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Within, the Future

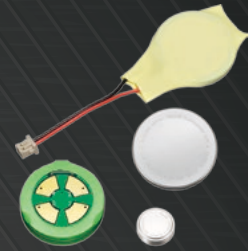
BATTERIES CATALOG

LITHIUM-ION RECHARGEABLE BATTERY



RECHARGEABLE BATTERY

COIN TYPE LITHIUM-ION RECHARGEABLE BATTERY (CLB)



LITHIUM MANGANESE DIOXIDE BATTERY



LITHIUM MANGANESE DIOXIDE RECHARGEABLE BATTERY



SILVER OXIDE BATTERY



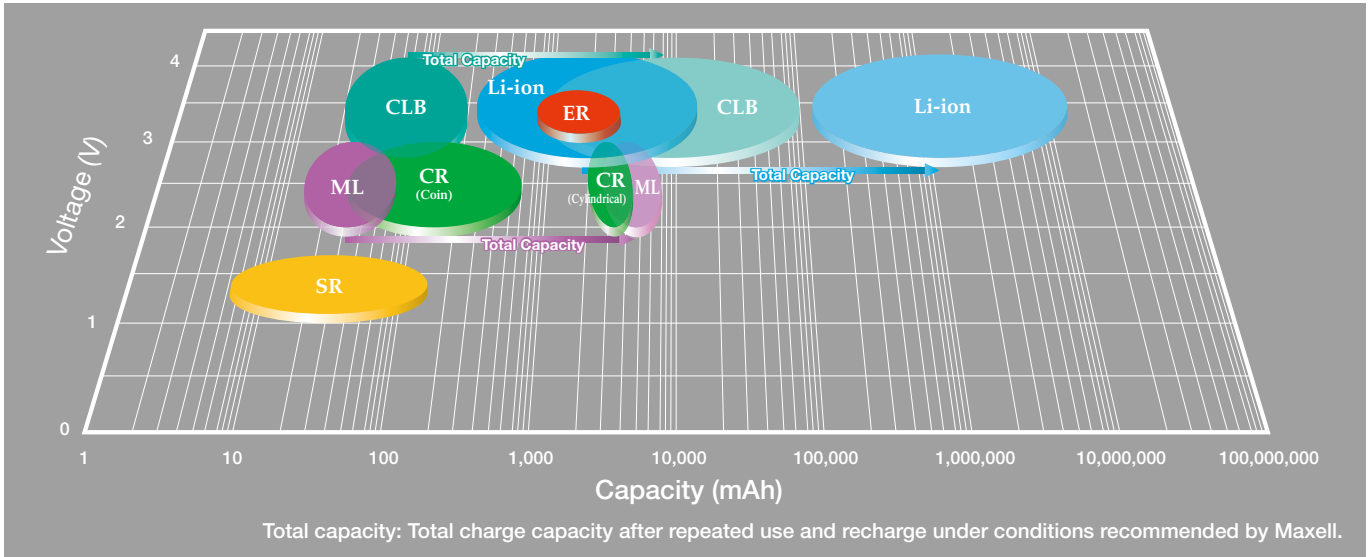
LITHIUM THIONYL CHLORIDE BATTERY



Maxell batteries: Meeting a variety of energy needs

Maxell supplies various battery lineups corresponding to application usage of diversified equipment, ranging from lithium-ion batteries as the main power sources of portable information devices to backup power sources for various electronics devices.

Position of Maxell Batteries



CONTENTS

Primary

CR	Lithium Manganese Dioxide Battery ————— 3-11
	<ul style="list-style-type: none"> ■ Heat Resistant Coin Type ■ Coin Type ■ Cylindrical Type

ER	Lithium Thionyl Chloride Battery ————— 12-17
-----------	---

SR	Silver Oxide Battery ——— 18-21
-----------	---------------------------------------

Secondary

CLB	Coin Type Lithium-ion Rechargeable Battery (CLB) ————— 22-25
	<ul style="list-style-type: none"> ■ Coin Type ■ CLB2032 Battery Unit

Li-ion	Lithium-ion Rechargeable Battery ————— 26-30
	<ul style="list-style-type: none"> ■ Prismatic Type ■ Laminated Type

ML	Lithium Manganese Dioxide Rechargeable Battery — 31-35
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	Dangerous Goods Transportation Regulations for Lithium Cells and Batteries ————— 36-38
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Application of Primary and Secondary Batteries

○ : When used as main power source. □ : When used as backup power source.

		Primary				Secondary			
		CR		ER	SR	CLB	Li-ion		ML
		Coin	Cylindrical				Prismatic	Laminated	
Automobiles, Two Wheels	Keyless Entry Systems	○				○			
	ETC (Electronic Toll Collection System)	○	○	○			○		
	TPMS (Tire-pressure Monitoring System)	○ (HR)							
	Electric Motorbikes/Pedelecs							○	
	AGVs (Automated Guided Vehicles), Floor Cleaners							○	
Medical	Thermometers	○			○				
	Blood Sugar Level Meters	○			○				
	Hearing Aids					○			
	Ambulatory Medical Devices (Infusion Pumps, etc.)						○	○	
	Portable Medical Devices (X-ray Apparatus, etc.)						○	○	
Industrial	FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)	○□	○□	□		○	○		□
	Robots (Multicopters, For Infrastructure Inspection, etc.)						○	○	
	Energy Storage Systems							○	
	Electronic Meters (Water, Gas, Electricity)	□	○□	○□					□
IT Hardware, Tele- communications	Mobile Phones, Smart Phones						○		
	Tablet PCs, Notebook PCs	□					○		□
	Desktop PCs	□							□
	PNDs (Personal Navigation Devices)						○		
	Activities Quantity Meters	○				○	○		
	Smart Watches					○	○		
	Head-mounted Displays						○		
	Communication Tags	○	○			○			
	OA Machines (Fax, Copiers, Printers)	□	□	□			○		□
	Electronic Dictionaries	○					○		
Calculators	○			○					
Audio, Imaging	Camcorders	□					○		□
	Digital Still Cameras	□					○		□
	Portable Media Players						○		
Timepieces	Watches	○			○	○			○
	Multifunctional Watches	○				○			○
	Table Clocks, Wall Clocks	○			○				
Other	Portable Game Devices	○					○		
	Remote Controllers	○							
	Fire Alarms		○	○					
	Beauty Appliances						○	○	

CR

Lithium Manganese Dioxide Battery (Li/MnO₂)



LITHIUM MANGANESE DIOXIDE BATTERY

Safety Instructions

This battery contains lithium, organic solvents, and other combustible materials. For this reason, improper handling of the battery could lead to distortion, leakage*, overheating, explosion, or fire, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents.

(* Leakage is defined as the unintentional escape of a liquid from a battery.)

⚠ Warnings — Handling

■ Keep battery out of reach of children.

Swallowing can lead to chemical burns, perforation of soft tissue, and death. Severe burns can occur within 2 hours of ingestion. If swallowed, seek medical attention immediately.

■ 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, or fire.

■ Never heat.

Heating the battery to more than 100 deg. C* could increase the internal pressure, causing distortion, leakage, overheating, explosion, or fire. (* Consult Maxell regarding heat resistant coin type lithium manganese dioxide batteries.)

■ 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.

Do not disassemble the battery, because the separator or gasket could be damaged, leading to distortion, leakage, overheating, explosion, or fire.

■ 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, or fire.

■ 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, explosion, or fire.

■ 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. This could cause distortion, leakage, overheating, explosion, or fire. 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 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, or fire 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.

■ Keep leaking batteries away from fire.

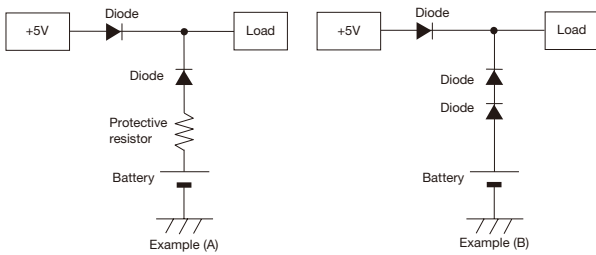
If leakage is suspected or you detect a strong odor, keep the battery away from fire, because the leaked liquid could catch on fire.

■ 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 as small as possible. Please keep the charged capacity due to leak current to within 1% of nominal capacity.

Using and setting protective resistors

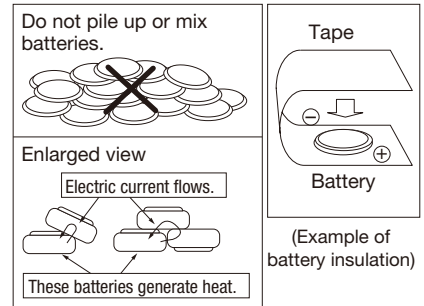
A protective resistor is used to prevent the battery from being charged by large surges of current during diode failure. Please set the resistor so that the maximum current shown in the right table is not exceeded. For example, say a CR2032 battery is used in sample circuit (A) in combination with a main power source 5 volt. Since the permitted charge current is 10mA and this battery's voltage is 3V, let the resistor be $R \geq (5V-3V)/10mA=0.2k \text{ ohm}$, meaning that at least 0.2k ohm is required.

Type	Maximum Current
CR2450HR	15mA
CR2450HR-Ex	15mA
CR2050HR	10mA
CR2032HR	10mA
CR2032H	10mA
CR2032	10mA
CR2025	10mA
CR2016	10mA
CR1632	4.0mA
CR1620	4.0mA
CR1616	2.5mA
CR1220	3.0mA
CR1216	2.5mA
CR17450 AH	20mA
CR17450 A	20mA
CR17335 A	20mA

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.



Caution — Handling/Storage

Never expose the battery to ultrasonic sound.

Exposing the battery to ultrasonic sound may cause short-circuiting because the inside material is broken into pieces, leading to distortion, leakage, overheating, explosion, or fire.

Never subject the battery to severe shock.

Dropping, throwing or stomping on the battery may cause distortion, leakage, overheating, explosion, or fire.

Never short-circuit the battery while installing into equipment.

Please be careful when installing the battery not to short-circuit it with metal portions of the equipment.

Use the correct battery suitable for the equipment.

The battery may not be suitable for the specific equipment due to the using conditions or type of equipment. Please select the suitable battery according to the handling instructions of the equipment.

Never use or leave the battery in a hot place such as under the direct rays of the sun or in a car in hot weather.

If you do, this may cause distortion, leakage, overheating, explosion, or fire.

Never allow the battery to come in contact with water.

If it does, this may cause the battery to rust or lead to distortion, leakage, overheating, explosion, or fire.

Never store the battery in a hot and humid environment.

Otherwise it may cause battery performance deterioration, deformation, leakage, overheating, or explosion.

Keep contact force more than 2N.

The battery voltage may be lower than intended value because of poor contact condition, please keep contact force more than 2N for suitable contact resistance.

Heat Resistant Coin Type Lithium Manganese Dioxide Battery



Overview

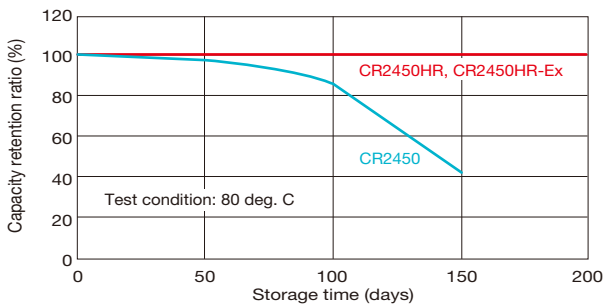
Maxell's original sealing technology and highly heat-resistant material expands operating temperature range remarkably, making the batteries supremely suitable for automobile applications — for powering TPMS (Tire Pressure Monitoring System) sensors, for example.

Features

- **Wide operating temperature range: -40 deg. C to +125 deg. C*** CR2450HR-Ex batteries can even be used at temperatures up to 150 deg. C, depending on other conditions.
- **Superior leak-resistant characteristics even under high temperature and acceleration.**
- **Can be used even under 2000G, which is equivalent to driving at 300km/h.**
- **Electric characteristics are maintained after long periods of exposure to high temperature and humidity.**

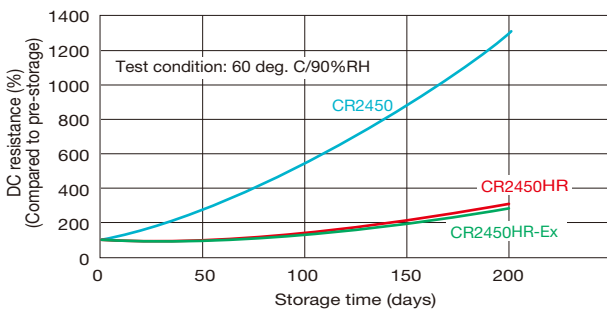
* When using at temperatures exceeding 85 deg. C, please consult Maxell in advance for conditions of use.

Fig. 1 Storage Characteristics under High Temperatures



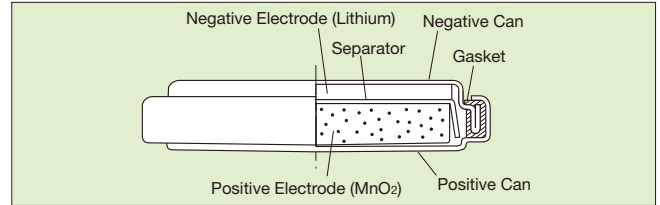
Very little deterioration in capacity due to high storage temperature of 80 deg. C, compared to CR2450 battery.

Fig. 2 Storage Characteristics under High Temperature/Humidity



Very little deterioration in internal resistance due to high humidity (60 deg. C/90%RH), compared to CR2450 battery.

Construction



UL Recognized Components

The heat resistant coin type lithium manganese dioxide battery is a UL (Underwriters Laboratories Inc.) recognized component. (Technician Replaceable)

Recognized models: CR2450HR, CR2050HR, CR2032HR
Certification Number: MH12568

Applications

- TPMS (Tire-Pressure Monitoring System)
- ETC (Electronic Toll Collection System)
- Communication Tags
- Set-Top Boxes
- OA Machines (Fax, Copiers, Printers)
- Notebook PCs ● Desktop PCs
- Medical Instruments, Cash Registers
- FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)
- Electronic Meters (Water, Gas, Electricity)

Products

Model	CR2450HR-Ex	CR2450HR	CR2050HR	CR2032HR
Nominal Voltage (V)	3	3	3	3
Nominal Capacity (mAh)*1	525	550	350	200
Nominal Discharge Current (mA)	0.2	0.2	0.2	0.2
Operating Temperature Range (deg. C)	-40 to +125 (max. 150)		-40 to +125	
Acceleration Resistance	Max. 2000G*3			Max. 3300G
Dimensions*2	Diameter (mm)	24.5	24.5	20.0
	Height (mm)	5.0	5.0	3.2
Weight (g)*2	6.8	6.8	4.1	3.0

*1 Nominal capacity indicates duration until the voltage drops down to 2.0V when discharged at a nominal discharge current at 20 deg. C.

