

Lithium ion battery specification

Model: TB_2770180AE_30Ah_LFP

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Date	2023.06.09	Signatory's Title	
Version	A1		

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Revision History

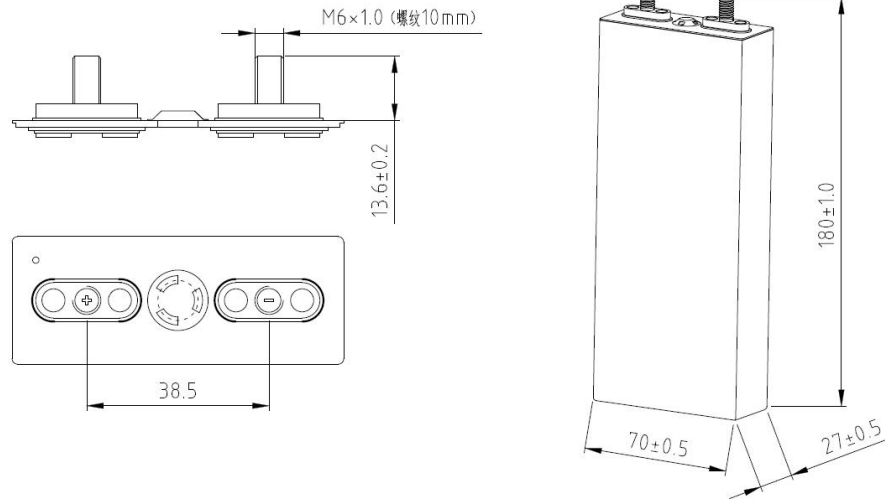
Version	Revision page	Revision description	Date	Prepare
A0	—	First edition	2019.08.12	Shaoqing Tang
A1	3	Internal impedance change to 3 mΩ	2020.10.15	Bing Yang
A2	3.4	Max continuous charge current change from 1C to 2C, and capacity retention $\geq 80\%$; Max continuous discharge current from 2C to 3C, and capacity retention $\geq 90\%$; Max pulse discharge current from 3C to 5C;	2021.03.02	Bing Yang
A3	1~11	1.Upgrade the version format. 2.Add the voltage range of 3.65-1.80V below 0°C. 3.Revise the max continuous charging current and the max continuous discharging current. Revise the max pulse charging current and their restricted temperature is revised from 25±5°C to 25±2°C. 4.Modify the cycling method and cycling life. 5.Modify the charging temperature, discharging temperature and storage temperature. 6.Revise the rate charging performance and capacity retention percentage and cycle number. Revise the charge retention and recovery from 85% and 90% to 90% and 92% respectively. 7.Delete the figures of electrical characteristics, add several charging/discharging strategies: continuous charging current table, continuous discharging current table, approved max pulse charging current table and approved max pulse discharging current. 8.Add warnings.	2023.06.09	Jiachen Wang

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1、 General

This product specification describes the technique standards, test methods and precaution notes of prismatic lithium ion (LiFePO₄) cells, manufactured by Shenzhen Topband Battery Co.,Ltd.

2、 Dimension (Unit: mm)



3、 Product specification

No.	Item	Standard	Remark
3.1	Nominal capacity	30Ah	25±2°C, 0.5C
3.2	Minimum capacity	29.5Ah	
3.3	Internal impedance	≤ 3mΩ	25±2°C, AC 1000Hz
3.4	Nominal voltage	3.2V	
3.5	Weight	680±20g	
3.6	Voltage range	3.65~2.00V	>0°C
		3.65~1.80V	≤0°C
3.7	Recommended charging current	≤1C	
3.8	Recommended discharging current	≤1C	
3.9	Max continuous charging current	2.0C	25±2°C, SOC<80%
3.10	Max pulse charging current	3.0C	25±2°C, 10s, SOC<80%
3.11	Max continuous discharging current	3.0C	25±2°C, SOC>20%
3.12	Max pulse discharging current	5.0C	25±2°C, 10s, SOC≥20%
3.13	Cycle life	4500 cycles (1.0C/1.0C)	25±2°C, 200±20Kgf, capacity retention≥70%
		6000 cycles (0.5C/0.5C)	
3.14	Charging temperature	0~60°C	
3.15	Discharging temperature	-20~60°C	
3.16	Storage temperature	-10~35°C	
3.17	Appearance	No break, scratch, distortion, contamination, leakage.	

