

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.

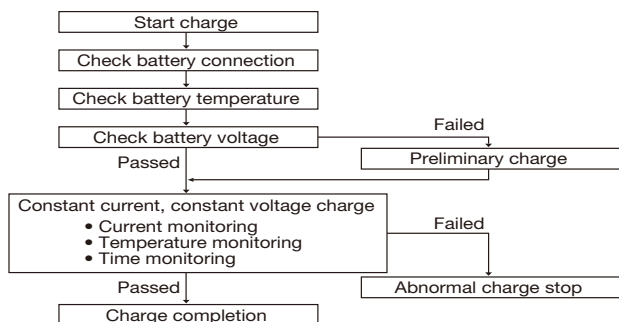
Charge conditions

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, 4.40±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.

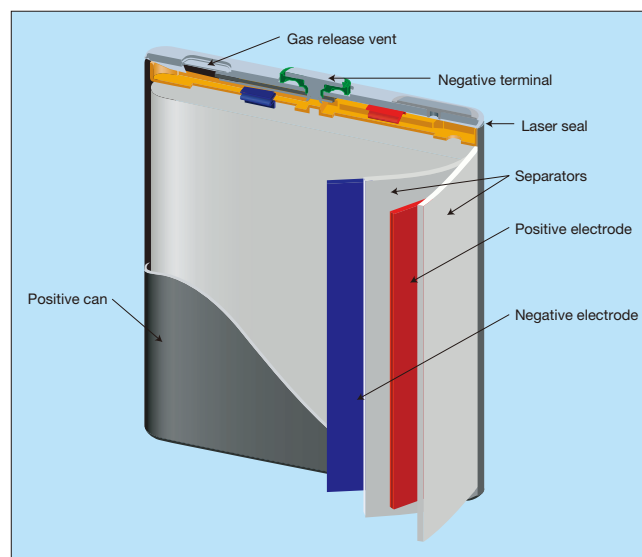
■ Excellent cost performance

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

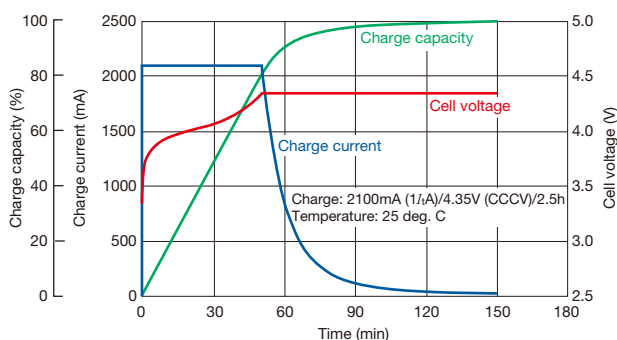


Applications

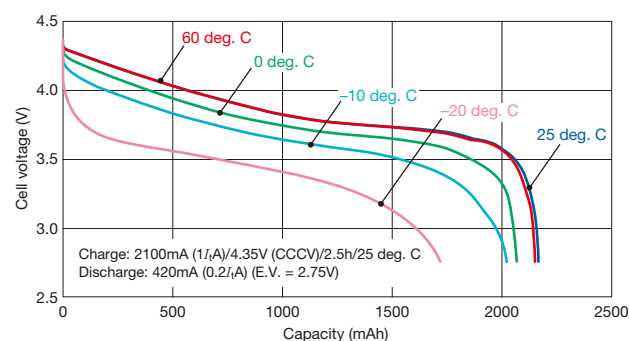
- Mobile phones, Smartphones
- Portable game devices
- Electronic books
- Electronic dictionaries
- Digital still cameras
- Digital audio players, etc.

Characteristics (ICP515161HR)