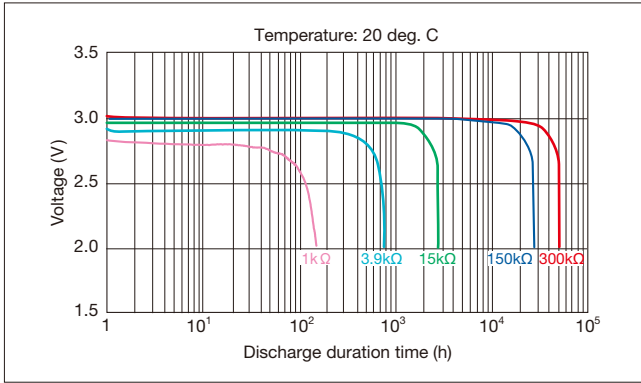
*2 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.

*3 Equivalent to acceleration when driving at 300km/h, when attached to a 17-inch wheel.

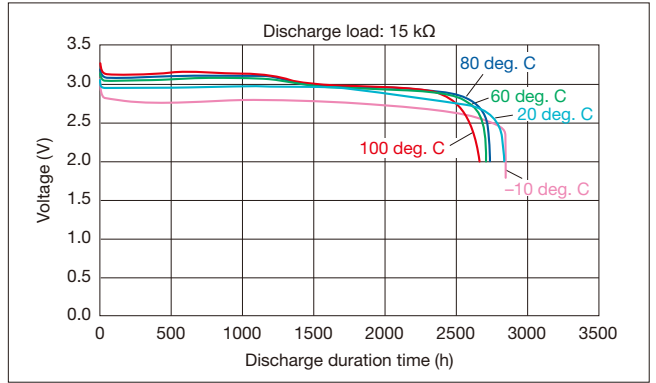
● Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Characteristics (CR2450HR)

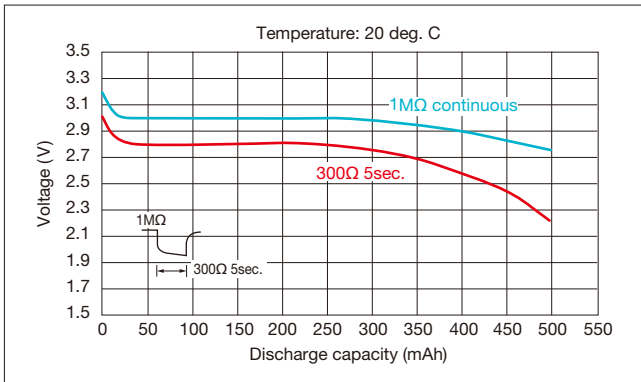
Discharge Characteristics



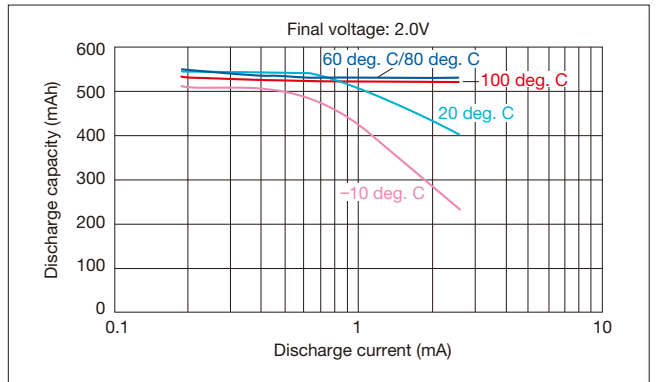
Temperature Characteristics



Pulse Discharge Characteristics



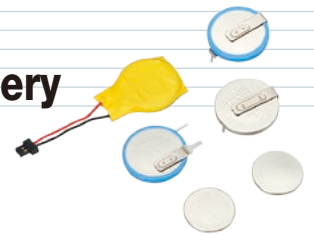
Relationship between Discharge Current and Discharge Capacity



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

CR2450HR T25	CR2450HR HAB-T40	CR2450HR SBO-T23	CR2450HR WK
<p>Actual appearance</p>			<p>Housing: ZHR-2 (JST) Contact: SZH-002GU-P0.5 (JST) Wire: AWG26 UL1061</p>
CR2050HR HBB-T66	CR2050HR SBO-T23	CR2032HR SAO-T60	<p> : Horizontal & Through hole Type : Horizontal & Surface mounting Type : Wire connector Type : Tin plating </p> <p>The above are examples. Processing to meet customer requests is possible.</p> <p>Visit our website for more information http://biz.maxell.com/en/ Go to: Products > Primary Batteries > CR (Heat Resistant Coin Type Lithium Manganese Dioxide Battery)</p>

Coin Type Lithium Manganese Dioxide Battery



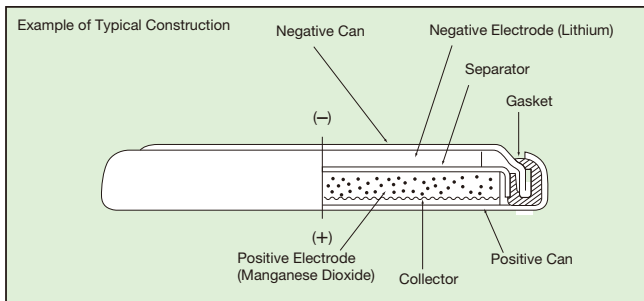
Overview

The coin type lithium manganese dioxide battery (CR battery) is a small, lightweight battery with an operating voltage of 3V and the ability to operate over a wide temperature range. It has a wide range of applications, both for powering devices such as wristwatches and electronic calculators and can be used in all types of electronic devices mainly as memory and RTC backup.

Features

- Optimum for Memory and RTC Backup (Fig. 1)**
 Displays long-term stable operating voltage at low load discharge.
- High 3 volt energy density**
 High energy density. At 3 volts (nominal voltage), it has about twice the voltage of alkaline button batteries and silver oxide batteries.
- Stable discharge characteristics through low internal resistance and high operating voltage**
 Employs highly conductive electrolyte, lowering internal resistance and providing stable operating voltage. This allows stable power to be obtained, with little change in operating voltage at room temperature as well as high and low temperatures.
- Superior leakage resistance and excellent storage characteristics (Fig. 2)**
 Employs a leak-resistant organic electrolyte, giving it better leakage resistance than battery types using alkaline electrolytes. Furthermore, the high degree of seal of the seal structure and application of sealant keep self-discharge to about 1% per year.
- Superior high rate discharge characteristics**

Construction



Principle and Reactions

The coin type lithium manganese dioxide battery uses manganese dioxide (MnO₂) as its positive active material, lithium (Li) as its negative active material, and an organic electrolyte solution.

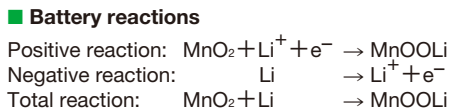


Fig. 1 Relationship between Discharge Current Consumption and Duration Time

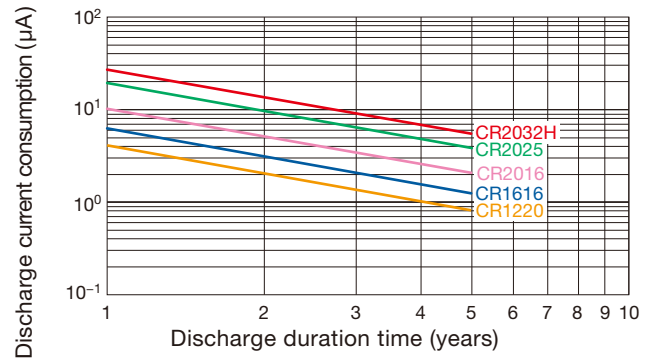
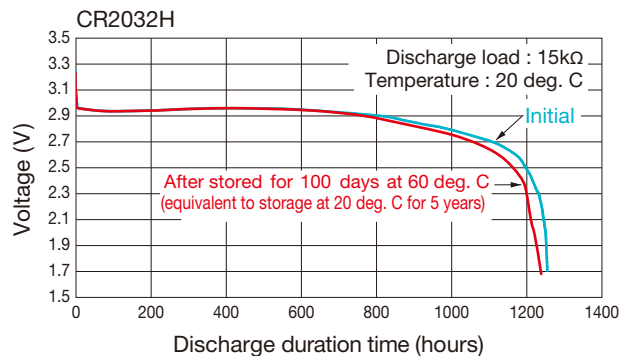


Fig. 2 Discharge Characteristics after Storage



UL Recognized Components

The coin type lithium manganese dioxide battery is a UL (Underwriters Laboratories Inc.) recognized component and user replaceable.

Recognized models:
 CR2032H, CR2032, CR2025, CR2016, CR1632, CR1620, CR1616, CR1220, CR1216
 Certification Number: MH12568

Applications

- Communication Tags
- OA Machines (Fax, Copiers, Printers)
- Digital Still Cameras
- Medical Instruments, Cash Registers
- Electronic Meters (Water, Gas, Electricity)
- FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)
- Notebook PCs
- Electronic Dictionaries
- Camcorders
- Keyless Entry Systems
- Remote Controllers
- Desktop PCs
- Calculators
- Watches
- Portable Game Devices

Products

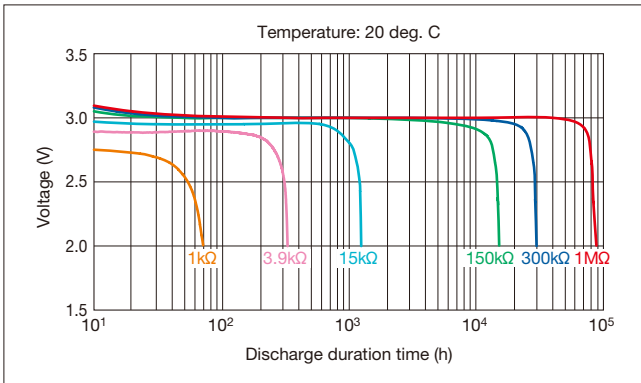
Model	CR2032H	CR2032	CR2025	CR2016	CR1632	CR1620	CR1616	CR1220	CR1216	
Nominal Voltage (V)	3	3	3	3	3	3	3	3	3	
Nominal Capacity (mAh) ^{*1}	240	220	170	90	140	80	55	36	25	
Nominal Discharge Current (mA)	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	
Operating Temperature Range (deg. C) ^{*2}	-20 to +85									
Dimensions ^{*3}	Diameter (mm)	20.0	20.0	20.0	20.0	16.0	16.0	16.0	12.5	12.5
	Height (mm)	3.2	3.2	2.5	1.6	3.2	2.0	1.6	2.0	1.6
Weight (g) ^{*3}	3.0	3.0	2.5	1.7	1.9	1.3	1.1	0.8	0.6	

*1 Nominal capacity indicates duration until the voltage drops down to 2.0V when discharged at a nominal discharge current at 20 deg. C.
 *2 When using these batteries at temperatures outside the range of 0 to +40 deg. C, please consult Maxell in advance for conditions of use.
 *3 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.

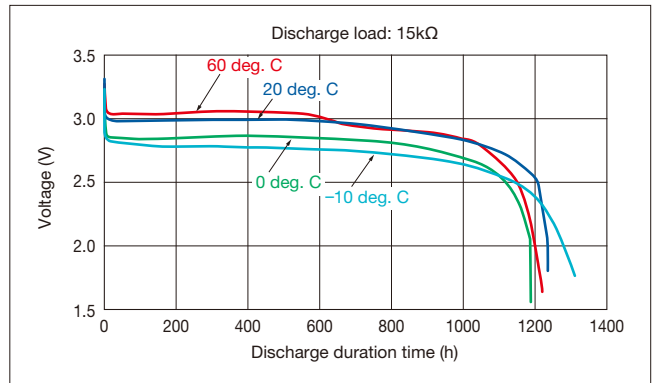
• Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Characteristics (CR2032H)

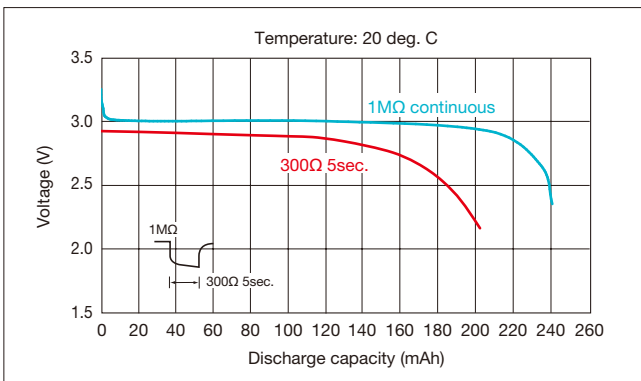
Discharge Characteristics



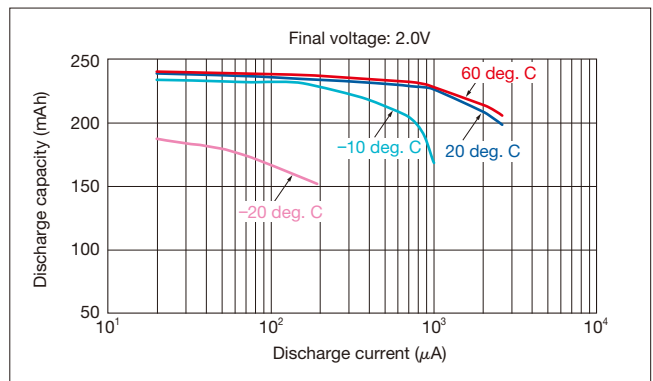
Temperature Characteristics



Pulse Discharge Characteristics



Relationship between Discharge Current and Discharge Capacity



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

CR2032 T6	CR2032 T6LES	CR2032 T19	CR2032 T23
CR2032 T33	CR2032 T26	CR2032 T34	CR2032 WK11
			<p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>
CR2032 WK12	CR2032 WK13	CR2032 WK14	CR2032 WK15
<p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>	<p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>	<p>Housing: DF3-4S-2C (Hirose) Contact: DF3-2428SCF (Hirose) Wire: AWG26 UL1007</p>	<p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>

The above are examples. Processing to meet customer requests is possible.

