

## RECHARGEABLE LITHIUM BATTERY SPECIFICATIONS

CUSTOMER : RE-ENERGY CO., LTD.

MODEL : ML1220A-PW

Approval by Customer

DATE :

SIGNATURE :

DATE : February 28, 2017

FDK CORPORATION  
Battery Business Group  
Lithium Battery Division  
Battery Development Division  
Battery Development Department  
Cell Engineering Section I

Drawn	<i>N. Yamamoto</i>
Checked	<i>Akai</i>
Approved	<i>S. Namuse</i>

We will regard this specification is accepted and approved by you and we apply it as a valid specification if your approved document was not returned before either earlier time the first delivery date of this product or after 6 months from issued date.

## 1. Scope

This specification is applicable to FDK Manganese Rechargeable Lithium Battery to be delivered to RE-ENERGY CO., LTD. via FDK TAIWAN LTD.

## 2. Name and Model

- 2.1 Name Manganese Rechargeable Lithium Battery  
2.2 Model ML1220A-PW

## 3. General Characteristics

- 3.1 Nominal Voltage 3 V  
3.2 Nominal Capacity \*1 15 mAh  
3.3 Continuous Charge Voltage \*2 DC 2.80 to 3.10 V  
Intermittent Charge Voltage \*3 DC 2.80 to 3.25 V  
3.4 Discharge End Voltage 2.00 V  
3.5 Weight Approx. 0.8 g  
3.6 Operating Temperature -20 to +60 °C

\*1 Average actual value discharged with the load of 15kohms to the end voltage of 2.00V after having been charged at 3.25V with the current limit resistor of 200ohms during 30hours at 23°C.

\*2 The cell and the load are connected in parallel to the charging power source, and normally charging power source supplies the electric force to the load. However, the cell supplies the electric force to the load when the charging power source is failed or stopped. This is the charging method, that is to say, the cell will keep charged all the time, and will have shorter discharging time.

\*3 Charging method is to connect a cell with the load after charged by the charging power source. In other words, the cell will keep charging condition and discharge condition repeated.

## 4. Shape and Dimension and Material

- 4.1 Shape and Dimension See figure-1.  
4.2 Terminal Material Positive : Stainless Steel  
Negative : Stainless Steel

## 5. Appearance

- 5.1 Indication : Model, plus polarity, FDK's brand, and so on shall be marked.  
(See figure-2)  
5.2 Manufacture date : The meaning of the abbreviation is shown in figure-3  
5.3 Appearance : Designated indication is shown, and there is no crack, dirt, deformation fractures, rust, creeping nor leakage that spoils value of goods.

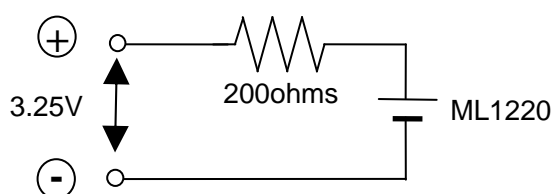
## 6. Electrical Characteristics

Test Item	Temp.	Performance	Test Method
Open Circuit Voltage (After received)	23°C	2.50 to 3.00 V (Approx. 90% charged)	---
Open Circuit Voltage (Fully charged)	23°C	3.00 to 3.25 V	6.1
Duration Time	60°C	Min. 70h	6.2
	23°C	Min. 75h	
	-20°C	Min. 40h	

Test Item	Temp.	Performance	Test Method
Overcharge	23°C	Duration time after overcharge. Min. 75h Any defect shall not be Observed in appearance	6.3
High Temperature Test	60°C	Duration time after high temperature storage Min. 70h	6.4
Leakage	60°C 90%RH	No leakage (checked with naked eyes)	6.5
Shelf Life	23°C	Duration time after storage Min. 75h	6.6
Charge/Discharge Cycle	23°C	Min. 300cycles	6.7
Vibration Test	---	Any defect shall not be observed in appearance.	6.8
Drop Test	---	Any defect shall not be observed in appearance.	6.9
Short Circuit	23°C	Any defect shall not be observed in appearance.	6.10

- 6.1 The cell shall be charged by connecting standard circuit as shown in figure-4 for 30hours. Open circuit voltage shall be measured within 3days after the cell was charged under the specified condition.

