

TO:

LiFePo₄ Battery Packs

SPECIFICATION FOR APPROVAL

Battery Type : LiFePo4 Battery
Battery Model : SNO-42110F-12S1P

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1. Summarization

This Specification describes the requirements of the LiFePO₄ rechargeable battery supplied by Starnovo Technology Co., Ltd., The product mentioned in the specification accord with Q/SHB002-2007 (based on GB/T18333.1-2001).

2 Description

2.1 Name: LiFePO₄ Battery Packs

2.2 Type: SNO-42110F-12S1P

3. Parameters

No.	Item	Unit	Parameters	Remark	
1	Nominal Capacity	Ah	10	Capacity according to standard discharge, After standard charge	
2	Nominal Voltage	V	38.4	Average Voltage according to standard discharge, After standard charge	
3	Charge Type	/	CC/CV	/	
4	Charge Cut-off Voltage	V	43.8	/	
5	Discharge Cut-off Voltage	V	31.8	/	
6	Charge current	A	≤15	constant current	
7	Discharge current	A	≤20	constant current	
8	Max. instantaneous discharge current	A	20	<15S	
9	Weight	kg	≤3.66	/	
10	Inner Resistance	mΩ	<5.0	/	
11	Dimension (L×W×H)	mm	126*84*230	/	
12	Working Temperature	Charging	°C	0~45	
		Discharging	°C	-20~60	
13	Storage Temperature	1 month	°C	-20~60	
		3 months	°C	-20~45	
		6 months	°C	-20~25	
	Atmospheric pressure	KPa	86~106	/	
	Relative Humidity	RH	25%~85%	/	
14	Power Management System	Overcharge protection	Monomer overcharge protection	V	3.90±0.05
			Protection of the release of monomer	V	3.80±0.05
			Total overcharge protection	V	15±0.5
			The release of the overall protection	V	14±0.5
			Overcharge protection delay	S	1

	Discharge protection	Single discharge protection	V	2.00±0.08
		Protection of the release of monomer	V	2.30±0.08
		Total discharge protection	V	10.0±0.5
		The release of the overall protection	/	Disconnect the load or charge
		Deep discharge protection delay	S	1
	Over-current protection	Protection of current	A	120
		Detention	mS	<50

4. Technical Requirements

4.1 Testing Conditions

- (1) Standard charge: Under temperature 20±5 °C, charge with 1I₃ constant current till it reaches to charge cut off voltage(3.85V), then starts to Charge with constant voltage, Till charge current<0.01C.
- (2) Standard discharge: Under temperature 20±5 °C, discharge with 1I₃ constant current till to discharge cut-off voltage(2.0V).
- (3) Standard testing environment:
 Temperature: 15-35°C;
 Relative Humidity: 25%~85%RH;
 Atmospheric pressure: 86kPa~106kPa.

4.2 Electrical Performance:

No.	Item	Testing Instructions	Requirement
1	Nominal Capacity	Temperature 20±5 °C, Measure discharge capacity to 2.0V cut-off within 1h after standard charge.(One time for the first 5times, meeting the requirements can do)	10.0Ah
2	High-current discharge performance	Temperature 20±5 °C, discharge with 5C constant current to discharge cut-off voltage within 1hrs after standard charge.	Discharge time ≥ 60 min. The battery shall not be metamorphose, rupture.
3	Low-temperature discharge performance	Keep the battery in the case at -20±2°C for 20hrs after standard charge. Measure the discharge time with constant discharge current 1I ₃ to cut-off voltage. Then, Temperature 20±5 °C, lay the battery for 2hrs, observe the appearance of the battery.	Discharge time ≥ 126min The battery shall not be metamorphose, rupture.
4	High-temperature discharge performance	Keep the battery in the case at 55±2°C for 5hrs after standard charge. Measure the discharge time with constant discharge current 1I ₃ to cut-off voltage. Then, Temperature 20±5°C, lay the battery for 2hrs, Observe the appearance of the battery.	Discharge time ≥ 171 min. The battery shall not be metamorphose, rupture.
5	Charge Retention	Temperature 20±5 °C after standard charge, keep the battery open circuit for 28 days. Then, Measure the discharge time with constant discharge current 1I ₃ to cut-off voltage.	Discharge time ≥ 144min

