



BST Power (Shenzhen) Limited
Hengyang LC Energy Storage Limited

SPECIFICATION

LFP Rechargeable Lithium Ion Battery

Model No.: IFR18650E1600

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1. General Information

1.1. Scope

This Product Specification describes the requirements for the rechargeable lithium ion battery which supplied by BST Power (Shenzhen) Limited, This Product has been Certificated by UL and CE.

1.2. Product classification: Cylindrical LFP rechargeable lithium ion battery

1.3. Model name: IFR18650E1600

2. Product Specifications

Items	Condition /Note		Specification
Capacity	Standard Charge/Discharge		1600mAh (C _{min})
Nominal Voltage	Average		3.20 V
Charge Voltage	Limited Charging Voltage		3.65 V
Charge Current	Standard Charge		320mA (0.2C ₅)
	Maximum Continuous Charge	10~60℃	1600mA (1.0C ₅)
		0~10℃	≤ 320mA (0.2C ₅)
Standard Charge (CC-CV)	Constant Current		320mA (0.2C ₅)
	Constant Voltage		3.65 V
	Cut-off Current (End)		16mA (0.01C ₅)
Standard Discharge	Constant Current		320mA (0.2C ₅)
	Cut-off Voltage (End)		2.0 V
Maximum Discharge	Maximum Continuous Discharge Current		4800mA (3.0C ₅)
Initial Internal Impedance	AC Impedance 1±0.1 KHz , 50% SOC, 25±2℃.		≤ 40mΩ
Weight	Approximate		≈40g
Operating Temperature	Charge		0℃ ~ 60℃
	Discharge		-20℃ ~ 60℃
Storage Temperature	1 month		-20℃ ~ 45℃
	3 months		-20℃ ~ 35℃
	6 months		-20℃ ~ 25℃
Voltage	Voltage of shipment		3.2V~3.4V

3. Appearance and Dimensions

3.1. Appearance

There shall be no such defect as scratch, flaw, crack, rust, discoloration, leakage, which may adversely affect commercial value of the cell.

3.2. Dimension



4. Performance Specifications

4.1. Standard Condition for test

4.1.1. Specified environment

Temperature: $25 \pm 2^\circ\text{C}$, Relative Humidity: 45%~85%RH, Atmospheric Pressure: 86-106kPa.

4.1.2. Standard Charge

Unless otherwise specified, the "Standard Charge" shall consist of charging at a constant current of 320mA ($0.2C_5$). The cells shall be charged at constant voltage to 3.65V, then charging with constant voltage 3.65V while tapering the charge current to 16mA ($0.01C_5$), Charging shall be cut-off.

4.1.3. Standard Discharge

Unless otherwise special requirements, the "Standard Discharge" shall consist of discharging at a constant current of 320mA ($0.2C_5$) to 2.0V.

4.1.4. Fast charge/discharge condition

Cells shall be charged at constant current of 1600mA ($1C_5$) to 3.65V with cut-off current of 16mA ($0.01C_5$).

Cells shall be discharged at constant current of 1600mA ($1C_5$) to 2.0V. The Cells remain on rest for 10 minutes after charge and 10 minutes after discharge.

4.2. Electrical Specification

Items	Test Condition	Specification
Cycle Life	Cells shall be charged and discharged per 4.1.4 2000 cycles. A cycle is defined as one charge and one discharge. The 2001st cycle discharge capacity shall be measured with 4.1.2 and 4.1.3	Capacity $\geq 80\%$ (C_{\min})

Rate Capacity	Charge Current	Discharge Current				
	320mA (0.2 C ₅)	320mA (0.2 C ₅)	1600mA (1.0C ₅)	4800mA (3.0 C ₅)		
		100%	≥ 93%	≥ 85 %		
Cells shall be charged according to 4.1.2 and discharged at different current respectively to 2.0 V. Note: Percentage as an index of the capacity at 320mA (0.2C ₅) is 100%.						
Storage Characteristics	<p>①Test the cells initial capacity according to 4.1.2 and 4.1.3, then charge the cells 50% SOC, then storage for 3,6,12 months respectively, then the cells be cycled for 3 times with charge with 320mA (0.2 C₅) and discharge with 320mA(0.2 C₅) at 20 ± 5°C, The maximum discharge capacity(longest discharge time) is recorded.</p>			<p>0.2 C₅ discharge time After 3 months storage, ≥4.5hrs After 6 months storage, ≥4.25hrs After 12 months storage, ≥4.0hrs</p>		
	<p>②Test the cells initial capacity according to 4.1.2 and 4.1.3. The discharge capacity is C1. Then the cells are stored for 28 days in 20 ± 5°C after fully charged (according to 4.1.2) and then be discharged using 320mA (0.2 C₅) at 20 ± 5°C. The capacity is defined as C2.</p>			Capacity Retention C2/C1 ≥ 85%		
	<p>③After the test as ②, the cells is cycled for 3 times using 320mA (0.2 C₅) at 20 ± 5°C, The maximum discharge capacity is C3.</p>			Capacity recoverable ratio C3/C1 ≥ 90%		
Discharge Performance	Discharge current		Discharge Degree			No leakage, No appearance defect
	320mA (0.2 C ₅)	-20°C	0°C	25°C	60°C	
		≥50%	≥70%	100%	≥98%	
Cells shall be Test initial capacity according to 4.1.2 and 4.1.3, then Cells be full-charged (according to 4.1.2). And then 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.						

4.3. Environmental Adaptability Specification

Items	Test Condition	Specification
Free Fall Test	The full-charged (according to 4.1.2) cells are dropped onto a concrete floor three times from 1.0 meter height for 1 cycle, 2 drops from each cell terminal and 1 drop from the side of can (3 total number of drops) . After the test, the cells shall be placed at least one hour , then test cells' OCV and take a visual inspection .	No explosion, No fire, No smoke. The OCV after the test no less than 90% before free-fall test.
Vibration Test	The full-charged (according to 4.1.2) cells are vibrated for 90~100 minutes per each of the three mutually perpendicular axis (x,y,z) with total excursion of 0.8mm frequency of 10 Hz to 55 Hz and sweep of 1Hz change per minute. After the test is completed, 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 ≤ 0.1%

Crush Test	The full-charged (according to 4.1.2) cells are put into Crusher. Use a force of $13\pm 1\text{KN}$ for the crushing ,when the cells get an abrupt voltage drop of one-third of the original voltage or 10% of deformation the initial dimension, stop the test and the force is released.	No explosion, No fire
Shock Test	The full-charged (according to 4.1.2) 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 75 g. The peak acceleration shall be between 125 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 $20\pm 5^\circ\text{C}$.	No explosion, No fire, No leakage. Mass loss $\leq 0.1\%$
Constant Humidity and Temperature Characteristics Test	The full-charged (according to 4.1.2) cells are stored at $40\pm 2^\circ\text{C}$ (90~95%RH) for 48 hours, then store the cells (according to 4.1.1) for 2 hours, Discharge the cells with 320mA (0.2C ₅) to 2.0 V, recorded discharge time and take a visual inspection .	The cell should be no deformation, no rust, no leakage, no fire, no smoking and no explosion. Discharge time $\geq 3\text{h}$
Altitude Simulation Test	The full-charged (according to 4.1.2) cells are to be stored for 6 hours at an absolute pressure of 11.6 KPa and a temperature of $20\pm 3^\circ\text{C}$. The cells' weight shall be recorded before and after test.	No explosion, No fire, No leakage. Mass loss $\leq 0.1\%$

