



山东润峰集团新能源科技有限公司

Shandong RealForce Enterprises Co., Ltd.

文件编号 Doc No. : SPEC-TC2-050

版本编号 REV: A0

页次 Page: 1 Of 17

生效日期 Date: 2011-02-10

# 锂离子动力电池

Lithium-ion Rechargeable Battery Pack

## 产品规格书

Specification

产品名称 **Product Name:** 磷酸铁锂电池组

**LiFePO4 Li-ion Battery Pack**

产品型号 **Product Model:** 16F80-001

产品规格 **Product Specification:** 48V80Ah

日期 **Date:** 2011-02-10

制 定	审 核	批 准
Prepared By	Checked By	Approved By



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### 一、产品概述 Product Overview

本产品为山东润峰集团新能源科技有限公司设计、制造的磷酸铁锂电池组（含 BMS）。电池组由 64 只 F20-08180225 单体电芯通过串并联方式组合而成。BMS 是电池组的重要部件，在使用过程中可实现对电池组的保护。适用于工作电流小于 100A 负载设备，具有高比能量、长寿命、安全可靠、使用温度范围宽等特性，是理想的绿色动力电源产品。

This product is  $\text{LiFePO}_4$  Li-ion battery pack(with BMS), composed of 64pcs battery cell F20-08180225 in serial and parallel mode. BMS is an important part of battery pack, could achieve protection for battery pack. The battery pack enjoys high specific energy and long life, be safe and reliable, can be used in wide temperature range and be applied to load of working current no less than 100A, is an ideal green power product.

### 二、产品命名规则 Product Naming Rules

pack 产品命名代码如下表示 Code of battery pack is as below:

3-1 型号标记 Model Marks





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三、规格参数 Specifications

项目 Item	标准 Standard	备注 Remark
规格 Specification	16F80-001	
标称电压 Nominal voltage	48V	
容量 Capacity	80Ah	40A 恒流放电至过放保护 Discharge at 40A constant current to over-discharge protection.
尺寸 Size (L*W*H)	382x248x147mm	
重量 Weight	47.2±0.2kg	
质量比能量 Mass ratio of energy	88Wh/Kg	
标准放电 Standard discharge	40±1A	
最大持续放电电流 Maximum continuous discharge current	80±0.5A	
放电截止电压 Discharge cut-off voltage	≥40V	电池过放保护时 Battery over-discharge protection
充电电压 Charge voltage	58.4±0.2V	配套充电器充电 Charg with matched charger
标准充电 Standard charge	24±0.5 A	
内阻 Resistance	≤20mΩ	放电口正、负极端之间 Between discharge port of positive and negative extremes
工作温度范围 Operating temperature range	-20~50℃	
存储温度范围 Storage temperature range	-40~50℃	
储存环境湿度 Storage humidity	5%~90%	
执行标准 Implementation Standards	QC/T743-2006	
充/放电接口 Charge/discharge interface	安德森接插头 Anderson plug	充电 50A, 放电 120A Charge 50A, Discharge 120A
外壳材质 Shell material	不锈钢 (厚度 1.5mm) Stainless steel	



#### 四、测试条件 Test conditions

##### 4-1 测试条件 Test Conditions

除特别指定，所有测试均在温度为 15℃~35℃、相对湿度 25%~85%、大气压力 86kPa~106kPa 环境中进行；

Unless otherwise specified, all tests are done at temperature between 15℃~35℃, relative humidity 25%~85%, atmospheric pressure 86kPa~106kPa.

##### 4-2 测量仪器 Test Instruments

a)测量电压用的直流电压表精度不低于 0.5 级，电压表内阻不低于 1kΩ/V；

DC voltage meter measures voltage with a precision not less than 0.5 , resistance no less than 1kΩ/V;

b)测量电流用的直流电表精度不低于 0.5 级；

DC ammeter accuracy is not less than 0.5;

c)测量温度用的温度计应具有适当的量程，其分度值不应大于 0.5℃；

Thermometer should have appropriate measuring range, the division value should not exceed 0.5℃;

d)测量时间用的计时器应按时、分、秒分度，至少应具有±1%的准确度；

Timer should be distinguished by hours, minutes and seconds, at least should have accuracy of ±1%.

