



-EVE Power CO., LTD Confidential Proprietary-

Model	LF50F	Specification No. 规格书编号	PBRI-LF50F-S01-LF	Version 版本	B
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Product Specification

产品规格书

Prismatic LFP Li-ion Battery

方形铝壳磷酸铁锂电池

Model 型号: LF50F

Drafted by 编制	Product Design Checked by 产品设计审核	Quality Checked by 品质审核	Sales Checked by 销售审核	Approved by 批准
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Company 公司名称:

Approved by 批准:

Date 日期:

August, 2022

EVE Power Co., Ltd 湖北亿纬动力有限公司



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Customer Requirements 客户要求

The specific requirements of customer should be provided and communicated with EVE Power. If the customer has special applications or working conditions other than those described in this specification, EVE can design and manufacture the product according to the customer's special requirements.

要求客户写出他们的需求信息并提前与湖北亿纬动力有限公司沟通。如果客户有一些特别的应用或者操作条件不同于此文件中所描述的,湖北亿纬动力有限公司可以根据客户的特别要求进行产品的设计和生产。

No. 序号	Requirements 特殊要求	Standards 标准
1		
2		
3		
4		
5		

Customer Code 客户代码: _____ Signature 签字: _____ Date 日期: _____



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Term Definition 术语定义

Product: Refers to rechargeable Prismatic LF50F LFP battery with aluminum shell manufactured by EVE Power Co., Ltd. in this specification.

产 品: 本规格书中的“产品”是指湖北亿纬动力有限公司生产的 LF50F 可充电方形铝壳 LFP 锂离子电池。

Customer: Refers to the buyer in the product sales contract signed with EVE.

客 户: 指与湖北亿纬动力有限公司签署产品销售合同中的买方。

Environment temperature: The ambient temperature where the cell is located.

环境温度: 电池所处的周围环境温度。

Cell temperature: The temperature measured by temperature sensor installed at the center of cell surface.

电池温度: 由接入电池表面中心的温度传感器测量的电池的温度。

Fresh battery: Refers to the state of the battery within 30 days from the date of manufacture of the product.

新鲜电池: 指电池自产品生产完成日期算起 30 天以内的状态。

Rate: The ratio of the charge-discharge current to the rated capacity of the battery is indicated by the letter C. For example, if the battery capacity is 50.0Ah, when the charging or discharging current is 25.0A corresponding to the charging or discharging rate of 0.5C.

倍 率: 充/放电电流与电池的额定容量值的比率，用字母 C 表示。例如，电池容量为 50Ah，当充电或放电电流为 25.0A 时，则充电或放电倍率为 0.5C。

State of Charge: Under unloaded conditions, the ratio of the battery capacity state to the rated capacity measured in ampere-hours or watt-hours. The abbreviation is expressed by SOC. For example, if the capacity of 50.0Ah is regarded as 100% SOC, the capacity is 0Ah corresponding to the 0% SOC at a current of 0.5C.

荷电状态: 在无负载的情况下，以安培小时或者以瓦特小时为单位计量的电池容量状态与额定容量的比值，缩写用 SOC 表示。如：若将容量为 50.0Ah 的状态视为 100%SOC，则容量为 0Ah 时，SOC 为 0%（电流为 0.5C）。

Cycle: The battery is charged and discharged once time according to the prescribed charging and discharging standards for a cycle.

循 环: 电池按规定的充放标准充放一次为一个循环。

Standard Charge: The charging mode described in 3.5 of this specification.

标准充电: 本规格书第 3.5 条所述的充电模式。

Standard Discharge: The discharge mode described in 3.6 of this specification.

标准放电: 本规格书第 3.6 条所述的放电模式。

Open Circuit Voltage: The voltage of the battery measured when no load or circuit is connected. The abbreviation is expressed by OCV.

开路电压: 没有接入任何负载和电路时测得的电池的电压，缩写用 OCV 表示。

DC Resistance: The ratio of the voltage change to the corresponding current change under working conditions, the

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abbreviation is DCR, and the test method is as described in section 3.7.3.4 of this specification.

直流内阻:工作条件下电池的电压变化与相应的电流变化之比,缩写用 DCR 表示,测试方法如本规格书第 3.7.3.4 条所述。

Pulse Current: The current or voltage pulses that appear periodically are called pulse currents. The pulse currents appear either in the same direction or in alternating positive and negative directions.

脉冲电流:以周期重复出现的电流或电压脉冲称为脉冲电流,脉冲电流或是以同一方向出现,或是以正、负交替变换方向出现。

Compression Force: When the module is assembled, the safety margin of the compressive force which the battery can withstand.

预紧力:模组组装时,电池可承受压缩力的安全边界。

Units of measurement: Refer to following table

测量单位: 见下表

Table 1 Unit of measurement

表 1 测量单位

No.	Unit 单位	Abbreviation 简写	Type 单位类型
1	Volt 伏特	V	Voltage 电压
2	Ampere 安培	A	Current 电流
3	Ampere-Hour 安培-小时	Ah	Capacity 容量
4	Watt-Hour 瓦特-小时	Wh	Energy 能量
5	Ohm 欧姆	Ω	Resistance 电阻
6	MilliOhm 毫欧姆	m Ω	Resistance 电阻
7	Degree Celsius 摄氏度	$^{\circ}\text{C}$	Temperature 温度
8	Millimeter 毫米	mm	Length 长度
9	Second 秒	s	Time 时间单位
10	Hertz 赫兹	Hz	Frequency 频率

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1. Basic Information 基本信息

1.1. Scope of Application 适用范围

This specification is applied to Prismatic LFP Battery of LF50F with aluminum shell manufactured by EVE Power Co., Ltd.

