MESSRS. XXXXXXXXXX Publication No. **I-055xx**

PRELIMINARY SPECIFICATIONS
FOR
LITHIUM ION RECHARGEABLE CELL
TYPE ; ICP653450AR X/S

March 7, 2005

Received by:

RECHARGEABLE BATTERY DIVISION
HITACHI MAXELL, LTD.

Issued by; _____ Checked by; _____

Approved by; _____

SPECIFICATIONS

1. Scope and Application

1.1 Scope

These specifications apply to the lithium ion rechargeable cells supplied by Hitachi Maxell, Ltd. to XXXXXXXXXX.

1.2 Application

The cells described in these specifications shall be used for a XXXXXXXXXX.

1.3 Cell composition

These cells shall be limited only for the composition of single cell battery or 2 cell battery (2 cell in series).

2. Type and Name

2.1 Name : Lithium Ion Rechargeable Cell
2.2 Item : ICP653450AR

3. Rating

3.1 Nominal Voltage : 3.7 V
3.2 Rated Capacity : 1200 mAh
Typical Capacity : 1250 mAh
Note : When discharged at 240 mA(0.2C) to 2.75 V after standard charge at 25℃
3.3 Charge Conditions
(1) Charge Voltage : 4.20±0.05 V
(2) Maximum Charge Current : 1200 mA (1C)
(3) Charge Method : CC-CV (Constant Current - Constant Voltage)
3.4 Discharge Conditions
(1) Maximum Continuous Discharge Current : 1800 mA (1.5C)
(2) Discharge End Voltage : 2.75 V
3.5 Temperature
(1) Charge : 0 ～ +45℃
(2) Discharge : -20 ～ +60℃
(3) Storage : -20 ～ +50℃ within 30 days (Shipped conditions)
(4) Long term storage : -20 ～ +35℃ within 90 days (Shipped conditions)
3.6 Relative Humidity : 65±20%RH
3.7 Weight : About 24.5 g
3.8 Dimensions : Refer to attached drawing. Drawing No.0443638317
3.9 Appearance : Shall be free from noticeable flaws, breaks, damage, discoloration, deformation, uneven, and other defects which impair the value of the commodity.
3.10 Packing : Refer to attached drawing. TBD.

4. Indication

The manufacture code and origin shall be indicated on the surface of the cell.

5. Required functions for charger, protection circuit and application

To insure the safety, charger and the protection circuit shall be satisfied all the following items. As safety device, please use in combination with the temperature fuse, PTC (Positive Temperature Coefficient), Thermistor, and Thermostat. The standard charging method is CC-CV (Constant Current-Constant Voltage).

5.1 Required functions for charger

No.	Items	Condition	Notes
1	Charging Method	CC-CV	
2	Maximum Charge Current	1200 mA	Per Cell
3	Rated Charge Voltage	4.20 V	Per Cell
4	Maximum Charge Voltage	4.25 V	Per Cell
5	Timer	5 hours Charge	Current: 1200 mA
6	Operating Temperature (Charge)	0～+45 ℃	

5.2 Required protection circuit

No.	Items	Condition	Notes
1	Overvoltage Limit	4.325±0.025 V	Per Cell
2	Charge Enable Voltage	4.20 ±0.05 V	Per Cell
3	Undervoltage Limit	2.20 V～2.75V	Per Cell
4	Discharge Enable Voltage	2.20 V～2.75V	Per Cell
5	Charge Prohibition Voltage	0.4 V or less	Per Cell
6	Overcurrent Limit	3600 mA (3C)	
7	PTC	VTP210 (Raychem Corporation) or PTC with same function	

5.3 Application

No.	Items	Condition	Notes
1	Maximum Continuous Discharge Current	1800 mA(1.5C)	Per Cell
2	Operating Temperature (Discharge)	-20～+60 ℃	

6. Performance and Characteristics

The cell shall satisfy all for Electrical (Table-1), Mechanical (Table-2) and Safety (Table-3) characteristics.

