Model	LF280K	Specification No.	RD-LF280K-S04-LF	Version	A

Product Specification

Prismatic LFP Cells
Model: LF280K

Drafted by	Product Design Checked by	Quality Checked by	Sales Checked by	Approved by
Shuao He	Hua Wang	Dong Chao		Dingding Yuan

Customer Recipient
company:
Approved by:
Date:

Mar., 2022

EVE Power Co.,Ltd

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Customer Requirements

EVE Power requires customer to provide specific requirements and communicates with EVE. If certain applications and operation conditions are out of the description of this specification, EVE may design and manufacture products according to customer's inputs.

No.	Special Requirements	Standards
1		
2		
3		
4		
5		

Customer Code: _____ **Signature:** _____ **Date:** _____

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Change History

Version	Date	Contents	Checked By
A	2022.03.31	First issue	Shuao He

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Contents

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Term Definition

Term	Definition
Product	Refers to rechargeable Prismatic 280K (280 Ah) LFP Cell with aluminum shell manufactured by EVE Power Co., Ltd. in this specification.
Customer	Refers to the buyer in EVE Power Sales Contract.
Environment temperature	Surrounding environmental temperature where the cell is located.
Cell temperature	Temperature measure by the temperature sensor installed at the center of cell surface.
Rate	The ratio of the charge/discharge current to the rated capacity of the cell is indicated by the letter C. For example, if the cell capacity is 280Ah, when the charging or discharging current is 140A, the charging or discharging rate is 0.5C.
State of charge	Under unloaded conditions, the ratio of the cell capacity state to the rated capacity measured in ampere-hours or watt-hours. The abbreviation is expressed by SOC. For example, if the capacity is 280Ah as 100% SOC, when the capacity is 0Ah, the SOC is 0%.
Cycle	The cell is charged and discharged in a cycle according to the prescribed charging and discharging standards. 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 re-generative charging. The discharge can be formed by combining some partial discharges.
Standard charge	The charging mode described in 3.5 of this specification.
Standard discharge	The discharge mode described in 3.6 of this specification.
Open circuit voltage	The voltage of the cell measured when unloaded or circuit is connected. The abbreviation is expressed by OCV.
DC resistance	The ratio of the voltage changes of the cell to the corresponding current change under working conditions, the abbreviation is DCR.
Module	Lithium-ion batteries combined in series and parallel, intermediate products formed between single cell cells and PACK which are integrated with cell monitoring and management devices.
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

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	negative directions.
Compression force	When the module is assembled, the battery bears the force perpendicular to the battery stacking direction.
The unit of measurement	"V" (Volt), Voltage "A" (Ampere), Current "Ah" (Ampere-Hour), Capacity "Wh" (Watt-Hour), Energy "Ω" (Ohm), Resistance "mΩ" (Milliohm), Resistance "°C" (degree Celsius), Temperature "mm" (millimeter), length "s" (second), Time "Hz" (Hertz), Frequency

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1. Fundamental Information

1.1. Scope of Application

This standard describes the product types, basic performance, test methods and precautions of square aluminum shell lithium iron phosphate batteries manufactured by EVE Power Co., Ltd.

1.2. Product Type

Prismatic LFP Cell With Aluminum Shell

1.3. Product Model

LF280K

2. Cell Specification

2.1. Fundamental Parameters

Items		Standards	Remarks
Min.Capacity		280 Ah	0.5C，25±2°C，2.5-3.65V
Min.Energy		896Wh	0.5C，25±2°C，2.5-3.65V
Initial IR		≤0.25 mΩ	AC，1kHz，40%SOC
Nominal Voltage		3.2 V	0.5C，2.5~3.65V
Weight		5420 g±300 g	
Charging Cut-off Voltage (U_{max})		3.65 V	
Discharging Cut-off Voltage (U_{min})		2.5V (>0°C) 2.0V (≤0°C)	
Standard Charging Current		140A	0.5C
Standard Discharging Current		140A	0.5C
25°C Standard Cycle		6000 cycles	Applying 300kgf±20kgf pre-pressure，0.5C，2.5~3.65V，Capacity retention rate≥80%，Or follow the cycling method provided by EVE
45°C Standard Cycle		2500 cycles	
Operation Temperature	Charging Temperature	0~60°C	
	Discharging Temperature	-30~60°C	
Storage Temperature	1 year	0~35°C	Delivery SOC State
	3 months	0~35°C	
	1 month	-20~45°C	
Welding Parameter of Al Busbar	Laser Welding Depth	≤2.5 mm	
	Max Pressure Force on Terminals	700 N	Max force in longitudinal direction, no deformation
	Max Torque Force on Terminals	6 N・m	Max torsion, non-loosen

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	Max Temperature on Terminals	130℃	The maximum temperature the terminals can withstand, at which the plastic pads will not deform

