

Specification Approval Sheet

研发已审

产品规格书

Customer Name
客户名称: 文石

Customer Model
客户型号: CLP446484P

Customer P/N
客户料号: OBT0073R

Product P/N
产品编码: MFP-436381-002

Product Description
产品描述: SB.10.436381-01/3950mAh/3.87V/
1S1P/RoHS2.0/HF/GWSPC201P

E.E 硬件制定	M.D 结构会签	Checked 审核	Approval 批准
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Customer Approved 客户承认 Stamp (盖章)	Approved by 批准
	Date/日期

惠州赣锋锂电科技有限公司
Huizhou Ganfeng Lienergy Battery Technology Co.,Ltd.

AMENDMENT RECORDS
修订记录

Revision 版本	Description 说明	Originator 编写	Date 日期
S0	New release 新发行	CCY	2022-12-12
A0	1. 合金电阻调整为 3mΩ, 并更改过流值 2. FPC 距离电池边缘 17.95 调整为 16.95mm 3. 增加 layout 图和包装图	CCY	2023-2-4
A1	更新图纸, 改 3M 胶位置	CCY	2023-2-6
A2	3M 胶增加尺寸	CCY	2023-2-8
A3	1.3M 胶增加全尺寸 2.FPC 钢片厚度由 0.3mm 改为 0.2mm	CCY	2023-02-14
B0	更改丝印内容	CCY	2023-03-01
B1	保护板更改备选 IC	CCY	2023-04-10
B2	更新移印内容	CCY	2023-06-20

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1. Scope 适用范围

The specification shall be applied to Lithium-ion Polymer (LIP) rechargeable battery which is manufactured by Huizhou Ganfeng Lienergy Battery Technology Co.,Ltd.

此产品规格书适用于惠州赣锋锂电科技有限公司制造的可充电聚合物锂离子电池。

2. Model 型号:

436381

3. Standard Test Conditions 标准测试条件

3.1 Environmental Conditions 环境条件

Unless otherwise specified, all tests stated in this Product Specification are conducted at below condition:

除非有其它规格说明，所有测试条件都遵循以下规格：

Temperature: 25±3℃

Humidity: 65±20% RH

温度：25±3℃

湿度：65±20% RH

3.2 Measuring Equipment 测试设备

Voltmeter 电压表	Accuracy of the grade is above 0.5 and input impedance is higher than 10KΩ/V. 精度等级 0.5 以上，内部阻抗>10K Ω /V
Ammeter 电流表	Accuracy of the grade is above 0.5. 精度等级 0.5 以上
Slide Caliper 卡尺	External battery use of Calipers or GO-ON-GO tooling test length, with and thickness; Built-in not-removable battery use of PPG measuring length, width, thickness, length 300 ± 30gf, width 300 ± 30gf, thickness 600 ± 30gf (厚度根据型号定义)。外置电池使用卡尺或通止规测试长，宽，厚； 内置不可拆电池使用 PPG 测量长、宽、厚，长度 300 ± 30gf，宽度 300 ± 30gf,厚度 600 ± 30gf (厚度根据型号定义)。
Impedance Meter 内阻仪	AC 1kHz should be used. 使用 AC 1kHz

Throughout this Specification, ‘*’ annotated criteria are applicable only to fresh unused battery products within 30days from manufactured by Huizhou Ganfeng Lienergy Battery Technology.

带“*”的规格仅适用于新鲜未使用过的电池，且从制造完成开始存储时间不超过 30 天。

4. Typical Parameters 主要参数

4.1 Cell Main Characteristics 电芯特性

Nominal Voltage 额定电压	Cell Maker 电芯制造商	Cell Model 电芯型号	Cell Minimum Capacity 电芯最小容量	Cell Nominal Capacity 电芯典型容量
3.87 V	GFL	436381	3970mAh	4050mAh

4.2 Battery Electrical Characteristics 电池特性

No.	Items 项目	Specifications 规格		
4.2.1	Charge Cut-off Voltage 充电截止电压	4.45V	0≤T≤45 °C	
		4.10V	45≤T≤60 °C	
4.2.2	Nominal Voltage 标称电压	3.87V		
4.2.3	Discharge Cut-off Voltage 放电截止电压	3.0 V		
4.2.4	* Minimal Capacity(C _{min}) * 最小容量	3950mAh @0.2C discharge @R.T. 常温环境下 0.2C 放电容量 3950mAh		
4.2.5	* Typical Capacity * 典型容量	4030mAh @0.2C discharge @R.T. 常温环境下 0.2C 放电容量 4030mAh		
4.2.6	Initial Capacity (C _{ini}) 初始容量	The initial capacity is 0.2C discharge to 3.0V after standard charging at room temperature. 常温环境下标准充电后 0.2C 放电到 3.0V, 为初始容量。		
4.2.7	Standard Charge 标准充电	790mA constant current charge to 4.45V, then constant voltage 4.45V charge till charge current declines to 79mA. 790mA 恒流充电至 4.45V, 然后 4.45V 恒压充电至截止电流 79mA		
4.2.8	Standard Discharge 标准放电	790mA constant current discharge to 3.0V 790mA 恒流放电至 3.0V		
4.2.9	Pre-charge Current 预充电流	Max 100mA @ 2.0~3.0V		
4.2.10	Voltage of shipment 出货电压	3.75 ~ 3.90V		
4.2.11	Initial Impedance 初始内阻	≤100mΩ	After standard charged, the battery is to be measured the initial impedance using a AC 1KHz meter at 25±3°C. 在 25±3°C 环境下, 将标准充电后的电池, 使用交流阻抗测试仪 (1KHz) 测量初始内阻。	
4.2.12	Operating Current and Operating Temperature 工作电流及温度范围	Charge/Discharge 充电/放电	Temperature 温度	Current & Voltage 电流 & 电压
		Charge 充电	0≤T≤20 °C	790mA max CC to 4.45V, CV to 79mA
			20<T≤45 °C	3950mA max CC to 4.2V, 1975mA CC to 4.45V ,CV to 79mA
			45<T≤60°C	1975mA CC max to 4.1V, CV to 79mA
		Discharge 放电	-20≤T≤0 °C	790mA max
0<T≤60 °C	3950mA max		≥3.0V	
4.2.13	Storage Condition (at shipping status state) 存储条件 (在出货状态下)	Storage time 存储时间	Temperature 温度	Humidity 湿度
		Within 3 months 三个月内	-20°C ~ 45°C	65±20% RH
		Within 6 months 六个月内	-20°C ~ 35°C	

