HANDYMAN®

OPERATOR'S MANUAL

WARNING

TO INSURE SAFE AND EFFICIENT OPERATION
OF THIS INSTRUMENT
PLEASE READ THIS MANUAL CAREFULLY BEFORE
ATTEMPTING ANY MEASUREMENTS OR TESTS

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CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

REV. 8/94

1.0 INTRODUCTION

1.1 MEET THE HANDYMAN

The Handyman Component Tester represents a giant step forward in portable test equipment. It works in conjunction with your present VOM, greatly enhancing its capabilities. The Handyman enables you to test SCRs, diodes, capacitors, transistors, contactor drivers, snubbers, suppressors and more, with a level of confidence never before possible with a VOM alone. How many times have you seen a component test "OK" with a VOM but found that it breaks down when full voltage is applied?

The Handyman is quite different from other testers in that it applies 200 volts to SCRs and diodes for evaluating blocking and reverse leakage. Capacitors may now be tested at or near their actual operating voltage. Numerous other components can be completely tested under realistic conditions where VOM testing alone would provide only marginal or inconclusive information. SCR firing and holding current tests along with diode forward conduction and simple continuity testing are all routine for the Handyman. For added convenience, an audible as well as a visual indication is provided for continuity tests. This enables the operator to devote full attention to circuit probing without the need for visual contact with the Handyman. It also tests its own battery and internal circuitry. The peak reading function allows you to use your VOM to measure the peak voltage developed across commutating capacitors on all SCR controls.

The Handyman tester requires a minimum of operator "judgment" or experience. A calibrated leakage detector tells you by means of a front panel indicator when a component is defective, without the use of a VOM. The VOM is optional on most tests if additional information is desired. By eliminating guesswork, defective components are spotted and good components are saved instead of being needlessly discarded because they are "suspect."

Occasionally, an SCR will fail under load after it is hot due to thermally induced stresses or a marginal turn-off time condition. Since these types of defects do not show up until the SCR has been operating at full load for several minutes or hours, the Handyman is not capable of detecting them. Part substitution is sometimes the only way of isolating thermally induced intermittent defects.

The Handyman is furnished complete with three high quality test leads, insulated test clips, plastic instruction card, and operator's manual. The Handyman is powered by eight standard alkaline "C" cells (Eveready E-93 or equal). Because of possible shelf depletion, batteries are **not** included.

1.2 THEORY OF OPERATION

The internal circuitry of the Handyman is arranged to perform two main classes of tests: (1) Forward conduction and continuity type tests at

low voltage (12 VDC) and, (2) Leakage or breakdown type tests at high voltage (200 VDC). Two auxiliary tests; battery self-test and peak reading, are also included.

The desired test is selected by means of a front panel four position, two pole rotary switch. One pole connects the 12 volt battery to the proper point for the desired test; the other pole switches the "anode" test jack. The four positions are: "Battery Test", "Off/Peak Reading", "Continuity", and "Leakage". The "cathode" and "VOM (—)" test jacks are common to the negative side of the 12 volt battery at all times.

In the "Battery Test" position, the battery voltage is compared with an internal reference voltage. If the loaded battery voltage is 10.0 volts or higher, the green "battery OK" LED is lighted. Fresh batteries will measure as high as 12.6 volts. Batteries are considered depleted for the purposes of this tester when they reach 10.0 volts, although they may still give some additional service in another application. The Handyman will still function with a battery voltage below 10.0 volts, however, the calibration of its measuring circuitry may no longer be accurate.

In the "Off/Peak Reading" position, battery power is completely turned off. The voltage peak reading network is internally connected between the "anode" and "VOM (+)" test jacks. This arrangement permits an A.C. waveform (such as found across commutating capacitors) to be introduced at the "anode" and "cathode" test jacks; the peak value of which may be measured by a VOM (at least 20,000 ohms/volt) connected at the "VOM" test jacks. The peak reading network "holds" the peak or highest voltage of each cycle, permitting the VOM to measure peak voltage instead of average voltage. The opposite (negative) peak may be measured by simply interchanging the "anode" and "cathode" test leads. Accuracy is within a few percent down to frequencies of 20-30 Hz. Peak voltages of up to 400 volts may be measured.

In the "Continuity" position, battery voltage (12 volts) is applied to the "anode" test jack through a load consisting of an incandescent lamp and a resistor in parallel. This arrangement is useful for all SCR and diode forward conduction tests, as well as simple continuity tests. The lamp is visible whenever the resistance of the external circuit connected at the "anode" and "cathode" test jacks is approximately 25 ohms or less. The lamp and resistor combination provide the necessary latching and holding current for testing large power SCRs. A solid-state audible signalling device is connected in parallel with the lamp and resistor. It is heard for all continuity and forward conduction tests. Additionally, a gate pulse is provided at the "gate" test jack when either of the two gate test pushbuttons is depressed. A capacitor pre-charged to 12 volts is discharged through one of the two resistors connected to the gate test jack, depending on which button is pressed. Two strengths of gate signal (approximately 800 ma and 25 ma) enables a rough test of gate sensitivity. Most SCRs will fire on the "Lo" gate test. If either button is held, a steady gate signal is

provided of approximately 10 ma for testing transistors, driver blocks, and other similar devices.

In the "Leakage" position, the 12 volt battery is connected to a DC-to-DC converter that produces approximately 200 volts DC for leakage tests and the "anode" test jack is connected to this 200 volt source. Voltage is not actually applied to the device under test until the "Leakage" pushbutton is depressed. For safety reasons, the "anode" test jack is connected to a discharging resistor when the "Leakage" pushbutton is released, providing a discharge path for capacitors and capacitive components such as snubbers. The 200 volt source is current limited to less than 12 ma when the "anode" and "cathode" terminals are shorted together. This prevents damage to either the tester or component under test, as well as providing a means to test breakdown devices such as zener diodes and varistors. The test voltage (or breakdown voltage) may be monitored at the VOM test jacks. The 200 volts cannot be applied accidentally. The function switch must be in the "Leakage" position **and** the "Leakage" pushbutton depressed before the 200 volts is applied to either the "anode" test jack or the VOM test jacks. The jacks are recessed for additional safety.

1.3 TECHNICAL SPECIFICATIONS

Types of Tests Performed:

- Simple Continuity (25 ohms or less)
- Diode and SCR Foward Conduction
- Diode Reverse Leakage and SCR Blocking at Two Sensitivity Levels
- SCR Gate Firing at Two Sensitivity Levels
- SCR Holding Current at One Level
- Capacitor Leakage and Approximate Capacitance
- Snubber Capacity and Leakage
- Varistor and Zener Breakdown Voltage
- Neon Lamps
- Certain networks called "Diode" or "Filter" Blocks
- EV-1 Contactor Driver Blocks and NPN Transistors
- Insulation Resistance

Continuity and Forward Conduction: Twelve (12) volts applied, load in series consisting of #1893 lamp in parallel with 27 ohm resistor and audible signalling device. Test current 500-600 ma. Lamp provides inrush current for SCR latching.

Gate Firing Pulse: Peak amplitude, 12 volts. Peak current 25 ma (Lo) or 800 ma (Hi). Exponential decay. Steady logic signal (Gate "Hi" button held) 10 ma.

High Voltage Supply: DC-to-DC converter supplies 215 volts nominal with fresh batteries (12.6 volts). Standby drain, 60 ma. Output current limited to 12 ma. Short-circuit protected.

Leakage Indicator: A comparator circuit measures the current flowing through the device under test during leakage tests. When this current exceeds approximately 1 ma (Lo) or 4 ma (Hi), the red LED "Excessive Leakage" indicator lights.

Peak Voltage Reading: A peak reading network "holds" the peak voltage appearing at the "anode" and "cathode" test jacks. This voltage may be read with a VOM (20K ohm/volt) at the VOM test jacks. Accuracy is within a few percent down to a frequency of 20 Hz. Range is 0-400 volts.

Battery Self-Test: A comparator checks the battery voltage at a 60 ma load against an internal zener reference. Battery voltages above 10.0 volts will light the green LED "Battery OK" indicator.

Power Source: Eight (8) standard 1.5 volt alkaline "C" cells (Eveready E-93 or equivalent). See battery recommendations.

Physical Size: 5¼" x 6⅞" x 3" overall.

Weight: 3.0 lbs. including batteries and test leads.

Operating Temperature Range: −20° to +120°F.(−28° to +50°C.).

1.4 SAFETY AND HANDLING

The Handyman was designed for safe and efficient operation, but if misused or abused, it can fail to give good service and may present a shock hazard. With reasonable care and attention to proper operating procedure, however, it should give many years of safe, trouble-free service. Do not drop the tester on a hard surface. Do not use test leads with insulation or plugs in poor condition. Always use insulated test clips. Attach test leads securely **BEFORE** starting tests. All tests performed with the function switch in the "Continuity" position use only the 12 volt battery and present no shock hazard. All tests using the "Leakage" position involve the 200 volt supply; however, the 200 volts is **not** applied to the device until the "Leakage" pushbutton is depressed. The voltage is removed and the discharging resistor connected when the button is released. All shock hazard can be easily avoided by simply not touching the metal portion of the test leads or any part of the device under test during the actual test. Always release both "Leakage" pushbuttons and, as an added precaution, return the function switch to "Off" before connecting or disconnecting test leads. Always use the VOM settings given in the "Operation" section (Section 4.0) for the particular test. If in doubt, use the 250 VDC range, positive polarity.

2.0 PREPARATION FOR USE

2.1 UNPACKING/INSPECTION FOR DAMAGE

Carefully unpack the Handyman and visually inspect it for obvious

shipping damage such as a cracked case, broken controls, or loose parts inside. Such damage should be reported to the carrier immediately.

2.2 BATTERY RECOMMENDATIONS

Because of possible shelf depletion, the Handyman is shipped **without** batteries. Eight (8) standard "C" cells are required, which are readily available. To install cells, remove the four screws holding the unit in its case and lift unit out. The Eveready "Energizer" Type E-93 battery is recommended. Substitutes are: Burgess AL-1; Mallory MN-1400; Ray-O-Vac 814, or Radio Shack 23-551. Rechargeable Ni-Cads are **not** recommended.

Battery life is estimated at three months for moderate to heavy use; six months for average use, and up to 12 months for light or occasional use. Conventional zinc-carbon cells may be used at a **considerable sacrifice** in battery life. Depleted cells should be removed immediately to prevent possible corrosion damage.

2.3 WARRANTY AND REPAIR

If any improper operation develops as a result of a manufacturing defect within two years from the date of purchase, with normal use, the unit will be repaired or replaced at no cost. If, in the opinion of Flight Systems, the unit has been subjected to other than normal use conditions, the warranty may be voided. In such cases, repair charges will be quoted at the same rates as for out-of-warranty repairs. Such repairs carry a one year warranty. Items specifically **excluded** from warranty coverage are: broken cases, lamps and batteries. Acid-damaged units may be returned as unrepairable.

Factory repair service and spare parts are always available at reasonable cost. Our service engineers are ready to assist you by telephone with questions you may have regarding component testing with the Handyman or with troubleshooting in general.

