



Rechargeable Li-ion Battery Specification Approval

DOC NO.: PS-0725
REV. : A/1
SHEET : 1 OF 18

对于任何细节和问题, 请告诉我们

For any details and enquiry, please contact VDL; Tel:0755-29961201,Fax:0755-29961203

VDL SPECIFICATION APPROVAL SHEET

VDL 产品承认书

Customer Name 客户代码: 1277

Customer Product Model 客户产品型号: FMG2

Battery Model 产品型号: FMG2

Product Capacity 产品容量: 1100mAh, 8.5Wh

Product Code 产品编码: 100100932144

Assembly Plant Code 组装厂编码: /

Terminal Code 终端编码: /

Prepared by 制作	Checked by 审核	Approved by 批准
郭超亮	刘伟	刘志明

Approved by customer 客户承认 (Stamp) (盖章)	Tested by 测试	Checked by 审核	Approved by 批准

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VDL® 业界领先的聚合物锂电池制造商



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Revision History
版本履历表

Revision 版本	Description 内容描述	Modify 修改人	Approval 审批人	Date 日期
A/0	First Issue 新版发行	向意	李海军	2023-10-30

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1. Scope 概述

The specification shall be applied to Lithium-ion Polymer rechargeable battery pack manufactured by **VDL Electronics Co., LTD.** It is the basis for product design, production and inspection. Its purpose is to let the customer know the quality standard and the instruction.

本产品承认书描述 VDL 电子有限公司设计制造的可充电聚合物锂电池，它是产品设计、生产和检验的依据。其作用是让客户了解产品的质量标准和正确使用方法。

Reference standard 参考标准:

GB/T 31241-2022 中华人民共和国国家标准《便携式电子产品用锂离子电池和电池组安全规范》

IEC/EN61960 欧盟锂电池标准

UL1642 美国锂电池安全标准

2.Product basic information 产品基本信息:

No.	Items 项 目	Parameter 参 数
1	Battery model 电池型号	FMG2
2	Design scheme 保护电路设计方案	2S1P
3	Rated capacity 额定容量	1100mAh (0.2C Standard discharge 0.2C 标准放电)
4	Nominal Energy 额定能量	8.5Wh
5	Nominal voltage 标称电压	7.7V
6	Shipment voltage 出货电压	7.9-8.2V
7	Charge ending voltage 充电限制电压	8.8V
8	Discharge ending voltage 放电终止电压	5.0V
9	Over current protection 过电流保护	Yes 有
10	Short circuit protection 短路保护功能	Yes 有
11	AC Impedance 内阻	$\leq 120\text{m}\Omega$
12	Battery Weight 电池组重量	About 35.7g
13	Max discharge current 最大放电电流	3A (连续放电模式 For continuous discharge mode) 瞬间电流 5.1A(Instantaneous current 5.1A)
14	Max charge current 最大充电电流	1.5C (连续充电模式 For continuous charge mode)
15	Cycle life 循环寿命	300 次充放电后，电池能恢复 80%的初始容量 After 300cycles charge/discharge, battery can recover 80% of its initial capacity



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3. Battery protection characteristics 电池保护特性(Ta=25°C)

项目 item	最小值 Min	典型值 Type value	最大值 Max	单位 Unit	检测度
过充保护电压/Over charge protection voltage	4.455	4.475	4.495	V	※
过充保护恢复电压/Over charge release voltage	-	-	-	V	◎
过充保护延迟时间/Over charge protection delay time	700	1000	1300	ms	◎
过放保护电压/Over discharge protection voltage	2.765	2.800	2.835	V	※
过放保护恢复电压/Over discharge release voltage	-	-	-	V	◎
过放保护延迟时间/Over discharge protection delay time	14	20	26	ms	◎
充电过流保护电流/Over charge current protection current	6.3	7.5	8.6	A	○
充电过流保护延迟时间/Over current protection delay time	11	16	21	ms	○
放电过流保护电流/Over discharge current protection current	8.5	10	11.5	A	※
放电过流保护延迟时间/Over current protection delay time	8	12	16	ms	◎
短路保护延迟时间/Short protection delay time	180	250	425	us	◎
负极内阻/Impedance	/	/	40	mΩ	○
正常状态下静态电流/Current consumption (Operation)	/	120	200	uA	※
休眠时消耗电流/Current consumption during sleep	/	55	75.0	uA	○
NTC 电阻 B25/85=3435K/NTC Resistor(环境温度 25°C)	9.9	10.0	10.1	KΩ	○
推荐存储条件/Recommendatory storage condition	Temperature range:-55 ~ +125°C Humidity:35% ~ 75%RH				
最低工作电压/The minimum operating voltage	2.80V			○	
标称容量 / Nominal Capacity	1650			mAh	※
标称电压 / Nominal Voltage	3850			mV	※
串数 / cell	1			/	○
温度精度 / Temperature Accuracy	Ta-5	Ta ^①	Ta+5	°C	※
电压精度 / Cell Voltage Accuracy	3980	4000 ^②	4020	mV	※
电流精度 / Current Accuracy	980	1000	1020	mA	※
化学 ID / Chem ID	2546			/	※

