

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.

Lithium Manganese Dioxide Rechargeable Battery

⚠ 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 in the figure below.

■ **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	ML1220
Charge Current	2mA or lower	2mA or lower	1mA 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.

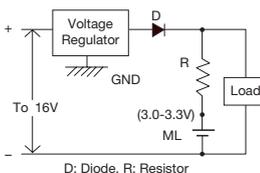


Table 2 Example of resistors

Model	Output Voltage of Voltage Regulator	
	3.1V	3.2V
ML2032	>550 ohm	>600 ohm
ML2016	>550 ohm	>600 ohm
ML1220	>1.1K ohm	>1.2K 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:

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

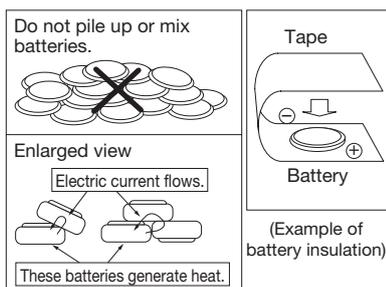
For example, the S-812C series, which has a maximum input voltage of 18V, or the S-817 series with a maximum input voltage of 10V (Seiko Instruments Inc.) can be used as a voltage regulator.

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.

⚠ 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

■ **Use within the rated temperature range of -20 to +60 deg. C.**

Otherwise the battery's charge and discharge characteristics may be reduced.

■ **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 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.

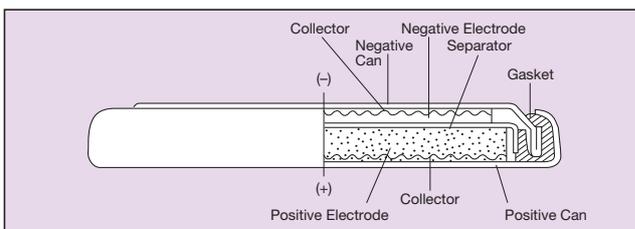
■ **Never store the battery in a hot and highly humid environment.**

Doing so may cause the performance of the battery to deteriorate. In certain environments, this may lead to distortion, leakage, overheating, explosion, or fire.

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.

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**



Features

■ **Approx. 2.5V operating voltage**

The operating voltage is about twice that of nickel cadmium rechargeable batteries. Displays a high discharge voltage of 2.8 V when at 10% of nominal capacity (depth of discharge is 10% or less), when charged at 3.0 to 3.3 V.

■ **Superior charge/discharge cycle characteristics (Fig. 2)**

Achieves 1,000 cycles of discharging to 10% of nominal capacity (Depth of discharge = 10%). The total discharge capacity is quite high at 100 times nominal capacity.

LITHIUM MANGANESE DIOXIDE RECHARGEABLE BATTERY

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 (Fig. 3)

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 (shipped fully charged).

Excellent floating characteristics (Fig. 4)

A specially formulated organic electrolyte is employed to provide stable discharge characteristics even if charged for a year at 3.3 V at 20 deg. C (according to accelerated test conducted by Maxell).

Excellent high rate discharge characteristics (Fig. 5)

Fig. 1 Charge Property

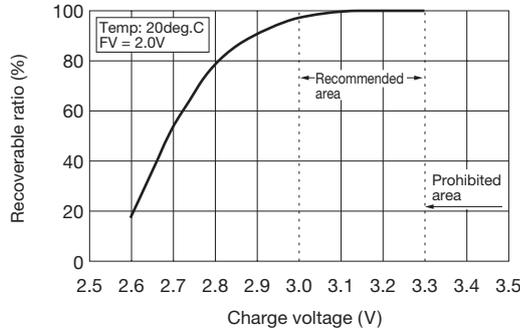


Fig. 2 Charge/Discharge Cycle Performance

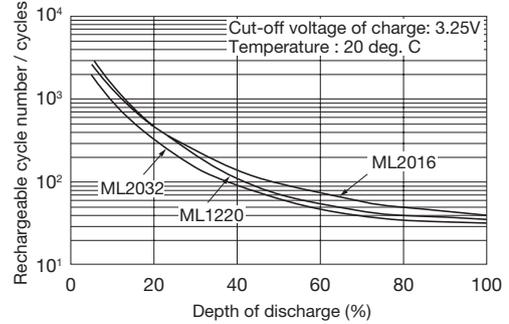
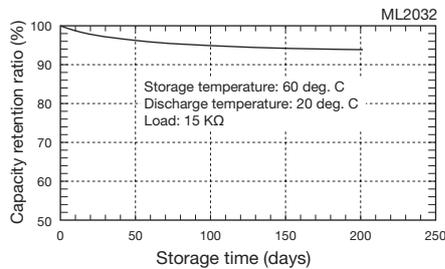
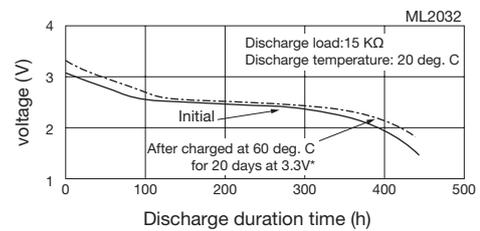


Fig. 3 Low Self-discharge



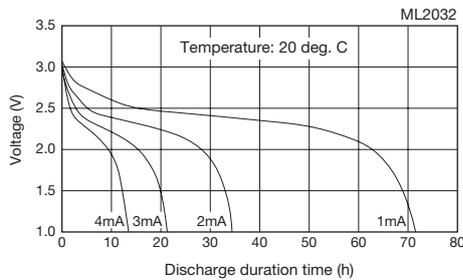
(when accelerating 20 days at 60 deg. C equivalent to 1 year at 20 deg. C)

Fig. 4 Overcharge Characteristics



* equivalent to storage at 20 deg. C for 1 year

Fig. 5 High Rate Discharge Characteristics



UL (Underwriters Laboratories Inc.) Recognized Components

Recognized models : ML2032, ML2016, ML1220

Certification Number : MH12568

Applications

- Mobile Phones
- PHS
- OA Machines (Fax, Copiers, Printers)
- Notebook PCs
- Desktop PCs
- PDAs
- Camcorders
- Digital Still Cameras
- Portable CD/MD Players
- Watches
- Medical Instruments, Cash Registers
- FA Instruments (Measuring Instruments, Onboard Microcomputers, Sensors)
- Electronic Meters (Water, Gas, Electricity)

Products

Model	ML2032	ML2016	ML1220	
Nominal Voltage (V)	3	3	3	
Nominal Capacity (mAh)**	65	25	18	
Nominal Discharge Current (μA)	200	200	100	
Charge, Discharge Cycle Lifetime	Discharge Depth of 10%	1,000 (6.5 mAh discharge) (total capacity 6,500 mAh)	1,500 (2.5 mAh discharge) (total capacity 3,750 mAh)	1,500 (1.8 mAh discharge) (total capacity 2,700 mAh)
	Discharge Depth of 20%	300 (13 mAh discharge) (total capacity 3,900 mAh)	500 (5 mAh discharge) (total capacity 2,500 mAh)	500 (3.6 mAh discharge) (total capacity 1,800 mAh)
Operating Temperature Range (deg. C)	-20 to +60	-20 to +60	-20 to +60	
Dimensions*	Diameter (mm)	20	20	12.5
	Height (mm)	3.2	1.6	2.0
Weight (g)*	3.0	1.8	0.7	

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

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

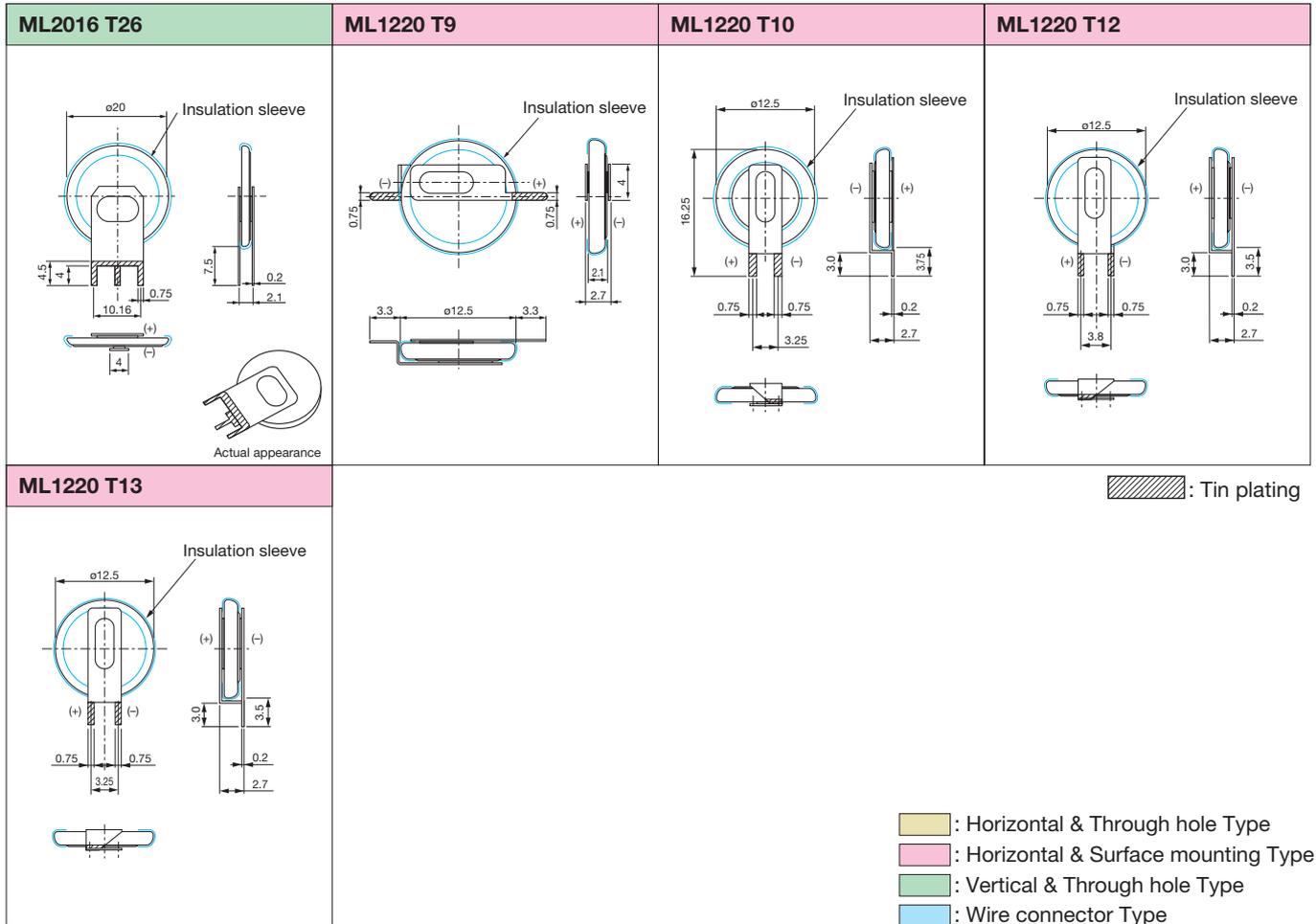
• Data and dimensions are just reference values. For further details, please contact your nearest Maxell dealer or distributor.

