

锂离子电池技术规格书

Lithium-ion Battery Pack Datasheet

电池组型号/Battery Pack Model: **4S4P-12.8V_400Ah**

料号/Part Number: **91410149**

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1 范围/Scope

本规格书描述本公司设计开发的锂离子电池产品，它是产品生产和检验的依据，以及让顾客了解产品的规格参数及正确使用方法。

This specification document describes the lithium-ion battery products designed and developed by our company. It serves as a reference for product manufacturing and testing, as well as to provide customers with information about the product's specifications and proper usage methods.

2 测试条件/Time Conditions

2.1 测试环境条件/Test Environment Conditions

除非另有规定，本规格书中各项试验应在标准大气条件下进行：

温度：15°C~35°C

相对湿度：45%~75%

大气压力：86kPa~106kPa

Unless otherwise specified, all tests mentioned in this specification document should be conducted under standard atmospheric conditions, which include the following ranges:

Temperature: 15°C to 35°C

Relative Humidity: 45% to 75%

Atmospheric Pressure: 86 kPa to 106 kPa

2.2 测量仪表与设备要求/Measurement Instrument and Equipment Requirements

2.2.1 测量电压的仪表精度应不低于 0.5 级，内阻应不小于 10KΩ/V。

2.2.2 测量电流的仪表精度应不低于 0.5 级。

2.2.3 测量时间的仪表准确度应不低于±0.1%。

2.2.4 测量温度的仪表准确度应不低于±0.5°C。

2.2.1 The instrument accuracy for voltage measurement should not be lower than level 0.5, and the internal resistance should not be less than 10KΩ/V.

2.2.2 The instrument accuracy for current measurement should not be lower than level 0.5.

2.2.3 The instrument accuracy for time measurement should not be lower than ±0.1%.

2.2.4 The instrument accuracy for temperature measurement should not be lower than ±0.5°C.

3 成品/Final Product

3.1 主要技术参数/Key Technical Parameters

项目 Item	参数 Parameter	备注 Remarks
额定容量 Rated Capacity	400Ah	0.5C 放电 0.5C Discharge
最小容量 Minimum Capacity	398Ah	
额定电压 Rated Voltage	12.8V	
内阻 Internal Resistance	$\leq 0.5\text{m}\Omega$	AC 1kHz 交流测 AC 1kHz AC Measurement 内阻 Internal Resistance
组合方式 Assemble Method	4S4P	
充电方式 Charging Method	CC/CV	恒流转恒压 Constant Current to Constant Voltage
标准充电电流 Standard Charging Current	0.2C	
最大充电电流 Maximum Charging Current	$\leq 400\text{A}$	
标准放电电流 Standard Discharge Current	0.2C	
最大放电电流 Maximum Discharge Current	$\leq 400\text{A}$	
充电限制电压 Charging Voltage Limit	14.6v	
放电截止电压 Discharge Cut-off Voltage	10V	

出厂电压 Factory Voltage	10V~14.6V	
重量 Weight	约44.21kg Approximately 44.21 kg	
充电温度 Charging Temperature	0°C~ + 45°C	
放电温度 Discharging Temperature	-20°C~ + 60°C	
储存温度 Storage Temperature	1 个月: -20~60°C 1 month: -20~60°C 3 个月: -10~40°C 3 months: -10~40°C 1 年: -5~20°C 1 year: -5~20°C	
相对湿度 Relative Humidity	45%~85% RH	

3.2 常规性能/Conventional Performance

项目 Item	测试方法 Test Method	判定标准 Criteria
标准充电 Standard Charging	<p>在环境温度为(25±2)°C条件下,用 0.2C 电流对电池充电,当电压到充电限制压时,改为充电限制压恒压充电,直到充电电流小于 0.02C 停止充电。</p> <p>Under ambient temperature conditions of (25±2)°C, charge the battery with a current of 0.2C until the voltage reaches the charging limited voltage. Then switch to constant voltage charging until the charging current drops below 0.02C, at which point charging should be stopped.</p>	充电时间≤8h Charging time ≤ 8 hours.

<p>额定容量 Rated Capacity</p>	<p>在环境温度为(25±2)°C条件下，以标准充电方式充满后，搁置0.5h，0.2C放电至放电截止电压，记录放电容量。</p> <p>Under ambient temperature conditions of (25±2)°C, fully charge the battery using the standard charging method, then let it stand for 0.5 hours. Discharge the battery with a current of 0.2C until the discharge cut-off voltage is reached, and record the discharge capacity.</p>	<p>≥最小容量 ≥Minimum capacity</p>
<p>内阻 Internal Resistance</p>	<p>使用AC 1kHz 检测方法 Use the AC 1kHz testing method.</p>	<p>参见3.1内阻项 Refer to 3.1 for Internal Resistance</p>
<p>荷电保持能力 Charge Retention Capacity</p>	<p>电池标准充电结束后，在环境温度为(25±2)°C条件下，将电池开路搁置28天，0.2C放电至放电截止电压V，记录放电容量。</p> <p>After the battery has completed the standard charging process, let it stand for 28 days at ambient temperature conditions of (25±2)°C. Discharge the battery with a current of 0.2C until the discharge cut-off voltage V is reached, and record the discharge capacity.</p>	<p>≥初始容量的 85% ≥ 85% of the initial capacity.</p>
<p>循环寿命 Cycle Life</p>	<p>在环境温度为(25±2)°C的条件下，以标准充电方式充满后，搁置0.5h，然后以电流0.2C恒流放电到放电截止电压，放电结束后，搁置0.5h，再进行下一个充放电循环，直至连续两次额定容量≤80%。</p> <p>Under the condition of ambient temperature (25±2)°C, the battery is fully charged using the standard charging method, followed by a 0.5-hour rest period. Then, it is discharged at a constant current of 0.2C until the discharge cut-off voltage is reached. After the discharge, a 0.5-hour rest period is observed before starting the next charge and discharge cycle. This process is repeated until the rated capacity reaches or falls below 80% for two consecutive cycles.</p>	<p>循环次数≥6000次 Number of cycles: ≥6000 times</p>

