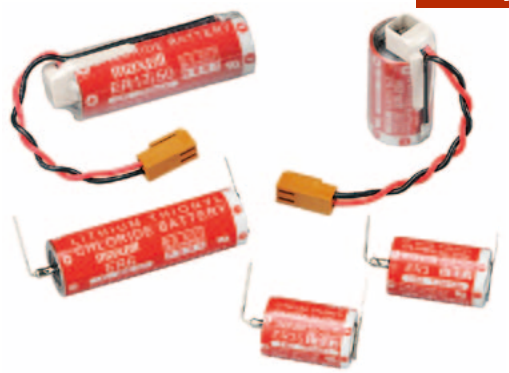
ER

Lithium Thionyl Chloride Battery ($Li/SOCl_2$)

Primary Battery



LITHIUM THIONYL CHLORIDE BATTERY

Safety Instructions

This battery is a high energy density sealed battery containing dangerous (Lithium) and deleterious (Thionyl Chloride) materials. For this reason, improper handling of the battery could lead to distortion, leakage*, overheating, explosion, fire, or generation of irritating/corrosive gases, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents.
For from your customers to your industrial waste processors (including recycled processor), please have them fully understand these instructions.
(* Leakage is defined as the unintentional escape of a liquid from a battery.)

⚠ Warnings — Handling

Do not recharge

■ **Never swallow.**
Always keep the battery out of the reach of infants and young children to prevent it from being swallowed. If swallowed, consult a physician immediately.

■ **Never apply an excessive force to the positive terminal.**
Because the positive terminal is sealed by a glass, subjecting this area to sudden jolts and excessive force (over 19.6 N) could destroy the glass seal. This could cause leakage and the generation of irritating/corrosive gases.

■ **Never drop.**
Dropping the battery could destroy the glass seal leading to leakage and the generation of irritating/corrosive gases.

■ **Never weld the terminals or weld a wire to the body of the battery directly.**
The heat of welding or soldering could cause the lithium to melt, or cause damage to the insulating material in the battery, leading to possible distortion, leakage, overheating, explosion, or fire, or generation of irritating/corrosive gases. When soldering the battery directly to equipment, solder only the tabs or leads. Even then, the temperature of the soldering iron must be below 350 deg. C and the soldering time less than 5 seconds. Do not use a soldering bath, because the circuit board with battery attached could stop moving or the battery could drop into the bath. Moreover do not use excessive solder, because the solder could flow to unwanted portions of the board, leading to a short-circuit or charging of the battery.

■ **Never short-circuit the battery.**
Do not allow the positive and negative terminals to short-circuit. Never carry or store the battery with metal objects such as a necklace or a hairpin. Do not take multiple batteries out of the package and pile or mix them when storing. Otherwise, this could lead to distortion, leakage, overheating, and explosion of the battery.

■ **Never charge.**
The battery is not designed to be charged by any other electrical source. Charging could generate gas and internal short-circuiting, leading to distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ **Never forcibly discharge.**
Forcibly discharging by an external power source or other batteries could cause the voltage to fall below 0V (reversing the poles), generating gas inside the battery and leading to distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ **Never heat.**
Heating the battery to more than 100 deg. C could increase the internal pressure, causing distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ **Never expose to open flames.**
Exposing to flames could cause the lithium metal to melt, causing the battery to catch on fire and explode.

■ **Never disassemble the battery.**
Disassembly could generate the irritating/corrosive gases. In addition, the lithium metal inside the battery could overheat, leading to catch on fire.

■ **Never deform.**
Deforming could cause leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ **Never reverse the positive and negative terminals when mounting.**
Improper mounting of the battery could lead to short-circuiting, charging or forced-discharging. This could cause distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ **Never use different batteries together.**
Using different batteries together, i.e. different type or used and new or different manufacturer could cause distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases because of the differences in battery property. If using two or more batteries connected in series or in parallel even same batteries, please consult with Maxell before using.

■ **Never allow liquid leaking from the battery to get in your eyes or mouth.**

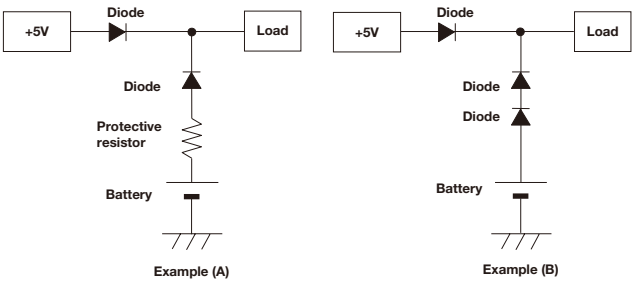
Because this liquid could cause serious damage, if it does come in contact with your eyes, flush them immediately with plenty of water and consult a physician. Likewise, if the liquid gets in your mouth, rinse immediately with plenty of water and consult a physician.

■ **Never touch the battery electrodes.**

Do not allow the battery electrodes to come in contact with your skin or fingers. Otherwise, the moisture from your skin could cause a discharge of the battery, which could produce certain chemical substances causing you to receive a chemical burns.

⚠ Warnings — Circuit Design for Back-up Use

This is a primary battery and cannot be charged. If used in memory or RTC back-up applications, be sure to use diodes to prevent charging from the main power source or other batteries, and a protective resistor to regulate the current as shown in the figure below. Note that the points described below should be taken into careful consideration when selecting diodes and protective resistors.



■ **Supplied voltage to load**

Because a diode and a resistor generate the voltage drop on operating, please take into consideration these voltage drops for supplied voltage to load.

■ **Using diodes to prevent charging**

Please choose diodes with leak current of no more than 0.5μA.

