

# **BATTERIES CATALOG**

**COIN TYPE LITHIUM-ION** 







LITHIUM MANGANESE





# 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.



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CR/SR/LR/CLB/Li-ion/ML

**Batteries** 

# **Application of Primary and Secondary Batteries**

		⊖ : Whe	n used as ma	ain power sour	ce. 🗌 : \	When used	as backup po	wer source.
			Prim	ary		Secondary		
		CR C	oin	CP	SP/I P	Li-ion		
		Conventional	Heat resistant	Cylindrical	button	Coin	Prismatic	ML
	LPWA equipment	0		0		0		
	BLE (Bluetooth low energy) equipment	0			0			
	Communication tags, beacons	0	0			0		
Communication/	Smart meters (gas, water, electricity)			0				
	Commercial radios						0	
	Wi-Fi routers						0	
	AR/VR						0	
	CGM (Continuous glucose monitoring)/ insulin pens	0			0			
	Hearing aids					0		
Medical/	Capsule endoscopes				0			
Healthcare	Medical thermometers, activity trackers	0			0			
	Infusion pumps						0	
	Wearable devices	0				0		
	DDS (Drug delivery systems)	0			0	0		
	TPMS (Tire-pressure monitoring systems)		0					
	ETC (Electric toll collection)		0	0				
Automotive	Keyless entry systems	0	0					
	eCall (automatic emergency call service) devices			0			0	
	Seat location sensors		0	0				
	Home security			0				
Disaster	Infrastructure monitoring (bridges, railways, etc.)		$\bigcirc$	0				
security	Fire/smoke alarms	0		0				
	Monitoring alarm sensors	0		0				
	AEDs			0				
	Temperature data loggers (HACCP temperature loggers)	0	0	0		0		
Industrial	Logistics tags	0	0	0				
equipment	FA instruments (measuring instruments, onboard microcomputers, sensors)	0	0	0		0	0	0
	Measuring tools (vernier calipers, etc.)	0			0			
	Mobile phones/smartphones						0	
	Smart watches, GPS watches					0		
Othor	Wrist watches	0			0			
ottici	Health and beauty equipment						0	
	Calculators, electronic dictionaries	0					0	
	Home game consoles						0	

# Lithium Manganese Dioxide Battery (Li/MnO<sub>2</sub>)

# Primary Battery

# 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

Туре	Maximum Current
CR2450HR	15mA
CR2450HR-Ex	15mA
CR2050HR	10mA
CR2032HR	10mA
CR2032HRS	10mA
CR2032H	10mA
CR2032	10mA
CR2025	10mA
CR2016	10mA
CR1632	4.0mA
CR1620	4.0mA
CR1616	2.5mA
CR1220	3.0mA
CR1216	2.5mA

R≧(5V-3V)/10mA=0.2k ohm,

meaning that at least 0.2k 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.

# <u>/</u>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.

# Heat Resistant Coin Type Lithium Manganese Dioxide Battery

# C R

#### Overview

Maxell's original sealing technology and highly heat-resistant material expands operating temperature range, making the batteries suitable for automobile applications — for powering TPMS (Tire Pressure Monitoring System) sensors, for example. The range of technologies where these batteries can be applied is expanding to include IoT sensors and HACCP temperature loggers that require a wide operating temperature range.

## **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.





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



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, CR2450HR-Ex, CR2050HR, CR2032HR, CR2032HRS Certification Number: MH12568

# **Applications**

- TPMS (Tire-Pressure Monitoring System)
- ETC (Electronic Toll Collection systems)
- Keyless entry systems
- Seat location sensors
- Communication tags, Beacons
- Temperature data loggers (HACCP temperature loggers)
- Logistics tags
- FA instruments (Measuring instruments, Onboard microcomputers, Sensors)
- IoT sensors

