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Power Semiconductor Tester
M3K
User's Guide

SPECIFICATIONS

Electrical specifications apply for an operating temperature range of 15°F to 120°F (-10°C to 50°C), relative humidity up to 80%.

Input Voltage	115V, 60Hz, 1A

High Voltage Mode (PRV/PFV)

Peak Reverse and Forward Voltage	0 - 3000 VAC
Peak Leakage Current @ 3 mohm	1 mA
Short Circuit Current	20 mA
Test Duration	max. 15 seconds

Gate Mode

Gate Voltage	0 - 15 VDC, 10 ohm source impedance
Anode Voltage	18 V, 10 ohm, 1/2 sine wave

Panel Meters

PRV/PFV Mode

Peak Anode Voltage	3000 V
Peak Leakage Current	19.99 mA

Gate Mode

Gate Voltage	19.99V
Gate Current	1999 mA

Oscilloscope Input

PRV/PFV Mode

X- axis (voltage) sensitivity	2.0 V/div=1000 V/div
Y-axis (current) sensitivity	2.0 V/div=10 mA/div

Gate Mode (Anode Voltage/Current Curve)

X- axis (voltage) sensitivity	2.0 V/div=10 V/div (Anode Voltage)
Y-axis (current) sensitivity	2.0 V/div=1 A/div (Anode Current)

Case Dimensions (H x W x L)	8" x 8" x 16"
Weight	10.6 Lbs.
Test Standard	JEDEC JC22, RS397

* * * * CAUTION * * * *

- This equipment operates at voltages as high as 3100 VAC.
- Under no circumstances should the equipment EVER be operated without using the 3 wire line cord, plugged into a properly grounded outlet.
- The equipment must be operated in strict accordance with the operating instructions. The procedures are set up so that the voltage is turned to zero before a test is started.

Do not touch, or allow anyone else to touch, the test leads or the device under test while the TEST BUTTON IS PRESSED!

THE "ART" OF TESTING POWER SEMICONDUCTORS

Manufacturers of power semiconductors follow the test methods outlined in the JEDEC sub-committee JC22 for SCRs and Diodes. The standard for SCRs is RS397. One of the most important conditions of this test is that the rated voltage MUST NOT be exceeded.

An ideal SCR or Diode can have voltage applied until the device reaches avalanche voltage. In practice, many devices have soft breakdown, "punch through" or surface breakdown before the rated leakage current is reached. For these devices, exceeding the rated voltage established by the manufacturer may result in instant failure or in down grading of the blocking characteristics.

Large devices have round silicon chips which have been beveled and contoured to reduce the voltage stress at the device junctions at the end of the chip. These devices generally reach avalanche voltage or "punch through" before breakdown occurs at the surface.

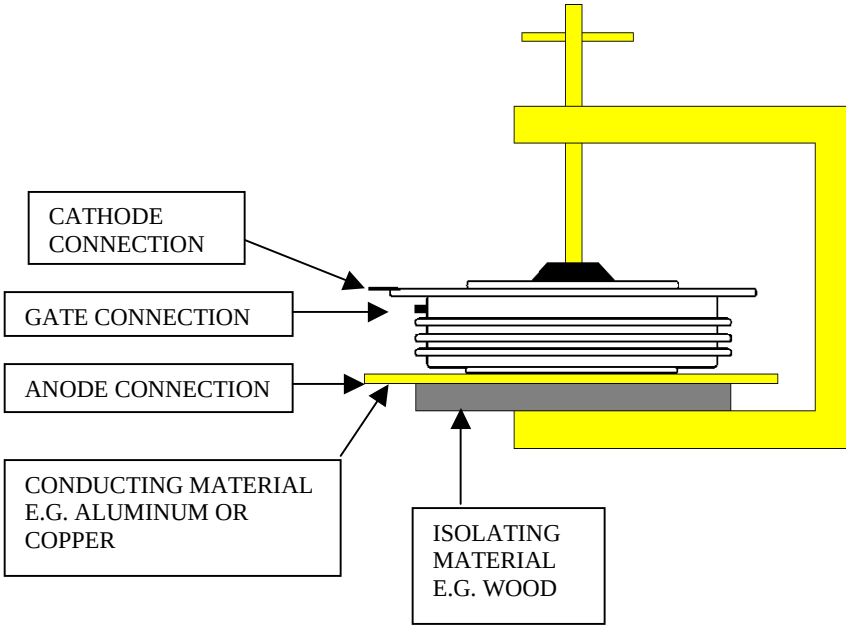
Small devices on the other hand are made from square chips. These devices are not protected by the above methods and many will break down at the edge of the chip before avalanche voltage is reached. This form of breakdown is almost always "fatal"

SUMMARY

- DON'T use an OHMMETER
- DON'T use a HI POT tester
- DO use a tester that conforms to the JEDEC standards
- NEVER exceed the manufacturers blocking voltage rating!
- NEVER exceed the manufacturers leakage current rating!
- If the maximum leakage current is reached before the rated blocking voltage is reached, STOP!
- If the rated blocking voltage is reached before the rated leakage current is reached, STOP!
- If possible, observe the E/I characteristics of the device on a X-Y oscilloscope.

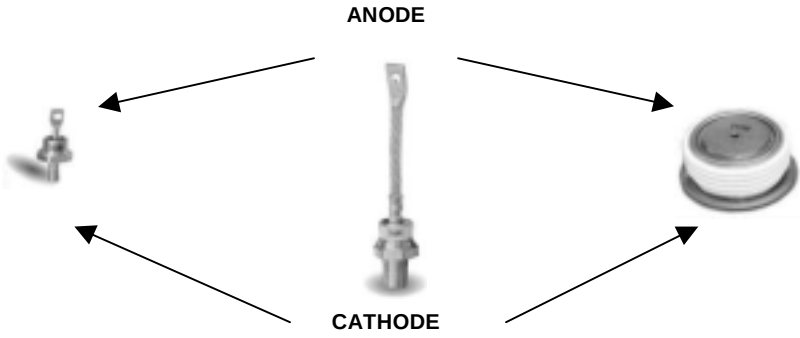
SIMPLE CLAMPING DEVICE
for
TESTING OF PRESSURE PACK DEVICES

The simple clamp arrangement below is sufficient for testing pressure pack devices, since the force required to test these devices only has to be approx. 200 lbs. However, for more sophisticated testing at elevated temperatures, a hot plate and a temperature sensor has to be added.



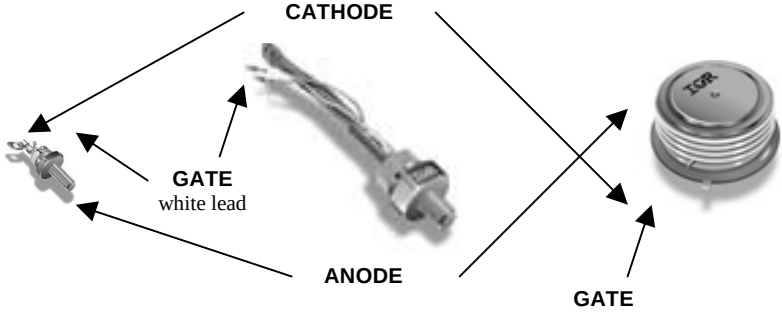
CONNECTIONS ON SCRS (THYRISTORS) AND DIODES

DIODE



NOTE : Diodes can have forward or reversed polarity. Polarity is determined by the direction of the diode symbol stamped on the component, i.e. arrow pointing towards the stud (or base) means forward polarity, arrow pointing towards the lead (or top) means reversed polarity.

SCR/THYRISTOR



OPERATING INSTRUCTIONS
*** CAUTION : UP TO 3300V ON TEST LEADS ***

INTRODUCTION

- This Power Semiconductor Tester is designed to perform testing of power semiconductors, such as, SCRs/Thyristors, Diodes, IGBTs, Transistors, and most MOS FETs. Cathode (Emitter) of the device under test is operated near ground potential.
- The tester performs three tests : PFV (Peak Forward Voltage), PRV (Peak Reverse Voltage), and Gate Voltage and Current to trigger (Base Current for Transistors). The test circuits are of the type recommended by the JEDEC test standards RS397. The PRV/PFV tests applies a PEAK REVERSE VOLTAGE or PEAK FORWARD VOLTAGE, half wave 60 Hertz wave form to the device and the resulting peak leakage current is measured by a peak storage circuit and displayed on a peak reading ammeter.
- The E/I curve of the device can be displayed on an X/Y oscilloscope.The DC Gate test is used to measure the DC gate voltage and current required to trigger the device into its On-state. The Anode (Collector) supply is half wave 60 Hertz wave form.
- The tester provides a Gate Voltage high enough to test for turn-on of IGBTs and MOS FETs.
- Both NPN and PNP bipolar transistors can be tested.

PREPARATIONS AND PRECAUTIONS

- Plug the tester into a properly grounded three wire receptacle.
- When testing pressure pack components (hockey pucks), the component **MUST** to be compressed at approx. 200-300 lbs. On page 4 is a suggested simple device for compressing these types of components.
- It is recommended that the instrument is connected to ground via the GROUND terminal on the front panel. **Note:** When testing IGBTs or Darlington Transistor modules, the base plate on the module under test **MUST** be connected to the GROUND terminal.
- **NEVER** keep the test button pressed over 15 seconds!
- **NEVER** touch the test leads or the device under test while the “TEST” button is depressed.
- **Always** turn the Voltage Control to the zero position before connecting or disconnecting the device under test.

It is possible to observe the E/I curve of the device under test by connecting an oscilloscope to the connector on the front panel with the optional 2 connector cable.Connect the BNC connector with a red and black wire to the X-axis and the BNC connector with a green wire to the Y-axis. Set the X-axis to 0.2V/div for a sensitivity of 200V/div and the Y-axis to 0.1V/div for a sensitivity of 1mA/div. The output sensitivity is automatically changed when the function switch is moved to the Gate position. Note that the Anode wave form is displayed during the gate test, not the E/I curve.

TESTING PROCEDURES

SCRs (THYRISTORS)

1. Make sure the Voltage Control is at the zero position (fully counter clock-wise) before turning the unit on. Connect the Anode, Gate and Cathode leads to the device to be tested. **DO NOT MIX UP THE ANODE AND CATHODE LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE GATE!**
2. Place the function switch in the PRV position and depress the "TEST" button.
3. Slowly raise the Voltage Control while observing the Peak Voltage and Peak Leakage Current on the panel meters. In a properly functioning device, the rated voltage should be reached before the current starts to rise **rapidly**, (the "break-over point"). If the break-over point is reached before the rated voltage, the device is marginal. **UNDER NO CIRCUMSTANCES MUST THE RATED VOLTAGE OF THE DEVICE BE EXCEEDED!**
4. Return the Voltage Control to the zero position
5. Place the function switch in the PFV position, depress the "TEST" button and repeat steps 3 and 4.
6. Place the function switch in the GATE position and depress the "TEST" button. (If the optional "ANODE POLARITY" and "GATE POLARITY" switches are installed, make sure both are in the "+" positions).
7. Slowly raise the Voltage Control while observing the "TRIGGER INDICATION" light. The Gate Voltage and Gate Current will be displayed on the panel meters. The meter reading should be taken just prior to the trigger point to avoid incorrect readings due to a gate impedance change after turn-on.
8. Return the Voltage Control to the zero position and disconnect the device.

DIODES

1 Make sure the Voltage Control is at the zero position (fully counter clock-wise) before turning the unit on. Connect the Anode and Cathode leads to the device to be tested.

1. Place the function switch in the PRV position and depress the "TEST" button.
2. Slowly raise the Voltage Control while observing the Peak Voltage and Peak Leakage Current on the panel meters. In a properly functioning device, the rated voltage should be reached before the current starts to rise rapidly, (the "break-over point"). **UNDER NO CIRCUMSTANCES MUST THE DEVICE'S RATED VOLTAGE BE EXCEEDED!**
3. Return the Voltage Control to the zero position

NOTE : Diodes only have to be tested in one direction. If the diode is forward biased (standard), the function switch should be in the PRV position. If the diode is reversed biased, the function switch should be in the PFV position.

TRANSISTORS

The procedure for testing transistors is basically the same as for SCRs, with the exception of terminology:

Cathode = Emitter, Anode = Collector, Gate = Base.

Both PNP and NPN transistors can be tested.

POWER MODULES

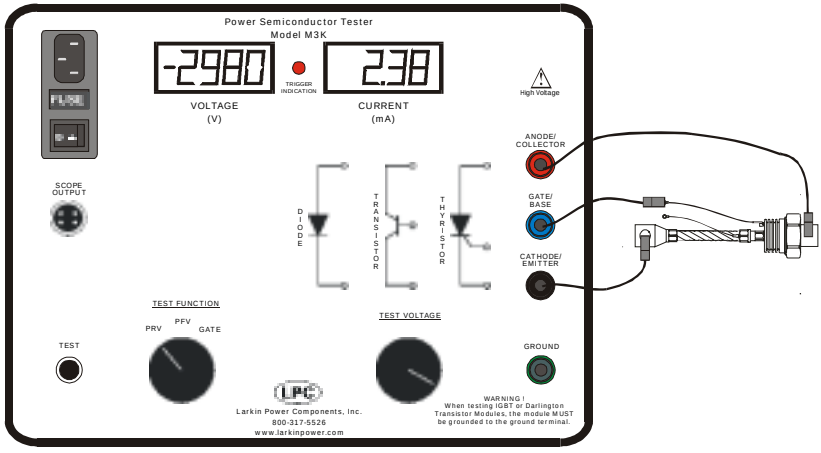
The procedure for testing Power Modules depends on the type of module, i.e. SCR/SCR, SCR/Diode, IGBT, Darlington Transistors, etc., and also how the different individual component inside the module can be accessed via the external terminals. For example, in some SCR/SCR or SCR/Diode modules, only one of the components can be individually tested through the external terminals. In these cases, components that can be accessed should be tested, and then an overall test of the module should be performed. Which of these testing procedures to follow depends on the component(s) in the Power Module. A typical example is shown on page 12.

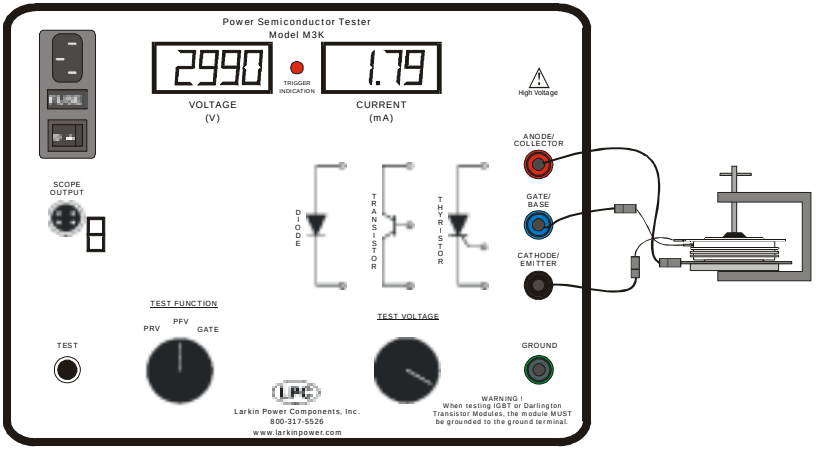
Note 1:

When testing IGBTs or Darlington Transistor modules, the base plate of the module under test **MUST** be connected to the GROUND terminal, or the module could be damaged.

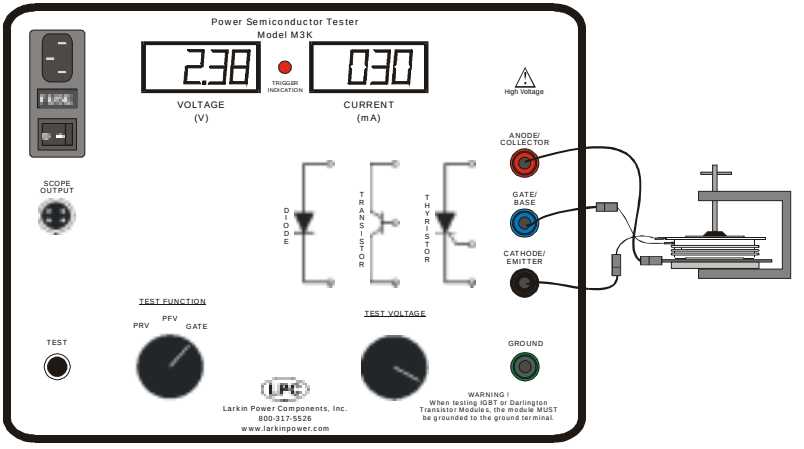
Note 2:
Since most IGBTs or Darlington Transistor modules have high impedance, it is a good idea to connect a 100k ohm resistor between the Gate and Cathode terminals on the tester.

TYPICAL TEST SET-UP
for
PRV/PFV BREAK-OVER TEST OF STUD MOUNTED AND PRESSURE PACK SCRs

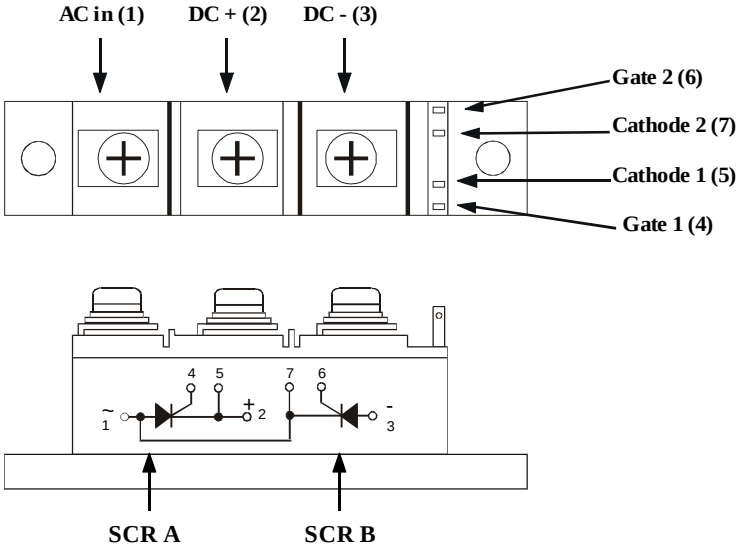




TYPICAL TEST SET-UP
for
GATE VOLTAGE/CURRENT TO TRIGGER TEST OF STUD MOUNTED AND PRESSURE PACK SCRs



TYPICAL TEST PROCEDURE
for
POWER MODULES

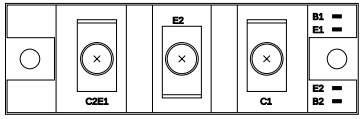


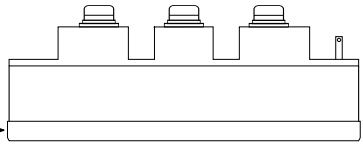
TESTING PROCEDURE

Connect the leads from the test instrument according to the below table for testing **SCR A** and **SCR B** individually, and follow the instructions on page 8.

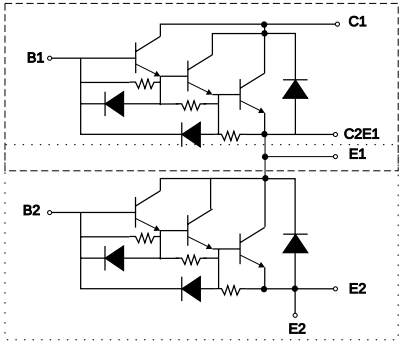
TESTER	ANODE	CATHODE	GATE
SCR A	1	2	4
SCR B	3	7	6

TYPICAL TEST PROCEDURE
for
TRANSISTOR MODULES
(IGBTS AND DARLINGTON TRANSISTORS)





BASE PLATE



TRANSISTOR CIRCUIT A

TRANSISTOR CIRCUIT B

TESTING PROCEDURE

1. Connect a test lead between the ground plate and the GROUND terminal on the tester.
2. Connect a 100k ohm resitor between the GATE and CATHODE terminals on the tester.
3. Connect the leads from the tester according to the below table, for testing **TRANSISTOR CIRCUIT A** and **TRANSISTOR CIRCUIT B** individually, and follow the instructions for testing SCRs on page 9 for testing SCRs.

TESTER	ANODE	CATHODE	GATE
TRANSISTOR CIRCUIT A	C1	C2E1(E1)	B1
TRANSISTOR CIRCUIT B	E1	E2	B2