

TECHNOLOGY FILE

FILE NAME: Specification for 18650C4 Cylindrical
Lithium Ion Rechargeable Battery

File Number	Prepared in Department	Version	Efficient Date	Dispensed Number
P3-PRO3/CT3-002/A/C	PRO3	A	2006.07.31	

PREPARED BY

REVIEWED BY

APPROVED BY

GB CELL

FILE NAME	FILE NUMBER	P3-PRO3/CT3-002/A/C		
Specification for 18650C4 Cylindrical Lithium Ion Rechargeable Battery	VERSION	A/00	PAGE	2/8

1. SCOPE AND APPLICATION

This specification describes the type and size, performance, technical characteristics, warning and caution of the lithium ion rechargeable battery. The specification only applies to 18650 battery supplied by GB CELL Li ion Battery Co., Ltd.

2. DEFINITION

- 2.1 Rated Capacity:** Under $23\pm 2^{\circ}\text{C}$, $65\pm 5\%\text{RH}$, it means the capacity value of being discharged by 2-hours ratio to end voltage 3.0 V, which is signed C_2 , the unit is mAh.
- 2.2 Slow Charge method:** Under $23\pm 2^{\circ}\text{C}$, $65\pm 5\%\text{RH}$, it can be charged to 4.2V with constant current of $0.2C_2$ mA, and then, charged continuously with constant voltage of 4.2V until the charged current is $0.01C_2$ mA.
- 2.3 Standard Charge method:** Under $23\pm 2^{\circ}\text{C}$, $65\pm 5\%\text{RH}$, it can be charged to 4.2V with constant current of $0.5C_2$ mA, and then, charged continuously with constant voltage of 4.2V until the charged current is $0.01C_2$ mA.
- 2.4 Quick Charge Method:** Under $23\pm 2^{\circ}\text{C}$, $65\pm 5\%\text{RH}$, it can be charged to 4.2V with constant current of $1C_2$ mA, and then, charged continuously with constant voltage of 4.2V until the charged current is $0.01C_2$ mA.
- 2.5 Slow Discharge Method:** Under $23\pm 2^{\circ}\text{C}$, $65\pm 5\%\text{RH}$, it can be discharged to the voltage of 3.0V with constant current of $0.2C_2$ mA.
- 2.6 Standard Discharge Method:** Under $23\pm 2^{\circ}\text{C}$, $65\pm 5\%\text{RH}$, it can be discharged to the voltage of 3.0V with constant current of $0.5C_2$ mA.
- 2.7 Quick Discharge Method:** Under $23\pm 2^{\circ}\text{C}$, $65\pm 5\%\text{RH}$, it can be discharged to the voltage of 3.0V with constant current of $1C_2$ mA.

3. BATTERY TYPE AND SIZE

3.1 Battery Type and Explication

GB CELL ———— 18 650 C4
Manufacturing Plant Diameter Length Special Property

3.2 Battery Size

Battery physical dimension listed in Table 1. The location of physical dimension of battery listed in Figure 1.

Table 1

Battery diameter(mm)		Battery length(mm)	
Min.	Max.	Min.	Max.
18.00	18.30	64.30	64.90

GB CELL

FILE NAME	FILE NUMBER	P3-PRO3/CT3-002/A/C		
Specification for 18650C4 Cylindrical Lithium Ion Rechargeable Battery	VERSION	A/00	PAGE	3/8

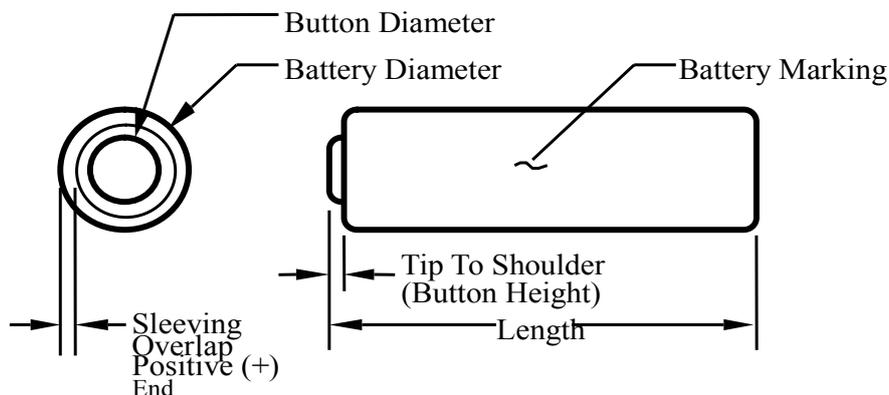


Figure 1

4. STRUCTION

The battery consists of the positive electrode, negative electrode, separator, electrolyte, crust, spacer block, combined button and so on.

