Lester Electrical

PORTABLE SCR REGULATED BATTERY CHARGER
TECHNICIAN SERVICE GUIDE

PLEASE SAVE THESE IMPORTANT SAFETY AND OPERATING INSTRUCTIONS

To be able to troubleshoot safely and effectively, it is important to read this guide COMPLETELY before beginning any tests.

LOOK FOR THIS SYMBOL TO POINT OUT SAFETY PRECAUTIONS. IT MEANS: *BECOME ALERT—YOUR SAFETY IS INVOLVED.* IF YOU DO NOT FOLLOW THESE SAFETY INSTRUCTIONS, INJURY OR PROPERTY DAMAGE CAN OCCUR.

CAUTION: REPAIRS BY QUALIFIED PERSONNEL ONLY. NOTE: MODIFYING THIS CHARGER FOR USE OTHER THAN THAT FOR WHICH IT WAS INTENDED, REPAIRS BY PERSONS NOT QUALIFIED, OR NOT USING ORIGINAL EQUIPMENT REPLACEMENT PARTS WILL VOID THE MANUFACTURER'S WARRANTY AND LIABILITY. INCORRECT REASSEMBLY MAY RESULT IN A RISK OF ELECTRIC SHOCK OR FIRE.

CAUTION: DO NOT EXPOSE CHARGER TO WATER, RAIN OR POWERWASH.

DANGER: HAZARD OF ELECTRIC SHOCK! ALWAYS UNPLUG THE ELECTRICAL CORDS, FIRST FROM THE AC OUTLET, AND THEN FROM THE CHARGER RECEPTACLE, BEFORE ATTEMPTING ANY REPAIRS OR SERVICE TO THE CHARGER. TURNING THE CHARGER OFF DOES NOT REDUCE THIS RISK.

WARNING: DO NOT OPERATE THE CHARGER IF IT IS MALFUNCTIONING. PERSONAL INJURY OR PROPERTY DAMAGE COULD RESULT.

WARNING: DO NOT TOUCH THE BATTERY TERMINALS OR CONTACTS ON THE CHARGING PLUG. AN ELECTRIC SHOCK COULD RESULT.

This service guide applies to most portable style SCR regulated charger designs but not all. This service guide does not cover railroad or heavy industrial styles of chargers. Please contact the factory for assistance if there is doubt regarding the appropriate service guide for a specific model of charger.

The battery charger is, at most, one third (1/3) of the complete system, which includes the equipment, the batteries, and the wiring to/from and between the batteries. To locate and correct a problem with certainty, initial diagnosis and testing must include all elements of the system. The charger is constructed so all parts can be tested and replaced with basic hand tools.

See the appropriate owners manual, the model number listed on the owners manual should match the model number on the faceplate of the charger, for detailed installation, operating procedures and safety precautions. FOLLOW ALL SAFETY PRECAUTIONS.

To discourage end users from disassembling the charger, Underwriters Laboratories and Canadian Standards Association require that the internal replaceable fuses be omitted from the Owners Manual wiring diagram and parts list for specific models. Those parts are included in the service wiring diagram contained in this service guide.

PROPER CARE OF DEEP-CYCLE BATTERIES

Batteries used on industrial equipment are subjected to severe deep-cycle duty on a daily basis. For this reason, it is important that only deep-cycle batteries are used. Although these batteries are designed to withstand such duty, the following precautions must be observed to obtain good performance and maximum cycle life.

1. New batteries should be given a full charge before their first use because it is difficult to know how long the batteries have been stored.
2. Limit the use of new batteries for the first 5 cycles. New batteries are not capable of their rated output until they have been discharged a number of times.
3. Do not excessively discharge batteries. Excessive discharge can cause polarity reversal of individual cells resulting in complete failure shortly thereafter. Limited use of new batteries will minimize the chance of cell reversal.
4. CHECK THE LEVEL OF THE ELECTROLYTE IN CONVENTIONAL LIQUID ELECTROLYTE LEAD ACID BATTERIES MONTHLY. MAINTAIN THE PROPER ELECTROLYTE LEVEL BY ADDING WATER WHEN NECESSARY. Electrolyte levels lower during discharge and rise during charge. Therefore, it is mandatory that water be added to cells ONLY when they are fully charged; do not overfill. Old batteries require more frequent additions of water compared to new batteries.
5. Keep tops of batteries clean and dry to prevent excessive self-discharge. Keep battery terminals reasonably tight.
6. Sulfation results when batteries in storage are not maintained in a charged, active state. Internal self-discharge can bring about the start of this condition in as little as three days in warm temperatures. Batteries allowed to sit unmaintained in storage will self-discharge, sulfate to various degrees and lose capacity. Repeated charging will generally result in the recovery of most of the battery's capacity, though some permanent loss can be expected.

BATTERY TYPES

Battery manufacturers frequently use the same battery cases for different battery types. Replaceable liquid electrolyte deep-cycle batteries have removable caps. Water electrolyzed by discharging and charging the battery is replaced through these openings.

Gel cell and sealed "maintenance–free" deep-cycle batteries are generally distinguished by non-removable cell caps. The physical appearance of the battery case is frequently the same as that of a replaceable liquid electrolyte battery though the cell caps are generally not removable.

Refer to the battery manufacturer's information panel on the battery case to determine the type of battery you have. If the information panel is missing or not legible, do not use the battery. Refer to your dealer if you do not understand what type of battery you are using and have them set the "BATTERY TYPE" switch on the charger accordingly, if equipped.

The "BATTERY TYPE" switch is a two-position slide switch visible on the front of the charger. Using a small screwdriver, slide the switch from one setting to the other through the opening. Take care not to damage the switch when moving it to the desired setting.

