

Lithium-ion Rechargeable Battery

Secondary Battery



LITHIUM-ION RECHARGEABLE BATTERY

Notes for Designers

Select the correct type of battery to match the operating conditions such as load current, etc.

- The information in this section is for lithium-ion cells only. Maxell offers these cells (excluding CLB) in battery pack format only. These include electronic circuits to prevent overcharge, overdischarge and so on. These battery packs are custom-developed and produced according to special requirements regarding operating conditions and specifications. As a result, a minimum number of units may apply to such customized orders from customers purchasing battery packs. For details, consult your nearest Maxell dealer or distributor.

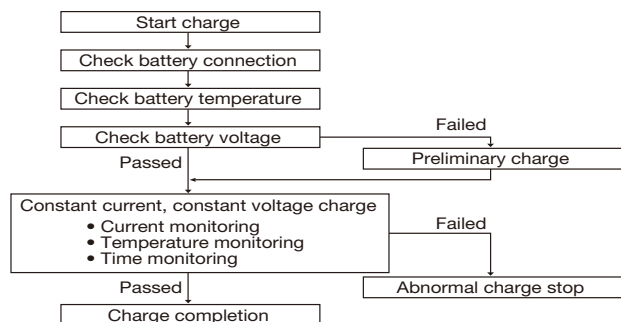
Charge conditions

To get the most out of lithium-ion batteries and use them safely, please read the following requirements carefully:

Charge mode	Constant current, constant voltage charge (CCCV)
Charge voltage	4.20±0.05V / cell, 4.35±0.05V / cell
Max. charge current	1I _A
Charge temperature	0 to +45 deg. C

Charge control flowchart (sample)

Refer to the following flowchart when designing constant current and constant voltage battery chargers.



Safety Instructions

Improper use of the battery may cause heat, fire, explosion, damage or reduced battery capacity. Please read and follow the handling instructions for the battery before and during usage. The followings are general cautions and guidelines only and as such may not include every possible usage scenario. The manufacturer will not be liable for actions taken or accidents caused.

Danger

- Do not dip or wet the battery in water, seawater, or other liquid. Otherwise the battery may be shorted, which may generate heat or cause damage.
- Do not put the battery into a fire. Otherwise, the electrolyte may burn or cause an explosion.
- Do not heat the battery. Otherwise the electrolyte may boil and resin parts may melt, causing leakage, explosion or fire.
- 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. If the battery is connected in reverse, it will be charged in reverse and may cause leakage, heat generation, explosion or fire due to an abnormal chemical reaction.
- Do not connect the battery in reverse relation to the positive (+) and negative (–) terminals in the charger or equipment. If the battery is connected in reverse, it will be charged in reverse, discharge excessive current and may cause heat generation, explosion or fire due to an abnormal chemical reaction.
- Do not let the battery terminals (+ and –) come into contact with a wire or any metal (like a metal necklace or a hairpin) with which it is carried or stored. In such a case, the battery will be shorted and discharge excessive current, which may result in heat generation, explosion or fire.
- Do not apply any heavy impact to the battery, throw or drop it. Otherwise the battery may be shorted and result in heat generation, explosion or fire.

- Do not drive a nail into, hammer or stamp on the battery. Otherwise the battery may be shorted and result in heat generation, explosion or fire.
- Do not solder the battery directly. Heat applied during soldering may melt resin parts such as separator or gasket, and result in leakage, heat generation, explosion or fire.
- Do not disassemble or alter the battery. Otherwise the battery may be shorted and result in heat generation or fire.
- Do not use or leave the battery near fire, heaters, inside an automobile in hot weather or under strong sunshine. Such conditions of high temperature may damage the separator, and the battery may be shorted and result in heat generation, explosion or fire.
- When charging the battery, do not use any battery charger not specified by the manufacturer. Always follow the charge conditions specified by the manufacturer. If the battery is charged under other conditions (a high temperature, a high voltage/current or an altered charger) not specified by the manufacturer, the battery may cause heat generation, explosion or fire due to abnormal chemical reactions.
- Do not connect the battery directly to an electric outlet or cigarette lighter socket in a car. Applying a high voltage may generate an excessive current and cause an electric shock. In such a case, the battery may leak electrolyte, overheat, explode or cause fire.