3.3 安全性能/Safety Performance

项目 Item	测试方法 Test Method	判定标准 Criteria
常温外部短路 Ambient Temperature External Short Circuit	<p>电池充满电后，放置在温度为 $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ 的条件下，待电池温度达到 $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ 时，在放置 30min，在用导线连接电池正负极端，并确保全部外部电阻为 80 ± 20 毫欧，（导线的电阻率温度系数小于 $5\cdot 10^{-3}/^{\circ}\text{C}$）当出现以下两种情形，实验终止：a) 电池温度下降到比峰值低 20%，b) 短接时间达到 24H。</p> <p>After fully charging the battery, place it in a temperature-controlled environment at $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$. Once the battery temperature reaches $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$, let it rest for 30 minutes. Then, connect the battery terminals with a wire, ensuring that the total external resistance is 80 ± 20 milliohms (with a wire resistance temperature coefficient less than $5\cdot 10^{-3}/^{\circ}\text{C}$). The experiment will be terminated under the following conditions: a) If the battery temperature drops by 20% compared to the peak value, or b) If the short-circuit time reaches 24 hours.</p>	<p>电池应不爆炸、不起火、最高温度不超过 150°C</p> <p>The battery should not explode, catch fire, or exceed a maximum temperature of 150°C.</p>
高温外部短路 High Temperature External Short Circuit	<p>电池充满电后，放置在温度为 $55^{\circ}\text{C}\pm 5^{\circ}\text{C}$ 的条件下，待电池温度达到 $55^{\circ}\text{C}\pm 5^{\circ}\text{C}$ 时，在放置 30min，在用导线连接电池正负极端，并确保全部外部电阻为 80 ± 20 毫欧，（导线的电阻率温度系数小于 $5\cdot 10^{-3}/^{\circ}\text{C}$）当出现以下两种情形，实验终止：a) 电池温度下降到比峰值低 20%，b) 短接时间达到 24H。</p> <p>After fully charging the battery, place it in a temperature-controlled environment at $55^{\circ}\text{C}\pm 5^{\circ}\text{C}$. Once the battery temperature reaches $55^{\circ}\text{C}\pm 5^{\circ}\text{C}$, let it rest for 30 minutes. Then, connect the battery terminals with a wire, ensuring that the total external resistance is 80 ± 20 milliohms (with a wire resistance temperature coefficient less than $5\cdot 10^{-3}/^{\circ}\text{C}$). The experiment will be terminated under the following conditions: a) If the battery temperature drops by 20% compared to the peak value, or b) If the short-circuit time reaches 24 hours.</p>	<p>电池应不爆炸、不起火、最高温度不超过 150°C</p> <p>The battery should not explode, catch fire, or exceed a maximum temperature of 150°C.</p>

<p>燃烧喷射 Fire Jetting</p>	<p>电池充满电后，将电池放置在实验工装的钢丝网上，需用单根金属丝固定样品电池在钢丝网上，用火焰加热电池，当出现以下三种情况可停止加热：a)电池爆炸；b)电池完全燃烧；c)持续加热30min，电池未起火、未爆炸。</p> <p>After fully charging the battery, place it on a wire mesh in the experimental fixture. Secure the sample battery to the wire mesh using a single metal wire. Heat the battery using a flame. The heating process can be stopped under the following three conditions: a) Battery explosion, b) Complete combustion of the battery, or c) Continuous heating for 30 minutes without the battery catching fire or exploding.</p>	<p>组成的电池的部件（粉尘状产物除外）或电池产物不得穿透铝网</p> <p>Components of the battery (excluding dust-like substances) or battery products should not penetrate the aluminum mesh.</p>
<p>过充电 Overcharging</p>	<p>单体电芯(不含保护板电路)，在 $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ 的环境下以 0.2C 恒流放电至终止电压，然后设置恒流电流为 3C、电压为 3.65V，直至电压达到最大值后，电池持续充电时间达到7小时，电池温度下降到比峰值低20%。</p> <p>For an individual cell (excluding the protection circuit), discharge it at a constant current of 0.2C to the termination voltage at a temperature of $25^{\circ}\text{C}\pm 2^{\circ}\text{C}$. Then, set the constant current to 3C and the voltage to 3.65V. Continue charging until the voltage reaches its maximum value. The battery should be continuously charged for 7 hours until the temperature drops by 20% compared to the peak value.</p>	<p>电池应不爆炸、不起火</p> <p>The battery should not explode or catch fire.</p>
<p>加速度冲击 Acceleration Shock</p>	<p>电池充满电后，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 75gm，峰值加速度为 $150\pm 25\text{gm}$，脉冲持续时间为 $6\text{ms}\pm 1\text{ms}$，电池三个相互垂直的方向依次进行三次加速度冲击。</p> <p>After fully charging the battery, fix it on an impact table and perform a half-sine pulse shock test. Within the first 3ms, the minimum average acceleration should be 75gm, and the peak acceleration should be $150\pm 25\text{gm}$. The pulse duration should be $6\text{ms}\pm 1\text{ms}$. Repeat the acceleration shock test three times in three mutually perpendicular directions of the battery.</p>	<p>电池应不爆炸、不起火、不破裂、不冒烟、不漏液和不泄气</p> <p>The battery should not explode, catch fire, rupture, smoke, leak liquid, or release gas.</p>

<p>热滥用 Thermal Abuse</p>	<p>电池充满电后放置于热箱中，温度以 $(5^{\circ}\text{C}\pm 2^{\circ}\text{C})/\text{min}$ 的速率升至 $130^{\circ}\text{C}\pm 2^{\circ}\text{C}$并保温 30min。</p> <p>After fully charging the battery, place it in a thermal chamber and gradually raise the temperature to $130^{\circ}\text{C}\pm 2^{\circ}\text{C}$ at a rate of $(5^{\circ}\text{C}\pm 2^{\circ}\text{C})/\text{min}$. Maintain the temperature for 30 minutes.</p>	<p>电池应不爆炸、不起火 The battery should not explode or catch fire.</p>
<p>温度循环 Temperature Cycling</p>	<p>电池按标准充电充满电后，将电池放置在温度为 $(25\pm 2)^{\circ}\text{C}$的温控箱体中进行如下步骤，(1)将样品放入温度为 $75^{\circ}\text{C}\pm 2^{\circ}\text{C}$的实验箱中保持 6H；(2)将实验箱温度降为 $-40^{\circ}\text{C}\pm 2^{\circ}\text{C}$变保持 6H；(3)以上几种温度的转换时间不超过 30min；(4)重复步骤 1-2，共循环10次。</p> <p>After fully charging the battery according to the standard charging procedure, place the battery in a temperature-controlled chamber at a temperature of $(25\pm 2)^{\circ}\text{C}$ and perform the following steps: (1) Keep the sample in an experimental chamber at a temperature of $75^{\circ}\text{C}\pm 2^{\circ}\text{C}$ for 6 hours, (2) Lower the temperature of the chamber to $-40^{\circ}\text{C}\pm 2^{\circ}\text{C}$ and keep it for 6 hours, (3) The transition time between different temperatures should not exceed 30 minutes, (4) Repeat steps 1-2 for a total of 10 cycles.</p>	<p>电池不泄漏、不泄气不爆炸、不起火和不破裂 The battery should not leak, release gas, explode, or catch fire.</p>
<p>强制放电 Forced Discharge</p>	<p>在环境温度为 $(25\pm 2)^{\circ}\text{C}$条件下，电池以 0.2C进行放电至终止电压，然后以1C的电流对电池进行反向充电，要求充电时间不低于90min。</p> <p>Under the condition of $(25\pm 2)^{\circ}\text{C}$ ambient temperature, discharge the battery at a rate of 0.2C until it reaches the termination voltage. Then, reverse charge the battery at a current of 1C, ensuring that the charging time is not less than 90 minutes.</p>	<p>电池应不起火和不爆炸 The battery should not catch fire or explode.</p>

<p>过压充电 Overvoltage Charging</p>	<p>电池充满电后，继续以最大充电电流恒流充电至 $n*6.0V$ 或者可以承受的最高电压值（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是没有保护电路的电池充电1H，对于有保护电路的电池充电至保护板电路动作。</p> <p>After fully charging the battery, continue charging it at the maximum charging current until it reaches either $n*6.0V$ or the maximum permissible voltage (whichever is higher), and maintain that voltage for constant voltage charging. For batteries without protection circuits or with removed protection circuits, charge for 1 hour. For batteries with protection circuits, charge until the protection circuit activates.</p>	<p>电池不泄漏、不泄气、不爆炸、不起火和不破裂</p> <p>The battery should not leak, release gas, explode, or catch fire.</p>
<p>过流充电 Overcurrent Charging</p>	<p>电池放完电后，然后以1.5倍的过流充电保护电流（1.5C）进行恒流充电，对于移除保护电路或是没有保护电路的电池充电至上限电压，对于有保护电路的电池充电至保护板电路动作。</p> <p>After discharging the battery, perform a constant current charge at 1.5 times the overcurrent charging protection current (1.5C). For batteries without protection circuits or with removed protection circuits, charge until reaching the upper limit voltage. For batteries with protection circuits, charge until the protection circuit activates.</p>	<p>电池不泄漏、不泄气不爆炸、不起火和不破裂</p> <p>The battery should not leak, release gas, explode, or catch fire.</p>
<p>欠压放电 Under-voltage Discharge</p>	<p>电池充满电后，以其最大放电电流恒流放电，对与移除保护电路或是没有保护电路的电池放电至 $(n*0.15)V$，对与有保护电路的电池充电至保护板电路动作。放电后静置10min,并继续按标准充满电。</p> <p>After fully charging the battery, discharge it at a constant current equal to its maximum discharge current. For batteries without protection circuits or with removed protection circuits, discharge until reaching $(n*0.15)V$. For batteries with protection circuits, discharge until the protection circuit activates. After the discharge, let the battery rest for 10 minutes and then continue with the standard full charging procedure.</p>	<p>电池不泄漏、不泄气不爆炸、不起火和不破裂</p> <p>The battery should not leak, release gas, explode, or catch fire.</p>

<p>过载 Overload</p>	<p>电池充满电后，然后以 1.5 倍的过流放电保护电流 (1.5C)进行恒流 放电，对与移除保护电路或是没有保护电路的电池放电至放电截止电 压，对与有保护电路的电池充电至保护板电路动作。</p> <p>After fully charging the battery, perform a constant current discharge at 1.5 times the overcurrent discharge protection current (1.5C). For batteries without protection circuits or with removed protection circuits, discharge until reaching the discharge cutoff voltage. For batteries with protection circuits, discharge until the protection circuit activates.</p>	<p>电池不泄漏、不泄气不爆炸、不 起火和不破裂</p> <p>The battery should not leak, release gas, explode, or catch fire</p>
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3.4 环境适应性/Environmental Adaptability