本产品规格书适用于湖北亿纬动力有限公司生产的 LF50F 方形铝壳锂离子电池。

1.2. Product Type 产品类型

Prismatic lithium-ion battery with aluminum shell 方形铝壳锂离子电池

1.3. Model 产品名称

LF50F

2. Cell Specification 电池规格参数

2.1. Basic Parameters 电池基本参数

Table 2 Basic parameters of battery

表 2 电池基本参数

Items 项目	Parameters 标准	Remarks 备注
Rated. Capacity C ₀ 额定容量 C ₀	50.0Ah	0.5C, 25±2°C, 2.5-3.65V Fresh battery 新鲜电池
Rated. Energy 额定能量	160.0Wh	0.5C, 25±2°C, 2.5-3.65V Fresh battery 新鲜电池
ACR 交流内阻	≤2.0mΩ	AC, 1kHz, 20~50%SOC Fresh battery 新鲜电池
Nominal Voltage 标称电压	3.2V	0.5C, 25°C±2°C, 2.5-3.65V
Weight 重量	1035±100g	/
Charging Cut-off Voltage 充电限制电压(U _{max})	3.65V	/
Discharging Cut-off Voltage 放电截止电压(U _{min})	2.5V (0°C<T<65°C) 2.0V (-20°C<T≤0°C)	/
Charging/ Discharging 充/放电	Standard Charging/Discharging Current 标准充/放电电流	0.5C/0.5C 25°C±2°C

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	Maximum Charging Current 最大充电电流		1C	25°C±2°C	
	Maximum Pulse Discharge Current 最大脉冲放电电流		1.2C	25°C±2°C	
Cycling Performance 循环性能	25°C Standard Cycle 25°C标准循环		1500 Cycles, 0.5C/0.5C	Capacity Retention≥80%. 容量保持率≥80%	
	45°C Standard Cycle 45°C标准循环		1000 Cycles, 0.5C/0.5C	Capacity Retention≥80%. 容量保持率≥80%	
Operation Temperature 工作温度	Charging Temperature 充电温度		0~65°C	/	
	Discharging Temperature 放电温度		-20~65°C	/	
Storage Temperature 存储温度	>1 Month, >1 个月		0~35°C	Delivery SOC State (20~50%) 出货 SOC 状态(20~50%)	
	≤1 Month, ≤1 个月		-20~45°C		

2.2. Product Parameters 产品规格

2.2.1. Dimension and Weight 尺寸、重量指标

Table 3 Battery size and weight index
表 3 电池尺寸重量指标

No.	Items 项目	Parameters 参数	Testing Methods 测试方法章节	
1	Terminal Height 总高(H)	129.8±0.5mm	3.7.1	
	Can-top Height 肩高高度(h)	127.0±0.5mm		
	Width 宽度(L)	148.3±0.5mm		
	Thickness 厚度(T)	26.7±0.5mm (300kgf, Delivery SOC)		
	Center distance of pole 极柱中心距 (l)	114.6±0.3mm		
2	Weight 重量	/	1035±100g	3.7.2

2.2.2. Electrical Performance Index 电性能指标

Table 4 Battery electrical performance index
表 4 电池电性能指标

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No.	Items 项目	Parameters 参数	Testing Methods 测试方法章节		
1	Capacity 容量	25°C, 0.5C Capacity 25°C, 0.5C 容量	≥50.0Ah	3.7.3.1	
2	Temperature Discharge Performance 高低温放电性能	-20°C Capacity Retention -20°C容量保持率	≥50%	3.7.3.2	
		0°C Capacity Retention 0°C容量保持率	≥80%		
		10°C Capacity Retention 10°C容量保持率	≥85%		
		55°C Capacity Retention 55°C容量保持率	≥95%		
3	Rate Discharge Performance 倍率放电性能	25°C, 0.2C Capacity Retention 25°C, 0.2C 容量保持率	≥100%	3.7.3.3	
		25°C, 0.5C Capacity Retention 25°C, 0.5C 容量保持率	≥100%		
		25°C, 1C Capacity Retention 25°C, 1C 容量保持率	≥98%		
4	DCR 直流内阻	25°C_1C_10s@50%SOC	≤3.0mΩ	3.7.3.4	
5	Cycling Performance 循环性能	25°C 0.5C/0.5C, 1500 Cycles 25°C 0.5C/0.5C, 1500 次	Capacity Retention ≥80% 容量保持率≥80%	3.7.3.5	
		45°C 0.5C/0.5C, 1000 Cycles 45°C 0.5C/0.5C, 1000 次	Capacity Retention ≥80% 容量保持率≥80%		
6	Storage Performance 存储性能	100%SOC, 25°C, 28 days 100%SOC, 25°C, 28 天	Capacity Recovery ≥96% 容量恢复率≥96%	3.7.3.6	
		100%SOC, 45°C, 28 days 100%SOC, 45°C, 28 天	Capacity Recovery ≥90% 容量恢复率≥90%		

2.2.3. Safety Performance 安全性能指标

Table 5 Battery safety performance index

表 5 电池安全性能指标

No.	Items 项目	Standard 标准	Testing Methods 测试方法章节
1	External Short-circuit 外部短路	No fire and explosion 不起火、不爆炸	3.7.4.1
2	Impact 重物冲击	No fire and explosion 不起火、不爆炸	3.7.4.2
3	Drop 跌落	No fire and explosion 不起火、不爆炸	3.7.4.3
4	Thermal Abuse 热滥用	No fire and explosion 不起火、不爆炸	3.7.4.4

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5	Overcharge 过充	No fire and explosion 不起火、不爆炸		3.7.4.5	
6	Forced Discharge 强制放电	No fire and explosion 不起火、不爆炸		3.7.4.6	

2.3. Battery Drawing 电池图纸

See Figure 4.

见图 4。

2.4. Appearance 外观

The battery should have no obvious scratches, cracks, rust stains, discoloration, or electrolyte leakage, which have any defects that affect the commercial value of the battery.

电池应无明显擦伤、裂痕、锈渍、变色或电解液泄漏这类对电池商用价值有影响的缺陷。

3. Testing Conditions 试验条件

3.1. Environmental Conditions 环境条件

Unless otherwise specified, the test should be carried out in an environment with a temperature of $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, a relative humidity of 15%~90% RH, and an atmospheric pressure of 86kPa to 106kPa. The ambient temperature mentioned in this specification refers to $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

除另有规定外，试验应在温度为 $25 \pm 2^{\circ}\text{C}$ ，相对湿度 15%-90% RH，大气压力为 86kPa~106kPa 的环境中进行。本规格书所提到的室温，是指 $25 \pm 2^{\circ}\text{C}$ 。

3.2. Measurement Instrument 测量设备

The accuracy of measuring instruments and meters should meet the following requirements:

测量仪器、仪表准确度应满足以下要求：

- 1) Voltage measuring device 电压测量装置: $\pm 0.1\%$;
- 2) Current measuring device 电流测量装置: $\pm 0.1\%$;
- 3) Temperature measuring device 温度测量装置: $\pm 0.5^{\circ}\text{C}$;
- 4) Dimension measuring device 尺寸测量装置: $\pm 0.01\text{mm}$;
- 5) Weight measuring device 重量测量装置: $\pm 0.1\text{g}$.