Warnings

- 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.
- Do not use the battery together with a primary battery such as a dry battery or other battery of a different capacity, type and/or brand. In such a case, over-discharge during use or over-charge during charging may occur and abnormal chemical reactions may cause heat generation, explosion or fire from the battery.
- If you notice any unusual odor, heat, discoloration, deformation or any other characteristic apart from what you are used to while using, charging or storing the battery, then take it out of the 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 an unusual odor, remove it from the vicinity of any fire immediately. The electrolyte may catch fire, which may cause heat generation or explosion.
- Do not let leaked electrolyte come into contact with the eyes. In the event of such contact, flush the eyes with plenty of water immediately and consult a doctor. Otherwise prolonged contact may cause serious injury.

Caution

- If the battery leaks and its electrolyte comes into contact with skin or clothes, wash the contact area well with tap water or other clean water right away. Otherwise skin may break out in a rash.
- When the battery is expected not to be used for a long time, take the battery out of the equipment or device and store it in a less humid area.
- After long periods of storage without being used, the battery should be charged before it is used. Charge the battery every 6 months to the level specified by the manufacturer, even if the battery is not used.
- Do not leave the battery pack connected to the charger. It may cause the degradation of battery performance, such as a shortening of battery life.
- Turn off your equipment or device power switch after use.
- Do not use the battery in other than the following temperature ranges:

Charge	0 deg. C to +45 deg. C
Discharge	-20 deg. C to +60 deg. C
Storage (less than 30 days)	-20 deg. C to +50 deg. C
Storage (less than 90 days)	-20 deg. C to +35 deg. C

Notes for treating used batteries

- Insulate (+) and (-) terminals with tape.
- Do not remove coating.
- Do not expose to rain or water.
- Do not disassemble.
- Do not leave under strong sunshine.
- Store in rugged receptacle and cover with a lid.



Features

■ Thin battery with high capacity

Maxell's original technologies, such as electrode technology, have realized thin batteries with high capacity that can be used in compact high-performance mobile devices.

■ Stable discharge under various temperature conditions

Lithium-ion batteries provide stable discharge within a wide range of temperatures, between -20 deg. C and 60 deg. C.

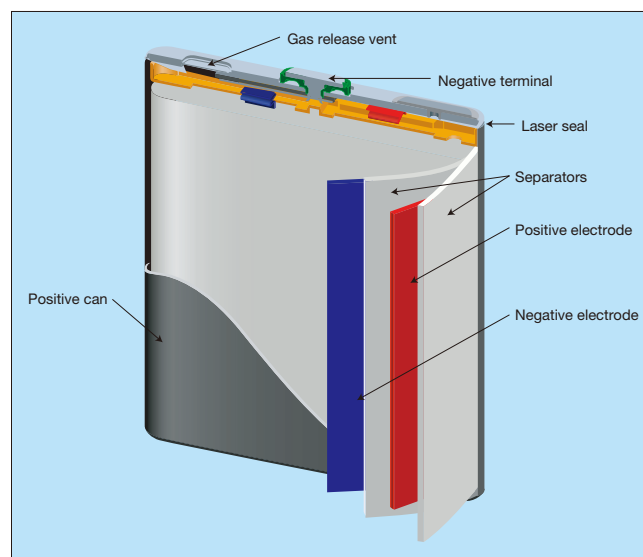
■ Excellent cost performance

Superior recharging properties ensure a service life of about 500 charge/discharge cycles under normal usage conditions. The superior cost/performance ratio ensures that lithium-ion batteries are ultimately more economical than primary batteries.

■ Higher energy density and an operating voltage of over 3.7V

A lithium-ion battery delivers and maintains a stable operating voltage of over 3.7V until final discharge — three times as much voltage as an Ni-Cd or Ni-MH battery provides. Therefore, it takes only one-third as many lithium-ion batteries to provide the equivalent amount of voltage as Ni-Cd or Ni-MH batteries provide. This means that portable devices can be made much smaller and lighter.

