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USER MANUAL

Super Capacitors

(Cylinder & Module Series)

Do not apply external forces to the product or port, such as twisting, bending, pushing, or knocking.This can cause the product or port to fall off, causing a circuit breaker, short circuit, or liquid leak.
Do not overheat the capacitor when heating in the binder curing furnace. For details, see Precautions for Using Double layer capacitors.

1.The structure and principles of EDLC

Figure 1 illustrates a cross-sectional view of a Cylindrical type cell EDLC.
The internal electrodes of the Capacitors are made from activated carbon.Subsequently, an electrolyte is impregnated onto the electrodes. This separator exhibits high insulating properties for ions and can penetrate between the electrodes, preventing short circuits. The seal between the top cover and the bottom casing is achieved by adding filler material.
EDLC is formed at the electrolyte interface, creating an extremely thin ionic layer at the electrodes (as shown in Figure 2). Charging can be achieved by applying voltage (as depicted in Figure 3).

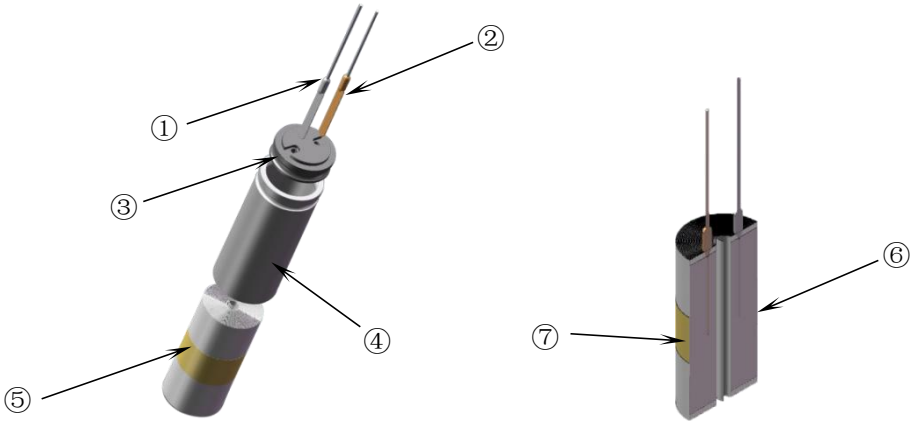


图 1

No.	①	②	③	④	⑤	⑥	⑦
Components	Lead （positive）	Lead （negative）	seal ring (PP)	Shell (stainless steel)	electrolytic paper	electrode	Tightening band

The EDLC acts as an insulator and does not allow the flow of current when an external DC voltage is applied.However, as the voltage increases and reaches the breakdown point, current will begin to flow. The magnitude of this voltage is referred to as the "breakdown voltage."Further increasing this voltage will result in the decomposition of the electrolyte and additional current flow. The voltage withstand capability of a double-layer capacitor is determined by the breakdown voltage. The composition of the breakdown voltage is determined by the electrolyte and electrode materials of the double-layer capacitor.
EDLC use activated carbon electrodes (solid) and organic electrolytes (liquid). The EDLC formed at the interface between the electrode and electrolyte is extremely thin, resembling a single molecule. Activated carbon used for electrodes has an exceptionally large surface area, which results in a very high capacitance.

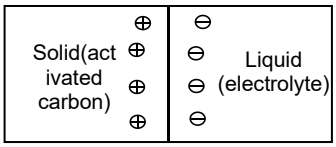


Figure 2

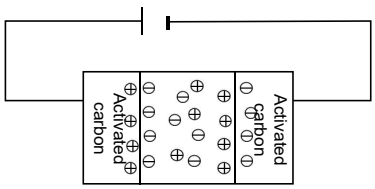


Figure 3

2.The polarity and operating voltage of EDLC

1.SEDLC have polarity, and it's important not to apply reverse voltage or alternating current voltage to them. Prolonged exposure to reverse voltage can not only shorten their lifespan but also potentially lead to leakage and other serious damage.
2.The rated voltage of a EDLC is the highest voltage it can safely handle during normal operation. Therefore, it's essential not to apply a voltage higher than the rated voltage to both ends of the EDLC. Operating at high voltage not only shortens its lifespan but also can lead to fatal failures such as increased gas generation, leakage, and rupture due to electrochemical reactions.

