

Presentation:

# PRODUCTION SPECIFICATION

## Rechargeable Lithium iron Phosphate Battery

Model: 12.8V 100Ah

Customer Approval (Date)

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## Revision History

Revision	Date	Originator	Description
00	2019/8/15	R&D Center	Original Release
01	2023/6/5	R&D Center	Add the bluetooth function

## 1. Scope

This Specification is applied to JOYKOO rechargeable lithium ion battery of the following mentioned type for various applications in power solution devices and power systems.

## 2. Battery Classification and Type

2.1 Battery Classification: JOYKOO Lithium Ion Battery

2.2 Battery Cell Model: 50160115

## 3. Technical Standard

The specification is based on the technical specification of GB/T 36276-2018 or IEC62619.

## 4. Nominal Specification

Cell Description Items		Specification	Remarks
4.1	Typical Capacity	102Ah	0.5C <sub>5</sub> A discharge
4.2	Minimum Capacity	100Ah	0.5C <sub>5</sub> A discharge
4.3 Nominal Voltage		3.2V	
4.4 Discharging Voltage (Min)		2.0V	
4.5 Charging Voltage (Max)		3.65±0.05V	
4.6 Charging Current (Std)		50A	0.5C <sub>5</sub> A (0 ~ +45°C)
4.7 Discharging Current (Std)		50A	0.5C <sub>5</sub> A (-20 ~ +60°C)
4.8 Max Charging Current		100A	1.0C <sub>5</sub> A (0 ~ +45°C)
4.9 Discharging Current (Max/Peak 3s)		200A	2.0C <sub>5</sub> A (-20 ~ +60°C)
4.10 Max continuous Discharging Current		100A	1.0C <sub>5</sub> A (5 ~ +45°C)
4.11 Cell Internal Impedance		≤0.5mΩ	AC Impedance 1kHz
4.12 Cell Cycle life		≥6000	0.5C <sub>5</sub> A (0 ~ +45°C)
4.13 Cell Dimension		5.0±0.3 mm	Thickness
		160.0±0.5 mm	Width
		115.0±0.5 mm	Length
4.14 Cell Weight		1.98kg	About

## 5. Battery Pack Nominal Specification

Battery Pack Description Items		Specification	Remarks
4.1	Typical Capacity	102Ah	0.5C <sub>5</sub> A discharge
4.2	Minimum Capacity	100Ah	0.5C <sub>5</sub> A discharge
4.3 Nominal Voltage		12.8V	
4.4 Discharging Voltage (Min)		10.0V	
4.5 Charging Voltage (Max)		14.60±0.05V	
4.6 Charging Current (Std)		50A	0.5C <sub>5</sub> A (0 ~ +45°C)
4.7 Discharging Current (Std)		50A	0.5C <sub>5</sub> A (-20 ~ +60°C)
4.8 Max Charging Current		100A	1.0C <sub>5</sub> A (0 ~ +45°C)
4.9 Discharging Current (Max/Peak 3s)		200A	2.0C <sub>5</sub> A (-20 ~ +60°C)
4.10 Max continuous Discharging Current		100A	1.0C <sub>5</sub> A (5 ~ +45°C)
4.11 Battery Internal Impedance		≤20mΩ	AC Impedance 1kHz
4.12 Combination Support		4S or 4P	4pcs Series or Parallel
4.13 Battery Dimension		330*175*215mm	Approximate
4.14 Battery Weight		10.6kg	About
4.15 Battery Cycle life		≥6000	0.5C <sub>5</sub> A (0 ~ +45°C)
4.16 Storage temperature range	< 1 Month	-20 ~ +60°C	
	< 3 Month	-20 ~ +45°C	
	< 12 Month	-20 ~ +25°C	
4.17 Charging temperature range		0 ~ +45°C	

## 6. Battery Outline Drawing



## 7. Electrical Characteristics

Item	Test Method	Performances
5.1 Full Charge	The charger supplies 0.2C <sub>5</sub> A constant current until battery voltage reaches 14.6V , then be changed at constant voltage of 14.6V while tapering the charge current to less than or equal to 0.01C <sub>5</sub> A.Charging time is 5.0 hours in all.	
5.2 Capacity	① Within 1 hour after fully charged, discharged at 0.5C <sub>5</sub> A continuously down to 10.0V.	≥ 100% capacity
	② Within 1 hour after fully charged, discharge at 1.0C <sub>5</sub> A continuously down to 10.0V.	≥ 95% capacity
5.3 Cycle life	A battery unit shall be repeated 6000 charge/discharge cycles, charged at CC-CV(0.2C <sub>5</sub> A- 14.6V) for 5 hours, discharged at 0.5C <sub>5</sub> A continuously down to 10.0V Cut-off Voltage , Measure discharge capacity.	≥ 80% capacity
5.4 Capacity retention	After fully charged, stored for 28 days at 20 °C, then for 1 hour at normal temperature and continuously discharge at 0.2C <sub>5</sub> A to 10.0V.	Capacity retention rate ≥ 95%

### ※Nominal Capacity

The minimum capacity in the specifications table. The term refers to the capacity when the charged batteries are discharged to the cut-off voltage for 5 hours at 20°C±5°C. It is indicated by C<sub>5</sub> (The unit is Ah or mAh).

### ※Typical Capacity

Typical capacity refers to the median value of the capacity when a battery is discharged to the cut-off voltage with the current of 0.2 C<sub>5</sub> A at 20°C±5°C.

### ※Limit Charge Voltage

Charged batteries with constant current to reach a voltage value, then keep the voltage constant and continue to charge them.The voltage is referred to as limited charge voltage. The value is 14.6V.

