



Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### Customer Requirements

Customers need to communicate and reach an agreement with EVE Power Co., Ltd. regarding special needs beyond the product specifications. For example, if special applications and operation conditions are not consistent with the description in this specification, EVE design and manufacture products according to customer's special requirements

No.	Special Requirements	Standards
1		
2		
3		
4		
5		

**Customer Code** : \_\_\_\_\_ **Signature** : \_\_\_\_\_ **Date** \_\_\_\_\_

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### Revision History

Version	Date	Contents	Checked By
A	2021.07.12	First issue	Hanchen Chen
B	2022.01.26	<ol style="list-style-type: none"> <li>1. Make a distinction between standard charge-discharge ratio and continuous charge-discharge ratio;</li> <li>2. Add the term definition of normal capacity and AC resistance;</li> <li>3. Add the center distance of cell poles;</li> <li>4. Increase the cell cycles to 2000 at 45 °C;</li> <li>5. Complete the cautions of battery in use.</li> </ol>	Hanchen Chen
C	2022.03.10	<ol style="list-style-type: none"> <li>1. Add the definition of “fresh battery” and supplement the definitions of “cell temperature” and “charging rate”;</li> <li>2. The initial internal resistance standard in the product performance index is changed to “0.32 mΩ ± 0.05 mΩ, AC, 1 kHz, 30% ~ 40% SOC, fresh battery”;</li> <li>3. Revision the safety limit parameters;</li> <li>4. Revision the charge and discharge parameters;</li> <li>5. Revision the testing methods of storage;</li> <li>6. Revision the standard of discharge performance;</li> <li>7. Add pretreatment before battery test.</li> </ol>	
D	2022.11.08	<ol style="list-style-type: none"> <li>1. Add product implementation standards;</li> <li>2. Add the battery performance parameters;</li> <li>3. Add batch definition and traceability requirements;</li> <li>4. Improve transportation and loading and unloading requirements and storage environment and method requirements;</li> <li>5. Add the confidentiality agreement;</li> <li>6. Add the rights and obligations of both parties.</li> </ol>	Hanchen Chen
E	2023.05.31	Adjust chapter content according to the latest EVE specification template.	

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

## Contents

### Customer Requirements

### Revision History

### Term Definitions

## 1 Fundamental Information

- 1.1 Scope of Application
- 1.2 Product Type
- 1.3 Product Model

## 2 Cell Specification and Parameters

- 2.1 Basic Specifications and Parameters
- 2.2 Electrical Performance Parameters
- 2.3 Safety Performance Parameters
- 2.4 Cell Drawing
- 2.5 Appearance

## 3 Test Conditions and Methods

- 3.1 Environmental Conditions
- 3.2 Measuring Instrument
- 3.3 Test Clamp Preparation and Installation
- 3.4 Dimensions
- 3.5 Weight
- 3.6 Internal Resistance
- 3.7 Pretreatment
- 3.8 Standard Charge
- 3.9 Standard Discharge
- 3.10 1C Capacity Calibration 1C
- 3.11 Rate Discharge Performance
- 3.12 High/Low Temperature Discharge Performance
- 3.13 The Capacity Retention and Recovery
- 3.14 Storage
- 3.15 Cycle Life
- 3.16 Swelling Force Test
- 3.17 Safety Performance

## 4 Cell Application Instructions

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

- 4.1 Welding Parameters Recommendation
- 4.2 Charge and Discharge Parameters
- 4.3 Safety Limits
- 4.4 Parameters Recommendation for Module Design
- 4.5 Thermodynamic Parameters

## 5 Precautions

- 5.1 Product End-life Management
- 5.2 Long-term Storage
- 5.3 Transportation and Handling Requirements
- 5.4 Operation Precautions
- 5.5 Confidentiality Agreement 保
- 5.6 Risk Warning

## 5.7 Disclaimer

## 6 Others

- 6.1 Rights and Obligations of EVE EVE
- 6.2 Rights and Obligations of Customer
- 6.3 Language Conflict Clause

## 7 Contact Information

### Appendix: Cell Drawing of LF105

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

## Term Definitions

**Product:** Refers to the LF105 rechargeable lithium-ion cell with prismatic aluminum shell manufactured by EVE Power Co., Ltd. (hereinafter referred to as EVE) in this specification.

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

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

**Cell temperature:** The temperature measured by temperature sensor installed at the center of cell surface. The selection of temperature sensor and measuring line shall be jointly agreed by EVE and the customer.

**Fresh cell:** Refers to cell within 7 days after production.

**Charging Rate:** The ratio of the charging current to the capacity which measured by the battery management system. For example, if the cell capacity is 105 Ah and the charging current is 52.5 A, the charging rate is 0.5C. If the cell capacity drops to 100 Ah and the charging current is 50 A, the charging rate is 0.5C.

**State of charge:** Under unloaded conditions, the ratio of the cell capacity state to the nominal capacity measured in ampere-hour or watt- hour. The abbreviation is expressed by SOC. For example, if the capacity at 105 Ah considered as 100% SOC, the capacity at 0 Ah, considered as 0% SOC.

**State of health:** The ratio of actual cell capacity to nominal capacity, the abbreviation is expressed by SOH. For example, if the cell capacity at 105 Ah considered as 100% SOH, the cell capacity decays to 84 Ah, considered as 80% SOH.

**Cycle:** The cell shall be charged and discharged once according to the specified charging and discharging standards as a cycle. The cycle includes short-term normal charging or a combination of regenerative charging and discharging processes. In the charging process, sometimes there is only normal charging and no regenerative charging. The discharge can be formed by combining some partial discharges.

**Standard charge:** The charging mode described in 3.8 of this specification.

**Standard discharge:** The discharging mode described in 3.9 of this specification.

**Open circuit voltage:** The voltage of the cell measured when unloaded or circuit is disconnected. The abbreviation is expressed by OCV.

**AC resistance:** Apply 1kHz sine wave current between the positive and negative poles of the cell, and the internal resistance obtained, which abbreviated as ACR. The test method is as described in section 3.6 of this specification.

**DC resistance:** The ratio of the voltage changes to the corresponding current change under working conditions, and the abbreviation is DCR. The test method is as described in section 3.6 of this specification.

**Module:** The intermediate product between single cell and pack, which is formed by lithium-ion cells in series and parallel after installing cell monitors and management devices.

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

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

**Compression force:** When the module is assembled, the cell can withstand the force perpendicular to the cell stacking direction.

**Swelling force:** The inherent characteristics such as the rebound of the electrode thickness may lead to cell expansion during use which generates force on the clamp.

**Units of measurement:** Refer to following table

Table 1 Units of measurement

No.	Units	Abbreviation	Type of units
1	Volt	V	Voltage
2	Ampere	A	Current
3	Ampere-Hour	Ah	Capacity
4	Watt-Hour	Wh	Energy
5	Ohm	$\Omega$	Resistance
6	Milliohm	m $\Omega$	Resistance
7	Degree Celsius	$^{\circ}\text{C}$	Temperature
8	Millimeter	mm	Length
9	Second	s	Time
10	Hertz	Hz	Frequency
11	Newton	N	Force
12	Kilogram-Force	kgf	Force

## 1 Fundamental Information

### 1.1 Scope of Application

This document describes the specification of the LF105 lithium-ion cell manufactured by EVE Power Co., Ltd.