3.0 FRONT PANEL FEATURES

3.1 CONTROLS

The front panel controls are simple, well marked, and easy to operate. The desired function is set by means of the bar knob function selector switch. It has four positions (starting with extreme left): "Battery Test"; "Off/Peak Reading"; "Continuity", and "Leakage". The last two positions are used for all tests (except peak reading) and are discussed in detail under "Operation". The two gate test pushbuttons, "Hi" and "Lo," provide signals of two different strengths at the white gate test jack as each button is pressed. These signals are used to test SCRs, transistors, and driver blocks. The "Leakage Lo" pushbutton serves a dual function. With the function selector in the "Leakage" position, pressing the "Leakage Lo"

pushbutton applies 200 volts DC to the anode and cathode test jacks. When the "Leakage Lo" pushbutton is released, the 200 volts DC is disconnected and a safety discharging resistor is connected across these jacks. When the "Leakage Hi" pushbutton is pressed along with the "Leakage Lo" pushbutton, the leakage detector threshold is changed from approximately 1 ma to 4 ma.

3.2 TEST JACKS

There are a total of five color-coded test jacks. The "Anode/Pos" jack (red) is used for the positive test lead. It is **ALWAYS** positive in polarity with respect to the "Cathode/Neg" jack (black). The "Gate" jack (white) is used for the gate test lead when testing SCRs and for the drive signal when testing transistors and similar devices. This jack should **NOT** be used unless the test calls for it. The "VOM" test jacks (red for positive/black for negative) enable the user to obtain additional valuable information in many of the tests. Use of the VOM is required in a few cases but is optional for most tests. Correct settings and readings are given for specific tests under "Operation".

3.3 INDICATORS

There are a total of three indicators: "Battery OK"; "Continuity", and "Excessive Leakage". The "Battery OK" indicator is a green LED that shows the battery condition. It should be lit when the function selector is in the "Battery Test" position. The "Continuity" indicator is a white incandescent lamp that lights brightly or glows visibly when the function selector is in the "Continuity" position and the resistance between the positive and negative test leads is 25 ohms or less. This indicator is used for device conduction tests and continuity tests. The audible signal, that works in conjunction with the continuity indicator, emits sound through a small hole at the top center of the panel. The "Excessive Leakage" indicator is a red LED that lights when the function selector is in the "Leakage" position and the current flowing in the device under test exceeds approximately 1 ma (Lo) or 4 ma (Hi). This indicator is used for device leakage and blocking tests such as SCRs, diodes and capacitors.

4.0 GENERAL COMPONENT TESTS

CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

4.1 CONTINUITY TEST	VOM
• Set function switch to "Continuity". • Connect red test lead to "Anode/Pos" test jack. • Connect black test lead to "Cathode/Neg" test jack. • Probe circuit to be tested, observing polarity (if applicable). • "Continuity" lamp is visible if circuit resistance is 25 ohms or less.	Not Used for straight continuity test. If circuit resistance is more than 25 ohms, use VOM.
4.2 DIODE FORWARD CONDUCTION TEST	**VOM**
• Set function switch to "Continuity". • Connect diode anode to "Anode/Pos" test jack. • Connect diode cathode to "Cathode/Neg" test jack. "Continuity" lamp should light. NOTE: Some diodes are reversed in their package. These types usually have an "R" suffix in the part number. Press-Pak (Hockey Puck) diodes require a minimum of 50 lbs. of squeezing force if not mounted.	2.5 VDC Range* 0.5 to 1.5 VDC *Start with 50 VDC Range switching to 2.5 VDC Range when "Continuity" lamp lights.
4.3 SCR FIRING/HOLDING TEST	**VOM**
• Set function switch to "Continuity". • Connect SCR anode to "Anode/Pos" test jack. • Connect SCR gate (white wire or small terminal) to "Gate" test jack. • Connect SCR cathode to "Cathode/Neg" test jack. NOTE: Press-Pak (Hockey Puck) SCRs require a minimum of 50 lbs. of squeezing force if not mounted.	2.5 VDC Range* 0.6 to 2.0 VDC *Start with 50 VDC Range switching to 2.5 VDC Range when "Continuity" lamp lights.

Audible signal on all "continuity" tests.

4.3 SCR FIRING/HOLDING TEST, continued	VOM
• Momentarily press 'Hi' or 'Low' gate test push - button as required to fire SCR. "Continuity" light should light and remain on if SCR has fired properly. If SCR will fire only on "Hi" gate test, it requires a high current gate pulse. (Normal for some large SCRs, but is an indication of poor gate sensitivity on small SCRs).If SCR will not fire on either gate test,it is defective.If"Continuity" light comes on **without** pressing either gate test button, it is shorted (VOM will read less than 0.6 volts). SCR should turn off when function selector is momentarily switched to "Off" position.	2.5 VDC Range* 0.6 to 2.0 VDC *Start with 50 VDC Range switching to 2.5 VDC Range when "Continuity" lamp lights.

4.4 DIODE REVERSE LEAKAGE TEST	VOM
• Set function switch to "Off". • Connect diode anode to "Cathode/Neg" test jack. • Connect diode cathode to "Anode/Pos" test jack. NOTE: Some diodes are reversed in their package. These types usually have an "R" suffix in the part number. Press-Pak (Hockey Puck) diodes require a minimum of 50 lbs. of squeezing force if not mounted. • Set function switch to "Leakage". • Press "Leakage Lo" button. If "Excessive Leakage" indicator lights, diode reverse leakage is more than 0.86 ma at the applied voltage as read on the VOM. This is excessive for most small and medium size diodes rated at up to 25 amps. It is permissible for all large diodes rated at over 100 amps such as the plugging and flyback diodes used on most forklift and mining controls. • If "Excessive Leakage" indicator was lighted in above test on a large diode, hold the "Leakage Lo" and "Hi" buttons at the same time. If "Excessive Leakage" indicator goes off, the diode is acceptable. If not, the diode leakage is above 4.2 ma at the applied voltage as read on the VOM. This corresponds to a projected leakage of over 10 ma at 300 volts, and the diode is considered defective and/or failure prone.	Optional 250 VDC Range 120 VDC Minimum

4.5 SCR BLOCKING/REVERSE LEAKAGE TEST	VOM
• Set function switch to "Off". • Connect SCR anode to "Anode/Pos" test jack. • Connect SCR cathode to "Cathode/Neg" test jack. NOTE: Press-Pak (Hockey Puck) SCRs require a minimum of 50 lbs. of squeezing force if not mounted. • Set function switch to "Leakage". • Press "Leakage Lo" pushbutton. If "Excessive Leakage" indicator lights, SCR blocking leakage is more than 0.86 ma at the applied voltage as read on the VOM. This is excessive for most small and medium size SCRs up to 60 amps. It is permissible for large stud and hockey puck-type SCRs rated at 100 amps or higher. • If "Excessive Leakage" indicator was lighted in above test on a large SCR, hold the "Leakage Lo" and "Hi" buttons at the same time. If "Excessive Leakage" indicator goes off, SCR is acceptable. If not, SCR leakage is above 4.2 ma at the applied voltage as read on the VOM. This corresponds to a projected leakage of over 10 ma at 300 volts, and the SCR is considered defective and/or failure prone. • For REVERSE leakage test, reverse test leads and repeat above.	Optional 250 VDC Range 120 VDC Minimum

4.6 CAPACITOR TEST	VOM
• Set function switch to "Off". • Connect capacitor to "Anode/Pos" and "Cathode/Neg" test jacks (observe polarity if capacitor is polarized). (SCR commutating capacitors are non-polarized). Do not test small capacitors with less than a 200 VDC rating. • Set function switch to "Leakage.". • Press and hold "Leakage Lo" pushbutton until "Excessive Leakage" indicator goes off, noting the time this takes. The approximate value of the capacitor may be determined from the table at right. If the indicator does not light, the capacitor value is 0 to 0.1 mfd. If the indicator stays on, the capacitor is leaky.	Optional 250 VDC Range 180 VDC Minimum when capacitor is fully charged. Mfd. Secs. 5 ½ 10 1 50 4 100 7 150 10 200 14 300 20

Audible signal on all "continuity" tests.

4.7 PEAK READING TEST	VOM
• Set function switch to "Off/Peak Reading". CAUTION: **ANY OTHER SETTING MAY RESULT IN DAMAGE TO THE HANDYMAN.** • Connect test leads (red for positive/black for negative) to the "Anode/Pos" and "Cathode/Neg" test jacks. Be sure the capacitor(s) of the system under test are discharged. • Using the insulated test clips, connect the test leads across the capacitor(s). Proceed as for setting current limit under stalled conditions and note the highest voltage reading. • Reverse the test leads and repeat the test. If either reading exceeds the DC voltage rating of the capacitor(s), the current limit setting must be reduced.	250 VDC Range Readings should not exceed DC voltage rating of capacitor in **either** direction.

4.8 SUPPRESSOR TEST	VOM
• Connect the "Anode/Pos" and "Cathode/Neg" test leads across the suppressor. • Set the function switch to "Leakage". • Press the "Leakage Lo" pushbutton. Varistor-type suppressors in the range of 0-150 volts will light the "Excessive Leakage" indicator and their voltage will read on the VOM. Varistor-type suppressors will read the same voltage when test is repeated with the test lead polarity reversed. The voltage read should always be somewhat higher (typically 2 times) than the voltage of the system on which they are used. Diode/Resistor suppressors should light the "Excessive Leakage" indicator in one direction only. No light in either direction indicates an "open"; while a light in both directions indicates a "short". The latter is rare since the resistor usually burns "open" if the diode shorts or is incorrectly connected. Capacitor/Resistor types should be tested as "Snubbers" (Refer to Sec. 5.5).	250 VDC Range Varistor: same voltage both directions. Diode/Resistor 180-200 VDC No Light 0-2 VDC Light

4.9 ZENER DIODE TEST	VOM
• Connect "Anode/Pos" test lead to **banded** end of zener diode. • Connect "Cathode/Neg" test lead to other end. • For greatest accuracy, move VOM positive lead from the "VOM +" test jack to the "Anode/Pos" test jack. (Zener Tests Only) • Set function switch to "Leakage". • Press "Leakage Lo" pushbutton. "Excessive Leakage" indicator will light and zener voltage can be read on the appropriate VOM voltage range.	250 VDC Range then 50 VDC or 10 VDC as required.

4.10 TRANSISTOR TEST	VOM
NPN power transistors may be given a functional test ("opens" and "shorts") with the Handyman. (Do not test PNP transistors). This test does not attempt to measure gain, leakage, or breakdown voltage as these parameters vary widely with different transistors. • Connect "Anode/Pos" test lead to transistor case or collector terminal. • Connect "Gate" test lead to base terminal. Connect "Cathode/Neg" test lead to the emitter terminal. • Set function switch to "Continuity". • Press "Gate" test "Hi" pushbutton. "Continuity" lamp should light and VOM reading should drop from approximately 12 volts to less than 0.5 volts.	10 VDC Range Voltage reading drops from approximately 12 VDC to less than 0.5 VDC. 10 VDC Range Voltage reading drops from approximately 12 VDC to less than 0.5 VDC.

CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

Audible signal on all "continuity" tests.