## **Products**

Model		CR2450HR-Ex	CR2450HR	CR2050HR	CR2032HR	CR2032HRS	
Nominal Voltage (V)		3	3	3	3	3	
Nominal Capacity (mAh)*1		525	550	350	200	200	
Nominal Discharge Current (mA)		0.2	0.2 0.2 0.2 0.2				
Operating Temp	erature Range (deg. C)	-40 to +125 (max. 150)		-40 to	o +125		
Acceleration Re	esistance		Max. 2000	G*3		3300G	
Diameter (mm)		24.5	24.5	20.0	20.0	20.0	
Dimensions	Height (mm)	5.0	5.0	5.0	3.2	3.2	
Weight (g) <sup>*2</sup>		6.8	6.8	4.1	3.0	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



## Minimum Voltage of Pulse Discharge



# Temperature Characteristics



#### Relationship between Discharge Current and Discharge Capacity



#### CR2450HR HAB-T40 CR2450HR SBO-T23 **CR2450HR T25** : Horizontal & Surface mounting Insulation sleeve (5) (5.0) (5) Туре : Wire connector Type 2-C0.5 MAX ø24.8 0 : Tin plating ġ 10-10 2.7 4.0 0.2 12.9 0.15 2.5 2.95 0 \$ 0.75 app CR2450HR SBB-T26 CR2450HR WK CR2050HR HBB-T66 Insulation sleeve (5) (4 1.8 7.5 5.5 Ň 5.7 35 (+ 1.8 10.4 0.2 N 0.2 0.2 $\Omega^{(-)}_{(+)}$ 5.7 Lead wire ZHR-2 (JST) SZH-002GU-P0.5 (JST) AWG26 UL1061 Housing: Contact: Wire: CR2050HR SBO-T23 CR2032HR SAO-T60 CR2032HRS HAB-T69 MAX ø20.5 (5) (3.2) Insulation sleeve Insulation sleev (21) e. 0.2 0.15 0.75 0.2 1.8 3.75 3.5 3.5 2.95 €₹ The above are examples. Processing to meet customer requests is possible.

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

: Horizontal & Through hole Type

C R

# 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 for powering devices such as various IoT sensors, medical equipment, data loggers and wearable devices.

# Features

Stable operating voltage under long-term low load discharge for Memory and RTC backup (Fig. 1)

#### 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 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



# **Principle and Reactions**

The coin type lithium manganese dioxide battery uses manganese dioxide (MnO<sub>2</sub>) as its positive active material, lithium (Li) as its negative active material, and an organic electrolyte solution.

#### Battery reactions

Positive reaction:	$MnO_2 + Li^+ + e^-$	→ MnOOLi
Negative reaction:	Li	$\rightarrow$ Li <sup>+</sup> +e <sup>-</sup>
Total reaction:	MnO₂+Li	ightarrow MnOOLi

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

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# Applications

- Wearable devices
- CGM (Continuous Glucose Monitoring)
- Keyless entry systems

- Communication tags, Beacons
- Medical thermometers, Activity trackers
- DDS (Drug Delivery Systems)
- FA instruments (Measuring instruments, Onboard microcomputers, Sensors)

# Products

Model		CR2032H	CR2032	CR2025	CR2016	CR1632	CR1620	CR1616	CR1220	CR1216
Nominal Voltage (V)		3	3	3	3	3	3	3	3	3
Nominal Cap	pacity (mAh)*1	240	220	170	90	140	80	55	36	25
Nominal Dis Current (mA	charge )	0.2 0.2 0.2 0.1 0.1 0.1 0.1 0.1 0.1 0.1						0.1		
Operating Te Range (deg.	emperature C) <sup>*2</sup>					-20 to +85				
Dimonsions*3	Diameter (mm)	20.0	20.0	20.0	20.0	16.0	16.0	16.0	12.5	12.5
Dimensions <sup>-3</sup>	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



# Minimum Voltage of Pulse Discharge



#### Temperature Characteristics



# Relationship between Discharge Current and Discharge Capacity



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C R



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

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

Visit our website for more information https://biz.maxell.com/en/batteries/ Go to: CR (Coin Type Lithium Manganese Dioxide Battery)





# LITHIUM MANGANESE DIOXIDE BATTERY (CYLINDRICAL)

# 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.)

# <u>//</u> 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 expose to heat.

Placing the battery in a hot location such as the vicinity of a fire or heating equipment could increase its internal pressure, causing distortion, leakage, overheating, or an explosion.