External Dimensions (unit : mm)

ML2032 T6	ML2032 T6 TUBE	ML2032 T14	ML2032 T25
ML2032 T32	ML2032 T17	ML2032 T26	ML2032 WK
			<p>Housing: HNC2-2.5S-4 (Hirose) Contact: HNC-2.5S-C-B (02) (Hirose) Lead wire: AWG26 UL1007</p>
ML2032 WK2	ML2016 T6	ML2016 T25	ML2016 T17
<p>Housing: ZHR-2 (JST) Contact: SZH-002T-P0.5 (JST) Lead wire: AWG26 UL1571</p>			

大豪电子
 电话: 0755-83233025
<http://www.szdahao.com>
<http://www.very-tec.com>

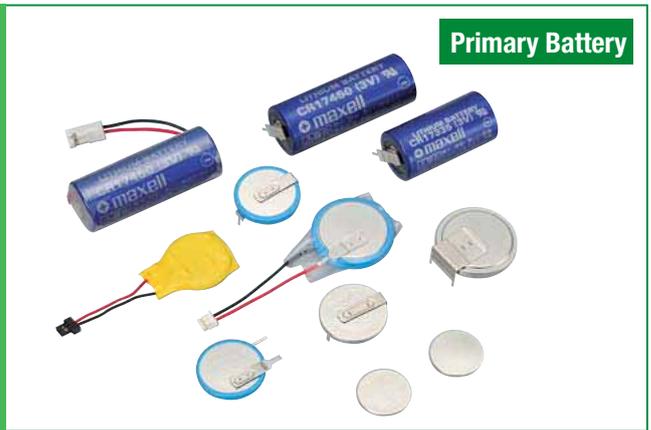
External Dimensions (unit : mm)



M
L

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

■ 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 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.

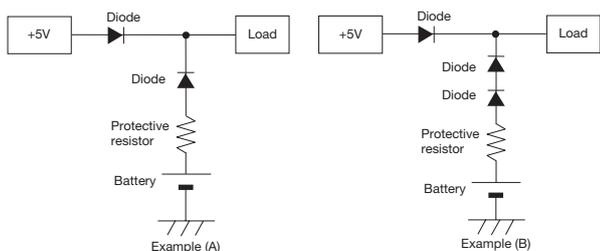
If leakage is suspected or you detect a strong odor, keep the battery away from fire, because the leaked liquid could catch on fire.

■ 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

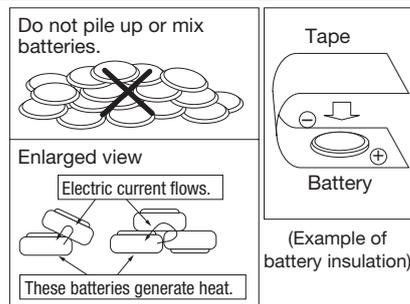
A protective resistor is used to prevent the battery from being charged by large surges of current during diode failure. Please set the resistor so that the maximum current shown in the right table is not exceeded. For example, say a CR2032 battery is used in sample circuit (A) in combination with a 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
CR2450	15mA
CR2430	15mA
CR2032H	10mA
CR2032	10mA
CR2025	10mA
CR2016	10mA
CR1632	4.0mA
CR1620	4.0mA
CR1616	2.5mA
CR1220	3.0mA
CR1216	2.5mA
CR1025	2.5mA
CR17450	20mA
CR17335	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 highly humid environment.

