

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.

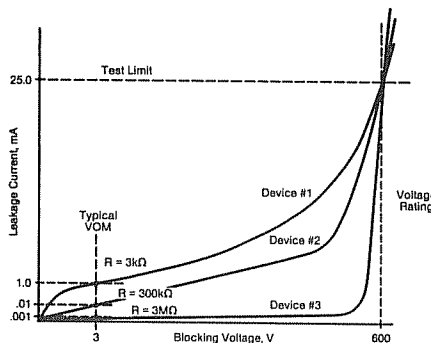


Figure 1. Representative Semiconductor Leakage Current vs. Blocking Voltage

Precautions

1. 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.
2. 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.

If there are any questions or problems related to semiconductor measurement techniques, contact your nearest Powerex Semiconductor Sales Representative for assistance.

Reference

Balenovich, J.D., "SCR and Diode Resistance Measurements with a Volt Ohmmeter," Westinghouse Tech Tip 5-5, Youngwood, PA: Westinghouse Electric Corp., Semiconductor Division, 1975.