备注:

① Ta: 室温;

② 4000 是标称单节电芯, 可根据单节电芯电压±20mV 检测

4. Condition adapting characteristics 环境适应性 (n=1)

No.	Items 项目	Test Method 测试方法	Criteria 标准
1	High/low Temperature 高/低温性能	After the cell fully charged at $23^{\circ}\text{C}\pm 2^{\circ}\text{C}$, measure the discharging capacity with discharging current 6.5W till 3.0 (V) cut off voltage at different temperature. (as compared with initial capacity) 在 $23^{\circ}\text{C}\pm 2^{\circ}\text{C}$ 条件下满充电后, 测量电池在不同温度下用 6.5W 电流放电至 3.0 (V) 所放出的容量 (与初始容量作为比较)。	在 -20°C 时 $\geq 50\%$ At -20°C : $\geq 50\%$ 在 -10°C 时 $\geq 70\%$ At -10°C : $\geq 70\%$ 在 0°C 时 $\geq 90\%$ At 0°C : $\geq 90\%$ 在 25°C 时 $\geq 100\%$ At 25°C : $\geq 100\%$ 在 70°C 时 $\geq 95\%$ At 70°C : $\geq 95\%$
2	Invariableness humid and hot 恒定湿热	After putting the cell in the invariableness humid and hot box of $40^{\circ}\text{C}\pm 2^{\circ}\text{C}$ and relative humidity of 90 ~ 95% for 48 hours. Discharge the cell to 3.0*n(V) cut-off voltage at 0.2C current. 将电池放入 $40^{\circ}\text{C}\pm 2^{\circ}\text{C}$ 及相对湿度为 90 ~ 95% 的恒温恒湿箱中 48 小时后, 再以 0.2C 电流放电至 3.0*n(V)。	No leakage, no fire, no explosion. The discharging time $\geq 3\text{h}$. 无泄漏, 无起火, 无爆炸。 放电时间 $\geq 3\text{h}$ 。
3	Vibration 振动	The fully charged cell is vibrated from 90 to 100 minutes at three mutually perpendicular planes with excursion of 0.8mm, and change the frequency from 10 to 55 HZ with 1Hz/min speed. 满充电后的电池在三个相互垂直的方向按振幅 0.8mm 的谐振形式进行振动, 频率在 10-55HZ 以 1Hz/min 的速率变化, 往复振动 90 至 100min.	No leakage, no fire, no explosion. 电池无漏液, 无冒烟, 无起火, 无爆炸
4	Free fall 自由跌落	The cell free falls from a height of 1m into the cement floor from X,Y,Z front and opposite direction of each direction. Then discharge the cell to 3.0*n(V) cut-off voltage with 1.0C current. 电池将从 1 米高处自由跌落到水泥地板上, 从 X、Y、Z 正反方向每个方向自由跌落一次, 再以 1.0C 放电至 3.0 (V)	No leakage, no fire, no explosion. 电池无漏液, 无冒烟, 无起火, 无爆炸

