Specification Approval Sheet

Name: Lithium-Ion Rechargeable Battery

Model: INR18650-22M

SPEC: 3.7V / 2200mAh

Specification Modification Records

Modification Time	Descriptions	Issued Date	Approved By
	Release 1	2025-03-10	

1 Scope

This specification is applied to the reference cylindrical Li-ion battery in this Specification and manufactured by Akyga Battery

2 Product Specification

Table 1

No.	Item	General Parameter		Remark
1	Rated Capacity	Nominal	2200mAh	0.2C discharge after Standard charge
		Minimum	2150mAh	
2	Nominal Voltage	3.7V		Mean Operation Voltage
3	Voltage at end of Discharge	2.75V		Discharge Cut-off Voltage
4	Charging Voltage	4.2V		
5	Internal Impedance	≤150mΩ		Internal resistance measured at AC 1KHZ after 50% charge The measure must uses the new batteries that within one week after shipment and cycles less than 5 times
6	Standard charge	Constant Current 0.2C_5A Constant Voltage 4.2V 0.02 C_5A cut-off		Charge time : Approx 6.0h
7	Standard discharge	Constant current 0.2C_5A end voltage 2.75V		
8	Fast charge	Constant Current 0.5C_5A Constant Voltage 4.2V 0.02 C_5A cut-off		Charge time : Approx 3.0h

Continuous the table 1

No.	Item	General Parameter	Remark
9	Fast discharge	Constant current 0.5C_5A end voltage 2.75V	
10	Maximum Continuous Charge Current	1.5A	Charge time : Approx 1.9h
11	Maximum Continuous Discharge Current	1.5A	
12	Operation Temperature Range	Charge: 0~45℃	65±20%R.H. Bare Cell
		Discharge: -20~60℃	
13	Storage Temperature Range	Less than 1 year: -20~25℃	65±20%R.H. at the shipment state
		less than 3 months: -20~45℃	
14	Battery Dimensions	Diameter: 18.5mm±0.5mm	Assembling Dimension
		Height 1: 69.5mm±0.5mm (Including pointed caps)	
		Height 2: 68.0mm±0.5mm (Excluding pointed caps)	
15	Battery pack Weight(	Approx: 48.5g	

3. Performance And Test Conditions

3.1 Standard Test Conditions

Test should be conducted with new batteries within one week after shipment from our factory and the battery should not be cycled more than five times before the test. Unless otherwise specified, test and measurement shall be done under temperature of 23±5℃and relative humidity of 45~85%.

3.2 Measuring Instrument or Apparatus

3.2.1 Dimension Measuring Instrument

The dimension measurement shall be implemented by instruments with equal or more precision scale of 0.01mm.

3.2.2 Voltmeter

Standard class specified in the national standard or more sensitive class having inner impedance more than 10kΩ/V

3.2.3 Ammeter

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

3.2.4 Impedance Meter

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

3.3 Standard Charge\Discharge

3.3.1 Standard Charge: Test procedure and its criteria are referred as follows:

Charging shall consist of charging at 0.2C_5A constant current rate until the cell reaches 4.2V. The cell shall then be charged at constant voltage of 4.2V while tapering the charge current. Charging shall be terminated when the charging current has tapered to 0.02C_5A . Charge time : Approx 6.0h, The cell shall demonstrate no permanent degradation when charged between 0 ºC and 45 ºC.

3.3.2 Standard Discharge

Cells shall be discharged at a constant current of 0.2C_5A to 2.75V @ 23 □ 5ºC

3.3.3 If no otherwise specified, the rest time between Charge and Discharge amount to 30min.

3.4 Appearance

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

3.5 Initial Performance Test

Table 2

Item	Test Method and Condition	Requirements
(1) Open-Circuit Voltage	The open-circuit voltage shall be measured within 24 hours after standard charge.	≥4.1V
(2) Internal impedance	Internal resistance measured at AC 1KHz after 50% charge.	≤150mΩ
(3) Minimal Rated Capacity	The capacity on 0.2C_5A discharge till the voltage tapered to 2.75V shall be measured after rested for 30min then finish standard charge.	Discharge Capacity ≥2150mAh

3.6 Temperature Dependence of discharge capacity

Battery pack should be charged per 3.3.1 and discharged @0.2C_5A to 2.75V. Except to be discharged at temperatures per Table 3. Battery should be stored for 3 hours at the test temperature prior to discharging and then should be discharged at the test temperature. The capacity of battery at each temperature shall be compared to the capacity achieved at 23ºC and the percentage shall be calculated. Each cell shall meet or exceed the requirements of Table 3.

Table 3

Discharge Temperature	-20℃	0℃	23℃	60℃
Discharge Capacity （0.2C5A ）	60%	90%	100%	95%

3.7 Cycle Life and Leakage -proof

Table 4

No.	Item	Criteria	Test Conditions
1	Cycle Life (0.5C_5A)	Higher than 80% of the Initial Capacities of the Cells 80%	Carry out 300 cycles Charging/Discharging in the below condition. • Charge: Standard Charge, per 3.3.1 • Discharge:0.5C_5A to 2.75V • Rest Time between charge/discharge:30min. • Temperature:23±5 ℃
2	Leakage-Proof	No leakage (visual inspection)	After full charge with standard charge, store at 60±3 ℃, 60±10%RH for 1 month.

4. Mechanical characteristics and Safety Test for single cells

Table 5 (Mechanical characteristics)

No.	Items	Test Method and Condition	Criteria
1	Vibration Test	After standard charging, fixed the cell to vibration table and subjected to vibration cycling that the frequency is to be varied at the rate of 1Hz per minute between 10Hz an 55Hz, the excursion of the vibration is 1.6mm. The cell shall be vibrated for 30 minutes per axis of XYZ axes.	No leakage No fire
2	Drop Test	The cell is to be dropped from a height of 1 meter twice onto concrete ground.	No explosion, No fire, no leakage.

Table 6 (Safety Test)

No.	Items	Test Method	Requirements
1	Short Circuit (23℃)	Each test sample battery, in turn, is to be short-circuited by connecting the (+) and (-) terminals of the battery with a Cu wire having a maximum resistance load of 5Ω for 10min.Tests are to be conducted at room temperature(20±2 ℃).	No explosion, No fire Temperature of the surface of the Cells are lower than 150℃
2	Short Circuit (60℃)	Each test sample battery, in turn, is to be short-circuited by connecting the (+) and (-) terminals of the battery with a Cu wire having a maximum resistance load of 5Ω for 10min.Tests are to be conducted at room temperature(60±2 ℃).	No explosion, No fire Temperature of the surface of the Cells are lower than 150℃
3	Over charge	Cell charged at 0.5C rate to 4.6V and kept the voltage constant until the current detection to 0.02C cut-off	No explosion, No fire
4	Over discharge	Battery Discharge at 0.5C till the voltage reaches to 0V, at room temperature(23±5 ℃)	No explosion, No fire

5. Protection circuit module

5.1 PCM Specification

Item	Test Condition
Over charge protection	The battery should be charged under 4.2V/1.5A. The charging should be shut off when the internal cell voltage becomes more than the specified protection voltage.
Over discharge Protection	The battery should be discharged within 0.5C; The discharging should be shut off when the internal cell voltage becomes less than the specified protection voltage.
Short protection	After rated charge, (+) and (-) terminals are connected with 10mΩ mental resistor or equivalence.

5.2 PCM Standard

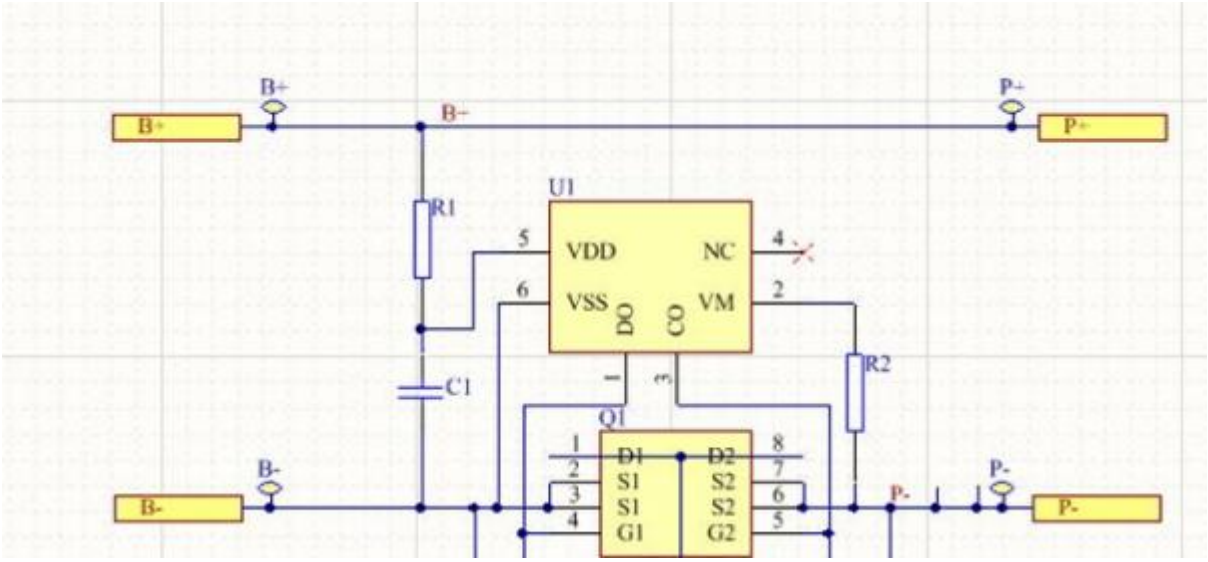
No	Item	Condition	Specification
1	Input Voltage	input Voltage	4.2V
2	Overcharge	Detection voltage	4.28±0.05V
3		Release voltage	4.08±0.05V
4		Detection delay time	Max 200ms
5	Over discharge	Detection voltage	2.4±0.1V
6		Release voltage	3.0±0.1V
7		Detection delay time	120ms
8	Over discharge current	Over current	2-5A
9		Delay time	5~20ms
10	Short circuit protection	Short detection delay time	Max 320us
11	Normal current consumption	Normal current consumption of PCM	≤8.0uA
12	Suggested working conditions	Max continuous charge/discharge current	1.5A
13	IR resistance	PCM Internal resistance / IR of PCM	≤50mΩ
14	PCB size / The final size of PCM	The length of final PCM	D=16.6±0.15mm
15		The width of final PCM	/
16		The thickness of final PCM	H=0.8±0.1mm

5.3 PCM parts list

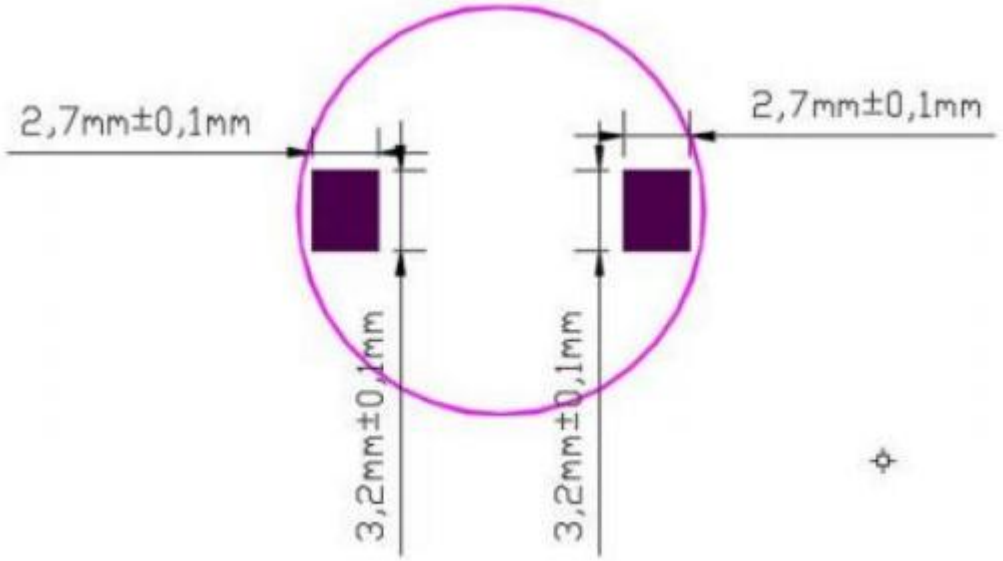


No.	Component Number	Component Name	Component Specifications	Q-ty
1	U1	Battery protection IC	DW01A/SOT-23-6	1
2	Q1	Silicon MOSFET	8205/TSSOP-8	1
3	R1	Resistance	SMD 100Ω ±5%/0603	1
4	R2	Resistance	SMD 1KΩ ±5%/0603	1
5	C1	Capacitance	SMD 0.1μ F±10%/50V/0603	1
6	B+ B-	Nickel Sheet	3.0*3.0*0.3mm	2
7	PCB	Printed Circuit Board	Green solder mask with white text, ENIG surface finish. 16.6*0.8mm/FR-4/1.0oz/	1

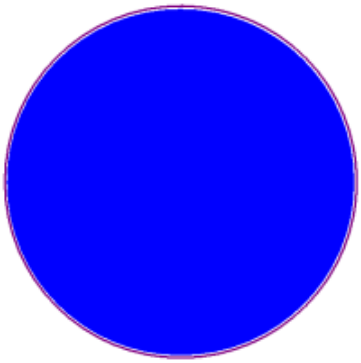
5.3 Schematic diagram



5.4 PCM size



5.5 PCB LAYOUT

Top Line	
Top screen printing	
Bottom Line	
Bottom screen printing	None

6. Handling of Cells

6.1 Prohibition short circuit

Never make short circuit cell. It generates very high current which causes heating of the cells and may cause electrolyte leakage, gassing or explosion that are very dangerous. The Li-Ion cell tabs may be easily short-circuited by putting them on conductive surface. Such outer short circuit may lead to heat generation and damage of the cell. An appropriate circuitry with PCM shall be employed to protect accidental short circuit of the battery pack.

7.Notice for Designing Battery Pack

7.1 Pack toughness

Battery pack should have sufficient strength and the cylindrical Li-Ion cell inside should be protected from mechanical shocks.

7.2 Cell fixing

The Li-Ion cell should be fixed to the battery pack by its large surface area. No cell movement in the battery pack should be allowed.

7.3 Inside design

No sharp edge components should be insides the pack containing the Li-Ion cell.

7.4 Tab connection

Ultrasonic welding or spot welding is recommended for Li-Ion cell tab connection method. Battery pack should be designed that shear force are not applied to the Li-Ion cell tab.

If apply manual solder method to connect tab with PCM, below notice is very important to ensure battery performance:

- The solder iron should be temperature controlled and ESD safe;
- Soldering temperature should not exceed 350°C;
- Soldering time should not be longer than 3s;
- Soldering times should not exceed 5 times, Keep battery tab cold down before next time soldering;
- Directly heat cell body is strictly prohibited, Battery may be damaged by heat above approx. 100°C

7.5 For mishaps

Battery pack should be designed not to generate heat even when leakage occurs due to mishaps.

1) Isolate PCM (Protection Circuit Module) from leaked electrolyte as perfectly as possible.
2) Avoid narrow spacing between bare circuit patterns with different voltage. (Including around connector)
3) Li-ion battery should not have liquid from electrolyte, but in case If leaked electrolyte touch bare circuit patterns, higher potential terminal material may dissolve and precipitate at the lower potential terminal, and may cause short circuit. The design of the PCM must have this covered.

8. Charge and Storage

8.1 Charge

8.1.1 Charge current:

Charge current should be less than maximum charge current specified in the Product Specification. Charge with higher current than recommended value may cause damage to battery electrical, mechanical and safety performance and could lead to heat generation or leakage.

8.1.2 Charge voltage:

Charge shall be done by voltage less than that specified in the Product Specification (4.2V/battery). Charge beyond 4.25V, which is the absolute maximum voltage, must be strictly prohibited. The charger shall be designed to comply with this condition.

It is very dangerous that charge with higher voltage than maximum voltage may cause damage to the battery electrical, mechanical safety performance and could lead to heat generation or leakage.

8.1.3 Charge temperature:

The battery shall be charged within 0℃~45℃range in the Product Specification.

8.1.4 Prohibition of reverse charge:

Reverse charge is prohibited. The battery shall be connected correctly. The polarity has to be confirmed before wiring, In case of the battery is connected improperly, the battery cannot be charged. Simultaneously, the reverse charge may cause damaging to the battery which may lead to degradation of battery performance and damage the battery safety, and could cause heat generation or leakage.

8.2 Discharge

8.2.1 Discharge current

The battery shall be discharged at less than the maximum discharge current specified in the Product Specification. High discharge current may reduce the discharge capacity significantly or cause over-heat.

8.2.2 Discharge temperature

The battery shall be discharged within -20℃~60℃range specified in the Product Specification.

8.2.3 Over-discharge:

It should be noted that the battery would be at over-discharged state by its self-discharge characteristics in case the battery is not used for long time. In order to prevent over-discharge, the battery shall be charged periodically to maintain between 3.6 and 3.8V.

Over-discharge may causes loss of battery performance, characteristics, or battery functions.

The charger shall be equipped with a device to prevent further discharge exceeding a cut-off voltage specified in the Product Specification. Also the charger shall be equipped with a device to control the recharging procedures as follows:

The battery pack shall start with a low current (0.01C) for 15-30 minutes, i.e.-charge, before rapid charge starts. The rapid charge shall be started after the (individual) cell voltage has been reached above 2.75V within 15-30 minutes that can be determined with the use of an appropriate timer for pro-charge.

8.3 Prevention of short circuit within a battery pack

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

9. Others

9.1. Cell connection

1) Direct soldering of wire leads or devices to the cell is strictly prohibited.
2) Lead tabs with pro-soldered wiring shall be spot welded to the cells.

Direct soldering may cause damage of components, such as separator and insulator, by heat generation.

9.2. 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 within the battery pack, which may cause generation of smoke or firing.

9.3 Prohibition of disassemble

1) Never disassemble the cells.
The disassembling may generate internal short circuit in the cell, which may cause gassing, firing, explosion, or other problems.

2)Electrolyte is harmful.
Li-ion battery should not have liquid from electrolyte flowing, but in case the electrolyte come into contact with the skin, or eyes, physicians shall flush the electrolyte immediately with fresh water and medical advice is to be sought.

9.4 Prohibition of dumping of battery pack into fire

Never incinerate nor dispose the battery pack in fire. These may cause explosion of the battery, which is very dangerous and is prohibited.

9.5 Prohibition of battery immersion into liquid such as water

The battery shall never be soaked with liquids such as water, seawater, and drinks such as soft drinks, juices, coffee or others.

9.6 Battery replacement

The battery replacement shall be done only by either battery supplier or device supplier and never be done by the user.

9.7 Prohibition of use of damaged batteries

The battery pack might be damaged during shipping by shock. If any abnormal features of the cells are found such as damages in a plastic envelop of the cell, deformation of the cell package, smelling of an electrolyte, an electrolyte leakage and others, the cells shall never be used any more.The battery with a smell of the electrolyte or a leakage shall be placed away from fire to avoid firing or explosion.

10. Period of Warranty

The period of warranty is one year from the date of shipment. Akyga Battery guarantees to give a replacement in case of batteries with defects proven due to manufacturing process instead of the customer abuse and misuse.

11. Other The 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.

12.Note:

Any other items which are not covered in this specification shall be agreed by customer and Akyga Battery.

13. Battery Pack Dimensions:

