DARRAH ELECTRIC COMPANY

DST5000

SEMICONDUCTOR TESTER

RevB01_02-05-16

Contents

Introduction

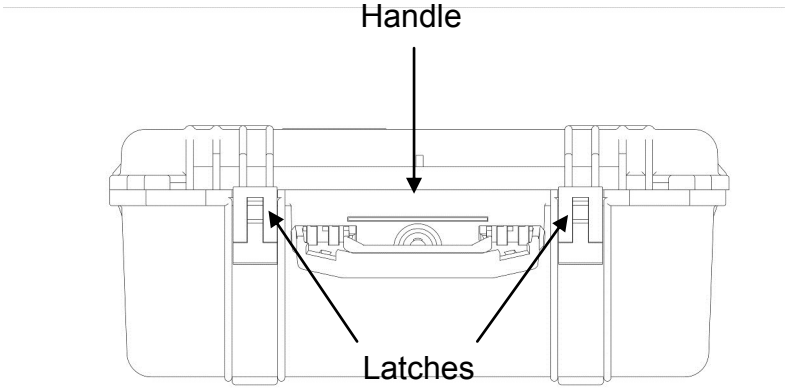
Thank you for purchasing the DST5000 Semiconductor tester.
To obtain maximum performance for this product please read this manual before using it and keep it in the tester for future reference.

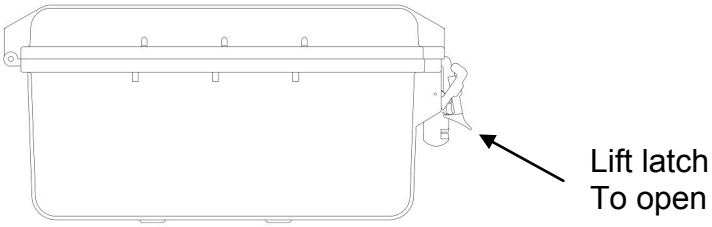
It is recommended that qualified test personnel have the training to know how to recognize and avoid any dangers that might be present when working on or near exposed electrical parts.

Verifying Package Contents / Open the Case

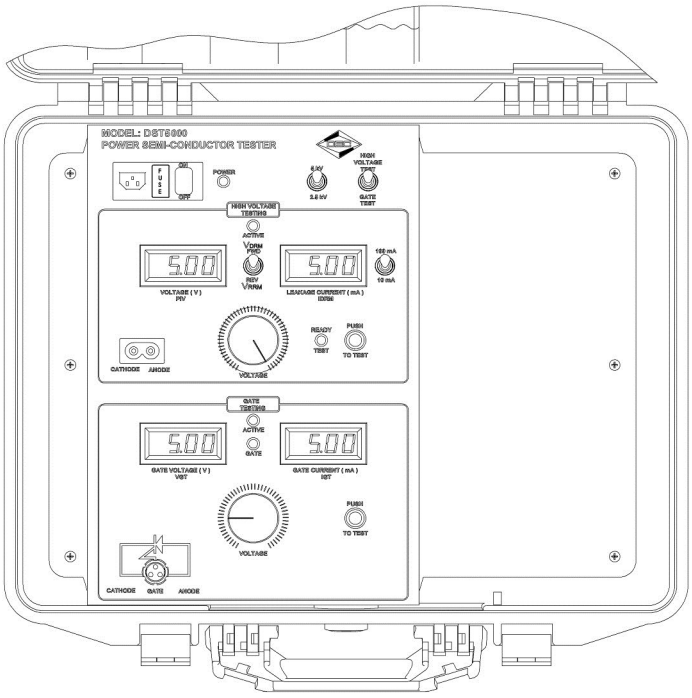
When you receive the instrument, inspect it carefully to ensure no damage occurred during shipment. In particular, check the accessories, panel switches and connectors. If damage is evident, or if it fails to operate according to the specifications, contact Darrah immediately.

♦**Open the Case**



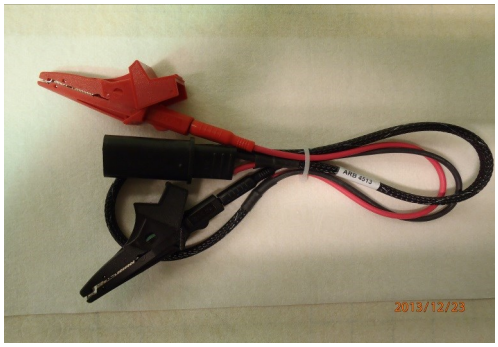


Main Unit



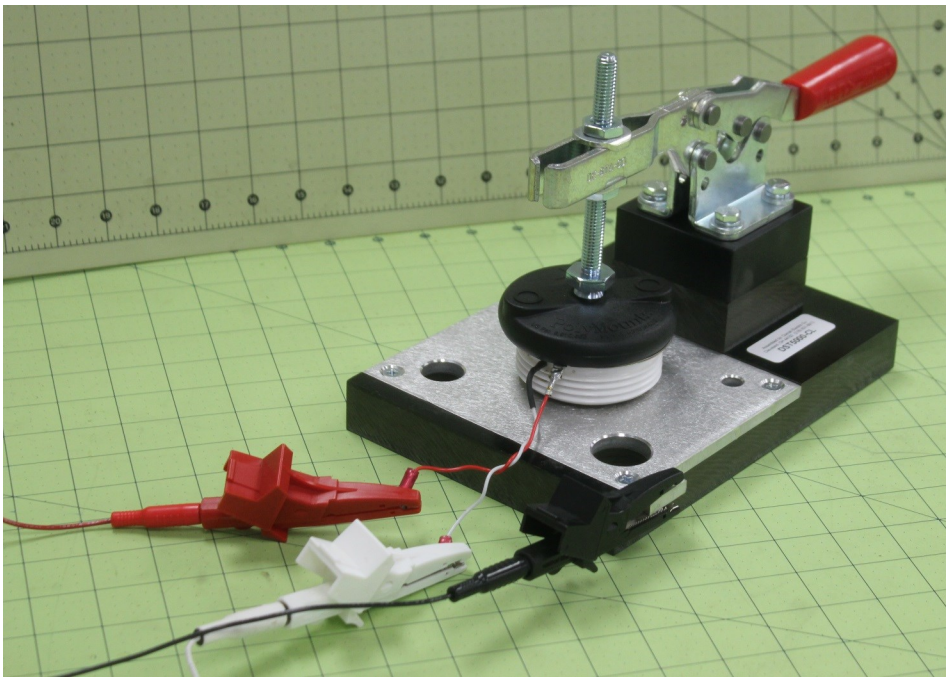
Test Cables

High Voltage Leads



Gate Leads

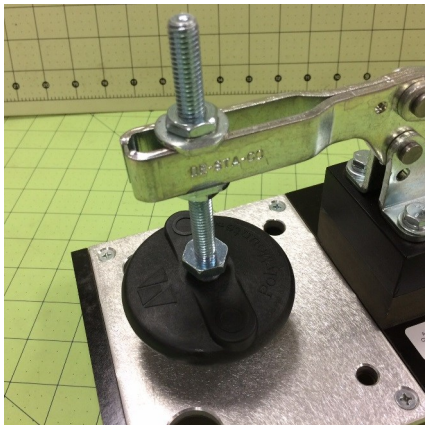
Clamp



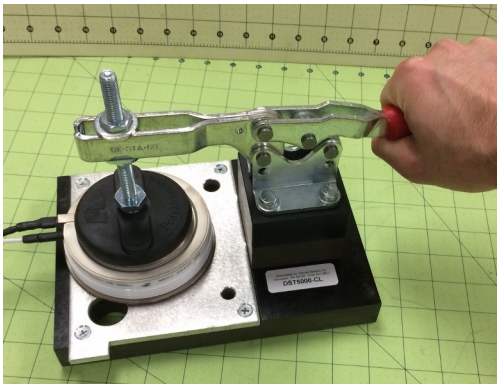
The Clamp has a dual purpose. It is primarily used for press pack semiconductors. In addition, the various size holes can be utilized to sit stud type SCR's and Diodes in. This allows the baseplate connection to be used and also keeps the semiconductors isolated from the work bench.

Note: It is recommended that this test be performed on a non-metallic work surface.

To secure the press pack semiconductor, first raise or lower the clamp bumper by adjusting the nuts and washers as needed. Raise the clamp to clear space on the baseplate for the press pack.



Place the press pack onto the clamp baseplate and center it underneath the bumper. Slowly and carefully push down on the handle until the bumper is firmly holding the press pack into place.



Use only enough pressure to secure the press pack in place. Be sure not to over-tighten the clamp.

The press pack is now secure for testing.

Safety Information

This instrument can produce High Voltage. Mishandling or improper use can result in severe electrical shock or even death. Be certain that you understand the instructions fully before attempting to operate this tester. We disclaim any responsibility for accidents or injuries due to misuse or not resulting directly from instrument defects.

Safety Symbols

This manual contains information and warnings essential for safe operation of the instrument and for maintaining it in safe operating condition. Before using it, be sure to carefully read the following safety precautions.

Indicates particularly important information that the user should read before using the instrument.

Indicates that dangerous voltage is present at this terminal or terminals.

Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.

Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.

Indicates that incorrect operation presents a possibility of injury to the user or damage to the instrument.

Preliminary Checks

Follow these precautions to ensure safe operation and obtain the full benefits of the tester.

Before using the instrument for the first time, verify that no damage occurred during storage or shipping. If you find any damage, contact Darrah for support.

⚠WARNING Before using the instrument, make sure that the insulation on the test leads and cables is undamaged and that no bare conductors are exposed. Using the product in such conditions could cause an electric shock resulting in severe injury or death. Contact Darrah for replacements.

Environment

Operating Temperature and Humidity:
0-40°C (32 to 104°F)
90% RH or Less (no condensation)

To avoid malfunctions and accidents, do not place the tester where it will be exposed to any of the following:	
 • Direct sunlight • High temperature	 • Corrosive or explosive gas
 • Sprayed/ splashed water • High humidity with condensation	 • Strong electromag-netic fields • Electrically charged objects
 • Dust	 • Mechanical vibration

Operating Precautions

DANGER Observe the following to avoid electric shock and short circuits.

- Prior to applying power to the tester perform a visual inspection to verify that no obvious damage has be done to the unit.

- Before connecting any leads to the tester ensure that it is operating satisfactorily by applying power and confirming that the green power light is illuminated.

- Do not apply power with any covers removed from the case. (High Voltage is present)

- Do not use the tester in environments containing ignitable gases, explosive powders etc. (Risk of explosion)

- Do not place the tester on an unstable or uneven surface. (if the tester falls electric shock or tester malfunction may result)

- Do not connect any leads to the instrument with the power on.

WARNING

- This tester produces HIGH VOLTAGE. To avoid electric shock, always wear appropriate insulated protection, such as rubber gloves, rubber boots, and a safety helmet, as specified in the Ordinance on Industrial Safety and Health.

- Before using the tester, inform those around you of your intention to do so.

DANGER

- DO NOT touch the clamps while the test is running.

- This tester is designed for use indoors. It can be operated at temperatures between 0 and 40°C (32 and 104°F) without degrading safety.

- To avoid damage to the tester, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.

- If the protective functions of the tester are damaged, either remove it from service or mark it clearly so that others do not use it inadvertently.

- Calibration and repair of this tester should be performed at the factory.

- Never modify the tester. Only Darrah should disassemble or repair the tester. Failure to observe these precautions may result in fire, electric shock or injury.

- After use always turn OFF the power and unplug the tester.

- Place the clamp inside the case and close the cover on the tester when not in use.

Overview 1

1.1 Product Overview

The DST5000 is an advanced Power Semiconductor Test System specially designed to make in-the-field measurements more reliable and faster. It gives the user the ability to quickly check forward/reverse voltage leakage current specifications as well as the gate-turn-on characteristics.

The tester has the functions and the purposes given below.

Function	Purpose
Gate Trigger Test	To provide “Gate Turn on” detail by providing an indicating light and display Gate Voltage and Current measurements.
High Voltage PFV	To determine the **P**eak **F**orward **V**oltage threshold of the semiconductor and its leakage current at rated voltage
High Voltage PRV	To determine the **P**eak **R**everse **V**oltage blocking threshold of the semiconductor and its leakage current at rated voltage

1.2 Features

♦Generates a wide range of Voltages from 0V to 5000V.
There are two main adjustable voltages for the High voltage tests. Using the Voltage Selector Switch you can select between 2.5kV or 5kV.

♦Dedicated Independent High Voltage and Gate Test modes.

♦Two hand operation for Safety.

♦Time out safety function to prevent over stressing.

♦Separate Leads for High Voltage and Gate Tests.

♦Digital Displays for both Voltage and Current measurements.

♦Light indicators for test functions.

1.3 Measurement Overview

The DST5000 is designed to perform testing of power semiconductors of all types:

- ♦ SCR's / Thyristors
- ♦ Diodes
- ♦ GTO's
- ♦ IGBT's

The tester performs three basic tests.

1. PFV (Peak Forward Voltage)
2. PRV (Peak Reverse Voltage)
3. Gate Trigger

1.4 Panel layout

Measurement Setup 2

2.1 Supplying Power

The tester is powered from the 120VAC power cord supplied with the unit. Only use a properly grounded three prong receptacle.

2.1.1 Connecting the AC Power Cord

Before inserting the power cord, ensure that the “Power On” switch on the tester is in the OFF position and that the High Voltage cables are not inserted.

2.2 Turning the Tester On & Off

Once the power cord has been inserted into the tester you are now ready to power the tester on. Turn on the power switch and the Green power light should illuminate. DO NOT power on until all cords have been connected.

2.3 Test Leads Description

There are two distinct sets of test leads with the tester. Each has a different plug connector for safety.

