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### 1. Scope

This specification describes the property indexes and technical requirements of the 12.8V 3.6Ah rechargeable Lifepo4 lithium ion battery manufactured by Shenzhen Polinovel Technology Co., Ltd (hereinafter to be referred as POLINOVEL ).

### 2. Product

2.1 Product Name: LiFePO4 Battery Pack

2.2 Cell Specification and configuration: LiFePo4 battery cell IFR26650 3.2V-3600mAh, 4S1P.

The whole battery system USES a total of 4pcs IFR26650 cylindrical battery cells, total 4 strings of 1 for 12.8V 3.6Ah, with built-in BMS and other components.

2.3 Model: PL1203

### 3. Product Parameters

No.	Item	Parameters	Remark
3.1	Rated Capacity	3.6Ah	Standard discharge after standard charge
3.2	Nominal Voltage	12.8V	Operating voltage
3.3	Charge Method	CC/CV	Constant current, constant voltage
3.4	Charge Voltage	14.6V	
3.5	Discharge Cut-off Voltage	10V	Voltage at end of discharge
3.6	Max. Charge Current	2A	
3.7	Max. Discharge Current	5A	
3.8	Weight (approx.)	408g	
3.9	Battery Dimension (L×W×H)	54x54x73mm	
3.10	Operation Temperature Range	Charge	0~45℃
		Discharge	-20~60℃
3.11	Storage Temperature Range	0~40℃	15~25℃ for long time storage
	Storage Humidity	RH<50%	

### 4. Battery Picture



Item	Description	Dimension
L	Length	54mm ±1mm
W	Width	54mm±1mm
H	Height	7mm±1mm

## 5. Test Conditions

### 5.1 Standard Test Conditions

All the tests mentioned in this specification should be conducted under standard temperature of  $23\pm 3^{\circ}\text{C}$  and relative humidity of 50%.

### 5.2 Measuring Instrument or Apparatus

All of the measuring instruments and facilities (include the equipment which monitor the test parameters) should be verified and calibrated qualified by relevant Chinese Calibration Regulation or certain standards within the valid date. All the test instruments and equipment should have the properties of adequate precision and stability, and the precision should be an order higher than the tested indicators or the tolerance should be less than one third of the tested parameters.

### 5.3 Standard Charging

Charging shall consist of charging at a  $0.2C_5A$  constant current rate until the battery reaches 14.6V. The battery shall then be charged at constant voltage of 14.6 volts while tapering the charge current. Charging shall be terminated when the charging current has tapered to 0.01 C. Charge time: Approx 5.5h, The battery shall demonstrate no permanent degradation when charged between  $0^{\circ}\text{C}$  and  $45^{\circ}\text{C}$ .

5.4 Standard Discharging

The battery should be discharged at a constant current of 0.2C<sub>5</sub>A to 10.0 volts @ 23° ± 3C

5.5 Others

If no otherwise specified, the rest time between Charge and Discharge amount to 30min.

**6. Battery Cell Performance**

6.1 Electrical Characteristics

NO	Item	Technical Requirements	Test Method
1	Appearance	The battery should be no damage, leakage, oil contamination and should be legibly marked.	Visual Inspection
2	Discharging Characteristics Under Nominal temperature	Discharging Capacity/Nominal Capacity×100% A) 0.3CA ≥100% B) 0.5CA ≥98% C) 1CA ≥95%	After the process of standard charging, the battery should be set aside for 1 hour, afterwards, discharging it at the current of 0.3C(A)、0.5C(A)、1C(A) separately until it reaches to minimum voltage of 2.5V, the test is allowed to be repeat 3 times if the discharging capacity can't reach to the nominal one.
3	Discharging Characteristics At Different Temperatures	Discharging Capacity/Nominal Capacity×100% A) 55℃≥95% (discharging cut-off voltage: 2.5V) B) 0℃≥90% (discharging cut-off voltage: 2.5V) C) -10℃≥80% (discharging cut-off voltage: 2.0V) D) -20℃≥70% (discharge cut-off voltage: 2.0V)	Measuring battery's initial capacity and initial status. After the process of standard charging, the battery should be set aside for 3 hours at the constant temperature of 55±2℃, afterwards, discharging it at the current of 0.3C(A) until it reaches to the cut-off voltage, and then, operating the procedure of standard charging at room temperature. At constant temperature, shelving the battery for 20mins in the proper sequence of 0±2 ℃/-10±2 ℃/-20±2℃, and measuring the cut-off capacity of it at the current of 0.3C(A).

4	Energy Retention Capability At Room Temperature	Residual Capacity ≥ Nominal Capacity × 95% Recoverable Capacity ≥ Nominal Capacity × 97%	Measuring battery's initial capacity and initial status. After standard charging, shelving the battery for 30 days under the condition of open circuit, and then, measuring the final status; calculating residual capacity of the battery when it reaches to the discharging cut-off voltage after discharging it at the current of 0.3C(A). The energy retention capability can be expressed as the percentage of nominal capacity. After nominal charging, shelving the battery for 30mins at the ambient temperature of ( 25±5 ) °C, discharging the battery until it reaches to cut-off voltage. Calculating discharging capacity (by Ah). The capability of capacity recoverable can be expressed as the percentage of nominal capacity.
5	Life Cycle	≥2000 Times	After the process of standard charging, shelving the battery for 30mins, afterwards, discharging the battery at the current of 0.3C until it reaches to cut-off voltage at the ambient temperature of ( 25±5 ) °C, and then proceed to the next cycle until the capacity reduce to 80% of the initial one. The numbers of cycling is defined as the battery's life cycle.
6	Initial Internal Resistance	In the state of half charging, measuring the alternating current impedance at the condition of AC 1KHz.	≤30mΩ

**6.2 Safety**

NO	Item	Technical Requirements	Test Method
1	Over-charge Test	No explosion, No fire	After the process of standard charging, shelving the battery for 1 hour at the ambient temperature of 20°C±5°C. Afterwards, charging the battery at the current of 1C(A) until it reaches to 5V which should be conducted under the same temperature.

2	Over-discharge Test	No Explosion, No Fire	After the process of standard charging, shelving the battery for 1 hour at the ambient temperature of 20°C±5°C. Afterwards, charging the battery at the current of 0.3C(A) until it reaches to 0V at the same temperature.
3	Short-Circuit Test	No Explosion, No Fire	After the process of standard charging, shelving the battery for 1 hour at the ambient temperature of 20°C±5°C. Afterwards, shorting circuit it for 10mins, and make sure the resistance of outside line should be less than 10mΩ.
4	Nail Penetration Test	No Explosion, No Fire	After the process of standard charging, shelving the battery for 1 hour at the ambient temperature of 20°C±5°C. Afterwards, penetrating the battery rapidly with a steel spike of φ3mm~φ8mm which should be perpendicular to the accumulator electroplating(the steel spike should stay inside of the accumulator).
5	Extrusion Test	No explosion, No Fire	After the process of standard charging, shelving the battery for 1 hour at the ambient temperature of 20°C±5°C. Afterwards, conducting the experiment in line with the conditions as listed bellow: a) Extrusion Direction: Pressing the battery perpendicularly to the accumulator electroplating. b) Extrusion Extent: Stop until the shell cracks or short circuit inside(the voltage of battery turns to be 0(V))
6	Drop Test	No explosion, no fire	After the process of standard charging, shelving the battery for 1 hour under the ambient temperature of 20°C±5°C. Afterwards, dropping the battery to the ground from a height of 1.5M, and it is required that the drop should be repeat 2 times on each face of the battery.

## 7. Transportation

The battery should be packed in boxes for delivery, and be delivered under the state of half charged. The battery should be prevented from vibration, shock , extrusion, sun-scorched and rain-drenched. It could be delivered by car, train, boat, airplane ,etc.

