

## Device Circuits

### *Designing Circuits Using Non-Solid and Solid Aluminum Electrolytic Capacitors*

#### Explanatory Notes

1. The polarity of a capacitor can be identified as follows:
  - Radial lead capacitors with two long lead wires indicate the negative polarity with a stripe or arrow on the side of the capacitor body. Additionally, if the lead wires are of different lengths, the shorter lead wire is the negative side and the longer lead is the positive side.
  - Snap-in capacitors indicate the negative polarity with a stripe or arrow on the side of the capacitor body and a black mark on the rivet head of the negative terminal.
  - Large can capacitors have polarity markings near the terminals.
  - Surface mount capacitors indicate the negative polarity with a black mark on the top of the outer case next to the negative terminal.

#### Examples of Polarity Markings



2. If capacitors are used in AC circuits, the following phenomena will occur:
  - Alternating current will overheat and short-circuit capacitors.
  - For non-solid capacitors gas as well as heat will rapidly generate in a capacitor causing an abnormal internal pressure. This pressure will cause the safety vent, if any, to rupture or damage the rubber seal causing electrolyte leakage. In extreme cases a capacitor may explode or catch on fire.
  - As the capacitor is damaged or destroyed, flammable materials will be expelled such as the electrolyte and other internal materials.
3. If a reverse voltage is applied to capacitors, the sequentially large amount of current can cause capacitors to fail as follows:
  - The device circuits may be short-circuited early on. This results in short circuit failure of the capacitors.
  - For non-solid capacitors gas as well as heat will rapidly generate in a capacitor causing an abnormal internal pressure. This pressure will cause the safety vent, if any, to rupture or damage the rubber seal causing electrolyte leakage. In extreme cases a capacitor may explode or catch on fire.

- As the capacitor is damaged or destroyed, flammable materials will be expelled such as the electrolyte and other internal materials. See footnotes.
4. Charge and discharge cycles that are rapidly repeated by devices such as strobe or welding equipment apply reverse voltages and currents to the cathode electrode of a capacitor and may damage the capacitor as follows:
- With the charge and discharge currents flowing into the non-solid capacitor, gas as well as heat will rapidly generate in a capacitor causing an abnormal internal pressure. This pressure will cause the safety vent, if any, to rupture or damage the rubber seal causing electrolyte leakage. In extreme cases a capacitor may explode or catch on fire.
  - As the capacitor is damaged or destroyed, flammable materials will be expelled such as the electrolyte and other internal materials. See footnotes.

Precaution

1. An aluminum electrolytic capacitor is usually polarized. Do not apply a reverse voltage or AC voltage to the capacitor. For circuits where polarity is occasionally reversed or unknown, use a bi-polar capacitor. However, even bi-polar capacitors must not be used for AC applications.
2. Do not use standard capacitors in circuits with frequent charge and discharge cycles. Consult the applications engineering department for special capacitors recommended for this application.

Footnotes

1. Although capacitors may not fail as described in section 1.3 or 2, the reverse voltages at least make the capacitance decrease by producing an oxide layer on the cathode electrode foil.
2. Examples of circuit voltage wave forms:

AC Circuit Alternative Polarity Circuit DC Circuit