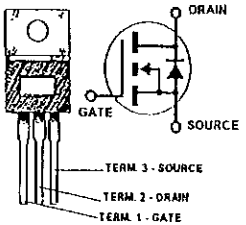
NOTE: FIRST VERIFY YOUR HANDYMAN IS F.E.T. CAPABLE

Handyman Units manufactured after June 1993 are F.E.T. Capable. Use this test to determine if yours can test F.E.T.s: **Set Handyman in OFF position. Using an Ohmmeter (Set to 10K Position), measure resistance from Gate to Cathode. Meter should indicate 100,000 ohm ± 5,000 ohms. If meter indicates infinite resistance or does NOT move, Handyman is NOT capable of testing F.E.T.s.**

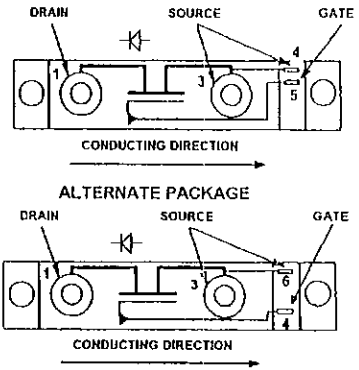
Your older Handyman CAN be modified to be F.E.T. capable. Contact Flight Systems for upgrade information.

4.11 N-CHANNEL FIELD EFFECT TRANSISTOR (FET) FORWARD CONDUCTION TEST	**VOM**
• Connect the F.E.T. drain to "anode/pos." test jack. • Connect the F.E.T. Source to "cathode/neg." test jack. • Connect the F.E.T. gate to "gate" test jack. • Set function switch to "Continuity". • If "continuity" lamp illuminates BEFORE button is pressed, the F.E.T. is bad and should be replaced. • Press the"Lo" or "Hi" gate button to allow the F.E.T. to conduct. The continuity light will illuminate and stay on as long as the gate button is depressed. Release the "Lo" or "Hi" gate button; the "continuity" light should go out. If "continuity" lamp stays on, then replace the F.E.T. - - - - - - CAUTION - - - - - - Do not attempt to test the leakage of a F.E.T. due to the presence of high voltage from the Handyman which could damage the drain/source connection in the F.E.T. Refer to illustrations below.	2.5 VDC Range* 0 to .7 VDC *Start with 50 VDC range, then switch to 2.5 VDC range when "continuity" lamp lights.

Basic FET Layout



G.E. EV-T5



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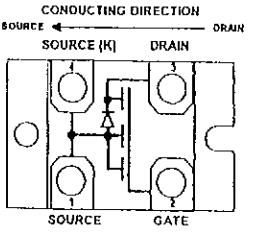


4.12 NEON LAMP TEST	VOM
• Connect "Anode/Pos" and "Cathode/Neg" test leads to lamp under test. • Set function switch to "Leakage". • Press "Leakage Lo" pushbutton. Both the lamp and "Excessive Leakage" indicator should light.	Optional 250 VDC Range 65-90 VDC

4.13 INSULATION RESISTANCE TEST	VOM
Quality of insulation in any circuit may be verified where the application of 200 volts DC would not be harmful (such as motor windings to frame or heat sink block to base plate). • Isolate circuit to be tested by disconnecting other related components that might provide a false leak path or be damaged by the test voltage. • Connect "Anode/Pos" and "Cathode/Neg" test leads to their test jacks and to the circuit to be tested, observing polarity (if applicable). • Set function switch to "Leakage". • Press "Leakage Lo" pushbutton. "Excessive Leakage" indicator may flash briefly as the button is pressed, indicating there is some capacitance present (this is normal). If indicator stays on, it shows the resistance of the test circuit is 150K ohms or **lower.** • Press "Leakage Lo" and "Hi" pushbutton at the same time. If indicator stays on, the resistance of the test circuit is 30K ohms or **lower.** NOTE: Conductive dirt and/or acid can easily cause a resistance below this value. If Leakage indicator stays on, look for conductive dirt or damaged or burned insulation. Correct problem and repeat the test.	Optional 250 VDC Range 180 VDC Minimum NOTE: Voltage reading may be much lower if leakage is severe.

CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

5.0 INDUSTRIAL FORKLIFT CONTROLS

EV-1, EV-10, EV-100, EV-200 **5.1 CONTACTOR DRIVER TEST** **IC3645CPM1RDA2, IC3645CPM1RDB2**	**VOM**
• Set function switch to "Continuity". • Connect test leads as follows: Terminal 1 to "Gate." Terminal 2 to "Cathode/Neg." Terminal 3 to "Anode/Pos." "Continuity" lamp should light when "Hi" gate test button is pressed. • Move the lead on Terminal 3 to Terminal 4 and repeat test. Failure of "Continuity" lamp to light on either test indicates a defective block. • Set function switch to "Leakage". • Press "Leakage Lo" pushbutton momentarily. The "Excessive Leakage" indicator will light. **This is normal.** VOM reading must be within limits shown. • Disconnect the "Gate" lead from terminal 1. • Move the "Cathode/Neg" lead from terminal 2 to terminal 3. • Press "Leakage Lo" pushbutton momentarily. "Excessive Leakage" indicator should not light. • Switch the leads on terminals 3 and 4. Press "Leakage Lo" pushbutton momentarily. "Excessive Leakage" indicator should not light.	10 VDC Range 1.7 VDC Maximum (lamp lit) 250 VDC Range For RDA2 60 VDC Minimum 90 VDC Maximum For RDB2 100 VDC Minimum 160 VDC Maximum

EV-1, EV-10, EV-100, EV-200 **5.2 HOUR METER DRIVER TEST** **IC3645CPM1HMB1**	**VOM**
• Set function switch to "Continuity". • Connect "Cathode/Neg" lead to terminal 4. • Connect "Anode/Pos" lead to terminal 1. "Continuity" lamp lights. • Connect "Anode/Pos" lead to terminal 2. "Continuity" lamp lights. • Connect "Anode/Pos" lead to terminal 3. "Continuity" lamp lights. • Connect "Cathode/Neg" lead to terminal 1 and "Anode/Pos" lead to terminal 4. • Set function switch to "Leakage" and press "Leakage Lo" pushbutton momentarily. "Excessive	

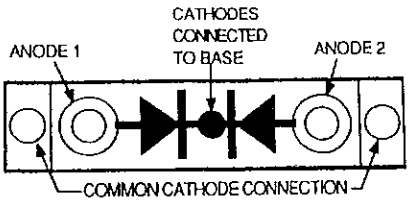
EV-1, EV-10, EV-100, EV-200 **5.2 HOUR METER DRIVER TEST,** continued **IC3645CPM1HMB1**	**VOM**
Leakage" indicator should not light. • Connect "Cathode/Neg" lead to terminal 2. Repeat Leakage Test. • Connect "Cathode/Neg" lead to terminal 3. Repeat Leakage Test.	
EV-1, EV-10, EV-100, EV-200 **5.3 TIME DELAY MODULE TEST** **IC3645CPM1TDA3, IC3645CPM1TDA4, IC3645CPM1TDD3**	**VOM**
• Connect the "Cathode/Neg" lead to terminal 2. • Connect the "Anode/Pos" lead to terminal 4. • Connect the VOM Neg lead to the Neg VOM jack. • Connect the Pos VOM lead to terminal 1. • Set function switch to "Leakage". • Press and hold "Leakage Lo" pushbutton. The "Excessive Leakage" indicator should light. • While holding the "Leakage Lo" button, connect terminal 4 to terminal 3 with an insulated test lead. • Remove test lead from terminal 3. VOM needle falls to zero after a time delay which varies according to P/N as follows: TDA3, TDA4; 2 sec, TDD3; 1 sec.	10 VDC Range 0 VDC 8–10 VDC
EV-1, EV-10, EV-100, EV-200, C185/M210 **5.4 THERMAL PROTECTOR TEST** **194B6376G2, 194B6376G1, 194B6376G4, 44A727009-G02, 44A727009-G01, 44A717475-G01, 205A7104G1**	**VOM**
• Connect "Cathode/Neg" and "Anode/Pos" test leads to thermal protector (non-polarized). • Connect VOM to VOM test jacks, observing polarity. • Set function switch to "Continuity". "Continuity" lamp should not light. Light indicates shorted thermal protector (no thermal cutback).	250 then 2.5 VDC Range

Audible signal on all "continuity" tests.

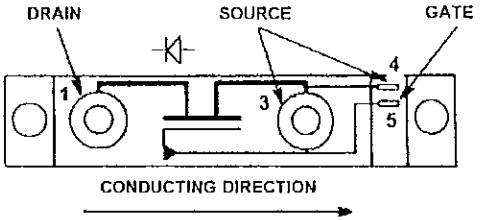
EV-1, EV-10, EV-100, EV-200, C185/M210 **5.4 THERMAL PROTECTOR TEST** continued	**VOM**
• Set function switch to "Leakage". Press "Leakage Lo" pushbutton momentarily and read VOM (optional). "Excessive Leakage" indicator should light. No light indicates open thermal protector (maximum thermal cutback). • Optionally read resistance at room temp. with VOM on Rx1 or Rx100 range.	0.75—1.5 VDC 100—200 ohms
EV-1, EV-100, EV-T5, EV-T6 **5.5 SNUBBER / FILTER TEST** (194B5393G1, 171B6551G1, 171B3940G1)	**VOM**
• Set function switch to "OFF". • Connect "Anode/Pos." and "Cathode/Neg." test leads to the filter assembly or snubber block. (Block may be connected by plugging leads into terminal holes.) Filter assembly or snubber block is non-polarized. • Set function switch to "Leakage". • Press "Leakage Lo" Pushbutton. The "Excessive Leakage" indicator should flash briefly. Repeat several times, waiting 3 seconds each time. If indicator does not flash or stay on, filter assembly or snubber block is defective.	Optional 250 VDC Range 180 VDC Min.
5.6 EV-T6 SNUBBER ASSEMBLY TEST (171B6589G1)	**VOM**
• Set function switch to "OFF". • Connect "Anode/Pos." to white/green wire from snubber assembly. • Connect "Cathode/Neg." to black wire from snubber assembly. • Set function switch to "Leakage". • Press "Leakage Lo" pushbutton. The "Excessive Leakage" indicator should flash briefly. Repeat several times, waiting 3 seconds each time. If indicator does not flash, or stays on, snubber is defective. Disconnect snubber from Handyman. • Connect red lead from VOM to red lead on snubber assembly. • Connect black lead from VOM to black lead on snubber assembly. • Select the Ohmmeter Scale indicated in column at right. Meter reading should be 27,400 Ohms.	Optional 250 VDC Range 180 VDC Min. OHMMETER R X 10,000 Range Indication* 2.7 on meter scale or 27,400 Ohms Approx. *Check & adjust the zero-ing of meter on the RX 10,000 by connecting the meter lead together.