5. PERFORMANCE

ITEM	SPECIFICATION
Normal Capacity	2200 mAh(0.5C ₂ mA discharge)
Normal Voltage	3.75 V
Charging Ending Voltage	4.2 V
Discharge Ending Voltage	3.0 V
Slow Charging Current	440 mA
Standard Charging Current	1100 mA
Quick Charging Current	2200 mA
Slow Discharge Current	440 mA
Standard Discharge Current	1100 mA
Quick Discharge Current	2200 mA
Internal Resistance	<70 mΩ(AC Impedance, 1000 Hz)
Weight	≤48 g
Appearance	Without break, scratch, distortion, contamination, leakage and so on

6. TECHNICAL CHARACTERISTIC

6.1 Battery Usage Conditions

Temperature of charge:	0~45℃
Temperature of discharge:	-20~60℃
Related Humidity:	65±5% RH
Atmospheric Pressure:	86~106 Kpa

GB CELL

FILE NAME Specification for 18650C4 Cylindrical Lithium Ion Rechargeable Battery	FILE NUMBER	P3-PRO3/CT3-002/A/C		
	VERSION	A/00	PAGE	4/8

6.2 Battery Testing Conditions

Temperature: 15~35℃
Relative Humidity: 45~75% RH
Atmospheric pressure: 86~106 KPa

6.3 Requirement of The Testing Equipment

Voltage instrument: the precision of voltage tester is no less than degree 0.5. The Internal resistance is not less than 10 KΩ/V.

Current instrument: the precision is no less than degree 0.5.

Stopwatch: the precision is not more than degree 0.1%.

Temperature instrument: the precision is no less than 0.5℃.

6.4 Electronic Performance

NO.	ITEM	CRITERION	TESTING METHOD
6.4.1	0.2C ₂ discharge performance	Discharge capacity is no less than normal capacity	Under 23℃±2℃, the battery is charged according to slow charge method, and then, it is discharged according to slow discharge method
6.4.2	0.5C ₂ discharge performance	Discharge capacity is no less than normal capacity	Under 23℃±2℃, the battery is charged according to standard charge method, and then, it is discharged according to standard discharge method
6.4.3	1C ₂ discharge performance	Discharge capacity is no less than normal capacity	Under 23℃±2℃, the battery is charged according to quick charge method, and then, it is discharged according to quick discharge method
6.4.4	Cycle life	The battery capacity shall be at least 80% of the original discharge capacity	Under 23℃±2℃, the battery is charged according to standard charge method, and then it is discharged according to standard discharge method, the discharge capacity is named by the original discharge capacity, a cycle defines as a charge and a discharge, and so on, the test is continued until the cycle number is 300
6.4.5	High-Low temperature discharge testing	When the battery is discharged according to the requirement of standard discharge method, the discharge capacity under -10℃ is more than 40% of the discharge capacity under 23℃; the discharge capacity under 0℃ is more than 75% of the discharge capacity under 23℃;	Batteries shall be charged according to standard charge method. Batteries shall be discharged at different temperatures of -10℃, 0℃, 23℃, 60℃ and discharged according to the requirement of standard charge method or quick charge method. Batteries shall be stored for 3 hours at the test temperature prior to discharge and then shall be discharged at the test