3.3. Testing Clamp Preparation 测试夹具准备

The single battery needs to be clamped with steel splints or aluminum alloy splints (thickness: $\geq 8\text{ mm}$). The splints need to cover the large surface of the battery. The splints are fixed with 4 M6 bolts. All sides of the splints need to be covered with insulating film, fixtures as shown below:

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单体电池需采用夹板（厚度： $\geq 8\text{mm}$ ）固定，夹板需要覆盖住电池大面，夹板之间采用 4 个 M6 螺栓固定，且夹板各个面均需用绝缘膜包覆，夹具工装如下图所示：

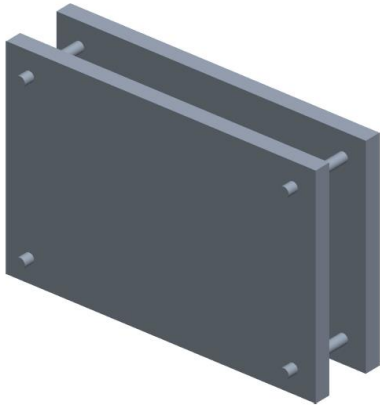


Fig. 1 Schematic diagram of battery clamp
图 1 电池夹具示意图

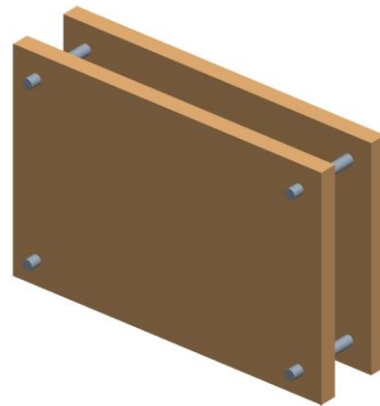


Fig. 2 Insulation film of battery clamp
图 2 电池夹具包绝缘膜示意图

3.4. Testing Clamp Installation 测试夹具安装

Place the battery covered with blue film and top film in the middle of the clamp, and the initial compression force is (200 ± 20) kgf.

将包覆有蓝膜和顶部绝缘片的电池置于夹具中间，初始预紧力为 $(200 \pm 20)\text{kgf}$ 。

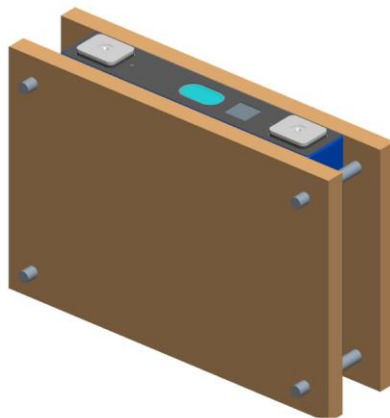


Fig. 3 Side view of battery shaft
图 3 电池轴测图

3.5. Standard Charge 标准充电方式

The battery is charged at a constant current of $0.5C$ to 3.65V under the condition of an ambient temperature of $25^\circ\text{C} \pm 2^\circ\text{C}$, and then transfers to constant voltage charging at 3.65V until the charging current is less than or equal to $0.05C$, and rest for 30min.

标准充电是在环境温度 $25 \pm 2^\circ\text{C}$ 的条件下，对电池以 $0.5C$ 的电流恒流充电至 3.65V ，然后在 3.65V 下转恒压充电，直至充电电流小于等于 $0.05C$ ，搁置 30min。

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3.6. Standard Discharge 标准放电方式

The battery is discharged at 0.5C constant current until the voltage reaches 2.5V cutoff under an ambient temperature of $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, and rest for 30min.

标准放电是在环境温度 $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 的条件下，对电池以 0.5C 的电流恒流放电，放电至电压达到 2.5V 截止，搁置 30min。

3.7. Testing Methods 测试方法

3.7.1. Dimension 尺寸

Testing Instrument 试验设备:

CMM Measuring Instrument CMM 测量仪

Testing Method 试验方法:

Use CMM Measuring instrument to measure the width, height, and thickness (300kgf) of the battery.

使用 CMM 测量仪测量电池宽度、高度和厚度(300kgf 下)。

*The thickness of the battery will increase as the SOC increases, and it will increase along with usage. The thickness in this specification indicates the thickness of the battery at the time of shipment (20%~50% SOC).

*电池厚度随着 SOC 增加会有所增加，随着使用时间增加会有所增加，此处厚度指出货时电芯的厚度(出货时 20~50%SOC)。

3.7.2. Weight 重量

Test Instrument 试验设备:

Electronic Scale 电子秤

Test Method 试验方法:

The weight of the battery is measured by using an electronic scale.

使用电子秤测量电池的重量。

3.7.3. Electrical Performance 电性能

3.7.3.1. 0.5C Discharge Capacity and Energy 0.5C 放电容量和能量

Under the condition of an ambient temperature of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, the battery is discharged to 2.5V and rests for 30min, then charged to 3.65V by standard charge mode (3.5) and then discharged to 2.5V by standard discharge mode (3.6), the final discharge capacity and discharge energy are 0.5C capacity and energy, respectively.

在环境温度 $25 \pm 2^{\circ}\text{C}$ 的条件下，1) 电池以 0.5C 的电流恒流放电至 2.5V，静置 30min；2) 电池按照 (3.5) 进行标准充电；3) 电池按照 (3.6) 进行标准放电，放电容量记录为 0.5C 容量，放电能量记录为 0.5C 能量。

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3.7.3.2. Temperature Discharge Performance 高低温放电性能

- 1) The battery is discharged to 2.5V by standard discharge mode (3.6);
- 2) The battery is charged to 3.65V by standard charge mode (3.5);
- 3) The battery stands at X°C for 4h and then discharged to the corresponding cutoff voltages at a current of 0.5C, rests for 30min, record the discharge capacity C_1 , C_1/C_0 is the capacity retention rate;

4) The battery stands at 25 °C for 4h;

5) Repeats the steps 2~4 to obtain the discharge capacity and capacity retention rate at different temperatures.