项目 Item	测试方法 Test Method	判定标准 Criteria
高温使用 High-temperature usage	<p>将满电的样品放在高温试验箱中，试验箱中的温度设为电池规定的充电 上限温度和放电上限温度，电池的充电和放电的上限温度及 80°C中的 最大值，待电池表面温度稳定后，保持 7H。</p> <p>Place the fully charged samples in a high-temperature test chamber, setting the temperature in the chamber to the upper limit for charging and discharging specified for the battery, as well as the maximum value within 80°C. After the surface temperature of the battery stabilizes, keep it for 7 hours.</p>	<p>切断电源，电池应不爆炸、不起火和不漏液</p> <p>Cut off the power supply, the battery should not explode, catch fire, or leak.</p>
振动 Vibration	<p>电池充满电后，将电池或电池组固定在振动台的台上，不可使电池或电池组变形，采用正弦波进行振动，并以对数扫频方式在 15min 内从 7Hz 扫频到 200Hz 并返回 到 7Hz。振动沿样品互相垂直的 3 个方向（其中一个方向必须与样品正负极所在平面垂直）进行，每个方向按上述对数扫频方式重复 12 次，振动 3h。对数扫频方式如下： 7Hz-18Hz 保持 9.8m/s² 的峰值加速度，将振幅保持在0.8mm（位移为 1.6mm）直至峰值加速度达到 78.4m/s²（频率约为 50Hz）。保持 78.4m/s² 的峰值加 速度直到频率增长到 200Hz。实验后在对电池进行一次充放电循环。</p> <p>After the battery is fully charged, fix the battery or battery pack on the vibration table without causing any deformation. Use a sine wave for vibration and perform logarithmic sweep frequency from 7Hz to 200Hz within 15 minutes and return to 7Hz. The vibration is conducted in three directions perpendicular to each other (one of which must be perpendicular to the plane where the positive and negative terminals of the sample are located), repeating the logarithmic sweep frequency method 12 times in each direction. The vibration lasts for 3 hours. The logarithmic sweep frequency method is as follows: from 7Hz to 18Hz, maintain a peak acceleration of 9.8m/s² while keeping the amplitude at 0.8mm (displacement of 1.6mm) until the peak acceleration reaches 78.4m/s² (at a frequency of approximately 50Hz). Maintain the peak acceleration of 78.4m/s² until the frequency increases to 200Hz. After the experiment, perform one charge-discharge cycle on the battery.</p>	<p>电池不泄漏、不破裂 不起火和不爆炸</p> <p>The battery should not leak, rupture, catch fire, or explode.</p>

<p>自由跌落 Free Fall</p>	<p>充电结束后，搁置 1-4H 后进行测试。将电池样品由高度为 1000mm 的位置自由跌落到置于混凝土板上，从 X、Y、Z 正负方向(六个方向) 每个方向自由跌落 1 次。(1000mAh 以上的高度1000MM, 1000mAh以下的1500MM)。</p> <p>After the charging is completed, let the battery rest for 1-4 hours before conducting the test. Release the battery sample freely from a height of 1000mm and let it fall onto a concrete plate, performing one free fall in each of the positive and negative directions of X, Y, and Z axes (six directions in total). (For batteries with a capacity of 1000mAh or higher, the height of the free fall is 1000mm, while for batteries with a capacity below 1000mAh, the height is 1500mm).</p>	<p>不泄漏，不起火和不爆炸</p> <p>No leakage, no fire, and no explosion.</p>
<p>低气压 Low Pressure</p>	<p>电池快速充电或标准充电后，将样品搁置在 (25±2) °C真空箱中，真空箱密闭后，逐渐减少其内部压力至不高于 11.6kPa(模拟海拔 15240m) 并保持 6H。</p> <p>After rapid charging or standard charging, place the sample in a (25±2)°C vacuum chamber. Once the vacuum chamber is sealed, gradually reduce the internal pressure to no higher than 11.6kPa (simulating an altitude of 15240m) and keep it for 6 hours.</p>	<p>电池应不泄漏，不泄气、不破裂不起火和不爆炸</p> <p>The battery should not leak, vent, rupture, catch fire, or explode.</p>

4 零部件/Components

4.1 电芯/Battery Cells

<p>生产厂家 Manufacturer</p>	<p>湖北亿纬动力有限公司 Hubei Eway Power Co., Ltd.</p>	<p>型号 Model</p>	<p>LF100LA</p>
<p>额定容量 Rated Capacity</p>	<p>100Ah</p>	<p>额定电压 Rated Voltage</p>	<p>3.2V</p>
<p>内阻 Internal Resistance</p>	<p>≤0.5mΩ</p>	<p>充电上限电压 Charging Max Voltage</p>	<p>3.65V</p>
<p>重量 Weight</p>	<p>约1.98KG Approximately 1.98 kg</p>	<p>放电截止电压 Discharge Cut-off Voltage</p>	<p>2.5V</p>

4.1.1 电池性能/Battery Performance

序号 Number	项目 Item	技术要求 Technical Requirements	测试方法 Test Method
1	25°C倍率放电性能 Discharge Performance Rate at 25°C	放电容量/标称容量× 100% A) 0.5C(A)≥100% B) 1C(A)≥98% Discharge Capacity/Nominal Capacity× 100% A) 0.5C(A)≥100% B) 1C(A)≥98%	电池标准充电后, 搁置0.5h, 分别以0.5C (A)、1C(A)进行放电至2.5V, 如果放电容量达不到技术要求, 此项试验允许重复3次。 After standard charging the battery, let it stand for 0.5 hours, then discharge it to 2.5V at 0.5C (A) and 1C (A) respectively. If the discharge capacity does not meet the technical requirements, this test can be repeated up to 3 times.
2	不同温度放电性能 Discharge Performance at Different Temperatures	放电容量/标称容量× 100% A) 55°C 1.0C≥95% B) -20°C 1.0C≥70% Discharge Capacity/Nominal Capacity× 100% A) 55°C 1.0C≥95% B) -20°C 1.0C≥70%	A) 电池标准充电后, 在55±2°C条件下搁置4h, 以1.0C(A)放电至2.5V B) 电池标准充电后, 在-20±2°C条件下搁置4h, 以1.0C(A)放电至2.0V A) After standard charging the battery, let it stand for 4 hours at 55±2°C, then discharge it to 2.5V at 1.0C(A). B) After standard charging the battery, let it stand for 4 hours at -20±2°C, then discharge it to 2.0V at 1.0C(A).