### ※Cut-off Voltage

Cut-off Voltage Refers to the end voltage when a battery is discharged to reach.The value is 10.0V

## 8. Temperature Adaptability

Item	Test Method	Performances
6.1 Temperature	Measure capacity with constant discharge current 0.2C <sub>5</sub> A to 10.0V cut-off at each temperature after complete charge at 20 °C .	-20°C, capacity ≥60% -10°C, capacity ≥75% 0°C, capacity ≥80% 60°C, Capacity ≥90%
6.2 Constant temperature /humidity	Percentage as an index of the capacity compared with 100% at 20 °C .. Keep the battery at 40°C . and 90%RH for 48hrs and then discharge at 0.2C <sub>5</sub> A to 10.0V Cut-off Voltage.	The battery shall not rupture, smoke, catch fire, vent or leak. The time of discharge is no less than 36 min.
6.3 Vibration	The battery will be vibrated 10 times in three mutually perpendicular directions with amplitude of 0.19-0.38 mm and changing frequency between 10 and 55Hz. The rate of scanning frequency is from 10Hz to 55 Hz with the rate of 1Hz per min.	The battery shall not rupture, smoke, catch fire, vent or leak.. The voltage is no less than 3.0V.
6.4 Shock	The battery will be impacted 1000±10 times with the acceleration of 100 m/s <sup>2</sup> and pulse lasting time 16ms.	The battery shall not rupture, smoke, catch fire, vent or leak.

## 9. Safety Characteristics

Item	Test Method	Performances
7.1 Short Circuit	The battery is to be short-circuited by connecting the positive and negative terminals of the battery with an external load of less than 100mΩ .	The battery shall not rupture or catch fire. The temperature < 150 °C .
7.2 Over charge	The battery charged completely will be charged continuously for 8hrs with the external power supply of the limit voltage of 3.8V and the current of 1C <sub>5</sub> A.	The battery shall not rupture or catch fire. The temperature < 150 °C .
7.3 Over discharge	After complete charge, the battery will be discharged to end voltage. Then connect with external load of 30Ω for 24hrs.	The battery shall not rupture, smoke, catch fire.

## 10 . Standard Test Conditions

### 10.1 Test Condition

Unless otherwise specified, all tests stated in this Product Specifications shall be conducted under the following atmosphere condition:

**Temperature:** 15°C– 35°C;      **Relative Humidity:** 45% – 75%;

**Atmospheric Pressure:** 86kPa – 106kPa.

## 10.2 Measuring meters & Instruments

10.2.1 Voltmeter should be up to grade 0.5 in precision. Its internal impedance should not be less than 10kΩ/V.

10.2.2 Ammeter should be up to grade 0.5 in precision.

10.2.3 Hour-meter should have a precision of ±0.1% or higher.

10.2.4 Thermometer should have a precision of ±0.5°C or higher.

10.2.5 The current of a constant-current supply should be stable and adjustable. Its variation shall be within ±1% during the charging and discharging process.

10.2.6 The voltage of a constant- voltage supply should be stable and adjustable. Its variation shall be within ±0.5%.

## 11. Design and Construction

The design, structure and dimension of the battery are shown on the above drawing (see figure) .

## 12. Appearance

There shall be no practical damage such as conspicuous liquid electrolyte leakage, flaw electrolyte leakage. Flaw, rust, dirt, and deformation. The battery must have marketability.

## 13. Packing and Shipping cells

### ① Inspection Before Shipment of the battery pack

. Inspect voltage, internal impedance and capacity and protection circuit function before shipment.

### ② Packing and Shipping cells

. When cells are re-shipped to assembling factory, make enough attention the packing to avoid stress by shipping. JOYKOO recommends the same package, when re-shipping, use the same parts and materials from JOYKOO for re-packing.

. The battery should be shipped with half-charged state and during transportation, there shall avoid shock, crush, under sun and shower and shall be shipped by truck, train, ship or airplane etc.

### ③ Abnormal cell

. Don't use abnormal cell which has damages by shipping stress, drop, short or something else, and which gives off electrolyte.

## 14. Precautions on Charge use

### ① Charge

. A battery must be charged with constant current-constant voltage.

. Charge current must be below 1.0C<sub>5</sub>A /cell.

. Charge voltage must be up to 3.65V/cell.

### ② Discharge

. Discharge current must be below 3.0C<sub>5</sub>A /cell.

. Discharge temperature range should be -20~60°C.

. Discharge end voltage must be over 2.50V/cell.

### ③ Required protection functions

Have protection circuit function which is described below inside battery pack, to insure safety of battery in case of misuse.

NO	Device	Items	Requirements
1	Charger	Charge termination voltage	3.60±0.025V
2	Protection Functions (For reference)	Excess Charge detection voltage	3.800±0.050V
3		Excess Charge release voltage	3.50±0.025V
4		Discharge termination voltage	2.50±0.10V
5		Excess discharge detection voltage	2.35±0.05V
6		Excess discharge release voltage	2.50±0.10V

### ④ Precautions

#### Precautions on Label

- . Write maker's name, trade mark, maker's nation, model number, nominal capacity, rate voltage and limit charge voltage, standard, code, +/- pole and precautions on label.

#### Precautions on Battery Pack Design

- . In case the battery pack is struck by hard shock or vibration, the battery pack has possibility to cause leakage, smoke, explosion.
- . Add the protection device PTC (e.g. VTP210.VTP170) or thermal fuse (e.g. TA1, TA2) for fear the trouble of the battery caused by the abnormality of equipment. The protection device must put on the battery properly in order that the protection device may get the accurate temperature of the batter.

