

## Technical Specification of LiFePO4 Battery Pack (12V6Ah)

**File#: Version A**

**Effective Date: June 26, 2019**

|               |                  |
|---------------|------------------|
| Model         | R-LFP12V6Ah      |
| Specification | 12V6Ah           |
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### 1. Scope

This document described Lithium Iron Phosphate Battery (12V6Ah), including mechanical design, basic performance, test method and notes for use. The product applies to storage system.

### 2. Mechanical Design

- 2.1 Battery specification: 12V6Ah
- 2.2 Battery dimension: L×W×H= 151mm×65mm×95mm
- 2.3 Cell Model: 32650 3.2V6Ah
- 2.4 Combination Method: 4S1P

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### 3. Battery Pack Basic Performance

| #  | Item                             | Parameter   | Remark  |
|----|----------------------------------|-------------|---|
| 1  | Rated Capacity                   | 6Ah         | 23°C ± 5°C, 0.33C constant current discharging, 10V cut off   |
| 2  | Rated Voltage                    | 12.8V       | Battery module rated voltage  |
| 3  | Standard Charge Current          | 1.2A (0.2C) | 0°C~45°C, 0.2C CC (Constant current) charge to 14.6V, then CV (constant voltage) charge, cut off when charging current ≤ 0.05C. |
| 4  | Max Charge Current               | 6A (1C)     | 0°C~45°C, do not exceed 1C  |
| 5  | Charge Cut Off Voltage           | 14.6V       |   |
| 6  | Standard Discharge Current       | 1.2A (0.2C) | -20°C~+60°C, 0.2C CC (Constant Current) discharge, cut off @ 10V.   |
| 7  | Max Continuous Discharge Current | 6A          | 25°C ± 3°C, continuous 6A discharge   |
| 8  | Discharge Cut Off Voltage        | 10V         |   |
| 9  | Max Pulse Discharge Current      | 12A         | 25°C ± 3°C; ≤ 1S  |
| 10 | Working Temperature (charge)     | 0°C~45°C    | During charge, battery and ambient temperature should not exceed 45°C.  |
| 11 | Working Temperature (discharge)  | -20°C~55°C  | Battery can work at specified temperature range with capacity loss in tolerance.  |
| 12 | Storage temperature              | -20°C~45°C  | (short term) Within 1 month   |
|    |                                  | -10°C~35°C  | (long term) Within 6 month  |
| 13 | Battery Weight                   | 0.9 ± 0.2Kg |   |
| 14 | Battery Impedance                | ≤ 65mΩ      | AC 1KHz impedance with half electricity   |

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### 4. Main Performance

#### 4.1 Battery pack main performance parameter

| # | Item                                     | Standard         | Test Method   |  |
|---|--|------------------|---|--|
| 1 | Discharge Rate Character                 | 0.33C            | 100%  | Test Temperature: 25°C±3°C; Charge: 0.2C constant current charge to 14.6V, transfer to constant voltage, cut off when current ≤0.05C<br>Discharge: 0.33C/0.5C constant current discharge cut off @10V.       |
|   |  | 0.5C             |   |  |
| 2 | Capacity & Temperature Character         | 55°C             | ≥95%  | Charge: 0.2C constant current charge to 14.6V, transfer to constant voltage, cut off when current ≤0.05C;<br>Discharge: 0.5C constant current discharge cut off at 10V; 2hours interval for the temperature. |
|   |  | 45°C             | ≥95%  |  |
|   |  | 25°C             | 100%  |  |
|   |  | 0°C              | ≥65%  |  |
|   |  | -10°C            | ≥50%  |  |
| 3 | Life Cycle Character                     | ≥2000times       | After finish the standard charging and 30 minutes rest, in 25±5°C, 0.33C constant current discharge to 10V cutoff ,and then start the next cycle ,end with the capacity decrease to 80% of the initial capacity. The number of cycles is defined as the cycle life of the battery |  |
| 4 | Storage Character (Recoverable capacity) | 25°C<br>6months  | ≥95%  | Charge battery with 60%~75% capacity for storage   |
|   |  | 45°C<br>3 months | ≥90%  |  |
|   |  | 60°C<br>1 month  | ≥90%  |  |

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| <b>4.2 Ambient Character</b>  |   |  |   |               |            |
| #                             | Item  | Standard   | Test Method   |               |            |
| 1                             | Steady damp heat test                       | No fire, No explosion, No leakage. Discharge capacity cannot be lower than 60% of initial capacity | After standard charge, test as below:<br>Temp: 40°C ± 5°C; Relative Humidity: 90% ~ 95%;<br>Standing time: 48h; take out and place for 2h at room temperature. Then discharge with 1C till cut off voltage  |               |            |
| 2                             | Vibration                                   | No fire, No explosion, No leakage.   | After standard charge, fix to vibration machine and vibrate 30 minutes each at XYZ direction.<br>Frequency Sweeping Rate: 1oct/min;<br>Vibration Frequency: 10Hz~30Hz;<br>Displacement amplitude (Single): 0.38mm;<br>Vibration Frequency: 30Hz~55Hz;<br>Displacement amplitude (Single): 0.19mm. |               |            |
| 3                             | Low Pressure                                | No fire, No explosion, No leakage.   | Under 25 ± 3°C ambient temperature, put cell into vacuum cabinet, and reduce internal pressure gradually to not high than 11.6kPa (Simulated altitude 15240m), keep 6 Hours.  |               |            |
| 4                             | Drop Test                                   | No fire, No explosion, No leakage.   | Under the condition of shipment, the battery is free fall from a height of 1 m to a concrete floor of 5 cm thick, repeat 3 times from X, Y, Z axis direction.   |               |            |
| <b>4.3 Safety Performance</b> |   |  |   |               |            |
| #                             | Item  | Standard   | Test Method   |               |            |
| 1                             | Over Charge Test                            | No fire, No explosion  | After standard charge, Under 25°C ± 3°C ambient temperature for 1h. Then under the same temperature, 0.5C constant current charge to 5V (the simple cell).  |               |            |
| 2                             | Over Discharge Test                         | No fire, No explosion  | After standard charge, Under 25°C ± 3°C ambient temperature for 1h. Then under the same temperature, 0.3 C constant current discharge to 0V (the simple cell).  |               |            |
| 3                             | Heat shock                                  | No fire, No explosion  | Put battery in hot cabinet, temperature is up with 5°C/min ± 2°C/min rate to 130°C ± 2°C and keep for 30mins  |               |            |
| 4                             | High Temperature Test                       | No fire, No explosion, Capacity recovery cannot less than 80%                                      | After standard charge, place battery in 85°C for 4h.  |               |            |
| 5                             | Short Circuit                               | No fire, No explosion  | After standard charge, Under 25°C ± 3°C ambient temperature for 1h. Then put the battery by external short circuit for 10 min, the outside line resistance should be less than 100 mΩ .   |               |            |

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| <b>5. PCM (Protection Circuit Management)</b> |   |   |                             |      |               |            |
| <b>5.1 Protection Parameter</b>               |   |   |                             |      |               |            |
| #   | Item  | Description                                   | Value                       | Unit |               |            |
| 1   | Over Charge Parameter                                   | Cell Over charge Detection Voltage            | 3700±30                     | mV   |               |            |
|   |   | Cell Over charge Release Voltage              | 3550±50                     | mV   |               |            |
|   |   | Battery pack Over charge Detection Voltage    | 14.8±0.05                   | V    |               |            |
|   |   | Battery Pack Over charge Release Voltage      | 14.2±0.1                    | V    |               |            |
|   |   | Over Charge Voltage Protection Delay Time     | 1±0.5                       | S    |               |            |
| 2   | Over Discharge Parameter                                | Cell Over discharge Detection Voltage         | 2350±30                     | mV   |               |            |
|   |   | Cell Over discharge Release Voltage           | 2500±50                     | mV   |               |            |
|   |   | Battery pack over discharge Detection voltage | 9.4±0.05                    | V    |               |            |
|   |   | Battery Pack over discharge release voltage   | 10±0.1                      | V    |               |            |
|   |   | Over discharge Voltage Protection Delay Time  | 1±0.5                       | S    |               |            |
| 3   | Balance   | Balance Voltage                               | /                           | V    |               |            |
|   |   | Balance Current                               | /                           | A    |               |            |
| 4   | Charge Over Current Parameter                           | Charge Over Current Protection                | 7±1                         | A    |               |            |
|   |   | Short circuit protection at charging port     | YES                         |      |               |            |
| 5   | Discharge Over Current Parameter                        | Discharge over current Protection             | 20                          | A    |               |            |
|   |   | Discharge over current Protection Delay Time  | 20~80                       | mS   |               |            |
|   |   | Short circuit protection at discharging port  | YES                         |      |               |            |
| 6   | Short circuit protection release                        |   | Remove load or charge       |      |               |            |
| 7   | Temperature Protection                                  | Charge  | High temperature protection | 55   | °C            |            |
|   |   |   | Low temperature protection  | -5   | °C            |            |
|   |   | Discharge                                     | High temperature protection | 75   | °C            |            |
|   |   |   | Low temperature protection  | -20  | °C            |            |
| 8   | Consumption   | Sleep mode                                    | 500                         | uA   |               |            |

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### 6. Storage and Transportation Requirement

| Item           |  | Requirement |
|----------------|--|-------------|
| Storage        | Less than 1 month  | -20℃ ~+45℃  |
| Temperature    | Less than 6 month  | -10℃ ~+35℃  |
| Humidity       |  | <70%RH      |
| Storage SOC    |  | 60~75% SOC  |
| Transportation | Battery should be in the condition of less than 30% charged by packaging boxes, should prevent violent vibration and impact during the transit or extrusion, prevent from rain and direct sunlight, suitable for cars, trains, ships, aircraft and other transportation vehicles |             |

### 7. Notes for Battery Usage

#### 7.1 Prohibition

For avoiding battery leakage, heat radiating, explosion, below prevent tips should be taken care of:

- a) Prohibition of disassemble or re-assembly;
- b) Prohibition of short circuited battery;
- c) Prohibition to use near hot source;
- d) Prohibition of dumping of battery into water, ocean or getting battery wet;
- e) Prohibition of charging near fire or under sunlight;
- f) Charge with specified charge according to charging requirement;
- g) Prohibition of inserting nail into battery, hammering or stepping on by foot;
- h) Prohibition of throwing;
- i) Prohibition to use with damaged or deformed battery;
- j) Prohibition of direct welding on battery pack;
- k) Prohibition of charging opposite or over discharging;
- l) Prohibition of charge opposite or opposite connection;
- m) Prohibition to use to unspecified equipment;
- n) Prohibition to direct touch with leaking battery.



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### 7.2 Attentions

- a) Prohibit of using battery in sunlight, otherwise will cause over hot, firing, or function failure, life reducing;
- b) Prohibit use near static place which over 15.2V;
- c) Prohibit charge at temperature below 0°C or above 60°C ;
- d) When use at first time, if has corrosion, or bad smell, or any other abnormal, please do not use.

### 7.3 Delivery requirements

| # | Item                           | Parameter                             | Remark                                |
|---|--------------------------------|---------------------------------------|---------------------------------------|
| 1 | Capacity                       | $\geq 6\text{Ah}$                     | 0.33C discharge                       |
| 2 | Rated Voltage                  | 12.8V                                 |                                       |
| 3 | Battery Impedance              | $\leq 65\text{m}\Omega$               | AC impedance                          |
| 4 | Insulation impedance           | $\geq 50\text{M}\Omega / 500\text{V}$ | Between the output terminals and case |
| 5 | Delivery capacity requirements | $\cong 30\% \text{ SOC}$              | Voltage range 12.8V-14.6V             |