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tech tips

How To Reform Electrolytic Capacitors

Many aluminum electrolytic capacitors become defective because they sit unused for extended periods of time. This Tech Tip will explain why this phenomenon occurs and how you can reform these electrolytics with your Z Meter.

What Is An Aluminum Electrolytic Capacitor?

Aluminum electrolytic capacitors are among the most common capacitors used today. These capacitors have become popular because they offer a large capacitance in a small package. This makes them ideal to use as filters in power supplies and couplers in low frequency circuits. However, aluminum electrolytic capacitors are also the least reliable capacitors on the market, because eventually every one of them will fail because of their construction, which is explained later.

An aluminum electrolytic capacitor consists of two aluminum foil plates separated by a porous strip of paper soaked with a conductive solution called the "electrolyte". This moist paper, however, is not the capacitor's dielectric. It serves as a spacer to prevent the two plates from mechanically shorting. The electrolyte conducts the charge from the negative plate, through the paper, and into direct contact with the dielectric.

The dielectric is a thin layer of aluminum oxide that is electrochemically formed on the positive foil plate. The key to an electrolytic is the fact that the capacitance increases linearly as the thickness of the dielectric decreases. Therefore, because of their extremely thin dielectric, electrolytics can have a large capacitance within a small package. Figure 1 shows an electrolytic's construction.

After the capacitor is formed, it is rolled up and placed in a cylindrical case. The case is then stamped with a manufacturing label. Most capacitors have the manufacturing date printed on the case along with the label. This date is printed in the form of a four digit number. The first two digits represent the year that the capacitor was produced, and the last two numbers signify the week of the year it was produced. For example a capacitor with a date code of 8318 stamped on its case was manufactured in 1983 during the 18th week. By checking this date you can determine exactly how long a capacitor has been sitting on a shelf.

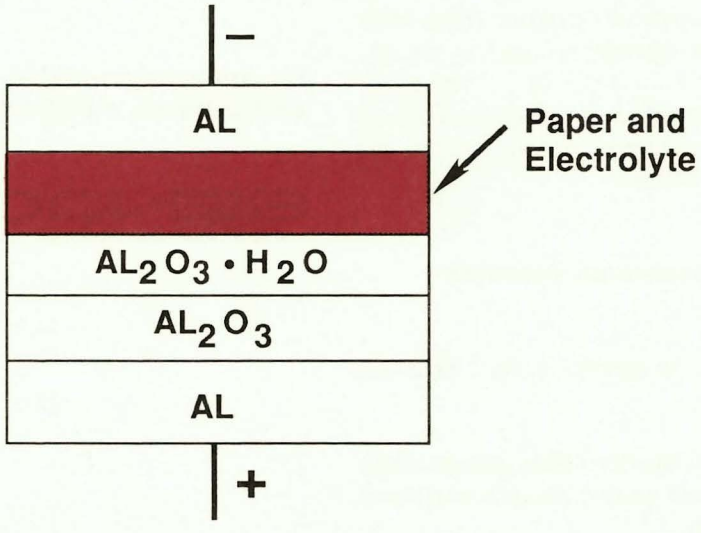

Fig. 1: As an aluminum electrolytic ages on the shelf, the aluminum-oxide dielectric material dissolves into the electrolyte causing leakage and dielectric absorption.

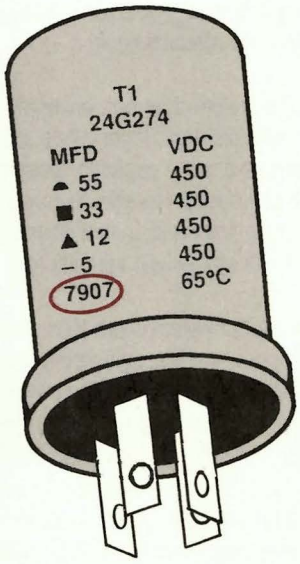

Fig. 2: The date code, found on most electrolytics, is a four-digit number indicating the year and the week the capacitor was made.

What Goes Wrong With Electrolytics?

Since the electrolyte inside the aluminum electrolytic capacitor is water-based, it will eventually dry out, causing capacitor malfunction. The

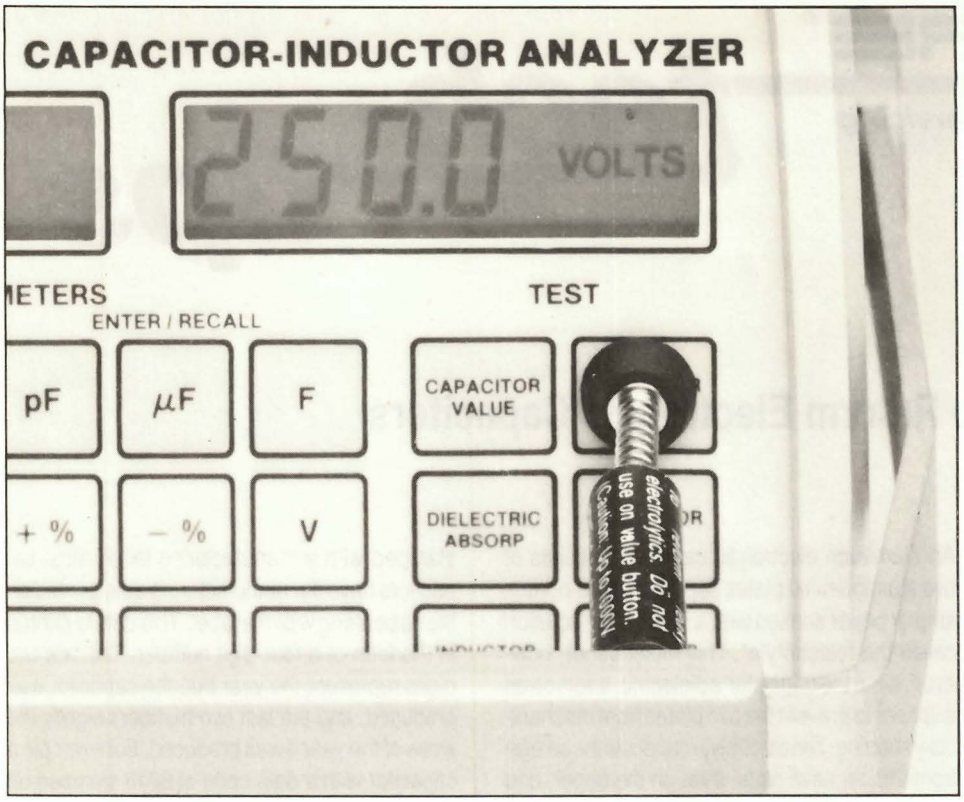

Fig. 3: Use the Z Meter's leakage voltage to reform electrolytics that have aged because of non-use.

capacitor is good, or at least reformable, as long as the electrolyte remains liquid.

When the electrolyte drys out, however, or the aluminum oxide dielectric layer deteriorates, the leakage goes up and the capacitor loses capacitance. This can happen to aluminum electrolytics just sitting on the shelf, in fact it's more likely to happen to an electrolytic that sits idle.

When an aluminum electrolytic starts this deterioration process, the first symptoms to look for with your Z Meter are larger amounts of dielectric absorption and leakage, although ESR may be present, too. These symptoms do not occur, however, at a linear rate over time. Once the capacitor starts to show these symptoms, the capacitor only has a short life left unless it is reformed quickly.

Reforming Aluminum Electrolytics

In many cases, the capacitor's electrolyte solution has not dried up. Instead, the dielectric oxide coating has deteriorated with time, causing problems in the capacitor. The oxide can be reformed by applying a voltage to the capacitor's plates. By using your Z Meter's leakage power supply test voltage on the capacitor, the electrolyte experiences a chemical reaction that helps restore the dielectric oxide to its original state.

Use the supplied TEST BUTTON HOLD DOWN ROD and your Z Meter to apply the rated leakage voltage to the capacitor for extended periods of time. The hold-down rod fits between the CAPACITOR LEAKAGE test button and the carrying handle to hold the LEAKAGE button in. Once the leakage current of the capacitor stays below the maximum allowable leakage limit, you may use the capacitor in-circuit. If the reforming process does not reduce the leakage current to an acceptable level, the electrolytic is defective and should be discarded.

To reform an aluminum electrolytic capacitor:

1. Connect the capacitor to the Z Meter test leads.

2. Choose or enter the Z Meter leakage voltage (the capacitor's working voltage or next lowest voltage step).

3. Depress the CAPACITOR LEAKAGE button, and while holding it in, place the 39G145, 39G154, or 39G201 TEST BUTTON HOLD DOWN ROD between the button and the handle.

4. Adjust the length of the rod by holding one end and turning the other until the hold down rod keeps the CAPACITOR LEAKAGE button depressed. (The 39G145 is preset for you.)

5. Apply the Z Meter's leakage voltage to the capacitor until the leakage reading is below the maximum acceptable leakage level for the value and voltage rating of the capacitor you are testing. Note: Some electrolytics may take only five minutes to reform while some may take an hour or more.

6. After the capacitor leakage has dropped below its maximum rated value, allow it to set for 30 minutes. Then recheck the value and leakage to see if reforming has improved the capacitor. If the capacitor checks bad once again, consider the capacitor bad and discard it. If it checks good, put it in circuit for normal use.

If the capacitor leakage does not drop to an acceptable level after several hours of reforming, remove the Z Meter and throw the capacitor away.

WARNING

Never use the TEST BUTTON HOLD DOWN ROD to hold in any button except the CAPACITOR LEAKAGE button. Damage to the Z Meter may result if it is used to latch another button since the protection circuits inside the Z Meter are bypassed when a test button is depressed.

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