5. Electrical Characteristics 电性能

No.	Items 项目	Test Method and Condition 测试方法	Criteria 标准
5.1	Full Charged Definition 充饱定义	With charging voltage 4.45V, current 0.5C continued to charge the battery, when charging current drops to 0.02C charging is terminated, shall be full charged. 以充电电压 4.45V, 电流 0.5C 对电池组持续充电, 当充电电流下降至 0.02C 时充电被终止, 即为充饱。	N.A
5.2	Full Discharged Definition 放空定义	Standard discharge current for continuous discharge, when the voltage drops to discharge cut-off voltage 3.0V discharge is terminated, shall be full discharged. 以标准放电电流进行持续放电, 当电压降至放电截止电压 3.0V 时放电被终止, 即为放空。	N.A
5.3	*Minimal Capacity *最小容量	The capacity means the discharge capacity of the battery, which is measured with discharge current of 0.2C with 3.0V cut-off voltage after the standard charge at 25±3°C. 电池放电容量, 即 25±3°C 环境标准充电后以 0.2C 恒流放电到 3.0V 所放出的容量。	≥3950mAh
5.4	Capacity of 3.4V 3.4V 的容量	The capacity means the discharge capacity of the battery, which is measured with discharge current of 0.2C with 3.4V cut-off voltage after the standard charge at 25±3°C. 电池放电容量, 即 25±3°C 环境标准充电后以 0.2C 恒流放电到 3.4 V 所放出的容量。	≥92% Cmin
5.5	Rate Discharge Capability 倍率放电性能	After standard charged, the battery is to be stored at 25±3°C and rest for 0.5~1.0 hours, then discharge with 0.2C /0.5C/ 1.0 C to 3.0V. 将标准充电后的电池在 25±3°C 环境下静置 0.5~1.0 小时, 然后以 0.2C/0.5C/1C 放电至 3.0V。	0.2C ≥100% Cini 0.5C ≥95% Cini 1.0C ≥85% Cini
5.6	Cycle Life 常温循环	Test temperature: 25±3°C. Charge the battery with 0.5C current and discharge the battery with 0.5C current until cell voltage reaches 3.0V. Repeat to 400 cycles. Record the thickness and internal resistance under the first and last full charge, and record the discharge capacity after the first and last full charge. 在 25±3°C 环境下, 0.5C 充/0.5C 放电循环 400 周。记录首次和末次满电下厚度及内阻, 记录首次和末次满电后放电容量。	Retention capacity ≥80% Thickness change ≤8% resistance change (reference) ≤50% 容量保持率 ≥80% 厚度变化 ≤8% 内阻变化 (仅参考) ≤50% (满电态 VS 满电态)
5.7	Cycle Life 7°C 循环	It was placed at 7±2°C for 4h, then charged at 0.2C/discharged at 1.0C for 20 cycles. The thickness and internal resistance at the first and last full charge at 7±2°C were recorded, and the discharge capacity after the first and last full charge at 7±2°C was recorded.	Retention capacity ≥60% Recovery capacity ≥70% at 25°C Thickness change ≤8% resistance change (reference) ≤50%

		<p>After the cycle was completed, the machine was taken out and cooled at $25 \pm 3^{\circ}\text{C}$ for 2h, then charged at 0.2C/discharged at 1.0C for 3 cycles. The maximum discharge capacity was set as the recovery capacity.</p> <p>在 $7 \pm 2^{\circ}\text{C}$ 环境静置 4h , 0.2C 充/1.0C 放电循环 20 周。记录 $7 \pm 2^{\circ}\text{C}$ 下首次和末次满电下厚度及内阻, 记录 $7 \pm 2^{\circ}\text{C}$ 下首次和末次满电后放电容量。循环完成后取出 $25 \pm 3^{\circ}\text{C}$ 环境下冷却 2h, 0.2C 充/1.0C 放循环 3 次, 取最大一次放电容量为恢复容量。</p>	<p>容量保持率 $\geq 60\%$ 常温恢复容量 $\geq 70\%$ 厚度变化 $\leq 8\%$ 内阻变化 (仅参考) $\leq 50\%$ (满电态 VS 满电态)</p>
5.8	Cycle Life 45°C 循环	<p>It was placed at $45 \pm 3^{\circ}\text{C}$ for 4h, then charged at 0.5C/discharged at 0.5C for 400 cycles. The thickness and internal resistance at the first and last full charge at $45 \pm 3^{\circ}\text{C}$ were recorded, and the discharge capacity after the first and last full charge at $45 \pm 3^{\circ}\text{C}$ was recorded.</p> <p>After the cycle was completed, the machine was taken out and cooled at $25 \pm 3^{\circ}\text{C}$ for 2h, then charged at 0.5C/discharged at 0.5C for 3 cycles. The maximum discharge capacity was set as the recovery capacity.</p> <p>在 $45 \pm 3^{\circ}\text{C}$ 环境静置 4h , 0.5C 充/0.5C 放电循环 400 周。记录 $45 \pm 3^{\circ}\text{C}$ 下首次和末次满电下厚度及内阻, 记录 $45 \pm 3^{\circ}\text{C}$ 下首次和末次满电后放电容量。循环完成后取出 $25 \pm 3^{\circ}\text{C}$ 环境下冷却 2h, 0.5C 充/0.5C 放循环 3 次, 取最大一次放电容量为恢复容量。</p>	<p>Retention capacity $\geq 70\%$ Recovery capacity $\geq 70\%$ at 25°C Thickness change $\leq 8\%$ resistance change (reference) $\leq 50\%$ 容量保持率 $\geq 70\%$ 常温恢复容量 $\geq 70\%$ 厚度变化 $\leq 8\%$ 内阻变化 (仅参考) $\leq 50\%$ (满电态 VS 满电态)</p>
5.9	High/Low Temperature Capability 高低温放电性能	<p>After standard charged, the battery is to be stored at 25/-20/-10/45/55/$\pm 3^{\circ}\text{C}$ for 4 hours, and then 0.2C constant current discharge to 3.0V at 25/-20/-10/45/55/$\pm 3^{\circ}\text{C}$</p> <p>将标准充电后的电池储存在 25/-20/-10/45/55/$\pm 3^{\circ}\text{C}$ 的环境中, 4 小时后 0.2C 恒流放电至 3.0V。</p>	<p>$\geq 100\%$ Cini at 25°C $\geq 40\%$ Cini at -20°C $\geq 70\%$ Cini at -10°C $\geq 95\%$ Cini at 45°C $\geq 90\%$ Cini at 55°C 25°C 容量保持率 $\geq 100\%$ Cini -20°C 容量保持率 $\geq 40\%$ Cini -10°C 容量保持率 $\geq 70\%$ Cini 45°C 容量保持率 $\geq 95\%$ Cini 55°C 容量保持率 $\geq 90\%$ Cini</p>