Note: the cut-off voltages of x = -20, 0, 10, and 55 °C correspond to 2.0, 2.0, 2.5 and 2.5V, respectively.

- 1) 电池按照 (3.6) 进行标准放电;
- 2) 电池按照 (3.5) 进行标准充电;
- 3) 电池在 X °C环境下搁置 4 小时, 然后以 0.5C 的电流恒流放电至放电截止电压, 静置 30min, 记录放电容量 C_1 , C_1/C_0 即为容量保持率;

4) 将温度调整至 25°C, 静置 4h;

5) 重复 2~4 工步, 得到不同温度的放电容量及容量保持率。

备注: 温度 X=-20, 0, 10 和 55°C对应的截止电压分别为 2.0、2.0、2.5 和 2.5V。

3.7.3.3. Rate Discharge Performance 倍率性能

- 1) The battery is discharged to 2.5V by standard discharge mode (3.6);
- 2) The battery is charged to 3.65V by standard charge mode (3.5);
- 3) The battery stands at 25°C for 4h and then discharged to 2.5V at a current of XC, the discharge capacity is recorded as C_2 , C_2/C_0 is the capacity retention rate;

4) repeats the steps 2-3 to obtain the discharge capacity and capacity retention rate at different rate. (X=0.2, 0.5 and 1.0C).

1) 电池按照 (3.6) 进行标准放电;

2) 电池按照 (3.5) 进行标准充电;

3) 电池在 25°C下搁置 4h, 再以 XC 恒流放电至截止电压 2.5V, 其中放电容量记为 C_2 , C_2/C_0 即为容量保持率;

4) 重复 2~3 工步, 得到不同倍率的放电容量与容量保持率。(X=0.2、0.5 和 1.0C)。

3.7.3.4. Internal Resistance 内阻

a. ACR: When the SOC is 20 %~50 % at ambient temperature of $25 \pm 2^\circ\text{C}$, test the cell with a frequency of AC 1 kHz.

b. DCR: 1) The battery is discharged to 2.5V by standard discharge mode (3.6), 2) The battery is charged to 3.65V by standard charge mode (3.5), 3) The battery is discharged at 0.5C for 1h (adjust the SOC to 50%), rests for

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3h, record the voltage at the end of rest as V_1 ; 4) The battery is discharged at a constant current of 1.0C for 10s, the voltage after discharge is recorded as V_2 ; 5) The DCR is calculated by $(V_1 - V_2) * 1000 / 50.0 \text{m}\Omega$.

a. 交流内阻 (ACR): 在环境温度 $25^\circ\text{C} \pm 2^\circ\text{C}$ 的条件下, 20% ~50%SOC 的电池采用 1kHz 的频率进行测试。

b. 直流内阻 (DCR): 1) 电池按照 (3.6) 进行标准放电; 2) 电池按照 (3.5) 进行标准充电; 3) 电池以 0.5C 的电流恒流放电 1h (调整 SOC 为 50%), 搁置 3h, 记录搁置末期电压 V_1 ; 4) 然后以 1.0C 电流恒流放电 10sec, 记录放电末期电压 V_2 ; 5) 计算 DCR, $\text{DCR} = (V_1 - V_2) * 1000 / 50.0 \text{m}\Omega$ 。

3.7.3.5. Cycling Performance 循环性能

Under the condition of ambient temperature of $25 \pm 2^\circ\text{C}$, prepare the clamp according to (3.3) before the test. When the SOC is shipped at room temperature, install the testing clamp according to the method in (3.4).

1) The battery is discharged to 2.5V at a current of 0.5C and rests for 30min, 2) The battery is placed in $25 \pm 2^\circ\text{C} / 45 \pm 2^\circ\text{C}$ for 4 hours, 3) The battery is charged to 3.65V at a constant current of 0.5C, and then switched to constant voltage charging at 3.65V, until the charging current is less than or equal to 0.05C, rests for 30min, 4) The battery is discharged to 2.5V at 0.5C constant current then rests for 30min, 5) Repeat steps from 3 to 4 until the discharge capacity of step 4 < 80% of the rated capacity, record the number of cycles.

在环境温度 $25 \pm 2^\circ\text{C}$ 的条件下, 测试前按照 (3.3) 进行夹具准备, 在常温下出货态 SOC 时, 按照 (3.4) 的方法安装测试夹具。

1) 电池在 25°C 下以 0.5C 恒流放电至 2.5V, 静置 30min; 2) 电池置于 $25 \pm 2^\circ\text{C} / 45 \pm 2^\circ\text{C}$ 的环境中, 搁置 4h; 3) 电池以 0.5C 的电流恒流充电至 3.65V, 然后在 3.65V 下转恒压充电, 直至充电电流小于等于 0.05C, 搁置 30min; 4) 电池以 0.5C 恒流放电至 2.5V, 搁置 30min; 5) 循环第 3-4 步, 直至第 4 步放电容量 < 80% 额定容量为终止, 记录充放电圈数。

Remarks: When the cycle capacity retention rate decreases by 5%, the charging current 0.5C current value is adjusted to $0.5\text{C} \times (1 - 5\% \times n)$ at this time, $n=0, 1, 2, 3, 4, \dots$, the battery undergo down-current cycles.

备注: 循环容量保持率每衰减 5% 时, 此时充电电流 0.5C 电流值调整为 $0.5\text{C} \times (1 - 5\% \times n)$, $n=0, 1, 2, 3, 4, \dots$, 电芯进行降流循环。

3.7.3.6. Storage Performance 存储性能

Under the condition of ambient temperature of $25 \pm 2^\circ\text{C}$, prepare the clamp according to (3.3) before the test. When the SOC is shipped at room temperature, install the testing clamp according to the method in (3.4).

1) The battery is discharged to 2.5V by standard discharge mode (3.6);

2) The battery is to 3.65V by standard charge mode (3.5), and then the batteries are stored in the temperatures of $25/45^\circ\text{C}$ for 28/ 28 days, respectively;

3) The battery is put aside for 4 hours at an ambient temperature of $25^\circ\text{C} \pm 2^\circ\text{C}$, then the battery is discharged to

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2.5V by standard discharge mode (3.6), record the discharge capacity as C_3 ;

4) The battery is charged to 3.65V by standard charge mode (3.5) and discharged to 2.5V by standard discharge mode (3.6), record the discharge capacity as C_4 ;

Capacity recovery rate= $C_4/C_0 \times 100\%$.

