

CTC Battery, Inc.

Lithium Iron Phosphate Battery Specification

Model: 25.6 V 9.9 Ah

10/25/2012

Rev 01

Robert Tan



Copyright© 2012 CTC Battery, Inc. All rights reserved.

DOCUMENT NOTICE: The information contained in this manual is the property of CTC Battery, Inc. ("CTC") and is subject to change without notice. CTC reserves the right to make changes in the design of its products or components as progress in engineering and manufacturing may warrant. It is the customer's responsibility to satisfy itself as to whether the information contained herein is adequate and sufficient for a user's particular use. It is the further responsibility of each user to ensure that all applications of CTC's products are appropriate and safe based on conditions anticipated or encountered during use. This document does not create any additional obligation for CTC and does not constitute additional warranties and representations.

The CTC, CTC BATTERY and CTC logo are trademarks of CTC Battery, Inc.

Questions: Please email to sales@ctcbattery.com.

Revision Control

This section describes the change made to each revision of this document.

| Revision | Change | Prepared By | Approved By | Date |
|----------|------------------------|-------------|-------------|---------|
| Rev 01 | Initial design release | Qidong Wang | | 7/09/12 |
| | | | | |

Table of Contents

| | |
|---|----|
| Scope | 5 |
| Model..... | 5 |
| Dimension and Weight | 5 |
| Product Specification | 6 |
| Cell Safety and Features | 7 |
| Protection..... | 8 |
| Performance and Testing Conditions..... | 10 |
| Handling of Battery | 10 |
| Others | 11 |
| Warranty | 11 |
| Storing the Battery..... | 11 |
| Other Chemical Reaction..... | 11 |
| Photo | 11 |
| Warning..... | 12 |
| Caution..... | 12 |

1. Scope

This specification is applied to the LiFePO4 battery pack in this Specification and manufactured by CTC Battery, Inc.

2. Model

| Item Code | Cell | Assembly | Voltage | Capacity |
|-----------|-------------------|----------|---------|----------|
| LFP256099 | IFR26650EC 3.3 Ah | 8S3P | 25.6V | 9.9 Ah |

3. Dimension and Weight

| No. | Item | General Parameter | Remarks |
|-----|----------------|-------------------|---------|
| 3.1 | Pack Dimension | High: 166mm | |
| | | Width: 76mm | |
| | | Length: 181mm | |
| 3.2 | Weight | Approx: 2.5kg | |

4. Product Specification

| No. | Item | General Parameter | Remarks |
|-----|--------------------------------------|--|--|
| 1 | Rated Capacity | 9.9 Ah | 0.2C standard charge / discharge |
| 2 | Nominal Voltage | 25.6 V | 3.2V / Cell |
| 3 | Discharge Cut-off Voltage | 20.0 V | |
| 4 | Charging Cut-off Voltage | 29.2 V | |
| 4 | Cycle Life | Capacity greater than 80% of the initial pack capacity | 800 cycles |
| | | | Charge: CC at 0.2C to 29.2V, then CV until current reaches 0.05C |
| | | | Rest: 30 min. |
| | | | Discharge: 0.2C to 10.0V |
| | | | Temperature: 20 ± 5°C |
| 9 | Standard Charge | 0.2C constant current (CC) charge to 29.2V, then constant voltage (CV) charge at 29.2V until charge current decline to ≤ 0.05C | Charge time : Approx 6h |
| 10 | Standard Discharge | Constant current at 0.2C rate | |
| | | Cut-off voltage 20.0V | |
| 11 | Maximum Continuous Charge Current | 20 A | |
| 12 | Maximum Continuous Discharge Current | 20 A | Maximum Discharge Current 40A 30S |
| 13 | Operation Temperature Range | Charge: 0°C to 45°C | |
| | | Discharge: -10°C to 60°C | |
| 14 | Storage Temperature Range | Less than 1 year : 0°C to 25°C | |
| | | Less than 3 months:- 5°C to 35°C | |

5. Cell Safety Features

| No. | Items | Inspection Method and Procedure |
|-----|-------------------------|--|
| 1 | Cell and Package | UN Manual of Test and Criteria Section (5th) 38.3 |
| 2 | Transportation - Air | IATA Dangerous Goods Regulations (IATA DGR) (53rd) |
| 3 | Transportation - Ocean | IMO International Maritime Dangerous Good Code |
| 4 | Transportation - Ground | GB12268 -2005 List of Dangerous Goods |

| No. | Test Item | Standard Requirement | Criteria |
|--------------------------------|------------------------|--|---|
| 1 | Altitude Simulation | UN Manual of Test and Criteria Section (5th) 38.3 Test T.1 | No mass loss, no leakage, no venting, no disassembly, no rupture and no fire and the open circuit voltage of each cell or battery after testing is not less than 90% of its voltage immediately prior to the procedure. |
| 2 | Thermal Test | UN Manual of Test and Criteria Section (5th) 38.3 Test T.2 | Same as above |
| 3 | Vibration | UN Manual of Test and Criteria Section (5th) 38.3 Test T.3 | Same as above |
| 4 | Shock | UN Manual of Test and Criteria Section (5th) 38.3 Test T.4 | Same as above |
| 5 | External Short Circuit | UN Manual of Test and Criteria Section (5th) 38.3 Test T.5 | The external temperature does not exceed 170°C, no disassembly, no rupture and no fire within six hours of this test. |
| 6 | Impact | UN Manual of Test and Criteria Section (5th) 38.3 Test T.6 | The external temperature does not exceed 170°C, no disassembly, no fire within six hours of this test. |
| 7 | Forced Discharge | UN Manual of Test and Criteria Section (5th) 38.3 Test T.8 | No disassembly, no fire within 7 days of this test. |
| 8 | Other | 1.2 M Drop Test | The tested package is capable of withstanding a 1.2 M drop test in any orientation without damage the cells or batteries contained therein, without shifting the contents so as to allow battery to battery or cell to cell contact and without release the contents. |
| Test Environment and Condition | | Ambient temperature: 20°C ~ 21°C; ambient humidity: /% | |

6. Protection

When Li-ion rechargeable battery is used over the permitted voltage or current, electrolyte may disassemble. This case will affect safety performance of Li-ion rechargeable battery.

| No. | Item | Test Condition | Criteria |
|-----|----------------------------------|---|-------------------------|
| 1 | Voltage | Charging voltage | DC: 3.65V / cell |
| 2 | Current | Low current consumption for single cell | $\leq 150 \mu\text{A}$ |
| | | Maximal continuous discharging current | 20 A |
| 4 | Over Charge Protection (cell) | Over charge detection voltage | $3.9 \pm 0.025\text{V}$ |
| | | Over charge detection delay time | 0.8to 1.5S |
| | | Over charge release voltage | $3.8 \pm 0.05\text{V}$ |
| 5 | Over Discharge Protection (cell) | Over discharge detection voltage | $2.0 \pm 0.05\text{V}$ |
| | | Over discharge detection delay time | 90~200mS |
| | | Over discharge release voltage | $2.3 \pm 0.05\text{V}$ |
| 6 | Over Current Protection | Over current detection voltage | 100mV |
| | | Over current detection current | $55 \pm 10\text{A}$ |
| | | Detection delay time | 8 ~ 16ms |
| | | Release condition | Disconnect the load |
| 7 | Short Protection | Detection condition | Exterior short circuit |
| | | Detection delay time | 380 ~520 us |

7. Performance and Testing Conditions

7.1 Standard Test Conditions

Test should be conducted with new batteries within one week after shipment from our factory and the batteries shall not be cycled more than five times before the test. Unless otherwise specified, test and measurement shall be done under temperature of $20\pm 5^{\circ}\text{C}$ and relative humidity of 45~85%. If it is judged that the test results are not affected by such conditions, the tests may be conducted at temperature $15\sim 30^{\circ}\text{C}$ and humidity 25~85%RH.

7.2 Measuring Instrument or Apparatus

7.2.1 Dimension Measuring Instrument

7.2.2 Voltmeter (Standard class specified in the national standard or more sensitive class having inner impedance more than $10\text{k}\Omega/\text{V}$)

7.2.3 Ammeter

Standard class specified in the national standard or more sensitive class. Total external resistance including ammeter and wire is less than 0.01Ω .

7.2.4 Impedance Meter

Impedance shall be measured by a sinusoidal alternating current method (1kHz LCR meter).

7.3 Standard Charge/Discharge

7.3.1 Standard Charge : 0.2C

Charging shall consist of charging at a 0.2C constant current rate until the battery reaches 29.2V. The battery shall then be charged at constant voltage of 29.2V volts while tapering the charge current. Charging shall be terminated when the charging current has tapered to $0.05 C_5A$.

Charge time: Approx 6 hour, The battery shall demonstrate no permanent degradation when charged between 0°C and 45°C .

7.3.2 Standard Discharge : 0.2C.

Battery shall be discharged at a constant current of 0.2C to 20.0V @
-10°C to 60°C

If no otherwise specified, the rest time between charging and
discharging is 30 minutes.

7.4 Appearance

There shall be no such defect as crack, rust, leakage, which may adversely affect
commercial value of battery.

8. Handling of Battery

8.1 Prohibition Short Circuit

Never short circuit battery. It generates very high current which causes heating of the battery and may cause electrolyte leakage, gassing or explosion that is very dangerous.

The poles may be easily short-circuited by putting them on conductive surface.

Such outer short circuit may lead to heat generation and damage of the battery.

An appropriate circuitry with PCM shall be employed to protect accidental short circuit of the battery pack.

8.2 Mechanical Shock

Falling, hitting, bending, etc. may cause degradation of battery characteristics.

9. Others

Prevention of short circuit within a battery pack.

Enough insulation layers between wiring and the cells shall be used to maintain extra safety protection.

The battery pack shall be structured with no short circuit internally, which may cause generation of smoke or firing.

10. Warranty

The period of warranty is 12 months from the date of shipment. CTC guarantees to give a replacement in case of battery with defects proven due to manufacturing process instead of the customer abuse and misuse.

11. Storing the Battery

The batteries should be stored at room temperature, charged to about 30% to 50% of capacity. We recommend that batteries be charged about once per half a year to prevent over-discharge.

12. Other Chemical Reaction

Because batteries utilize a chemical reaction, battery performance will deteriorate over time even if stored for a long period of time without being used. In addition, if the various usage conditions such as charge, discharge, ambient temperature, etc. are not maintained within the specified ranges the life expectancy of the battery may be shortened or the device in which the battery is used may be damaged by electrolyte leakage. If the batteries cannot maintain a charge for long periods of time, even when they are charged correctly, this may indicate it is time to change the battery.

13. Photo



14. Warning: Risk of Fire, Explosion or Burn.

- 14.1 Do not short circuit the (+) and (-) terminals with any metals.
- 14.2 Do not immerse, throw and wet battery in water.
- 14.3 Do not heat above 60°C or throw battery into fire.
- 14.4 Do not disassemble, crush or modify the battery.
- 14.5 Do not put battery into a microwave oven, dryer, or high-pressure container.
- 14.6 Do not use battery with dry batteries and other primary batteries, or batteries of a different type, brand or package.
- 14.7 Stop using the battery if abnormal heat, odor, deformation, or abnormal condition is detected.
- 14.8 Stop charging the battery if charging is not completed within the specified time.

15. Caution

- 15.1 Do not charge or discharge the battery outside of its stated operating temperature range. Reduce charging limits for lower operating temperature.
- 15.2 Do not connect more than one module in series. This battery is designed for direct replacement of lead acid battery.
- 15.3 Do not expose the battery to heat in excess of 60°C during operation, 60°C in storage; do not incinerate or expose to open flames.
- 15.4 Remove the battery from equipment immediately when its life cycle has expired.
- 15.5 Do not incinerate or dispose the battery, recycle the battery to your nearest recycling center as per the appropriate local regulations.