5.10	Electrostatic Discharge (ESD) 静电放电	After standard charged, the battery is required to pass ESD test, contact discharge: $\pm 4\text{KV}$, 5 times, air discharge: $\pm 8\text{KV}$, 5times. Each interval of the two discharge test is 1minutes. 将标准充电后的电池每个端子进行 $\pm 4\text{kV}$ 接触放电测试各5次和 $\pm 8\text{kV}$ 空气放电测试各5次, 每两次放电测试之间间隔1分钟。	No Fire, No Explosion. Its protection function shall not fail if it is equipped with protection circuit. 不起火、不爆炸, 如有保护电路其保护功能不应失效
5.11	Retention Capability 荷电保持能力	After standard charging, 0.2C is discharged to 3.0V, which is the initial capacity .After standard charged, the battery is to be stored at $25 \pm 3^\circ\text{C}$ for 28 days, then discharge with 0.2C to 3.0V at $25 \pm 3^\circ\text{C}$. Then standard charge and discharge with 0.2C to 3.0V at RT. 标准充电后 0.2C 放电到 3.0V, 为初始容量。将标准充电后的电池在 $25 \pm 3^\circ\text{C}$ 环境下存放 28 天, 取出后在以 0.2C 恒流放电至 3.0 V。然后在 $25 \pm 3^\circ\text{C}$ 下标准充电后再以 0.2C 放电至 3.0V。	$\geq 80\%$ Cini Recovery $\geq 90\%$ Cini 容量保持率 $\geq 80\%$ Cini 容量恢复率 $\geq 90\%$ Cini
5.12	Room temperature Storage 常温储存	1. Storage for 90 days under shipment voltage at $25 \pm 2^\circ\text{C}$ 2. Storage for 180 days under shipment voltage at $25 \pm 2^\circ\text{C}$ 1.出货状态下, 在 $25 \pm 2^\circ\text{C}$ 环境下, 存储 90 天; 2.出货状态下, 在 $25 \pm 2^\circ\text{C}$ 环境下, 存储 180 天。	Within 90 days, Recoverable capacity $\geq 98\%$ C_{\min} Within 180 days, Recoverable capacity $\geq 95\%$ C_{\min} 1.存储 90 天, 容量恢复率 $\geq 98\%$ C_{\min} 2.存储 180 天, 容量恢复率 $\geq 95\%$ C_{\min}
5.13	High Temperature and humidity Storage (60°C , 90~95%RH) 高温高湿存储 (60°C , 90~95%RH)	After standard charging, 0.2C is discharged to 3.0V, which is the initial capacity. After standard charging, the initial thickness was tested. The battery was stored at $60 \pm 3^\circ\text{C}$ and 90~95%RH for 7 days to test the hot thickness. After taking it out, it was cooled at room temperature for 2h to test the cold thickness, and at the same time, 0.2C constant discharge charge was used to 3.0V. Then discharge to 3.0V at 0.2C after standard charge at $25 \pm 3^\circ\text{C}$. 标准充电后 0.2C 放电到 3.0V, 为初始容量。标准充电后测试初始厚度, 电池在 $60 \pm 3^\circ\text{C}$, 90~95%RH 环境下存放 7 天, 测试热态厚度, 取出后常温冷却 2h 后测试冷态厚度, 同时 0.2C 恒流放电至 3.0 V。然后在 $25 \pm 3^\circ\text{C}$ 下标准充电后再以 0.2C 放电至 3.0V。	Retention capacity $\geq 80\%$ Cini Recovery capacity $\geq 90\%$ Cini Thermal thickness change $\leq 15\%$ initial thickness Cold thickness change $\leq 10\%$ initial thickness 容量保持率 $\geq 80\%$ Cini 容量恢复率 $\geq 90\%$ Cini 热态厚度变化 $\leq 15\%$ 初始厚度 冷态厚度变化 $\leq 10\%$ 初始厚度

5.14	<p>High temperature Storage (85°C 4H) 高温存储 (85°C 4H)</p>	<p>After standard charging, 0.2C is discharged to 3.0V, which is the initial capacity. After standard charging, the initial thickness was tested. The battery was stored at 85±2°C for 4 hours to test the hot thickness. After taking it out, it was cooled at room temperature for 2h to test the cold thickness, and at the same time, 0.2C constant discharge charge was used to 3.0V. Then discharge to 3.0V at 0.2C after standard charge at 25±3°C. 标准充电后 0.2C 放电到 3.0V, 为初始容量。标准充电后测试初始厚度, 电池 85±2°C 环境下存 4h, 测试热态厚度, 取出后常温冷却 2h 后测试冷态厚度, 同时 0.2C 恒流放电至 3.0 V。然后在 25±3°C 下标准充电后再以 0.2C 放电至 3.0V。</p>	<p>Retention capacity ≥80% Cini Recovery capacity ≥90% Cini Thermal thickness change ≤15% initial thickness old thickness change ≤10% initial thickness 容量保持率≥80% Cini 容量恢复率≥90% Cini 热态厚度变化≤15%初始厚度 冷态厚度变化≤10%初始厚度</p>
5.15	<p>High temperature Storage (70°C 48H) 高温存储 (70°C 48H)</p>	<p>After standard charging, 0.2C is discharged to 3.0V, which is the initial capacity. After standard charging, the initial thickness was tested. The battery was stored at 70±3°C for 48 hours to test the hot thickness. After taking it out, it was cooled at room temperature for 2h to test the cold thickness, and at the same time, 0.2C constant discharge charge was used to 3.0V. Then discharge to 3.0V at 0.2C after standard charge at 25±3°C. 标准充电后 0.2C 放电到 3.0V, 为初始容量。标准充电后测试初始厚度, 电池 70±3°C 环境下存 48h, 测试热态厚度, 取出后常温冷却 2h 后测试冷态厚度, 同时 0.2C 恒流放电至 3.0 V。然后在 25±3°C 下标准充电后再以 0.2C 放电至 3.0V。</p>	<p>Retention capacity ≥80% Cini Recovery capacity ≥90% Cini Thermal thickness change ≤15% initial thickness old thickness change ≤10% initial thickness 容量保持率≥80% Cini 容量恢复率≥90% Cini 热态厚度变化≤15%初始厚度 冷态厚度变化≤10%初始厚度</p>

6. Battery Safety Performance 电池安全性能

No.	Items 项目	Test Method and Condition 测试方法	Criteria 标准
6.1	Over-voltage Charge 过压充电	After standard charged, the battery is to be charged with constant current at the maximum charging current to 6.0V (or the highest voltage it may withstand choose the higher of the two), keep such voltage and charge with the constant voltage. As for the battery with protection circuit, charge till the protection circuit responses. 将标准充电后的电池继续以最大充电电流恒流充电至6.0V（或者可能承受的最高电压值，两者取较高者），并保持该电压进行恒压充电。对于移除保护电路或者没有保护电路的电池组的充电1h，对于保留保护电路的电池组充电至保护电路动作。	No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液
6.2	Over-current Charge 过流充电	After standard discharged, the battery is to be charged with constant current at 1.5 times the protection current for over-current charge. As for the battery with protection circuit removed or without protection circuit, charge to the upper limit of charging voltage. As for the battery with protection circuit, charge till the protection circuit responses. 将标准放电后的电池以1.5倍的过流充电保护电流进行恒流充电。对于移除保护电路或者没有保护电路的电池组的充电至充电上限电压，对于保留保护电路的电池组充电至保护电路动作。	No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液
6.3	Under-voltage Discharge 欠压放电	After standard charged, the battery is to be discharged with constant current the maximum discharge current. As for the battery with protection circuit removed or without protection circuit, discharge the battery with protection circuit removed or without protection circuit to 0.15V. As for the battery with protection circuit, discharge the battery with protection circuit constantly till the protection circuit responses. Rest it for 10 minutes after discharging, and let it fully charged again as per the test method specified in 6.1. 将标准充电后的电池以其最大放电电流恒流放电。对于移除保护电路或者没有保护电路的电池组放电至 0.15V，对于保留保护电路的电池组放电至保护电路动作。放电后静置 10 分钟，进行标准充电。	No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液
6.4	Overload 过载	After standard charged, the battery is to be discharged with constant current at 1.5 times the protection current for over-current charge. As for the battery with protection circuit removed or without protection circuit, discharge to discharging cut-off voltage. As for the battery with protection circuit, discharge till the protection circuit responses. 将标准放电后的电池以 1.5 倍的过流充电保护电流恒流放电。对于移除保护电路或者没有保护电路的电池组放电至放电截止电压，对于保留保护电路的电池组放电至保护电路动作。	No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液