2.2. Product Parameters

2.2.1. Dimension and Weight

No.	Items		Standards	Testing Methods
1	Dimension	Terminal Height	207.2±0.5 mm	3.8.1
		Can-top Height	204.6±0.5 mm	
		Length	173.7±0.5 mm	
		Thickness	72.0±1.0 mm	
2	Weight	Weight (Including blue film, can-top film)	5420 g±300 g	3.8.2

2.2.2. Electrical Performance Parameters

No.	Items		Standards	Testing Methods
1	Nominal Capacity	0.5C Capacity	≥280.0Ah	3.8.3.1
2	Nominal Energy	0.5C Energy	≥896.0Wh	3.8.3.1
3	Rate Discharge Performance at 25℃	0.5C(A)	≥100%	3.8.3.2
		1C(A)	≥98%	3.8.3.2
4	Discharge Performance at different temperature	55℃	≥95%	3.8.3.3
		-20℃	≥70%	3.8.3.4
5	Charge Retention and Capacity Recovery	25℃, 28 days	Capacity Retention≥95%	3.8.3.5
			Capacity Recovery≥97%	
6	Cycle	25℃±2℃@0.5C/0.5C (300kgf compression force), or EVE cycle method	6000 cycles, capacity/nominal capacity≥80%	3.8.3.6
		45℃±2℃@0.5C/0.5C (300kgf compression force), or EVE cycle method	2500 cycles, capacity/nominal capacity≥80%	3.8.3.7
7	Storage	25℃, 28 days, fresh battery, 50 % SOC	capacity retention ⩾96% capacity recovery rat ⩾98%	3.8.3.9

2.2.3. Safety Performance parameters

No.	Items	Standards	Testing Methods
1	Over Charge	No fire, No explosion	3.8.4.1
2	Over Discharge	No fire, No explosion	3.8.4.2

3	External Short-circuit	No fire, No explosion	3.8.4.3
4	Extrusion Test	No fire, No explosion	3.8.4.4
5	Drop Test	No fire, No explosion	3.8.4.5
6	Low Pressure	No fire, No explosion, No leakage	3.8.4.6
7	Heating	No fire, No explosion	3.8.4.7
8	Thermal Runaway	No fire, No explosion	3.8.4.8

2.3. Cell Drawing

See Appendix.

2.4. Out Appearance

The cell should have none of obvious scratches, cracks, rust stains, discoloration, or electrolyte leakage, which have any defects that affect the commercial value of the cell.

3. Testing Conditions

3.1. Environmental Conditions

Unless otherwise specified, the test should be carried out in an environment with a temperature of 25°C ± 2°C, a relative humidity of 15%-90% RH, and an atmospheric pressure of 86 kPa to 106 kPa. The ambient temperature mentioned in this specification refers to 25°C±2°C.

3.2. Measurement Instrument

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

A. Voltage measuring device: ±0.1%;

B. Current measuring device: ±0.1%;

C. Temperature measuring device: ±0.5°C;

D. Dimension measuring device: ±0.01mm;

E. Weight measuring device: ±0.1g.

3.3. Testing Clamp Preparation

The single cell needs to be clamped with steel splints or aluminum alloy splints (thickness: 10 mm). The splints need to cover the large surface of the cell. The splints are fixed with 6 M6 bolts. All sides of the splints need to be covered with insulating film. Fixtures as shown below

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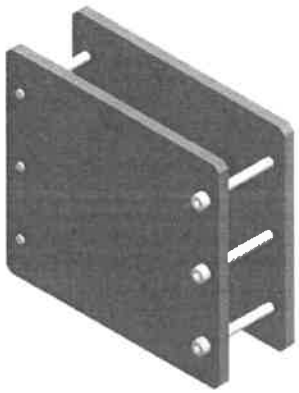
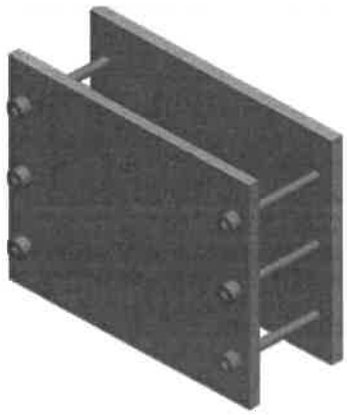


Schematic diagram of cell clamp



Insulation film of cell clamp

3.4. Testing Clamp Installation

Place the cell (~40% SOC) covered with blue film (material: PET, thickness 0.1mm) and top film (material: PC, thickness 0.3mm) in the middle of the clamp, and the initial compression force is (300 kgf±20kgf).

Schematic diagram of cell coating

Side view of cell shaft

3.5. Standard Charge

Standard charging is to charge the battery with a constant current of 140A to 3.65V under the condition of an ambient temperature of 25°C±2°C, and then transfer to constant voltage charging at 3.65V until the charging current is less than or equal to 14A, and rest for 30min.

3.6. Standard Discharge

Standard discharge is to discharge the battery at a constant current of 140A at an ambient temperature of 25°C± 2°C, discharge until the voltage reaches 2.5V, and rest for 30 minutes.

3.7. Capacity and Energy Calibration

The capacity and energy calibration is to charge according to the (3.5) standard charge under the condition of an ambient temperature of 25±2°C, constant temperature and no convection, and then discharge according to the (3.6) standard discharge, rest for 30 minutes. First, repeat the standard charging method and discharge method 3 times

making it active, and then repeat the standard charging method and discharge method 5 times. The average discharge capacity of the last 3 times is the 0.5C discharge capacity, the recorded discharge capacity is the calibrated capacity C_0, and the average discharge energy of the last 3 times is the 0.5C discharge energy. Record the discharge energy as the calibration energy E_0.

3.8. Testing Methods

3.8.1. Dimension

Testing Instrument: Automatic wrapping machine.

Testing Method: Use the wrapping machine to measure the length, width and height of the battery.

Test conditions: 300kgf±20kgf.

The thickness of the battery will increase as the SOC increases, and it will increase along with usage. The thickness here indicates the thickness of the battery at the time of shipment (30%~40% SOC at the time of shipment).

3.8.2. Weight

Test Instrument: electronic scale.

Test Method: use the electronic scale to measure the weight of the battery.

3.8.3. Electrical Performance

3.8.3.1. 0.5C Discharge Capacity and Energy

Under the condition of an ambient temperature of 25°C±2°C, the battery is charged according to the (3.5) standard charge, and then discharge according to the (3.6) standard discharge, rest for 30 minutes, and record the discharge capacity and discharge energy. First, repeat the standard charging method and discharge method 3 times making it active, and then repeat the standard charging method and discharge method 5 times. When the range of the test results of 3 consecutive times is less than 3% of the rated capacity, the test can be terminated early. The average discharge capacity of the last 3 times is the 0.5C discharge capacity, and the last 3 times average discharge energy is 0.5C discharge energy.

3.8.3.2. 25°C Rate Discharge Performance

Under the condition of an ambient temperature of 25°C±2°C, constant temperature and no convection, the battery is charged according to the (3.5) standard charge, rest for 30 minutes, and then is discharge respectively to 2.5 V with a constant current of 140 A and 280A, record the discharge capacity C_1 and C_2, C_1/C_0 is the 140A discharge capacity, C_2/C_0 is the 280A discharge capacity. If the discharge capacity fails to meet the technical requirements, the test can be repeated three times.

3.8.3.3. 55°C Capacity Retention Rate

Under the condition of an ambient temperature of 25°C±2°C, carry out capacity calibration (3.7) of the battery.

The battery is charged according to the (3.5) standard charge, then leave it at 55°C±2°C for 5 hours, discharge it to 2.5 V with a constant current of 140 A under the environment of 55±2°C, record the discharge capacity C_3, C_3/C_0 is the capacity retention rate at 55°C.

3.8.3.4. -20°C Capacity Retention Rate

Under the condition of an ambient temperature of 25°C±2°C, carry out capacity calibration (3.7) of the battery. The battery is charged according to the (3.5) standard charge, then leave it at -20°C±2°C for 24 hours, discharge it to 2.0 V with a constant current of 140 A under the environment of -20±2°C, record the discharge capacity C_4, C_4/C_0 is the capacity retention rate at -20°C.

3.8.3.5. 25°C Capacity Retention and Capacity Recovery

Under the condition of an ambient temperature of 25°C±2°C, carry out capacity calibration (3.7) of the battery. The battery is charged according to the (3.5) standard charge, then leave it at 25°C±2°C for 28 days, and then discharge according to the (3.6) standard discharge under the environment of 25±2°C (record the discharge capacity C_5), and then discharge according to the (3.6) standard discharge after charging according to the (3.5) standard charge (record the discharge capacity C_6). the capacity retention rate = $C_5/C_0\times100\%$ and the capacity recovery rate = $C_6/C_0\times100\%$.

3.8.3.6. 25°C Standard Cycle

Before the test, prepare the fixture according to (3.3) When the SOC is 30%~40% at room temperature, install the test fixture according to the method of (3.4)

Pre-cycle capacity test: discharge the battery at a constant current of 140 A to 2.5 V at an ambient temperature of 25 °C ± 2 °C, put it aside for 30 min, then charge it to 3.65 V with a constant current of 140 A, and switch to constant voltage charging with the cut-off current of 14 A, let it stand for 30 minutes and then discharge it to 2.5 V at a constant current of 140 A. Repeat the charge method and discharge method 5 times and record the discharge capacity C_6, The average discharge capacity of the last 3 times is the initial discharge capacity C_7.

Cycle test: ambient temperature 25°C±2°C;

a. Charge the battery with a constant current of 140 A to 3.65 V, then switch to constant voltage charging to 14 A to cut off, and leave it for 30 minutes;

b. Discharge to 2.5 V at a constant current of 140A and leave it for 30 minutes;

c. Repeat a-b.

Capacity test after cycle: discharge the battery at a constant current of 140 A to 2.5 V at an ambient temperature of 25 °C ± 2 °C, put it aside for 30 min, then charge it to 3.65 V with a constant current of 140 A, and switch to constant voltage charging with the cut-off current of 14 A, let it stand for 30 min, then discharge to 2.5 V at a constant current of 140 A, record the discharge capacity C_8, and the capacity retention rate = $C_8/C_7\times100\%$.

3.8.3.7. 45°C Standard Cycle

Preparation for the fixture: When the SOC is 30%~40% at room temperature, install the test fixture according to the method of (3.4)

Pre-cycle capacity test: discharge the battery at a constant current of 140 A to 2.5 V at an ambient temperature of 25 °C ± 2 °C, put it aside for 30 min, and then discharge according to the (3.6) standard discharge after charging according to the (3.5) standard charge. Repeat the charge method and discharge method 5 times, the average discharge capacity of the last 3 times is the initial discharge capacity C_9.

Cycle test: ambient temperature 45°C±2°C;

a. Charge the battery with a constant current of 140A to 3.65 V, then switch to constant voltage charging to 14 A to cut off, and leave it for 30 minutes;

b. Discharge to 2.5 V at a constant current of 140 A and leave it for 30 minutes;

c. Repeat a-b.

Capacity test after cycle: discharge the battery at a constant current of 140 A to 2.5 V at an ambient temperature of 45 °C ± 2 °C, put it aside for 30 min, then charge it to 3.65 V with a constant current of 140 A, and switch to constant voltage charging with the cut-off current of 14 A, let it stand for 30 min, then discharge to 2.5 V at a constant current of 140 A, record the discharge capacity C_{10}, and the capacity retention rate = $C_{10}/C_9 \times 100\%$.

3.8.3.8. EVE Recommended Circulation

Prepare the fixture according to (3.3) before the test, and install the test fixture according to the method of (3.4) when the SOC is 30 % ~ 40 %.

Capacity calibration before cycle: Carry out capacity calibration on the battery (3.7), and record the calibration capacity C_0.

25 °C step charge cycle steps:

a. Ambient temperature 25±2°C, 300±20 kgf down-stair charging cycle;

b. 0.5 C constant current charge to 3.6 V;

c. 0.1 C constant current charge to 3.65 V;

d. Leave it for 30 minutes in the open circuit state, discharge it to 2.5 V with a constant current of 0.5 C, and leave it for 30 minutes;

e. Repeat steps b to d;

45 °C step charge cycle steps:

a. Ambient temperature 45±2°C, 300±20 kgf down-stair charging cycle;

b. 0.5 C constant current charge to 3.6 V;

c. 0.1 C constant current charge to 3.65 V;

d. Leave it for 30 minutes in the open circuit state, discharge it to 2.5 V with a constant current of 0.5 C, and leave it for 30 minutes;

e. Repeat steps b through d.

3.8.3.9. Storage at 25°C

Perform capacity calibration on the fresh battery(Packaging offline ≤30 days) (3.7), charge the battery with a constant current of 140 A for 60 minutes (record discharge capacity C_{11}); Then leave it for 28 days at an ambient temperature of 25±2°C; Under the condition of constant current discharge to 2.5 V at a current of 140 A (record discharge capacity C_{12}), set aside for 30 min, then charge at a constant current of 140 A to 3.65 V, then transfer to constant voltage charging to 14 A, set aside for 30 min, constant current discharge to 2.5 V at a current of 140 A (discharge capacity C_{13} was recorded). Capacity retention rate=$C_{12}/C_{11}\times100\%$, capacity recovery rate=$C_{13}/C_0\times100\%$.

3.8.4. Safety Performance

3.8.4.1. Over Charge Test

Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100%SOC according to (3.5) standard, and then install the test fixture according to (3.4). The battery is charged in constant current mode at the safety test temperature of 25°C±5°C until the voltage reaches 1.5 times of the battery charging termination voltage (5.475V) or the time reaches 1h, and the charging current is 1C. Observe for 1h. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)

3.8.4.2. Over Discharge Test

Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100%SOC according to (3.5) standard, and then install the test fixture according to (3.4). Under the condition of a safety test temperature of 25°C±5°C, the battery is discharging in constant current mode until the time reaches 90min or the voltage reaches 0V, and the discharge current is 1C. Observe for 1h. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)

3.8.4.3. External Short-circuit Test

Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100% SOC according to (3.5) standard, and then install the test fixture according to (3.4). Under the condition of a safety test temperature of 25°C±5°C, the positive and negative terminals of the cell are short-circuited externally for 10 minutes, and the resistance of the external circuit should be less than 5mΩ. Observe for 1h. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)

3.8.4.4. Extrusion Test

Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100%SOC according to (3.5) standard. Experiment according to the following conditions.