5. Safety performance 安全性能 (n=1)

No.	Items 项目	Test Method 测试方法	Criteria 标准
1	Forced discharge 强制放电	Discharge the cell to the cut-off voltage with 0.2C current and then reverse charge the cell for more than 90 mins with 1C current. 电池先以 0.2C 放电至终止电压, 再以 1C 电流, 对电池进行反向充电, 90min 以上	No fire, no explosion 无起火, 无爆炸
2	Overcharge 过充电	After discharged with 0.2C to the cut-off voltage, charge the cell with 3.0C/4.6V for 7.0hrs. 0.2C 放电至截止电压后, 电池用 3C /4.6V 恒流恒压充电 7.0h	No explosion, no fire 无起火、无爆炸
3	Low pressure 低气压	Put the fully charged cell in a vacuum chamber at ambient temperature 20~25°C for 6 hrs. The vacuum environment pressure is set to be less than 11.6kPa, simulating an altitude of 15240m. 电池放在一个模拟真空的空间放置 6 小时, 环境温度 为 20~25°C, 真空环境压力≤11.6kpa, 模拟 15240m 高空低压环境	No leakage, no fire, no explosion 无泄漏, 不起火, 不爆炸
4	Short test 短路测试	Short circuit the fully charged cell by connecting the positive and negative terminals with resistance load 80 ±20 mΩ at room temperature 20~25°C. The cell remains on test for 24 hrs or until the surface temperature declines by 20 % of the maximum temperature rise, whichever is the sooner. 在室温 20~25°C下, 把充满电电池的正负极用 80±20 mΩ 的负载连接起来, 使电池外部短路。结束条件: 测试时间 24 小时或者表面温度下降到最高温度的 20%。	No fire, no explosion. The temperature of the cell surface not exceeds 150°C. 无起火, 无爆炸 电池表面温度不超过 150°C。
6	Crush test 挤压测试	A fully charged cell is to be crushed between two flat surfaces. The force for the crushing is to be applied by a hydraulic ram or similar force mechanism. The flat surfaces are to be brought in contact with the cell and the crushing is to be continued until an applied force of 13 ±1kN is reached. Once the maximum force has been obtained it is to be released. 满充电池, 放置在两块平面金属板间, 持续施压 13±1kN 的压力, 直到液压油缸施加的压力达到 13KN (17.2Mpa) 时 停止。	No fire, no explosion 无起火, 无爆炸

6. Testing requirements 测试要求**6.1 Battery test environment 电池试验环境** (无特别注明时, 试验环境应符合此项要求)Temperature 温度: $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Relative humidity 相对湿度: 45 ~ 85% RH

Atmospheric pressure 大气压力: 86 ~ 106 kPa

6.2 Measuring instrumentation requirements 测量仪表要求

Voltage instrumentation requirements: Measuring the voltage meter accuracy no less than 0.5 magnitude

电压仪表要求: 测量电压的仪表的精确度不低于 0.5 级

Current instrumentation requirements: Measuring the current meter accuracy no less than 0.5 magnitude

电流仪表要求: 测量电流的仪表精确度不低于 0.5 级

Time instrumentation requirements: Measuring the time meter accuracy no less than 0.1%

时间仪表要求: 测量时间的仪表精确度不低于 0.1%

Temperature instrumentation requirements: Measuring the temperature meter accuracy no less than 0.5°C 温度仪表要求: 测量温度的仪表准确度不低于 0.5°C

Impedance instrumentation requirements: Measuring impedance should by sinusoidal alternating (1 KHZ) test

内阻仪表要求: 测量内阻应由正弦交变(1KHZ)进行测试

7. Operation temperature and humidity range 运行温湿度范围**7.1 Charging temperature and the Current requirements 充电环境温度及电流要求:**

Temperature 温度	Max charge current 允许最大充电电流	Maximum relative humidity 最大相对湿度
$0^{\circ}\text{C} \leq T \leq 10^{\circ}\text{C}$	0.3C to 8.8V	90%
$10^{\circ}\text{C} < T \leq 45^{\circ}\text{C}$	1.5C to 8.8V	90%
$45^{\circ}\text{C} < T \leq 60^{\circ}\text{C}$	1.5C to 8.2V	90%

7.2 Discharge temperature 放电环境温度: $-20^{\circ}\text{C} \sim +70^{\circ}\text{C}$, Maximum relative humidity: 90% $-20^{\circ}\text{C} \sim +70^{\circ}\text{C}$, 最大相对湿度: 90%**8. Storage temperature and humidity range (At 50% SOC) 存储温湿度范围 (在 50% SOC 条件下)****8.1 Environmental conditions 存放条件:**

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 $23 \pm 2^{\circ}\text{C}$ and humidity of $65 \pm 20\%$ RH.

