



THUNDERBATTERY

Lithium-iron Phosphate Rechargeable Cell

Model: T3.2V3400MAH3CF

Remark: Thunderbattery may, at any time, at its sole discretion, make changes to the technical and functional specifications, the design, process, materials or other features of any of the batteries.

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1. Scope

This Product Specification describes the requirements for the rechargeable lithium ion cell to be supplied by Thunder Battery.

2. Description and Model

Description: Lithium-iron phosphate rechargeable cell

Model: T3.2V3400MAH3CF

3. Nominal specifications

No.	Item	Specifications		
		Typ		
3.1	Nominal Capacity	Typ	3500mAh	
		Min.	3400mAh	
3.2	Nominal Voltage	3.2 V		
3.3	Charging Cut-off Voltage	3.65 V		
3.4	Charging Method	CC-CV Charge with Constant Current to stated voltage, then with constant voltage to cut-off current. (see 6.1))		
3.5	Initial Charging Current	Standard Charge	680mA (0.2C ₅)	
		Max. Charge	> 10°C	3400mA (1.0C ₅)
			0~10°C	≤680mA (0.2C ₅)
3.6	(ms) Max. Pulse Discharge Current	17000mA (5.0C ₅)		
3.7	Standard Discharge Current	680mA (0.2 C ₅)		
3.8	Max. Continuous Discharge Current	10200mA (3.0C ₅)		
3.9	Discharge Cut-off Voltage	2.0 V		
3.10	Operating Temperature	Charge	0°C ~ 60°C	
		Discharge	-20°C ~ 60°C	
3.11	Storage Temperature	1 month	-20°C ~ 45°C	
		3 months	-20°C ~ 35°C	
		6 months	-20°C ~ 25°C	
3.12	Weight	About 82g		



4. Outline dimensions

See attached drawing (fig. 1)

The dimension measurement shall be implemented by instruments with equal or more precious scale of $\pm 1\%$.

5. Appearances

The cell surface should be no mechanical damage, leakage and corrosion; The appearance of the cell should have clear product identification.

6. Electrical characteristics

Test should be conducted with new cells within three months after shipment from our factory and cells shall not be cycled more than five times before test. Unless there is special requirement, test shall be done under temperature of $25\pm 2^\circ\text{C}$ and relative humidity of 45%~85%. The test results are not affected evidently by such conditions of temperature 20~30°C or humidity 45%~85%RH.

Items	Test condition	Criteria
6.1 Standard Charge	The "Standard Charge" means charging with constant current 680mA (0.2C ₅) to 3.65V, then charging with constant voltage 3.65V to 34.0mA (0.01C ₅) under $25\pm 5^\circ\text{C}$, charging time will not more than 8h. Use Lithium-ion battery charger, which with an accuracy $\pm 0.05\text{V}$.	
6.2 Minimum Capacity	The capacity means the discharge capacity of the cell, which is measured with discharge current 680mA (0.2C ₅) to cut-off voltage at 2.0V at $25\pm 2^\circ\text{C}$ rest for 30 minutes after the Standard Charge.	Minimum Capacity $\geq 3400\text{mAh}$
6.3 Cycle Life	At $25\pm 5^\circ\text{C}$, each cycle is an interval between the charge (CC with 1700mA (0.5C ₅) to 3.65V, then CV at 3.65V to cut-off current at 34.0mA (0.01C ₅), rest for 30min and discharge (discharge current with 1700mA (1.0C ₅) to cut-off voltage at 2.0V), rest for 30min. After 3000 cycles, rest for 1 day, then checks the capacity as 6.2.	After 3000 cycles capacity $\geq 80\%$ Minimum Capacity
6.4 Internal Impedance Capacity	Impedance shall be measured by a sinusoidal alternating current method. Internal resistance measured at $1\pm 0.1\text{KHz}$ after charging with 50% capacity	$\leq 25\text{m}\Omega$



