

Notes on Using Ioxus Ultracapacitors

1. Environment:

The enclosed Ultracapacitor is packaged in a rubber-sealed aluminum case containing an organic electrolyte. For safe usage, we suggest that you avoid using or storing the product in any of the conditions listed below. If unavoidable, please contact Ioxus for advice before usage. Before using Ioxus ultracapacitors, please find and read the full MSDS for this product at:

<http://www.ioxus.com/documents/UltracapacitorMSDS9-15-2011.pdf>

- a. In direct contact with water, salt water, or oil
- b. Exposure to direct sunlight
- c. Subject to high temperature and / or humid environments with likelihood of water condensation
- d. In contact with chemically active gas
- e. Stored in acid or alkaline environments

2. Circuitry:

- a. Do not apply any voltage higher than the rated voltage. Overvoltage may damage the Ultracapacitor by causing abrupt increase of leakage current, decrease in capacitance, and increase of internal resistance.
- b. This product is polarized - do not apply reverse voltage. The negative lead is marked on all products, indicated by the black stripe or a " - " symbol
- c. A serially connected module with Ultracapacitors may exhibit voltage imbalances between individual cells. When a serial module in such a state is charged up, one or more of its cells may become subject to overvoltage. Overvoltage should be avoided because it causes faster deterioration of capacitance and internal resistance of the individual cell and may lead to a premature failure. Therefore, series-connected modules should observe the following guidelines:
 - i. The tolerance range of capacitance of Ultracapacitors is -10% to +20% of nominal capacitance. This means that the capacitance difference could be up to a maximum of 30% between capacitors. In a series-connected module, the disparity in capacitance among capacitors adversely affects the final voltage distribution when the module is fully charged. For example, consider an extreme case of a module where two capacitors differing in capacitance by 30% are connected in series. When this module is charged to 4.6V, the voltages of the capacitors shall become 2.0V and 2.6V, respectively, causing a voltage disparity of 0.6V. The more capacitors that are connected in series, the greater the voltage disparity becomes; and the resulting over-voltage condition for some of the capacitors may eventually cause their premature failure. Therefore, when designing a series-connected module, the recommendation is to calculate the acceptable tolerance level of capacitance disparity as a function of the total number of capacitors in the module and then select for the module only those caps falling within the range.
 - ii. For safety sake, Ioxus recommends the design rule whereby the rated voltage of each cell is assumed to be less than 2.15V or 2.5V when serially connected in a module cells rated at 2.3V or 2.7V, respectively.
 - iii. If capacitors prepared for a series connection show different initial voltage readings, then this voltage disparity will be maintained even after being connected and charged.

Check before installation, whether each capacitor is in the acceptable tolerance range calculated for your application. Also, you must be careful not to short terminals, which may cause a voltage disparity to worsen.

- iv. When cells are prepared for serial connection, and are measured, some may show levels up to 0.5V. In this case, connect a resistor rated at a few ohms to completely discharge the cell to 0.0V.
- v. After a series connection of cells, and before charging, check the voltage of each cell to see if voltage variations between caps is less than 0.1V
- d. Avoid repeated quick charges and discharges, which may cause cells to overheat and lead to a decrease in capacitance and increase in internal resistance, which will adversely affect the useful life of the cell or module.
- e. Cell life is closely correlated with ambient temperature. If temperature is lowered by 10°C, the life expectancy of the cell will be approximately doubled. Therefore, in order to ensure long life, the product should be used at a temperature lower than the rated maximum temperature.
- f. If cells are part of circuitry or in a system, avoid contacting both ends of the terminals with conductive material, as it may cause discharge of a very high current, exceeding several thousand amperes.

3. Mounting:

- a. Do not scratch or file the lead terminals. The terminals are plated with metal and the removal of the plated material will cause poor solderability.
- b. Do not overheat when soldering. Solder temperature lower than 260°C and time shorter than 5 seconds are recommended. For hand soldering, tip temperature should be no higher than 350°C (662°F) for a maximum contact time of 3 seconds. Only the snap-in terminals should come into contact with liquid solder or iron. Excessive heat on the snap-in terminal boards can cause damage to seals, shrink sleeve, and electrodes resulting in shortened life or premature part failure.
- c. **(Snap-In Type Only) IMPORTANT! DO NOT DEFORM, PULL or TWIST** the terminals. The terminals are attached to the electrodes in the interior of the aluminum casing and are tightly embedded in the rubber-plug sealing the casing. Repeated or forceful bending, pulling, or twisting of the terminal may create a path opening along the terminal in the rubber for electrolyte to leak out. The electrolyte leakage may not only shorten the useful life of the product, but it may also cause corrosion and/or short-circuit of neighboring circuitry. If deforming the terminal is unavoidable or essential to the assembly process, please use needle-nose pliers to bend the lead wire while holding the base of the same terminal using another needle-nose pliers so that the force applied to the wire is not transmitted to the rubber seal.
- d. **(Snap-In Type Only)** Ioxus recommends utilizing a PC board when connecting the cells to the circuit or electronic devices. In addition, avoid placing exothermic components near the Ultracapacitor or on the opposite side of the PC board.
- e. **(Snap-In Type Only)** Please maintain a minimum distance of 3 mm between the bottom surface (opposite terminals) of the cell and other components/housings in order to allow for unimpeded venting of gas through the safety vent.



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4. Cleaning:

- a. Never wash Ultracapacitors, as this may cause contamination, corrosion and/or a short-circuit.
- b. Contact Ioxus if cleaning is necessary after soldering. Certain solvents may cause damage.

5. Storage:

- a. Do not store in high temperature and/or high humidity environment. Store the product at temperatures between 5°C and 30°C, where relative humidity is less than 60%. Avoid abrupt temperature changes, which may cause condensation and deterioration of the product. Also, avoid exposing the product in direct sunlight for extended periods as it may cause deterioration and discoloration of the sleeve.
- b. During storage, do not cause a short-circuit by touching both terminals of the capacitor simultaneously with a conductive material.
- c. Do not store the product in an ambient atmosphere containing water droplets or toxic gases.
- d. Avoid exposure to acid or alkaline liquids, vapor and/or toxic gases.
- e. The ultracapacitor contains trace amounts of electrolyte. Contact with hands, bare skin, etc, may be harmful. **DO NOT DISASSEMBLE CELLS.**

6. Disposal:

- a. When disposing ultracapacitors, consign them to a specialized industrial waste processor for proper recycling. To recycle Ioxus ultracapacitors, please contact Battery Solutions. Their full contact information is listed below:

Battery Solutions Inc.
5900 Brighton Pines Ct.
Howell, MI 48843
Phone: 248-446-5632
www.batteryrecycling.com
Contact: Dave Nelson
E-mail: dave@batteryrecycling.com

If you have questions about Ioxus products, please contact us using the following methods

Ioxus, Inc.
18 Stadium Circle
Oneonta, NY 13820
Email: info@ioxus.com
Telephone: 607-433-9011
Fax: 607-433-9014