3	<p>25°C荷电保持与恢复能力</p> <p>Capacity Retention and Recovery Performance at 25°C</p>	<p>容量保持率: 剩余容量/标称容量$\geq 95\%$</p> <p>容量恢复率: 恢复容量/标称容量$\geq 97\%$</p> <p>Capacity Retention: Remaining Capacity / Nominal Capacity $\geq 95\%$</p> <p>Capacity Recovery: Recovered Capacity / Nominal Capacity $\geq 97\%$</p>	<p>1) 电芯标准充电后, 25±2°C下静置28天;</p> <p>2) 存储结束后, 电芯在25°C下以0.5C恒流放电至2.5V, 静置30min; 计算容量保持率;</p> <p>3) 电芯在25±2°C下以0.5C恒流恒压充电至3.65V/0.05C截止, 静置30min;</p> <p>4) 电芯在25°C下以0.5C恒流放电至2.5V, 静置30min。计算容量恢复率;</p> <p>5) 3-4步容量恢复步骤允许重复3次。</p> <p>1) After standard charging, the cell is kept at 25±2°C for 28 days.</p> <p>2) After storage, the cell is discharged at a constant current of 0.5C to 2.5V at 25°C, and then left for 30 minutes. Calculate the capacity retention.</p> <p>3) The cell is charged at a constant current of 0.5C and constant voltage of 3.65V/0.05C at 25±2°C, and then left for 30 minutes.</p> <p>4) The cell is discharged at a constant current of 0.5C to 2.5V at 25°C, and then left for 30 minutes. Calculate the capacity recovery.</p> <p>5) Steps 3 and 4 of capacity recovery can be repeated up to 3 times.</p>
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4	<p>25°C循环寿命</p> <p>25°C Cycle Life</p>	<p>≥4000次 @ 1.0C/1.0C</p> <p>≥4000 cycles @ 1.0C/1.0C</p>	<p>(25±2)°C, 电池在200kgf 夹具下: 以1.0C(A)恒流恒压充电至3.65V, 截止电流0.05C(A), 搁置30min, 以1.0C(A)恒流放电至2.5V, 搁置30min, 再进行下一循环至容量衰减为标称容量的80%止。</p> <p>At (25±2)°C, the battery is placed under a 200kgf fixture: charged at a constant current and voltage of 1.0C(A) to 3.65V, with the current cutoff at 0.05C(A), left for 30 minutes, discharged at a constant current of 1.0C(A) to 2.5V, left for 30 minutes, and then proceeds to the next cycle until the capacity decay reaches 80% of the nominal capacity.</p>
5	<p>35°C循环寿命</p> <p>35°C Cycle Life</p>	<p>≥2800次 @ 1.0C/1.0C</p> <p>≥2800 cycles @ 1.0C/1.0C</p>	<p>(35±2)°C, 电池在200kgf夹具下: 以1.0C(A)恒流恒压充电至3.65V, 截止电流0.05C(A), 搁置30min, 以1.0C(A)恒流放电至2.5V, 搁置30min, 再进行下一循环, 至容量衰减为标称容量的80%止。</p> <p>At (35±2)°C, the battery is placed under a 200kgf fixture: charged at a constant current and voltage of 1.0C(A) to 3.65V, with the current cutoff at 0.05C(A), left for 30 minutes, discharged at a constant current of 1.0C(A) to 2.5V, left for 30 minutes, and then proceeds to the next cycle until the capacity decay reaches 80% of the nominal capacity.</p>

6	<p>45°C循环寿命</p> <p>45°C Cycle Life</p>	<p>≥1800次 @ 1.0C/1.0C</p> <p>≥1800 cycles @ 1.0C/1.0C</p>	<p>(45±2)°C, 电池在200kgf夹具下: 以1.0C(A)恒流恒压充电至3.65V, 截止电流0.05C(A), 搁置30min, 以1.0C(A)恒流放电至2.5V, 搁置30min, 再进行下一循环, 至容量衰减为标称容量的80%止。</p> <p>At (45±2)°C, the battery is placed under a 200kgf fixture: charged at a constant current and voltage of 1.0C(A) to 3.65V, with the current cutoff at 0.05C(A), left for 30 minutes, discharged at a constant current of 1.0C(A) to 2.5V, left for 30 minutes, and then proceeds to the next cycle until the capacity decay reaches 80% of the nominal capacity.</p>
7	<p>寿命终止管理</p> <p>End-of-life Management</p>	<p>容量/标称容量<70%</p> <p>Capacity/Nominal Capacity < 70%</p>	<p>电池使用过程中, 超出寿命终止规定时应停止使用电池。</p> <p>During battery usage, the battery should be discontinued if it exceeds the end-of-life termination criteria.</p>

4.1.2 安全性能/Safety Performance

序号 Number	项目 Item	技术要求 Technical Requirements	测试方法 Test Method
1	过放电 Over-discharge	不爆炸、不起火 No explosion, no ignition	参考: GB/T 36276-2018 《电力储能用锂离子电池》 Reference: GB/T 36276-2018 "Lithium-ion Batteries for Stationary Energy Storage"
2	过放电 Over-discharge	不爆炸、不起火 No explosion, no ignition	
3	短路 Short Circuit	不爆炸、不起火 No explosion, no ignition	
4	跌落 Falling	不爆炸、不起火 No explosion, no ignition	
5	加热 Heating	不爆炸、不起火 No explosion, no ignition	
6	挤压 Compression	不爆炸、不起火 No explosion, no ignition	
7	低气压 Low Pressure	不爆炸、不起火 No explosion, no ignition, no leakage	
8	热失控 Thermal Runway	不爆炸、不起火 No explosion, no ignition	

4.2 保护板参数/Protection Board Parameters

4.2.1 电气参数/Electrical Parameters

4.2.1 电气参数(测试需在温度 $25\pm 2^{\circ}\text{C}$,相对湿度 $65\pm 20\%$ 的室内进行。) 4.2.1 Electrical Parameters (Testing should be conducted indoors at a temperature of $25\pm 2^{\circ}\text{C}$ and relative humidity of $65\pm 20\%$.)					
功能 Function	测试项目 Test Item Specification	规格 Specification			单位 Unit
		最小值 Min	典型值 Typical Value	最大值 Max	
工作电压 Operating Voltage	电压范围 Voltage Range	8.8		15	V
工作电流 Operating Current	充电电流 Charging Current			200	A
	放电电流 Discharging Current			200	A