Cell Structure

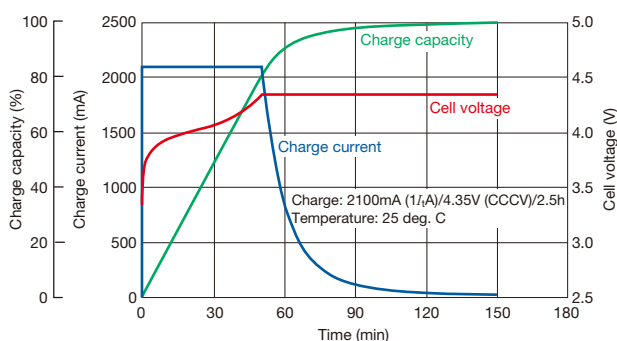


Applications

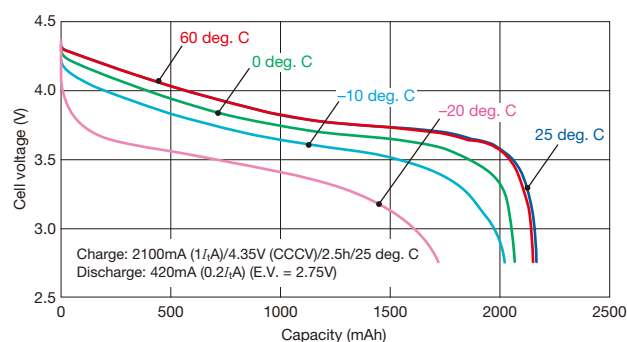
- Mobile phones, Smartphones
- Portable game devices
- Electronic books
- Electronic dictionaries
- Digital still cameras
- Digital audio players, etc.

Characteristics (ICP565156HR)

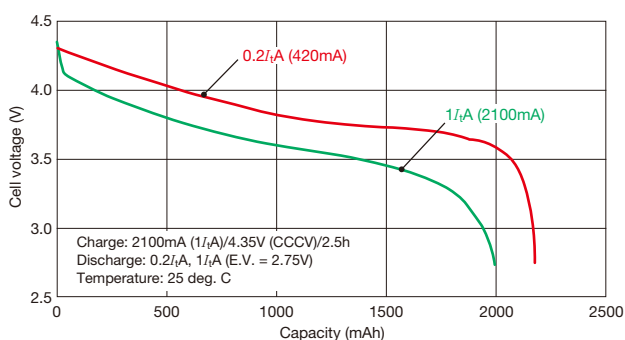
■ Charge characteristics



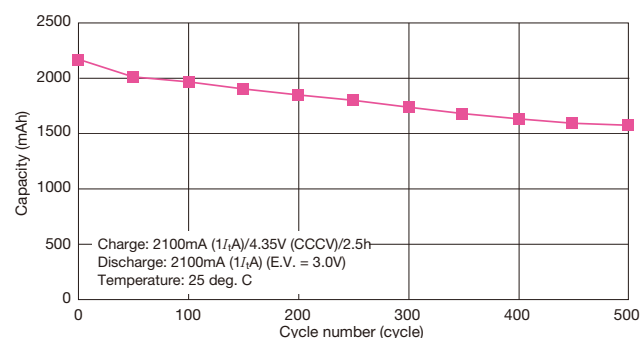
■ Discharge temperature characteristics



■ Discharge load characteristics



■ Cycle life characteristics



Products

Model ^{*1}		ICP404251XR	ICP405362HR	ICP463450AR	ICP494261SRU	ICP514657HSU
Dimensions (mm) ^{*2}	Thickness	3.85±0.1	3.78±0.15	4.4±0.2	4.7±0.2	4.85±0.15
	Width	41.8±0.2	52.8±0.1	33.8±0.2	41.8±0.2	46.05±0.15
	Height	50.8+0/-0.5 ^{*5}	62+0/-0.4 ^{*5}	49.6+0/-0.5	61.0+0/-0.5 ^{*5}	56.5+0/-0.5 ^{*5}
Weight (g) ^{*3}		20	31	18	29	31
Charge (CCCV)	Max. voltage (V)	4.2	4.35	4.2	4.2	4.35
	Max. current (A)	1.02	1.70	0.92	1.50	1.80
Discharge (CC)	End voltage (V)	2.75	2.75	2.75	2.75	2.75
	Max. current (A)	1.53	2.550	1.380	2.250	2.700
End voltage (V)		3.7	3.8	3.7	3.7	3.8
Minimum capacity (mAh) ^{*4}		1020	1700	920	1500	1800

Model ^{*1}		ICP515161HR	ICP565156HR	ICP653450AR	ICP653850XRU	ICP704546HRU
Dimensions (mm) ^{*2}	Thickness	4.85±0.15	5.3+0.1/-0.15	6.2±0.3	6.2±0.3	6.7±0.2
	Width	50.3±0.1	50.3±0.1	33.8±0.2	37.8±0.2	44.6±0.1
	Height	60.5+0/-0.4 ^{*5}	55.5+0/-0.4 ^{*5}	49.6+0/-0.5	50.0+0/-0.5	46.3+0/-0.3 ^{*5}
Weight (g) ^{*3}		35	35	24	28	33
Charge (CCCV)	Max. voltage (V)	4.35	4.35	4.2	4.2	4.35
	Max. current (A)	2.10	2.10	1.20	1.50	1.96
Discharge (CC)	End voltage (V)	2.75	2.75	2.75	2.75	2.75
	Max. current (A)	3.15	3.15	1.80	2.25	2.94
End voltage (V)		3.8	3.8	3.7	3.7	3.8
Minimum capacity (mAh) ^{*4}		2100	2100	1200	1500	1960

*1 "U" indicates that the cell has an upper positive terminal.

