

Specification for Li-ion Battery

Model: ICR18650C2

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1. Scope

The specification is suitable for Li-Ion Cylindrical battery produced by YOKU Energy (Zhangzhou) Co, Ltd.

2. Model

ICR18650C2 3.7V/2200mAh

3. Basic Performance

Item	Performance	Remark
Nominal Capacity	2200mAh	0.2C ₅ A discharging
Min Capacity	2150mAh	0.2C ₅ A discharging
Nominal Voltage	3.7V	
Discharge Cut-off Voltage	3.0V	
Charge Mode (Standard)	CC/CV	0°C ~ 50°C
Charge Cut-off Voltage (Standard)	4.20±0.03V	
Charge Current (Standard)	440mA (0.2C ₅ A)	
Charge Current (Quick)	2200mA (1.0C ₅ A)	
Discharge Current (Standard)	440mA (0.2C ₅ A)	
Discharge Current (Quick)	2200mA (1.0C ₅ A)	-20°C ~ +60°C
Impedance	≤70mΩ	AC 1kHz
Weight	45.5±1g	
Operating Temperature: Standard Charge	0°C ~ +50°C	
Standard Discharge	-20°C ~ +60°C	
Storage Temperature: Short term within 1 month	-20°C ~ +60°C	
Medium term within 3 months	-20°C ~ +45°C	Relative Humidity: 45% ~ 75%
Long term within 1 year	-5°C ~ +30°C	

4. Performance & Test Method

Item	Test Method	Determination Standard
4.1 Quick Charge	CC/CV Mode, under the temperature $20\pm 5^{\circ}\text{C}$, constant current charging at $1.0C_5A$ to 4.2V, and then constant voltage charging until charging current is $\leq 0.01C_5A$	
4.2 Standard Charge	CC/CV Mode, under the temperature $20\pm 5^{\circ}\text{C}$, constant current charging at $0.2C_5A$ to 4.2V, and then constant voltage charging until charging current is $\leq 0.01C_5A$	
4.3 Cycle Life	Under the temperature $(22.5\pm 2.5)^{\circ}\text{C}$, after standard charging, set aside 1.0h, and then constant current discharging at $0.5C_5A$ to 3.0V, after discharging, set aside 1h, and then the next one charge & discharge cycles. One cycle is defined as once charging and once discharging for the cell, doing so 300 times.	After 300 cycles, the remaining capacity /original capacity $\geq 80\%$
4.4 Discharge performance under high & low temperature	After full charge as per the standard charging mode, place the cell under the temperature 25°C for 3h, and then discharge at 0.5C to 3.0V; After full charge as per the standard charging mode, place the cell under the temperature 60°C for 3h, and then discharge at 0.5C to 3.0V; After full charge as per the standard charging mode, place the cell under the temperature 0°C for 3h, and then discharge at 0.5C to 3.0V; After full charge as per the standard charging mode, place the cell under the temperature -10°C for 3h, and then discharge at 0.5C to 3.0V; Record the discharge capacity under different temperature. Compare discharge capacity under different temperature with the discharge capacity under the temperature 25°C , and calculate the percentage of capacity	discharge capacity under 10°C /discharge capacity under $25^{\circ}\text{C} \geq 55\%$ discharge capacity under 0°C /discharge capacity under $25^{\circ}\text{C} \geq 85\%$ discharge capacity under 60°C /discharge capacity under $25^{\circ}\text{C} \geq 90\%$
4.5 Impedance	Use AC 1kHz test method and the instrument with the accuracy 0.5 above to measure the impedance between the positive and the negative. (*Note 1)	$\leq 70\text{m}\Omega$
4.6 Electricity Retainment	Under the temperature $20\pm 5^{\circ}\text{C}$, charging the cell as per standard charge mode, discharging it as per standard discharge mode, cycle 10 times, measure the cell capacity, record the 10 th discharge capacity and mark it as the original discharge capacity. Then, after full charge the cell as per standard charge mode, place it under the	Remaining capacity /original capacity $\geq 95\%$ Resume capacity /original capacity $\geq 98\%$

	temperature 25°C to store for 28days. After storage, discharging it as per standard discharge mode, mark it as the remaining capacity. Afterward, charging the cell as per the standard charge mode and discharging it as per the standard discharge mode, discharge capacity is marked as resume capacity. Calculate the percentage of remaining capacity.	
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*Note 1: During the testing process, if the test instrument use additional fixed fixture, as the case may be less the impedance of fixed fixture and lead wires. However, for the batteries in the same batch, the impedance value can only subtract the same value of fixture and wires, and the difference between the maximum and the minimum should be less than 30mΩ.

