Spec. No.	ICR18650-22E	Version No.	0.0

SPECIFICATION OF PRODUCT

for Lithium-ion Rechargeable Cell

Model : ICR18650-22E

November, 2004

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1. Scope

This product specification has been prepared to specify the rechargeable lithium-ion cell

2. Description and Model

2.1 Description Cell (lithium-ion rechargeable cell)

2.2 Model ICR18650-22E

3. Nominal Specifications

Item	Specification
3.1 Nominal Capacity	2200mAh (0.2C, 2.75V discharge)
3.2 Minimum Capacity	2150mAh(0.2C, 2.75V discharge)
3.3 Charging Voltage	4.2 ±0.05 V
3.4 Nominal Voltage	3.7V
3.5 Charging Method	CC-CV (constant voltage with limited current)
3.6 Charging Current	Standard charge: 1100mA Rapid charge : 2200mA
3.7 Charging Time	Standard charge : 3hours Rapid charge : 2.5hours
3.8 Max. Charge Current	2200mA(ambient temperature 25℃)
3.9 Max. Discharge Current	4400mA(ambient temperature 25℃)
3.10 Discharge Cut-off Voltage	2.75V
3.11 Cell Weight	48.0g max
3.12 Cell Dimension	Height : 65.00mm max Diameter : 18.25mm max
3.13 Operating Temperature	Charge : 0 to 45℃ Discharge: -20 to 60℃
3.14 Storage Temperature	1 year : -20~25℃(1*) 3 months : -20~45℃(1*) 1 month : -20~60℃(1*)

Note (1): If the cell is kept as ex-factory status(50% of charge),
the capacity recovery rate is more than 80%.

4. Outline Dimensions

See the attachment(Fig. 1)

5. Appearance

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

6. Standard Test Conditions

6.1 Environmental Conditions

Unless otherwise specified, all tests stated in this specification are conducted at temperature 25±5℃ and humidity 65±20%.

6.2 Measuring Equipment

(1) Ammeter and Voltmeter

The ammeter and voltmeter should have an accuracy of the grade 0.5 or higher.

(2) Slide caliper

The slide caliper should have 0.01 mm scale.

(3) Impedance meter

The impedance meter with AC 1kHz should be used.

7. Characteristics

7.1 Standard Charge

This "Standard Charge" means charging the cell with charge current 1100mA and constant voltage 4.2V at 25℃ for 3hours.

7.2 Standard Discharge Capacity

The standard discharge capacity is the initial discharge capacity of the cell, which is measured with discharge current of 440mA with 2.75V cut-off at 25℃ within 1 hour after the standard charge.

Standard Discharge Capacity ≥ 2150mAh

7.3 Initial internal impedance

Initial internal impedance measured at AC 1kHz after rated charge.

Initial internal impedance ≤ 100mΩ

7.4 Temperature Dependence of Discharge Capacity

Capacity comparison at each temperature, measured with discharge constant current 440mA and 2.75V cut-off after the standard charge is as follows.

Charge Temperature	Discharge temperature			
25℃	-10℃	0℃	23℃	40℃
Relative Capacity	50%	80%	100%	80%

Note: If charge temperature and discharge temperature is not the same,
the interval for temperature change is 3 hours.
Percentage as an index of the capacity at 25℃(=2150mAh) is 100%.

7.5 Temperature Dependence of Charge Capacity

Capacity comparison at each temperature, measured with discharge constant current 440mA and 2.75V cut-off after the standard charge is as follows.

	Charge temperature			Discharge temperature
	0℃	25℃	45℃	25℃
Relative Capacity	80%	100%	80%	

Note: If charge temperature and discharge temperature is not the same,
the interval for temperature change is 3 hours.
Percentage as an index of the capacity at 25℃(=2150mAh) is 100%.

7.6 Charge Rate Capabilities

Discharge capacity is measured with constant current 440mA and 2.75V cut-off after the cell is charged with 4.2V as follows.

	Charge Condition			
Current	0.2C (440mA)	0.5C (1100mA)	1.0C (2200mA)	2.0C (4400mA)
Cut-off	7h or 0.05C	2.5h or 0.05C	2.5h or 0.05C	2.5h or 0.05C
Relative Capacity	100%	95%	90%	80%

Note: Percentage as an index of the capacity at 25℃(=2150mAh) is 100%.