■ **Using and setting protective resistors**

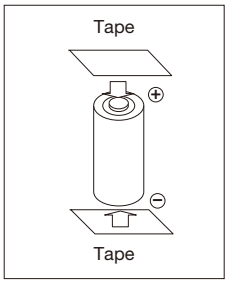
A protective resistor is used to prevent the battery from being charged by large surges of current during diode failure. Please set the resistor so that the maximum current shown in the right table is not exceeded. For example, say an ER6 battery is used in sample circuit (A) in combination with a main power source 5 volt. Since the permitted charge current is 100μA and this battery's voltage is 3.6V, let the resistor be R≧ (5V-3.6V)/100μA=14k ohm, meaning that at least 14k ohm is required.

Type	Maximum Current
ER18/50	125μA
ER17/50	125μA
ER6	100μA
ER6C	100μA
ER17/33	70μA
ER3	50μA
ER3S	40μA

Note: If the diodes broke down, it is necessary for safety to replace them as soon as possible even though using a protective resistor. Considering the trouble of diodes and resistors, other safety measures should be incorporated in the circuit design.

⚠ Warnings — Disposal

The battery may be regulated by national or local regulation. Please follow the instructions of proper regulation. As electric capacity is left in a discarded battery and it comes into contact with other metals, it could lead to distortion, leakage, overheating, or explosion, so make sure to cover the (+) and (-) terminals with friction tape or some other insulator before disposal.



(Example of battery insulation)

⚠ Caution — Handling

■ **Minimum transient voltage**

The various tests have shown that the minimum transient voltage is influenced greatly by the actual conditions of use and storage. Therefore, please design your circuits using no more than the standard discharge current, taking into account the voltage drop due to the minimum transient voltage. Please consult with Maxell beforehand if you are unsure of anything.

■ **Installing, removing, and disposing of batteries**

1) When installing a battery in a device, make sure that the positive terminal is facing up, or at least to the side. As this battery uses liquid thionyl chloride as the positive active material, placing the positive terminal at the bottom will cause the thionyl chloride to become maldistributed, which could prevent the needed performance from being obtained when a large amount of current is used.

2) Please have the installation, removal, and disposal of this battery performed by a technician with a thorough understanding of the Warnings and Cautions on handling.

■ **Storage**

Avoiding storing the battery in direct sunlight, or in excessively hot and humid locations, and store it out of the way of rainwater and other adverse environmental elements.

■ **Bundling**

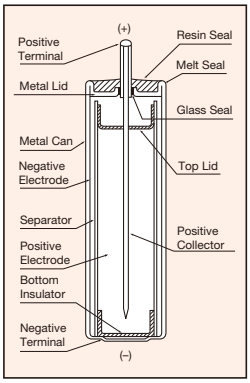
When bundling the battery with a product, be sure to use cushioning and other packing to protect the battery (and especially the positive terminal) from jolts and shocks during transportation.

The ER battery is for industrial use only.
When replacement is necessary, please contact the manufacturer of your equipment.

Overview

This battery is ideal for such long-term applications as power for electronic devices and electric power, water, and gas meters, and especially as a backup power source for memory ICs.

Construction



Principle and Reactions

The lithium thionyl chloride battery uses liquid thionyl chloride ($SOCl_2$) as its positive active material, and lithium (Li) as its negative active material. The reactions of the battery are shown below.

■ Battery reactions

Positive reaction: $2SOCl_2+4Li^++4e^- \rightarrow 4LiCl+S+SO_2$
Negative reaction: $Li \rightarrow Li^++e^-$
Total reaction: $2SOCl_2+4Li \rightarrow 4LiCl+S+SO_2$

Features

■ High 3.6-V voltage

The lithium thionyl chloride battery achieves a high voltage of 3.6 V.

■ Flat discharge characteristics

The change of internal resistance during discharge is minimal, allowing for flat discharge voltage until end of discharge life.

■ High energy density

Provides high energy density of 970m Wh/cm^3 with discharge current of 100µA (ER6 type).

■ Wide usable temperature range

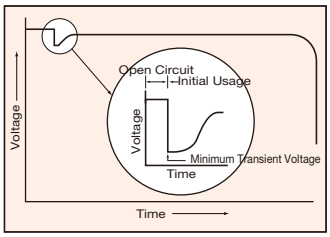
Can be used over a wide temperature range : - 55 deg. C to +85 deg. C (please consult with Maxell if using in temperatures of -40 deg. C or less).

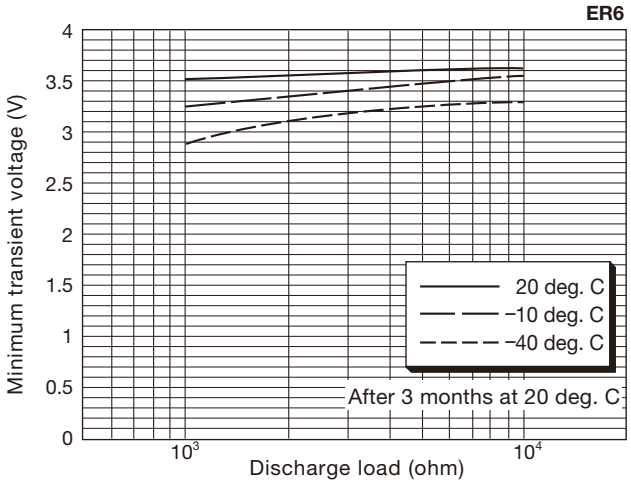
■ Superior long-term reliability

The extremely low self-discharge, together with the use of a hermetic seal, allows for stable use over long periods.

Minimum transient voltage

The lithium thionyl chloride battery has remarkably lower self-discharge when compared with conventional batteries. This is because a lithium chloride membrane is formed over the negative lithium surface, blocking reaction with the positive material. When first discharging after storage, resistance from this lithium chloride membrane may temporarily reduce the voltage at the initiation of discharge. The lowest voltage at this time is called minimum transient voltage, and the lower the temperature, and the larger the discharge current, the lower the voltage will be. Because minimum transient voltage is greatly influenced by storage time and conditions, it is necessary to take this into sufficient consideration when designing a device.





The figure above shows minimum transient voltage using a fresh battery.

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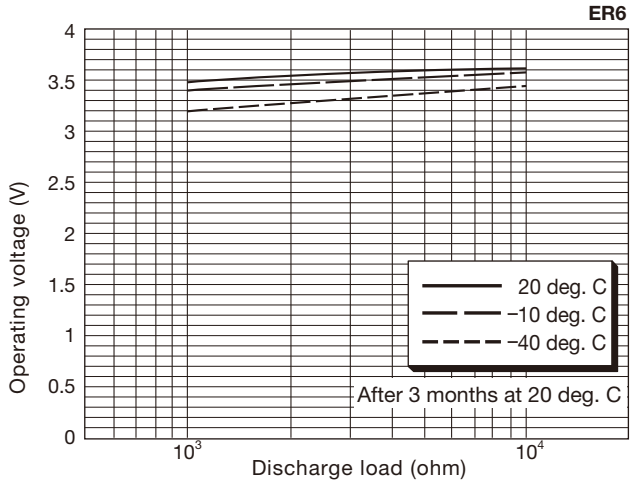
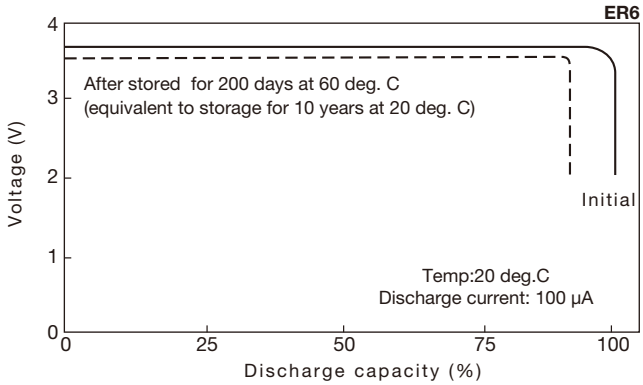
Relationship between Discharge Load and Operating Voltage

The operating voltage of a battery falls as the discharge load increases and temperature falls. In the case of initial use, an electric potential of at least 3V will be maintained even at temperatures of −40 deg. C at discharge of less than 1mA.



Storage Characteristics

The lithium thionyl chloride battery is made from chemically stable inorganic materials. Additionally, a sealing method employing a laser-welded seal structure and hermetic seal hinders the admittance of outside air. These features provide superior storage characteristics, holding down self-discharge to no more than 1% of capacity per year at normal temperatures.



UL Recognized Components

The lithium thionyl chloride battery is a UL (Underwriters Laboratories Inc.) recognized component. (Technician Replaceable)

Recognized models: ER18/50, ER17/50, ER6, ER6C, ER17/33, ER3, ER3S

Certification Number: MH12568

Applications

- OA Machines (Fax, Copiers, Printers)
- Medical Instruments, Cash Registers
- FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)
- Electronic Meters (Water, Gas, Electricity)
- ETC (Electronic Toll Collection System)
- Home Fire/Smoke Alarm

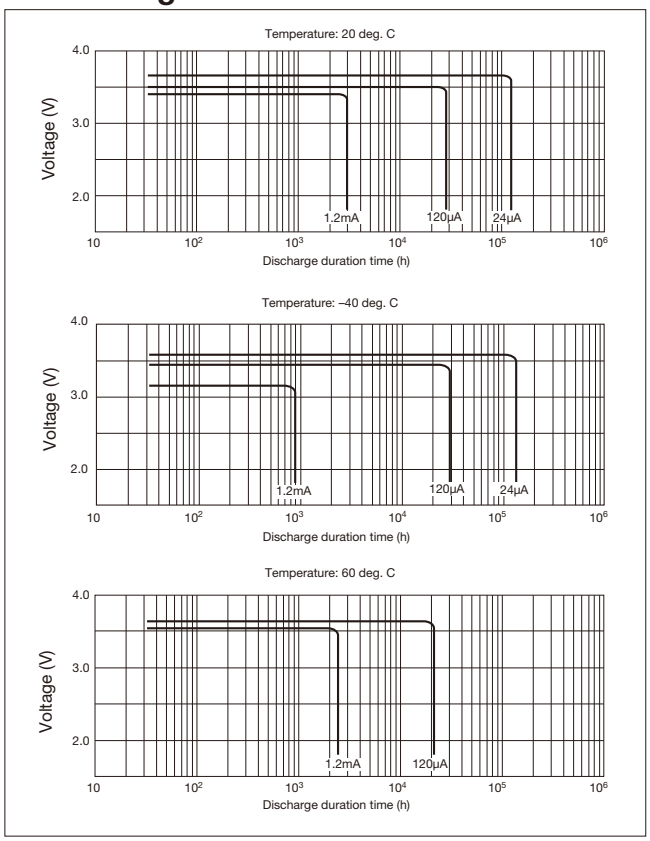
Products

Model		ER18/50	ER17/50	ER6	ER6C	ER17/33	ER3	ER3S
Nominal Voltage (V)		3.6	3.6	3.6	3.6	3.6	3.6	3.6
Nominal Capacity (mAh)**		3,650	2,750	2,000	1,800	1,600	1,100	790
Nominal Discharge Current (µA)		125	125	100	100	75	40	35
Operating Temperature Range (deg. C)		−55 to +85	−55 to +85	−55 to +85	−55 to +85	−55 to +85	−55 to +85	−55 to +85
Dimensions*	Diameter (mm)	18	17	14.5	14.5	17.0	14.5	14.5
	Height (mm)	52.6	52.6	53.5	51	35	29.9	26
Weight (g)*		22	20	15	15	13	8	7