在环境温度 $25 \pm 2^\circ\text{C}$ 的条件下，测试前按照 (3.3) 进行夹具准备，在常温下出货态 SOC 时，按照 (3.4) 的方法安装测试夹具。

- 1) 电池按照 (3.6) 进行标准放电；
- 2) 然后按照 (3.5) 进行标准充电，电池在 $25/45^\circ\text{C}$ 环境下存储 28d/28d；
- 3) 电池存储后取出后在 $25^\circ\text{C} \pm 2^\circ\text{C}$ 下搁置 4 小时，按照标准放电方式 (3.6) 放电（记录放电容量 C_3 ）；
- 4) 按照标准充电方式 (3.5) 充电，用标准放电方式 (3.6) 放电（记录放电容量 C_4 ）。

容量恢复率= $C_4/C_0 \times 100\%$

3.7.4. Safety Performance 安全性能

3.7.4.1. External Short-circuit 外部短路

Under the condition of an ambient temperature of $25^\circ\text{C} \pm 5^\circ\text{C}$, the battery is charged at a constant current of 0.5C to 3.65V, and then transfers to constant voltage charging at 3.65V until the charging current is less than or equal to 0.05C. Then the battery is then short-circuited by connecting the positive and negative terminals with a total external resistance of $30\text{m}\Omega \pm 10\text{m}\Omega$. The battery is to remain on test for 6h or until the case temperature declines by 80% of the maximum temperature rise, whichever is the sooner.

(Refer to IEC 62619:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications).

在环境温度 $25^\circ\text{C} \pm 5^\circ\text{C}$ 的条件下，对电池以 0.5C 的电流恒流充电至 3.65V，然后在 3.65V 下转恒压充电，直至充电电流小于等于 0.05C。在安全试验环境温度下，使用 $30 \pm 10\text{m}\Omega$ 的外部电阻连接正极和负极极柱进行短路，电池在短路的工况下保持 6 小时，或直至壳体的温度下降至最大温度的 80%，上述两个条件满足一种就可以停止测试。

(参考 IEC 62619:2017 《碱性和非酸性电解液电池—工业用二次锂离子电池安全要求》)。

3.7.4.2. Impact 重物冲击

Under the condition of an ambient temperature of $25^\circ\text{C} \pm 5^\circ\text{C}$, the battery is charged at a constant current of 0.5C to 3.65V, and then transfers to constant voltage charging at 3.65V until the charging current is less than or equal to 0.05C. The battery is discharged to 50%SOC at a current of 0.2C.

The battery is placed on a flat concrete or metal floor. A type 316 stainless steel bar with a diameter of 15.8 mm $\pm 0.1\text{mm}$ and at least 60mm in length or the longest dimension of the cell, whichever is greater, is placed across the centre of the cell or cell block. A 9.1kg rigid mass is then dropped from a height of $610\text{mm} \pm 25\text{mm}$ onto

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the bar placed on the sample. And then a cylindrical or prismatic cell is to be impacted with its longitudinal axis parallel to the flat concrete or metal floor and perpendicular to the longitudinal axis of the 15.8 mm diameter curved surface lying across the centre of the test sample. A prismatic battery is also to be rotated 90 degrees around its longitudinal axis so that both the wide and narrow sides will be subjected to the impact. Each sample is to be subjected to only a single impact with separate samples to be used for each impact.

(Refer to IEC 62619:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications).

在环境温度 $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$ 的条件下, 对电池以 0.5C 的电流恒流充电至 3.65V, 然后在 3.65V 下转恒压充电, 直至充电电流小于等于 0.05C, 然后电芯以 0.2 C 电流恒流放电至 50%SOC。

将电芯放置于光滑的水泥地面或金属地面上 (金属地板需采用适当的措施避免电芯与地板发生外部短路), 然后将直径 $\phi = (15.8 \pm 0.1)$ mm, 长度 $L > 60$ mm 和电芯最长尺寸两者中最大值的 316 不锈钢, 放置在电芯中央并与电芯垂直。使用 $m = 9.1$ kg 的物体从高度 $H = (610 \pm 25)$ mm 跌落到钢棒上, 方形的电池要围绕其纵轴旋转 90 度, 以便电池宽面和窄面均收到冲击测试, 每只电池只接受一次冲击。

(参考 IEC 62619:2017 《碱性和非酸性电解液电池—工业用二次锂离子电池安全要求》)。

3.7.4.3. Drop 跌落

Under the condition of an ambient temperature of $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$, the battery is charged at a constant current of 0.5C to 3.65V, and then transfers to constant voltage charging at 3.65V until the charging current is less than or equal to 0.05C. The mass of the battery is less than 7kg, so the battery is dropped so as to obtain impacts in random orientations. The battery is dropped three times from a height of 1.0m onto a flat concrete or metal floor (The metal floor should be taken appropriate measures to avoid external short circuits between battery and the floor).

(Refer to IEC 62619:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications).

在环境温度 $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$ 的条件下, 对电池以 0.5C 的电流恒流充电至 3.65V, 然后在 3.65V 下转恒压充电, 直至充电电流小于等于 0.05C。电池质量小于 7kg, 跌落方向随机。电池在 1.0m 高的位置跌落到平坦的混凝土或金属地板上 (金属地板需采用适当的措施避免电芯与地板发生外部短路) 三次。

(参考 IEC 62619:2017 《碱性和非酸性电解液电池—工业用二次锂离子电池安全要求》)。

3.7.4.4. Thermal Abuse 热滥用

Under the condition of an ambient temperature of $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$, the battery is charged at a constant current of 0.5C to 3.65V, and then transfers to constant voltage charging at 3.65V until the charging current is less than or equal to 0.05C. The full charged battery, stabilized in an ambient temperature of $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$, is placed in a gravity or circulating air-convection oven, the oven temperature is raised at a rate of $5^{\circ}\text{C}/\text{min}\pm 2^{\circ}\text{C}/\text{min}$ to a temperature of $85^{\circ}\text{C}\pm 5^{\circ}\text{C}$. The battery remains at this temperature for 3 h before the test is discontinued.