- Gate Test Leads
  - RED - Cathode
  - WHITE - Gate
  - BLACK - Anode
- High Voltage Test Leads
  - RED - Cathode
  - BLACK - Anode

Before inserting the High Voltage leads into the tester make sure the unit is powered off and the crocodile clips are attached first. This will prevent possible shock or injury.

Note: Only one set of leads should be used at a time.

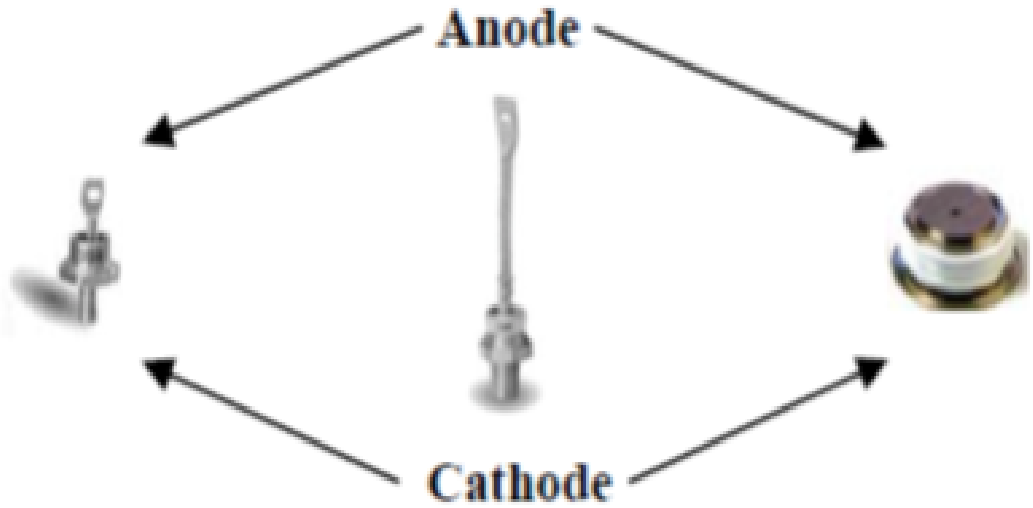
2.4 Using the Clamp for Press Pack Semiconductors

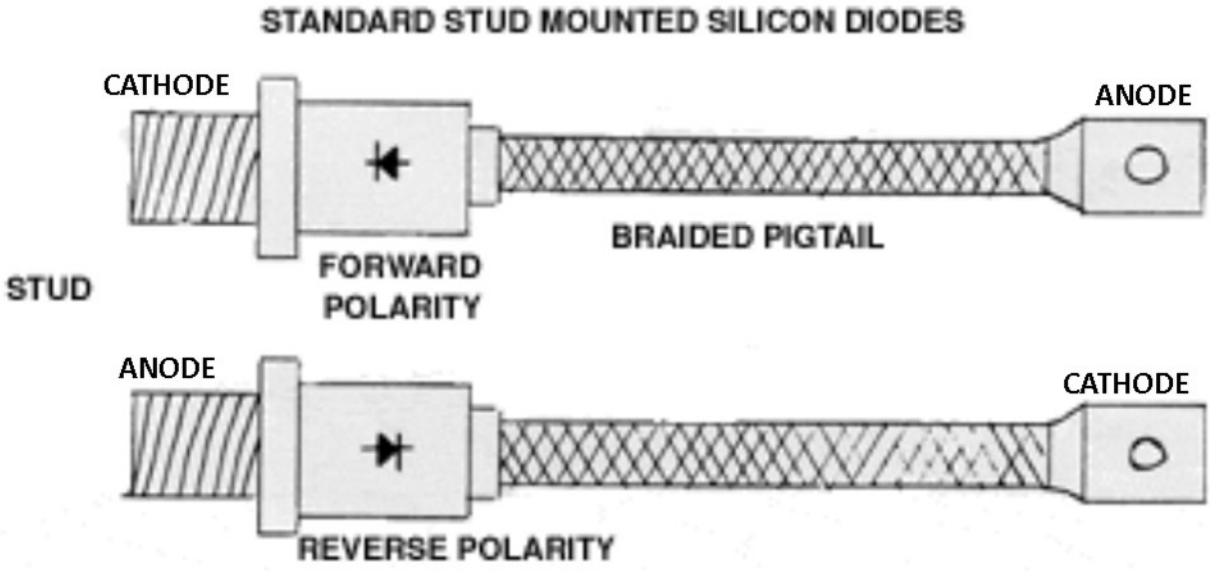
Place the semiconductor under test with the Anode down. Use only enough pressure to snap the clamp handle down. Do not over clamp the semiconductor. See page 5 for details.

2.5 Connections on Diodes & SCR's (Thyristors)

Note: Diodes can have a 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.

Diodes

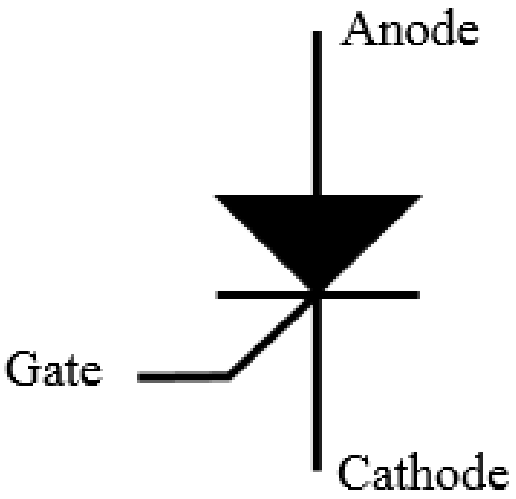


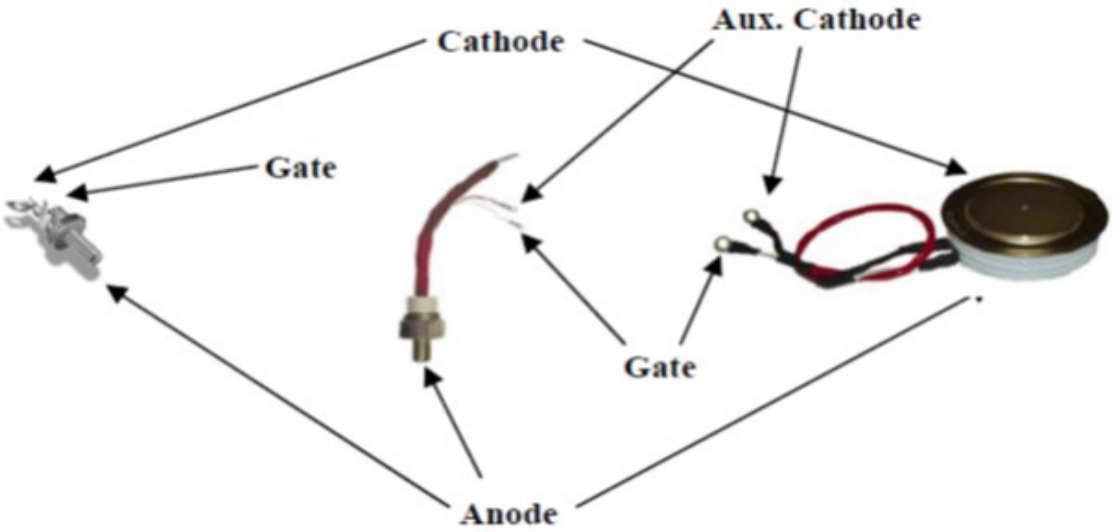


Forward and Reverse diodes are identified by their number or diode symbol, which is an arrow with a perpendicular line across the arrow point. If the arrow points towards the base or stud, the diode is forward polarity. If the arrow points towards the pigtail, the diode is reverse.

Note: Refer to the manufacturer's datasheet for pinout definitions.

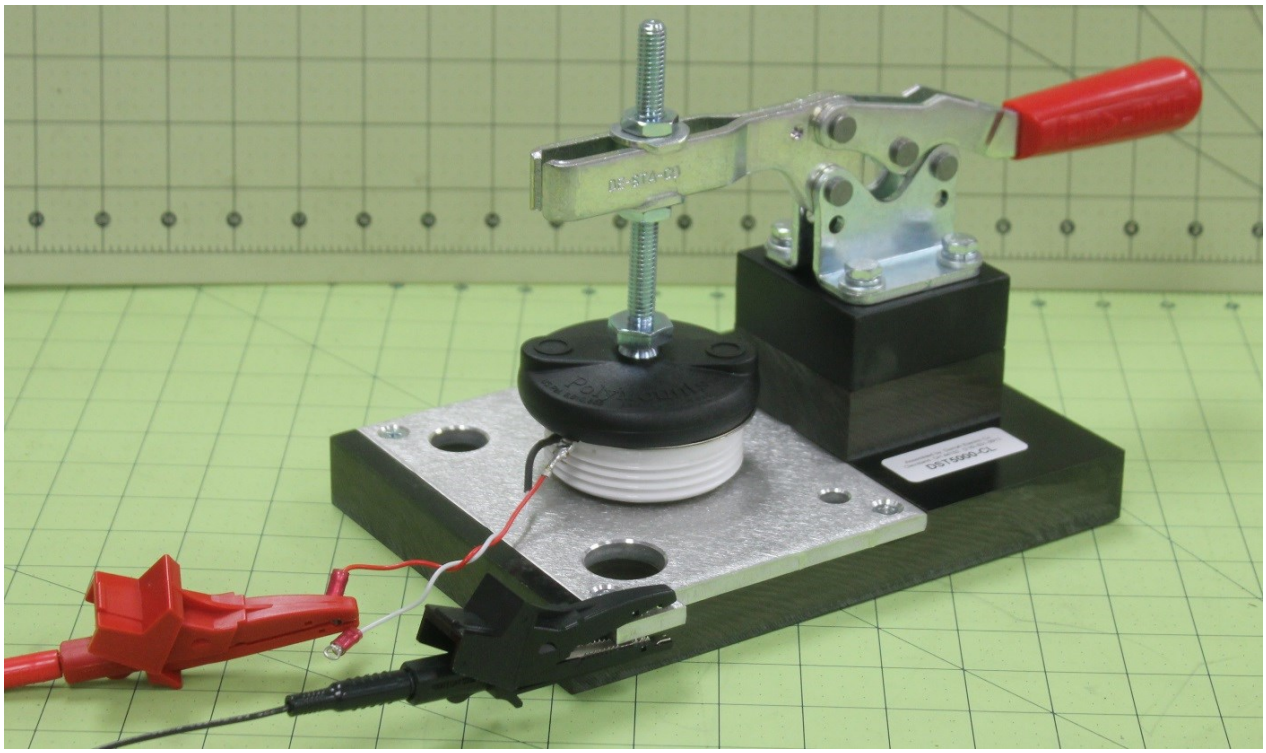
SCR's / Thyristors





Testing 3

3.1 SCR's / Thyristors



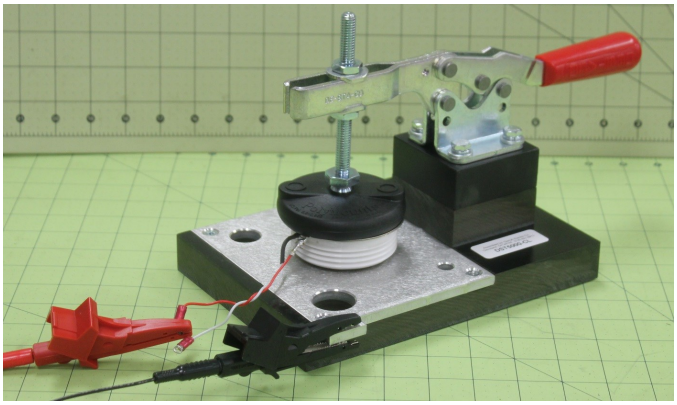
3.1.1 PRV / PFV Test — SCR's / Thyristors

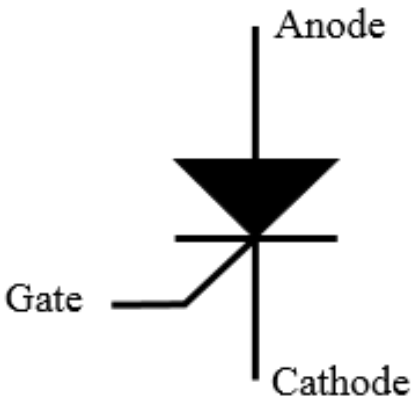
When testing press-pack semiconductors, it is important to note that they must be clamped with sufficient force to make internal contact between the silicon and the pole faces. Using the Clamp provided will achieve this. Refer to the Clamp instructions on page 5 for more details.

See below to connect the Anode (BLACK) and Cathode (RED) leads to the SCR.

Note: The Gate lead (WHITE) needs to be at least 1 inch away from any high voltage. It is recommended that this lead be taped off as a precaution.

Note: Before testing, check with the manufacturer's datasheet for the device specifications.





WARNING **DO NOT MIX UP THE GATE & EITHER THE ANODE OR CATHODE LEAD**

1. With the tester in the OFF position insert the High Voltage test cables into the appropriate socket on the tester.

2. Determine the Voltage rating of the Semiconductor you are about to test. This can be found in the device **manufacturer's datasheet**. If it is 2.5kV or less, select the 2.5kV setting on the voltage selector switch. If it is between 2.5kV & 5kV select the 5kV option.