### 1.2 Product Type: Prismatic lithium-ion cell with aluminum shell.

### 1.3 Product Model: LF105

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

## 2 Cell Specification and Parameters

### 2.1 Basic Specifications and Parameters

Table 2 Basic specifications and parameters

Items	Specification	Notes
Nominal Capacity	105.0 Ah	0.5C / 0.5C, 25°C ± 2°C, 2.5 V ~ 3.65 V, Fresh cell
Nominal Energy	336.0 Wh	
Nominal Voltage	3.2 V	0.5C discharge, 25°C ± 2°C, 2.5 V ~ 3.65 V
End-off-charge Voltage	3.65 V	/
End-off-discharge Voltage	2.5 V (T > 0°C) 2.0 V (T ≤ 0°C)	/
Standard Charging Current	52.5 A	0.5C
Maximum Instantaneous Charging Current	2C	30 s, ≤ 80% SOC, 25°C ± 2°C
Standard Discharging Current	52.5 A	0.5C
Maximum Instantaneous Discharging Current	3C	30 s, ≥ 30% SOC, 25°C ± 2°C
Initial IR	0.32 mΩ ± 0.05 mΩ	AC, 1 kHz, 19% ~ 40% SOC, Fresh cell
Direct Current Resistance (DCR)	≤ 1.8 mΩ	25°C, 50% SOC, 1C, 10 s, Fresh cell
Weight	1980 g ± 60 g	/

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

Dimension (With Insulation Film)	Terminal Height 1 (H1)	200.50 mm ± 0.50 mm	With Terminal
	Can-top Height 2 (H2)	195.50 mm ± 0.50 mm	Without Terminal
	Length	130.30 mm ± 0.50 mm	/
	Thickness (T)	36.35 mm ± 0.50 mm	(300 kgf ± 20 kgf compression force, Delivery SOC)
	Center Distance between Poles	67 mm ± 1 mm	/
Operation Temperature	Charge Temperature	-10°C~65°C	/
	Discharge Temperature	-35°C~65°C	/
Storage Temperature	3 months	0°C ~ 35°C	Delivery SOC
	1 month	-20°C ~ 45°C	
Swelling force at EOL		≤ 30000 N	80% SOH



Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

2.2 Electrical Performance Parameters

Table 3 Electrical performance parameters

Items	Specifications			Testing Methods
Rate Discharge Performance	Items	Discharging Capacity	Capacity Retention	/
	Rate			
	1C	C <sub>0</sub>	100%	
	0.5C	C <sub>1</sub>	C <sub>1</sub> / C <sub>0</sub> ≥ 98%	3.11
High/Low Temperature Discharge Performance	Items	Discharging Capacity	Capacity Retention	3.12
	Temp.			
	-20°C	C <sub>2</sub>	C <sub>2</sub> / C <sub>0</sub> ≥ 75%	
	0°C	C <sub>3</sub>	C <sub>3</sub> / C <sub>0</sub> ≥ 85%	
	25°C	C <sub>0</sub>	100%	
	45°C	C <sub>4</sub>	C <sub>4</sub> / C <sub>0</sub> ≥ 97%	
	55°C	C <sub>5</sub>	C <sub>5</sub> / C <sub>0</sub> ≥ 97%	
The Capacity Retention and Recovery (100% SOC)	Items	Capacity Retention	Capacity Recovery	3.13
	Temp.			
	25°C & 28days	≥ 96% * C <sub>0</sub>	≥ 97% * C <sub>0</sub>	
	45°C & 28days	≥ 93% * C <sub>0</sub>	≥ 95% * C <sub>0</sub>	
	55°C & 7days	≥ 95% * C <sub>0</sub>	≥ 96% * C <sub>0</sub>	
Storage (50% SOC)	Items	Capacity Recovery		3.14
	Temp.			
	25°C & 28days	≥ 98% * C <sub>0</sub>		
	45°C & 28days	≥ 97% * C <sub>0</sub>		
Cycle Life	25°C Cycle 25°C	4000 cycles, 80% SOH, 25°C		3.15
	45°C Cycle 45°C	2000 cycles, 80% SOH, 45°C		

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 2.3 Safety Performance Parameters

Table 4 Safety performance parameters

Items	Specifications	Testing Methods
Over-discharge	No fire, No explosion	3.17.1
Over-charge	No fire, No explosion	3.17.2
External Short-circuit	No fire, No explosion	3.17.3
Heating	No fire, No explosion	3.17.4
Temperature Cycling	No fire, No explosion	3.17.5
Crush Test	No fire, No explosion	3.17.6

### 2.4 Cell Drawing: See Appendix

#### 2.5 Appearance

The cell shall not have any defects that may affect their commercial values, including obvious scratches, cracks, rust stains, discoloration, or electrolyte leakage.

## 3 Test Conditions and Methods

### 3.1 Environmental Conditions

Unless otherwise specified, the test should be carried out in an environmental temperature of  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ , relative humidity of 10% ~ 90%, and atmospheric pressure of 86 kPa to 106 kPa. The room temperature mentioned in this specification refers to  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ .

### 3.2 Measuring Instrument

The accuracy of measuring device should meet the following requirements:

- A. Voltage measuring device  $\pm 0.05\text{ \%FS}$ ;
- B. Current measuring device  $\pm 0.05\text{ \%FS}$ ;
- C. Temperature measuring device  $\pm 1\text{ }^{\circ}\text{C}$ ;
- D. Dimension measuring device  $\pm 0.01\text{ mm}$ ;
- E. Weight measuring device  $\pm 0.1\text{ g}$

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

Note: During the testing process, voltage, current, ambient temperature, and cell temperature must be recorded. It is recommended to collect the cell temperature at the terminal and the center of large surface (or side).

### 3.3 Test Clamp Preparation and Installation

#### 3.3.1 Ordinary Steel Clamp

The single cell shall be clamped with steel splints (thickness: 8 mm). The splints need to cover the large surfaces of the cell and be fixed with 6 M6 bolts. All sides of the splints need to be covered with insulating film. Clamp as shown below:

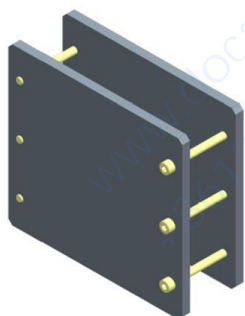


Fig. 1 Diagram of cell clamp

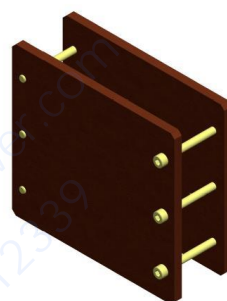


Fig. 2 Diagram of the clamp covered with insulation film

Place the cell (15% ~ 40% SOC) which is covered with blue film (material: PET, thickness: 0.1mm) and top film (material: PC, thickness: 0.3 mm) in the middle of the splint, fix the steel fixture with 6 M6 bolts to ensure that the initial preload of the cell on the fixture is 300 kgf  $\pm$  20 kgf. Then use a micrometer to measure the thickness of the cell (at upper, middle and lower) with splints, and the thickness tolerance shall be controlled within 0.3 mm.