Figure-4



- 6.2 Duration time shall be measured at continuous discharge under the load of 15kohms to a 2.00V cut-off voltage after the cell was charged under the specified condition in section 6.1.
- 6.3 The cell shall be charged for 30days by connecting standard circuit as shown in Figure-5. Duration time shall be measured at continuous discharge under the load of 15kohms to a 2.00V cut-off voltage.
- 6.4 Store the cell in the Temperature Chamber at 60°C for 20days after the cell was charged under the specified condition in section 6.1.  
Duration time shall be measured at continuous discharge under the load of 15kohms to a 2.00V cut-off voltage.
- 6.5 Store the cell in the Temperature & Humidity Chamber at 60°C 90%RH for 30days.
- 6.6 Store the cell at 23°C for 1year.  
Duration time shall be measured at continuous discharge under the load of 15kohms to a 2.00V cut-off voltage after the cell was charged under the specified condition as specified in section 6.1.
- 6.7 Charging method : charge current 0.5mA, Cut-off voltage 3.25V.  
Discharging method : discharge current 0.5mA, discharge period 4hours.  
The cell shall be cycled as above until its closed circuit voltage falls below 2.00V.
- 6.8 Vibration test shall be done as follows.  
Amplitude : 2mm  
Frequency : 16.7Hz  
Directions : 30minutes in each of three mutually perpendicular directions
- 6.9 The cell shall withstand ten drops from 75cm in any orientation onto an oak board.
- 6.10 The cell shall be short-circuited at 23°C for 1day after having been charged under the specified condition in section 6.1.

## 7. Standard Test Conditions and Instruments

- 7.1 If it is not specified particularly, all tests shall be performed at  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , Max.75%RH. All cells shall be kept in the above conditions for at least 2hours prior to the test. If it is not specified particularly, the humidity environment at high temperature test shall be 'dry' under 2%RH.
- 7.2 If temperature tolerance and humidity tolerance are not written down, the temperature tolerance shall be  $\pm 2^{\circ}\text{C}$ , and the humidity tolerance shall be  $\pm 5\%$ .
- 7.3 Voltmeter  
The internal resistance shall be more than 10Mohms. However, the internal resistance for the voltmeter used for measuring duration time shall be more than 1Mohms or ten times of the load, whichever larger.
- 7.4 Load Resistance  
Load resistance shall include any external resistance of a cell and tolerance shall be within  $\pm 0.5\%$  even during discharge.
- 7.5 Time for Test  
Any tests shall be started within 3days after the specified storage period.
- 7.6 Initial Test  
Initial test shall be started within 1month after delivery.

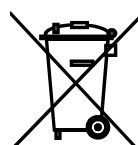
## 8. Others

- 8.1 This cell covers UL's requirements to be a Recognized Components File MH13421.
- 8.2 The amount of lithium metal in this cell is less than 0.3g per cell, which does not apply to Dangerous Goods (class 9) in regulations of air transportation (IATA-DGR) and maritime transportation (IMDG-Code). So this cell is permitted to be carried normally as non-dangerous goods on the condition that it can meet all the requirements of the respective transportation regulations. However, when lithium metal cells are transported in accordance with section II by air, there is a restriction in the number of packages to transport per one air way bill and the means of transportation; One package only and transport by cargo aircraft only. Also, when lithium metal cells are transported in the form of two or more packages they are permitted to transport if the packaging form is in accordance with Section I A and Section I B.  
For more information on transportation of this cell, please refer to the UN Recommendations (Recommendations on the Transport of Dangerous Goods), IATA Dangerous Goods Regulations, IMDG Code (International Maritime Dangerous Goods Code) or contact us.
- 8.3 These batteries are in compliance with EU Battery Directive.  
Batteries apply to EU Battery Directive and are not applicable to RoHS Regulations, However, these batteries do not contain the substances listed in RoHS Regulations such as Lead, Mercury, Cadmium, Hexavalent Chromium, PPB and PBDE.
- 8.4 This cell is not manufactured with class I ozone depleting substances, and does not contain class I ozone depleting substances.
- 8.5 In case of a battery shipment across the entire EU:  
Preparing for EU New Battery Directive is necessary. Indication of dustbin mark on cell/battery bodies does not apply to coin-shaped cells, because the surface area of these cells is too small to add the mark, which is less than the indication size specified in Clause #5, Article #21 of EU Battery Regulations.  
Consequently, we would like to suggest you to indicate the dustbin mark (1cm×1cm or larger) on the smallest package such as a cosmetic box for applications in which these cells are incorporated.  
As these EU Battery Regulations apply only in Europe, the indication of this dustbin mark might cause unnecessary troubles in other countries. In order to prevent this, we have added the letters of "EU" above the dustbin mark, meaning "these regulations apply only in Europe." However, this alternative can be decided in your company.

