Specification of Rechargeable Li-ion Battery

可充电锂离子电池组规格书

Battery model 电池组型号： AEC541329

Product description 产品描述： 1S1P(Cell+PCM+Wire)

Product No. 产品编码： A010597049A

Prepared by (R&D) 编制(R&D)	Checked by (R&D) 审核(R&D)	Approved by (R&D、QA) 批准(R&D、QA)	
Harry Chuk 2020.06.12	石竞伟 2020.06.12	 2020.06.12	 2020.06.12

Customer Approval 客户确认	Signature/Date 签名/日期	
	Company Name/Stamp 公司名称/盖章	
	Customer material number: 客户物料编号：	

AMENDMENT RECORDS

规格变更记录

Revision 版本	Description 描述	Prepared by (R&D) 编制(R&D)	Date 日期
V01	New release 新发放	Harry Chuk	2020.06.12

1. Scope/范围

This document describes the product specification and using condition of the Rechargeable Li-ion Battery supplied by AEC (Apower Electronics Co.,Ltd.).

本文件描述了广东国光电子有限公司生产的可充电锂离子电池组的产品性能及使用条件。

2. Product/产品

2.1 Name ： Rechargeable Li-ion Battery

名 称：可充电锂离子电池组

2.2 Battery model 电池组型号： AEC541329

Product Description产品描述：1S1P（Cell+PCM+Wire）

PCM 保护板： HF4010BAWHTB

3. Specification /产品规格

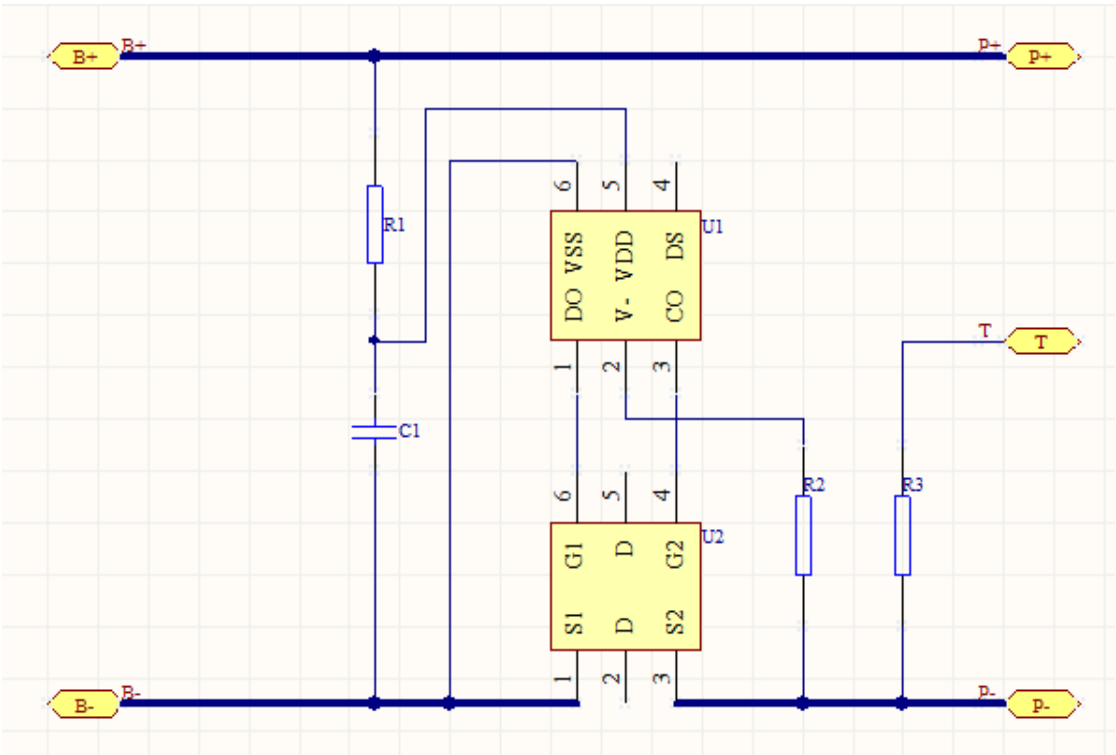
Item 项目	Specification 规格				
3.1 Nominal voltage 标称电压	3.80 V				
3.2 Rated capacity 额定容量	170 mAh	Charging the battery at constant current 0.2C to 4.35V, then charging it at constant voltage 4.35V till 0.025C. Standing within 1hour, the battery will be discharged to 3.0V at 0.2C. 0.2C恒流充电至4.35V，再4.35V恒压充电至0.025C截止. 静置不超过1小时，再以0.2C放电至3.0V截止			
3.3 Battery impedance 电池组内阻	≤ 250 mΩ	The specifications include cell, PCM and wire. measured at AC 1kHz, 25±3℃. 测试条件为AC 1kHz，25±3℃，包含电池、保护板、导线。			
3.4 Shipment voltage 出货电压	3.85~4.00 V	As of shipment. 出厂时的电压			
3.5 Limited charging voltage 充电限制电压	4.35 V	充电截止电压（Charging Cut-off Voltage）			
3.6 Maximum Charging Current 最大充电电流	Ambient temperature 环境温度	Relative humidity 相对湿度	Charging current 充电电流	Limited charging voltage 充电限制电压	Cut-off current of CV 恒压截止电流
	0°C ~ 45°C	65±20%	3.0C	Max. 4.35V	0.025C
3.7 Recommendation Charging Current 推荐充电电流	0.5 C	85 mA			
3.8 Recommendation Discharging Current 推荐放电电流	0.5 C	85 mA			
3.9 Maximum Discharging Current 最大放电电流	5.0 C	850 mA	-20°C~60°C ; 65±20%RH		
3.10 Discharge cut-off voltage 放电截止电压	3.0 V	Cell standard cut-off voltage/电池标定截止电压			
	2.8 V	Typical low voltage for discharge protection/欠压放电保护电压典型值			
3.11 Operating temperature Range （Discharging）操作温度范围（放电）	–20~60℃				
3.12 Storage environment (50% state of charge) 储存环境(50%电量)	-20°C ~ 45°C in three months 25±3°C over three months Humidity: 65±20%RH 储存期在3个月内：温度-20°C ~ 45°C，湿度65±20%RH 储存期超过3个月：温度25±3°C，湿度65±20%RH				
3.13 Battery weight (Approx.) 电池组大约重量	3.5 g				