The lithium iron cell impedance would increase in whole storage process, while the capacity would decrease, cell would be charged in 9.1.1 and discharged in 9.1.2

除非另有规定, 电池应在装运后一个月进行测试, 且在测试前一段时间内不得循环(充放电)。所有试验均在 23

±2°C、65±20% RH 湿度下进行。锂电池在整个存储过程中阻抗会增大，容量会减小，电池在 9.1.1 条件下进行充电，在 9.1.2 条件下进行放电。

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
Storage Charge State	As received	100%	As received	100%	As received	100%
Recovered Capacity	90%	80%	95%	90%	85%	80%
Recovered Impedance @100% Charge State	150%	150%	120%	150%	150%	160%

9. Electrical Characteristics 电气特性

9.1 Battery standard charge/discharge 电池组标准充/放电

9.1.1 standard charge 标准充电

At 25°C±3°C conditions, CC 0.2C/CV 8.8V, when charging current drops to 0.05C charging is terminated.

在25°C±3°C条件下，以0.2C恒电流，8.8V恒电压充电至电流降到0.05C截止。

9.1.2 Standard Discharge 标准放电

Standard discharge current 0.2C for continuous discharge, when the voltage drops to discharge cut-off voltage 6.0V discharge is terminated, shall be full discharged.

以标准放电电流 0.2C 进行持续放电，当电压降至放电截止电压 6.0V 时放电被终止，即为放空。

9.2 Maximum charge current 最大充电电流

At 25°C±3°C conditions, CC 1.5C/CV 8.8V, when charging current drops to 0.05C charging is terminated, The charging time limited 2h.

在25°C±3°C条件下，以1.5C恒电流，8.8V恒压，充电至电流降到0.05C截止，限时2小时。

9.3 Maximum discharge current 最大放电电流

At 23°C±2°C condition, discharge the cell with 3A.

在23°C±2°C条件下，以3A对电池进行放电。

9.4 Initial impedance 初始内阻

At 25°C±3°C ambient temperature, after standard charged battery pack, AC impedance tester(1KHz) measuring the initial impedance should be ≤120mΩ.

在 25°C±3°C 环境温度下，经过标准充电的电池，使用交流阻抗测试仪（1KHz）测量初始内阻应 ≤120mΩ.

9.5 Initial capacity 初始容量

The initial capacity is for standard charge to full, in 5 hour, the capacity measured at 25°C±3°C conditions with discharge current of 0.2C till 6.0V cut-off voltage.

The initial capacity ≥1100mAh.

电池初始容量为电池以标准充电方式满充，5小时内，在25°C±3°C条件下以0.2C电流放电至6.0V截止所放出的容量，初始容量 ≥1100mAh.

9.6 Retention Capability 荷电保持能力

After full charging, storing the battery 28 days with $20\pm 5^{\circ}\text{C}$ condition, and then discharge with discharge current of 0.2C till 6.0V cut-off voltage, discharge time should be $\geq 255\text{min}$

电池满充电后, 在 $20\pm 5^{\circ}\text{C}$ 的环境条件下存放 28 天, 然后以 0.2C 电流连续放电至 6.0V 终止电压, 放电时间 $\geq 255\text{min}$

9.7 Cycle life 循环寿命

Battery cycle life is tested at $25^{\circ}\text{C}\pm 3^{\circ}\text{C}$. For each cycle test, battery is charged using 5A constant current until battery voltage meet 8.8V. Then, battery is charged by constant voltage until battery charging current drop to 0.05C. After that, battery is discharged by 2.0C constant current until battery voltage drop to 6V. Repeat until each 50th cycle.

At each 50 cycle, battery capacity will be tested. The test condition is that the battery is charged using 0.5C constant current until the battery voltage meet 8.8V. Then, battery is charged by constant voltage until the charging current drop to 0.02C. After that, battery is discharged by 0.2C constant current until battery voltage drop to 6V.

If the discharge time is more than or equal to 4hours (80% of initial battery capacity), battery need to repeat above 50cycles charge/discharge test. If not, cycle life test is completed.

Cycle life should be 300 cycles or above. the thickness after swelling will be less than 108%.

电池在温度 $25^{\circ}\text{C}\pm 3^{\circ}\text{C}$ 条件下循环测试, 以 5A 恒流充电到电压 8.8V, 然后恒压充电到截止电流 0.05C。再以 2.0C 恒流放电到 6.0V, 为 1 个循环周期。这样重复 50 次。

每 50 次做一次容量检测。以 0.5C 恒流充电到 8.8V, 然后恒压充电到截止电流 0.02C。再以 0.2C 恒流放电到 6.0V。

如果放电时间大于等于 4 小时 (80%初始容量), 电池必须再重复 50 次充放电测试。否则, 循环寿命测试结束。循环寿命应该大于等于 300 次, 膨胀后厚度 $\leq 108\%$ 。。

9.8 Shipments battery capacity 电池出货容量

SShipments battery capacity is 50~ 70%.