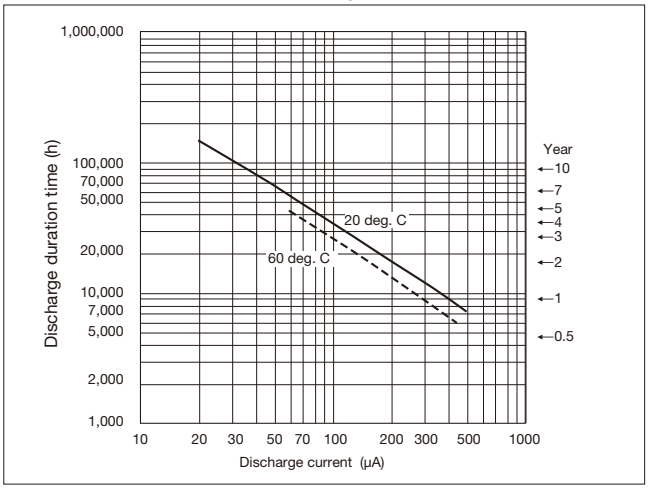
* Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.
** Nominal capacity indicates duration until the voltage drops down to 3.0V when discharged at a nominal discharge current at 20 deg. C.
• Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

ER18/50 (3650mAh)

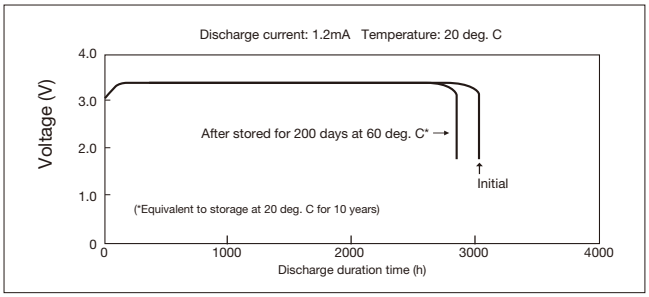
Discharge Characteristics



Relationship between Discharge Current and Duration Time

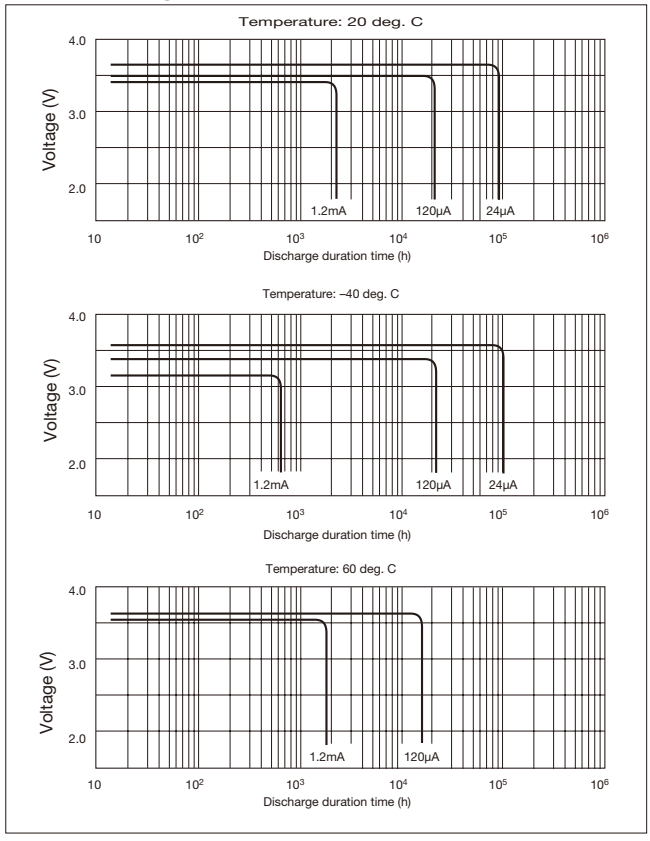


Storage Characteristics

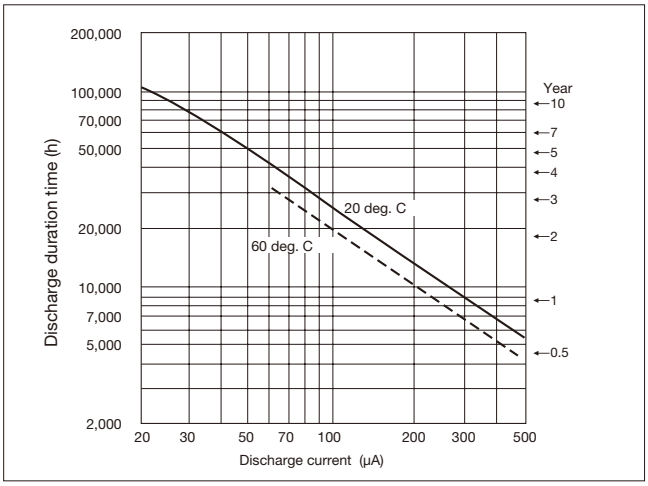


ER17/50 (2750mAh)

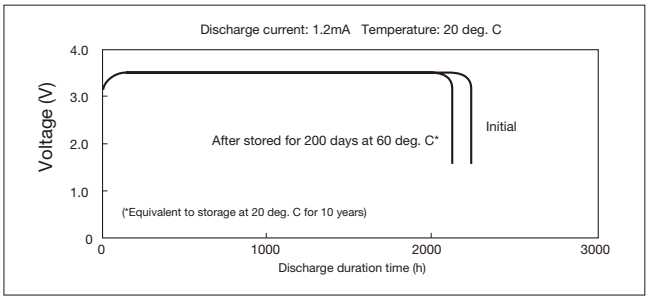
Discharge Characteristics



Relationship between Discharge Current and Duration Time



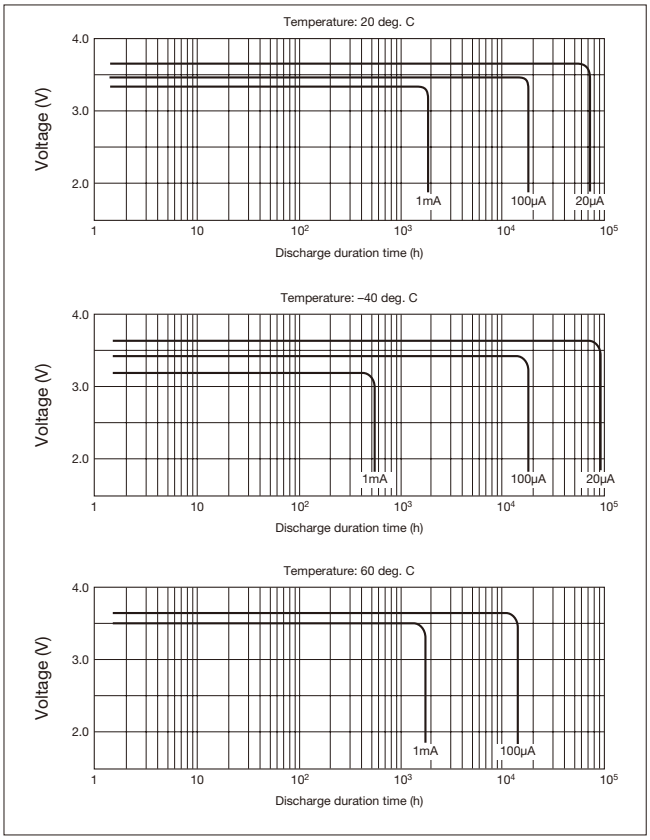
Storage Characteristics



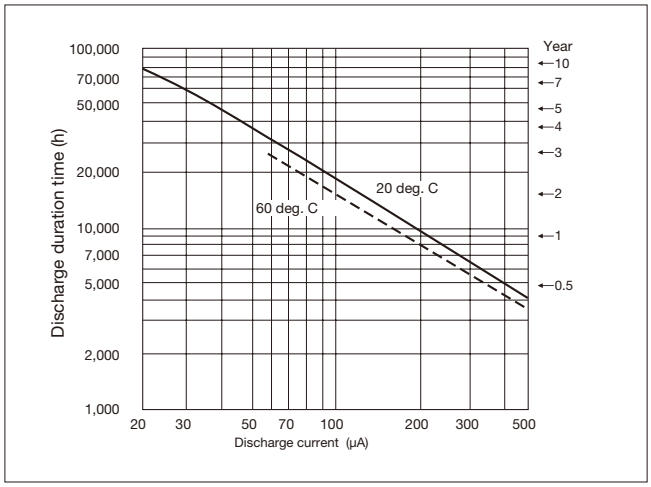
ER

ER6 (2000mAh)