Doing so may cause the performance of the battery to deteriorate. In certain environments, this may lead to distortion, leakage, overheating, explosion, or fire.

■ Keep contact pressure more than 2N.

The battery voltage may be lower than intended value because of poor contact condition, please keep contact pressure 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 CR2450HR and/or CR2450HR-Ex at temperatures exceeding 85 deg. C, please consult Maxell in advance for conditions of use.

Construction

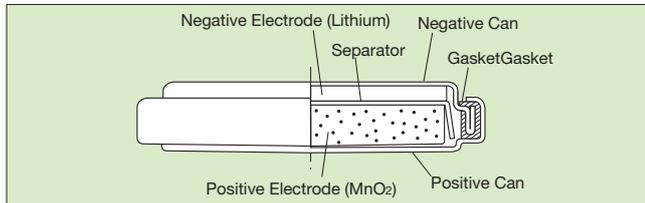
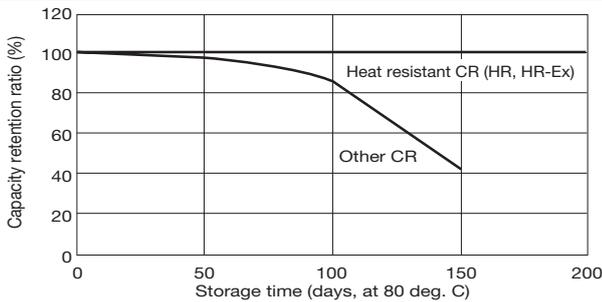
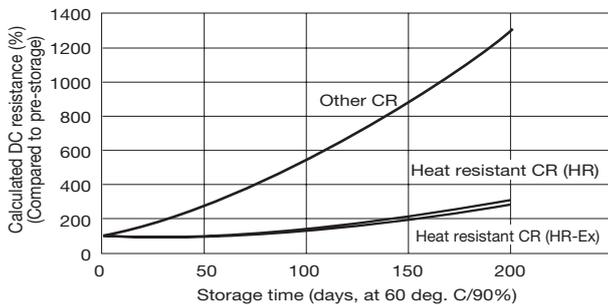


Fig. 1 Storage Characteristics under High Temperatures



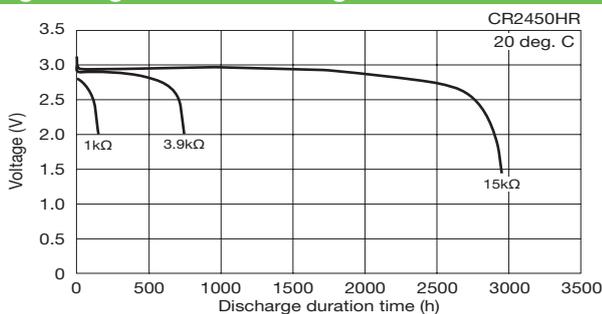
Very little deterioration in capacity due to high storage temperature of 80 deg. C, compared to other CR batteries.

Fig. 2 Storage Characteristics under High Temperature/Humidity

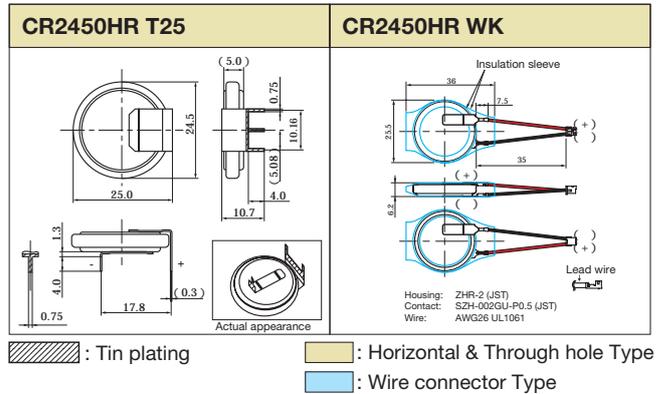


Very little deterioration in internal resistance due to high humidity (60 deg. C/90%RH), compared to other CR batteries.

Fig. 3 High Rate Discharge Characteristics



External Dimensions (unit : mm)



UL Recognized Components

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

Recognized model: CR2450HR
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	CR2450HR-Ex
Nominal Voltage (V)	3	3
Nominal Capacity (mAh)**	550	525
Nominal Discharge Current (mA)	0.2	0.2
Operating Temperature Range (deg. C)	-40 to +125	-40 to +125 (max.150)
Acceleration Resistance	Max. 2000G***	
Dimensions*	Diameter (mm)	24.5
	Height (mm)	5.0
Weight (g)*	6.8	