#### 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.



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	

Туре	Maximum Current
CR17335A	20mA
CR17450A	20mA
CR17450AH	20mA
CR17500AU	20mA

 prevent the battery from being
 CR17450AH
 20mA

 charged by large surges of current
 CR17500AU
 20mA

 during diode failure. Please set the
 resistor so that the maximum current shown in the right table is not

exceeded. For example, say a CR17450A battery is used in sample circuit (A) in combination with a main power source 5 volt. Since the permitted charge current is 20mA and this battery's voltage is 3V, let the resistor be  $R \ge (5V-3V)/20mA = 0.1k$  ohm, meaning that at least 0.1k 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.

# <u> Caution</u> — 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.

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# **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 long-term reliability makes it ideal for use as a power source in industrial applications such as IoT devices and smart meters (e.g. gas, water, electricity). Battery packs can also be produced to meet special customer requirements.

# Features

#### High energy density

High energy density has been achieved by optimizing the filling rate of the material by means of a unique electrode structure.

#### Long-term reliability lasting more than 10 years\*

The employment of a heat-resistant gasket and a laser-seal structure prevents water and foreign matter intrusion and electrolyte leakage, realizing long-term reliability that lasts more than 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

#### Supports various package design configurations

Package design proposals are available according to the customer's needs.

We have designed a wide range of packages for 1 to 35 batteries.



35 parallel batteries for outdoor usage

\* 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 (MnO<sub>2</sub>) as its positive active material, and lithium (Li) as its negative active material.

#### Battery reactions

Positive reaction:	MnO₂+Li <sup>+</sup> +e <sup>-</sup>	ightarrow MnOOLi
Negative reaction:	Li	$\rightarrow$ Li <sup>+</sup> +e <sup>-</sup>
Total reaction:	MnO₂+Li	ightarrow MnOOLi

## **UL Recognized Components**

The cylindrical type lithium manganese dioxide battery is a UL (Underwriters Laboratories Inc.) recognized component. (User Replaceable)

Recognized models: CR17450A, CR17335A, CR17450AH Certification Number: MH12568

# **Applications**

- Smart meters (e.g. gas, water, electricity) IoT devices
- Communication devices (e.g. 3G, LTE, LPWA)
- In-vehicle devices
   Security devices
- Memory backup power

# Products

Model		CR17450AH	CR17450A	CR17335A	
Nominal Vo	ltage (V)	3	3 3		
Nominal Ca	pacity (mAh) <sup>*1</sup>	3000	2500	1650	
Nominal Discha	arge Current (mA)	A) 1 5 5			
Operating Te Range (deg.	emperature C) <sup>*2</sup>	-40 to +85			
Dimensione <sup>*3</sup>	Diameter (mm)	17	17	17	
Dimensions *	Height (mm)	45	45	33.5	
Weight (g)	*3	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 When using at temperatures exceeding 60 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 (CR17450A)**

# Discharge characteristics



#### Pulse discharge characteristics



# Characteristics (CR17450AH)

## Discharge characteristics



#### Pulse discharge characteristics



#### Temperature characteristics



#### Storage characteristics



#### Temperature characteristics



#### Storage characteristics





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

: Horizontal & Through hole Type

: Wire connector Type

: Tin plating

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



# Silver Oxide Battery/ LR Button Battery

# SILVER OXIDE BATTERY / LR BUTTON 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.)

# <u> Marnings</u> — 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. It should fundamentally not be used for backup applications as this may result in it being charged.

#### 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.

#### 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.

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.



#### **Overview**

Button-type silver oxide batteries are characterized by high-energy per unit volume and stable operating voltage. As a result, they are used as a power source for applications such as quartz watches, and in recent years their use has expanded to medical devices and BLE devices. In 1976, Maxell was the first company in Japan to successfully market button-type silver oxide batteries, and has many years of experience and know-how. Also, in consideration of the environment, all products are designed to use zero mercury.

# **Features**

#### Stable discharge characteristics

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

#### High-energy density

A silver oxide battery's high-energy density per unit volume provides approx. twice the amount of energy capacity as button-type alkaline batteries.