5.7 EV-T5/T6 COMPONENT IDENTIFICATION

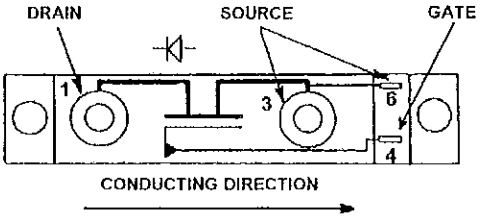
Free-Wheeling / Plugging Diode Block
(EV-T5/T6 3/4 Rec)



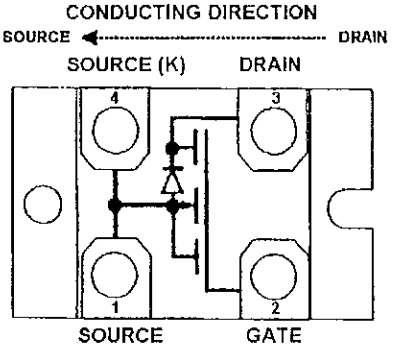
T5 Mosfet



ALTERNATE PACKAGE



T6 Mosfet



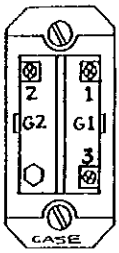
5.8 TESTING EV-10/EV100 SPECIAL COMPONENTS

• ILLUSTRATIONS BELOW INDICATE CATHODE & ANODE POSITIONS

EV-10 #2/5 REC PACK

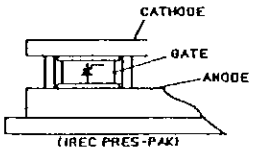
5 REC
1—CATHODE (–)
2—ANODE (+)
G1—GATE

2 REC
3—CATHODE (–)
CASE—ANODE (+)
G2—GATE

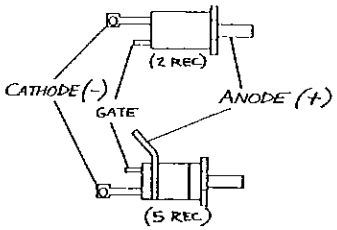


EV-10 #1 REC

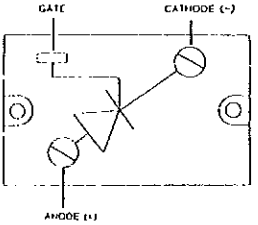
NOTE: 1 REC MUST BE IN PLACE WITH CORRECT SPRING PRESSURE



EV-10 INDIVIDUAL #2 and #5 RECS



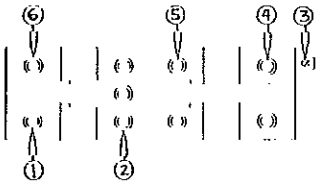
EV-100 #2 and #5 PRESS PACK RECS



EV-100 FILTER TERMINAL BLOCK TEST

- Set function switch to "Continuity"
- Connect "Anode/Pos" test jack to test point (1)
- Connect "Cathode/Neg" test jack to test point (2). "Continuity" light should come on
- Disconnect BOTH test leads
- Connect "Anode/Pos" test jack to test point (3)
- Connect "Cathode/Neg" test jack to test point (4), then to test point (5), then to test point (6). On each test point (4)(5)(6) the "Continuity" light should come on

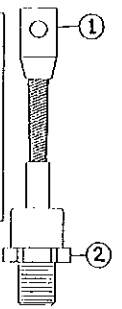
EV-100 FILTER MOUNTING TERMINAL BLOCK TEST POINT DIAGRAM



EV-T5, EV-T6 DIODE MODULE 5.9 FORWARD CONDUCTION TEST 328A1515AAP2 (T5), 328A1515AAP3 (T6)	VOM
• Set function switch to "Continuity". • Connect #1 terminal of the module to "Anode/Pos." test jack. • Connect the module mounting base to "Cathode/ Neg." test jack. Continuity lamp should light. • Repeat procedure using terminal #2 and module mounting base. LEAKAGE TEST- • Set function switch to "Off". • Connect terminal #1 of the module to "Cathode/Neg." test jack. • Connect module mounting base to "Anode/Pos." test jack. • Set function switch to "Leakage". • Press "Leakage Lo" button. • If "Excessive Leakage" indicator lights, diode reverse leakage is more than 0.86 ma at the applied voltage as read on the VOM. This is excessive for most small and medium size diodes rated at up to 25 amps. It is permissible for all large diodes rated at over 100 amps, such as the plugging and flyback diodes used on most forklift and mining controls. • If "Excessive Leakage" indicator was lit in above test on a large diode, hold the "Leakage Lo" and "Hi" buttons at the same time. If "Excessive Leakage" indicator goes off, the diode is acceptable. If not, the diode leakage is above 4.2 ma at the applied voltage as red on the VOM. This corresponds to a projected leakage of over 10 ma at 300 volts, and the diode is considered defective and/or failure prone.	2.5 VDC Range* .05 to 1.5 VDC. *Start with 50 VDC Range switching to 2.5 VDC Range when "Continuity" lamp lights. Optional - 250 VDC Range 120 VDC Min.

5.10 #3/#4 REC CHART-ANODE (+) AND CATHODE (-) POSITIONS

PANEL TYPE	C185	M210	EV-1	EV-10	EV-100
POSITION ①	ANODE (+)	ANODE (+)	CATHODE (-)	CATHODE (-)	CATHODE (-)
POSITION ②	CATHODE (-)	CATHODE (-)	ANODE (+)	ANODE (+)	ANODE (+)



5.11 DIODE AND FILTER BLOCK TEST P/Ns as shown in table	VOM
Various two and three terminal networks known as "diode" or "filter" blocks are frequently found on vehicle SCR controls. They contain a variety of components singly or in combination. While some can be tested by a VOM only, many require two or more tests involving the Handyman. Each block must pass **all** of the tests shown. The exact **order** of these tests does **not** affect the results. The blocks are tabulated by General Electric part number (first column) for convenience. The second column shows which tester, VOM or Handyman, is to be used (voltage tests require both). The third column shows the VOM Range or Handyman function to be used in each test. The fourth and fifth columns show where to connect the "Anode/Pos" and "Cathode/Neg" test leads with respect to the diode block terminals. Polarity **must** be observed. For leakage tests, the "Leakage Lo" pushbutton is to be pressed momentarily to obtain the reading/indication. The sixth column shows the **correct** reading or indication for each test. When testing blocks containing a capacitor, the "Excessive Leakage" indicator will flash for ¼ to ½ second, depending on the value.	Required where indicated. See tabulated data for settings and results. Use 250 VDC Range for **ALL** voltage tests.

Note: Tables follow on pages 23 - 26

Audible signal on all "continuity" tests.

5.11 DIODE AND FILTER BLOCK TESTS, continued

DIODE/FILTER BLOCK PART NUMBER	TESTER	RANGE/FUNCTION	ANODE POS	CATHODE NEG	READING/ INDICATION
139B2510:					
G1	VOM	Rx 10,000	A	C	56K ohms
G2/G4/G5	HAN	CONTINUITY	A	C	LIGHT
G7	HAN	LEAKAGE	C	A	NO LIGHT
G3	VOM HAN	Rx 100 LEAKAGE	A C	C A	1,000 ohms NO LIGHT
G6	VOM	Rx 10,000	A	C	15K ohms
148B6203:					
G11	VOM HAN	Rx 100 LEAKAGE	1 2	2 1	1,300 ohms NO LIGHT
G12	VOM HAN	Rx 100 LEAKAGE	1 2	2 1	3,000 ohms NO LIGHT
G13	VOM HAN	Rx 100 LEAKAGE	1 2	2 1	1,700 ohms NO LIGHT
G14	HAN	LEAKAGE	1	2	60-90 VDC
G15	VOM VOM	Rx 100 Rx 100	1 2	3 3	1,800 ohms 220 ohms
G16	VOM	Rx 10,000	1	2	27K ohms
G17	VOM VOM	Rx 100 Rx 100	1 2	3 3	1,200 ohms 220 ohms
G18/38	HAN HAN HAN HAN	CONTINUITY CONTINUITY LEAKAGE LEAKAGE	1 3 2 2	2 2 1 3	LIGHT LIGHT NO LIGHT NO LIGHT
G19	VOM VOM	Rx 100 Rx 100	1 2	3 3	3,900 ohms 220 ohms
G20	VOM VOM	Rx 1 Rx 100	1 2	3 3	100 ohms 3,300 ohms
G21	HAN HAN	LEAKAGE LEAKAGE	1 2	2 3	60-90 VDC 60-90 VDC
G22/43	HAN	LEAKAGE	1	2	FLASHES
G23	VOM	Rx 100	1	2	220 ohms
G24	VOM	Rx 1	1	2	100 ohms
G25	VOM HAN HAN	Rx 100 LEAKAGE LEAKAGE	1 2 2	2 1 3	1,300 ohms NO LIGHT FLASHES
G26	VOM	Rx 100	1	2	390 ohms
G27	VOM	Rx 100	1	2	680 ohms

5.11 DIODE AND FILTER BLOCK TESTS, continued					
DIODE/FILTER BLOCK PART NUMBER	TESTER	RANGE/FUNCTION	ANODE POS	CATHODE NEG	READING/ INDICATION
148B6203:					
G28	VOM VOM	Rx 100 Rx 100	1 3	2 2	2,700 ohms 220 ohms
G29A	VOM	Rx 100	2	3	220 ohms
G30	VOM VOM	Rx 100 Rx 100	1 2	3 3	2,200 ohms 220 ohms
G31	HAN HAN HAN HAN	CONTINUITY CONTINUITY LEAKAGE LEAKAGE	2 2 1 3	1 3 2 2	LIGHT LIGHT NO LIGHT NO LIGHT
G32	HAN VOM	LEAKAGE Rx 100	1 2	2 3	60-90 VDC 330 ohms
G33/35/44/47	HAN	LEAKAGE	1	3	FLASHES
G34	VOM HAN HAN	Rx 100 CONTINUITY LEAKAGE	1 2 3	2 3 2	10K ohms LIGHT NO LIGHT
G36	VOM	Rx 1	1	2	75 ohms
G37	HAN HAN HAN	LEAKAGE LEAKAGE CONTINUITY	1 2 3	3 3 2	FLASHES NO LIGHT LIGHT
G39	HAN HAN	CONTINUITY LEAKAGE	2 1	1 2	LIGHT NO LIGHT
G40	VOM VOM	Rx 100 Rx 100	1 2	2 3	3,600 ohms 1,200 ohms
G41	VOM VOM	Rx 100 Rx 100	1 2	2 3	10K ohms 10K ohms
G42	VOM	Rx 1	1	2	195 ohms
G45	VOM	Rx 1	1	2	180 ohms
G46	HAN HAN	CONTINUITY LEAKAGE	1 3	3 1	LIGHT NO LIGHT
G48	HAN HAN HAN	LEAKAGE LEAKAGE CONTINUITY	1 2 3	2 3 2	60-90 VDC NO LIGHT LIGHT
G49	HAN HAN VOM	CONTINUITY LEAKAGE Rx 100	1 2 1	2 1 3	LIGHT NO LIGHT 3,300 ohms
G50	HAN	LEAKAGE	1	2	FLASHES
G51	VOM	Rx 100	1	2	390 ohms

Audible signal on all "continuity" tests.