- : Horizontal & Through hole Type
- : Horizontal & Surface mounting Type
- : Vertical & Through hole Type
- : Wire connector Type

: Tin plating

Visit our website for more information

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

Go to: Products > Primary Batteries > CR (Coin Type Lithium Manganese Dioxide Battery)

Cylindrical Type Lithium Manganese Dioxide Battery



Overview

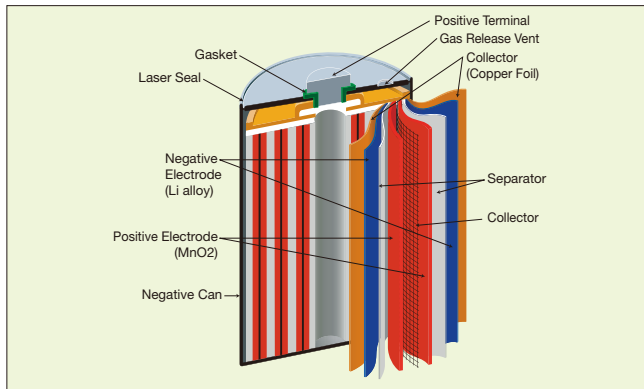
Maxell's cylindrical type lithium manganese dioxide battery realizes stable discharge characteristics with its original sealing structure, improved electrical-conductivity structure, and negative electrode material. This battery's high reliability makes it ideal for use as a power source in industrial applications such as security devices and electronic meters. Assembled batteries can also be produced to meet special customer requirements. For details, please contact your nearest Maxell dealer or distributor.

Features

- **Long-term reliability of 10 years***
The employment of a heat-resistant gasket and a laser-seal structure prevents water intrusion and electrolyte evaporation, ensuring a long-term reliability of 10 years. The self-discharge rate is about 0.5% per year.
- **Stable discharge characteristics**
The original negative electrode material maintains low internal resistance even at high depths of discharge and ensures stable discharge.
- **Superior low-temperature characteristics**
- **High safety due to internal short-circuit prevention structure**

* Designed lifetime at 20 deg. C when not yet used.
Actual lifetime will vary depending on conditions such as discharge current and temperature.

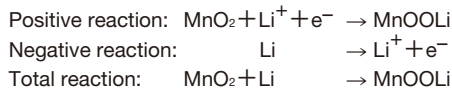
Construction



Principle and Reactions

The cylindrical type lithium manganese dioxide battery uses manganese dioxide (MnO₂) as its positive active material, and lithium (Li) as its negative active material.

Battery reactions



UL Recognized Components

The cylindrical type lithium manganese dioxide battery is a UL (Underwriters Laboratories Inc.) recognized component. (Technician Replaceable)
 Recognized model: CR17450 AH (User Replaceable)
 Recognized models: CR17450 A, CR17335 A
 Certification Number: MH12568

Applications

- Security Devices
- Communication Tags
- ETC (Electronic Toll Collection System)
- Home Fire/Smoke Alarms
- Electronic Meters (Gas, Water, Electricity)
- Memory Backup Power

Products

Model	CR17450 AH	CR17450 A	CR17335 A
Nominal Voltage (V)	3	3	3
Nominal Capacity (mAh)*1	3000	2500	1650
Nominal Discharge Current (mA)	1	5	5
Operating Temperature Range (deg. C)	-40 to +85		
Dimensions*2	Diameter (mm)	17	17
	Height (mm)	45	45
Weight (g)*2	24	22	17

*1 Nominal capacity indicates duration until the voltage drops down to 2.0V when discharged at a nominal discharge current at 20 deg. C.
 *2 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.
 • Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

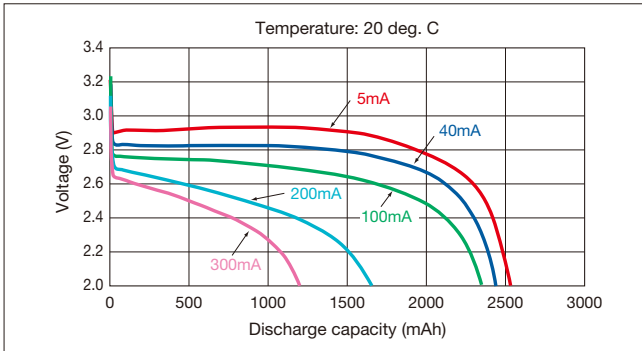
External Dimensions with Terminals and Wire Connectors (unit : mm)

CR17450 A VO-T3	CR17450 A WK 41	CR17450 A 2WK 35	CR17335 A VO-T3	CR17335 A WK 11
	<p>Housing: PHR-2 (JST) Contact: SPH-002T-P0.5S (JST) Lead Wire: AWG26 UL1007</p>	<p>Housing: PHR-2 (JST) Contact: SPH-002T-P0.5S (JST) Lead Wire: AWG26 UL1007</p>		<p>Housing: PHR-2 (JST) Contact: SPH-002T-P0.5S (JST) Lead Wire: AWG26 UL1007</p>

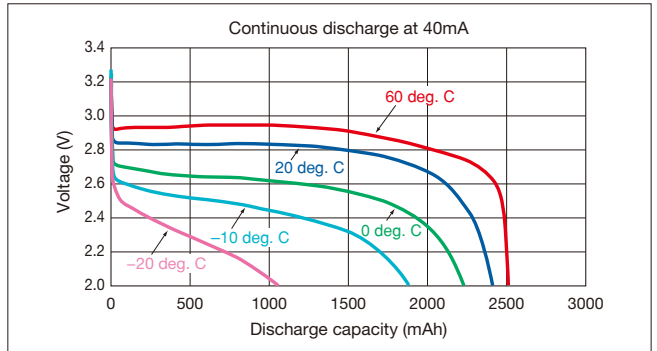
Legend: Horizontal & Through hole Type
 Wire connector Type
 Tin plating
 The above are examples. Processing to meet customer requests is possible.

Characteristics (CR17450 A)

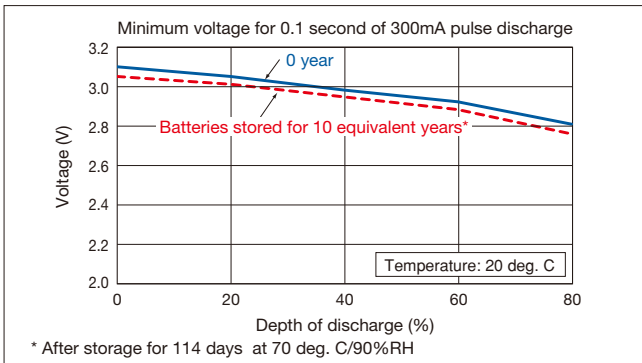
Discharge characteristics



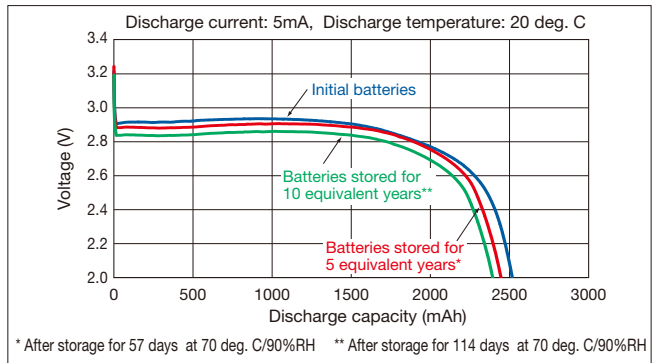
Temperature characteristics



Pulse discharge characteristics

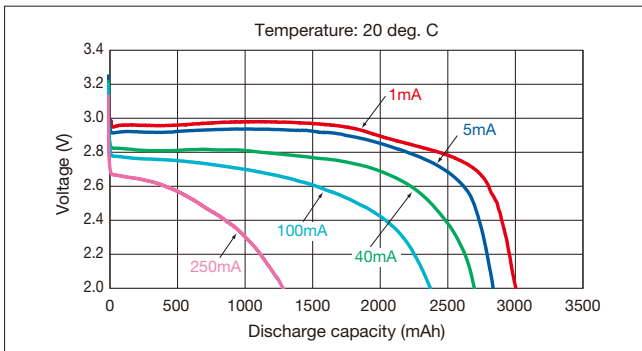


Storage characteristics

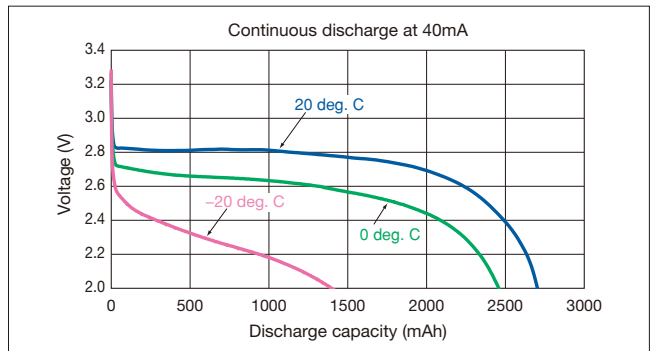


Characteristics (CR17450 AH)

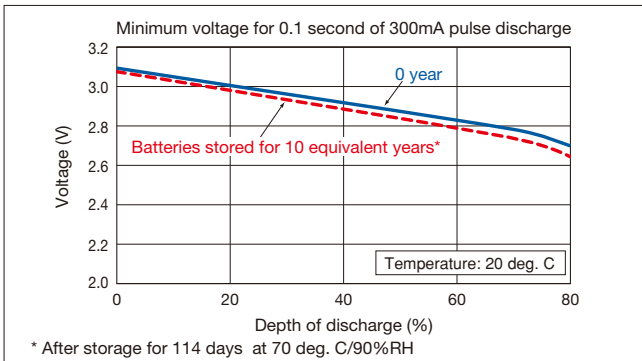
Discharge characteristics



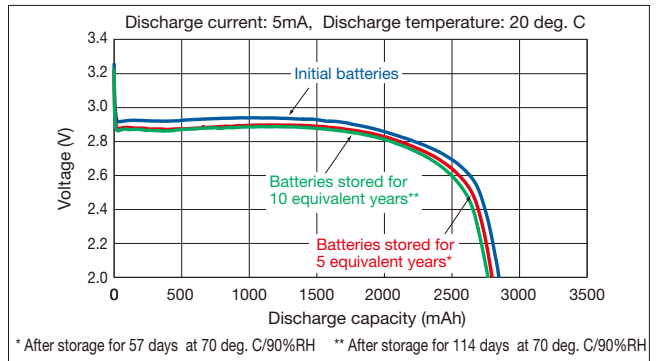
Temperature characteristics



Pulse discharge characteristics



Storage characteristics



Visit our website for more information

<http://biz.maxell.com/en/> Go to: Products > Primary Batteries > CR (Cylindrical Type Lithium Manganese Dioxide Battery)

Li/Thionyl Chloride Battery

Lithium Thionyl Chloride Battery (Li/SOCl₂)



LITHIUM THIONYL CHLORIDE BATTERY

ER

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, 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.

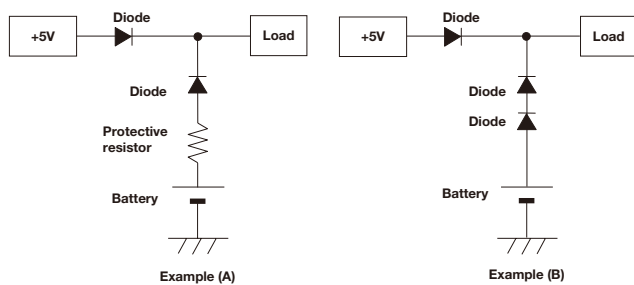
Because this liquid could cause serious damage, if it does come in contact with your eyes, flush them immediately with plenty of water and consult a physician. Likewise, if the liquid gets in your mouth, rinse immediately with plenty of water and consult a physician.

■ 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 0.5 μ A.

■ 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

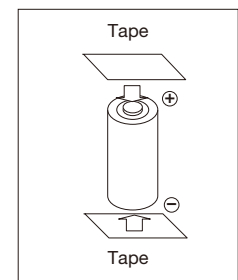
main power source 5 volt. Since the permitted charge current is 100 μ A and this battery's voltage is 3.6V, let the resistor be $R \geq (5V-3.6V)/100\mu A=14k$ ohm, meaning that at least 14k ohm is required.

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

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.
- 3) Please remove and dispose of the battery when device is no longer in use. If the battery is left in the device, electrolyte may leak from the battery generating irritating/corrosive gas.
- 4) If the sealed area is damaged in any way, corrosive and conductive electrolyte may leak from the battery. Please consider this when designing devices.

■ Never allow the battery to come in contact with water.

If it does, this may cause the battery to rust or lead to distortion, leakage, overheating, explosion, or fire.

■ Never store the battery in a hot and humid environment.

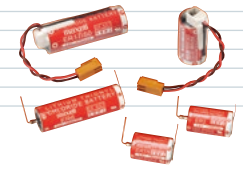
Otherwise it may cause battery performance deterioration, deformation, leakage, overheating, or explosion.

■ 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.

Lithium Thionyl Chloride Battery



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.

Features

■ High 3.6-V voltage

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

■ 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/cm³ with discharge current of 100μA (ER6 type).

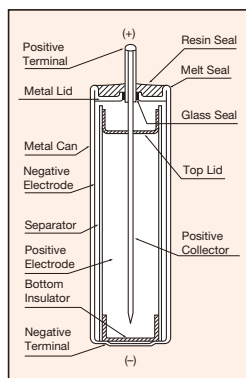
■ Wide usable temperature range

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.

Construction



Principle and Reactions

The lithium thionyl chloride battery uses liquid thionyl chloride (SOCl₂) as its positive active material, and lithium (Li) as its negative active material. The reactions of the battery are shown below.

■ Battery reactions

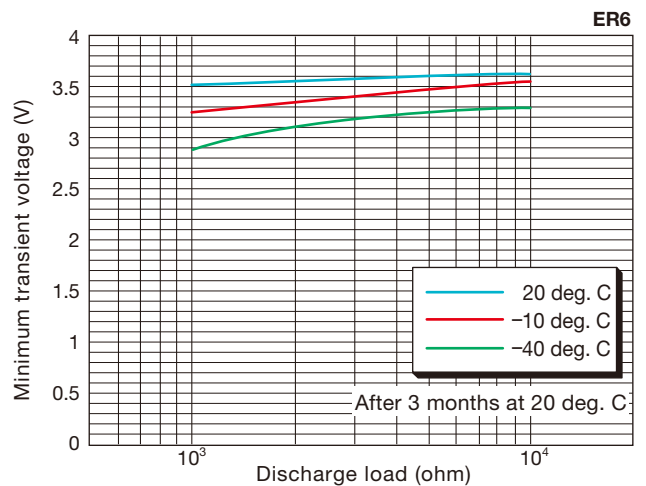
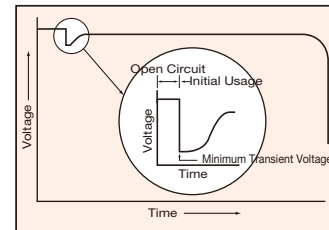
Positive reaction: $2\text{SOCl}_2 + 4\text{Li}^+ + 4\text{e}^- \rightarrow 4\text{LiCl} + \text{S} + \text{SO}_2$

Negative reaction: $\text{Li} \rightarrow \text{Li}^+ + \text{e}^-$

Total reaction: $2\text{SOCl}_2 + 4\text{Li} \rightarrow 4\text{LiCl} + \text{S} + \text{SO}_2$

Minimum transient voltage

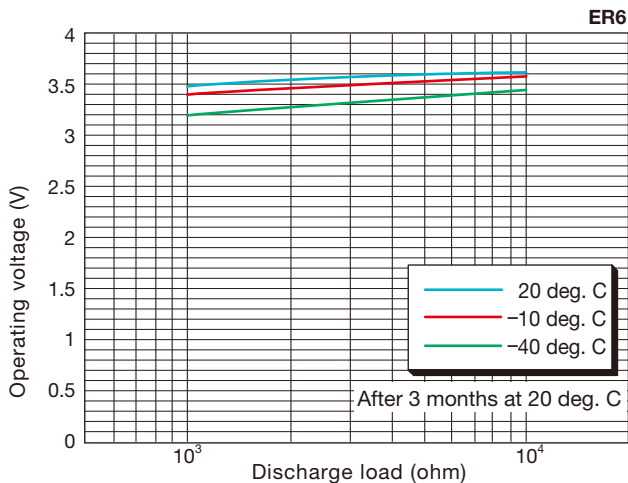
The lithium thionyl chloride battery has remarkably lower self-discharge when compared with conventional batteries. This is because a lithium chloride membrane is formed over the negative lithium surface, blocking reaction with the positive material. When first discharging after storage, resistance from 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.