3. Circuits through which ripple currents pass

1.The internal resistance of EDLC is higher than that of electrolytic capacitors. EDLC may generate heat due to ripple currents.When using a capacitor in a circuit through which ripple currents pass, monitor the

4.The influence of ambient temperature on EDLC

1.Capacitor life is affected by usage temperatures. Capacitor life is approximately doubled when the temperature is decreased by 10℃. Therefore, lower the usage temperature as much as possible. Using capacitors beyond the guaranteed range may cause rapid deterioration of their characteristics and cause them to break down.
2.The usage temperature of EDLC should not only consider the ambient temperature around the device but also take into account the internal temperature, as well as the heat generated by internal components such as power transistors and resistors. It's important to account for the self-heating temperature caused by ripple currents. Additionally, avoid installing heat-generating components on the backside of the EDLC.

5.Life calculation

The life of the EDLC is affected by the operating voltage and operating temperature, which conforms to the following equation:

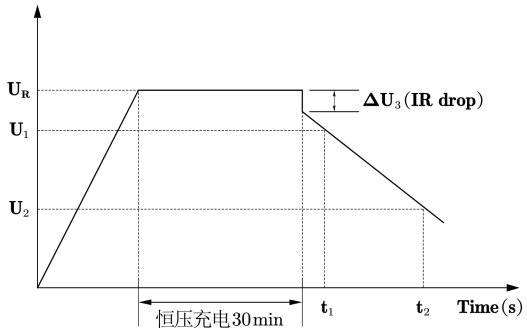
$$\mathbf{L = L_0 \times 3.25\frac{T_0 - T}{10} \times 1.52\frac{V_0 - V}{0.1}}$$

L : is the theoretical lifetime at T temperature;
L_0 : is the working life of the highest rated working temperature;
T : is the actual working temperature;
T_0 : is the highest rated working temperature;
V : is the actual working voltage;
V_0 : is the highest rated working voltage.

6.Capacity Computing

$$C = \frac{I \times (t_2 - t_1)}{U_1 - U_2}$$

C : Capacity(F)
I : discharge current
$\mathbf{t_1}$: The time from the start of discharge until the voltage reaches U1(s)
$\mathbf{t_2}$: Time from discharge to voltage U2 (s)
$\mathbf{U_1}$: Initial voltage(V)
$\mathbf{U_2}$: Termination voltage(V)



7.The voltage drop when used as a backup power supply

When the main power source is turned off, EDLC switch from power failure detection mode to backup power operation mode. During this transition, the instantaneous startup current and the internal resistance of the capacitors can cause a drop in open-circuit voltage. It's important to refer to the impedance and usage current values listed in the relevant product specifications provided by the manufacturer.

8.In series

To ensure the voltage balance when the EDLC is connected in series, the resistor and the EDLC can be considered in parallel to play the role of leakage voltage division.

9.Precautions for Welding

When soldering supercapacitor products onto a printed circuit board, it is crucial to avoid subjecting the supercapacitors to excessive heat stress. Overheating can not only degrade their electrical characteristics but can also lead to critical failures beyond just cosmetic damage, such as poor airtightness and increased internal pressure causing leakage or short circuits. Please adhere to the following guidelines:

1.Use a soldering iron to weld：

During the soldering process, please avoid direct contact between the soldering iron and the product body. Maintain the soldering iron temperature below 350° C and complete the soldering within 4 seconds. If performing continuous soldering operations, allow a 15-second interval for every 3 consecutive soldering operations.