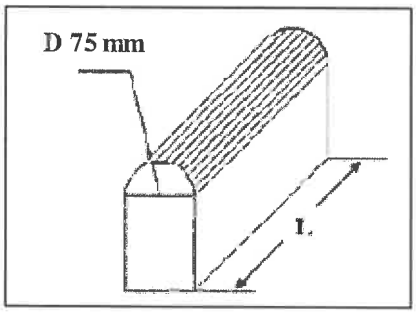
a) Extrusion direction: apply pressure perpendicular to the direction of the battery cell plate;

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

c) Extrusion speed: (5±1) mm/s;

d) Extrusion degree: stop extruding when the voltage reaches 0V or the deformation reaches 30% or the extruding force reaches (13±0.78) kN; Keep it for 10 minutes.

e) Observe it for 1h. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)



3.8.4.5. Drop Test

Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100%SOC according to (3.5) standard. Drop the positive or negative terminal of the battery cell from a height of 1.5m to the concrete floor once. Then observe it for 1h. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)

3.8.4.6. Low Pressure Test

Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100%SOC according to (3.5) standard, and then install the test fixture according to (3.4). Then put the cell into the low-pressure box, adjust the pressure to 11.6kPa, make the temperature (25±2) °C, stand for 6h, and then observe it for 1h. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)

3.8.4.7. Heating Test (130°C)

Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100%SOC according to (3.5) standard. And put the battery into the temperature chamber, and the temperature chamber will rise from room temperature to 130°C±2°C at a rate of 5°C/min, and keep this temperature for 30 minutes before stopping heating, then observe it for 1h. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)

3.8.4.8. Thermal Runaway Test

(1) Under the condition of an ambient temperature of 25°C±2°C, the cell is charged to 100%SOC according to (3.5) standard.

(2) Use a flat or rod-shaped heating device, and its surface should be covered with ceramic, metal or insulating layer. The heating power of the heating device should be in the range of 300-1000W. Complete the assembly of the

battery cell and the heating device, the heating device should be in direct contact with the battery, and the size of the heating device should not be larger than the heated surface of the battery cell; Install a temperature monitor, and the detection point temperature sensor is arranged on the side of the principle heat conduction. That is installed on the opposite side of the heating device, the temperature data sampling interval should not be greater than 1s, the accuracy should be ±2°C, and the diameter of the temperature sensor tip should be less than 1mm.

(3) After the battery is fully charged, continue to charge for 12 minutes at a constant current of 1C.

(4) Start the heating device and continue to heat the test object with its maximum power. When thermal runaway occurs or the temperature of the monitoring point reaches 300°C, stop triggering and turn off the heating device.

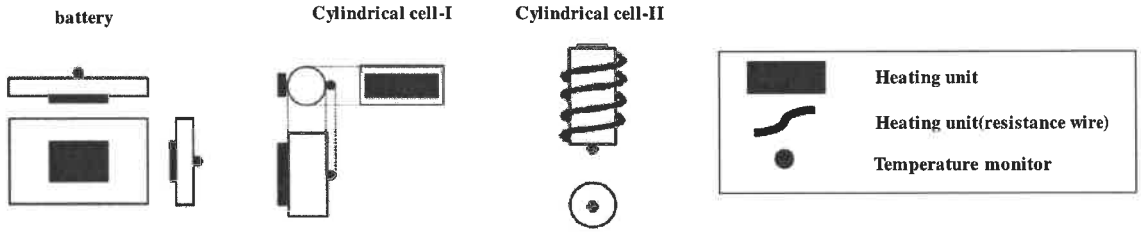
(5) Observe it for 1h, and whether thermal runaway occurs is determined according to the following conditions:

a) The test object generates a pressure drop;

b) The temperature of the monitoring point reaches the protection temperature of the battery;

c) Temperature rise rate of monitoring points≥1°C/s;

When a)&c) or b)&c) occurs, it is determined that the battery is thermally out of control. (Refer to GB/T 36276-2018 Lithium ion battery for electrical energy storage)



Schematic diagram of thermal runaway experiment

4. Charge and Discharge Parameters

4.1. Charge Mode

Parameters	Product Specifications	Condition
Standard charging current	0.5C	25°C±2°C
Maximum continuous charging current	1C	25°C±2°C
Standard charging voltage	Single battery≤3.65 V	
Standard charging mode	Refer to Section 3.5	
Standard charging temperature	25°C±2°C	
Absolute charging temperature (battery temperature)	0°C~60°C	No matter what charging mode the battery is in, once the battery temperature exceeds the absolute charging temperature range, charging will stop
Absolute charging voltage	Max 3.65V	No matter what charging mode the battery is in, once the battery voltage exceeds the absolute charging voltage, the charging will stop

Note: In order to ensure the safe use of the whole life cycle and maximize the service life of the battery, the charging current (rate) must be adjusted according to the SOH (capacity attenuation) of the battery. The BMS should ensure this function,

monitor the actual charging current (and allowable charging current limit), and trigger fault and protection functions when necessary.