6.5	External Short Circuit Test 外部短路测试	After standard charged, the battery is to be short-circuited by connecting the positive and negative terminals with a total external resistance of $80 \pm 20\text{m}\Omega$. The battery remains on test for 24 hours or until the surface temperature declines by 20% of the maximum temperature rise. 将标准充电后的电池用电阻为 $80 \pm 20\text{m}\Omega$ 的导线连接电池的正负极使其外部短路,实验中电池能维持 24 小时或表面温度下降到最高温升值的 20%停止。	No Fire, No Explosion battery temperature not exceed 150°C 不起火、不爆炸、 电池的外部表面温度不超过 150°C 。
6.6	High Temperature External Short Circuit Test 高温外部短路测试	After standard charge, the battery is to be short-circuit by connecting the positive and negative terminals of the battery with a circuit load having a resistance load of $80 \pm 20\text{m}\Omega$ at $55 \pm 3^{\circ}\text{C}$. The battery remains on test for 24 hours or until the surface temperature declines by 20% of the maximum temperature rise. 将标准充电后的电池在 $55 \pm 3^{\circ}\text{C}$ 环境下用电阻为 $80 \pm 20\text{m}\Omega$ 的导线连接电池的正负极使其外部短路, 实验中电池能维持 24 小时或外部温度下降到最高温升值的 20%停止。	No Fire, No Explosion battery temperature not exceed 150°C 不起火、不爆炸、 电池的外部表面温度不超过 150°C 。
6.7	Forced Discharge Test 强制放电测试	After standard discharged, the battery is to be charged in reverse with a current of 1C for 90 minutes. 将标准放电后的电池以 1C 电流反向充电 90 分钟。	No Fire, No Explosion No Leakage 不起火、不爆炸、 不漏液

7. Mechanical and Environmental Test 环境

No.	Items 项目	Test Method and Condition 测试方法	Criteria 标准
7.1	Low Pressure Test 低气压测试	After standard charged, the battery is to be stored in a vacuum box at $25 \pm 3^{\circ}\text{C}$. Pump the vacuum to reduce the pressure to 11.6kPa (simulated altitude 15240m) and keep the pressure for 6 hours. 将标准充电后的电池放置于 $25 \pm 3^{\circ}\text{C}$ 的真空箱中, 抽真空将箱内压强降至 11.6kPa (模拟海拔高度 15240m), 并保持 6 小时。	No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液
7.2	Temperature Cycling Test 温度循环测试	After standard charged, the battery is to be stored in a temperature-controlled box at $75 \pm 3^{\circ}\text{C}$ for 6 hours. Then decrease the temperature to $-40 \pm 3^{\circ}\text{C}$ within 30 minutes and keep this temperature for 6 hours. Then increase the temperature to $75 \pm 3^{\circ}\text{C}$ within 30 minutes. Repeat previous steps for 10 cycles. 将标准充电后的电池放置在 $75 \pm 3^{\circ}\text{C}$ 的温控箱内保持 6 小时; 然后在 30 分钟内将实验箱温度降为 $-40 \pm 3^{\circ}\text{C}$, 并保持 6 小时; 再次在 30 分钟内将实验箱温度升为 $75 \pm 3^{\circ}\text{C}$; 重复以上步骤循环 10 次。	No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液
7.3	Free Fall Test 自由跌落测试	After standard charged, the battery is to be dropped onto the concrete board from the height of 1.0m, drop it from each surface once and altogether 6 times. 将标准充电后的电池从 1 米的高度自由跌落到水泥地板上, 每个面各跌落一次, 共进行六次试验。	No Fire, No Explosion 不起火、不爆炸 测试后开路电压不低于 90% 的初始电压
7.4	Vibration Test 振动测试	After standard charged, the battery is to be fixed on the vibration test bench and conduct the sine vibration test. Vibrate according to a sine wave with an amplitude of 0.8mm (total maximum displacement 1.6mm) in three mutually perpendicular directions, XYZ, and the frequency is increased from 7Hz to 200Hz and then drops back to 7Hz. Each direction 12 cycles. The cycle time of vibration in each direction is 3 hours. 将标准充电后的电池固定在振动试验台上并进行正弦振动测试, 在 X Y Z 三个相互垂直的方向按振幅 0.8mm (总最大位移量 1.6mm) 的正弦波进行振动, 频率从 7Hz 增加到 200Hz 然后再降回 7Hz。每个方向进行 12 个循环, 每个方向循环时间共计 3 小时。	No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液 测试后开路电压不低于 90% 的初始电压, 内阻增加不高于初始的 10%, 厚的 5%。

7.5	Acceleration Impact Test 加速度冲击测试	<p>After standard charge, the battery is to be fixed on the impact bench to conduct half-sine pulse impact test. Within initial 3ms, the minimum accelerated speed is $75g_n$, the peak is $150\pm 25g_n$, and the pulse duration is $6\pm 1ms$. Conduct the test 3 times for each direction of the battery.</p> <p>将标准充电后的电池固定在冲击台上进行半正弦脉冲冲击实验。在最初的 3ms 内, 最小平均加速度为 $75g_n$, 峰值加速度为 $150\pm 25g_n$, 脉冲持续时间为 $6\pm 1ms$。电池每个方向进行三次加速度冲击试验。</p>	<p>No Fire, No Explosion No Leakage 不起火、不爆炸、不漏液</p>
7.6	Crush Test 挤压测试	<p>After standard charged, the battery is to be crushed between two flat surfaces, And apply a pressing force of $13\pm 0.78KN$ perpendicular to the board direction. Once the maximum pressure is reached, the test can be stopped. During the test, the battery must not have an external short circuit.</p> <p>将标准充电后的电池置于两个平面间进行挤压, 垂直于板方向施加 $13\pm 0.78KN$ 的挤压力, 一旦达到最大压力即可停止试验。试验过程中电池不能发生外部短路。</p>	<p>No Fire, No Explosion 不起火、不爆炸</p>
7.7	Constant Temperature and Humidity Test 恒定湿热测试	<p>After standard charged, the battery is to be stored at $40\pm 3^\circ C$ and relative humidity 90~95% for 48 hours. Then rest the battery in an environment of $25\pm 3^\circ C$ for 2 hours.</p> <p>将标准充电后的电池放入 $40\pm 3^\circ C$ 及相对湿度为 90~95% 的环境中 48 小时。然后将电池在 $25\pm 3^\circ C$ 环境下静置 2 小时。</p>	<p>No Fire, No Explosion No Leakage 不起火、不爆炸、不泄露</p>
7.8	Thermal Abuse Test 热滥用测试	<p>After standard charged, the battery is to be placed in the baking oven. The temperature of the oven is raised at a rate of $5\pm 3^\circ C/minutes$ to a temperature of $130\pm 3^\circ C$, and remains at this temperature for 30 minutes.</p> <p>将标准充电后的电池放置于热箱中。热箱温度以每分钟 $5\pm 3^\circ C$ 的速率升至 $130\pm 3^\circ C$ 并保温 30 分钟。</p>	<p>No Fire, No Explosion 不起火、不爆炸、</p>