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3.18	Terminal torsion	$\leq 5.5\text{Nm}$
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4、Test Conditions

4.1 Standard Test Conditions

4.1.1 All tests defined in this Product Specification are conducted at temperature $25\pm 2^\circ\text{C}$, humidity 15%~90%RH, atmospheric pressure 86~106kPa.

4.1.2 Unless there are other special instructions, all performance was tested with unused cells within 1month after production date.

4.2 Standard Charging Method

The "Standard Charging" means in an ambient temperature of $25\pm 2^\circ\text{C}$, the cells are discharged with 0.5C constant current to the cut-off voltage of 2.0V. Following 1 hour standing, the cells are charged with 0.5C constant current to the voltage of 3.65V, after that, charging mode is changed into constant voltage charging mode until the charging current reduces to 0.05C. Finally the cells are stopped charging and put aside for 1 hour.

5、Electrical Characteristics

No.	Item	Test method	Criteria
5.1	High Temperature Discharging Performance	The cells are charged in accordance with 4.2, and stored at an ambient temperature of $55\pm 2^\circ\text{C}$ for 5h, then discharged to 2.0V with 0.5C constant current. After that, place the cells in the ambient temperature of $25\pm 2^\circ\text{C}$ for 4h then check their appearance.	1. Capacity retention $\geq 95\%$ 2. No deformation, No crack.
5.2	Low Temperature Discharging Performance	The cells are charged in accordance with 4.2, and stored at an ambient temperature of $-20\pm 2^\circ\text{C}$ for 24h, then discharged to 1.8V with 0.5C constant current. After that, place them in the ambient temperature of $25\pm 2^\circ\text{C}$ for 4h, then check their appearance.	1. Capacity retention $\geq 60\%$ 2. No deformation, No crack.
5.3	2C Rate Charging Performance	Under the ambient temperature of $25\pm 2^\circ\text{C}$, the cells are a. Discharged to 2.0V with 1.0C constant current, stay for 1h. b. Charged to 3.65V with 2.0C constant current, stay for 1h. c. Discharged to 2.0V with 1.0C constant current.	Capacity retention $\geq 80\%$
5.4	3C Rate Discharging Performance	The cells are charged in accordance with 4.2, then discharged to 2.0V with 3.0C current at an ambient temperature of $25\pm 2^\circ\text{C}$.	Capacity retention $\geq 90\%$
5.5	Charge Retention and Recovery	The cells are charged in accordance with 4.2, and stored at an ambient temperature of $25\pm 2^\circ\text{C}$ for 28 days, and then discharged to 2.0V with 1.0C constant current.	Capacity retention $\geq 90\%$ Capacity recovery $\geq 92\%$
5.6	Cycle Life ($25\pm 2^\circ\text{C}$)	The cells are charged to 3.65V with 1.0C constant current and charged to cut-off current of 0.05C with constant voltage of 3.65V, then stay for 30min,	≥ 4500 cycles

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	subsequently, the cells are discharged to 2.0V with constant current of 1.0C and stay for 30min, followed by next charge-discharge cycle. Record all the cycles until the retention capacity percentage < 70%. (With initial 20%-50%SOC, 200±20Kgf preload)	
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6、 Environmental Characteristics