充电保护 Charging Protection	充电器电压(CC-CV) Charger Voltage	14.4			V
	过充保护电压 Overcharging Protection Voltage	3.700	3.750	3.800	V
	过充保护延时时间 Overcharging Protection Delay Time	500	1000	2000	mS
	过充保护恢复电压 Overcharging Protection Recovery Voltage	3.450	3.550	3.650	V
均衡功能 Balancing Function	均衡开启电压 Balancing Activation Voltage	3.400	3.500	3.600	V
	均衡电流 Balancing Current	120		160	mA
放电保护 Discharging Protection	过放保护电压 Overdischarging Protection Voltage	2.100	2.200	2.300	V
	过放保护延时时间 Overdischarging Protection Delay Time	4000	5000	6000	mS
	过放保护恢复电压 Overdischarging Protection Recovery Voltage	2.600	2.700	2.800	V
	过放保护恢复条件 Overdischarging Protection Recovery Condition	充电 Charging			

过流保护 Overcurrent Protection	充电过流保护电流值 Charging Overcurrent Protection Current Value	300		500	A
	充电过流保护延迟 Charging Overcurrent Protection Delay	500	1000	1500	mS
	充电过流保护恢复条件 Charging Overcurrent Protection Recovery Condition	断开充电器 Disconnect Charger			
	放电过流1保护电流值 Discharging Overcurrent 1 Protection Current Value	700		900	A
	放电过流1保护延迟 Discharging Overcurrent 1 Protection Delay	100	200	300	mS
	放电过流2保护电流值 Discharging Overcurrent 2 Protection Current Value	1400		1800	A
	放电过流2保护延迟 Discharging Overcurrent 2 Protection Delay	10	20	30	mS
	放电过流保护恢复条件 Discharging Overcurrent Protection Recovery Condition	断开负载或者充电 Disconnect Load or Charging			

短路保护 Short Circuit Protection	短路保护电流Short Circuit Protection Current	2000		3500	A
	短路保护延迟时间 Short Circuit Protection Delay Time	100	250	400	uS
	短路保护恢复Short Circuit Protection Recovery	断开负载 Disconnect Load			
温度保护(内置) Temperature Protection (Built-in)	充电高温保护 Charging Overtemperature Protection	85	90	95	°C
	充电高温保护释放 Charging Overtemperature Protection Release	50	65	80	°C
	放电高温保护 Discharging Overtemperature Protection	80	90	95	°C
	放电高温保护释放 Discharging Overtemperature Protection Release	50	65	80	°C
内阻 Internal Resistance	放电回路内阻 Discharge Circuit Resistance		10	20	mR
自耗电 Self-Consumption	工作模式 Operating Mode		30	50	uA
工作温度 Operating Temperature	正常工作范围 Normal Operating Range	-20		70	°C
存储温度 Storage Temperature	湿度低于90% Humidity less than 90%	-40		85	°C
保护板尺寸 Protection Board Dimension	长度*宽度*高度 Length*width*height	(160±2)*(105±2)*(20±2) 不含铜条长度 (160±2)*(105±2)*(20±2) Excluding copper strip length			mm

4.2.2 保护功能说明/Explanation of Protection Functions

过充保护: 电池在充电状态下, 电压不断升高, 当保护板检测到**任意一节电芯电压高于过充保护值**, 保护板立即开始计时, 当时间达到过充保护延时以后, 保护板关断充电**MOS**管 充电截止, 此时不能充电。

Overcharge Protection: When the battery is in the charging state and the voltage continues to rise, if the protection board detects that the voltage of **any cell is higher than the overcharge protection value**, the protection board immediately starts timing. When the time reaches the overcharge protection delay, the protection board shuts down the charging **MOS** tube, and charging stops, and charging cannot be carried out at this time.

过充保护恢复: 保护板出现过压保护以后, 电池静置或者放电状态下, 电池电压下降, 当保护板检测到**每一节电压都低于过充保护恢复电压**时, 保护板输出信号 开启充电**MOS**管, 此时可以充电。

Overcharge Protection Recovery: After overvoltage protection appears on the protection board, the battery voltage decreases under idle or discharge conditions. When the protection board detects that **each cell's voltage is lower than the overcharge protection recovery voltage**, the protection board outputs a signal to turn on the charging **MOS** tube, and charging can be carried out at this time.

过放保护: 电池在放电状态下, 电压不断降低, 当保护板检测到**任意一节电芯电压低于过放保护值**, 保护板立即开始计时, 当时间达到过放保护延时以后, 保护板输出信号关断放电**MOS**管, 放电截止, 负载锁定电路工作, 此时不能放电。

Over-discharge Protection: When the battery is in the discharge state and the voltage continues to drop, if the protection board detects that the voltage of **any cell is lower than the over-discharge protection value**, the protection board immediately starts timing. When the time reaches the over-discharge protection delay, the protection board outputs a signal to shut down the discharge **MOS** tube, discharge stops, the load lock circuit works, and discharge cannot be carried out at this time.

过放保护恢复: 保护板出现过放保护以后, 电池静置或者充电状态下, 电池电压不断上升, 当保护板检测到**每一节电压都高于过放保护恢复电压**时, 此时**再断开负载或者是充电**, 保护板输出信号, 开启放电**MOS**管, 此时可以放电。

Over-discharge Protection Recovery: After over-discharge protection appears on the protection board, the battery voltage continuously rises under idle or charging conditions. When the protection board detects that **each cell's voltage is higher than the over-discharge protection recovery voltage**, then disconnect the load or charge, the protection board outputs a signal to turn on the discharge **MOS** tube, and discharging can be carried out at this time.

过流保护: 电池在静置或者放电状态下 电流突然加大, 当保护板检测到电流达到过流保护值此时保护板开始计时, 当回路中电流持续时间达到过流保护延迟时间后, 保护板输出信号关断放电**MOS**管, 负载锁定电路工作, 此时不能放电。

Overcurrent Protection: When the battery is idle or in a discharge state and the current suddenly increases, when the protection board detects that the current reaches the overcurrent protection value, the protection board starts timing. When the current in the circuit continues for a time reaching the overcurrent protection delay, the protection board outputs a signal to shut down the discharge **MOS** tube, the load lock circuit works, and discharge cannot be carried out at this time.

