RoHS

GLOBAL AGENCY COREA

SPECIFICATION FOR APPROVAL
(承认书)

CUSTOMER (客户)
BLUEBIRD㈜

CUSTOMER P/N (客户料号)

DESCRIPTION (品名规格)
Rechargeable Lithium-ion Polymer Cell

MODEL NO. (品号)
SP454292SF 2910mAh

DATE (日期)
2020-12-14

CUSTOMER (客户)

QUALITY DEPT 品质管理部	BUSINESS DEPT 业务管理部	APPROVED BY 承认

GAC

APPROVED 审核	CHECKED 确认	DESIGNED 作成

GAC㈜ 경기도 안양시 동안구 엘에스로 91번길 16-39(안양IT밸리) 1201호
TEL 031-346-2812 / 010-2482-2812

History of revision

NO.	Date	Originator	Items revised / reason of revision
0	10/16/2017	Huang Xinghua	Original Release

1. SCOPE

The product specification describes the requirements of the Lishen Lithium Ion Polymer cell SP495569SF. Should there be any additional information needed, customers are advised to contact Tianjin Lishen Battery Joint-Stock Co.,Ltd..

2. DESCRIPTION AND MODEL

2.1. Description: Lithium Ion polymer rechargeable cell

2.2. Cell Part Number: SP454292SF

3. GENERAL SPECIFICATIONS

3.1. Minimum Capacity	2910mAh (0.2CmA discharge after 6 months)		
	2960 mAh (0.2CmA discharge fresh cell)		
3.2. Charging Voltage	4.4V		
3.3. Nominal Voltage	3.85V (0.2CmA discharge)		
3.4. Standard Charge	Method: Constant Current and Constant Voltage (CC/CV)		
	0°C ~ 10°C	Current/ Voltage	0.5C(1455mA) 4.1V/0.2C(582mA) 4.4V
		End Current	1/30C(97mA)
	10°C ~ 20°C	Current/ Voltage	1.0C(2910mA) 4.2V/0.5C(1455mA) 4.4V
		End Current	1/30C(97mA)
	20°C ~ 45°C	Current/ Voltage	1.0C(2910mA) 4.2V/0.7C(2037mA) 4.4V
		End Current	1/30C(97mA)
	45°C ~ 60°C	Current/ Voltage	0.5C(1455mA) 4.1V
		End Current	1/30C(97mA)
3.5. Maximum Charge Current	1C(2910mA)		
3.6. Standard Discharge	Method: Constant Current (CC)		
		Current	0.2C(582mA)
		End Voltage	3.0V
3.7. Maximum Discharge Current	1C(2910mA)		
3.8. Weight	（40±2）g		
Cell Dimensions	Length:	90.3 +0/-1mm (without Tab film)	
	Cell body length	87.3 +0/-1mm	
	Width:	41.3 ±0.3mm	

	Shipping Thickness:	4.51+0/-0.3mm (50%SOC，Measured with weighting 500gf PPG at 23±5℃)
	Charging Thickness:	4.60 +0/-0.3mm (100%SOC，Measured with weighting 500gf PPG at 23±5℃)
3.9. Operating Temperature&Moisture	Charge	0°C ~ 50°C, less than 85%RH
	Discharge	-20°C ~ 60°C, less than 85%RH
	Standard charge&discharge temperature range	23±5℃
3.10. Storage Temperature	1 month	-20°C ~ 45 °C, 20°C is recommended storage temperature.
	6 months	-20°C ~ 35 °C, 20°C is recommended storage temperature.

4. OUTLINE DIMENSION (UNIT: mm)

Dimension: max4.51mm (T) ×max41.6mm (W) ×max90.3mm (L)

