



## Specification Approval Sheet

Name : Li-18650 3.7V 5200

Model : \_\_\_\_\_

SPEC : 3.7V 5200mAh

Approved By	Checkup	Make

Customer Confirmation	Signature	Date
	Company Name :	
	Stamp :	

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## **1 Scope**

This specification describes the technological parameters and testing standard for the lithium ion rechargeable battery manufactured and supplied by Tenergy Corporation.

## **2 Products specified**

2.1 Name Cylindrical Lithium Ion Rechargeable Battery

2.2 Type Li-18650 3.7V 5200

## **3 References**

In this specification reference is made to: GB/T182847-2000, UL1642 and IEC61960-1:2000.

## **4 Caution:**

4.1. Please read these specifications carefully before testing or using the battery as improper handling of a Li-ion battery may result in lose of efficiency, heating, ignition, electrolyte leakage or even explosion.

4.2 While testing the battery by charging and discharging, please use test-equipment especially designed for Li-ion battery. Do not use ordinary constant current and constant voltage (CC/CV) power supplies. These do not protect the battery from being overcharged and over-discharged, resulting in possible loss of functionality or danger.

4.3 When charging and discharging batteries or packing them into equipment, reversing the positive and negative terminals will result in overcharging and over-discharging of the battery(s). This could lead to serious loss of efficiency and even explosions.

4.4 Do not solder directly on the battery. Do not resolve the battery.

4.5 Do not put battery(s) in pockets or bags together with metal products such as necklaces, hairpins, coins, screws, etc. Neither stores them together without proper isolation. Do not connect the positive and negative electrode directly with each other through conductive materials. This can result in a short circuit of the battery.

4.6 Do not beat, throw or trample the batteries, do not put the battery into washing machines or high-pressure containers.

4.7 Keep the battery away from heat sources such as fires, heaters, etc. Do not use or store battery(s) at locations where the temperature can exceed 60°C, such as in direct sunlight. This may lead to the generation of excessive heat, ignition and lose of efficiency.

4.8 Do not get batteries wet or throw them into water. When not in use, place the batteries in a dry environment at low temperatures.

4.9 While during use, testing or storing batteries, batteries become hot, distribute a smell, change color, deform or show any other abnormalities, please stop using or testing immediately. Attempt to isolate the battery and keep it away from other batteries.

4.10 Should electrolyte get into the eyes, do not rub the eyes, rinse the eyes with clean water and seek medical attention if problems remain. If electrolyte gets onto the skin or clothing, wash with clean water immediately.



**5 Basic characteristics**

5.1 Capacity (25±5°C)	Nominal Capacity : 5200mAh (2.6A Discharge) Minimum Capacity : 5090mAh (1.04A Discharge)
5.2 Nominal Voltage	3.7V
5.3 Internal Impedance	≤ 120mΩ
5.4 Discharge Cut-off Voltage	3.0V
5.5 Max Charge Voltage	4.20±0.05V
5.6 Standard Charge Current	2.6A
5.7 Rapid Charge Current	5.2A
5.8 Standard Discharge Current	2.6A
5.9 Rapid Discharge Current	5.2A
5.10 Max Pulse Discharge Current	10.4A
5.11 Weight	Appro 100g
5.12 Max. Dimension	Thickness: 18.5±0.5mm Width: 37.5±0.5mm Height : 67±1mm
5.13 Operating Temperature	Charge: 0 ~ 45°C Discharge: -20 ~ 60°C
5.14 Storage Temperature	During 1 month: -5 ~ 35°C During 6 months: 0 ~ 35°C

**6 Standard conditions for test**

All the tests need to be done within one month after the delivery date under the following conditions: Ambient Temperature: 25±5°C; Relative Humidity: 65±20%

Standard Charge	Constant Current and Constant Voltage (CC/CV) Current = 2.6A Final charge voltage = 4.2V Final charge Current = 0.104A
Standard Discharge	Constant Current (CC) Current = 2.6A End Voltage = 3.0V

**7 Appearance**

All surfaces must be clean, without damages, leakage and corrosion. Each product will have a product label identifying the model.



**8 Characteristics**

In this section, the Standard Conditions of Tests are used as described in part 6.

**8.1 Electrical Performances**

Items	Test procedure	Requirements
8.1.1 Nominal Voltage	The average value of the working voltage during the whole discharge process.	3.7V
8.1.2 Discharge Performance	The discharge capacity of the battery, measured with 2.6A down to 3.0V within 1 hour after a completed charge.	≥114min
8.1.3 Capacity Retention	After 28 days storage at 25±5°C, after having been completely charged and discharged at 1.04A, discharge to 3.0V, the residual capacity is above 80%	Capacity≥4160mAh
8.1.4 Cycle Life	After 299 cycles at 100% DOD. Charge and discharge at 2.6A, and plus 1 day, measured under 1.04A charge and discharge, the residual discharge capacity is above 80% of initial capacity (Cycle life may be determined by conditions of charging, discharging, operating temperature and/or storage.)	300 cycles the residual capacity ≥4160mAh
8.1.5 Storage	(Within 3 months after manufactured) The battery is charged with 2.6A to 40-50% capacity and stored at ambient temperature 25±5°C, 65±20%RH for 12 months. After the 12 months storage period the battery is fully charged and discharged to 3.0V with 1.04A	Discharge time≥4h

**8.2 Safety Performances**

Items	Test procedure	Requirements
8.2.1 Short Circuit	The battery is to be short-circuited by connecting the positive and negative terminals of the battery directly with copper wire with a resistance of less than 0.05Ω.	No fire no explosion.
8.2.2 Impact Test	A test sample battery is to be placed on a flat surface. A 5/8 inch (15.8mm) diameter bar is to be placed across the center of the sample. A 20 pound (9.1kg) weight is to be dropped from a height of 24 ±1 inch (610±25mm) onto the sample.	No fire no explosion.
8.2.3 Overcharge (3C/10V)	The battery is connected with a thermocouple and put in a fume hood. The positive and negative terminals are connected to a DC power supply set at 15.6A and 10V until the battery reaches 10V and the current drops to approximately 0A. Monitor the temperature of battery. When the temperature of the battery is approximately 10°C less than the peak value, the test is completed.	No fire, no explosion.
8.2.4 Thermal shock	After standard charging, heat the battery to 150±2°C at a rate of 5±2°C /min and keep it at this temperature during 10 minutes.	No fire, no explosion.

**8.3 Environmental tests**

Items	Test procedure	Requirements
8.3.1 High temperature performance	The fully charged battery is put at 55±2°C for 2 hours and then discharged to 3.0V at 2.6A.	Capacity≥4160mAh
8.3.2 Low temperature performance	The fully charged battery is placed during 16-24 hours at -20±2°C and then discharge to 2.75V at 1.04A.	Capacity≥3640mAh



8.3.3 Anti-vibration	The fully charged battery is fixed on a platform and vibrated in the X , Y and Z directions for 30minutes at the speed 10ct/min Frequency: 10~30Hz, Vibration amplitude 0.38mm. Frequency: 30~55Hz, Vibration amplitude 0.19mm.	No deformation should be visible. Not leak, smoke and/or explode. Voltage should be not less than 3.6V.
8.3.4 Drop Test	The fully charged battery is dropped from a height of 1m onto a 15~20mm hard board in X, Y and Z directions once for all axis. Then the battery is discharged at 2.6A to 3.0V followed by 3 or more cycles with the standard charge rate and a discharge at 2.6A.	No fire, no explosion. Discharge Time≥102min

### 9 Packing

Batteries are at a half-charged state when packed. The packing box surface will contain the following: name, type, nominal voltage, quantity, gross weight, date, capacity and impedance.

### 10 Transportation

During transport, do not subject the battery(s) or the box (es) to violent shaking, bumps, rain and direct sunlight. Keep the battery(s) at a half-charged state.

### 11 Long-term Storage

The battery should be used within a short period after charging because long-term storage may cause loss of capacity by self-discharging. If the battery is kept for a long time(3months or more), It is strongly recommended that the battery is stored at dry and low-temperature and Keep the battery(s) at a half-charged state. the battery should be shipped in 50% charged state. In this case, OCV is from 3.65V to 3.85V. Our shipping voltage is 3.75-3.80v . because storage at higher voltage may cause loss of characteristics.

- over a period of 1 month: -5 ~ 35°C, relative humidity: ≤75%.
- over a period of 6 months: -20~ 25°C, relative humidity: ≤75%.

### 12 Warranty

8.1The warranty period of this product is 12 months starting at the date of delivery from the factory.

8.2Warranty will be void if the batteries are used outside these specifications.

8.3Ryder will not be liable for any damages, personal, material, immaterial or otherwise, when the batteries are used outside these specifications.

### 13 Changes of specifications

The information in this specification is subject to change without prior notice.

### 14 For reference only

The information contained in this document is for reference only and should not be used as a basis for product guarantee or warranty. For applications other than those described here, please consult your nearest Ryder Sales Office or Distributors.

### 15 Pack Quality Requirement for safety and quality

15.1 The battery pack's consumption current.



- Sleep Mode : Under 250uA.
- Shut Down Mode : Under 10uA / Under 3.0V.  
Under 1uA / Under 2.5V.
- 15.2 Operating Charging Voltage of a battery.
- Normal operating voltage of a battery is 4.20V
- Max operating voltage of a battery is 4.25V.
- 15.3 Pre-charging function
- Pre-charge function should be implemented to prevent abnormal high rate charging after deep discharge.
- Pre-charging condition Operation : Under 3.0V
- Charging current : Under 150mA/Battery.(Continuous)
- Pre-charge stop (Normal Charge Start) : All batteries reach 3.0V
- 15.4. Battery voltage monitoring system.
- The system (Charger or Pack) should equip a device to monitor each Battery voltage and to stop charging if a battery imbalance happened.

**16 PCB Performance**

**16.1 Electrical characteristics**

Item	Symbol	Content	Criterion
Over charge Protection	V <sub>DET1</sub>	Over charge detection voltage	4.25±0.05V
	t <sub>DET1</sub>	Over charge detection delay time	0.7~1.3s
	V <sub>REL1</sub>	Over charge release voltage	4.05±0.05V
Over discharge protection	V <sub>DET2</sub>	Over discharge detection voltage	2.5±0.1V
	t <sub>DET2</sub>	Over discharge detection delay time	14~26ms
	V <sub>REL2</sub>	Over discharge release voltage	3.0±0.05V
	V <sub>DET3</sub>	Over current detection voltage	0.2±0.015v
	IDP	Over current detection current	9.0~13.0A
	t <sub>VDET3</sub>	Detection delay time	8.0~16.0ms
		Release condition	Cut load

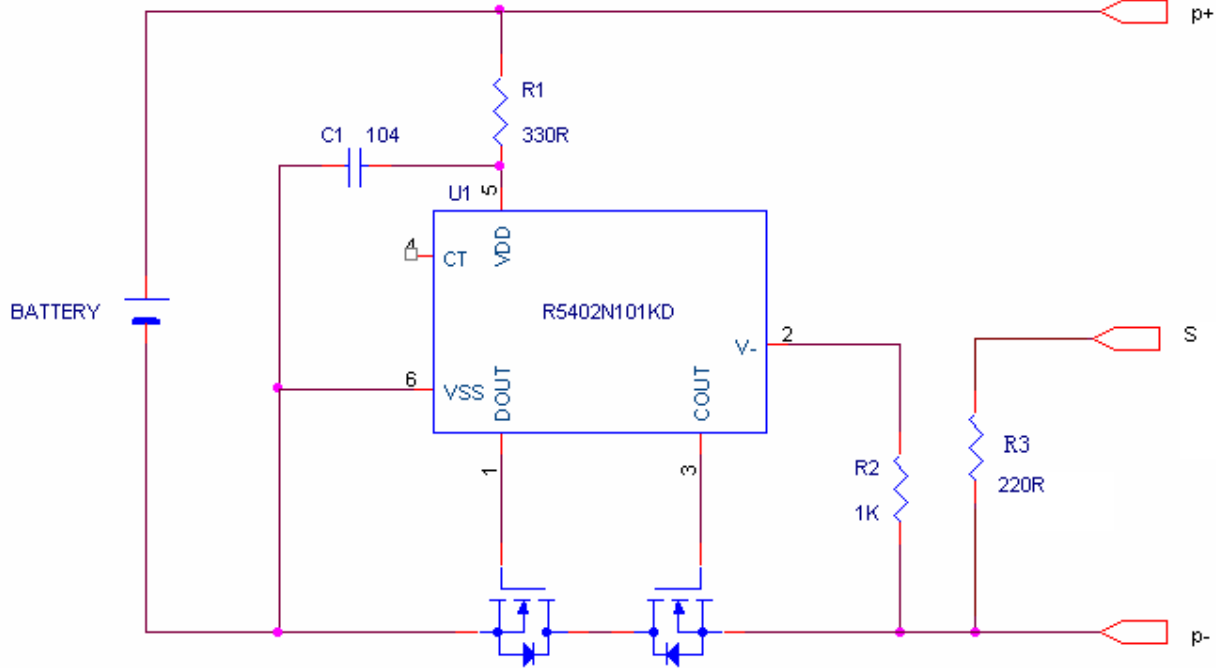


		Detection condition	Exterior short circuit
	TSHORT	Detection delay time	230~500us
		Release condition	Cut short circuit
	RDS	Main loop electrify resistance	VC=4.2V ; RDS≤40mΩ
Current consumption	I <sub>DD</sub>	Current consume in normal operation	4.0μA Type 8.0μA Max

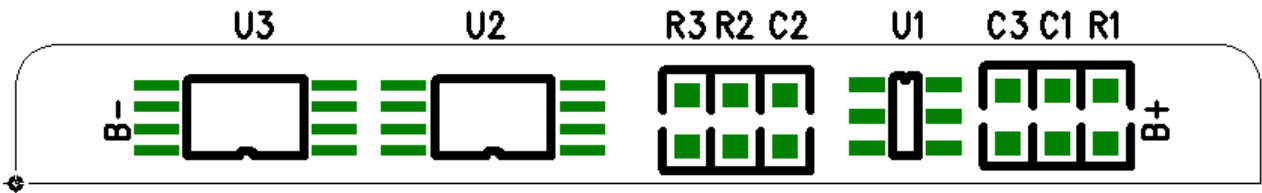
**16.2 Parts list**

NO.	Location	Part name	Specification			Maker/Remark
1	U1	Battery protection IC	R5402N101KD	SOT-23-6	1	RICOH
2	U2,U3	Silicon MOSFET	FTD2017R	TSSOP-8	2	SANYO
3	R1	Resistance	SMD 330Ω±5%	0603	1	YAGEO
4	R2	Resistance	SMD 1KΩ±5%	0603	1	YAGEO
5	R3	Resistance	SMD 220Ω±5%	0603	1	YAGEO
6	C1	Capacitance	SMD 0.1μF	0603	1	TDK
7	PCB	Print circuit board	I-1661 38*4.2*0.6 mm		1	AS

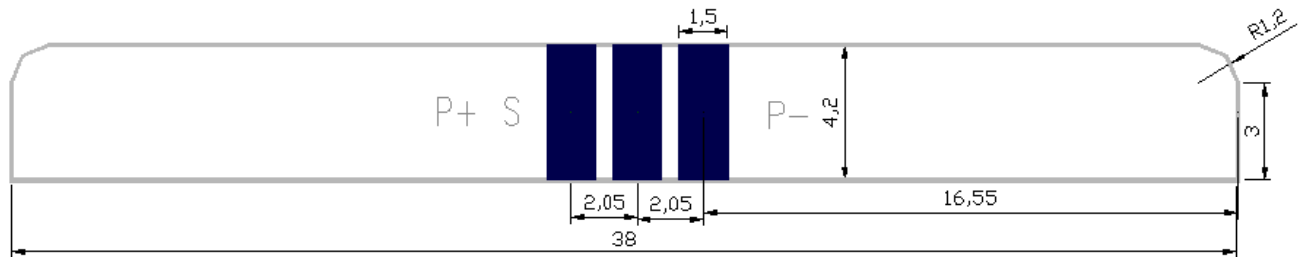
### 16.3 Application Circuit



### 16.4 PCB layout



### 16.5 PCB Maps



**16.6 Terminal explanations**

- 1、B+ : Connected to the battery' s positive terminal
- 2、B- : Connected to the battery' s negative terminal
- 3、P+ : Connected to the battery' s output or the charger' s positive terminal
- 4、P- : Connected to the battery' s output or the charger' s negative terminal

**17 Battery Pack Drawing**