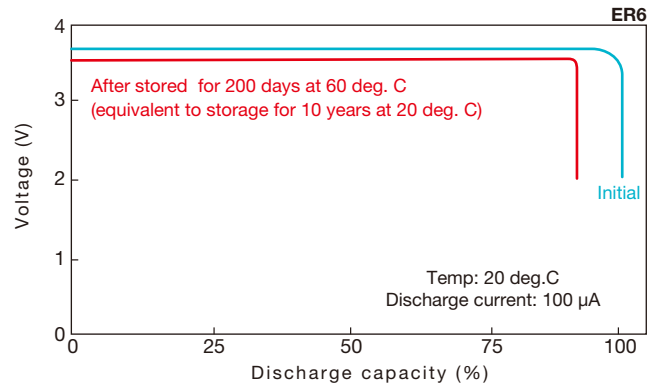
Relationship between Discharge Load and Operating Voltage

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)*1	3650	2750	2000	1800	1600	1100	790	
Nominal Discharge Current (µA)	125	125	100	100	75	40	35	
Operating Temperature Range (deg. C)	-55 to +85							
Dimensions*2	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)*2	22	20	15	15	13	8	7	

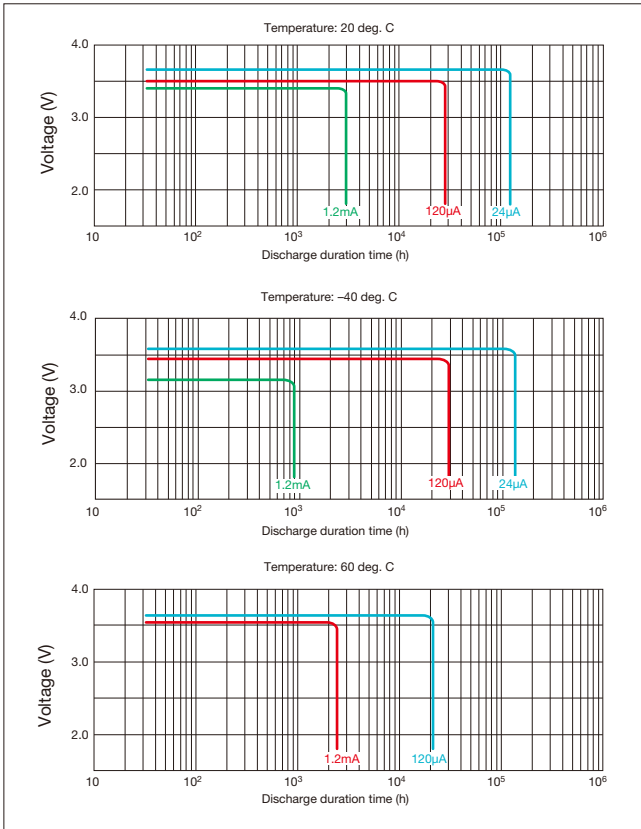
*1 Nominal capacity indicates duration until the voltage drops down to 3.0V when discharged at a nominal discharge current at 20 deg. C.

*2 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.

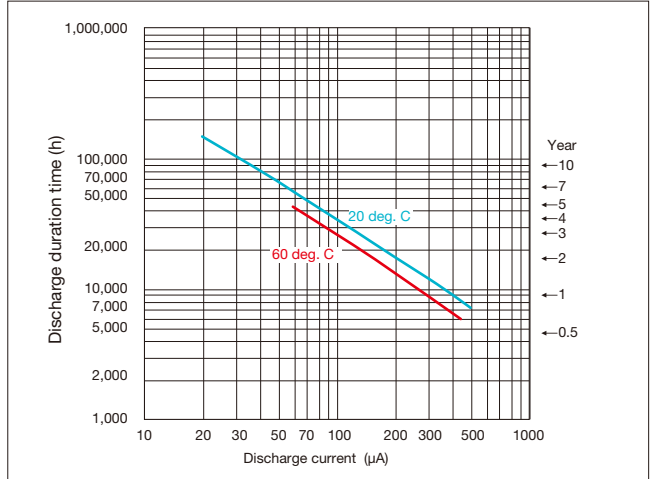
- Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Characteristics (ER18/50)

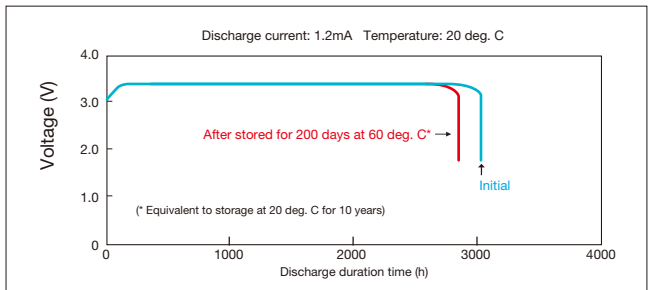
Discharge Characteristics



Relationship between Discharge Current and Duration Time

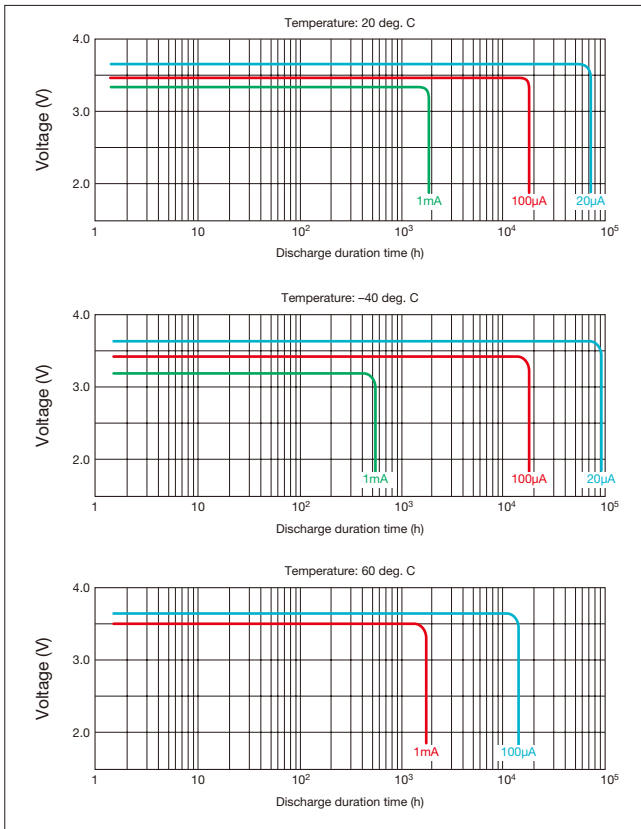


Storage Characteristics

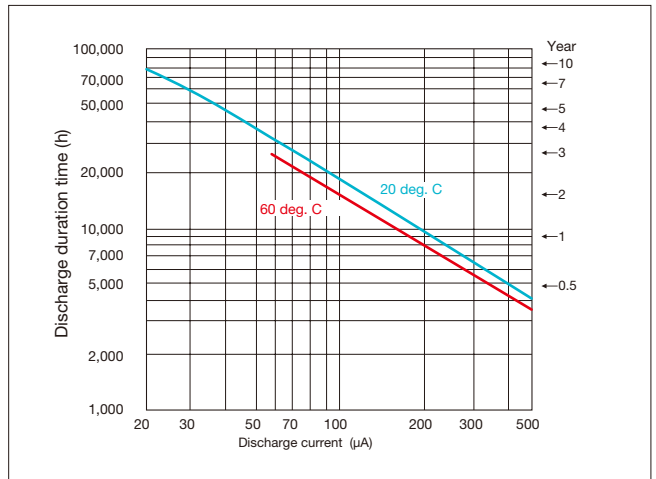


Characteristics (ER6)

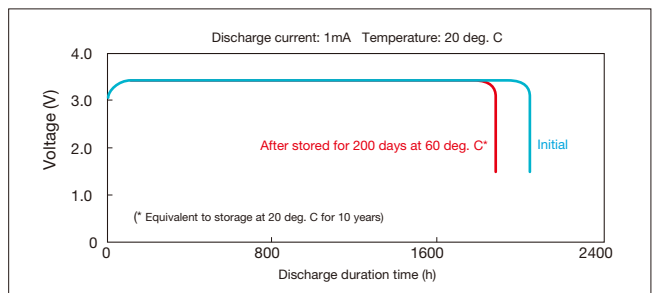
Discharge Characteristics



Relationship between Discharge Current and Duration Time

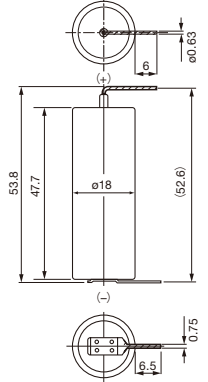
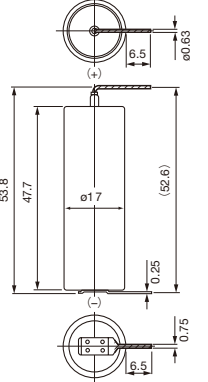
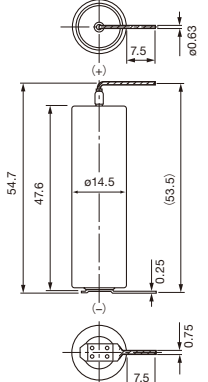
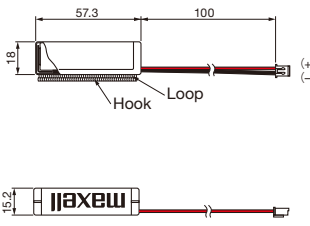
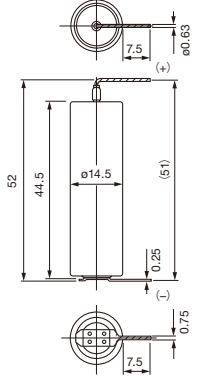
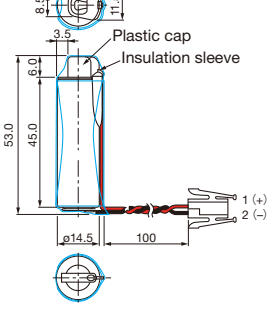
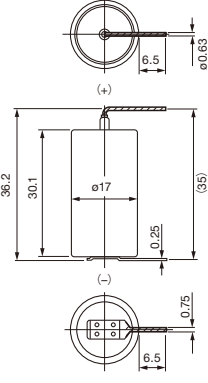
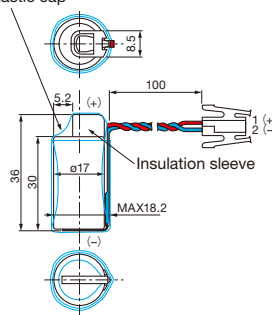
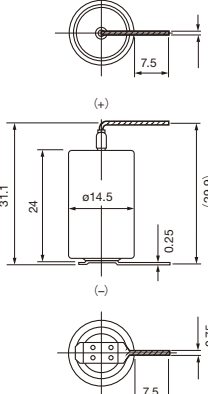
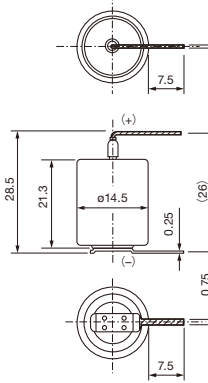


Storage Characteristics



E R E

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

ER18/50 #2 PC	ER17/50 #2 PC	ER6 #2 PC	
			
ER6K-#17	ER6C #2 PC(2)	ER6C WKP	
 <p data-bbox="151 1176 438 1243"> Housing: XHP-2 (JST) Contact: SXH-001GH-P0.6 (JST) Lead wire: AWG26 UL1007 </p>		 <p data-bbox="821 1198 1141 1265"> Housing: HNC2-2.5S-2 (Hirose) Contact: HNC-2.5S-C-B (03) (Hirose) Lead wire: AWG26 UL1007 </p>	
ER17/33 #2 PC	ER17/33 WKP	ER3 #2 PC	ER3S #2 PC
	 <p data-bbox="486 1691 798 1758"> Housing: HNC2-2.5S-2 (Hirose) Contact: HNC-2.5S-C-B (03) (Hirose) Lead wire: AWG26 UL1007 </p>		

The above are examples. Processing to meet customer requests is possible.

 : Horizontal & Through hole Type

 : Wire connector Type

 : Tin plating

Visit our website for more information

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

Go to: Products > Primary Batteries > ER (Lithium Thionyl Chloride Battery)

SR

Silver Oxide Battery

Primary Battery



SILVER OXIDE BATTERY

Safety Instructions

Improper handling of the battery could lead to distortion, leakage*, overheating, or explosion, causing bodily injury or equipment trouble. Especially touch with liquid leaked out of battery could cause injury like a loss of eyesight. Please observe the following instructions to prevent accidents.

(* Leakage is defined as the unintentional escape of a liquid from a battery.)

⚠ Warnings — Handling

■ Never swallow.

Always keep the battery out of the reach of infants and young children to prevent it from being swallowed. If it is swallowed, consult a physician immediately.

■ Never allow liquid leaking from the battery to get in your body.

The battery contains strong alkaline liquid, which is deleterious material. If it does come in contact with your eyes, flush them immediately with plenty of water and consult a physician, because the alkaline liquid could cause becoming blind. Likewise, if the liquid gets in your mouth, rinse immediately with plenty of water and consult a physician. The alkaline liquid could also cause the skin irritation and/or chemical burns. If the liquid adheres to the skin or clothes, immediately flush it with plenty of water.

■ 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, or explosion.

■ Never expose to open flames.