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

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

*** 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.

Fig. 1 Relationship between Discharge Current Consumption and Duration Time

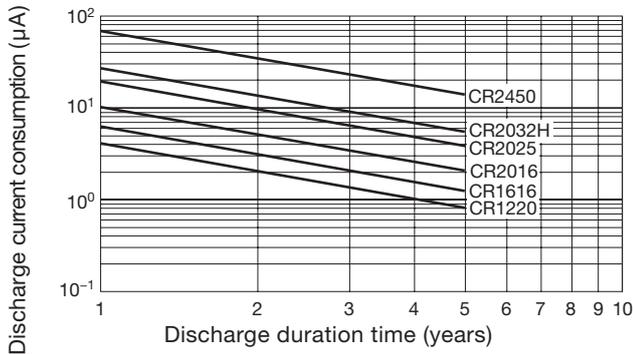


Fig. 2 Discharge Characteristics after Storage

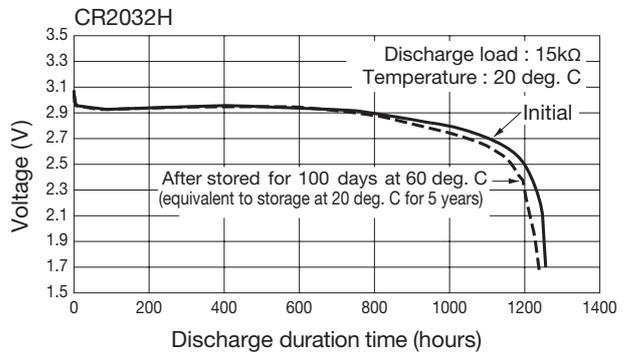
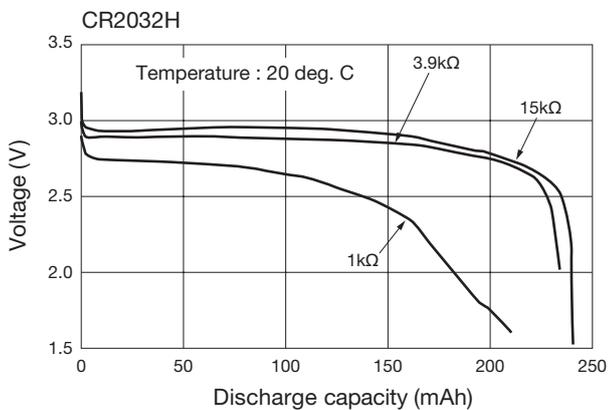


Fig. 3 High Rate Discharge Characteristics



UL Recognized Components

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

Recognized models:

CR2450, CR2430, CR2032, CR2032H, CR2025, CR2016, CR1632, CR1620, CR1616, CR1220, CR1216, CR1025

Certification Number: MH12568

CR

Applications

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

Products

Model	CR2450	CR2430	CR2032H	CR2032	CR2025	CR2016	CR1632	CR1620	CR1616	CR1220	CR1216	CR1025	
Nominal Voltage (V)	3	3	3	3	3	3	3	3	3	3	3	3	
Nominal Capacity (mAh)**	610	290	240	220	170	90	140	80	55	36	25	30	
Nominal Discharge Current (mA)	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Operating Temperature Range (deg. C)***	-20 to +85												
Dimensions*	Diameter (mm)	24.5	24.5	20.0	20.0	20.0	20.0	16.0	16.0	16.0	12.5	12.5	10.0
	Height (mm)	5.0	3.0	3.2	3.2	2.5	1.6	3.2	2.0	1.6	2.0	1.6	2.5
Weight (g)*	6.6	4.6	3.0	3.0	2.5	1.7	1.9	1.3	1.1	0.8	0.6	0.6	

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

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

*** When using these batteries at temperatures outside the range of 0 to +40 deg. C, please consult Maxell in advance for conditions of use.

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

External Dimensions (unit : mm)

CR2450 T25S	CR2032 T6	CR2032 T6LES	CR2032 T14
CR2032 T15	CR2032 T16	CR2032 T19	CR2032 T23
CR2032 T25	CR2032 T5	CR2032 T20	CR2032 T33

: Tin plating

External Dimensions (unit : mm)

CR2032 T7	CR2032 T17	CR2032 T26	CR2032 T34
<p>Insulation sleeve</p>	<p>Insulation sleeve</p>	<p>Actual appearance</p>	<p>Insulation sleeve</p>
CR2032 WK11	CR2032 WK12	CR2032 WK13	CR2032 WK14
<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>	<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>	<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>	<p>Insulation sleeve</p> <p>Lead wire</p> <p>Housing: DF3-4S-2C (Hirose) Contact: DF3-2428SCF (Hirose) Wire: AWG26 UL1007</p>
CR2032 WK15	CR1616 T	CR1220 T4	<p>Tin plating</p>
<p>Insulation sleeve</p> <p>Adhesive tape</p> <p>Lead wire</p> <p>Housing: DF13-2S-1.25C (Hirose) Contact: DF13-2630SCF (Hirose) Wire: AWG28 UL1571</p>		<p>Insulation sleeve</p>	