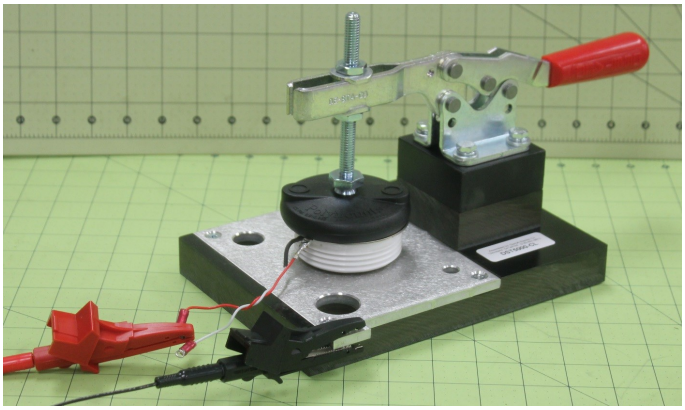
3. Determine what Leakage Current rating of the Semiconductor you are about to test is rated at. This can be found in the device **manufacturer's datasheet**. If it is 10 mA or less, select the 10 mA setting on the current selector switch. If it is between 10 mA & 100 mA select the 100 mA option.

Note: The tester has an over current protection system built in, so the unit will automatically trip if the set current is exceeded.

4. Select the "High Voltage Test" option.

5. Select **REV** (VRRM) or **FWD** (VDRM) in the High Voltage Testing portion of the front panel.

6. Connect the Anode (BLACK) and Cathode (RED) leads to the semiconductor being tested.



DANGER

DO NOT touch the clamps while the test is running.

DO NOT MIX UP THE ANODE & CATHODE LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE GATE!

WARNING

Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on. The tester will not indicate a "ready" state until the dial is in its Zero position.

DANGER

YOU ARE ABOUT TO BEGIN A HIGH VOLTAGE TEST. ENSURE THAT THE WORK AREA IS CLEAR AND THAT ALL PERSONNEL ARE CLEAR OF THE WORK AREA. THE TEST MUST BE PERFORMED ON A NON-CONDUCTING SURFACE.

Note: There is a 60 second time out function built into this test for safety reasons. Should the test "time out" the "Test Ready" light will go out. Release the test button and turn the voltage control dial counterclockwise back to zero wait 5 seconds for the "Test Ready" light to illuminate. Only then can testing commence.

7. Turn the tester ON. The Green Power light should illuminate.

8. The Green Test Ready light should be illuminated.

9. Press and Hold the “Push To Test” button in the High Voltage test section. The yellow Active light will illuminate.

Note: The Voltage control dial must be turned all the way counterclockwise, or the test cannot begin.

CAUTION: If the Ready Test light is flashing, the Voltage control dial must be turned all the way counter-clockwise to the zero position.

10. Slowly turn the Voltage control dial clockwise until the rated voltage of the device is reached. **Under no circumstances must the rated voltage of the device be exceeded.**

Per the PFV/PRV switch, the tester is either applying a positive (PFV) 60HZ Half Wave voltage across the Anode and Cathode or a Negative (PRV) Half Wave voltage across the Anode and Cathode. The voltage meter displays the measured peak voltage applied to the device under test. Note that it does not indicate polarity, so a PRV test will show the same polarity as a PFV test even though the applied voltage polarity is different. The current meter displays the measured peak current in line with the device under test

Refer to the **manufacturer’s datasheet** for maximum PFV and PRV.

11. Note the leakage current at rated voltage.

Note: If the semiconductor is shorted, the tester will automatically disconnect the voltage to the semiconductor when the max current setting is reached - 10mA or 100mA Note that the decimal point on the panel meter will blink during an over current condition and will stop blinking after the unit has resumed a steady state.

12. Return the Voltage Control Dial to Zero. **Make sure the Voltage meter reads zero before touching the test cables or test unit.**

Note: the FWD/REV voltage switch can be toggled to repeat this test with the opposite polarity voltage applied.

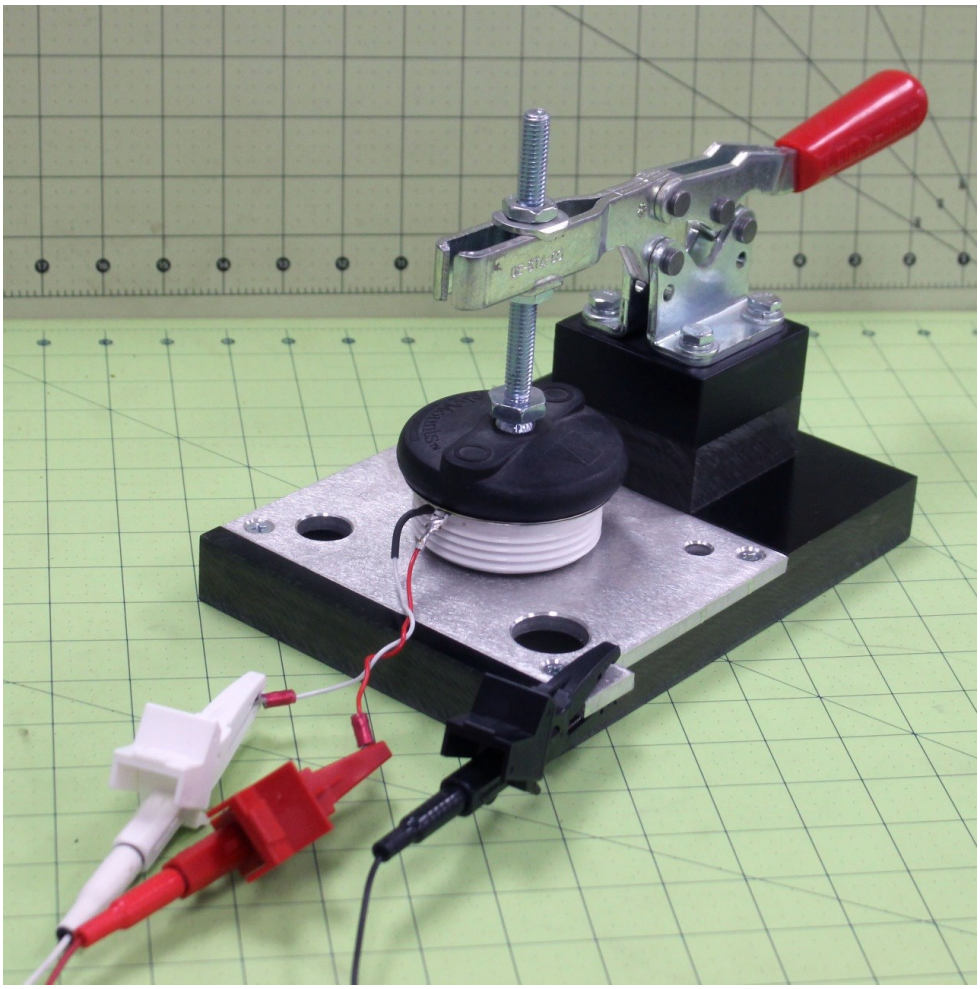
13. Turn off the power prior to removing the leads.

3.1.2 Gate Test — SCR's / Thyristors

When testing press-pack semiconductors, it is important to note that they must be clamped with sufficient force to make internal contact between the silicon and the pole faces. Using the Clamp provided will achieve this. Refer to the Clamp instructions on page 5 for more details.

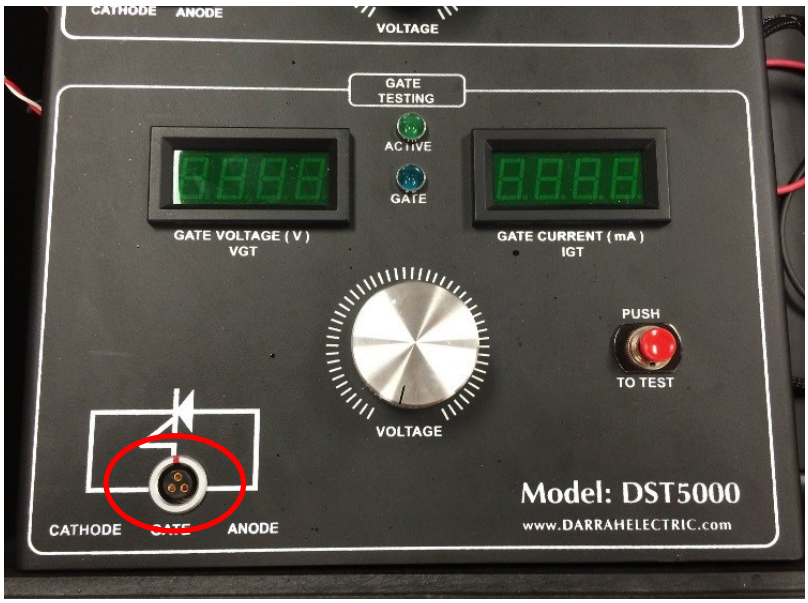
Note: Before testing, check with the manufacturer's datasheet for the device specifications.

See below to connect the Anode (BLACK), Cathode (RED) & Gate (WHITE) leads to the SCR.



3.1.2 Gate Test — SCR's / Thyristors

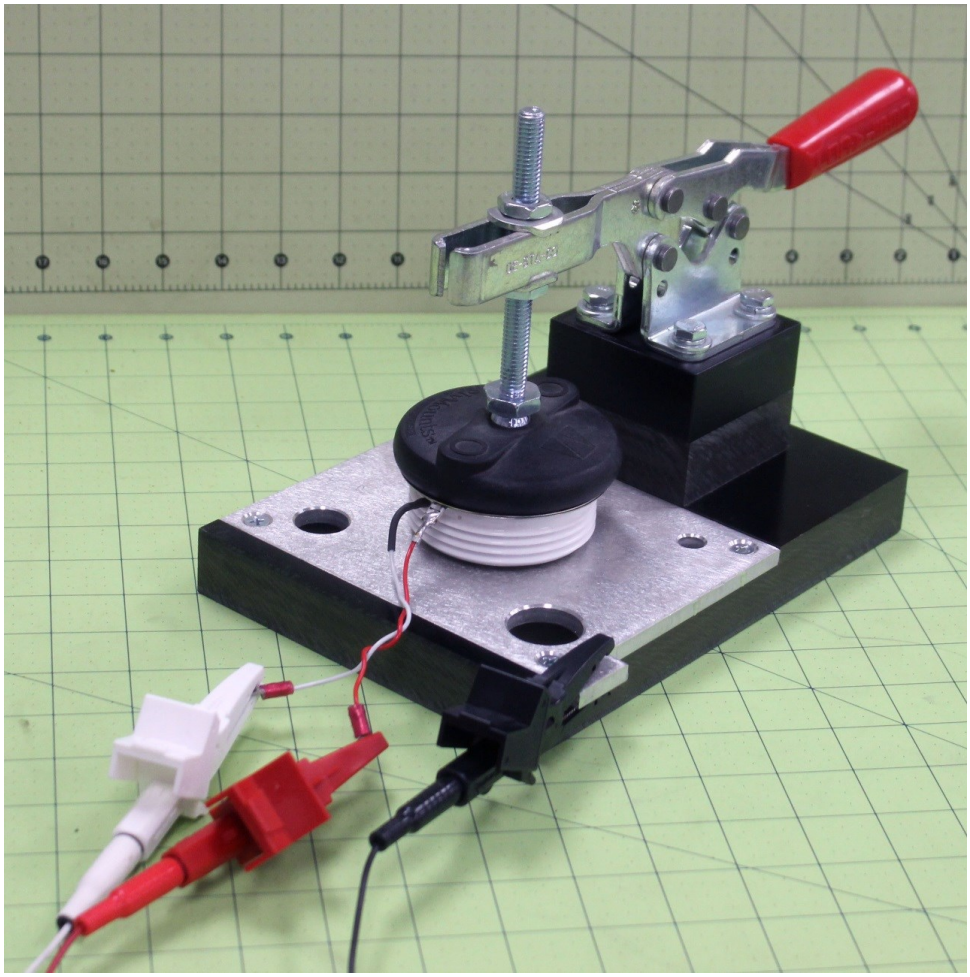
1. With the tester in the OFF position insert the Gate Test cables into the appropriate socket on the tester.



2. Determine the Voltage rating of the Semiconductor you are about to test. The min/max turn-on characteristics can be found on the device **manufacturer's datasheet**.

3. Select the "Gate Test" option.

4. Connect the Anode (BLACK), Cathode (RED) & Gate (WHITE) leads to the semiconductor being tested.



DANGER DO NOT touch the clamps while the test is running.

WARNING Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on.

5. Turn the tester ON. The Green Power light should illuminate.

6. Press and Hold the “Push To Test” button in the Gate test section. The green Active light will illuminate.

7. Slowly turn the Voltage control dial clockwise until the Blue Gate Trigger Light illuminates. **Under no circumstances must the rated current of the device be exceeded.**

Refer to the **manufacturer's datasheet** for device specifications.

Note the Gate Voltage (Vgt) & Gate Current (Igt) just prior to the light illuminating.

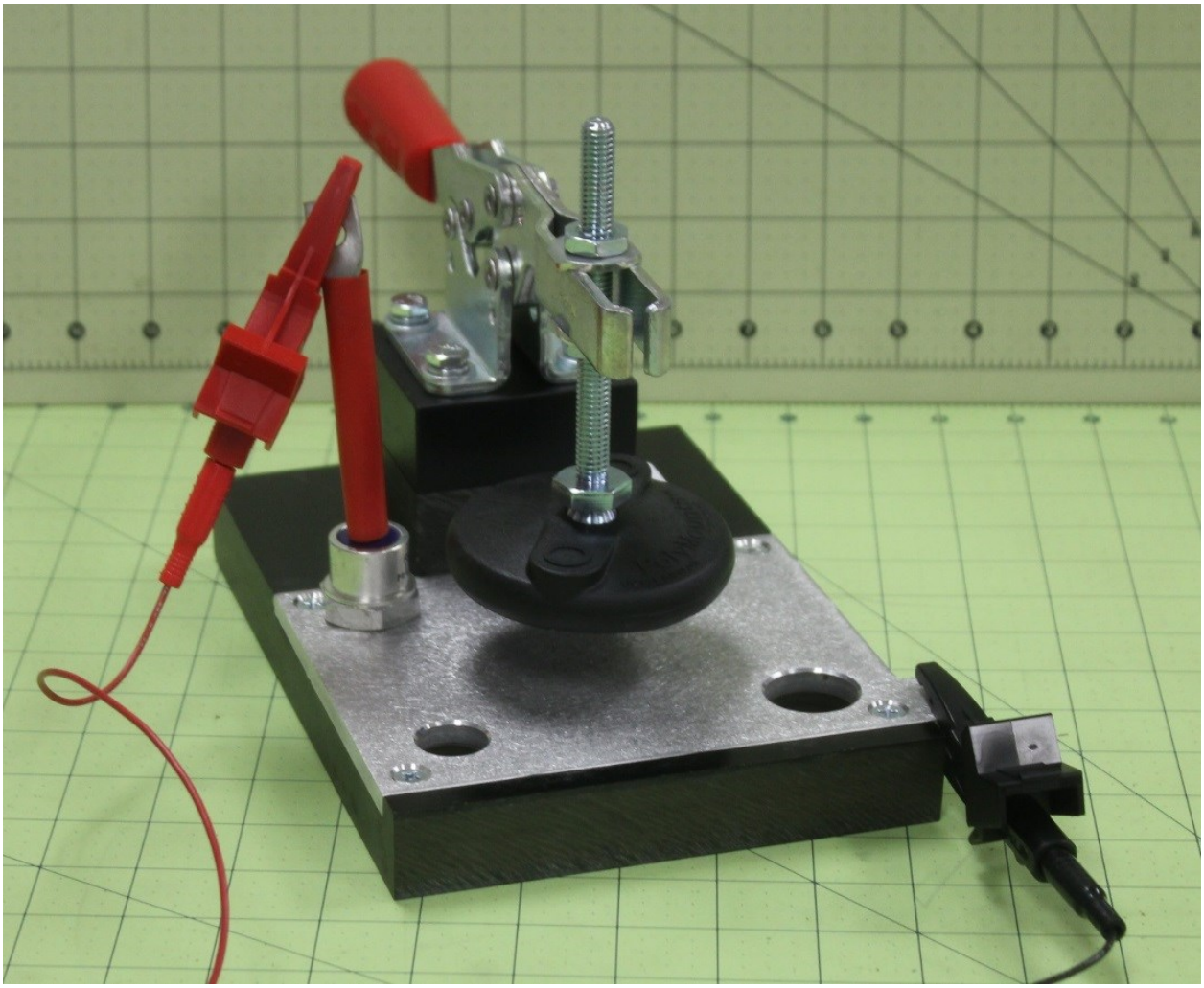
Note: When the test is active, a 60Hz 0-15V Square wave is applied across the Anode and Cathode. A 7.5ohm load is in series with the anode terminal, so when it is fully gated on, the max load current will be ~2A. The panel meters display the DC gate voltage and gate current applied to the device under test. The Gate LED illuminates upon the detection that the Anode and Cathode begins to conduct.

Note that the gate voltage and gate current should be recorded as the maximum values right before the Gate LED Illuminates. Under some conditions, the gate current may actually show a decrease after gating ON, and that is normal behavior, thus the maximum value seen must be taken before the device gates ON.

8. Return the Voltage Control Dial to Zero.

9. Turn off the power prior to removing the leads.

3.2 Diodes



3.2.1 PRV / PFV Test — Diodes

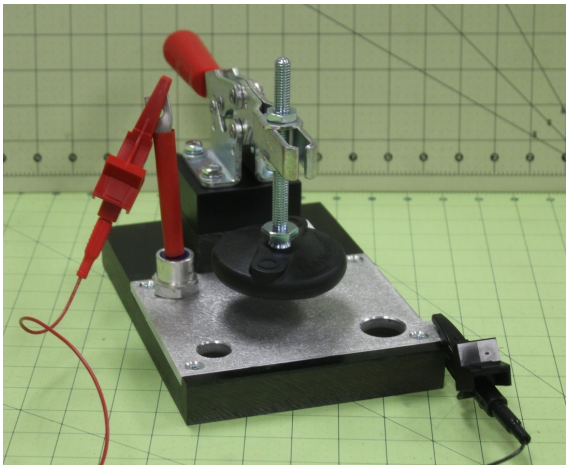
Functioning diodes will only conduct in the Forward direction and block in the Reverse direction. It does not matter whether they are Forward or Reverse polarity diodes.

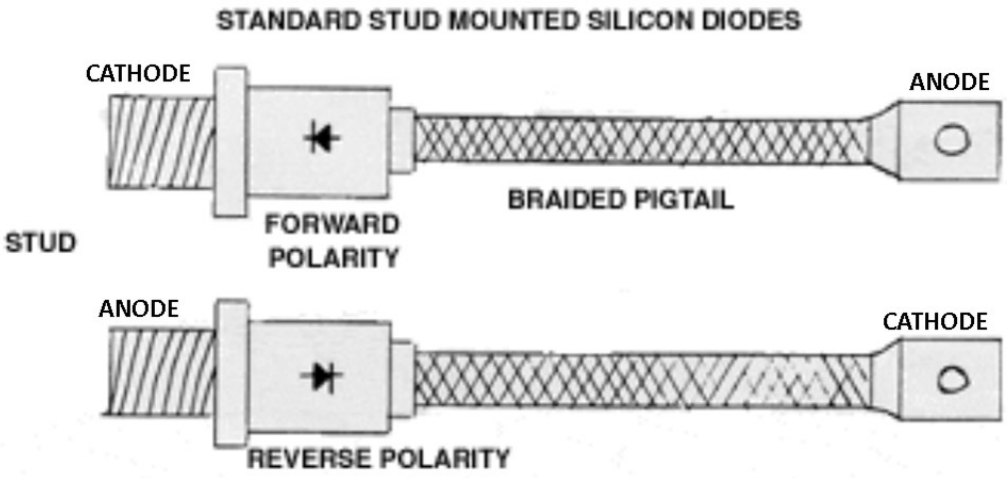
Always connect the RED test lead to the Cathode of the diode and the BLACK test lead to the Anode.

A properly functioning diode will always block voltage when the test switch is in the PRV (Reverse) position. Likewise, when the test switch is in the PFV (Forward) position, the diode will conduct.

Note: Before testing, check with the manufacturer's datasheet for the device specifications.

See below to connect the Anode (BLACK) and Cathode (RED) leads to the Diode.





1. With the tester in the OFF position insert the High Voltage test cables into the appropriate socket on the tester.

2. Determine the Voltage rating of the Semiconductor you are about to test. This can be found in the device **manufacturer's datasheet**. If it is 2.5kV or less, select the 2.5kV setting on the voltage selector switch. If it is between 2.5kV & 5kV select the 5kV option.

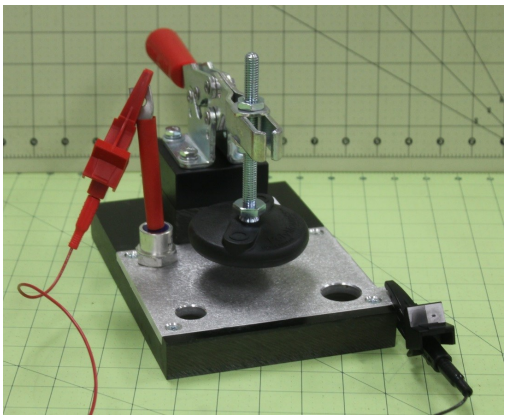
3. Determine what Leakage Current rating of the Semiconductor you are about to test is rated at. This can be found in the device **manufacturer's datasheet**. If it is 10 mA or less, select the 10 mA setting on the current selector switch. If it is between 10 mA & 100 mA select the 100 mA option.

Note: The tester has an over current protection system built in, so the unit will automatically trip if the set current is exceeded.

4. Select the "High Voltage Test" option.

5. Select **REV** (VRRM) or **FWD** (VDRM) in the High Voltage Testing portion of the front panel.

6. Connect the Anode (BLACK) and Cathode (RED) leads to the semiconductor being tested.



DANGER DO NOT touch the clamps while the test is running.

WARNING Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on. The tester will not indicate a "ready" state until the dial is in its Zero position.

DANGER **YOU ARE ABOUT TO BEGIN A HIGH VOLTAGE TEST. ENSURE THAT THE WORK AREA IS CLEAR AND THAT ALL PERSONNEL ARE CLEAR OF THE WORK AREA. THE TEST MUST BE PERFORMED ON A NON-CONDUCTING SURFACE.**

Note: There is a 60 second time out function built into this test for safety reasons. Should the test "time out" the "Test Ready" light will go out. Release the test button and turn the voltage control dial counterclockwise back to zero wait 5 seconds for the "Test Ready" light to illuminate. Only then can testing commence.

7. Turn the tester ON. The Green Power light should illuminate.

8. The Green Test Ready light should be illuminated.

9. Press and Hold the “Push To Test” button in the High Voltage test section. The yellow Active light will illuminate.

Note: The Voltage control dial must be turned all the way counterclockwise, or the test cannot begin.

CAUTION: If the Ready Test light is flashing, the Voltage control dial must be turned all the way counter-clockwise to the zero position.

10. Slowly turn the Voltage control dial clockwise until the rated voltage of the device is reached. **Under no circumstances must the rated voltage of the device be exceeded.**

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Refer to the **manufacturer’s datasheet** for maximum PFV and PRV.

11. Note the leakage current at rated voltage.

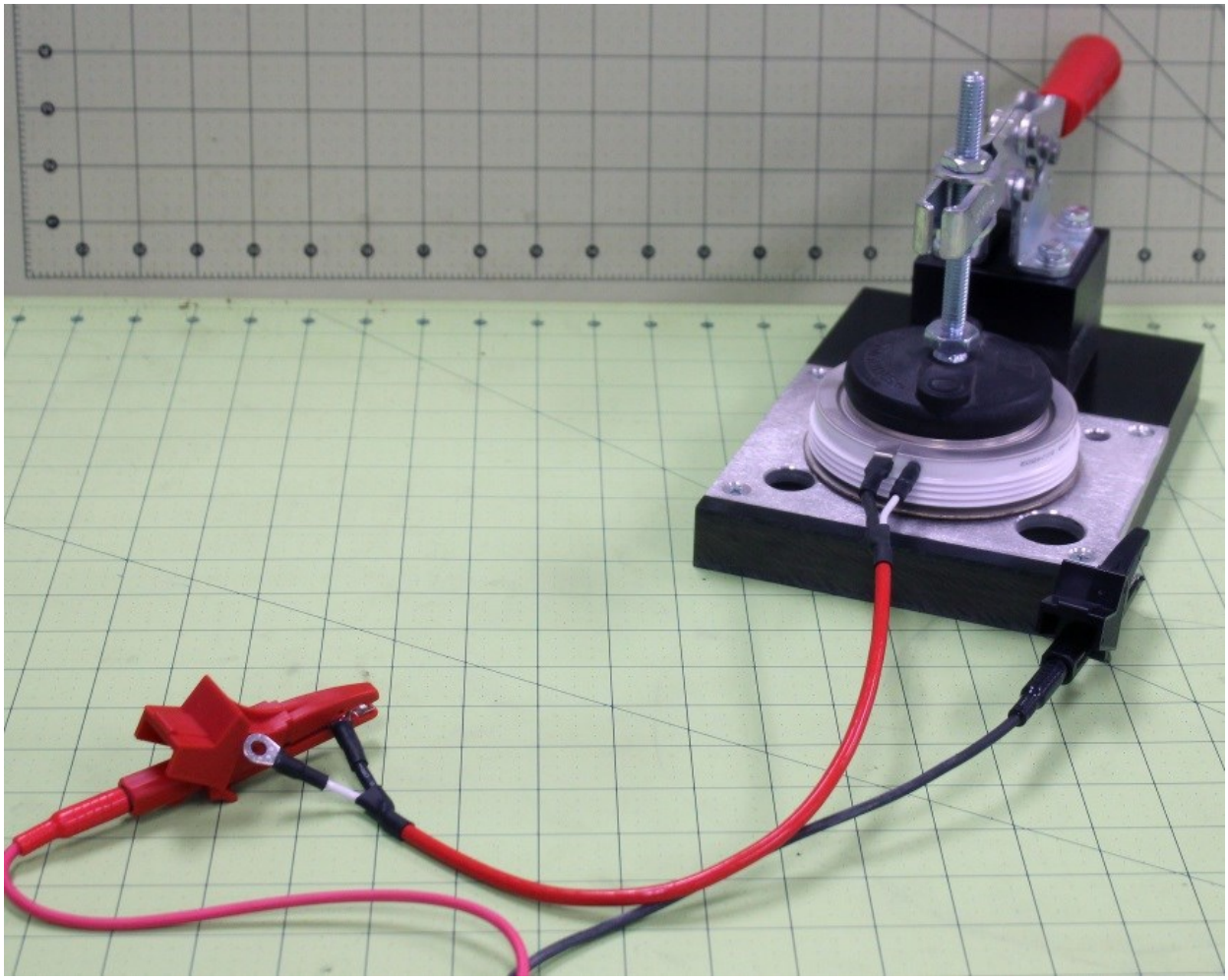
Note: If the semiconductor is shorted, the tester will automatically disconnect the voltage to the semiconductor when the max current setting is reached - 10mA or 100mA Note that the decimal point on the panel meter will blink during an over current condition and will stop blinking after the unit has resumed a steady state.

12. Return the Voltage Control Dial to Zero. **Make sure the Voltage meter reads zero before touching the test cables or test unit.**

Note: the FWD/REV voltage switch can be toggled to repeat this test with the opposite polarity voltage applied.