7.7 Discharge Rate Capabilities

Discharge capacity is measured with the various currents in under table and 2.75V cut-off after the standard charge.

	Discharge Condition			
Current	0.2C (440mA)	0.5C (1100mA)	1.0C (2200mA)	2.0C (4400mA)
Relative Capacity	100%	95%	90%	80%

Note: Percentage as an index of the capacity at 25℃(=2150mAh) is 100%.

7.8 Cycle Life

Each cycle is an interval between the charge (charge current 1100mA) with 2.5h or

0.05C cut-off and the discharge (discharge current 1100mA) with 2.75 V cut-off.
Capacity after 299cycles and plus 1 day, measured under the same condition in 7.2

Capacity ≥ 1505mAh(70% of the capacity at 25℃)

7.9 Storage Characteristics

Capacity after storage for 30days at 25℃ from the standard charge, measured with discharge current 1100mA with 2.75V cut-off at 25℃.

Capacity retention(after the storage) ≥ 1720mAh (80% of the capacity at 25℃)

7.10 Status of the cell as of ex-factory

The cell should be shipped in 50% charged state. In this case, OCV is from 3.65V to 3.85V.

8. Mechanical Characteristics

8.1 Drop Test

Test method: Cell(as of shipment or full charged) drop onto the oak-board (thickness: ≥30mm) from 1.5m height at a random direction 6 times.

Criteria: No leakage

8.2 Vibration Test

Test method: Cell(as of shipment) is vibrated along 2 mutually perpendicular axes with total excursion of 1.6mm and with frequency cycling between 10Hz and 55Hz by 1Hz/min.

Criteria: No leakage

9. Safety

9.1 Overcharge Test

Test method: To charge the standard charged cell with 12V and 2.2A at 25℃ for 2.5 hours.

Criteria: No fire, and no explosion.

9.2 External Short-circuit Test

Test method: To short-circuit the standard charged cell by connecting positive and negative terminal by less than 50mΩ wire for 3hours.

Criteria: No fire, and no explosion.

9.3 Reverse Charge Test

Test method: To charge the standard charged cell with charge current 2.2A By –12V for 2.5 hours.

Criteria: No fire, and no explosion.

9.4 Heating Test

Test method: To heat up the standard charged cell at heating rate 5℃ per minute up to

130℃ and keep the cell in oven for 60 minutes.
Criteria: No fire, and no explosion.

10. Warranty

Responsible for replacing the cell against defects or poor workmanship for 3months from the date of shipping. Any other problem caused by malfunction of the equipment or mix-use of the cell is not under this warranty.

The warranty set forth in proper using and handling conditions described above and excludes in the case of a defect which is not related to manufacturing of the cell.

11. Others

11.1 Storage for a long time

If the cell is kept for a long time(3months or more), It is strongly recommended that the cell is preserved at dry and low-temperature.

11.2 Other

Any matters that specifications does not have, should be conferred with between the both parties.

11.3 PTC Specification

	PTC Specification (in the Cell)			
Item	Hold Current	Resistance	Power Dissipation	Resistance After Trip
Spec.	2.7A	9~18mΩ	Max. 2.5W	Max. 33mΩ

