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Lithium-ion Polymer Battery Specification

Model: JA-603048P

| Draft | Examine | Approve |
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AMENDMENT RECORDS

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| A/0 | New release | 2017-01-16 | Henry Huang |
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1. Scope

This document describes the Product Specification of the Lithium-ion Polymer (LIPB) Battery supplied by J & A ELECTRONICS.

2. Model: JA-603048P

3. Specification

| No. | Items | Specifications | |
|-----|---|---|------------------|
| 1 | Charge voltage (V)(CC/CV) | 4.2 | |
| 2 | Nominal voltage (V) | 3.7 | |
| 3 | Cut-off voltage (V) | 3.0 | |
| 4 | Max. charge current (continuous charging) | 0.5C | |
| 5 | Rated Capacity Min. capacity (0.2C) | 800mAh 780mAh | |
| 6 | Impedance | ≅ 80mΩ(1kHz AC Impedance) | |
| 7 | Standard charging time | 3.0 hours (Ref.) | |
| 8 | Max. discharge current | 1.0C | |
| 9 | Operating temperature & relative humidity % | Charging: 0°C~55°C, 90% RH Max. Discharging: -20°C~60°C, 90% RH Max. | |
| 10 | Storage condition | -20°C~45°C, 65%±20% RH | |
| 11 | Recommended storage condition | 20°C±5°C, 65%±20% RH | |
| 12 | Weight | Approx 32.5g | |
| 13 | Dimension (mm) | Item | cell |
| | | Length | 50.5mm /-1.0 |
| | | Width | 30.0mm +0.5/-0.5 |
| | | Thickness | 6.0mm +0.1/-0.1 |

4. Cell Performance Criteria

4.1 Visual inspection

There shall be no such defects such as scratch, flaw, crack, and leakage, which may adversely affect Commercial value of the cell.

4.2 Standard environmental test condition

Unless otherwise specified, all tests stated in this Product Specification are conducted in the following conditions:

Temperature : 23 ± 5 °C ,Relative Humidity : 65 ± 20%

4.3 The requirement of measure instrument

- (1) The measure instrument is passed tested by qualified institute.
- (2) The accuracy of the size instrument is not more than 0.01mm.
- (3) The accuracy of multimeter is not less than 0.5%. While measure the voltage, the internal resistance mustn't less than 10KΩ.
- (4) The principal of the internal resistance is 1KHz LCR, the accuracy is 0.2%.
The internal resistance is changeable, it varies according to the temperature and the charging mode. And it is relevant to the PTC and the length and the capacity of the drawing line.
- (5) The current accuracy of the battery test system is more than $\pm 0.1\%$, is basically accuracy is $\pm 0.5\%$, timer accuracy is less than $\pm 0.1\%$.
- (6) The accuracy of the temperature meter is less than $\pm 0.5^\circ\text{C}$

4.4 Visual inspection

There shall be no such defect as scratch, crack, and leakage, which may adversely affect commercial value of the cell.

4. 5 Electrical characteristics

| Item | Test Method and Condition | Criteria |
|----------------------|--|--|
| Full Charging | Charging the cell initially with constant current at 0.5 C5 A to 4.2V, and then with constant voltage at 4.2V till charge current declines to 0.01 C5 A, the charging time is 3.5 hours | |
| Rated Capacity | ① After the full charging 1 hours ,with discharge current of 0.2 C5 A till 3.0V cut-off voltage ② After the full charging 1 hours ,with discharge current of 0.5 C5 A till 3.0V cut-off voltage | Over 285 minutes Over 110 minutes |
| Cycle life | Continue charge and discharge for 300 cycles at $20^\circ\text{C}\pm 5^\circ\text{C}$.condition, then discharge 0.2 C5 A till 3.0V cut off voltage, measure the discharging capacity.. | $\geq 80\%$ Rated Capacity |
| Retention Capability | After full charging, storing the battery 28 days with $20^\circ\text{C} \pm 5^\circ\text{C}$.condition,and then staying 1 hours with discharge current of 0.5 C5 A till 3.0V cut-off voltage. | Recovery capacity $\geq 85\%$ |

※ Nominal Capacity

The Nominal capacity is the Min. capacity of the J & A production specification indicates, denotes the cell supply power with discharging 5h speed till cut off voltage at $20^\circ\text{C} \pm 5^\circ\text{C}$ condition. It is showed C5, the unit is Ah or mAh.