6	Cycle Life	Temperature $20\pm 2^{\circ}\text{C}$, Charge with constant charge current $1I_3$ to charge cut-off voltage, Then charge with constant voltage to the current $\leq 0.01C$, Then, stop charge. 10 min later, discharge with discharge current $0.5C$ to 100% of the capacity DOD. 10 min later, repeat the cycle, till the capacity of lasting 24times $\leq 80\%$ of the Nominal Capacity, Then consider the life of battery end.	Cycle Life ≥ 2000 times
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4.3 Misuse testing:

No	Item	Testing instruction	Requirement
1	Falling off testing	After standard charge , drop the battery from the height of 1.5m to the hardwood floor 20mm thin , 2 times one direction , 6 times altogether. During the testing, make note of the changes of voltage and the temperature .	No explosion, no leakage, no fire.
2	Extrusion testing	After standard charge ,lay the battery at $20\pm 5^{\circ}\text{C}$ for 1 hour. a) Extrusion direction: press in he vertical direction of the battery polar board. b) Extrusion area: $\geq 20\text{cm}^2$ Extrusion extent: till the rupture of the battery rind and till to be short-circuited inside(voltage be 0V).	No explosion、no fire (distortion and leakage allowed)
3	Puncture testing	After standard charge ,put the battery at $20\pm 5^{\circ}\text{C}$ for 1 hr .Then puncture the battery in the direction of electrode board with the high temperature-proof steel pin with 3mm diameter.(the pin staying in the battery) . The test must be conducted in the protective condition .During the test, make note of the changes of the voltage and the temperature .	No explosion、no fire (distortion and leakage allowed)
4	Calefaction testing	Put the battery in the case at constant temperature of $70\pm 2^{\circ}\text{C}$ for 120min and observe the appearance of the battery . Meanwhile, make note of the changes of the battery voltage.	No explosion、no fire (distortion and leakage allowed)

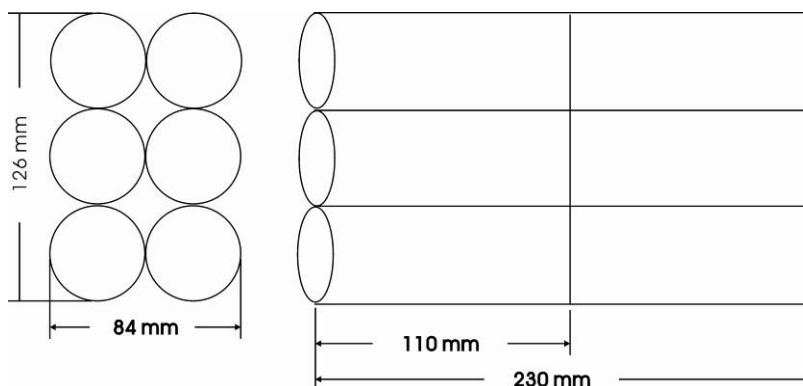
4.4 Safety Performance

No	Item	Testing Instructions	Requirement
1	Short Circuit performance	After charging the battery standardly put it under the temperature of $20\pm 5^{\circ}\text{C}$ for 1 hrs and then short-circuit the battery for 10 min ,connecting the positive and negative terminals of it (The resistance of the circuitry $\leq 5\text{ m}\Omega$). Notice the change of the temperature, battery current and the voltage during the experiment.	No fire ,no explosion
2	Over charge Performance	After charging the battery standardly, put it under the temperature of $20\pm 5^{\circ}\text{C}$ for 1 hrs The battery with thermocouple is to be put into the fume cupboard .Charge it with constant current $0.3C$ to 4.1 voltage. Observe the appearance of the battery. Notice the change of the temperature, battery current and the voltage during the experiment.	No fire ,no explosion
3	Over discharge performance	After standard charge and under the temperature of $20\pm 5^{\circ}\text{C}$, discharge the battery (if there is BMS, please	No explosion, no leakage, no

disconnect the BMS first) with the current of 113 till the voltage of the battery is 0v . Notice the change of the temperature, battery current and the voltage during the experiment .

fire .