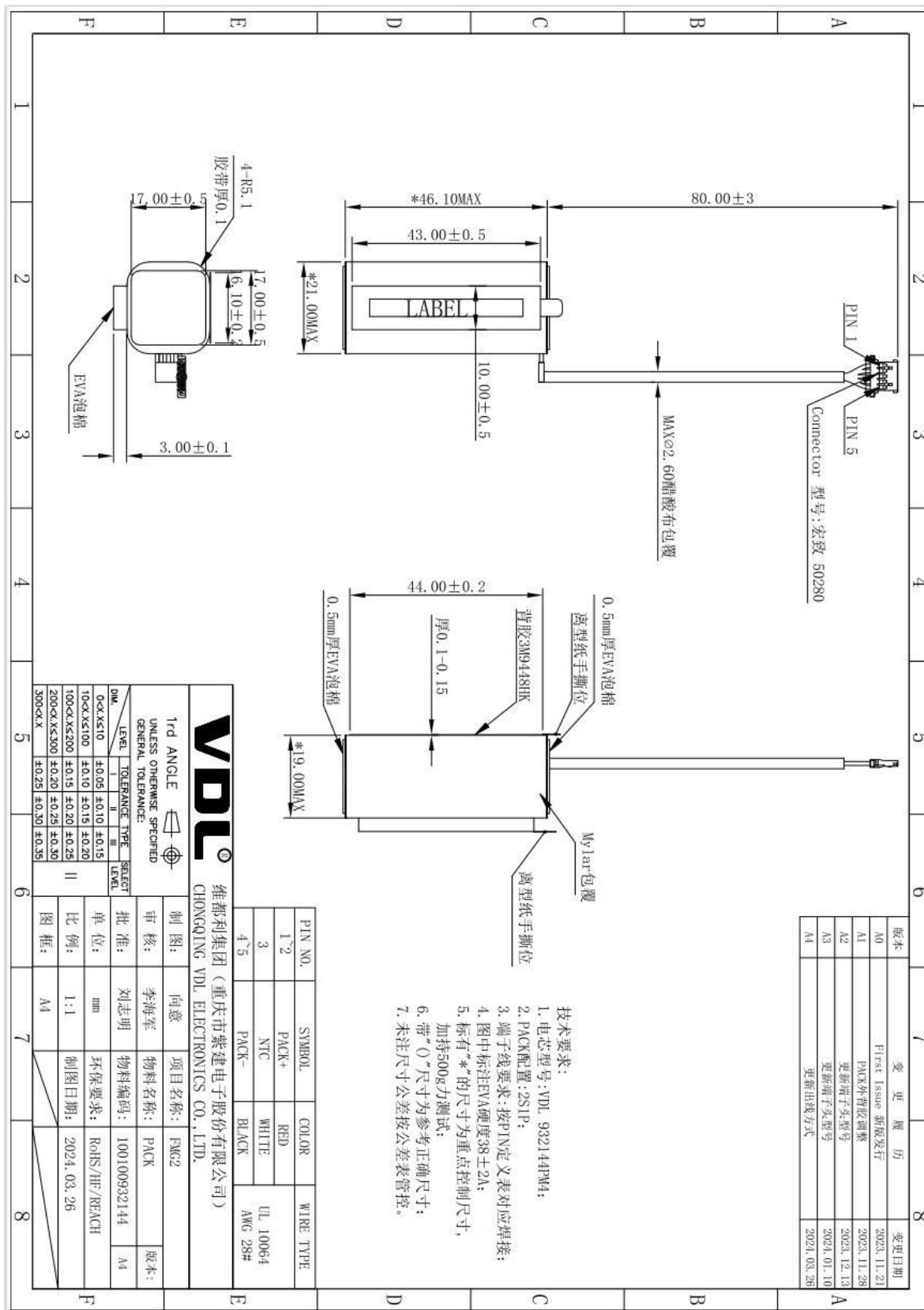
电池的出货容量为 50 ~ 70%.