4. 6 Condition adapting characteristics

| Items | Test Method and Condition | Criteria |
|------------------------------|--|--|
| Temperature | After the battery full charging at 20 °C± 5°C, measure the discharging capacity with discharging current 0.2C5A till 3.0V cut off voltage at different temperature. | At -20°C is 40% At 0 °C is 60% At 55°C is 95% |
| Invariableness humid and hot | After put the battery in the invariableness humid and hot box of 40 °C± 2°C and relative humidity of 65 ± 20% for 48 hours, and with discharging current 0.2C5A till 3.0V cut off voltage. | No visible distortion, fire or explosion, the discharging time over 36 minutes |
| Vibration | The full charging battery vibrate from 90 to 100 minutes at three mutually perpendicular planes with excursion of 0.8mm, and change the frequency from 10 to 50 HZ with 1hz/min speed. | No visible evidence of leakage, fume, fire or explosion |
| Free fall | The battery fall from 1m height to 20mm thickness of hardwood for the way of positive and negative of x,y,z each once. | No visible evidence of leakage, fume, fire or explosion |

5. Safety performance

| No. | Items | Test Method and Condition | Criteria |
|-----|-----------------------------------|--|---|
| 1 | Continuous Charge test | The Battery discharged in accordance with standard charge at 20±5°C, then charged using the method specified by manufacturer, and it should be held at the specified end of charge Voltage for total period of 30 days. | No Leakage, no visible evidence of electrolyte loss, no explosion & no fire |
| 2 | Over discharge / over charge test | The battery should be charged according to standard charge at 20 ± 5°C, discharge the battery at constant 0.5C, until battery circuitry terminates discharge or 0V, then charge the battery with 0.5C until battery circuitry terminates charge or 4.3V, for 30 times cycles | |
| 3 | Thermal shock | The battery to be tested with 65± 2°C for 48 hours, move to -20°C within 5 minutes for 24 hours, standby in ambient temperature 23± 5°C for 24 hours. | |
| 4 | Altitude test (Low pressure) | The battery to be fully charged according to standard charging condition. And then to be store in a vacuum chamber which pressure less than 11.6 KPa (Equivalent to 2300m from sea level for 6 hours.) | |

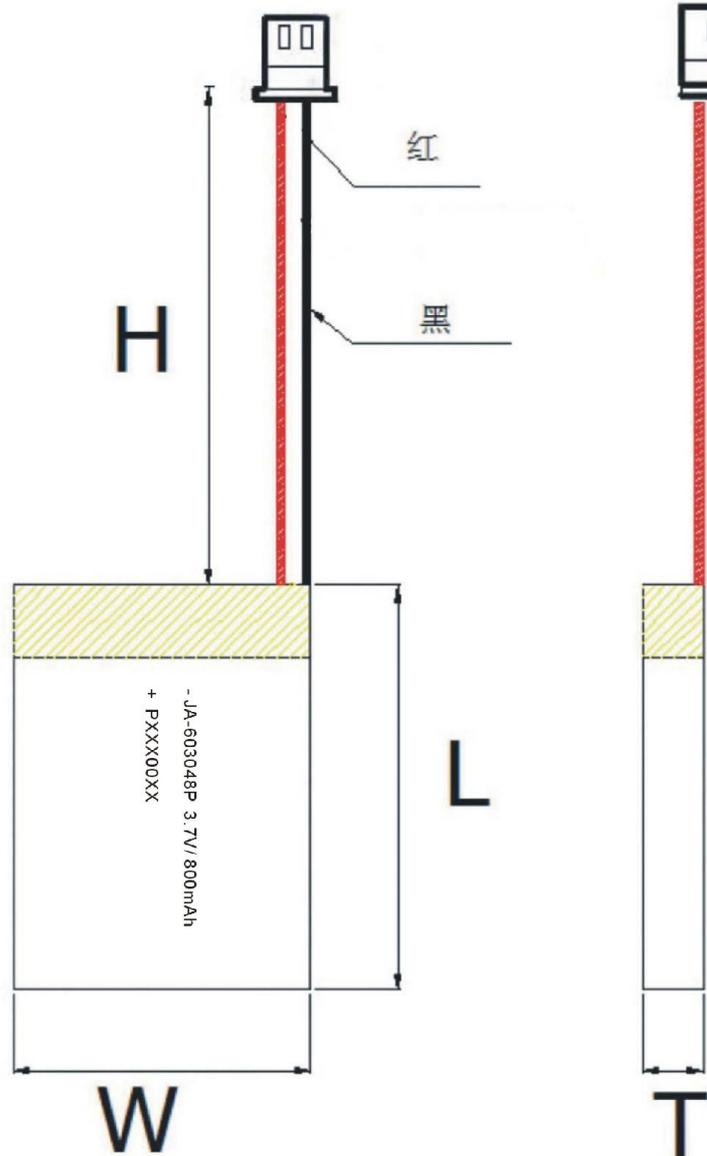
| | | | |
|---|-----------------------|---|---|
| 5 | Short test | The battery to be fully charged with standard charging condition, and short the positive and negative terminal with wire resistance = 100mΩ | No explore, no fire, Max. Temp. of battery surface should not exceed 160°C |
| 6 | Free fall test | The battery is fully charged with standard charging condition, and fall from 1m height to concrete ground surface for each panel twice | No Leakage, no visible evidence of electrolyte loss, no explosion & no fire |
| 7 | Thermal exposure test | The battery is fully charged in standard charging condition, and store in the over with 130± 2°C for 30 minutes. | |