5.11 DIODE AND FILTER BLOCK TESTS, continued

DIODE/FILTER BLOCK PART NUMBER	TESTER	RANGE/FUNCTION	ANODE POS	CATHODE NEG	READING/ INDICATION
148B6203:					
G52	HAN	CONTINUITY	2	1	LIGHT
	HAN	CONTINUITY	2	3	LIGHT
	VOM	Rx 100	1	2	10K ohms
	VOM	Rx 100	3	2	10K ohms
G53	VOM	Rx 100	2	1	1,200 ohms
	HAN	LEAKAGE	2	3	36 VDC
G54	VOM	Rx 100	2	1	2,100 ohms
	HAN	LEAKAGE	1	2	NO LIGHT
G55	VOM	Rx 1	1	2	50 ohms
G56	VOM	Rx 1	1	2	25 ohms
G57	VOM	Rx 10,000	2	1	KICK THEN INF
	HAN	LEAKAGE	2	3	0.5 VDC
G58	VOM	Rx 100	1	3	KICK THEN INF
G59	VOM	Rx 1	1	2	32 ohms
	HAN	LEAKAGE	2	3	FLASHES
G60	VOM	Rx 100	1	3	8,200 ohms
G61	VOM	Rx 100	1	2	KICK THEN 8,200 ohms
G62	VOM	Rx 10,000	1	3	27K ohms
G63	VOM	Rx 100	1	2	1,000 ohms
	VOM	Rx 100	1	3	8,200 ohms
G64	VOM	Rx 1	3	2	68 ohms
	HAN	LEAKAGE	1	3	NO LIGHT
G65	VOM	Rx 100	2	1	9,000 ohms
	HAN	LEAKAGE	1	2	NO LIGHT
G66	HAN	LEAKAGE	1	2	FLASHES
G67	VOM	Rx 100	1	2	1,000 ohms
G68	VOM	Rx 1	2	1	16 ohms
	VOM	Rx 1	2	3	16 ohms
	HAN	LEAKAGE	1	2	NO LIGHT
	HAN	LEAKAGE	3	2	NO LIGHT
G69	HAN	LEAKAGE	1	3	FLASHES
G70	VOM	Rx 1	1	2	51 ohms

5.11 DIODE AND FILTER BLOCK TESTS, continued

DIODE/FILTER BLOCK PART NUMBER	TESTER	RANGE/FUNCTION	ANODE POS	CATHODE NEG	READING/ INDICATION
148B6203:					
G71	HAN	CONTINUITY	2	1	LIGHT
	HAN	CONTINUITY	2	3	LIGHT
	HAN	LEAKAGE	1	2	NO LIGHT
	HAN	LEAKAGE	3	2	NO LIGHT
G72	VOM	Rx 100	1	2	4,700 ohms
	HAN	CONTINUITY	3	2	LIGHT
	HAN	LEAKAGE	2	3	NO LIGHT
G73	HAN	CONTINUITY	3	2	LIGHT
	HAN	LEAKAGE	2	3	NO LIGHT
	HAN	LEAKAGE	2	1	FLASHES
G74	HAN	LEAKAGE	1	3	LIGHT
G75	HAN	LEAKAGE	1	3	FLASHES
G76	VOM	Rx 100	2	1	1,600 ohms
	HAN	LEAKAGE	1	2	NO LIGHT
	HAN	LEAKAGE	2	3	FLASHES
G77	VOM	Rx 1	2	3	100 ohms
G78	VOM	Rx 1	2	3	200 ohms
G79	VOM	Rx 100	2	1	2,200 ohms
	VOM	Rx 100	2	3	2,200 ohms
G80	VOM	Rx 10,000	1	3	180K ohms
G81	VOM	Rx 10,000	1	3	250K ohms
G82	VOM	Rx 100	1	3	390 ohms
G83	HAN	LEAKAGE	1	3	NO LIGHT
	HAN	CONTINUITY	3	1	LIGHT
G84	VOM	Rx 100	1	2	560 ohms
G85	VOM	Rx 100	2	1	8,200 ohms
	VOM	Rx 100	2	3	8,200 ohms
G86	VOM	Rx 1	2	1	10 ohms
	HAN	CONTINUITY	2	3	LIGHT
	HAN	LEAKAGE	3	2	NO LIGHT
G87	VOM	Rx 100	2	1	115K ohms
	VOM	Rx 100	2	3	7,500 ohms
	HAN	LEAKAGE	1	2	NO LIGHT
G88	HAN	LEAKAGE	1	3	NO LIGHT
G89	VOM	Rx 100	2	3	3,900 ohms
	VOM	Rx 100	2	1	3,900 ohms
G90	HAN	LEAKAGE	1	3	FLASHES

Audible signal on all "continuity" tests.

5.12 VEHICLE FRAME ISOLATION

The European Countries require the testing of Electric Vehicle Frame Isolation. The test involves checking for Battery Voltage being introduced to the vehicle frame.

This condition could possibly result in an electrical shock, or cause a fire hazard. The test can be performed by using the Handyman Model 269C. Test sequence follows:

- Disconnect the vehicle battery connector from the vehicle connector.
- Connect the black lead from the Handyman cathode/neg. jack to the vehicle frame (unpainted area).
- Connect the red lead from the Handyman anode/pos. jack to the pos. or neg. vehicle battery pack connector. (Test should be performed with battery pack in the vehicle). Select the leakage position on the Handyman; press the "low" leakage button. The leakage L.E.D. should not light; if it does, it indicates a leakage current in excess of 1 milliamps, which in turn indicates a resistance of less than 1000 ohms per volt. Repeat the test using the other vehicle battery connection. If either connection fails the test, correct the leakage problem and re-test.

CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

6.0 GENERATOR CONTROLS

CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

6.1 ENGINE-GENERATOR SET CONTROLS

Solid-state voltage regulators and brushless exciter type alternators have come into widespread use. Most of the control components can be conveniently tested with the Handyman and a VOM, particularly rectifier diodes and SCR's. Continuity and insulation resistance tests are used on generator windings and transformers.

The Handyman test is more conclusive than a VOM test alone. Some tests require the use of the VOM in conjunction with the Handyman when a resistance or a voltage is to be measured. The two instruments used *in combination* comprise a very effective measurement tool. Specific testing information is given below for the Onan "YD" and "UR" Series generators and regulators.

6.2 ONAN REGULATOR BOARDS

The procedure below checks out the output SCR bridge, field diode and a large portion of the input circuitry. Failure of *any one test* means a bad regulator board.

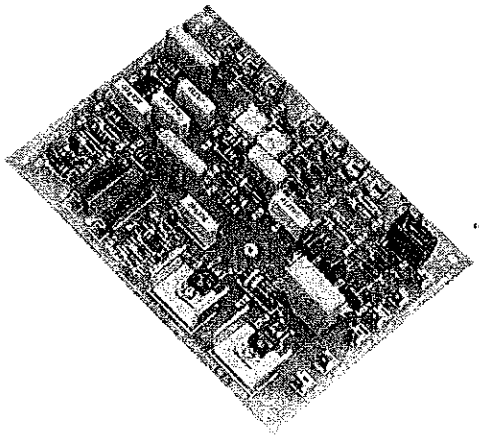
TABLE 6.2.1 "YD" TYPE REGULATOR

Component	Function	Anode/ Pos. (Red)	Cathode/ Neg. (Black)	Test / Result
CR13 (SCR)	Continuity	10	8	Connect CR13 or CR16 gate to cathode neg. -NO light; Remove neg. from gate & light will be ON (Except 300-1006 Series)*
CR16 (SCR)	(Make Connections First)	9	8	
CR12	Continuity	7	10	Light
		10	7	No Light
CR14		7	9	Light
		9	7	No Light
CR15		7	8	Light
		8	7	No Light
CR8	Leakage "LO"	4	V4	Leakage light stays ON
		V4	4	Leakage light FLASHES
CR9		6	V4	Leakage light stays ON
		V4	6	Leakage light FLASHES
CR10	Continuity	1	4	Light
	Leakage "LO"	4	1	Leakage light FLASHES
CR11		1	6	Leakage light stays ON
CR11, C8		6	1	Leakage light FLASHES

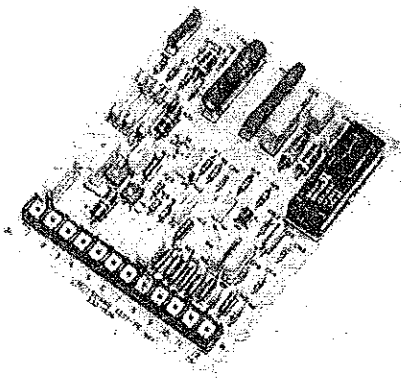
*Note: On 300-1006 gate MUST remain on CR13 or CR16; Light comes on and stays on when "LO" gate test button is pressed and released.

TABLE 6.2.2		"UR" TYPE REGULATOR		
VOM Connection +	VOM Connection –	VOM Range	Component(s)	Test / Result
1	5	RX 1	F1, CR8, K1, R1	Approx. 100 ohms
2	5	RX 1	F1, CR9, K1, R1	Approx. 100 ohms
3	5	RX 1	F3, R3, R1	Approx. 80 ohms
4	5	RX 1	F2, R2, R1	Approx. 80 ohms
Handyman +	Handyman –	Function Select	Component(s)	Test / Results
1	2	Leakage "LO"	C3, R5, CR8, CR9	Leakage light flashes. If light remains on, check CR8, CR9, C3 or R5

TYPICAL "YD" & "UR" REGULATOR
CONTROL BOARDS



Onan P/N 300-1540
"YD" Regulator Board



Onan P/N 332-1956
"UR" Regulator Board

6.3 ONAN "YD" & "UR" COMPONENT TESTS

IMPORTANT: Disconnect leads to component under test. Carefully ZERO the VOM.

TABLE 6.3.1 "UR" & "YD" COMPONENT TESTS

THESE TESTS FOR "UR"COMPONENTS

Component	Tester	Range/ Function	Anode/ Pos.	Cathode/ Neg.	Test / Result
SCR Bridge (CR21) SCR 1	H A N D Y M A N	Continuity	AC-1*	"+" Gate G1	Press "LO" gate test - Cont. lights
		Leakage	"+"	AC-1*	Press "LO" leakage - leakage lamp flashes
SCR Bridge (CR21) SCR 2		Continuity	AC-2*	"+" Gate G2	Press "LO" gate test - Cont. lights
		Leakage	"+"	AC-2*	Press "LO" leakage - leakage lamp flashes
SCR Bridge (CR21) CR-1		Continuity	"–"	AC-1*	Cont. lights
		Leakage	AC-1*	"–"	Press "LO" leakage - leakage lamp flashes
SCR Bridge (CR21) CR-2		Continuity	"–"	AC-2*	Cont. lights
		Leakage	AC-2*	"–"	Press "LO" leakage - leakage lamp flashes
SCR Bridge (CR21) CR-3		Continuity	"–"	"+"	Cont. lights
		Leakage	"+"	"–"	Press "LO" leakage - leakage lamp flashes

** AC-1 & AC-2 For text reference only*

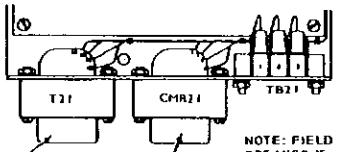
FOLLOWING TESTS FOR "UR" & "YD" COMPONENTS

Commutating Reactor CMR21	VOM	RX1	1	2	Approx. 0.4 ohms
			3	4	
	H-Man	Leakage	1	3	Press "LO" leakage - No leakage light
			1	Frame	
			3		
Reference Transformer T21 Standard "YD"**	VOM	RX1	H1	H2	113-139 ohms
			X1	X2	133-163 ohms
	H-Man	Leakage	H1	X1	Press "LO" leakage - No leakage light
			H1	Frame	
			X1		
Brushless Exciter Field F1 - F2	VOM	RX1	F1	F2	12.2 ohms 10%
	H-Man	Leakage	F1, F2	Frame	Press "LO" leakage - No leakage light

CHART CONTINUES ON NEXT PAGE →

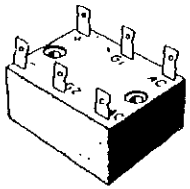
TESTS FOR "UR" & "YD" COMPONENTS (Cont.)					
Component	Tester	Range/ Function	Anode/ Pos.	Cathode/ Neg.	Test / Result
Brushless Exciter Rotor	VOM or OHM	RX1	T1 T2 T1	T2 T3 T3	0.5 - 0.6 ohms
	H-Man	Leakage	T1 T2, T3	Shaft	Press "LO" leakage - No leakage light
Generator Rotor F1 - F2	VOM	RX1	F1	F2	2.0 - 2.75 ohms
	H-Man	Leakage	F1 F2	Shaft	Press "LO" leakage - No leakage light
Generator Stator T1 thru T12	H-Man	Leakage	T1-T12	Frame	Press "LO" leakage - No leakage light***
	See MFG.'s Major Svc. Manual for Stator resistance tests - Requires Kelvin Bridge				
** Refer to Onan Maint. Manual for "UR" Ref. Transformer T21 Test *** *Except Grounded Stator Motors See MFG.'s Circuit Diagram*					

6.3.2 "UR" & "YD" COMPONENT DIAGRAMS



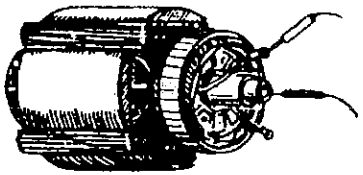
REFERENCE VOLTAGE TRANSFORMER

COMMUTATING REACTOR

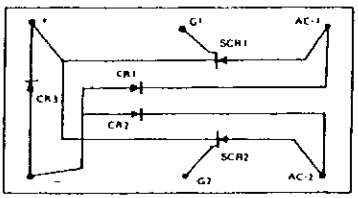


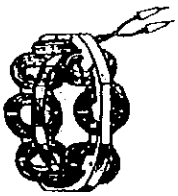
NOTE: *"AC" Terminal Designations are for text reference only*

SCR BRIDGE (CR21)
Used with UR Type Voltage Regulator

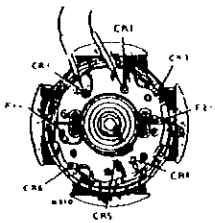


GENERATOR ROTOR

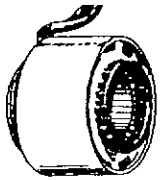




EXCITER FIELD



EXCITER ROTOR



GENERATOR STATOR

6.4 ONAN YD FIELD FLASHING PROCEDURE

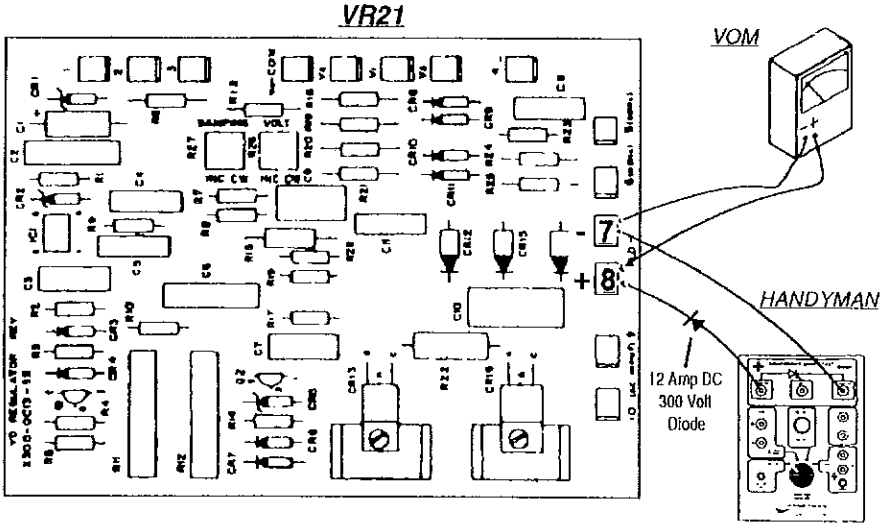
Use this procedure if voltage fails to build up due to weak residual magnetism in the exciter field or after rotor replacement.

1. Connect the Handyman and VOM to terminals 7 & 8 of the YD regulator as shown, observing polarity. (Set VOM to 250V range.) Terminal 8 is positive. The diode is the same as used in the brushless exciter and MUST be included to protect the Handyman. (SEE ILLUSTRATION 6.4.1)

2. With the Handyman function switch in the "Off/Peak Reading" position, start engine. A residual voltage may show on the VOM.

3. Momentarily rotate "function" switch to "continuity" until VOM shows normal voltage build-up (50-150V), then return function to "off".

6.4.1 ILLUSTRATION - Field Flashing Procedure



6.5 RECREATIONAL VEHICLE GEN SETS

The "UN" Series Generator is the type commonly used on mobile homes and recreational vehicles. The output power capacity of this generator is usually in the 2500 to 6000 wattage range. The logic board for this type Gen Set controls the following features of the generator: start, stop, fuel soledoid and charge rate.

TABLE 6.5.1 TESTING COMPONENTS FOUND ON THE C-859 START/STOP CONTROL BOARD

NOTE: FIRST DISCONNECT CONTROL BOARD FROM THE SYSTEM

Component	Function	Anode/ Pos. (Red)	Cathode/ Neg. (Black)	Test / Result
CR1 A1S1 (Elect)	Continuity	16	6	Continuity lamp lights
	Leakage	6	16	Press "LO" leakage button. Leakage lamp flashes
CR2	Continuity	8	6	Continuity lamp lights
	Leakage	6	8	Press "LO" leakage button. Leakage lamp flashes
CR3	Continuity	8	17	Continuity lamp lights
	Leakage	17	8	Press "LO" leakage button. Leakage lamp flashes
CR4	Continuity	13	9	Continuity lamp lights
	Continuity	9	13	Continuity lamp DOES NOT light
CR8	Continuity	1 & 14	12	Continuity lamp lights
	Leakage	12	1 & 14	Press "LO" leakage button. Leakage lamp flashes
CR9	Continuity	1 & 14	3 & 11	Continuity lamp lights
	Leakage	3 & 11	1 & 14	Press "LO" leakage button Leakage lamp flashes
F2 & A1S2	Continuity	5	16	Press start/stop switch to start position. Continuity lamp lights
A1S1 (hand crank)	Continuity	5	6	Press elect/hand crank switch to hand crank position. Continuity lamp lights
Q1	Continuity	7 (2)	8	Apply Pos. to Pin 2. Continuity lamp lights (dimly)
Q2	Continuity	16	9 (8)	Lamp dim until Neg. applied to Pin 8. Continuity lamp lights
F3	Continuity	2	10	Continuity lamp lights
"W1" Ammeter Shunt	Continuity	17	18	Continuity lamp lights

6.5.2 RECREATIONAL VEHICLE GEN SET CHARGING CIRCUIT TEST

Most RV Generators have a LO and HI charge rate. The generator uses a charge resistor (G1R1) to determine LO-HI charge rate. If the generator does not charge in a LO current state, but functions normally in the HI charge state, check resistance of G1R1 terminal 2 & 3; should be approximately 8.3 OHMS. If the generator charges in a LO state, but not a HI state, check charge resistor G1R1 terminal 3 & 4; should be approximately 3.8 OHMS. If resistance checks OK, the problem may be in the generator exciter field, armature field or the control board (C859). Check control board Q1, Q2, CR3 and F2 using the tests from table 5.5.1 (on preceding page). These tests include the charging circuit on the printed circuit board.

6.5.3 BREAKER POINT CIRCUIT (GAS ENGINES ONLY)

If the generator does not start, check ignition breaker point circuit. Select the Handyman continuity position and hook the anode lead to terminal #1 on the control board; hook negative lead to terminal #13 on the control board and MANUALLY turn the flywheel. Do NOT apply power.) When the breaker points close, the continuity light on the Handyman will light up. Continued rotation of the flywheel will extinguish the continuity lamp. If the test fails, check breaker points and point gap.

6.6 BASLER REGULATOR (KR-4F & KR-7F TYPE REGULATOR)

The KR-4F & KR-7F Series Regulators are used on any generator having an exciter field resistance of 25 to 400 OHMS. The output power of the Regulator is 63 VDC @ 2.5A for the KR-4F Series and 125VDC @ 3.5A for the KR-7F Series (these are maximum ratings). The KR Series Regulator may be used for a voltage range from 110 to 600 VAC, depending upon the programming of the regulator input sensing transformers.

6.6.1 EXCITER FIELD TEST (GEN SET USED w/BASLER REGULATOR)

Measure the exciter field resistance with an Ohmmeter. Remove the F+ and F− wires from the regulator; connect the red lead to F+ and the black lead to F−, from exciter field winding. The meter should indicate a reading between 25 to 400 OHM for the KR-4F Regulator, and a reading between 36 to 400 OHM for the KR-7F Regulator. Remove meter leads and connect the field leads back to the regulator on the respective terminals.

TABLE 6.6.2 TESTING OUTPUT CIRCUITRY ON BASLER KR-4F & KR-7F REGULATORS				
Component	Function	Anode/ Pos. (Red)	Cathode/ Neg. (Black)	Test / Result
C13,R38,R39 C11,R31,R32 D21 (H/S)	Leakage	F+	F–	Press "LO" leakage button. Leakage lamp remains on for 3-5 seconds, then goes out.
D21 (H/S)	Continuity	F–	F+	Continuity lamp lights
SCR-2 (H/S) CR10, CR11 *D24 (H/S)	Leakage	F+	4	Press "LO" leakage button. Leakage lamp remains on for 3-5 seconds, then goes out.
CR10, CR11 *D24 (H/S)	Continuity	4	F+	Continuity lamp lights
SCR-1 (H/S) CR10, CR11 *D24 (H/S)	Leakage	F+	3	Press "LO" leakage button. Leakage lamp remains on for 3-5 seconds, then goes out.
CR10, CR11 *D24 (H/S)	Continuity	3	F+	Continuity lamp lights
D22 (H/S)	Leakage	4	F–	Press "LO" leakage button. Leakage lamp remains on for 3-5 seconds, then goes out.
D22 (H/S)	Continuity	F–	4	Continuity lamp lights
D23 (H/S)	Leakage	3	F–	Press "LO" leakage button. Leakage lamp remains on for 3-5 seconds, then goes out.
D23 (H/S)	Continuity	F–	3	Continuity lamp lights
C16	Leakage	F+	Chassis	Press"LO" leakage button. Leakage lamp remains on for 3-5 seconds, then goes out.
C15	Leakage	F–	Chassis	SAME AS PRIOR STEP
C12, R36	Leakage	3	4	SAME AS PRIOR STEP
RF1-3	Leakage	3	Chassis	SAME AS PRIOR STEP
RF1-4	Leakage	4	Chassis	SAME AS PRIOR STEP

H/S = MOUNTED ON HEATSINK * = INDICATES KR7F UNIT

Note: Earlier Version may have a Different Component Designation

TABLE 6.6.3 TESTING THE INPUT VOLTAGE SENSING TRANSFORMER ON BASLER KR-4F & KR-7F VOLTAGE REGULATORS				
VOM Range	Sensing Input	Meter Positive (+)	Meter Neg. (–)	Test / Result (All Readings in OHMS)
R X 1	100 - 136	(Blue)	E1	Approx. 40-45
R X 1	208 - 240	(Brown)	E1	Approx. 75-80
R X 100	400 - 480	(Orange)	E1	Approx. 450-KR4F / 700KR7F
R X 100	500 - 600	(Gray)	E1	Approx. 650-KR4F / 1000-KR7F
-ZERO OHMETER BEFORE RESISTANCE IS MEASURED-				

(Note: This table is used to locate an open or shorted transformer.)

CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

7.0 GENERAL EQUIPMENT & CONTROLS

CHECK HANDYMAN BATTERIES (Sect. 8.1) BEFORE PERFORMING ANY TESTS!

7.1 HIGH INTENSITY DISCHARGE LIGHTING

7.1.1 INTRODUCTION

High Intensity Discharge (HID) lamps and their fixtures are used in a variety of applications. The HID fixture consists of the following components: lamp, capacitor, reactor or transformer (or both, depending on lamp type) and ignitor (also depending on lamp type). The operation of these devices will be explained later. HID fixtures are used in warehouses, gymnasiums, hangars, distribution facilities and automotive service centers, to name a few applications.

7.1.2 LAMP TYPES

1. **Mercury Vapor** - standard Mercury Vapor lamps emit a bluish/white light and are used for general outdoor lighting applications. Average lamp life is 16,000 to 24,000 hours.

2. **High Pressure Sodium (HPS)** - standard HPS lamps emit a golden/white light and are commonly used on highway exit/entrance ramps. Average lamp life is 10,000 to 24,000 hours.

3. **Metal Halide** - Metal Halide lamps emit a white light and are generally used in gymnasiums. Average lamp life is 5,000 to 20,000 hours.

7.1.3 CAPACITOR TYPE

The Capacitor is a dry film or oil filled construction (non-polarized), 7 thru 55 mfd and 120 thru 525 vac range. The Capacitors should not contain any PCB agents (Polychlorinated Biphenyls).

7.1.4 REACTOR

The purpose of the Reactor is to limit the amount of current through the lamp after the gases in the lamp ignite. It reacts to circuit current flow.

7.1.5 AUTO - TRANSFORMER

The Auto-Transformer is used to convert (or transform) the line voltage to a higher or lower voltage, depending on the lamp, ignitor and reactor voltage/current range.

7.1.6 IGNITOR

The Ignitor is used to produce a high voltage pulse to start the lamp arcing internally; this ignites the gases in the lamp. When the lamp is fully lit, the Ignitor will cease its pulsing operation. Ignitor life is approximately 10,000 hours.

7.1.7 THEORY OF OPERATION

This paragraph explains the operation of the high intensity discharge (HID) lamp circuit. Alternating current (AC) is applied to the transformer, which converts that voltage to the operating voltage of the lamp circuit (depends on ignitor and lamp rating). The capacitor on some circuits is connected to the primary of the transformer to aid in line filtering. The filter is used in most circuits for voltage stabilization. The reactor (when used) is used to limit the current thru the lamp after the lamp has come up to operating temperature. The ignitor takes the system voltage and converts it to a high voltage short duration pulse (2500V max PK pulse several hundred microsec in duration). This high voltage pulse is primarily used to ignite the gases in the inner gas tube of the lamp. The heated gases start to glow, which in turn gives off a light after approximately 3-6 minutes. The gases are vaporized at a temperature of 900-1000 degrees F. When the lamp has reached full operating temperature, the ignitor shuts off. The ignitor is only used on the start cycle of the operation. The lamp type determines the construction and operating characteristics of the HID fixture. The type of gas and elements combined with the gases in the tube determine the color of the light given off by the lamp.

7.1.8 H.I.D. COMPONENT TESTING-GENERAL INFORMATION

The following sections deal with the testing of components in the HID lamp circuit using the Handyman Model 269C Component Tester.

All components should be disconnected electrically before testing.

TABLE 7.1.8A AUTO-TRANSFORMER / REACTOR CONTINUITY

Component	Handyman		Function	Test / Result
	Anode/Red	Cathode/Black		
Auto Transformer	Comm	Comm	Continuity	Continuity - Cont. Lamp Lights
	CAP	" "		
	120 (Line)	" "		
	208 (Line)	" "	(Same with Every Step)	No Light - Open Winding
	240 (Line)	" "		
	277 (Line)	" "		(Same with Every Step)
Reactor	X3	X1		
	Cap	X1		

7.1.9 AUTO-TRANSFORMER / REACTOR LEAKAGE TEST

Insert the black lead in the cathode/neg. jack of the Handyman and connect the other end of the lead to the frame of the autotransformer or reactor. Insert the red lead in the anode/pos. jack of the Handyman and connect the other end to the lead of autotransformer or reactor (or check each lead separately). Select the leakage position with the function selector on the Handyman. Press the "LO" leakage button; the Red leakage LED should not illuminate. Note: 200 VDC is applied to the device under test. Refer to section 4.13 for more details.

7.1.10 CAPACITOR TEST (OPEN, SHORT, LEAKAGE & CORRECT VALUE)

Note: Isolate the leads of the capacitor from the circuit. Check voltage rating of capacitor. **Do not test capacitors with a voltage rating less than 200 VDC.** Most capacitors used in A/C circuits are nonpolarized. Connect the Red Handyman lead to anode/pos. jack of the Handyman and also to one terminal of capacitor. Connect the Black Handyman lead to the cathode/neg. jack of the Handyman and also to the other terminal of the capacitor. Select the leakage position with the Handyman function selector. Press "Lo Leakage" button. If leakage LED does not illuminate, wait 5 seconds and check the test lead connection.If connections are OK, repeat test. If still no indication, capacitor is open. If LED stays on for more than 10 seconds, check valve and compare it to the table in section 4.6. If LED stays on longer than value in table, the capacitor has changed value, or is shorted and thus needs to be replaced.

TABLE 7.1.10A				CAPACITANCE TEST	
M F D	Time (Sec)	M F D	Time (Sec)	M F D	Time (Sec)
5	.5	25	2 - 2.5	45	3.5 - 4
10	1	30	2.5 - 3	50	4
15	1.5	35	3	55	4.5
20	2	40	3 - 3.5	Check Table in Sec. 4.6 for higher values	
Note: Times given are approx. capacitor values					

7.1.11 CAPACITOR TEST - TERMINAL TO HOUSING ISOLATION (METAL CAN TYPE)

Connect the black Handyman test lead to the cathode/neg. jack and the other end to the capacitor housing. Connect the red Handyman test lead to the anode/pos. jack and the other end to one terminal of the capacitor. Set function selector to the leakage position. Press the "Lo Leakage" button on the Handyman; the leakage LED should NOT illuminate. If it DOES illuminate, the capacitor should be replaced. Repeat test for the other capacitor terminal.

7.1.12 IGNITOR TESTING

Ignitors are generally grouped into two basic catagories: One type is used for 52-55V lamps and the other is used for 100V lamps. The lamp voltage usually corresponds to the lamp wattage. The HID lamp circuits which use lamp ignitors can be tested accordingly. Connect the HID Module (P/N 40-269P-25) to the Handyman by plugging it into the anode/pos. and the cathode/neg. Handyman jacks. Connect the ignitor module to the respective jack on the HID module. Connect a DVM (Digital Voltmeter) or a VOM (Volt Ohmmeter Simpson 260 or eqv.) to the proper meter jacks on the side of the HID Module. NOTE: Check to insure that meter is on proper voltage range.

Use table 7.1.12A for testing ignitors used in high pressure sodium lamp applications. Table 7.1.12B is to be used when testing ignitors used in metal halide lamp applications. Rotate the ignitor voltage potentiometer on HID module FCCW. Select the continuity position on the Handyman. The green power "ON" LED will illuminate on the HID module. If the green LED does not illuminate, check the Handyman batteries by selecting the battery test position on the Handyman. The green battery "OK" LED should illuminate; if not, replace the Handyman's batteries. (Refer to section 8.2 of this manual for battery replacement instructions.)

Slowly rotate the Ignitor Voltage Potentiometer on the HID Module clockwise. The ignitor out LED (Red) will start to flash, indicating the ignitor is firing. The voltage on the VOM will indicate the firing voltage of the ignitor. Note: to obtain the precise firing voltage, slowly rotate the HID Module's Ignitor Voltage Potentiometer counterclockwise until the red LED has just stopped flashing, then read the voltage. If the red LED comes on continuously with the pot fully counterclockwise, check and make sure the ignitor is properly hooked up; if connections are OK, then the ignitor is bad. Also, if the potentiometer is rotated fully clockwise and the red LED does not illuminate, check ignitor connection; if the connections are OK, the ignitor is bad.

Tables 7.1.12A and 7.1.12B, as mentioned in the preceding text, are found on the following page.

NOTE: The HID Module (P/N 40-269P-25) as described above is an optional accessory which can be purchased through your Handyman Distributor or Supplier. (An illustration appears on page 43)

TABLE 7.1.12A	IGNITOR TEST - HIGH PRESSURE SODIUM	
Ignitor Part No.	VOM Reading	Results
L1551 - J4 L1551 - H4 L1551 - H5	Approx. 125 VDC	Red LED starts to flash
L1501 - H4 L1501 - J4 L1505 - H5 L1560 - H5 L1571 - H5	Approx. 250 VDC	Red LED starts to flash
TABLE 7.1.12B	**IGNITOR TEST - METAL HALIDE**	
Ignitor Part No.	VOM Reading	Results
L1525 - H6	Approx. 125 VDC	Red LED starts to flash
L1510 - H4 L1521 - H5 L1531 - H5 L1532 - H4 L1533 - H4 L1540 - H4	Approx. 250 VDC	Red LED starts for flash

7.2 WELDER CONTROLS

Most Welders have power diodes and power SCR circuitry incorporated in them. The diodes/SCR modules are used to change the input AC to rectified DC voltages and to control the amount of DC current applied to the electrodes. Some Welders have high value capacitors for DC filtration. The Handyman Component Tester is capable of testing all these components for shorts or leakage. The testing of specific components is covered in the "General Components Tests" section of this manual: Diodes - Sect. 4.2 & 4.4, SCR's - Sect. 4.3 & 4.5 and Capacitors - Sect. 4.6.

7.3 BATTERY CHARGERS

Battery Chargers are similar to Welders in that they convert input AC to rectified DC. The battery voltage is then monitored and the charger supplies the required current to charge the battery to a fully charged state. This is accomplished by using Power Diodes, SCR's and Capacitors in conjunction with a logic control board to monitor battery condition and control charging current to the battery. The SCR, Diode and Capacitor may be tested for a shorted or leakage condition by using the Handyman. The tests are described in the "General Component Tests" section of this manual: Diodes - Sect. 4.2 & 4.4, SCR's - Sect. 4.3 & 4.5 and Capacitors - Sect. 4.6.

8.0 USER SERVICE, CARE AND SPARE PARTS

8.1 BATTERY SELF-TEST	VOM
• Set function switch momentarily to "Battery Test". Green "Battery OK" indicator will light if batteries are in satisfactory condition. NOTE: Batteries may recover and indicate "OK" after a period of non-use. Press "Leakage Lo" to read voltage.	Optional 250 VDC Range 180 VDC Min.

8.2 BATTERY REPLACEMENT

The batteries are replaced by removing the four screws securing the front panel to the case and lifting the unit out. See Section 2.2 BATTERY RECOMMENDATIONS. Observe the polarity markings on the battery holder.

8.3 LAMP REPLACEMENT

Unscrew the lens from the lamp socket assembly. Remove the lamp by pressing down and rotating counter-clockwise, then withdrawing lamp from socket (bayonet base). Install new lamp by reversing above procedure. **USE ONLY NO. 1893 LAMP.** Other lamps may compromise performance on SCR tests.

8.4 CARE AND TIPS FOR BETTER OPERATION

With reasonable care, the Handyman will give years of trouble-free service. Treat it the same as you would a quality volt-ohmmeter. Avoid splashing the unit with chemicals or cleaning solvents. Avoid using or storing near battery charging areas. The Handyman may be cleaned with a solf cloth dampened with a mild detergent, rinsing afterward. Avoid excess moisture. Replace depleted batteries immediately. Keep the duration of tests as short as possible, always returning the function switch to the "Off" position. Follow the recommended procedure for each test. The function switch **MUST ALWAYS** be in the "Off" position for peak voltage tests. If it is not, voltage introduces via the "Anode" and "Cathode" test jacks could cause permanent damage to the Handyman.

9.0 SPARE PARTS & ACCESSORIES

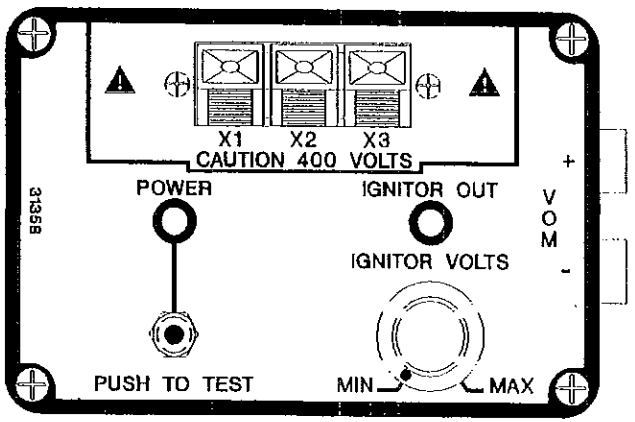
9.1 SPARE PARTS

Description	Part No.	Description	Part No.
Enclosure	40-269P-18	Insulated Boot (black)	40-269P-11
Knob	40-269P-02	Heavy-Duty Clip Lead (red)	40-269P-12
Lamp	40-269P-19	Heavy-Duty Clip Lead (black)	40-269P-13
Panel Screws (set of 4)	40-269P-04	Heavy-Duty Clip Lead Set	40-269P-14
Lens, Clear	40-269P-05	Carrying Case	40-269P-15
Test Lead (36" red)	40-269P-06	Standard Clip Lead Set	40-269P-16
Test Lead (36" black)	40-269P-07		
Test Lead (12" white)	40-269P-08		
Test Clip (alligator)	40-269P-09		
Insulated Boot (red)	40-269P-10		

The above parts are considered user replaceable. Please contact your Handyman Distributor or Supplier to order.

9.2 H.I.D.MODULE

The H.I.D. Module, as described in Section 7.1.12 is an Optional Plug-In Accessory for the Model 269C Handyman. It permits the Handyman to perform tests on various types of Ignitors, as used in High Intensity Discharge lighting systems. The H.I.D. Module, part number 40-269P-25 is available through your Handyman Distributor or Supplier. A layout drawing of the H.I.D. Module faceplate appears below.



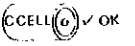
HANDYMAN®

COMPONENT TESTER

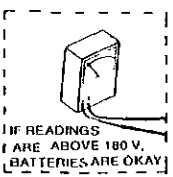
INSTRUCTIONS FOR TESTING SOLID-STATE CONTROL COMPONENTS ON

- GENERATOR SETS
- MOTOR STARTERS
- AC/DC VARIABLE-SPEED DRIVES
- ELECTRIC WELDERS
- SHIPYARD AND CONTAINER CRANES
- ELECTRIC FORKLIFT TRUCKS
- MINE LOCOMOTIVES AND SCOOPS
- ELECTRIC TOW TRACTORS
- ELECTRIC DELIVERY VANS
- AUTOMATED HANDLING / PACKAGING SYSTEMS

BATTERY SELF TEST

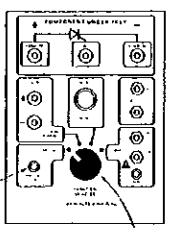


VOM OPTIONAL



IF READINGS ARE ABOVE 180 V, BATTERIES ARE OKAY

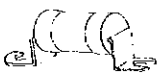
LED INDICATOR LIGHTS IF BATTERY IS OKAY. BATTERY TEST IS MADE UNDER ACTUAL LOAD CONDITIONS



FUNCTION SELECTOR IN "BATTERY" TEST POSITION

UNIT MAY STILL FUNCTION WITH LOW BATTERIES, HOWEVER, CALIBRATION ON GATE AND LEAKAGE TESTS MAY BE AFFECTED.

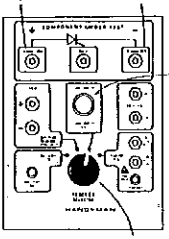
CONTINUITY TEST



TO CIRCUIT UNDER TEST

VOM NOT REQUIRED

CONTINUITY TEST MAY BE POLARITY DEPENDENT ON SOME CIRCUITS

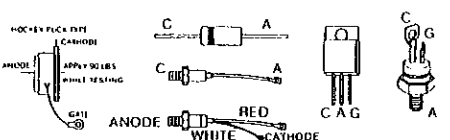


FUSES, WIRING, ETC.

CONTINUITY LAMP IS VISIBLE WHEN RESISTANCE BETWEEN TEST LEADS IS IN THE RANGE OF 0-25 OHMS

FUNCTION SELECTOR IN "CONTINUITY" TEST POSITION

SCR BLOCKING VOLTAGE (LEAKAGE) TEST DIODE REVERSE

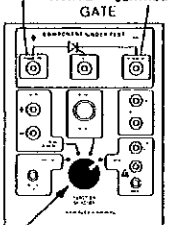


- IMPORTANT -

SOME STUD TYPE DIODES HAVE THEIR ANODE AND CATHODE REVERSED. SUFFIX "R" IN PART NO

VOM MEASURES TEST VOLTAGE

250 VDC RANGE



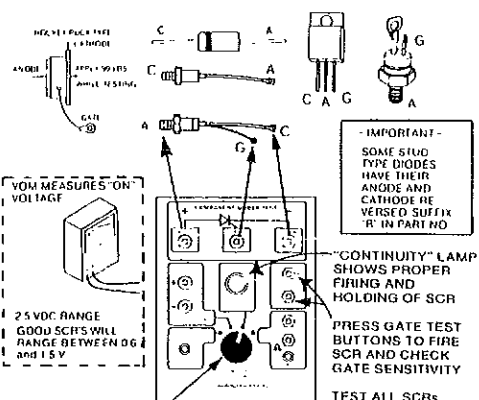
PRESS "LO" LEAK TEST BUTTON MOMENTARILY. APPLIES 200 V. LED INDICATOR SHOWS LEAKAGE IN EXCESS OF 1 MA

VOM OPTIONAL

FUNCTION SELECTOR IN "LEAKAGE" TEST POSITION

PRESS "LO" and "HI" BUTTONS TOGETHER. INDICATOR SHOWS LEAKAGE IN EXCESS OF 4.2 MA

DIODE AND SCR FORWARD CONDUCTION



- IMPORTANT -

SOME STUD TYPE DIODES HAVE THEIR ANODE AND CATHODE REVERSED SUFFIX "R" IN PART NO

VOM MEASURES "ON" VOLTAGE

2.5 VDC RANGE

GOOD SCR'S WILL RANGE BETWEEN 0.6 and 1.5 V

"CONTINUITY" LAMP SHOWS PROPER FIRING AND HOLDING OF SCR

PRESS GATE TEST BUTTONS TO FIRE SCR AND CHECK GATE SENSITIVITY

TEST ALL SCRs USING "LO" GATE TEST BUTTON

SOME LARGER SCRs ONLY MAY REQUIRE USING "HI" GATE TEST BUTTON TO FIRE

FUNCTION SELECTOR IN "CONTINUITY" TEST POSITION

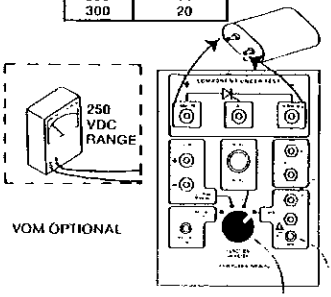
(SWITCH FUNCTION SELECTOR MOMENTARILY TO OFF/PEAK READING AND THEN BACK TO REPEAT TEST)

NO LIGHT-DIODE OR SCR OPEN. SCR MUST STAY OFF AFTER FUNCTION SELECTOR IS SWITCHED OFF MOMENTARILY

CAPACITOR LEAKAGE AND CAPACITANCE TEST

WATCH WITH SWEEP SECOND HAND OR DIGITAL WITH "SECONDS" TO CHECK TIME UNTIL LEAKAGE INDICATOR GOES OFF FOR APPROX. MFD VALUE

MFD	SECONDS
5	½
10	1
50	4
100	7
150	10
200	14
300	20



CAUTION! OBSERVE POLARITY ON POLARIZED UNITS

PRESS AND HOLD LEAKAGE "LO" TEST BUTTON WHILE CAPACITOR CHARGES

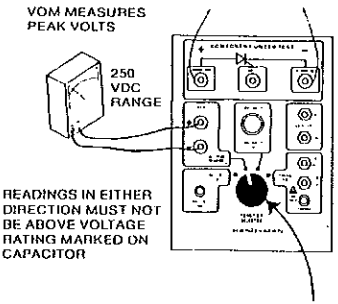
SAFETY FEATURE
CAPACITOR IS AUTOMATICALLY DISCHARGED WHEN BUTTON IS RELEASED

NOTE ELAPSED TIME UNTIL LEAKAGE INDICATOR GOES OUT. IF LEAKAGE LIGHT STAYS ON, CAPACITOR IS BAD.

PEAK READING VOLTAGE TEST

FOR MEASURING THE PEAK (INSTEAD OF AVERAGE) VALUE OF ANY A.C. VOLTAGE. TO DETERMINE IF COMPONENT RATINGS ARE BEING EXCEEDED.

TO COMMUTATING CAPACITOR(S) OR OTHER COMPONENT UNDER TEST

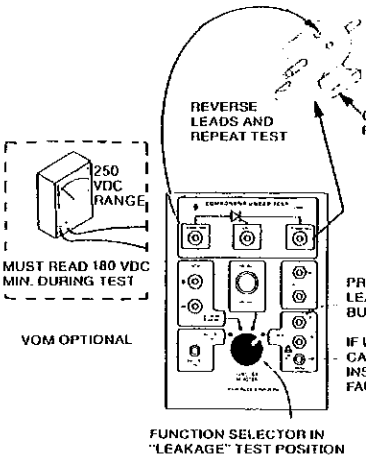


FUNCTION SELECTOR IN "OFF/PEAK READING" TEST POSITION

DO NOT MOVE SWITCH DURING TEST OR DAMAGE TO HANDYMAN MAY RESULT

INSULATION RESISTANCE TEST

TYPICAL INSULATION TEST ON MOTOR OR GENERATOR



PRESS AND HOLD LEAKAGE "LO" TEST BUTTON

IF LEAKAGE INDICATOR STAYS ON, INSULATION IS FAULTY

ZENER AND SUPPRESSOR TEST