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(Refer to IEC 62619:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications).

在环境温度 $25 \pm 5^\circ\text{C}$ 的条件下，对电池以 0.5C 的电流恒流充电至 3.65V，然后在 3.65V 下转恒压充电，直至充电电流小于等于 0.05C。将充满电的电芯放置在温度为 $(25 \pm 5)^\circ\text{C}$ 的烘箱中，使温度由 $(25 \pm 5)^\circ\text{C}$ 上升至 $(85 \pm 5)^\circ\text{C}$ ，温度的上升速率为 $(5 \pm 2)^\circ\text{C}/\text{min}$ ，随后将在 $(85 \pm 5)^\circ\text{C}$ 的环境中放置 3 小时。

(参考 IEC 62619:2017 《碱性和非酸性电解液电池—工业用二次锂离子电池安全要求》)。

3.7.4.5. Overcharge 过充

Under the condition of an ambient temperature of $25^\circ\text{C} \pm 5^\circ\text{C}$, the battery is discharged to 2.5V at a current of 0.2C, and then the battery is charged with a constant current equal to the maximum specified charging current of the battery (1.0C) until the voltage reaches 1.2 times the maximum voltage value (3.65V). Then, the charging is terminated. The test shall be continued until the temperature of the battery surface reaches steady state conditions (less than 10°C change in a 30-minute period) or returns to ambient temperature.

(Refer to IEC 62619:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications).

在环境温度 $25 \pm 5^\circ\text{C}$ 的条件下，电池以 0.2C 电流恒流放电至 2.5V，随后使用最大充电电流 (1.0C) 将电池充电至 1.2 倍的最大可持续充电电压 (指 3.65V)。直至温度下降至环境温度或者样品在 30min 内温度变化小于 10°C 时，停止测试。

(参考 IEC 62619:2017 《碱性和非酸性电解液电池—工业用二次锂离子电池安全要求》)。

3.7.4.6. Forced Discharge 强制放电

Under the condition of an ambient temperature of $25^\circ\text{C} \pm 5^\circ\text{C}$, the battery is discharged to 2.5V at a current of 0.2C, and then the battery is forced to discharge at a constant current of 1C for 90 minutes. If the maximum discharge current XC cannot reach 1C, continue to discharge with the maximum discharge current for t min ($t = 1\text{C}/\text{XC} * 90\text{min}$).

If the voltage of the battery reaches the target voltage (-3.65 V) during the test period, the battery voltage should be kept stable for the rest of the time by reducing the discharge current.

(Refer to IEC 62619:2017 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications).

在环境温度 $25 \pm 2^\circ\text{C}$ 的条件下，电池以 0.2C 电流恒流放电至 2.5V。然后 1 C 恒定电流强制放电 90 min，如果最大放电电流 XC 达不到 1C，则用最大放电电流持续放电 t min ($t = 1\text{C}/\text{XC} * 90\text{min}$)；

如果在测试时间段内，电芯的电压达到目标电压 (-3.65 V)，则应该通过降低放电电流，在剩余的时间保持电芯电压稳定。

(参考 IEC 62619:2017 《碱性和非酸性电解液电池—工业用二次锂离子电池安全要求》)。

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4. Charge and Discharge Parameters 充放电参数

4.1. Charge Mode 充电模式

Table 6 Charging mode parameter table

表 6 充电模式参数表

Items 项目	Specification 规格	Condition 条件
Standard charging current 标准充电电流	0.5C	25°C±2°C
Maximum continuous charging current 最大充电可持续电流	1.0C	25°C±2°C
Standard charging cut-off voltage 标准充电截止电压	Single battery ≤ 3.65V 单体电池 ≤ 3.65V	
Standard charging mode 标准充电模式	Refer to section 3.5 参考 3.5 节	
Standard charging temperature 标准充电温度	25°C±2°C	
Absolute charging temperature (battery temperature) 绝对充电温度 (电池温度)	0~65°C	No matter what charging mode the battery is in, once the battery temperature exceeds the absolute charging temperature range, charging will stop 无论电池处于何种充电模式，电芯温度一旦超过绝对充电温度范围，即停止充电
Absolute charging voltage 绝对充电电压	Max 3.65 V 最大 3.65V	No matter what charging mode the battery is in, once the battery voltage exceeds the absolute charging voltage, the charging will stop 无论电池处于何种充电模式，电芯电压一旦超过绝对充电温度范围，即停止充电

4.2. Discharge Mode 放电模式

Table 7 Discharging mode parameter table

表 7 放电模式参数表

Items 项目	Specification 规格	Condition 条件
Standard discharge current 标准放电电流	0.5C	25°C±2°C
Maximum continuous discharge current 最大放电可持续电流	1.0C	25°C±2°C



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Discharge cut-off voltage 放电截止电压	2.5V	Temperature T > 0°C 温度 T > 0°C			
	2.0V	Temperature T ≤ 0°C 温度 T ≤ 0°C			
Standard discharge mode 标准放电模式	Refer to section 3.6 参考 3.6 节				
Standard discharge temperature 标准放电温度	25°C±2°C	/			
Absolute discharge temperature (battery temperature) 绝对放电温度 (电池温度)	-20~65°C	No matter what discharge mode the battery is in, once the battery temperature exceeds the absolute discharge temperature range, the discharge will stop 无论电池处于何种放电模式，电池温度一旦超出绝对放电温度范围，即停止放电			
Absolute discharge voltage 绝对放电电压	Min 2.5V (T > 0°C) Min 2.0V (T ≤ 0°C) 最小 2.5V (T > 0°C) 最小 2.0V (T ≤ 0°C)	No matter what kind of discharge mode the battery is in, once the battery voltage is less than the absolute discharge voltage, it stops discharging 无论电池处于何种放电模式，电池电压一旦小于绝对放电电压，即停止放电			

4.3. Charge Mapping table 充电 Mapping 表

Table 8 Charge Mapping table
表 8 充电 Mapping 表

SOC \ 温度°C	温度°C							
	0	(0~10)	[10~20)	[20~25)	[25~45)	[45~55)	[55~60)	[0~65)
0%~60%	0	0.1	0.2	0.5	1.0	0.5	0.2	0
60%-70%	0	0.1	0.2	0.5	0.8	0.5	0.2	0
70%-80%	0	0.1	0.2	0.5	0.5	0.5	0.2	0
80%-90%	0	0.1	0.2	0.5	0.5	0.5	0.2	0
90%-95%	0	0	0.1	0.3	0.3	0.3	0.2	0
95%-100%	0	0	0	0.1	0.1	0.1	0.1	0

