



**CAPACITOR
COMPETENCE**
since 1958

ENERGY CAPACITORS HANDLING PRECAUTIONS



ENGINEERED SOLUTIONS

JIANGHAI EUROPE
Electronic Components GmbH

WARNING JIANGHAI is not liable for any extent of possible injuries or damages to persons or things, of any kind, caused by the improper application of and/or operating conditions harmful to Energy-Capacitors. Misapplications which may cause failures include, but are not limited to: operating current or peak current or voltage outside the specified range, operating voltage above surge voltage specified, temperature exposure outside of the specified operating temperature range. Examples of harmful operating conditions comprise, but are not limited to: unusual storage or transport temperatures, excessive and/or rapid changes of ambient temperature or humidity, heavy mechanical shock or vibration, corrosive and abrasive particles in the ambient (cooling) air, conducting dust in the ambient (cooling) air, oil or water vapor or corrosive substances, explosive gas or dust, operation under extremely high or low ambient pressure conditions (below or above sea level), superimposed radio frequency voltages, radioactivity. In case of doubt about the impact of operating conditions on capacitor performance, please contact JIANGHAI.

PERSONAL SAFETY Electrical or mechanical misapplication of Energy-Capacitors may be hazardous. Personal injury or property damage may result from explosion of a capacitor or from the expulsion of electrolyte due to mechanical disruption or the release of a safety vent of a capacitor. In case of injury or skin or eye exposure to electrolyte, immediately seek professional medical advice. Before using Energy-Capacitors in any application, please read these Handling Precautions, familiarizing thoroughly with the information contained herein. Please check before using any of our Energy-Capacitors if these components fulfill the requirements of your application and that warnings and instructions for use are followed.

WARRANTY The information contained in this datasheet does neither form part of any quotation nor of a contract, it is believed to be accurate, reliable and up to date. Quality data are based on the statistical evaluations of a large quantity of parts and do not constitute a guarantee in a legal sense. However, agreement on these specifications does mean that the customer may claim for replacement of individual defective capacitors within the terms of delivery. We cannot assume any liability beyond the replacement of defective components. This applies in particular to any further consequences of component failure. Furthermore it must be taken into consideration that the figures stated for lifetime, failure rates and outlier percentages refer to the average production status and are therefore to be understood as mean values (statistical expectations) for a large number of delivery lots of identical capacitors. These figures are based on application experience and data obtained from preceding tests under normal conditions, or – for purpose of accelerated aging – more severe conditions. JIANGHAI reserves the right to change these specifications without prior notice. Any application information given is advisory and does not form part of any specification. The products are not primarily designed for use in life supporting applications, devices or systems where malfunction of these products can reasonably be expected to result in personal injury. JIANGHAI customers using or selling these products for use in such applications without prior written consent of JIANGHAI do so at their own risk and agree fully to indemnify JIANGHAI for any damage resulting from such improper use or sale. This version of the datasheet supersedes all previous versions.

HANDLING GUIDELINES

- (1) Energy-Capacitors must not be used in AC and filtering circuits.
- (2) The actual operating voltage must not exceed the max. specified operating voltage and it must not fall below the min. specified operating voltage.
- (3) Please check the polarity before using. If operated under reverse polarity conditions, the capacitors will not only suffer from a shortened life time, but they may even swell, and electrolyte leakage or other malfunctions may result.
- (4) Environment: The operating temperature has an influence on the life time of the capacitors, and the maximum specified operating temperature must never be exceeded.
- (5) Current drain during discharge needs to be controlled to avoid a voltage drop below the min. voltage of the capacitor. The permissible current drain I_k is usually specified in the datasheet.
- (6) Capacitors in series connection: when capacitors are connected in series connection it must be ensured that the operating voltage of any single capacitor does not exceed to the limit of the max. and min. operating voltages. Systems for balancing and monitoring as well

as modules are available on request. Please contact the JIANGHAI EUROPE Sales office for further Information.

- (7) Energy-Capacitors must not be short-circuited. Discharge below the minimum voltage will destroy the capacitor.

PRECAUTIONS

- (1) Prohibition of disassembly

Any attempt to disassemble the capacitor may result in short circuits to the capacitor, which may generate gas, and may cause electrolyte leakage, explosion or other problems.

- (2) Prohibition of dumping capacitors into fire to avoid potential risk of explosion.
- (3) Prohibition of immersing capacitors into water or seawater or any similar liquid.
- (4) Prohibition of using damaged capacitors: If any abnormal features of the capacitors are found (especially such as damages of the package, electrolyte leakage or others) the capacitor cannot be used anymore and must be stored away from open flames.
- (5) Prohibition of short-circuit or use outside the specified operating voltage range.
- (6) Prohibition of reverse voltage.

PRECAUTIONS FOR DEVICES USING ENERGY-CAPACITORS The operating conditions for modules, devices or application using Energy-Capacitors must follow the detailed operating condition of the individual cell.

OPERATING VOLTAGE (U_k) Energy-Capacitors are specified with a maximum operating voltage $U_{max} = U_R$ and a minimum operating voltage U_{min} . For a safe operation, these limits must be strictly adhered to.

SURGE VOLTAGE Maximum voltage, which may be applied to the capacitor for a short period of maximum 5 seconds within the complete lifetime.

EFFECT OF CURRENT FLOW Energy-Capacitor used with large currents will generate heat. Do not apply currents exceeding the maximum charge/discharge current. It may generate heat, deform, explode or lose electrolyte. Comply with the maximum specified charge/discharge currents in the datasheet.

OPERATING CURRENT (I_k) The rated charge/discharge current is the current which can be used to charge and discharge the capacitor repeatedly without any pause. The current generates a temperature increase of 15 degrees and must be considered with existing outside temperature. The maximum temperature must not be exceeded.

MAX. CONSTANT CURRENT (I_{max}) The maximum constant charge/discharge current is specified with a minimum pause between charging cycles of 15 seconds. The current generates a temperature increase of 40 degrees and must be considered with existing outside temperature. The maximum temperature must not be exceeded.

SURGE CURRENT (I_s) The surge current is the maximum charge/discharge current and it is limited (see datasheet). The maximum temperature must not be exceeded.

SELF-DISCHARGE CURRENT (I_{SD}) The self-discharge current is specified after 3 months at ambient temperature of 25°C, relative humidity between 25% to 85% and without further voltage applied with t in seconds.

$$I_{SD} = \frac{C \cdot (U_R - U_D)}{t}$$

SELF-DISCHARGE VOLTAGE The self-discharge voltage is specified at ambient temperature 25±2°C. The following procedure must be followed to determine the self-discharge voltage drop:

- (a) the capacitor is charged to rated voltage with constant current (operational current, see datasheet)
- (b) the capacitor is kept at the rated voltage for 30 minutes
- (c) open the circuit and store the capacitor for 72 hours at an ambient temperature of 25±2°C



(d) measure the self-discharge voltage between the capacitor terminals with a high ohmic voltmeter.

LEAKAGE CURRENT (I_{LEAK}) The leakage current is specified at ambient temperature $25\pm 2^{\circ}\text{C}$. The following procedure must be followed to determine the leakage current:

- the capacitor is charged to rated voltage with constant current (operational current, see datasheet)
- the capacitor is kept at the rated voltage for 72 hours, during which the leakage current declines to a steady-state value
- measure the leakage current between the capacitor terminals for the characteristic leakage current

POLARITY The terminals of the product have a (positive or negative) polarity mark. Please check the polarity before using. Never apply any reverse voltage.

LIFETIME There are many different lifetime definitions known without any true standard definition. Take special care when capacitors of different manufacturers or technologies are compared. In the case of lifetime tests, please consider the rated operating voltage and rated operating temperature. Do not exceed the rated operating current.

LOAD LIFE Period of time, during which the technical parameters of all capacitors stay within the given limits. JIANGHAI does not allow for outliers.

HIGH TEMPERATURE STORAGE TIME Period of time, during which the technical parameters of all capacitors stay within the given limits. JIANGHAI does not allow for outliers.

CYCLE LIFE Number of charge and discharge cycles at ambient temperature 25°C during which the technical parameters of all capacitors stay within the given current limits and voltage range. JIANGHAI defines this without allowing for outliers.

TEMPERATURE CHARACTERISTICS The parameters of the capacitor are dependent of the temperature. Please check the datasheet or ask for assistance to define the temperature dependencies.

AC INTERNAL RESISTANCE (ESR_{AC}) Please note that the capacitor must not be connected to alternating voltage during regular operation. The only exemption is the determination of the ESR_{AC} , by a test procedure devised to determine the ESR without charging the component. At ambient temperature $25\pm 2^{\circ}\text{C}$ the capacitor is discharged to U_{min} with constant current I_R before testing. A sinusoidal alternating current signal with an amplitude of maximum 5 mA and a frequency of 1kHz is applied, then the decreasing alternating voltage at the capacitor is detected. The AC internal resistance of the capacitor is calculated according to the following formula:

$$ESR_{AC} = \frac{V_{AC}}{I_{AC}}$$

DC INTERNAL RESISTANCE (ESR_{DC}) At ambient temperature $25\pm 2^{\circ}\text{C}$, the DC internal resistance of a capacitor is evaluated by following these steps:

- the capacitor is charged to the rated voltage U_R with constant current I_R
- the capacitor is kept at the rated voltage U_R for 30 minutes
- the capacitor is discharged to the minimum operating voltage U_{min} with a constant current I_R , measure the voltage U_i after 30ms discharge
- repeat the steps for three times from (a) to (c)
- calculate the DC internal resistance of capacitor (R_{DC}) within the third cycle according to the following formula:

$$ESR_{DC} = \frac{(U_R - U_i)}{I}$$

VIBRATION AND MECHANICAL STRESS Capacitors are sensitive to vibration and mechanical forces applied on the leads. Do not use capacitors, which have been dropped onto a rigid surface.

INSULATION If any defect of the sleeve is visible, the component should not be used – the same holds for any kind of visible damage. A capacitor should be electrically isolated from the following parts: aluminum case, cathode lead wire, anode lead wire and circuit pattern, and auxiliary terminal of snap-in type. The sleeve of the capacitor is not an insulator and therefore the standard capacitor should not be used in a place where insulation function is needed. Please contact JIANGHAI if a higher grade of insulation is required.

ELECTROLYTE AND SEPARATOR PAPER Electrolyte and separator paper used in Energy-Capacitors may be flammable. Also electrolyte is electrically conductive. Therefore in case electrolyte gets in contact with PC board it may cause corrosion of circuit pattern or cause short circuit between patterns, and may lead to smoke generation or ignition in worst case.

CAUTION DURING USE OF CAPACITORS Do not touch the terminals of capacitors. Keep the capacitor free from conductive solution, such as acids, alkali and so on. Ensure that the operating environment of the equipment into which the capacitor has been built is within the specified conditions mentioned in the catalogue or specification sheets.

SAFETY VENT (RADIAL AND SNAP-IN) The safety vent needs some free space to open properly. Allow free headroom of at least 2mm for diameter $\leq 16\text{mm}$, more than 3mm for diameter 18-35mm. Do not place any wires or PCB tracks above the valve.

SOLDERING Please only use manual soldering. Don't use reflow soldering or wave-soldering or infrared heating or air heating. Heat shock will decrease the electric performance of capacitors or cause malfunction.

- Soldering temperature for radial and snap-in types should not exceed 260°C and soldering time not exceed 5s.
- Soldering temperature for pouch bag types should not exceed 420°C and soldering time not exceed 10s.

Take measure at prevent Energy-Capacitors becoming short-circuited during the soldering process.

GLUEING, CLEANING AND COATING Do not use fixing agents or cleaning substances containing halogens. Do not use coating and moulding components that completely seal the capacitors from the environment. Also never use solvents containing: Halogenated hydrocarbons, alkali, petroleum, trichloroethylene/ethane, xylene, acetones, trichloro trifluoroethane, tetrachloroethylene, methylene chloride, chloroform, acetates, ketones, esters, chlorides and bromides.

MOUNTING Other devices, which are mounted near the capacitor, should not touch the capacitor. Heat transferred from other components to the capacitor may reduce the lifetime of the capacitor. Do never bend or twist the capacitor after soldering to avoid stress on the leads. Radial capacitors are not protected against mechanical forces on the leads. Forces on the pins might damage the capacitor. No printed circuit board tracks are allowed between the lead pads of the capacitor.

TRANSPORTATION

- Do not apply excessive vibration or shock when transporting the product.
- Prevent the packaging from being dropped during transportation or being stabbed by fork, lift forks etc. during freight handling.
- Package the product with individual terminals isolated to prevent short-circuits between them.
- Do not allow the product to get wet from, for example, rainwater, seawater, ice and snow, dew condensation, or freezing during transportation.
- Package the product in materials strong enough to prevent damage from stacking.



(6) Avoid fumigation and spraying insecticides (especially with bromides) in the import or export procedures which can cause corrosion. This applies also to the finished devices.

STORAGE CONDITIONS FOR LITHIUM-ION-CAPACITORS When storing the product for a long period of time, pack it in a way that stacking does not damage the product, taking care to preserve the isolation between individual terminals to prevent a short circuit between them.

- (1) temperature 0°C to 35°C and relative humidity below 65%
- (2) storage voltage 3,4V to 3,7V
- (3) storage time above 1 year should be avoided

STORAGE CONDITIONS OF ELECTROLYTIC-DOUBLE-LAYER-CAPACITORS When storing the product for a long period of time, pack it in a way that stacking does not damage the product, taking care to preserve the isolation between individual terminals to prevent a short circuit between them.

- (1) temperature 15°C to 35°C and relative humidity below 65%
- (2) uncharged state (Voltage:0-0,3V)
- (3) storage time above 4 year should be avoided

MAINTENANCE Periodical inspection should be carried out for the capacitor: visual inspection to check pressure relief open or leakage of electrolyte, electrical characteristic as self-discharge current and capacitance.

AIR TRANSPORTATION REGULATIONS Currently, Energy-Capacitors are not considered as dangerous goods in 2015IATA Regulations (status as of January 1st, 2019). However, as air transportation regulations may change, it is recommended that you should check the regulations each time you are transporting Lithium-Ion Capacitors and use an appropriate transportation method.

IN CASE OF EMERGENCY

- (1) If the capacitor becomes deformed or damaged, stop using it and replace it immediately.
- (2) If the cell starts leaking electrolyte or released gas and smoke, stop using it and replace it immediately. Keep away from open flames or sources of ignition. Leaked electrolyte might cause short circuits on the PCB.

EMERGENCY ACTIONS When the pressure relief vent is open and some gas blows out from the capacitor, please turn the main switch of the equipment off or pull out the plug from the power outlet immediately. During safety vent operation, extremely hot gas (>100°C) may blow out of the capacitors. Do not stand close to the capacitors. In case of eye contact, rinse the open eye(s) with clean water immediately. In case of ingestion, gargle with water immediately, do not swallow. In the case of innervation please exposed to fresh air. Do not touch electrolyte but wash skin with soap and water in case of skin contact. In the case of an accident with electrolyte, please consult a doctor.

DISPOSAL Following the rules of WEEE, Energy-Capacitors must be collected separately as electronic waste.

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