4. PCM/保护板

4.1 PCM SPECIFICATION (Testing condition:TEM=25℃, RH≤75%)/保护板规格(测试条件：25℃，相对湿度≤75%)

No. 序号	Items 项目	Specifications/规格		
		Min.	Typical	Max.
1	Over-charge detection voltage(V) 过充保护电压(V)	4.375	4.400	4.425
2	Over-charge detection delay time(s) 过充保护延时(s)	0.8	1.0	1.2
3	Over-discharge detection voltage(V) 过放保护电压(V)	2.75	2.80	2.85
4	Over-discharge detection delay time(ms) 过放保护延时(ms)	102	128	154
5	Over-current detection discharge current(A) 放电过流保护(A)	2.0	4.0	6.0
6	Over-current detection delay time(ms) 过流保护延时(ms)	6.4	8.0	9.6
7	Short-circuit protection 短路保护	Yes/有		
8	Current consumption operation mode(uA) 工作时消耗电流(uA)	--	2.5	6.0
9	Current consumption power-down mode(uA) 休眠时消耗电流(uA)	--	--	0.1
10	0V battery charge function 0V电池充电功能	Available/允许		

4.2 PCM SCH/保护板原理图

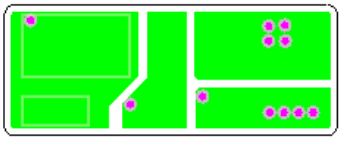


4.3 Bill of PCM/保护板元件清单

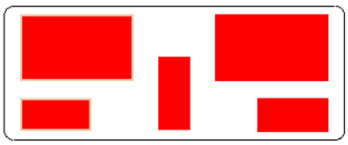
No. 序号	Description 描述	Symbol 标识	Model 型号	Vendor 厂商	Q'ty 数量
1	IC	U1	S-8261BAM	Ablic(Seiko)	1pcs
			HY2113-TB6B	Hycon	
2	MOSFET	U2	WNMD2179	Willsemi	1pcs
			CJL8820 for second source	JCET	
3	Resistor	R1	330Ω	YAGEO/Skywell/ UniOhm/RALEC	1pcs
4	Resistor	R2	2kΩ	YAGEO/Skywell/ UniOhm/RALEC	1pcs
5	NTC	R3	NTCG103JF103FT 10K ±1% B=3435K	TDK	1pcs
6	Capacitor	C1	0.1uF	YAGEO/Skywell/ UniOhm/RALEC	1pcs