6.5 Rate Capacity	<table border="1"> <thead> <tr> <th>Charge current</th> <th colspan="4">Discharge current</th> </tr> </thead> <tbody> <tr> <td>680mA (0.2C₅)</td> <td>680mA (0.2C₅)</td> <td>1700mA (0.5C₅)</td> <td>3400mA (1.0C₅)</td> <td>10200mA (3.0C₅)</td> </tr> <tr> <td></td> <td>100%</td> <td>≥95%</td> <td>≥92%</td> <td>≥85%</td> </tr> </tbody> </table>				Charge current	Discharge current				680mA (0.2C ₅)	680mA (0.2C ₅)	1700mA (0.5C ₅)	3400mA (1.0C ₅)	10200mA (3.0C ₅)		100%	≥95%	≥92%	≥85%	
	Charge current	Discharge current																		
680mA (0.2C ₅)	680mA (0.2C ₅)	1700mA (0.5C ₅)	3400mA (1.0C ₅)	10200mA (3.0C ₅)																
	100%	≥95%	≥92%	≥85%																
Cells shall be charged according to 6.1, and discharge different current respectively to 2.0V at 25 °C. The percentage shall be calculated using discharging capacity compared to the minimum capacity.																				
6.6 Storage Characteristic	<p>1. Test the initial capacity at 25±2°C and record, then charge the cells with 50% capacity, then storage for 3, 6, 12 months respectively, then the cell is cycled for 3 times with charge with 680mA (0.2C₅) and discharge with 680mA (0.2C₅) at 25±2°C, The maximum discharge capacity (longest discharge time) is recorded.</p>			680mA(0.2C) discharge time: After 3 months storage ≥4.5hrs After 6 months storage ≥4.25hrs After 12 months storage ≥4.0hrs																
	<p>2. The cell is charged and discharged using 680mA (0.2C₅) at 25±2°C. The discharge capacity is C1. The cell is stored for 28 days in 25 ±2°C after fully charged and then is discharged using 680mA (0.2C₅) at 25±2°C. The capacity is defined as C2.</p>			Capacity Retention C2/C1≥85%																
	<p>3. After the test as (2.) , The cell is cycled for 3 times using 680mA (0.2C₅) at 25±2°C, The maximum discharge capacity is C3.</p>			Capacity recoverable ratio C3/C1≥90%																
6.7 Voltage	Voltage of shipment			3.2V~3.4V																
6.8 Discharge Performance	<table border="1"> <thead> <tr> <th>Discharge current</th> <th colspan="4">Discharge temperature</th> </tr> </thead> <tbody> <tr> <td>680mA (0.2C₅)</td> <td>- 20°C</td> <td>0°C</td> <td>25°C</td> <td>60°C</td> </tr> <tr> <td></td> <td>≥50%</td> <td>≥70%</td> <td>100%</td> <td>≥98%</td> </tr> </tbody> </table>				Discharge current	Discharge temperature				680mA (0.2C ₅)	- 20°C	0°C	25°C	60°C		≥50%	≥70%	100%	≥98%	No leakage, No appearance defect
	Discharge current	Discharge temperature																		
680mA (0.2C ₅)	- 20°C	0°C	25°C	60°C																
	≥50%	≥70%	100%	≥98%																
Cells shall be charged according to 6.1 and discharged at 680mA (0.2C ₅) to 2.0 V. Cells shall be stored for 4 hours at the test temperature prior to discharging and then shall be discharged at the test temperature, The percentage shall be calculated using discharging capacity compared to the minimum capacity.																				



7. Environmental adaptability

Items	Test condition	Criteria
7.1 Free Fall Test	The full charged cell is to be free felled from a height of 1000mm (the lowest point of the cell) to the concrete ground, from the X, Y, Z plus or minus six directions and felled 1 times in each direction.	No explosion, No fire, No smoke. The OCV after the test no less than 90% before free-fall test.
7.2 Vibration Test	A full-charged cell is to be subjected to simple harmonic motion with amplitude of 1.6 mm total maximum excursion. The frequency is to be varied at the rate of 1 hertz per minute between 10 and 55 hertz. After the test is completed, And the cell returned to the starting position. The cell shall be vibrated for 30 minutes per axis of XYZ axes. The samples should be observed for 6 hours after the test, and also check the weight loss of cells before and after the test.	Not explosion, No fire, No leakage, Mass loss $\leq 0.1\%$
7.3 Crush Test	The full-charged cell is to be crushed between two flat surfaces. The force for the crushing to be applied by a hydraulic ram with a 32mm diameter piston. The Crushing is to be continued until a pressure readind of 17.2mPa reached on the Hydraulic ram, applied force of(13±1)kN, Once the maximum pressure has been obtained it is to be released.	No explosion, No fire
7.4 Shock Test	The full charged cell has only two axes of symmetry in which case only two directions shall be tested. Each shock is to be applied in a direction normal to the face of the cell. For each shock the cell is to be accelerated in such a manner that during the initial 3 milliseconds the minimum average acceleration is 75g. The peak acceleration shall be between 125g and 175g. The samples should be observed for 6 hours after the test, and also check the weight loss of cells before and after the test. Cells shall be tested at a temperature of 20±5°C	No explosion, No fire, No leakage. Mass loss $\leq 0.1\%$
7.5 Altitude Simulation Test	The full-charged cells are to be stored for 6 hours at an absolute pressure of 11.6 KPa and a temperature of 20±3°C.	No explosion, No fire, No leakage
7.6 Constant Humidity and Temperature Characteristics Test	Under the temperature of 20±5°C, after charging the cell with 680mA(0.2C ₅), then put the cell into the constant temperature and humidity oven with 40±2°C and 90~95% for 48h, then store the cells at RT for 2hrs, and discharge the cells with 3400mA (1.0C ₅) to 2.0 volts.	The cell should Be no obvious deformation, leakage, rust, smoking and explosion. Discharge time ≥ 36 min