PERSONAL PRECAUTIONS

1. Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
2. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.
3. Wear complete eye and clothing protection. Avoid touching eyes while working near batteries.
4. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 10 minutes and get medical attention immediately.
5. NEVER smoke or allow a spark or flame in the vicinity of batteries.
6. Be extra cautious to reduce risk of dropping a metal tool onto battery. It might spark or short circuit battery or other electrical part that may cause explosion.

7. Remove personal metal items such as rings, bracelets, necklaces and watches when working with a lead-acid battery or charger. A lead-acid battery can produce a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
8. NEVER allow a battery to freeze and NEVER attempt to charge a frozen battery.

CHARGER TEST PROCEDURES

Disconnect both the AC and DC charger cordsets. Remove the screws on each side of the charger and lift the cover off. Refer to the service wiring diagram in this service guide and compare to the charger under test to locate the described test points. Make sure that all the charger's internal connections are secure and tight.

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SECTION 1 – CHARGER DOES NOT TURN ON

The electronic timer kit is powered by the battery and/or the AC line voltage and will not operate unless powered by the proper DC battery voltage and polarity and/or AC line voltage. The minimum amount of DC voltage required for the charger to recognize a battery is connected varies by model. Table 1 will provide general guidelines for testing but may not represent the actual minimum voltage, which may be lower.

Charger Nameplate DC Voltage	Typical DC Voltage Required
12	**8**
24	**16**
36	**25**
48	**33**

Table 1

Inspect and test for good AC and DC fuses/circuit breakers before proceeding with this test. If either the AC or DC fuse is blown or circuit breaker has tripped, proceed to the appropriate section for the AC or DC protection device involved.

PART A

Indicator light(s) do not illuminate after connections to AC line voltage and battery system are made.

Measure and record battery system DC voltage at battery posts of machine.

Connect the positive (+) voltmeter lead to the positive (+) battery system post and the Negative (-) voltmeter lead to the negative (-) battery system post. Reread the charger nameplate information for the specified DC VOLTS and verify the battery system has the proper DC voltage for the charger.

If battery maintenance has recently been performed, check the battery system to determine if a battery has been installed reverse polarity. A common error is to install one or more 6-volt batteries in a battery pack in reverse polarity.

Measure and record battery DC voltage at charging receptacle.

If no DC voltage is measured or the DC voltage measured is lower than the DC voltage measured at the batteries, repair or replace charging wires, attachments, and circuitry in equipment.

Measure and record battery DC voltage inside charger case.

With both AC cord and charging plug disconnected, remove the cover from the charger and refer to the wiring diagram for that model of charger. Connect the positive voltmeter lead to the same point inside the charger where the WHITE (+) DC cord lead connects. Connect the negative voltmeter lead to the same point inside the charger where the BLACK (-) DC cord lead connects. Test points E & F on the service wiring diagram. Connect the DC output cord to the equipment charging receptacle and record the DC voltage measured. See figure 1.

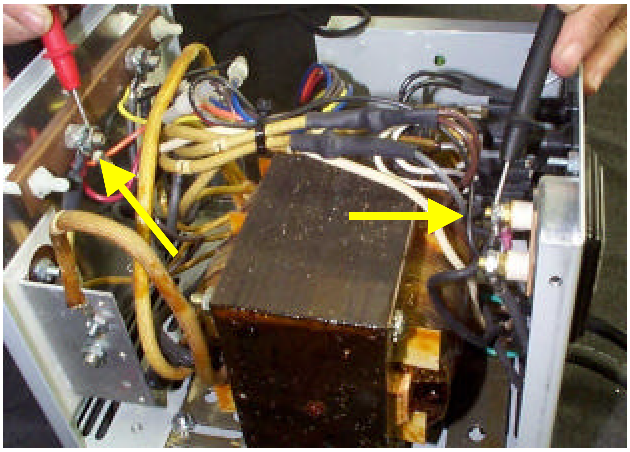


Figure 1

The DC voltage measured at these test points must be the same as the battery system voltage measured at the batteries, before the charger can operate. If the voltage measured is zero, or lower than the results of prior measurements, then replace the DC charging cordset and/or the equipment charging receptacle and retest.

Measure and record battery DC voltage at electronic timer kit.

If the DC voltage measured at test points E & F are correct, carefully remove the timer kit edge connector or flag terminals attached to the DC sense leads of the control cable from the electronic timer. Carefully examine the control cable assembly, electronic timer assembly connector and compare to the wiring diagram for the charger model. The same DC voltage at test points E & F must be present at the connector contacts of the RED (+) positive (pin 9 of the edge connector) and BLACK (-) negative (pin 5 of the edge connector) control cable assembly sense wires, as shown on the service wiring diagram. If no DC voltage is measured or the DC voltage measured is lower than the DC voltage measured at test points E & F, repair or replace the control cable assembly. See figure 2.

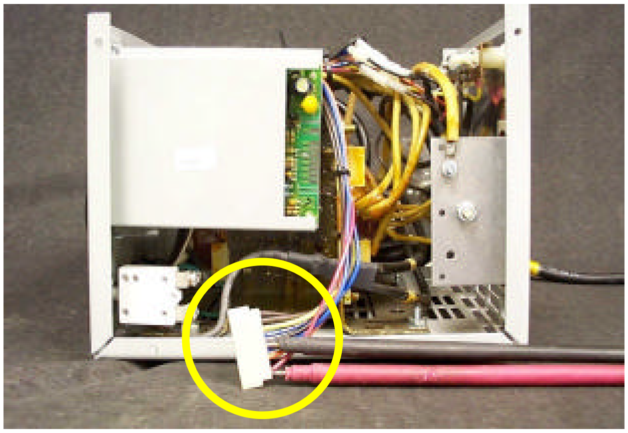


Figure 2

If the DC voltage measured at the electronic timer edge connector or flag terminals is correct, testing of the AC line voltage must be performed.