4.4 Layout/布线图

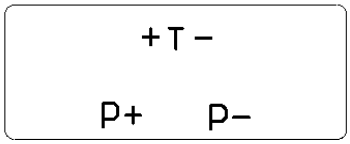
Top Layer



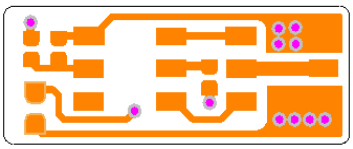
Top Solder



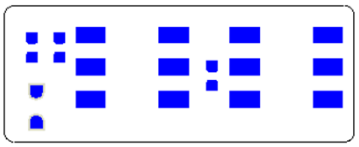
Top Overlay



Bottom Layer



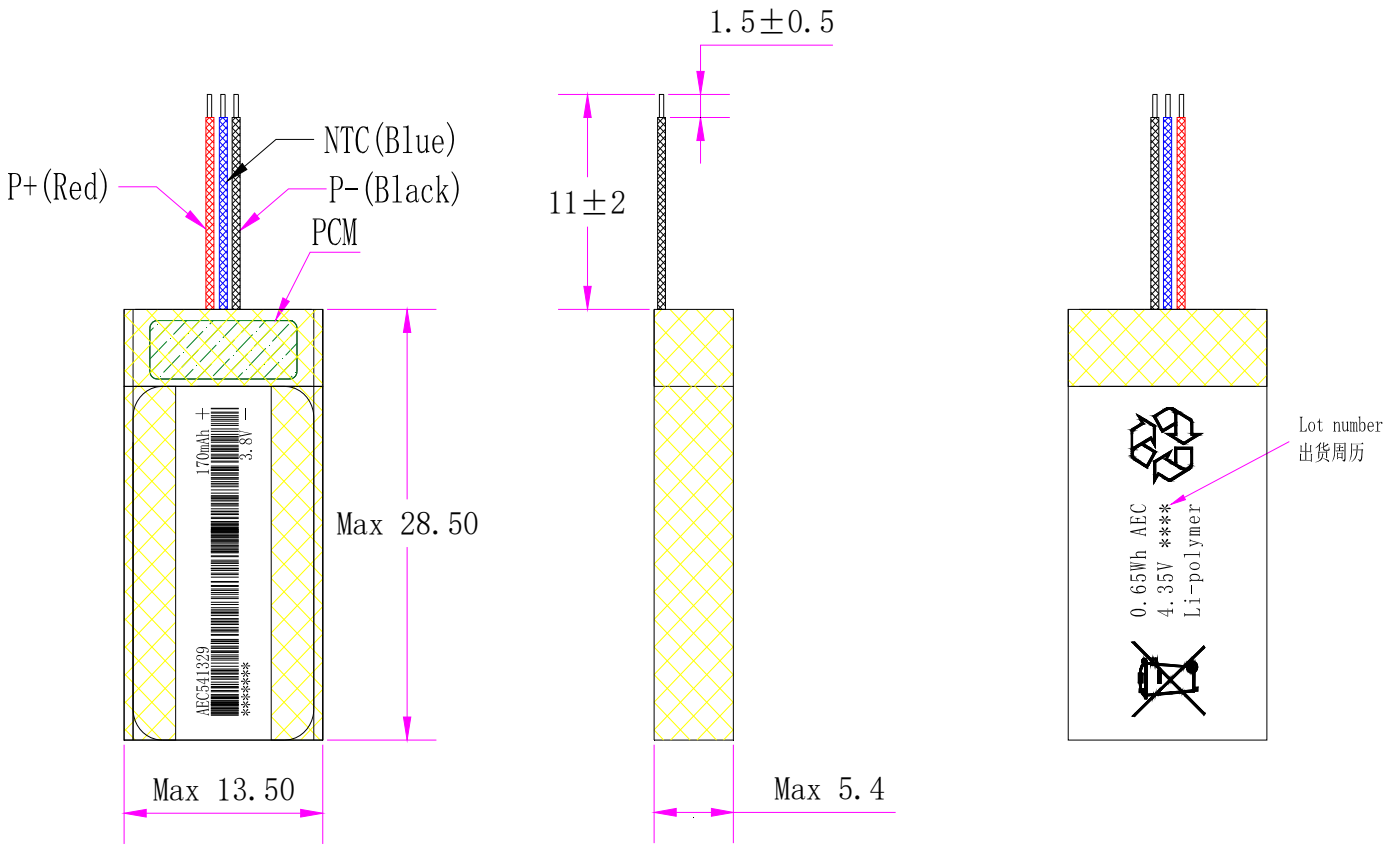
Bottom Solder



Bottom Overlay



5. Outward appearance and Dimension /外型和物理尺寸



Unit：mm

Bill of Battery/电池组清单：

Item 序号	Name 名称	Model 型号	Specification 规格描述	Quantity 用量	Remark 备注
1	Cell 电池	541329	3.8 V 170 mAh	1	
2	PCM 保护板	HF4010BAWHTB	4.40V/2.8V	1	
3	Wire 电子线	AWG32	UL10064 AWG32 Red,Blue,Black	3	
4	Tape 胶带	Kapton	PI		

6. Test method/测试方法

6.1 Standard environmental test condition/测试条件

Unless otherwise specified, all tests stated in this BATTERY SPECIFICATION are conducted at below conditions.

Temperature: 25±3℃; Relative humidity : 65±20%; Atmosphere pressure: 86kPa~106kPa.

除特别说明外，本规格书中所有测试均在以下环境中进行.

温度：25±3℃； 相对湿度：65±20%；大气压力：86kPa~106kPa.

6.2 Measuring Equipment/测量仪表与设备要求

Requirement of voltage meter： The accuracy is not less than ±0.5%.

测量电压的仪表准确度应不低于±0.5%,.

Requirement of ampere meter：The accuracy is not less than ±0.5%.

测量电流的仪表准确度应不低于±0.5%.

Requirement of time meter：The accuracy is not less than ±0.1%.

测量时间的仪表准确度不低于±0.1%.

Requirement of thermometer：The accuracy is not less than±0.5℃.

测量温度的仪表准确度不低于±0.5℃.

Constant current resource is constantly adjustable, which alters within ±1%.

恒流源的电流恒定可调,在充电或放电过程中,其电流变化应在±1%范围内.