8. Safety characteristics

Items	Test condition	Criteria
8.1 Short circuit	Each test sample cell, in turn, is to be short-circuited by connecting the positive and negative terminals of the cell with a Cu wire having a maximum resistance load of $80\pm 20\text{m}\Omega$. The sample is to discharge until a fire or exposition is obtained, or until it has reached a completely discharge state of less than 0.2V and the sample case temperature has returned to $\pm 10^\circ\text{C}$ of the ambient temperature. Tests are to be conducted at $20\pm 5^\circ\text{C}$ and $55\pm 5^\circ\text{C}$. Cell Condition: Fresh, Fully charged cell.	No explosion, No fire, The highest temperature of the cell surface is less than 150°C
8.2 Over charge	Cells are discharged at constant current of 680mA ($0.2C_5$) to 2.0 volts. After standard discharge, Cells are charged at constant current of 3400mA ($1.0C_5$) and constant voltage of 10.0V. The test should not be finished until lasting for more than 7 hours, reaching the final description by manufacturer or explosion, catching fire. Cell Condition: Fresh, Fully charged cell.	No explosion, No fire
8.3 Over discharge	After standard charge. Cells are discharged at constant Current of 680mA ($0.2C_5$) to 2.0V, and the positive and negative terminal is connected by a 30Ω wire for 24 hours. Cell Condition: Fresh, Fully charged cell.	No explosion, No fire
8.4 Forced discharge	The cell shall be discharge to 2.0V with the current 680mA ($0.2C_5$), then the discharge cell is subjected to reverse charge at 3400mA ($1.0C_5$) for not less than 90minutes.	No explosion, No fire
8.5 Heating Test	The cell has been charged at 45°C , 10°C or done cycle life at this temp. Cells are heated in a circulating air oven at a rate of $5\pm 2^\circ\text{C}$ per minute to $130\pm 2^\circ\text{C}$ and remain for 10 minutes. Cell Condition: the cell has been pre processed with charging at 45°C , 10°C or has been cycle at those temperatures, return to room temperature ($20 \pm 5^\circ\text{C}$) and then be examined	No explosion, No fire
8.6 High Temperature Storage Test	Put cell into the $75^\circ\text{C}\pm 2^\circ\text{C}$ box and keep the cell in the box for 7 days after it be charged according to 6.1, and then take it out. Cell Condition: Fresh, Fully charged cell.	No explosion, No fire
8.7 Thermal-cold Cycling Performance Test	The full-charged cell is placed in $75\pm 2^\circ\text{C}$ for 6h, and then put the Cell in -40°C for 6h; change temperature time $< 30\text{min}$, then repeat it for 10 cycles. Finally the cell is placed in room temperature for 24h. Watch the appearance of cell.	No explosion, No fire, No smoke Open circuit voltage changed not less than 90%, mass loss limit: $\leq 0.1\%$



9. Suggest Use

When Li-ion rechargeable cell is used over the permitted voltage or current, electrolyte may disassemble, and it will affect the electrical and safety performance of the cell.

The parameters of protection circuit module as follows:

Over charge protection voltage	3.90±0.025V
Over discharge protection voltage	2.00±0.08V
Over current protection	≤17.0A (for reference)

10. Warranty

From the beginning of the shipment date, shelf-life is 24 months (storage temperature should less than 25°C), or has completed 3000 cycles (test method according to 6.3), whichever comes first.