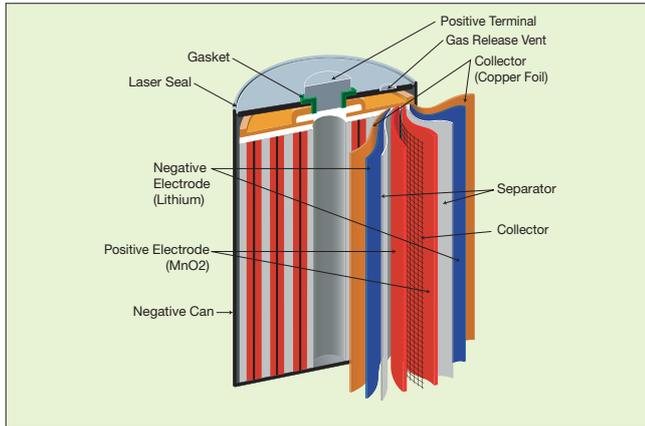
- : Horizontal & Through hole Type
- : Horizontal & Surface mounting Type
- : Vertical & Through hole Type
- : Wire connector Type

Cylindrical Type Lithium Manganese Dioxide Battery

Overview

The cylindrical type lithium manganese dioxide battery (CR battery) features high capacity and excellent load characteristics due to Maxell's unique winding method and improved electrical-conductivity structures. Because of its high-reliability, this battery is ideal for industrial use in, for example, security equipment and the power source of electronic meters.

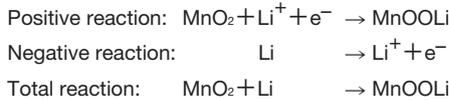
Construction



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 models: CR17450, CR17335
 Certification Number: MH12568

Features

High capacity batteries

Maxell's unique winding method and effective utilization of positive and negative electrodes realize high capacity.

Low self-discharge rate and long battery life

A laser seal structure ensures air tightness. Minimized electrode surface areas reduce the self-discharge rate.

Superior storage characteristics

The optimization of positive materials and employment of a high-reliability sealing structure stabilize pulse discharge characteristics over a wide usable temperature range after long-time storage or discharge.

Applications

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

Products

Model	CR17450	CR17335
Nominal Voltage (V)	3	3
Nominal Capacity (mAh)**	2600	1750
Nominal Discharge Current (mA)	5	5
Operating Temperature Range (deg. C)	-40 to +85	-40 to +85
Dimensions* Diameter (mm) X Height (mm)	17 x 45	17 x 33.5
Weight (g)*	22	16

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

External Dimensions (unit : mm)

CR17450 VO-T3	CR17450 WK 41	CR17335 VO-T3	CR17335 WK 11
	<p>Housing: PHR-2(JST) Contact: SPH-002T-P0.5S(JST) Lead Wire: AWC26 UL1007</p>		<p>Housing: PHR-2(JST) Contact: SPH-002T-P0.5S(JST) Lead Wire: AWC26 UL1007</p>

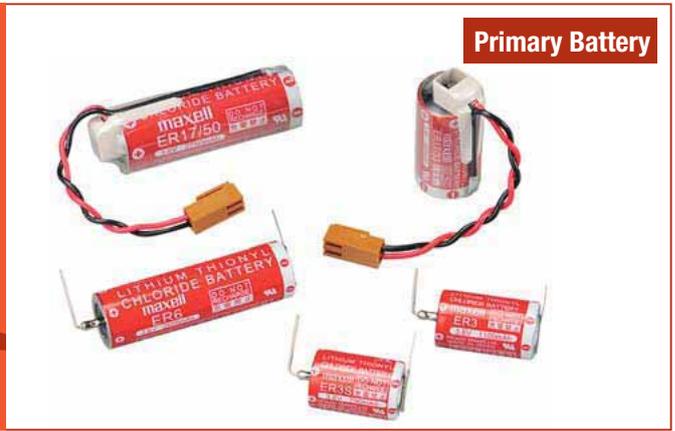
: Tin plating

: Horizontal & Through hole Type

: Wire connector Type

Li/SOCl₂

Lithium Thionyl Chloride Battery (Li/SOCl₂)



LITHIUM THIONYL CHLORIDE BATTERY

Safety Instructions

This battery is a high energy density sealed battery containing dangerous (Lithium) and deleterious (Thionyl Chloride) materials. For this reason, improper handling of the battery could lead to distortion, leakage*, overheating, explosion, fire, or generation of irritating/corrosive gases, causing bodily injury or equipment trouble. Please observe the following instructions to prevent accidents.

For from your customers to your industrial waste processors (including recycled processor), please have them fully understand these instructions.

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

⚠ Warnings — Handling

Do not recharge

■ Never swallow.

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

■ Never apply an excessive force to the positive terminal.

Because the positive terminal is sealed by a glass, subjecting this area to sudden jolts and excessive force (over 19.6 N) could destroy the glass seal. This could cause leakage and the generation of irritating/corrosive gases.

■ Never drop.