Constant voltage resource is constantly adjustable, which alters within ±0.5%.

恒压源的电压可调, 其电压变化范围为±0.5%.

7. Visual Inspection/外观

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

不允许有任何影响电池性能的外观缺陷，如裂纹、裂缝、泄漏等。

8. Cell Performance Specification/电池性能规格

8.1 Cell Electrical characteristics

电性能

<table>
<tr><th>Items</th><th>Test Method and Condition</th><th>Criteria</th></tr>
<tr><td>8.1.1
Full charge
满充电</td><td>Charge to 4.35V with 0.5C, then go on charging with constant voltage 4.35V till charge current declines to 0.025C .
以0.5C电流恒流充至4.35V，再4.35V恒压充电至电流小于0.025C。</td><td>/</td></tr>
<tr><td>8.1.2
Rated capacity
额定容量</td><td>The capacity means the discharge capacity of the battery that was discharged to 3.0V with discharge current of 0.2C within 1h after the full charge.
电池满充电后1小时内用0.2C电流放电，放电至3.0V截止的放电容量。</td><td>≥ 170 mAh</td></tr>
<tr><td>8.1.3
RT Cycle life
常温循环寿命</td><td>Charge to 4.35V with 3C of CV , Cut-off current to 0.3C . then discharge to 3.0V with 0.5c, and discharge capacity after 400 cycles
以3C恒流恒压至4.35V，截止电流0.3C，然后以0.5c放电至3.0V，400次循环后放电容量。</td><td>≥80%
Minimum capacity</td></tr>
<tr><td>8.1.4
Temperature capacity test
温度性能</td><td colspan="2">Temperature capacity test is the discharging ability at 0.2C of the battery in different temperature as follow after fully charged in a temperature of 25℃,the time between charging and discharging must beyond 3 hours.
不同温度条件下的放电容量对比，即在25℃常温条件下电池满充电后，在下表所示温度下以0.2C放至3.0V的容量。如果充电和放电温度不是同一温度时，温度变化的间隔时间要求是3小时。
<table>
<tr><th>Charge temperature
充电温度</th><th colspan="4">Discharge temperature
放电温度</th></tr>
<tr><td rowspan="2">25℃</td><td>-10℃</td><td>0℃</td><td>25℃</td><td>60℃</td></tr>
<tr><td>≥60%</td><td>≥80%</td><td>100%</td><td>≥95%</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>8.1.5
Self-discharge
自放电</td><td colspan="5">The fully-charged battery stores under the conditions as Item 6 for 28 days and discharges with 0.2C till 3.0V. Testing the capacity after the discharge.
满充电后在如第6项所述的测试条件下储存28天，检测0.2C放电至3.0V的容量。</td><td>Capacity
≥80%
Minimum capacity</td></tr>
<tr><td rowspan="8">8.1.6
Storage characteristics
存储特性</td><td rowspan="2">SOC
荷电状态</td><td colspan="5">The battery store at different SOC, the initial capacity VS time（25℃）
电池不同荷电状态条件下存储，初始容量随时间变化如下（25℃）：</td></tr>
<tr><td>Storage duration
存储时间</td><td>3 months</td><td>6 months</td><td>9 months</td><td>12 months</td></tr>
<tr><td rowspan="2">Approx. 50% charge state (3.83＜OCV≤3.98V)</td><td>Recovered capacity
（%）容量恢复率</td><td>95.00%</td><td>93.00%</td><td>91.00%</td><td>90.00%</td></tr>
<tr><td>Recovered impedance
（%）内阻恢复率</td><td>120.00%</td><td>130.00%</td><td>135.00%</td><td>140.00%</td></tr>
<tr><td rowspan="2">Approx. 70% charge state (3.98＜OCV≤4.13V)</td><td>Recovered capacity
（%）容量恢复率</td><td>92.00%</td><td>88.00%</td><td>86.00%</td><td>85.00%</td></tr>
<tr><td>Recovered impedance
（%）内阻恢复率</td><td>125.00%</td><td>135.00%</td><td>145.00%</td><td>150.00%</td></tr>
<tr><td rowspan="2">Approx. 100% charge state (4.13＜OCV≤4.35V)</td><td>Recovered capacity
（%）容量恢复率</td><td>90.00%</td><td>85.00%</td><td>82.00%</td><td>80.00%</td></tr>
<tr><td>Recovered impedance
（%）内阻恢复率</td><td>130.00%</td><td>140.00%</td><td>150.00%</td><td>160.00%</td></tr>
</table>

8.2 Mechanical specification/机械特性

Items	Test method and condition	Criteria
8.2.1 Vibration test 振动	Batteries are firmly secured to the platform of the vibration machine without distorting the batteries in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face. 试验电池和电池组紧固在振动机上，所受振动为正弦波形，频率在7Hz和200Hz之间摆动再回到7Hz的对数扫频为时15min。这一过程须在三个互相垂直的电池安装方位的每一方向都重复进行12次，总共为时3h。其中一个振动方向必须与端面垂直。	No explosion, no fire, no leakage. 不爆炸，不起火，不漏液
8.2.2 Drop test 跌落	The cell is to be dropped onto concrete ground from a height of 1.0 meter six times . 电池从1.0m高处自由落于混凝土板上，共进行6次。	No explosion, no fire 不爆炸，不起火