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---



Fig. 3 Diagram of cell filming

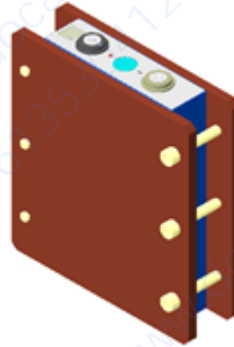


Fig. 4 Diagram of cell with clamp

### 3.3.2 Swelling force clamp

Place the cell (15% ~ 40% SOC) which is covered with blue film (material: PET, thickness: 0.1mm) and top film

(material: PC, thickness: 0.3 mm) in the middle of the splint, adjusting Swelling force clamp pretensioning device and the initial compression force is (300 kgf  $\pm$  20 kgf). Then use a micrometer to measure the thickness of the cell (at upper, middle and lower) with splints, and the thickness tolerance shall be controlled within 0.3 mm.

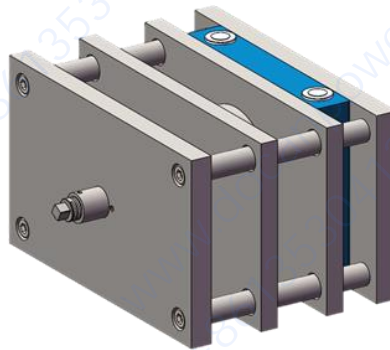


Fig. 5 Diagram of cell with swelling force clamp

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 3.4 Dimensions

Test instrument: Automatic wrapping machine;

Test method: Use the wrapping machine to measure the length, width and height of the cell. And apply a 300 kgf  $\pm$ 20 kgf force on it.

The thickness of the cell will increase as the SOC increases as well as with the using time. The thickness here indicates the thickness of the cell at the time of delivery.

### 3.5 Weight

Test instrument: electronic scale;

Test method: measure the weight of the cell by electronic scale.

### 3.6 Internal Resistance

a.ACR: test the cell at delivery SOC with 1kHz sine wave current at room temperature.

b.DCR: Capacity calibration is carried out according to 3.10. Charge cell to 3.65 V with constant current of 1C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05C. Rest for 30 min, and discharge with constant current of 0.5C for 60 min afterwards (adjust the SOC to 50%). Then rest for 1 h, and record the voltage  $V_1$  at the end of the period. Put a 10 s discharge pulse current of 1C and record the voltage  $V_2$  at the end of the pulse, and calculate the DCR.,  $DCR = (V_1 - V_2) \times 1000 / 105$  (m $\Omega$ ).

### 3.7 Pretreatment

Before the formal test, pretreat the cell to ensure it is activated and stable. The steps are as follows:

- Charge the cell according to the standard charging mode;
- Discharge the cell according to the standard discharging mode;
- Repeat a~b no more than 5 times;

If the discharge capacity of the cell changes no more than 3% of the nominal capacity for two consecutive times, it is considered that the cell has completed the pretreatment, and the pretreatment cycle can be terminated.

### 3.8 Standard Charge

Charge cell to 3.65 V with constant current of 0.5C at ambient temperature of  $25^\circ\text{C} \pm 2^\circ\text{C}$ , then charge at constant voltage of 3.65 V until the current decreases to 0.05C, and rest for 30 min.

### 3.9 Standard Discharge

Discharge the cell to 2.5 V with constant current of 0.5C at ambient temperature of  $25^\circ\text{C} \pm 2^\circ\text{C}$ , and rest for 30 min

#### 3.10 1C Capacity Calibration 1C

Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $25^\circ\text{C} \pm 2^\circ\text{C}$  (constant temperature without air convection). Then charge at constant voltage of 3.65 V until the current decreases to 0.05C, rest for 30 min. After that, discharge the cell to 2.5 V with constant current of 1C, lastly rest for 30 min. Repeat the above steps 5 times, and the average discharge capacity of the last 3 times is the 1C discharge capacity, which is recorded as  $C_0$ .

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 3.11 Rate Discharge Performance

Capacity calibration is carried out according to 3.10. Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , and then charge at constant voltage of 3.65 V until the current decreases to 0.05C. After that, rest for 30 min, and discharge it to 2.5 V with constant current of 0.5C. Discharge capacity is recorded as  $C_1$ , and  $C_1 / C_0 \times 100\%$  is the capacity retention rate at 0.5C.

### 3.12 High/Low Temperature Discharge Performance

#### 3.12.1 $-20^{\circ}\text{C}$ Capacity Retention Rate

Capacity calibration is carried out according to 3.10. Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , and then charge at constant voltage of 3.65 V until the current decreases to 0.05C. After that, rest the cell at  $-20^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 24 h, and discharge it to 2.0 V with constant current of 1C under the environment of  $-20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Discharge capacity is recorded as  $C_2$ , and  $C_2 / C_0 \times 100\%$  is the capacity retention rate at  $-20^{\circ}\text{C}$ .

#### 3.12.2 $0^{\circ}\text{C}$ Capacity Retention Rate $0^{\circ}\text{C}$

Capacity calibration is carried out according to 3.10. Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , and then charge at constant voltage of 3.65 V until the current decreases to 0.05C. After that, rest the cell at  $0^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 24 h, and discharge it to 2.0 V with constant current of 1C under the environment of  $0^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Discharge capacity is recorded as  $C_3$ , and  $C_3 / C_0 \times 100\%$  is the capacity retention rate at  $0^{\circ}\text{C}$ .

#### 3.12.3 $45^{\circ}\text{C}$ Capacity Retention Rate

Capacity calibration is carried out according to 3.10. Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , and then charge at constant voltage of 3.65 V until the current decreases to 0.05C. After that, rest the cell at  $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 5 h, and discharge it to 2.5 V with constant current of 1C under the environment of  $45^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Discharge capacity is recorded as  $C_4$ , and  $C_4 / C_0 \times 100\%$  is the capacity retention rate at  $45^{\circ}\text{C}$ .

#### 3.12.4 $55^{\circ}\text{C}$ Capacity Retention Rate

Capacity calibration is carried out according to 3.10. Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , and then charge at constant voltage of 3.65 V until the current decreases to 0.05C. After that, rest the cell at  $55^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 5 h, and discharge it to 2.5 V with constant current of 1C under the environment of  $55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Discharge capacity is recorded as  $C_5$ , and  $C_5 / C_0 \times 100\%$  is the capacity retention rate at  $55^{\circ}\text{C}$ .

### 3.13 The Capacity Retention and Recovery

#### 3.13.1 $25^{\circ}\text{C}$ Capacity Retention and Recovery

Capacity calibration is carried out according 3.10. Charge the cell to 3.65 V with constant current of 1C, then switching to constant voltage charging at 3.65 V until the charging current reaches 0.05C, and rest for 28 days afterwards at ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Discharge the cell to 2.5 V with constant current of 1C at ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  (record the discharge capacity as  $C_6$ ), and rest for 30 min. Then charge it to 3.65 V with constant current of 1C, switching to constant voltage charging when the cut-off current is 0.05C, and rest for 30 min. Then discharge to 2.5 V with constant current of 1C (record the discharge capacity  $C_7$ ). Capacity retention rate= $C_6 / C_0 \times 100\%$ , capacity recovery rate= $C_7 / C_0 \times 100\%$ .