Dropping the battery could destroy the glass seal leading to leakage and the generation of irritating/corrosive gases.

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

The heat of welding or soldering could cause the lithium to melt, or cause damage to the insulating material in the battery, leading to possible distortion, leakage, overheating, explosion, or fire, or generation of irritating/corrosive gases. When soldering the battery directly to equipment, solder only the tabs or leads. Even then, the temperature of the soldering iron must be below 350 deg. C and the soldering time less than 5 seconds. Do not use a soldering bath, because the circuit board with battery attached could stop moving or the battery could drop into the bath. Moreover do not use excessive solder, because the solder could flow to unwanted portions of the board, leading to a short-circuit or charging of the battery.

■ Never short-circuit the battery.

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

■ Never charge.

The battery is not designed to be charged by any other electrical

source. Charging could generate gas and internal short-circuiting, leading to distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ Never forcibly discharge.

Forcibly discharging by an external power source or other batteries could cause the voltage to fall below 0V (reversing the poles), generating gas inside the battery and leading to distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ Never heat.

Heating the battery to more than 100 deg. C could increase the internal pressure, causing distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ Never expose to open flames.

Exposing to flames could cause the lithium metal to melt, causing the battery to catch on fire and explode.

■ Never disassemble the battery.

Disassembly could generate the irritating/corrosive gases. In addition, the lithium metal inside the battery could overheat, leading to catch on fire.

■ Never deform.

Deforming could cause leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ Never reverse the positive and negative terminals when mounting.

Improper mounting of the battery could lead to short-circuiting, charging or forced-discharging. This could cause distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases.

■ Never use different batteries together.

Using different batteries together, i.e. different type or used and new or different manufacturer could cause distortion, leakage, overheating, explosion, fire, or generation of irritating/corrosive gases because of the differences in battery property. If using two or more batteries connected in series or in parallel even same batteries, please consult with Maxell before using.

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

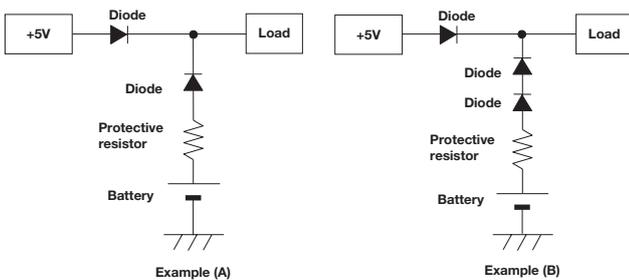
Because this liquid could cause serious damage, if it does come in contact with your eyes, flush them immediately with plenty of water and consult a physician. Likewise, if the liquid gets in your mouth, rinse immediately with plenty of water and consult a physician.

■ **Never touch the battery electrodes.**

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

⚠ **Warnings — Circuit Design for Back-up Use**

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



■ **Supplied voltage to load**

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

■ **Using diodes to prevent charging**

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

■ **Using and setting protective resistors**

A protective resistor is used to prevent the battery from being charged by large surges of current during diode failure. Please set the resistor so that the maximum current shown in the right table is not exceeded. For example, say an ER6 battery is used in sample circuit A in combination with a

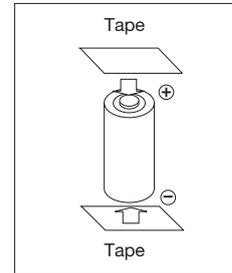
Type	Maximum Current
ER18/50	125μA
ER17/50	125μA
ER6	100μA
ER6C	100μA
ER17/33	70μA
ER3	50μA
ER3S	40μA

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

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

⚠ **Warnings — Disposal**

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



(Example of battery insulation)

⚠ **Caution — Handling**

■ **Minimum transient voltage**

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

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

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

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

■ **Storage**

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

■ **Bundling**

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

Lithium Thionyl Chloride Battery

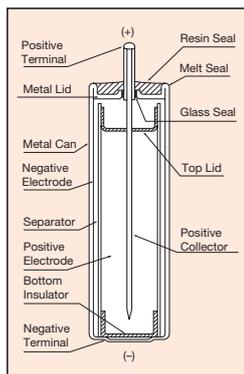
The ER battery is for industrial use only.

When replacement is necessary, please contact the manufacturer of your equipment.

Overview

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

Construction



Principle and Reactions

The lithium thionyl chloride battery uses liquid thionyl chloride (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: $2\text{SOCl}_2 + 4\text{Li} \rightarrow 4\text{LiCl} + \text{S} + \text{SO}_2$

Features

High 3.6-V voltage

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

Flat discharge characteristics

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

High energy density

Provides high energy density of 970m Wh/cm³ with discharge current of 100μA (ER6 type).

