 % SOC, AC 1KHz
5	Charge current (CC-CV)	Max charge current	6C	The maximum charge current of the battery does not exceed 1C under 10°C ~ 45°C
		Cut-off voltage	3,65V	
6	Discharge	Max discharge current	6C	Preference value
		Max transient discharge current	10C	
		Cut-off voltage	2,5V	
7	Charging time	Standard charge	2h	0,5C charge (time is reference)
		Fast charge	1h	1,0C charge (time is reference)
8	Recommended SOC window		SOC: 10% ~ 90%	
9	Charging temperature		0°C ~ 55°C	See the appendix for details
10	Discharging temperature		-20°C ~ 55°C	The battery can work normally at specified temperature range with capacity loss in tolerance.
11	Storage temperature	Short-term (1 month)	-20°C ~ 45°C	
		Long-term (1 year)	0°C ~ 35°C	
12	Storage humidity		<70 %	
13	Battery weight		141g ± 2 g	

5. Test conditions

5.1 Standard test conditions

The test should be conducted with new batteries within one month after shipment from our company and the cells shall not be cycled more than five times before the test. Unless otherwise defined, test stated in this specification should be conducted at the temperature (25 ± 2)°C, humidity 45% ~ 85% and standard atmospheric pressure 86KPa ~ 106KPa.

5.2 Measuring equipment requirements

All measuring equipment (including test equipment and instruments for monitoring and monitoring test parameters) shall be tested or qualified according to the relevant national verification procedures or relevant standards and shall be valid for the period of validity. All test instruments and equipment should have sufficient accuracy and stability, the accuracy should be higher than the measured accuracy of an order of magnitude or error is less than one-third of the allowable error of the measured parameters.

5.3 Standard charge

The standard charge means charging the cell with charge current 0,5CA and constant voltage 3,65V at the temperature (25 ± 2)°C, 0,05CA cut off.

5.4 Standard discharge

The standard discharge means discharging the cell with discharge current 0,5CA and cutoff voltage 2,5V at the temperature (25 ± 2)°C. If required, the battery can be discharged with constant current 1,0CA to a cutoff voltage 2,5V.

6. Battery performance

6.1 Test conditions

No.	Item	Requirements	Test method
1	Appearance	Battery should be clearly marked without any defect such as breakage, leakage and oil pollution.	
2	Normal discharge performance	Discharge capacity / nominal capacity x 100 % A) 0,33CA ≥ 100 % B) 0,5 CA ≥ 98 % C) 1 CA ≥ 97 %	After standard charge and 1-hour rest, discharge to 2,5V cutoff with the current of 0,33C (A), 0,5C (A), a 1C (A) respectively. Repeat 3 times, if the capacity is not qualified.

3	Discharge performance at different temperatures	Discharge capacity / nominal capacity x 100 % A) ≥ 95 % at 55°C (cutoff: 2,5V) B) ≥ 70 % at -20°C (cutoff: 2,0V)	Measure the initial capacity and state of the battery. After standard charge and 3-hour rest at the temperature 55°C, discharge the battery with the current of 1,0C(A) to 2,5V cutoff. After standard charge at the temperature (25 ± 2)°C and 20-hour rest at the temperature (-20 ± 2)°C, measure the termination capacity with the current 0,2C (A).
4	Charge retention at room temperature	Capacity retention ≥ 95% Capacity recovery ≥ 97%	Measure the initial capacity and state of the battery. After standard charge and open the circuit for 30 days, discharge to 2,5V cutoff with the current of 1,0C (A) and calculate the remaining capacity. The retention can be expressed as a percentage of nominal capacity. After standard charge and 30-minute rest, calculate the discharging capacity (Ah). The recovery can be expressed as a percentage of nominal capacity. The recovery is measured with discharge current 1,0CA with 2,5V cutoff at the temperature (25 ± 2)°C.
5	Cycle life	≥ 3500 cycles	The battery cell is under the action of preset 300kgf force. After standard charge and 30-minute rest, discharge to 2,5V cutoff with the current of 1,0C (A) at the temperature (25 ± 2)°C. Then start the next cycle, end with the capacity decrease to 80 % of the initial capacity. The number of cycles is defined as the cycle life of the battery.
6	Initial impedance	≤ 10mΩ	30% SOC condition, measure the AC 1KHz AC impedance

6.2 Safety tests

No.	Item	Test methods	Requirements
1	Over charge	After standard charge and 1-hour rest at the temperature (25 ± 5)°C, charge the battery with the current of 1CA to 5V.	No fire, no explosion
2	Over discharge	After standard charge and 1-hour rest at the temperature (25 ± 5)°C, discharge the battery with the current of 1CA to cutoff 0V.	No fire, no explosion