8.3 Cell safety 电池安全测试

Items	Test method and condition	Criteria
8.3.1 Crush test 挤压	The pressure on the surface of the fully charged cell do not stop being raised until 17.2 Mpa when the cell is crushed by two flat surfaces.(Max. 13kN) 满充电电池被两平板挤压。挤压的最大压强为17.2Mpa,最大作用力为13kN。当达到最大值即停止。	No explosion, no fire. 不爆炸，不起火
8.3.2 Heating test 热滥用	The temperature of the baking box which contains cell is raised to 130±2℃ at a rate of 5℃/min and remains at this temperature for 10 minutes. 满充电电池在烘箱中测试。烘箱自室温起以5℃/min的升温速率升至130±2℃，并在130±2℃温度下保持10分钟。	No explosion, no fire . 不爆炸，不起火

8.3.3 Short-Circuit test 短路	After full charge, the positive and negative polarities are connected together by a copper wire whose resistance is 80±20mΩ. 满充电电池用80±20mΩ电阻的铜导线连接其正负极至电池体温度接近室温。	No explosion, no fire . 不爆炸，不起火
8.3.4 Over-charge test 过充	The cell is overcharged to 4.6V with a current of 3C and then charged with constant voltage 4.6V until continuous charging time to 7 hours. 电池在3C恒流恒压下过充至4.6V，直至持续充电时间达到7 小时。	No explosion, no fire . 不爆炸，不起火

9. Charging/充电

Charging current and charging voltage should be less than specified in the BATTERY SPECIFICATION.

The charger shall be designed to comply with BATTERY SPECIFICATION.

It is dangerous that charging with higher current or voltage than Product Specification may cause damage to the battery electrical, mechanical safety performance.

充电电流和充电电压不得超出本规格书中所规定的最大值。

充电器的设计应满足本规格书的要求。

使用超出本规格书要求的电流和电压范围可能引起电池充放电性能、机械性能和安全性能的问题。

10. Warranty/品质保证

Period of warranty: 12 months after shipment;

产品保质期: 自交货期开始算起后的12个月；

Range of warranty: Operating within the specified current , voltage ranges and working temperature range, the battery performs normally without swelling, 0V and electrolyte-leaking. Battery damage caused by misuse or incorrect storage cannot apply the Warranty.

If the life cyle meets the requirement of the Specification, the battery is invalid in advance.

保 质 范 围: 在规格书规定的充放电电压范围、电流范围、工作温度等正常使用及存放条件下电池可进行充放电，无气鼓、零电压、漏液等不良现象。不当使用或存放造成电池不良不在保质范围内。当循环寿命达到规格书中要求后，电池提前过保质期。

11. Liability/产品责任

Please use the Lithium ion batteries supplied by AEC under the product specification .It may cause fire or expansion if the cells are used incorrect .We(AEC) will not guarantee the safety unless the cells are used under the product specification.

请客户务必按照所提供的规格说明书和所附的注意条款来使用广东国光电子有限公司生产的电池。不正确地使用电池，可能会导致电池性能异常、发热、着火或破裂现象。对于客户在超出规格说明书以外的情况下使用电池，广东国光电子有限公司不保证其使用性能和安全性能。

12. Identification/成品电池块（组）上标识

Warnings would better be marked on the surface of the battery which is tied up by certain cells：

*Using the charger designated by the manufacturer(AEC).

*Don't throw the battery in fire or heat it .

*Don't short-circuit by connecting the positive and negative polarities together.

*Don't disassemble the battery or change its structure.

对用于制作电池块（组），请在电池块（组）上标记以下警告：

*使用（制造厂商）指定的充电器。

*禁止将电池投入火中或对电池加热。

*禁止将电池正负极短路。

*禁止拆开，改变电池（组）结构。

13. Notice for Designing Battery /电池组设计注意事项

13.1 Battery design

电池组设计

13.1.1 Battery shell should be with enough mechanical strength, to protect the inner cell from mechanical shock;

电池外壳应有足够的机械强度以保证其内部电池免受机械撞击；

13.1.2 No cell movement in the battery should be allowed;

电池不得在壳内活动；

13.1.3 No Sharp edge or bulge components should be inside the pack containing the battery;

外壳内安装电池的部位不应有锋利的边角或凸起；

13.2 Avoid some components to contact the edge of packing foil of batteries ;

避免导电元件与电池包装铝箔的边缘接触；

13.3 Tab connection

电池的连接

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

建议使用超声波焊接或点焊技术来连接电池与保护电路模块或其它部分；

13.3.2 The tab is not very firm. Don't bend the tab。especially the positive pole. It will rupture easily;

电池极耳的机械强度并非十分坚固，弯折容易断裂，尤其是正极耳.禁止多次弯折极耳；

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

如使用手工锡焊，须注意以下事项，以保证电池的功能：

1). The solder iron should be temperature controlled and ESD safe;

烙铁的温度可控且防静电；

2). Soldering temperature should below 350℃;

烙铁温度应该小于 350°C；

3). Soldering time should not be longer than 3s ;

锡焊时间不能超过 3 秒；

4). Soldering times should not exceed 3 times ,secondary welding should be done after the poles are cooling;

锡焊次数不能超过 3 次，必须在极耳冷却后再进行二次焊接；

5). Heating up the cell is strictly prohibited, and the cell will be completely destroyed at 100°C.

