FFH4D3

PN: GT-SLF-FFH4D3-0702

Designed by	Product manager approval	Sales manager approval	Project manager approval	QA manager approval

Customer Confirmation	Signiture	Date
	Customer Code	
	Stamp	

Confidential : ( ) Level 3 ( ) Level 2 (√) Level 1 ( )

广州市麦盛能源科技有限公司

Guangzhou Maisheng Energy Technology Co., Ltd.

Edition	Description	Date	Status
A0	New release	2018/08/13	

Requirements

FFH4D3 (A0 Edition)

Specific requirements by the customer are stated below. This product of Tipsun Battary will be designed and manufactured accordingly to ensure the stated requirements to be satisfied.

	Requirement	Specification
1		
2		
3		
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5		

Customer Code: _____ **Signature:** _____ **Date:** _____

Content

Terms	Definition
Product	Referring to the 100Ah-3.2V-LFP secondary battery manufactured by Tipsun Battery.
Customer	Referring to the buyer in Sales Agreement.
Tipsun Battery	Referring to the seller in Sales Agreement.
PN	Referring to Part Number, a specific serial number given to a product manufactured for certain customer.
Battery Management System (BMS)	Referring to a monitoring system integrated in each battery pack and designed for monitoring, management and protection of battery cluster, which enhances safety application and prolongs battery life.
Ambient Temperature	Referring to the temperature of the air surrounding the battery.
Cell Temperature	Referring to the surface temperature of a battery cell typically captured by sensors of a BMS.
C-Rate	Referring to a measure of the rate at which a battery is discharged relative to its actual maximum capacity. A 0.5C rate means that the discharge current will discharge the entire battery in 2 hours.
Cycle	Referring to the number of complete charge/discharge cycles that the battery is able to support before that its capacity falls under 80% (or a criterion specified in *Sale Agreement*) of its original capacity.
Date of Manufacture	Referring to the date when a product is made, which is labeled on the top of each battery.
Open Circuit Voltage (OCV)	Referring to the voltage between the battery terminals with no load applied, which depends on the battery state of charge, increasing with state of charge.
Capacity Recovery	Referring to the discharge capacity which can be restored to a battery cell through various treatments, and which is the maximum result of at least 3 capacity tests carried out under the standard charge/discharge condition specified in 2.2.3, 2.3.1 and 2.3.5 and using the charge/discharge method specified in 2.2.3, 2.3.1 and 2.3.5.
Supply Agreement	Referring to the terms and conditions set by Tipsun Battery and the customer and under which Tipsun Battery will manufacture and supply products according to this specification.
Standard Charge Mode	Referring to the charge method stated in 2.2.3.
Standard Discharge Mode	Referring to the discharge method with a 50A discharge current stated in 2.3.1 or that with a minimum 2.5V OCV stated in 2.3.5.
Warranty	Referring to a specified period in which Tipsun Battery promise to repair or replace the product if necessary.
State of Charge (SOC)	Referring to the amount of charge remaining, as a percentage of the full charge, at a given moment.
Temperature Rise	Referring to the temperature rise of cells during charge or discharge under the standard charge/discharge condition specified in 2.2.3, 2.3.1 and 2.3.5.
Initial Status	Referring to the cell status within 7 days since its Date of Manufacture.

Units of Measurement	V—Volt A— Ampere Ah— Ampere-hour Wh— Watt-hour Ω— Ohm mΩ— MilliOhm ℃— Degree Celsius mm— Millimetre s— Second Hz— Hertz

1. Scope

This product specification delivers the performance specifications, working conditions and safety risks of 3.2V-100Ah-LFP secondary battery (PN GT-SLF-FFH4D3-0702) manufactured by Tipsun Battery.

2. Performance Specifications

2.1 Overview

No.	Description/ Item	Specifications	Remarks
2.1.1	Nominal Capacity	101Ah	• 2.5~3.65V • 50A Discharge Current • Initial Status
2.1.2	Minimum Capacity	100 Ah	• 2.5~3.65V • 50A Discharge Current • Initial Status
2.1.3	Operating Voltage Range	2.50 - 3.65V	• N.A.
2.1.4	Initial Inner Resistance (1KHz)	≤0.45mΩ	• Initial Status • 50% SOC (50Ah)
2.1.5	Outgoing Voltage	≥3.250V	• Initial Status • 50% SOC (50Ah)
2.1.6	Initial SOC	≈40%SOC (40 Ah)	• N.A.
2.1.7	Charge Temperature Range	0 ~ 55℃	• Refer to 2.2
2.1.8	Discharge Temperature Range	-20 ~ 55℃	• Refer to 2.3
2.1.9	Weight	≤2.2Kg	• N.A.

2.1.10	Self-discharge	≤3.5% per month	25℃ / 50% SOC / Within 3 months since Date of Manufacture
2.1.11	Dimensions	Refer to 9. Cell Design Drawing	• N.A.

2.2 Charge Mode & Specifications

No.	Description/ Item	Specifications	Remarks
2.2.1	Standard Charge Current	0.5C	25℃
2.2.2	Standard Charge Voltage	≤3.65V	
2.2.3	Standard Charge Mode	Using 0.5C Constant Current (CC) to charge to 3.65V, then Constant Voltage (CV) at 3.65V to charge until charge current reaches the lower limit of 5±0.5A.	
2.2.4	Standard Charge Temperature	25℃	Cell Temperature
2.2.5	Absolute Charge Temperature	0～55℃	Terminating charge process, once the cell temperature is beyond Absolute Charge Temperature.
2.2.6	Absolute Charge Voltage	≤3.8V	Terminating charge process, once the cell OCV is beyond Absolute Charge Voltage.

2.2.7 Other Charge Mode

Cell Temperature	Standard Charge	Rapid Charge	Cell Temperature
＜0℃	Prohibited to charge	Prohibited to charge	＜0℃
0～10℃	Charge Current 0.1C	Prohibited to charge	0～10℃
10～15℃	Charge Current 0.2C	Charge Current 0.3C	10～15℃
15～25℃	Charge Current 0.3C	Charge Current 0.5C	15～25℃
25～45℃	Charge Current 0.5C	Charge Current 1.0C	25～45℃
45～55℃	Charge Current 0.3C		
＞55℃	Prohibited to charge		

2.3 Discharge Mode

No.	Description	Parameters	Remarks
2.3.1	Standard Discharge Current	50A	• 25℃
2.3.2	Maximum Continuous Discharge Current	100A	• N.A.
2.3.3	Maximum Discharge Long-Pulse Current	200A	• 3 minutes maximum
2.3.4	Maximum Discharge Short-Pulse Current	300A	• Cell temperature lower than 50℃ • When SOC＞40%, 60s maximum

			• When SOC<40%, 10s maximum
2.3.5	Discharge cut-off Voltage	≥2.5V	• N.A.
2.3.6	Standard Discharge Temperature	25℃	• Cell Temperature
2.3.7	Absolute Discharge Temperature	-20～55℃	Regardless of the discharge mode, the discharge process should be terminated, once the cell temperature is beyond Absolute Discharge Temperature.

2.4 Regenerate Pulse Charge Mode

Regenerate Pulse Charge must be carried out under the circumstances stated below. Pulse current and duration need to be strictly controlled according to cell temperature and SOC. Any violation may cause permanent damage to batteries for which Tipsun Battery will be relieved from its liability.

2.4.1The maximum regenerate pulse charge voltage 3.65V.

2.4.2Regenerate pulse charge current and duration

SOC	Cell Temperature				
	≤0℃	0℃~10℃	10℃~20℃	20℃～55℃	≥55℃
＞95%	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited
80%~95%	Prohibited	Prohibited	≤1C / ≤5s	≤1C / ≤10s	Prohibited
50%~80%	Prohibited	≤1C / ≤5s	≤1C / ≤10s	≤1.5C / ≤10s	Prohibited
＜50%	Prohibited	≤1.0C / ≤10s	≤1.5C / ≤10s	≤2.0C / ≤10s	Prohibited

2.4.3 Rest intervals between pulses ought to be no shorter than the pulse duration. Any charge current is prohibited during rest intervals, whereas discharge current or no current is allowed.

2.5 Capacity at Low Temperature (Initial Status)

No.	Description	Specifications	Remarks
2.5.1	Capacity at 25℃	≥100Ah	Charge/Discharge at 25±2℃
2.5.2	Capacity at 0℃	≥85Ah	Charge at 25±2℃/Discharge at 0℃ with 1.0C (2.0~3.65V)
2.5.3	Capacity at -10℃	≥75 Ah	Charge at 25±2℃/Discharge at -10℃ with 1.0C (2.0~3.65V)
2.5.4	Capacity at -20℃	≥70Ah	Charge at 25±2℃/Discharge at -20℃ with 1.0C (2.0~3.65V)

2.6Safety & Reliability

This product complies with the requirements of State-set mandatory standard of quality (GB/T 31485-2015) and of transportation (UN38.3).

3. Temperature Rise

During the measurement of temperature rise, battery cells should be set upright (according to 9. Cell Design Drawing) and placed in a large room with a stable temperature and enough convection. Temperature sensors should record both cell temperature and time. Temperature rise equals to cell temperature after discharge minus that before discharge.

No.	Description/ Item	Specifications	Remarks
3.1	Continuous Discharge Temperature Rise	≤10℃	• Discharge Current of 50A • Duration of 2 hours
3.2	Pulse Discharge Temperature Rise	≤5℃	• Discharge Current of 300A • Duration of 10s at any SOC

4. Storage Specifications

No.	Description/ Item	Specifications	Remarks
4.1	Capacity Recovery (Short-term)	≥97Ah	At initial status with 50% SOC, stored in a room with ambient temperature of 25℃ for 60 days.
4.2	Capacity Recovery (Long-term)	≥95Ah	At initial status with 50% SOC, stored in a room with ambient temperature of 25℃ for 183 days.
4.3	Absolute Storage Temperature	-20～55℃	N.A.
4.4	Capacity Retention	≥80 Ah（2000 Cycles）	After storage, using standard charge/discharge mode.

5. Termination of Battery Life

A customer should monitor and record the inner resistance of each battery cell. Both parties should agree on the method to measure inner resistance. When the inner resistance of a cell reaches 250% of that of its initial status, it should be terminated immediately. Any violation may cause safety hazards for which Tipsun Battery will be relieved from its liability.

6. Working Conditions

6.1 A BMS should be integrated in battery packs to ensure monitoring, management and protection of each battery cell.

6.2 A customer should provide BMS requirements, such as system specifications, framework, data and format, so Tipsun Battery would deliver BMS design and establish battery management profile accordingly.

6.3 Without the consent of Tipsun Battery, no changes may be made to BMS design or framework.

6.4 Operation data of battery should be recorded for responsibility determination of product quality. Incomplete operation data will relieve Tipsun Battery from its liability for battery quality.

6.5 A BMS should have the following primary functions.

No.	Description	Specifications	Protections
6.5.1	Charge cut-off Voltage	3.65V	Terminating charge process when cell OCV reaches 3.65V.
6.5.2	First Over-charge Protection	≥3.8V	Limiting charge current to 0 when cell OCV reaches 3.8V.
6.5.3	Second Over-charge Protection	≥4.0V	Limiting charge current to 0 when cell OCV reaches 4.0V. Locking BMS before the problem is identified and resolved.
6.5.4	Discharge cut-off Voltage	2.5V	Terminating discharge process when cell OCV reaches 2.5V.
6.5.5	First Over-discharge Protection	2.0V	Limiting discharge current to 0 when cell OCV reaches 2.0V.
6.5.6	Second Over-discharge Protection	1.8V	Limiting discharge current to 0 when cell OCV reaches 1.8V. Locking BMS before the problem is identified and resolved.
6.5.7	Short Circuit Protection	Prohibit Short Circuit	Cutting off overcurrent devices (fuses, circuit breakers).
6.5.8	Overcurrent Protection	Referring to 2.3	Limiting current within specified range according to 2.3.
6.5.9	Overheating Protection	Referring to 2.2 & 2.3	Terminating charge/discharge process when cell temperature is beyond the limits specified in 2.3 & 2.3.
6.5.10	Charging Time Protection	≤8h	Terminating charge process when charging time exceeds 8 hours.

Note 6.5.2, 6.5.3, 6.5.5, and 6.5.6 are warnings. Batteries are out of working condition in these cases and should be segregated and protected by the BMS or the customer. Tipsun Battery will be relieved from liability for quality issues and subsequent damage (to the customer or to a third party) caused by the abuse of batteries stated in 6.5.2, 6.5.3, 6.5.5, and 6.5.6.

6.6 Cell OCV below 1.5V may cause permanent damage to the battery for which Tipsun Battery will be relieved from liability. According to 2.3.5, when discharge cut-off voltage is lower than 2.5V, the rest interval should be prolonged before the next charge.

6.7 If batteries are to be stored beyond 30 days, they should be charged to at least 50% SOC.

6.8 According to 2.2, charging at low temperature is prohibited regardless of the charge mode. Any violation may considerably lower the battery capacity, for which Tipsun Battery will be relieved from liability. The BMS should monitor and manage the ambient temperature according to the temperature range of standard charge and regenerate charge.

6.9 Batteries should be placed in a container with enough convection or other effective cooling system. Otherwise, Tipsun Battery will be relieved from liability for quality issues and subsequent damage (to the customer or to a third party) caused by overheating of batteries.

6.10 Batteries should be placed in a container which complies with the requirements of State-set standard of waterproof and dustproof. Otherwise, Tipsun Battery will be relieved from liability for quality issues and subsequent damage (to the customer or to a third party) caused by corrosion of batteries

7. Safety Precautions

7.1 Prevent batteries from being immersed in water.

7.2 Prevent batteries from fire or overexposure to any high temperature environment specified in 2.1.7 & 2.1.8. Cell temperature should never exceed 55℃ or the BMS should shut down the battery system.

7.3 Prevent direct connection between the positive and negative terminal of a cell. The resulting short circuit could damage the product and generate heat that can cause burns. Special caution is required to prevent short circuiting any battery since the consequences can be very dangerous. Care must be taken during the installation of the battery pack to ensure batteries cannot be inserted in reverse. Also, caution must be given to prevent accidental short-circuiting of the battery.

7.4 Never reverse charge for it causes rapid gas generation and increased gas pressure, thus causing batteries to swell or rupture.

7.5 Prevent batteries from overcharge. A BMS should provide overcharge protection specified in 6.5.3 and 7.11.

7.6 Never leave the battery in the charger once it is fully charged. A timer is required to cut off the battery from the charger should charging time exceed 8 hours (6.5.10& 7.11) or batteries may overheat and cause fire.

7.7 Avoid flame or sparks that could ignite the hydrogen gas produced by the battery and cause an explosion. Connection and disconnection of cables to battery terminals is one of the most common causes of sparks.

7.8 Avoid using airtight battery compartments. In some cases, gases (oxygen, hydrogen) may be given off, and there is a danger of the batteries bursting or rupturing in the presence of a source of ignition (sparks generated by a motor switch, etc.).

7.9 Wear eye protection when working around batteries and prevent eyes and skin from contacting electrolyte. Batteries contain corrosive acid and produce explosive gas a byproduct of their operation. Acid on the skin should be neutralized with a solution of baking soda and water made into a paste. In case acid contacts eyes, flush with clear water and seek medical attention immediately.

7.10 Prevent batteries from vibration, collision and crush to preempt short circuit caused by distortion.

7.11Prevent batteries from improper termination of charge, including overtime termination (6.5.10), overvoltage termination (6.5.2 & 6.5.3) and overcurrent termination (6.5.8). Improper termination of charge may occur when the battery system malfunctions. Any charging process regardless of the charge mode should be terminated before the problem is identified and resolved. The BMS should limit charge current to 0 or lock down the battery system to preempt further charging process, while also delivering warning messages to operators.

7.12 The test described in 2.6, if incorrectly performed, may cause fire or explosion, and thus requires professionals with proper equipment and laboratory.

8. Warnings & Hazards

8.1 Warning Notice

> Warning
>
> Due to various hazards, precautions must be taken when operating and maintaining the battery system.
>
> The test described in 2.6, if incorrectly performed, may cause fire or explosion.
>
> Proper protective equipment is needed to operate the battery system.
>
> Battery system maintenance requires professionals with effective safety training.

8.2 Types of hazard

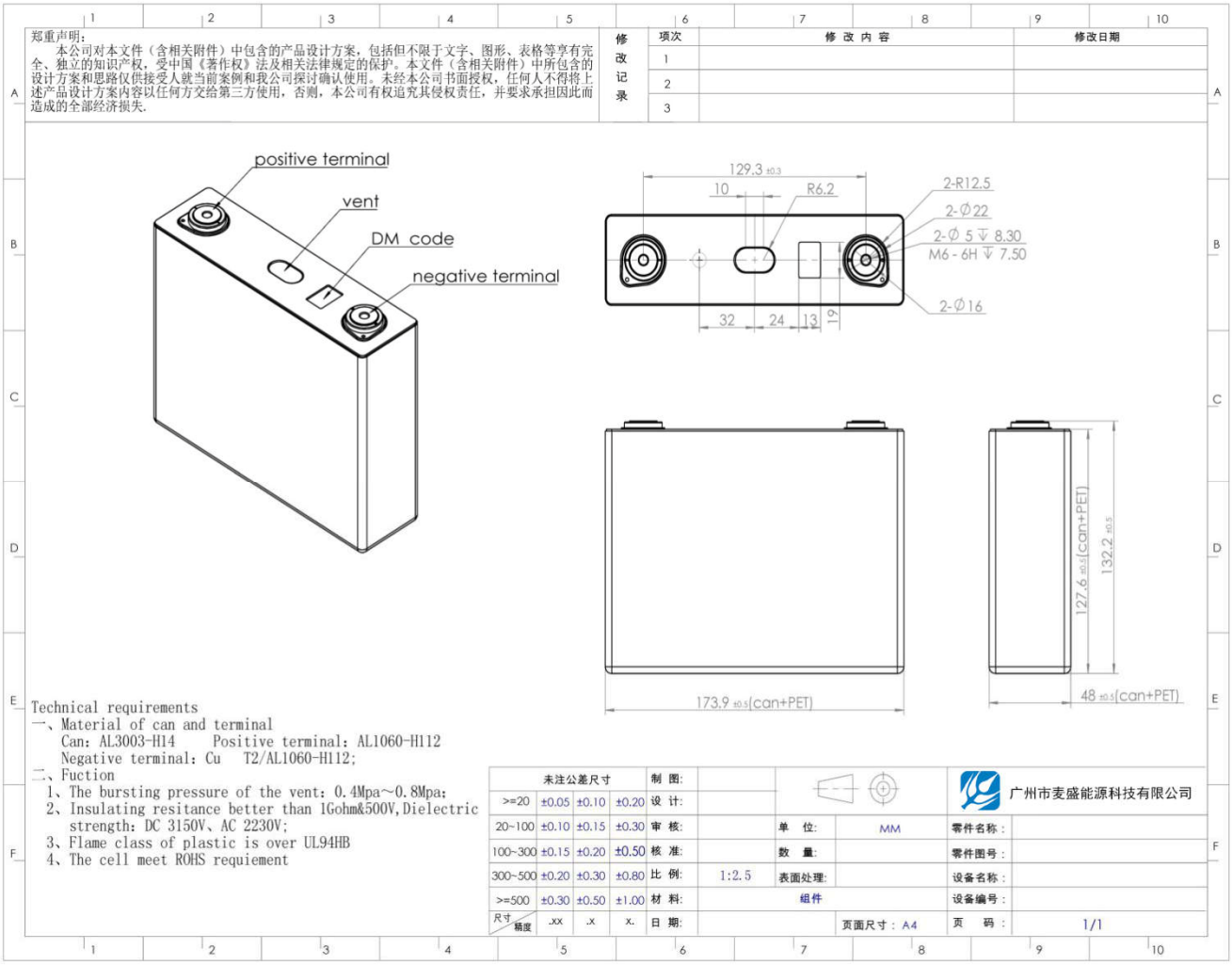
The customer should acknowledge the following types of hazards in battery operation.

8.2.1 Shock hazards occur when electric current passes through a person. Shocks range in severity from painful, but otherwise harmless, to heart-stopping lethality.

8.2.2 Chemical hazard caused by exposure to electrolyte.

8.2.3 Thermal hazards occur when electric power causes undesired heating effects whenever electric energy is converted to thermal energy at a rate faster than it can be safely dissipated.

9. Cell Design Drawing



Requirements

FFH4D3 (A0 Edition)

Specific requirements by the customer are stated below. This product of Tipsun Battary will be designed and manufactured accordingly to ensure the stated requirements to be satisfied.

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Customer Code: _____ **Signature:** _____ **Date:** _____