4.2. Other charging modes

4.2.1. Constant power charging

Cell temperature /°C		0	5	10	15	20	25	45	50	55	60
Max charging power (P)	0%~100% SOC	0	0.12	0.3	0.5	0.8	1.0	0.8	0.5	0.25	0

4.2.2. Staged constant power charging

Cell temperature /°C		0	5	10	15	20	25	45	50	55	60
Max charging power (P)	0%~70% SOC	0	0.2	0.4	0.6	1.0	1.0	1.0	0.75	0.5	0
	70%~100% SOC	0	0.1	0.2	0.4	0.6	1.0	0.5	0.25	0.2	0

4.3. Discharge Mode

Parameters	Product specifications	Condition
Standard discharge current	0.5C	25°C±2°C
Maximum continuous discharge current	1C	25°C±2°C
Discharge cut-off voltage	2.5 V	Temperature T>0°C
	2.0 V	Temperature T≤ 0°C
Standard discharge mode	Under the condition of 25°C±2°C, discharge the battery at a constant current of 0.5C(A) to a final voltage of 2.5V.	
Standard discharge temperature	25°C±2°C	
Absolute discharge temperature (battery temperature)	-30°C~60°C	No matter what discharge mode the battery is in, once the battery temperature exceeds the absolute discharge temperature range, the discharge should stop
Absolute discharge voltage	Min 1.8V	No matter what kind of discharge mode the battery is in, once the battery voltage is less than the absolute discharge voltage, the discharge should stop

4.3.1. Other discharge modes

Cell temperature /°C		-30	-20	-10	-5	0	5	45	50	55	60
Max discharging power (P)	0%~100% SOC	0	0.2	0.4	0.5	0.5	1.0	1.0	0.5	0.5	0

4.4. Pulsing Mode

4.4.1. Pulsing Discharging Mode

30s pulse discharge rate /C unit: C-rate																	
T (°C) / SOC	-30	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60
(0%,10%]	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
(10%,20%]	0.1	0.2	0.2	0.2	0.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
(20%,30%]	0.15	0.3	0.3	0.3	0.3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
(30%,40%]	0.15	0.3	0.3	0.5	0.5	1.5	1.5	1.5	1.5	1.5	2.0	2.0	2.0	1.5	1.5	1.5	1.5	1.5
(40%,100%]	0.4	0.8	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2.0	2.0	2.0	1.5	1.5	1.5	1.5	1.5

4.4.2. Pulsing(Charge) Feedback Mode

30s pulse charge rate /C unit: C-rate													
T (°C) / SOC	0	5	10	15	20	25	30	35	40	45	50	55	60
(0%, 60%]	0.2	0.3	0.5	0.7	1.5	2.0	2.0	2.0	1.0	1.0	0.5	0.3	0.15
(60%, 70%]	0.2	0.3	0.5	0.7	1.5	2.0	2.0	2.0	1.0	1.0	0.5	0.3	0.15
(70%, 80%]	0.2	0.3	0.5	0.7	1.5	2.0	2.0	2.0	1.0	1.0	0.5	0.2	0.1
(80%, 90%]	0.2	0.2	0.3	0.7	1.5	1.5	1.5	1.5	0.5	0.5	0.2	0.2	0.1
(90%, 95%]	0.0	0.2	0.2	0.7	1.0	1.0	1.0	1.0	0.5	0.5	0.2	0.0	0
(95%,100%)	0.0	0.2	0.2	0.5	0.7	0.7	0.7	0.7	0.5	0.5	0.0	0.0	0

5. Safety Limits

5.1. Voltage Limits

Items	Category	Parameters	Protective Action
Charging Voltage	First	3.7 V	BMS alarm
	Second	3.75 V	Reduce battery charging current or power
	Third	3.80 V	Cut off the current and force the battery to stop working
Discharging	First	2.0 V (>0°C); 1.9 V (≤0°C)	BMS alarm

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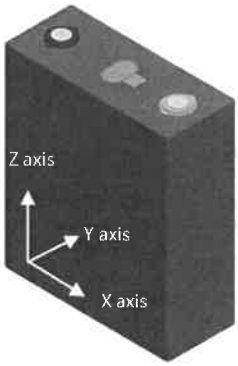
Voltage	Second	1.9 V (>0°C); 1.8 V (≤0°C)	Reduce battery charging current or power
	Third	1.85 V (>0°C); 1.75 V (≤0°C)	Cut off the current and force the battery to stop working

5.2. Temperature Limits

Items	Value	Remarks
Recommended Operating Temperature Range	10°C~45°C	Recommended battery usage temperature range.
Maximum operating temperature	60°C	If the battery temperature exceeds the maximum operating temperature, the power needs to be reduced to 0.
Minimum operating temperature	-30°C	If the battery temperature exceeds the minimum operating temperature, the power needs to be reduced to 0.
Maximum safe temperature	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.
Minimum safe temperature	-35°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.

6. Parameters Recommendation for Module Design

6.1. Battery Directions



6.2. Battery Compression Force

When the module is assembled, the safety margin of the compressive force that battery can withstand. The test conditions are as follows:

-Compression area:

173.7mm×204.4mm(L×H)

-Compression speed:0.02 mm/s

-Compression direction: Y direction

-Battery SOC: 100%

Observation	Compression Force
Internal defects	50 kN
Leakage	>100 kN

It can be seen from the above table, that the compression force of the battery cannot exceed 50 kN, otherwise the

battery may be damaged.

