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tech tips

Why The Z Meter STOP TESTING Alarm Provides Safe Capacitor Analyzing

We all have experienced, at one time or another, the effects of a capacitor holding a charge; whether you are monitoring a test point in a circuit, or removing a capacitor from the circuit. This effect is typical of capacitors, and is due to the charge/discharge time of the capacitor. Under certain conditions, a charged capacitor could blow the Z Meters' protection fuse or cause circuit problems.

The Z Meters now incorporate a STOP TESTING alarm to indicate when the protection circuits fail or the test lead fuse blows.

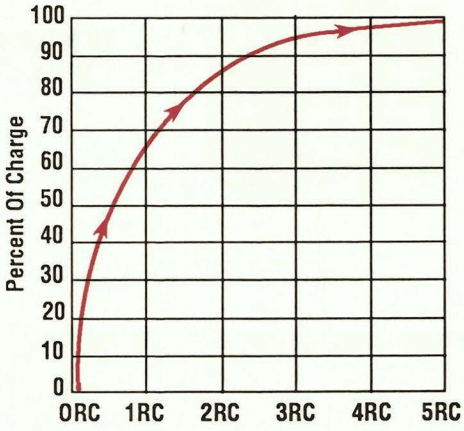

Fig. 1: RC charge time constant.

In this Tech Tip we will review the principles of charging and discharging capacitors, and demonstrate the importance of knowing that the capacitor is fully discharged. Then, we will follow with an explanation of how the Z Meter alarm indicates a shock potential, and the steps that should be taken when the alarm has activated.

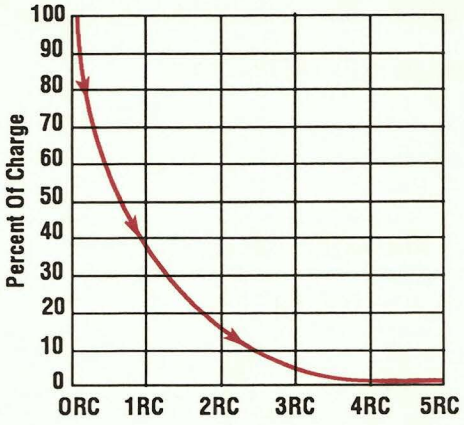

Fig. 2: Discharge time for a capacitor.

Understand Why Capacitors Remain Charged

Inside the capacitor's dielectric material, there are tiny electric dipoles. When a voltage is applied to the plates of the capacitor, the dipoles are stressed and forced to line up in rows creating stored energy in the dielectric. The dielectric has undergone a physical change similar to that of soft iron—when it is exposed to current it becomes a magnet.

If we were able to remove the dielectric of a charged capacitor and then measure the voltage on the plates of the capacitor, we would find no voltage. Reinserting the dielectric and then measuring the plates, we would find the voltage that the capacitor had been charged to before we had removed the dielectric. The charge of the capacitor is actually stored in the dielectric material. When the capacitor is discharged, the electric dipoles become re-oriented in a random fashion, discharging their stored energy.

When a capacitor is connected to a voltage source, it does not become fully charged instantaneously, but takes a definite amount of time. The time required for the capacitor to charge is determined by the size or capacity of the capaci-

Figure 3: Capacitor banks are used to obtain a high CV rating.

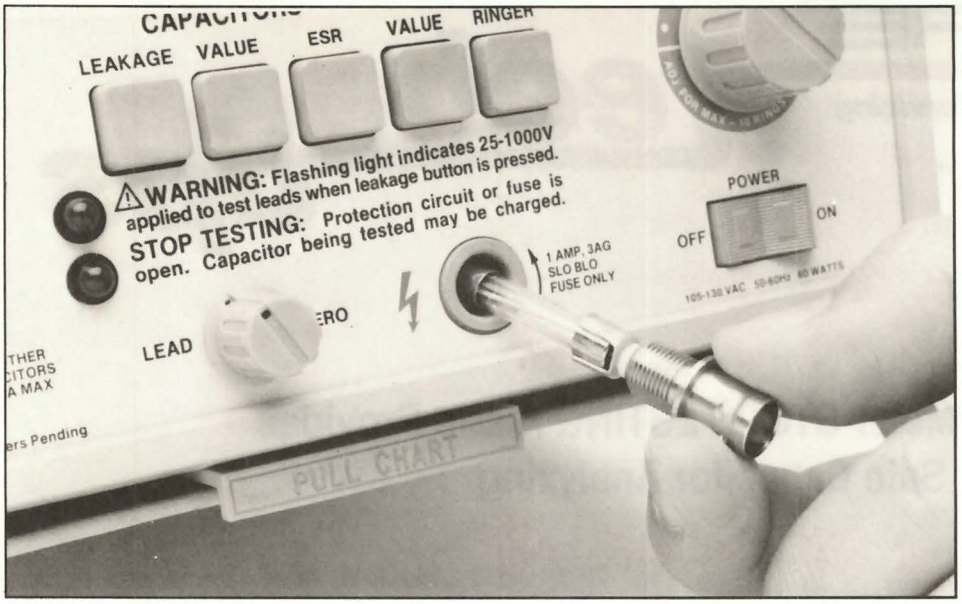

Fig. 4: Remove the test lead input fuse to activate the STOP TESTING alarm.

***NOTE**: You should, at this time, familiarize yourself with this feature by removing the test lead fuse (Figure 4).*

When the STOP TESTING indicators activate:

1. Stop all testing with the Z Meter.

2. Carefully discharge the capacitor you are testing by connecting a 10K ohm 1 watt resistor across the terminals (Figure 5).

3. Replace the test lead fuse if blown, or remove the voltage from the point the test leads are connected to.

4. Resume testing.

tor, and the resistor in series with the capacitor or its own internal series resistance. This is called the RC time constant (Figure 1). Capacity in Farads multiplied by resistance in Ohms equals the RC time constant in seconds. The curve of the charge of the capacitor is the RC charge curve.

The RC discharge curve (Figure 2) is dependent on the resistance of the discharge path to ground. In-circuit, this resistance varies with the design. When the capacitor is used as memory backup, for example, the discharge resistance is quite high, allowing the capacitor to discharge very slowly.

These ideas play an important role when considering capacitors with high CV rating. A capacitor with a high value (C) and high voltage (V) rating will take longer to discharge than capacitors with a low CV rating.

You may also run into capacitor banks that are used to give a high CV rating when a single capacitor is not available (Figure 3). These capacitors can store fairly large amounts of energy, presenting shock potential problems for the servicer.

The Z Meters provide a 25 ohm discharge path, which is switched across the capacitor terminals whenever the test buttons are not being pressed. This resistance discharges the capacitor very quickly. However, you may still notice some capacitor with the higher CV rating taking a couple of seconds to full discharge.

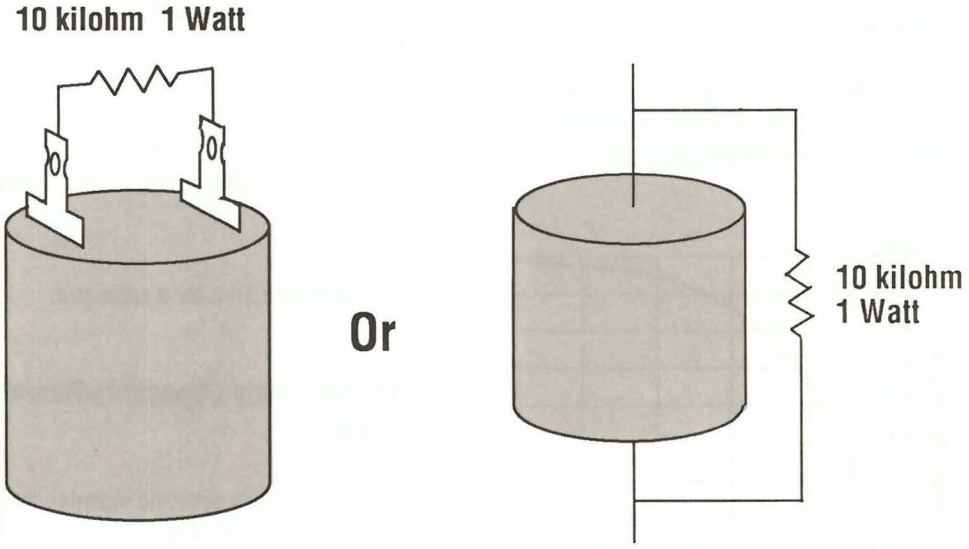

Fig. 5: Connect a 10 k ohm 1 watt resistor across the capacitor terminal for discharging.

Z Meter STOP TESTING ALARM

The Z Meters are designed to provide you with the safest possible method of testing capacitors, yet still perform dynamic leakage tests with up to 1000 VDC applied. The STOP TESTING indicators of the Z Meters are a flashing LED indicator on the front panel and an internal audible alarm. This important feature alerts you when a shock potential exists due to either the test lead fuse having blown, preventing the capacitor from discharging, or that you have connected to a charged circuit.

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