Exposing to flames could cause explosion of the battery.

■ Never heat.

Heating the battery to more than 100 deg. C could increase the internal pressure, causing distortion, leakage, overheating, or explosion.

■ Never disassemble or deform the battery.

Disassembly or deforming of the battery could cause the leakage, overheating, or explosion due to an internal short-circuits.

⚠ Caution — Handling/Storage

■ Never reverse the positive and negative terminals when mounting.

Improper mounting of the battery may lead to short-circuiting, charging or forced-discharging. This may cause distortion, leakage, overheating, or explosion.

■ Never short-circuit the battery while installing into equipment.

Please be careful when installing the battery not to short-circuit it with metal portions of the equipment.

■ Never weld the terminal or wire to the body of the battery directly.

The heat of welding or soldering may cause distortion, leakage, overheating, or explosion of the battery.

■ Never use different batteries together.

Using different batteries together, i.e. different type or used and new or different manufacturer may cause distortion, leakage, overheating, or explosion because of the differences in battery property.

■ Never leave the used battery in equipment.

Long time leaving in the equipment may generate gas leading to distortion, leakage, overheating, or explosion and the equipment may be damaged.

■ Remove the battery from equipment while not in use for a long time.

Gas may be generated in the battery leading to leaking and damaging of the equipment.

■ **Never subject the battery to severe shock.**

Dropping, or throwing or stomping on the battery may cause distortion, leakage, overheating, or explosion.

■ **Use the correct battery suitable for the equipment.**

The battery may not be suitable for the specific equipment due to the using conditions or type of equipment. Please select the suitable battery according to the handling instructions of the equipment.

■ **Never use or leave the battery in a hot place such as under the direct rays of the sun or in a car in hot weather.**

If you do, this may cause distortion, leakage, overheating, and explosion of the battery.

■ **Never store the battery in a hot and humid environment.**

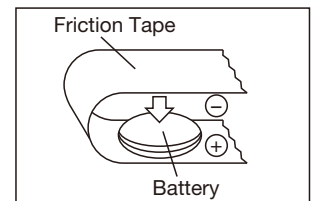
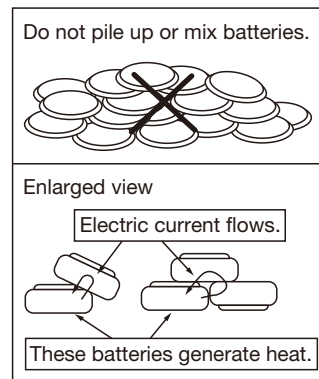
Otherwise it may cause battery performance deterioration, deformation, leakage, overheating, or explosion.

■ **Never allow the battery to come in contact with water.**

If it does, this may cause the battery to rust or lead to distortion, leakage, overheating, and explosion.

⚠ Caution — 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 may 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



Overview

Maxell is the first company in Japan to successfully market button-type silver oxide batteries. Based on many years of experience and know-how in various fields, the SR battery is suitable for precision electronic devices such as quartz watches, where high-energy density per unit volume and a stable operating voltage are required. Various product lineups are available to meet the growing need for supplying power to various types of watches, ranging from large to compact, thin models.

Zero-mercury, zero-lead added types are also available. For more information, please contact Maxell.

Features

■ Stable discharge characteristics

A discharge curve during discharge supplies a stable voltage until the end of the discharge life.

■ High-energy density

High-energy density per unit volume provides approx. twice as the amount of energy capacity as button-type alkaline batteries.

■ Excellent discharge load characteristics

Employing an alkaline electrolyte, the SR battery features excellent discharge load characteristics. Depending on the composition of the electrolytes, two models are available; (1) a low-drain type for analog watches, and (2) a high-drain type for multi-function watches incorporating an alarm, illumination light, etc.

■ Superior leakage* resistance

Featuring Maxell's original leak-resistant processing, the SR battery has excellent leakage resistance, which suppresses the electrolyte from rising up and seeping out — a basic phenomenon of alkaline electrolytes.

(* Leakage is defined as an unintended escape of liquid from a battery.)

■ Taking environment in consideration

As one of its measures to reduce the environmental impact, Maxell draws upon its original technology to realize longer-lasting, superior leakage-resistant characteristics without using mercury and lead.

Principle and Reactions

The button-type silver oxide battery uses silver oxide (Ag_2O) as its positive active material and zinc (Zn) as its negative active material. Potassium hydroxide (KOH) (W-type) or sodium hydroxide (NaOH) (SW-type) is used as an electrolyte.

■ Battery reactions

Positive reaction $\text{Ag}_2\text{O} + \text{H}_2\text{O} + 2\text{e}^- \rightarrow 2\text{Ag} + 2\text{OH}^-$

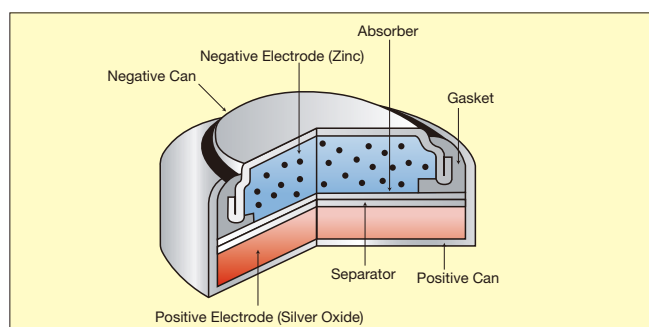
Negative reaction $\text{Zn} + 2\text{OH}^- \rightarrow \text{ZnO} + \text{H}_2\text{O} + 2\text{e}^-$

Total reaction $\text{Ag}_2\text{O} + \text{Zn} \rightarrow 2\text{Ag} + \text{ZnO}$

Applications

- Watches
- Calculators
- Medical Instruments
- Measuring Instruments

Construction



Products

High drain type													
Model	SR44W	SR43W	SR1130W	SR1120W	SR936W	SR927W	SR920W	SR41W	SR726W	SR721W	SR626W	SR621W	
Nominal Voltage (V)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	
Nominal Capacity (mAh)*	165	125	79	55	75	60 57	39	39	28	25	28	18	
Nominal Discharge Current (µA)	200	200	100	100	100	100	100	50	50	50	50	50	
Dimensions	Diameter (mm)	11.6	11.6	11.6	11.6	9.5	9.5	9.5	7.9	7.9	7.9	6.8	6.8
	Height (mm)	5.4	4.2	3.05	2.05	3.6	2.73	2.05	3.6	2.6	2.1	2.6	2.15
Weight (g)	2.2	1.8	1.2	1.0	1.1	0.8	0.6	0.7	0.5	0.45	0.4	0.3	

Low drain type												
Model	SR44SW	SR43SW	SR1136SW	SR1130SW	SR1120SW	SR1116SW	SR936SW	SR927SW	SR920SW	SR916SW	SR914SW	SR41SW
Nominal Voltage (V)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Nominal Capacity (mAh)*	165	125	100	83	55	29	71	55 50	45 39 35	26.5	22	45
Nominal Discharge Current (µA)	200	100	100	100	100	50	100	100	50	50	35	50
Dimensions	Diameter (mm)	11.6	11.6	11.6	11.6	11.6	9.5	9.5	9.5	9.5	9.5	7.9
	Height (mm)	5.4	4.2	3.6	3.05	2.05	1.65	3.6	2.73	2.05	1.65	1.45
Weight (g)	2.2	1.7	1.6	1.2	1.0	0.7	1.1	0.8	0.7 0.6	0.5	0.45	0.7

Low drain type												
Model	SR731SW	SR726SW	SR721SW	SR716SW	SR712SW	SR626SW	SR621SW	SR616SW	SR527SW	SR521SW	SR516SW	SR512SW
Nominal Voltage (V)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Nominal Capacity (mAh)*	36	33	25	23 22	10	30 28 26	23 18	16 15	17	16 13	12.5	5.5
Nominal Discharge Current (µA)	50	50	30	30	20	30	30	20	30	20	20	5
Dimensions	Diameter (mm)	7.9	7.9	7.9	7.9	7.9	6.8	6.8	6.8	5.8	5.8	5.8
	Height (mm)	3.1	2.6	2.1	1.68	1.29	2.6	2.15	1.65	2.7	2.15	1.65
Weight (g)	0.7	0.5	0.45	0.3	0.25	0.4	0.3	0.3	0.3	0.3	0.2	0.14

Low drain type		General type							
Model	SR421SW	SR416SW	SR44	SR43	SR1130	SR1120	SR41	4SR44	
Nominal Voltage (V)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	6.2	
Nominal Capacity (mAh)*	12	8.3	165	125	79	55	39	160	
Nominal Discharge Current (µA)	20	10	200	100	100	100	50	200	
Dimensions	Diameter (mm)	4.8	4.8	11.6	11.6	11.6	11.6	7.9	13
	Height (mm)	2.15	1.65	5.4	4.2	3.05	2.05	3.6	25.2
Weight (g)	0.17	0.12	2.2	1.8	1.2	1.0	0.7	11.7	

* Nominal capacity indicates the duration until the voltage drops to 1.2V when discharged at a nominal discharge current at 20 deg. C.
 • Data, dimensions and weight are reference values only. For further details, please contact your nearest Maxell office.

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Go to: Products > Primary Batteries > SR (Silver Oxide Battery)

CLB

Coin Type Lithium-ion Rechargeable Battery

Secondary Battery



COIN TYPE LITHIUM-ION RECHARGEABLE BATTERY (CLB)

Notes for Designers

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

■ Charge conditions

To get the most out of coin type lithium-ion batteries and use them safely, please use specified charge IC, protection IC and read the following requirements carefully: For different charge IC, protection IC, consult your nearest Maxell dealer or distributor.

Charge conditions

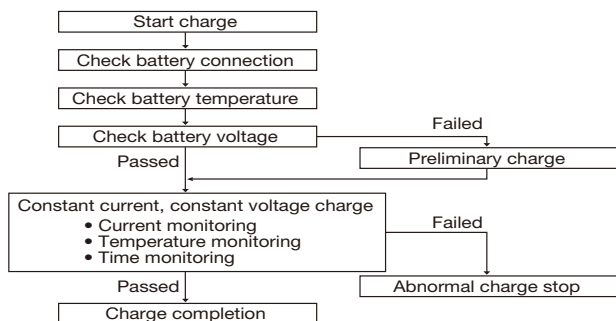
Charge IC	Specified IC by Maxell
Charge method	Constant current, constant voltage charge
Charge voltage	4.20±0.05V / cell
Standard charge current	0.5I _N A
Max. charge current	1.0I _N A
Charge temperature	0 to +45 deg. C

Protection conditions

Protection IC	Specified IC by Maxell
---------------	------------------------

■ Charge control flowchart (sample)

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



Safety Instructions

The battery contains organic solvents and other combustible materials. For this reason, improper handling of the battery could lead to distortion, leakage*, overheating, explosion or fire, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents. The following 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.

(* Leakage is defined as the unintentional escape of a liquid from a battery.)

⚠ 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 or fire.
- Do not heat the battery. Otherwise heating the battery could increase the internal pressure, causing leakage, explosion, overheating 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 distortion, leakage, overheating, explosion or fire due to an abnormal chemical reaction during charge or an excessive current during discharge.
- 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 overheating, explosion, fire or heat generation of the metal necklace or the hairpin.
- Do not apply any heavy impact to the battery, throw or drop it. Do not apply heavy load to the battery causing distortion. Otherwise the battery may be shorted and result in leakage, overheating, explosion or fire.
- Do not drive a nail into, hammer or stamp on the battery. Otherwise the battery may be shorted and result in destruction, distortion, overheating, explosion or fire.
- Do not weld a terminal or weld a wire to the body of the battery directly. The heat of welding or soldering could cause damage to the insulating material or the structure in the battery, leading to distortion, leakage, overheating, explosion, or fire. When soldering the battery directly to equipment, use the battery with tabs or leads and solder only the tips of 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 by connecting to power source.

- Do not disassemble or alter the battery. Otherwise the insulating materials or the inside structure could be damaged, leading to distortion, leakage, overheating, explosion or fire.
- 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. Otherwise over-discharging the battery may cause an abnormal chemical reaction in the battery and result in the degradation of battery performance, such as a shortening of battery life, distortion, leakage, overheating or fire.
- When charging the battery, 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 distortion, overheating, 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.
- 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 overheating, explosion or fire.
- Do not use the battery with any equipment or device other than those specified by the manufacturer. Any such practice may expose your equipment or device to an abnormal current, which may result in distortion, overheating, explosion or fire.

⚠ Warnings

- Do not 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.
- 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 overheating, 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.
- Design your equipment so that the end user cannot replace the battery by mistake. If you are an equipment manufacturer and need to replace the battery, please use a new one of the same type and same model as the existing one. Because this is a rechargeable battery, its characteristics are completely different from other primary batteries (e.g. coin type lithium manganese dioxide batteries: CR) or other secondary batteries (e.g. lithium manganese dioxide rechargeable batteries: ML) even though their shapes are alike. If a different battery is installed in the circuit in place of a CLB battery, gas could be generated or the primary battery could be short-circuited by charging. This could lead to distortion, leakage, overheating, explosion or fire.
- 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 overheating, 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 explosion or fire.
- 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.
- When charge does not stop in an expected period of time, stop charging. Otherwise the battery may cause overheating, explosion or fire.

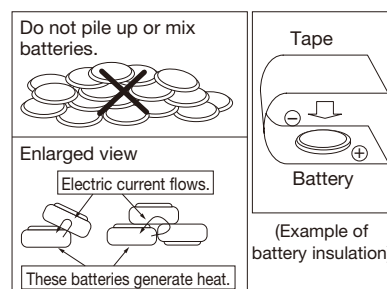
⚠ Caution

- Use protection circuit in the application or a battery pack in order to prevent over-charge or over-discharge. Excess charge current or charge voltage may cause distortion, leakage, overheating, explosion or fire.
- Do not allow the battery electrodes to come in contact with your skin or fingers. Do not stick the battery on skin with adhesive tape or glue. Otherwise the moisture from your skin could cause a discharge of the battery, which could produce certain chemical substances causing you to receive chemical burns.
- Please be careful when installing the battery not to short-circuit it with metal portions of the equipment. Otherwise this could lead to distortion, leakage, overheating, explosion or fire.
- Keep the contact force at more than 2N for stable contact resistance. Otherwise the battery voltage may be lower than intended value due to poor contact condition.
- Do not use or leave the battery in a hot and highly humid place such as under the direct rays of the sun or in a car in hot weather. It may cause distortion, leakage, overheating, explosion or fire.
- Do not leave the battery or battery pack being charged after charge is finished. Otherwise it may cause the degradation of battery performance, such as a shortening of battery life.
- 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.
- 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

⚠ 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.





Overview

Developed by Maxell, the coin type lithium-ion rechargeable battery has a high-rate discharge characteristic of up to 2I_A, made possible by the battery's original stacked electrode structure. This compact high-power battery is designed for small portable devices that have communication and charging functions.