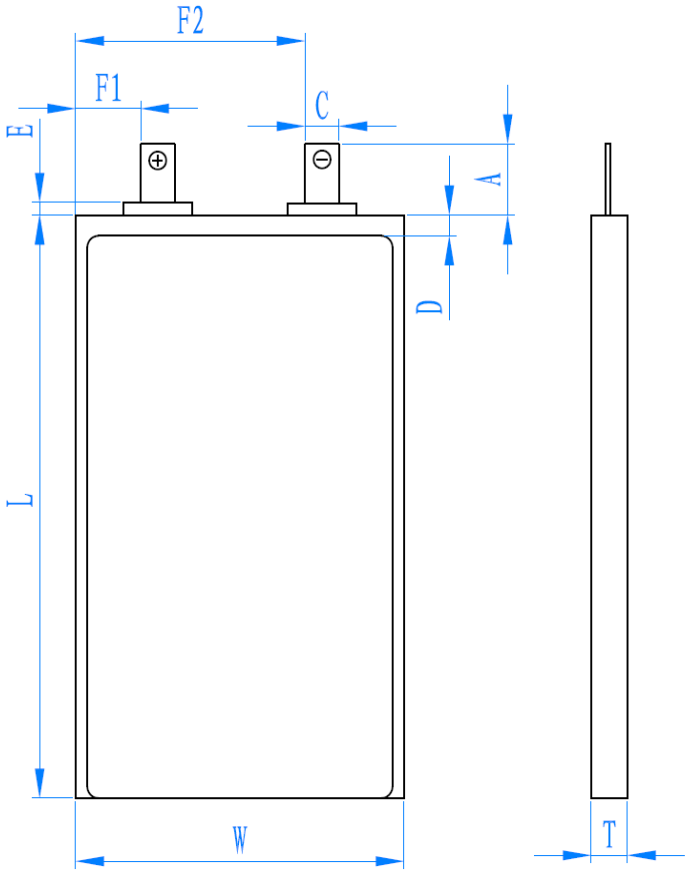


Figure 1

Description		Dimension and Spec
Thickness	T	4.51+0/-0.3mm
Width	W	41.3±0.3mm
Length	L	90.3+0/-1mm
Tab length	A	5.5±0.5mm
Tab width	C	6.0±0.2mm
Top Sealing Length	D	2.9±0.6mm
Tab Sealant Length	E	0.2-1.5mm
Tab distance （+）	F1	10.6±1mm
Tab distance （-）	F2	25.6±1mm

Note: Tab distance can be changed according to customer requirement.

5. APPEARANCE

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

6. TEST CONDITION AND DEFINITIONS

6.1. Measuring Equipment

6.1.1. Ammeter and Voltmeter

The ammeter and voltmter should have an accuracy of ±0.1mA and ±0.1mV, respectively.

6.1.2. Slide caliper

The slide caliper should have a scale of 0.05mm.

6.1.3. Impedance meter

The impedance meter with AC 1kHz should be used.

6.2. Environmental&storage conditions:

Unless otherwise specified, Cells shall to be tested within one month after shipment and not be cycled (charge/discharge) over one time before the test. All tests shall be performed at 20 ± 5°C and humidity of 65±20% RH.

The lithium iron cell impedance would increase in whole storage process, while the capacity would decrease, cell would be charged in 7.1.1 and discharged in 7.2.1.

Storage Temperature	23°C	23°C	23°C	23°C	60°C	60°C
Storage Duration	1 Year	1 Year	90 Days	90 Days	1 Week	1 Week
State of Charge(SOC)	As received	100%	As received	100%	As received	100%
Recovered Capacity	90%	80%	95%	90%	90%	85%
Recovered Impedance @ 100% SOC	150%	150%	120%	150%	150%	160%

6.3. Definitions:

6.3.1. C Rate ("C"):

The rate (milliamperes) at which a fully charged cell is discharged to its end voltage in one (1) hour. The end voltage for the cell is 3.0volts.

6.3.2. C Capacity:

The capacity (milliampere-hour) obtained during a C discharge. Capacity should be reported based on discharging at 23±2°Cunless otherwise specified. For test purposes, C is defined as the minimum rated capacity of the cell.

7. CHARACTERISTICS

7.1. Charge Characteristics:

7.1.1. Charging shall consist of charging at constant current rate of 0.5C mA until the cell voltage reaches 4.4V. The cell shall then be charged at constant voltage of 4.4V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 20mA.

7.1.2. Charging shall consist of charging at constant current rate of 0.5C mA until the cell voltage reaches 4.4V. The cell shall then be charged at constant voltage of 4.4V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 100mA.