#### Excellent discharge load characteristics

Alkaline electrolyte is used to provide excellent discharge load characteristics. Depending on the composition of the electrolyte, two models are available; a low-drain type (SW type) for analog watches and a high-drain type (W type) for multi-function watches (which incorporate an alarm and a light), medical equipment, 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.

## Construction



#### **Principle and Reactions**

The button-type silver oxide battery uses silver oxide (Ag<sub>2</sub>O) 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 (Silver Oxide Battery)

#### Battery reactions (LR Button Battery)

Total reaction  $2MnO_2+Zn+H_2O \rightarrow 2MnOOH+ZnO$ 

# **Applications**

#### SR: Silver Oxide Battery

- Analog watches
- Calculators Medical instruments BLE devices

#### LR: LR Button Battery

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- Toys LED lights Crime prevention buzzers
- Medical thermometers

# **Products**

High dr	High drain type												
Model		SR44W	SR43W	SR1130W	SR1120W	SR936W	SR927W	SR920W	SR916W	SR41W	SR726W	SR721W	SR716W
Nomina	l 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 C	apacity (mAh)*	165	125	79	55	75	60 57	39	23	39	28	25	18
Nominal Disc	charge Current (µA)	200	200	100	100	100	100	100	50	50	50	50	30
Dimonsions	Diameter (mm)	11.6	11.6	11.6	11.6	9.5	9.5	9.5	9.5	7.9	7.9	7.9	7.9
DITICIISIONS	Height (mm)	5.4	4.2	3.05	2.05	3.6	2.73	2.05	1.65	3.6	2.6	2.1	1.68
Weight	(g)	2.2	1.8	1.2	1.0	1.1	0.8	0.6	0.5	0.7	0.5	0.45	0.3

High drain type				Low drain type											
Model		SR626W	SR621W	SR44SW	SR43SW	SR1136SW	SR1130SW	SR1120SW	SR1116SW	SR936SW	SR927	7SW	SR92	0SW	SR916SW
Nomina	l Voltage (V)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.5	5	1.5	55	1.55
Nominal C	Capacity (mAh)*	28	18	165	125	100	83	55	29	71	55 \$	50	45	35	26.5
Nominal Disc	charge Current (µA)	50	50	200	100	100	100	100	50	100	10	0	5	0	50
Dimensions	Diameter (mm)	6.8	6.8	11.6	11.6	11.6	11.6	11.6	11.6	9.5	9.5	5	9.	5	9.5
Dimensions	Height (mm)	2.6	2.15	5.4	4.2	3.6	3.05	2.05	1.65	3.6	2.7	3	2.0	)5	1.65
Weight	(g)	0.4	0.3	2.2	1.7	1.6	1.2	1.0	0.7	1.1	0.8	3	0.7	0.6	0.5

Low dra	Low drain type												
Model		SR914SW	SR41SW	SR731SW	SR726SW	SR721SW	SR716SW	SR712SW	SR626SW	SR621SW	SR616SW	SR527SW	SR521SW
Nominal	l 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 C	apacity (mAh)*	22	45	36	33	25	23	10	30 27	23 18	16 15	17	16 13
Nominal Disc	charge Current (µA)	35	50	50	50	30	30	20	30	30	20	30	20
Dimensione	Diameter (mm)	9.5	7.9	7.9	7.9	7.9	7.9	7.9	6.8	6.8	6.8	5.8	5.8
Dimensions	Height (mm)	1.45	3.6	3.1	2.6	2.1	1.68	1.29	2.6	2.15	1.65	2.7	2.15
Weight (	(g)	0.45	0.7	0.7	0.5	0.45	0.3	0.25	0.4	0.3	0.3	0.3	0.2

Low dr	Low drain type						General type				
Model		SR516SW	SR512SW	SR421SW	SR416SW	SR44	SR43	SR1130	SR1120	SR41	
Nomina	Voltage (V)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	
Nominal Capacity (mAh)*		12.5	5.5	12	8.3	165	125	79	55	39	
Nominal Disc	charge Current (μA)	20	5	20	10	200	100	100	100	50	
Dimensione	Diameter (mm)	5.8	5.8	4.8	4.8	11.6	11.6	11.6	11.6	7.9	
Dimensions	Height (mm)	1.65	1.25	2.15	1.65	5.4	4.2	3.05	2.05	3.6	
Weight	(g)	0.2	0.14	0.17	0.12	2.2	1.8	1.2	1.0	0.7	

LR Button Battery							
Model		LR44	LR43	LR1130	LR1120	LR41	
Nominal Voltage (V)		1.5	1.5	1.5	1.5	1.5	
Nominal Capacity (mAh)*		110	75	45	55	25	
Nominal Disc	charge Current (μA)	100	100	100	100	70	
Dimensione	Diameter (mm)	11.6	11.6	11.6	11.6	7.9	
Dimensions	Height (mm)	5.4	4.2	3.05	2.05	3.6	
Weight (	g)	1.8	1.5	1.2	0.9	0.6	

\* 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.

• This product conforms to EU Battery Directive. Mercury is not intentionally added to materials during manufacture.



**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	0.5 <i>I</i> tA					
Max. charge current	1.0 <i>I</i> tA					
Charge temperature	0 to +45 deg. C					
Protection conditions						

Protection IC

#### Charge control flowchart (sample)

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

Specified IC by Maxell



# **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.)

# <u> 1</u> 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. 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.

Please consult Maxell in advance for information about soldering conditions.

- 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.

# <u> W</u>arnings

- 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. Swallowing may lead to burns, perforation of soft tissue, and death. Severe burns can occur within 2 hours of ingestion.
- 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 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.

# <u> Caution</u>

- 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. 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  $2I_t$ A by means of an original stacked electrode structure. This compact high-power rechargeable battery is designed for small portable devices such as IoT devices, wearables and hearables that have communication 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 incorporated unique technologies gained during its development of crimping and electrode coating. The stainless steel battery body suppresses swelling.

#### Superior safety

Separator-wrapped positive electrodes prevent to make internal short-circuit. Safety is ensured even if external short-circuit occurs.

# Certification

• UL 1642 Recognized models (Technician Replaceable): CLB2032, CLB2016, CLB937A, CLB740H

Certification Number: MH12568

- IEC 62133-2 Recognized models: CLB2032, CLB937A, CLB740H
- UN 38.3 (Dangerous goods transportation regulations) Recognized models: CLB2032, CLB2016, CLB937A, CLB740H

# Characteristics (CLB2032)

# Charge characteristics



Discharge load characteristics



# **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		CLB2032	CLB2016	CLB937A	CLB740H		
Initial	Diameter	20	20	9.5	7.85		
dimensions (mm) <sup>*1</sup>	Height <sup>*2</sup>	3.45	2.0	3.9	4.0		
Weight (g)	'1	3.0	2.1	0.7	0.5		
	Max. voltage (V)	4.2	4.2	4.2	4.2		
(CCCV)	Standard current (mA)	35	15	9	9.5		
	Temperature (deg. C)	0 to +45					
<b>_</b>	End voltage (V)	3.0	3.0	3.0	3.0		
Discharge (CC)	Max. current (mA)	140	60	36	19		
Temperature (deg. C)		-20 to +60					
Nominal voltage (V)		3.7	3.7	3.7	3.8		
Nominal ca	apacity (mAh) <sup>*3</sup>	70	30	18	19* <sup>4</sup>		

\*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: 0.5/rA/4.2V (CCCV)/End current 0.03/rA, Discharge: 0.2/rA/E.V. = 3.0V, Temperature 20 deg. C
   \*4 Nominal capacity is according to the following conditions: Charge: 0.5/rA/4.2V
- (CCCV)/End current 0.03/A, Discharge: 1mA/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.

#### Discharge temperature characteristics







# **Characteristics (CLB2016)**



# Discharge load characteristics



Discharge temperature characteristics







# C L B

# **Characteristics (CLB937A)**

## Charge characteristics







Discharge temperature characteristics



Cycle life characteristics





# **Characteristics (CLB740H)**











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



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

Visit our website for more information https://biz.maxell.com/en/batteries/ Go to: CLB (Coin Type Lithium-ion Rechargeable 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	1 <i>I</i> tA				
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.

# A 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.

# Li-ion

- 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.
- Remove the charged battery from the charger.
- Do not recharge without using a charged battery (without discharging at all). The battery may swell.
- 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.

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# **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.

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# **Characteristics (ICP616180AWR)**

# Charge characteristics



#### Discharge load characteristics



Discharge temperature characteristics



# Cycle life characteristics



Visit our website for more information https://biz.maxell.com/en/batteries/

Go to: Prismatic Lithium-ion Rechargeable Battery

**Secondary 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.



#### (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:

 $(R) \ge ((Output Voltage of Voltage Regulator) - 2) / (Nominal Charge Current)$ 

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.

# A 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.

Μ



# **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

Producto



# **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

MnO<sub>2</sub>+(Li-AI) Charge LiMnO<sub>2</sub>+AI Discharge

# 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)

1100000						
Model			ML2032	ML2016		
Nominal voltage (V)			3	3		
Nominal capacity (mAh)*1			65	25		
Nominal discharge current (μA)			200	200		
Charge, discharg	ge [	Discharge depth of 10%	1,000 (6.5mAh discharge) (total capacity 6,500mAh)	1,500 (2.5mAh discharge) (total capacity 3,750mAh)		
cycle lifetime	I	Discharge depth of 20%	300 (13mAh discharge) (total capacity 3,900mAh)	500 (5mAh discharge) (total capacity 2,500mAh)		
Operating tempe	erature	e range (deg. C)	-20 to +60			
Dimonsions*2	Diam	eter (mm)	20	20		
Dimensions 2	Heigl	ht (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)**



Relationship between Discharge Current and Duration Time



Over Charge Characteristics



Charge/Discharge Cycle Performance







# High Rate Discharge Characteristics



Storage Characteristics



# Self-discharge Characteristics





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

Visit our website for more information

https://biz.maxell.com/en/batteries/

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

# Dangerous Goods Transport Regulations for Lithium Cells and Batteries

January 2022

It is important for those involved in shipments of lithium cells and batteries to understand the regulations as explained here. Since the information here is a summary of the regulations, please use the latest Dangerous Goods Regulations listed in the Normative Reference section to confirm the details.

Section		Section IB	Section IA	
Lithium Metal Content		Cell: ≤ 1.0 g Battery: ≤ 2.0 g	Cell: > 1.0 g Battery: > 2.0 g	
Package Limits	Quantity	No limit		
	Net Weight	Cargo aircraft only 2.5 kg	Cargo aircraft only 35 kg	
Quantity of Package per Consignment		No limit		
Classification		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 Lithium battery hazardous label	Cargo aircraft only label Lithium battery hazardous label	
Documents		Declaration for DG Air waybill <sup>*1</sup>		
Training		Record of DG training and test		

## Packing instructions for lithium metal batteries (PI 968)

\*1 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.

Packing instructions for ittnium-ion batteries (PI 96	Packing	instructions	for lithiur	m-ion	batteries	(PI	965
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Section		Section IB	Section IA	
Watt Hour		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		
	Net Weight	Cargo aircraft only 10 kg	Cargo aircraft only 35 kg	
Quantity of Package per Consignment		No limit		
Classification		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 Lithium battery hazardous label	Cargo aircraft only label Lithium battery hazardous label	
Documents		Declaration for DG Air waybill <sup>*2</sup>		
Training		Record of DG training and test		

\*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.

# <Drawings of labels>

## Cargo aircraft only label





\* Place for UN number(s) \*\* Place for telephone number for additional information

Lithium battery hazardous label



# Major additional information for air transport of lithium cells and batteries

The test summary must be made available as specified in the UN Manual of Tests and Criteria, Part III, sub-section 38.3, paragraph 38.3.5.

# 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 program.
- 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.
- 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 21st revised edition
- UN (United Nations): Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria 7th revised edition

#### Air Transportation

- ICAO (International Civil Aviation Organization): Technical Instructions for the Safety Transport of Dangerous Goods by Air 2021-2022 edition
- IATA (International Air Transport Association): Dangerous Goods Regulations 63rd edition

#### Marine Transportation

• IMO (International Maritime Organization): International Maritime Dangerous Goods (IMDG) Code 2020 Edition



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

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Maxell, Ltd. Marketing & Sales Division





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