过流保护恢复: 保护板出现放电过流保护以后, 放电**MOS**管被关断, 回路中电流变为**0**.此时断开负载或者是充电, 保护板输出信号, 开启放电**MOS**管 此时可以放电。

Overcurrent Protection Recovery: After the discharge overcurrent protection appears on the protection board, the discharge **MOS** tube is shut off and the current in the circuit becomes **0**. Then disconnect the load or charge, the protection board outputs a signal, turns on the discharge **MOS** tube, and discharging can be carried out at this time.

4.2.3 编号详解/Explanation of Numbering

JBD – ZP04S008 – L4S – 200A – 200A – B – S
(1) (2) (3) (4) (5) (6) (7)

- (1) 嘉佰达电子科技有限公司简称 JBD
- (2) 我可保护板型号: ZP04S008, 支持4串保护板。
- (3) L4S即此次送样为磷酸铁锂类型电池4串保护板。
- (4) 最大充电电流 如果超过此电流, 可能造成保护板永久损坏。
- (5) 最大放电电流, 如果超过此电流, 可能造成保护板永久损坏。
- (6) 均衡功能标志。
- (7) 支持串联保护, 最高支持4组串联。

- (1) Jia Bai Da Electronics Technology Co., Ltd. is abbreviated as JBD
- (2) Our protection board model: ZP04S008, supports 4-string protection board.
- (3) L4S indicates that the sample sent this time is a 4-string protection board for lithium iron phosphate type batteries.
- (4) Maximum charging current. If this current is exceeded, it may cause permanent damage to the protection board.
- (5) Maximum discharge current. If this current is exceeded, it may cause permanent damage to the protection board.
- (6) Equalization function mark.
- (7) Supports series protection, up to 4 groups in series.

贵司收到规格书和样品后, 验证测试完成, 如果需要后续批量, 请签署此份规格书后, 并将此份规格书回传至我司, 我司会按照此份规格书参数 给贵司批量。

After you receive the specification and the samples, and complete the verification testing, if you need subsequent batches, please sign this specification and return it to us. We will provide you with batches according to the parameters of this specification.

此规格书定义了东莞市嘉佰达电子科技有限公司(后文简称“我司”)根据贵公司提供的设计要求, 设计并制造的锂电池组管理系统的功能、电气参数、机械参数及包装运输和安装使用方法。经贵公司确认生效, 此规格书仅限我司及贵公司内部使用, 未经我司许可不得给予第三方, 且我司拥有对此规格书的最终解释权。

This specification defines the functions, electrical parameters, mechanical parameters, and packaging transportation and installation methods of the lithium battery management system designed and manufactured by Dongguan Jiabaida Electronic Technology Co., Ltd. (hereinafter referred to as "our company") according to the design requirements provided by your company. Upon your company's confirmation, this specification is only for internal use by our company and your company, and must not be given to a third party without our company's permission. Furthermore, our company has the final right to interpret this specification.

5 包装、储存、运输/Packaging, Storage, and Transportation

5.1 包装/Packaging

- 1) 装有电池产品的包装盒应放在干燥、防尘、防潮的包装箱内。
 - 2) 包装示意图
- 1) Packaging boxes containing battery products should be placed in dry, dust-proof, and moisture-proof packaging boxes.
 - 2) Packaging diagram



5.2 储存/Storage

- 1) 产品应存放在干燥，通风，并能防雨，雪的室内，不应与活性化学物品或起尘物品存放在一起，箱体应放妥垫起，距地面不小于 100mm。
 - 2) 产品应避免受阳光直射，离热源（暖气设备等）不应少于 2m。
 - 3) 产品不应倒置及卧放，不应受任何机械冲击或重压。
 - 4) 电池或电池组应在荷电不超过 30%~50% 的状态下以及环境温度为 5°C~35°C 的条件下，进行存储或运输。
- 1) The product should be stored indoors in a dry, well-ventilated area that is protected from rain and snow. It should not be stored together with reactive chemicals or dusty materials. The product should be properly placed on a pad or raised surface, with a distance of at least 100mm from the ground.
 - 2) The product should be protected from direct sunlight and kept at least 2 meters away from heat sources such as heating equipment.
 - 3) The product should not be inverted or placed horizontally, and it should be protected from any mechanical shocks or heavy pressure.
 - 4) Batteries or battery packs should be stored or transported in a state of charge not exceeding 30% to 50% and under ambient temperatures of 5°C to 35°C.

5.3 运输/Transportation

- 1) 在运输过程中，产品不应受到剧烈机械冲击，暴晒，雨淋，不应倒置。
 - 2) 在装卸过程中，产品应轻放，严防摔掷，翻滚，重压。
- 1) During transportation, the product should not be subjected to severe mechanical shocks, prolonged exposure to sunlight, or rain. It should not be inverted.
 - 2) During loading and unloading, the product should be handled with care to prevent dropping, rolling, or excessive pressure.

6 成品尺寸及接口说明/Product Dimensions and Interface Description

成品尺寸：L450*W439*H155，单位 mm，输入输出接口：M6 螺丝，橙正、黑负。

Product dimensions: L450*W439*H155 (in millimeters). Input/output interface: M8 screw, orange positive, black negative.



7 使用说明与注意事项/Instructions and Precautions

7.1 使用说明/Instructions

- 1) 使用电池前，请仔细阅读使用说明书和电池表面标识。
 - 2) 请在正常的、室内环境中使用电池。温度：-20~+35℃，相对湿度：55±20%。
 - 3) 在使用过程中，应远离热源、高压，避免儿童玩弄电池。切勿摔打电池。本电池只能使用配套充电器充电。不要将电池放在充电器中充电超过 24h。
 - 4) 切勿将电池正负极短路，切勿自己拆装电池，也勿让电池受潮，以免发生危险。
 - 5) 长期不用时，请将电池储存完好。让电池处于半荷电状态。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。将电池保存在阴凉干燥处。
 - 6) 废弃电池请安全妥当处理，不要投入火中或液体中。
- 1) Before using the battery, please read the user manual and check the surface markings of the battery.
 - 2) Please use the battery in normal indoor environments. Temperature: -20 to +35°C, relative humidity: 55±20%.
 - 3) During use, keep the battery away from heat sources and high voltage, and prevent children from playing with the battery. Do not drop or strike the battery. Only use the provided charger to charge the battery. Do not charge the battery in the charger for more than 24 hours.
 - 4) Do not short-circuit the positive and negative terminals of the battery, and do not disassemble the battery by yourself

or let the battery get wet to avoid potential hazards.