禁止直接加热电池，高于 100°C会导致电池损坏；

6). Don't let the electric iron contact the surface of the cell.

禁止电烙铁头接触电池表面。

Please use the battery according to the provisions as below ,Incorrect using of the battery may cause fire or expansion, and destroy its performance.

请仔细阅读并遵照以下条款安装使用电池，不正确的使用可能会导致电池气鼓、着火等，降低了电池的性能或破坏电池。

14. Warnings 警告

14.1 Don't throw the battery in fire or heat it or store it in high temperature place ;

请勿将电池放入火中，或对电池加热，请勿在高温下储存电池；

14.2 Don’t operate or use the battery under high temperature or next to the heating material;

禁止在高温环境下或热源旁操作或者使用电池,禁止将电池加热或者投入火中；

14.3. Don't fix the positive and negative of the battery reversely to the electrical equipment ;

安装电池时请勿将正负极反接；

14.4 Don't connect the positive and negative polarities by metallic conductor such as a metallic wire;

请勿将电池正负极用金属物体（如导线）直接连接等方式造成电池短路；

14.5 Don’t impact or scrape the surface of the battery by spiculate parts;

禁止用尖锐部件碰撞或刮擦电池表面；

14.6 Don't stab it with a needle,beating,treading,fold or other way;

请勿用针刺、用锤敲打、用力踩踏、弯折或其它方式对电池进行撞击；

14.7 Don’t drop or fling the battery randomly;

禁止坠落、抛掷电池；

14.8 Keep the cell sealed!(Don't open or deform folding edge, don't bend or fold sealing edge,etc);

请勿破坏电池密封(包括打开折边、弯折封边等)；

14.9 Don't disassemble the battery or change its structure!;

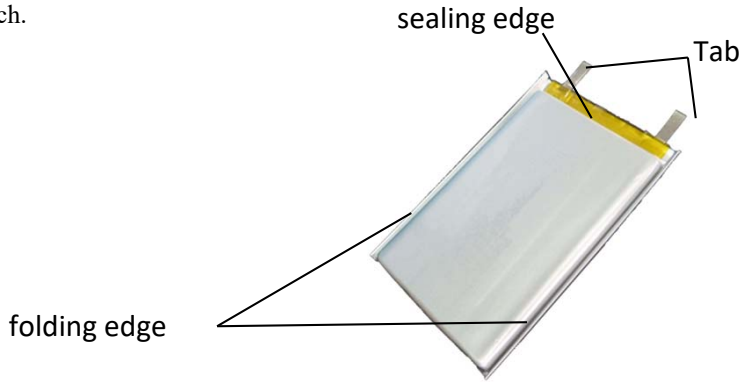
请勿乱拆电池，请勿随意改变电池结构；

14.10 Don't throw the battery in water, please keep it from humidity.

请勿将电池放入水中，储存时注意电池不要受潮。

14.11 Don't connect negative potential with the pouch.

禁止负电位与铝塑膜短接。



15. Attention注意

15.1 Please use the qualified equipment to charge and discharge the battery, and follow the right instructions.

充放电时请勿用不合格设备，并遵循正确的使用说明。

15.2 Don't use batteries of different types or batteries supplied by different manufacturer together. Don't use the old and new batteries together.

请勿将不同厂家或不同种类、型号的电池以及新旧电池混用。

15.3 Don't charge or discharge the hot, inflation, distorted or electrolyte-leakage battery.

请勿将发热、气鼓、变形或漏液电池放入设备中充放电。

15.4 Don't let the battery over-charge or over-discharge.

在充放电时，不能超出本规格书规定的电压、电流范围。

16. Reminding提醒

16.1 Don’t use the damaged batteries (the sealing edge was damaged, the pack was damaged, the electrolyte leakage, etc.). If the battery heating when using, go far away from the battery, it may avoid unnecessary damage;

禁止使用已损坏的电池(电池封口封边损坏,外壳破损,闻到电解液,电解液泄漏等). 操作电池时,如果发现电池发热,要立即远离该电池以免造成不必要的伤害；

16.2 Theoretically, there is not flowing electrolyte in the battery, but if the leakage of electrolyte happen, or the electrolyte splash down to the skin, eyes or other parts of the body, wash with water and go to hospital immediately;

聚合物锂离子电池理论上不存在流动的电解液,但万一有电解液泄漏而接触到皮肤、眼睛或身体其它部位,应立即用清水冲洗并就医；

16.3 The batteries supplied by AEC (Apower Electronics Co.,Ltd.) had passed the QC before sales, if there is any abnormal problem such as unidentified heating,expansion and peculiar smell,please contact with us;

电池组出货前已由QC严格检查，如客户发现所购电池有发热、气鼓或异味现象，请与我司联系；

16.4 The inspection for IQC of customer should be done within 7 days after the batteries have been received.

客户收到电池后，应在7天内完成进料检验。

16.5 If single cell voltage is less than 3.0V, and can't be charged to 3.0V with current 0.2C within 30min, then should stop charging, and the battery shouldn't be used again.