6.3. Battery Expansion Force

6.3.1. Testing Conditions

Before the test, prepare the fixture according to 3.3. When the SOC is 30%~40%, install the expansion force test fixture according to the method of 3.4.

At ambient temperature

-Charge: 140 A constant current charge to 3.65 V, then constant voltage charge to cut-off current 14 A (0.05C), rest for 30 minutes.

-Discharge: discharge at 140 A constant current to 2.5 V, and rest for 30 min.

According to the charging and discharging conditions, cycle to 60% of the initial capacity, and record the battery expansion force before and after the cycles.

6.3.2. Testing Results

Expansion Force	BOL	≤3000 N
	EOL	≤50000 N

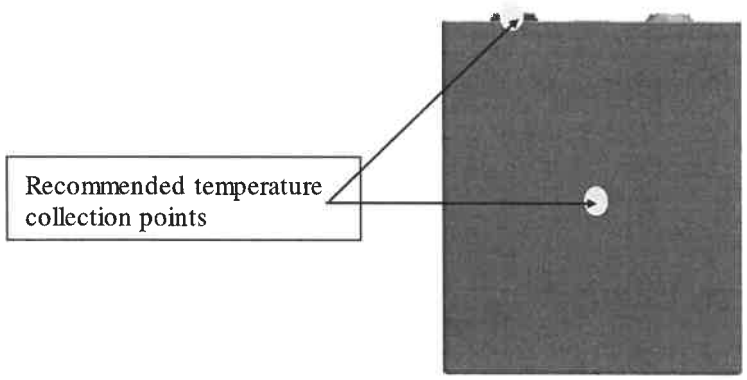
6.4. Thermodynamic Parameters

Testing method:·reference standards: GB/T 10295-2008、ASTM E1269-2011

Mean thermal conductivity	**Thermal Conductivity (W/mK)**	
	X/Z direction	Y direction
	20~21W/mK	2~3 W/mK
Mean heat capacity	Heat Capacity (kJ/(kg·K))	
	0.9~1.1	

6.5. Recommended Temperature Collection Points (Battery temperature field distribution)

When collecting temperature on the battery surface, it is recommended that the temperature collection points to be arranged at the center of the positive pole and the large surface, as shown in the figure.



7. Battery Operation Instruction and Precautions

7.1. Product End-life Management

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 60% of the nominal capacity (25°C) or the end of battery life which both customer and EVE agree on is coming, the battery should not to be operated. 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.

7.2. Long-term Storage

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. The recommended storage conditions are 30%~40%SOC，0~25°C，≤60%RH.

7.3. Transportation

Battery for shipping should be packed in boxes with the SOC of 30%~40%. The severe vibration, impact, extrusion, sun and rain should be prevented during shipping. Applicable methods of transportation include truck, train, ship, airplane, etc.

7.4. Operation Precautions

- It is forbidden to inversely charge. Correctly connect the positive and negative poles of the battery, and reverse charging is strictly prohibited.
- It is forbidden to over-discharge. During the normal use of the battery, in order to prevent over-discharge, the battery should be charged regularly to maintain the voltage above 2.8 V.
- 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 solder the battery.

- It is forbidden to directly pierce the battery with nails or other sharp objects.
- It is forbidden to use or place the battery under high temperature (under hot sunlight), such as in a car under direct sunlight or in a hot day.
- It is forbidden to use it in places with strong static electricity and strong magnetic fields.
- If the battery leaks and the electrolyte splashes on the skin, clothes, eyes, mouth, nose, etc., immediately wash the affected area with running 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, stop using it.

7.5. Disclaimer

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.

