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USER MANUAL

Lithium ion Capacitors

(LIC & LIB Series)

Li-ion capacitors are shipped in a charged state.
It is dangerous if a short circuit forms between the terminals because they have stored energy when they leave the factory. Please read this user manual carefully and handle the product with extreme care.

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1.Product Description

(1) Comparison of capacity, voltage and self-discharge

The energy density of lithium-ion capacitors is lower than that of lithium-ion batteries, but the output density is high; the energy density of single volume is 10~15Wh/L, which is much larger than the capacity of 2~8Wh/L of electric double layer capacitors, which is the latter's energy density. Twice.

In terms of voltage, the highest voltage of lithium-ion capacitors can reach 4V, which is similar to that of lithium-ion batteries, much higher than that of electric double-layer capacitors, and smaller than both in terms of self-discharge.

(2) Security

Due to the use of lithium oxide, the positive electrode of lithium-ion batteries not only contains a large amount of lithium, which can form lithium dendrites and pierce the separator, but also contains oxygen, an important ignition element. Once the battery is short-circuited, the overall thermal decomposition can develop, and the reaction with the electrolyte can cause combustion. The positive electrode of lithium-ion capacitors is activated carbon. Even if the internal short circuit will react with the negative electrode, it will not react with the electrolyte. In theory, it will be much safer than lithium batteries.

(3) Long life

In order to achieve long life, lithium-ion batteries have a certain range of charge and discharge depth limits, which reduces the substantially usable capacity. The charge and discharge principle of electric double layer capacitors is simply to adsorb or remove the electrolyte in the It is difficult to extend the practical life by this alone. However, even if the positive electrode potential of the lithium ion capacitor is lowered, the voltage of the cell itself does not drop significantly, so the capacity can be ensured.

(4) High temperature resistance

Under high temperature conditions, the electrolyte and the positive electrode are prone to oxidative decomposition. Therefore, it may be necessary to reduce the potential of the positive electrode under high temperature conditions. However, when the potential decreases, the overall voltage of the electric double layer capacitor will drop, and the capacity cannot be ensured. Lithium-ion batteries, on the other hand, cannot reduce pressure, which is prone to safety problems. Only lithium-ion capacitors can be used in locations where the positive electrode potential is far from the oxidative decomposition region, so they have excellent high-temperature performance.

2.Related Categories of LIC

PRODUCT	KIND	SHAPE	TERMINAL	TEMPERATURE RANGE	LIFE
1 BATTERY (DRY BATTERY)	1/2AA, 1/2A, etc.	Cylindrical (AA battery)	Positive and negative terminals	0°C to 30℃	1 time
SECONDARY BATTERY	The main rechargeable batteries are nickel metal hydride, nickel cadmium, lead acid (lead storage battery), lithium ion (including lithium battery and lithium ion polymer battery)	Cylindrical soft case	Positive and negative terminals	0°C to 65°C	<2000 times
SUPER CAPACITOR (EDLC)	High capacity (3000F~)	Cylindrical, square	Positive and negative ends or one end	-40℃ to 65℃	>500,000 times
	medium capacity (350~3000F)	Cylindrical	Ox horns		
	small capacity (0.033~350F)	Cylindrical, button, ceramic	Lead or pin		
LITHIUM ION CAPACITORS (LIC)	capacity 10~1100F	Cylindrical, soft pack	Positive and negative terminals or leads	-40℃ to 65℃	>50,000 times

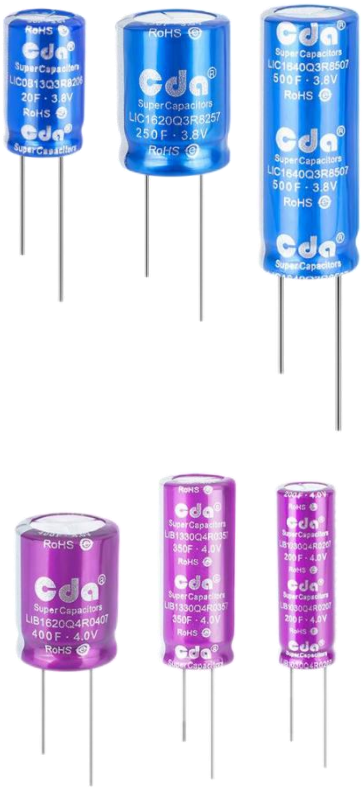
3.Explanation of Warning Signs

	**This symbol indicates prohibited actions.**
	**This symbol indicates instructions that must be strictly followed.**
	**This symbol indicates general precautions.**

4.General Specifications

Item	Performance	
	LIC	LIB
Operating temperature	-20°C to +65°C @ 3.8V -20°C to +85°C @ 3.5V	-40°C to +65°C @ 4.0V
Storage temperature	-40°C to +85°C	-40°C to +85°C
Capacitance range	10F to 750F	200F to 1100F
Capacitance tolerance	-0%~+100%(+25°C);-20%~+80%(+25°C)	-10%~+30%(+25°C)
Rated voltage	3.8 VDC	4.0 VDC
Minimum rated voltage	2.5 VDC	2.5 VDC
Surge voltage	4.2 VDC	4.2 VDC
Temperature characteristics	Capacitance change: Within ±50% of initial measured value at +25°C (-20°C to +70°C) Internal resistance: Within ±800% of initial measured value at +25°C (at -20°C)	
Endurance (At rated voltage & max. operating temp)	After 1000 hours Capacitance change: ±30% of initial rated value Internal resistance: Within 4 times of initial specified value	
Projected cycle life (From rated voltage to 1/2 rated voltage at 25°C)	After 50,000 cycles: Capacitance change: Within ±30 % of initial rated value Internal resistance: Within 2 times of initial specified value	
Shelf life	After 2 years at 25°C without load, the capacitor shall meet the specified endurance limits.	

5.Precautions for Product Use

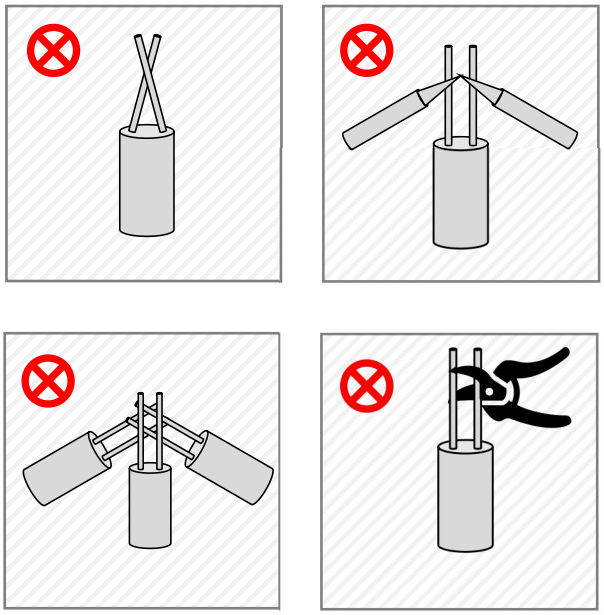


Notice

1. The operating temperature of lithium ion capacitors should not exceed the upper or lower limit of the rated temperature
2. Lithium ion capacitors should be used under nominal voltage. At the same time, in order to prolong the service life of the product, it is recommended that the monomer be used within the rated voltage (2.5-3.8V).
3. Please confirm the polarity of lithium ion capacitors before use, and reverse connection is prohibited.
4. The external environment temperature has an important influence on the life of lithium ion capacitors, please keep away from heat sources.
5. Do not directly contact the lithium ion capacitors with water, oil, acid or soil.
6. Do not squeeze, nail or disassemble lithium ion capacitors.
7. Do not discard lithium-ion capacitors randomly. When discarding, please dispose of them in accordance with national environmental protection standards.

6.Storage Matters

Never use LIC for the following operations.



Notice

1. Lithium-ion capacitors cannot be handled in places where the relative humidity is above 85% or containing toxic gases. In this environment, the leads and shells are susceptible to moisture and shell corrosion, resulting in short-circuiting of the lithium-ion capacitors.

2.If the lithium ion capacitor needs to be stored for a long time, please store it at a temperature of -10~55℃, relative humidity below 60%, and a well-ventilated production facility. Exposure to the sun is strictly prohibited.

7.Notes on circuit applications.

	Cell • If the voltage of the capacitor exceeds the upper limit voltage or falls below the lower limit voltage, the capacitor will be permanently damaged. Therefore, avoid overcharging or overdischarging. Never use a capacitor after it has been overcharged or overdischarged.
	Multiple cells • When multiple capacitors are used in series or in parallel, ensure that the voltage of each capacitor is consistent (cell1=cell2=cell3=...), and the leakage current of the capacitors is consistent.
	protect circuit • Monitor whether each capacitor is within the upper and lower limit voltage range, and do not use it again when it is overcharged or overdischarged. • Not only the protection circuit part, but also systems such as the charging circuit side and the discharging circuit side should be designed.
	Prevent leakage • The capacitor may be discharged below the lower limit voltage due to the consumption current of the protective circuit. Calculate the time required to discharge the capacitor to the lower limit voltage due to current consumption, and add the switch to prevent leakage current if necessary.
	Balanced circuit • There are many types of balancing circuits, but avoid connecting capacitors that constantly discharge capacitors, such as connecting simple resistors, as this may cause overdischarge. • If voltage is continuously applied to the capacitors through the charging circuit, there may

	be an imbalance at the end of the charging period due to individual differences in each capacitor. Therefore, the function of the balancing circuit should not be turned off when a voltage is applied across the capacitor. • When the voltage of the capacitor is unbalanced, the protection circuit of the overcharge protection voltage and the overdischarge protection voltage detects earlier than expected. For example, the difference between the two capacitors is 0.1V, the overcharge protection voltage is 3.8V/4.0V, and the overdischarge protection voltage is limited to 2.5V, so the allowable voltage range is 7.5V~5.0V. (7.5 V = 3.8 V + 3.7 V, 5.0 V = 2.5 V + 2.5 V. If the 2 capacitors in series have the same voltage, the allowable voltage range is 7.5 V to 5.0 V.) • When a large current is repeatedly charged and discharged, the balance circuit cannot work effectively, and a small charging current should be used to balance the voltage of the capacitor when it is close to full charge.
	**Charge and discharge circuit** • If there is no input voltage etc. in the charging circuit, the energy of the capacitor will be discharged to the charging circuit side, and the capacitor may fall below the lower limit voltage. Please consider the circuit. • If the capacitor's power is used for control or I/O signals, check to see if the capacitor is charging or discharging through an unintended path. For example, if the IR of the diode is large, the capacitor may charge and discharge unintentionally. As a result, the voltage of the capacitor may exceed the upper or lower limit voltage. • It is very dangerous to charge and discharge on the path that does not pass through the charge stop or discharge stop switch, because the protection function does not work, and the capacitor continues to charge and discharge.
	**Vent Clearance** Our recommendations for proper capacitor mounting and spacing are as follows. Cell Diameter / Clearance Requirement 6.3~10mm / 2mm or more 13~16mm / 3mm or more 18mm / 4mm or more

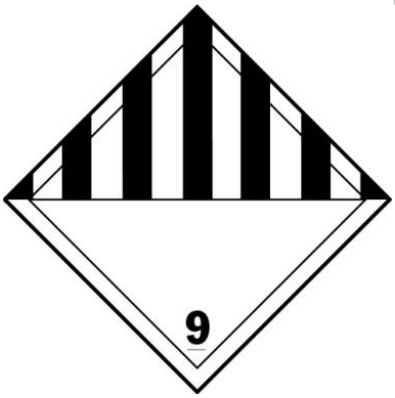
8.Capacitor leads bent or cut

	Do not bend or cut the leads without a tool holding the battery in place. Provide a fixed portion between the stress application point at the time of bending and the product body so that no stress is applied to the product body when bending or cutting the lead terminal.
	Do not bend or cut the bottom of the lead terminal. Please keep a certain distance from the main body of the product (the standard is more than twice the diameter of the wire), and then bend the wire. Due to the stress applied to the inside of the product, failures such as internal short circuits may occur.

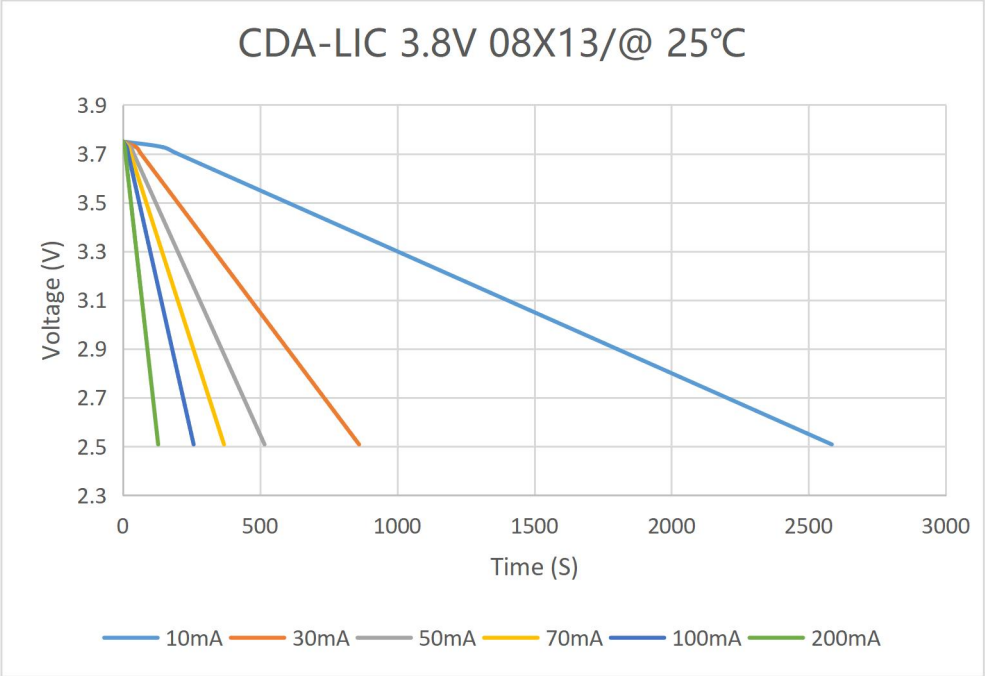
9.Maintenance and inspection

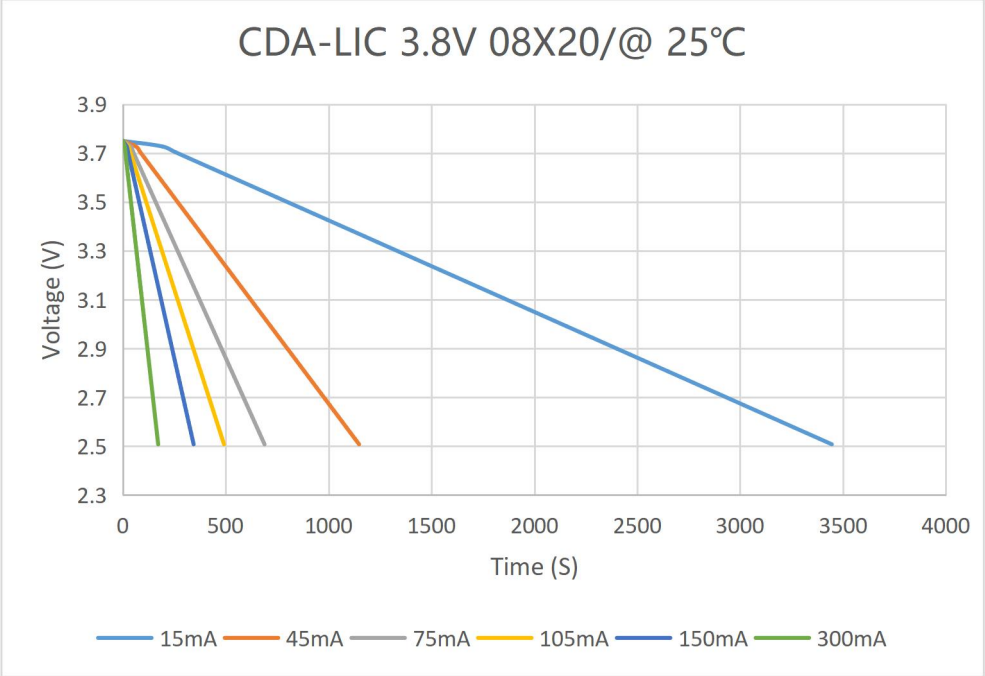
	Equipment using lithium-ion capacitors should periodically check the following items. 1) Appearance: Whether there are obvious abnormalities, such as deformation, expansion, electrolyte leakage, etc. 2) Electrical characteristics: Items specified in the catalog or delivery specification documents. • If any abnormality is found in the above inspection, please stop using the product and take appropriate measures or replace it.

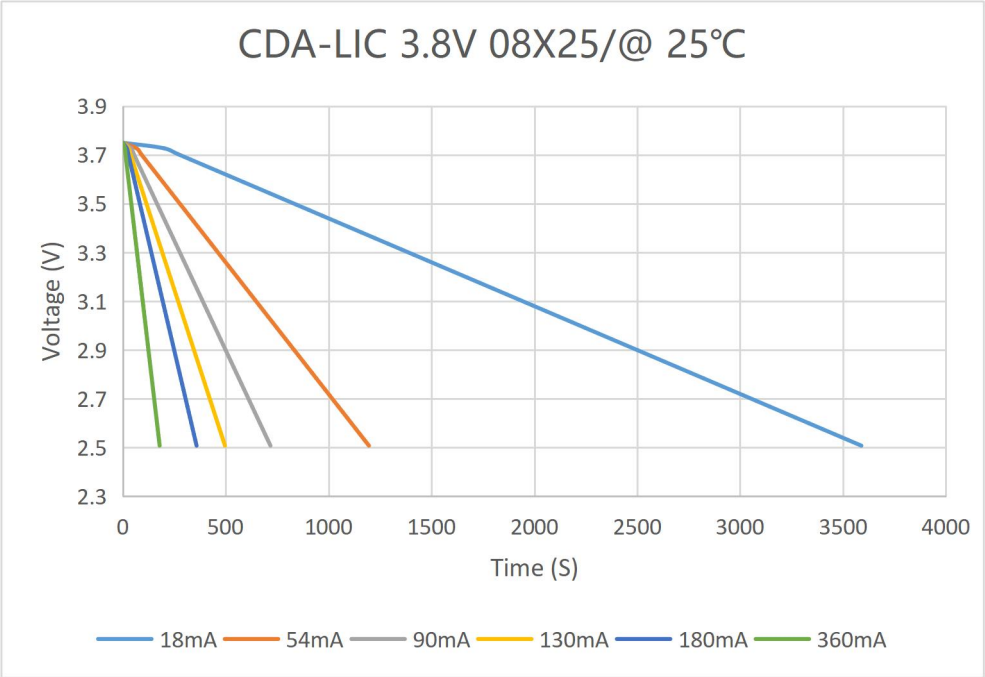
10.Transportation

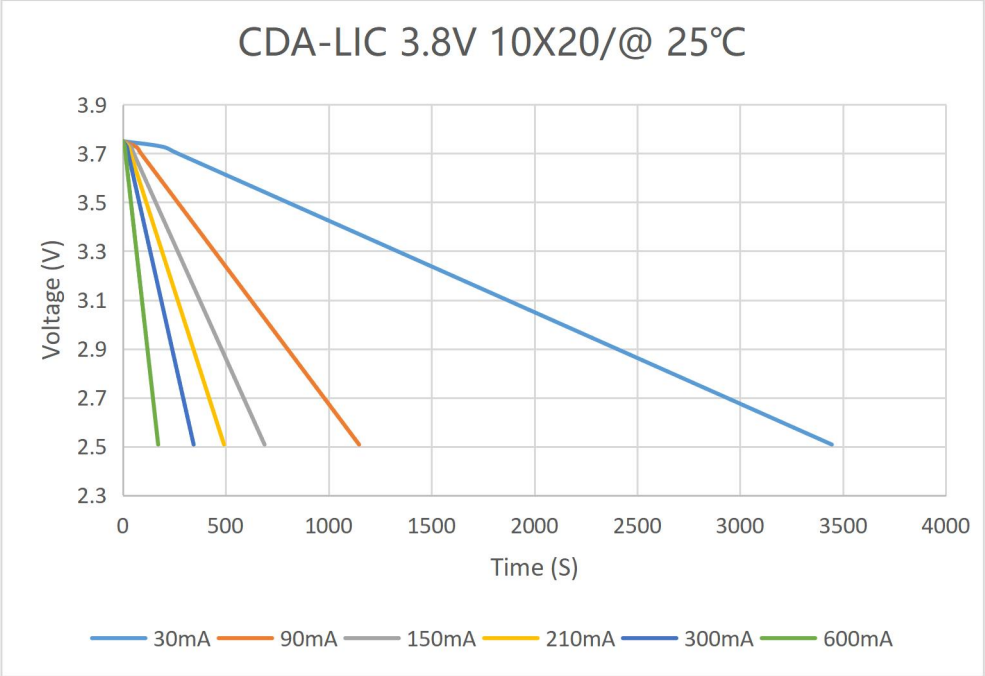
	When transporting the product, do not subject it to excessive vibration or shock.
	Prevent the package from falling during transportation or being stabbed by the elevator during cargo loading and unloading.
	Pack the product in a material strong enough to prevent stacking damage.
	Separate the terminals when packaging the product to prevent short circuits between them.
	Do not let the product get wet by rain, sea water, ice and snow, condensation or freezing during transportation.
	Before and after transportation, confirm that the capacitor voltage is within the specified range.
	【Air Transport Regulations】 Lithium-ion capacitors belong to UN Recommendation UN3508 (capacitors, asymmetrical (energy storage capacity greater than 0.3Wh), due to their energy content, LIC series (270F~750F, 0.31~0.85Wh) and LIB series are suitable. IATA: UN3508 Class9, A196 IMDG Code: UN3508 Class9 372* *A196 and 372 have the same content. Since LIC series (270F~750F, 0.31~0.85Wh) and LIB series meet the following requirements, they are not subject to any regulation except A196. 1) Energy storage capacity greater than 0.3Wh but less than 20Wh. 2) Special pallets and independent packaging, no risk of short circuit. 3) It has a safety vent to safely release the pressure accumulated during use. 4) Can withstand 95 kPa differential pressure test. 5) Without packaging, it will not be damaged even if dropped from a height of 1.2 m onto a flat surface. ●LIC series 10F～120F products, UN3508 less than 0.3Wh, not applicable. ●Be sure to check the latest shipping regulations for details.  **No.9** Symbol (seven vertical stripes in upper half): black;Background: white;Figure 9' underlined in bottom corner

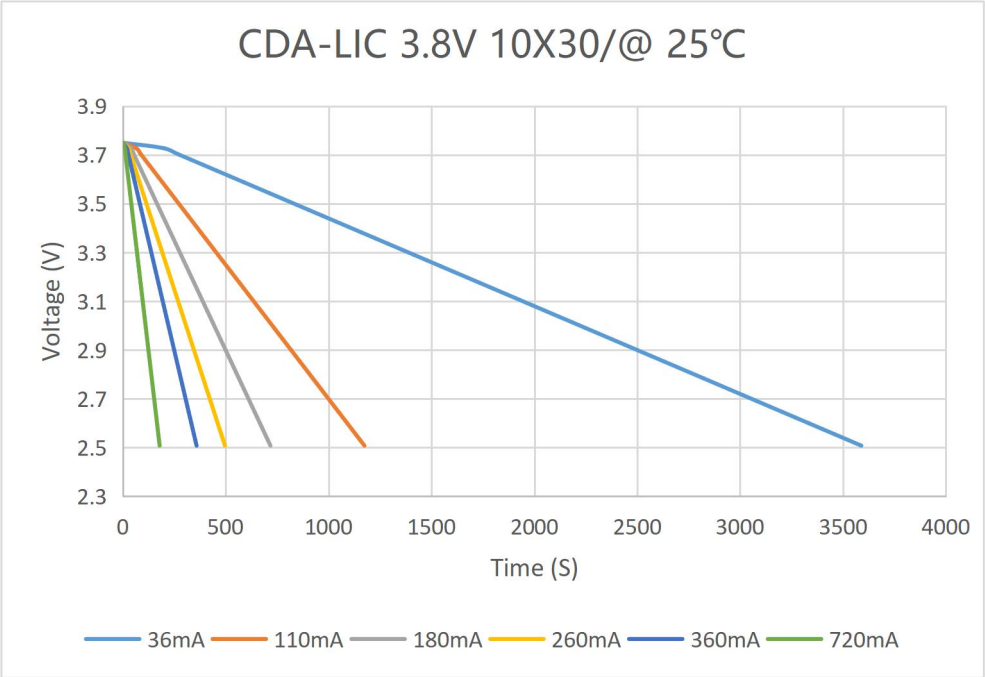
11.Discharge Curves

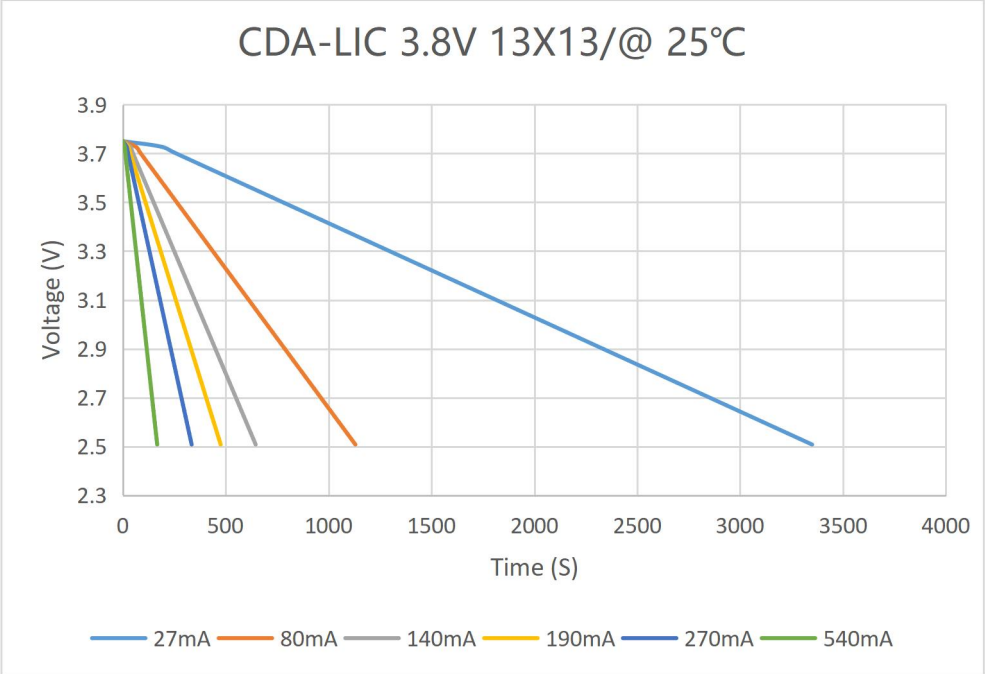


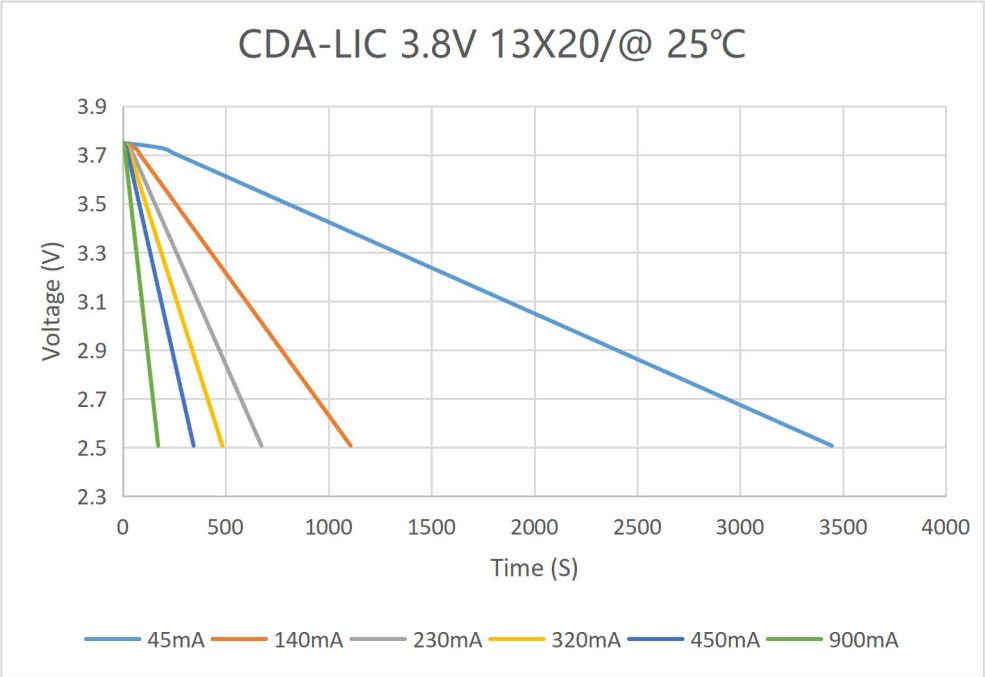


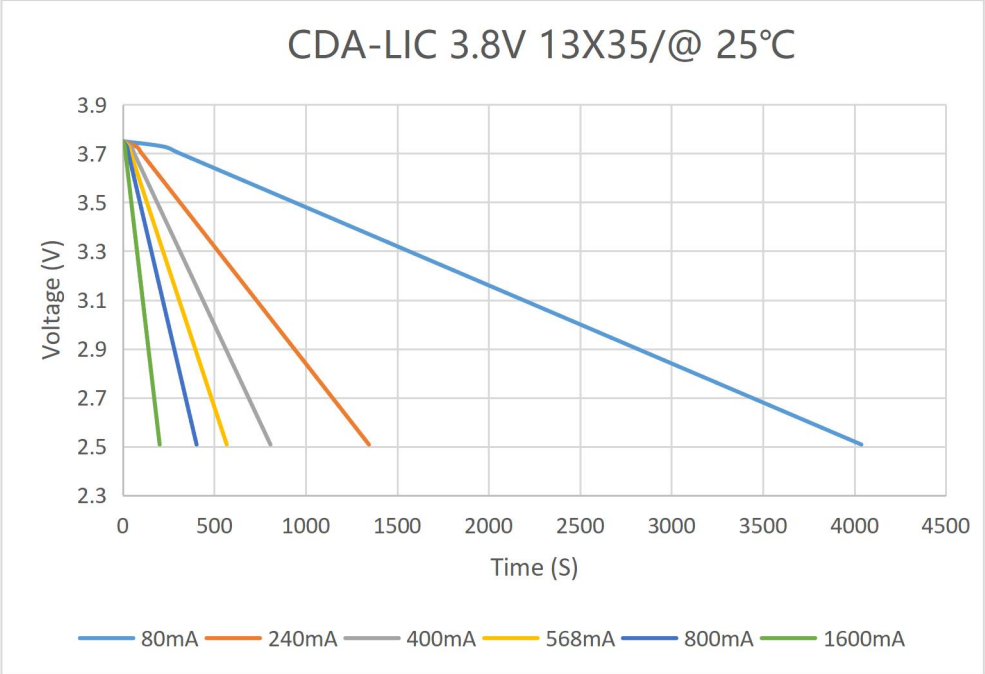


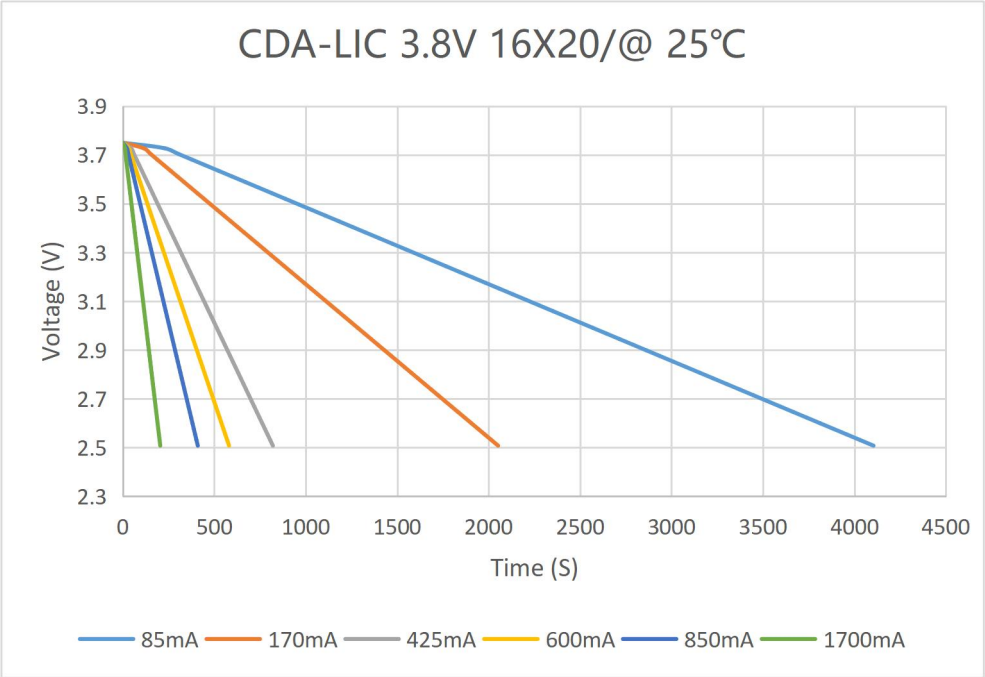


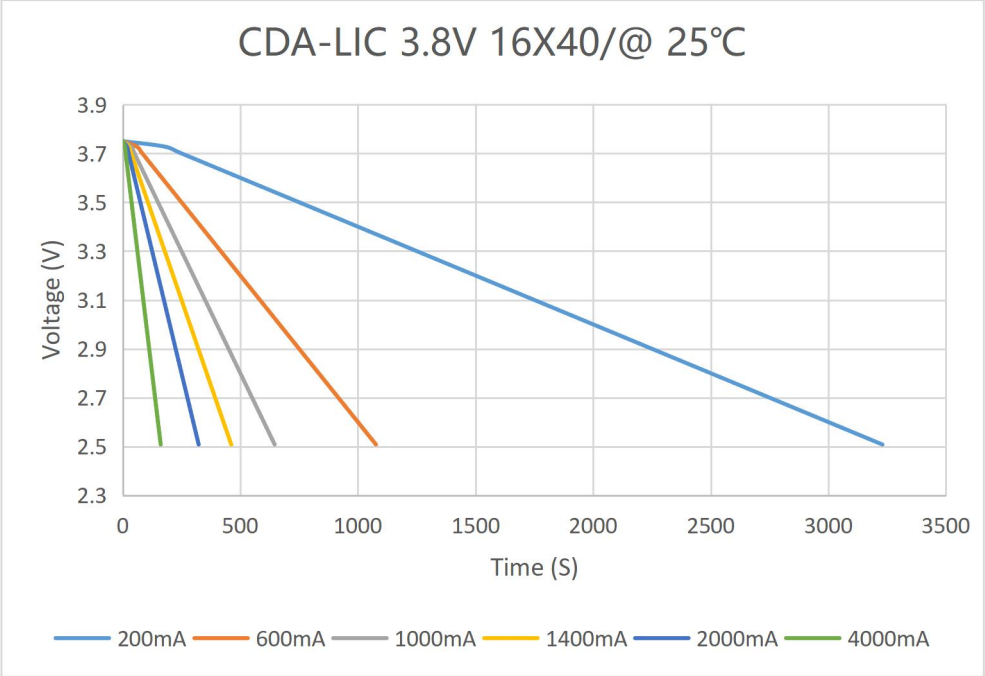


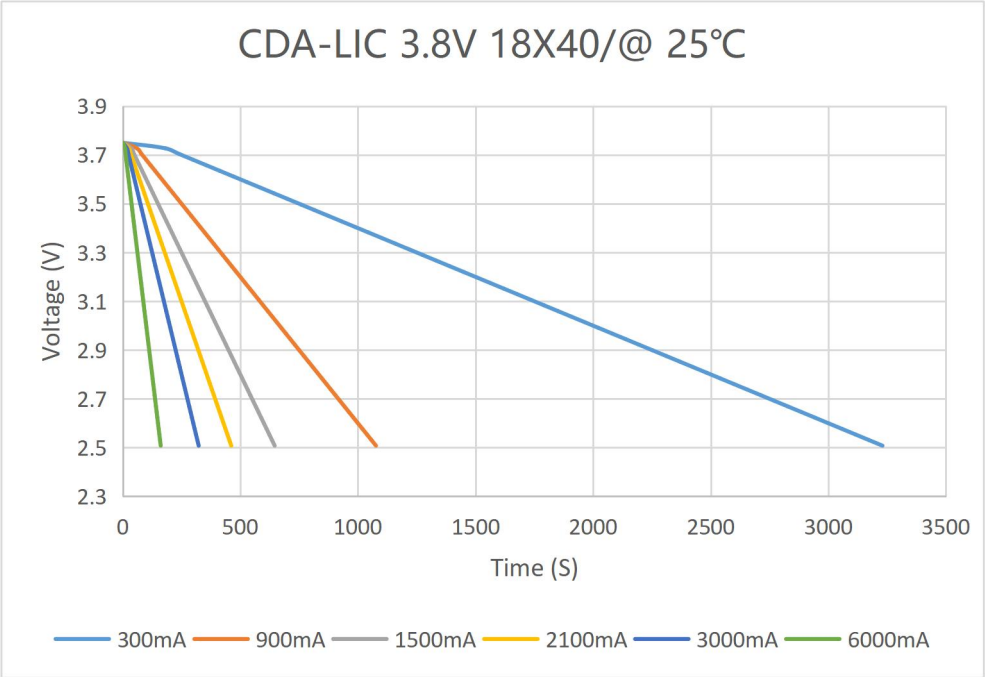


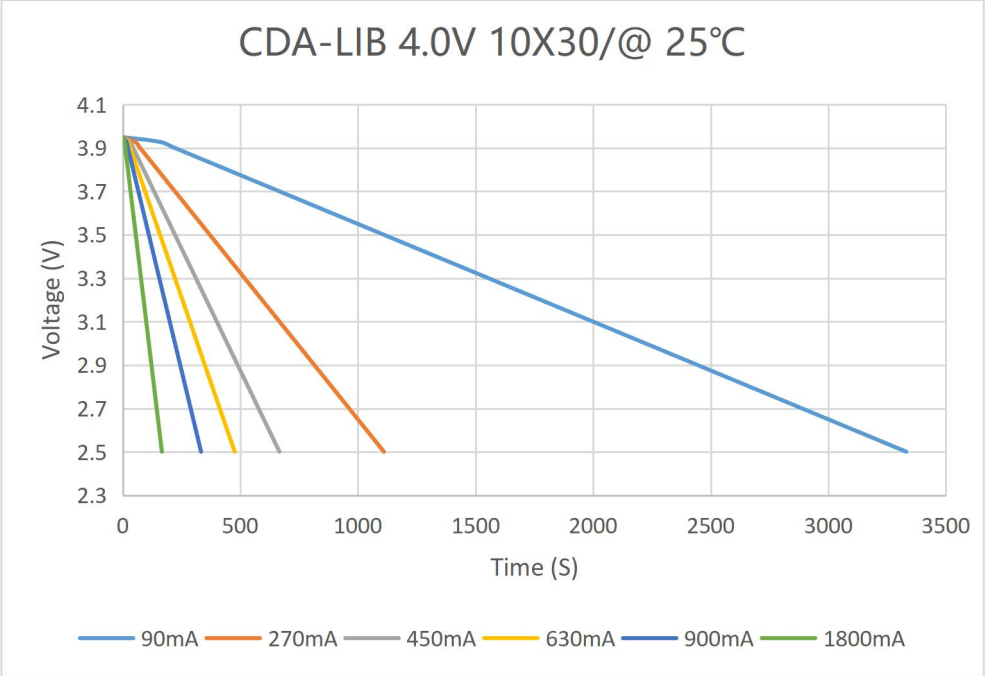


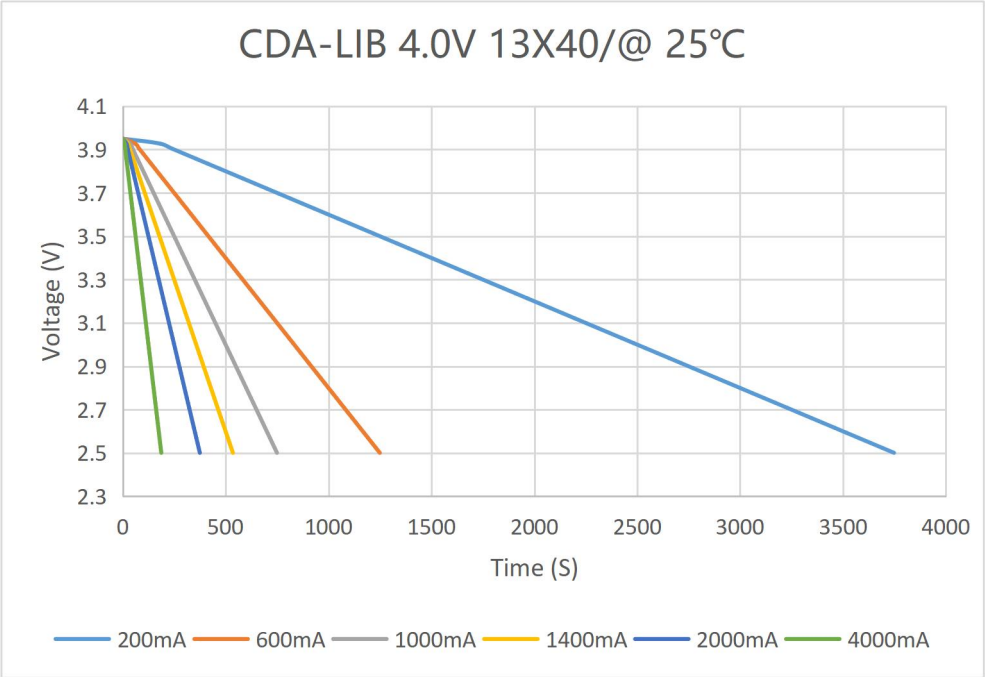


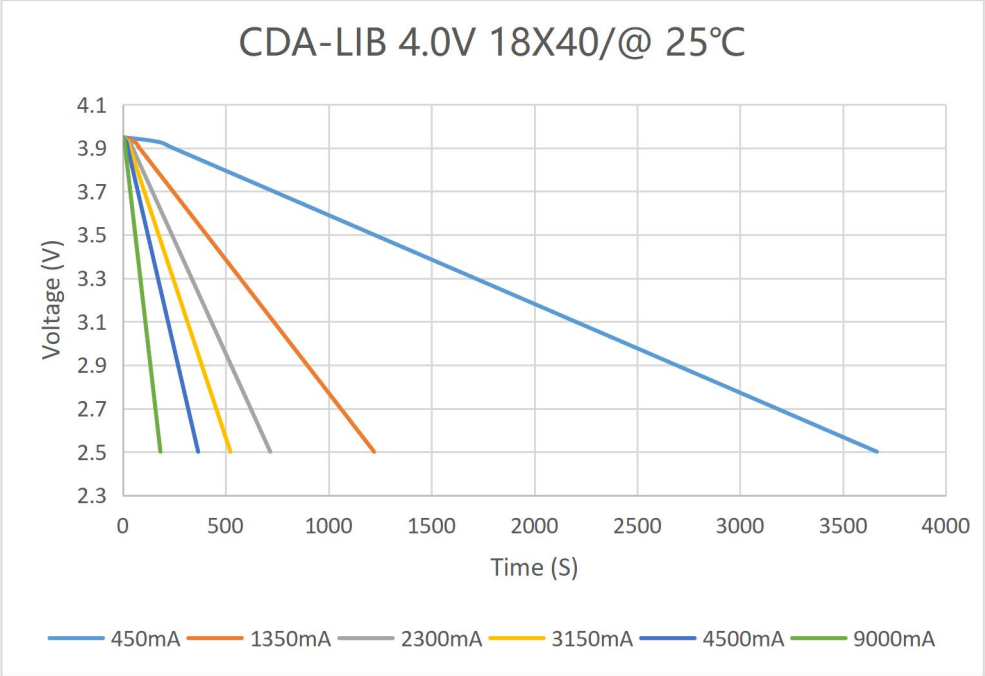






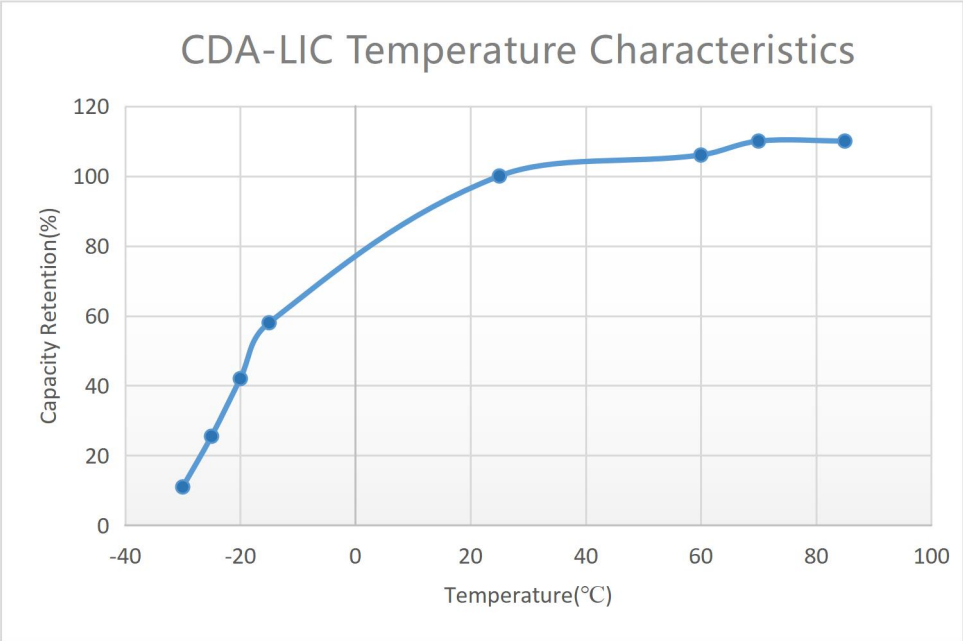


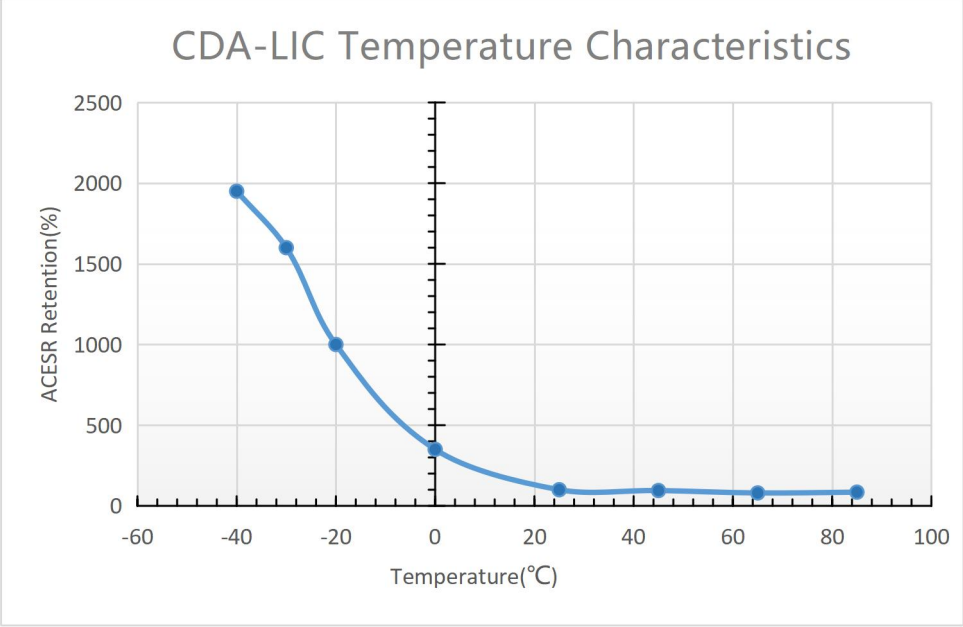




12.Temperature characteristic relationship

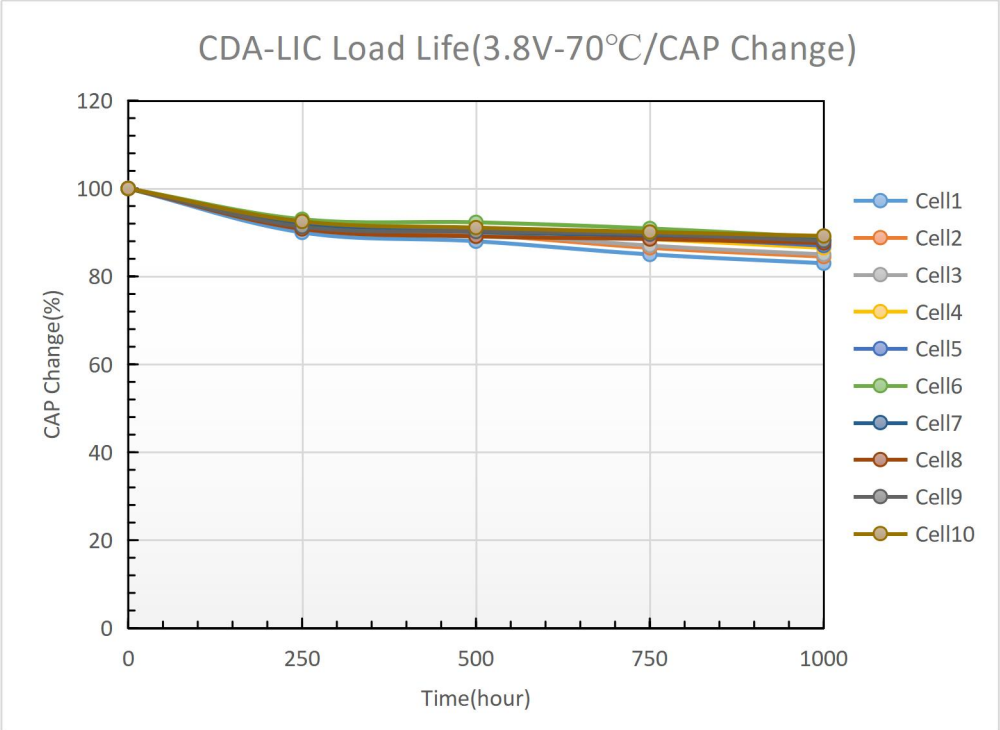
Representative average temperature characteristics of capacitance and ESR.

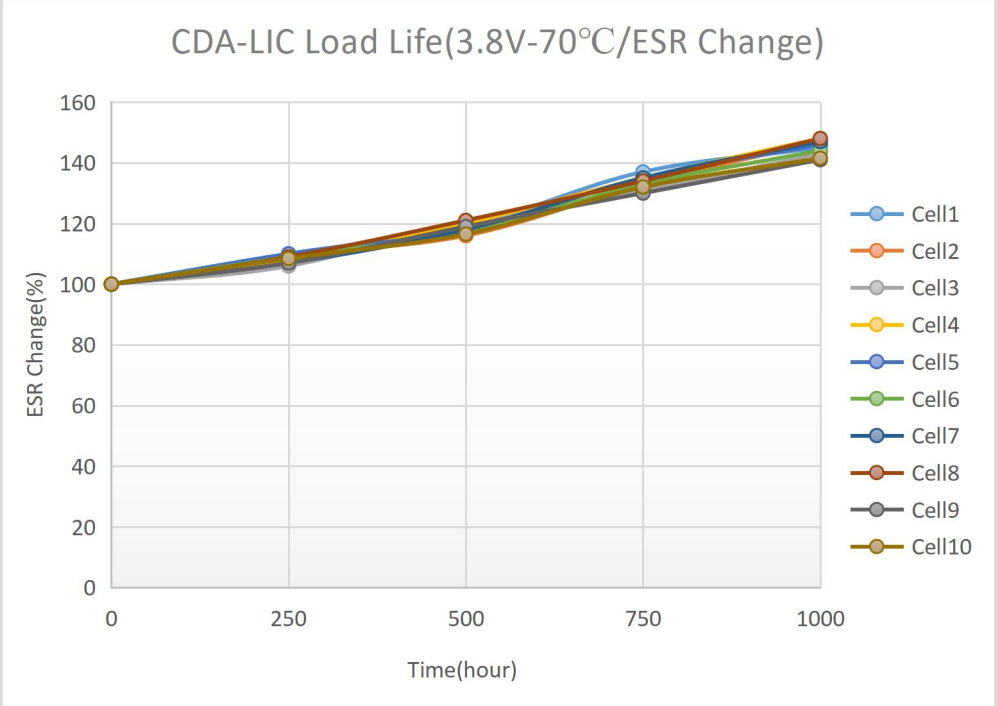




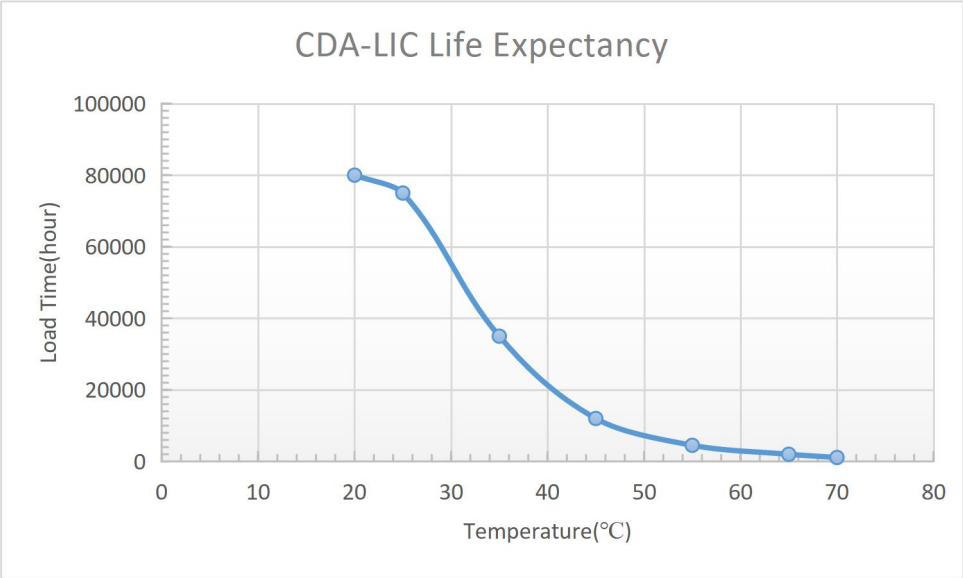
13.Life performance

13.1. 3.8V 70 ℃ 1000 hours after capacity and internal resistance change curve.

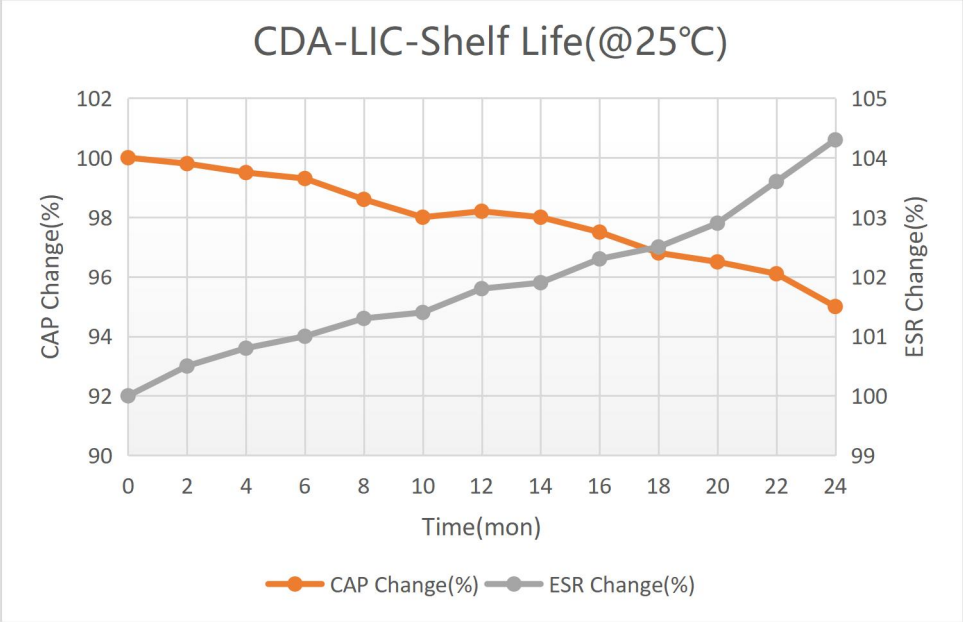




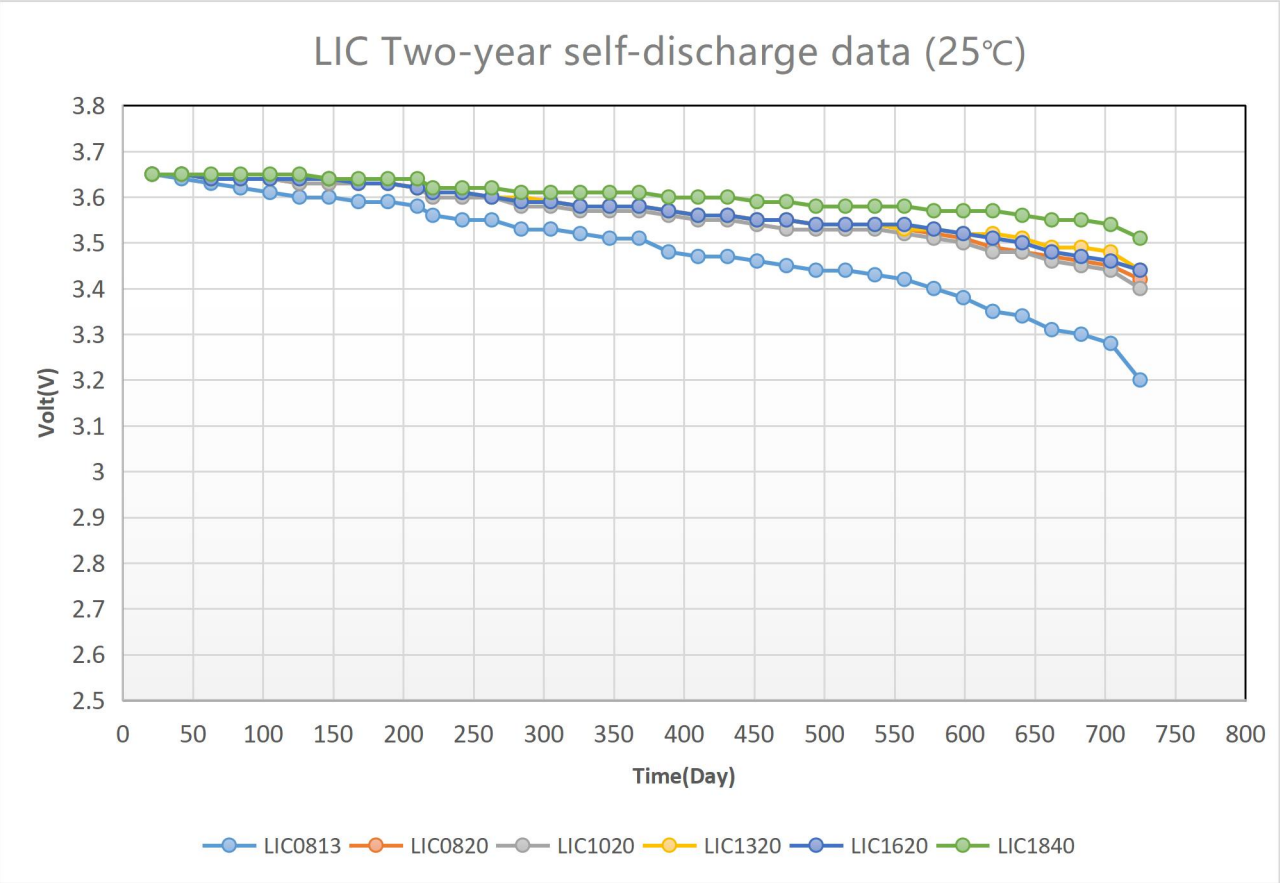
13.2. Lifetime estimation at different temperatures.



13.3. Shelf life at room temperature (@25 ℃)



14.Self-discharge characteristics



15.Soldering

⚠	Soldering: LIC&LIB series hybrid capacitors can only be soldered by hand. The soldering iron temperature should not exceed 350°C and the soldering time should not exceed 5 seconds.
🚫	Do not reflow solder: Exposure to infrared or convective reflow temperatures will degrade the electrical performance of the capacitor and may cause the cell to swell, leak, or rupture.
🚫	Do not wave solder: Wave soldering will short the pins and cause irreparable damage to the battery.
❗	Do not clean the board after adding the LIC capacitor: The board assembly should be completed and all related cleaning done before adding the live battery.The secondary process of soldering LIC capacitors should be performed with no-clean flux and no additional cleaning should be performed.