International
IOR Rectifier
DESIGN TIPS

DT 93-1

INTERNATIONAL RECTIFIER APPLICATIONS • 233 KANSAS ST. • EL SEGUNDO, CA 90245 • TEL: (310) 322-3331 • FAX: (310) 322-3332

TESTING HIGH-POWER SCRs AND DIODES

by Donald A. Dapkus II
Application Engineer

This Design Tip is intended to help field service and repair personnel test high power SCRs and diodes using simple, portable test set-ups. International Rectifier's SCRs and diodes are rated for very high power levels. Testing the characteristics of these devices presents some problems unless the proper equipment is available.

Test Equipment

One of the best methods of testing these devices is to use a curve tracer to simultaneously display the current and voltage. Using a curve tracer, it is possible to determine if a power device is damaged or not by measuring breakdown voltages, leakage currents, forward voltages, etc. However, curve tracers such as the Tektronix 576 are expensive pieces of equipment whose use is nearly limited to power devices. Thus, many companies can not devote the resources necessary to obtain this piece of sophisticated equipment.

We are now presented with a dilemma - how to test these devices without the use of a curve tracer. Is it possible to use an ohmmeter or megger? For extremely limited testing, yes, for dwelving deeper into the device's operation, no. Basically, if the device is so totally damaged that it is completely shorted, then this test will work. However, if the device is not completely shorted, the results obtained may be misleading due to the small test currents and/or voltages. This may lead to confusion or a faulty conclusion as good devices may measure resistances that vary by three or four times, or even appear as an open circuit. Often times, a good device is discarded because of these faulty testing methods. Bad devices may block up to approximately 100V, and then break down before their rated voltage.

As an alternative to using an ohmmeter or megger, simple test circuits can be constructed that allow limited testing of power devices for proper operation. This Design Tip presents three sample circuits for testing these devices. These test circuits go from extremely simple to slightly more complex.

Testing

When testing SCRs, there are two parameters that are crucial to the device's operation: I_{GT} - the DC gate current required to trigger the SCR, and I_H - the holding current necessary to keep the SCR conducting once it has been successfully fired. At room temperature for most of International Rectifier's SCRs, I_{GT} is less than 150 mA, and I_H is less than 500 mA. (If in doubt, please check the SCR's data sheet to ensure that the test circuit is providing the necessary drive and load currents.)

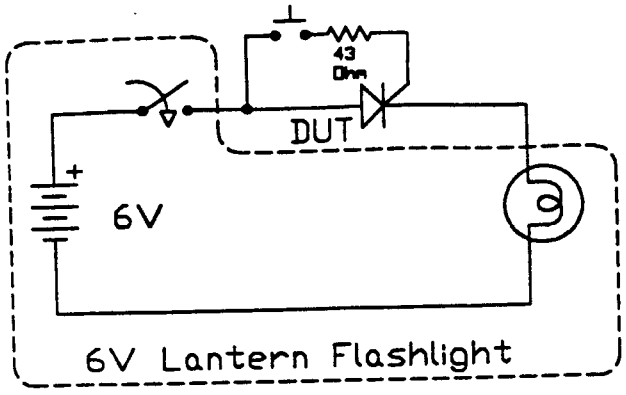

Figure 1 - SCR I_{GT} & I_H Tester

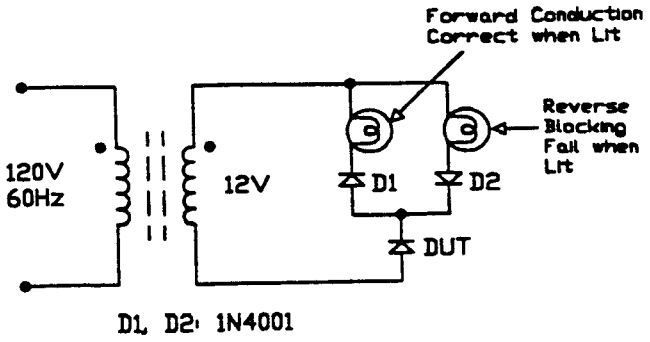

Figure 2 - Diode Tester

This first test circuit, shown in Figure 1, is simply a 6V latern-type flashlight modified to test the holding function of SCRs. This is an extremely handy test circuit to use in the field. Basically, the SCR is connected in series with the lamp and battery, with a momentary switch providing the gate pulse required to fire the SCR.

The test circuit in Figure 2 is used to test diodes. Two incandescent bulbs double as both loads, as well as indicators. If the diode is damaged, and no longer has reverse blocking capability, both lamps will illuminate, indicating a bad diode. Otherwise, the left lamp should light indicating the diode is functioning properly. Nearly any 12V lamp will work, and D1, and D2 can be nearly any diode. This circuit is limited by the small test currents and voltages available.

Finally, Figure 3 depicts the most complete test setup. Rectified line voltage is applied to the DUT (Device Under Test, i.e., the SCR or diode), to ensure

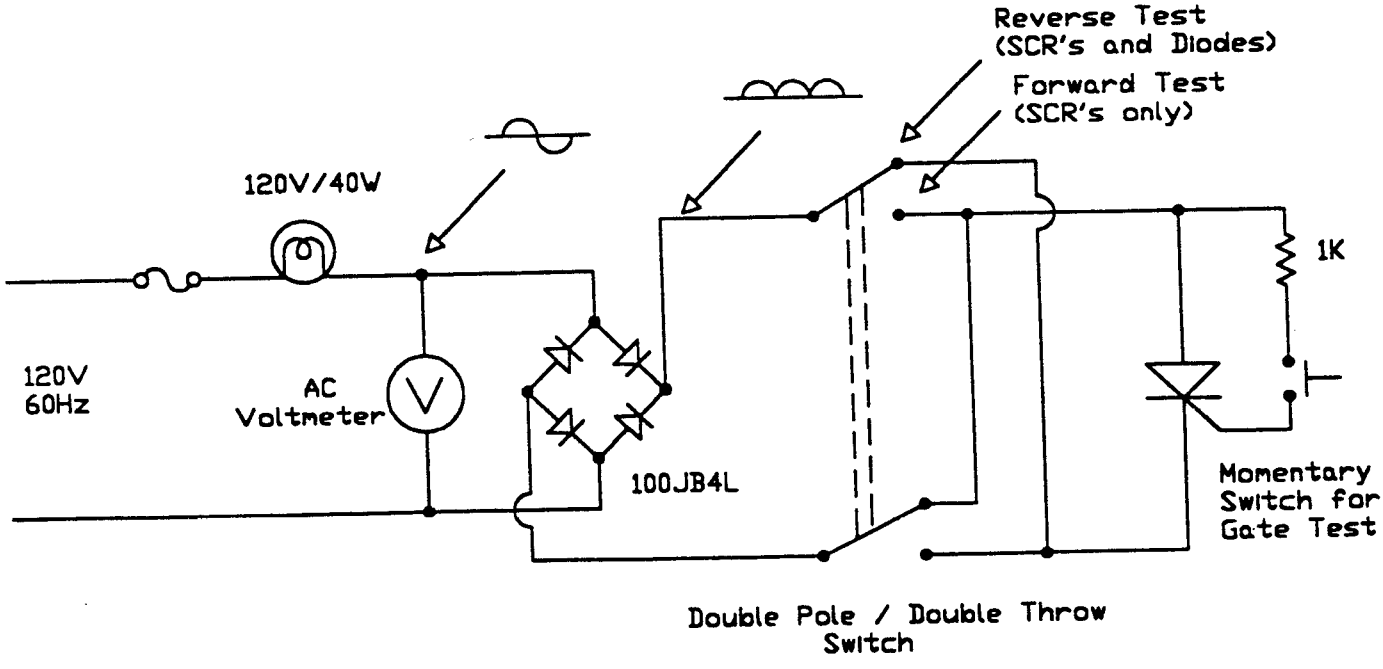

Figure 3 - SCR Blocking/Gating and Diode Blocking Tester

DPDT switch selects the test between forward and reverse. The reverse test confirms that both SCRs and diodes block under application of reverse voltage. If the lamp lights during this test, then the DUT is not blocking reverse voltage, and is damaged. This circuit is much more complex than the previous two, but provides the best results because it uses relatively high voltage to test the blocking characteristics.

The forward test is used for SCRs only. This tests the gate of the SCR. The lamp should remain off until the momentary switch is depressed, at which time the lamp should light. The lamp will go out as soon as the switch is released.

Hockey Puk

For the highest power levels, International Rectifier offers the hockey puk package. This is a very reliable, low thermal resistance package in which the contact to the silicon is established by applying external pressure with a clamp. Attempting to measure the characteristics of a hockey puk without having it correctly mounted in a clamp will result in erroneous measurements (likely an open circuit) as proper contact will not be made internally.

Conclusion

Through the use of the simple circuit ideas presented here, high power devices can be debugged for proper operation. The use of an ohmmeter or megger is not recommended. While the above testers provide more reliable information on the functionality of the devices; only curve tracers can accomplish this task thoroughly. The flashlight circuit (Figure 1) is ideal for field use due to its simplicity. The circuit in Figure 3 is ideal for the lab of a technician who often tests SCRs and diodes, but does not have access to a curve tracer.