Table-1 Electrical Characteristics

No.	Items	Performances	Conditions	Test Methods
1	Discharge capacity	More than 300 min. discharge (more than 1200 mAh)	Discharge at 240 mA (0.2C)	7.2.6
2	High rate discharge capacity	More than 54 min. discharge (more than 1080 mAh)	Discharge at 1200 mA (1C)	7.2.7
3	Endurance in cycles	More than 210 min. discharge (more than 840 mAh)	After 500 cycles Discharge at 240 mA (0.2C)	7.2.8
4	Discharge capacity at -20℃	More than 150 min. discharge (more than 600 mAh)	Discharge at -20℃, 240 mA (0.2 C)	7.2.9
5	Charge retention	More than 255 min. discharge (more than 1020 mAh)	Stored at 20℃ for 28 days, Discharge at 240 mA (0.2 C)	7.2.10
6	Capacity recovery	More than 270 min. discharge (more than 1080 mAh)	Stored at 20℃ for 28 days, Re-charge, Discharge at 240 mA (0.2 C)	7.2.11
7	Capacity recovery after long term storage	More than 210 min. discharge (more than 840 mAh)	Discharge at 1200 mA (1C) Stored at 40℃ for 90 days, Re-charge, Discharge at 240 mA (0.2 C)	7.2.12
8	Impedance	Less than 70 mΩ	AC 1kHz	7.2.13

Table-2 Mechanical Characteristics

No.	Items	Performances	Test Methods
1	Drop	No failure of appearance and construction More than 276 min. discharge at 240 mA (0.2 C)	7.2.14
2	Vibration	No failure of appearance and construction More than 276 min. discharge at 240 mA (0.2 C)	7.2.15

Table-3 Safety Characteristics

No.	Items	Performances	Conditions	Test Methods
1	Terminal short circuit	No explosion, no fire and no smoke.	Short circuit at 10 mΩ	7.2.16
2	Overcharge	Ditto	Charge at 4.5V, 2 hours	7.2.17
3	Constant resistance over discharge	Ditto	Discharge at 30 Ω (Equivalent to 120 mA(0.1C)) 24 hours	7.2.18
4	High temperature exposure	Ditto	Exposure at 100℃ 5 hours	7.2.19
5	Over voltage forced discharge	Ditto	Charge at -5 V, 2 hours	7.2.20

7. Test

7.1 Test conditions and instruments

7.1.1 Temperature and humidity

Unless otherwise specified, the measurement is executed at a temperature of 25±2℃ and at a relative humidity of 65±20%.

7.1.2 Initial test

Initial test is started within 20 days after delivery.

7.1.3 Measuring instruments and devices

(1) Dimension measurement is carried out using a caliper whose measuring range is from 0 mm to 300 mm and precision is 1/20 mm or more precise.

(2) Voltage measurement is carried out using a DC voltmeter, which can measure from 0 V to 20 V. The precision of the voltmeter is ±1 mV or more precise, and input impedance is more than 10 MΩ.

(3) Discharge is carried out using electronic load equipment. The precision of the current is ±0.5% or more precise.

(4) Impedance is carried out using an LCR meter with 4 terminals at 1 kHz. To eliminate the direct current component, 1 μF of condenser in series to current pole is added.

7.2 Test methods

7.2.1 Appearance

Appearance is judged visually.

7.2.2 Dimensions

The measuring instrument as specified 7.1.3(1) is used. However, the measurement which might cause any short circuit is carried out with insulator inserted.

7.2.3 Complete Charge

In the case of finding the capacity by discharging, the cell is charged at 1200 mA (1C) of constant current and 4.20 V constant voltage for 3 hours. Complete Charge means the state of the cell after completing the charge with these conditions.

7.2.4 Standard Discharge

Standard Discharge means the cell is discharged at 240 mA (0.2C) of constant current until the output voltage reaches 2.75 V.

7.2.5 Fast Discharge

Fast Discharge means the cell is discharged at 1200 mA (1C) of constant current until the output voltage reaches 2.75 V.

7.2.6 Discharge capacity

After Complete Charge, within 1 hour, the duration time of Standard Discharge is measured.

7.2.7 High rate discharge capacity

After Complete Charge, within 1 hour, the duration time of Fast Discharge is measured.

7.2.8 Endurance in cycles

After 499 cycles of Complete Charge and Fast Discharge, Discharge capacity as specified 7.2.6 is measured.

7.2.9 Discharge capacity at -20℃

After Complete Charge at 25±2℃, the duration time of Standard Discharge at -20℃ is measured.

7.2.10 Charge retention

After Complete Charge, the sample cells are stored at 20℃ for 28 days, respectively. After taking them out of a chamber, they are cooled in normal room conditions for more than 1 hour and the duration time of Standard Discharge is measured.

7.2.11 Capacity recovery

After Complete Charge, the samples cells are stored at 20℃ for 28 days, respectively. They taken out of a chamber are cooled in normal room conditions for more than 1 hour, and Standard Discharge. After the discharge, Complete Charge is made again and the duration time of Standard Discharge is measured.

7.2.12 Capacity recovery after long term storage

After Complete Charge, Fast Discharge and then, the sample cells are stored at +40℃ for 90 days. After the storage, they are taken out of a storage chamber and cooled in normal room conditions for more than 1 hour. Complete Charge is made again and the duration time of Standard Discharge is measured.

7.2.13 Impedance

The measurement is carried out in accordance with the item of 7.1.3(4).

7.2.14 Drop

The sample cells are dropped from a height of 1 m onto an oak board, top down, bottom down, and 4 times horizontally down. Appearance of the sample cells is visually examined.

After that, Standard Discharge and then, Complete Charge is made again and the duration time of Standard Discharge is measured.

7.2.15 Vibration

The sample cells is given vibrations of amplitude of 4 mm and a frequency of 16.7 Hz for consecutive 1 hour in an arbitrary direction.

After that, Standard Discharge and then, Complete Charge is made again and the duration time of Standard Discharge is measured.

7.2.16 Terminal short circuit

After Complete Charge, (+) and (-) terminals are connected with 10 mΩof the 4 terminal precision type metal clad resistor by soldering. After 1 hour, all cells being tested are visually examined.

7.2.17 Overcharge

After Complete Charge, the sample cells are charged at 1200 mA(1C) of a constant current and 4.5V of a constant voltage for 2 hours. All cells being tested are visually examined.

7.2.18 Constant resistance over discharge

After Complete Charge, both terminals (+,-) of each cell are connected with a resistor of 30 Ω (equivalent to 120 mA(0.1C)) by soldering. After 24 hours discharge, all cells being tested are visually examined.

7.2.19 High temperature exposure

After Complete Charge, all cells being tested are stored in a chamber of 100℃ for 5 hours. After taking the cells out of the chamber, all the cells are visually examined.

7.2.20 Over voltage forced discharge

After Complete Charge, all cells being tested are reversely charged at a constant current of 2400 mA(2C) and a constant voltage of 5 V for 2 hours. All the cells are visually examined.

8. Cell Capacity at Shipment

The cell capacity at shipment is 30 - 60 % of the full capacity.

9. Prior Notice of Change

In the case specifications, materials, production processes, and control systems for the products are to be changed, Hitachi Maxell, Ltd. will inform notice of the change in writing together with quality and reliability data to the customer in advance. Also, the customer will inform requirement of the change in writing to Hitachi Maxell, Ltd.

10. Product Liability

You are kindly requested to use the cell which is delivered from Hitachi Maxell, Ltd. in strict accordance with the specification and remarks include at the end of this document. Improper usage of the cell, an accident of a fire may occur due to the cell generating heat, catching fire of exploding. Hitachi Maxell, Ltd. shall not be responsible against any accidents occurring due to use outside those written in this specification. Hitachi Maxell, Ltd. shall not be responsible against any accident caused by matters which is not written in this specification.

11. Limited Warranty

(1) Hitachi Maxell Ltd. will be responsible for replacing the cell against defects in workmanship and materials for a period of 1 year from manufacture code that Hitachi Maxell Ltd. can confirm such defects are coming from manufacturing abnormality. Any other problem is not under this limited warranty. The manufacture code is indicated in attached TBD.

(2) Hitachi Maxell, Ltd. makes no warranties against any accidents occurring due to use outside scope and application written in this document.

(3) Hitachi Maxell, Ltd. makes no warranties against any losses or lost earnings incurred by the customer or third parties arising from any usage of the cell.

(4) Hitachi Maxell, Ltd. makes no other warranties expressed or implied except as provided in this limited warranty.

12. Indications on Battery Pack

The following warnings should be indicated on the battery packs.

* Use a specified charger by (the manufacturer).
* Do not throw the battery in fire, or add heat.
* Do not short circuit the battery terminals.
* Do not disassemble, alter, or solder the battery.
* Do not use the battery any purpose other than specified.

13. Notice of the battery pack assembly

The following procedures must be taken note during the battery pack assembly to avoid any damage, burn, and performance failure of the battery. However, Hitachi Maxell, Ltd. will not guarantee against any defects or accident caused by processing method which is not written here.

(1) Storage

The battery contains chemical material. Storage in unsuitable condition (temperature, humidity, etc.) may reduce initial performance (OCV, impedance, capacity, etc.).

- Do not storage the battery in hot and/or humid environment.
- Use the decided packing box.
- Do not storage the battery as fully charge state.
- Do not storage the battery as a load is connected.

(2) Handling

The battery can doubles as a positive or negative terminal. The battery is easily short-circuited, when any metal touch the terminal and can of battery. Short-circuit of the battery may result in heat generation, leakage, or impedance increment.

- Do not short-circuit (+) and (-) of the battery.
- Do not contact batteries mutually.

The battery has the weak spot that made intentionally (the gas release vent). Applied pressure to it and/or terminal of the battery may result in leakage, or impedance increment.

- Do not apply pressure and impact to the battery (particularly, the gas release vent).
- Do not use the battery which was dropped once
- Do not reuse the battery, which was assembled (welding, etc) once and then disassembled.

(3) Resistance welding, Case welding (Ultrasonic welding)

Improper welding condition (abnormal pressure, etc.) may cause damage of the insulator of the battery terminal and crack of the can, resulting in leakage. And damage of the terminal may result in impedance increment.

- Carefully examine welding condition in advance, and carry out it with optimal condition
- Do not apply heavy pressure to the battery.

(4) PCB (Protection Circuit Board) installation

In the case the semiconductor on PCB is damaged, the battery is charged with abnormal current or voltage, resulting in heat generation, explosion, or fire.

- Do not touch the parts on PCB directly.
- Do not treat the PCB without electrostatic protection.
- Do not put the PCB in position received the influence of the accidental leakage.

(5) Soldering

Heat applied during soldering may damage the insulator (resin) of the battery terminal, resulting in leakage, or impedance increment. In the case the parts on PCB is displaced or unfastened, the battery is charged with abnormal current or voltage, resulting in heat generation, explosion, or fire.

- Do not solder the battery directly.
- Do not heat the battery and PCB (except the terminal) during the soldering operation.
- Do not short-circuit terminal-to-terminal and/or other parts of PCB

If you have any question about battery pack assembly, please consult with Hitachi Maxell, Ltd.

The following hazard alarm signals and words must appear in manuals and/or instructions for users, especially at the point of use.

HANDLING INSTRUCTIONS FOR LITHIUM ION RECHARGEABLE BATTERY

Please read and follow the handling instructions for the battery before use. Improper use of the battery may cause heat, fire, explosion, damage or capacity deterioration of the battery. However, the manufacturer will not guarantee against any accident caused by the usage which is not written here.

(When using the battery)

⚠ DANGER
● Do not dip or wet the battery in water, seawater, or other liquid. If the protecting device assembled in the battery is damaged, the battery may be charged with an abnormal current and voltage, which may result in the cause of heat generation, explosion, or fire of the battery.
● The battery has a predetermined polarity. If the battery will not connect well to the charger or equipment, do not try to connect the battery forcefully. Check the polarity first. In the case the battery is connected in reverse, it is charged reversely and may cause acid leakage, heat generation, explosion, or fire due to an abnormal chemical reaction.
● Do not put the battery into a fire or heat it. In such a case, the insulator in the battery may be melted, the gas release vent and protection mechanism may be damaged, all of which may cause heat generation, explosion, or fire.
● Do not connect the battery reversed in positive (+) and negative (-) terminals in the charger or equipment. In the case the battery is connected in reverse, it is charged reversely during charge, and causes an excessive current during discharge, and may cause heat generation, explosion, or fire due to an abnormal chemical reaction.
● Do not let the battery terminals (+ and -) contact a wire or any metal (like a metal necklace or a hairpin) with which it carried or stored together. In such a case, the battery is shorted and causes an excessive current, which may result in heat generation, explosion, or fire.
● Do not apply heavy impact to the battery, or throw or drop it. Strong impact may damage the protecting device, which may result in heat generation, explosion, or fire of the battery.
● Do not drive a nail in, hit with a hammer, or stamp on the battery. In such a case, the battery may be deformed and shorted, and the protecting device may be damaged, which may cause heat generation, explosion, or fire of the battery.
● Do not solder the battery directly. Heat applied during soldering may damage the insulator or the gas release vent and protection mechanism, which may result in acid leakage, heat generation, explosion, or fire of the battery.
● Do not disassemble or alter the battery. The battery contains the protection mechanism and protection device in order to avoid any danger. If these are damaged, heat, explosion or fire may be caused.
● Charge the battery every 6 months to the amount specified by the manufacturer, even if the battery is not used. An excessive over-discharge may cause an abnormal chemical reaction, which may result in the cause of acid leakage, or fire of the battery.

⚠ WARNING
● Do not place or leave the battery and equipment in the reach of infants. Improper use of the battery may cause danger.

⚠ WARNING
● Do not put the battery in a microwave oven or a pressure cooker. Sudden heat may damage the seal of the battery and may cause heat generation, explosion, or fire of the battery.
● Do not use the battery together with a dry battery or other primary battery or other battery of a different capacity, types and / or brand. In such a case, over-discharge during use, or over-charge during charge may occur and abnormal chemical reactions may cause heat generation, explosion, or fire of the battery.
● If you notice any bad odor, heating, discoloration, deformation, or any other change from what your are used to while using, charging, storing the battery, take it out of equipment or charger, and avoid using it. Using it in such state may result in heat generation, explosion, or fire.
● If the battery leaks or emits a bad odor, take it away from any fire immediately. The electrolyte may catch fire, which may cause heat generation, explosion, or fire.
● Do not let leaked electrolyte come into contact with eyes. In such a case, immediately wash the area of contact with clean water and seek help from a doctor. If not treated soon, prolonged contact may cause serious injury.

⚠ CAUTION
● Do not use or leave the battery in a place exposed to strong direct sunlight, or in a car under the blazing sun, or high temperature sources. Such a high temperature may cause acid leakage.
● If you find the battery rusty, bad odor, heating, or any other defective before using the battery for the first time after purchase, do not use it. Take it back to the dealer instead.
● In case young children use the battery, instruct them on the contents of the instructions and ensure the battery is correctly used by them at all times.
● If the battery leaks and its electrolyte contact with skin or clothes, wash it well with tap water or other clean water right away. Leaving it, it is may cause a rash on skin.
● If you have any question regarding the battery, contact the following place. Keep the handling instructions and your equipment instructions in a suitable place for future reference Contact address : Phone : Fax :
● Read the instructions of your equipment regarding the battery installation and removal from the equipment so as not to mishandle and waste the battery.
● The battery was charged a little before shipment for temporary use by an end user. In case your equipment does not operate with the battery or in the case of a long use, charge the battery with a specified charger once.
● Carerfully read the instructions of your equipment before use.
● When the battery is expected not to be used for a long time, take the battery out of the equipment and store it in a less humid area
● Turn off your equipment power switch after use
● In the case the battery terminals are dirty, clean the terminals with a dry cloth before use, otherwise, the contact with equipment might cause insufficiency, and power failure or charge failure
● Despite being rechargeable, the battery has a limited life span. Replace it, when usage time becomes short.
● As for a used battery, please recycle, after covering the battery terminals (+ and -) with a insulation tape or inserting it to individual poly-bag.