DANGER: HAZARD OF ELECTRIC SHOCK! THE FOLLOWING TESTS REQUIRE THE CHARGER TO BE CONNECTED TO A LIVE AC OUTLET. FOLLOW ALL ELECTRICAL SAFETY PRECAUTIONS TO AVOID ELECTRIC SHOCK!

Inspect and test for proper AC supply voltage at the outlet.

Disconnect the DC output cord from the equipment charging receptacle. Verify the charger AC power plug is disconnected and measure the AC line voltage at the outlet with a suitable meter. If no voltage is measured, test additional outlets until AC voltage is measured. Read the charger nameplate for the required nominal AC voltage and verify this matches the measured AC voltage at the outlet. Make sure the charger voltage selector switch is set to the correct position, if equipped.

Verify charger AC input circuit wiring is correct.

Locate the charger nameplate model number and verify it and the model number listed on the wiring diagram specific for the model being serviced match. With the charger cover removed, inspect and verify the charger is wired correctly according to the wiring diagram.

Measure and record the AC line voltage at the charger power switch.

Connect the AC power plug to a live electrical outlet with the proper AC voltage per charger nameplate and, if equipped, voltage selector switch setting. Locate the WHITE and BLACK AC power cord lead connections to the power switch. Attach leads from a suitable AC voltmeter to these AC cordset connections and verify the presence of proper AC voltage. If no voltage is measured, replace the AC cordset with the replacement service part specified on the parts list for this specific model charger and retest.

Measure and record the AC line voltage at the AC fuse(s) or circuit breaker(s).

If the presence of AC voltage on the cordset is verified, move the AC voltmeter test leads to the transformer side of the AC fuse(s) or circuit breakers(s). Test points A and B on the service wiring diagram. See figure 3.

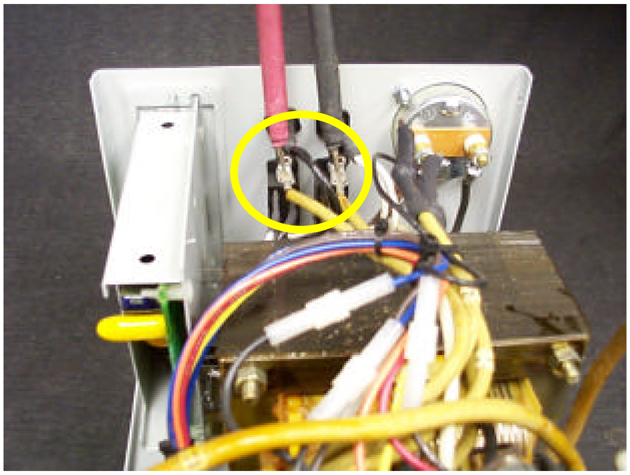


Figure 3

If no AC voltage is measured on the transformer side of the AC fuse(s) or circuit breaker(s), test points A and B, remove the AC power plug from the AC outlet. Test for continuity through the power switch, AC voltage selector switch and AC fuse(s)/fuseholder(s) or circuit breaker(s). Replace all parts measuring no continuity with replacement service part(s) specified on the parts list for this specific model charger and retest.

If the correct AC voltage is measured on the transformer side of the AC fuse(s) or circuit breaker(s), proceed to **Section 3, Part B, Test for correct transformer auxiliary coil voltage.** If the transformer auxiliary coil test indicates a failed transformer, test for correct charger indicator light operation after transformer replacement. If the transformer auxiliary coil test indicates proper AC voltage output or the indicator lights still do not illuminate after transformer replacement, the electronic timer must be repaired or replaced. Replace the electronic timer with the replacement service part specified on the parts list for the specific model of charger being serviced and confirm indicator light illumination.

WARNING: ALWAYS TEST SCRs BEFORE REPLACING AN ELECTRONIC TIMER. DAMAGE AND SUBSEQUENT FAILURE WILL OCCUR TO ALL ELECTRONIC TIMERS INSTALLED IN A CHARGER THAT CONTAINS A SHORTED ANODE TO GATE SCR, IF CONNECTED TO AC POWER.

For SCR testing instructions see **Section 4, SCR Testing Procedure.**

Part B

Indicator lights illuminate but charger does not produce output.

Charger models with an ammeter will show no deflection, models without an ammeter but with a fault light indicator may show an overvoltage fault condition.

THIS MALFUNCTION SYMPTOM MAY BE DUE TO FACTORS OTHER THAN THE CHARGER'S PERFORMANCE. TO HELP ISOLATE THE PROBLEM, IT IS OFTEN NECESSARY TO USE THE CHARGER ON A DIFFERENT SET OF BATTERIES AND THE ORIGINAL SET OF BATTERIES ON ANOTHER CHARGER.

Test for battery voltage increase.

This condition may be caused by a high resistance in the DC charging circuit due to a bad connection or batteries. Using an appropriate DC voltmeter, measure and record the DC voltage across the batteries without the charger connected. Connect the charger AC power plug to a live AC outlet and the DC output plug to the equipment charging receptacle. Note and record the initial voltage increase measured.

Under normal operation the battery system voltage will usually increase one or two volts when the charger first turns on. After the initial increase the battery voltage will gradually rise over time to it's final on-charge voltage. The final on-charge voltage will vary depending on battery age, condition, temperature and other factors. Conventional wet lead-acid batteries will usually reach an on-charge votlage of 2.5 volts per cell or higher, while sealed batteries usually do not exceed 2.4 volts per cell.

If the measured voltage increase on the batteries indicates the full on-charge voltage when the charger turns on, the source of the high resistance must be corrected to obtain proper charging. Rework bad connections on batteries or replace bad battery cables and/or batteries.

If the measured voltage increase on the batteries indicates normal rise, perform the same test where the WHITE (+) DC cord lead connects (test point E) and the BLACK (-) DC cord lead connects (test point F) in the charger, see figure 1. If the measured voltage increase indicates the full on-charge voltage when the charger turns on, correct the source of the high resistance. Repair or replace the charger DC cordset, equipment charging receptacle and/or equipment wiring.

Inspect and test charger DC circuit.

If the measured battery system voltage increase on the batteries and at charger test points E and F indicate normal operation, disconnect both the AC power plug from the outlet and the DC plug from the equipment charging receptacle.

Inspect and make sure all connections to the fuse/circuit breaker, shunt and ammeter, if equipped, are secure and tight.

If the charger being serviced has an ammeter and the needle did <u>not</u> deflect but the charger passed the "**Test for battery voltage increase"**, replace the ammeter with the replacement service part specified on the parts list for the specific model of charger being serviced and retest.

If the charger being serviced does not have an ammeter and the charger passed the "**Test for battery voltage increase"** or replacement of the ammeter did not correct the problem, measure continuity of the charger's DC circuits.

Place one test lead of continuity meter where the WHITE (+) DC cordset lead connects (test point E) and the other test lead of the continuity meter on the SCR side of the shunt, to measure the positive output side. If continuity is not measured, rework connections to the shunt and/or replace failed shunt and retest.

To measure the negative output side, place one test lead of the continuity meter where the BLACK (-) DC cordset lead connects (test point F) and the other test lead of the continuity meter on the SCR side of the DC fuse/circuit breaker. If continuity is not measured, rework connections to the DC fuse/circuit breaker and ammeter, if equipped, or replace failed DC fuse, fuseholder/circuit breaker and/or ammeter, as needed and retest.

If the charger passes both the "**Test for battery voltage increase"** and "**Inspect and test charger DC circuit**" proceed to **Section 3, Part A, Test for correct transformer output coil voltage.** If the transformer output coil voltage test indicates a failed transformer, retest charger for proper operation after transformer replacement. If the transformer passes the output coil voltage test or the charger still has no output after transformer replacement, the electronic timer must be repaired or replaced.

WARNING: ALWAYS TEST SCRs <u>BEFORE</u> REPLACING AN ELECTRONIC TIMER. DAMAGE AND SUBSEQUENT FAILURE WILL OCCUR TO ALL ELECTRONIC TIMERS INSTALLED IN A CHARGER THAT CONTAINS A SHORTED ANODE TO GATE SCR, IF CONNECTED TO AC POWER.

For SCR testing instructions, see **Section 4, SCR testing procedure.**

Part C

Indicator light(s) illuminate, charger produces output but ammeter does not deflect.

If the charger is known to be producing output current, by performing the **Test for battery voltage increase, Section1, part B** or by measuring output current with an external ammeter, but the charger's ammeter needle doesn't deflect, replace the ammeter with the replacement service part listed on the parts list for the specific model of charger being serviced.

SECTION 2 – CHARGER DOES NOT TURN OFF

This malfunction symptom may be due to factors other than the charger's performance, such as bad batteries or charging larger capacity batteries than the charger is rated for. Chargers with a fault light will indicate a "maximum charge time exceeded" fault.

Bad batteries may not allow the battery system to obtain an overall gassing point voltage, which is approximately 2.25 volts per cell. (2.25 volts per cell X the number of cells in the battery system = battery system gassing point voltage) The electronic timer monitors the batteries for a full charge condition <u>after</u> the battery voltage reaches the gassing point. Verify the battery system is capable of reaching the gassing point voltage. If the batteries cannot reach the gassing point voltage, the useful life of the batteries has ended and replacement is required.

Verify the charger is providing the charge rate specified on the charger nameplate, DC AMPS, at the start of the charge cycle (battery voltage below 2 volts per cell). If the charger does not output the specified amount of DC amperes, see **Section 1, Part B, Test for battery voltage increase** and **Section 4 SCR Testing.** If a lower than specified charge rate is noted and the findings of the **Test for battery voltage increase** are normal, an SCR may have failed. Each charger has two SCRs.

Part A

Does not turn off.

This may be caused by a failed SCR and/or electronic timer. If the charger is found to be producing a high finish charge rate, while the batteries are at or above the typical finish voltage of 2.30 volts per cell or higher, test for a shorted anode to gate SCR, see **Section 4-SCR Testing**. If an SCR with a shorted anode to gate is found, the electronic timer has been damaged and must also be replaced. Replace with the replacement service parts specified on the parts list for the specific model of charger being serviced and retest. If both SCRs test good, repair or replace the electronic timer.

Part B

Turns off too soon or runs too long.

If batteries have not been used or charged regularly, they may be sulfated and will not produce their full capacity. Repeated cycles (at least 5) of a light discharge, followed by a full charge, will generally result in the recovery of most of the battery's capacity. Do not interpret this reduced battery capacity as being caused by the charger's turning off too soon. The charger is working properly if, after several charge cycles, the battery capacity increases to near normal. Sulfation occurs most often when batteries have been stored without weekly charging. New batteries may also be sulfated due to extended shipment or storage time prior to sale.

As batteries age, individual cells may weaken, causing a reduction in battery capacity. This condition normally results in a higher finish rate on conventional wet lead-acid batteries and shorter charge times for both conventional and sealed types of batteries. Do not interpret this shorter charging time and reduced battery capacity as being caused by the charger's turning off too soon. The battery is aging naturally and the charger is working properly. When the batteries will no longer perform as required, they should be replaced.

The charger is designed to cease charging when essentially no further electrochemical reaction is occurring inside the battery. The electronic timer senses the progress of the reactions and, when these reactions virtually cease, turns the charger off.

For conventional wet lead-acid batteries there are two ways to test if the electrochemical reaction has actually ceased.

1. An accurate hydrometer can be used to determine cessation of the electrochemical charging reaction. If the measured specific gravity of several cells does not increase in three (3) consecutive readings taken one hour apart while the charger continues to charge, the charger is operating too long.
2. An accurate 5 1/2-digit digital voltmeter can be used to determine the cessation of the electrochemical charging reaction. Connect the voltmeter test leads to the positive (+) and negative (-) posts of the battery system being charged. Monitor and record the on-charge voltage at 30-minute intervals. If the on-charge battery voltage either begins to decrease between 30-minute intervals or increases by less than 0.012 DC volts in two consecutive 30-minute intervals, the charger is operating too long.

To test sealed or gel batteries, an accurate digital ammeter can be used to determine the cessation of the electrochemical charging reaction. Break the DC charging circuit and insert the digital ammeter in-line with the circuit. Monitor and record the on-charge current at 30-minute intervals when the battery system voltage is at or above 2.32 volts per cell. If the on-charge current does not decrease by 0.015 DC milliAMPS in two consecutive readings, the charger is operating too long.

In the event of an AC power interruption when the charger is on, the charger will automatically restart when AC power is restored. This power outage can make the apparent charge time seem longer than the actual charge time. To check for AC power interruptions, plug an electric clock into the same outlet to which the charger AC cord is connected. Charge normally and note any time difference between the test clock time and the actual time.

If battery maintenance has recently been performed, check the battery system to determine if a battery has been installed reverse polarity. A common error is to install one or more 6-volt batteries in a battery pack in reverse polarity.

If testing indicates the charger is turning off too soon or operating too long, replace the electronic timer with the replacement service part specified on the parts list for the specific model of charger being serviced and retest.

WARNING: ALWAYS TEST SCRs BEFORE REPLACING AN ELECTRONIC TIMER. DAMAGE AND SUBSEQUENT FAILURE WILL OCCUR TO ALL ELECTRONIC TIMERS INSTALLED IN A CHARGER THAT CONTAINS A SHORTED ANODE TO GATE SCR, IF CONNECTED TO AC POWER.

SECTION 3 - TRANSFORMER TESTING PROCEDURE

DANGER: HAZARD OF ELECTRIC SHOCK! THE FOLLOWING TESTS REQUIRE THE CHARGER TO BE CONNECTED TO A LIVE AC OUTLET. FOLLOW ALL ELECTRICAL SAFETY PRECAUTIONS TO AVOID ELECTRIC SHOCK!

The transformer primary coil must be energized by the AC voltage and frequency specified on the charger nameplate in order to obtain accurate test results. Verify the specified voltage is present at test points A and B on the service wiring diagram, see figure 3. If no voltage or an incorrect amount of voltage is measured, testing of the AC circuit is required before transformer testing can be performed. Begin the AC circuit testing with **Inspect and test for proper AC supply voltage at the outlet.**

Part A

Test for correct transformer output coil voltage.

Disconnect the AC power plug from the outlet and the DC output plug from the equipment charging receptacle. Remove the cover from the charger and disconnect both transformer output coil leads from the heatsink plates. For personal safety, make sure the transformer leads are isolated and not making contact with any components or the case of the charger. Attach the test leads of a suitable AC voltmeter to the transformer output coil leads, tests points C and D on the service wiring diagram, see figure 4. Reconnect the AC power plug to a live outlet. Measure and record the AC voltage present at the transformer output coil leads and compare to the values in table 2.

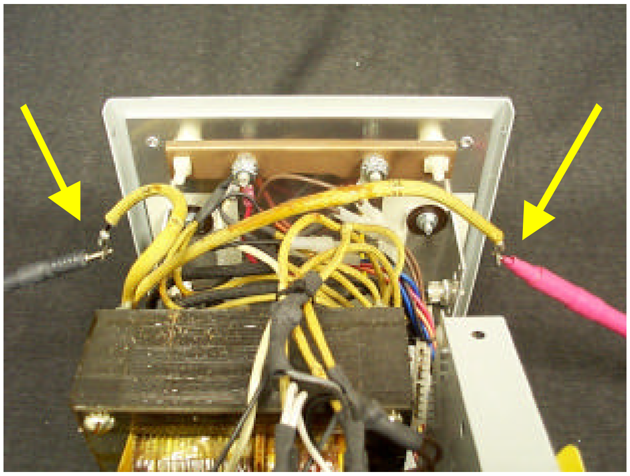


Figure 4

If the measured AC voltage indicates the transformer has failed, indicated by significantly lower voltage readings, replace the transformer with the replacement service part specified on the parts list for the model charger being serviced.

Part B

Test for correct transformer auxiliary coil voltage.

Disconnect the AC power plug from the outlet and the DC output plug from the equipment charging receptacle. Remove the cover from the charger. Carefully remove the timer kit edge connector or flag terminals attached to the DC sense leads of the control cable from the electronic timer.

Before measuring the auxiliary coil output voltage, inspect and test for continuity the transformer auxiliary coil lead extensions. Also, inspect the contacts in the edge connector for distortion, corrosion or any condition that would prevent electrical contact with the pads on the electronic timer. Measure continuity of the transformer auxiliary coil circuit by placing the test probes of a continuity meter on pins 4 and 6 of the electronic timer edge connector. If no continuity is measured between the two points, rework or replace the transformer extension leads, edge connector and/or transformer, as needed.

Attach the test leads of a suitable AC voltmeter to the auxiliary lead contacts in the edge connector, pins 4 and 6 on the service wiring diagram. See figure 5. Reconnect the AC power plug to a live outlet. Measure and record the AC voltage present at the specified edge connector pins and compare to the values in table 2.

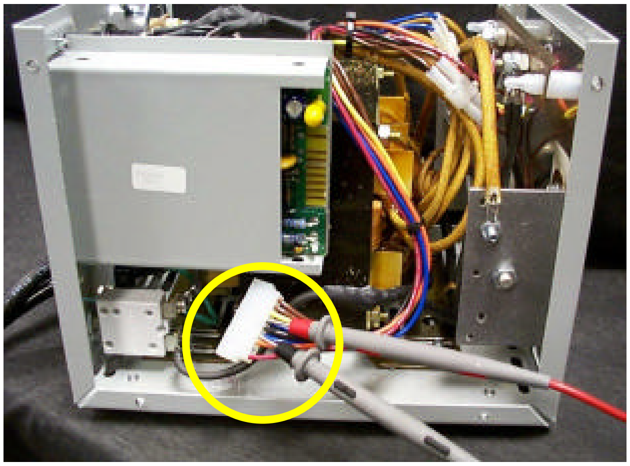


Figure 5

If the measured AC voltage indicates the transformer has failed, indicated by significantly lower voltage readings, replace the transformer with the replacement service part specified on the parts list for the model of charger being serviced.

Charger Nameplate DC Voltage	No Load Output Coil AC Voltage*	No Load Auxiliary Coil AC Voltage
12	28-44	24-32
24	56-90	
36	90-126	
48	120-168	
Note: The voltage readings are approximate and transformer failure is indicated when the measured AC voltages are SIGNIFICANTLY LOWER than the listed values. **(*) The wide AC voltage range is the result of various AC line voltages that many charger models have been designed to operate on.**		

Table 2

If it should become necessary to replace a terminal on one of the transformer leads, the new terminal must be crimped AND soldered.

SECTION 4 – SCR TESTING

The feedback control design of the charger makes it possible for one SCR in the SCR assembly to not function and the charger to still have some output. This condition can be detected by noting the temperature of the separate SCRs and replacing the complete assembly if one of the SCRs feels cold and the other hot. This condition may also suggest it's presence by continual melting of the DC fuse, see **Section 6 – Charger DC Circuit Breaker Trips/Fuse Blows** for additional information.

An SCR can fail in a shorted or open mode. Shorted SCRs can be detected by measuring the resistance between the legs of the SCR with an ohm-meter. An SCR that is shorted Anode to Cathode will cause the DC circuit breaker to trip or fuse to blow, see **Section 6 – Charger DC Circuit Breaker Trips/Fuse Blows** for more information. An SCR with a shorted anode to gate can be detected by measuring the resistance between the anode to gate. To do so, first disconnect the charger AC power plug from the outlet and the DC output cord from the equipment charging receptacle. Remove the charger's cover and carefully remove the control cable edge connector from the electronic timer. Locate the in-line bullet connectors on the brown leads (gate) of the SCRs and disconnect, see figure 6.

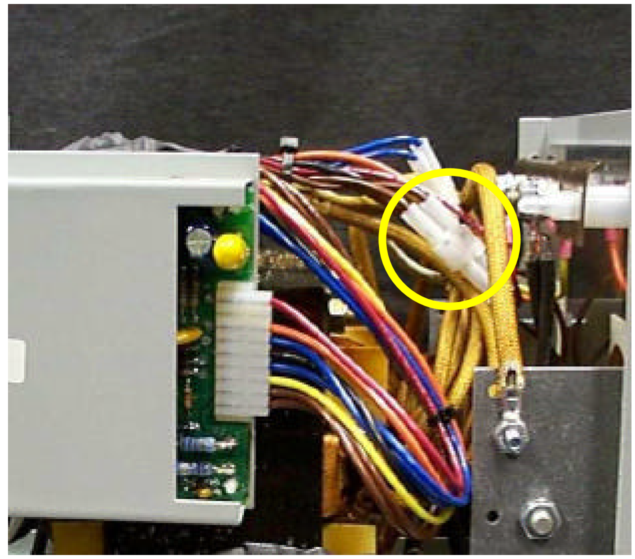


Figure 6

Using an ohm-meter, measure the resistance between between the brown gate lead of the SCR and the heatsink plate (SCR anode). Test each SCR separately. Connect the positive (+) lead of the ohm-meter to the heatsink plate (anode) of one SCR. Connect the negative (-) lead of the ohm-meter to the brown gate lead for that same SCR. The resistance for a good SCR should be about 20 megohms. Reverse the leads of the ohm-meter and test the SCR again. Resistance for a good SCR should be in the megohms.

The resistance of a failed SCR, regardless of ohm-meter polarity, will be about 50 ohms.

If an SCR with a shorted anode to gate is located, the electronic timer has been damaged and must be repaired or replaced with the SCR assembly.

WARNING: ALWAYS TEST SCRs BEFORE REPLACING AN ELECTRONIC TIMER. DAMAGE AND SUBSEQUENT FAILURE WILL OCCUR TO ALL ELECTRONIC TIMERS INSTALLED IN A CHARGER THAT CONTAINS A SHORTED ANODE TO GATE SCR, IF CONNECTED TO AC POWER.

DANGER: HAZARD OF ELECTRIC SHOCK! THE FOLLOWING TEST REQUIRES THE CHARGER TO BE CONNECTED TO A LIVE AC OUTLET. FOLLOW ALL ELECTRICAL SAFETY PRECAUTIONS TO AVOID ELECTRIC SHOCK!

The SCRs may be electrically tested for an open condition by turning them on one at a time manually while the charger is energized. To do so, first disconnect the charger AC power plug from the outlet and the DC output cord from the equipment charging receptacle. Remove the charger's cover and carefully remove the control cable edge connector from the electronic timer.

Before testing the SCRs, inspect and test for continuity the gate lead of each SCR. (Note: The SCRs in some charger designs are soldered directly into the printed circuit board and will not have gate leads.) First, inspect the contacts in the edge connector for distortion, corrosion or any condition that would prevent electrical contact with the pads on the electronic timer. Measure the continuity of each BROWN gate lead by placing one test probe from the continuity meter on the brown gate lead at the SCR. Place the remaining test probe on the appropriate contact in the electronic timer edge connector, pins 1 and 2 on the service wiring diagram. Repeat the same test on the remaining SCR gate lead. If no continuity is measured on the gate lead(s), rework or replace the edge connector, in-line bullet connector and/or wiring, as needed.

Each SCR may be turned on manually by connecting a 3 volt battery to the SCR. (Note: Some SCRs may require only 1.5 volts DC to forward bias.) Connect the AC power plug to a live outlet, connect the DC output plug to a fully charged battery pack and set the power switch to AUTO. Connect the negative (-) end of the battery to the output side of the SCR (cathode) by attaching to the shunt, test point E on the service wiring diagram, or the positive DC cordset connection. Momentarily touch the lead from the positive (+) end of the battery to the gate lead of each SCR in the electronic timer edge conenctor, pins 1 & 2 on the service wiring diagram. See figure 7. Do not continue this for more than a few seconds as it is possible to damage the SCRs and charger.

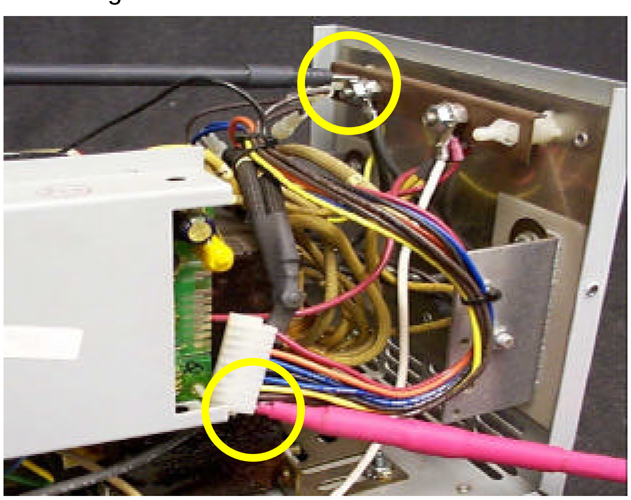


Figure 7

If the SCRs are good, the charger's ammeter will indicate current flow when each SCR gate lead is touched by the positive (+) end of the battery. For chargers without an ammeter an in-line ammeter may be used in the DC charging circuit to test for current flow or a DC voltmeter may be used to test for momentary battery voltage increase.

If the ammeter does not indicate current flow for each SCR, the SCR not causing ammeter deflection has failed and the SCR assembly must be replaced.

SECTION 5 – CHARGER AC CIRCUIT BREAKER TRIPS/FUSE BLOWS

Before proceeding, verify the rating of the blown fuse is correct for the model of charger being serviced. If the value is lower than specified for the charger being serviced, install a fuse of correct size and recheck charger operation. If the AC protection device is a circuit breaker, the quickest and most accurate way to eliminate the possibility of a faulty breaker is to replace the breaker with a known good one.

There are two modes of failure, instantaneous and delayed blowing of the AC protection device. If the AC protection device allows the charger to operate for a period of time before blowing, this is usually the result of gradual heating of the protection device. Inspect the connections to the circuit breaker/fuse for signs of heat caused by a loose connection, corrosion, physical damage or otherwise.

If the AC protection device itself passes inspection, the most likely cause is a failed SCR. The failure of one SCR will force the remaining SCR to try and produce the charger's full output. This results in a high current draw on the portion of the input AC sine wave that the remaining good SCR is rectifying. The higher AC current draw eventually causes enough heating of the AC protection device to cause it to blow. See **Section 4 – SCR Testing.**

Instantaneous blowing of the AC protection device indicates a direct short. Refer to the service wiring diagram, the only component following the AC protection device is the transformer. If the AC protection device itself passes testing and inspection, replace the transformer and retest. If the wiring diagram for the specific model of charger being serviced shows any other component(s) between the AC protection device and the transformer, isolate each component and test with a continuity meter for a shorted condition before replacing the transformer.

⚠DANGER: REPLACE THE FUSE OR FUSE ASSEMBLY ONLY WITH THE CORRECT FUSE OR FUSE ASSEMBLY. FIRE, PROPERTY DAMAGE, AND PERSONAL INJURY CAN

RESULT IF THE CHARGER IS USED WITH AN INCORRECT FUSE.

SECTION 6 – CHARGER DC CIRCUIT BREAKER TRIPS/FUSE BLOWS

Before proceeding, verify the rating of the blown fuse is correct for the model of charger being serviced. If the value is lower than specified for the charger being serviced, install a fuse of correct size and recheck charger operation. If the DC protection device is a circuit breaker, the quickest and most accurate way to eliminate the possibility of a faulty breaker is to replace the breaker with a known good one.

There are two modes of failure, instantaneous and delayed blowing of the DC protection device. If the DC protection device allows the charger to operate for a period of time before blowing, this is usually the result of gradual heating of the protection device. Inspect the connections to the circuit breaker/fuse for signs of heat caused by a loose connection, corrosion, physical damage or otherwise.

If the DC protection device itself passes inspection, confirm the DC voltage polarity from the battery system is correct. Disconnect the AC power plug from the electrical outlet, remove the charger's cover, connect the DC output cord to the equipment charging receptacle and measure the DC voltage present at test points E and F on the service wiring diagram. See figure 1. Verify the positive (+) is on test point E, WHITE DC cordset lead, and the negative (-) is on test point F, BLACK DC cordset lead.

If the proper polarity is not measured, locate and correct the wiring defect. If the correct polarity is measured at test points E and F, the cause of the DC protection device opening may be caused by a shorted SCR. See **Section 4 – SCR Testing.**

DANGER: REPLACE THE FUSE OR FUSE ASSEMBLY ONLY WITH THE CORRECT FUSE OR FUSE ASSEMBLY. FIRE, PROPERTY DAMAGE, AND PERSONAL INJURY CAN RESULT IF THE CHARGER IS USED WITH AN INCORRECT FUSE.

SECTION 7 – BUILDING CIRCUIT BREAKER TRIPS/FUSE BLOWS

This condition can be caused by a charger problem, a "weak" fuse or circuit breaker protecting the circuit, or an overloaded circuit. If the building AC power fuse or circuit breaker blows, connect the charger to other outlets (on different circuits) in the building. If the charger operates properly on other circuits, have a qualified electrician check the original circuit. If the charger causes other fuses or circuit breakers (in the building) to blow, the charger must be checked for a problem.

Disconnect both the AC power plug from the outlet and the DC output plug from the equipment charging receptacle. Remove the charger cover. Locate the charger nameplate model number and verify it and the model number listed on the wiring diagram specific for the model being serviced match. Inspect and verify the charger is wired correctly according to the wiring diagram.

Locate and disconnect the transformer primary coil leads from the AC fuse(s)/circuit breaker(s), test points A and B on the service wiring diagram. See figure 3. Using a continuity tester, measure the continuity between the two flat blades of the AC power plug, see figure 8.

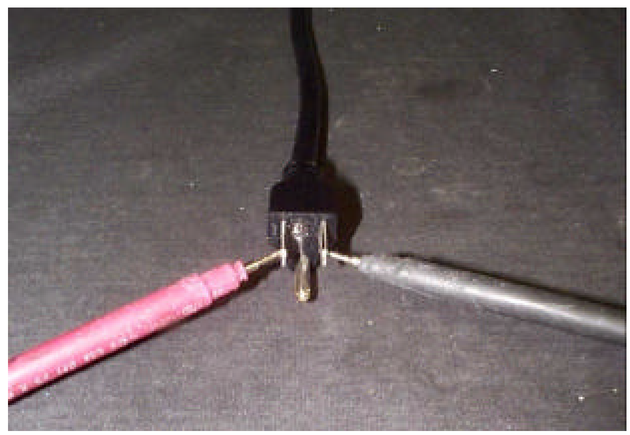


Figure 8

If no continuity is measured between the two flat blades of the AC power plug, replace the transformer and retest.

If continuity is still measured between the two flat blades of the AC power plug, disconnect the AC cordset lead(s) from the on/off power switch. Again, measure for continuity between the two flat blades of the AC power plug, as shown in figure 8. If continuity is still measured between the two flat blades of the AC power plug, replace the AC cordset and retest.

If no continuity is measured between the two flat blades of the AC power plug, isolate each remaining component (on/off power switch, AC voltage selector switch and any additional components shown in the wiring diagram specific for the model being serviced) in the AC input circuit and measure for continuity. Replace the failed component(s) that measure continuity with the replacement service part(s) specified on the parts list for the model charger being serviced and retest.

SECTION 8 – FACTORY ASSISTANCE

Technical support is available from the factory Monday through Friday, 8am – 4:30pm CT.

Contact may be made by the following methods:

Mail: Lester Electrical

625 West ‘A’ Street

Lincoln, NE 68522-1794 USA

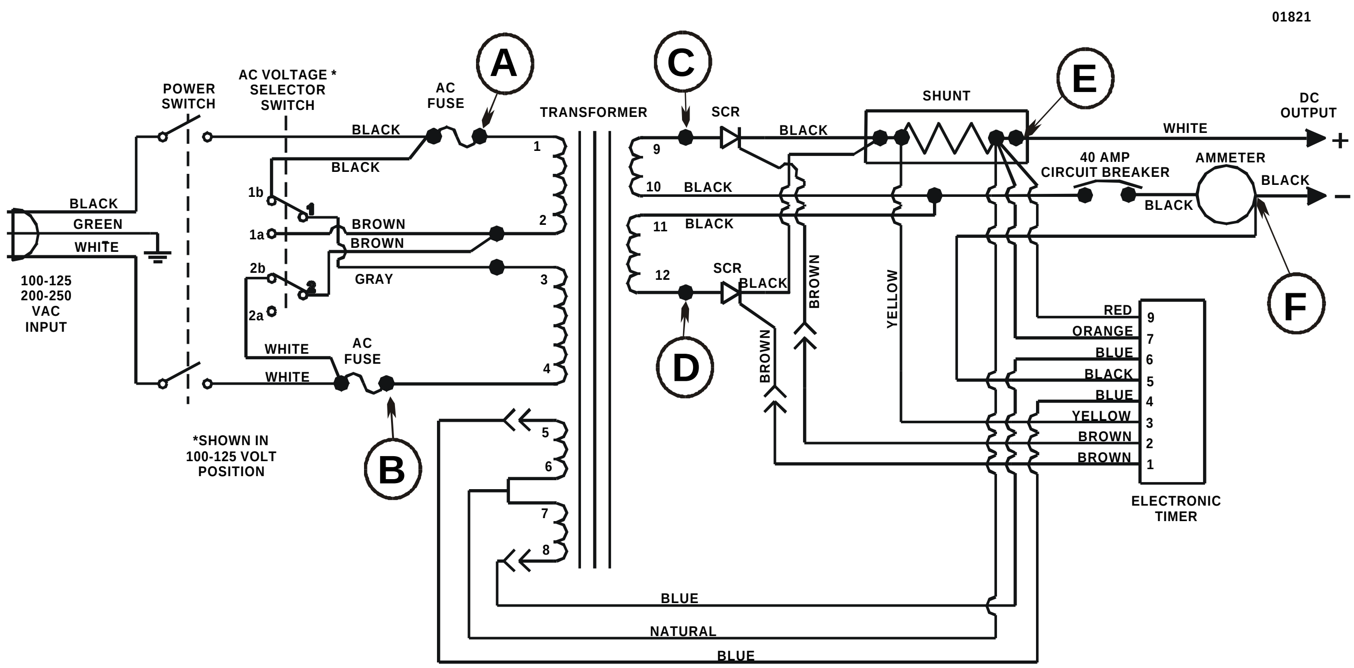
Attention: Service Department

Phone: (402) 477-8988

FAX: (402) 474-1769

E-mail: service@lesterelectrical.com

SERVICE WIRING DIAGRAM



PLEASE REFER TO THE SPECIFIC DIAGRAM IN THE OWNERS MANUAL.