7.6. Other

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

8.Contact Information

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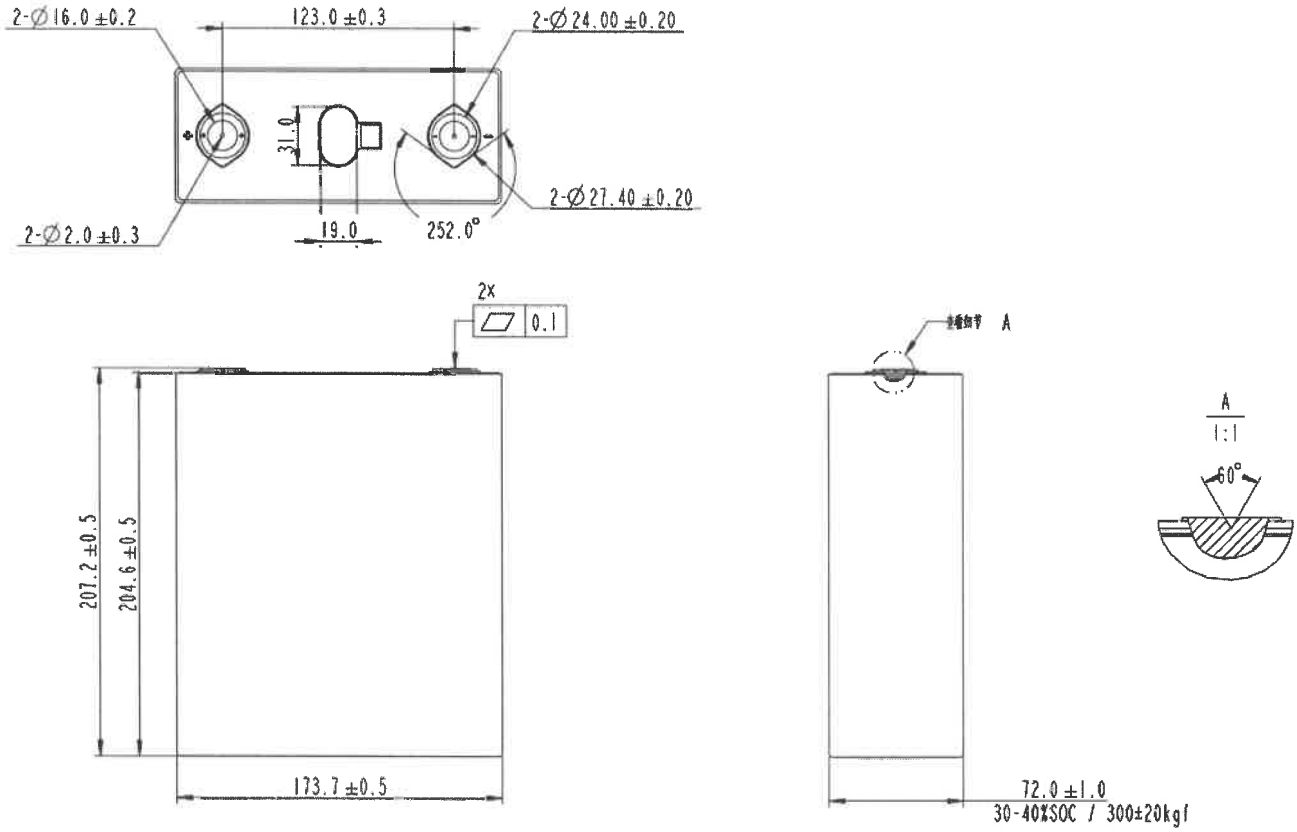
Appendix: Battery Size and Appearance Diagram



Battery Size

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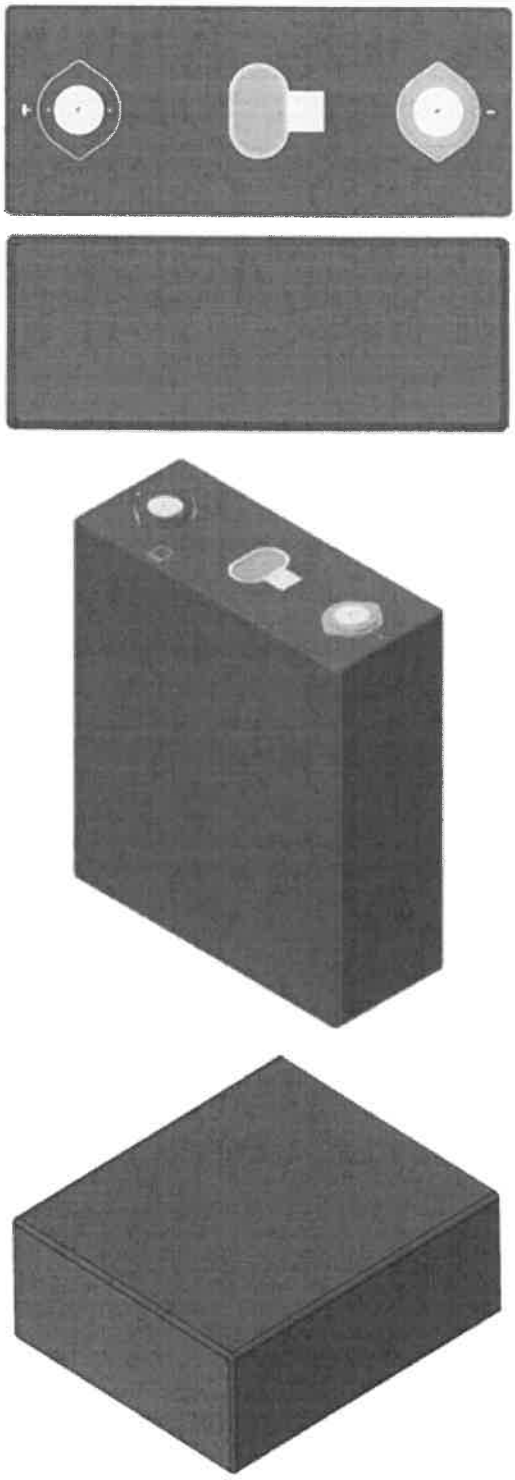

Battery Appearance Diagram