5. Environmental Adaptation Performance

Item	Test Method	Determination Standard
5.1 Constant humidity & temperature test	After quick charge the cell, put it into 40±2°C, relative humidity 90%-95% constant temperature and humidity box for 48h, and then take the cell out to set aside for 2h under the temperature 20±5°C, visually inspect the battery appearance, and discharge to 3.0V at constant current 1.0C ₅ A	Discharging time ≥36min; No appearance deformation, no explosion, no fire, no smoke or leakage
5.3 Vibration	Fix full charged cell on a platform ,adjust the testing equipment as per the following frequency and relative amplitude, and vibrate for 30minutes from 10Hz to 55Hz in each directions X , Y and Z at the speed 1 oct/ min Frequency: 10Hz~30Hz Amplitude: 0.38mm Frequency: 30Hz~55Hz Amplitude: 0.19mm After vibration, observe the battery appearance and measure the battery voltage.	Voltage≥3.7V No evident appearance damage, no leakage, no smoke, or explosion
5.4 Drop Test	After quick charge, drop the cell from the height 1000mm to the hard board with the thickness 18mm ~20mm. Drop once in the positive and negative direction of X, Y, and Z (total 6 directions). Visually inspect the battery appearance, discharge at constant current 1C ₅ A to 2.75V, and then do 3 or more charge & discharge cycle at 1C ₅ A.	No evident appearance damage, no leakage, no smoke and no explosion.

6. Safety Performance

Item	Test Method	Determination Standard
6.1 Over Charge	After charge the cell as per standard charge mode, CC/CV charge (CC 3C and CV 10V), watch the temperature change during testing process, when the cell temperature drops to 10°C lower than the peak, end the experiment.	No leakage, no smoke, no fire, and no explosion.
6.2 Over discharge	Testing environmental temperature: 20±5°C After full charge as per standard charging mode, discharge for 12h at 0.2C until discharge capacity reaches 250% of rated capacity or protection device acts.	No smoke, no fire and no explosion.
6.3 Short Circuit	After full charge the cell as per standard charge mode, do short circuit testing under the room temperature. Place thermocouple cells in the fume hood, use copper wires to short circuit the positive and the negative(total resistance of the circuit less than 50mΩ), and watch the temperature changes, when the cell temperature drop to 10°C lower than the peak, end the experiment.	No explosion and no fire.
6.4 Heavy Impact	Place the battery on the impact table, the hammer of 10Kg free-fall from the height 1mm to impact the battery fixed on the fixture. The largest surface of the battery should be perpendicular to the table surface.	The battery can be deformed, but no fire, no explosion.
6.5 Thermal Shock	After full charge the cell as per standard charge mode, put the cell into the oven, and rise the oven temperature to 130°C at the speed of 5°C/min. When the cell gets 130°C, keep it for 10 minutes in the oven of 130°C, or until the cell fires and explodes. Record the time from when the cell gets 130°C to that the cell fires or explodes.	Within 30minutes after the cell gets 130°C, the cell doesn't fire and explode.
6.6 Puncture Test	Testing environmental temperature: 20±5°C After full charge as per standard charge mode, the center of the cell is perpendicularly pierced by the nail of diameter 3mm at the speed of 40mm/s.	No smoke, no fire and no explosion.
6.7 Crush Test	Testing environmental temperature: 20±5°C After full charge as per standard charge mode, place the cell between two flat surfaces to press. The pressure vessel is forced vertically to the cylindrical cell and presses the cell. Use hydraulic piston of diameter 32mm, pressure 13KN, once get max pressure value, you release pressure.	No fire and no explosion

7. Testing Conditions

7.1 Testing Environmental Conditions

Unless otherwise specified, each experiment in the specification should be done under the standard atmospheric conditions.