#### 五、电性能、安全性能及机械性能 Electrical, Secure and Mechanical Performance Testing

##### 5-1 标准充电 Standard Charge

用直流稳压电源以电压为 58.4V，电流 0.3C(A) 恒流充电至电流降至 0.1C(A)。Charge with constant current 0.3C(A) to 58.4V, then charge with constant voltage 58.4V to current 0.1C(A);

##### 5-2 标准放电 Standard Discharge

按（5-1）方法充电后，用 1C(A) 电流恒流放电至电池过放保护或总电压低于 40V；

After charge by (5-1) method, discharge at 1C(A) constant current to battery over-discharge protection or total voltage lowers 40V;

##### 5-3 电池容量 Battery Capacity

按（5-2）方法放电，记录放电时间（小时），容量(Ah)=0.5C(A) \* 放电时间(小时)；

Discharge by (5-4) method, record discharge time(hours), capacity(Ah)=0.5C(A)\*Discharge

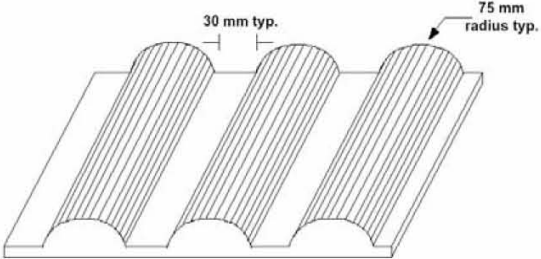


time(hours);

5-4 电化学性能 Electrochemical Properties

测试项目 Test Items	测试方法 Test Methods	技术要求 Technical Requirements
标称电压 Nominal voltage	电池标准放电后，静置 1~3 小时 Standard discharge the battery, and then put aside for 1 to 3 hours	电池电压≥48.0V Voltage≥48.0V
20℃放电容量 Discharge capacity at 20℃	电池标准充电后，以 1C (A) 电流放电，记录电池放电容量 Standard charge the battery. Discharge at 1C(A) current. Record discharge capacity	≥95%标称容量 ≥95% Nominal capacity
-20℃放电容量 Discharge capacity at -20℃	电池标准充电后，在-20℃±2℃存储 20h 后，以 1C (A) 放电至终止电压，记录放电容量 Standard charge the battery, and then put aside at -20℃±2℃ for 20h. Discharge at 1C(A) current to cut-off voltage to record discharge capacity	≥70%标称容量 ≥70% Nominal capacity
55℃放电容量 Discharge capacity at 55℃	电池标准充电后，在 55℃±2℃存储 5h 后，以 1C (A) 放电至终止电压，记录放电容量 Standard charge the battery. and then put aside at Put aside at 55℃±2℃ for 5h. Discharge at 1C(A) current to cut-off voltage to record discharge capacity	≥95%标称容量 ≥95% Nominal capacity
荷电保持能力与容量恢复能力 Charge retention and capacity recovery capability	电池标准充电后，常温搁置 28d 或 55℃搁置 7d Standard charge the battery, and then put aside at room temperature for 28d or 55℃ for 7d	荷电保持率≥80% Charge retention rate≥80% 容量恢复率≥90% Recovery rate of charge≥90%
循环寿命 Cycle life	电池在 20℃±5℃条件下，以 0.5C (A) 充电 80%soc; 1C (A) 放电至终止条件，依此循环。每 25 次循环按标准充放电检测一次电池容量，当容量小于 80%的额定容量时终止测试 Charge at 0.5C(A) in 20℃±5℃ to 80% soc. Discharge at 1C(A) to terminal condition. Test the capacity according to standard charge and discharge methods for every 25 cycles. When the capacity is less than 80% of the nominal capacity, terminate the test.	≥1800 次 ≥1800 cycles

5-5 安全性能测试 Safe performance test

测试项目 Test item	测试方法 Test method	技术要求 Technical
短路试验 Short circuit test	蓄电池组充电后，在 20℃±5℃条件下搁置 1h。将蓄电池经外部短路 10min，外部线路电阻应小于 5mΩ After charge batteries, place at 20℃±5℃ for 1h. Short the battery for 10min, the external circuit resistance should be less than 5mΩ.	不爆炸、不起火 No explosion, no fire
挤压试验 Squeeze test	挤压板形式如下图所示：一侧是平板，一侧是异性板。异性板的半圆柱形挤压头的典型直径为75mm，挤压头间的典型间距为30mm。 Squeeze plate is shown below: one side is flat, one side is the opposite board. Head diameter of the opposite plate semi-cylindrical extrusion is 75mm. Typical spacing between the squeeze head is 30mm.  <ol style="list-style-type: none"> <li>1) 挤压方向：垂直于蓄电池单体排列方向施压。 Squeeze direction: Force on the direction perpendicular to arranged battery.</li> <li>2) 挤压程度：挤压至蓄电池组原始尺寸的 85%，保持 5min 后再挤压至蓄电池模块原始尺寸的 50%。 Squeeze extent: Squeeze battery to 85% of original size. Keep 5min, then squeeze the battery to 50% of original size.</li> </ol>	不爆炸、不起火 No explosion, no fire
针刺试验 Prick test	用如图所示的钉板从垂直于蓄电池串联方向迅速贯穿三只串联的电池蓄电池，每只钢钉至少贯穿 3 只并联的蓄电池，钉板为导电材料制作。钢钉保持在蓄电池内部，保持至少 1h。如图所示，钢钉直径为 3~8mm，长度不小于 90mm。 Pierced three batteries quickly from the direction perpendicular to the series batteries with the nail plate which is conductive. Every nail pierces through at least three parallel batteries. Keep the nail in the batteries for at least 1h. Diameter of the nail is 3~8mm, length is more than 90mm.	不爆炸、不起火 No explosion, no fire

		
<p>加热试验 Heating test</p>	<p>将蓄电池置于 <math>85^{\circ}\text{C} \pm 2^{\circ}\text{C}</math> 恒温箱内，并保温 120min。 Put the battery in constant temperature box of <math>85^{\circ}\text{C} \pm 2^{\circ}\text{C}</math>, keep 120min.</p>	<p>无燃烧、无爆炸 No fire, No explosion</p>
<p>过放电试验 Over-discharge test</p>	<p>蓄电池组充电。在 <math>20^{\circ}\text{C} \pm 5^{\circ}\text{C}</math> 条件下搁置 1h。然后在同一温度条件下，蓄电池以 <math>1/3\text{C}</math> 电流放电，直至某一单体电池电压达到 0V（如果有电子保护线路，应暂时除去放电电子保护线路） Charge the battery. Place at <math>20^{\circ}\text{C} \pm 5^{\circ}\text{C}</math> for 1h, then discharge in <math>1/3\text{C}</math> current at same temperature until some cell's voltage is 0V(if there are electronic protection circuit, remove it temporarily).</p>	<p>不爆炸、不起火、不漏液 No explosion, no fire, no leakage</p>
<p>过充电试验 Over-charge test</p>	<p>按照如下两种充电方式进行充电（两者选一即可）。 (1) 以 <math>1\text{C}</math> 电流充电 90min 或某一单体电池电压达到 5.0V（其中一个条件优先达到即停止试验）。 (2) 以 <math>3\text{C}</math> 电流充电至某一单体电池电压达到 10.0V 即停止试验。 Charge in accordance with the following two ways(Choosing one between the twos). (1)Charge at <math>1\text{C}</math> current for 90min or until voltage of some single battery reaches 5.0V(stop test when fulfills either condition). (2)Charge at <math>3\text{C}</math> current until the voltage of some single battery reaches 10.0V, then stop the test.</p>	<p>不爆炸、不起火 No explosion, no fire</p>





5-6 机械性能 **Mechanical properties**

测试项目 Test item	测试方法 Test method	技术要求 Technical requirements																								
绝缘性能 Insulation performance	用绝缘测试仪检测（500V 档）检测正负极与电池壳体（安装螺钉）之间的绝缘电阻。 Detective the insulation resistance between positive pole and shell (mounting screws), negative pole and shell (mounting screws) with insulation tester(500V file).	≥10MΩ																								
振动性能测试 Vibration performance tests	按三种方向进行振动测试（平放、侧放、竖放）。 (1) 侧放 (a) 以 5G 峰值加速度，进行 2000 次正弦曲线循环，频率范围为 10~30Hz。 (b) 从 10Hz 升到 90Hz 然后再回到 10Hz，进行 60 次正弦扫描振动，扫描速度为 1Hz/s。整个周期为 6 小时。采用以下 G 水平： <table border="1" style="margin-left: 40px;"> <tr> <td>频率范围 (HZ)</td> <td>峰值加速度 (G)</td> </tr> <tr> <td>10~20</td> <td>3.0</td> </tr> <tr> <td>20~40</td> <td>2.0</td> </tr> <tr> <td>40~90</td> <td>1.5</td> </tr> <tr> <td>90~140</td> <td>1.0</td> </tr> <tr> <td>140~190</td> <td>0.75</td> </tr> </table> (2) 竖放 (a)：以 3.5G 的峰值加速度，按正弦曲线循环 4000 次，频率范围为：10~30HZ。 (b)：从 10HZ 到 190HZ 然后再回到 10HZ 进行 60 次正弦曲线扫描，扫描速度 1HZ/S，总时间 6 小时，采用以下的 G 水平： <table border="1" style="margin-left: 40px;"> <tr> <td>频率范围 (HZ)</td> <td>峰值加速度 (G)</td> </tr> <tr> <td>10~15</td> <td>2.5</td> </tr> <tr> <td>15~30</td> <td>1.75</td> </tr> <tr> <td>30~60</td> <td>1.25</td> </tr> <tr> <td>60~110</td> <td>1.0</td> </tr> <tr> <td>110~190</td> <td>0.75</td> </tr> </table> (3) 平放 按照 (1) 的方法进行测试。 振动测试前后检测电池模块的直流内阻、绝缘性能、密封性能。带管理板的电池组经振动后需测试数据采集与传输是否有异常。 Test vibration performance of three different direction (flat, on its side, erected) (1) Side Lay	频率范围 (HZ)	峰值加速度 (G)	10~20	3.0	20~40	2.0	40~90	1.5	90~140	1.0	140~190	0.75	频率范围 (HZ)	峰值加速度 (G)	10~15	2.5	15~30	1.75	30~60	1.25	60~110	1.0	110~190	0.75	不允许出现放电电流锐变、电压异常、电池壳变形、电解液溢出等现象 Discharge current sharply change, abnormal voltage, battery shell deformation, electrolyte leakage is not allowed.
频率范围 (HZ)	峰值加速度 (G)																									
10~20	3.0																									
20~40	2.0																									
40~90	1.5																									
90~140	1.0																									
140~190	0.75																									
频率范围 (HZ)	峰值加速度 (G)																									
10~15	2.5																									
15~30	1.75																									
30~60	1.25																									
60~110	1.0																									
110~190	0.75																									



(a) At peak acceleration is 5G to take 2000 times sinusoidal cycles in the frequency range 10~30Hz.  
(b) Raise frequency from 10Hz to 90Hz, then return to 10Hz. Take sine sweep vibration for 60 times with scan rate of 1Hz/s. The entire cycle is 6h. Adopt following acceleration levels:

Frequency range (HZ)	Peak acceleration (G)
10~20	3.0
20~40	2.0
40~90	1.5
90~140	1.0
140~190	0.75

(2) Keep upright

(a) At peak acceleration is 3.5G to take 4000 times sinusoidal cycles in the frequency range 10~30Hz.

(b) raise frequency from 10Hz to 190Hz, then return to 10Hz, take sine sweep vibration for 60 times with scan rate of 1Hz/s. The entire cycle is 6h. Adopt following acceleration levels:

Frequency range (HZ)	Peak acceleration (G)
10~15	2.5
15~30	1.75
30~60	1.25
60~110	1.0
110~190	0.75

(3) Flat wise

Test according to (1) methods.

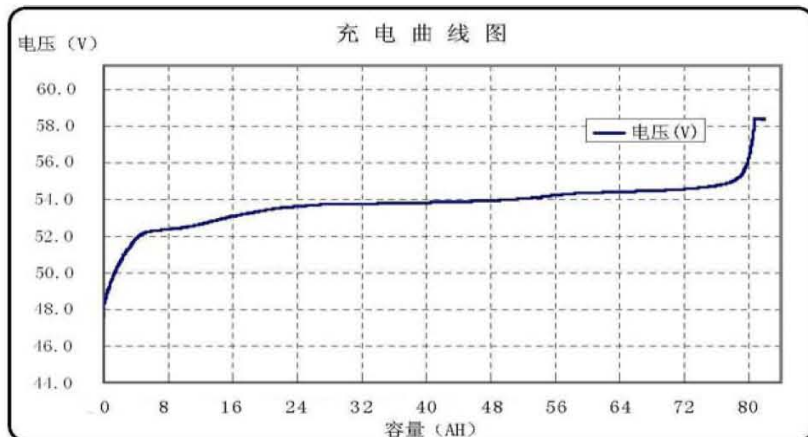
Test DC resistance, insulation, sealing performance of battery module before and after vibration. Test the data acquisition and transmission is abnormal or not after vibration if there is protection board.

### 六、特征曲线 Characteristic curve

#### 6-1 常温充电曲线 Charge curves at room temperature

在常温下以 0.3C 充电，充电截止电流为 4A，充电限制电压为 58.4V。

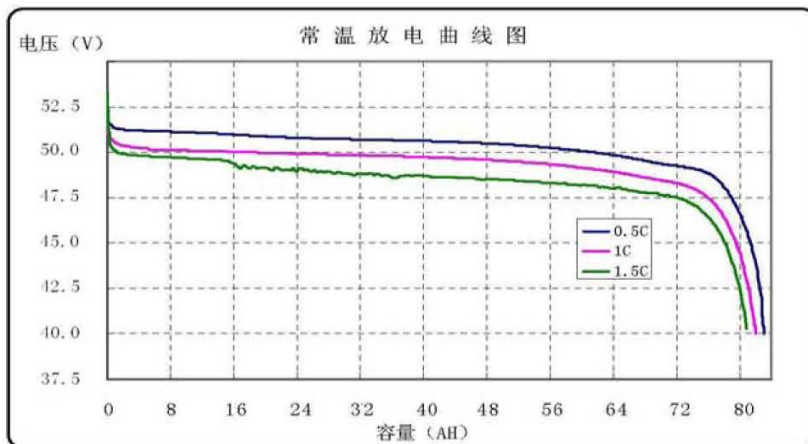
Charge at 0.3C under room temperature. Charge cut-off current is 4A. Charge cut-off voltage is 58.4V.



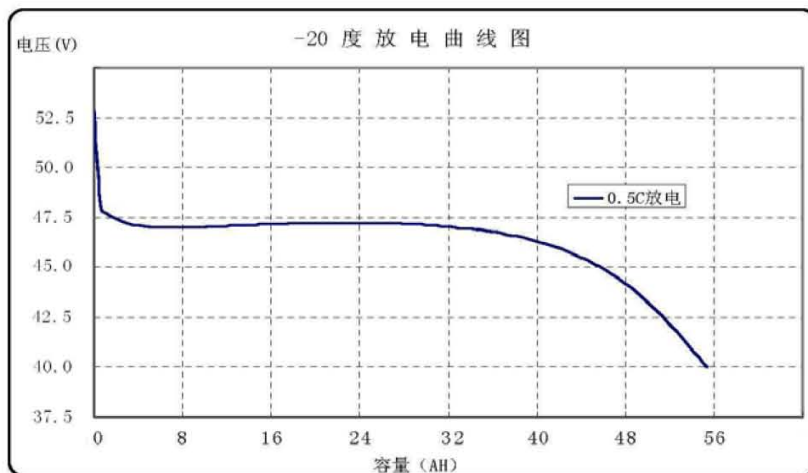
#### 6-2 不同倍率放电曲线 Discharging curves at different current

分别以 0.5C、1C、1.5C 放电，放电截止电压为 40V。

Discharge at different current of 0.5C, 1C, 1.5C to cut-off voltage of 40V.



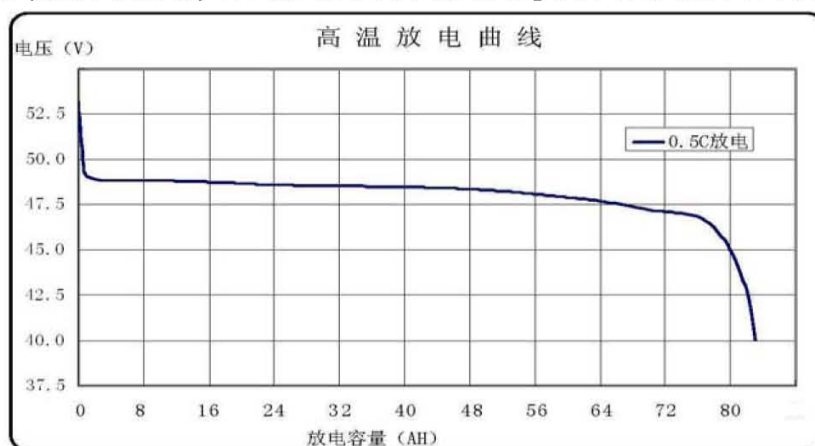
#### 6-3 -20℃下放电曲线 Discharge curve at -20℃



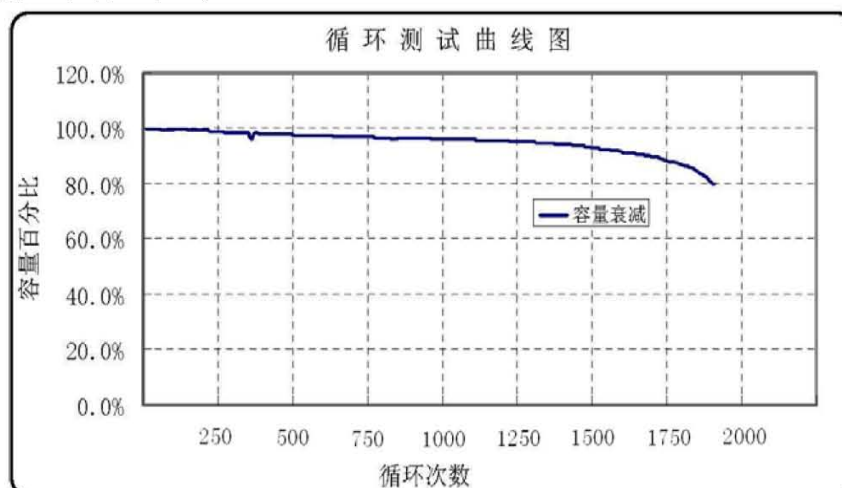
6-4 高温放电曲线 High-temperature discharge curve

在 55°C 高温下静置 8 小时后以 0.5C 恒流放电，截止电压为 40V。

After place battery for 8h at 55°C, discharge at constant 0.5C current to cut-off voltage of 40V.



6-5 循环寿命曲线 Cycle life curve



七、产品结构特性 Characteristics of the Product Structure

7-1 电池组结构 Battery pack structure



1、充电和放电接口 The interface of charge and discharge

2、单节电压采集端口 Single voltage acquisition ports

7-2 保护板结构 Protection board structure



项目 Item	最小值 Minimum	标准值 Standard Value	最大值 Maximum
过充保护 (V) Overcharge protection (V)	3.6	3.65	3.75
过充恢复 Overcharge recovery	3.58	3.5	3.6
过放保护 (V) Discharge protection (V)	2.3	2.5	2.7
过放恢复 (V) Discharge recovery (V)	2.7	2.8	2.85
过流保护 (A) Over-current protection (A)	110	120	150
短路保护 (A) Short-circuit protection (A)		有	
均衡电压 (V) Balanced voltage (V)	3.48	3.5	3.6
均衡电流 (A) Balanced current (A)		2	3
内阻 (mΩ) Resistance (mΩ)		20	25

7-3 充电器结构 Charger structure



项目 Item	最小值 Minimum	标准值 Standard Value	最大值 Maximum
输入电压 (V) Input voltage (V)	110	220	250
输出电压 (V) Output voltage (V)	57.6	58.4	59.2
输出电流 (A) Output current (A)	19.5	20	20.5
输入频率 (Hz) Input frequency (Hz)	15	50	60
散热模式 Heat dissipation model		风扇 Fan	
外壳材质 Shell material		铝合金 Al alloy	
输入接口 Input interface		美标 American standard	
输出接口 Output interface		50A 安德森插件 50A Anderson plug	

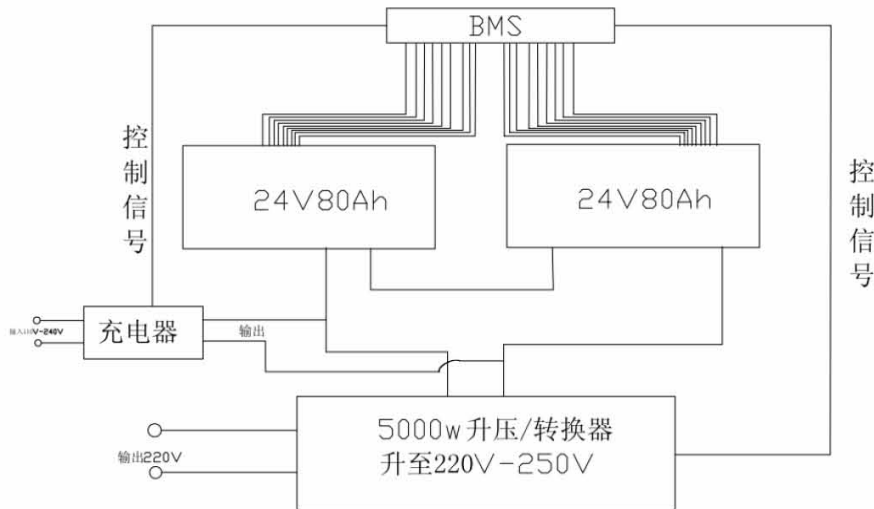
7-4 成品包装示意图 Finished pack diagram

成品包装时每两组 24V80Ah 装一个木箱。

Pack two sets 24V80Ah batteries into one wooden case



7-5 工作原理图 Working principle diagram



## 八、贮存、维护与运输 Storage, Maintenance and Transportation

### 8-1 贮存 Storage

电池组需长期贮存时，请将电池组充电至 50%左右的电量（放完电后，用充电器（10A）充电 5~6 小时即可），放置于干燥、通风处，每 3 个月用充电器充电 1~2 小时。

When the battery pack to be long-term stored, charge the battery pack to about 50% capacity( after discharging completely, charge for 5 - 6h at 10A),store in dry and ventilated place, charge 1 to 2h for every 3 months.

电池组与充电器应贮存在清洁、干燥、通风处，应避免与腐蚀性物质接触，远离火源及热源。

The battery pack and charger should be stored in clean, dry and ventilated place, avoid contacting with corrosive materials and be away from fire and heat.

### 8-2 运输 Transportation

电池组与充电器应包装后进行运输，在运输过程中应防止剧烈振动、冲击或挤压，防止日晒雨淋。可使用汽车、火车、轮船、飞机等交通工具进行运输。

The battery pack and charger should be packaged for transport, prevent excessive vibration, shock or extrusion in transport process and prevent the sun and rain. The battery pack can be transported by cars, trains, ships, aircraft and other vehicles etc.

### 8-3 维护 Maintenance

a) 电池组贮存时，应以 40%~60%的荷电态贮存。

The battery pack should be stored in 40%~60% charged capacity.

b) 电池组长期不使用时，建议每三个月左右进行补充一次电，用充电器补充 1~2h 即可。



If battery pack is not used for a long period, it should be replenish charging one time for 1 to 2h for every three month.

c) 在维护过程中, 请勿自行重新装卸电池组中的电池, 否则将会引起电池性能的下降。

In the maintenance process, please do not disassemble the battery pack, otherwise it will cause a decline of battery performance.

d) 不得擅自拆换电池组中的任何电池, 严禁解剖电池。

Forbid to remove any cell in the battery pack. Forbid dissecting battery cells.

九、典型故障及故障排除 Typical Trouble and Troubleshooting

故障现象 Symptom	故障原因 Trouble Reason	故障排除 Troubleshooting
电池组无输出 Battery with no-output	电池组输出线未连接 Battery output cable is not connected	按照规格书要求正确连接好电池组输出线 Connect the output line properly in accordance with the specifications
	电池组已没电 Battery pack is out of power	对电池组进行充电 Charging the battery pack
充电器电源指示灯不亮 Charger power light is off	充电器市电输入插头未正确插入 Input charger plug is not properly inserted	将充电器输入插头按说明书要求插到市电插座上 Enter the charger plug into the mains supply plug according to the operation manual
电池组不能充电 Battery pack can not be charged	充电器输出插头松动 Charger output plug loose	检查充电器输出插头是否与电池组接插牢靠 Check the charger output plug and battery plug is firm or not
	电池组已经充满电 Battery pack is fully charged	电池组可以正常使用 Battery pack can be used normally

十、使用电池注意事项 Battery Handling Precautions

\* 勿将电池组投入水中或将其弄湿!

Forbid to immerse battery in water or allow it to get wet!

\* 禁止在火源或极热条件下给电池组充电! 勿在热源(如火或加热器)附近使用或贮存电池组! 如果电池泄漏或发出异味, 应立即将其从接近明火处移开。第一次使用电池, 需将电池充满电后再使用!

Don't charge, use and store battery near a heat source such as fire and heater! If the battery



leaks or releases strange odor, pls remove it from place near fire place immediately. Fully charge the battery before first-time using.

\* 勿将正负极接反!

Forbid to reverse the positive and negative pole!

\* 勿将电池组投入火中或给电池组加热!

Forbid to throw the battery pack into fire or heat it!

\* 禁止用导线或其他金属物体将电池组正负极短路!

Forbid to short-circuit battery with wire or other metal objects!

\* 禁止用钉子或其他尖锐物体刺穿电池组壳体, 禁止锤击或脚踏电池组!

Forbid to nail, knock or trample battery!

\* 禁止以任何方式分解电池组和电池!

Forbid to disassemble the battery and battery pack in any way!

\* 禁止将电池组置于微波炉或压力容器中!

Forbid to put the battery into microwave oven or pressure vessel!

\* 如果电池组发出异味、发热、变形、变色或出现其他任何异常现象时不得使用; 如果电池组正在使用或充电, 应立即从用电器或充电器上取出并停止使用!

If the battery pack gives off odor, gets heat, deformation, discoloration or appears any abnormal phenomenon, stop using it; please remove the battery from electrical appliances and stop using it, when the battery is being used or charged!

\* 不能使用处于极热环境中的电池组, 如阳光直射或热天的车内。否则, 电池组会过热, 这样就会影响性能、缩短电池组的使用寿命!

Forbid to use battery pack in a very hot environment, such as under direct sunlight or in car on hot day. Otherwise, the battery pack will overheat, which will affect battery performance and shorten battery life!

\* 如果电池漏液后电解液进入眼睛, 不要擦, 应立即用水冲洗, 立即寻求医疗救助。如不及时处理, 眼睛将会受到伤害!

If the battery leaks and electrolyte leakage enters into the eyes, do not rub, rinse with water immediately and seek immediate medical assistance. If not in time, eyes will be hurt!

\* 环境温度会影响放电容量, 环境温度超出标准环境时 (25±5℃), 放电容量会有所降低!





Ambient temperature will affect the discharge capacity, if the ambient temperature is beyond the standard environment ( $25\pm 5^{\circ}\text{C}$ ), the discharge capacity will drop!

特别注意事项 Special Considerations:

\* 电池组在充电过程中, 如果出现异味、异常声响, 请立即停止充电。

During charging, if there is odor and unusual noise, immediately stop charging.

\* 电池组在放电过程中, 如果出现异味、异常声响, 请立即停止放电。

During discharging, if there is odor, unusual noise, immediately stop charging.

\* 如果出现上述现象, 请与厂家联系, 请勿私自拆卸。If there are above phenomenon, please contact the manufacturer, do not disassemble by yourself.

#### 十一、产品责任 Product Liability

\* 本公司对违反本规格书规定操作而导致的意外不负任何责任;

We assume no responsibility for the accident of not operating in accordance with the specification.

\* 本规格书内容因提高产品质量或升级相关技术参数而变更的, 本公司恕不另行通知。如需了解最新产品信息, 请与本公司联系索取。

If the contents of this specification is changed because improving product quality or upgrading technical parameters, we will not give notice . For the latest product information, please contact our company.

如有疑问, 请按以下地址联系:

If you have any questions, please contact the following address:

厂址: 山东润峰新能源科技有限公司

山东省济宁市微山经济开发区润峰工业园

Address: Shandong RealForce Enterprises Co., Ltd.

Realforce Industrial Park, Weishan Economic Development Zone, Jining City, China.

服务热线 Service hotling: 400-188-8968

电话 Tel: 86-537-8699997

传真 Fax: 86-537-8699916

邮箱 E-mail: sales@realforce.com.cn

网址 Website: http: //www.realforce.com.cn