Features

■ High power

A unique stacked electrode structure enables power of up to 140mA (CLB2032).

■ Discharge capability of CLB2032 is approximately 40 times better*

* Compared with Maxell's CR2032 at 60% available capacity

■ 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.

■ High reliability

Maxell has concentrated its original technologies, accumulated during the development of crimping and electrode coating technologies, into this highly reliable CLB battery. The stainless steel battery body minimizes battery swelling.

■ Superior safety

Separator-wrapped positive electrodes help prevent internal short-circuits. Safety is ensured even when external short-circuits occur.

UL (Underwriters Laboratories Inc.) Recognized Components (Technician Replaceable)

Recognized models: CLB3032, CLB2032, CLB2016, CLB937
Certification Number: MH12568

Applications

- Biological information monitoring systems
- Wearable data devices
- Medical sensor networks
- Environment monitoring systems
- Logistics management systems
- Rechargeable hearing aids
- Remote keyless entry systems (RKE)
- Multifunction watches

Products

Model		CLB3032	CLB2032	CLB2016	CLB937
Initial dimensions (mm) ^{*1}	Diameter	30	20	20	9.5
	Height ^{*2}	3.6	3.45	2.0	3.9
Weight (g) ^{*1}		7.5	3.0	2.1	0.7
Charge (CCC) ³	Max. voltage (V)	4.2	4.2	4.2	4.2
	Standard current (mA)	100	35	15	9
	Temperature (deg. C)	0 to +45			
Discharge (CC)	End voltage (V)	3.0	3.0	3.0	3.0
	Max. current (mA)	400	140	60	36
	Temperature (deg. C)	-20 to +60			
Nominal voltage (V)		3.7	3.7	3.7	3.7
Nominal capacity (mAh) ^{*3}		200	70	30	18

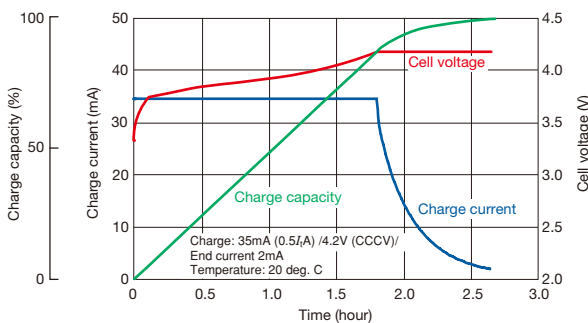
*1 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.

*2 100% charged

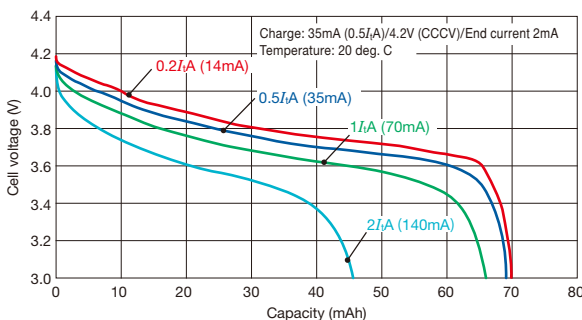
*3 Nominal capacity is according to the following conditions: Charge: 0.5I_A/4.2V (CCC)/End current 2mA (CCC)/End current 0.03I_A, Discharge: 0.2I_A/E.V. = 3.0V, Temperature 20 deg. C
• Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Characteristics (CLB2032)

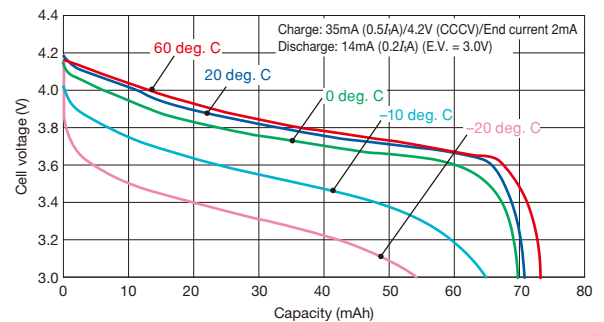
■ Charge characteristics



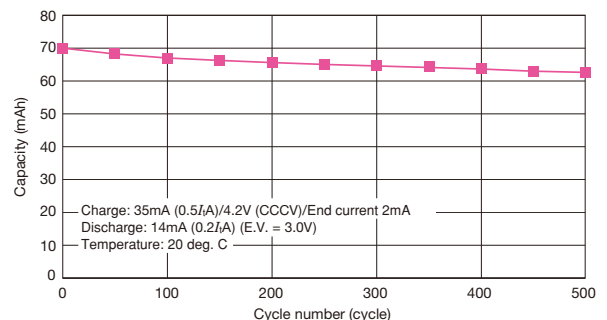
■ Discharge load characteristics



■ Discharge temperature characteristics



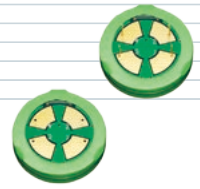
■ Cycle life characteristics



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Go to: Products > Rechargeable Batteries > CLB (Coin Type Lithium-ion Rechargeable Battery)



Overview

Maxell has developed a CLB2032 battery unit that includes battery control functions. This battery unit facilitates circuit design and can be installed quickly.

Features

■ Small CLB2032 battery unit that includes battery control functions

With a diameter of 20mm* and a height of 5mm, this small battery unit includes a charge control, protection function and voltage regulator.

■ Facilitates circuit design

This CLB2032 battery unit has essential control circuits, enables easy circuit design and can be installed quickly.

■ Charge control function

The charging process is controlled automatically.

■ Protection function

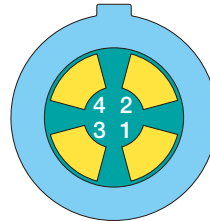
Under-voltage, over-voltage and other limitations are controlled automatically.

■ Voltage regulation (optional)

The CLB2032 battery unit includes a DC/DC converter, which enables the device to have constant voltage supply and detect low power when charging is necessary. This supports easier circuit design from a primary battery to a rechargeable battery by using existing circuit designs.

* Diameter excludes projection.

Pin Configuration



1. Output (Vout)
2. Input (+5V)
3. Charge status (CHG)
4. GND

Products

Model		CLB2032 BU
Dimensions (mm)*1	Diameter*2	20
	Height	5.0
Weight (g)*1		3.8
Charge (CV)	Input voltage (V)	5.0
	Temperature (deg. C)	0 to +45
Discharge (CC)	End voltage (V)	3.0 (2.7*4)
	Max. current (mA)	140
	Temperature (deg. C)	-20 to +60
Nominal voltage (V)		3.7/3.0*5
Nominal capacity (mAh)*3		70

*1 Dimensions and weight are for the product itself, but may vary depending on terminal specifications and other factors.

*2 Diameter excludes projection.

*3 Nominal capacity is according to the following conditions: Charge: 0.5I_A/4.2V (CCCV)/End current 2mA, Discharge: 0.2I_A/E.V. = 3.0V, Temperature 20 deg. C without DC/DC converter

*4 2.7V means the under-voltage limit by the protection circuit

*5 The DC/DC converter enables voltages of between 3.7V and 0.8V. 3.0V is an example.

• Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

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

CLB2032 T1	CLB2032 WK1	CLB2032 BU PB	CLB2032 BU CB
	<p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Lead wire: AWG28 UL1571</p>	<p>Pin configuration</p> <ol style="list-style-type: none"> 1. Output (Vout) 2. Input (+5V) 3. Charge status (CHG) 4. GND <p>Gold plating</p>	<p>Terminal configuration</p> <ol style="list-style-type: none"> 1. Output (Vout) 2. Input (+5V) 3. Charge status (CHG) 4. GND <p>Gold plating</p>

The above are examples. Processing to meet customer requests is possible.

Visit our website for more information

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Go to: Products > Rechargeable Batteries > CLB2032 Battery Unit

Li-ion

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.

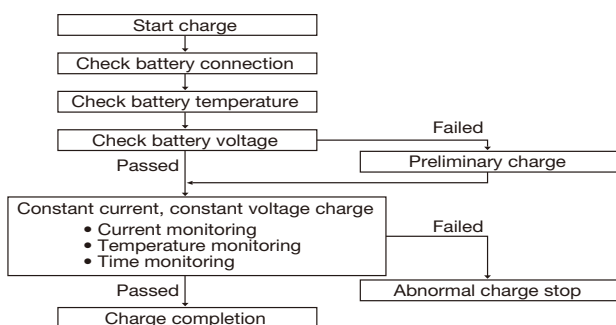
■ Charge conditions

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, 4.40±0.05V / cell
Max. charge current	1I _t 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 gasify 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.

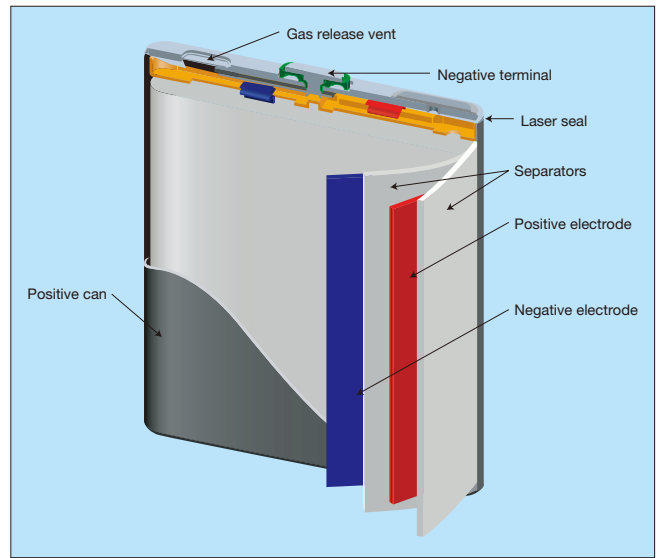
■ Excellent cost performance

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

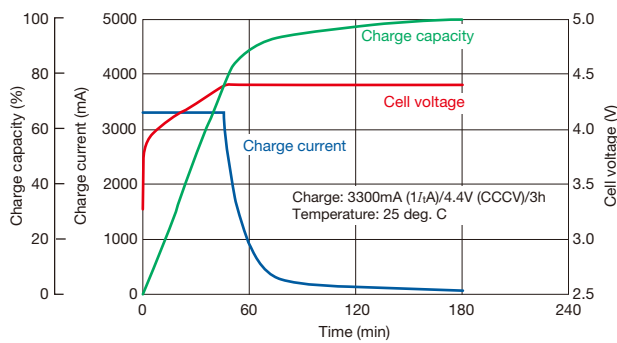


Applications

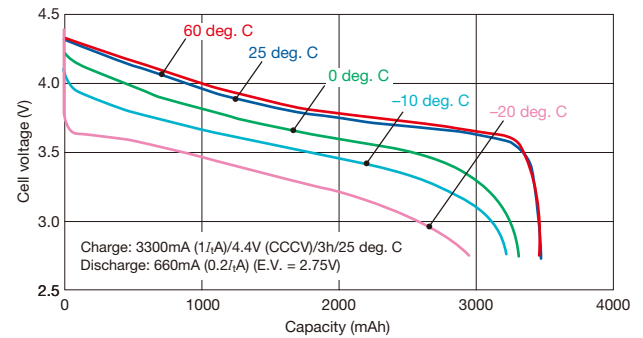
- Mobile phones, Smartphones
- Portable game devices
- Electronic books
- Electronic dictionaries
- Digital still cameras
- Digital audio players, etc.

Characteristics (ICP474998SWS)

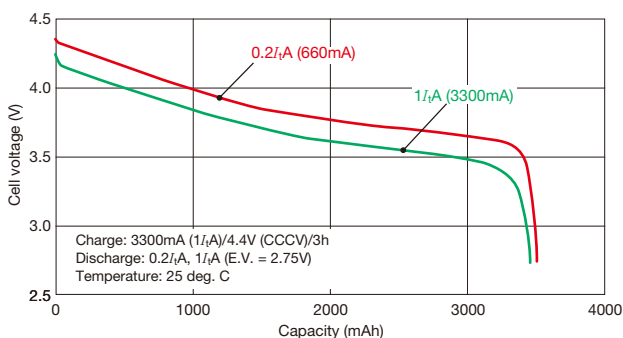
■ Charge characteristics



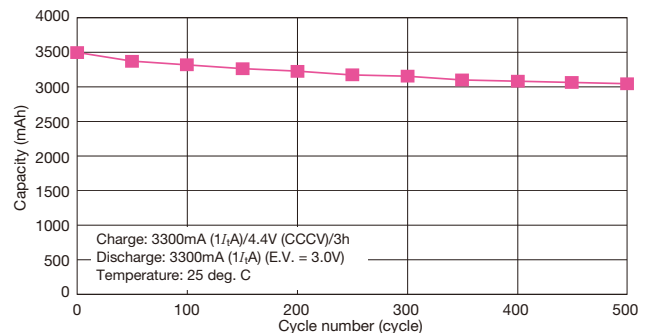
■ Discharge temperature characteristics



■ Discharge load characteristics



■ Cycle life characteristics



Li-ion

Products (Cell)

Model*1		ICP382230AQS	ICP415168SWR	ICP456475AWR	ICP463048XS	ICP474998SWS	ICP492547SRU
Dimensions (mm) ²	Thickness	3.65±0.15	3.85±0.2	4.25±0.15	4.3±0.2	4.45±0.25	4.6±0.2
	Width	21.85±0.15	50.85±0.1	63.15±0.1	29.3±0.2	48.5±0.2	24.1±0.2
	Height	30.0+0/-0.4	67.45+0/-0.5 ⁵	74.55+0/-0.4 ⁵	47.8+0/-0.6	97.35+0/-0.5 ⁵	46.1+0/-0.5 ⁵
Weight (g) ³		5.5	33	49	15.5	52	11
Charge (CCCV)	Max. voltage (V)	4.35	4.40	4.40	4.20	4.40	4.20
	Max. current (A)	0.40	2.05	3.00	0.75	3.30	0.54
Discharge (CC)	End voltage (V)	2.75	2.75	2.75	2.75	2.75	2.75
	Max. current (A)	0.50	3.08	4.50	1.13	4.95	0.80
Nominal voltage (V)		3.8	3.85	3.85	3.7	3.85	3.7
Minimum capacity (mAh) ⁴		250	2050	3000	750	3300	535

Model*1		ICP545483AHR (Under development)	ICP653450AHR	ICP653865SRU	ICP103444AHRU	ICP103450AHR
Dimensions (mm) ²	Thickness	5.1±0.2	6.2±0.3	6.2±0.3	9.7±0.3	9.7±0.3
	Width	53.35±0.1	33.8±0.2	37.8±0.2	33.6±0.2	33.6±0.2
	Height	82.65+0/-0.5 ⁵	49.6+0/-0.5	64.35+0/-0.5 ⁵	44.0+0/-0.4 ⁵	50.15+0/-0.5
Weight (g) ³		55	24	35	32	35.5
Charge (CCCV)	Max. voltage (V)	4.20	4.35	4.20	4.35	4.35
	Max. current (A)	3.00	1.36	1.80	1.85	2.16
Discharge (CC)	End voltage (V)	2.75	2.75	2.75	2.75	2.75
	Max. current (A)	4.50	2.04	2.70	2.78	3.24
Nominal voltage (V)		3.7	3.8	3.7	3.8	3.8
Minimum capacity (mAh) ⁴		2660	1360	1800	1850	2160

*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/4.20V-4.40V/3h, Discharge CC: 0.2I_t/E.V. = 2.75V, Temperature: 25 deg. C

*5 No positive terminal plate on the cell bottom

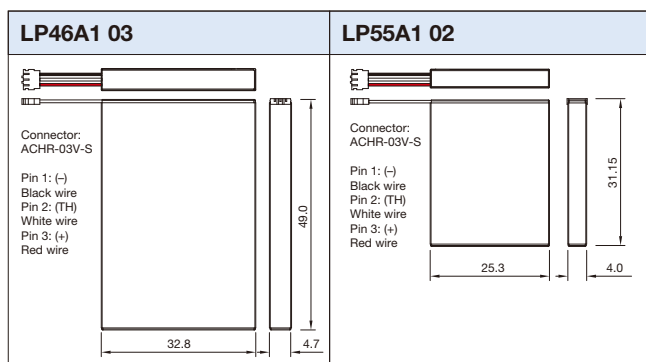
- Characteristics listed in this catalog are standard measured examples. Maxell does not guarantee these data.
- Specifications are subject to change without notice.
- This data is for lithium-ion cells only. Maxell offers these cells in battery pack format only. These include electronic circuits to 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.
- For further details, please contact your nearest Maxell dealer or distributor.