*2 Dimensions of fresh cell without tube

*3 Approximate values

*4 Measured under the following conditions: Charge CCCV: 1I_t/4.2V/3h, Discharge CC: 0.2I_t/E.V. = 2.75V, Temperature: 25 deg. C

*5 No positive terminal plate on the cell bottom







- Characteristics listed in this catalog are standard measured examples. Maxell does not guarantee these data.
- Specifications are subject to change without notice.
- This data is for lithium-ion cells only. Maxell offers these cells in battery pack format only. These include electronic circuits to prevent overcharge, over discharge and so on. These battery packs are custom-developed and produced according to special requirements regarding operating conditions and specifications. As a result, a minimum number of units may apply to such customized orders from customers purchasing battery packs.

Dangerous Goods Transportation Regulations for Lithium Cells and Batteries

Some transportation regulations have been recently revised and will come into effect after Jan. 1, 2013. Revised UN recommendations require cells and batteries to be manufactured under a quality management program. This requirement has been incorporated into the IMDG Code and ICAO TI/IATA DRG. Maxell factories have been certified for ISO 9001 and therefore meet this requirement.

- 1) Transportation except by air: Actual operation is the same as before. (see ref.)
- 2) Air transportation: Former packing instructions 965 and 968 have been divided into Section I (class 9 dangerous goods) and Section II (exempt from class 9 dangerous goods). The revised packing instructions consist of Section IA, Section IB and Section II. Section IA (class 9 dangerous goods) is almost the same as the former Section I. Former Section II is divided into Section IB (class 9 dangerous goods) and Section II (exempt from class 9 dangerous goods). The new Section IB covers items that were formerly exempted from regulation but which must be shipped as class 9 dangerous goods from 2013. A summary is shown in the following table. Please use updated IATA regulations (54th edition and later) to confirm details.

Technical Instructions for lithium metal batteries (PI 968)





Section		Section II		Section IB	Section IA
Lithium Metal Content		Cell: ≤ 0.3 g Battery: ≤ 0.3 g	Cell: ≤ 1.0 g Battery: ≤ 2.0 g	Cell: ≤ 1.0 g Battery: ≤ 2.0 g	Cell: > 1.0 g Battery: > 2.0 g
Package Limits	Quantity	N/A	≤ 2 batteries or ≤ 8 cells	> 2 batteries or > 8 cells	N/A
	Weight	2.5 kg net weight	N/A	2.5 kg gross weight Passenger and cargo aircraft	2.5 kg net weight (Pass.) 35 kg net weight (Cargo)
Classification		Exempted		Class 9	
Packaging		1.2 M drop test			UN performance packaging
Labels		 Note 1)	 Note 2)	  Note 3)	  Note 3)
Documents		Invoice (Air Waybill) Additional document		Air Waybill Additional document	Declaration for DG Air Waybill
Training		Adequate instructions		DG training	

Note 1): Handling label Note 2): Class 9 hazardous label

Note 3): Cargo aircraft only label 1) For USA: Label is required for Section IB or Section IA.

2) Not for USA: Label is required for Section IA and over 2.5 kg of packing weight.

Technical Instructions for lithium ion batteries (PI965)

Section		Section II		Section IB	Section IA
Watt Hour Rating		Cell: ≤ 2.7 Wh Battery: ≤ 2.7 Wh	Cell: ≤ 20 Wh Battery: ≤ 100 Wh	Cell: ≤ 20 Wh Battery: ≤ 100 Wh	Cell: > 20 Wh Battery: > 100 Wh
Package Limits	Quantity	N/A	≤ 2 batteries or ≤ 8 cells	> 2 batteries or > 8 cells	N/A
	Weight	2.5 kg net weight	N/A	10 kg gross weight Passenger and cargo aircraft	5 kg net weight (Pass.) 35 kg net weight (Cargo)
Classification		Exempted		Class 9	
Packaging		1.2 M drop test			UN performance packaging
Labels		 Note 1)	 Note 2)	  Note 4)	
Documents		Invoice (Air Waybill) Additional document		Air Waybill Additional document	Declaration for DG Air Waybill
Training		Adequate instructions		DG training	

Note 4): Cargo aircraft only label: Label is required for Section IA and over 2.5 kg of packing weight.