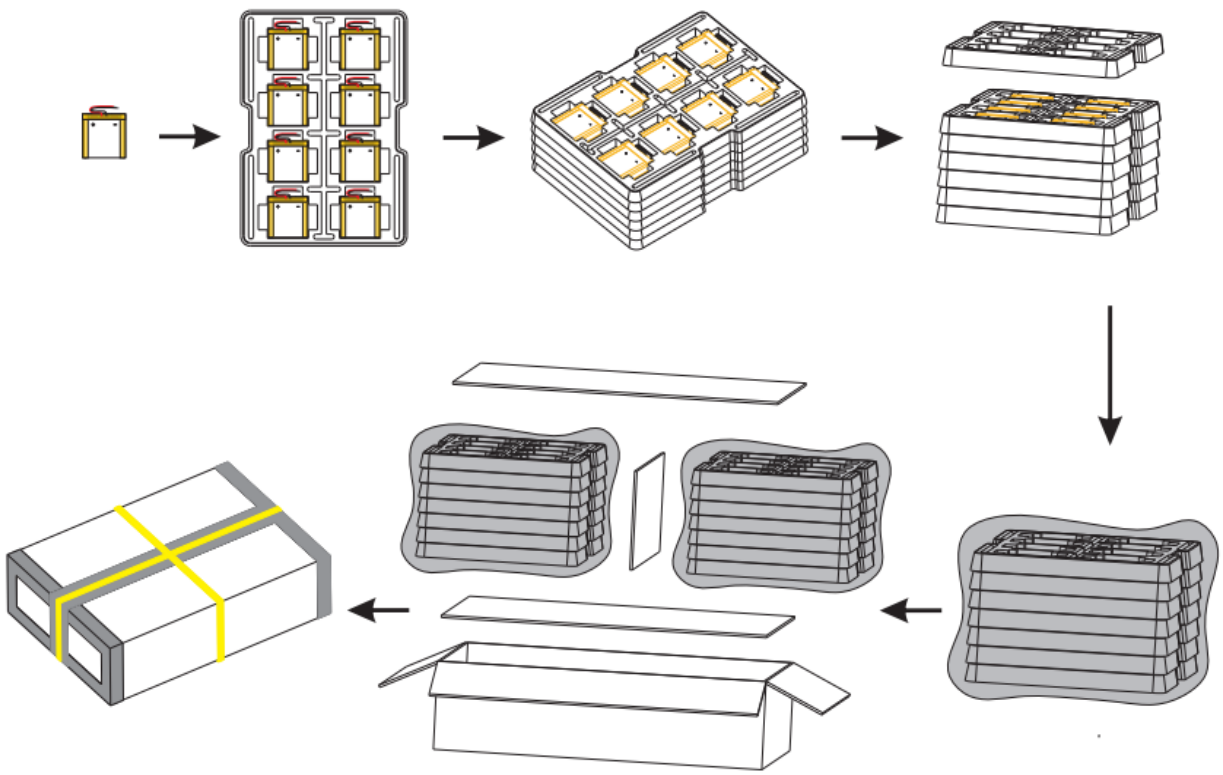
当单颗电池电压低于3.0V且以0.2C充电30分钟单颗电池电压仍未到达3.0V，应停止充电，电池应禁止再次使用。