Standard Prismatic Lithium-ion Rechargeable Battery Pack (Soft Pack)

Features

- Small and light
- Allows our customers to adopt a lithium-ion rechargeable battery with minimal cost (no initial costs for development or a new tooling)
- Small minimum order quantity

External Dimensions (unit : mm)



Products

Model		LP46A1 03	LP55A1 02
Dimensions (mm) ¹	Thickness	4.7±0.3	4.0±0.3
	Width	32.8±0.5	25.3±0.5
	Height	49.0±0.5	31.15±0.5
Weight (g) ²		16	7
Charge (CCCV)	Max. voltage (V)	4.20±0.05	4.35±0.05
	Max. current (A)	0.75	0.40
Discharge (CC)	End voltage (V)	3.00	3.00
	Max. current (A)	1.125	0.50
Nominal voltage (V)		3.7	3.8
Minimum capacity (mAh) ³		750	250
Minimum order quantity		200 pcs	250 pcs

*1 Dimensions of unused battery without wire

*2 Approximate values

*3 Charge CCCV: 1I_t/4.2V-4.35V/3h

Discharge CC: 0.2I_t/E.V. = 3.00V

Visit our website for more information

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

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



Features

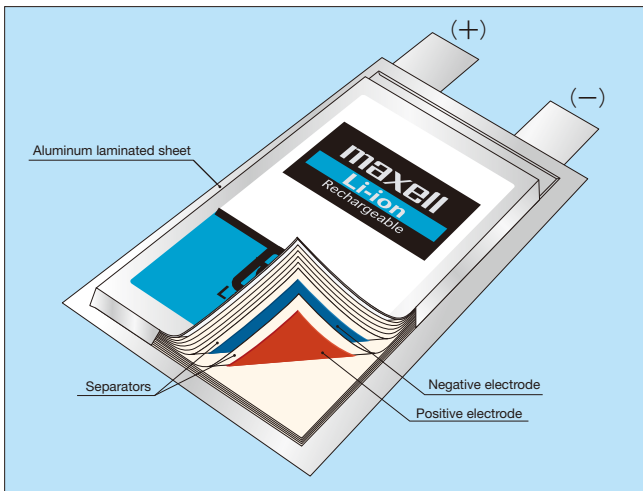
Thin battery with large capacity

Realization of a thin, large-capacity lithium-ion rechargeable battery with an aluminum laminated sheet. Excellent heat transfer characteristics during charge and discharge.

Superior discharge characteristics, cycle withstand ability

The combination of Maxell's original electrode technologies and a stacked electrode structure enables low impedance, stable performance at high-rate discharge and stable cycle characteristics.

Cell Structure



Applications

- Electric motorbikes/Electric power-assisted bicycles, AGVs (automated guided vehicles)
- Robotic devices
- Energy storage systems (ESSs), UPS backup systems, etc.

Products (Cell)

Model		L0678G8C1	L15A0N8C1
Dimensions (mm) ^{*1}	Thickness	Max. 6.6	Max. 7.6
	Width	78+1/-1	100+0/-2
	Height ^{*2}	168+1/-1	228+0/-2
Weight (g) ^{*3}		140	310
Charge (CCCV)	Max. voltage (V)	4.2	4.2
	Max. current (A)	12	30
Discharge (CC)	End voltage (V)	2.5	2.5
	Max. current (A)	12	30
Nominal voltage (V)		3.7	3.7
Minimum capacity (Ah) ^{*4}		6.0	15.0

*1 Dimensions of fresh cell

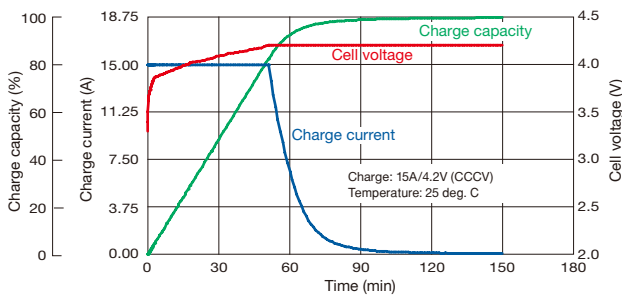
*2 Measured without terminals

*3 Approximate values

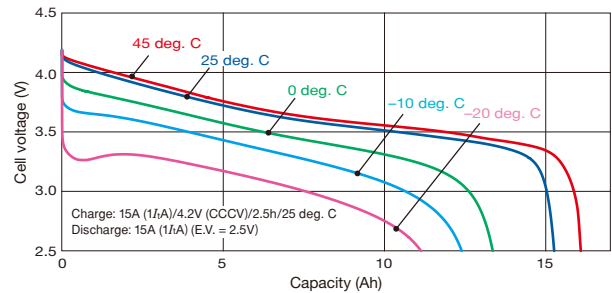
*4 Measured under the following conditions: Charge CCCV: 1I_t/4.2V/2.5h, Discharge CC: 0.2I_t/E.V. = 2.5V, Temperature: 25 deg. C

Characteristics (L15A0N8C1)

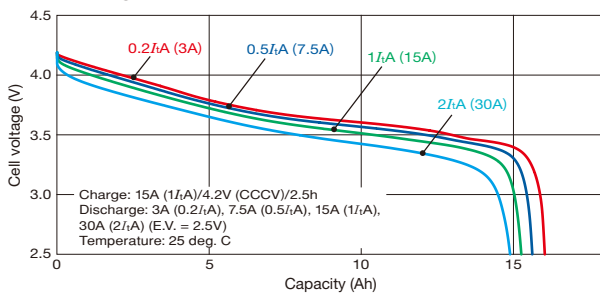
Charge characteristics



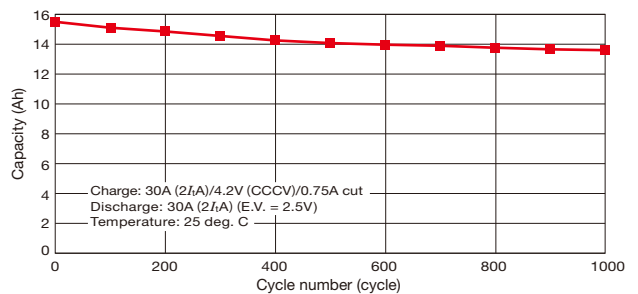
Discharge temperature characteristics



Discharge load characteristics



Cycle life characteristics



• 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.

ML

Lithium Manganese Dioxide Rechargeable Battery



LITHIUM MANGANESE DIOXIDE RECHARGEABLE BATTERY

Safety Instructions

This battery contains lithium, organic solvents, and other combustible materials. For this reason, improper handling of the battery could lead to distortion, leakage*, overheating, explosion, or fire, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents. (* Leakage is defined as the unintentional escape of a liquid from a battery.)

⚠ Warnings — Handling

■ 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.

■ Do not replace.

Depending on the battery manufacturer, there might be major differences in performance even among the same types or models of batteries. If you are an equipment manufacturer and need to replace the battery, please use a new one of the same type and same model as the existing one. Because this is a rechargeable battery, its characteristics are completely different from a primary battery even though their shapes are alike. If a primary battery is installed in the circuit in place of a rechargeable battery, gas could be generated or the primary battery could be short-circuited by charging. This could lead to distortion, leakage, overheating, explosion, or fire. Please design your equipment so that the end user cannot replace the battery by mistake.

■ Never use two or more batteries connected in series or in parallel.

If batteries are connected together, it is very difficult to design a circuit to observe whether or not the batteries are charged at specified voltage or current as described in "Warning -Circuit Design".

■ Never reverse the positive and negative terminals when mounting.

Improper mounting of the battery could lead to equipment trouble or short-circuiting. This could cause distortion, leakage, overheating, explosion, or fire.

■ 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. Please be careful when installing the battery not to short-circuit it with metal portions of the equipment. Otherwise, this could lead to distortion, leakage, overheating, explosion, or fire.

■ Never heat.

Heating the battery to more than 100 deg. C could increase the internal pressure, causing distortion, leakage, overheating, explosion, or fire.

■ 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.

Do not disassemble the battery, because the separator or gasket could be damaged, leading to distortion, leakage, overheating, explosion, or fire.

■ 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. 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 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.

■ Keep leaking batteries away from fire.

If leakage is suspected or you detect a strong odor, keep the battery away from fire, because the leaked liquid could catch on fire.

■ Never touch the battery electrodes.

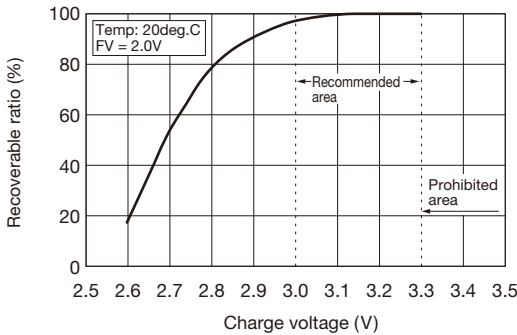
Do not allow the battery electrodes to come in contact with your skin or fingers. Otherwise, the moisture from your skin could cause a discharge of the battery, which could produce certain chemical substances causing you to receive a chemical burns.

Warnings – Circuit Design

Never set the charge voltage above 3.3V.

Charging at a higher voltage could cause the generation of gas, internal short-circuiting, or other malfunctions, leading to distortion, leakage, overheating, explosion, or fire. For details, see the recommended circuits below.

Fig. 1 Charge Property



Always charge at the nominal currents shown below.

Large surges of current could degrade the battery’s characteristics, leading to distortion, leakage, overheating, explosion, or fire. To avoid excessive current at the initiation of charging, make sure to attach a protective resistor for current control. See the recommended circuits below.

Table 1 Nominal Charge Current by Model

Model	ML2032	ML2016
Charge Current	2mA or lower	2mA or lower

Recommended circuits

Please refer to the representative basic circuits shown below. If you have any questions about circuit design, please feel free to contact Maxell.

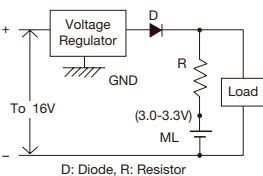


Table 2 Example of resistors

Model	Output Voltage of Voltage Regulator	
	3.1V	3.2V
ML2032	>550 ohm	>600 ohm
ML2016	>550 ohm	>600 ohm

(How to select a protective resistor for the current control)

The maximum charge current flows in the battery when charged at an end voltage of 2V. Therefore, the value of the resistor is calculated using this equation:

$$R \geq ((\text{Output Voltage of Voltage Regulator}) - 2) / (\text{Nominal Charge Current})$$

For example, the S-812C series, which has a maximum input voltage of 18V, or the S-817 series with a maximum input voltage of 10V (Seiko Instruments Inc.) can be used as a voltage regulator.

Note 1: If the main power source voltage is stable, the charge voltage can be allotted from main power source divided by the combination of resistors.

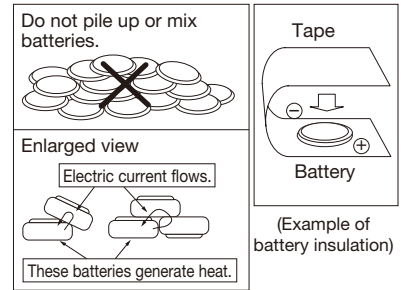
Note 2: Because the battery height must be changed by charge and discharge cycle, place a minimum of 1mm space between the battery and device or chassis.

Never over-discharge the battery.

If the battery is over-discharged to below the specified voltage (2.0V), it may not be rechargeable.

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.



Caution – Handling/Storage

Never expose the battery to ultrasonic sound.

Exposing the battery to ultrasonic sound may cause short-circuiting because the inside material is broken into pieces, leading to distortion, leakage, overheating, explosion, or fire.

Never subject the battery to severe shock.

Dropping, throwing or stomping on the battery may cause distortion, leakage, overheating, explosion, or fire.

Use the correct battery suitable for the equipment.

The battery may not be suitable for the specific equipment due to the using conditions or type of equipment. Please select the suitable battery according to the handling instructions of the equipment.

Never use or leave the battery in a hot place such as under the direct rays of the sun or in a car in hot weather.

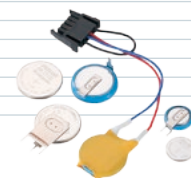
If you do, this may cause distortion, leakage, overheating, explosion, or fire.

Never allow the battery to come in contact with water.

If it does, this may cause the battery to rust or lead to distortion, leakage, overheating, explosion, or fire.

Never store the battery in a hot and humid environment.

Otherwise it may cause battery performance deterioration, deformation, leakage, overheating, or explosion.