7.1.3. Charging shall consist of charging at constant current rate of 0.5C mA until the cell voltage reaches 4.4V. The cell shall then be charged at constant voltage of 4.4V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 1/30C(97mA).

7.1.4. Charging shall consist of charging at constant current rate of 0.7C mA until the cell voltage reaches 4.4V. The cell shall then be charged at constant voltage of 4.4V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 1/30C(97mA).

7.1.5. Charging shall consist of charging at constant current rate of 1.0C mA until the cell voltage reaches 4.4V. The cell shall then be charged at constant voltage of 4.4V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 1/30C(97mA).

7.2. Discharge Characteristics:

7.2.1. Cells shall be discharged at a constant current of 0.2C to 3.0 volts.

Discharge is to be performed at 23 ± 5°C unless otherwise noted (such as capacity versus temperature).

7.2.2. Cells shall be discharged at a constant current of 0.5C to 3.0 volts.

Discharge is to be performed at 23 ± 5°C unless otherwise noted (such as capacity versus temperature).

7.2.3. Cells shall be discharged at a constant current of 1.0C to 3.0 volts.

Discharge is to be performed at 23 ± 5°C unless otherwise noted (such as capacity versus temperature).

7.3. Internal Impedance

The impedance shall be measured at AC 1000 Hz initially.

Initial Internal Impedance ⩽35mohm

7.4. Original capacity

The capacity means the discharge capacity of the cell. Cells shall be charged per 7.1.1 and discharged per 7.2.2.

Original capacity ≥2960mAh

7.5. Cycle Life

7.5.1. Test condition is according to below.

a. Charging Condition: 1.0C charge to 4.25V, 0.7C charge to 4.4V, 1/30C(97mA) cut-off.

b. Discharging Condition: 1.0C discharge to 3.2V.

c. Rest Time: 10min between charge and discharge.

d. Repeat cycles: 800 Cycles (23℃) / 300 Cycles (45℃).

e. Measure thickness after 800 Cycles (23℃) / 300 Cycles (45℃).

f. Measure relative capacity according to 0.5C charge 4.4V 20mA cut-off & 0.2C discharge to 3.0V.

NOTE: 23℃ per 100cycles & 45℃ per 50cycles testing capacity.

7.5.2. Test Criteria

	Life Cycle Criteria	Note
Cycle counts	800	23± 5°C
	300	45± 5°C
Relative Capacity	80%	Compare to original capacity(0.2C)
Cell Thickness	9%	Compare to initial thickness

7.6. HALT Characteristics

7.6.1. Test condition is according to below.

a. Charging Condition: 1C charge to 4.4V, 97mA cut-off.

b. Discharging Condition: 1C discharge to 3.0V.

c. Rest Time: 10min between charge and discharge.

d. Repeat cycles: 10 Cycles.

e. Measure thickness after 10 cycles.

7.6.2. Test Criteria

	Life Cycle Criteria	Note
Cycle counts	10	70 ± 5°C
Cell Thickness	9%	Compare to initial thickness

7.7. Floating Charging Characteristics

Cells shall be continuous charged per 7.1.5 at 45 ±5°C for 15 days. Measured the cell thickness at 100%SOC, the swelling rate≤9%.

7.8. Thermal Shock Characteristics

Cells shall be charged per 7.1.1 and discharged per 7.2.1 and the capacity shall be recorded. Cells shall be then charged 100% SOC and stored in a charged condition at the humidity chamber of 65°C with 90% relative humidityfor 4 hours. Then stored in the -20°C chamber for 4 hours within 30 minutes. Each step cycled 8times. After storage, measure the residual capacity per 7.2.1. Calculate the percent residual capacity by dividing the residual capacity by the original capacity. Recovery capacity≥ 90% original capacity. Measured the cell thickness at 100%SOC, the swelling rate≤9%.

7.9. Cell Voltage (as of shipment)

Cell Voltage Range for Non-air transport: 3.81~3.91V (50%SOC）

Cell Voltage Range for Air transport: 3.70~3.80V (30%SOC）

8. SAFETY

Summary：Safety for SP454292SF (Cap.Min.2910mAh)

Test	Condition	LGE Spec.	Qty	Note	Result
Overcharge	2.0C， 4.6V， 5hours (without PTC)	NF/NE	10	Fully Discharged	OK
External Short	80mΩ Ext. 5hr Short-circuit at 55℃(not over 150℃)	NF/NE	10	4.4V Charged	OK
Heating	Heating battery at 130℃ ± 2℃ by 5 ± 2℃ / min (for 60min)	NF/NE	10	4.4V Charged	OK
Crush	13kN pressure on the surface of the battery	NF/NE	10	4.4V Charged	OK
Triangular rod crush	1.5kN pressure on the surface of the battery with triangular rod	NF/NE	10	4.4V Charged	OK
Dent	1.3kN pressure on the Cathode tab position with Ø6 mm round tip	NF/NE	10	4.4V Charged	OK

8.1. External Short-circuiting

Test method ：Cell, fully charged, is to be short circuited by connecting the positive and negative terminals with a total external resistance of less than 0.08ohm wire. The test shall be continued until the cell voltage falls below 0.1V and the cell case temperature has returned to room temperature.

Criterion: No Explosion, No Fire, the temperature of the cell surface should not exceed 150℃.

8.2. Overcharge

Test method ：Cell without PTC, fully discharged, is charged at a constant current of 2C. Cell voltage increases with time during this step. When the cell voltage reaches 4.6V, the cell continues to be charged at that voltage value for 5 hours and cell temperature descends to 20°C.

Criterion: No Explosion, No Fire.

8.3. Heating

Test method : Cell, fully charged, is to be heated in a gravity convection or circulating air oven.The oven temperature will be ramped at 5°C per minute to 130°C and held at 130°C for 60 minutes .

Criterion: No Explosion, No Fire.

8.4. Crush

Test Condition : Cell, fully charged, is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram with a 1.25 inch (32 mm) diameter piston. The crushing is to be continued until a pressure reading of 2500 psig (17.2 MPa) is reached on the hydraulic ram, applied force of 13 kN. Once the maximum pressure has been obtained it is to be released.

Criterion : Not explode, No fire.

8.5. Triangular Rod Crush

Test Condition : Cell, fully charged, is to be crushed with triangular rod (35mm). The force for the crushing is to be applied by a hydraulic ram with a 1.25 inch (32 mm) diameter piston. The crushing is to be continued until a pressure reading of 2500 psig (17.2 MPa) is reached on the hydraulic ram, applied force of 1.5 kN. Once the maximum pressure has been obtained it is to be released.

Criterion : Not explode, No fire.

8.6. Dent

Test Condition : Cell, fully charged, is to be crushed with Ø6 mm round tip on the cathode tab position surface. The force for the crushing is to be applied by a hydraulic ram with a 1.25 inch (32 mm) diameter piston. The crushing is to be continued until a pressure reading of 2500 psig (17.2 MPa) is reached on the hydraulic ram, applied force of 1.3 kN. Once the maximum pressure has been obtained it is to be released.

Criterion : Not explode, No fire.

9. MARKING

LISHEN CELL MARKING (RRODUCTION DATA)

The cell will be marked with manufacture name,LISHEN (Tianjin Lishen Battery Joint-Stock Co., Ltd)

The cell will be marked with the cell part number.

The cell will be marked with the nominal voltage.

The cell will be marked with the LISHEN internal code.

The cell will be marked with DAILY date code which should be consistent with the cell manufacturing date.

7: 2017 (7 : 2017, 8 : 2018, 9 : 2019, 0 : 2020…..)

40 : Weeks (01~55weeks)

1 : Monday (1 Monday, 2 Tuseday, 3 Wednesday, 4Thursday…)

A : Production Order ex) 1'st : A, 2'nd : B, 3'rd : C…)

7401A : Lot number

01 : Quantity Code ex) 1~999 Q'ty : 01, 1000~1999 Q'ty : 02, 2000~2999 Q'ty : 03…)

001 : Serial Number

All markings shall be printed directly on the back surface of the cell.

The information of two-dimensional code is N287205A01001.

Printing information and position can change if there is special requirement for customer LISHEN CELL MARKING (PRODUCTION DATA)

10. WARRANTY

As long as the cell is treated in accordance with this Product Specification and/or Handling Precautions and Prohibitions, Supplier warrants that the cell should be free from any defect for a period of 6 months from the date of shipment.