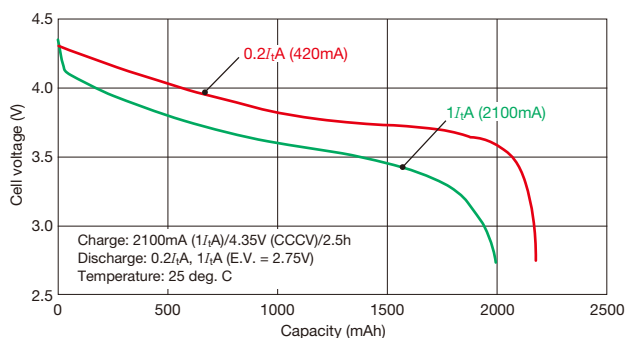
■ Charge characteristics



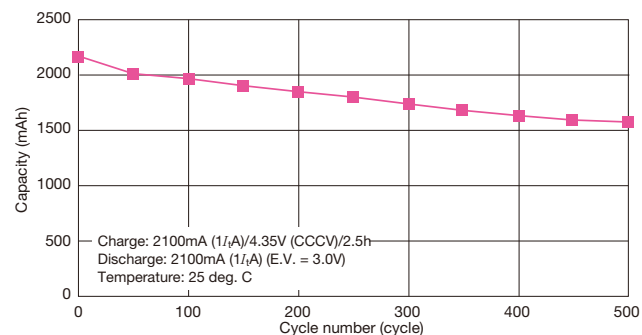
■ Discharge temperature characteristics



■ Discharge load characteristics



■ Cycle life characteristics



Products

Model ^{*1}		ICP382230AQS	ICP404251XR	ICP446584AHR	ICP463450AR	ICP494261SRU
Dimensions (mm) ^{*2}	Thickness	3.65±0.15	3.9±0.2	4.15±0.15	4.4±0.2	4.7±0.2
	Width	21.9±0.15	41.8±0.2	64.8±0.2	33.8±0.2	41.8±0.2
	Height	30.0+0/-0.4	50.8+0/-0.5	83.5+0/-0.5	49.6+0/-0.5	61.0+0/-0.5 ^{*5}
Weight (g) ^{*3}		6	19	54	18	29
Charge (CCCV)	Max. voltage (V)	4.35	4.20	4.35	4.20	4.20
	Max. current (A)	0.40	1.02	3.20	0.92	1.50
Discharge (CC)	End voltage (V)	2.75	2.75	2.75	2.75	2.75
	Max. current (A)	0.50	1.53	4.80	1.38	2.25
Nominal voltage (V)		3.8	3.7	3.8	3.7	3.7
Minimum capacity (mAh) ^{*4}		250	1020	3200	920	1500

Model ^{*1}		ICP515161HR	ICP535154WR	ICP653450AR	ICP704546HRU	ICP103444AHRU
Dimensions (mm) ^{*2}	Thickness	4.9±0.3	5.0±0.25	6.2±0.3	6.7±0.3	9.7±0.3
	Width	50.3±0.2	50.85±0.2	33.8±0.2	44.6±0.2	33.6±0.2
	Height	60.5+0/-0.5	54.1+0/-0.5	49.6+0/-0.5	46.5+0/-0.5	44.0+0/-0.5
Weight (g) ^{*3}		36	33	24	35	32
Charge (CCCV)	Max. voltage (V)	4.35	4.40	4.20	4.35	4.35
	Max. current (A)	2.10	2.00	1.20	1.96	1.85
Discharge (CC)	End voltage (V)	2.75	2.75	2.75	2.75	2.75
	Max. current (A)	3.15	3.00	1.80	2.94	2.78
Nominal voltage (V)		3.8	3.85	3.7	3.8	3.8
Minimum capacity (mAh) ^{*4}		2100	2000	1200	1960	1850

*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/A/4.20V-4.40V/3h, Discharge CC: 0.2I/A/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.
- For further details, please contact your nearest Maxell dealer or distributor.

Visit our website for more information

<http://biz.maxell.com/en/>

Go to: Products > Rechargeable Batteries > Prismatic Lithium-ion Rechargeable Battery

Dangerous Goods Transportation Regulations for Lithium Cells and Batteries

Some transportation regulations have been recently revised and will come into effect after Jan. 1, 2015. The summary is shown in the following table. Please use updated Dangerous Goods Regulations listed in Normative Reference to confirm details.








■ The major revisions for air transport of lithium cells and batteries

(1) Lithium metal cells and batteries transported as cargo will be restricted to cargo aircraft only.

Note. The prohibition does not apply to lithium metal batteries packed with equipment (PI 969) or contained in equipment (PI 970).

(2) Gross mass will change to net quantity for both lithium ion cells and batteries (PI 965 Section IB) and lithium metal cells and batteries (PI 968 Section IB)

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
	Net Weight	Cargo aircraft only 2.5 kg	Cargo aircraft only N/A	Cargo aircraft only 2.5 kg	Cargo aircraft only 35 kg
Classification		Exempted		Class 9	
Packaging		Strong outer packaging 1.2 M drop test			UN performance packaging
Labels		 		 	 
Documents		Invoice (air waybill)* Additional documents***		Declaration for DG Air waybill** Additional documents***	Declaration for DG Air waybill**
Training		Adequate instructions		DG training	

Note 1): Handling label Note 2): Cargo aircraft only label (necessary for lithium metal cells and batteries)

Note 3): Class 9 hazardous label

* The words "lithium metal batteries, in compliance with Section II of PI 968" and "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when an air waybill is used. This description should appear in the "Nature and Quantity of Goods" box.






