SCR Measurement, Diode Measurement



## Tech Tip

# SCR and Diode Resistance Measurements with a Volt-Ohmmeter

### Introduction

Many users of SCRs and diodes lack the proper equipment to make semiconductor parameter measurements. The conventional battery operated volt-ohmmeter (VOM) is sometimes used to distinguish acceptable from unacceptable devices based upon a resistance reading. A measurement of this type can lead to erroneous conclusions. The valid versus erroneous measurements are the subject of this Application Information.

### VOM Measurements

The semiconductor measurements which are generally made with a VOM involve the blocking voltage rather than the "on-state" characteristics. These DC resistance measurements are made across the anode-cathode of a SCR or diode and across the gate-cathode of a SCR since its characteristic is similar to the anode-cathode of a diode. The present Powerex diodes and SCRs have blocking voltage ratings from 100V to 4400V. The only valid SCR or diode resistance indications on a VOM are "open" and "short". The anode-cathode or gate-cathode measurement must show a short (0 resistance) in both directions (forward and reverse polarity) for a device to be considered "shorted" and infinite resistance for an "open". A diode normally shows low resistance in the forward direction and high resistance when the VOM probes are reversed. Hence, the VOM can be a check on diode polarity. The SCR normally has a high resistance across the anode-cathode in both directions. For a SCR to be open, the gate-cathode must also show open. An open failure on Powerex high power semiconductor is a rare event. Because of compression bonded encapsulation construction, the semiconductor elements are almost always under pressure, and even if damaged, the electrodes generally cannot separate.

A measured resistance value with a VOM is an erroneous semiconductor device measurement technique for segregating devices. When a resistance measurement on a semiconductor is taken with a volt- ohmmeter, the internal battery voltage, typically 1.5 or 3.0 volts, and the device's corresponding leakage current at the VOM voltage level determine the magnitude of resistance. The semiconductor also has a non-linear blocking voltage/leakage current characteristic which implies a non-linear resistance curve. Semiconductor devices are tested at the factory at rated voltage to meet the rated leakage current at the rated junction temperature. Thus, devices may have a range of resistance as shown in Figure 1 and still be within the manufacturer's rating.

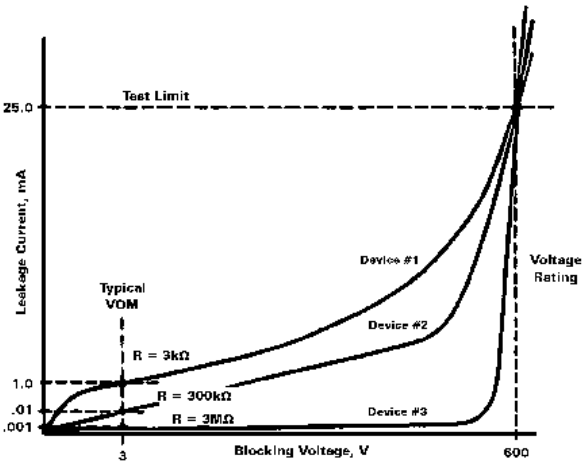


**Figure 1. Representative Semiconductor Leakage Current vs. Blocking Voltage**

**Precautions**
Determine if the resistance measurement is being taken across the device and not something else in the circuit. Open an anode, cathode, or gate connection if in doubt.

If a disc device is being measured, make sure it is under sufficient force (approximately 200 lb.) to get a reading. Otherwise, a device can appear to have high resistance in both directions because contact is not being made internally.

**Summary**
A volt-ohmmeter resistance measurement technique is not recommended for determining acceptable semiconductor devices. There are circuits available for “on-state”, blocking voltage, and other parameter measurements in the Westinghouse SCR Designers Handbook, Second Edition. As a quick check for devices in a circuit, a VOM will allow you to determine if a device has failed catastrophically.

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Information taken from Powerex Rectifier and Thyristor Applications and Technical Data Book, 10/93

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