11. Shipping

The capacity of delivery cell is approximately charged with 50% capacity. Please prevent the cell from violent vibration, impact, exposure, moisture during transportation.

12. Product Liability

The performance and warning of product should be both sides negotiated in advance to confirm, and the obligations of the parties or the responsibility scope should be clear. Thunder Battery responsible for problems due to the defect of product. Unaccomplished matters from this specification should be settled through friendly negotiation.

13. Others

13.1 If cell is stored for a long time (for example. more than 3 months); the cell should be kept in the dry and low temperature.

13.2 The cell is suggested to be recharged within 3 months after delivery, and must be recharged within 6 months after delivery.



13.3 Measuring instrument

13.3.1 Voltmeter

Inner impedance of voltmeter is more than 10 M Ω when Cell voltage is measured.

13.3.2 Impedance Meter

Impedance shall be measured by a sinusoidal alternating current method (1 kHz LCR meter).

13.3.3 Ammeter

Total external resistance including ammeter and wire is less than 0.01 Ω .

14. Caution

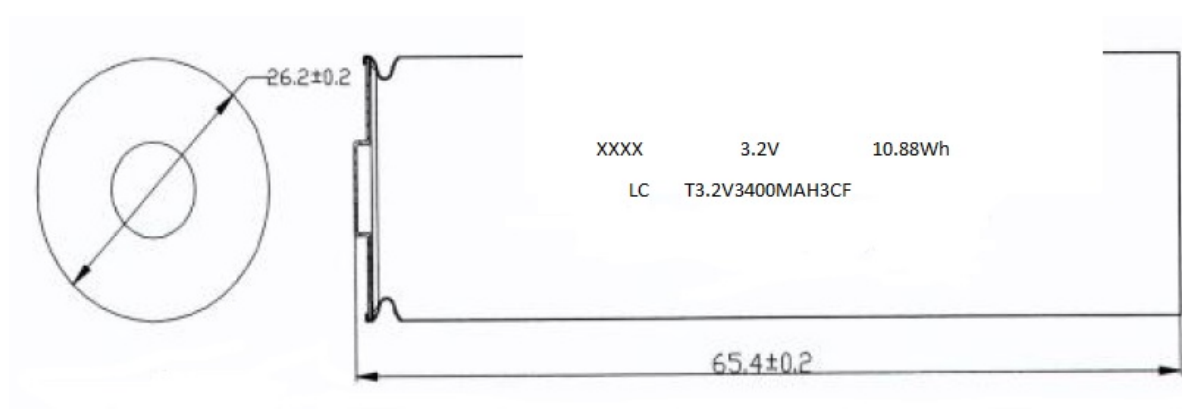
- To ensure the correct use of the cell, please read the rules carefully before using.
- When charging the Cell, use dedicated chargers and follow the specified conditions.
- Do not heat or throw the cell into fire or water.
- Do not put cell in your pockets or a bag together with metal objects, such as necklaces, Hairpins, coins, screws. Do not store cell with such objects.
- Do not short circuit the (+) and (-) terminals with other metals.
- Do not place cell in a device with the (+) and (-) in the wrong way around.
- Do not pierce cell with a sharp object such as a needle.
- Do not hit the cell with a hammer, tread or throw the cell.
- Do not use a cell with serious scar or deformation.
- Do not use cell with dry batteries and other primary cells, or cells of a different package, type, or brand.
- Please stop using the cell if abnormal heat, odor, discoloration, deformation or any other abnormal thing happened during using, charging or storing.
- If liquid leaking from the cell gets into your eyes, do not rub your eyes. Wash them well with clean water and go to see a doctor immediately.
- Store cells out of reach of children so that they are not accidentally swallowed.
- Thoroughly read the user's manual for the charge before charging the cell.



- When not using cell for an extended period, remove it from the equipment and store in a place with low humidity and low temperature.
- While the cell pack is charged, used and stored, keep it away from objects or materials with static electric charges.
- The cell can be used within the following temperature ranges. Do not exceed these ranges.
- Charge temperature range: 0°C to 60°C.
- Discharge temperature range: -20°C to 60°C.

Fig. 1 Dimension drawing T3.2V3400MAH3CF

(Unit: mm) With plastic film





NOTES