13. Turn off the power prior to removing the leads.

3.3 GTO's



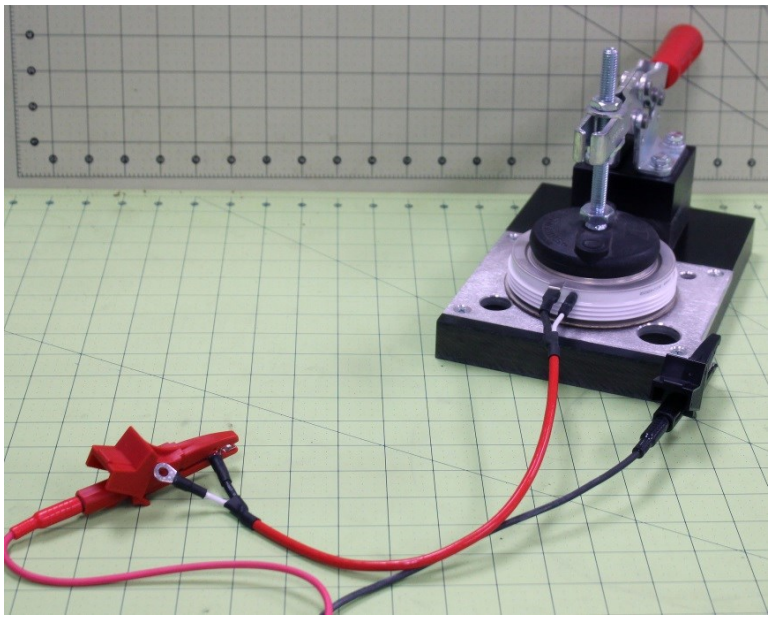
3.3.1 PRV / PFV Test — GTO's

When testing press-pack semiconductors, it is important to note that they must be clamped with sufficient force to make internal contact between the silicon and the pole faces. Using the Clamp provided will achieve this.

It is necessary when carrying out the PFV test to short the Gate and Cathode leads together.

Note: Before testing, check with the manufacturer's datasheet for the device specifications.

See below to connect the Anode (BLACK) and Cathode (RED) leads to the GTO.



Note that the Anode on a GTO is the Flange side.

⚠WARNING DO NOT MIX UP THE ANODE & CATHODE LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE GATE!

Note: When testing Asymmetrical OR Short Type GTOs , the device is incapable of blocking reverse voltage, so expect a high current reading when performing the PRV test.

1. With the tester in the OFF position insert the High Voltage test cables into the appropriate socket on the tester.

2. Determine the Voltage rating of the Semiconductor you are about to test. This can be found in the device **manufacturer's datasheet**. If it is 2.5kV or less, select the 2.5kV setting on the voltage selector switch. If it is between 2.5kV & 5kV select the 5kV option.

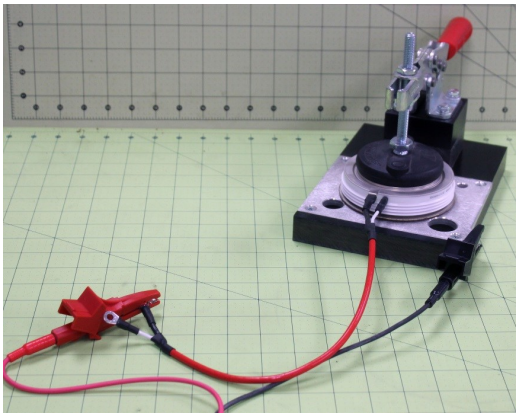
3. Determine what Leakage Current rating of the Semiconductor you are about to test is rated at. This can be found in the device **manufacturer's datasheet**. If it is 10 mA or less, select the 10 mA setting on the current selector switch. If it is between 10 mA & 100 mA select the 100 mA option.

Note: The tester has an over current protection system built in, so the unit will automatically trip if the set current is exceeded.

4. Select the "High Voltage Test" option.

5. Select **REV** (VRRM) or **FWD** (VDRM) in the High Voltage Testing portion of the front panel.

6. Connect the Anode (BLACK) and Cathode (RED) leads to the semiconductor being tested.



DANGER DO NOT touch the clamps while the test is running.

DO NOT MIX UP THE ANODE & CATHODE LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE GATE!

WARNING Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on. The tester will not indicate a "ready" state until the dial is in its Zero position.

DANGER **YOU ARE ABOUT TO BEGIN A HIGH VOLTAGE TEST. ENSURE THAT THE WORK AREA IS CLEAR AND THAT ALL PERSONNEL ARE CLEAR OF THE WORK AREA. THE TEST MUST BE PERFORMED ON A NON-CONDUCTING SURFACE.**

Note: There is a 60 second time out function built into this test for safety reasons. Should the test "time out" the "Test Ready" light will go out. Release the test button and turn the voltage control dial counterclockwise back to zero wait 5 seconds for the "Test Ready" light to illuminate. Only then can testing commence.

7. Turn the tester ON. The Green Power light should illuminate.

8. The Green Test Ready light should be illuminated.

9. Press and Hold the “Push To Test” button in the High Voltage test section. The yellow Active light will illuminate.

Note: The Voltage control dial must be turned all the way counterclockwise, or the test cannot begin.

CAUTION: If the Ready Test light is flashing, the Voltage control dial must be turned all the way counter-clockwise to the zero position.

10. Slowly turn the Voltage control dial clockwise until the rated voltage of the device is reached. **Under no circumstances must the rated voltage of the device be exceeded.**

Per the PFV/PRV switch, the tester is either applying a positive (PFV) 60HZ Half Wave voltage across the Anode and Cathode or a Negative (PRV) Half Wave voltage across the Anode and Cathode. The voltage meter displays the measured peak voltage applied to the device under test. Note that it does not indicate polarity, so a PRV test will show the same polarity as a PFV test even though the applied voltage polarity is different. The current meter displays the measured peak current in line with the device under test

Refer to the **manufacturer’s datasheet** for maximum PFV and PRV.

11. Note the leakage current at rated voltage.

Note: If the semiconductor is shorted, the tester will automatically disconnect the voltage to the semiconductor when the max current setting is reached - 10mA or 100mA Note that the decimal point on the panel meter will blink during an over current condition and will stop blinking after the unit has resumed a steady state.

12. Return the Voltage Control Dial to Zero. **Make sure the Voltage meter reads zero before touching the test cables or test unit.**

Note: the FWD/REV voltage switch can be toggled to repeat this test with the opposite polarity voltage applied.

13. Turn off the power prior to removing the leads.

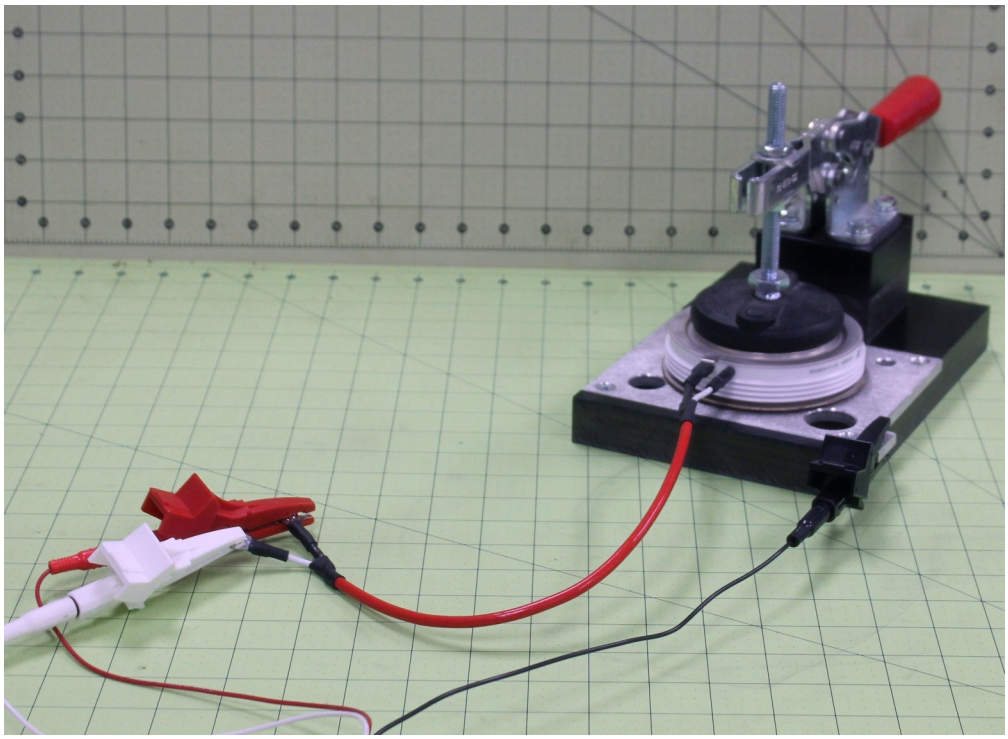
3.3.2 Gate Test — GTO's

With the tester in the OFF position insert the Gate Test cable into the appropriate socket on the tester.

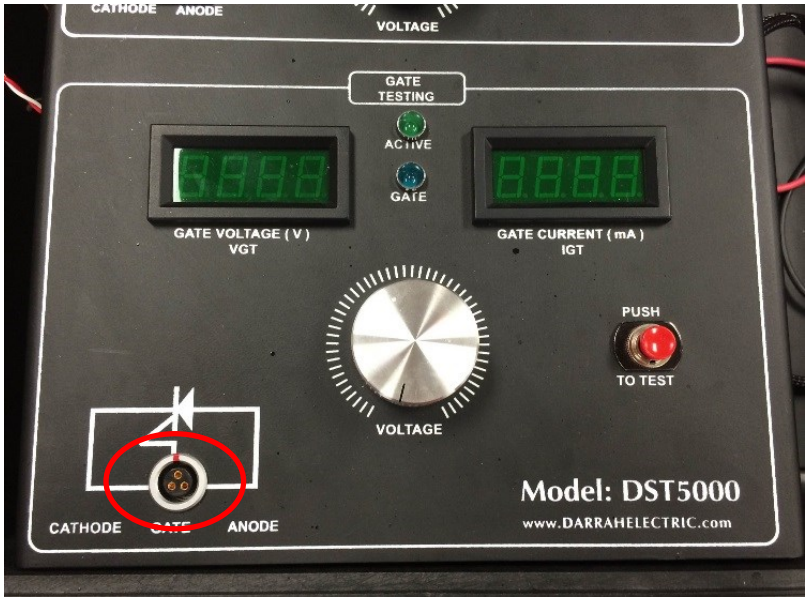
When testing press-pack semiconductors, it is important to note that they must be clamped with sufficient force to make internal contact between the silicon and the pole faces. Using the Clamp provided will achieve this. Refer to the Clamp instructions on page 5 for more details.

Note: Before testing, check with the manufacturer's datasheet for the device specifications.

See below to connect the Anode (BLACK), Cathode (RED) & Gate (WHITE) leads to the GTO.



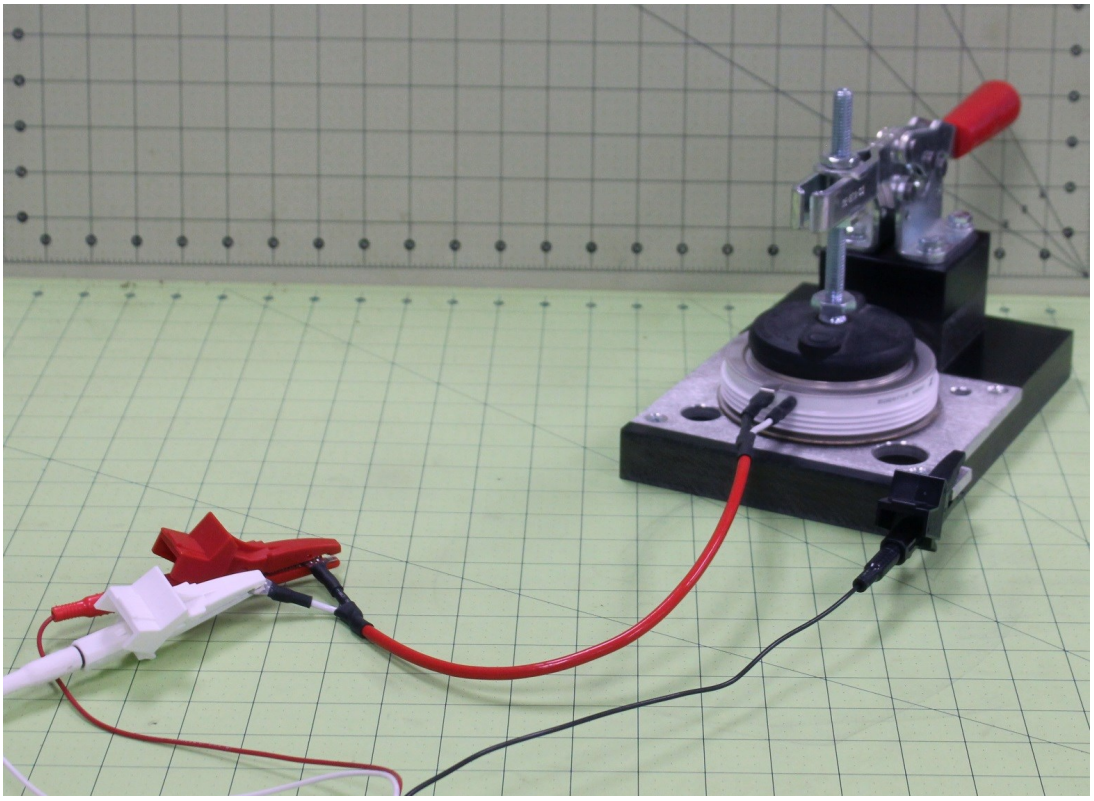
1. With the tester in the OFF position insert the Gate Test cables into the appropriate socket on the tester.



