

Other Circuit Design Precautions

Designing Circuits Using Non-Solid and Solid Aluminum Electrolytic Capacitors

Explanatory Notes

1. As operating temperature changes, the electrical characteristics of a capacitor change.

At high temperatures: Increase in leakage current.

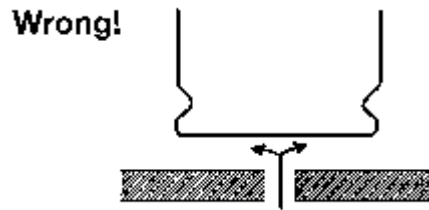
At low temperatures: Decrease in capacitance and increase in $\tan \delta$ and impedance.

As the frequency changes, the electrical characteristics of a capacitor change.

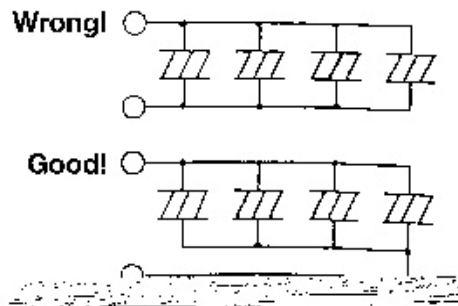
At high frequency: Decrease in capacitance, increase in $\tan \delta$ and decrease in equivalent series resistance.

At low frequency: Increase in equivalent series resistance and eventual heat generation due to ripple current.

2. If a double-sided printed circuit board has a through-hole (except the holes for the terminals) under the capacitor, during the soldering process the solder may rise through the hole, melt or crack the outer sleeve, expose the aluminum can and cause the circuit to fail. Note that this problem will occur most frequently with through-hole circuit boards.



3. Tightening the screw-insert terminals must be within the maximum torque specified in the product literature (non-solid). Too much torque will strip the threads. On the other hand, if the screws are not tightened enough, high contact resistance may overheat the terminals and damage the capacitor. If a thick copper plate like a bus bar is screwed on the terminals, use screws matching the thickness.
4. If capacitors are connected in parallel and one capacitor has a low resistance, improper wiring will cause the ripple current to be unevenly distributed to the individual capacitors, and excessive ripple current will flow into one or more of the capacitors causing capacitor damage.



Precaution

1. Electrical characteristics of capacitors vary with respect to temperature and frequency. Consider these variables when designing device circuits.
2. If using a double-sided printed circuit board, design the device circuits so that any through-hole is not located under the capacitor.
3. Do not over-tighten the screws of screw-insert terminals and mounting clamps. The maximum torques are specified in the product literature.
4. If using more than one capacitor connected in parallel, balance the current flow in individual capacitors.
5. If using more than one capacitor connected in series, connect resistors in parallel with the individual capacitors to balance the voltage.

Footnotes

Capacitors are not immune to failure such as short circuit or open circuit. Regardless of the cause of failure, if device safety is imperative, consider the following design alternatives:

- (1) Add protective circuits or protective devices to ensure the safety of the equipment.
- (2) Add redundancy circuits so that a single failure cannot cause the device to fail.