9.9 Agency approvals 承认机构

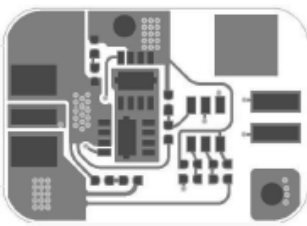
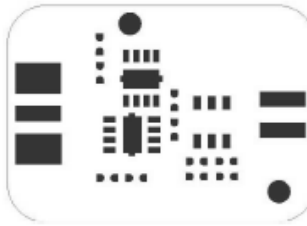
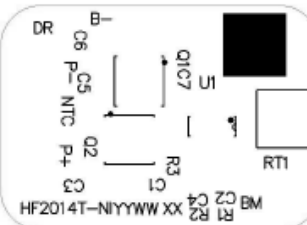
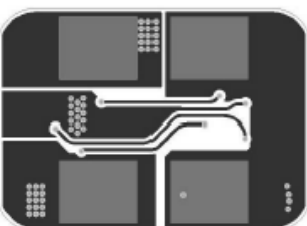
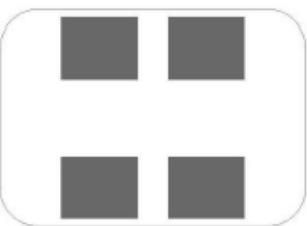
VDL battery safety performance is designed according to UL1642 standard and CE Directive requirement, the product' s safety performance is conforming to UL1642 standard and CE Directive requirement.

VDL 电池的安全性能是根据 UL1642 标准和 CE 指令要求制定.产品的安全特性与 UL1642 标准和 CE 指令要的要求是一致的.

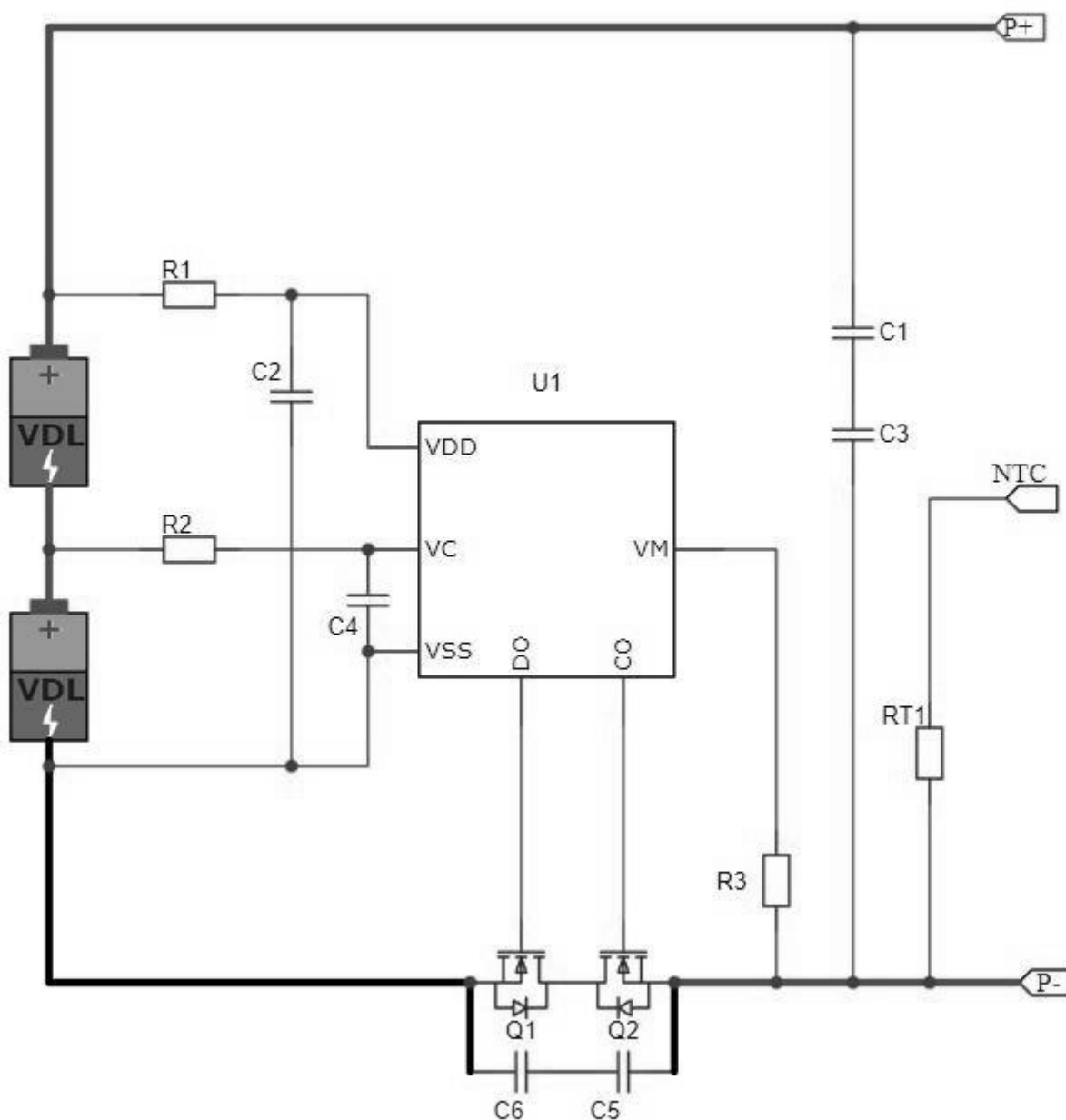
10. Battery structure diagram 电池架构图(Sketch map 示意图)