4.4. Pulse Mode 脉冲模式

4.4.1. Pulse Discharge Mode 脉冲放电模式

Table 9 30s Pulse Discharge rate table
表 9 30s 脉冲放电倍率表

30s pulse discharge rate/C 30s 脉冲放电倍率/C																		
SOC\T	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65
100%	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	1.0	1.0	1.0	1.0	0



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95%	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	1.0	1.0	1.0	1.0	0
90%	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	1.0	1.0	1.0	1.0	0
80%	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	1.0	1.0	1.0	1.0	0
70%	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.0	1.0	0.8	0.8	0.5	0
60%	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.5	0
50%	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.5	0
40%	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.5	0
30%	0.3	0.3	0.3	0.5	0.5	0.5	0.8	0.8	0.8	1.0	1.0	1.0	0.8	0.8	0.5	0.5	0.3	0
20%	0.3	0.3	0.3	0.5	0.5	0.5	0.8	0.8	0.8	1.0	1.0	1.0	0.8	0.8	0.5	0.5	0.3	0
10%	0	0	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0
5%	0	0	0	0	0	0	0	0	0.2	0.2	0.2	0	0	0	0	0	0	0
0%	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4.4.2. Pulse Feedback Mode 脉冲回馈模式

Table 10 30s Pulse Feedback rate table

表 10 30s 脉冲回馈倍率表

30s pulse feedback rate/C 30s 脉冲回馈倍率/C															
SOC\T	0	5	10	15	20	25	30	35	40	45	50	55	60	65	
100%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	
95%	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0
90%	0.1	0.1	0.1	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0
80%	0.1	0.1	0.2	0.5	0.5	0.8	0.8	0.8	0.5	0.5	0.5	0.5	0.5	0.1	0
70%	0.2	0.2	0.5	0.5	0.5	0.8	0.8	0.8	0.5	0.5	0.5	0.5	0.5	0.2	0
60%	0.2	0.2	0.5	0.5	0.8	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.2	0
50%	0.2	0.2	0.5	0.8	0.8	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.2	0
40%	0.2	0.2	0.5	0.8	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.2	0
30%	0.3	0.3	0.5	0.8	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.3	0
20%	0.3	0.3	0.5	0.8	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.3	0
10%	0.3	0.3	0.5	0.8	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.3	0
5%	0.3	0.3	0.5	0.8	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.3	0
0%	0.3	0.3	0.5	0.8	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.3	0

5. Safety Limits 安全限制

5.1. Voltage Limits 电压限制

Table 11 Safety limit voltage parameters

表 11 安全限制电压参数

Model	LF50F	Specification No. 规格书编号	PBRI-LF50F-S01-LF	Version 版本	B
Item 项目	Category 类别	Parameters 参数	Protection Action 保护动作		
Charge Voltage 充电电压	First Over-Charging Protection 第一级过充保护	3.70V	Decrease current or power 降流或降功率		
	Second Over-Charging Protection 第二级过充保护	3.80V	Stop charging 停止放电		
Discharge Voltage 放电电压	First Over-Discharging Protection 第一级过放保护	2.0V (T>0°C) 1.9V (-20°C≤T≤0°C)	Decrease current or power 降流或降功率		
	Second Over-Discharging Protection 第二级过放保护	1.9V (T>0°C) 1.8V (-20°C≤T≤0°C)	Stop discharging 停止放电		

5.2. Temperature Limits 温度限制

Table 12 Safety limit temperature parameters

表 12 安全限制温度参数

Item 项目	Specification 规格	Remark 备注
Recommended Operating Temperature Range 推荐使用温度范围	10°C~45°C	Recommended battery usage temperature range. 推荐使用电池的温度范围
Maximum operating temperature 最高使用温度	60°C	If the battery temperature exceeds the maximum operating temperature, the current needs to be reduced to 0. 如果电池使用温度超过最高操作温度, 电流需要降为 0
Minimum operating temperature 最低使用温度	-20°C	If the battery temperature exceeds the minimum operating temperature, the current needs to be reduced to 0. 如果电池使用温度超过最低操作温度, 电流需要降为 0
Maximum safe temperature 最高安全温度	65°C	If the battery temperature exceeds the maximum safe temperature, it will cause irreversible and permanent damage to the battery, and the user should not use it higher than the maximum safe temperature. 如果电池使用温度超过最高安全温度, 将会造成电池不可逆的永久性损坏, 用户使用时不得高于最高安全温度
Minimum safe temperature 最低安全温度	-20°C	If the battery temperature exceeds the minimum safe temperature, it will cause irreversible and permanent damage to the battery, and the user should not lower the minimum safe temperature when using it. 如果电池使用温度超过最低安全温度, 将会造成电池

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		不可逆的永久性损坏，用户使用时不得低于最低安全温度			

6. Battery Operation Instruction and Precautions 电池操作说明及注意事项

6.1. Product End-life Management 产品寿命终止管理

The battery life is limited. Customers should establish an effective tracking system to monitor and record the internal resistance and capacity of each battery during its life. The measurement method and calculation method of internal resistance and capacity need to be discussed and agreed between the customer and EVE Power Co., Ltd. When the internal resistance of the battery in use exceeds 150% of the initial internal resistance of the battery or the capacity is less than 70% of the nominal capacity, the battery should not to operate. Violation of this requirement will exempt EVE Power Co., Ltd. from its responsibility for product quality assurance in accordance with the product sales agreement and this specification.

电池使用期限是有限的，客户应建立有效的跟踪系统监测并记录每个使用期限内电池的内阻和容量。内阻及容量的测量方法和计算方法需要客户和湖北亿纬动力有限公司共同讨论和双方同意。当使用中电池的内阻超过这个电池最初内阻的 150%或容量小于标称容量的 70%，应停止使用电池。违反该项要求，将免除湖北亿纬动力有限公司依据产品销售协议以及本规格书所应承担的产品质量保证责任。

6.2. Long-term Storage 长期存储

After the battery is charged, it should be used as soon as possible to avoid loss of usable capacity due to self-discharge. If storage is required, the battery needs to be stored in a low SOC state, and the battery needs to be charged and discharged every 6 months. The recommended storage conditions are: 20%~50% SOC, 0°C~35°C, relative humidity ≤60%.