12. Outline Dimension

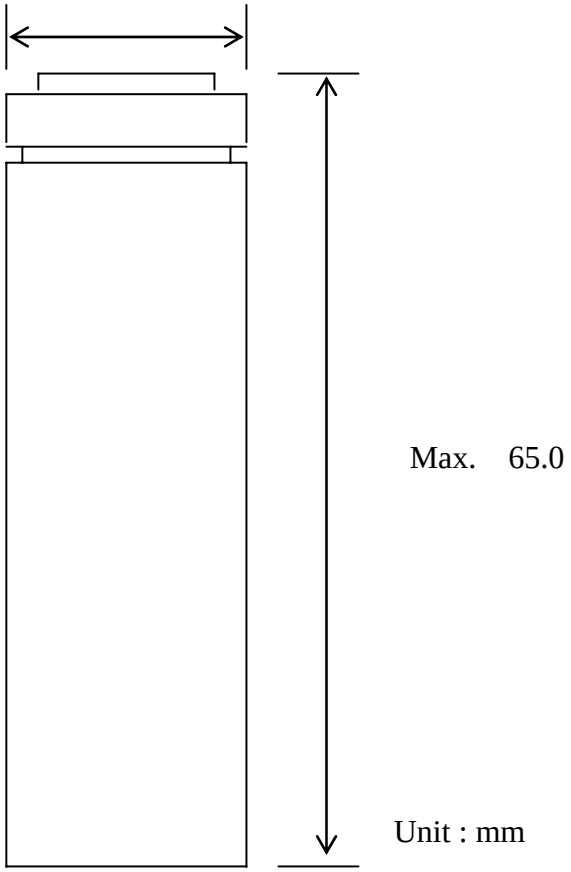

Fig.1. Outline Dimensions of ICR18650-22E

Spec. No.	ICR18650-22E	Version No.	0.0

See before using lithium-ion cell

1. General

This document has been prepared to describe the appropriate cautions and prohibitions, which the customer should take or employ when the customer uses and handles the lithium ion cell to be manufactured and supplied in order to obtain optimum performance and safety.

2. Charging

2.1 Charging current

Charging current should be less than maximum charge current specified in the product specification.

2.2 Charging voltage

Charging should be done by voltage less than that specified in the product specification.

2.3 Charging time

Continuous charging under appropriate voltage does not cause any loss of characteristics. However, the charge timer is recommended to be installed from a safety consideration, which shuts off further charging at time specified in the product specification.

2.4 Charging temperature

The cell should be charged within a range of specified temperatures in the product specification.

2.5 Reverse charging

The cell should be connected, confirming that its poles are correctly aligned. Inverse charging should be strictly prohibited. If the cell is connected improperly, it may be damaged.

3. Discharging

3.1 Discharging

3.1.1 The cell should be discharged at less than maximum discharge current specified in the product specification.

3.2 Discharging temperature

3.2.1 The cell should be discharged within a range of temperatures specified in the product specification.

3.2.2 Otherwise, it may cause loss of characteristics.

3.3 Over-discharging

3.3.1 The system should equip with a device to prevent further discharging exceeding discharging cut-off voltage specified in the product specification.(over-discharging)

3.3.2 Over-discharging may cause loss of performance, characteristics, of battery function.

3.3.3 Over-discharging may occur by self-discharge if the battery is left for a very long time without any use.

3.3.4 The charger should equip with a device to detect cell voltage and to determine recharging procedures.

4. Storage

4.1 Storage conditions

4.1.1 The cell should be stored within a range of temperatures specified in the product specification.

4.1.2 Otherwise, it may cause loss of characteristics, leakage and/or rust.

4.2 Long-term storage

4.2.1 The cell should be used within a short period after charging because long-term storage may cause loss of capacity by self-discharging.

4.2.2. If long-term storage is necessary, the cell should be stored at lower voltage within a range specified in the product specification, because storage at higher voltage may cause loss of characteristics.

5. Cycle life

5.1 Cycle life performance

5.1.1 The cell can be charged/discharged repeatedly up to times specified in the produce specification with a certain level of capacity also specified in the product specification.

5.1.2 Cycle life may be determined by conditions of charging, discharging, operating temperature and/or storage.

6. Design of System

6.1 Connection between the cell and the battery

6.1.1 The cell should not be soldered directly with leads. Namely, the cell should be welded with leads on its terminal and then be soldered with wire or leads to soldered lead.

6.1.2 Otherwise, it may cause damage of component, such as separator and insulator, by heat generation.

6.2 Positioning the battery in the System

6.2.1 The battery should be positioned as possible as far from heat sources

and high temperature components.

6.2.2 Otherwise, it may cause loss of characteristics.

6.3 Mechanical shock protection of the battery

6.3.1 The battery should equip with appropriate shock absorbers in order to minimize shock.

6.3.2 Otherwise, it may cause shape distortion, leakage, heat generation and/or rupture.

6.4 Short-circuit protection of the cell

6.4.1 The cell equips with an insulating sleeve to protect short-circuit which may occur during transportation, battery assembly and /or system operation.

6.4.2 If the cell sleeve is damaged by some cause such as outside impact, it may cause short-circuit with some wiring inside the battery.

6.5 Connection between the battery and charger/system

6.5.1 The battery should be designed to be connected only to the specified charger and system.

6.5.2 A reverse connection of the battery, even in the specified system, should be avoided by employing special battery design such as a special terminals.

7. Battery Pack Assembly

7.1 Prohibition of usage of damaged cell

7.1.1 The cell should be inspected visually before battery assembly.

7.1.2 The cell should not be used if sleeve-damage, can-distorsion and/or electrolyte-smell is detected.

7.2 Terminals handling

7.2.1 Excessive force on the negative terminal should be avoided when external lead is welled.

7.3 Transportation

7.3.1 If the cell is necessary to transported to order place, such as the battery manufacturer, careful precautions should be taken to avoid damage of cell.

8. Others

8.1 Disassembly

8.1.1 The cell should not be dismantled from the battery pack.

8.1.2 Internal short-circuit caused by disassembly may lead to heat generation and/or venting.

8.1.3 When the electrolyte is coming in contact with the skin or eyes, flush immediately with fresh water and seek medical advice.

8.2 Short-circuiting

8.2.1 Short-circuit results in very high current which leads to heat generation.

8.2.3 An appropriate circuitry should be employed to protect accidental short-circuiting.

8.3 Incineration

8.3.1 Incinerating and disposing of the cell in fire are strictly prohibited, because it may cause rupture.

8.4 Immersion

8.4.1 Soaking the cell in water is strictly prohibited, because it may cause melt of components to damaged to functions.

8.5 Mixing use

8.5.1 Different types of cell, or same types but different manufacturer's cell may lead to cell rupture or damage to system due to the different characteristics of cell.

8.6 Battery exchange

8.6.1 Although the cell contains no environmentally hazardous component, such as lead or cadmium. the battery should be disposed according to the local regulations when it is disposed.

8.6.2 The cell should be disposed with a discharged state to avoid heat generation by an inadvertent short-circuit.

8.7 Caution - The Battery used in this device may present a risk of fire or chemical burn if mistreated. Do not disassemble, heat above 100℃ or incinerate.

. Use of another battery may present a risk of fire or explosion.

Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.

Spec. No.	ICR18650-22E	Version No.	0.0

Lithium Ion Rechargeable Batteries

SAFETY INSTRUCTIONS

Please follow the warnings and precautions listed below to avoid possible hazards from the improper use of batteries and to ensure correct and safe use of them. The following notes should be put in an appropriate and effective location in each end-use product and its instruction manual.

Warning

1. Do not short-circuit the battery, as it may generate heat.
   To avoid short-circuiting, do not let the battery come in contact with metal objects at any time, especially when transporting.
2. Do not put the battery into a fire, as it may swell or explode.
   Do not use near any type of heat source. When battery leaks electrolyte or emit a strange smell, discontinue use and move battery away from the heat source.
3. Cover terminals with insulating tape before proper disposal.
4. Do not solder the battery directly. Heat applied during soldering may damage the safety vent in the battery's positive cover.
5. Do not alter or disassemble the battery. Do not take off the battery's cover or jacket.
6. Do not deform the battery by applying pressure. Do not throw, hit or drop the battery. Do not subject the battery to mechanical shocks.
7. Do not submerge the battery in water, or any type of liquid .
   Do not expose the battery to any type of water, such as rain or moisture, as it might heat, corrode, or not function occasionally.
8. Do not connect the battery reversed in positive (+) and negative (-) terminals. Do not charge the battery with polarities reversed, as it may swell or explode.
9. Do not use any chargers that was not specified
   Do not charge the battery under conditions that was not specified as it may leak electrolyte, heat or explode.
10. Do not use the battery with other makers' batteries, different types and.or models of batteries such as dry batteries, nickel-metal hydride batteries, or nickel-cadmium batteries. Do not use old and new Li-ion batteries together, as they might leak electrolyte, heat or explode.
11. Do not mistreat the battery, or use the battery in applications not recommended
12. Contact before using a serial or parallel connection of batteries.
13. Contact before using protection devices (PTC, Bi-metal, Thermal, etc) operated by temperature. If the protection device was attached incorrectly, the battery may heat or explode when the protection devices do not operate properly.
14. Contact when design the protection circuit(PCM).
    If the protection circuit was designed incorrectly, the battery may heat or explode when the protection circuit does not operate properly.
15. Do not let electrolyte come into contact with skin, eyes, or clothing. If contact with skin or eyes occurs, immediately seek help from a doctor.
16. Keep the battery out of reach of babies and children to avoid any accidents.
17. Do not put batteries in a microwave oven or pressure cooker.
18. Although rechargeable, the battery has a limited life-span. Replace when usage time between charges become short.
19. Do not store at or use in temperatures above 60℃.
20. Do not short-circuit the cells when open the carton.
21. If there are any problems of the battery, immediately keep the battery at safe place