No.	Item	Test Method	Criteria																																
6.1	Temperature cycle	<p>The cells are charged in accordance with 4.2, and then repeat the following procedures for 5 cycles, then check the cells' appearance.</p> <table border="1"> <thead> <tr> <th>Temperature C°</th> <th>Time increment min</th> <th>Delta time min</th> <th>Temperature alteration ratio C°/min</th> </tr> </thead> <tbody> <tr> <td>25</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>-40</td> <td>60</td> <td>60</td> <td>13/12</td> </tr> <tr> <td>-40</td> <td>90</td> <td>150</td> <td>0</td> </tr> <tr> <td>25</td> <td>60</td> <td>210</td> <td>13/12</td> </tr> <tr> <td>85</td> <td>90</td> <td>300</td> <td>2/3</td> </tr> <tr> <td>85</td> <td>110</td> <td>410</td> <td>0</td> </tr> <tr> <td>25</td> <td>70</td> <td>480</td> <td>6/7</td> </tr> </tbody> </table>	Temperature C°	Time increment min	Delta time min	Temperature alteration ratio C°/min	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	No leakage, no fire, no explosion, no vent
Temperature C°	Time increment min	Delta time min	Temperature alteration ratio C°/min																																
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																																
6.2	Low-pressure Test	The cells are charged in accordance with 4.2, then stored for 6h at a vacuum of -90KPa, after that put the cells in room temperature for 6h, then check the cells' appearance.	No leakage, no fire, no explosion, no vent																																
6.3	Vibration Test	<p>The cells are charged in accordance with 4.2, and then installed onto the vibration machine. Equipment parameters of frequency and amplitude are set as below (the frequency is to be varied at the rate of 1oct/min between 10 and 55 Hz, and repeat vibration for 30 min. The cells are tested in three mutually perpendicular directions, i.e.X,Y,Z):</p> <p>(a) frequency:10Hz~30Hz,amplitude: 0.38mm;</p> <p>(b) frequency:30Hz~55Hz amplitude: 0.19mm;</p>	<p>1.No scratch, no fire, no explosion, no vent;</p> <p>2. The voltage is not less than 3.2V.</p>																																

6.4	Mechanical shock	The cells are tested in accordance with 4.2, and then secured to the testing machine by means of rigid mount which supports all mounting surfaces of the cells. Each cell shall be subjected to a total of three shocks of equal magnitude. The shocks are to be applied in each of three mutually perpendicular directions. The acceleration and impulse time are as follows: acceleration of impulse peak value:100m/s ² , shock frequency:40~80 times/min, impulse lasting time: 16 min, shock times:1000±10.	1. No scratch, no leakage, no fire, no explosion, no vent; 2. The voltage is not less than 3.2V.
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7、 Other Charging and Discharging Strategies

7.1 Maximum Continuous Charging Current

Maximum Continuous Charging Current /C													
Temp	Limit Voltage	SOC											
		0	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
0°C	3.65	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
5°C	3.65	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
10°C	3.65	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
15°C	3.65	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.3	0.3
20°C	3.65	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.5
25°C	3.65	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.5	1.0	0.5
30°C	3.65	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.5	1.0	0.5
35°C	3.65	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.5	1.0	0.5
40°C	3.65	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.0	1.0	0.5
45°C	3.65	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.5
50°C	3.65	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.5
55°C	3.65	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4
60°C	3.65	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.1	0.1	0.1

7.2 Maximum Continuous Discharging Current

Maximum Continuous Discharging current /C													
Temp	Limit Voltage	SOC											
		5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
-20°C	1.80	0.05	0.10	0.15	0.35	0.35	0.35	0.35	0.35	0.75	1.00	1.00	1.00
-15°C	1.80	0.05	0.10	0.20	0.35	0.35	0.35	0.35	0.35	0.75	1.00	1.00	1.00
-10°C	1.80	0.10	0.20	0.50	0.50	0.50	0.75	0.75	0.75	0.75	1.00	1.00	1.00
-5°C	1.80	0.20	0.40	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0°C	2.00	0.20	0.40	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5°C	2.00	0.30	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
10°C	2.00	0.35	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
15°C	2.00	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

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20℃	2.00	0.50	1.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
25℃	2.00	0.50	1.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
30℃	2.00	0.50	1.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
35℃	2.00	0.50	1.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
40℃	2.00	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
45℃	2.00	0.30	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
50℃	2.00	0.25	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
55℃	2.00	0.05	0.10	0.20	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
60℃	2.00	0.05	0.10	0.20	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40

7.3 Approved Maximum Pulse Charging Current

Approved Maximum Pulse (10s) Charging Current /C													
Temp	Limit Voltage	SOC											
		0	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
0℃	3.65	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
5℃	3.65	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
10℃	3.65	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
15℃	3.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.50	0.50
20℃	3.65	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.00
25℃	3.65	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	1.50	1.00
30℃	3.65	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	1.50	1.00
35℃	3.65	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	1.50	1.00
40℃	3.65	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.00
45℃	3.65	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.00
50℃	3.65	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.00
55℃	3.65	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.20	0.80
60℃	3.65	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.20	0.20	0.20