- 5) When not in use for a long time, store the battery in a good condition. Keep the battery in a partially charged state. Wrap the battery with non-conductive material to prevent direct contact with metal, which may damage the battery. Store the battery in a cool and dry place.
- 6) Dispose of the battery properly and safely. Do not throw it into fire or liquid.

7.2 注意事项/Precautions

- 1) 请不要在强阳光暴晒的环境下使用电池，以免发热、变形、冒烟。至少避免电池性能下降、减少寿命。
 - 2) 电池中装有保护电路可以避免各种意外情况的发生。不要在产生静电的场所使用电池，因为高压静电容易损坏保护板，而导致电池工作不正常，发热、变形、冒烟或起火燃烧。
 - 3) 推荐的充电温度范围是 0-45°C。在超出此范围的环境中充电有可能造成电池性能下降、减少寿命。
 - 4) 在使用电池之前，请仔细阅读使用手册并经常在需要时阅读。
 - 5) 请使用专用充电器和推荐的充电方式，在推荐的环境条件下给电池充电。
 - 6) 在第一次使用电池时，若发现电池不整洁或有异味等不正常现象，不可继续使用电池，应将电池返回销售商。
 - 7) 儿童使用电池前，应受父母指导，并在使用中受监督是否正确。
 - 8) 电池应放在孩童不能得到的位置。应避免孩童将电池从充电器取出、玩弄。
 - 9) 假如皮肤或衣物接触到电池漏液，用清水冲洗，以免造成皮肤不适。
 - 10) 购买电池时，请注意销售商联络方法。以便在需要时及时与销售商取得联系，得到咨询。
 - 11) 保用期是自出厂之日起十二个月。但是，属于使用不当而非质量问题，即使在保用期内生产厂家也不会无偿更换新电池。
 - 12) 如果将电池用于其他设备，请与供应商讨论保护功能的完善性。至少应该咨询电池的大电流、快速充电、特殊应用的问题。
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- 1) Please avoid using the battery in environments with strong sunlight to prevent overheating, deformation, and smoking. This can cause a decrease in performance and shorten the battery's lifespan.
 - 2) Batteries with built-in protection circuits can prevent various unexpected incidents. Do not use the battery in places where static electricity is generated, as high-voltage static electricity can damage the protection circuit, resulting in abnormal battery operation, overheating, deformation, smoking, or even fire.
 - 3) The recommended charging temperature range is 0-45°C. Charging the battery in environments outside this range may cause a decrease in performance and shorten its lifespan.
 - 4) Before using the battery, please read the user manual carefully and refer to it whenever necessary.
 - 5) Please use a dedicated charger and follow the recommended charging method to charge the battery in the recommended environmental conditions.
 - 6) If you find any abnormalities such as dirtiness or unusual odor when using the battery for the first time, do not continue using it and return the battery to the retailer.
 - 7) Children should be guided by parents and supervised during battery usage to ensure proper handling.
 - 8) Keep the battery in a place inaccessible to children. Avoid children removing the battery from the charger and playing with it.

- 9) If skin or clothing comes into contact with battery leakage, rinse with water to prevent discomfort.
- 10) Please pay attention to the contact information of the retailer when purchasing the battery, so that you can contact them for consultation when needed.
- 11) The warranty period is twelve months from the date of purchase. However, if the battery is improperly used rather than having a quality issue, the manufacturer will not provide free replacement even within the warranty period.
- 12) If using the battery for other devices, discuss with the supplier regarding the adequacy of protection functions. At least consult about high current, fast charging, and special application issues related to the battery.

7.3 警告/Warning

- 1) 不可与其它类型的一次或二次电池混用，否则会因为不正常的充、放电造成电池发热、冒烟、变形或燃烧。
 - 2) 将电池置于孩童不能得到的地方，以避免孩童噙咬或吞咽电池。如果吞咽了电池，应迅速送医院处理。
 - 3) 如果超过正常充电时间很长时间充电器仍在充电，应停止充电。不正常的充电有可能会使电池发热、冒烟、变形或燃烧。
 - 4) 不可置于微波炉或其他压力容器中，瞬间加热或结构损坏会使电池发热、冒烟、变形或燃烧。
 - 5) 假如发现电池漏液（或有异味），应让电池远离火源。否则，渗漏的电解液会着火，甚至造成其它危险。
 - 6) 假如发现电池有异味、变形、变色或扭曲，应让电池离开手机或充电器并弃用。使用不正常的电池会发热、冒烟、变形或燃烧。
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- 1) Do not mix the battery with other types of primary or secondary batteries. Improper charging or discharging can cause the battery to overheat, smoke, deform, or ignite.
 - 2) Keep the battery out of reach of children to prevent them from biting or swallowing the battery. If a battery is swallowed, seek medical attention immediately.
 - 3) If the charger continues to charge for an unusually long time beyond the normal charging duration, stop charging. Abnormal charging can cause the battery to overheat, smoke, deform, or ignite.
 - 4) Do not place the battery in a microwave or other pressurized containers as sudden heating or structural damage can cause the battery to overheat, smoke, deform, or ignite.
 - 5) If battery leakage is detected (or if there is an unusual odor), keep the battery away from any sources of fire. Leaking electrolyte can ignite and pose additional hazards.
 - 6) If the battery shows any signs of an unusual odor, deformation, discoloration, or distortion, remove the battery from the device or charger and discontinue its use. Using an abnormal battery can result in overheating, smoking, deformation, or combustion.