Temperature: 20°C~30°C

Relative Humidity: 45%~75%

Atmospheric Pressure: 86kPa~106kPa

7.2 The requirements for test instruments and equipment.

7.2.1 The accuracy of voltage should be more than 0.5%, and the impedance should be more than 10KΩ/V.

7.2.2 The accuracy of ampere meter should be more than 0.5%.

7.2.3 The relative error of the instrument measuring the time is $\pm 0.1\%$

7.2.4 When constant current load, the constant current can be adjusted within the voltage measured and relative error of the current is $\pm 0.1\%$

7.2.5 After the battery voltage reaches constant voltage value, the charge power supply (or charger) can be changed into constant voltage charging.

8. Appearance

The outer surface, interface reed surface and the label of new battery should be uniform color, cleanliness, no scratches and mechanical damage; by visual inspection. During various testing, battery appearance should be kept intact and should be no distortion, no burst, and no leakage.

9. Transportation

The battery should be in the state of charge 20—50% to be packed into the boxes for transportation. During the transportation, prevent severe vibration, shock or extrusion; prevent the sun and rain, suitable for cars, trains, ships, aircraft and other common means of transport.

10. Storage

The battery should be stored at a clean, dry and well ventilated room of ambient temperature $-5^{\circ}\text{C}\sim 35^{\circ}\text{C}$, should avoid contact with corrosive substances, and should be far away from fire and heat.

The battery should be charged once every six months during the storage.

During the processing, using the cells and batteries in the inventory for delivery should follow the principle “first in first out”.

From the date of storage, the preservation period is 12 months. The products more than the preservation period must be re-inspected by batch before delivery of the qualified for ordering party. The batches unqualified must be checked as per re-submitted batch. If still unqualified, the products will be on disposal by the ordering party.

11. Marks and Package

11.1 Package

Each battery should have a packing box. There are two packages: Easy box and Independent packaging boxes. The Product Inspection Qualified Certification enclose in the package box. The packaging boxes containing batteries should be stored in a dry, dustproof, moistureproof carton.

Outside the box should be labeled with name, type, quantity, gross weight, the manufacturer and their contact address, date of manufacture, but also the "handle with care", "afraid of wet," "upward" and other necessary marks. The marks of its package, storage and transportation should comply with the regulations GB191-1990.

11.2 Marks

Each battery shall have the Chinese symbol: product name, model, nominal voltage, rated capacity, charge limited voltage, the number of the implementation standard, positive and negative polarity, trademarks and caution instructions, as well as manufacturing date, batch number, manufacturer name (or the serial number include the data above). Which allows the number of the implementation standard, manufacturer name, factory address, postcode and contact telephone to logo on the packaging box or the instructions.

12. Safety Regulations and Instructions

12.1 Recommended items

- 12.1.1 Before use the battery, please carefully read the instruction and the mark on the battery surface.
- 12.1.2 Please be in normal indoor environment to use the battery.
Temperature $-20\sim+35^{\circ}\text{C}$, and relative humidity $65\pm 20\%$
- 12.1.3 In the course of use, please stay away from heat, high pressure, and avoid the children to play with battery. Don't beat the battery. The battery only uses the matching charger. Don't charge the battery on the charger more than 24h.
- 12.1.4 Don't short circuit the positive and the negative. Don't disassemble the battery. Don't damp the battery to avoid the danger.
- 12.1.5 If the battery isn't used for a long time, please store it well. Keep the battery in half-charged status, neither full charge nor completely discharge. Package the battery in the non-conductive material to avoid direct contact with the metal, causing the cell damage. Please store the cells in a cool dry place.
- 12.1.7 Please safely handle the wasted cells. Don't put it into fire or water.

12.2 Danger Caution

12.2.1 Don't assemble the battery

The protection circuit board inside the battery pack can avoid the danger. Inappropriate disassembly will damage the protection function and cause the battery heat, smoke, deformation or burning.

12.2.2 Don't short circuit the battery

Don't connect the positive with the negative by the metal. Don't store and move the battery together with the metal. If the battery is short circuit, the large current will flow through and damage the battery, causing the battery heat, smoke, deformation or burning.

12.2.3 Don't heat and burn the battery

Heating and burning the battery will cause the separator melt, safety function failure or electrolyte burning. Overheating will cause the battery the battery heat, smoke, deformation or burning.

12.2.4 Don't use the battery near heat

Don't use the battery near fire, the oven or the environment more than 80°C Overheating will lead to short circuit and cause the battery heat, smoke, deformation or burning.

12.2.5 Don't wet the battery

Don't wet the battery, let alone the battery into water. Or else, it will cause the function of protect circuit inside failure and abnormal chemical reaction, and the battery may heat, smoke, deform or burn.

12.2.6 Avoid charging the battery near fire or under direct sunlight, or else, which will cause the function of protect circuit inside failure and abnormal chemical reaction, and the battery may heat, smoke, deform or burn.

12.2.7 Use specified charger and collect charge

Using non-exclusive charger to charge the battery will cause danger. Charging under the abnormal conditions will cause the function of protect circuit inside failure and abnormal chemical reaction, and the battery may heat, smoke, deform or burn.

12.2.8 Don't damage the battery

Don't use the metal to cut into the battery, hammer, or beat batteries, or other means to damage the battery, otherwise it will cause the battery heat, smoke, deformation or burning, or even dangerous.

12.2.9 Don't directly solder the battery

Overheating will cause the separator melt, protection function failure and battery heat, smoke, deformation or burning.

12.2.10 Don't directly connect the battery with the power outlet or car cigarette lighter to charge.

High pressure, large current will flow through the battery and cause it heat, smoke, deformation or burning.

12.2.11 Don't use the battery for other devices

Inappropriate conditions of use will damage the battery performance, reduce the life, even will cause the battery heat, smoke, deformation or burning.

12.2.12 Don't directly touch the battery leakage

Electrolyte leakage can cause the skin discomfort. In case the electrolyte into the eyes, rinse with water as soon as possible, not rubbing the eyes, and quickly sent to hospital.

12.3 Caution

12.3.1 Can't be mixed with other battery

Can't be mixed with other types of primary or secondary battery to use, otherwise abnormal charging & discharging will cause the battery heat, smoke, deformation or burning.

12.3.2 Keep away from Children

Keep the battery out of reach of the children, to avoid the children bite or swallow it. If the children swallow the battery, should be promptly sent to hospital.

12.3.3 Don't be placed on the charger for a long time

If exceed much more than the normal charging time, the charger is still charging, please stop charging. Abnormal charging may cause the battery heat, smoke, deformation or burning.

12.3.4 Don't be placed in the microwave oven or other pressure vessel

Instant heating or structural damage will cause the battery heat, smoke, deformation or burning.

12.3.5 The leaking battery don't be near to fire

If find battery leakage (or stale), should keep away from fire. Otherwise, the electrolyte leakage will be on fire, even cause other hazards.

12.3.6 Don't use abnormal battery

If it is found the battery stale, deformation, discoloration, or distortion, should remove the battery from the mobile or charger and abandon.

12.4 Notice

12.4.1 Use the battery under the strong direct sunlight

Don't use the battery under the direct strong sunlight, to avoid the battery heat, deformation, smoke, battery performance degradation and the reduction of cycle life.

12.4.2 Antistatic

The battery equipped with protection circuit can avoid all kind of accident happening. Don't use the battery near the static site, because the static electricity (99V above) can easily damage the protection circuit board, and lead to the battery not working properly, heat, deformation, smoke or fire.

12.4.3 Charge Temperature range

Recommended charge temperature range is 0--40°C. In an environment beyond this range may cause the battery charging performance degradation, reducing cycle life.

12.4.4 Manual

Before using the battery, please carefully read the manual and often need to read.

12.4.5 Charge Mode

Please use specified charger and recommended charge mode to charge the battery under the recommended environment.

12.4.6 First Use

In the first use of the battery, if find the battery unclean, stale, or other abnormal phenomenon, please don't continue to use the battery in the mobile or other equipments, and should return the battery to the seller.

12.4.7 The use of Children

Before the children use the battery, they should be subject to parental guidance and supervised if they operate the battery correctly.

12.4.8 Avoid the children touching with the battery

Keep the battery out of reach of the children. Avoid the children removing the battery from the charger or mobile to play with.

12.4.9 Note leakage

If the battery leakage touches the skin or the clothes, please wash it with water to avoid the skin discomfort.

12.4.10 Consultation

When buy the batteries, please note the contact information of the seller, so that can contact with the seller to consult when you need.

12.4.11 Warranty Period

Warranty period is 1 year from the date that the batteries are shipped out from the factory. The cycle life is 300 times.

But, improper use rather than quality issue is, even in the warranty period the manufacturer can't replace new battery free of charge.

12.4.12 Safety use

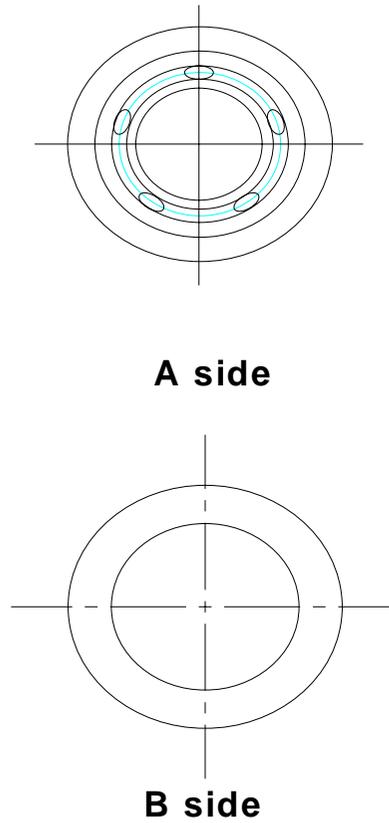
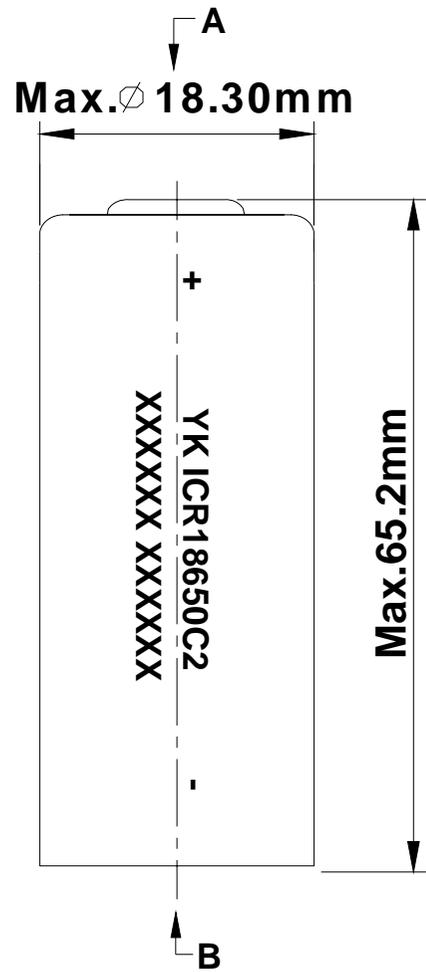
If the batteries are used in other devices, please contact with vendor to discuss with the perfection of the protection function, at least should consult the battery's max discharge current, fasting charge, special application problem.

13. Others

The above can be used as the framework of the rule both the supplier and the buyer request for the battery performance and testing. If no new written, agreement or change notification, please comply with the above to implement.

The specification is formulated based on the relative rule of GB/T18287-2000

14. Battery pack dimension and the instruction of printing



Cell printing instruction:

