GE Energy	**Functional Testing Specification**
Parts & Repair Services ***Louisville, KY***	**LOU-GE-4005E1211AH**

Test Procedure for a Brushless Exciter

DOCUMENT REVISION STATUS: Determined by the last entry in the "REV" and "DATE" column

REV.	DESCRIPTION	SIGNATURE	REV. DATE
A	Initial release	M. Starling	5/12/2011
B			
C			

PREPARED BY	REVIEWED BY	REVIEWED BY	QUALITY APPROVAL
M. Starling			C. Wade
DATE	**DATE**	**DATE**	**DATE**
5/12/2011			5/12/2011

1. SCOPE

1.1 This is a functional testing procedure for a Brushless Exciter.

2. STANDARDS OF QUALITY

2.1 Refer to the current revision of the IPC-A-610 standard for workmanship standards.

3. APPLICABLE DOCUMENTS

3.1 The following document(s) shall form part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue shall apply.
3.1.1 Check board's electronic folder for more information

4. ENGINEERING REQUIREMENTS

4.1 Equipment Cleaning
4.1.1 Equipment should be clean and free of debris prior to applying power unless performing an initial check. Refer to site specific SRA's for cleaning guidelines.
4.2 Equipment Inspection
4.2.1 Equipment should be visually inspected for any defects prior to applying power. This inspection should include the following as a minimum:
4.2.1.1 Wires - broken, cracked, or loosely connected
4.2.1.2 Terminal strips / connectors - broken or cracked
4.2.1.3 Components - visually damaged
4.2.1.4 Capacitors - bloated or leaking
4.2.1.5 Solder joints - damaged or cold
4.2.1.6 Circuit board - burned or de-laminated
4.2.1.7 Printed wire runs / Traces - burned or damaged

5. EQUIPMENT REQUIRED

5.1 The following equipment is required to perform the process requirements. Equipment may be substituted provided that all accuracy's and test ratios are equivalent or better.

Qty	Reference #	Description
1		Fluke 87 DMM (or Equivalent)
1		Oscilloscope
1		Megger
1		60VDC Power Supply

6. Testing

6.1 The following pages pertain to testing the 4005E1211AH Brushless Exciter/

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

Voltage can be Adjusted to Refine test V

PLEASE NOTE:

Several optional sections of this test procedure have been designed to test the brushless exciter converter while it is partially disconnected from its normal armature circuit. The ac ring assembly of the armature circuit interconnects the following bus connection points of the converter assembly:

Test SCR1 and Pos Diode bank, Reverse for SCR2 → connect 60VDC on each Diode 1-6 (one at a time) connect the Reg -60vdc to E3C. touch Gate to Anode 100Ω limit current to 1A for hold.

E1A to E1B.
E2A to E2B.
E3A to E3B to E3C to E3D.

During normal operation, the power diodes D11 and D12 ensure that the voltage on the NEG terminal of the 4006L4304 (M-1) Firing Circuit Module is never more than 3 volts more positive than the voltage on its E3 terminal. If the voltage on the NEG terminal of the 400614304 (M-1) Firing Circuit Module with respect to the voltage on its E3 terminal exceeds 6 volts positive, the 4006L4304 module may be damaged. When the SCR's Turn on this is a dead short,

It is strongly recommended that the bolted connections between the ac ring assembly and the converter bus connection points E3B, E3C, and E3D be maintained secure during all test procedures unless a deficiency is noted and a component must be isolated to verify that it is operable. Refer to Figure 1.

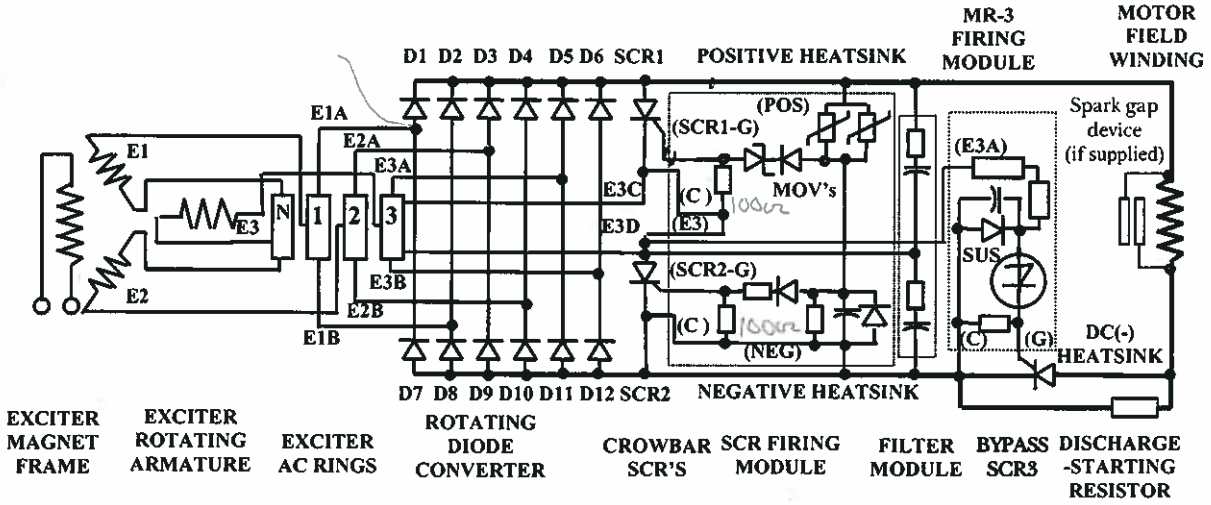

Figure #1 BRUSHLESS EXCITER SCHEMATIC DIAGRAM

Gate to Cat = SCR1 = 29.4Ω

Gate to cat = SCR2 = 29.4Ω

SCR - 1Amp hold current,

All diodes will measure (.3V) - No Less. (could measure to .1 if New)

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005E1211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

PURPOSE OF TESTS AND PROCEDURES:

1. Circuit Interconnection and Assembly Check
To ensure that converter is properly assembled and wired.

2. Ground Insulation Check
To measure the insulation between the converter heat sinks and the steel hub assembly.

3. Motor Field and Discharge Resistor Isolation Procedure.
To properly disconnect one end of the motor field and discharge resistor network allow their circuits and that of the brushless exciter converter to be tested without the test results being corrupted by the other circuits. **NOTE THAT THE MOTOR FIELD AND DISCHARGE RESISTOR CIRCUITS MUST BE FULLY RECONNECTED TO THE BRUSHLESS EXCITER CONVERTER BEFORE POWER IS APPLIED TO THE MOTOR STATOR OR SEVERE DAMAGE WILL OCCUR.**

4. Diode Forward Voltage Test and SCR/DIODE Leakage Test
To confirm that the converter diodes and SCR's meet normal healthy measurements using a diode check and ohmmeter functions on a multimeter.

5. SCR Filter Check (optional)
To confirm that snubber circuits in parallel with each of the converter SCR's are functional. The filter [snubber] circuit operation will also be confirmed during the crowbar SCR firing level check.

6. Crowbar SCR firing Level Check
To confirm that both of the crowbar SCR's fire properly and that the filter circuit is operating properly.

7. MR-3 and By-pass SCR Check
To confirm that the MR-3 module properly gates the by-pass SCR.

8. Optional Individual Diode Forward Voltage Test and SCR/DIODE Leakage Test
To confirm that each of the individual converter diodes and SCR's meet normal healthy measurements using a diode check and ohmmeter functions on a multimeter. This test should be considered if an open circuit diode is suspected. Bolted connections between the ac ring assembly and the E1A, E1B, E2A, E2B, and E3A diode bus connections points must be temporarily undone and the connections separated with insulation for this test.

9. Optional Diode Bridge Operational Check
To confirm that the power diode and Crowbar SCR circuits function properly with substantial voltage and current levels applied. Bolted connections between the ac ring assembly and the E1A, E1B, E2A, E2B, and E3A diode bus connections points must be temporarily undone and the connections separated with insulation for this test.

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

EQUIPMENT REQUIRED:

1. Two multimeters, one of which contains an ohmmeter and diode checker function.
2. A 500 volt dc Megger type insulation tester.
3. A capacitance meter or capacitor meter function of a multimeter capable of measuring 1 microfarad. (optional)
4. A switchable 230 to 575 volt ac single phase power supply. Note that this can consist of a 480 to 120 volt 500 to 1000 VA control transformer operated in reverse with the input power connected to the 120 volt winding.
5. A 60 to 300 ohm, greater than or equal to 200 watts.
6. An isolated switchable 30 volt ac single phase power supply capable of delivering up to 0.5 amps. Note that this can consist of the 480 volt to 120 volt transformer described in item #4 with 120 volts applied to the 480 volt winding.
7. An isolated switchable 10 to 100 volt dc power supply capable of delivering 2 amps or more continuously.
8. A 5 to 50 ohm resistor capable of acting as a current limiting resistor for the power supply listed under item #7 to limit the current to approximately 2 amps or more depending on the capability of the resistor and the power supply.
9. A storage oscilloscope or high speed chart recorder with high voltage probes.
10. An optional 30 to 100 volt ac single phase power supply capable of delivering up to 5 amps for the optional diode bridge test.
11. An optional 5 to 18 ohm 200 to 600 watt resistor for the optional diode bridge test.

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

TEST PROCEDURES:

1. Circuit Interconnection and Assembly Check

Compare the assembly and interconnection of the converter to the schematic diagram and assembly diagrams and notes on the Converter Assembly drawing 4005E1211AH and the Brushless Exciter Assembly Drawing applicable to the motor being tested. Note that Groups 1, 3, 6, 7, 11, and 16 of the drawing provide connection points for three #1/0 cables for the positive dc field leads on the heat sink nearest the armature and three #1/0 cables for the negative dc field leads on the by-pass SCR heat sink on the end of the exciter. Similarly Groups 2, 4, and 5 of the drawing provide connection points for two #1/0 cables for the positive dc field leads and two connection points for the negative dc field leads.

Refer to the brushless exciter assembly drawing to determine the configuration of the discharge resistor network. Some discharge resistor networks have all resistor poles in one series connection. For this arrangement one lead of the resistor network will be connected to the negative heatsink via an insulated stud which passes through the positive heatsink and the other lead of the resistor network is connected directly to the by-pass SCR heatsink by a bolt threaded into the aluminum heatsink.

Discharge resistor networks can also contain two parallel connected circuits. For this arrangement two leads of the resistor network will be connected to the negative heatsink via a single insulated stud which passes through the positive heatsink and the other two leads of the resistor network are connected directly to the by-pass SCR heatsink by two separate bolts threaded into the aluminum heatsinks.

Note that the twisted pair gate - cathode leads are white for the gate pin connection and red for the cathode connection.

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

2. Ground Insulation Check

Temporarily connect E1A to E2A to E3A to E1B to E2B to E3B to E3C to E3D to the Positive heat sink to the Negative heat sink, to the by-pass SCR heatsink. Note that if all bolted connections between the brushless exciter armature ac ring assembly and the converter diode and SCR busses are solidly maintained, then the ac windings of the brushless exciter armature circuit will automatically connect E1A to E2A to E3A to E1B to E2B to E3B to E3C to E3D. As such Temporary jumpers from E3D to the positive heatsink to the negative heat sink to the by-pass SCR heatsink are all that are required. Refer to Figure 2. Connect a 500 volt Megger between the Negative dc cable connection point and the hub assembly or motor shaft steel and ensure that the insulation level is greater than 10 megohms. Record the results. Megger Voltage _____ Volts _____ Ohms. Refer to Figure 2.

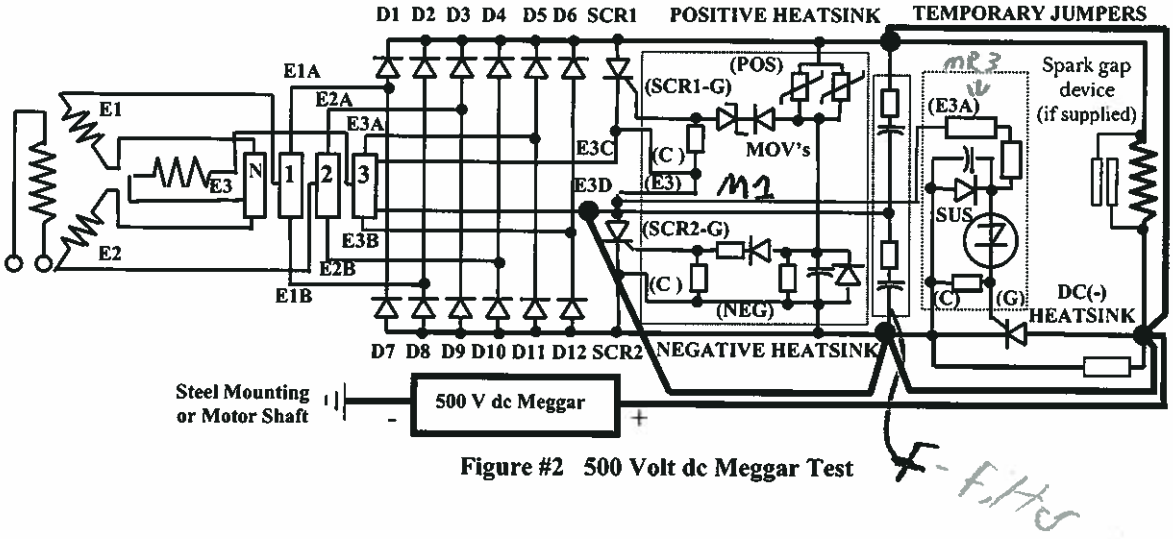

Figure #2 500 Volt dc Meggar Test

Remove all temporary jumpers before proceeding with further tests.

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

3. Motor Field and Discharge Resistor Isolation Procedure.

Temporarily disconnect all power cables by removing the 5/16" bolts from the by-pass SCR heatsink and isolate the ends of 'the cables from all devices and heatsinks. Note that two or three of #1/0 AWG leads should be from the negative side of the motor field winding and one or two of the smaller leads should be from one side of the discharge resistor network. Refer to Figure 3.

This procedure should be followed before proceeding with any of the following test procedures as it provides an open circuit load to the output of the brushless exciter and disconnects the discharge resistor network from being in parallel with the by-pass SCR.

With one end of the motor field winding disconnected from the brushless exciter converter, and no ground faults detected, motor field dc resistance checks, and optional ac impedance and pole drop tests can be performed with the brushless exciter converter not contributing to any measurement errors.

Similarly, the resistance of the discharge resistor network can be measured without concern of the measurements being corrupted.

NOTE THAT THE MOTOR FIELD AND DISCHARGE RESISTOR CIRCUITS MUST BE FULLY RECONNECTED TO THE BRUSHLESS EXCITER CONVERTER BEFORE POWER IS APPLIED TO THE MOTOR STATOR OR SEVERE DAMAGE WILL OCCUR.

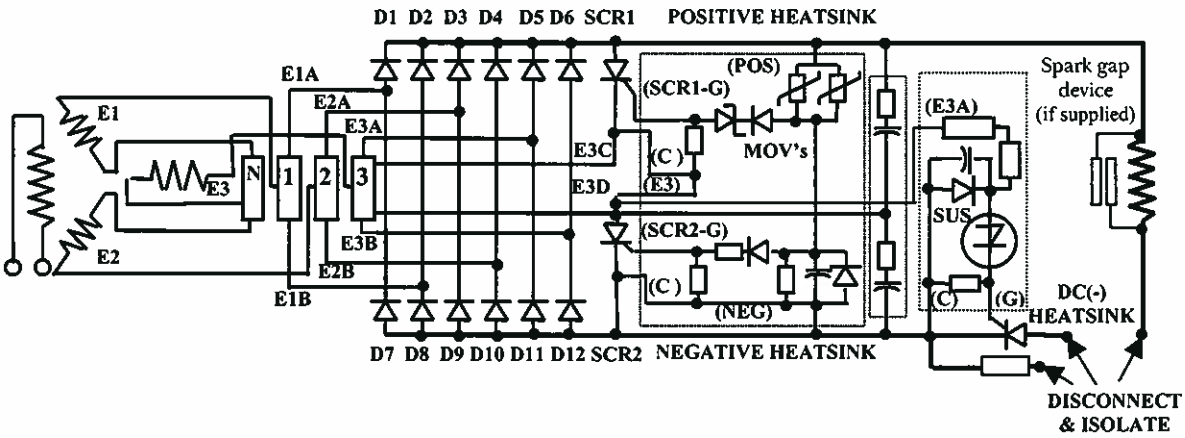

Figure #3 DISCONNNECTION & ISOLATION REQUIRED FOR TESTS

PGE 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

4. Diode Forward Voltage Test and SCR/DIODE Leakage Test

Carefully inspect the converter and note that a control wire is used to connect the E3A control pin of the MR-3 control module, mounted dead center on the by-pass SCR heat sink, to the SCR1 surge sink using a hex socket head screw. Temporarily disconnect this wire for the following tests. Temporarily replace the screw to ensure that the wire from the filter module remains solidly electrically connected to the SCR1 surge sink. Refer to Figure 4.

As the ac ring assembly and brushless exciter armature winding circuit essentially tie all of the ac connections together, all diodes and SCR's between the ac windings and a particular bus will be measured together. Shorted devices will be found but a single open device will not. If an open device is suspected or if a shorted device is detected and must be identified, proceed to the optional test described in section #8 of this test procedure.

The Motor Field and Discharge Resistor Isolation Procedure which is detailed in step 3 of this test plan should be performed before proceeding with this test.

The reverse blocking capabilities of the diodes and SCR's, and the integrity of the filter and firing circuit modules are checked before measuring the forward drop of the diodes to ensure that these readings are not corrupted by failed device somewhere else in the circuit.

Use the ohmmeter function of a digital multimeter to confirm that the blocking impedance of the diodes and SCR's is greater than 500 kilo-ohms. Note that the internal capacitances of the Filter module may cause the ohmmeter to be slow to settle at a steady reading. Record your results:

Devices	Pos. Meter Terminal	Neg. Meter Terminal	Impedance
D1//D2//D3// D4//D5//D6//SCR1	POS. H/S	E3C	_____ OHMS
D7//D8//D9// D10//D11//D12//SCR2	E3C	NEG. H/S	_____OHMS
SCR3 (FWD.)	BY—PASS H/S (—DC)	NEG. H/S	_____OHMS
SCR3 (REV.)	NEG. H/S	BY—PASS H/S (—DC)	_____OHMS

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

4. Diode Forward Voltage Test and SCR/DIODE Leakage Test (continued)

Use the diode checker mode of a digital multimeter to confirm that the forward voltage drop of each diode group is between .3 and .75 volts dc.
Record the results:

Diode Group	Pos. Meter Term.	Neg. Meter Term.	Forward Voltage
D1//D2//D3// D4//D5//D6	E3C	POS. H/S	_____VOLTS
D7//D8//D9// D10//D11//D12	NEG. H/S	E3C	_____VOLTS

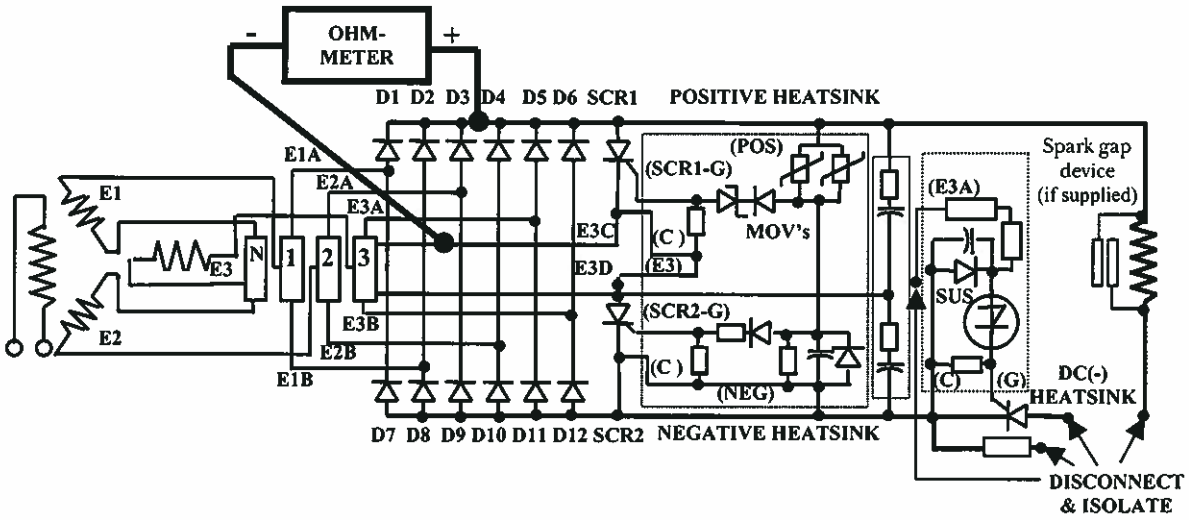

Figure #4 TYPICAL TEST CONNECTIONS TO MEASURE REVERSE LEAKAGE RESISTANCE

If proceeding directly to the following optional filter test, then leave the wire between the SCR1 surge sink and the E3A pin on the MR-3 control module temporarily disconnected from the SCR1 surge sink.

If not proceeding to the following optional filter test, then reconnect the wire between the SCR1 surge sink and the E3A pin on the MR—3 control module to the SCR1 surge sink using either a new locking type screw or use Loctite 222 or 242 removable thread locker with the original screw.

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

5. SCR Filter Check (optional)

If the wire connecting the E3A pin of the MR-3 control module has not already been disconnected from the SCR1 surge sink for the preceding test, then carefully inspect the converter and note that a control wire is used to connect the E3A control pin of the MR-3 control module, mounted dead center on the by—pass SCR heat sink, to the SCR1 surge sink using a hex socket head screw. Temporarily disconnect this wire for the following tests. Temporarily replace the screw to ensure that the wire from the filter module remains solidly electrically connected to the SCR1 surge sink. Refer to Figure 5.

The Motor Field and Discharge Resistor Isolation Procedure which is detailed in step 3 of this test plan should be performed before proceeding with this test.

Note that capacitance meter readings are sometimes corrupted by devices in parallel with the capacitance being measured. If the following test results do not fall within the pass criteria, please note that the filters will be tested using an indirect method in the crowbar tests which follow. Temporarily disconnecting the filter from the surrounding circuitry can also be used to isolate it for the capacitance measuring procedure.

Use the capacitance meter function of a digital multimeter to read the capacitance of the filter networks.

First connect the positive lead of the meter to the positive heatsink (POS. H/S) and the negative lead of the meter to the E3B connection point. The measured capacitance reading should be between 0.8 microfarads and 1.2 microfarads. Record your Results.

Measured capacitance = _____ Microfarads.

Refer to Figure 5. Note that some digital capacitance meters may not correctly measure the capacitance as it is in series with 25 ohms and in parallel with the D6 diode.

Then connect the positive lead of the meter to the E3B connection point and the negative lead of the meter to the negative heatsink (NEG. H/S). The measured capacitance reading should be between .8 microfarads and 1.2 microfarads. Record your Results.

Measured capacitance = _____ Microfarads.

Note again that some digital capacitance meters may not correctly measure the capacitance as it is in series with 25 ohms and in parallel with the D12 diode.

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

5. SCR Filter Check (optional) (continued)

Reconnect the wire between the SCR1 surge sink and the E3A pin on the MR-3 control module to the SCR1 surge sink using either a new locking type screw or use Loctite 222 or 242 removable thread locker with the original screw.

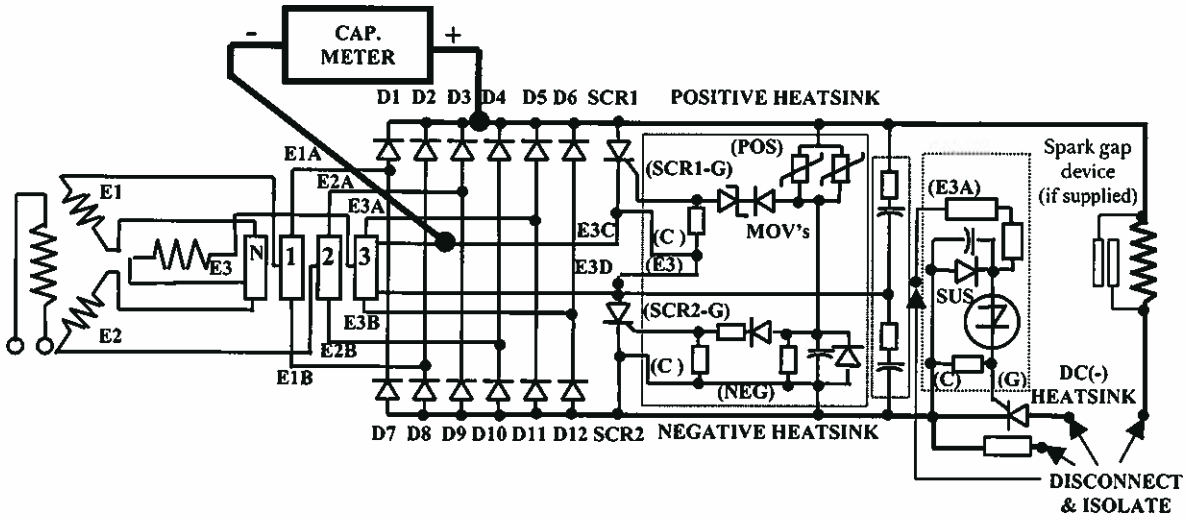

Figure #5 TYPICAL TEST CONNECTIONS TO MEASURE SNUBBER CAPACITANCE

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

6. Crowbar SCR firing Level Check

There are nine groups to the 4005E1211AH Brushless Exciter Converter drawing. Brushless Exciter Converters with drawing numbers 4005E1211AH-G001, G002, and G011 use a Firing Circuit Module 4006L4304 G003 that has a crowbar operation level of 190 volts (+/-10%). Brushless Exciter Converters with drawing numbers 4005E1211AH-G003, G004, and G005 use a Firing Circuit Module 4006L4304 G002 that has a crowbar operation level of 250 volts (+/-10%). Brushless Exciter Converters with drawing numbers 4005E1211AH-G006 and G016 use a Firing Circuit Module 4006L4304 G007 that has a crowbar operation level of 350 volts (+/-10%). Brushless Exciter Converters with drawing number 4005E1211AH-G007 use a Firing Circuit Module 4006L4304 G008 that has a crowbar operation level of 300 volts (+/-10%).

For the Crowbar SCR firing level check test it is absolutely essential that converter points E3B, E3C, and E3D be solidly connected together, which is the case if they are left bolted to the armature circuit. If the converter has been separated from the armature ac ring assembly, then secure jumpers must be installed between E3B, E3C, and E3D. For this test a switchable AC voltage source, in series with a current limiting resistor, is momentarily connected across the positive [POS. H/S] and negative [NEG. H/S] heat sinks. The voltage between the heatsinks is monitored with an oscilloscope (preferably storage) with 100 to 1 probes, or by a suitably attenuated high speed chart recorder. The oscilloscope or chart recorder is used to check for the voltage at which the SCR Crowbar firing circuit operates. The peak of the sine wave of the voltage applied should be at least 50 volts above the highest expected firing level. The full test voltage should be stepped on for periods of no longer than 2 seconds out of each 2 minute period. The test voltage should not be gradually increased until crowbar firing is achieved as this will cause overheating of the crowbar firing circuit and may result in its destruction.

It should be noted that when the sine wave of the test voltage source goes negative, the current limited source will be effectively shorted by the diodes in the converter and when the sine wave is higher than the SCR Crowbar Operation Level, the SCR's will fire and again short the current limited power source. The voltage source and current limiting resistors must therefore be sized to withstand the short circuit levels of current that is required for the test. The resistors should be sized to produce 2 to 10 amps of short circuit current with the voltage source used.

Refer to the following chart for suggested voltage and resistor values:

400SE1211AH Group Number	SCR Crowbar Operating Voltage	Test Voltage Source Range	Resistance Range 2 < (Volts/Ohms) < 10
1, 2, and 11	170 to 210 volts	230 to 575 VAC	60 to 300 ohms
3, 4, and 5	225 to 275 volts	230 to 575 VAC	60 to 300 ohms
6 and 16	315 to 385 volts	310 to 575 VAC	60 to 300 ohms
7	270 to 330 volts	270 to 575 VAC	60 to 300 ohms

The Motor Field and Discharge Resistor Isolation Procedure that is detailed in step 3 of this test plan should be performed before proceeding with this test.

INSTRUCTIONS FOR TESTING OF THE 4005E1211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

6. Crowbar SCR firing Level Check (continued)

Connect the test circuit as shown in Figure 6 with a temporary jumper between the BY-PASS H/S and the NEG. H/S. Temporarily jumper E3D to the Positive heat sink [POS. H/S] to test for the proper operation of SCR2.

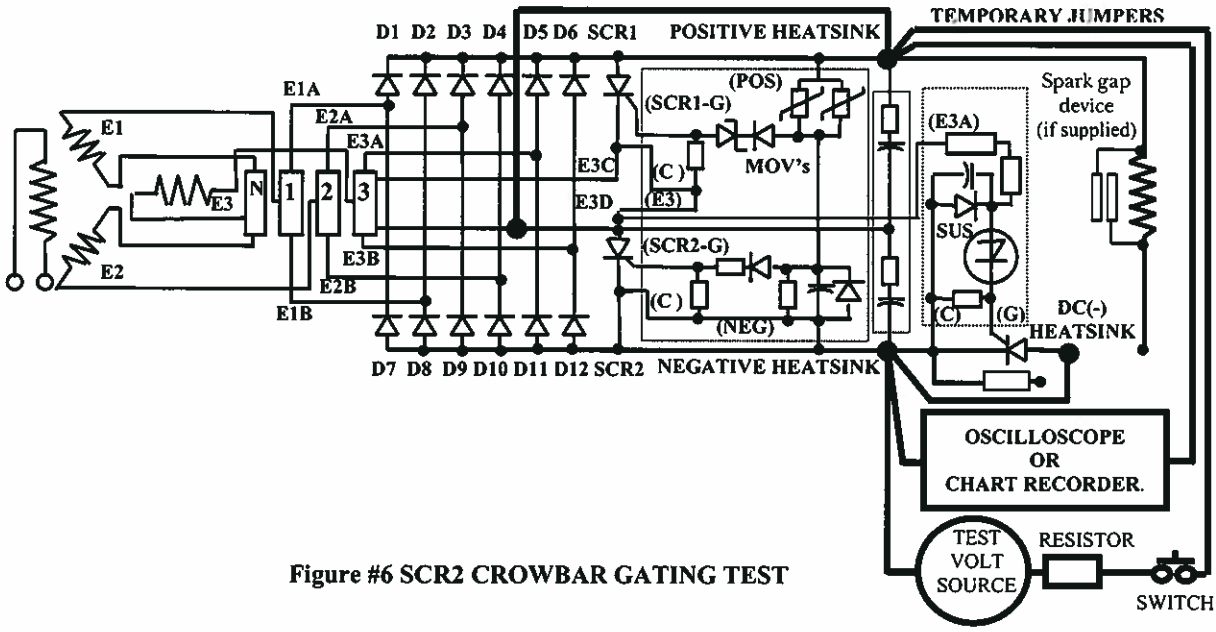

Figure #6 SCR2 CROWBAR GATING TEST

Momentarily apply the test voltage and ensure that the voltage wave shape across the positive and negative heat sinks appears as shown in Figure 7. Ensure that the SCR Crowbar Operating Voltage is within the limits specified for the 4005E1211AH group number used.

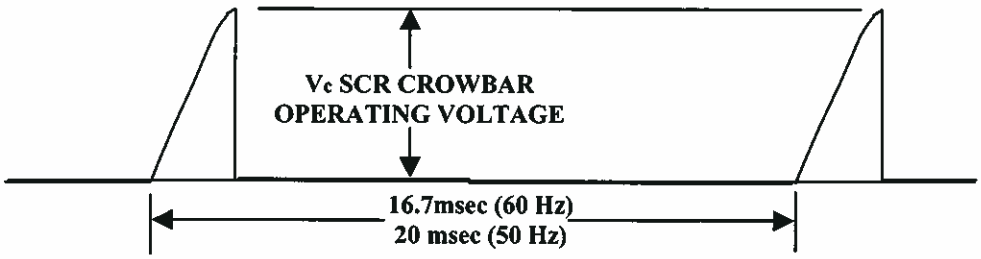

Figure 7 Crowbar Operating Voltage of SCR2

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

6. Crowbar SCR firing Level Check (continued)

Connect the test circuit as shown in Figure 8 with a temporary jumper between the (BY-PASS H/S and the NEG. H/S]. Temporarily jumper E3D to a Negative heat sink [NEG. H/S] to test for the proper operation of SCR1.

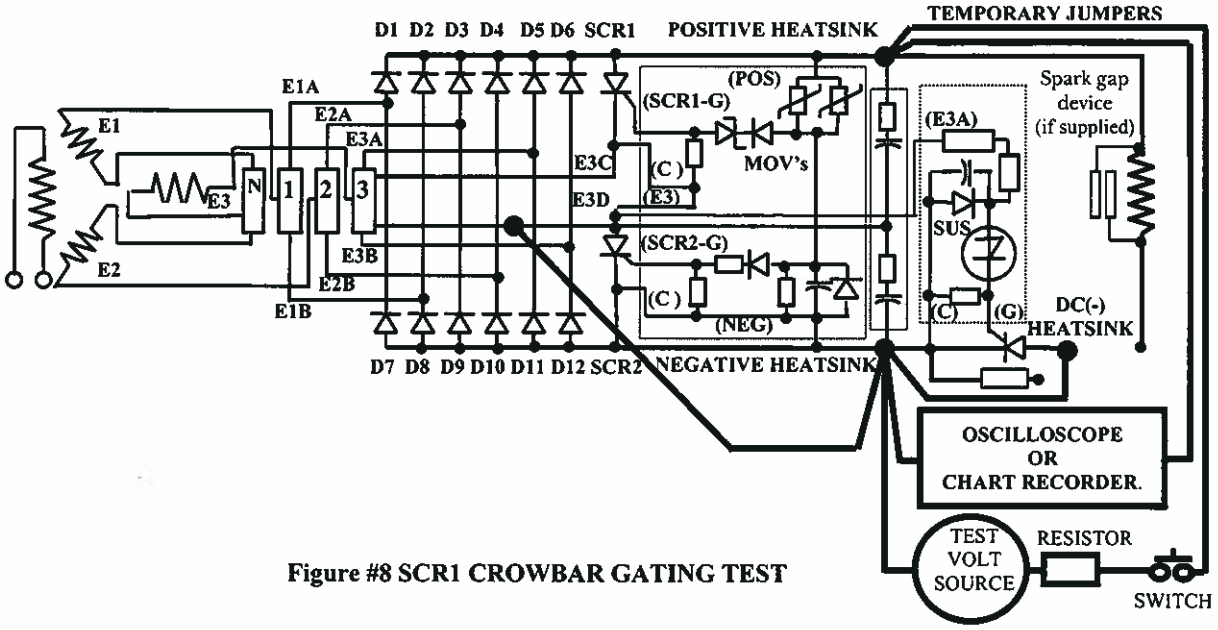

Figure #8 SCR1 CROWBAR GATING TEST

Momentarily apply the test voltage and ensure that the voltage wave shape across the positive and negative dc cable connections appears as shown in Figure 9. Ensure that the SCR Crowbar Operating Voltage is within the limits specified for the 4005E1211AH group number used.

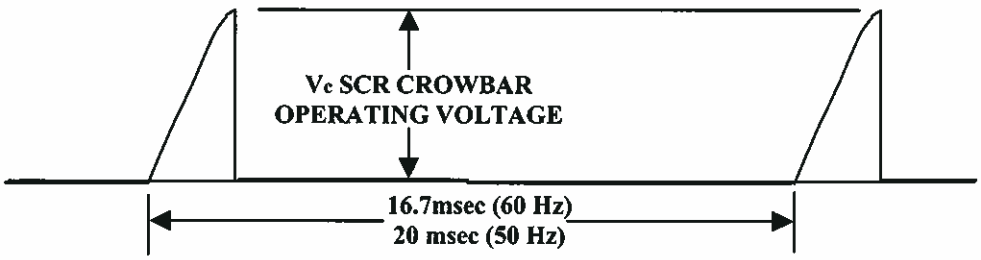

Figure 9 Crowbar Operating Voltage of SCR1

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

6. Crowbar SCR firing Level Check (continued)

Connect the test circuit as shown in Figure 10 with a temporary jumper between the [BY-PASS H/S and the NEG. H/S] but with no extra jumper from E3D to confirm the proper coordinated crowbar operation of SCR1 with SCR2 and the filter module.

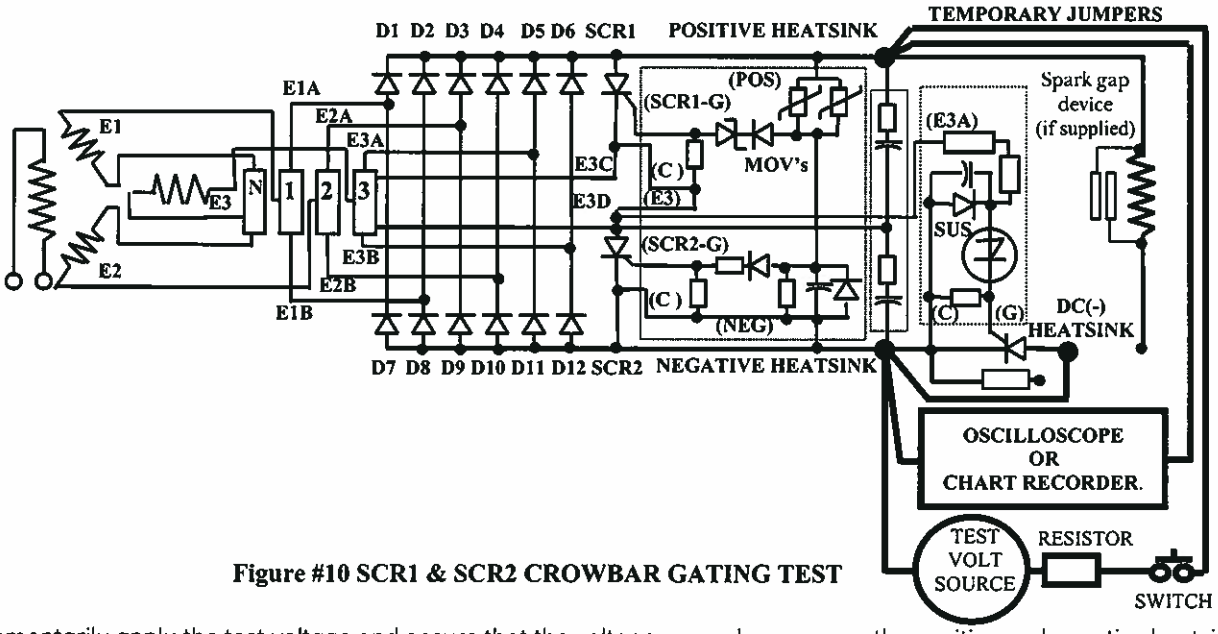

Figure #10 SCR1 & SCR2 CROWBAR GATING TEST

Momentarily apply the test voltage and ensure that the voltage wave shape across the positive and negative heatsinks appears as shown in Figure 11. Ensure that the SCR Crowbar Operating Voltage is within the limits specified for the 400SE1211AH group number used.

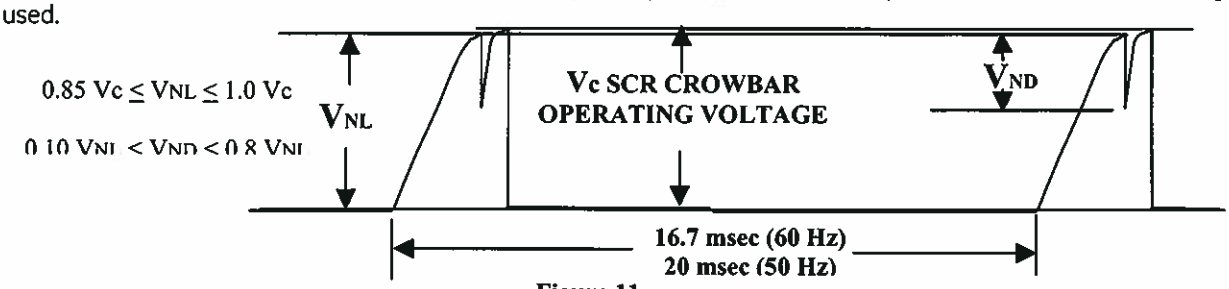

Figure 11
Crowbar Operating Voltage of Combined SCR1 & SCR 2 Showing Voltage Notch to Indicate that Output Filters are Functioning Properly

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

6. Crowbar SCR firing Level Check (continued)

Referring to Figure 11, note that the maximum voltage attained and the position of the "notch" determines whether the crowbar circuit is operating properly and that the depth of the notch determines whether the filter circuits are operating properly. The leading edge of the notch should occur at between 85% and 100% of maximum voltage attained. The notch depth should be between 10% and 80% of the magnitude of the voltage wave shape at which the leading edge of the notch occurs.

Record the readings:

Jumpers	Voltage Source	Resistance	SCR Crowbar Operation Voltage
Per Figure 6	_____VAC	_____Ohms	_____Volts
Per Figure 8	_____VAC	_____Ohms	_____Volts
Per Figure 10	_____VAC	_____Ohms	_____Volts
Per Figure 10	Notch Leading Edge Voltage:		_____Volts
Per Figure 10	Notch Depth Voltage:		_____Volts

Ensure that the temporary jumper between the [BY-PASS H/S] and the [(NEG. H/S] is removed.

Note that the switchable voltage source, current limiting resistor, and monitoring equipment, used by the Crowbar SCR firing level check test, is also required for the following by-pass SCR check in test #7.

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

7. MR-3 and By-pass SCR Check

The Motor Field and Discharge Resistor Isolation Procedure, which is detailed in step 3 of this test plan, should be performed before proceeding with this test.

To confirm that the bypass SCR does not false trigger when high voltages are applied, connect a temporary jumper between the [P05. H/S and the NEG. H/S], and connect the switchable current limited power source and monitoring equipment, used for the Crowbar Firing Level Check of test #6, between the [BYPASS H/S and the NEG. H/S] as shown in Figure 12A.

Momentarily apply the test voltage between [BYPASS H/S and the NEG. H/S] and ensure that the bypass SCR fully blocks the voltage in both directions by noting that the full bidirectional sine wave of the power source should also appear across the SCR. Note that the maximum off state leakage current of the bypass SCR should be less than 0.1 ampere.

Record the source voltage level (_____ VAC), current limiting resistance value (_____OHMS), and the voltage across the bypass SCR (_____ VAC). Remove the power source and temporary jumper.

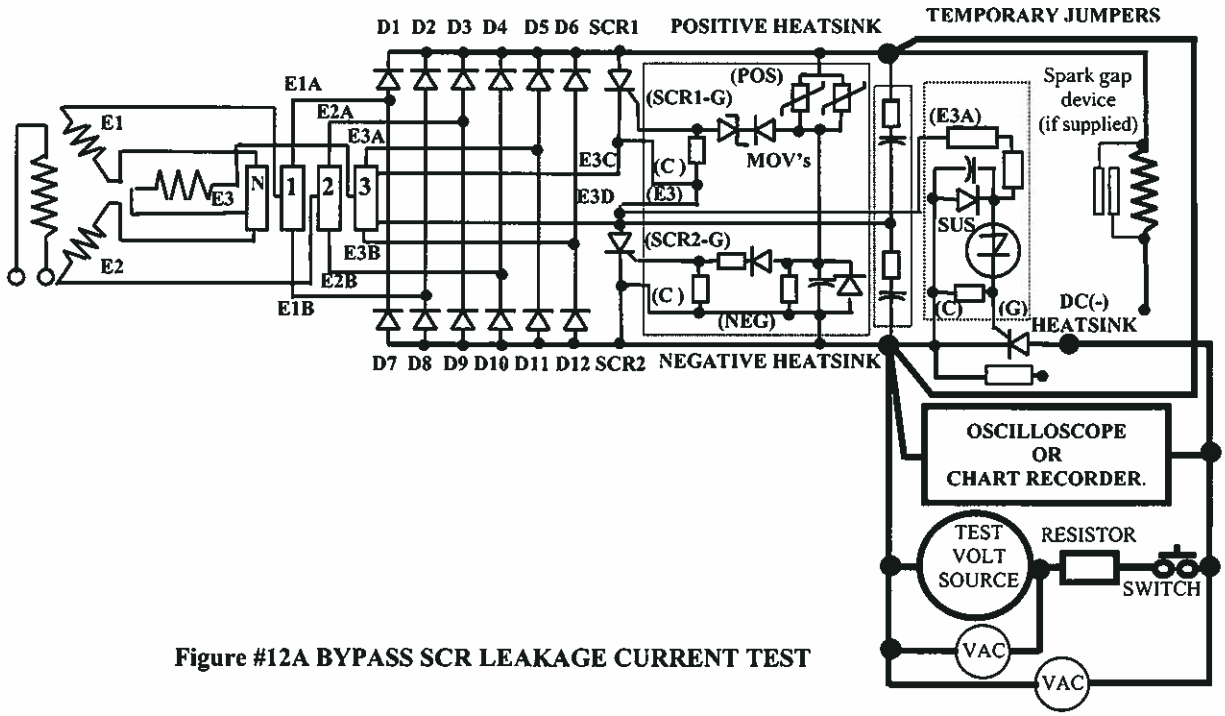

Figure #12A BYPASS SCR LEAKAGE CURRENT TEST

To test for the proper gating of the bypass SCR, connect a switchable 10 to 100 volt dc power source through a 10 to 40 ohm resistor (suitably sized for cont. operation at equal to or greater than 2 amps) with the positive side connected to the BY-PASS heatsink (-DC) [ANODE of SCR3] and the negative side connected to the NEGATIVE heat sink [NEG. H/S]. Leave the switch open. The ripple on the 10 to 100 volt dc power source should not be greater than 50 % of the output voltage peak to peak.

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

7. MR-3 and By-pass SCR Check (continued)

Connect a switchable, isolated, 30 volt ac power source, through a 60 to 300 ohm resistor between E3D and the NEGATIVE heat sink [NEG. H/S]. Leave the switch open. Install dc voltmeters as shown in Figure 12B.

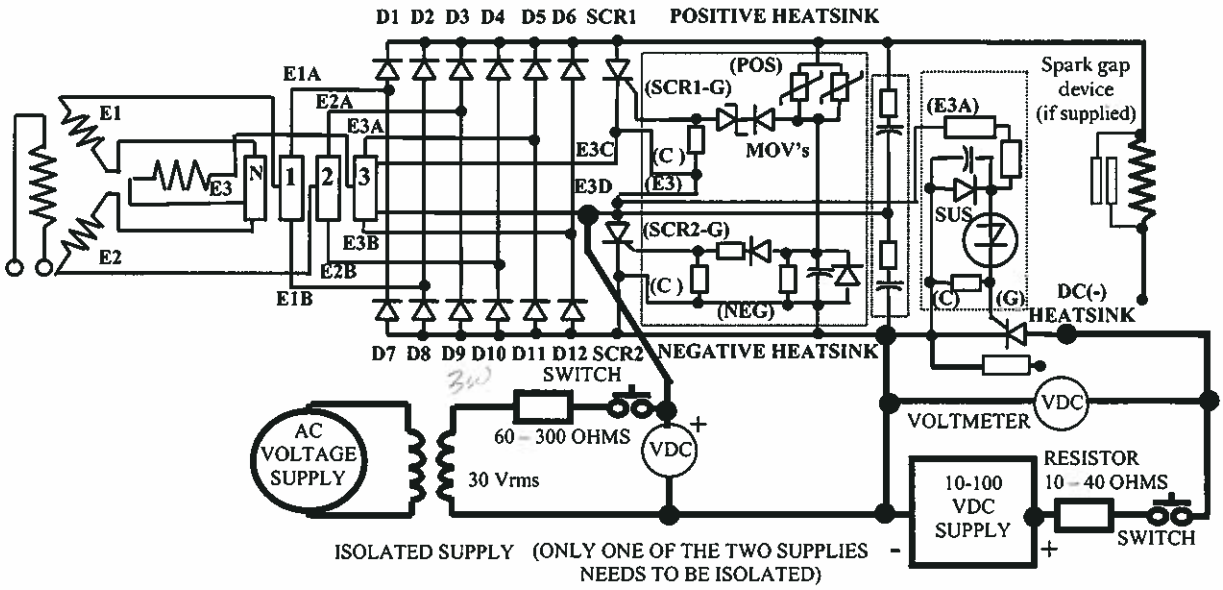

Figure #12B BYPASS SCR GATING TEST

Close the 10 to 100 volt dc source switch and ensure that the voltage across SCR3 is equal to the output of the 100 volt dc source. Close the 30 volt ac power source switch and ensure that within 20 milliseconds the voltage across SCR3 [BY-PASS H/S to NEG. H/S] drops to less than 2 volts dc. Record your results.
The voltage on SCR3 with both switches closed is _____ Vdc.

Ensure that the voltage on E3D with respect to the NEGATIVE heat sink [NEG. H/S] is between 8 and 14 volts dc. Record your results. The voltage on E3D with respect to NEGATIVE heat sink is _____Vdc with the 30 volt ac switch closed. Open the 30 volt ac switch and ensure that the voltage on SCR3 remains at less than 2 volts. Record your results. The voltage on SCR3 with the 10 to 100 volt dc switch closed and the 30 volt ac switch closed and then opened is _____Vdc. Open the 10 to 100 volt dc source switch. The voltage on SCR3 should drop to zero.

Repeat the procedure. Close the 10 to 100 volt dc source switch and ensure that the voltage across SCR3 is equal to the output of the 10 to 100 volt dc source. Close the 30 volt ac power source and ensure that within 20 milliseconds the voltage on across SCR3 drops to less than 2 volts dc. Record your results. The voltage on SCR3 with both switches closed is _____Vdc. Open the 30 volt ac switch and ensure that the voltage on SCR3 remains at less than 2 volts. Record your results. The voltage on SCR3 with the 10 to 100 volt dc switch closed and the 30 volt ac switch closed and then opened is _____ Vdc. Open the 10 to 100 volt dc source switch. The voltage on SCR3 should drop to zero.

PGEI 5271B

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

8. Optional Individual Diode Forward Voltage Test and SCR/DIODE Leakage Test

This test should be considered if an open circuit diode is suspected or if the converter is being "bench" tested with all connections between the converter and the armature ac ring assembly disconnected. Bolted connections between the ac ring assembly and the E1A, E1B, E2A, E2B, and E3A diode bus connections points must be temporarily undone and the connections separated with insulation for this test as shown in Figure 13. If all bolted connections between the converter and the ac ring assembly are undone and isolated, then temporary jumpers between the converter points E3B, E3C, and E3D must be made for this test.

Carefully inspect the converter and note that a control wire is used to connect the E3A control pin of the MR-3 control module, mounted dead center on the by-pass SCR heat sink, to the SCR1 surge sink using a hex socket head screw. Temporarily disconnect this wire for the following tests. Temporarily replace the screw to ensure that the wire from the filter module remains solidly electrically connected to the SCRI surge sink. Refer to Figure 13.

The Motor Field and Discharge Resistor Isolation Procedure which is detailed in step 3 of this test plan should be performed before proceeding with this test.

The blocking capabilities of the diodes and SCR's, and the integrity of the filter and firing circuit modules are checked before measuring the forward drop of each diode to ensure that these readings are not corrupted by a failed device somewhere else in the circuit.

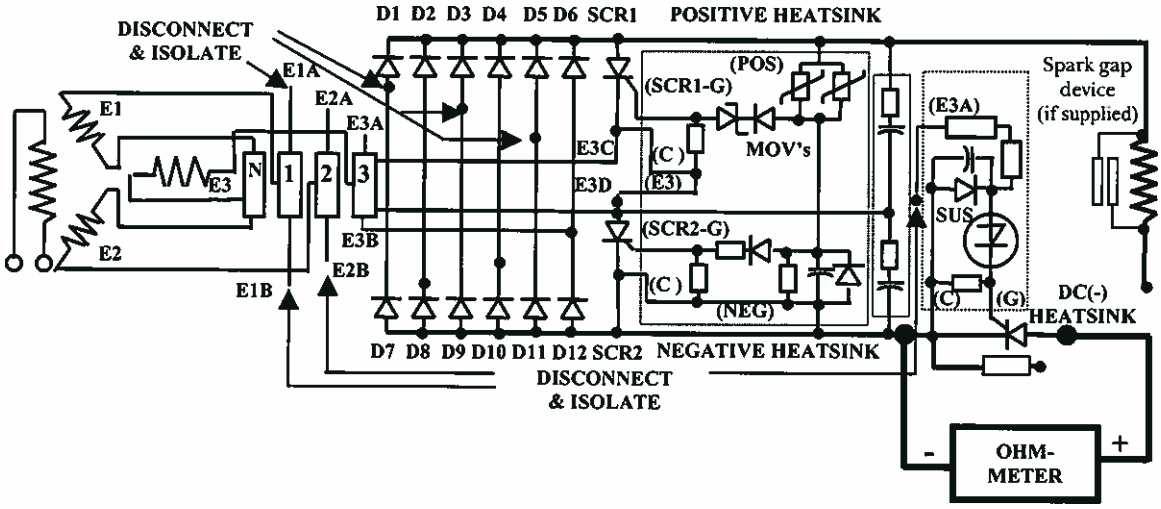

Figure #13 TYPICAL TEST CONNECTIONS (TO MEASURE BYPASS SCR FWD LEAKAGE)

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

8. Optional Individual Diode Forward Voltage Test and SCR/DIODE Leakage Test (continued)

Use the ohmmeter function of a digital multimeter to confirm that the blocking impedance of the diodes and SCR's is greater than 500 kilo-ohms. Note that the internal capacitances of the Filter module may cause the ohmmeter to be slow to settle at a steady reading. Record your results:

Device	Pos. Meter Terminal	Neg. Meter Terminal	Impedance
D1	POS. H/S	E1A	_____OHMS
D2	POS. H/S	E1B	_____OHMS
D3	POS. H/S	E2A	_____OHMS
D4	POS. H/S	E2B	_____OHMS
D5	POS. H/S	E3A	_____OHMS
D6, SCR1	POS. H/S	E3B	_____OHMS
D7	E1A	NEG. H/S	_____OHMS
D8	E1B	NEG. H/S	_____OHMS
D9	E2A	NEG. H/S	_____OHMS
D10	E2B	NEG. H/S	_____OHMS
D11	E3A	NEG. H/S	_____OHMS
D12, SCR2	E3B	NEG. H/S	_____OHMS
SCR3 [FWD]	BY-PASS H/S	NEG. H/S	_____OHMS
SCR3 [REV]	NEG. H/S	BY-PASS H/S	_____OHMS

Use the diode checker made of a digital multimeter to confirm that the forward voltage drop of each diode is between .3 and .75 volts dc. Record the results:

Device	Pos. Meter Terminal	Neg. Meter Terminal	Impedance
D1	E1A	POS. H/S	_____Vdc
D2	E1B	POS. H/S	_____Vdc
D3	E2A	POS. H/S	_____Vdc
D4	E2B	POS. H/S	_____Vdc
D5	E3A	POS. H/S	_____Vdc
D6	E3B	POS. H/S	_____Vdc
D7	NEG. H/S	E1A	_____Vdc
D8	NEG. H/S	E1B	_____Vdc
D9	NEG. H/S	E2A	_____Vdc
D10	NEG. H/S	E2B	_____Vdc
D11	NEG. H/S	E3A	_____Vdc
D12	NEG. H/S	E3B	_____Vdc

Reconnect the wire between the SCR1 surge sink and the E3A pin on the MR-3 control module to the SCR1 surge sink using either a new locking type screw or use Loctite 222 or 242 removable thread locker with the original screw.

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

9. Optional Diode Bridge Operational Check

Due to the work involved in this test it is usually only performed on converters which will not be operated in the near future and an assurance is needed that the converter will be fully functional at a later date. A prime candidate Is a converter that will be placed in stores for use later during an emergency breakdown. If there is no reason to suspect that the converter will not operate properly, and if the converter is being mounted on a motor for immediate use, it is recommended that the crowbar and impedance checks be considered sufficient to prove that the converter is fully functional.

To confirm that the power diode and Crowbar SCR circuits function properly with substantial voltage and current levels applied. Bolted connections between the ac ring assembly and the E1A, E1B, E2A, E2B, and E3A diode bus connections points must be temporarily undone and the connections separated with insulation for this test. It Is essential that the E3B to E3C to E3D connections between the converter and the exciter armature ac ring assembly be solidly made for this test.

The Motor Field and Discharge Resistor Isolation Procedure which is detailed in step 3 of this test plan should be performed before proceeding with this test.

This test will sequentially apply a single phase ac fused voltage source to ac connections of the three single phase full wave diode bridges formed by the 12 diodes of the converter. A resistive load, suitably sized to provide approximately 5 amps of current will be applied between Positive heat sink [POS. H/S] and the Negative heat sink [NEG. H/S]. A temporary jumper should be installed between the anode and cathode of SCR3 for this test. The peak of the ac voltage source must not trigger the SCR Crowbar Firing Circuit so voltage source should be between 30 and 100 VAC. The power rating of the test resistor should be sized to continually withstand the approximate 5 amp current for several minutes at a time if not continually.

Connect the appropriate ac voltage source between E1A and E2A, and the appropriate test load resistor between the Positive and Negative heat sinks as shown in Figure 14. Use a voltmeter to measure the ac rms voltage of the source and the dc average voltage across the test load resistor and ensure that the output voltage is 0.9 times the ac rms input voltage minus 2 volts.

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

9. Optional Diode Bridge Operational Check (continued)

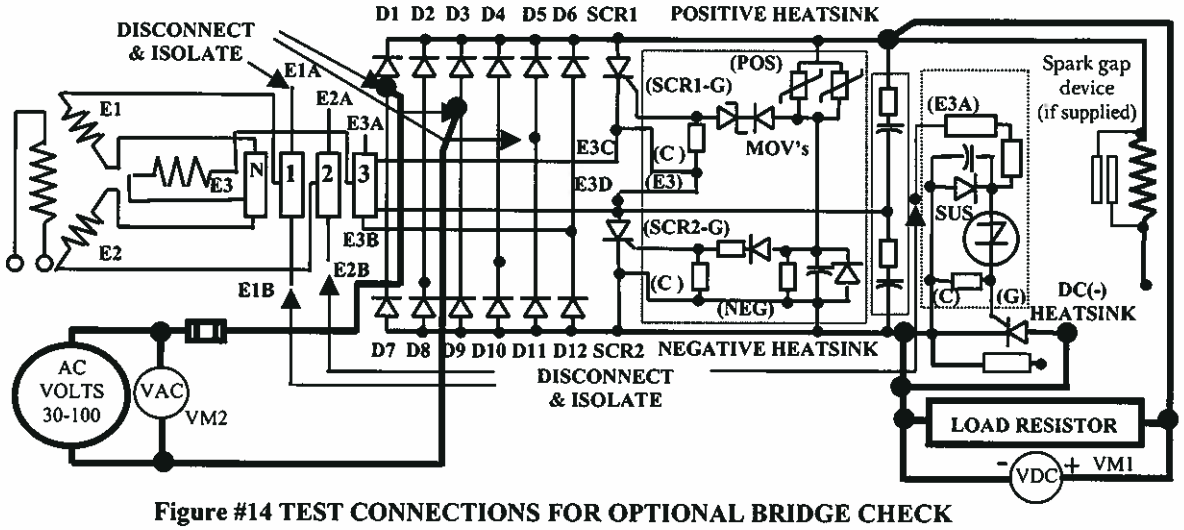

Figure #14 TEST CONNECTIONS FOR OPTIONAL BRIDGE CHECK

Connect the appropriate ac voltage source between E3A and E3B, and the appropriate test load resistor between the Positive and Negative heatsinks as shown in Figure 15. Use a voltmeter to measure the ac rms voltage of the source and the dc average voltage across the test load resistor and ensure that the output voltage is 0.9 times the ac rms input voltage minus 2 volts.

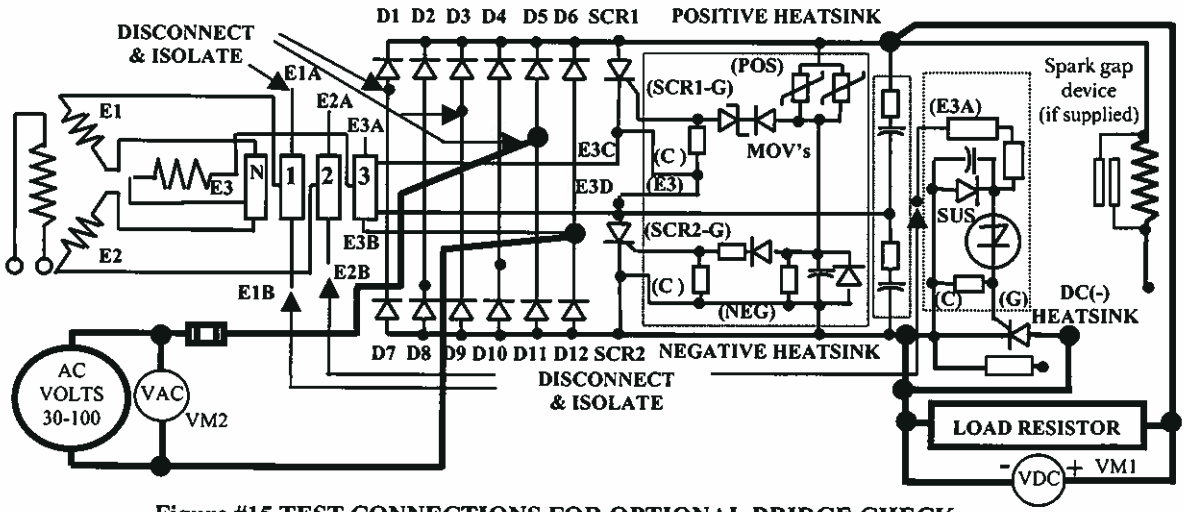

Figure #15 TEST CONNECTIONS FOR OPTIONAL BRIDGE CHECK

INSTRUCTIONS FOR TESTING OF THE 4005EI211AH BRUSHLESS EXCITER WITH DISCHARGE RESISTOR BYPASS SCR WHILE THE EQUIPMENT IS MOUNTED ON THE MOTOR ROTOR

9. Optional Diode Bridge Operational Check (continued)

Connect the appropriate ac voltage source between E1B and E2B, and the appropriate test load resistor between the Positive and Negative heat sinks as shown in Figure 16. Use a voltmeter to measure the ac rms voltage of the source and the dc average voltage across the test load resistor and ensure that the output voltage is 0.9 times the ac rms input voltage minus 2 volts.

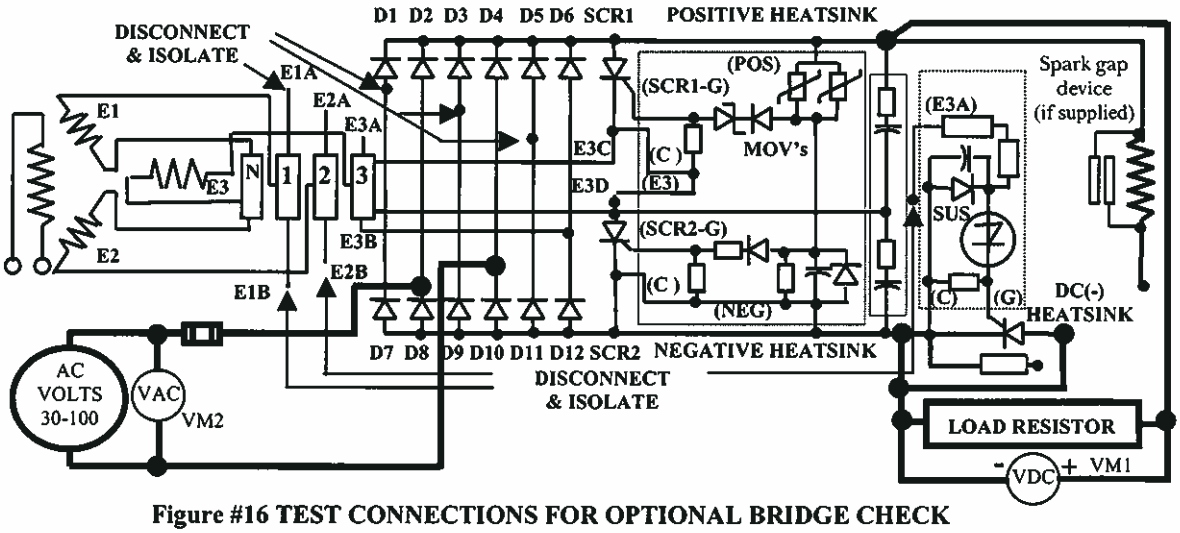

Figure #16 TEST CONNECTIONS FOR OPTIONAL BRIDGE CHECK

Record your results:

Input Terminals	Input Volts(VM2)	Output Volts(VM1)
E1A to E2A	_____ Vac	_____ Vdc
E3A to E3B	_____ Vac	_____ Vdc
E1B to E2B	_____ Vac	_____ Vdc

NOTE THAT THE MOTOR FIELD AND DISCHARGE RESISTOR CIRCUITS MUST BE FULLY RECONNECTED TO THE BRUSHLESS EXCITER CONVERTER BEFORE POWER IS APPLIED TO THE MOTOR STATOR OR SEVERE DAMAGE WILL OCCUR.

End of Test.