8. Battery Protection Characteristics 电池保护特性

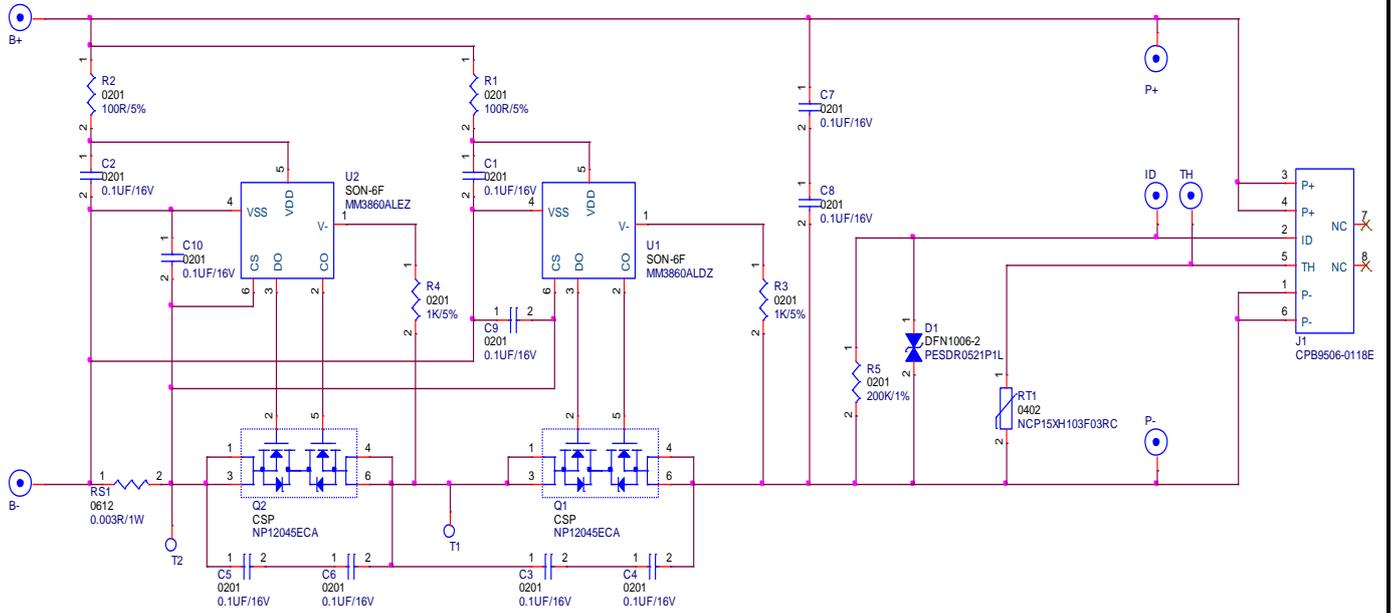
主选保护参数@25℃ Test items 测试项目	Unit. /单位	一次保护参数 MM3860ALDZRE			二次保护参数 MM3860ALEZRE		
		最小值 (Min)	典型值 (TYP)	最大值 (Max)	最小值 (Min)	典型值 (TYP)	最大值 (Max)
Over charge protection voltage 过充电保护电压	V	4.51	4.53	4.55	4.53	4.55	4.57
Over charge release voltage 过充恢复电压	V	4.3	4.33	4.36	4.32	4.35	4.38
Over charge protection delay time 过充电保护延时	S	0.81	1.02	1.23	0.81	1.02	1.23
Over discharge protection voltage 过放电保护电压	V	2.315	2.35	2.385	2.065	2.1	2.135
Over discharge release voltage 过放恢复电压	V	2.46	2.55	2.64	2.21	2.3	2.39
Over discharge protection delay time 过放电保护延时	mS	51.2	64	76.8	51.2	64	76.8
Charge over current protection current 充电过流保护电流	A	7.0	—	9.0	9.0	—	11.5
Charge over current protection delay time 充电过流保护延时	mS	12.8	16	19.2	12.8	16	19.2
Over current protection current (1) 1次放电过流保护电流	A	6.0	—	8.0	6.0	—	8.0
Over current protection delay time (1) 1次放电过流保护延时	mS	2867.2	3584	4300.8	2869.2	3586	4302.8
Over current protection current (2) 2次放电过流保护电流	A	9.0	—	12.5	9.0	—	12.5
Over current protection delay time (2) 2次放电过流保护延时	mS	12.8	16	19.2	12.8	16	19.2
Short protection delay time 短路保护延时	μS	196	280	392	196	280	392
Short protection 短路保护		短路保护			有		
		恢复条件			断开负载		
Current consumption 正常状态下静态电流	μA	≤8					
Current consumption 过放状态下静态电流	μA	≤1.2					
0V 电池充电功能		允许					
NTC 电阻	KΩ	7~14 KΩ@15~35℃					
ID 电阻	KΩ	190~210					

备选保护参数@25°C		一次保护参数 R5612L106AG			二次保护参数 R5612L107AG		
Test items 测试项目	Unit. /单位	最小值 (Min)	典型值 (TYP)	最大值 (Max)	最小值 (Min)	典型值 (TYP)	最大值 (Max)
Over charge protection voltage 过充电保护电压	V	4.51	4.53	4.55	4.53	4.55	4.57
Over charge release voltage 过充恢复电压	V	4.285	4.33	4.375	4.305	4.35	4.395
Over charge protection delay time 过充电保护延时	S	768	1024	1331.2	768	1024	1331.2
Over discharge protection voltage 过放电保护电压	V	2.315	2.35	2.385	2.065	2.1	2.135
Over discharge release voltage 过放恢复电压	V	2.475	2.55	2.625	2.225	2.3	2.375
Over discharge protection delay time 过放电保护延时	mS	48	64	80	48	64	80
Charge over current protection current 充电过流保护电流	A	7.0	—	9.0	9.0	—	11.5
Charge over current protection delay time 充电过流保护延时	mS	12.75	17.0	22.1	12.75	17.0	22.1
Over current protection current (1) 1次放电过流保护电流	A	6.0	—	8.0	6.0	—	8.0
Over current protection delay time (1) 1次放电过流保护延时	mS	2688	3586	4659	2688	3586	4659
Over current protection current (2) 2次放电过流保护电流	A	9.0	—	12.5	9.0	—	12.5
Over current protection delay time (2) 2次放电过流保护延时	mS	12	16	20.8	12	16	20.8
Short protection delay time 短路保护延时	μS	210	280	380	210	280	380
Short protection 短路保护		短路保护			有		
		恢复条件			断开负载		
Current consumption 正常状态下静态电流	μA	≤8					
Current consumption 过放状态下静态电流	μA	≤0.4					
0V 电池充电功能		允许					
NTC 电阻	KΩ	7~14 KΩ@15~35°C					
ID 电阻	KΩ	190~210					