2. Determine the Voltage rating of the Semiconductor you are about to test. The min/max turn-on characteristics can be found on the device **manufacturer's datasheet**.

3. Select the "Gate Test" option.

4. Connect the Anode (BLACK), Cathode (RED) & Gate (WHITE) leads to the semiconductor being tested.



DANGER DO NOT touch the clamps while the test is running.

WARNING Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on.

5. Turn the tester ON. The Green Power light should illuminate.

6. Press and Hold the “Push To Test” button in the Gate test section. The green Active light will illuminate.

7. Slowly turn the Voltage control dial clockwise until the Blue Gate Trigger Light illuminates. **Under no circumstances must the rated current of the device be exceeded.**

Refer to the **manufacturer's datasheet** for device specifications.

Note the Gate Voltage (Vgt) & Gate Current (Igt) just prior to the light illuminating.

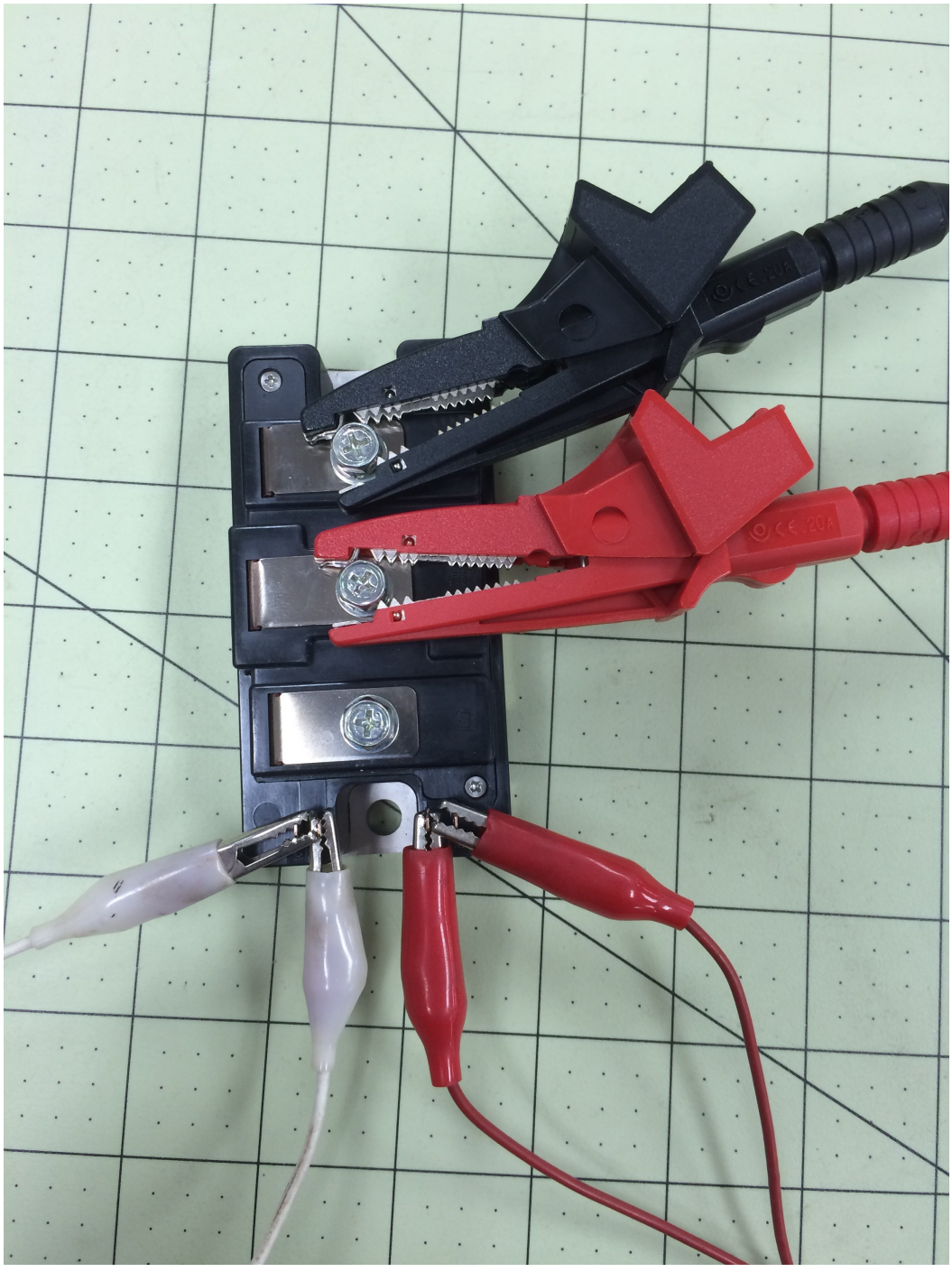
Note: When the test is active, a 60Hz 0-15V Square wave is applied across the Anode and Cathode. A 7.5ohm load is in series with the anode terminal, so when it is fully gated on, the max load current will be ~2A. The panel meters display the DC gate voltage and gate current applied to the device under test. The Gate LED illuminates upon the detection that the Anode and Cathode begins to conduct.

Note that the gate voltage and gate current should be recorded as the maximum values right before the Gate LED Illuminates. Under some conditions, the gate current may actually show a decrease after gating ON, and that is normal behavior, thus the maximum value seen must be taken before the device gates ON.

8. Return the Voltage Control Dial to Zero.

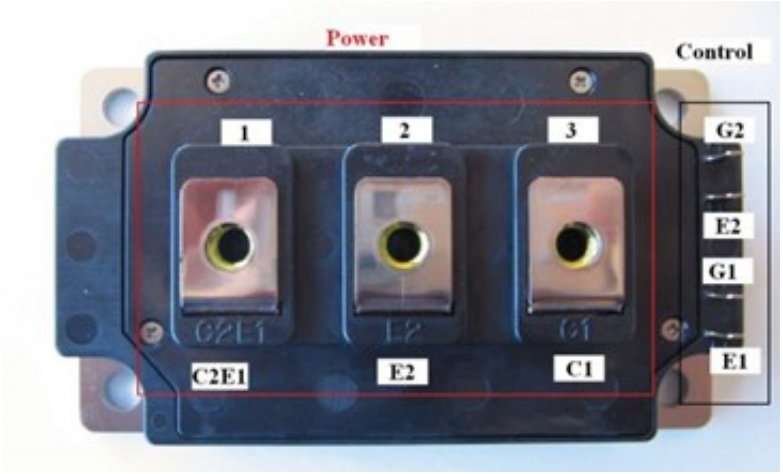
9. Turn off the power prior to removing the leads.

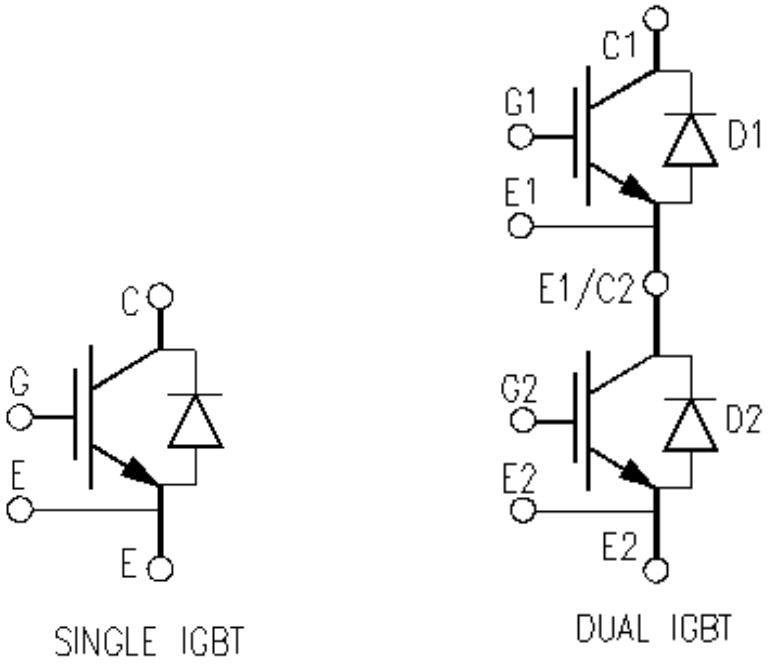
3.4 IGBT's



3.4.1 PRV / PFV Test — IGBT's

Examples of IGBT's:

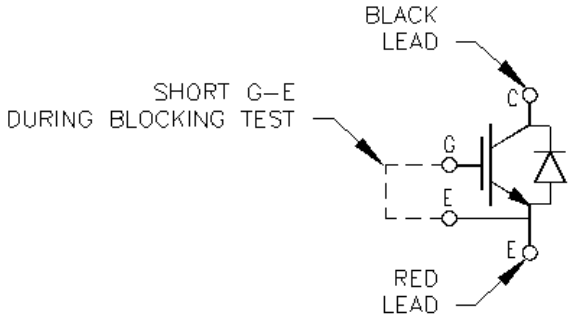




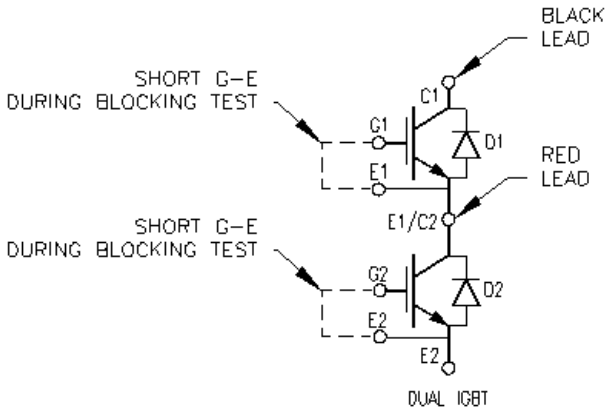
Note: Before testing, check with the manufacturer's datasheet for the device specifications.

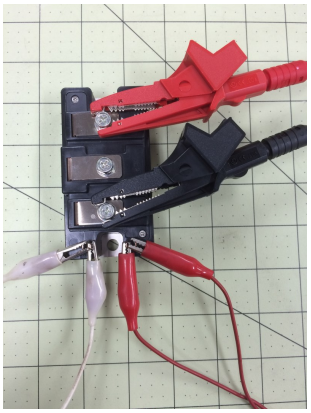
⚠WARNING IGBT Modules are very sensitive to ESD (Electro Static Discharge). It's recommended to handle them with care and ALWAYS use anti-static protection.

See below for test lead connections. Using the red and black test lead set, connect them to the device to be tested.
NOTE: For Dual IGBT's, this test must be performed on both upper and lower IGBT's.

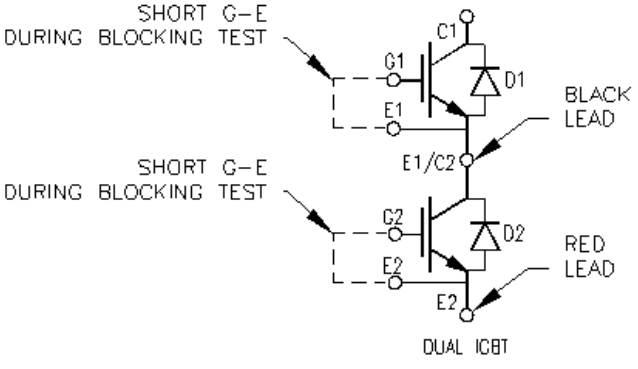


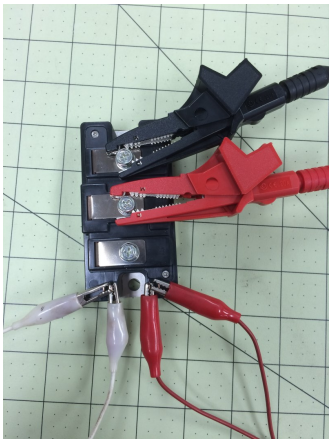
Blocking test connections for a single IGBT





Blocking test connections for upper IGBT





Blocking test connections for lower IGBT

1. With the tester in the OFF position insert the High Voltage test cables into the appropriate socket on the tester.

2. Determine the Voltage rating of the Semiconductor you are about to test. This can be found in the device **manufacturer's datasheet**. If it is 2.5kV or less, select the 2.5kV setting on the voltage selector switch. If it is between 2.5kV & 5kV select the 5kV option.

<u>Never exceed this rating as permanent damage to the IGBT will result.</u>

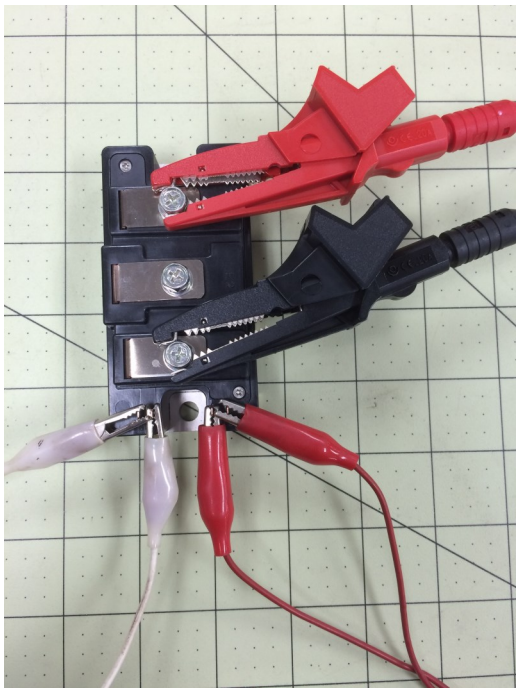
3. Determine what Leakage Current rating of the Semiconductor you are about to test is rated at. This can be found in the device **manufacturer's datasheet**. If it is 10 mA or less, select the 10 mA setting on the current selector switch. If it is between 10 mA & 100 mA select the 100 mA option.

Note: The tester has an over current protection system built in, so the unit will automatically trip if the set current is exceeded.

4. Select the "High Voltage Test" option.

5. Select **REV** (VRRM) or **FWD** (VDRM) in the High Voltage Testing portion of the front panel.

6. Connect the Anode (BLACK) and Cathode (RED) leads to the semiconductor being tested.



Upper IGBT **Lower IGBT**

Examples of connections

NOTE: For Dual IGBT's, this test must be performed on both upper and lower IGBT's.

DANGER DO NOT touch the clamps while the test is running.

DO NOT MIX UP THE ANODE & CATHODE LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE GATE!

WARNING Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on. The tester will not indicate a "ready" state until the dial is in its Zero position.

DANGER **YOU ARE ABOUT TO BEGIN A HIGH VOLTAGE TEST. ENSURE THAT THE WORK AREA IS CLEAR AND THAT ALL PERSONNEL ARE CLEAR OF THE WORK AREA. THE TEST MUST BE PERFORMED ON A NON-CONDUCTING SURFACE.**

Note: There is a 60 second time out function built into this test for safety reasons. Should the test "time out" the "Test Ready" light will go out. Release the test button and turn the voltage control dial counterclockwise back to zero wait 5 seconds for the "Test Ready" light to illuminate. Only then can testing commence.

7. Turn the tester ON. The Green Power light should illuminate.

8. The Green Test Ready light should be illuminated.

9. Press and Hold the “Push To Test” button in the High Voltage test section. The yellow Active light will illuminate.

Note: The Voltage control dial must be turned all the way counterclockwise, or the test cannot begin.

CAUTION: If the Ready Test light is flashing, the Voltage control dial must be turned all the way counter-clockwise to the zero position.

10. Slowly turn the Voltage control dial clockwise until the rated voltage of the device is reached. **Under no circumstances must the rated voltage of the device be exceeded.**

Per the PFV/PRV switch, the tester is either applying a positive (PFV) 60HZ Half Wave voltage across the Anode and Cathode or a Negative (PRV) Half Wave voltage across the Anode and Cathode. The voltage meter displays the measured peak voltage applied to the device under test. Note that it does not indicate polarity, so a PRV test will show the same polarity as a PFV test even though the applied voltage polarity is different. The current meter displays the measured peak current in line with the device under test

Refer to the **manufacturer’s datasheet** for maximum PFV and PRV.

11. Note the leakage current at rated voltage.

Note: If the semiconductor is shorted, the tester will automatically disconnect the voltage to the semiconductor when the max current setting is reached - 10mA or 100mA Note that the decimal point on the panel meter will blink during an over current condition and will stop blinking after the unit has resumed a steady state.

12. Return the Voltage Control Dial to Zero. **Make sure the Voltage meter reads zero before touching the test cables or test unit.**

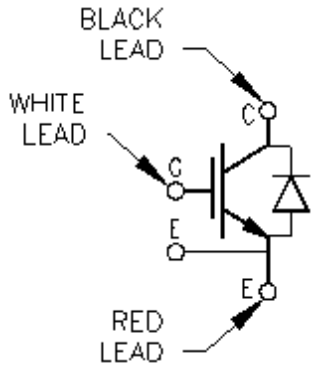
Note: the FWD/REV voltage switch can be toggled to repeat this test with the opposite polarity voltage applied.

13. Turn off the power prior to removing the leads.

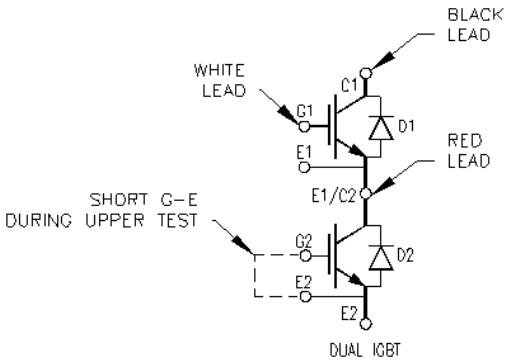
3.4.2 Gate Test — IGBT's

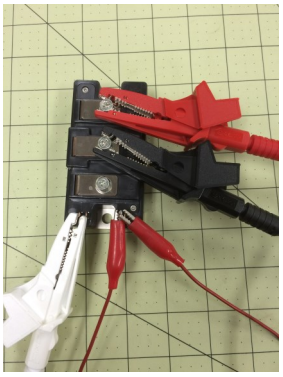
Note: Before testing, check with the manufacturer's datasheet for the device specifications.

Connect the test leads to the semiconductor as illustrated below.

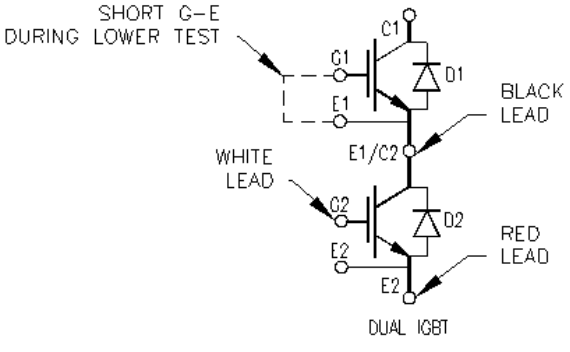


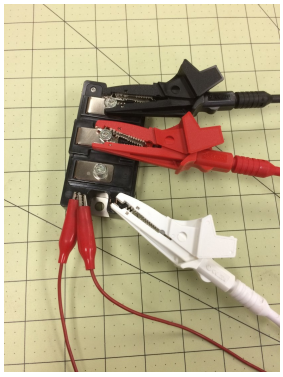
Single IGBT Gate test connections





Gate test connections for upper IGBT





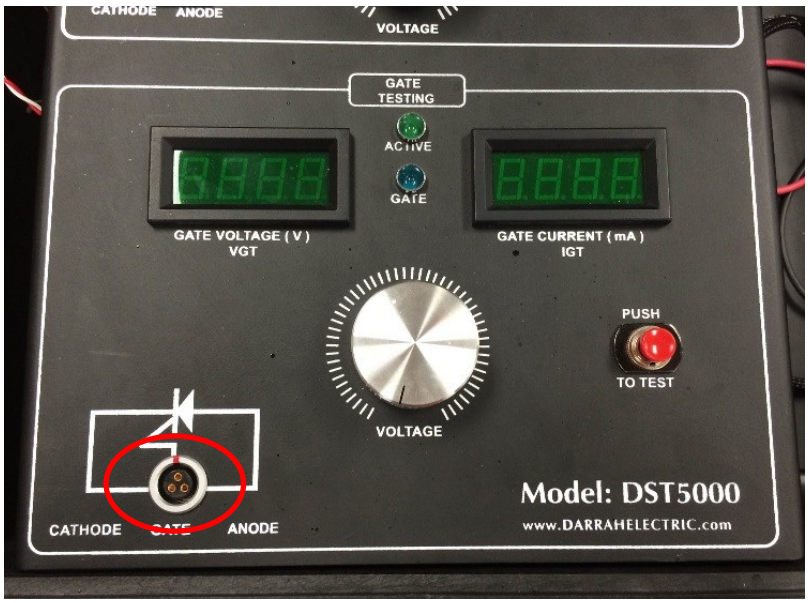
Gate test connections for lower IGBT

Note: If the Blue Gate Trigger Light illuminates before raising the voltage dial, the IGBT may be shorted and a forward blocking test should be performed.

Note: Due to the fact that the IGBT is a MOS input device, very little or sometimes negative gate current will be displayed when testing IGBT's.

⚠WARNING **IGBT Modules are very sensitive to ESD (Electro Static Discharge). It's recommended to handle them with care and ALWAYS use anti-static protection.**

1. With the tester in the OFF position insert the Gate Test cables into the appropriate socket on the tester.



2. Determine the Voltage rating of the Semiconductor you are about to test. The min/max turn-on characteristics can be found on the device **manufacturer's datasheet**.

3. Select the "Gate Test" option.

4. Connect the Anode (BLACK), Cathode (RED) & Gate (WHITE) leads to the semiconductor being tested.

Upper IGBT

Lower IGBT

Examples of connections

DANGER DO NOT touch the clamps while the test is running.

WARNING Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on.

5. Turn the tester ON. The Green Power light should illuminate.

6. Press and Hold the “Push To Test” button in the Gate test section. The green Active light will illuminate.

7. Slowly turn the Voltage control dial clockwise until the Blue Gate Trigger Light illuminates. The device under test should trigger at approximately 7 volts. See **manufacturer's datasheet** for the min/max gate trigger voltages.

Note: Due to the fact that the IGBT is a MOS input device, very little or sometimes negative gate current will be displayed when testing IGBT's.

Note the Gate Voltage (Vgt) & Gate Current (Igt) just prior to the light illuminating.

Note: When the test is active, a 60Hz 0-15V Square wave is applied across the Anode and Cathode. A 7.5ohm load is in series with the anode terminal, so when it is fully gated on, the max load current will be ~2A. The panel meters display the DC gate voltage and gate current applied to the device under test. The Gate LED illuminates upon the detection that the Anode and Cathode begins to conduct.

Note that the gate voltage and gate current should be recorded as the maximum values right before the Gate LED Illuminates. Under some conditions, the gate current may actually show a decrease after gating ON, and that is normal behavior, thus the maximum value seen must be taken before the device gates ON.

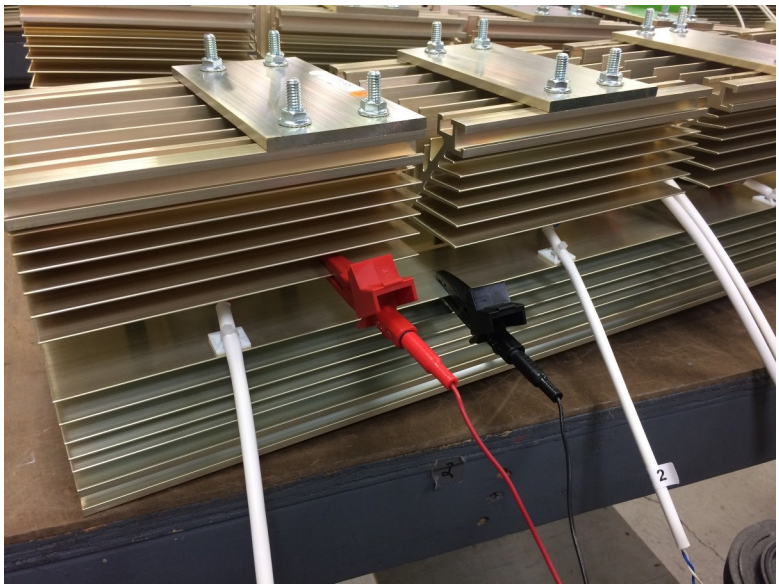
8. Return the Voltage Control Dial to Zero.

9. Turn off the power prior to removing the leads.

3.5 Assemblies

3.5.1 PRV / PFV Test — Assemblies

See below to connect the Anode (BLACK) and Cathode (RED) leads to an Assembly.



Note: Before testing, check with the manufacturer's datasheet for the device specifications.

⚠WARNING **DO NOT MIX UP THE ANODE & CATHODE LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE GATE!**

1. With the tester in the OFF position insert the High Voltage test cables into the appropriate socket on the tester.

2. Determine the Voltage rating of the Semiconductor you are about to test. This can be found in the device **manufacturer's datasheet**. If it is 2.5kV or less, select the 2.5kV setting on the voltage selector switch. If it is between 2.5kV & 5kV select the 5kV option.

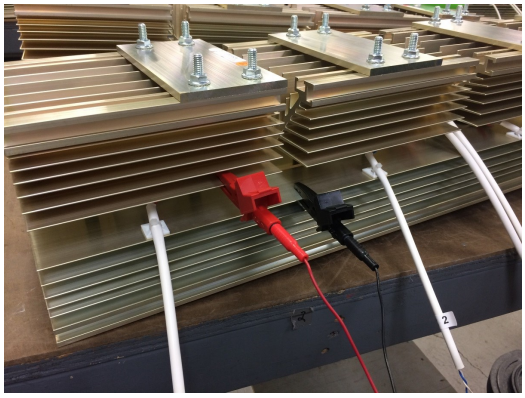
3. Determine what Leakage Current rating of the Semiconductor you are about to test is rated at. This can be found in the device **manufacturer's datasheet**. If it is 10 mA or less, select the 10 mA setting on the current selector switch. If it is between 10 mA & 100 mA select the 100 mA option.

Note: The tester has an over current protection system built in, so the unit will automatically trip if the set current is exceeded.

4. Select the "High Voltage Test" option.

5. Select **REV** (VRRM) or **FWD** (VDRM) in the High Voltage Testing portion of the front panel.

6. Connect the Anode (BLACK) and Cathode (RED) leads to the semiconductor being tested.



DANGER

DO NOT touch the clamps while the test is running.

DO NOT MIX UP THE ANODE & CATHODE LEADS OR HIGH VOLTAGE WILL BE APPLIED TO THE GATE!

WARNING

Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on. The tester will not indicate a "ready" state until the dial is in its Zero position.

DANGER

YOU ARE ABOUT TO BEGIN A HIGH VOLTAGE TEST. ENSURE THAT THE WORK AREA IS CLEAR AND THAT ALL PERSONNEL ARE CLEAR OF THE WORK AREA. THE TEST MUST BE PERFORMED ON A NON-CONDUCTING SURFACE.

Note: There is a 60 second time out function built into this test for safety reasons. Should the test "time out" the "Test Ready" light will go out. Release the test button and turn the voltage control dial counterclockwise back to zero wait 5 seconds for the "Test Ready" light to illuminate. Only then can testing commence.

7. Turn the tester ON. The Green Power light should illuminate.

8. The Green Test Ready light should be illuminated.

9. Press and Hold the “Push To Test” button in the High Voltage test section. The yellow Active light will illuminate.

Note: The Voltage control dial must be turned all the way counterclockwise, or the test cannot begin.

CAUTION: If the Ready Test light is flashing, the Voltage control dial must be turned all the way counter-clockwise to the zero position.

10. Slowly turn the Voltage control dial clockwise until the rated voltage of the device is reached. **Under no circumstances must the rated voltage of the device be exceeded.**

Per the PFV/PRV switch, the tester is either applying a positive (PFV) 60HZ Half Wave voltage across the Anode and Cathode or a Negative (PRV) Half Wave voltage across the Anode and Cathode. The voltage meter displays the measured peak voltage applied to the device under test. Note that it does not indicate polarity, so a PRV test will show the same polarity as a PFV test even though the applied voltage polarity is different. The current meter displays the measured peak current in line with the device under test

Refer to the **manufacturer’s datasheet** for maximum PFV and PRV.

11. Note the leakage current at rated voltage.

Note: If the semiconductor is shorted, the tester will automatically disconnect the voltage to the semiconductor when the max current setting is reached - 10mA or 100mA Note that the decimal point on the panel meter will blink during an over current condition and will stop blinking after the unit has resumed a steady state.

12. Return the Voltage Control Dial to Zero. **Make sure the Voltage meter reads zero before touching the test cables or test unit.**

Note: the FWD/REV voltage switch can be toggled to repeat this test with the opposite polarity voltage applied.

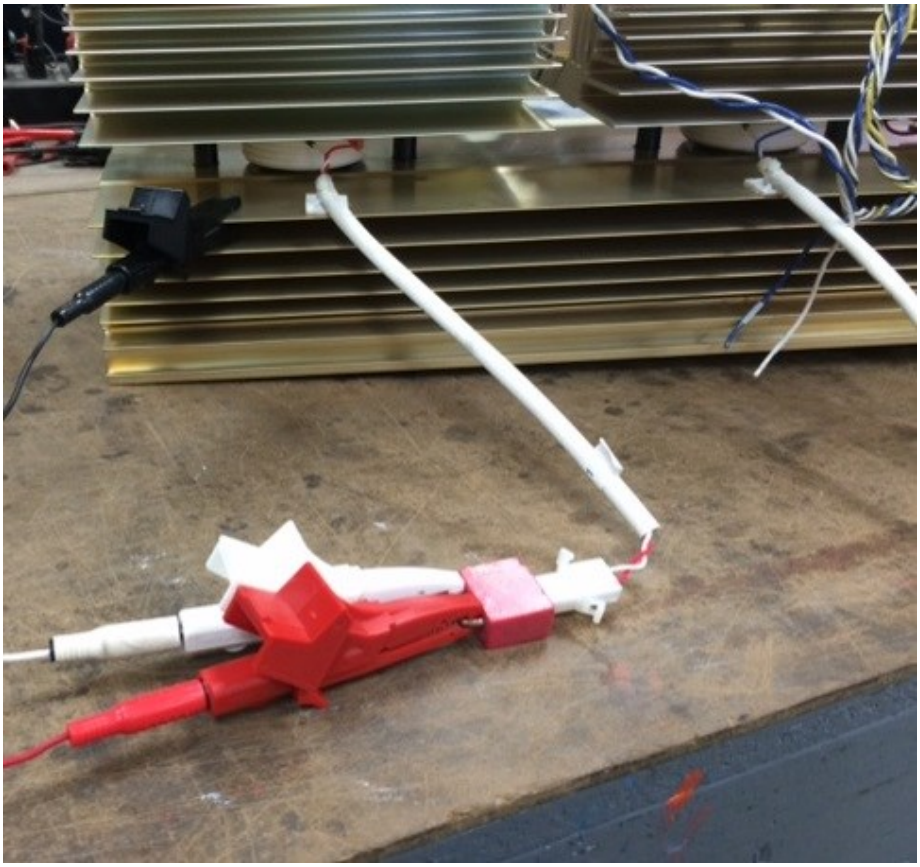
13. Turn off the power prior to removing the leads.

3.5.2 Gate Test — Assemblies

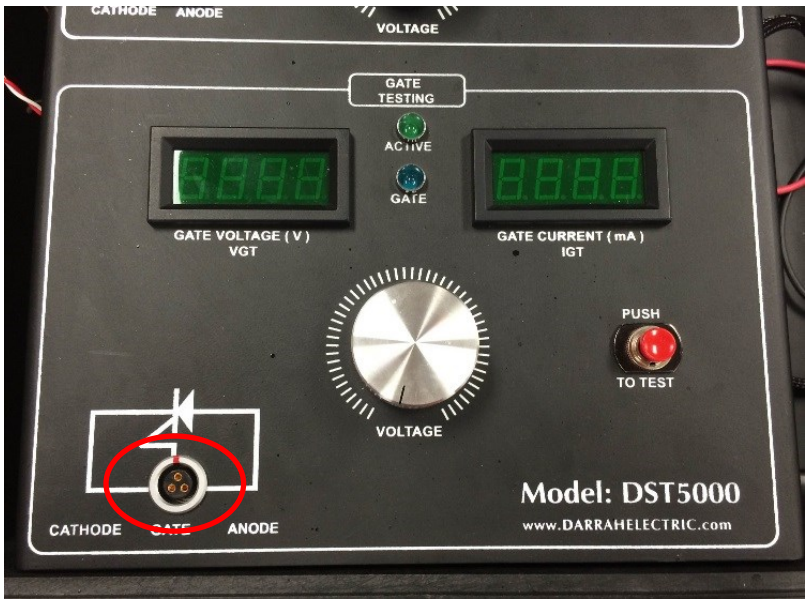
With the tester in the OFF position insert the Gate Test cable into the appropriate socket on the tester.

Note: Before testing, check with the manufacturer's datasheet for the device specifications.

See below to connect the Anode (BLACK), Cathode (RED) & Gate (WHITE) leads to an Assembly.



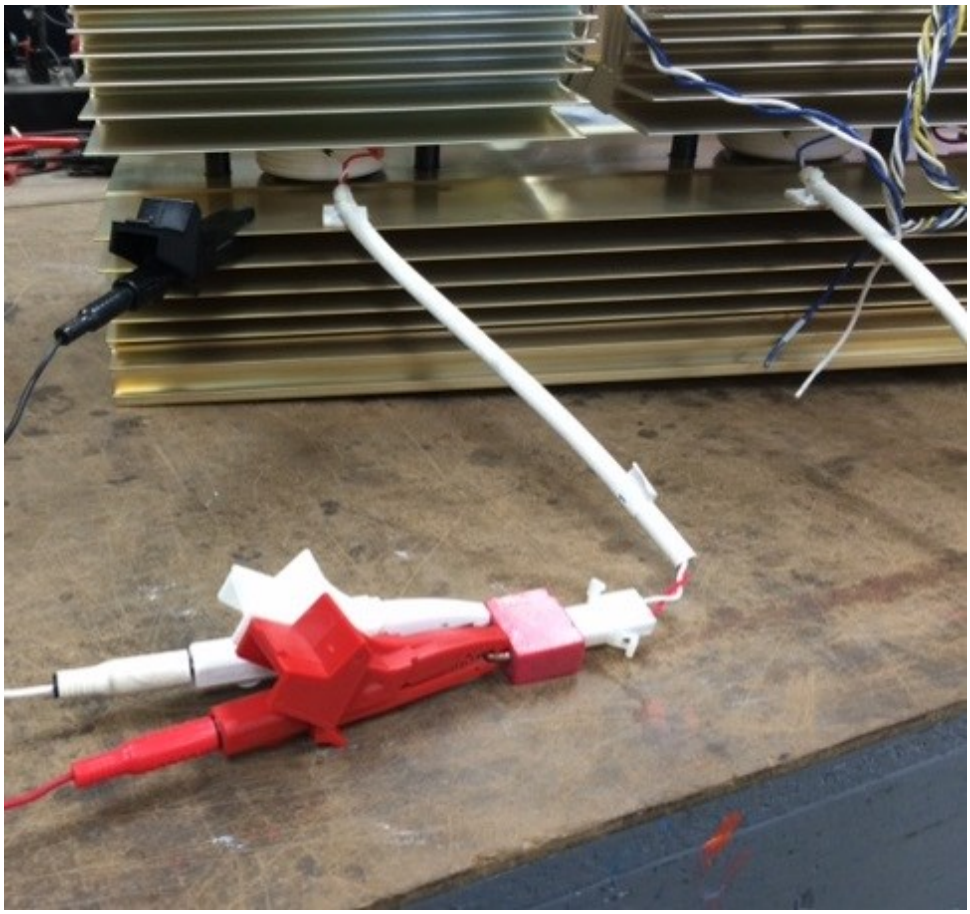
1. With the tester in the OFF position insert the Gate Test cables into the appropriate socket on the tester.



2. Determine the Voltage rating of the Semiconductor you are about to test. The min/max turn-on characteristics can be found on the device **manufacturer's datasheet**.

3. Select the "Gate Test" option.

4. Connect the Anode (BLACK), Cathode (RED) & Gate (WHITE) leads to the semiconductor being tested.



DANGER DO NOT touch the clamps while the test is running.

WARNING Ensure that the Voltage Control Dial is at the Zero position (Fully counter clock-wise) before turning the tester on.

5. Turn the tester ON. The Green Power light should illuminate.

6. Press and Hold the “Push To Test” button in the Gate test section. The green Active light will illuminate.

7. Slowly turn the Voltage control dial clockwise until the Blue Gate Trigger Light illuminates. **Under no circumstances must the rated current of the device be exceeded.**

Refer to the **manufacturer's datasheet** for device specifications.

Note the Gate Voltage (Vgt) & Gate Current (Igt) just prior to the light illuminating.

Note: When the test is active, a 60Hz 0-15V Square wave is applied across the Anode and Cathode. A 7.5ohm load is in series with the anode terminal, so when it is fully gated on, the max load current will be ~2A. The panel meters display the DC gate voltage and gate current applied to the device under test. The Gate LED illuminates upon the detection that the Anode and Cathode begins to conduct.

Note that the gate voltage and gate current should be recorded as the maximum values right before the Gate LED Illuminates. Under some conditions, the gate current may actually show a decrease after gating ON, and that is normal behavior, thus the maximum value seen must be taken before the device gates ON.

8. Return the Voltage Control Dial to Zero.

9. Turn off the power prior to removing the leads.

Results 4

4.1 Interpreting Test Results

Below are guidelines on how to determine with reasonable certainty the condition of the device being tested.

Determining the Gate Functionality:

The Gate function is very straight forward. The gate should trigger (LED on front panel light up) at .7 to 2 V and 40 to 200 mA on the panel meters. If not, the device is faulty. Note that a GTO will have a slow turn-on, i.e. the LED will turn on gradually.

Determining the High Voltage Functionality:

The very first thing to determine is the rating of the device. It is imperative to know the voltage rating of the device. This can usually be determined by the part number. An alternative would be to multiply the supply voltage to the device by 1.42 and then multiply the result by 2. This formula will give the approximate rating of the device, since most manufacturers will design bridges and drives with a safety factor of 2 times the peak-to-peak line voltage. For example, if the line voltage is 460 VAC, the formula will be 460x1.41x2= 1297. Round off to 1300 V.

When the voltage rating of the device is determined, follow the step-by-step instructions in the manual.

Evaluating the High Voltage Test Result:

A bad device is easy to determine – there will be no voltage reading on the tester. (Note that a diode will be shorted in one direction). Also note that an Anode short GTO will show only 17 volts (approximately) in one direction.

The following approximate rule-of-thumb can be used to determine marginal components:

- Devices up to 25 mm wafer size - Maximum 2-4 mA leakage at rated voltage
- Devices up to 47 mm wafer size - Maximum 4-5 mA leakage at rated voltage
- Devices over 80 mm wafer size - Maximum 5-6 mA leakage at rated voltage

Troubleshooting 5

5.1 Frequently Asked Questions

Q: The POWER light will not illuminate.
A: Check the power cord to make sure it is properly plugged in to the outlet and into the tester.

Q: The READY TEST light will not illuminate.
A: Check the power cord to make sure it is properly plugged in to the outlet and the tester. Then make sure the voltage meter is turned all the way to the zero position (counter-clockwise).

Q: During the High Voltage PRV/PFV test, the LEAKAGE CURRENT meter will not move from zero.
A: Make sure the high voltage test cables are properly plugged into the tester and connected to the semiconductor being tested.

Q: During the Gate test, the GATE CURRENT meter will not move from zero.
A: Make sure the gate test cables are properly plugged into the tester and connected to the semiconductor being tested.

Q: The meter readings are all over the place.
A: Check to make sure the cables are properly connected to the semiconductor, and that the semiconductor is tightly clamped.

Q: During High Voltage testing, the green Ready test light is flashing every few seconds.
A: Make sure the voltage control dial is turned all the way counter-clockwise to zero, then press the Push to Test button to begin testing.

If the above solutions do not solve the problem you are experiencing, contact Darrah Electric.

- All reasonable care has been taken in production of this manual, but if you find any points which are unclear or in error please contact Darrah Electric directly.
- In the interests of product development, the contents of this manual are subject to revision without prior notice
- Unauthorized reproduction or copying of this manual is prohibited.

Darrah Electric Co.
5914 Merrill Avenue
Cleveland, Ohio 44102

www.darrahelectric.com
216-631-0912