-EVE Power Co., Ltd. Confidential Proprietary-

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 3.13.2 45°C Capacity Retention and Recovery

Capacity calibration is carried out according 3.10. Charge the cell to 3.65 V with constant current of 1C, then switching to constant voltage charging at 3.65 V until the charging current decreases to 0.05C, and rest for 28 days afterwards at ambient temperature of 45°C ± 2°C. Rest for 5h at ambient temperature of 25°C ± 2°C, and then discharge the cell to 2.5 V with constant current of 1C (record the discharge capacity C<sub>8</sub>). After rest for 30 min, charge it to 3.65 V with constant current of 1C, and switch to constant voltage charging when the cut-off current is 0.05C. Rest for 30 min, and then discharge to 2.5 V with constant current of 1C (record the discharge capacity C<sub>9</sub>). Capacity retention rate= C<sub>8</sub> / C<sub>0</sub> × 100 %, capacity recovery rate= C<sub>9</sub> / C<sub>0</sub> × 100 %.

### 3.13.3 55°C Capacity Retention and Recovery 55°C

Capacity calibration is carried out according 3.10. Charge the cell to 3.65 V with constant current of 1C, then switching to constant voltage charging at 3.65 V until the charging current decreases to 0.05C, and rest for 7 days at ambient temperature of 55°C ± 2°C. Rest for 5h at ambient temperature of 25°C ± 2°C, and discharge the cell to 2.5 V with constant current of 1C (record the discharge capacity C<sub>10</sub>). After rest for 30 min, then charge it to 3.65 V with constant current of 1C, and switch to constant voltage charging when the cut-off current is 0.05C. Rest for 30 min, and then discharge to 2.5 V with constant current of 1C (record the discharge capacity C<sub>11</sub>). Capacity retention rate= C<sub>10</sub> / C<sub>0</sub> × 100 %, capacity recovery rate=C<sub>11</sub> / C<sub>0</sub> × 100 %.

## 3.14 Storage

### 3.14.1 25°C Storage

Capacity calibration is carried out according 3.10. Charge the cell to 3.65 V with constant current of 1C, switching to constant voltage charging until the cut-off current is 0.05C, and rest for 30 min. Then discharge cell to 2.5 V with constant current of 1C. Rest for 28 days at ambient temperature of 25°C ± 2°C. Discharge the cell to 2.5 V with constant current of 1C at ambient temperature of 25°C ± 2°C, and rest for 30 min. Then charge it to 3.65 V with constant current of 1C, switching to constant voltage charging until the cut-off current is 0.05C, and rest for 30 min. Then discharge to 2.5V with constant current of 1C (record the discharge capacity C<sub>12</sub>). Capacity recovery rate=C<sub>12</sub> / C<sub>0</sub> × 100%.

### 3.14.2 45°C Storage

Capacity calibration is carried out according 3.10. Charge the cell to 3.65 V with constant current of 1C, switching to constant voltage charging until the cut-off current is 0.05C, and rest for 30 min. Then discharge cell to 2.5 V with constant current of 1C. Rest for 28 days at ambient temperature of 45°C ± 2°C. Rest for 5h at ambient temperature of 25°C ± 2°C, and discharge the cell to 2.5 V with constant current of 1C. Rest for 30 min, charging it to 3.65 V with constant current of 1C, and switch to constant voltage charging until the cut-off current is 0.05C. Rest for 30 min, and then discharge to 2.5 V with constant current of 1C (record the discharge capacity C<sub>13</sub>). Capacity recovery rate= C<sub>13</sub> / C<sub>0</sub> × 100%.



Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 3.15 Cycle Life

#### 3.15.1 25°C 0.5C / 0.5C Cycle 25°C 0.5C / 0.5C

Before the test, prepare and install the clamp according to 3.3.1.

Initial capacity test before cycling: test the cell capacity according to (3.10). and record the initial capacity as  $C_0$ .

Cycle test: ambient temperature  $25^\circ\text{C} \pm 2^\circ\text{C}$ ;

- a. Charge the cell to 3.65 V with constant current of 0.5C, and then charge at constant voltage of 3.65 V until the current decreases to 0.05C and rest for 30 min;
- b. Discharge to 2.5 V with constant current of 0.5C and rest for 30 min;
- c. 4000 cycles according to steps a ~ b.

Capacity test after cycle: discharge the cell to 2.5 V with constant current of 0.5C at ambient temperature of  $25^\circ\text{C} \pm 2^\circ\text{C}$ . Rest for 30 min, then charging it to 3.65 V with constant current of 0.5C, and switch to constant voltage charging until the cut-off current is 0.05C. Rest for 30 min, then discharging to 2.5 V with constant current of 0.5C, and record the discharge capacity  $C_{14}$ . The capacity retention rate =  $C_{14} / 105 \times 100\%$ .

#### 3.15.2 45°C 0.5C / 0.5C Cycle 45°C

Before the test, prepare and install the clamp according to 3.3.1.

Initial capacity test before cycling: test the cell capacity according to (3.10). and record the initial capacity as  $C_0$ .

Cycle test: ambient temperature  $45^\circ\text{C} \pm 2^\circ\text{C}$ ;

- a. Charge the cell to 3.65 V with constant current of 0.5C, then switching to constant voltage charging until the cut-off current is 0.05C, and rest for 30 min;
- b. Discharge to 2.5 V with constant current of 0.5C and rest for 30 min;
- c. 2000 cycles according to steps a ~ b.

Capacity test after cycle: discharge the cell to 2.5 V with constant current of 0.5C at ambient temperature of  $25^\circ\text{C} \pm 2^\circ\text{C}$ . Rest for 30 min, then charging it to 3.65 V with constant current of 0.5C, and switch to constant voltage charging until the cut-off current is 0.05C. Rest for 30 min, then discharging to 2.5 V with constant current of 0.5C, and record the discharge capacity  $C_{15}$ . The capacity retention rate =  $C_{15} / 105 \times 100\%$ .

#### 3.15.3 Recommend EVE Cycling Method EVE

Before the test, prepare and install the clamp according to 3.3.1.

Initial capacity test before cycling: test the cell capacity according to (3.10). and record the initial capacity as  $C_0$ .

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

3.15.3.1 Steps of 25 °C Staged Charging Cycle 25 °C

- a. Ambient temperature at 25°C ± 2°C;
- b. With 1C constant current charging capacity as 80% C<sub>0</sub>;
- c. 0.8C constant current charging to 3.5 V;
- d. 0.5C constant current charging to 3.6 V;
- e. 0.1C constant current charging to 3.65 V;
- f. Rest for 30 min in an open circuit state, discharge to 2.5 V with constant current of 1C, and rest for 30 min;
- g. Repeat steps from b to f. When the cycle capacity retention rate decreases by 5%, the current value of 1C is

adjusted to  $1C \times (1 - 5\% \times n)$ , n=1, 2, 3, 4, ...; ensure the charging time remains the same every 5% decay, and the specific steps are shown in the corresponding charging and discharging ammeter of the staged charging cycle;

- a. Ambient temperature 45°C ± 2°C;
- b. With 1C constant current charging capacity as 80% C<sub>0</sub>;
- c. 0.8C constant current charging to 3.5 V;
- d. 0.5C constant current charging to 3.6 V;
- e. 0.1C constant current charging to 3.65 V;
- f. Rest for 30 min in an open circuit state, discharge to 2.5 V with constant current of 1C, and rest for 30 min;
- g. Repeat steps from b to f. When the cycle capacity retention rate decreases by 5%, the current value of 1C is adjusted to  $1C \times (1 - 5\% \times n)$ , n=1, 2, 3, 4, ...; ensure the charging time remains the same every 5% decay, and the specific steps are shown in the corresponding charging and discharging ammeter of the staged charging cycle;
- h. 2000 cycles according to steps b ~ g.