电池进行充电后，需尽快使用，以免因自放电而造成可用容量损失。若需要存储，则电池需要在低 SOC 态下进行存储，且每 6 个月对电池进行一次充放电。推荐的存储条件为：20%~50% SOC，0°C~35°C，相对湿度≤60%。

6.3. Transportation 运输

Battery for shipping should be packed in boxes with the SOC of 20%~50%. The severe vibration, impact, extrusion, sun and rain should be prevented during shipping. Applicable methods of transportation include truck, train, ship, airplane, etc.

产品的运输应在不大于 20~50%SOC 下包装成箱进行。在运输过程中应防止剧烈振动、冲击或挤压、避免日晒雨淋。适用于汽车、火车、轮船、飞机等交通工具运输。

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6.4. Operation Precautions 操作说明

- It is strictly forbidden to immerse the battery in water. When it is not in use, it should be placed in a cool and dry environment.
- It is forbidden to use and leave the battery next to heat and high temperature sources, such as fire, heater, etc.
- Please use a special charger for lithium-ion batteries when charging.
- During usage, it is strictly prohibited to reverse the positive and negative terminals of the battery.
- Do not throw the battery in the fire or heater.
- It is forbidden to use metal to directly connect the positive and negative terminals of the battery to short-circuit.
- It is forbidden to transport or store the battery with metal, such as hairpins, necklaces, etc.
- It is forbidden to knock or throw, step on, or bend the battery.
- It is forbidden to directly weld the battery or pierce the battery with nails or other sharp objects.
- It is forbidden to use or place the battery under high temperature (under hot sunlight), otherwise it may cause the battery to overheat or fail to function and shorten its life.
- It is forbidden to use it in places with strong static electricity and strong magnetic fields; otherwise it will easily damage the battery safety protection device and bring hidden dangers of safety.
- If the battery leaks and the electrolyte splashes on the skin or clothes, immediately wash the affected area with running water. If the battery leaks and the electrolyte enters the open parts of the human body such as the eyes, mouth, nose, etc., immediately rinse the eyes with a large amount of water and send to a doctor for treatment immediately, otherwise it will cause serious harm to the human body.
- If the battery emits peculiar smell, heat, discoloration, deformation, or any abnormality during use, storage, or charging, immediately remove the battery from the device or charger and stop using it.
- 严禁将电池浸入水中，保存不用时，应放置于阴凉干燥的环境中
- 禁止将电池在热高温源旁，如火、加热器等使用和留置
- 充电时请选用锂离子电池专用充电器
- 在使用过程中，严禁将电池正负极颠倒
- 禁止将电池丢于火或加热器中
- 禁止用金属直接连接电池正负极短路
- 禁止将电池与金属，如发夹、项链等一起运输或贮存
- 禁止敲击或抛掷、踩踏和弯折电池等
- 禁止直接焊接电池和用钉子或其它利器刺穿电池
- 禁止在高温下（炙热的阳光下）使用或放置电池，否则可能会引起电池过热或功能失效、寿命减短

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- 禁止在强静电和强磁场的地方使用,否则易破坏电池安全保护装置,带来不安全的隐患
- 如果电池发生泄露,电解液进入眼睛,请不要揉擦,应用清水冲洗眼睛,并立即送医治疗,否则会伤害眼睛
- 如果电池发出异味、发热、变色、变形或使用、贮存、充电过程中出现任何异常,立即将电池从装置或充电器中移离并停用

6.5. Disclaimer 免责声明

If the product demanding party does not use the provisions in this manual, which causes social impact and affects the reputation of EVE Power Co., Ltd., EVE Power will pursue the responsibility of the product demanding party. According to the degree of impact on EVE Power, the product demand party must provide compensation to EVE Power.

如果由于产品需求单位不按本说明书中的规定进行使用,造成社会性影响,并对湖北亿纬动力有限公司的声誉造成影响的,湖北亿纬动力有限公司将会追究产品需求单位的责任。根据对湖北亿纬动力有限公司造成的影响程度,产品需求单位需向湖北亿纬动力有限公司提供赔偿。

6.6. Other 其它

Any matters not mentioned in this specification must be negotiated and determined by both parties.
任何本规格书中未提及的事项,须经双方协商确定。

7. Contact Information 联系方式

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8. LF50F Drawing LF50F 电池图纸

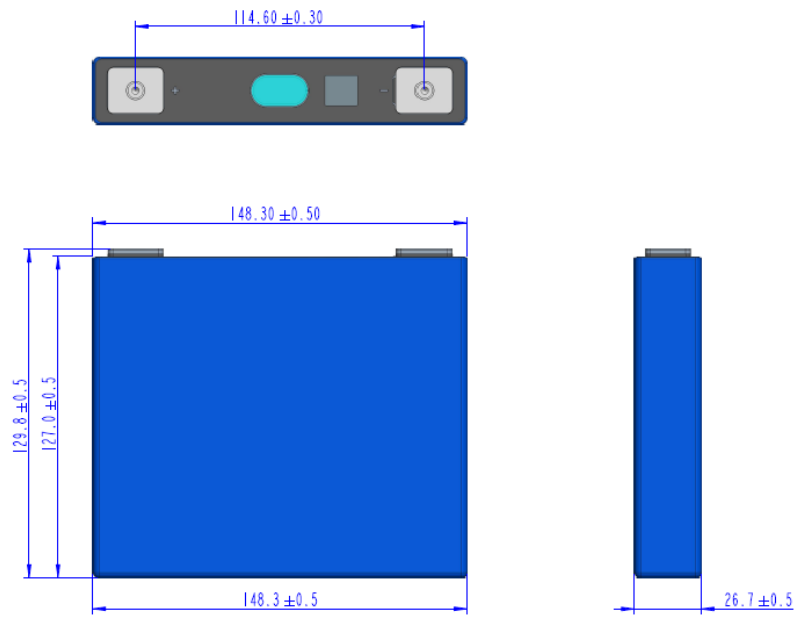


Fig.4 Cell Drawing of LF50F

图 4 LF50F 电池图纸