Foil Capacitor Polarity

Which terminal of a foil capacitor acts as the screen?

By H. Friedli

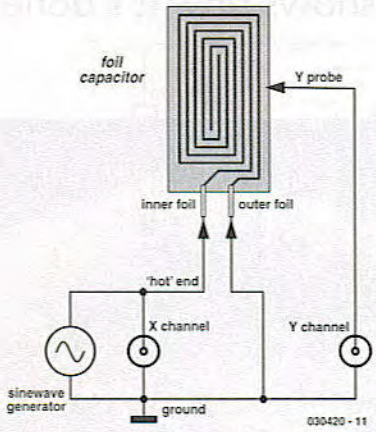

Figure 1. Method of connecting a foil capacitor to a sinewave generator and an oscilloscope.

As most of you will be able to confirm, an electrolytic capacitor has to be connected the right way around in an electronic circuit. If you get the connections wrong, the innards of the capacitor will greet you when the power is switched on — the capacitor can will rupture, spilling its liquid or partly vaporised contents across the circuit board or (in the case of older high-voltage electrolytics) spouting it high up into the air. The rupture is not a silent process either as most of you will have learned the hard way. Depending on the size of the capacitor, a small explosion may occur. By contrast, fixed capacitors are non-polarized components and therefore not prone to explode unless they are operated way beyond their specifications in respect of voltage or surge current.

The is however one type of fixed capacitor that may still be qualified as 'polarised'. We're talking about foil capacitors, which can pick up noise when connected the wrong way around. This may affect the operation of sensitive electronic circuits like preamplifiers, the negative effects consisting of hard to explain levels of hum or cross-talk, or a tendency to oscillate. Take, for example, the wire of the coupling capacitor connected to the (very high-impedance) input grid of a valve. This particular wire must be connected to the inner foil of the coupling capacitor, the outer foil being connected to the anode of the driving valve, which represents a much lower impedance.

With many types of capacitor, the outer foil is marked by, for example, a dash, a dot or some other indication. Unfortunately this is not common practice among manufacturers and even the print on the capacitor may not always provide a definitive clue to how the foils are arranged inside the device.

Trick of the trade

A simple tricks is available that allows you to relate the capacitor wires to the rolled up foils inside. A sinewave voltage is applied to the capacitor as well as to the X (horizontal) input of a dual-trace oscilloscope. The test signal should have a frequency of about 1 kHz and a level of a couple of volts peak to peak. The probe connected to the Y channel is held close to the capacitor's plastic encapsulation. On the 'scope display you watch the amplitude changes in a very sensitive input range. With the 'scope set to X-Y mode, a more or less opened, widened or possibly sloping ellipse should be seen. If the ellipse widens in the Y direction when the probe is moved closer to the capacitor body, the outer foil is connected to the 'hot' (signal) end of the generator output. If it becomes narrower, the same foil is connected the ground. To verify the outcome, swap the capacitor connections and repeat the test.

If you are unable to see a clear shape change to the ellipse, either the signal voltage or the test frequency is too low, the Y channel is not sensitive enough or the effect of your hands is too large. By fitting the tip of the Y probe with a small disc results in a larger capacitance between the outer foil and the Y-channel input. This may help to improve the reliability of the test described above.

Once you've unequivocally identified the connections that go with a capacitor's inner and outer foil, that does not mean the outcome can be applied to other, identical capacitors! The author found inconsistencies even among capacitors from a batch produced by one of and the same (reputable) manufacturer. In practice, each foil capacitor has to be tested individually if you want to be absolutely sure where its wires are best connected to in your circuit.

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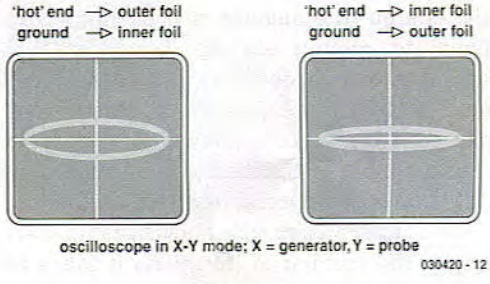

Figure 2. Left: wrong polarisation; right: correct polarisation.