Corresponding Charging Current Table for Staged Charging Cycle:

Table 5 Corresponding charging current meter for stepped charging cycle

Items	Current/Capacity	Current capacity / calibrated capacity × 100% (SOH)			
		> 95%	[95% ~ 90%)	[90% ~ 85%)	[85% ~ 80%)
Charging Current (A)	1C	105.0	99.75	94.5	89.25
	0.8C	84	79.8	75.6	71.4
	0.5C	52.5	49.88	47.25	44.63
	0.1C	10.5	9.98	9.45	8.9
Discharging Current (A)	1C	105.0	105.0	105.0	105.0
1C constant Current Charge to 80% C <sub>0</sub> ;		80% C <sub>0</sub>	76% C <sub>0</sub>	72% C <sub>0</sub>	68% C <sub>0</sub>

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

Notes: When the cycle capacity retention rate decreases by 5%, the charging current 1C / 0.8C / 0.5C / 0.1C current value is adjusted to  $1C / 0.8C / 0.5C / 0.1C \times (1 - 5\% \times n)$  at this time,  $n=0, 1, 2, 3, 4, \dots$ ; set the current according to the charging and discharging ammeter corresponding to the stepped charging.

Prepare and install the clamp according to 3.3.2. before the test.

Cycle according to (3.15.3.1) and record cell swelling force during test process.

### 3.17 Safety Performance

#### 3.17.1 Over-discharge

Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and then switch to constant voltage charging at 3.65 V until the charging current decreases to 0.05C. Discharge the cell with constant current of 1C for 90 min at  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$  of safety test. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction cell safety requirements)

#### 3.17.2 Over-charge

Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and switch to constant voltage charging at 3.65 V until the charging current reaches 0.05C, then installing the test clamp according to 3.3.1. After charge the cell to 1.1 times of the termination voltage, or 115% SOC with constant current of not less than  $1/3\text{C}$  at the safety test ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , stop charging. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction cell safety requirements)

Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and then switch to constant voltage charging at 3.65 V until the charging current reaches 0.05C. The positive and negative terminals of the cell are short-circuited externally for 10 min under the safety test ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and the resistance of the external circuit should be less than 5 m $\Omega$ . Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction cell safety requirements)

Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and then switch to constant voltage charging at 3.65 V until the charging current reaches 0.05C. Put the cell into the temperature chamber, and the temperature chamber will rise from room temperature to  $130^{\circ}\text{C} \pm 2^{\circ}\text{C}$  at a rate of 5  $^{\circ}\text{C}/\text{min}$ , and keep this temperature for 30 min before stop heating. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction cell safety requirements)

#### 3.17.5 Temperature Cycling

Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and then switch to constant voltage charging at 3.65 V until the charging current reaches 0.05C. Put the cell into the temperature chamber, and adjust the temperature chamber according to the following table and figure, and cycle for 5 times. (Refer to GB 38031-2020 electric vehicles traction cell safety requirements)

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

Table 6 Temperature cycle corresponding parameter table

Temperature	Time Increment	Time Accumulation	Temperature Change Rate
25	0	0	0
-40	60	60	13/12
-40	90	150	0
25	60	210	13/12
85	90	300	2/3
85	110	410	0
25	70	480	6/7

### 3.17.6 Crush

Charge the cell to 3.65 V with constant current of 1C at ambient temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and then switch to constant voltage charging at 3.65 V until the charging current reaches 0.05C. Test under the following conditions at a safety test environment temperature of  $22^{\circ}\text{C} \pm 5^{\circ}\text{C}$ :

a) Crushing direction: apply pressure perpendicular to the direction of the cell plate, or the same direction that the cell is most susceptible to be crushed in the layout of the whole vehicle;

b) The form of the crushing plate: a semi-cylinder with a radius of 75 mm, the length (L) of the semi-cylinder is greater than the size of the cell being crushed (refer to the figure below);

c) Crushing speed: not more than 2 mm/s;

d) Crushing degree: stop crushing after the voltage reaches 0 V or the deformation reaches 15% or the crushing force reaches 100000 N or 1000 times the weight of the test object;

e) Keep it for 10 min. Observe for 1 h. (Refer to GB 38031-2020 electric vehicles traction cell safety requirements)

## 4 Cell Application Instructions

### 4.1 Welding Parameters Recommendation

Table 7 Parameters Table

Items	Specifications	Notes	
Welding Parameter of Al Busbar	Laser Welding Depth	$\leq 2.0 \text{ mm}$	/
	Max Pressure Force on Poles	700 N	Max force in longitudinal direction, no deformation.
	Max Torque Force on Poles	6 N m	Max torsion, non-loosen.
	Max Temperature Force on Poles	$130^{\circ}\text{C}$	The maximum temperature that the pole bears before the plastic pad deforms.

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

#### 4.2 Charge and Discharge Parameters

The following data is the reference performance data of LF105 Cell during BMS design. Actual use is subject to the using mode and conditions agreed by both parties.

##### 4.2.1 Charging Mode

Table 8 Charging mode parameter table

Parameters	Product Specifications	Notes
Standard Charging Current	0.5C	25°C ± 2°C
Maximum Continuous Charging Current	1C	
Standard Charging Cut-off Voltage	Single cell ≤ 3.65 V	
Standard Charging Mode	Refer to section 3.8	
Standard Charging Temperature	25°C ± 2°C	
Absolute Charging Temperature (Cell Temperature)	-10°C ~ 65°C	No matter what charging mode the cell is in, once the cell temperature exceeds the absolute charging temperature range, stop charging.
Absolute Charging Voltage	Max 3.65 V	No matter what charging mode the cell is in, once the cell voltage exceeds the absolute charging voltage, stop charging.

##### 4.2.2 Other Charging Modes

###### 4.2.2.1 Continuous Charging Modes

Table 9 Continuous charging modes / C-cell level (unit: C-Rate)

T / SOC	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	98%	100%
-10°C	0	0	0	0	0	0	0	0	0	0	0	0	0
-5°C	0.15	0.15	0.15	0.15	0.12	0.12	0.08	0.08	0.07	0.05	0.05	0.05	0
0°C	0.3	0.3	0.3	0.25	0.12	0.12	0.1	0.1	0.08	0.08	0.05	0.05	0
5°C	0.45	0.45	0.35	0.35	0.25	0.25	0.19	0.16	0.13	0.12	0.12	0.12	0
10°C	0.7	0.68	0.65	0.56	0.5	0.5	0.37	0.37	0.37	0.37	0.12	0.12	0
25°C	1	1	1	1	1	1	1	1	1	0.8	0.5	0.5	0
45°C	1	1	1	1	1	1	1	1	1	0.8	0.5	0.5	0
55°C	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0
60°C	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0
65°C	0	0	0	0	0	0	0	0	0	0	0	0	0

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

#### 4.2.2.2 Pulse Feedback Modes

Table 10 30 s pulse feedback rate / C-cell level (unit: C-Rate)

T\SOc	0%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
-10°C	0	0	0	0	0	0	0	0	0	0	0	0	0
-5°C	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0
0°C	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0
10°C	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.4	0.25	0
20°C	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.8	0.4	0
25°C	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
30°C	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
35°C	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
45°C	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
50°C	2	2	2	2	2	2	2	2	2	2	1.6	0.8	0
55°C	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.2	0.8	0
60°C	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0
65°C	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: In order to ensure the safe use during the whole life cycle and maximize the service life of the cell, the charging power (rate) must be adjusted according to the SOH (capacity attenuation) of the cell. It should be ensured that the BMS has this function to monitor the actual charging power (and allowable charging power limit), and trigger fault and protection functions when necessary.