## 15. Storage Condition

### ① Storage Temperature and Humidity

- . Store the battery at temperature range -5℃~+35℃, relative humidity of less than 75% and no corrosive gas atmosphere. Keep far away from fire or heat.
- . No condensation on the battery.

### ② Long Period Storage

- . In case of long period storage (more than 3 months), store the battery at temperature range -5~+25℃, low humidity, no corrosive gas atmosphere. And in this case, charge/discharge condition of one full cycle, and store the battery at 3.2V/cell.

## 16. Exemption from Warranty

- . JOYKOO will not be responsible for trouble occurred by handling outside of the precautions in this specification.
- . JOYKOO will not be responsible for trouble occurred by matching electric circuit, battery packs and chargers.
- . JOYKOO will not be responsible for any fault resulted from little cover falling off due to welding or



from not welding at 15 centimeter of battery flank from above/ at the bottom of battery.

## 17. Safety Instruction

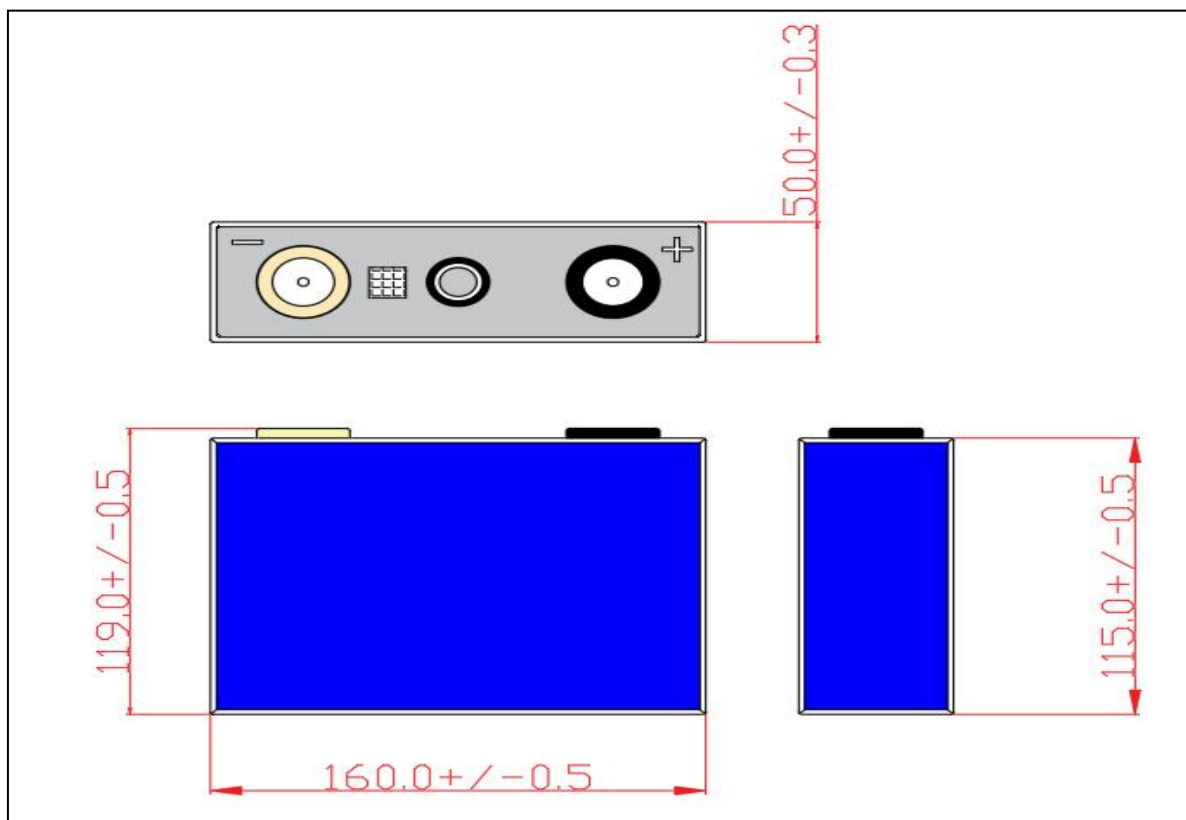
### Prohibition Points and Handle

The battery includes the flammable objects such as the organic solvent. If the handling is missed there will be possibility that the battery rupture, flames or hot, or it will cause the deterioration or damage of battery. Please observe the following prohibitive matters. And also, add the protection device the equipment for fear that the trouble would affect the battery by the abnormality of equipment. In addition, mention the following matters as "Prohibition Points on Handle" in the instruction manual of the equipment.