(When charging the battery)

⚠ DANGER
● Do not use any battery charger not specified by (manufacturer's name), also, follow the charge conditions specified by (manufacturer's name) If the battery is charged under other conditions (a high temperature, a high voltage / current, or an altered charger) not specified by (manufacturer's name), the battery may cause heat generation, explosion, or fire with abnormal chemical reactions.
● Do not connect the battery directly to an electric outlet or cigarette heater socket in a car. Applying a high voltage may generate an excessive current, and get an electric shock. In such a case, the battery may leak electrolyte, overheat, explode, or cause fire.
● Do not charge the battery near fire or in a car under the blazing sun. Such a high temperature may cause damage of the protecting device in the battery, which may result in heat generation, explosion, or fire.

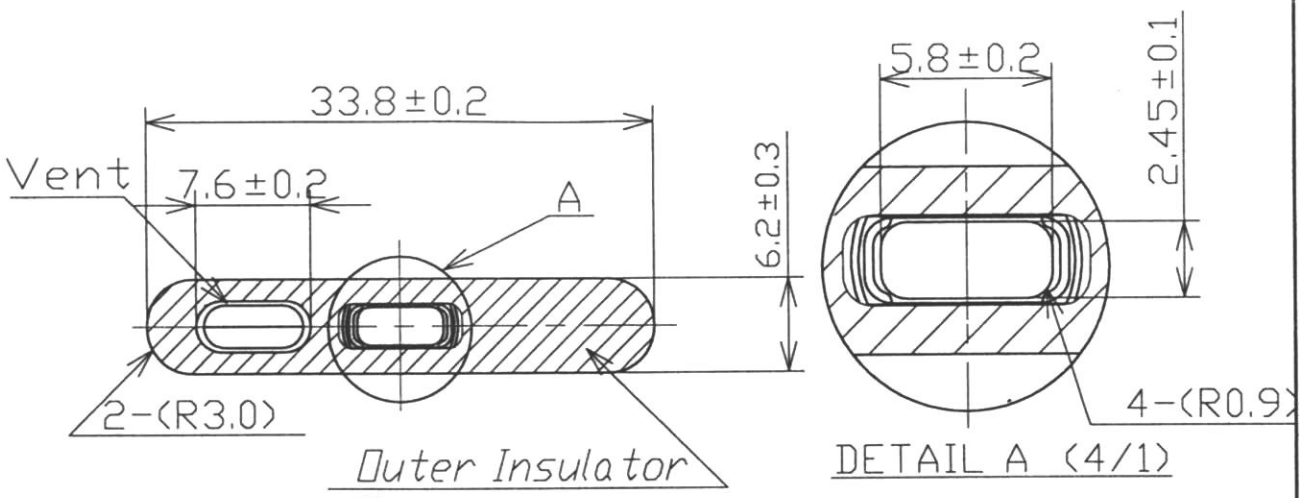
⚠ WARNING
● Discontinue charging after specified charging time even if the charge is not complete. Otherwise, the battery might cause heat generation, explosion, or fire.