Parameters	Product Specifications	Notes
Standard Discharge Current	0.5C	25°C ± 2°C
4.2.3 Discharge Mode Maximum Continuous Discharge Current	1C	
Discharge Cut-off Voltage	2.5 V 2.0 V	Temperature T > 0°C Temperature T ≤ 0°C
Standard Discharge Mode	Refer to Section of 3.9	
Standard Discharge Temperature	25°C ± 2°C	
Absolute Discharge Temperature (Cell Temperature)	-35°C ~ 65°C	No matter what discharge mode the cell is in, once the cell temperature exceeds the absolute discharge temperature range, stop discharging.
Absolute Discharge Voltage	Min 2.5 V (T > 0°C) Min 2.0 V (T ≤ 0°C)	No matter what kind of discharge mode the cell is in, once the cell voltage is less than the absolute discharge voltage, stop discharging.

#### 4.2.4 Other Discharging Modes

Table 11 Discharge mode parameter table

##### 4.2.4.1 Continuous Discharging Modes <https://www.docanpower.com/>

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

Table 12 Continuous discharge rate / C-cell level (unit: C-Rate)

T / SOC	0%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
-36°C	0	0	0	0	0	0	0	0	0	0	0	0	0
-35°C	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
-30°C	0	0.03	0.06	0.12	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
-20°C	0	0.06	0.12	0.25	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
-10°C	0	0.19	0.38	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
0°C	0	0.28	0.56	1	1	1	1	1	1	1	1	1	1
25°C	0	0.38	0.75	1	1	1	1	1	1	1	1	1	1
60°C	0	0.38	0.75	1	1	1	1	1	1	1	1	1	1
65°C	0	0	0	0	0	0	0	0	0	0	0	0	0

4.2.4.2 Pulsing Discharging Modes

Table 13 30 s pulse discharge rate / C-cell level (unit: C-Rate)

T\SOC	0%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
-36°C	0	0	0	0	0	0	0	0	0	0	0	0	0
-35°C	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
-30°C	0	0.03	0.06	0.12	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
-20°C	0	0.06	0.12	0.25	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
-10°C	0	0.19	0.38	0.62	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
-5°C	0	0.25	0.5	1	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12
0°C	0	0.28	0.56	1.06	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18
5°C	0	0.31	0.62	1.12	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
10°C	0	0.33	0.66	1.22	2.43	2.43	2.43	2.43	2.43	2.43	2.43	2.43	2.43
15°C	0	0.34	0.68	1.32	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63
20°C	0	0.36	0.72	1.41	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82
25°C	0	0.38	0.75	1.5	3	3	3	3	3	3	3	3	3
45°C	0	0.38	0.75	1.5	3	3	3	3	3	3	3	3	3
60°C	0	0.38	0.75	1.5	3	3	3	3	3	3	3	3	3
65°C	0	0	0	0	0	0	0	0	0	0	0	0	0

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 4.3 Safety Limits

#### 4.3.1 Application Conditions

Customer shall ensure strict compliance with the following cell application conditions:

- Customer shall configure a battery management and monitoring system to strictly monitor, manage and protect each cell. And a battery management archive shall be established to keep all monitoring data of the cells, so as to be a reference for problems tracing and product quality responsibility division. **EVE is not responsible for product quality assurance if no complete monitoring data of the battery system during its service life is provided.**
- The waterproof and dustproof problems of the cell shall be fully considered in the design of the pack, and the pack must meet the waterproof and dustproof grade stipulated by relevant national standards. **EVE is not responsible for the damage (such as corrosion, rust, etc.) of the cell caused by waterproof and dustproof problems.**
- It is forbidden to mix different types of cells in the same battery system (or vehicle), otherwise, EVE will not be responsible for the quality assurance.**

#### 4.3.2 Voltage Limits

Table 14 Safety limit voltage parameters

Items	Categories		Protective Actions
Charging Voltage	Charging Ends	3.65 V	When the cell voltage reaches 3.65 V, stop charging.
	First Over-Charging Protection	3.80 V	When the cell voltage reaches 3.8 V, stop charging.
	Second Over-Charging Protection	3.85 V	When the cell voltage reaches 3.85 V, stop charging and lock the battery management system until the technician solves the problem.



Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
Discharging Voltage	Discharging Ends	Min 2.50 V	Temperature $T > 0^{\circ}\text{C}$ . When the cell voltage reaches 2.5 V, stop discharging.		
		Min 2.00 V	Temperature $T \leq 0^{\circ}\text{C}$ . When the cell voltage reaches 2.0 V, stop discharging.		
		Min 2.00 V	Temperature $T > 0^{\circ}\text{C}$ . When the cell voltage reaches 2.0 V, reduce the current to the minimum.		
		Min 1.90 V	Temperature $T \leq 0^{\circ}\text{C}$ . When the cell voltage reaches 1.9 V, reduce the current to the minimum.		
	Second Over-Discharging Protection	Min 1.85 V	Temperature $T > 0^{\circ}\text{C}$ . When the cell voltage is lower than 1.85 V, stop charging and lock the battery management system until the technician solves the problem.		
		Min 1.75 V	Temperature $T \leq 0^{\circ}\text{C}$ . When the cell voltage is lower than 1.75 V, stop charging and lock the battery management system until the technician solves the problem.		
BMS protection	Short Circuit protection	Short circuit is not allowed	When a short circuit occurs, the cell is disconnected by the over-current device.		
	Long Charging Time Protection	Charging time within 8 h	If the charging time is longer than 8 h, the charging will be terminated.		

**Notes**

a) **If the cell charging voltage exceeds the cut-off voltage, corresponding protective actions need to be taken.**

**EVE shall not be responsible for any cell quality issues caused by exceeding the protection voltage.**

b) **If the cell discharging voltage reaches the cut-off voltage, it is necessary to charge as soon as possible to prevent the cell from being over-discharged. EVE shall not be responsible for any cell quality issues caused by over-discharge.**

4.3.3 Temperature Limits

Table 15 Safety limit temperature parameters

Items	Parameters	Notes
Recommended Operating Temperature Range	$10^{\circ}\text{C} \sim 35^{\circ}\text{C}$	Recommend cell usage temperature range.
Maximum Operating Temperature	$65^{\circ}\text{C}$	If the cell temperature exceeds the maximum operating temperature, the power needs to be reduced to 0.
Minimum Operating Temperature	$-35^{\circ}\text{C}$	If the cell temperature exceeds the minimum operating temperature, the power needs to be reduced to 0.
Maximum Safe Temperature	$65^{\circ}\text{C}$	If the cell temperature exceeds the maximum safe temperature, irreversible and permanent damage will be caused. The user should not use it under environments higher than the maximum safe temperature.
Minimum Safe Temperature	$-35^{\circ}\text{C}$	If the cell temperature exceeds the minimum safe temperature, irreversible and permanent damage will be caused. The user should not use it under environments lower than the minimum safe temperature.

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

**Notes**

- a) **Prohibit charging the cell at low temperature (below -10°C) and the minimum safety temperatures specified by this specification, otherwise EVE will not be responsible for any quality assurance liability.**
- b) **The heat dissipation design of battery may effect cell electrical performance, EVE will not be responsible for any assurance liability regarding cell quality issues caused by the heat dissipation design.**

4.4 Parameters Recommendation for Module Design

4.4.1 Cell Directions

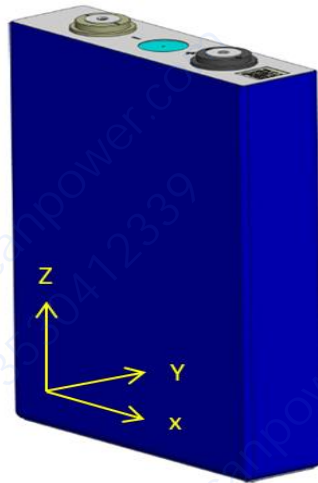


Fig.6 Diagram of LF105 Cell direction

4.4.2 Cell Compression Force

When forming modules, a compression force in the direction of vertical thickness is applied to the cells in order to make them better arranged and fixed. If the compression force is too large, the cells may be damaged or even leak. Cell compression force test conditions are as follows:

- Compression area            130.3mm × 195.5 mm (L × H2)
- Compression speed            0.02 mm/s
- Compression direction        Y direction
- Cell SOC            SOC: 15%~40 %

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

Table 16 Cell compression force limit parameters

Observation	Compression Force
Recommend Compression Force	3000 N ~ 7000 N
Instantaneous Maximum Compression Force	10000 N

The compression force of the cell shall be no larger than 10000 N, otherwise the cell may be damaged.

#### 4.4.3 Cell Swelling force

The inherent characteristics such as the rebound of the electrode thickness may lead to cell expansion during use which generates force on the clamp., and the force increases with the attenuation of the cell capacity. The cell swelling force at BOL and EOL (80%SOH) is shown below:

Table 17 Cell Swelling force parameters

Swelling force	BOL	$\leq 3000$ N
	EOL (80%SOH)	$\leq 30000$ N

Customer shall fully consider the influence of the cell Swelling force when designing the module.

#### 4.4.4 Recommend Temperature Collection Points

The recommended temperature collection points are the poles or code when collecting temperature of the cell surface.

#### 4.5 Thermodynamic Parameters

Test method:

Reference standards: GB/T 10295-2008、ASTM E1269-2011

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

GB/T 10295-2008、ASTM E1269-2011

Table 18 Cell thermal conductivity parameter

Mean Thermal Conductivity	Thermal Conductivity W/(m K)	
	X/Z Direction	Y Direction
	15 ~ 20 W/(m K)	2 ~ 4 W/(m K)
Mean Heat Capacity	Heat Capacity kJ/(kg K)	
	0.9~1.2 kJ/(kg K)	

## 5 Precautions

### 5.1 Product End-life Management

The cell life is limited. Customers should establish an effective tracking system to monitor and record the internal resistance and capacity of each cell 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. When the internal resistance of the cell in use exceeds 150% of the initial internal resistance of the cell, or the capacity is less than 70% of the nominal capacity, the cell should not to be operated. **Violation of this requirement will exempt EVE from its responsibility for product quality assurance in accordance with the product sales agreement and this specification, as well as all related liabilities such as loss compensation caused thereby.**

### 5.2 Long-term Storage

After charging, the cell should be used as soon as possible to avoid loss of usable capacity due to self-discharge. If long-term storage is required, adjust the cell SOC to 15%~40%. The recommended storage conditions are: 0°C ~ 35°C, relative humidity ≤ 60%.

The state of charge (SOC, capacity state) of the cell should be kept at 15% ~ 40% during storage. In order to prevent the performance differences after long-term storage (more than three months), perform a standard charge-discharge cycle every 3 months. It is recommended that the storage time after receiving the cells should not exceed half a year to avoid quality problems due to storage overdue.

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 5.3 Transportation and Handling Requirements

- It is not allowed to ship with inflammable, explosive and corrosive articles in the same vehicle during transportation, and stacking is prohibited during large package transportation; The product shall not be exposed to rain, snow and other liquid substances without any protection, or suffer mechanical damage;
- While handling, lift trucks or special tools shall be used to load and unload products; Handle with care, do not throw or squeeze, which may cause cell damage or personal injury. It is strictly prohibited to put cells together with corrosive substances such as acid and alkali.

### 5.4 Operation Precautions

- It is strictly forbidden to immerse the cell in water. When it is not in use, it should be placed in a cool and dry environment.
- Do not over-charge the cell. Otherwise, cell overheating and fire may occur. During cell installation and use, hardware and software must be protected against multiple over-charge failures. See 4.3 of this specification for the minimum requirements of protection.
- It's necessary to set a reasonable charging time limit, otherwise, the cell may overheat, resulting in thermal runaway or fire. BMS management failure of this kind shall be considered during module design.
- If improper charge termination occurs, the root reasons shall be found and resolved before reuse to avoid negative effects on electrical and safety performances.
- It is forbidden to over-discharge. During the normal use of the cell, charge the cell regularly to keep the voltage above 2.8 V, so as to avoid over-discharge.
- It is forbidden to use or place the cell at a high temperature environment. Otherwise, cell overheat, function failure or life shorten may occur.
- The temperature of the cell shall not exceed 65°C in any normal use, otherwise the BMS must shut down the cell and stop cell operation.
- Please use a special charger for lithium-ion batteries when charging.
- During use, please connect the positive and the negative of the cell strictly according to the labels and instructions, and reverse charging is forbidden.
- It is forbidden to use metal to directly connect the positive and the negative of the cell to short-circuit. Otherwise, strong current and high temperature may cause personal injury or fire.
- It is forbidden to transport or store the cell with metal, such as hairpins, necklaces, etc.
- It is forbidden to knock, throw, step on or bend the cell.
- It is forbidden to directly weld the cell.
- It is forbidden to directly pierce the battery with nails or other sharp objects.
- Try to protect the cell from mechanical shock, collision and pressure impact. Otherwise, the cell may be short-circuited internally, resulting in high temperature and fire.
- It is forbidden to use it in places with strong static electricity and strong magnetic fields; otherwise cell safety protection devices may be damaged and cause safety hazards.
- Customer shall securely fix the cell to a solid surface and bind the power cord in a proper place to avoid arcing and sparks caused by friction.