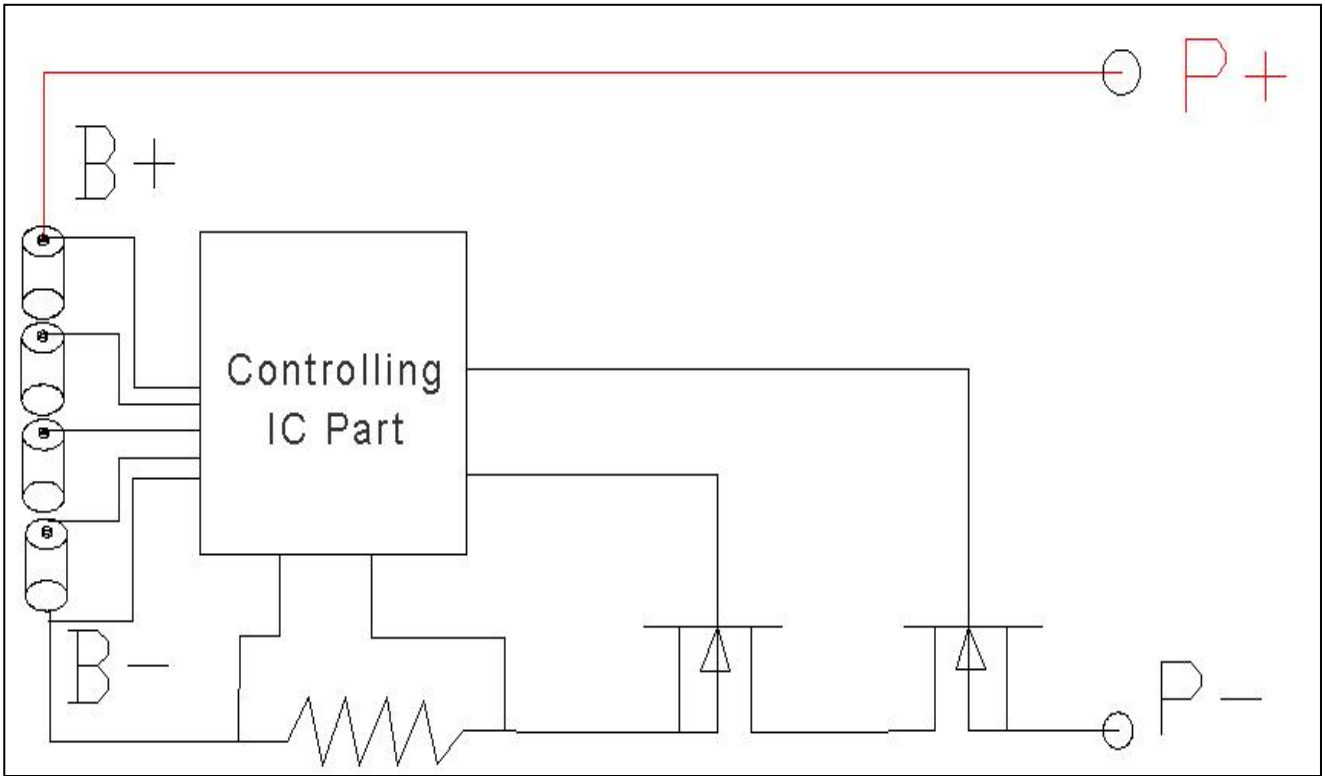
## 18. Warranty Period of Battery

The warranty period of a battery is for 60 months after shipment. However, even if a battery is unusual within this period, JOYKOO will replace a new battery for free as long as it is clear that the problem is that failure of battery manufacturing process and the battery isn't used at the abnormal usage.

## 19. Outline Drawing for Cell



**20. PCB Schematic diagram**



**21. PCBA Electronic Standard**

P+/B+	Discharge positive electrode/Battery cathode		
P-/C-	Charge negative/Discharge anode		
		B4	Battery pack 4 positive poles
		B3	Series 3 positive electrode for battery pack
		B2	Series 2 positive electrode for battery pack
		B1	Series 1 positive electrode
		B-	Battery pack negative