4.4. Safety Specification

Items	Test Condition	Criteria
External Short-Circuit Test	Fresh cells shall be full-charged (according to 4.1.2) , the positive and negative terminals of the cell is connected by a $80\pm 20\text{m}\Omega$ wire .Test sample cells are conducted at $20\pm 5^\circ\text{C}$ and $55\pm 5^\circ\text{C}$. Unless otherwise the sample cells are exploded , fire or voltage have reached a completely discharge state of less than 0.2V ,and while the temperature of explosion-proof box has returned to $\pm 10^\circ\text{C}$ of the ambient temperature, end the test.	No explosion, No fire, The highest temperature of the cells' surface less than 150°C
Overcharge Test	Fresh cells shall be full-charged (according to 4.1.2) , Cells are charged at constant current of 1600mA (1.0 C ₅) and constant voltage of 10.0V while tapering charge current. Charging shall be continued for 7 hours. Unless otherwise the sample cells are exploded , fire ,end the test.	No explosion, No fire
Overdischarge Test	After Fresh cells be full-charged (according to 4.1.2) and be discharged (according to 4.1. 3), The positive and negative terminals of the cells are connected by a 30Ω wire for 24 hours.	No explosion, No fire
Forced discharge Test	Fresh cells be discharged (according to 4.1. 3), then cells are subjected to reverse charge at 1600mA (1.0 C ₅) for not less than 90minutes.	No explosion, No fire

Heating Test	Cells be full-charged (according to 4.1.2), and be heated in a circulating air oven at a rate of $5\pm 2^{\circ}\text{C}$ per minute to $130\pm 2^{\circ}\text{C}$. At oven is to remain for 10 minutes . The sample shall return to room temperature ($20 \pm 5^{\circ}\text{C}$)and then be examined.	No explosion, No fire
Hot and Low Temperature Cycle	The full-charged cells are placed in a chamber ,raising the chamber-temperature to $75\pm 2^{\circ}\text{C}$ and maintaining this temperature for 6h, then reducing the chamber-temperature to -40°C and maintaining this temperature for 6h; change temperature time $<30\text{min}$, repeat it for 10 cycles. Finally the cells are placed in room temperature for 24h. Then inspect the appearance of the samples.	No explosion, No fire, No smoke, Open circuit voltage changed not less than 90%,mass loss limit: $\leq 0.1\%$
High Temperature Storage Test	The full-charged cells are placed in a circulating air oven at $80\pm 2^{\circ}\text{C}$ for 7h , then the surface temperature of cells returned to room temperature, Inspect the appearance of the samples.	No explosion, No fire
Impact Test	The full-charged cells are placed on a flat surface. A $15.8\pm 0.1\text{mm}$ diameter bar is to be placed across the center of the sample. A $9.1\text{kg}\pm 0.46\text{kg}$ mass is to be dropped from a height of $610\pm 25\text{mm}$ to the center of the cells vertically. Inspect the appearance of the samples.	No explosion, No fire
Nail Test	The full-charged cells are pierced thoroughly by a $\Phi 2\sim 5\text{mm}$ needle, from the direction perpendicular to the cells .the speed of nail is $10\sim 40\text{mm/s}$, keep the needles in the cells for at least 1h.	No explosion, No fire

5. Use Suggestion

When rechargeable Li-ion cells are used over the permitted voltage or current, electrolyte may disassemble, and it will affect the electrical and safety performance of the cells. (The parameters of protection circuit module as follows):

Over charge protection voltage	$3.90\pm 0.025\text{V}$
Over discharge protection voltage	$2.00\pm 0.08\text{V}$
Over current protection	$\leq 9\text{A}$ (for reference)

5.1. Warranty

From the beginning of the shipment date, shelf-life is 12 months (storage temperature should less than 25°C), or has completed 2000 cycles (test method according to 4.1.4), whichever comes first.

5.2. 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. BST responsible for problems due to the defect of product. Unaccomplished matters from this specification should be settled through friendly negotiation.

5.3. Others

- 5.3.1. 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.
- 5.3.2. The cell is suggested to be recharged within 3 months after delivery, and must be recharged within 6 months after delivery.

6. Cautions

- .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.