PRODUCT SPECIFICATION

Rechargeable Lithium Ion Battery

Type: 53173200-200Ah

Approved by RD	Approved by TTC	Approved by PE	Approved by QA	Approved by M&S
Client Approval	**Signature :**		**Company Stamp :**	
	Date :			
	Company Code :			

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AMENDMENT RECORDS

Revision	Description	Date	Approval
A	Original Release	2019-04-18	Ronnie

Content

Scope

The purpose of this document is to specify the specifications of 200Ah 3.2V rechargeable lithium ion LFP cells with Tipsun Part Number EC-AU200-53173200-13FA (“Product”) to be supplied by Tipsun to Client. This Product is designed and intended to be exclusively used by Client and/or its customers within Target Application Zone. Any intended or unintended usage of the Product by Client and/or its customers outside the Target Application Zone constitutes a material breach of the Contract by Client and hereby releases Tipsun from any and all obligations and/or liabilities.

2 Definition and Note

Terms	Definition /Note
Tipsun	Dichen New Energy CO., Ltd
PN	The unique Tipsun internal part number to identify the Product to be supplied to Client;
Client	Purchaser of Tipsun market &sales agreement;
Product	Product means the same as set out on the document Scope;
Ambient Temperature	The ambient air temperature of the environment to which the Products are exposed;
BMS	Battery Management System;
Cell Temperature	The temperature of the cell and must be measured by an external thermal sensors which has to be selected and installed by client in close proximity of product in use;
Charge C-Rate	The ratio of charging current to the latest cell capacity as frequently measured by the Battery Management System, with a unit of measure denoted by “C”. For example, the initial cell capacity is 200Ah and a Charge C-Rate of 1/3C equals to a charge current of 67A. The charge current shall be adjusted from time to time based on the latest cell capacity so that the Charge C-Rate complies with the requirement as set out in paragraph 2.2;
Cycle	means a state reached when a total of 200.0Ah charge is discharged from a cell as recorded by BMS and it may consist of a summation of a few segments of partial discharges;
OCV	Open circuit voltage;
Recoverable Capacity	Capacity of a cell measured in accordance with paragraphs 2.2.3, 2.3.1 and 2.3.5 after storage, the measurement of which can be taken after repeating the Standard Charge and the Standard Discharge as set out in paragraphs 2.2.3, 2.3.1 and 2.3.5, respectively, for a maximum of three times;
Residual Capacity	Capacity of a cell measured in accordance the Standard Charge and the Standard Discharge as set out in paragraphs 2.2.3, 2.3.1 and 2.3.5, respectively after storage but prior to any recharge;
Standard Charge	The default charging method set out in paragraph 2.2.3 titled “Standard Charging Method”;
Standard	A discharge current of 1/3 C as set out in paragraph 2.3.1 with a discharge cut-off voltage of

Discharge	2.5V as set out in paragraph 2.3.5;
State of Charge or SOC	The linear scale of charge held by a cell as measured by capacity either in Ah or Wh. 100% SOC means a cell is fully charged at 3.65V while 0% SOC means a cell is fully discharged

	down to 2.5V. The SOC should indicate a no load situation;
Target Application Zone	The geometric region where the Products are intended to be used as set out in Scope;
Temperature Rise	The increase of cell temperature from one state to another in certain event such as charging or discharging;
“V?(Volt)	Unit of measure for electrical voltage
“A?(Ampere)	Unit of measure for electrical current;
“Ah?(Ampere-Hour)	Unit of measure for electrical charge;
“Wh?(Watt-Hour)	Unit of measure for electrical energy;
“ ” (Ohm)	Unit of measure for electrical resistance;
“mΩ?(MilliOhm)	Unit of measure for electrical resistance;
“°C”(degreeCelsius)	Unit of measure for temperature;
“mm?(millimetre)	Unit of measure for length;
“s?(second)	Unit of measure for time;
“Hz?(Hertz)	Unit of measure for frequency.

3 Electrical specification

Throughout this specification, numeric criteria annotated by “*” means such criteria are only applicable to fresh unused Product within 7 days from delivery by Tipsun. Products either have been used or stored for a period longer than 30 days by Client and/or its customer may exhibit an inferior numeric parameter than such criteria. Client agrees that such occurrence does not constitute nonconformance of specification.

3.5 General

No.	Parameter	Specification	Condition / Note
2.1.1	Typical capacity	*200Ah	At a 1C discharge current (25±2°C CC+CV)
2.1.2	Minimum capacity	*200Ah	At a 1C discharge current (25±2°C CC+CV)
2.1.3	Operating voltage	2.5 ~ 3.65V 2.5 ~ 3.65V 2.0 ~ 3.65V	-5℃ T 55℃ -20℃ T -5℃ -30℃ T -20℃
2.1.4	Impedance(1kHz)	≤0.20mΩ	at a fresh state
2.1.5	Shipping capacity	30%SOC	SOC conformity at the same bath
2.1.6	Operating temperature (charging)	-15 – 55°C	See paragraph 2.2
2.1.7	Operating temperature (discharge)	-30 – 55°C	See paragraph 2.3
2.1.8	Weight	4.18±0.2 Kg	including hard case and cap

2.1.9	Self-discharge	≤3.5%/Month	Count after fresh cell need Standard Charge to 50%SOC and storage at 25±2°C for 3 month
2.1.10	Cell dimension	Reference specification 9	-

3.6 Charging

No.	Parameter	Specification	Condition /Note
2.2.1	Standard charge current	1/2C	25±2℃
2.2.2	Standard charge voltage	3.65V	-15 – 55°C
2.2.3	Standard charge method	1/2C constant current charge to 3.65V for cell, then switch to constant voltage charge until charge current declines to ≤10.3±0.3A	
2.2.4	Standard charge temperature	25±2℃	1/2C
2.2.5	Absolute charge temperature （Cell temperature）	-15 –55°C	Stop charging once cell Temperature is outside this range regardless of the charging mode adopted
2.2.6	Absolute charge voltage	3.65V max.	Stop charging once voltage exceeds this voltage regardless of the charging mode (including regeneration) adopted

2.2.7 Other Continuous Charge Conditions (C)

Temp.（℃）	SOC:0%	SOC:10%	SOC:20%	SOC:30%	SOC:40%	SOC:50%	SOC:60%	SOC:70%	SOC:80%	SOC:90%	SOC:95%	SOC: 100%
[-15~-10)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0
[-10~0)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.08	0.06	0.05	0.05	0
[0~7)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.15	0.15	0.10	0.10	0
[7~15)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.45	0.40	0.30	0.20	0
[15~25)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.60	0.50	0.20	0
[25~35)	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.80	0.70	0.60	0.30	0
[35~45)	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.80	0.70	0.60	0.30	0
[45~50)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.50	0.30	0.20	0
[50~55)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.45	0.40	0.20	0.15	0

2.3 Discharging

No.	Parameter	Specification	Condition /Note
2.3.1	Standard discharge current	1/2C	25±2℃
2.3.2	Maximum discharge current (continuous)	1C	N.A.
2.3.3	Maximum discharge current (long pulse)	2C	3 minutes duration maximum followed by a “zero current rest period” of same duration
2.3.4	Maximum discharge current (short pulse)	3C	60 second duration maximum while cell Temperature ≤ 50°C and SOC>40%SOC; 10 second duration maximum while cell Temperature ≤ 50°C and SOC≤40%SOC;
2.3.5	Discharge cut-off voltage	2.50V	-5 –55°C

		minimum	
2.3.6	Standard discharge temperature	25±2℃	1/2C
2.3.7	Absolute discharge temperature （Cell temperature）	-30 –55°C	Different current at different temperature

2.3.8 Other continuous discharge Conditions (C)

Temp.（℃）	SOC:0%	SOC:10%	SOC:20%	SOC:30%	SOC:40%	SOC:50%	SOC:60%	SOC:70%	SOC:80%	SOC:90%	SOC:100%
[-30~-20)	0	0.00	0.03	0.05	0.10	0.15	0.20	0.20	0.20	0.20	0.20
[-20~-10)	0	0.03	0.05	0.10	0.20	0.30	0.30	0.30	0.30	0.30	0.30
[-10~0)	0	0.10	0.20	0.30	0.40	0.50	0.50	0.50	0.50	0.50	0.50
[0~7)	0	0.15	0.30	0.50	0.60	0.80	0.80	0.80	0.80	0.80	0.80
[7~15)	0	0.20	0.40	0.60	0.70	0.90	0.90	0.90	0.90	0.90	0.90
[15~25)	0	0.30	0.50	0.70	0.80	1.00	1.00	1.00	1.00	1.00	1.00
[25~35)	0	0.30	0.50	0.70	0.80	1.00	1.00	1.00	1.00	1.00	1.00
[35~45)	0	0.30	0.50	0.70	0.80	1.00	1.00	1.00	1.00	1.00	1.00
[45~50)	0	0.20	0.30	0.50	0.60	0.80	0.80	0.80	0.80	0.80	0.80
[50~55)	0	0.05	0.10	0.15	0.20	0.30	0.30	0.30	0.30	0.30	0.30

2.4 Regeneration

Regeneration means a cell is charged by pulse current regenerated during application. The regenerated voltage should be strictly regulated at all SOC and Cell Temperature. The magnitude and duration of pulse charging current should be strictly regulated according to the SOC and Cell Temperature listed on the table below. Regeneration charging of the cell outside this allowable condition may cause permanent internal damage to the Product and shall render Tipsun's warranties under the Contract inapplicable, thereby releasing Tipsun from any liability in connection therewith.

2.4.1 Regeneration voltage 3.65V maximum.

2.4.2 Allowable regeneration current and duration

Regen for 10s

Temp. (℃)	SOC: 0%	SOC: 10%	SOC: 20%	SOC: 30%	SOC: 40%	SOC: 50%	SOC: 60%	SOC: 70%	SOC: 80%	SOC: 90%	SOC: 95%	SOC: 100%
[-15~-10)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.02	0.01	0.01	0.01	0
[-10~0)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.15	0.15	0.10	0.05	0
[0~7)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.30	0.25	0.20	0.10	0
[7~15)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.60	0.55	0.20	0
[15~25)	1.20	1.20	1.20	1.20	1.20	1.20	1.10	1.00	0.90	0.80	0.30	0
[25~35)	1.50	1.50	1.50	1.50	1.50	1.50	1.30	1.20	1.00	0.90	0.50	0
[35~45)	1.50	1.50	1.50	1.50	1.50	1.50	1.30	1.20	1.00	0.90	0.50	0
[45~50)	1.20	1.20	1.20	1.20	1.20	1.20	1.10	1.00	0.90	0.80	0.40	0
[50~55)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.70	0.60	0.55	0.20	0

Regen for 30s

Temp. (℃)	SOC: 0%	SOC: 10%	SOC: 20%	SOC: 30%	SOC: 40%	SOC: 50%	SOC: 60%	SOC: 70%	SOC: 80%	SOC: 90%	SOC: 95%	SOC: 100%
[-15~-10)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0
[-10~0)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.12	0.10	0.05	0.03	0
[0~7)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.25	0.18	0.15	0.10	0
[7~15)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.55	0.50	0.30	0.20	0
[15~25)	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.80	0.72	0.60	0.30	0
[25~35)	1.20	1.20	1.20	1.20	1.20	1.20	1.00	0.90	0.80	0.60	0.30	0
[35~45)	1.20	1.20	1.20	1.20	1.20	1.20	1.00	0.90	0.80	0.60	0.30	0
[45~50)	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.80	0.60	0.30	0.20	0
[50~55)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.55	0.50	0.20	0.15	0

2.4.3 After each regeneration pulse, there should be a “rest period” with duration equal to or long than the relevant regeneration pulse. A “rest period” can either be discharging or zero current state. No regeneration is allowed within a “rest period”.

1.1 Low Temperature Discharge Capacity

No.	Parameter	Specification	Condition /Note
2.5.1	Capacity at 25°C	*≥200.0Ah	Standard Charge at 25±2°C, Standard Discharge at 25°±2C (Cell Temperature in both cases)
2.5.2	Capacity at 55°C	*≥180Ah	Standard Charge at 25±2°C, Standard Discharge at 55±2°C (Cell Temperature in both cases)
2.5.3	Capacity at -20°C	*≥140Ah	Standard Charge at 25±2°C, Standard Discharge at -20±2°C (Cell Temperature in both cases)

1.2 Safety and Reliability

This product is in tested and full compliance with requirement under the Chinese Coercive Certification and UN38.3 transportation certification.

4 Temperature Rise

The cells shall be allowed to cool down by unrestricted natural convection in a reasonably large room with stable Ambient Temperature. The temperature of each shall be measured with calibrated thermal couple sensor(s) capable of capturing data logging with respect to time. The temperature should be measured at the center of cell surface. Temperature rise is defined as temperature after discharge minus temperature just before discharge.

No.	Parameter	Specification	Condition /Note
3.1	Temperature Rise (continuous)	≤ 10°C	When a cell is discharged at a 100A current for a period of 120min
3.2	Temperature Rise (pulse)	≤ 5°C	When a cell is discharged at a 600.0A current for a period of 10s when SOC 20%

5 Storage And Cycle Performance

No.	Parameter	Specification	Condition /Note
4.1	Recoverable Capacity	*≥190Ah	Standard Charge to 100% SOC, storage at 25±2°C for 30 days，discharge 1C at 25±2°C
4.2	Cycled Capacity	≥160Ah within 3000 Cycles	Standard charge and discharge, Temp. :25±2°C

6 Product End of Life Management

This cell is designed to service with a finite life time. Client shall develop and implement an active tracking system to monitor and record impedance of each Product in its entire service life. Client and/or its customer shall stop using any of the Products when its impendence exceeds 250% of the value when it was fresh. Failure to comply with this requirement shall render Tipsun's warranties under the Contract inapplicable, thereby releasing Tipsun from any liability in connection therewith.

7 Application Conditions

Client shall ensure that the following application conditions in connection with the Products are strictly observed:

1.1 A reasonable number of thermal sensors shall be installed by Client in close proximity each Product in use to sense and measure Cell Temperature. Client shall make use of this sensor to monitor and record Cell Temperature throughout the entire service life of such cell. The Cell Temperature is a critical parameter for determining whether Client shall be entitled to Tipsun's warranties under the Contract.

1.2 Client shall procure that each Product shall be used under the strict monitor, control and protection by the Battery Management System to be incorporated by Client.

- Client shall provide detailed information of the BMS, including but not limited to its design, features, setting, and data file format to Tipsun for design review and record keeping.

- Once the detailed information of the BMS has been reviewed and agreed by Tipsun, Client shall not modify or change the design, features, setting or data file format of the BMS without the prior written agreement by Client.

- Client shall keep complete records of the BMS monitoring data throughout the entire service life of each Product, including keeping record of number of occurrence of Rush Charge, which will be used in the determination and judgment of any product warranty and liability claim entitlement. No warranty or liability claim will be considered without a complete set of BMS monitoring records capturing the entire service life of the relevant Product.

- The BMS shall include the following monitoring and control features as a minimum requirement.

No.	Parameter	Specification	Action
6.2.4.1	Stop charging	3.65V maximum	Stop charging when cell voltage reaches 3.65V
6.2.4.2	1st Overcharge protection	≥3.80V	Stop charging when cell voltage reaches 3.65V
6.2.4.	2nd Overcharge	4.00V	When cell voltage reaches 4.00V, lock up BMS

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	protection		until technical trouble shooting.
6.2.4.4	Stop discharging	2.50V minimum	When cell voltage falls lower than 2.50V, decrease the current to a minimum
6.2.4.5	1st Over discharge protection	2.00V minimum	When cell voltage falls lower than 2.00V, decrease the current to a minimum
6.2.4.6	2nd Over discharge protection	1.50V minimum	When cell voltage falls lower than 1.50V, lock up BMS until technical trouble shooting.
6.2.4.7	Short circuit protection	No short circuit allowed	Disconnect cell terminals by over-current protector or internal fuse when short circuit occurs
6.2.4.8	Over current protection	See paragraph 2.3	Limit discharge current by BMS to values within specification
6.2.4.9	Overtemperature protection	See paragraphs 2.2 and 2.3	Stop charging and discharging when temperature exceeds specification (2.2.5, 2.3.7)
6.2.4.10	Charging time out limit	The charging time is within 8 hours	Stop charging if changing time exceeds 8 hours

• Prevent draining any Product down to over discharge state. A Product may be permanently damaged internally when the cell voltage is lower than 2.1V and therefore should be strictly prohibited, failing which Tipsun's warranties under the Contract shall cease to apply, thereby releasing the Tipsun from any liability in connection therewith. After discharge cut-off in accordance with paragraph 2.3.5, internal power consumption of the system should be reduced to a minimum to prolong the idle time before recharge. Client undertakes to educate the users of the Products or other parties who may come to handle the Products to recharge the cells at minimum time intervals to prevent reaching the over discharge state.

• When the Products are intended to be stored for a prolonged period of time (more than one month), reduce SOC to around 50%. Prolonged storage at 100% SOC unnecessarily degrades the capacity of the Products.

• Prevent charging the Products at a temperature which is not allowed under the specification hereunder (including standard charge, optional fast charge, emergency charge and regeneration), otherwise unnecessary degradation of the capacity of the Products may occur. Follow the specification on minimum charging and regeneration temperature and use the BMS to control it. Charging at temperature lower than the specification hereunder shall render Tipsun's warranties under the Contract inapplicable, thereby releasing Tipsun from any liability in connection therewith.

8 Safety Precautions

Client shall ensure that the following safety precautions in connection with the Products are strictly observed:

8.5 Do not immerse cells into water.

8.6 Do not drop cells into fire or expose them to any high temperature environment exceeding operation temperature

as set out in paragraphs 2.1.6 and 2.1.7, otherwise fire hazards may present. At all time, Cell Temperature should not exceed 55°C, shut down system by BMS when it occurs.

8.7 Do not short circuit cell terminals, otherwise high current and temperature may cause body injury or fire hazards. Metallic cell terminals are exposed from plastic packaging and ample safety precautions should be implemented to avoid short circuiting them during system integration or connections.

8.8 Always connect cell terminals according to its label(s) in right polarity. Reverse charging is strictly prohibited.

8.9 It is extremely dangerous to overcharge a cell which may cause overheating and fire hazards. Multiple level of fail safe overcharge protection should be implemented in a BMS. See paragraph 6.2.4 for minimum requirement to be adopted by the BMS for protection. See also paragraph 7.11.

8.10 Normal charging should finish within a charging time out limit as set out in paragraph 6.2.4.8. When charging continues longer than charging time out limit, it tends to overheat the cells which may cause overheating and fire hazards. A timer should be implemented in the charger circuit and set up properly. In case charging does not terminate normally within charging time out limit, ensure that the timer will intervene and stop the charging. See also paragraph 7.11.

8.11 Products should be securely fixed to solid platform, and power cables should be securely attached by fastener to avoid intermittent contact which may cause arcing and sparks.

8.12 Do not service cells and electrical connections within plastic package of cell. Improper electrical connection within a cell may cause overheating in service.

8.13 In the event of electrolyte leakage, avoid contacting electrolyte with skin or eyes. In case come into contact, wash affected area with large amount of water and seek medical help. Do not swallow any parts or substances within a cell.

8.14 Protect cells from mechanical shock, impact and pressure. Internal electrical circuit may short circuit to generate high temperature and fire hazards.

8.15 When cells charging is terminated improperly for reasons such as exceeding allowable charging time, cut-off due to exceeding charging voltage or cut-off due to exceeding charging current, all these events are defined as “improper charge termination”. Such event may indicate that there is current leaking within a cell system or some components have started to malfunction and subsequent charging of such cell system without finding and fixing root cause of problem may cause potential overheat or fire hazards. When such event occurs, the BMS should lock itself up to prevent subsequent charging and notice should be given to the user to return the vehicle to dealer for servicing. Subsequent charging should only be resumed after the system has been thoroughly checked by qualified technician who can identify and fix root cause attributed to the “improper charge termination”.

8.16 Performing tests as described in paragraph 2.6 may result in fire or explosion of the Products. Such tests shall only be performed in qualified laboratories by qualified personnel with proper safety precautions taken. Running these tests in an improper way may result in severe personal body injury or property damages.

7.13. The usage of the cells without a BMS or similar System is strictly prohibited.

9 Hazard Warning

9.5 Warning statement

WARNING

CELLS ARE POTENTIALLY DANGEROUS AND PROPER PRECAUTIONS MUST BEOBSERVED 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.

9.6 Types of Hazards

Client acknowledges the following potential hazards in connection with the usage and handling of the Products:

- Working with battery can expose the handler to chemical, shock and/or arcing hazards. Although a person's body might react to contact with direct current voltage differently than from contact with alternate current voltage, Client shall take a conservative position and consider the risk of shock or electrocution to be the same for both alternate current and direct current exposures greater than 50 volts.

- Cells expose its handler to chemical hazards associated with the electrolyte used in the cell.

- When selecting work practices and personal protective equipment, Client and its employees shall consider potential exposure to these hazards and therefore prevent accidental short-circuit that can result in electrical arcing, explosion, and/or "thermal runaway" of the cells.

10Mechanical Drawing