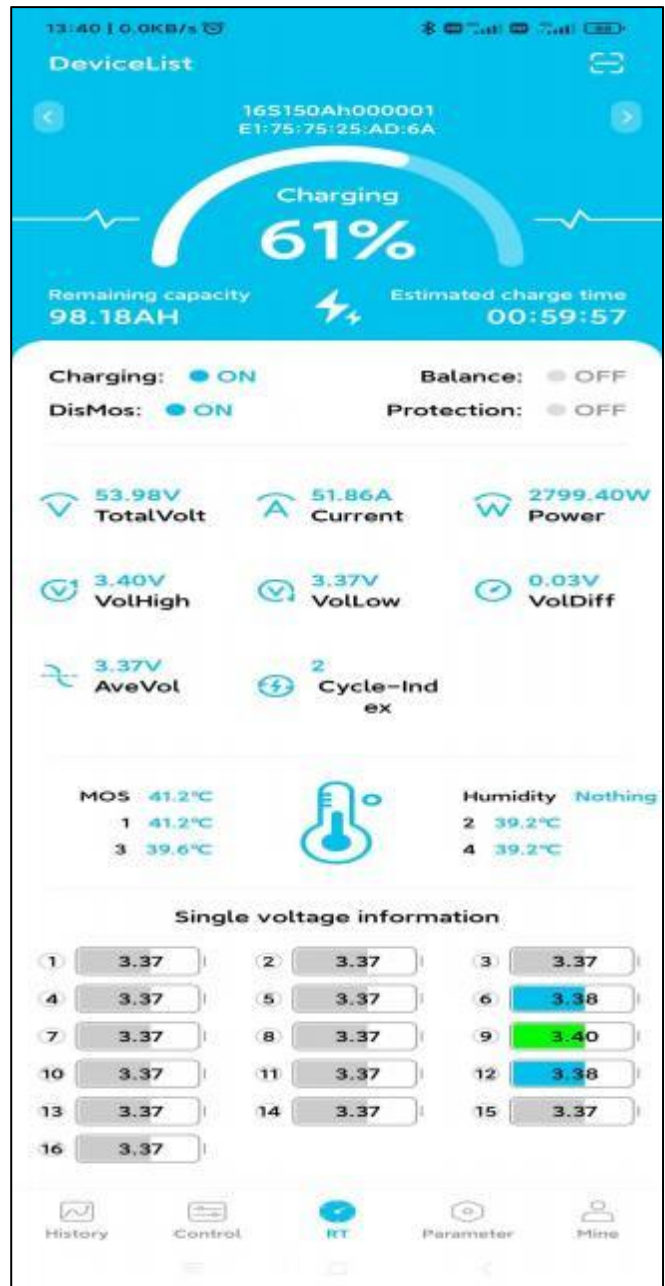
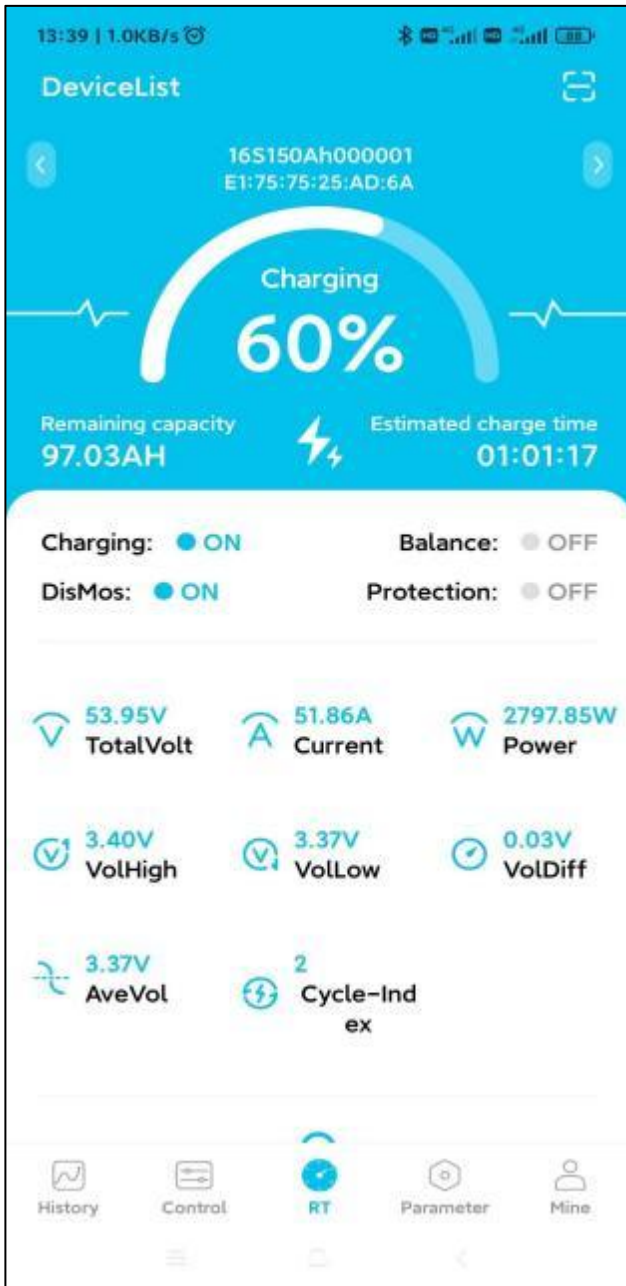
**22. PCBA Function**

Function Item	Symbol	Content	Criterion
Over charge Protection	V <sub>DET1</sub>	Over charge detection voltage	3.80±0.050V
	t <sub>VDET1</sub>	Over charge detection delay time	2000mS
	V <sub>REL1</sub>	Over charge release voltage	3.60±0.050V
Over discharge protection	V <sub>DET2</sub>	Over discharge detection voltage	2.20±0.050V
	t <sub>VDET2</sub>	Over discharge detection delay time	2000mS
	V <sub>REL2</sub>	Over discharge release voltage	2.60±0.10V
Over current protection	I <sub>DP</sub>	Over current detection current	110A
	t <sub>VDET3</sub>	Detection delay time	7.0~13.0mS
Short protection		Detection condition	Exterior short circuit
	T <sub>SHORT</sub>	Detection delay time	280~900uS
		Release condition	Cut short circuit
Interior resistance	R <sub>SS</sub>	Main loop electrify resistance	R <sub>SS</sub> ≤20mΩ
Current consumption	I <sub>DD</sub>	Current consumption in normal operation	Max15.0μA
Dimension of the PCM	Length	The length of the PCM	160.0±0.15mm
	Width	The width of the PCM	105.0±0.15mm
	Thickness	The thickness of the PCM	Max10.0mm

### 23. PCB Layout



**24. Bluetooth Function display**

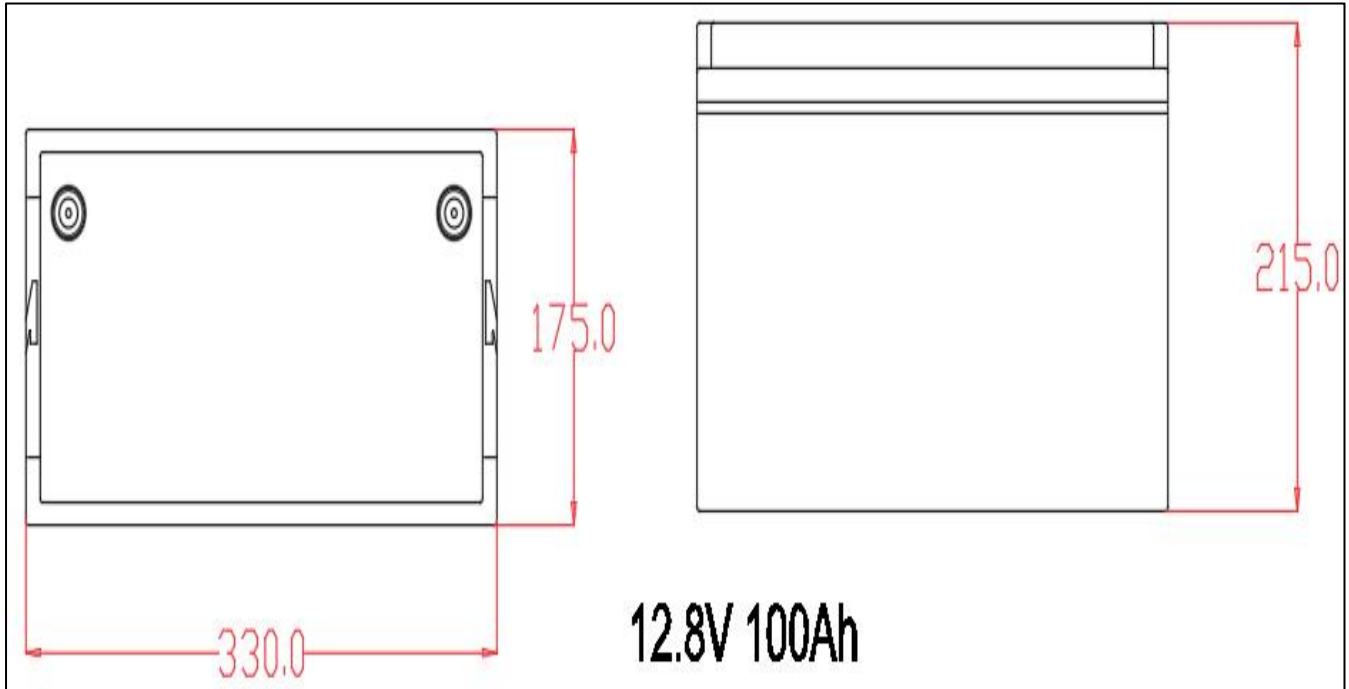


**Bluetooth connection step:**

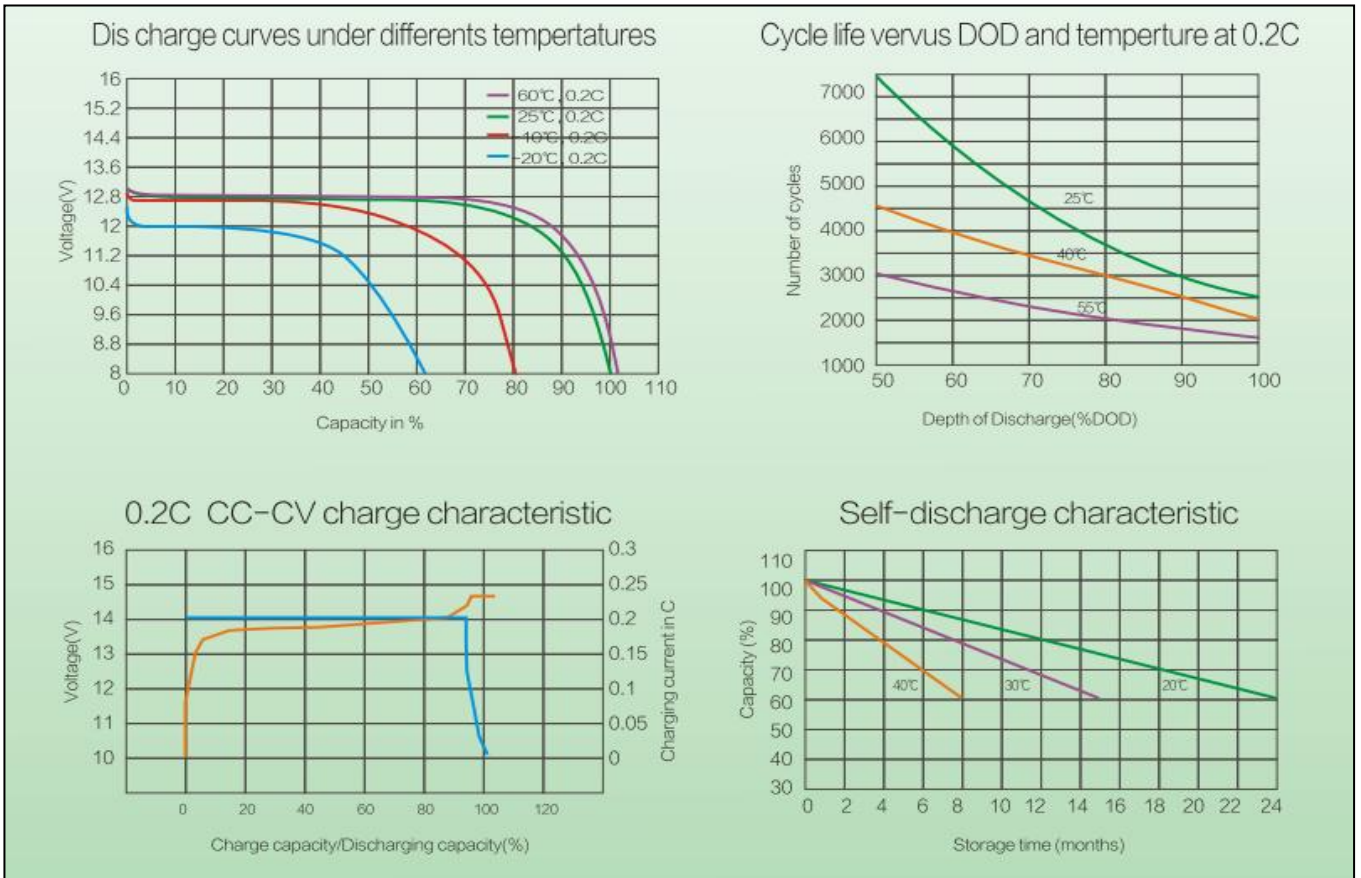
1. Open the Bluetooth and find the xiaoxiang APP, connect to the APP. It will identify the mobile phone system is English or Chinese version by himself.
2. Through the function list, you can check anyone you want to know, charging status, power left, Estimated charging time, remaining capacity. Single cell voltage information.
3. Parameter setting, you can set the parameter through the APP. And it has history function, you can check history parameter set up through it.

## 25. Battery Dimension

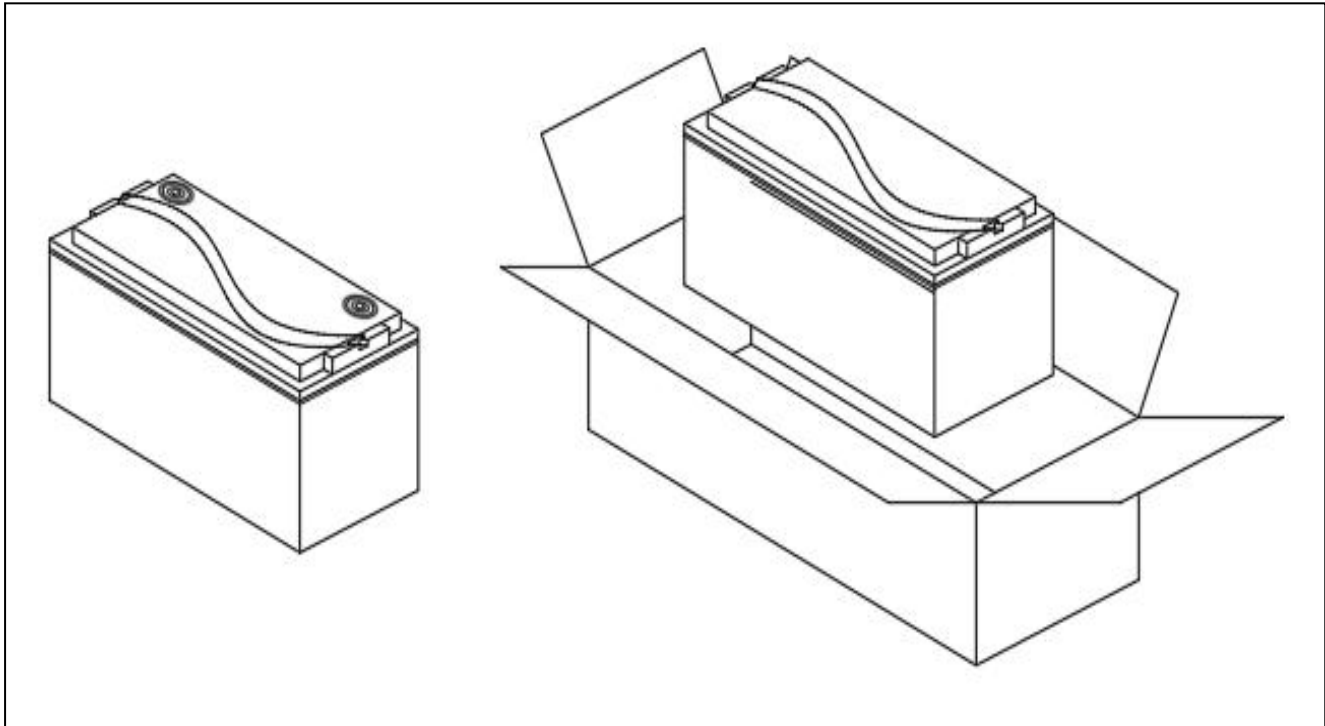
Max: Length 330mm\* Width 175mm\* Height 215mm



## 26. Discharge Curve of the Battery



## 27. Packing Instructions.



# Danger!

### 1. Disassemble and Reconstruction

**“Do not disassemble or reconstruct battery”**

The battery pack has safety function and protection circuit to avoid the danger. If they have serious damage, it will cause the generating heat, smoke, rupture or flame.

### 2. Short-circuit

**“Don not short-circuit battery”**

Do not connect + and – terminals with metals (such as wire). Do not carry or store the battery with metal objects (such as wire, chain necklace or hairpins). If the battery is short-circuited excessive large current will flow and then the generating heat, smoke, rupture or flame will occur. And also, it causes generating heat at metals.

### 3. Incineration and Heating

**“Do not incinerate or heat the battery”**

These occur the melting of insulator, damage of gas release vent or safety function, or ignition on electrolyte. Above mentioned matters cause the generating heat, smoke, rupture or flame.

### 4. Use nearby Heated Place

**“Do not use or leave battery nearby fire, stove or heated place(more than 80°C)”**

In case that separator made of Aluminium is melted by high temperature, the internal short-circuit occurs in individual cells and then it causes the generating heat, smoke, rupture or flame. In addition, do not use the battery under the heated place(more than 80°C).

### 5. Immersion

**“Do not immerse the battery in water or sea water, or get it wet”**

If the protection circuit included in the battery is broken, the battery will be charged at extreme current or voltage and the abnormal chemical reaction occurs in it. And then it causes the generating heat, smoke, rupture or flame.

### 6. Charge nearby Heated Place

**“Do Not charge battery nearby the fire or under the blazing sun”**

if the protection circuit to avoid the danger works under high temperature or it is broken, the battery will be charged at abnormal current (or voltage) and abnormal chemical reaction will occur. It causes the generating heat, smoke, rupture or flame.

## 7. Charger and Charge Condition

### **“Do use the specified charger and observe charging requirement”**

If the battery is charged with unspecified condition (under high temperature over the regulated value, excessive high voltage or current over regulated value, or remodeled charger), there are cases that it will be overcharged or the abnormal chemical reaction will occur in cells. It causes the generating heat, smoke, rupture or flame.

## 8. Penetration

### **“Don to drive a nail into the battery, stick it by hammer, or tread it”**

As the battery might be broken or deformed and then it will be short-circuited, it causes the generating heat, smoke, rupture or flame.

## 9. Impact

### **“Do Not give battery impact or throw it”**

The impact might cause leakage, heat, smoke, rupture, and/or fire of cell in the battery. And also if the protection circuit in the battery is broken, the battery will be charged abnormal voltage or current, and abnormal chemical reaction might occur. It might cause leakage, heat, smoke, rupture, and/or fire.

## 10. Deformation

### **“Do not use the battery with conspicuous damage or deformation”**

It causes the generating heat, smoke, rupture or flame.

## 11. Soldering

### **“Do not make the direct soldering on battery”**

As the insulator is melted by heat or the gas release vent (or safety function) is broken, it causes the generating heat, smoke, rupture or flame.

## 12. Reverse Charge and Over-discharge

### **“Do not reverse polarity (and terminals)”**

On charging, the battery is reverse-charged and abnormal chemical reaction occurs. And also, there may be case that unexpected large current flows on discharging. These cause the generating heat, smoke, rupture or flame.

## 13. Reversed Polarity Use

### **“Do not reverse-charge or reverse-connect”**

The battery has polarity. In case the battery is not connected with charger or equipment smoothly, do not force them and do check polarity of battery. If the battery is connected to opposite polarity with charger, it will be reverse-charged and abnormal chemical reaction will occur. It causes the generating heat, smoke, rupture or flame.

## 14. Inappropriate Use For Other Equipment

### **“Do not use battery for other equipment”**

If the battery is used for unspecified equipment, it will deteriorate its performance and cycle-life. At worst, abnormal current will flow or battery may generate heat, smoke, rupture or flame.

## 15. Leakage

### **“Do not touch leaked battery”**

Do not touch your eyes but wash them immediately, and then see a doctor if leaked electrolyte is into your eyes. If pay no attention to your eyes, it will cause eye disease.

## 16. Wasted battery handling

A) Never throw out the used battery optionally.

B) Never put the wasted battery into fire to avoid any explode or fire.

C) The wasted battery should be recycled specially, can not be abandoned with other rubbish.

D) Different size wasted battery can not be abandoned together.

E) In order to avoid any break of the battery and make it heat, discharge the battery until it has no voltage before abandoned.

# Warning !

## 1. Mixed Use

### “Do not use Lithium Ion battery in mixture”

Do not use Lithium Ion battery with the primary batteries or secondary batteries whose capacity or kinds or maker is different. If do that, the battery will be discharged or charged excessively in use. And it may cause the generating heat, smoke, rupture or flame because of the abnormal chemical reaction in cells.

## 2. Ingestion

### “Keep the battery away from babies”

Keep the little battery out of the reach of babies in order to avoid troubles by Swallowing. In case of swallowing the battery, see a doctor immediately.

## 3. Charging Time

### “Do not continue to charge battery over specified time”

If the battery is not finished charging over regulated time, let it stop charging. There is possibility that the battery might generate heat, smoke, rupture or flame.

## 4. Storage

### “Do not get into a microwave or a high pressure container”

It causes the generating heat, smoke, rupture or flame because of a sudden heat or damage of sealing condition of battery.

## 5. Leakage

### “Do not use a leaked battery nearby fire”

If the liquid leaks from the battery (or the battery gives out bad smell), let the battery leave from flammable objects immediately. Unless do that, the electrolyte leaked from battery will catch fire and it will cause the smoke, flame or rupture of it.

## 6. Rust, Charging color and Deformation

### “Do not use an abnormal battery”

In case the battery has bad smell or is generated its changing color or deformation or causes something wrong in using (includes charging and storage). Let it take out from equipment or charger and do not use it. If an abnormal battery is used, it will generate heat, smoke, rupture or flame.



# Caution!

## 1. Use under strong sunshine

Do not use or leave the battery under the blazing sun(or in heated car by sunshine). The battery may generate heat, smoke or flame. And also, it might cause the deterioration of battery's characteristics or cycle life.

## 2. Static Electricity

The battery pack has the protection circuit to avoid the danger. Do not use nearby the place where generates static electricity (more than 100V) which gives damage to the protection circuit. If the protection circuit were broken, the battery would hide danger.

## 3. Charging Temperature Range

Charging temperature range is regulated between 0°C and 40°C. Do not charge the battery out of recommended temperature range. Charging out of recommended range might cause the generating heat or serious damage of batter. And also, it might cause the deterioration of battery's characteristics and cycle life.

## 4. Manual

Please read the manual before using the battery and let it keep after reading.

## 5. Charging method

Please read the manual of specified charger about charging method.

## 6. First time use

When the battery has rust, bad smell or something abnormal at first-time using, do not use the equipment and go to bring the battery to the shop which it was bought.

## 7. Leakage

If the skin or cloth is smeared with liquid form the battery, wash with fresh water. It may cause the skin inflammation.