<FDK Indication>



<EU Indication>



- 8.6 The packaging specification is shown in figure-5.

## 9. Precautions in Handling

Rechargeable lithium batteries contain lithium active material and flammable materials such as organic solvents. Erroneous handling of lithium batteries may result in heat generation, explosion or fire possibly leading to injury. To ensure safety and to avoid any possibilities of any accidents, please observe the following precautions.

### 9.1 Precautions for the safe handling of lithium secondary batteries.

(1) Do not cause short-circuiting.

If connection is made between the positive (+) and negative (-) terminals directly or via accidental contact with conductive objects, the batteries will short-circuit and high current will flow causing heat generation which may lead to casing rupture or fire.

(2) Do not heat.

If non-reflowable batteries are heated to above 100°C, seal insulating separators other polymer components may be damaged resulting in electrolyte leakage and or internal short circuiting leading to heat generation.

This effect may cause rupture or fire. Moreover do not dispose the batteries in fire, explosion and or burning may result.

(3) Do not solder directly onto battery casing.

Attempts to solder directly onto battery casing may cause over-heating. Damage to internal insulation as well as damage to sealing may result in leakage. Even if no visible damage is caused right after soldering, weakened seals may lead to leakage during long term service causing damage to other components.

(4) Do not disassemble nor deform.

If batteries are disassembled, irritant gases may be released.

Exposed lithium alloy may react leading to fire. If batteries are deformed by pressure or impact, sealing may be damaged leading to leakage, also, internal insulation may be damaged leading to internal short circuit.

(5) Do not mix different types of batteries.

In case the plurality of batteries are used, the mixture of different type of batteries, the mixture of new and old batteries of the same type, or the mixture of different manufacture of the same type of batteries, may make the batteries over-discharged by the differences of characteristics such as the voltage of the batteries, and it may cause swelling, rupture or fire.

(6) Ensure correct polarity.

If positive (+) and negative (-) terminals of the batteries are reversed during installation, the batteries may short-circuit, over-discharge (\*4) or become reversed in polarity depending on the application. This may lead to causing rupture and fire.

(7) Do not overcharge (\*5) by high current and/or high voltage.

Do not over-discharge. (polarity reversal)

If batteries are over-charged by high current or if batteries are over-discharged to polarity reversal, internal gas pressure will rise, which will lead to swelling, rupture and fire.

(8) Do not use batteries for unspecified purposes.

Differences in voltage or terminal configuration may cause an imperfect connection, fire, heat generation, leakage or bursting.

(9) In case of leakage or an abnormal odor keep away from fire to prevent ignition of any leaked electrolyte.

(10) Do not put into conducting liquid (such as solder baths) whose conductivity is more than 350μS/cm.

If batteries are put into the conducting liquid, then electric corrosion may occur and inflammable gases may be released.

\*4 Overdischarge : to discharge below the specified end of discharge voltage. In extreme cases of over-discharge the polarity of the battery will become reversed.

\*5 Overcharge : to continue charge after the battery has been fully recharged.

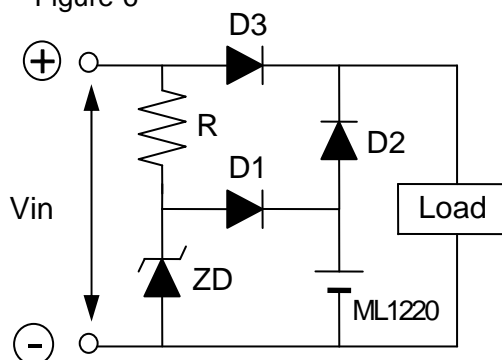
### 9.2 Precautions in designing equipment circuits in which batteries are incorporated.

(1) Batteries shall be located as far away as possible from any heat sources. In the event of circuit failure, the batteries should not be exposed to temperature in excess of 100°C except reflow.

(2) Over charging

In case of floating charge, the charging voltage should be as low as possible within the range of between 2.80V/cell and 3.10V/cell. To avoid overcharging, use a circuit like Figure-6. If the cell is charged to a higher voltage than specified, there will be swelling, corrosion, leakage, rupture, or burn.

Figure-6



$I_z$  : Current that flows through ZD when fully charged.

$V_z$  : Zener diode voltage when the  $I_z$  current goes through ZD.

$V_F$  (0.1 $\mu$ A) : Voltage value when 0.1 $\mu$ A goes through D1 (0.1 $\mu$ A is the current that occurs at fully charged point.)

a) Cautions when setting up R, D1, ZD.

(1) Set up to obtain the following.

$$2.80\text{V/cell} \leq V_z - V_F(0.1\mu\text{A}) \leq 3.10\text{V/cell}$$

(2)  $I_z$  should be 5mA or lower.

b) Cautions when setting up D2.

Set up the leak current at 0.1 $\mu$ A or lower to prevent over charge.

(3) Over discharge

If the batteries are over-discharged to below the specified end of discharge voltage (2.00V/cell), there will be significant deterioration in battery performance. If the battery is forced to discharge till polarity reversal, the battery may swell, rupture or burn.

It is therefore recommended that consideration should be given for the need to incorporate over-discharge protections.

### 9.3 Storage precautions

(1) Batteries shall be stored in a dry place with minimal temperature variation.

(Relative humidity less than 60% at constant temperature between 10 and 30°C.) High humidity and high temperatures will result in battery performance deterioration as well as corrosion.

(2) Do not expose batteries to direct sunlight or expose them to moisture to avoid deterioration of performance.

### 9.4 Precautions in the event of swallowing a lithium battery

Please keep away from children and infants to avoid the possibility of swallowing by mistake. Furthermore, it is strongly recommended that careful attention should be paid to the method of fixing batteries into products to avoid the chance of them being readily removed. In the event of swallowing a lithium battery seek immediate medical attention.

### 9.5 Guarantee of product

(1) We certify that the battery shall comply with the specification defined in this document for 1 year after shipping from our factory. We will supply only substitute or replacement battery immediately with free of charge, in case the defects and problems are caused by our fault apparently in this period, and we don't bear any further liabilities.

(2) With regard to confirmation of matching between battery and your apparatus, and verifying of battery life under condition of set mounting, such confirmation shall be in your responsibility.

(3) We cannot accept any responsibility if you handle, apply, amount, test, service or check of batteries with improper or incorrect manner, and if you did not obey guidance, caution, warning or information which defined in this document, our rational instruction or suggestion.

(4) We will regard this specification is accepted and approved by you and we apply it as a valid specification if your approved document was not returned before either earlier time the first delivery date of this product or after 6 months from issued date.

### 9.6 Requests for keeping quality and safety

Please contact FDK if your intended application requires the battery to operate outside of those conditions described previously.

For example

(1) In case of applying batteries for other applications.

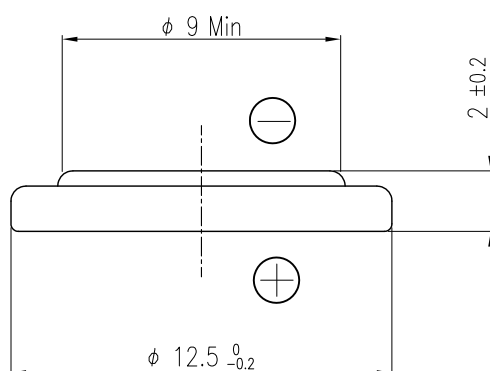
(2) In case of connecting batteries in series or in parallel in circuits.

(3) In case of plastic molding for batteries.

(4) In case of spot welding terminals onto batteries.

(5) In case of cleaning or welding by ultrasonic.