Wide usable temperature range

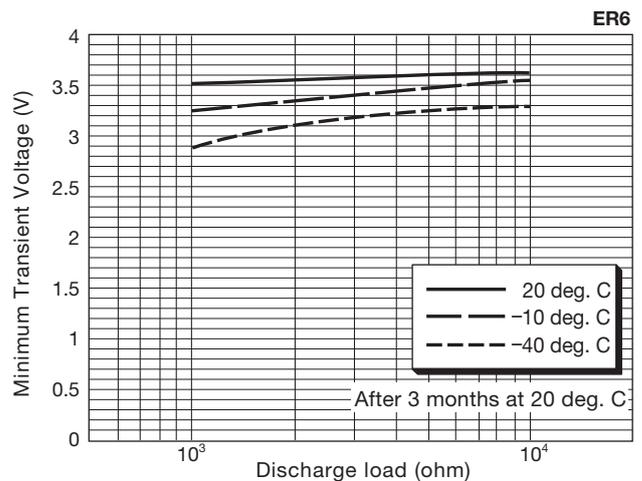
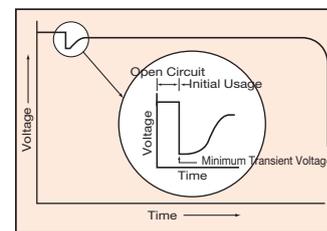
Can be used over a wide temperature range : - 55 deg. C to +85 deg. C (please consult with Maxell if using in temperatures of -40 deg. C or less).

Superior long-term reliability

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

Minimum transient voltage

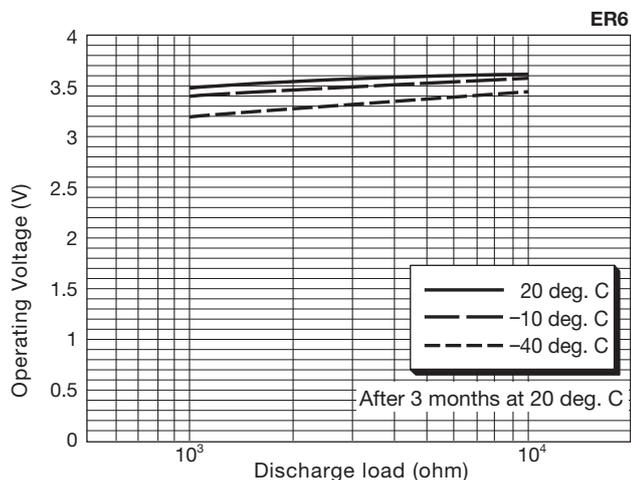
The lithium thionyl chloride battery has remarkably lower self-discharge when compared with conventional batteries. This is because a lithium chloride membrane is formed over the negative lithium surface, blocking reaction with the positive material. When first discharging after storage, resistance from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

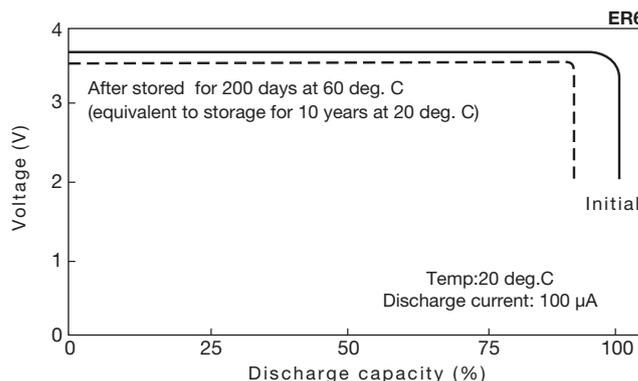
Relationship between Discharge Load and Operating Voltage

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 3 V will be maintained even at temperatures of -40 deg. C at discharge of less than 1 mA.



Storage Characteristics

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



UL Recognized Components

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

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

Certification Number: MH12568

Applications

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

Products

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

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

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

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



External Dimensions (unit : mm)

ER18/50 #2 PC	ER17/50 #2 PC	ER6 #2 PC	
ER6K-#17	ER6C #2 PC(2)	ER6C WKP	
<p>Housing: XHP-2(JST) Contact: SXH-001GH-P0.6(JST) Lead wire: AWG26 UL1007</p>		<p>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	ER3 WKP
	<p>Housing: HNC2-2.5S-2(Hirose) Contact: HNC-2.5S-C-B(03)(Hirose) Lead wire: AWG26 UL1007</p>		<p>Housing: IL-2S-S3L-(N)(JAE) Contact: IL-C2-1-10000(JAE) Lead wire: AWG24 UL1007</p>
ER3S #2 PC	ER3S WKP	ER3SR #12	
	<p>Housing: IL-S-2S-S2C2-S Contact: IL-S-C2-1-10000 Lead wire: AWG26 UL1007</p>	<p>Housing: 2695-02RP Contact: 2759 GS Lead wire: AWG26 UL1007</p>	

JIT

: Tin plating

: Horizontal & Through hole Type
 : Wire connector Type

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	110	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 24	23 18	16 15	17	16 14	11.8	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	0.2	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 and dimensions are reference values only. For further details, please contact your nearest Maxell office.

SRC