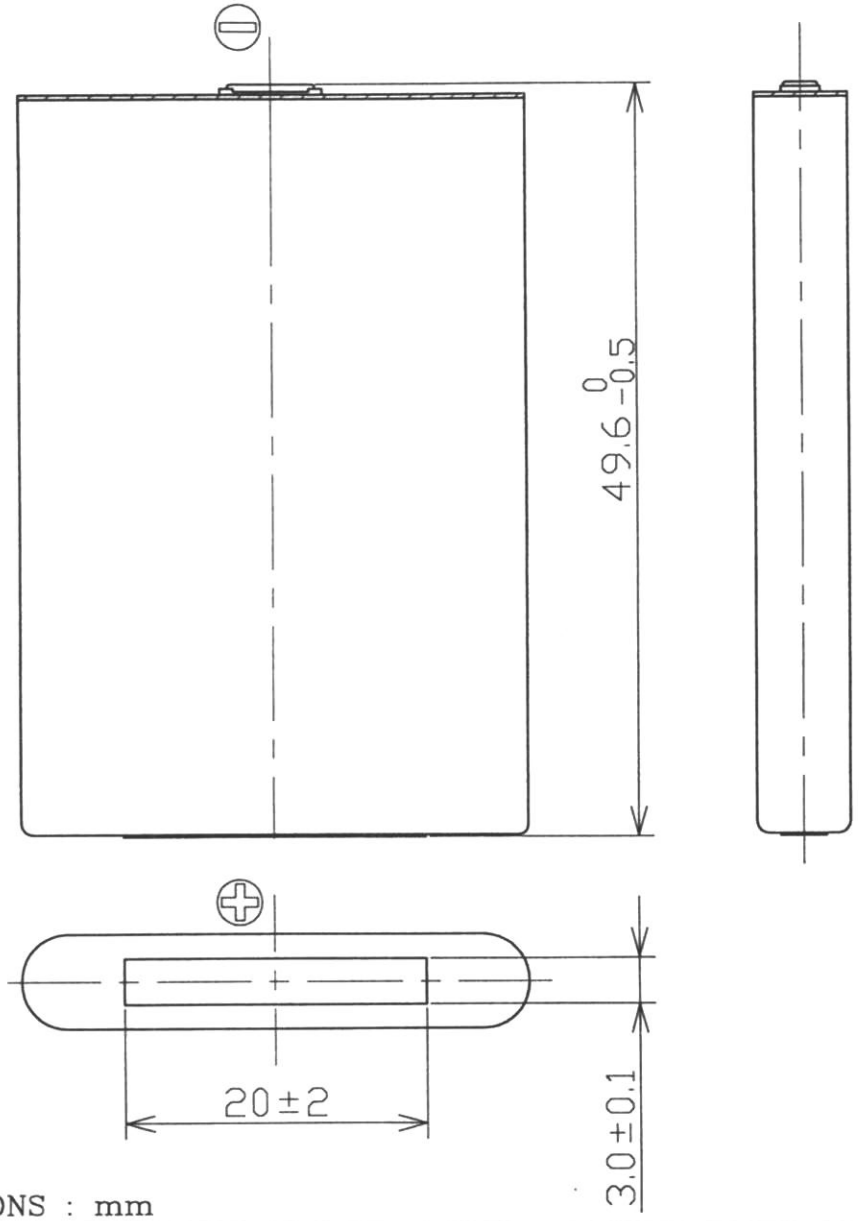
⚠ CAUTION
● Do not use the battery in other than the following conditions. Otherwise, the battery might cause heat generation, damage. Charge: 0℃ ～ +45℃
● Carerfully read the instructions for the specified charger to learn how to charage the batery.
● Do not charge the battery over the specified time described in the instructions.

(When discharging the battery)

⚠ DANGER
● Do not use or leave the battery in a place near fire, heaters, or high temperature sources. Such a high temperature may cause heat generation, explosion, or fire.
● Do not use the battery with any equipment other than specified. Any such practice may expose some types of equipment to an abnormal current, which may result in heat generation, explosion, or fire.

⚠ CAUTION
● Do not use the battery in the place where the static electricity (more than the limit of the manufacturer's guarantee) occurs. Otherwise, the protecting device in the battery might be damaged and cause heat generation, explosion, or fire.
● Do not use the battery in other than the following conditions Discharge : -20℃ ～ +60℃ Store (less than a month) : -20℃ ～ +50℃ (on the charge of 50 %) Store (more than a month) : -20℃ ～ +35℃ (on the charge of 50 %)





DIMENSIONS : mm

	PROJECTION	SCALE	TITLE	SH.
		2/1	ICP653450AR	—

REGD.	DWN.	K. Urano	Feb. 02. 05	Hitachi Maxell,Ltd Kyoto Japan	KYOTO WORKS DWG. No. 04363638317
	CHKD.	Y. Shimakawa	Feb. 02. 05		REV.
	APPD.	Y. Shimakawa	Feb. 02. 05		