Figure-1 Shape and Dimension



Unit : mm

Figure-2 Positive Can Marking

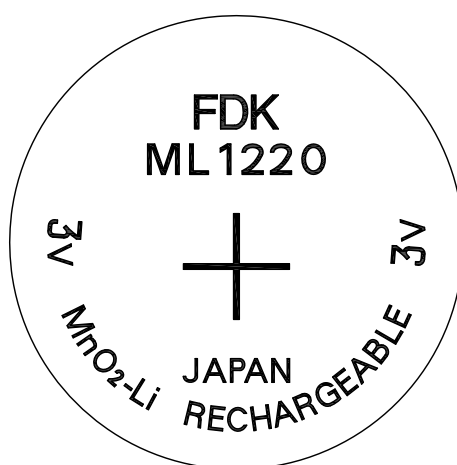




Figure-3 Indication of Production Lot

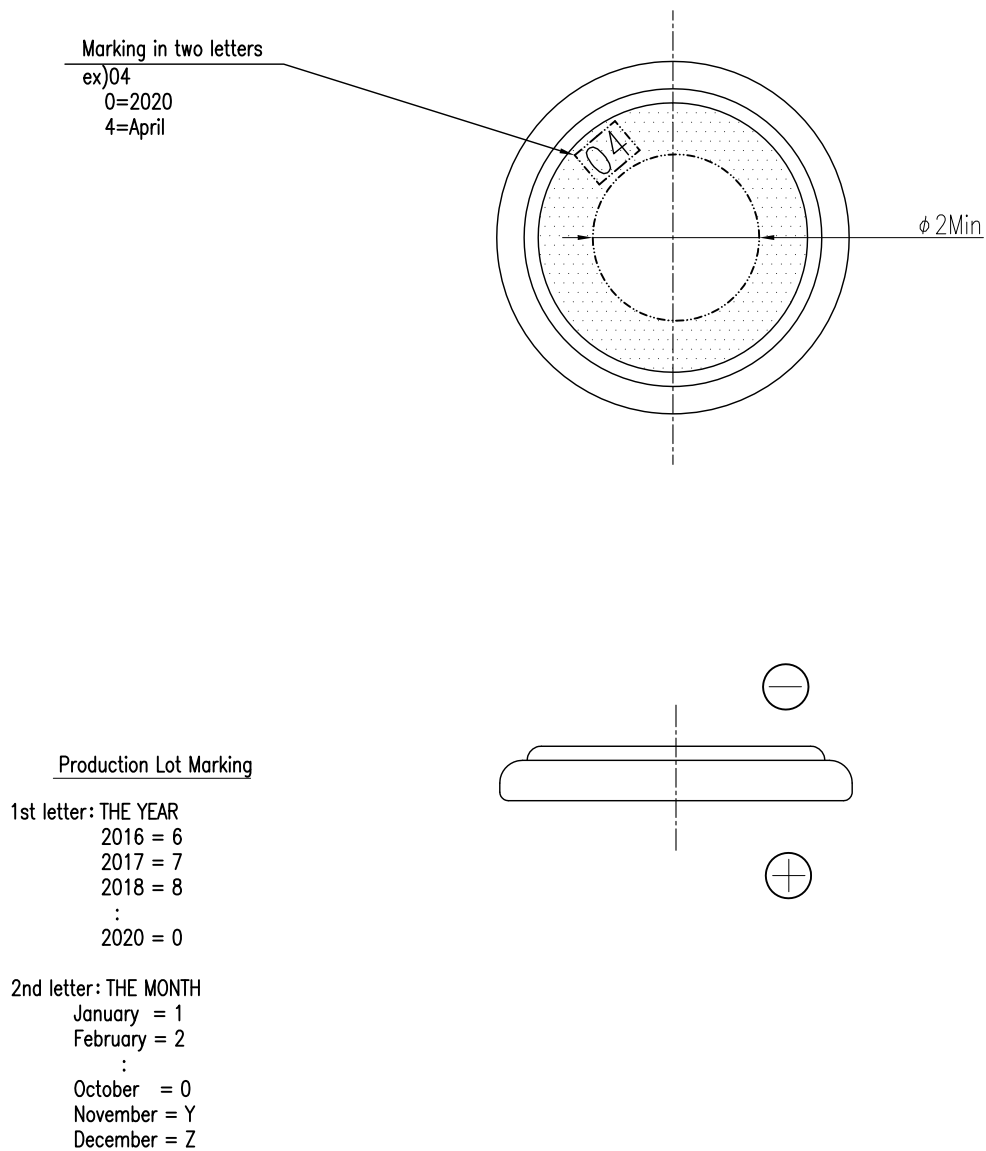
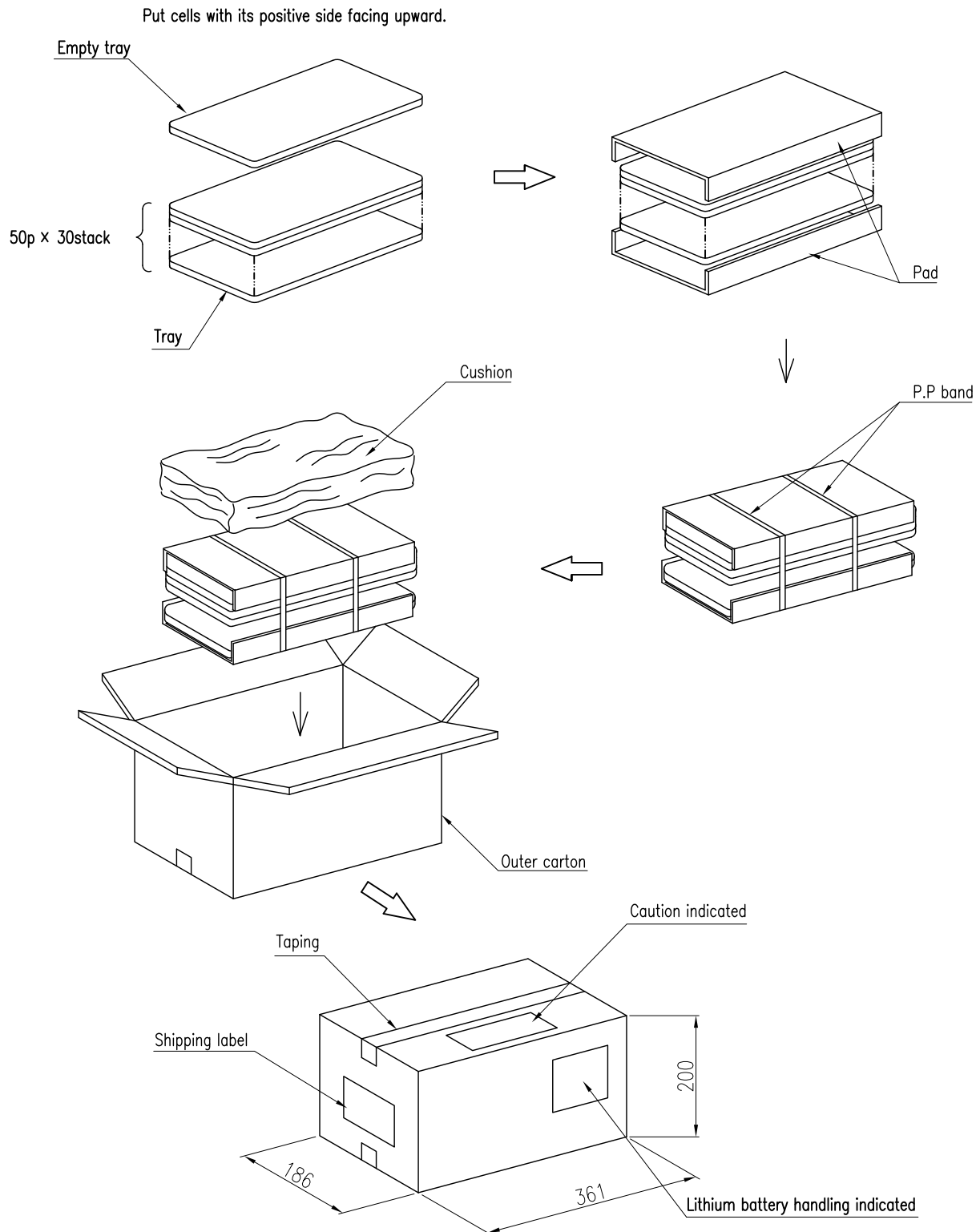


Figure-5 Packaging Specification



Outer carton in which 1500p contained  
 Weight : 2.4kg ( weight for packaging materials included )  
 ※All dimension is specified by outer size.

Unit : mm

Model

ML1220A-PW