6. Storage

| Item | Storage Condition | | Storage Period | Capacity (mAh) |
|-----------------------|-------------------|--------------------|----------------|----------------|
| | Voltage (V) | Temperature (°C) | | Recovery |
| 1. User short storage | Normal | Ref. 4.2 condition | 1 month | 90% |
| 2. User long storage | Normal | Ref. 4.2 condition | 3 month | 85% |
| 3. Long term storage | Normal | Ref. 4.2 condition | 6 month | 85% |
| 4. Long term storage | Normal | Ref. 4.2 condition | 12 month | 80% |

7.Product Drawing & BOM (Bill of material)

7.1 Product Drawing



| L (mm) | W (mm) | T (mm) | H1 (mm) | H (mm) |
|---------|---------|--------|---------|---------|
| 50.5max | 30.5max | 6.1max | / | 50+3/-0 |

7.2 Spray Content: (cell)

- JA-603048P
800mAh / 3.7V

+ Pxxx00xx ————— Date Code

7.3 Important Parameter:

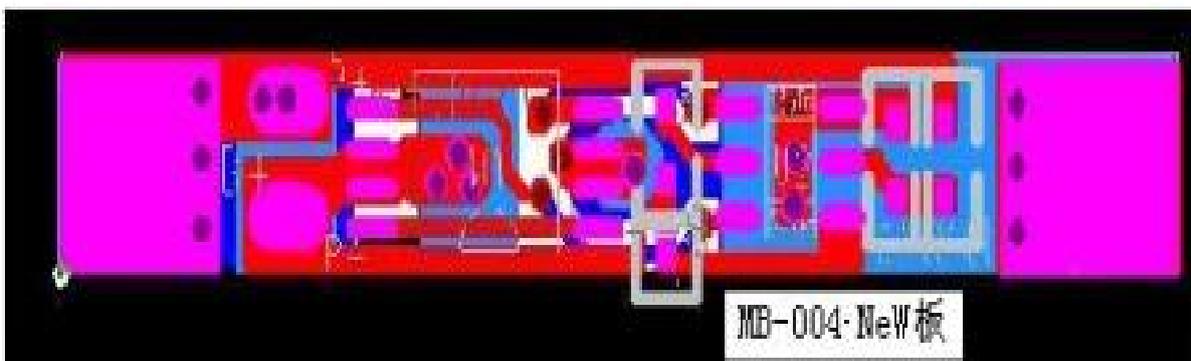
| NO | Item | Specification | Remark |
|----|--------------------------|-----------------------------------|--------------|
| 1 | Cell species | 603048P | |
| 2 | Rated capacity | 800mAh | |
| 3 | Open circuit voltage | ≥3.8V | |
| 4 | Over charging voltage | 4.28 ± 0.025V | |
| 5 | Over discharging voltage | 2.9+0.062V | |
| 6 | Short circuit | Short protection and release auto | |
| 7 | Storage temperature | -5~35℃ | |
| 8 | Impedence | ≤ 180mΩ | Battery Pack |