7.4 Approved Maximum Pulse Discharging Current

Approved Maximum Pulse (10s) Discharging Current /C													
Temp	Limit Voltage	SOC											
		5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	100%
-20℃	1.80	0.05	0.10	0.25	0.55	0.55	0.55	0.55	0.55	0.75	1.00	1.00	1.00
-15℃	1.80	0.10	0.20	0.40	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00
-10℃	1.80	0.15	0.30	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
-5℃	1.80	0.25	0.50	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
0℃	2.00	0.25	0.50	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
5℃	2.00	0.40	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
10℃	2.00	0.40	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

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15℃	2.00	0.50	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
20℃	2.00	0.50	3.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
25℃	2.00	0.50	3.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
30℃	2.00	0.50	3.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
35℃	2.00	0.50	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
40℃	2.00	0.50	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
45℃	2.00	0.40	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
50℃	2.00	0.30	1.00	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
55℃	2.00	0.15	0.60	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
60℃	2.00	0.06	0.13	0.30	0.60	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

8、 Safety test

All below tests are carried out on the equipment with forced ventilation and explosion-proof device. Before test, all cells are charged in accordance with 4.2, and stored for 24h prior to the test.

No.	Item	Test Method	Criteria
8.1	Short- circuit Test	The cells are charged accordance with 4.2, after that the cells are short-circuited by connecting the positive and negative terminals with a wire for 10min, the wire has a maximum resistance load of 5mΩ. Observe them for 1h.	No fire, no explosion
8.2	Overcharge Test	The cells are charged in accordance with 4.2, and then charged with 1C constant current till the voltage reaches 1.5 times of the specified end-off charging voltage or the charging time reaches 1h. Observe them for 1h.	No fire, no explosion
8.3	Overdischarge Test	The cells are charged in accordance with 4.2, and then discharged for 90min with 1C constant current. Observe them for 1h.	No fire, no explosion, no leakage
8.4	Crush Test	The cells are charged in accordance with 4.2. and then two of the largest surface areas of the cells are compressed, the compressive force is put by a hydraulic piston with a diameter of 32 mm. The compression is continued until the pressure reaches 17.2 MPa, the pressure reaches 13 kN, and the pressure is released when the maximum pressure is reached.	No fire, no explosion
8.5	Impact Test	The cells are charged in accordance with 4.2, and then placed on the impact flat. A Φ15.8mm bar is to be placed on the center of the cells. A 9.1kg hammer is dropped from a height of 610mm onto the cells, the	No fire, no explosion

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		distortion is allowed.	
8.6	Nail Test	a) The cells are charged in accordance with 4.2 b) Use a $\phi 5\text{mm} \sim \phi 8\text{mm}$ high-temperature resistance steel needle, with speed of $25 \pm 5\text{mm/s}$, to go through the cells from vertical direction of pole plates, the penetrate position should be close to the geometric centers of plate surfaces. The steel needles remains in the cells to be observed for 1h.	No fire, no explosion
8.7	Heating Test(130°C)	The cells are charged in accordance with 4.2, and then heated in a circulating air oven. The temperature of the oven is raised at a rate of 5°C per minute to $130 \pm 3^\circ\text{C}$ and remained for 30 min.	No fire, no explosion

9、 Shipment

The cells shall be shipped at 20-50% SOC . The remaining capacity before charging shall depends on the storage time and conditions. To ensure the cells in a good transport environment is necessary.

10、 Warranty

10.1 In this specification, quality assurance protocol is the main quality assurance protocol if it conflicts with the quality assurance protocol.

10.2 If due to customers' abuse or misuse, Shenzhen Topband Battery Co.,Ltd will not exchange cells for free.

10.3 Shenzhen Topband Battery Co.,Ltd will not undertake any responsibility for breach of safety operation problems.

10.4 Shenzhen Topband Battery Co.,Ltd shall be exempt from warranty for fault cells come from by matching electric circuit connection, other battery packs and charger.

