

SPECIFICATIONS
FOR LITHIUM BATTERY
ML2016

<u>APPROVED SIGNATURE</u> :	_____
<u>YOUR NAME(Please Print)</u> :	_____
<u>TITLE</u> :	_____
<u>DATE</u> :	_____

Typed : Tami Tomofuji Date: May 24, 2001

Checked : Jatsuya Shigeno Date: May. 24, 2001

Approved : K. Sano Date: May. 25, 2001

1. Scope

These specifications are applicable to the lithium batteries supplied by Hitachi Maxell, Ltd.

2. Applicable Battery Type : Manganese-Dioxide Lithium Secondary Battery3. Battery Type and Performance

- 3.1 Type (Designation) : ML 2 0 1 6
- 3.2 Nominal voltage : 3. 0 volts
- 3.3 Nominal discharge capacity : 2 5 mAh (Load : 15k Ω , End voltage : 2.0V)
- 3.4 Standard discharge current : ≤ 0.2 mA
- 3.5 Outside dimensions : As per drawing attached
- 3.6 Standard weight : 2. 1 g
- 3.7 Characteristics
- 3.7.1 Open circuit voltage : Will satisfy the figure in Table 1.
- 3.7.2 Service life : Ditto
- 3.7.3 Cycle life : Ditto
- 3.7.4 Over-charge characteristics : Ditto
- 3.7.5 Over-discharge characteristics : Ditto
- 3.7.6 Electrolyte leakage resistance : Ditto
- 3.8 Appearance : Will be free from flaw, stain, deformation, uneven tone, electrolyte leakage and other defects which impair the value of the commodity.
- 3.9 Brand : The brand name of "MAXELL" is used.
- 3.10 Symbol of manufactured month and year
- Manufactured month and year will be shown on the surface of the battery.
- Example:
- 0 1 - 0 5 (Manufactured in May, 2001)
- 0 1 - 1 0 (Manufactured in October, 2001)
- 0 1 - 1 1 (Manufactured in November, 2001)
- 0 1 - 1 2 (Manufactured in December, 2001)
- 0 2 - 0 1 (Manufactured in January, 2002)

Table 1

1. Open circuit voltage

Initial	2.9 to 3.3 V
After 60 days storage at 60°C	2.8 to 3.2 V

2. Service life

Load resistance	15000 Ω	
Discharge method	24 hours/day	
End voltage	2.0 V	
Minimum duration (Initial)	20°C	135 hours
	-20°C	110 hours
	60°C	135 hours
Minimum duration (After 60 days storage at 60°C)	20°C	115 hours

3. Cycle life

Minimum number at 20°C (Initial)	Discharge depth: 100%	30 cycles
	Discharge depth: 10%	800 cycles
Minimum number at 20°C (After 60 days storage at 60°C)	Discharge depth: 100%	23 cycles

4. Over-charge characteristics

Charge method	3.3 V, 20 days, at 60°C, $R_L=3000 \Omega$
Load resistance	15000 Ω
Discharge method	24 hours/day
Minimum duration at 20°C (Initial)	135 hours

5. Over-discharge characteristics

Discharge method	1 k Ω , 20 days, at 20°C
Charge method	3.25 V, 4.8 hours, at 20°C, $R_L=2000 \Omega$
Load resistance	15000 ohms
Discharge method	24 hours/day
Minimum duration at 20°C (Initial)	130 hours

6. Electrolyte leakage resistance

No visible electrolyte leakage will take place at following conditions:

1. Initial
2. After 60 days storage at 60 °C
3. After 60 days storage at 45 °C and 90 %RH

Initial test : A test commencing within one month after delivery.

4. Test

4.1 Measurement conditions and instruments

4.1.1 Temperature and Humidity

Unless otherwise specified, the measurement will be executed at temperature of $20 \pm 2^\circ\text{C}$ and at relative humidity of $65 \pm 20\%$.

4.1.2 Storage conditions

(1) Unless otherwise specified, the storage conditions for sample batteries will be at the temperature of less than 25°C and at relative humidity of less than 75%.

(2) The test after storage will be commenced within one month after storage.

4.1.3 Measuring instruments and devices

(1) Voltage measurement will be carried out using the DC voltmeter which can measure from 0V to 4V. The precision of the voltmeter will be $\pm 1\text{mV}$ or more precise and the input impedance will be more than $10\text{M}\Omega$.

(2) Load resistance will include all the resistance of the external circuit and its tolerance will be within 0.5%.

(3) Dimension measurement will be carried out using the caliper whose measuring range is from 0mm to 150mm and precision is 1/100mm or more precise.

4.2 Test methods (Testing procedure)

4.2.1 Dimensions

Use the measuring instrument as specified in the Item 4.1.3 (3).

4.2.2 Open circuit voltage

Measure the voltage between both terminals using the voltmeter specified in the Item 4.1.3 (1).

Before the measuring, the battery should be at $A^\circ\text{C}$ for B hours (See Table 2).

Table 2.

A	B
$20 \pm 2^\circ\text{C}$	above 12 hours

4.2.3 Service life

Leave the battery samples at A° for B hours(See Table 3), and discharge them continuously through the discharge load specified in Table 1. Carry out the discharge test until the discharge voltage falls down to not less than the end voltage specified in Table 1, and the service life will be the discharge time while the discharge voltage keeps above the specified end voltage.

Table 3.

	A	B
Room temperature	$20 \pm 2^\circ\text{C}$	above 12 hours
Low temperature	$-20 \pm 2^\circ\text{C}$	12 to 24 hours
High Temperature	$60 \pm 2^\circ\text{C}$	12 to 24 hours

4.2.4 Cycle life

(1) 100% charge-discharge test:

- (a) Leave the battery samples at A° for B hours(See Table 2).
- (b) Discharge the battery samples continuously through $1.5\text{K}\Omega$ load for 10 hours.
- (c) Right after above discharge, charge the battery samples by the power supply of $3.25 \pm 0.01\text{V}$ for 14 hours. ($R_L=200\Omega$)
- (d) Right after above charge, repeat (b) and (c).
Count the number of cycles until the duration time(end voltage: 2.0V) reach less than 6 hours.

(2) 10% charge-discharge test:

- (a) Leave the battery samples at A° for B hours(See Table 2).
- (b) Discharge the battery samples continuously through $1.5\text{K}\Omega$ load for 1 hour.
- (c) Right after above discharge, charge the battery samples by the power supply of $3.25 \pm 0.01\text{V}$ for 2 hours. ($R_L=200\Omega$)
- (d) Right after above charge, repeat (b) and (c).
Count the number of cycles until the duration time(end voltage: 2.0V) reach less than 1 hour.

4.2.5 Over-charge characteristics

- (a) Charge the battery samples continuously by the power supply of 3.3V for 20 days at $60 \pm 2^\circ\text{C}$ ($R_L=300\Omega$).
- Measure the service life by the method specified in 4.2.3(at $20 \pm 2^\circ\text{C}$).

4.2.6 Over-discharge characteristics

- (a) Discharge the battery samples continuously through $1k\Omega$ for 20 days at $20\pm 2^\circ\text{C}$.
- (b) After above discharge, charge the battery samples by the power supply of $3.25\pm 0.01\text{V}$ for 48 hours at $20\pm 2^\circ\text{C}$ ($R_L=200\Omega$).

Measure the service life by the method specified in 4.2.3 (at $20\pm 2^\circ\text{C}$).

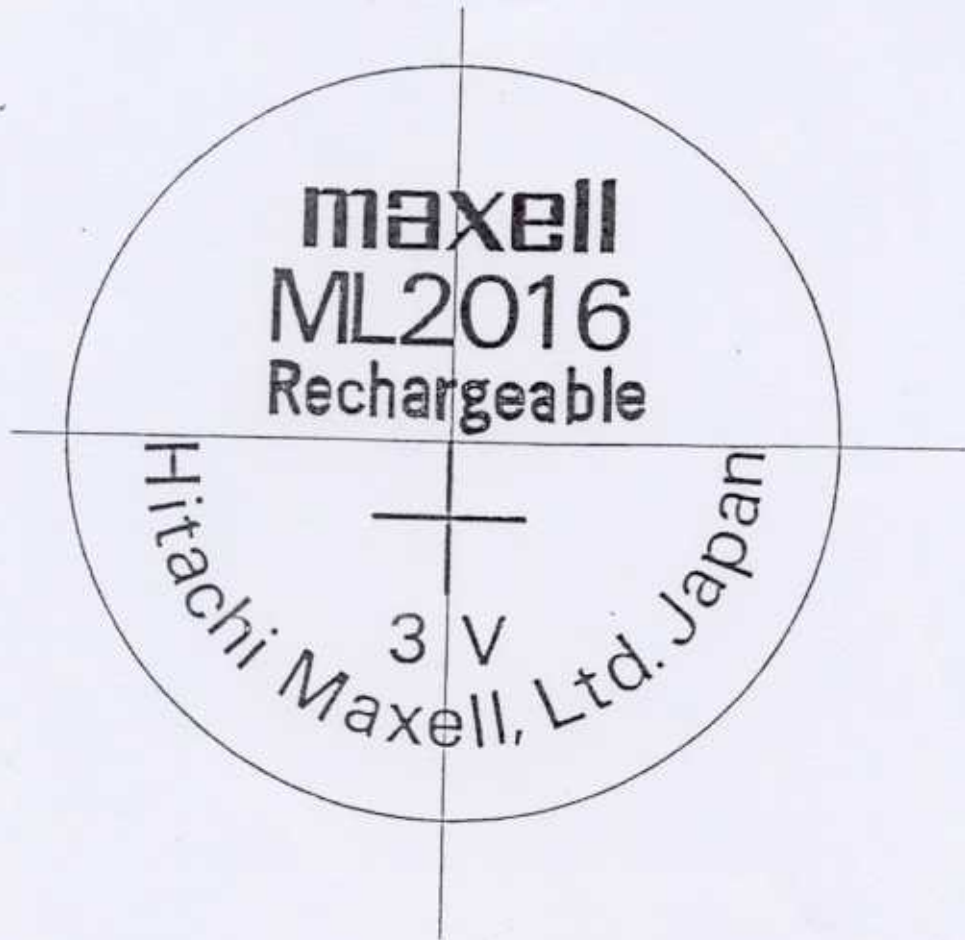
4.2.7 Electrolyte leakage resistance

(1) High temperature storage

- (a) Store the battery samples at $60\pm 2^\circ\text{C}$ for the period specified in table 1.
- (b) After above storage, leave the battery at $20\pm 2^\circ\text{C}$ for 12 hours.
- (c) Check the state of the leakage by the naked eyes.

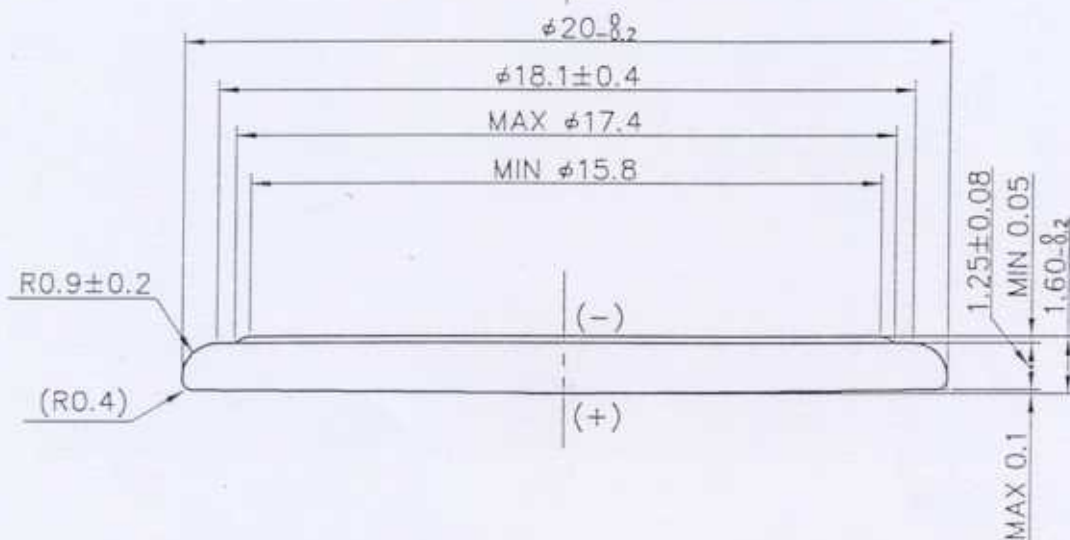
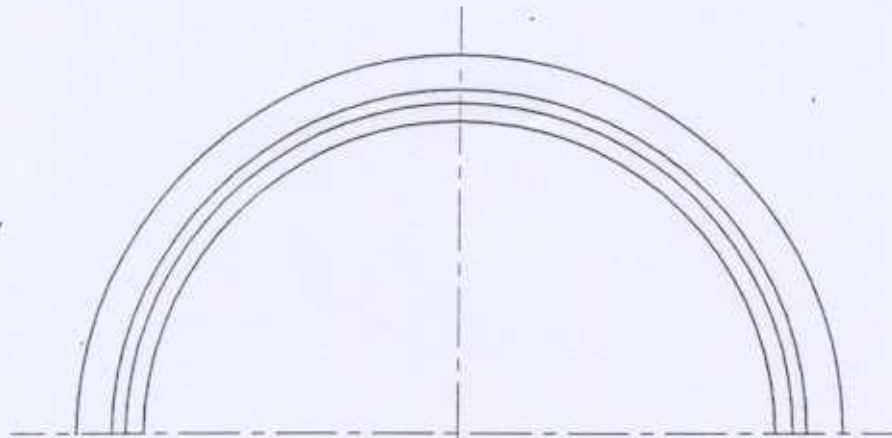
(2) High temperature and high humidity storage

- (a) Store the battery samples at $45\pm 2^\circ\text{C}$ and 90%RH for the period specified in table 1.
- (b) After above storage, leave the battery at $45\pm 2^\circ\text{C}$ for 3~5 hours and after that leave the battery at $20\pm 2^\circ\text{C}$ for 12 hours.
- (c) Check the state of the leakage by the naked eyes.



DIMENSIONS : mm

		PROJECTION 	SCALE $\frac{5}{1}$	TITLE Stamp for ML2016	SIL —
REGD.	DWN. T. Sudo July 31 '95	Hitachi Maxell, Ltd.		OSAKA WORKS DWG. No.	REV.
	CHKD. M. Inoue July 31 '95	Osaka Japan		01 4 2606002	
	APPD. O. Kage Aug. 03 '95				



DIMENSIONS : mm

REGD.		DWN. <i>J. Tomita</i>	PROJECTION	SCALE	TITLE	SH.
		CHKD. <i>A. Goto</i>		5/1	ML2016	—
		APPD. <i>A. Goto</i>	Hitachi Maxell, Ltd.		ONO WORKS DWG. NO.	REV.
			Ono Japan		01 42605029	



Warning

on use of Maxell coin-type Lithium Manganese Dioxide Rechargeable Batteries.

Improper handling of this battery may cause leakage, heat generation, explosion and fire. Strictry observe the precautions below in handling this battery.

(1) DO NOT REPLACE WITH A PRIMARY BATTERY.

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 for a rechargeable battery, it will be charged and may be deformed, leaked, generated the heat, fired or exploded. To prevent these, do not let user to replace the battery by themselves.

(2) NEVER OVER-CHARGE 3.3V OR MORE.

Charging may cause gas generation or internal short-circuiting, followed by fire or explosion.

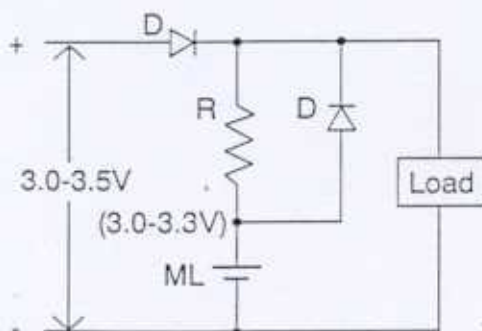
(3) CHARGE UNDER THE CONDITIONS SPECIFIED BELOW.

If a large current is flowed into the battery, it may be degraded or may short circuit, leading to heat generation, fire or explosion. To prevent this, design a protection resistor into the circuit.

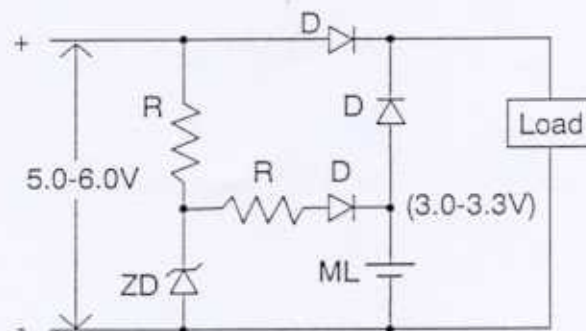
	ML2032	ML2016	ML1220
Charge current	less than 2mA	less than 2mA	less than 1mA

(4) WHEN USING THE BATTERY IN A MEMORY BACKUP CIRCUIT, DESIGN THE CIRCUIT USING DIODES AND RESISTORS.

The following are generally recommended as memory backup circuits for secondary batteries. In case of memory backup failure, correctly designed circuits are required to reduce the flow of current from the main power source into the battery.



* In case of using of 3V-power-source.



* In case of using of 5V-power-source.

D: Diode; ZD: Zener Diode; R: Resistor

(5)DO NOT CONNNECT MULTIPLE BATTERIES.

(6)NEVER REVERSE THE POSITIVE AND NEGATIVE TERMINALS WHEN MOUNTING THE BATTERY.

The improper connection of the battery may lead to short-circuiting, charging or forced-discharging, followed by heat generation or an explosion.

(7)NEVER SHORT THE POSITIVE AND NEGATIVE TERMINALS OF THE BATTERY.

Short-circuiting may cause heat generation from the battery or an explosion.

(8)NEVER DEFORM OR CRUSH THE BATTERIES.

The deformation of the battery can cause leakage or internal short-circuiting with heat generation, followed by an explosion.

(9)NEVER DISASSEMBLE THE BATTERIES.

Disassemble of the battery can cause irritating and corrosive gases to leak. Exposing the lithium in the battery to water can cause heat generation or fire.

(10)NEVER USE THE BATTERY TOGETHER WITH DIFFERENT TYPE BATTERIES.

Using the battery together with different type batteries or using old and new batteries together may lead to charging or over-discharging because of the differences in voltage or capacity, followed by an explosion. If two or more batteries are to be connected in a series and/or placed in a parallel arrangement, consult us in advance.

(11)PLEASE USE THE BATTERY WITHIN OPERATING TEMPERATURE RANGE -20°C ~60°C (-4 ° F~140 ° F).

Charging and discharging at higher or lower temperature than the specification may cause the deterioration of characteristics.

(12)NEVER HEAT ABOVE 80°C(176 ° F) NOR EXPOSE OF IN FIRE.

This battery contains inflammable materials such as lithium metal and organic solvent. If exposed of in fire, it may cause ignite or explosion. If heated above 80°C(176° F), plastic materials in the battery such as the gasket may be damaged, causing leakage, short circuit, or fire.

(13) NEVER SOLDER THE BODY OF BATTERY DIRECTLY.

When soldering the battery to the equipment, soldering must be done by tabs or leads only. However, even then, the soldering temperature must be below 270°C (518 ° F) and the soldering time must be less than 5 seconds. When applying an automatic soldering to the battery, make sure that the battery is not suspended or dropped into the soldering bath.

(14) DISPOSING OF THIS BATTERY, INSULATE THE BATTERY BY ADHESIVE TAPE, ETC.

If the battery comes into contact with other metallic objects, it may cause heat generation, fire or explosion. When many batteries are to be disposed of at a time, please consult us.

**Warning** on Storage.**(1) STORE IN COOL AND DRY PLACE BUT PREVENT CONDENSATION ON CELLS OR BATTERIES.**

Elevated temperature can result in a shortened battery life.

(2) NEVER TREAT THE BATTERY VIOLENTLY.**(3) NEVER LEAVE THE BATTERY AT TEMPERATURE OF 40°C (104° F) OR MORE.****(4) NEVER LEAVE THE BATTERY AT RELATIVE HUMIDITY OF 75% OR MORE.**

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