7.4 BOM (Bill of material)

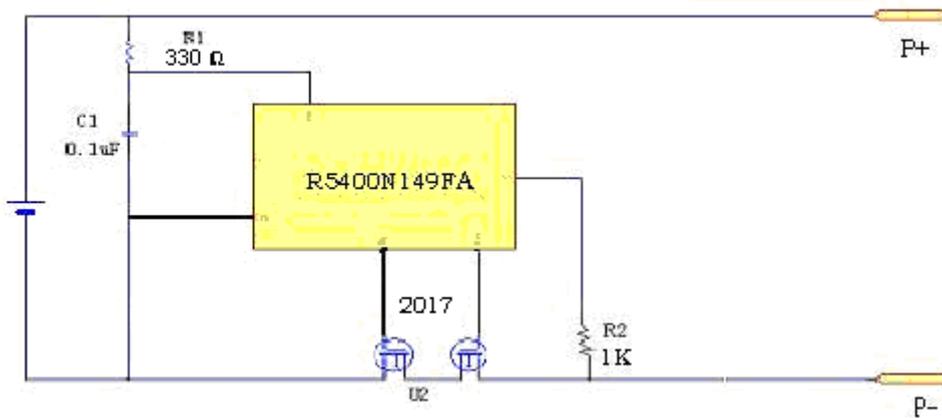
| NO | Material Name | Specification | Unit | Qty | Remark |
|----|---------------|---|------|-----|--------|
| 1 | Cell | 603048P | PCS | 1 | ROHS |
| 2 | PCBA | MB-04 | PCS | 1 | ROHS |
| 3 | Lead | Red wire , AWG24# (UL1007 φ 1.4mm or To Be Determined) | PCS | 1 | ROHS |
| 4 | Lead | Black wire, AWG24# (UL1007 φ 1.4mm or To Be Determined) | PCS | 1 | ROHS |

8. Protection Circuit Module (PCM)

8.1 Figure Dimension/Printing Circuit



8.2. Circuit Diagram



8.3 Bill Of Material Of PCM

| Item | Name | Specification | Qty | Remark |
|------|------|-----------------------------------|-----|--------|
| 1 | U1 | R5400149FA (or the same standard) | 1 | |
| 2 | U2 | FTD2017 (or the same standard) | 1 | |
| 3 | C1 | 0.1uF/0402 | 1 | |
| 4 | R1 | 330Ω/0402 | 1 | |
| 5 | R2 | 1KΩ/0402 | 1 | |
| 6 | PCB | MB-004 | 1 | |