9. PCM Key Components 保护板主要元件

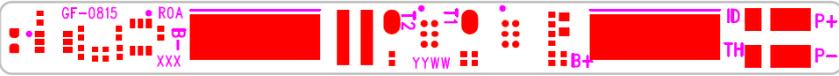
NO. 序号	Parts name 器件名称	Package 封装	Description 描述	Qty 数量	Symbol 位号	Manufacturer 品牌	Remark 备注
1	IC	SON-6F	MM3860ALDZRE	1	U1	美上美	主选
		DFN1814-6C	R5612L106AG			理光	备选
2	IC	SON-6F	MM3860ALEZRE	1	U2	美上美	主选
		DFN1814-6C	R5612L107AG			理光	备选
3	MOSFET	CSP	NP12045ECA	2	Q1,Q2	POWERCORE	主选
		CSPB2213-6	CJ6207SP			长电	备选
4	Resistor	0201	100R/5%	2	R1,R2	国巨	主选
			330R/5%			国巨	备选
5	Resistor	0201	1K/5%	2	R3,R4	国巨	
6	NTC	0402	NCP15XH103F03RC	1	RT1	村田	主选
			NTCG103JF103HT			TDK	备选
7	Resistor	0201	200KΩ/1%	1	R5	国巨	
8	Capacitor	0201	0.1UF/16V/X5R	10	C1-C10	国巨	
9	Resistor	0612	3mR/1% /1W RLN06FTCR003	1	RS1	大毅	主选
			3mR/1% /1W MHTC1206M1W0R003 F4			华德	备选
10	ESD 管	DFN1006-2	PESDR0521P1L	1	D1	智晶	
11	L 型镍片	/	8*3*3*0.1 mm 底部镀铜	2	B+,B-	/	
12	PCB	/	GF-0815 R0A	1	/	/	
13	FPC	/	GF-0815 FPC R0A	1	/	/	
14	连接器	/	CPB9506-0118E	1	J1	SMK	

10. Schematic Circuit Diagram 电路原理图



11. PCB Layout PCB 布线图

顶层焊盘



顶层走线



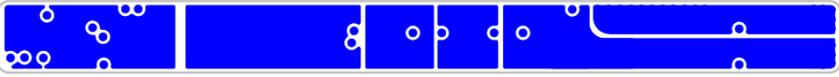
中间 1 层



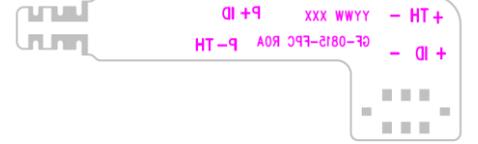
中间 2 层



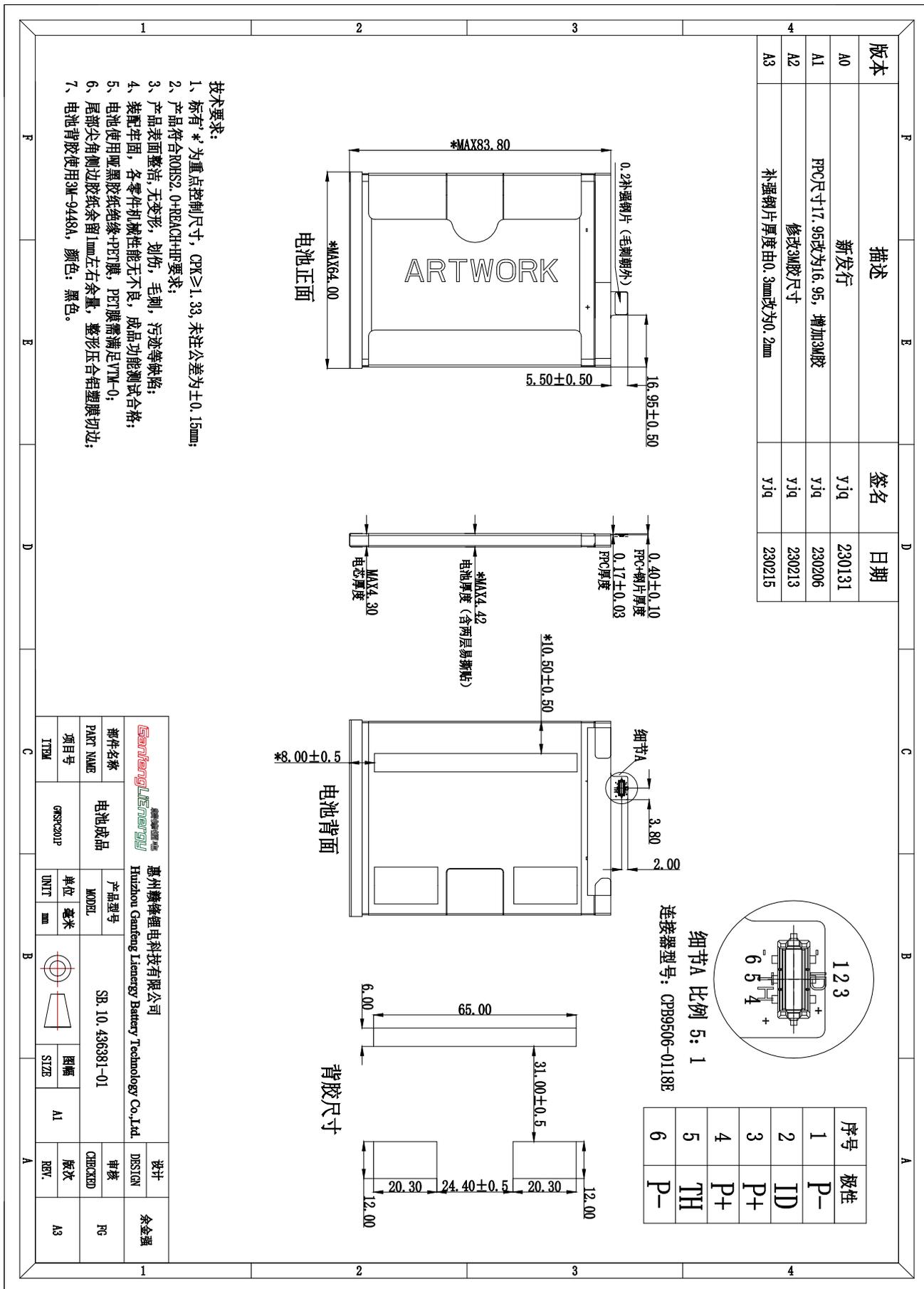
底层走线



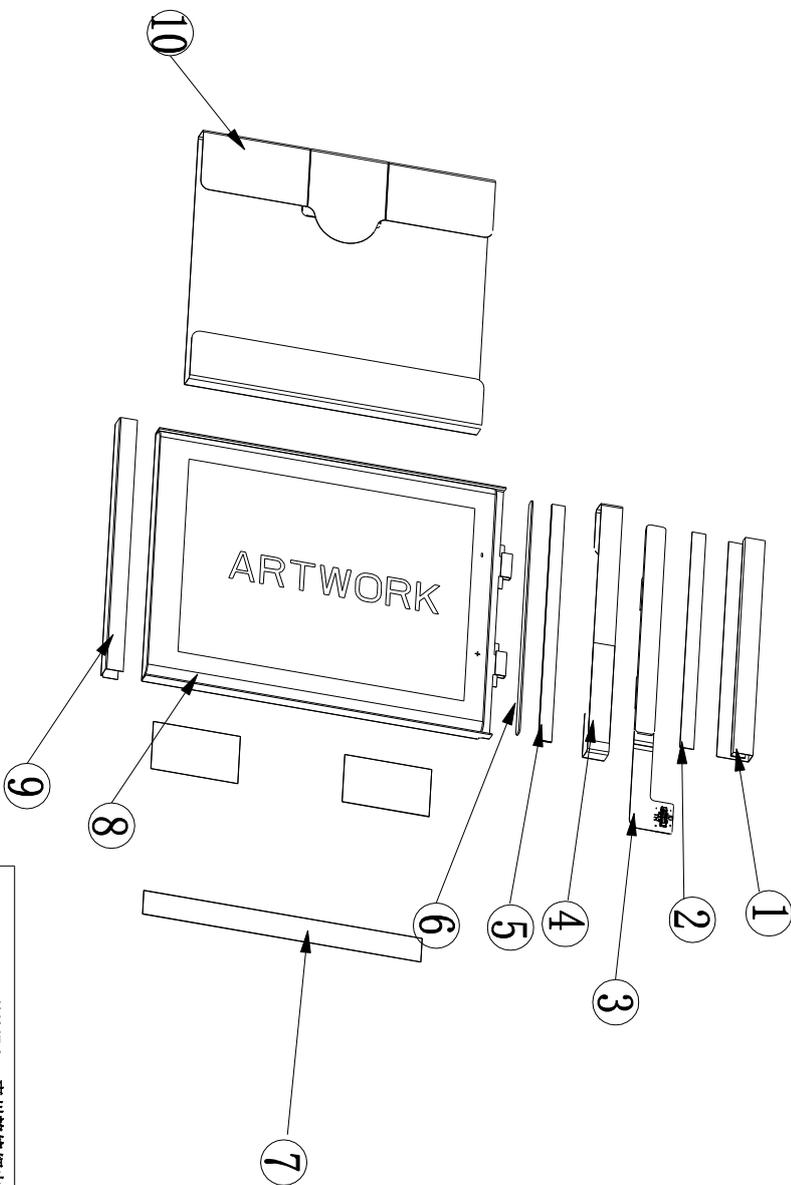
底层焊盘



12. Battery Outline Drawing 电池外形尺寸图



版本	描述	签名	日期
A0	新发行	yjq	230131
A1	增加3M胶	yjq	230206



DIV	DEG	A	B	C	ANGLE
0-5	±0.02	±0.05	±0.10	±0.10	0°-30°±0.1°
6-10	±0.05	±0.10	±0.15	±0.15	31°-60°±0.3°
11-50	±0.10	±0.15	±0.20	±0.20	61°-90°±0.5°
51-100	±0.15	±0.20	±0.25	±0.25	
	±0.15%	±0.20%	±0.25%	±0.25%	

		惠州赣锋锂电科技有限公司 Huizhou Ganfeng Lienergy Technology Co., Ltd.		设计 DESIGN 余金强	
零件名称 PART NAME	装配图	产品型号 MODEL	单位 UNIT	图例 SIZE	审核 CHECKED 版本 REV.
项目号 ITEM	GMS201P	SR. 10. 436381-01	mm	AI	FG

序号	名称	数量 (PCS)
1	包板胶纸	1
2	双面胶	1
3	PCM	1
4	电池头部绝缘胶纸	1
5	电芯顶部绝缘胶纸	1
6	硅胶垫	1
7	3M胶	1
8	电芯	1
9	尾部绝缘胶纸	1
10	易撕贴	1

13. Printed content 印刷内容



编码规则:

GF:代表赣锋, 固定码。

GWS:固定码。

CLP446484P:项目代号, 固定不变。

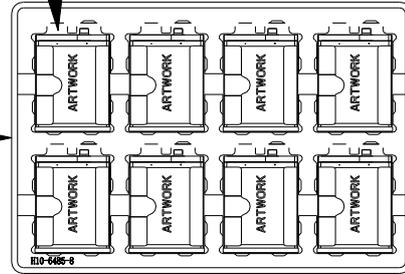
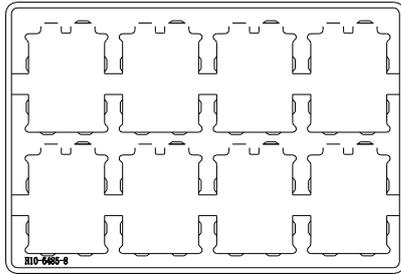
230616: 生产年月日, 表示2023年06月16号, 按实际日期变更。

000001: 流水码, 000001-999999

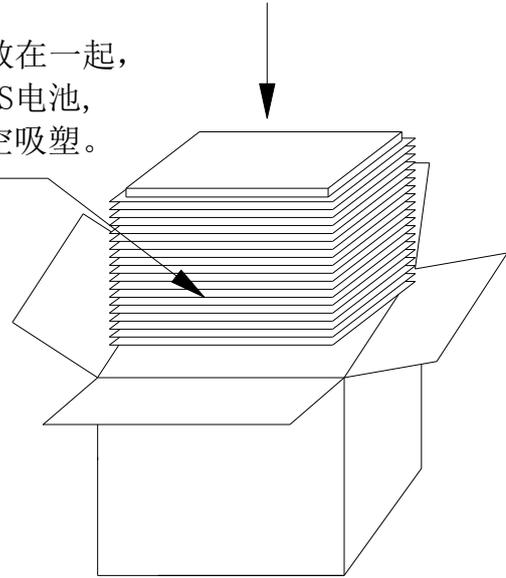
生产日期随实际变更, 不体现在二维码内。

14. Package 包装图

将电芯/电池放置吸塑盒中
每个吸塑盒放置8个成品电池



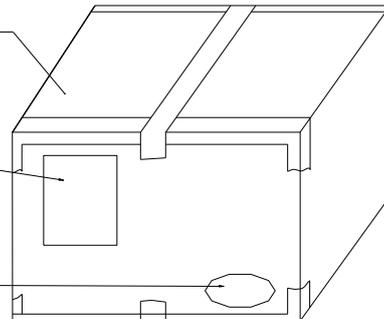
将装好电池的吸塑叠放在一起，
每箱装19层，共152PCS电池，
最后在上方放置一层空吸塑。



纸箱按要求装满
成品电池，再用
胶带进行封装。

箱唛

环保标签



Product Identification Card
成品标识卡

客户名称: CSR	日期: Date
GF产品编码: GF Product No.	
产品编码: Product No.	
GF订单编号: GF Order No.	
订单编号: order No.	
箱号: Box No.	数量: QTY
净重: N.W. Kg	总重: GR.WT. Kg
操作员: Operator	检验员: QC
备注: Remarks	

惠州赣锋锂电科技有限公司
Huizhou Ganfeng Lienergy Battery Technology Co., Ltd.

15. Battery Precautions and Safety Instructions 电池组使用注意事项及安全说明

(1) Please be sure to take to comply with the specifications and the following precautions to use with batteries, did not follow the specifications for the operation caused any accidents Huizhou Ganfeng Lienergy Battery Technology Co., Ltd. will not accept any responsibility.

(2) Guarantee to keep the battery in good repair in 12 months from the shipment.

(3) Please use 0.5C current to charge up 60% capacity after the battery placed 3 months.

(4) Before use the battery, carefully read the instruction manual and battery labels on the surface.

(5) Need to use the original battery charger, and should be placed in a dry ventilated place.

(6) Such as long-term when not in use, the battery charger to charge state half full, remove the battery from the device and separated, to avoid metal contact with the battery, causing short-circuit or damage to the phenomenon.

(7) In use or during storage, battery found there has been high fever, leakage, odor, distortion and other anomalies, please stop using it immediately and stay away from the battery.

(8) Do not short-circuit the battery positive and negative, and careful not to allow the battery to moisture, to avoid danger.

(9) In the process of using, keep away from heat, High pressure place, and do not beat, hit the battery.

(10) Battery end of life should be immediately removed from the equipment, Please properly handle security of spent batteries, do not put into fire or water.