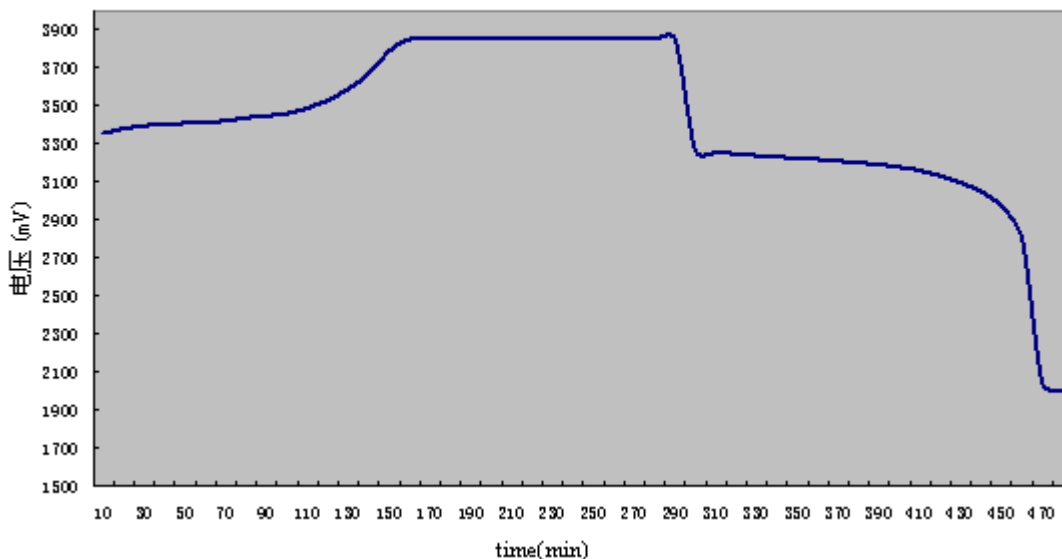
5. Sketch map of product :



6. Typical curves :

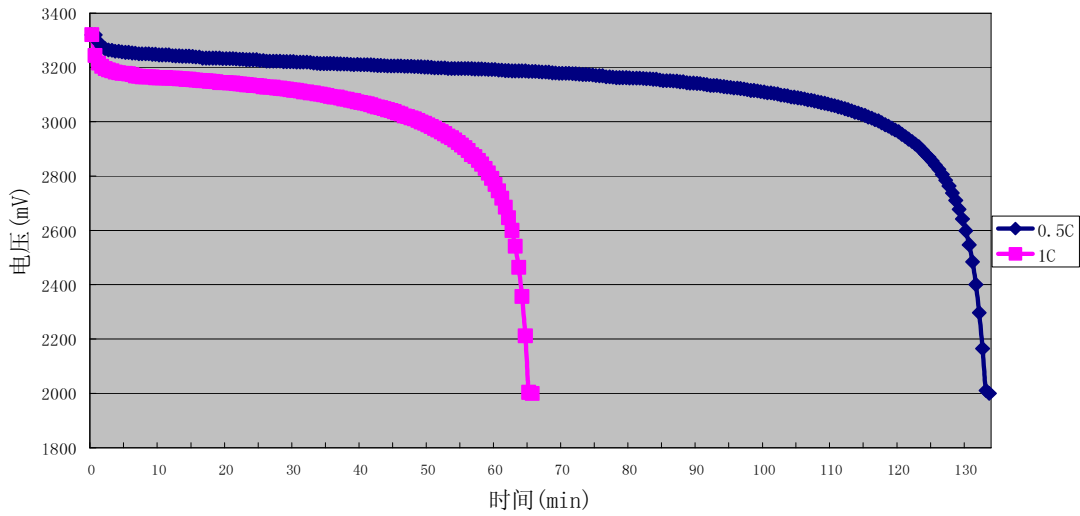
6.1 Typical charge/discharge curve graph:

battery charge&discharge testing curve



6.2 Discharge curve at different rate:

磷酸铁锂电池0.5C、1C倍率放电曲线图



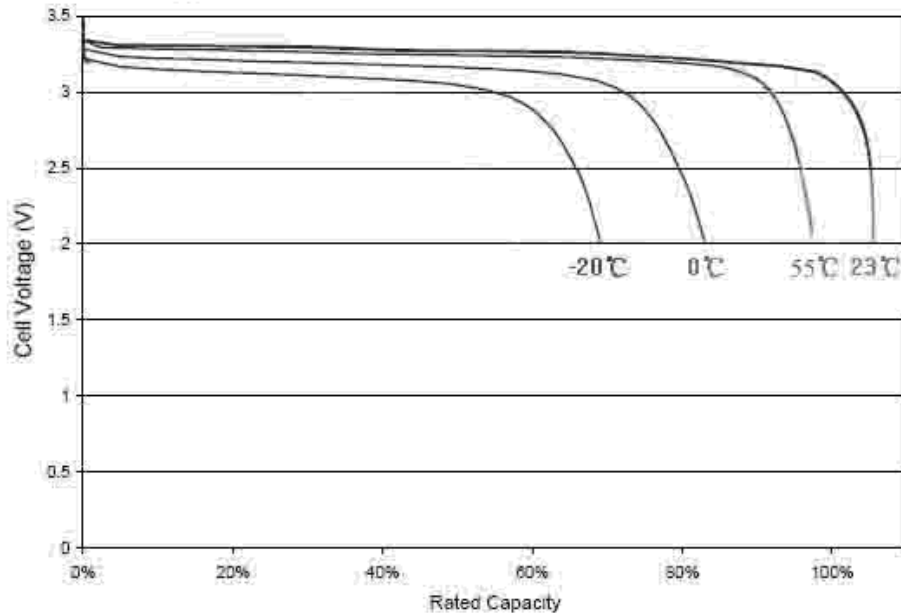
This curve shows the discharge capacity at high drain rate. The Max discharge current allowed is 3C, which is the instantaneous current within 15s.

6.3 High/Low-temperature testing typical curve:

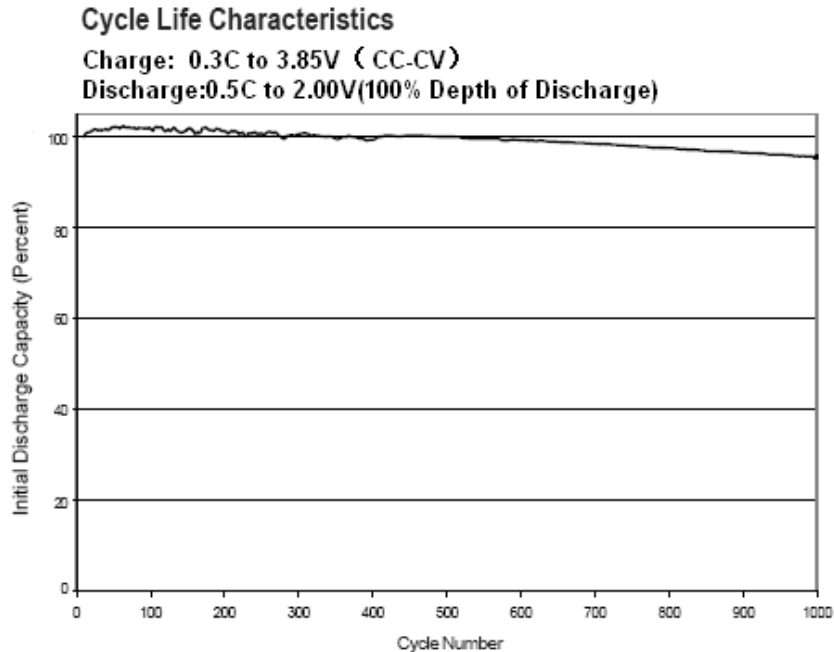
Discharge Temperature Characteristics

Charge: C/3 to 3.85V (CC-CV)