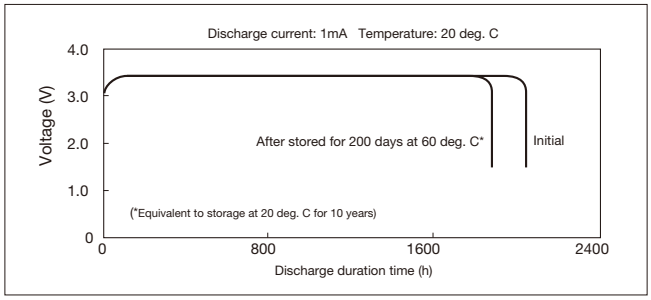
Discharge Characteristics



Relationship between Discharge Current and Duration Time

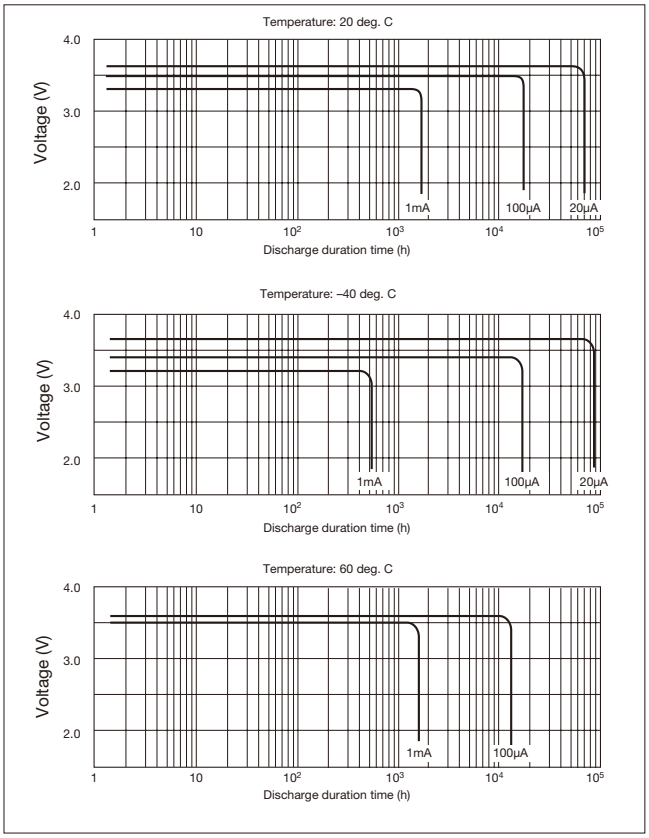


Storage Characteristics

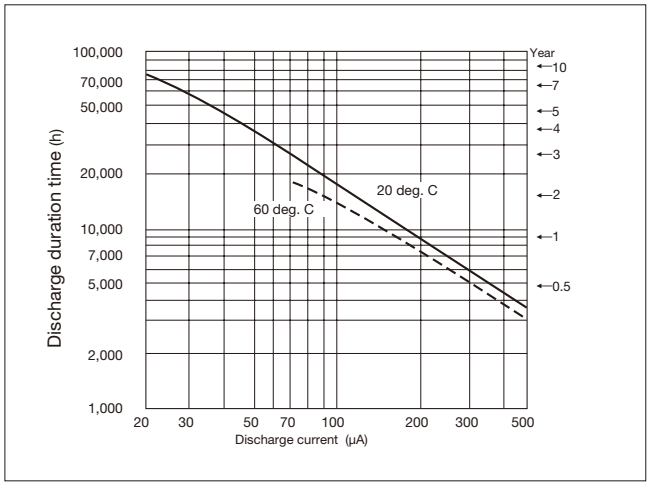


ER6C (1800mAh)

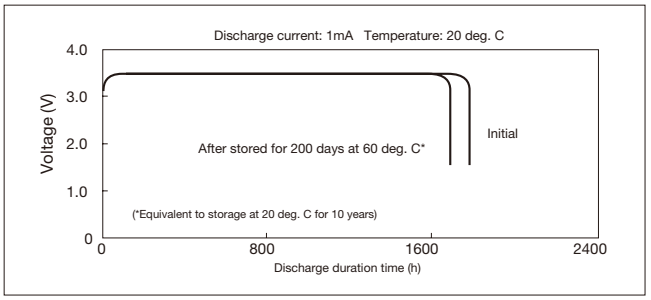
Discharge Characteristics



Relationship between Discharge Current and Duration Time

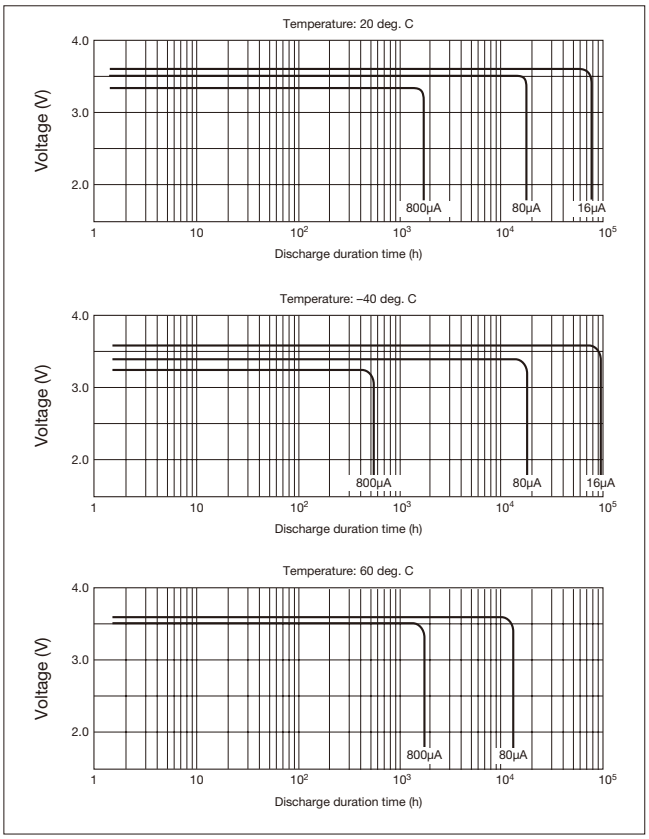


Storage Characteristics

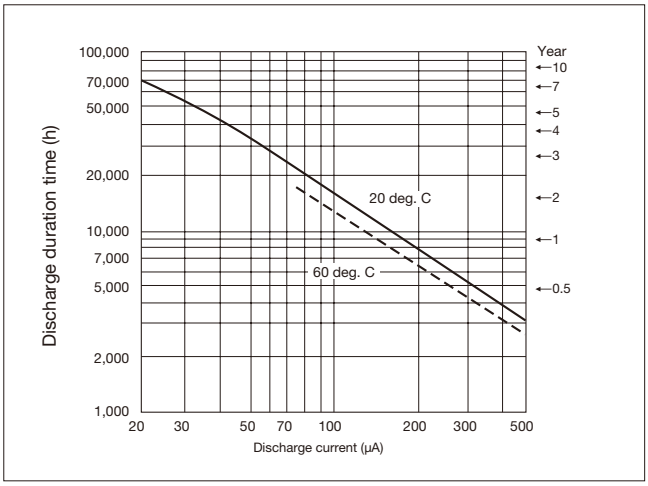


ER17/33 (1600mAh)