(1) 请您必需遵守本规格书和以下使用注意事项使用电池，对于没有按照规格书进行操作所造成的任何意外事故，惠州赣锋锂电科技有限公司将不承担任何责任。

(2) 从出厂代码日起 12 个月内保修。

(3) 电池每放置三个月,请预先以 0.5C 充电 1 次,即让电池具备 60% 以上的电量。

(4) 使用电池前, 请仔细阅读使用说明书和电池表面标识。

(5) 电池需使用原装充电器充电, 并应放置在干燥通风场所。

(6) 如长期不使用时, 请将电池充电至半满电荷状态, 把电池从设备中拆除并分开放置, 避免金属接触电池, 造成短路或损坏现象。

(7) 在使用或储存期间, 如发现电池有出现高温发热、漏液、散发异味、变形及其它异常现象时, 请立即停止使用并远离电池。

(8) 切勿将电池正负极短路, 并注意不可让电池受潮, 以免发生危险。

(9) 使用过程中, 应远离热源、高压场所, 并勿摔打、撞击电池。

(10) 电池寿命终止应立刻从设备中取出, 废弃电池请安全妥善处理, 切勿投入火中或水中。

16. Warning, Notice and Caution 警告、注意及危险



(1) Please use special testing equipment for Li-ion battery when doing charging and discharging tests. Common CC/CV power supply etc. are forbidden, in order to avoid disabling battery functions or potential dangerous caused by over-charge and over discharge.

(2) The charger shall be equipped a full charge detection. The charger shall detect the full-charged state by a timer, current detection or open circuit voltage detection. When the charger detects the full-charge, the charger shall stop charging. Do not apply the continuous charging (trickle charging) method.

(3) Do not put the battery into a fire, or heat the battery. Keep the battery away from heat and fire. Do not store the battery in high temperature environment.

(4) Do not connect the battery reversed in positive (+) and negative (-) terminals in the charger or equipment.

(5) Do not let the battery terminals (+and-) contact a wire or any metal (like a metal necklace or a hairpin) with which it is carried or stored together. Otherwise it may cause short-circuit.

(6) Do not drive a nail in, hit with a hammer, or stamp on the battery, do not strike the battery in other ways.

(7) Do not disassemble or alter the outside structure of the batteries. Welding is not allowed to be conducted on the battery.

(8) Do not directly solder the battery terminals.

(9) Do not attempt to disassemble or modify deform the battery in any way.

(10) Do not submerge the battery in water, do not wet the battery when store the battery.

(11) Avoid to charge battery near a fire source or in direct sunlight.

(12) Don't directly contact with the leaking battery.

(1) 对电池进行充放电测试时，请使用锂离子电池专用测试设备，严禁使用普通恒流恒压源等不能限流设备对电池进行充放电，以避免电池被过充过放而引起电池功能失效或发生危险；

(2) 充电器需要有监测电池充满电的装置。充电器使用通过定时，电流检测或开路电压检测电池的满电状态，当充电器检测到电池充满电时，应停止充电。电池不能用持续充电（涓流充电）方法充电；

(3) 禁止将电池扔进火里，或加热电池。远离热源和火源。禁止在高温下储存电池；

(4) 电池连接到充电器或设备时禁止将正负极反接；

(5) 禁止将电池正负极接触到与之一起携带或储存的导线或任何金属（如金属项链和发卡），可能引起短路；

(6) 禁止用钉穿刺、用锤打击或踩踏电池，禁止以其他方式敲打电池；

(7) 禁止拆卸或改变电池外部结构。禁止在电池上直接焊接；

(8) 禁止直接焊接电池端子！

(9) 禁止以任何方式分解或使电池变形；

(10) 禁止将电池放入水中，储存时禁止弄湿电池；

(11) 避免在火源附近或阳光直射下充电；

(12) 不要直接触及漏液电池。



NOTICE 注意

- (1) Battery should be charged and discharged with proper charger, in compliance with correct operation contents.
- (2) Children should not be allowed to play with them. Do not eat the battery.
- (3) Do not use the battery with other maker's batteries, different types and/or models of batteries such as dry batteries, nickel-metal hydride batteries, or nickel-cadmium batteries, or new and old lithium batteries together.
- (4) Do not charge the battery continuously for more than 12 hours. Do not leave the battery in the charger for a long time (more than 24 hours)
- (5) Do not use the battery if it emits an odor and/or heat, changes color and/or shape, leaks electrolyte, or cause any other abnormality. If the battery is in use or being recharged, remove it from the device or charger immediately and discontinue use. Do not leave the battery in a charger or equipment.
- (6) Do not discharge the battery continuously when it is not charged.
- (7) Do not use or store the battery where is exposed to extremely hot, such as under window of a car in direct sunlight in a hot day. Otherwise, the battery may be overheated. This can also reduce battery performance and/or shorten service life.
- (8) When the batteries are not be used for a long time, please store them safely so that they will stay in a half-charged state. Please wrap the batteries with non-conductive materials in order that metallic materials will not contact the batteries directly, which may result in damage to the batteries. Keep the batteries in a cool and dry place.

- (1) 电池须遵循正确的操作规范，用专用充电器充放电；
- (2) 避免儿童玩弄电池；禁止食用电池；
- (3) 禁止与其他厂商的电池一起使用，禁止与不同种类或型号的电池如干电池、镍氢电池或镍镉电池一起使用，禁止新旧锂电池一起使用；
- (4) 禁止连续充电超过 12 小时，不要把电池长时间（超过 24h）留置于充电器；
- (5) 如果电池发出异味和/或发热，改变颜色和/或变形，漏液，或有其他任意异常时不得使用；如果电池正在使用或充电，应立即从用电器中或充电器上取出并停止使用；禁止将电池留在充电器或设备上；
- (6) 电池未充电时禁止持续放电；
- (7) 不要使用处于极热环境中的电池，如阳光直射或热天的车内。否则，电池会过热，可能着火（点燃），这样就会影响电池的性能、缩短电池的使用寿命；
- (8) 长期不用时，请将电池处于适宜储存的半荷电状态储存。请用不导电材料包裹电池，以避免金属直接接触电池，造成电池损坏，将电池保存阴凉干燥处。



CAUTION 危险

- (1) Follow Manufacturer's Instruction.
- (2) In case young children use the battery, instruct them on the contents of the instructions and ensure the battery is correctly used by them at all times.
- (3) The battery was inspected carefully by QA before shipment to confirm with the specifications. However, in the case of any abnormality such as bad smell or heat after purchase, please bring it and communicate with us.
- (4) If the battery leaks and electrolyte gets in your eyes, do not rub them. Instead, rinse them with clean running water and immediately seek medical attention. If left as is, electrolyte can cause eye injury.
- (5) When the battery is abandoned, cannot be used as a common urban garbage disposal. Correct handling of the method, please refer to the local regulations of the processing of waste electronic products.

- (1) 按厂家提供的方法使用；
- (2) 假如儿童使用电池，应指导他们按说明书使用，确保他们一直正确使用电池；
- (3) 电池出厂前都经过 QA 仔细检查。但是，万一购买后发生异味、发热等异常，请随时与我们沟通；
- (4) 如果电池漏液后电解液进入眼睛，不要擦拭，应用水冲洗，立即寻求医疗救助。如不及时处理，眼睛将会受到伤害；
- (5) 当电池废弃后，不能作为普通城市垃圾处理。正确的处理方法请查阅当地有关废旧电子产品处理的规定。