3	Short circuit test	After standard charge and 1-hour rest at the temperature (25 ± 5)°C, the battery is to be short-circuited with copper wire of a maximum resistance load 10mΩ for 10 minutes.	No fire, no explosion
4	Nail pricking	After standard charge, prick through the sample battery from the perpendicular direction of the battery plate with a nail having a diameter of 3mm ～8mm. Steel nail remains in panels.	No fire, no explosion
5	Extrusion test	After standard charge and 1-hour rest at the temperature (25 ± 5)°C, test according to the following conditions: a) Extrusion direction: perpendicular to the direction of the battery plate pressure. b) Extrusion degree: until the battery case is broken or the internal short circuit (battery voltage becomes 0V).	No fire, no explosion
6	Drop test	After standard charge and 1-hour rest at the temperature (25 ± 5)°C, the battery is dropped from a height of 1,5 meter twice onto concrete floor.	No fire, no explosion

7. Transportation

For shipping, the battery should be packed in boxes with the condition of half charged. There should be no violent vibration, impact extrusion, sun and rain during shipping. The battery is suitable for transportation by cars, trains, ships, aircraft and other transportation vehicles.

8. Storage and other matters

8.1 Long-term storage

Batteries should be stored (more than 1 month) indoor with a dry and clean environment at the temperature 0°C ~ 35°C. Avoid contact with corrosive substances and stay away from fire and heat source. The battery should be charged and discharged every 6 months. The voltage for storage is between 3,0 ~ 3,3 V (30 ~ 50% SOC).

8.2 Other matters

Any matters not mentioned in this specification shall be negotiated by both parties.

9. Handling of cells

9.1 Charging

9.1.1 Charging current

Charging current shall not exceed the maximum charging current in this specification. Otherwise it would cause problems in charge and discharge performance, mechanical performance and safety performance and may cause heat or leakage.

9.1.2 Charging voltage

Charging voltage shall not exceed the maximum charging voltage in this specification.
Otherwise it would cause problems in charge and discharge performance, mechanical performance and safety performance and may cause heat or leakage.

9.1.3 Charging temperature
Batteries must be charged within the ambient temperature range of 0°C ~ 55°C.

9.1.4 Forbidding reverse charge
Battery should be connected correctly. It is strictly prohibited to reverse charge. Otherwise it will cause the battery scrap and produce safe hidden trouble.

9.2 Discharge
9.2.1 Discharging current
Discharging current shall not exceed the maximum charging current in this specification. Otherwise it would cause dramatical capacity loss and overheating.

9.2.2 Discharging temperature
Batteries must be discharged within the ambient temperature range of -20°C ～ 55°C.

9.2.3 Forbidding over-discharge
Battery management system (BMS) should be installed to prevent over-discharge during the normal usage. Over-discharge will cause the battery scrap and produce safety hazard. It is necessary to state that for the battery not used for a long time, it may over-discharge due to the self-discharge characteristics. To prevent the occurrence of over-discharge, the battery should be regularly charged and the voltage should remain above 2,9V.

9.3 Battery handling precautions
9.3.1 Before using the battery, please read the specification and pay attention to the battery surface logo.

9.3.2 Please use the battery in a normal indoor environment at the temperature: -20°C ～ 55°C, relative humidity: 15 ~ 90 %, atmospheric pressure: 86 ~ 106KPa.

9.3.3 During the usage, the battery should be kept away from heat and fire. Prevent children from playing with the battery. Do not beat, fall or impact the battery.

9.3.4 This battery can only be charged with a charger with specified parameters (e.g.: it does not exceed the voltage 3,65V and current 6A).

9.3.5 Do not short-circuit the battery at any time, otherwise it can cause serious damage to the battery and cause danger.

9.3.6 If the battery is not in use for a long time, please keep it in a semi-charged state. Not in fully charged or fully discharged state.

9.3.7 The waste battery should be dealt with in a safe and secure way. Do not throw the battery into fire or water.

9.3.8 Battery box design considerations
a) The battery box should have sufficient mechanical strength to prevent the internal battery from mechanical impact.
b) There should be no sharp corners in the location for placing the battery inside the box.
c) The measurements for increasing air convection, waterproof and dustproof and others are needed.

9.3.9 Battery connection
a) Polish the pole with abrasive paper before use, otherwise it would cause bad contact or failure.
b) Use specific tools, such as a spanner, to connect the battery.