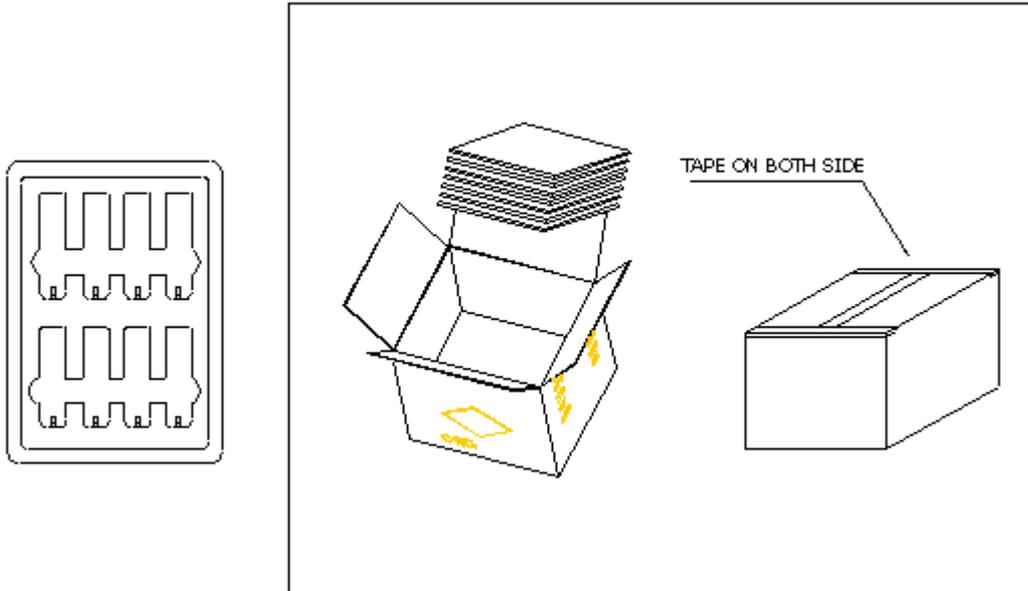
8.4. Electricity Characteristics

| NO | Item | Parameter | Unit |
|----|------------------------------------|----------------------------|------|
| 1 | Control IC operating voltage | 1.5~10 | V |
| 2 | Over charging detection voltage | 4.28 ± 0.025 | V |
| 3 | Over charging delay time | 0.7~1.3 | s |
| 4 | Over discharging detection voltage | 2.9 ± 0.062 | V |
| 5 | Over discharging delay time | 20~60 | ms |
| 6 | Over current detection voltage | 0.125 ± 0.015 | V |
| 7 | Over current delay time | 10~20 | ms |
| 8 | Short circuit protect voltage | V _{DD} -0.9 ± 0.3 | V |
| 9 | Short circuit protect delay time | 5~50 (The type is 5) | us |
| 10 | Over current release impedance | 50~150 (The type is 100) | kΩ |
| 11 | Current consumption | 2.0~6.0 | uA |

| | | | |
|----|--------------|---------|---|
| 12 | Over current | 3.0~6.0 | A |
|----|--------------|---------|---|

8. Packaging

The battery are delivered in trays with 8PCS; See attached figure 30 trays are stacked and in a parcels. In a bulk package (8X30=240pcs in one packaging) then put into carton.



J & A reserve rights of changing packing methods of each model without prior to notice to customers.

Appendix

Handling Precautions and Guideline For LIPB (Lithium-Ion Polymer Batteries)

Subject to change without notice

Preface

This document of 'Handling Precautions and Guideline LIP Rechargeable Batteries' shall be applied to the battery cells manufactured by J & A.

Note (1):

The customer is requested to contact J & A in advance, if and when the customer needs other applications or operating conditions than those described in this document. Additional experimentation may be required to verify performance and safety under such conditions.

Note (2):

J & A will take no responsibility for any accident when the cell is used under other conditions than those described in this Document.

Note (3):

J & A will inform, in a written form, the customer of improvement(s) regarding proper use and handling of the cell, if it is deemed necessary.

1. Charging

1.1 Charging current

Charging current should be less than maximum charge current specified in the Product Specification. Charging with higher current than recommended value may cause damage to cell electrical, mechanical and safety performance and could lead to heat generation or leakage.

1.2 Charging voltage:

Charging shall be done by voltage less than that specified in the Product Specification (4.2V/cell). Charging beyond 4.30V, which is the absolute maximum voltage, must be strictly prohibited. The charger shall be designed to comply with this condition. It is very dangerous that charging with higher voltage than specified value may cause damage to the cell electrical, mechanical safety performance and could lead to heat generation or leakage.

1.3 Charging temperature

The cell shall be charged within the specified temperature range in the Product Specification.

1.4 Prohibition of reverse charging:

Reverse charging is prohibited. The cell shall be connected correctly. The polarity has to be confirmed before wiring. In case of the cell is connected improperly, the cell cannot be charged. Simultaneously, the reverse charging may cause damaging to the cell which may lead to

degradation of cell performance and damage the cell safety, and could cause heat generation or leakage.

2. Discharging

2.1 Discharging current

The cell shall be discharged at less than the maximum discharge current specified in the Product Specification. High discharging current may reduce the discharging capacity significantly or cause over-heat.

2.2 Discharging temperature

The cell shall be discharged within the temperature range specified in the Product Specification

2.3 Over-discharging:

It should be noted that the cell would be at an over-discharged state by its self-discharge characteristics in case the cell is not used for long time. In order to prevent over-discharging, the cell shall be charged periodically to maintain between 3.7V and 3.9V. Over-discharging may cause loss of cell performance, characteristics, or battery functions. The charger shall be equipped with a device to prevent further discharging exceeding a cut-off voltage specified in the Product Specification. Also the charger shall be equipped with a device to control the recharging procedures as follows:

The cell battery pack shall start with a low current (0.01C) for 16 - 30 minutes, i.e. pre-charging, before rapid charging starts. The rapid charging shall be started after the individual cell voltage has been reached above 3V within 16 - 30 minutes that can be determined with the use of an appropriate timer for pre-charging. In case the individual cell voltage does not rise to 3V within the pre-charging time, then the charger shall have functions to stop further charging and display the cell/pack is at abnormal state.

3. Protection Circuit Module (PCM)

The cell/battery pack shall be with a PCM that can protect cell/battery pack properly. PCM shall have functions of (1) overcharging prevention, (2) over-discharging prevention, and (3) over current prevention to maintain safety and prevent significant deterioration of cell performance. The over current can occur by external short circuit

3.1 Overcharging prohibition:

Overcharging prevention function shall stop charging if any one of the cells of the battery pack reaches 4.305V.

