DRAFT

SPECIFICATIONS
FOR LITHIUM BATTERY
ML1220

Edan Instruments,Inc.

APPROVED SIGNATURE :

YOUR NAME (Please Print) :

TITLE :

DATE :

Typed : Date:

Checked : Date:

Approved : Date:

-In order to confirm your acceptance of this specification, please return one copy signed by an appropriate authority.

-Notice! Any order placed for the product's herein specified, after you have received this documents, will be taken as your acceptance of this specification.

HITACHI MAXELL ENERGY, LTD.

1. Scope

These specifications are applicable to the lithium batteries supplied by Hitachi Maxell Energy, Ltd. to Edan Instruments, Inc.

2. Applicable Battery Type		Manganese-Dioxide Lithium Secondary Battery
3. Battery Type and Performance		
3.1	Type (Designation)	ML1220
3.2	Nominal voltage	3.0 volts
3.3	Nominal discharge capacity	18mAh(Load: 30k ohm, End voltage: 2.0V)
3.4	Standard discharge current	Less than or equal to 0.1mA
3.5	Outside dimensions	As per drawing attached. note) The ML battery is a secondary battery and the change of the battery height(thickness) will occur when the battery is charged or discharged. Please establish the space more than 1mm around a battery.
3.6	Standard weight	0.7 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	Guarantee	1 year from manufacture code
3.9	Appearance	Will be free from flaw, stain, deformation, uneven tone, electrolyte leakage and other defects which impair the value of the commodity.
3.10	Brand	The brand name of "MAXELL" is used.
3.11	Symbol of manufactured month and year	Manufactured month and year will be shown on the surface of the battery. Example : 11A (Manufactured in January, 2011) 15A (Manufactured in May, 2011) 10A (Manufactured in October, 2011) 1YA (Manufactured in November, 2011) 1ZA (Manufactured in December, 2011)

Table 1

DRAFT

1. Open circuit voltage

Initial	2.9 to 3.3 V
After 12 months storage	2.8 to 3.2 V

2. Service life

Load resistance		30k ohms
Discharge method		24 hours / day
End voltage		2.0 V
Minimum duration (Initial)	20 deg. C -20 deg. C 60 deg. C	180 hours 145 hours 180 hours
Minimum duration (After 20 days storage at 60 deg. C)	20 deg. C	150 hours

3. Cycle life

Minimum number at 20 deg. C (Initial)	Discharge depth: 100% Discharge depth: 10%	23 cycles 600 cycles
Minimum number at 20 deg. C (After 20 days storage at 60 deg. C)	Discharge depth: 100%	20 cycles

4. Over-charge characteristics

Charge method	3.3 V, 20 days at 60 deg. C, R_L=600 ohms
Load resistance	30k ohms
Discharge method	24 hours / day
Minimum duration at 20 deg. C (Initial)	180 hours

5. Over-discharge characteristics

Discharge method	2k ohms, 20 days at 20 deg. C
Charge method	3.25 V, 48 hours at 20 deg. C, R_L=390 ohms
Load resistance	30k ohms
Discharge method	24 hours / day
Minimum duration at 20 deg. C (Initial)	170 hours

6. Electrolyte leakage resistance

No visible electrolyte leakage will take place at following conditions:

1) Initial
2) After 20 days storage at 60 deg. C
3) After 60 days storage at 45 deg. C and 90% RH

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

DRAFT

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+/-2 deg. C and at relative humidity of 65+/-20%.

4.1.2 Storage conditions

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

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 +/-1mV or more precise and the input impedance will be more than 10M ohms.

(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 of which measuring rage 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).

4.2.3 Service life

Leave the battery samples at A deg. C for B hours (See Table 2), 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 2.

	A	B
Room temperature	20+/-2 deg. C	above 12 hours
Low temperature	-20+/-2 deg. C	12 to 24 hours
High Temperature	60+/-2 deg. C	12 to 24 hours

4.2.4 Cycle life

(1) 100% charge-discharge test:

(a) Leave the battery samples at 20 +/- 2deg. C above 12 hours.

(b) Discharge the battery samples continuously through 2.7k ohms load for 12 hours.

(c) Right after above discharge, charge the battery samples by the power supply of 3.25+/-0.01V for 17 hours (R_L=390 ohms).