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

- It is forbidden to use plastic for cell encapsulation and electrical connection. Improper electrical connection may cause overheat during cell use.
- If the cell leaks and the electrolyte spills onto the skin or clothes, immediately wash the affected area with running water. If the cell leaks and the electrolyte enters the eyes, mouth, nose and other open parts of the human body, immediately wash with plenty of water and seek medical treatment immediately, otherwise serious injuries will be caused to the human body. No person or animal is allowed to swallow any part of the cell or any substance contained in the cell.
- If the cell emits peculiar smell, heat, discoloration, deformation, or any abnormality during use, storage, or charging, immediately remove the cell from the device or charger and stop using it.
- It is prohibited to disassemble the product without the written consent of EVE.

#### 5.5 Confidentiality Agreement

**The customer shall keep the cooperation content highly confidential. Without the permission of EVE, the customer shall not disclose any content of the technical agreement to a third party. Otherwise, the customer will be held responsible according to relevant laws.**

#### 5.6 Risk Warning

##### 5.6.1 Warning Declaration

### **Warning**

**The cell has potential hazards, and take proper precautions when operating and maintaining the cell!**

**The cell must be operated with proper tools and protective equipment.**

**Cell maintenance must be performed by professional with cell expertise and safety training.**

**Failure to comply with these warnings could result in multiple disasters.**

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

### 5.6.2 Types of Dangerous

Customer must be aware of the following potential hazards in the use and operation of cells:

- a) There is a risk from electric shocks or electric arcs during operation.
- b) There is a risk from the electrolyte or other chemicals.

Proper operation methods and protective equipment shall be selected to avoid short circuit, explosion or thermal runaway

### 5.7 Disclaimer

**If the product demand party or user does not use the product in accordance with the provisions of this specification, EVE will no longer take any relevant responsibility such as product quality assurance liability and loss compensation caused thereby. In case of any negative impact on EVE's reputation due to the above-mentioned actions, EVE reserves the right to investigate the legal liability of the product demand party.**

## 6 Others

### 6.1 Rights and Obligations of EVE

- EVE shall inspect according to the inspection standards in the protocol signed with the customer, and the products provided shall meet the requirements of various parameters in the protocol;
- EVE shall provide customer with stable and reliable products confirmed by both parties;
- EVE is obliged to provide high-quality services for its products, and the service standards shall be in accordance with the standards promised by EVE;
- EVE shall provide timely technical support and service in case of any problem or failure during the use and maintenance of system products by customer.

### 6.2 Rights and Obligations of Customer

- Customer must conduct production in strict accordance with the technical data provided by EVE, and strictly implement the cell prevention measures, safety limits and cell operation instructions in the technical data provided by EVE.
- Customer has the obligation to ensure the safety of products by EVE and shall take corresponding fire prevention, waterproof and other measures.
- Customer has the obligation to make fair and detailed use records and monitoring data of product operation for EVE's products, which can be used as a reference for the division of product quality responsibilities. If there is no complete monitoring data within the service life of the battery system, EVE shall not be responsible for product quality assurance.
- Customer has the obligation to notify EVE's personnel to be present and be informed of the actual situation when products of EVE operate abnormally.
- In the process of product manufacturing, customer shall take all corresponding responsibilities for the problems or accidents caused by the operation in violation of the safety rules or the use beyond the conditions specified in this technical agreement and the combination of the product and the circuit (not the quality defects of the product itself).

Remarks: Any matter not mentioned in this specification must be negotiated and determined by both parties.

### 6.3 Language Conflict Clause

This specification is written in both Chinese and English. In case of any difference between the Chinese version and the English version, the Chinese version shall prevail.

Model	LF105	Specification No.	PBRI-LF105-D06-01	Version	E
-------	-------	-------------------	-------------------	---------	---

**Appendix: Cell Drawing of LF105**

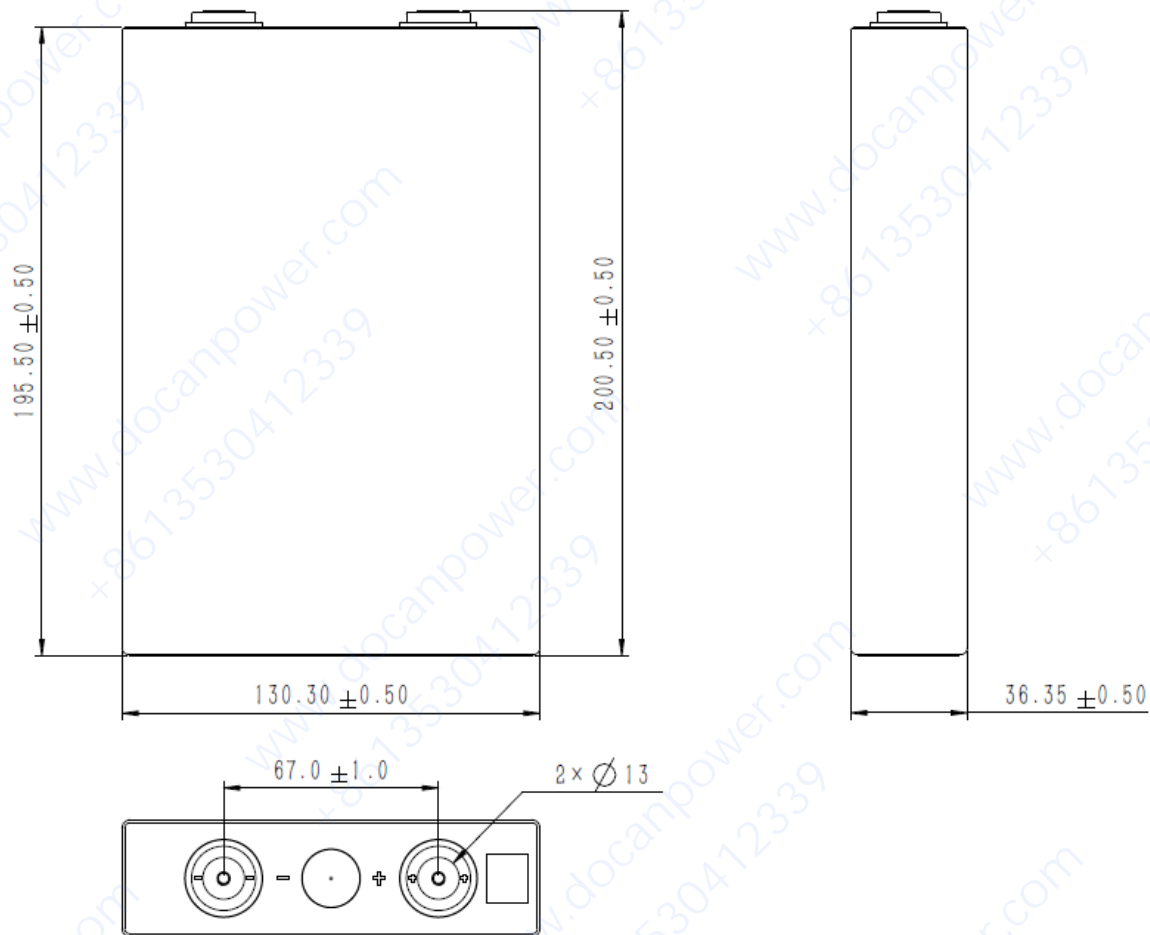


Fig.7 Diagram of Cell Size and Appearance