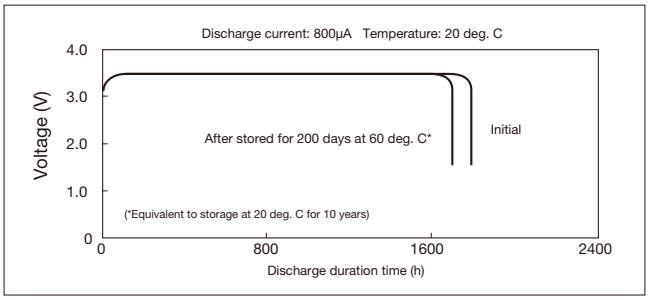
Discharge Characteristics



Relationship between Discharge Current and Duration Time

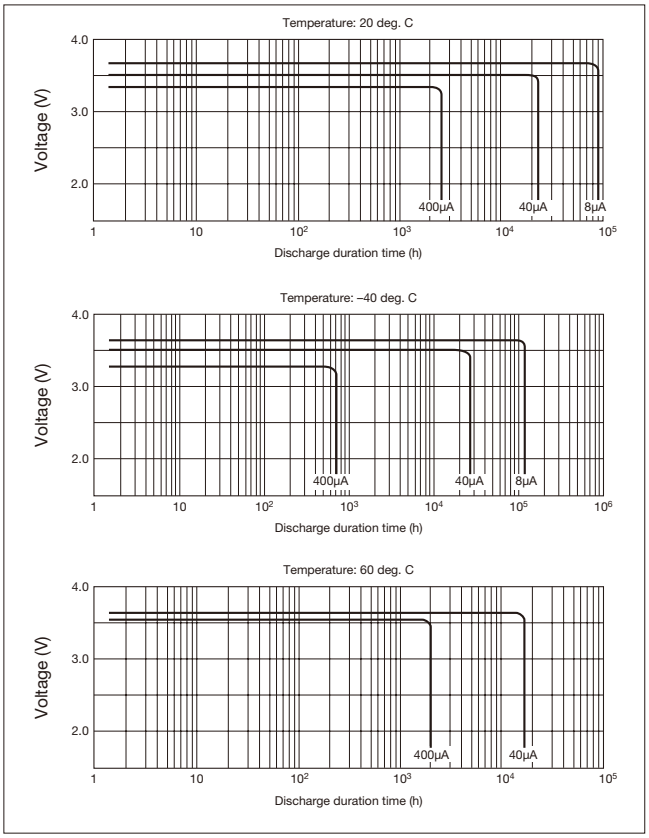


Storage Characteristics

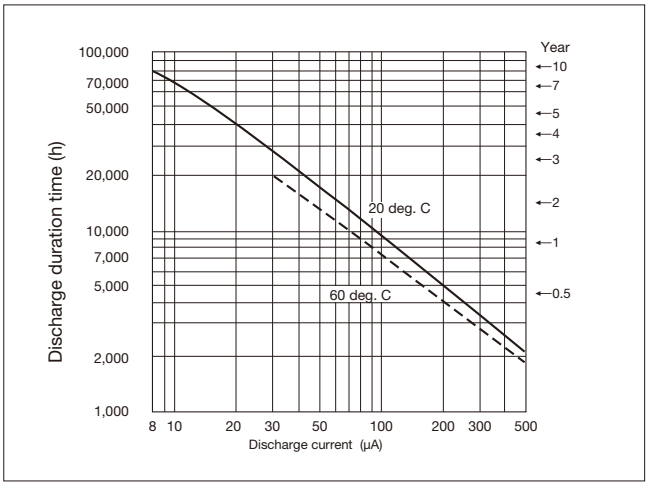


ER3 (1100mAh)

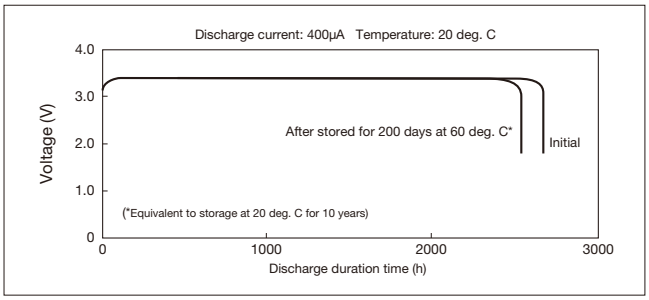
Discharge Characteristics



Relationship between Discharge Current and Duration Time

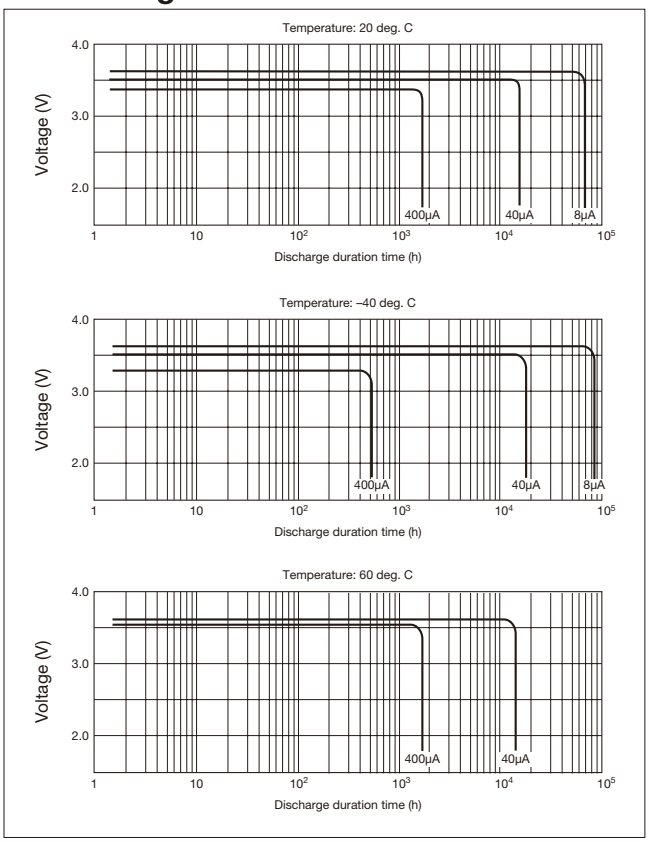


Storage Characteristics

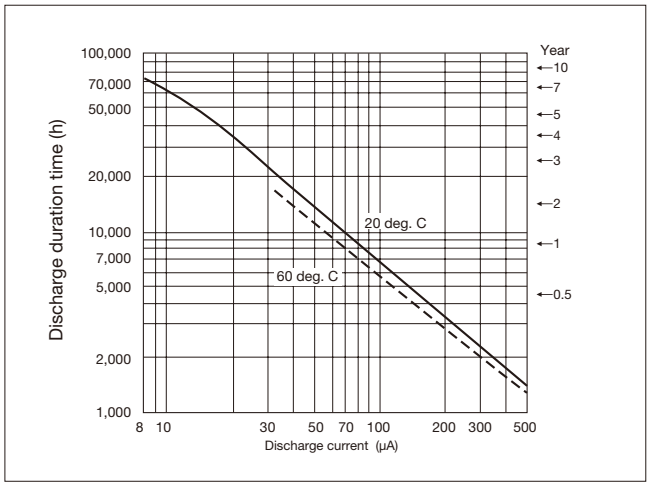


ER3S (790mAh)