11. PCB Layout PCB 布线图

Top Layer	
Top Solder	
Top Overlay	
Bottom Layer	
Bottom Solder	
Bottom Overlay	

12. Schematic circuit diagram 电路原理图



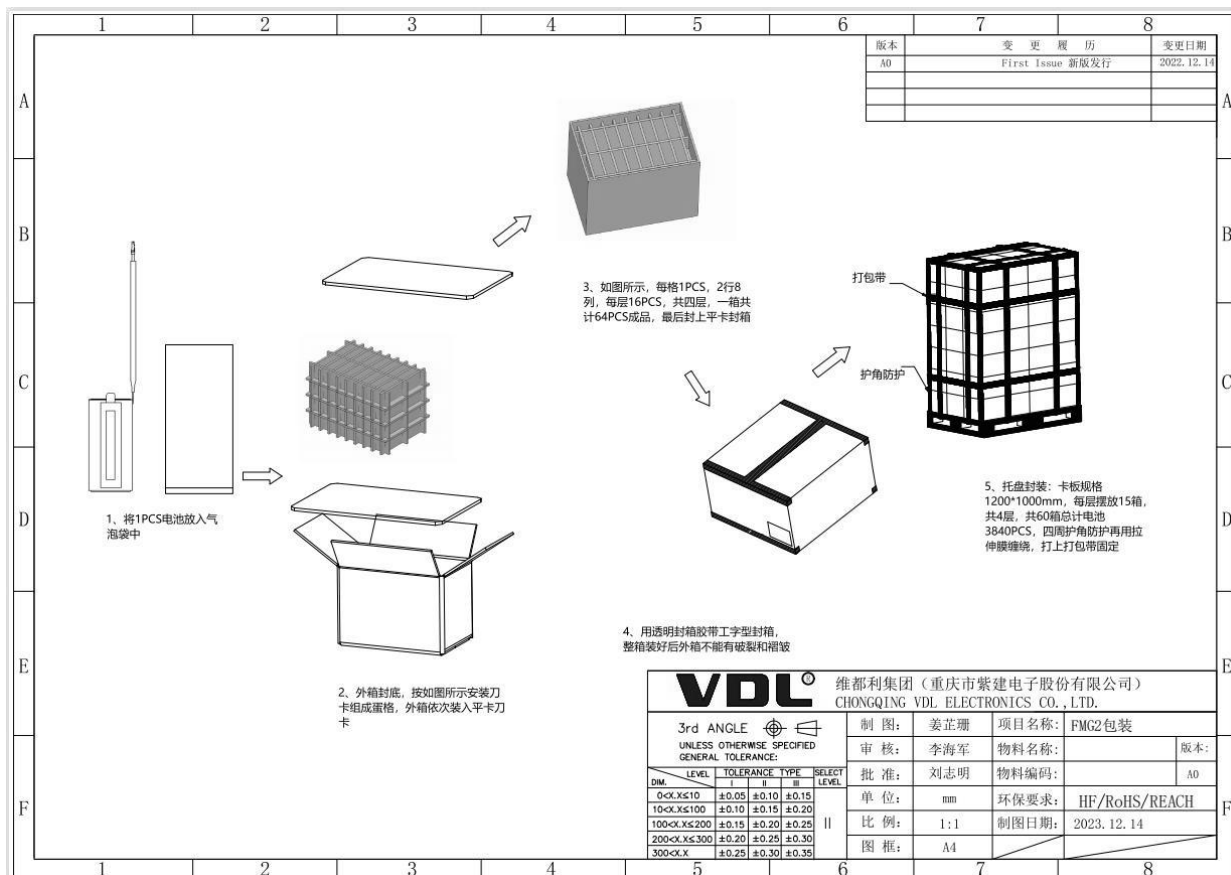
13. BOM (Bill of materials) 电池物料清单

Material Name (零件名称)	Specification(规格型号)	Position(零件位置)	Qty(用量)
IC	HY2120DE-B1K	U1	1
MOS	CJAB35N03S, PDFN3.3x3.3-8L	Q1.Q2	2
贴片电阻	330Ω±5%	R1, R2	2
贴片电阻	2KΩ±5%	R3	1
贴片电容	0.1uF±10%, 16V	C1~C6	6
镍片	TBD	B1+,B1-, B2+,B2-	4
NTC	10K@25°C±1%, B(25/50)=3380±1%	RT1	1
PCB	FR4, 2 层	PCB	1

Note: The battery of materials should be consistent with the requirements of the RoHS&REACH&HF&Sb Free.

注：电池组所使用的材料应符合 RoHS&REACH&无卤&无镉的要求.

14. Packaging method 包装方式



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

Please be sure to comply with the specifications and the following precautions to use with batteries. For any accident caused by operation not following the specifications, VDL Electronics Co., Ltd will not take any responsibility

请您务必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, VDL 电子有限公司将不承担任何责任。

- ◆ Warranty period is 12 months after shipment date.
从出厂代码日起 12 个月内保修。
- ◆ When the battery is stored for 3 months, it should be charged with 0.5C current to 50% SOC.
电池每放置三个月,请预先以 0.5C 充电 1 次,即让电池具备 50%以上的电量。
- ◆ Before using the battery, carefully read the instruction manual and battery labels on the surface.
使用电池前, 请仔细阅读使用说明书和电池表面标识。
- ◆ Please use the original battery charger. The battery should be placed in a dry and ventilated place.
电池需使用原装充电器充电, 并应放置在干燥通风场所。
- ◆ If the battery is not used for a long time, please charge the battery to 50% SOC status. Remove the battery from the device and place it separately, to avoid the short-circuit and damage caused by

contacting metal.

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.

- ◆ When using or during storage, if the battery is hot, with leakage, odor, distortion or other anomalies, please stop using it immediately and stay away from the battery.