GB CELL

FILE NAME		FILE NUMBER	P3-PRO3/CT3-002/A/C		
Specification for 18650C4 Cylindrical Lithium Ion Rechargeable Battery		VERSION	A/00	PAGE	5/8
		the discharge capacity under 60°C is more than 95% of the discharge capacity under 23°C. When the battery is discharged according to the requirement of quick discharge method, the discharge capacity under -10°C is more than 30% of the discharge capacity under 23°C; the discharge capacity under 0°C is more than 75% of the discharge capacity under 23°C; the discharge capacity under 60°C is more than 90% of the discharge capacity under 23°C	temperature. The discharge capacity of a battery at each temperature shall be compared to the discharge capacity achieved at 23°C±2°C and the percentage shall be calculated		
6.4.6	Storage Performance	Residual capacity is more than 80% of the original discharge capacity	Under 23±2°C, after standard fully charge, according to standard charge method, the battery is discharged according to standard discharge method, this discharge capacity is named by the original discharge capacity. Then the battery is stored under 25°C for 28 days. After storage, the battery is charged according to the requirement of standard charge method, and then discharged according to the requirement of standard discharge method, this discharge capacity is named by the residual capacity, the residual capacity is compared to the original discharge capacity and the percentage shall be calculated		

6.5 Environmental Characteristics

NO.	ITEM	CRITERION	TESTING METHOD
6.5.1	Static Humidity	The battery capacity shall be more than 80% of the original discharge capacity and the impedance shall be less than 120 mΩ. There shall be no electrolyte leakage. There shall be no rusting. Part marking must be legible	Batteries are to be exposed to 60°C with 90% to 95% relative humidity for 168 hours. After humidity exposure, batteries are to return to room temperature to "dry out" for 4 hours. Following humidity exposure, batteries shall be discharged according to the requirement of quick discharge method to measure the recovered capacity. The recovered capacity is compared to the original discharge capacity and the percentage shall be calculated. The recovered impedance shall be measured using an AC impedance meter at 1000 Hz and the impedance shall be recorded
6.5.2	Vibration	The battery impedance shall be	Batteries shall be attached to a vibration table directly

GB CELL

FILE NAME		FILE NUMBER	P3-PRO3/CT3-002/A/C		
Specification for 18650C4 Cylindrical Lithium Ion Rechargeable Battery		VERSION	A/00	PAGE	6/8
		less than 120 mΩ. There shall be no electrolyte leakage	and subjected to vibration cycling that consists of 10 Hz to 60 Hz to 10 Hz in a period of five minutes. The total excursion of the vibration is 0.060 inches. The batteries shall be vibrated for one half hour per axis in each of three mutually orthogonal axes. The recovered impedance shall be measured using an AC impedance meter at 1000 Hz and the impedance shall be recorded		
6.5.3	Mechanical Shock	There shall be no electrolyte leakage	Batteries from temperature shock shall be subjected to one half-sine pulse, 1300 g's for 0.3 milliseconds in each direction along three mutually orthogonal axes (a total of 6 shocks)		
6.5.4	Temperature Shock	The recovered capacity shall be more than 60% of the original discharge capacity. The battery impedance shall be less than 120 mΩ. There shall be no electrolyte leakage	After standard fully charge, according to standard charge method, batteries are discharged according to quick charge method, the capacity which is named by the original discharge capacity shall be recorded. Battery impedance shall be measured using an AC impedance meter at 1000 Hz and the impedance shall be recorded. Batteries are to be fully charged according to standard charge method prior to temperature shock exposure. Adjust the temperature of the cold zone chamber to -20 °C and the hot zone chamber to 60 °C. After the chambers have stabilized at their respective temperatures, put fully charged batteries into the cold zone chamber and maintain for 1 hour. Then transfer into the hot zone chamber (transfer time ≤10 seconds) and maintain for another 1 hour. Then, transfer the batteries back to the cold zone chamber (transfer time ≤10 seconds). Repeat this cycle 32 times for a total of 64 hours. After testing, batteries are charged according to standard charge method, and discharged according to quick charge method, the capacity which is named by the recovered capacity. The recovered impedance shall be measured using an AC impedance meter at 1000 Hz and the impedance shall be recorded		

6.6 Safety Characteristic

NO.	ITEM	CRITERION	TESTING METHOD
6.6.1	Overcharge Testing	Batteries must not emit leakage, flame, fire or explode	The overcharge testing is performed using a constant current of 3A. The end voltage is 4.6 V
6.6.2	Overdischarge Testing	Batteries must not emit leakage, flame, fire or explode	After standard fully charge, according to standard charge method, the battery is discharged to 3.0 V

GB CELL

FILE NAME Specification for 18650C4 Cylindrical Lithium Ion Rechargeable Battery	FILE NUMBER	P3-PRO3/CT3-002/A/C		
	VERSION	A/00	PAGE	7/8