(Ref.)

Except air transportation, the necessary requirements to transport lithium metal batteries or lithium ion batteries as exempted from class 9 dangerous goods (non-restricted goods) are as follows;

1. The minimum requirements to transport lithium metal batteries;

- 1) For a lithium metal or a lithium alloy cell, the lithium content must not be more than 1 g. For a lithium metal or lithium alloy battery, the aggregate lithium content must not be more than 2 g.
- 2) Each cell or battery must be of the type proven to meet the requirement of each test in the UN Manual of Tests and Criteria, 5th revised edition, Part III, sub-section 38.3.
- 3) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
- 4) Each consignment must be accompanied by a document for transport with an indication that:
the package contains lithium metal cells or batteries;
the package must be handled with care and that a flammability hazard exists if the package is damaged;
special procedure should be followed in the event that the package is damaged, to include inspection and repackaging if necessary;
and a telephone number for additional information.
- 5) Each package must be capable of withstanding a 1.2 m drop test.

2. The minimum requirements to transport lithium ion batteries;

- 1) For lithium ion cells, the Watt-hour rating is not more than 20 Wh. For lithium ion batteries, the Watt-hour rating is not more than 100 Wh. The Watt-hour rating must be marked on the outside of the battery case except for batteries manufactured before January 1, 2009.
- 2) Each cell or battery is of the type proven to meet the requirement of each test in the UN Manual of Tests and Criteria, 5th revised edition, Part III, sub-section 38.3.
- 3) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
- 4) Each consignment must be accompanied by a document for transport with an indication that:
the package contains lithium ion cells or batteries;
the package must be handled with care and that a flammability hazard exists if the package is damaged;
special procedure should be followed in the event the package is damaged, to include inspection and repackaging if necessary; and
a telephone number for additional information.
- 5) Each package must be capable of withstanding a 1.2 m drop test.

Maxell will provide certificates for 1) and 2) as the need arises. Documentation for 3) and 4) needs to be prepared by the customer. If our package is used for transport, Maxell will provide the certificate for 5) as the need arises. However, if the customer's package is used, the customer must confirm the package can withstand a 1.2 m drop test. Furthermore, even if our package is used for transport, the telephone number printed on the label must be changed to that of the sender (customer).

Certified Management Systems (Japan)

ISO 14001

The Maxell group has been certified for the ISO14001 Environmental Management System and has made efforts to reduce environmental impacts throughout the product lifecycle.



ISO14001
Hitachi Maxell, Ltd.
Certificate No.: EC97J1148
Registration Date: December 24, 1997
Recertification Date: December 15, 2011
Certificate Expiry: December 14, 2014
Scope of Registration: Development, design, manufacture, sales and related services of information media, batteries, parts, devices and electronic appliances

ISO9001



ISO9001
HITACHI MAXELL, LTD.
ENERGY DIVISION
MICRO BATTERY DEPARTMENT
Certificate Number: JQA-0986
Registration Date: September 29, 1995
Last Renewal Date: December 19, 2012
Expiry Date: December 18, 2015

Scope of Registration: The design/development and the manufacture of cylindrical alkaline battery, silver oxide battery, alkaline button battery, manganese dioxide lithium battery (coin type and cylindrical type), thionyl chloride lithium battery, manganese dioxide lithium rechargeable battery, titanium carbon lithium rechargeable battery and coin type lithium rechargeable battery.



ISO9001
HITACHI MAXELL, LTD.
ENERGY DIVISION
LITHIUM ION BATTERY DEPARTMENT
Certificate Number: JQA-3029
Registration Date: January 29, 1999
Last Renewal Date: December 27, 2011
Expiry Date: December 26, 2014

Scope of Registration:
• The design/development and manufacture of lithium-ion rechargeable battery.
• The design/development and manufacture (outsources) of lithium-ion rechargeable battery.

ISO/TS 16949



JQA-AU0078

ISO/TS16949
HITACHI MAXELL, LTD.
ENERGY DIVISION
MICRO BATTERY DEPARTMENT
ONO WORKS
Certificate Number: JQA-AU0078
Registration Date: January 7, 2005
Last Renewal Date: January 7, 2011
Expiry Date: January 6, 2014

Remote Supporting Functions: MAXELL EUROPE LTD.
MAXELL CORPORATION OF AMERICA

Scope of Registration: The design/development and manufacture of manganese dioxide lithium batteries (coin type) for automobile use.



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