Lithium Ion Battery
Specification Approval Sheet

Model: INR18650E-3350mAh

Designed	Checked	Approved
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1. Scope

This document describes the Product Specification of the Lithium-ion rechargeable cell supplied by Superpack (Guangdong Superpack Technology Co., Ltd).

2. Definition

2.1 Rated capacity

Rated capacity: Cap=3350mAh, minimum capacity: Cap=3350mAh. Under 25±5℃, It means the capacity value of being discharged by 5-hours rate to end voltage 2.75V, which is signed Cap, the unit is mAh.

3. Model

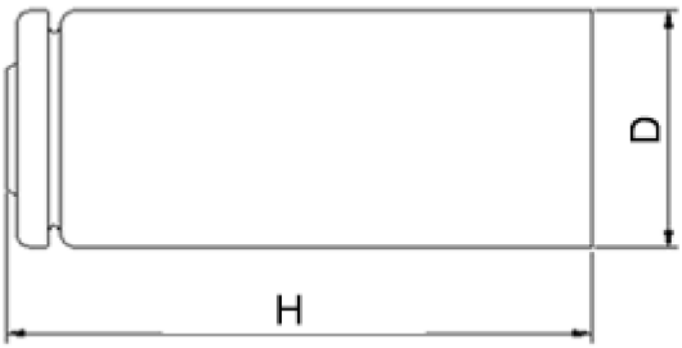
3.1 Model and description

Model: INR18650E-3350mAh

Description: Cylindrical Li-ion rechargeable cell of LiNiCoMnO2

3.2 Cell dimensions

Cell physical dimensions listed in Figure 1(unit: mm)



Cell dimension Table

No.	Name	Dimension Parameters
1	D (Diameter)	18.2±0.3mm
2	H (Height)	65.0±0.3mm

4. Characteristics

No.	Item	Specifications
1	Nominal voltage	3.6V
2	Charge cut-off voltage/charge cut-off current	4.2 ±0.05 V /0.02C at 0℃＜T≤45℃
3	Discharge cut-off voltage	2.75V at -20℃≤T60℃
4	Nominal capacity	3350mAh@ 0.2C at 25℃
5	Standard charging current	0.2C (670mA)
6	Charging time	Standard charge：4.0 h Ref
7	Standard discharge current	0.2C (670mA)
8	Max charge current	＜0℃: cannot charging
		0℃≤T＜5℃：≤0.1C
		5℃≤T＜20℃：≤0.3C
		20℃≤T＜35℃：≤0.5C
		35℃≤T≤45℃：≤0.3C
		＞45℃:cannot charging
9	Max discharge current	＜ -20℃: can not discharging
		-20℃≤T＜0℃：≤0.2C
		0℃≤T＜15℃：≤0.7C
		15℃≤T＜25℃：≤1.0C
		25℃≤T＜35℃：≤1.5C
		35℃≤T＜45℃：≤1.0C

		45℃≤T≤60℃：≤0.7C
		＞60℃：cannot discharging
10	Operating Temperature (Cell Surface Temperature) working temperature	Charge：0 to 45°C Discharge：-20 to 60°C
11	Storage temperature & humidity	Temperature：-20° C～+35° C Humidity：≤85%RH
12	Weight	Less than 50 ± 2g
13	Dimension	Diameter: 18.2±0.3mm Height：65.0±0.3mm

5. Cell Performance Criteria

5.1 Cell testing conditions

Unless otherwise specified, all tests stated according to following:

Temperature： 25±5℃

Humidity：≤85%RH

Use standard charge and standard discharge method

5.2 Requirement of the testing equipment

Voltage meter: The voltage tester internal resistance is ≥ 10 K/V

Temperature meter: The precision is ≤0.5℃

5.3 Electronic performance

No.	Item	Test Method and Condition	Standard
1	0.2C Rated Cap.	Discharging at current of 0.2C to 2.75V after standard charge.	≥3350mAh
	0.5C Rated Cap.	Discharging at current of 0.5C to 2.75V after standard charge.	≥3250mAh
	1.0C Rated Cap.	Discharging at current of 1.0C to 2.75V after standard charge.	≥3050mAh
2	40℃ Cap.	Discharging at current of 0.2C to 2.75V after standard charge.	≥3050mAh
	25℃ Cap.	Discharging at current of 0.2C to 2.75V after standard charge.	≥3350mAh
	0℃ Cap.	Discharging at current of 0.2C to 2.75V after standard charge.	≥2680mAh

	-10℃ Cap.	Discharging at current of 0.2C to 2.75V after standard charge.	≥2345mAh
3	Cycle Life	Test condition: Temperature: 23± 5°C Charge:0.5C CC to 4.2V, and then CV(4.2V) to 0.02C Discharge: Constant discharge current of 0.5C to 3.0V ⩾80%of initial discharge capacity	≥500cycles
4	Initial Impedance	AC Impedance, 1kHz, 50% SOC	⩽40 mΩ
5	Capacity retention	Stored at 25°C for 28days after standard charge, and then discharge at 0.2C to 2.75V at 25°C	≥3050mAh
6	Capacity recovery	Stored at 25°C for 28days after standard charge, discharge at 0.2C to 2.75V, and then standard charge/discharge 1cycle at 25°C	≥3250mAh

5.4 Safety characteristics

No.	Item	Test Method and Condition	Criteria
1	Overcharge (3C/4.6V)	The cell is charged by 3C (10A) current with 4.6V or 1h charging time. The test is to be end and observed 1h.	No explosion No fire
3	Brine Immersion	Each fully charged cell is immersed in 3.5% Nail solution (weight percent, this solution concentration is same to seawater) for 2 hours.	No explosion No fire
4	Over discharge	Charge：Standard charge. Discharge： Constant discharge at current of 1C for 2.5 hours.	No explosion No fire No leakage
5	Short test (25°C)	Short-circuit the standard charged cell by connecting positive and negative terminal 10min by less than 100mΩ wire.	No explosion No fire
6	Heating test	The cell is to be heated in a gravity convection or circulating air oven. The temperature of the oven is to be raised at a rate of 5℃ per minute to a temperature of 130±2℃ and remain for 30 minutes and observed for 1 hour.	No explosion No fire

5.5 Reliability characteristics

No.	Items	Test Method and Condition	Criteria
1	Vibration test	The cell shall be charged at standard charging condition and vibrated for 30 minutes per-each of the three mutually perpendicular axes (x, y, z) with total excursion of 1.6mm, the frequency varies between 10Hz and 55Hz at 1Hz / minute.	No explosion No fire No leakage
2	Drop test	The cell shall be charged at standard charging condition, and dropped from a height of 1.5 meter to concrete floor for 6 times (+/- direction on x, y axes).	No explosion No fire No leakage
3	Impact test	The cell shall be charged at standard charging condition, and put a rod (ϕ15.8mm) on the cell, and then a heavy block (9.1Kg) crashes on the cell from a certain height (61.0cm).	No explosion No fire
4	Crush test	The cell shall be charged at standard charging condition, and place between two horizontal plates until the pressure between the two plates reaches 13KN. Measure its temperature and observe event.	No explosion No fire
5	Shock test	The cell shall be charged at standard charging condition, and shock 6 times every axis, total 18 shocks, peak acceleration is 150g/s and pulse duration is 6 ms.	No explosion No fire No leakage

6 Storage and Others

6.1 Cell storage conditions

Recommend at least with 25% SOC at -10°C ~ 35°C for long storage, it is better to check the voltage each month and re-charge if the voltage lower than 3.6V.

Storage humidity: ≤ 85%RH

6.2 Others

Any matters that this specification does not cover should be conferred between the customer and Superpack technology, Co., LTD.

7 Handling Instructions for Lithium ion Rechargeable Cell.

7.1 Caution and Precaution.

7.1.1 Charging

a) Charging voltage must be set 4.20V/cell. Concerning charge voltage tolerance of charger, charging voltage must be set below 4.20V/cell. Even if the charge could be out of order, charge voltage of charger should not be above 4.25V/cell to avoid over- charging. Cell life will be shortened by charging voltage above 4.20V.

b) Charge the cell at a constant current of 0.5C until 4.20V is attained.

c) Maintain charge voltage at 4.20V for 2.0 hours (recommended for maximum capacity).

d) No reverse charging

e) In case of cell voltage is below 2.75V, cell should be charged with per-charge that current is below0.1C. Then cell voltage reach over 2.75V, standard charge starts. And if cell voltage never reaches to 2.75Vin specified period (timer), charger will stop charging.

f) By timer, current detection and open circuit voltage detection, charger detects full charge. When charger detect cell is full charged, charger stop charging.

7.1.2 Discharging

a) Discharge current must be below 1.5C /cell.

b) Discharge end voltage must be over 2.45V.

c) Do not over-discharge cell below 2.0V/cell.

d) Discharge temperature range should be -20 °C ~ +55°C.

7.1.3 Environmental using conditions

a) When the cell is charged.：0°C~45°C

b) When the cell is discharged.：-20°C ~ +55°C

c)Charge or discharge out of recommended range might cause the generating heat or serious damage of cell. And also, it might cause the deterioration of cell's characteristics and cycle life.

7.1.4 Storage

a)Any storage, cell should be in low humidity, no corrosive gas atmosphere area. And there is no press and condensation on the cell.

b) Recommend at least with 25% SOC at -10°C ~ 35°C for long storage, it is better to check the voltage each month and re-charge if the voltage lower than 3.6V.

c) Storage humidity: ≤ 85%RH

7.1.5 Precautions on Handling Lithium Ion Cells

a) When the cells are connected in series, use same rank cells, use same lot number cells and use same charging date cells. These date show label for carton on the master carton. Further, the cell's voltage and impedance have to be checked and matched as uses of cells. Superpack recommends match cells keep voltage within 7mV difference and impedance within 2mΩ difference at least.

b) Inspect voltage and internal impedance before using.

c) When cells are re-shipped to assembling factory, make enough attention the packing to avoid stress by shipping. Superpack recommends the same package shipped from Superpack when re-shipping. Even if after open package, when re-shipping, use the same parts and materials from Superpack for re-packing.

d) Do not use abnormal cell which has damages by shipping stress, drop, short or something else, and which gives off electrolyte odor.

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

f) Do not use cell nearby the place where generates static electricity (more than 100V).

g) Please read the manual before using the cell and please reread if necessary.

h) Please read the manual of specified charger about charging method.

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

j) In case younger children use the cell, their parents teach how to use cells according to the manual with care.

k) Keep the cell out of the reach of younger children. And also, pay attention to cell be taken out it from the charger or equipment by little children.

l) If the skin or cloth is smeared with liquid from the cell, wash with fresh water. It may cause the skin inflammation, see a doctor immediately.

7.1.6 Cell position in equipment and charger.

To avoid degradation of cell performance by heat, a cell should set the place apart from heat generating electronic parts inside equipment and charger.

7.1.7 Precautions on Battery Pack Design.

a) Battery pack Shape, Mechanism and Material· Do not make the shape and mechanism which easy connect to other equipment and charger.

· Do not make the terminal shape which easy cause short circuit by metal object such as necklaces, hairpins, etc. And further, have over current protection function to prevent outer short circuit.

· Do not make the terminal shape and mechanism which connect reverse to equipment.

- Do not make the shape and mechanism which static electricity and water easy go through the battery pack inside.
- Make the shape and mechanism which can inspect protection circuit function before the battery pack makes completely.
- Fix cells with mold case by rib, tape, glue etc., but do not make damage cells (especially sealing part) by rib or sharp part of mold case. In case of the battery pack is struck by hard shock or vibration, the battery pack has possibility to cause leakage, smoke, explosion.
- Weld mold case by glue. Not weld mold case by ultra-sonic welding.

b) Protection Circuit insure safety of battery

- Overcharge protection should work below 4.25V/cell by charge. Then charge current shall be shut down.
- At the voltage range 1.7~2.3V/cell, over-discharge protection should work. Then discharge current shall be shut down and consumption current is below 1μA.
- When discharge current exceed about A, over-discharge current protection should work. Then over-discharge current shall be shut down.

c) Electric circuit

- To avoid to discharge during storage, design the low consumption current electronic circuit(e.g. Protection circuit, fuel gauge, etc) inside battery pack.

d) Cell connection

- Do not solder onto a cell in order to avoid a damage on the cell. Weld spot welding lead plate onto cell, and solder lead wire or lead plate.

7.2 Precautions and Safety Instructions.

The cell includes the flammable objects such as the organic solvent. If the handling is missed there will be possibility that the cell rupture flames or hot, or it will cause the damage to the cell and/or personal injury. Please observe the following prohibitive matters. And also, add the protection device the equipment for fear that the trouble would affect the cell by the abnormality of equipment. Please read and observe the standard cell precautions below before using utilization.

7.2.1 Don’t use or expose the cell to extreme heat, flame, disposed in fire or water or get it wet. Don’t modify or disassemble the cell. It will be dangerous, and may cause ignition, heating, leakage or explosion.

7.2.2 Don’t short-circuit cell positive (+) and negative (-) terminals. Keep away from metal or other conductive materials. Jumbling the cells of direct contact with positive (+) and negative (-) terminals or other conductive materials may cause short-circuit. Don’t reverse the positive (+) and negative (-) terminals for any reason.

7.2.3 Don't use the unspecified charger and breach charging requirement. Cell charged with unspecified condition maybe lead cell to be overcharged or abnormal chemical reaction. It causes the generating heat, smoke, rupture .

7.2.4 Don't overcharge, over-discharge, drive nail into the cell, strike it by hammer or tread it.

7.2.5 Don't give cell impact or drop, and not use the cell with conspicuous damage or deformation.

7.2.6 Don't connect cell to the plug socket or car-cigarette-plug. Don't use lithium-ion cell in mixture of different batch or use cell for other equipment.

7.2.7 Do not use or leave the cell under the blazing sun (or in heated car by sunshine), and keep cell away from little children in order to avoid troubles by Swallowing. In case of swallowing the cell, see a doctor immediately.

7.2.8 If the cell gives off an odor, generates heat, becomes discolored, or in any way appears abnormal during use, recharging or storage, immediately remove (Don't touch a abnormal cell directly) it from the device or cell charger and stop using it.

7.2.9 Do not continue to charge cell over specified time. If the cell is not finished charging over regulated time, let it stop charging. There is possibility that the cell might generate heat, smoke, rupture or flame.

7.2.10 Do not get cell into a microwave or a high-pressure container. It causes the generating heat, smoke, rapture or flame because of a sudden heat or damage of sealing condition of cell.

7.2.11 Don't solder the cell directly. Excessive heating may cause deformation of the cell components such as the gasket, which may lead to the cell swelling, leakage, explosion, or ignition.

7.2.12 Do not touch a leaked cell directly or put a leaked cell nearby fire.

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

7. 3 Consultation

7.3.1 If there are problems in this specification, Superpack can consider to change specification after discussion, please contact with us.

7.3.2 For the sake of safety assurance, please discuss the equipment design, its system and protection circuit of Lithium-ion cell with Superpack in advance. And consult about the high rate current, rapid charge and special application in the same way.