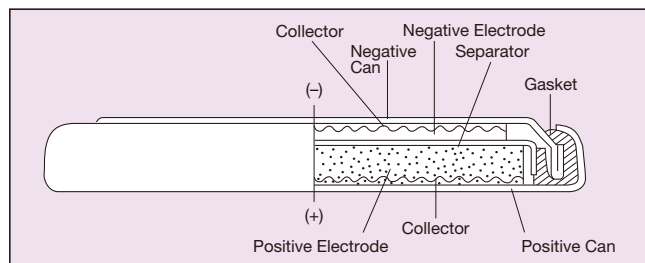
Overview

The coin type lithium manganese dioxide rechargeable battery is a small, lightweight rechargeable battery. This battery employs specially treated manganese dioxide for the positive material and a lithium-aluminum compound for the negative material. A specially formulated organic electrolyte is also used, yielding excellent discharge characteristics with low self-discharge.

Features

- Approx. 2.5V operating voltage**
 The operating voltage is about twice that of nickel cadmium rechargeable batteries. Displays a high discharge voltage of 2.8V when at 10% of nominal capacity (depth of discharge is 10% or less), when charged at 3.0 to 3.3V.
- Superior charge/discharge cycle characteristics**
- Wide -20 deg. C to 60 deg. C usable temperature range**
 Demonstrates stable operating voltage in temperatures as low as -20 deg. C and as high as 60 deg. C.
- Low self-discharge and superior leakage resistance**
 Self-discharge at 20 deg. C is no more than 2% per year. Supplies a nominal capacity of about 95% even when stored at 20 deg. C for roughly five years (according to accelerated test conducted by Maxell). And since organic electrolyte is used, the battery has superior leakage resistance.
- Excellent floating characteristics**
 A specially formulated organic electrolyte is employed to provide stable discharge characteristics even if charged for a year at 3.3V at 20 deg. C (according to accelerated test conducted by Maxell).
- Excellent high rate discharge characteristics**

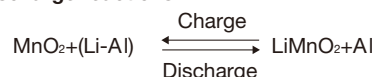
Construction



Principle and Reactions

The coin type lithium manganese dioxide rechargeable battery is a 3V battery using specially treated manganese dioxide for the positive material, a lithium-aluminum compound for the negative material and a specially formulated organic electrolyte solution.

■ Charge/Discharge reactions



UL (Underwriters Laboratories Inc.) Recognized Components

Recognized models: ML2032, ML2016
 Certification Number: MH12568

Applications

- OA Machines (Fax, Copiers, Printers)
- Notebook PCs
- Desktop PCs
- Camcorders
- Digital Still Cameras
- Watches
- Medical Instruments, Cash Registers
- FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)
- Electronic Meters (Water, Gas, Electricity)

Products

Model		ML2032	ML2016
Nominal voltage (V)		3	3
Nominal capacity (mAh)*1		65	25
Nominal discharge current (µA)		200	200
Charge, discharge cycle lifetime	Discharge depth of 10%	1,000 (6.5mAh discharge) (total capacity 6,500mAh)	1,500 (2.5mAh discharge) (total capacity 3,750mAh)
	Discharge depth of 20%	300 (13mAh discharge) (total capacity 3,900mAh)	500 (5mAh discharge) (total capacity 2,500mAh)
Operating temperature range (deg. C)		-20 to +60	
Dimensions*2	Diameter (mm)	20	20
	Height (mm)	3.2	1.6
Weight (g)*2		3.0	1.8

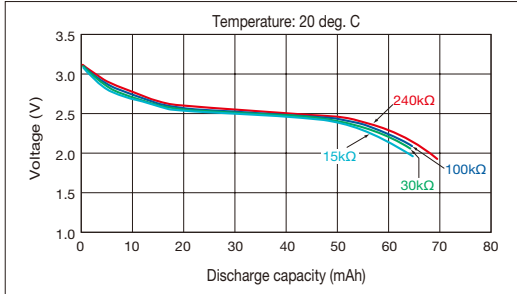
*1 Nominal capacity indicates duration until the voltage drops down to 2.0V when discharged at a nominal discharge current at 20 deg. C.

*2 Dimensions and weight are for the battery itself, but may vary depending on terminal specifications and other factors.

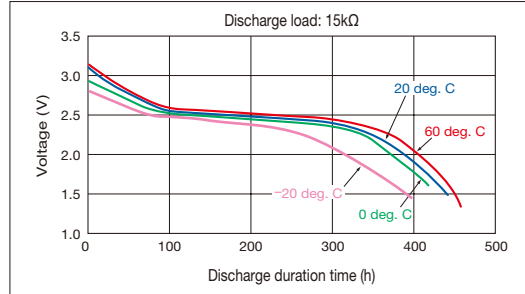
• Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

Characteristics (ML2032)

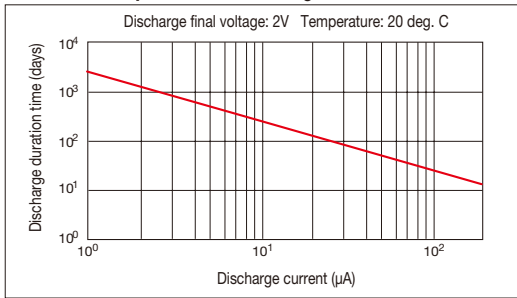
Discharge Characteristics



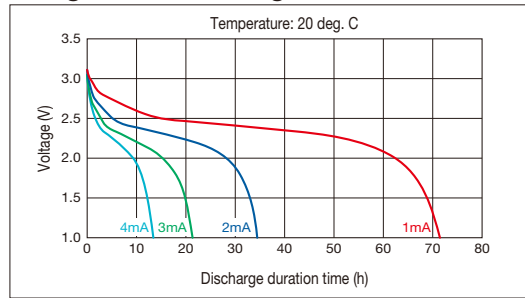
Temperature Characteristics



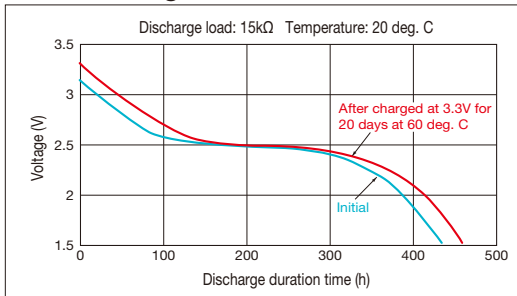
Relationship between Discharge Current and Duration Time



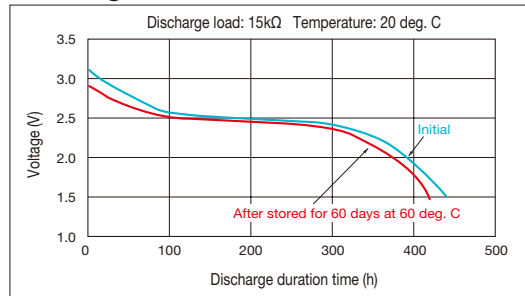
High Rate Discharge Characteristics



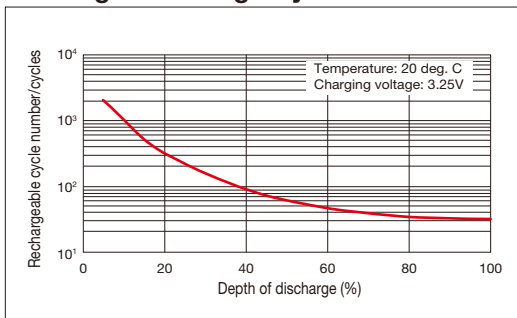
Over Charge Characteristics



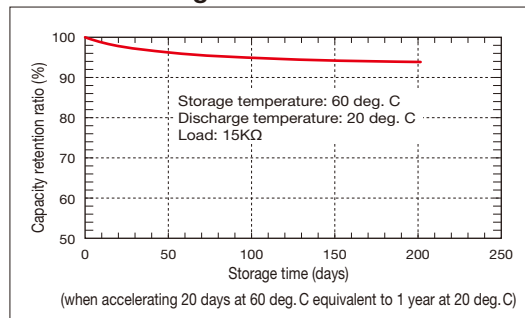
Storage Characteristics



Charge/Discharge Cycle Performance



Self-discharge Characteristics



ML

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

ML2032 T6	ML2032 T6 TUBE	ML2032 T14	ML2032 T25
ML2032 T32	ML2032 T17	ML2032 T26	ML2032 WK
ML2032 WK2	ML2016 T6	ML2016 T25	ML2016 T17
ML2016 T26	<p> : Horizontal & Through hole Type : Vertical & Through hole Type : Wire connector Type : Tin plating </p>		
	<p>The above are examples. Processing to meet customer requests is possible.</p>		

Visit our website for more information

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

Go to: Products > Rechargeable Batteries > ML (Coin Type Lithium Manganese Dioxide Rechargeable Battery)

Update on Dangerous Goods Transportation Regulations for Lithium Cells and Batteries

January 2018

Some transportation regulations have recently been revised. It is important for those involved in shipments of lithium cells and batteries to understand the changes to the regulations as explained here. Since the information here is a summary of the changes, please use the updated Dangerous Goods Regulations listed in the Normative Reference section to confirm the 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	No limit	≤ 2 batteries or ≤ 8 cells	> 2 batteries or > 8 cells	No limit
	Net Weight	Cargo aircraft only 2.5 kg	Cargo aircraft only N/A	Cargo aircraft only 2.5 kg	Cargo aircraft only 35 kg
Quantity of Package per Consignment		No more than 1		No limit	
Classification		Exempted		Class 9	
Packaging		Strong rigid outer packaging 1.2 m drop test			UN specification packaging
Labels (see drawing on following page)		Cargo aircraft only label Lithium battery mark		Cargo aircraft only label Lithium battery mark Lithium battery hazardous label	Cargo aircraft only label Lithium battery hazardous label
Documents		Air waybill ^{*1}		Declaration for DG Air waybill ^{*2}	Declaration for DG Air waybill ^{*2}
Training		Establishment of documented procedures. Learning and reviewing these procedures, and maintaining training records.		Record of DG training and test	

*1 The words "Lithium metal batteries in compliance with Section II of PI 968" and "Cargo Aircraft Only" or "CAO" must be included on the air waybill, when an air waybill is used. The information should be shown in the "Nature and Quantity of Goods" box of the air waybill.

*2 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.

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	
State of Charge (SOC)	Not exceeding 30% of rated capacity				
Package Limits	Quantity	No limit	≤ 2 batteries or ≤ 8 cells	> 2 batteries or > 8 cells	No limit
	Net Weight	Cargo aircraft only 2.5 kg	Cargo aircraft only N/A	Cargo aircraft only 10 kg	Cargo aircraft only 35 kg
Quantity of Package per Consignment	No more than 1		No limit		
Classification	Exempted		Class 9		
Packaging	Strong rigid outer packaging 1.2 m drop test			UN specification packaging	
Labels (see drawing below)	Cargo aircraft only label Lithium battery mark		Cargo aircraft only label Lithium battery mark Lithium battery hazardous label	Cargo aircraft only label Lithium battery hazardous label	
Documents	Air waybill ^{*3}		Declaration for DG Air waybill ^{*4}	Declaration for DG Air waybill ^{*4}	
Training	Establishment of documented procedures. Learning and reviewing these procedures, and maintaining training records.		Record of DG training and test		

^{*3} The words "Lithium-ion batteries in compliance with Section II of PI 965" and "Cargo Aircraft Only" or "CAO" must be included on the air waybill, when an air waybill is used. The information should be shown in the "Nature and Quantity of Goods" box of the air waybill.

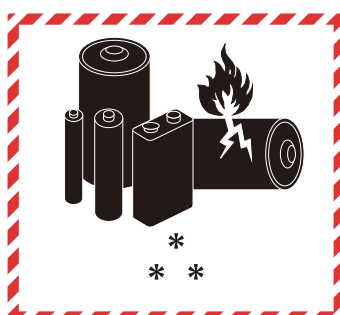
^{*4} The words "Dangerous Goods as per attached Shipper's Declaration" and "Cargo Aircraft Only" or "CAO" must appear in the air waybill's "Handling Information" column.

<Drawings of labels>

Cargo aircraft only label



Lithium battery mark



* Place for UN number(s)

** Place for telephone number for additional information

Lithium battery hazardous label



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

- 1) The specifications of the new Class 9 Lithium Battery hazard label have been added and come into effect as of January 1, 2017. The Class 9 Miscellaneous Dangerous Goods hazard label may continue to be used until December 31, 2018.
- 2) The specifications of the lithium battery mark have been revised and come into effect as of January 1, 2017.
- 3) An additional document to accompany consignments of Section IB of PI 965 and PI 968, and Section II of PI 965-PI 970 are no longer required as of January 1, 2017.

Reference

Except air transportation, the minimum requirements to transport lithium cells and batteries as exempted from class 9 dangerous goods (non-restricted goods) are as follows:

- 1) Cells and batteries shall be manufactured under a quality management programme.
- 2) For a lithium metal cell, the lithium content is not more than 1 g. For a lithium metal battery, the aggregate lithium content is not more than 2 g.
For a lithium-ion cell, the Watt-hour rating is not more than 20 Wh. For a lithium-ion battery, 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.
- 3) 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, Part III, sub-section 38.3.
- 4) Cells shall be packed in inner packaging that completely encloses the cell. The inner packaging shall be packed in strong rigid outer packaging.
- 5) A lithium battery mark must be marked on each package. A UN number and a telephone number must be placed on the mark for additional information.
- 6) Each package must be capable of withstanding a 1.2 m drop test.
- 7) Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass.

Maxell will provide certificates for 2) and 3) as the need arises. Documentation for 4) and 5) needs to be prepared by the customer. If our package is used for transport, Maxell will provide the certificate for 6) 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 mark must be changed to that of the sender (customer).

Normative References

Major applicable regulations for the transportation of lithium cells and batteries are as follows:

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

- UN (United Nations): Recommendations on the Transport of Dangerous Goods: Model Regulations 19th revised edition
- UN (United Nations): Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria 6th revised edition

Air Transportation

- ICAO (International Civil Aviation Organization): Technical Instructions for the Safety Transport of Dangerous Goods by Air 2017-2018 edition
- IATA (International Air Transport Association): Dangerous Goods Regulations 59th edition

Marine Transportation

- IMO (International Maritime Organization): International Maritime Dangerous Goods (IMDG) Code 2016 Edition

■ The major revisions for UN Model Regulations 19th Revised Edition

- 1) The specifications of the new Class 9 Lithium Battery hazard label have been added and come into effect as of January 1, 2017. The Class 9 Miscellaneous Dangerous Goods hazard label may continue to be used until December 31, 2018.
- 2) The specifications of the lithium battery mark have been revised and come into effect as of January 1, 2017. The provisions concerning marking in SP 188 of 18th revised edition may continue to be applied until December 31, 2018.
- 3) An additional document to accompany consignments in SP 188 is no longer required as of January 1, 2017.

The IMDG Code 2016 edition will contain the descriptions of these UN recommendations. The voluntary compliance date is January 1, 2017. Compliance becomes mandatory on January 1, 2018. Although the regulations for land transportation in each country are based on UN recommendations, some districts, or countries may establish their own special requirements. Therefore the shipper shall confirm with the forwarder in advance.

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