10.5 It's out of guarantee service by Shenzhen Topband Battery Co.,Ltd after customer assemble the cells(if the cells generate defects during the process of assembly).

10.6 This specification was developed after consultation between the parties. For projects not included in this specification, Shenzhen Topband Battery Co., Ltd. does not undertake quality assurance.

11、 Precautions and Safety Instructions

Abusive use of (lithium-ion) LiFePO_4 rechargeable batteries would cause damage to the cell and/or personal injury. Please read the precautions and safety instructions below before using.

11.1 Standard cell precautions

- a. Do not expose the cells to extreme heat or flame.
- b. Do not short circuit, over-charge or over-discharge the cells.
- c. Do not subject the cells to strong mechanical shocks.
- d. Do not immerse the cells in water, or get it wet.
- e. Do not disassemble or modify the cells.
- f. Do not handle or store with metal objects like necklaces, coins or hairpins, etc.
- g. Do not use the cells with conspicuous damage or deformation.
- h. Do not connect cells to the plug socket.

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- i. Do not touch a leaked cell directly.
- j. Do not mix the new and old Lithium-ion cells and use together.
- k. Do not expose the cells to blazing sun (or in heated car by sunshine).
- l. Keep cells away from children and pets.
- m. Do not nail into the cells, strike it by hammer or tread it.
- n. Do not impact or throw the cells.
- o. Do not direct contact the cells positive and negative electrode with aluminum case.

11.2 Cell Operation Instructions

11.2.1 charging

- a. The best temperature range of charging is 15°C to 35°C.
- b. Charge the cells at a constant current of 0.5C until 3.65V, and then at a constant voltage of 3.65V until current is 0.05C. The continuous charging rate over 2.0C is not allowed.(C : Rated Capacity of cell)
- c. Use a matched or recommend (CC/CV) lithium-ion (Li⁺) battery charger.

11.2.2 Discharging

- a. The continuous discharging rate over 3.0C is not allowed. The discharging cut-off voltage is 2.0V.
- b. For maximum performance, the cells should be discharged in a temperature range of 15°C to 35°C.

11.2.3 Storage Recommendations

- a. In case of long period storage (more than 3 months), store the cells at temperature range of -10~+35°C, low humidity, no corrosive gas atmosphere.
- b. Charge and discharge the cells every 3months is recommended, charge and discharge the cells every 6months is obligatory. Charging and discharging steps as below:
In temperature of 25±2°C, the cells should be discharged with 0.5C current to 2.0V, and stay for 30min, then 0.5C constant current and 3.65V constant voltage charged until the current reaches 0.05C, after stay for 30min, 0.5C current discharged to 2.0V, stay for 30min, finally 0.5C charged to about 30%SOC.
- c. To protect the cells, appropriate storage environment is necessary.

Note 1. The customer is required to contact Shenzhen Topband Battery Co.,Ltd in advance, if and when the customer needs other applications or operating conditions beyond those described in this document.

Note 2. Shenzhen Topband Battery Co.,Ltd shall take no responsibility for any accident when the cells are used under other conditions than those described in this specification.

12.Requirement for safety assurance

For safety assurance, please discuss with Shenzhen Topband Battery Co.,Ltd in advance for your equipment design, the circuit protection of battery/cells, high rate discharge, rapid charge and other aspects of special application.

WARNING

CELLS ARE POTENTIALLY DANGEROUS AND PROPER PRECAUTIONS MUST BE OBSERVED IN HANDLING AND MAINTENANCE.

RUNNING TESTS ON THE CELLS IMPROPERLY MAY RESULT IN SEVERE PERSONAL BODY INJURY OR PROPERTY DAMAGES.

WORK ON CELLS MUST BE PERFORMED ONLY WITH PROPER TOOLS AND PROTECTIVE EQUIPMENT MUST BE USED.

CELL MAINTENANCE MUST BE CARRIED OUT BY PERSONNEL KNOWLEDGEABLE OF CELLS AND TRAINED IN THE SAFETY PRECAUTIONS INVOLVED.

FAILURE TO OBSERVE THE ABOVE MAY CAUSE VARIOUS HAZARDS.