



Larkin Power Components, Inc.

P.O. Box 14667, Spokane, WA 99214-0667, U.S.A.

Phone: 800-317-5526 Fax: (509) 891-5627

E-mail : lpc@larkinpower.com Web page : www.larkinpower.com

Power Semiconductor Tester

M3K

User's Guide



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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 - 3300 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 3500 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 3400 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!

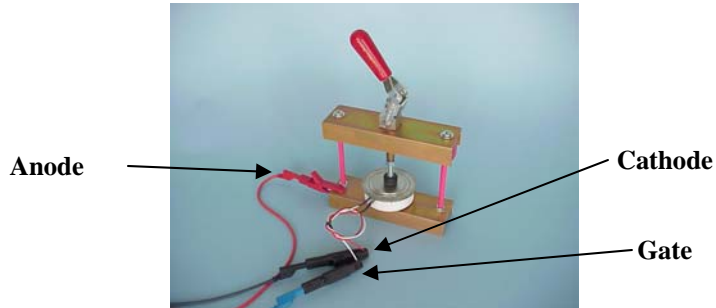
If the maximum leakage current is reached before the rated blocking voltage is reached, STOP!

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.

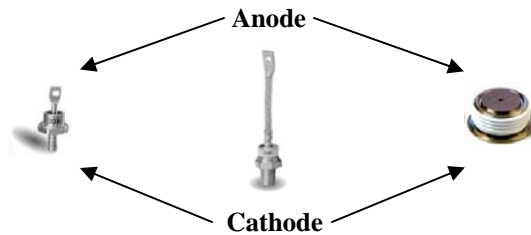
**SIMPLE CLAMPING DEVICE
for
TESTING OF PRESSURE PACK DEVICES**

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.



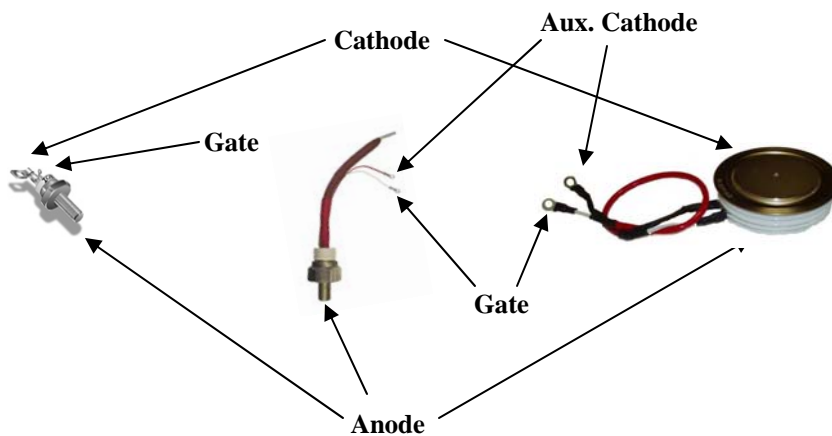
CONNECTIONS ON DIODES AND THYRISTORS

Diodes



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.

SCRs/Thyristors



OPERATING INSTRUCTIONS

***** CAUTION : UP TO 3400V 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.

The 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 5 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.

SCRs (THYRISTORS)

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!**

Place the function switch in the PRV position and press the “TEST” button.

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!**

Return the Voltage Control to the zero position

Place the function switch in the PFV position, depress the “TEST” button and repeat steps 3 and 4.

Place the function switch in the GATE position and press the “TEST” button.

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.

Return the Voltage Control to the zero position and disconnect the device.

DIODES

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.

Place the function switch in the PRV position and press the “TEST” button.

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!**

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

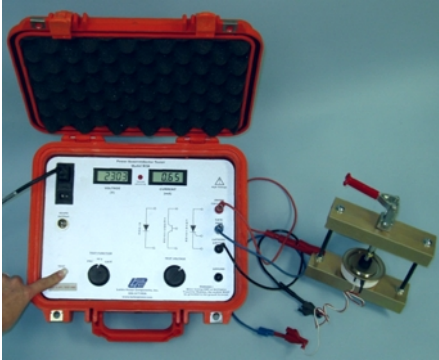
The procedure for testing transistors is basically the same as for SCRs, with the exception of terminology:

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

All types of transistors can be tested, such as, Darlingtons, IGBTs, and bipolar transistors.

TESTING SET-UP AND PROCEDURES

PRESSURE PACK (Hockey Puck) SCRs (Thyristors)



Make sure the Voltage Control is at the zero position (fully counter clockwise) 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!**



Place the function switch in the PRV position and press the “TEST” button. Slowly increase the voltage 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”).

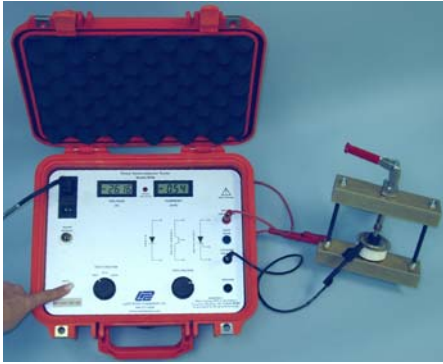


Place the function switch in the PFV position and repeat procedure described above.



Place the function switch in the GATE position and slowly raise the Voltage Control while observing the “TRIGGER INDICATION” light. If the light does not turn on, the Gate on the SCR is faulty, and the device should be replaced.

PRESSURE PACK (Hockey Puck) Diodes



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

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.



Place the function switch in the PRV (PFV) position and press the “TEST” button.

Slowly increase the voltage 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”).

STUD MOUNTED DIODES



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

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.

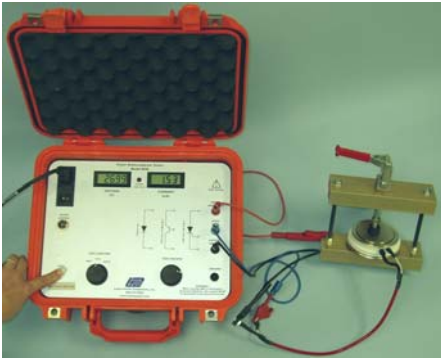


Place the function switch in the PRV (PFV) position and press the “TEST” button.

Slowly increase the voltage 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”).

GTOs (Gate Turn Off Thyristors)



Make sure the Voltage Control is at the zero position (fully counter clockwise) 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!**



Place the function switch in the PRV position and press the “TEST” button. Slowly increase the voltage 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”).

Note: Most GTOs are “Anode Short” type, which means that the anode break-over voltage is only between 17 and 19 volts.



Place the function switch in the PFV position and repeat procedure described above.



Place the function switch in the GATE position and slowly raise the Voltage Control while observing the “TRIGGER INDICATION” light.

If the light does not turn on, the Gate on the SCR is faulty, and the device should be replaced.

Note: The Gate on a GTO turns on at a lower voltage than a SCR. Typical values are between 0.6 and 0.8 volt.

POWER MODULES

Power Modules comes in a variety of configurations and sizes. The testing procedures described below illustrates the the set-up for a Dual Thyristor Bridge. The principle is the same for Thyristor/Diode, Diode/Diode, and single Diode or Thyristor Modules.



Make sure the Voltage Control is at the zero position (fully counter clockwise) 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!**



Place the function switch in the PRV position and press the “TEST” button. Slowly increase the voltage 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”).



Place the function switch in the PFV position and repeat procedure described above.



Place the function switch in the GATE position and slowly raise the Voltage Control while observing the “TRIGGER INDICATION” light.

If the light does not turn on, the Gate on the SCR is faulty, and the device should be replaced.

Transistor Modules (IGBTs and Darlingtons)



Connect a test lead between the ground plate of the component and the GROUND terminal on the tester.

Connect a 100 kohm resistor between the BASE and EMITTER terminals on the tester.

DO NOT MIX UP THE COLLECTOR AND EMITTER LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE BASE!



Place the function switch in the PRV position and press the “TEST” button. Slowly increase the voltage while observing the Peak Voltage and Peak Leakage Current on the panel meters.

In most transistor modules, the current will rise immediately due to the circuit design.



Place the function switch in the PRV position and press the “TEST” button. Slowly increase the voltage 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”).



Place the function switch in the BASE position and slowly increase the voltage while observing the “TRIGGER INDICATION” light.

If the light does not turn on, the Base is faulty, and the device should be replaced.

Note: Typical turn-on voltage is 5-6 V. The current is so low in transistor base circuit, that it will not show on the current meter.

Diode Modules for Rotating Rectifiers



Make sure the Voltage Control is at the zero position (fully counter clockwise) before turning the unit on. Connect the Anode and Cathode leads to the diode to be tested.

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.



Place the function switch in the PRV (PFV) position and press the “TEST” button.

Slowly increase the voltage 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”).

Both diodes in this modules are rated at 2600 V.

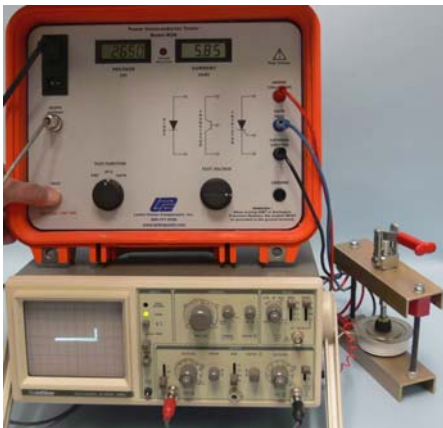
USING THE OSCILLOSCOPE OPTION



Connect the oscilloscope cable as shown.

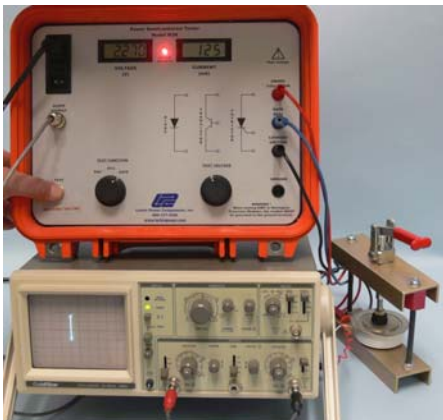
Place the function switch in the PRV position and press the “TEST” button. Slowly increase the voltage while observing the Peak Voltage and Peak Leakage Current on the panel meters

In a properly functioning device, the rated voltage should be reached before the current starts to rise **rapidly**, (the “break-over point”), which can be seen on the oscilloscope display.



Place the function switch in the PFV position and press the “TEST” button. Slowly increase the voltage 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”), which can be seen on the oscilloscope display.



Place the function switch in the GATE position and slowly raise the Voltage Control while observing the “TRIGGER INDICATION” light.

If the light does not turn on or the oscilloscope graph does not turn from horizontal to vertical, the Gate on the SCR is faulty, and the device should be replaced.

Note: The oscilloscope option can be used while testing any type of power semiconductor mentioned in this manual



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