(d) Right after above charge, repeat (b) and (c). Count the number of cycles until the duration time (end voltage: 2.0 V) reach less than 7.2 hours.

(2) 10% charge-discharge test:

(a) Leave the battery samples at 20 +/- 2deg. C above 12 hours.

(b) Discharge the battery samples continuously through 2.7k ohms load for 1.2 hours.

(c) Right after above discharge, charge the battery samples by the power supply of 3.25+/-0.01V for 2.4 hours (R_L=390 ohms).

(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 1.2 hours.

4.2.5 Over-charge characteristics

Charge the battery samples continuously by the power supply of 3.3V for 20 days at 60+/-2 deg. C (R_L=600 ohms). Measure the service life by the method specified in 4.2.3 (at 20+/-2 deg. C).

4.2.6 Over-discharge characteristics

(a) Discharge the battery samples continuously through 2k ohms for 20 days at 20+/-2 deg. C.

(b) After above discharge, charge the battery samples by the power supply of 3.25+/-0.01V for 48 hours at 20+/-2 deg. C (R_L=390 ohms). Measure the service life by the method specified in 4.2.3 (at 20+/-2 deg. C).

4.2.7 Electrolyte leakage resistance

(1) High temperature storage

(a) Store the battery samples at 60+/-2 deg. C for the period specified in Table 1.

(b) After above storage, leave the battery at 20+/-2 deg. 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+/-2 deg. C and 90%RH for the period specified in Table 1.

(b) After above storage, leave the battery at 45+/-2 deg. C for 3-5 hours and after that leave the battery at 20+/-2 deg. C for 12 hours.

(c) Check the state of the leakage by the naked eyes.

DRAFT

5. Limited warranty

(1)This product, if defective in materials or workmanship, will be replaced free of charge, when returned to Hitachi Maxell Energy, Ltd. Replacement is the sole obligation under this warranty. This warranty expressly excludes incidental and consequential damages caused by use of, or inability to use, this product.

(2)When customer does any work on the battery except instructions in this specifications, for example wire is soldered to the tab or battery surface directly, Hitachi Maxell Energy, Ltd. can not warrant any battery performance including safety and the customer shall undertake the responsibility of all damage caused by this battery.

(3)Confirm and assure the matching and reliability of batteries on actual set or unit application with customer's responsibility.

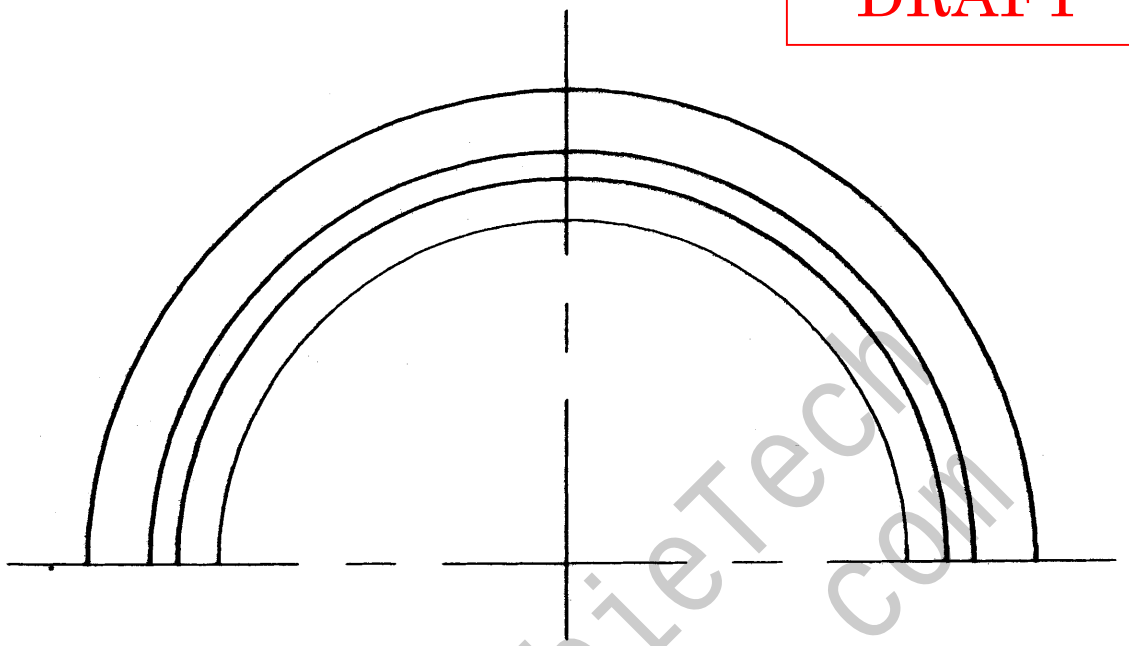
(4)In the case of the following situation, it will be assumed that Hitachi Maxell Energy, Ltd. does not take responsibility.

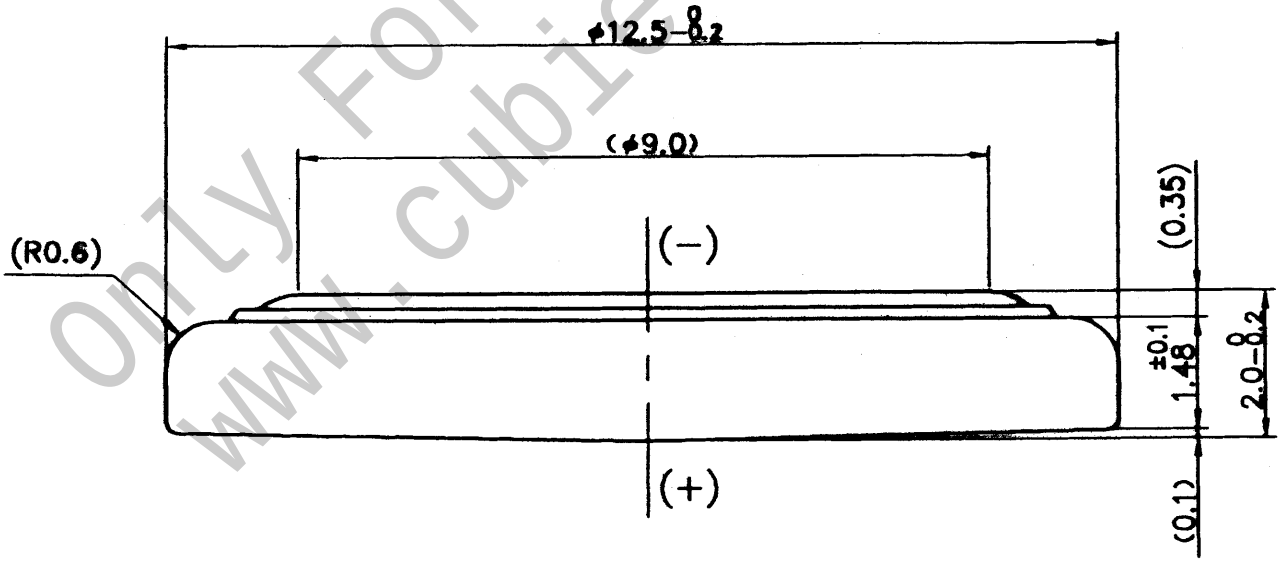
(i) When the appropriate handling, use, installation, or examination of batteries were not carried out.

(ii) When the instructions, attentions or warnings mentioned in this specification were not followed.

(iii)When the rational instructions or advice of Hitachi Maxell Energy, Ltd. were not followed.

DRAFT





DIMENSIONS : mm

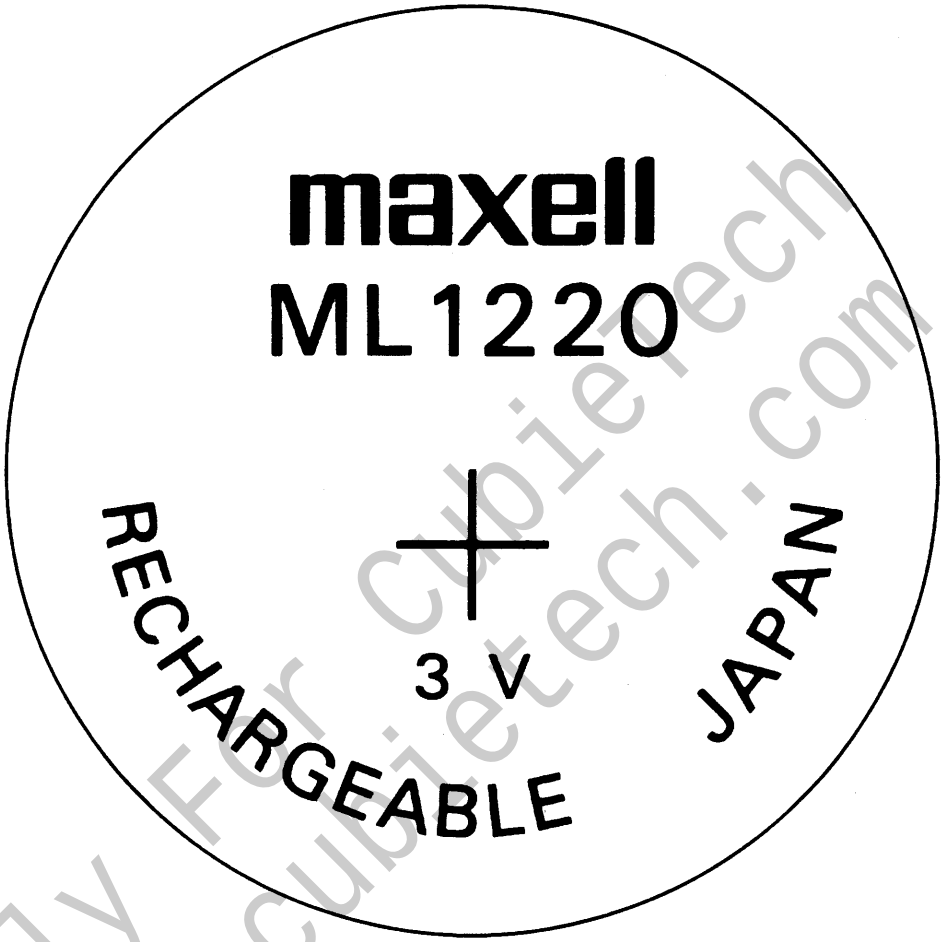
	PROJECTION	SCALE	TITLE	SH.
		10/1	ML1220	—

REGD.				REV.
	DWN.		Hitachi Maxell,Ltd.	
	CHKD.		Ono Japan	
	APPD.			

ONO WORKS DWG. NO.

01 4261 5024

DRAFT



DIMENSIONS : mm

	PROJECTION	SCALE	TITLE	SH.
		10/1	Stamp for ML1220	
REGD. DWN. K.Nishida Aug.22'97 / CHKD. S.Sekiya 8.22.97 / APPD. S.Sekiya 8.22.97	Hitachi Maxell, Ltd. Ono Japan		ONO WORKS DWG. NO. 01426116003	REV.

DRAFT

Dec. 2007 **Maxell**

Safety Instructions

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

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

! Warning - Handling

● Never swallow.

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

● Do not replace.

There could be some large differences even between battery manufacturers, not to mention between types or models. If you are equipment manufacturer and you should replace the battery, please use new same type and same model battery of Maxell. 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, gas could be generated or the primary battery could be short-circuited by charging, leading to distortion, leakage, overheating, explosion, or fire. Please design your equipment so that end user cannot replace the battery by mistake.

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

It is very difficult to design the circuit so that each battery can be observed the instructed charging voltage or charging current in warning of circuit design mentioned later.

● Never reverse the positive and negative terminals when mounting.

The 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 keep battery with metal goods such as a necklace or a hairpin. Please be careful on installing not to be short-circuited via metal parts of the equipment. Otherwise battery could cause distortion, leakage, overheating, explosion, or fire.

● Never heat.

Heating the battery more than 100 degree C could increase the internal pressure leading to 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 fire and explode violently.

● **Never disassemble.**
Separator or gasket could be damaged. This could cause distortion, leakage, overheating, explosion, or fire.

● **Never weld the terminal or wire to the body of the battery directly.**
The heat on welding such as soldering could cause a melting of lithium, or a damage of insulating material in the battery. This could cause distortion, leakage, overheating, explosion, or fire. When soldering the battery directly to equipment, soldering must be done only on tabs or leads. Even then, the temperature of soldering iron must be below 350 degree C and the soldering time must be less than 5 seconds as low and short as possible. Do not use soldering bath, because the board with battery could stop on the bath or the battery could drop into the bath. Moreover notice not to solder excessively, because excessive solder could go to unintended portion on the board leading to short or charge of the battery.

● **Never touch the liquid leaked out of battery.**
If the liquid comes into eyes, immediately flush eyes with plenty of water and consult a physician, because the liquid could damage eyes. If the liquid comes into mouth, immediately rinse by plenty of water and consult a physician.

● **Never bring fire close to battery liquid.**
When leakage or strange smell are suspected, keep the battery away from a fire immediately because the leaked liquid could catch fire.

● **Never keep in touch with battery.**
Keeping in touch with battery on the skin by such as a tape could damage the touched area of the skin.

DRAFT

⚠ Warning – Circuit Design

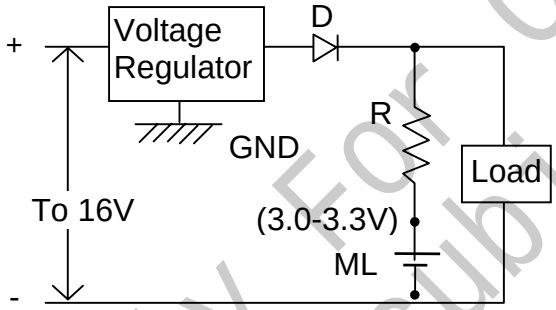
● Never set charge voltage above 3.3V.
To charge at higher voltage could cause the generation of gas, internal shirt-circuiting, or other malfunctions, leading to distortion, leakage, overheating, explosion, or fire. For details, see the recommended circuits in the figure below.

● Always charge at the nominal currents shown below.
Large surges of current could degrade the battery's characteristics, leading to distortion, leakage, overheating, explosion, or fire. To avoid excessive current at the initiation of charging, make sure to attach protective resistance for current control. See the recommended circuits in the figure below.

Table 1 Nominal Charge Current by Model

Model	ML2032	ML2016	ML1220
Charge Current	2mA or lower	2mA or lower	1mA or lower

● Recommended Circuits
Please refer to the representative basic circuits shown in figures below. If you have any questions about circuit design, please consult with Maxell freely.



D: Diode, R: Resistance

Table 2 Example of resistance

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

(How to select the protective resistance for current control)
The maximum charge current is flown on charged at the end voltage (2.0V) of battery. Therefore the value of resistance is calculated from following equation.

(R)>=((Output Voltage of Voltage Regulator) – 2) / (Nominal Charge Current)

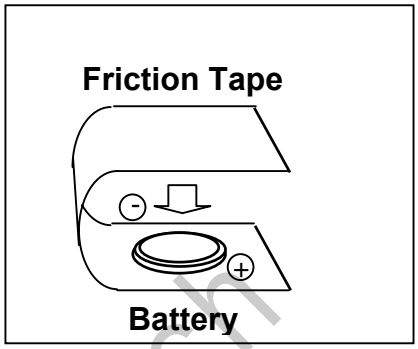
For example, S-812C series, which maximum input voltage is 18V or S-817 series, which maximum input voltage is 10V (Seiko Instruments Inc.) can be used as voltage regulator.

Note 1: If a main power source voltage is stable, the charge voltage can be allotted from main power source divided by the combination of resistances.
Note 2: Because that the battery height must be changed by charge and discharge cycle, place a minimum 1mm space between the battery and device or chassis.

DRAFT

Warning – Disposal

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



(Example of battery insulating)

Caution – Handling/Storage

● **Use within rated temperature range (-20 to 60 degree centigrade).**
Otherwise the charge and discharge characteristics may be reduced.

● **Never expose the battery in ultrasonic.**
Exposing the battery in ultrasonic may cause short-circuiting by powdering of the inside material leading to distortion, leakage, overheating, explosion, or fire.

● **Never treat the battery violently.**
Deforming or strong shock by dropping, or throwing may cause distortion, leakage, overheating, explosion, or fire.

● **Keep contact pressure more than 2N.**
The battery voltage may be lower than intended value because of poor contact condition. Please keep contact pressure more than 2N for suitable contact resistance.

● **Never use or leave the battery in hot place such as under the direct rays of the sun or in the car under the burning sun.**
Otherwise this may cause distortion, leakage, overheating, explosion, or fire of the battery.

● **Never let the battery contact with water.**
Contact of the battery with water may cause distortion, leakage, overheating, explosion, or fire of the battery. And rust may be generated.

● **Never store the battery in hot and high humid place.**
Otherwise the property of the battery may deteriorate. Under certain circumstances, this may cause distortion, leakage, overheating, explosion, or fire.