			Then the battery is connected by a 30 Ω electronic load and discharged for 24 h
6.6.3	130°C Oven Testing	Batteries must not emit flame or explode	After standard fully charge, according to standard charge method, the battery is put in the oven. And then the oven temperature will be ramped at 5°C per minute to 130°C and held at 130°C. When the temperature of the battery is 130°C, the battery is maintained for 60 minutes in the 130°C oven
6.6.4	150°C Oven Testing	Batteries must not emit flame or explode	After standard fully charge, according to standard charge method, the battery is put in the oven. And then the oven temperature will be ramped at 5°C per minute to 150°C and held at 150°C. When the temperature of the battery is 150°C, the battery is maintained for 10 minutes in the 150°C oven
6.6.5	Crush Testing	Batteries must not emit flame or explode	After standard fully charge, according to standard charge method, the battery shall be crushed between two flat surfaces. The crushing force is to be applied by a hydraulic ram with a 1.25 inch (32 mm) diameter piston. Crushing force is approximately 13 KN. Once the maximum pressure has been obtained it is to be released
6.6.6	Short Circuit Testing	Batteries must not emit flame, explode or experience temperatures higher than 150°C	Short circuit tests shall be performed at room temperature and 60°C. After standard fully charge, according to standard charge method, the batteries are to reach equilibrium at test temperature by remaining at the specified temperature for at least 30 minutes and no longer than 60 minutes before the terminals are shorted. The test shall be continued until the battery voltage falls below 0.1 V and the battery case temperature has returned to a value within 10°C of the original testing temperature
6.6.7	Reverse Charge Testing	Batteries must not emit flame or explode	Batteries shall be subjected to a discharge at be reverse charged with constant current of 1C ₂ mA to a value of -10 voltages for a total period of 8 hours by connecting them in series to an electronic load and a power supply in reverse polarity (set to 10V)
Note	All above safety tests will be finished under 23°C \pm 2°C except for special statement and ventilation with protective equipment		

7. WARING AND CAUTIONS IN HANDING THE LITHIUM-ION BATTERY

WARNING

The specification is the corporation standard of GB CELL , any unauthorized xeroxing or circulation is not allowed

GB CELL

FILE NAME	FILE NUMBER	P3-PRO3/CT3-002/A/C		
Specification for 18650C4 Cylindrical Lithium Ion Rechargeable Battery	VERSION	A/00	PAGE	8/8

Danger warning (it should be described in manual or instruction for users, indicated especially)

To prevent the possibility of the battery from leaking, heating, explosion, please observe the following precautions:

- Don't immerse the battery in water. Please put it in cool and dry environment if no using.
- Do not use and leave the battery near a heat source such as fire or heater.
- Being charged, using the battery charger specifically for that purpose.
- Don't reverse the positive and negative terminals.
- Don't connect the battery to an electrical outlet directly.
- Don't discard the battery in fire or heater.
- Don't connect the positive and negative terminal directly with metal objects.
- Don't transport and store the battery together with metal objects such as necklaces, hairpins.
- Don't strike, throw or trample the battery.
- Don't directly solder the battery.
- Don't pierce the battery with a nail or other sharp object.

CAUTION

- ◆ Don't use or leave the battery at very high temperature conditions(for example, strong direct sunlight or a vehicle in extremely hot conditions). Otherwise, it can overheat or fire or its performance will be degenerate and its service life will be decreased.
- ◆ Don't use it in a location where is electrostatic and magnetic greatly, otherwise, the safety devices may be damaged, causing hidden trouble of safety.
- ◆ If the battery leaks and the electrolyte get into your eyes, don't wipe eyes, instead, deurate the eyes with clean running water, and immediately seek medical attention. Otherwise, eyes injury can result.
- ◆ If the battery gives off an odor, generates heat, becomes discolored or deformed, or in any way appear abnormal during usage, recharging or storage, immediately remove it from the device or battery charger and stop using it.
- ◆ In case the battery terminals are dirt, clean the terminals with a dry cloth before use. Otherwise power failure or charge failure may occur due to the poor connection with the instrument.
- ◆ Be aware discharged batteries may cause fire; Tape the terminals to insulate them.