3.2 Over-discharge prohibition:

Over-discharging prevention function shall work to minimize a dissipation current to avoid further drop in

cell voltage of 2.30V or less per cell in any cell of the battery pack. It is recommended that the dissipation

current of PCM shall be minimized to 0.5uA or less with the over-discharge prevention. The protection

function shall monitor each bank of the battery pack and control the current all the time.

4.Storage

The cell should be stored within the proper voltage and temperature range specified in the Product Specification.

5. Handling of Cells

Since the battery is packed in soft package, to ensure its better performance, it's very important to Carefully handle the battery

5.1 Soft Aluminum foil

The soft aluminum packing foil is very easily damaged by sharp edge parts such as Ni-tabs, pins and needles.

Surface scratch

- Don't strike battery with any sharp edge parts
- Trim your nail or wear glove before taking battery
- Clean worktable to make sure no any sharp particle



5.2 Sealed edge

Sealing edge is very flimsy.

- Don't bend or fold sealing edge

Tab bending

5.3 Folding edge

The folding edge is form in battery process and passed all hermetic test

- Don't open or deform folding edge



5.4 Tabs

The battery tabs are not so stubborn especially for aluminum tab.

- Don't bend tab.

Tab bending

5.5 Mechanical shock

- Doesn't Fall, hit, bend battery



5.6 short

- Short terminals of battery is strictly prohibited, it may damage battery.



Cell tumble distortion



Cell extrusion distortion



Edge bending

6. Notice for Designing Battery Pack

6.1 Pack design

- Battery pack should have sufficient strength and battery should be protected from mechanical shock
- No Sharp edge components should be inside the pack containing the battery.

6.2 PCM design

- The overcharge threshold voltage should not be exceed 4.30V
- The over-discharge threshold voltage should not be lower than 2.30V

- The PCM should have short protection function built inside

6.3 Structure design

- Battery pack should be designed that shear would not be applied to the battery tabs.
- PCM is better to be designed suitable for installing on the sealing edge of battery to use space

efficiently, as below photos

6.4 Structure design



7. Notice for Assembling Battery Pack

7.1 Tab connectional

Ultrasonic welding or spot welding is recommended to connect battery with PCM or other parts.

If apply manual solder method to connect tab with PCM, below notice is very important to ensure

battery performance.

a) The solder iron should be temperature controlled and ESD safe

b) Soldering temperature should not exceed 1300°C

c) Soldering time should not be longer than 3s

d) Directly heat cell body is strictly prohibited, Battery may be damaged by heat above approximate 100°C

7.2 Cell fixing

The battery should be fixed to the battery pack by its large surface area.

No cell movement in the battery pack should be allowed.



8. Others

8.1 Prevention of short circuit within a battery pack

Enough insulation layers between wiring and the cells shall be used to maintain extra safety protection. The battery pack shall be structured with no short circuit within the battery pack, which may cause generation of smoke or firing.

8.2 Prohibition of disassembly

1) Never disassemble the cells The disassembling may generate internal short circuit in the cell, which may cause gassing, fining, explosion, or other problems.

2) Electrolyte is harmful LIP battery should not have liquid from electrolyte flowing, but in case the electrolyte come into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

8.3 Prohibition of dumping of cells into fire

Never incinerate nor dispose the cells in fire. These may cause explosion of the cells, which is very dangerous and is prohibited.

8.4 Prohibition of cells immersion into liquid such as water

The cells shall never be soaked with liquids such as water, seawater, and drinks such as soft drinks, juices, coffee or others.

8.5 Cells replacement

The battery replacement shall be done only by either cells supplier or device supplier and never be done by the user.

8.6 Prohibition of using the damaged cells

The cells might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in a plastic envelop of the cell, deformation of the cell package, smelling of an electrolyte, an electrolyte leakage and others, the cells shall never be used any more. The Cells with smell of the electrolyte or leakage shall be placed away from fire to avoid firing or exploding

8.7 Power consumption at standby status

Products using LIB battery can charge from 0V but not preferred: Power consumption of products with LIB battery at standby status maybe cause battery discharged deeply.

8.8 Placed battery for a long time.

Please use 0.5c current to charge up 80% capacity after the battery placed 3 months.

8.9 Guarantee to keep the battery in good repair

Guarantee to keep the battery in good repair in 12 month from the shipment.