** The words "Dangerous Goods as per attached Shipper's Declaration" and "Cargo Aircraft Only" or "CAO" must appear in the air waybill's "Handling Information" column.

*** Additional documents must indicate:

- 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 procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
- A telephone number for additional information.

This information can be written in the Declaration for DG's "Additional Handling Information" column or on the air waybill.

Technical instructions for lithium-ion batteries (PI 965)

Section		Section II		Section IB	Section IA
Watt hour		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
	Net Weight	2.5 kg	N/A	10 kg Passenger and cargo aircraft	5 kg: Passenger aircraft 35 kg: Cargo aircraft
Classification		Exempted		Class 9	
Packaging		Strong outer packaging 1.2 M drop test			UN performance packaging
Labels				 	 
Documents		Invoice (air waybill)* Additional documents***		Declaration for DG Air waybill** Additional documents***	Declaration for DG Air waybill**
Training		Adequate instructions		DG training	

* The words "Lithium ion batteries in compliance with section II of PI 965" must appear in the air waybill's "Nature and Quantity of Goods" box, when an air waybill is used. The words "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when transported by cargo.

** The words "Dangerous Goods as per attached Shipper's Declaration" must appear in the air waybill's "Handling Information" column. The words "Cargo Aircraft Only" or "CAO" must appear on the air waybill, when transported by cargo.

*** Additional documents must indicate:

- 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 procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
- A telephone number for additional information.

This information can be written in the Declaration for DG's "Additional Handling Information" column or on the air waybill.

■ The major revisions for UN Model Regulations 18th Revised Edition

- (1) Damaged or defective cells or batteries shall be transported as "Class 9" hazardous goods according to Special Provision 376 and Packing Instruction P908 or LP904.
 - (2) Cells and batteries transported for disposal or recycling shall be transported as "Class 9" hazardous goods according to Special Provision 377 and Packing Instruction P909.
- The IMDG Code 2014 edition will contain the descriptions of these UN recommendations. The voluntary compliance date is Jan. 1, 2015. Compliance becomes mandatory on Jan. 1, 2016.
- Although these revisions will be reflected in each country's regulations, some districts, countries or airlines may establish their own special requirements. Therefore the shipper shall confirm with the forwarder in advance.

Reference

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

1. The minimum requirements to transport lithium metal batteries as non-restricted goods are as follows;

- a) Cells and batteries shall be manufactured under a quality management program.
- b) 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.
- c) Each cell or battery must be of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, 5th revised edition, Part III, sub-section 38.3.
- d) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
- e) 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 procedures 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.
- f) Each package must be capable of withstanding a 1.2 m drop test.
- g) Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass.

2. The minimum requirements to transport the lithium-ion batteries as non-restricted goods are as follows;

- a) Cells and batteries shall be manufactured under a quality management program.
- b) 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 those manufactured before Jan. 1, 2009.
- c) 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.
- d) A battery handling label must be displayed on each package. A telephone number must be printed on the label for additional information.
- e) 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 procedures should be followed in the event the package is damaged, to include inspection and repackaging if necessary; and
 - a telephone number for additional information.
- f) Each package must be capable of withstanding a 1.2 m drop test.
- g) Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass.

Maxell will provide certificates for b) and c) as the need arises. Documentation for d) and e) needs to be prepared by the customer. If our package is used for transport, Maxell will provide the certificate for f) 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).

Major Normative Reference

UN (United Nations) Recommendations (Air, Marine, Overland transportation)

- UN (United Nations) Recommendations on the Transport of Dangerous Goods: Model Regulations 18th revised edition
- UN (United Nations) Recommendations on the Transport of Dangerous Goods: Manual of Test and Criteria 5th revised edition, Amendment 2

Air Transportation

- International Civil Aviation Organization (ICAO): Technical Instructions for Safety Transport of Dangerous Goods by Air, 2015-2016 edition
- International Air Transport Association (IATA): Dangerous Goods Regulations, 56th edition 2015

Marine Transportation

- International Maritime Organization (IMO): International Maritime Dangerous Goods (IMDG) Code, 2012 edition (This is applicable until Dec. 31, 2015)
- International Maritime Organization (IMO): International Maritime Dangerous Goods (IMDG) Code, 2014 edition (This is applicable on and after Jan. 1, 2015 and will be mandatory on and after Jan. 1, 2016)

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Visit our website at: biz.maxell.com

Maxell is accredited with international quality management standard ISO 9001 and international environmental management standard ISO 14001 certifications.

Catalog contents accurate as of August 2015.

Data and dimensions are just reference values.

Contents on this catalog are subject to change without notice.

Committed to the highest quality assurance management standards as well as responsibility to the environment.

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