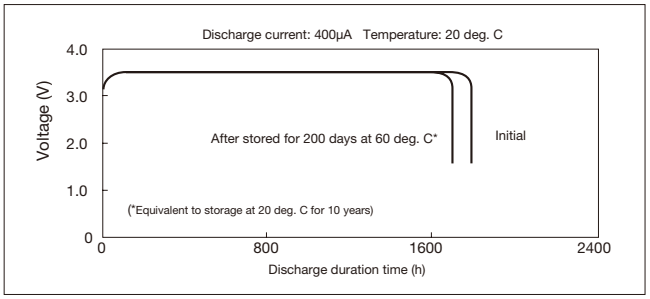
Discharge Characteristics



Relationship between Discharge Current and Duration Time

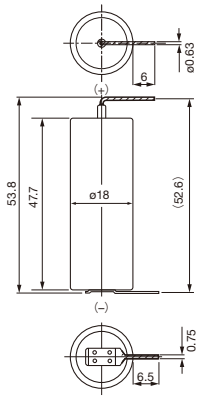


Storage Characteristics

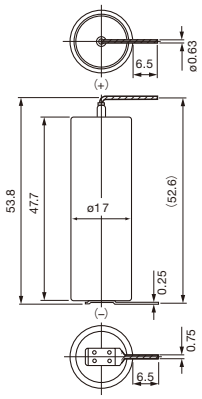


External Dimensions with Terminals and Wire Connectors (unit : mm)

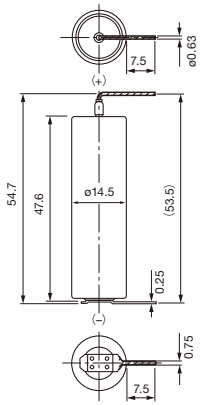
ER18/50 #2 PC



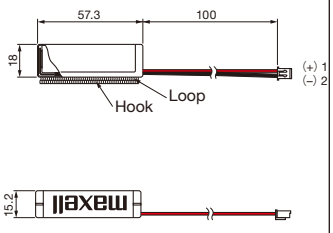
ER17/50 #2 PC



ER6 #2 PC

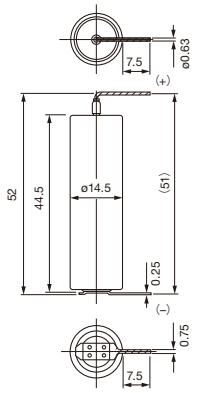


ER6K-#17

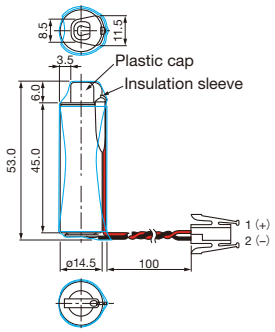


Housing: XHP-2 (JST)
Contact: SXH-001GH-P0.6 (JST)
Lead wire: AWG26 UL1007

ER6C #2 PC(2)

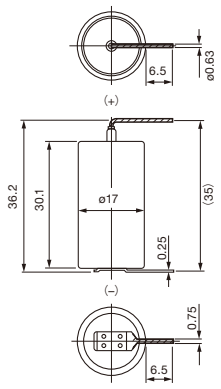


ER6C WKP

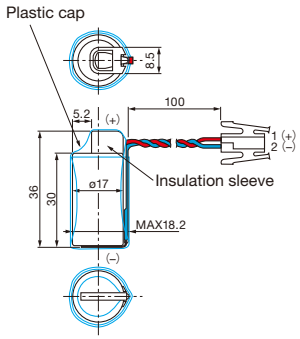


Housing: HNC2-2.5S-2 (Hirose)
Contact: HNC-2.5S-C-B (03) (Hirose)
Lead wire: AWG26 UL1007

ER17/33 #2 PC

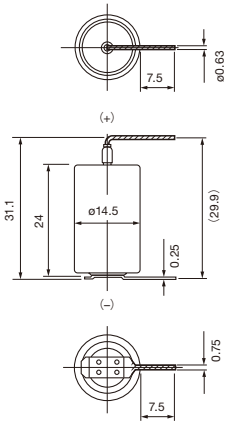


ER17/33 WKP

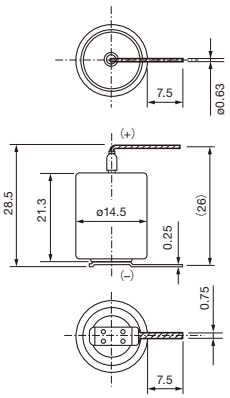


Housing: HNC2-2.5S-2 (Hirose)
Contact: HNC-2.5S-C-B (03) (Hirose)
Lead wire: AWG26 UL1007

ER3 #2 PC



ER3S #2 PC



: Tin plating

: Horizontal & Through hole Type
: Wire connector Type

ER

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)	
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 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

CM009

JQA-0986

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.

JQA-3029

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.

maxell

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