2.Wave Soldering：

a.Do not touch the solder tank during Soldering；

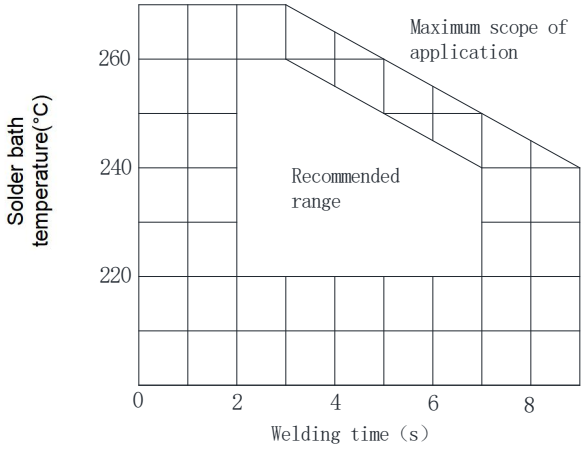
b.When Soldering, please control the temperature of the main body of the product within 100° C for 60 seconds, and the peak temperature within 105° C.The standard conditions are shown below.In addition, even within the specified temperature range, the product temperature may also rise more than expected due to the size of the circuit board and the relationship between the surrounding parts, so it is recommended to confirm the main temperature of the supercapacitor product during Soldering.

c.Other heat stress

When using a curing oven to bake the circuit board for resin fixation, please ensure that the product surface temperature remains below 100° C for no more than 60 seconds (with a maximum of 105° C). Additionally, during this process, keep the residual voltage of the product below 0.3 V.

d.Others

To enhance solderability, there may be a tin-plated layer on the leads and soldering pads. Therefore, abrasive actions like filing can potentially damage the tin-plated layer and reduce solderability. Applying excessive force to the leads or soldering pads may lead to breakage or misalignment, resulting in a degradation of characteristics.



Pre-heating temperature：110 °C or under（on the surface of circuit board）
100°C or under（on the surface of capacitor）
Pre-heating time：60 s or under
Board thickness：0.8 mm or more

10. Emergency procedures

If the capacitors generate heat, then smoke may come out of the exterior resin. Under these conditions turn off the equipment immediately and stop using it.
Do not place your face or hands close to the capacitor, burns may be caused.

11.Storage&Maintenance

Please avoid storing supercapacitors in high-temperature and high-humidity environments. It is recommended to store them in a well-packaged state in an environment at room temperature of 25 ± 10° C with a relative humidity below 80%. It's advisable not to exceed a storage period of 24 months. Avoid storing capacitors under the following conditions.

(1) Exposed to water, high temperatures or humidity, or when condensation can occurs.
(2) Exposed to oil or in environments filled with gaseous oil contents.
(3) Exposed to salt water or environments filled with saline substances.
(4) In environments filled with harmful gases (hydrogen disulfide, sulfurous acid, nitrous acid, chlorine, bromine, bromomethane, etc.)
(5) Exposed to direct sunlight, ozone, ultraviolet or radial rays.
(6) Exposed to vibrations or mechanical impact.

12.Precautions for Installation and Lead Bending

Please do not scratch or file the lead terminals or card-edge terminals. The terminals have been electroplated to ensure good solder wetting. Any physical or chemical alteration of the surface may affect the solderability of the lead and card-edge terminal devices.
Avoid mechanical impacts, such as dropping on the floor, and prevent damage to the casing and leads. Do not exceed the rated values for vibration and shock of the EDLC device.
(For pin-type only) Important! Do not deform (Figure 1), pull (Figure 2), or twist (Figure 3) the pins at the terminals. The pins or needles connect to the electrodes inside the aluminum casing and are sealed with rubber containing electrolyte.
Repeatedly or forcefully bending, pulling, or twisting the pins may damage this seal and result in electrolyte leakage. Electrolyte leakage can shorten the lifespan of the EDLC and may also lead to corrosion and/or short circuits of nearby PCB components. If pin deformation is unavoidable or necessary for the assembly process, you can bend the pins away from the bottom of the leads at the rubber section (as shown in Figure 4). The minimum recommended distance from the bottom of the pin is the radius of the device. In all lead operations, ensure that no pressure is applied to the bottom of the leads.

Figure 1

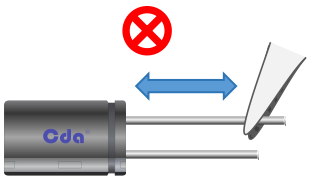


Figure 2

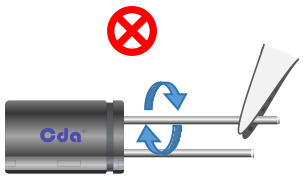


Figure 3

Figure 4

13.The "leakage" of Supercapacitors

The so-called "leakage" phenomenon is, in fact, an issue known as "alkali creeping." This oily substance primarily occurs at the negative lead or negative terminal of the supercapacitor. The oily substance exhibits strong alkalinity (with a pH value around 12). Through spectroscopic analysis, the main component of this oily substance is identified as tetraethylammonium hydroxide.
The root cause of this issue is as follows: When supercapacitors are held at their rated voltage in a long-term "float charge" state, the negative electrode of the double-layer capacitor absorbs ammonium ions over an extended period. These ammonium ions react with hydroxyl groups on the surface of the activated carbon and within the micropores, forming trace amounts of highly alkaline tetraethylammonium hydroxide. Additionally, alkaline solutions have a "creeping" property on metal surfaces. As a result, the formed alkaline solution "creeps" through aluminum pins or aluminum foil strips, causing slight corrosion of the rubber stopper or cap of the capacitor. This alkaline substance then "creeps out" of the capacitor, extending along the aluminum pins or terminals and ultimately corroding the circuit board.
This "alkali creeping" issue is a creep reaction, and it typically becomes evident in double-layer supercapacitors after 3-5 years.
Recommendation: To reduce the risk of circuit board corrosion, it is advisable to add insulating gaskets or silicone gel at the capacitor terminals. If you have any special processing requirements of this nature, please contact our company for assistance.

14. Precautions for capacitor installation

When mounting a capacitor on a printed circuit board, please confirm the following before designing.
① Align the hole spacing of the printed circuit board with the terminal spacing of the capacitor.
② During design, do not place wiring and circuit boards close to the pressure valve part of the capacitor.
③ Unless otherwise specified in the delivery specification, the following spacing should be maintained above the pressure valve part of the capacitor.

Cell Diameter	Clearance Requirement
6.3~10mm	2mm or more
13~16mm	3mm or more
18mm	4mm or more

④ When the pressure valve of the capacitor is installed on one side of the printed circuit board, please align the position of the pressure valve and open the exhaust hole when the pressure valve is working.
⑤ When installing, do not put the sealing part of the screw terminal type downward. When placing it horizontally, do not place the pressure valve and anode terminal downwards.

15.Cleaning

cleaning method
Object: All varieties, all specifications
Ethanol based cleaning agent
Isopropyl alcohol
water-based cleaning agent
Advanced ethanol
Pine Alpha ST-100S (Arakawa Chemical Industry)
NEWPOL B12 (Sanyo Chemical Industry)
Surfactants
Clean Through 750HS, 750HN, 750K, 750J (Kao)

Cleaning conditions: Use dipping, ultrasonic and other methods, and the total cleaning time should not exceed 5 minutes. (The cleaning fluid temperature is below 60° C.) After cleaning, please dry the capacitor and the installed printed circuit board with hot air for more than 10 minutes at the same time. In addition, when the washing liquid falls between the shell and the envelope, if the temperature of the hot air is too high, the envelope will soften and expand. Therefore, please make sure that the temperature of the hot air does not exceed the temperature at which the envelope softens (80° C).
In addition, if the drying is not sufficient after washing, it may cause secondary shrinkage of the jacket, expansion of the base plate and other poor appearance. Need to pay attention. Please do a good job in pollution management of the cleaning agent (conductivity, pH value, specific gravity, water content, etc.). After cleaning, do not store it in an environment with cleaning fluid or in a sealed container. Depending on the cleaning method, product labels may disappear or become blurred.

14.Discarding

Dispose of capacitors as industrial waste. They are comprised of various metals and resin.