16.6 The battery stored beyond three months should be charged to 3.7~3.9V/cell with constant current at 0.5C .

电池储存超过三个月，请客户对电池用0.5C电流充电至单个电池电压3.7~3.9V。

17.Package/包装

Package sketch map/ 包装示意图



THERMISTOR R-Temp

R25: 10kΩ±1%
B25/85: 3435K±1%

TDK P/N: NTCG103JF103F
TDK P/N: NTCG163JF103F

Temp (deg.C)	Min kΩ	Nom kΩ	Max kΩ
-40	181.2	188.5	196.1
-39	171.8	178.6	185.6
-38	162.9	169.2	175.8
-37	154.5	160.4	166.6
-36	146.5	152.1	157.9
-35	139.1	144.3	149.7
-34	132.0	136.9	141.9
-33	125.4	130.0	134.7
-32	119.1	123.4	127.8
-31	113.2	117.2	121.3
-30	107.6	111.3	115.2
-29	102.3	105.8	109.4
-28	97.30	100.6	104.0
-27	92.57	95.64	98.80
-26	88.09	90.97	93.93
-25	83.86	86.56	89.33
-24	79.85	82.38	84.98
-23	76.06	78.43	80.86
-22	72.47	74.69	76.97
-21	69.06	71.14	73.28
-20	65.84	67.79	69.79
-19	62.78	64.61	66.49
-18	59.88	61.60	63.35
-17	57.13	58.74	60.39
-16	54.53	56.03	57.58
-15	52.05	53.46	54.91
-14	49.70	51.03	52.38
-13	47.47	48.71	49.99
-12	45.35	46.52	47.71
-11	43.34	44.43	45.55
-10	41.42	42.45	43.50
-9	39.61	40.57	41.55
-8	37.88	38.78	39.70
-7	36.23	37.08	37.95
-6	34.67	35.46	36.28
-5	33.18	33.93	34.69
-4	31.76	32.46	33.18
-3	30.41	31.07	31.74
-2	29.13	29.75	30.37
-1	27.91	28.49	29.07
0	26.74	27.28	27.83
1	25.63	26.14	26.66
2	24.57	25.05	25.53
3	23.56	24.01	24.46
4	22.60	23.02	23.44
5	21.68	22.07	22.47
6	20.80	21.17	21.54
7	19.97	20.31	20.66
8	19.17	19.49	19.82
9	18.41	18.71	19.01
10	17.68	17.96	18.25
11	16.98	17.25	17.52
12	16.32	16.57	16.82
13	15.68	15.91	16.15
14	15.08	15.29	15.51
15	14.49	14.70	14.90
16	13.94	14.13	14.32
17	13.41	13.59	13.76
18	12.90	13.07	13.23
19	12.41	12.57	12.72
20	11.95	12.09	12.24
21	11.50	11.64	11.77
22	11.08	11.20	11.33
23	10.67	10.78	10.90
24	10.28	10.38	10.49
25	9.900	10.00	10.10
26	9.533	9.633	9.733
27	9.182	9.282	9.381
28	8.845	8.945	9.044
29	8.523	8.622	8.721
30	8.213	8.312	8.410
31	7.917	8.015	8.113
32	7.633	7.730	7.827
33	7.360	7.456	7.553
34	7.099	7.194	7.290
35	6.848	6.942	7.037
36	6.607	6.700	6.795
37	6.376	6.468	6.562
38	6.154	6.245	6.338
39	5.941	6.031	6.123
40	5.736	5.826	5.916
41	5.540	5.628	5.717
42	5.351	5.438	5.526
43	5.170	5.255	5.342
44	4.995	5.080	5.166
45	4.827	4.911	4.996
46	4.666	4.749	4.832
47	4.511	4.592	4.675
48	4.362	4.442	4.523
49	4.219	4.297	4.377
50	4.081	4.158	4.237
51	3.948	4.024	4.102
52	3.820	3.895	3.971
53	3.697	3.771	3.846
54	3.578	3.651	3.725
55	3.464	3.536	3.609
56	3.354	3.425	3.496
57	3.249	3.318	3.388
58	3.146	3.215	3.284
59	3.048	3.115	3.183
60	2.953	3.019	3.086
61	2.862	2.927	2.992
62	2.774	2.837	2.902
63	2.689	2.751	2.815
64	2.607	2.668	2.731
65	2.528	2.588	2.650
66	2.452	2.511	2.571
67	2.378	2.436	2.496
68	2.307	2.364	2.423
69	2.238	2.295	2.352
70	2.172	2.227	2.284
71	2.108	2.163	2.218
72	2.047	2.100	2.154
73	1.987	2.039	2.093
74	1.929	1.981	2.033
75	1.874	1.924	1.976
76	1.820	1.869	1.920
77	1.768	1.817	1.866
78	1.718	1.765	1.814
79	1.669	1.716	1.764
80	1.622	1.668	1.715
81	1.577	1.622	1.668
82	1.533	1.577	1.623
83	1.490	1.534	1.579
84	1.449	1.492	1.536
85	1.409	1.451	1.494
86	1.371	1.412	1.454
87	1.334	1.374	1.416
88	1.298	1.337	1.378
89	1.263	1.302	1.342
90	1.229	1.267	1.306
91	1.196	1.234	1.272
92	1.164	1.201	1.239
93	1.133	1.170	1.207
94	1.104	1.139	1.176
95	1.075	1.110	1.146
96	1.047	1.081	1.117
97	1.020	1.054	1.088
98	0.993	1.027	1.061
99	0.968	1.001	1.034
100	0.943	0.975	1.008
101	0.919	0.951	0.983
102	0.896	0.927	0.959
103	0.873	0.904	0.935
104	0.852	0.881	0.912
105	0.830	0.860	0.890
106	0.810	0.838	0.868
107	0.790	0.818	0.847
108	0.770	0.798	0.827
109	0.752	0.779	0.807
110	0.733	0.760	0.788
111	0.715	0.742	0.769
112	0.698	0.724	0.751
113	0.681	0.707	0.733
114	0.665	0.690	0.716
115	0.649	0.674	0.699
116	0.634	0.658	0.683
117	0.619	0.643	0.667
118	0.605	0.628	0.652
119	0.590	0.613	0.637
120	0.577	0.599	0.622
121	0.563	0.585	0.608
122	0.550	0.572	0.595
123	0.538	0.559	0.581
124	0.526	0.546	0.568
125	0.514	0.534	0.556