Specification Approval Sheet

ICR18650F9

1. Scope

This specification describes technical parameters and test standards for the lithium-ion rechargeable cell CMICR18650F9, manufactured and supplied by Akyga battery

These parameters and standards mainly refer to GB 31241-2014 and UL1642.

2. Product Specification

2.1 Type：Cylindrical Lithium Ion Rechargeable Cell

2.2 Model：CMICR18650F-3350mAh

3. Basic Characteristics

Technical Parameters	Specification		Condition/Note
3.1 Capacity	Typical	3350mAh	Standard charge/discharge (Refer to 4.1 and 4.2)
	Minimum	3250mAh	
3.2 Nominal Voltage	3.6V		
3.3 Internal Impedance	≤60mΩ		AC 1kHz
3.4 Standard Charge (Refer to 4.1)	0.3C(975mA) 4.2V 50mA		Constant current Constant voltage End condition(Cut off)
3.5 Max. Charge Voltage	4.20V		
3.6 Rapid Charge Current	0.5C (1625mA)		
3.7 Standard Discharge	0.2C(650mA) 2.5V		Constant current End condition(Cut off)
3.8 Max. Discharge Current	0.5C(1625mA) 1.5C(4875mA)		-20~5℃ 5~50℃
3.9 Max. Pulse Discharge Current	2.0C (6500mA)		
3.10 Operating Temperature (Charge)	0 ~ 45℃		
3.11 Operating Temperature (Discharge)	-20℃ ~ 50℃		
3.12 Storage Temperature (for Shipping State)	One month	-20℃ ~ 50℃	Recovery ratio ≥ 80%
	Three months	-20℃ ~ 45℃	Recovery ratio ≥ 80%
	One year	-20℃ ~ 25℃	Recovery ratio ≥ 75%
3.13 Weight	Max. 49.0g		
3.14 Max. Dimension	Diameter (Φ)	18.6mm	
	Height (H)	65.2mm	

4. Standard Conditions for Test

1. Without stating specifically, all the electrical characteristics are obtained under the following conditions: Ambient temperature: 25 ± 2℃; Relative humidity: ≤ 75%.

2. Without stating specifically, all the safety tests are conducted under the following conditions: Ambient temperature: 20 ± 5℃; Relative humidity: ≤ 75%.

4.1 Standard Charge	0.3C(975mA), CC-CV to 4.2V, 50mA cut off
4.2 Standard Discharge	0.2C(650mA), CC to 2.5V
4.3 Charge/Discharge Condition	Charge: 0.3C(975mA), CC-CV to 4.2V, 50mA cut off, rest for 10min; Discharge: 0.5C(650mA), CC to 2.5V, rest for 20min

5. Characteristics

5.1 Electrical Characteristics

Items	Test Procedure	Requirements	
5.1.1 Nominal Voltage	Charge as described in 4.1, and discharge as described in 4.2. Calculate the average working voltage during discharge process.	3.6V	
5.1.2 Discharge Characteristic	Charge under the condition of 4.1, and discharge under the condition of 4.2.	≥ 3250mAh	
5.1.3 Cycle Life	Charge as described in 4.1, rest for 10min, and discharge with the current of 0.5C(1625mA) to 2.75V and then rest for 20min. Repeat cycling till discharge capacity in 2 successive cycles is less than 80% of the initial capacity.	≥ 300 Cycles	
5.1.4 Rate Performance	Charge as described in 4.1, rest for 10min, and discharge with different constant currents and cut off at 2.5V. Calculate the ratio of above capacities to the standard discharge capacity as described in 4.2.	0.2C	= 100%
		0.5C	≥ 94%
		1C	≥ 90%
		2C	≥ 80%
5.1.5 Storage at High Temperature	Charge as described in 4.1, store in the environment with temperature of 60 ± 2℃ for 7 days, and discharge as described in 4.2; charge and discharge as described in 4.3 for 3 times and record the recovery capacity.	Recovery ratio ≥ 80%	

5.1.6 Temperature Dependency of Capacity	Charge as described in 4.1, and discharge in the environment with different temperatures. Calculate the ratio of above discharge capacities to discharge capacity at temperature of 25 ± 2℃.	-10℃	≥ 70%
		0℃	≥ 80%
		25℃	= 100%
		50℃	≥ 95%
5.1.7Capacity Retention at Room Temperature	Fully charge as described in 4.1, store for 30 days, and discharge as described in 4.2. Calculate the retention ratio of capacity	Retention ratio ≥ 90%	
5.1.8 Storage	(After manufactured within 3 months) Charge as described in 4.1 until the capacity reaches 40-50%; store for 12 months in the environment with relative humidity of 45%~85%; charge and discharge as described in 4.1 and 4.2, respectively, and record the discharge capacity and calculate the retention ratio of capacity.	Retention ratio ≥ 80%	

5.2 Electrical Tests

Items	Test Procedure	Requirements
5.2.1 Short Circuit at 20 ± 5℃	The sample cell should be fully charged as described in 4.1 rest for 30min, and then short-circuited by connecting positive and negative terminals with a circuit load having a resistance of 80 ± 20mΩ at 20 ± 5℃. The temperature of the case should be measured during the test. The cell should remain on test for 24 hours or until the temperature of the case declines by 20% of the maximum temperature.	No fire，no explosion, and maximum surface temperature ≤ 150℃
5.2.2 Abnormal Charge	The sample cell should be discharged as described in 4.2, and subjected to the charging process to 4.6V with the current of the greater one between the 3C and three times of the charging current recommended by the manufacturer. The temperature of the case should be measured during the test. The test should be continued until the charging time reaches 7 hours or the	No fire，no explosion.

	temperature of the case declines by 20% of the maximum temperature.	
5.2.3 Forced-Discharge	The sample cell should be discharged as described in 4.2, and subjected to the forced discharge process with the reverse current of 1C. The test time is 90 min.	No fire , no explosion.

5.3 Mechanical Tests

Items	Test Procedure	Requirements
5.3.1 Vibration	The sample cell should be fully charged as described in 4.1, and fixed on a vibration platform. Then it is to be subjected to simple harmonic motion with an amplitude of 0.8 mm(1.6mm total maximum excursion). The frequency is to be varied at the rate of 1 Hz/min between 10 and 55 Hz, and return in not less than 90 nor more than 100 min. The above process should be conducted at both axial and radical directions(three mutually perpendicular directions for prismatic and pouch cell).	No fire, no explosion, and no leakage.
5.3.2 Drop	The sample cell should be fully charged as described in 4.1, and dropped onto a flat concrete floor from 1m height. The positive and negative electrode side should be dropped once, respectively, and the cylindrical surface twice. Each cell should be dropped four times.	No fire, no explosion.
5.3.3 Impact	The sample cell should be fully charged as described in 4.1, and placed on a flat surface . A metal bar with a diameter of 15.8mm(5/8 in) is to be placed across the center of the sample, and perpendicular to the longitudinal axis of the cell. A weight of 9.1kg(20 lb) is to be dropped from a height of 0.61m(24 in) onto the sample.	No fire, no explosion.
5.3.4 Crush	The sample cell should be fully charged as described in 4.1, placed between two flat surfaces	No fire, no explosion.

	and crushed with its longitudinal axis parallel to the flat surfaces. Crush the cell in the direction perpendicular to the flat surfaces with a crushing force of 13.0±0.2kN. The test is completed once the crushing force reaches the maximum value.	

5.4 Environmental Tests

Items	Test Procedure	Requirements
5.4.1 Low Pressure	The sample cell should be fully charged as described in 4.1, and stored for 6 hours at an absolute pressure of 11.6kPa (1.68psi) and a temperature of 20 ± 5°C, followed by 1 hour's observation.	No fire, no explosion, and no leakage
5.4.2 Heating	The sample cell should be fully charged as described in 4.1, and placed in a gravity or circulating air convection oven with an initial temperature of 20 ± 5℃. Raise the oven temperature at a rate of 5 ± 2℃/min to the test temperature 130 ± 2℃ and remain at this temperature for 30 minutes.	No fire, No explosion.

6. Outline Dimensions

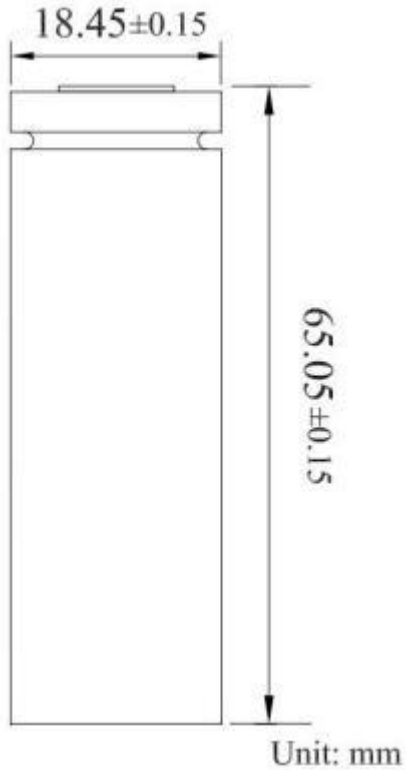

Fig. 1 Outline Dimensions of CMICR18650F-3350mAh(with tube)

7. Cautions

Please read this specification carefully before testing or using the cells because improper handling of the Li-ion cells may lead to efficiency loss, heating, electrolyte leakage, ignition or even explosion.

7.1 Caution in Use

7.1. 1 Abnormal operations such as overcharge (voltage > 4.2V), over discharge (voltage < 2.5V) and overcurrent charge-discharge (maximum current allowed at present temperature) should be prohibited during cell using. It is strictly prohibited to use the cell in the environment easily causing problems, such as static electricity and poor sealing (water and dust entering).

7.1.2 Charging with the current more than 0.5C(1625mA), using in the high-temperature/low-temperature, vibration, or humid environment, and matching unstable cells will reduce the cycle life of the cell.

7.1.3 The cell shall not be used in the environment of high frequency microwave or ultrasonic wave. When using in series and parallel, it is recommended to coat the high-voltage wire with electromagnetic insulation cover to prevent the electromagnetic wave from damaging adjacent devices and human body.

7.1.4 Avoid overlapping or contact between the positive and negative terminal wires of the battery to reduce the risk of short circuit.

7.1.5 The battery should be charged and discharged in strict accordance with this specification to

ensure the battery's cycle life and safety.

7.1.6 When the batteries are assembled in a module for use, the cells with the same capacity, internal resistance, batch and charged state shall be used. The packing standard of the batteries should be strictly in accordance with the technical agreement. The temperature difference inside the battery pack should be less than 5℃ when the pack is working.

7.1.7 Do not charge the battery when temperature is less than 0℃. Please store it in the environment with temperature more than 0℃ for a period of time before charging. Recommended store time as follows:

Outside Temperature	-5℃ ≤ T ≤ 0℃	-10℃ ≤ T ≤ -5℃	-15℃ ≤ T ≤ -10℃	-20℃ ≤ T ≤ -15℃
Time	2h	5h	8h	10h

7.2 Safety Caution

7.2.1 The battery should be placed away from babies and children. If there is any emergency such as deglutition, scald or explosion, please go to the hospital immediately.

7.2.2 When charging or discharging the battery, please use professional test equipment designed for Li-ion batteries. Do not use ordinary constant current or constant voltage (CC/CV) power chargers without limitation of current or voltage. These chargers do not protect the battery from being overcharged and over-discharged, and may lead to function failure and be dangerous.

7.2.3 When charging, discharging, or assembling the battery, avoid reversing the positive and negative terminals. Or it would lead to overcharge and over-discharge of the battery, causing serious failure, or even explosion.

7.2.4 Do not solder the battery directly. Do not disassemble the battery.

7.2.5 Do not put the battery in pockets or bags with metal objects, such as necklaces, hairpins, coins, screws, etc. Neither store the battery without proper isolation, nor connect the positive and negative electrodes directly with conductive materials. Or the battery may be short-circuited.

7.2.6 Do not hammer, throw or trample the battery. Do not put the battery into washing machines or high-pressure containers.

7.2.7 Keep the battery away from heat sources, such as fires, heaters, etc. Do not use or store the battery in direct sunlight or at places where temperature could exceed 60℃. Or the battery may generate excessive heat, ignite and fail.

7.2.8 Do not get the battery wet or throw it into water. When the battery is not in use, place it in a dry environment with relatively low temperature.

7.2.9 If the battery becomes abnormally hot, give out smell, change color, deform or show any other abnormalities during using, testing or storing, please stop using or testing immediately. Attempt to isolate the battery and stay away.

7.2.10 If the leaking electrolyte from the battery gets into your eyes, do not rub your eyes. Rinse the eyes with clean water and seek medical attention if problems remain. If the electrolyte gets onto the skin or clothing, wash with clean water immediately.

8. Packing

Cells need to be at half-charged state when packed. The surface of the packing boxes shall contain the following information: product name, type, nominal voltage, quantity, gross weight, date, capacity and impedance.

9. Transportation

During transportation, do not subject the cells or the boxes to violent shaking, bumps, rain or direct sunlight. Cells can be transported by truck, train, ship and airplane, etc.

10. Long-term Storage

When delivered, cells are charged to the voltage of 3.20V ~ 4.00V. Storing cells at/more than 80% SOC for a long time will lead to capacity loss and cycle life loss, please keep cells into use within 90 days when the capacity is more than 80%.

Cells may have lower capacity than they're expected due to the self-discharge when cells are to be delivered at 30% SOC.

Do not use or store the cells when the voltage is less than 2.5V.

11. Warranty

The warranty period of this product is 12 months from the ex-factory date. This warranty will be void if the cells are used in ways that deviate from this specification.

12. Exclusion of Liability

The company is not liable for any problems arising from non compliance with this specification.

The company is not liable for any problems arising from the use of electrical circuits, battery packs and chargers.

The company does not guarantee the quality of the defective batteries caused by customers in the battery assembly process after shipment.