Discharge: C/3 as indicated



6.4 Cycle life curve:



7. Storage

The place of preserving the battery must accord with the following requirements: Indoor, The temperature of environment is between $-5^{\circ}\text{C} \sim 35^{\circ}\text{C}$, The relative humidity is $\leq 75\%$, The place must be clean dry and ventilative;

Avoid contacting to the corrosives;

Keep far away from fire and heat;

Keep the battery 50%~60% charge state;

Avoid being over-charged, the battery should be charged once per 3~6 months when preserved.

8. Battery maintenance

- (1) Be sure to charge the new battery fully before using for the first time. The battery will reach its max capacity after 3-5 times of full charging and discharging.
- (2) The battery should be used in the ventilative and dry environment. Avoid being near to fire.
- (3) The best working temperature range for the battery is $15^{\circ}\text{C} - 40^{\circ}\text{C}$. Beyond that, there will be effect on the battery's normal working.
- (4) Don't short circuit the battery by connecting the cathode and anode, in case of any danger.
- (5) Don't wash the outer shell of the battery with impregnant. In case of fire, please use Carbon Chlorin to put out fire instead of CO_2 .
- (6) If the battery goes wrong, please deliver that to the factory service centre or relevant organization for proper disposal
- (9) Don't dismantle the battery at will and never open the electrolyte-injecting hole.

9. Notice when using the battery :

In case of leakage, heat, fire, performance decrease etc, please use the battery according to the following regulations .Our company won't take any responsibility for any mis-operation not according to this specification.

- (1) Handle with care, do not shake.
- (2) Don't immerge the battery in the water or other liquid , in case of damp .Especially on rainy days , take care to prevent the water from going into the controller and motor ,in case of short- circuit .
- (3) Avoid being short-circuited, connecting the anode and cathode .
- (4) Please charge the battery with the Special charger provided by Starnovo Technology Co., LTD.
- (5) Don't dismantle the battery, as that may cause inner short-circuit and then decomposition of the inner material, fire and even explosion accordingly. In addition, dismantling the battery may cause the leakage of the electrolyte, which will do bad to the human body. If the electrolyte is spattered onto skin, eye and other part of the body, please wash with clean water immediately and go to the doctor at once.
- (6) Don't dispose the battery with fire, in case of any danger.
- (7) If the battery is damaged, distorted or there is leakage of the electrolyte or the taste of electrolyte and some similar abnormal phenomena, dont use the battery any more . Please deliver that to the factory service centre or relevant organization for proper disposal In addition, battery with electrolyte leakage should be far away from fire, in case of explosion.
- (8) Battery replacement
The battery provider should be responsible for replacing and installing the battery. The consumer shouldn't replace that at will.
- (9) Dismantle without permission
The consumer shouldn't dismantle the battery at will. Or our company won't take any responsibility.

10. Notice during the transportation :

- (1) The battery is suitable for being transported by truck, train , plane . During transportation, please avoid solarization, drench and serious shake.
- (2)The battery pack must be packed with insulated material and marked with logo of frangibility in case of any damage caused by bumping in transit.
- (3) Don't upside down the battery. Don't upside down' is needed.
- (4) Handle with care in transit. Can't throw or impact the battery.
- (5) Don't place any heavy objects on battery pack.
- (6) Don't mix-transport with flammable or explosive consignment, or metal objects with sharp end.
- (7) Outer packing should be marked away from moisture, water, and fire.

11. Other

Any issues not included, suppliers and customers can negotiate.