10. Warning and precautions before using the battery

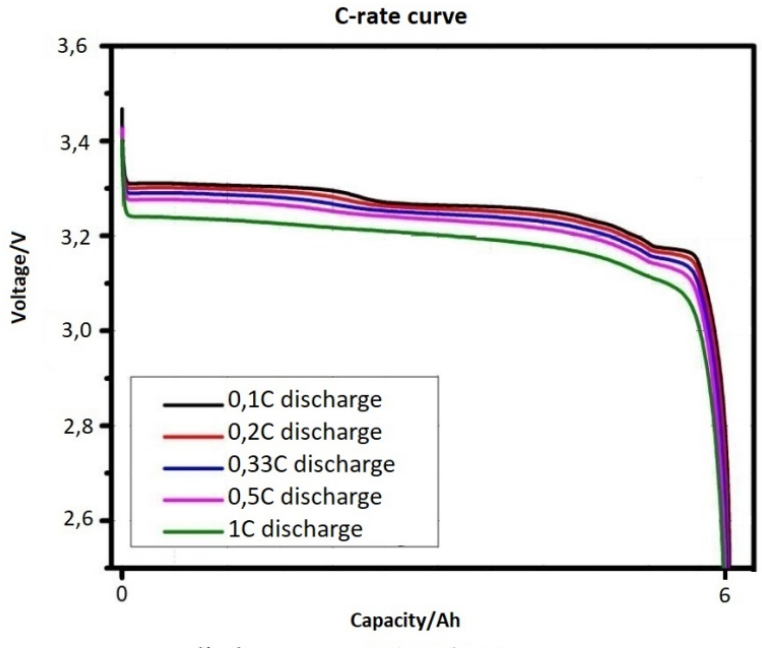
Failure to observe the following warning and precautions may result in battery leakage, overheating, explosion and/ or fire.

Warning!
1. Do not immerse the battery in water and do not allow it to get wet.
2. Do not use or put the battery near the source of heat, such as fire, heating etc.
3. Charge the battery with a specified charger according to charging requirements.
4. Do not reverse the positive (+) and negative (-) terminals.
5. Do not put the battery into a fire or apply direct heat to it.
6. Do not short-circuit the battery by connecting wires or other metal objects to the positive (+) and negative (-) terminals.
7. Do not ship or store the battery together with metal objects, such as necklaces, hairpins, etc.
8. Do not knock, throw, tread or bend the battery.
9. Do not directly solder the battery terminals or pierce the battery casing with a nail or other sharp objects.

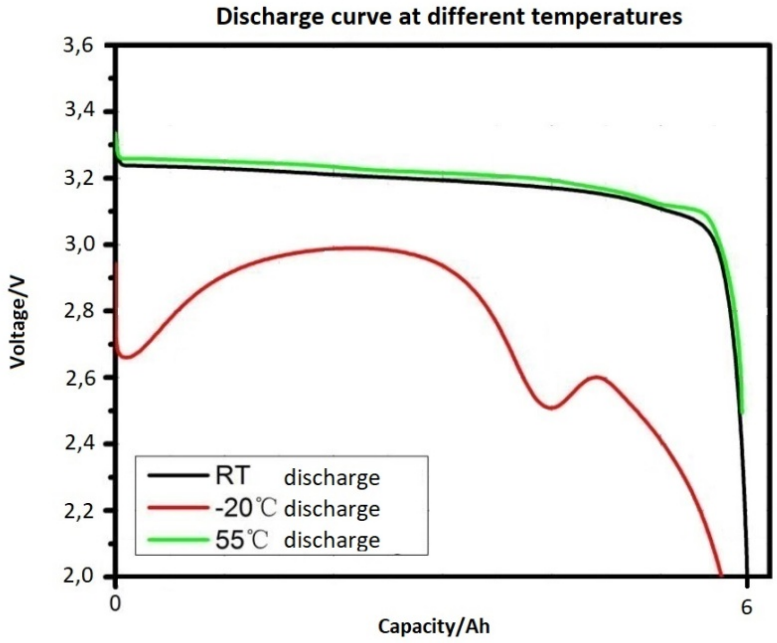
Precautions
a) Do not use or store the battery in extremely hot places, such as under window of a car in direct sunlight in a hot day. Otherwise the battery may be overheated. This can also reduce battery performance and/or shorten service life.
b) Do not use the battery in places with a strong electrostatic and magnetic field, otherwise the battery can be destroyed and cause danger.
c) Do not use the battery if it gives off an odor, generates heat, changes color or have any problems during usage, storage and discharging.

Appendix: Battery performance curves

Graph 1: C-rate curve



Graph 2: Discharge curve at different temperatures



Graph 3: Cycle performance (1,0C) curve

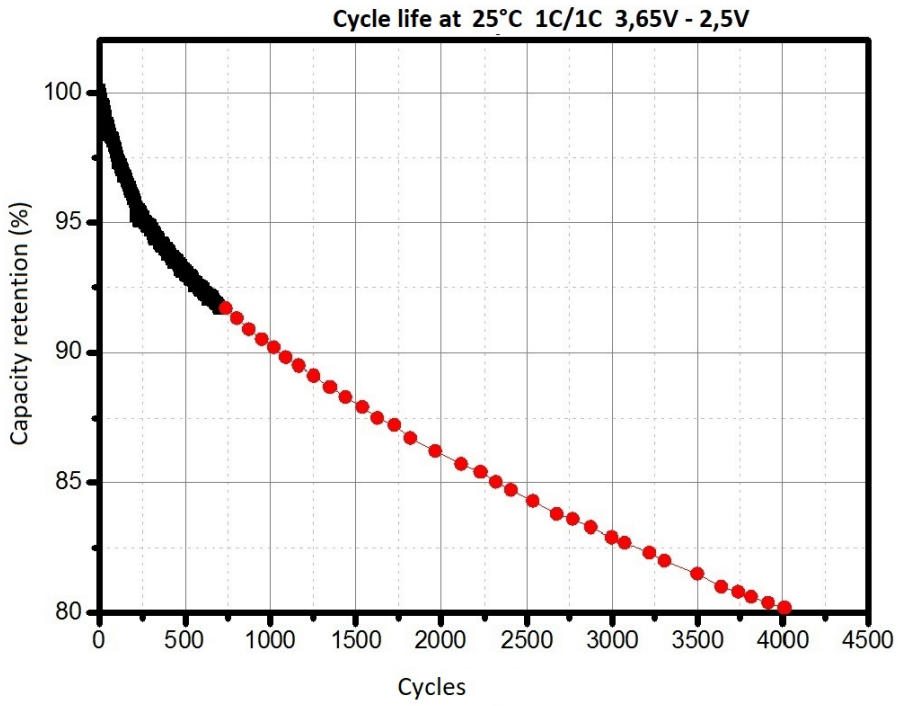


Table 1
The allowable continuous charging current for the cell under different temperature

Battery temperature	Standard charge	Fast charge	Pulse charge
<0°C	Charging is not allowed	Charging is not allowed	Charging is not allowed
0~10°C	Charge to 3,6V cutoff with the current of 0,2C	Charging is not allowed	Charging is not allowed
10~45°C	Charge to 3,65V cutoff with the current of 0,5C	Charging current is 1,0C	Refer to table 3
45~50°C	When the voltage is <3,60V,charge below 0,2C		
50~55°C	When the voltage is <3,60V, charge below 0,1C		
>55°C	Charging is not allowed		

Note: During the charging and discharging process, the temperature of cell is not allowed to exceed 55°C.

Table 2

Table of the current MAP of continuous discharging at different temperatures and SOC conditions

Temperature / SOC (%)	55°C	50°C	45°C	25°C	10°C	0°C	-10°C	-20°C
100	3	3	6	6	6	1,8	1,2	1,2
90	3	3	6	6	6	1,8	1,2	1,2
80	3	3	6	6	3	1,8	1,2	1,2
70	6	6	6	6	3	1,2	1,2	0,6
60	6	6	6	6	1,8	1,2	0,6	0,6
50	6	6	6	6	1,8	1,2	0,6	0,6
40	3	3	3	3	1,2	0,6	0,6	0,6
30	1,8	1,8	1,8	1,8	1,2	0,6	0,6	0,3
20	1,8	1,8	1,8	1,8	1,2	0,6	0,3	0
10	1,8	1,8	1,2	1,2	0,6	0,3	0	0
0	0	0	0	0	0	0	0	0

Table 3

The permissible transient (30S) maximum charge current (Ic) of the cell at different temperatures and SOC conditions

SOC (%) / Temperature	100	90	80	70	60	50	40	30	20	10	0
55°C	0	3,6	3,6	3,6	3,6	7,2	7,2	7,2	7,2	7,2	7,2
50°C	0	7,2	7,2	7,2	7,2	18	18	18	18	18	18
45°C	0	18	18	18	18	36	36	36	36	36	36
25°C	0	18	36	36	36	36	36	36	36	36	36
10°C	0	3,6	7,2	18	36	36	36	36	36	36	36
0°C	0	0	7,2	7,2	7,2	7,2	18	18	18	18	18

Table 4

The permissible transient (30S) maximum discharge current (Id) of the cell at different temperatures and SOC conditions

SOC (%) / **Temperature**	**100**	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**	**0**
55°C	36	36	36	36	36	36	36	36	36	36	0
25°C	36	36	36	36	36	36	36	36	36	36	0
10°C	36	36	36	36	36	36	36	36	18	18	0
0°C	36	36	36	36	36	36	18	18	18	7,2	0
-10°C	36	36	36	36	18	18	7,2	7,2	7,2	0	0
-20°C	18	18	18	18	10,8	10,8	3,6	3,6	3,6	0	0