## 8. Storage

The battery should be stored (more than 1 month) in clear, dry and ventilated room under ambient temperature

of  $-20^{\circ}\text{C}\sim 45^{\circ}\text{C}$ , and it should be kept away from caustic material, combustion source and heat source. Charging and discharging the battery every six months, and make sure the storage voltage should be  $12.8\sim 13.4\text{V}$ .

## 9. Battery Operation Instruction

### 9.1 Charging

#### 9.1.1 Charging Current

The charging current should not be higher than the maximum current indicated in this specification.

#### 9.1.2 Charging Voltage

The charging voltage should not be higher than the maximum voltage indicated in this specification.

#### 9.1.3 Charging Temperature

The battery should be charged under the ambient temperature range of  $0^{\circ}\text{C}\sim 45^{\circ}\text{C}$ ..

#### 9.1.4 Reverse Charging is Forbidden

Properly assemble the cathode and anode of the batteries. Charge the battery in constant current and constant voltage way. Reverse charge is forbidden which will cause damage to the battery.

### 9.2 Discharging

#### 9.2.1 Discharging Current

The discharging current should not be higher than the maximum current indicated in this specification. Over high discharge current may incur the problem of intensely drooping of the capacity and over fever.

#### 9.2.2 Discharging Temperature

The battery should be discharged under the ambient temperature range of  $-20^{\circ}\text{C}\sim 60^{\circ}\text{C}$ .

#### 9.2.3 Over Discharging Is Forbidden

In the course of normal use, the battery management system should be applied to avoid to over discharging. If the battery is over discharged, it may be damaged or safety problem may be occurred.

Please pay attention that the battery can be in the state of over discharged because of self-discharge during the process of storage of the batteries which haven't be used for a long time. To avoid this, the battery should be charged according to a fixed schedule, and the voltage should be maintained above  $12.8\text{V}$ .



## 10. Cautions in Use

10.1 Please read the instruction carefully and pay attention to the marks on the surface of battery before using it.

10.2 Please use the battery under normal indoor environment, temperature:  $-20^{\circ}\text{C}\sim 55^{\circ}\text{C}$ ; humidity:  $(65\pm 20)\%$ .

10.3 In the procedure of using the battery, please isolate it from heat source, fire source, and keep the children away from play with it, never beat, drop or shock it.

10.4 This battery only can be used with configured charger.

10.5 Short circuit is forbidden at any time, which may leads to the damage of battery, or even incur danger.

10.6 If you do not use it for a long time, please make sure it is well stored, keep it on the state of being half charged, do not fully charge or discharge it.

10.7 Discarded battery should be well disposed, do not throw it in the fire or under the water.

## 11. Warnings

- Do not immerse the battery under water, store it in the cool and dry environment when not use it.
- Keep it away from heat source like fire, heater when use or store it.
- Please use lithium-ion special charger when charging it.
- Please make sure the polarity is not reversed during the usage.
- Do not dispose battery into the fire or heater
- Do not connect the cathode with the anode directly by metals which could cause short circuit.
- Do not transport or store the battery with metals like hairpin, necklace.
- Do not strike, throw, tread or bend the battery
- Do not solder directly to the battery or penetrate it by using nails or other edge tools.
- Do not use or place the battery where has high temperature(under the hot sun) , otherwise the phenomenon of overheat, improper function, the shorten life span may occur.
- Do not use the battery in the high electrostatic field and high magnetic one, otherwise it leads to the damage of the safety device which causes unsafe issue.
- If the leakage of electrolyte happens, and the electrolyte enters into eyes, instead of rubbing your eyes, you should rinse it out with clear water, and get a treatment in the hospital immediately, or it may hurt the eyes
- If the battery gives out peculiar smell, has a fever, changes color and becomes deformed, or any abnormal phenomenon occurs during the usage, storage, charging process, you should stop and remove it immediately from the device or charger.

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



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**Version**

**Number: A/1**

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