The warranty set forth above or described in Handling Precautions and Prohibitions excludes a defect which is not related to manufacturing of the cell.

Any actions which would cause the short between the Ni(-) tab and Al layer of pouch(cell package material) must be forbidden,any issues which casued by these actions are not related to manufacturing of the cells.

11. OTHERS

Any matter not included in this specification shall be conferred between the both parties.

If there are problems in this specification, Lishen can consider to change specification after discussion.

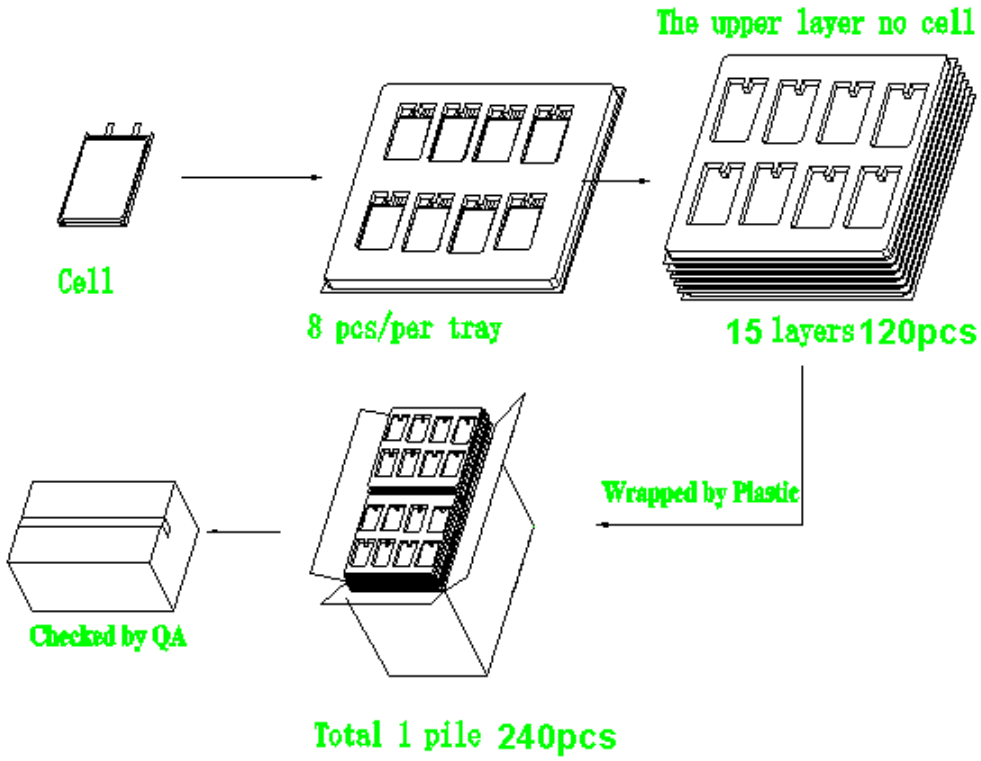
12. STORAGE FOR A LONG TIME

In case of long period storage (more than 3 months), the cell is storaged at temperature range-20°C~+25°C, low humidity, no corrosive gas atmosphere.

13. SHIPPING

Capacity of cell at shipping is appox. 25±5% of full capacity.

14. PACKAGING：



HANDLING PRECAUTIONS AND PROHIBITIONS

FOR RECHARGEABLE LITHIUM-ION POLYMER BATTERIES

Preface

This document of "Handling Precautions and Prohibitions for Polymer Lithium Ion Rechargeable Batteries" shall be applied to the battery cells that are to be manufactured by LISHEN (Tianjin lishen battery joint-stock co., LTD).

Note:

1) The customer is requested to contact LISHEN 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.

2) LISHEN will take no responsibility for any accident when the cell is used under other conditions than those described in this document.

3) LISHEN 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 performance and safety characteristics 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 (4.4V/cell). Charging beyond 4.45V, 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 cell performance and safety characteristics 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.

If the cell is charged at the temperature out of the specified range, leakage, heat generation or other damages may be caused.

Repeated charging and discharging at high and low temperature may cause degradation of cell performance even within the specified temperature range.

1.4 Prohibition of reverse charging:

Reverse charging is prohibited. The cell shall be connected correctly. The polarity has to be confirmed before you make wiring. In case of the cell is connected improperly, the cell cannot be charged. Simultaneously, the reverse charging may cause damaging to the cell(s) 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 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 causes loss of cell performance, characteristics, or battery functions.

The charger shall be equipped with a device to prevent further discharging exceeding a cut-off voyage 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 15 - 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 15 - 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 under abnormal state.

3. PROTECTION CIRCUIT MODULE (PCM)

3.1 The cell/battery pack shall be with a PCM that can protect cell/battery pack properly.

3.2 PCM shall have functions of (i) overcharging prevention, (ii) over-discharging prevention, and (iii) over current prevention to maintain safety and prevent significant deterioration of cell performance. The over current can occur by external short circuit

3.3 Overcharging prohibition:

Overcharging prevention function shall stop charging if any one of the cells of the battery pack reaches 4.4V above.

3.4 Over-discharge prohibition:

Over-discharging prevention function shall work to minimize a dissipation current to avoid further drop in cell voltage of 2.75V or less per cell in either cell of the battery pack. It is recommended that the dissipation current of PCM shall be designed to minimized to 0.5uA after the overdischarge prevention function works.

The protection function shall monitor each bank of the battery pack for controlling the current all the time.

4. STORAGE

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

Lead tabs with pre-soldered wiring shall be spot welded to the cells.

5. OTHERS

5.1 Cell connection

Direct soldering of wire leads or devices to the cell is strictly prohibited.

Direct soldering may cause damage of components, such as separator and insulator, by heat generation

5.2 Ultrasonic welding of battery pack casing

Ultrasonic welding of plastic lid to the plastic shell can be applied. However, the welding shall be done to avoid the ultrasonic wave power to the cells. Otherwise it may cause serious damage to the cells.

5.3 Prevention of short circuit within a battery pack

Enough insulation layer between wiring and the cell shall be used to maintain multiple safety protection.

The battery pack shall be structured with no short circuit within the battery pack. The short circuit within the pack may cause generation of smoke or firing.

5.4 Prohibition of disassembly

Never disassemble the cells:

The disassembling may cause a chance to generate internal short circuit in the cell. Which may cause gassing, firing, explosion or other troubles.

Electrolyte is harmful:

An electrolyte happens to be leaked out from the cells is harmful to the human bodies. If the electrolyte is contact with the skin, eyes or others, the electrolyte shall be flushed immediately with fresh water and see a doctor.

5.5 Prohibition of short circuit

Never make short circuit the cells. It makes generation of very high currents which subsidiary cause heating of the cells which may cause the electrolyte leakage, gassing or explosion which are very dangerous.

An appropriate circuitry with PCM shall be employed to protect accidental short circuit of the battery pack.

5.6 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.

5.7 Prohibition of cells immersion into liquid such as water

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

5.8 Battery cells replacement

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

5.9 Prohibition of use of 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 a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing or explosion.

5.10 Battery pack structure

Protection circuit shall be isolated from the cell considering the case electrolyte leakage occurred by mishap. Battery pack shall be designed not to allow running the leaked electrolyte to protection circuit as much as possible.

Tolerance for electrolyte shall be considered when selection the battery case material.

5.11 Protection circuit module design

Electrolyte has corrosive characteristics. Protection circuit module may not work correctly if electrolyte attaches to it.

The follows should be considered for protection circuit module design:

Main wiring patterns shall be away from each other as much as possible.

Conductive patterns and connection terminals that are possible to be short-circuited by electrolyte leakage should be away from each other as much as possible. (Another method is coating the whole surface of the module by resin.)

5.12 Marking

The customer shall prepare the comprehensive explanation and appropriate markings for the end users.

The battery packs will need its packing and handling (or safety) instructions in which cell usage, storage replacement or others in accordance with regulations, if any.

The prohibited items mentioned in this document, regulations in UL1642, and others shall be clearly explained to the users.

The marking shall also be done, in which necessary items based on the marking guidelines of the rechargeable lithium ion batteries for maintaining safety of the cells.