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.
- ◆ Do not short-circuit the battery positive and negative terminals. Do not damp the battery to avoid any danger.
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.
- ◆ Please keep the battery away from heat, high voltage place. Please do not beat or hit the battery.
使用过程中, 应远离热源、高压场所, 并勿摔打、撞击电池.
- ◆ Remove the battery immediately from the device when the battery life ends. Please dispose the waste battery properly. Do not put it into fire or water.
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.
- ◆ Keep small cells and batteries which are considered swallowable out of the reach of children.
- ◆ 将电池远离孩童不能得到的地方, 以避免孩童噬咬或吞咽电池
- ◆ Swallowing may lead to burns, perforation of soft tissue, and death. Severe burns can occur within 2 h of ingestion. In case of ingestion of a cell or battery, seek medical assistance promptly.
如果吞咽了电池, 应迅速送医院处理, 吞咽有可能导致烧伤、软组织穿孔和死亡, 摄入后 2 小时内可能发生严重烧伤
- ◆ In case of ingestion of a cell or battery, seek medical assistance promptly.
如果摄入电芯或电池, 应立即寻求医疗援助.



Rechargeable Li-ion Battery Specification Approval

DOC NO.: PS-0725
REV. : A/1
SHEET : 18 OF 18

Customer Inquiry

客户要求

1.If the customer approves the specification and samples, please sign the specification back to VDL within 1 week. It is invalid when expires.

如果客户认可本承认书和样品, 请于 7 天内回签本承认书给 VDL 电子有限公司, 过期视为无效。

2. If the customer requires more explanation or the operating conditions are different from the specification content, please write down your information and contact VDL Electronics Co., Ltd in advance. VDL Electronics Co., Ltd could design and build products according to your special request.

如果客户需要其他方面的说明或工作条件与规格书内容不一致,请客户提前和 VDL 电子有限公司联系. VDL 电子有限公司将按照贵公司特殊要求设计和开发产品.特殊要求标准:

项 目 序号	Special Request 特殊要求	Criteria 标准
1		
2		
3		
4		
5		
6		

Company Name : Signature : Date:

公司名称:

签名:

日期: