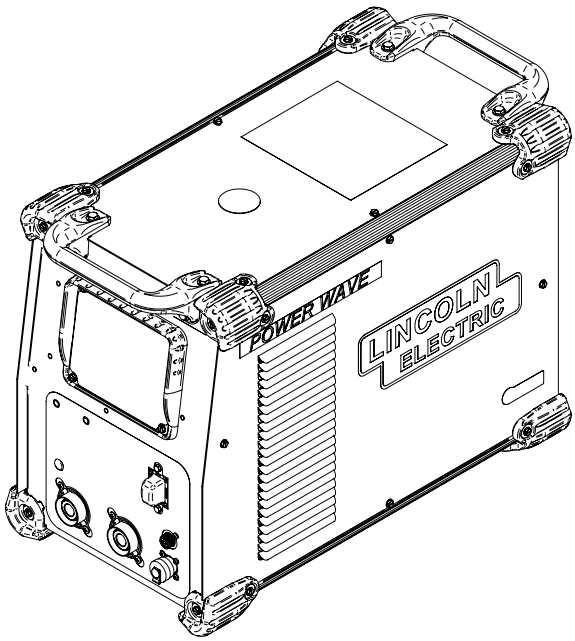
LINCOLN ELECTRIC

POWER WAVE® S350

For use with machines having Code Numbers:

11694, 11782, 11753, 11783,
11589, 12371, 12394 and 11625

SERVICE MANUAL



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THE LINCOLN ELECTRIC COMPANY
22801 St. Clair Avenue • Cleveland, OH • 44117-1199 • U.S.A.
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THANK YOU FOR SELECTING A QUALITY PRODUCT BY LINCOLN ELECTRIC.

PLEASE EXAMINE CARTON AND EQUIPMENT FOR DAMAGE IMMEDIATELY

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

SAFETY DEPENDS ON YOU

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation ... and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

⚠ WARNING

This statement appears where the information must be followed exactly to avoid serious personal injury or loss of life.

⚠ CAUTION

This statement appears where the information must be followed to avoid minor personal injury or damage to this equipment.

KEEP YOUR HEAD OUT OF THE FUMES.

DON'T get too close to the arc. Use corrective lenses if necessary to stay a reasonable distance away from the arc.

READ and obey the Safety Data Sheet (SDS) and the warning label that appears on all containers of welding materials.

USE ENOUGH VENTILATION or exhaust at the arc, or both, to keep the fumes and gases from your breathing zone and the general area.

IN A LARGE ROOM OR OUTDOORS, natural ventilation may be adequate if you keep your head out of the fumes (See below).

USE NATURAL DRAFTS or fans to keep the fumes away from your face.

If you develop unusual symptoms, see your supervisor. Perhaps the welding atmosphere and ventilation system should be checked.

WEAR CORRECT EYE, EAR & BODY PROTECTION

PROTECT your eyes and face with welding helmet properly fitted and with proper grade of filter plate (See ANSI Z49.1).

PROTECT your body from welding spatter and arc flash with protective clothing including woolen clothing, flame-proof apron and gloves, leather leggings, and high boots.

PROTECT others from splatter, flash, and glare with protective screens or barriers.

IN SOME AREAS, protection from noise may be appropriate.

BE SURE protective equipment is in good condition.

Also, wear safety glasses in work area **AT ALL TIMES.**

SPECIAL SITUATIONS

DO NOT WELD OR CUT containers or materials which previously had been in contact with hazardous substances unless they are properly cleaned. This is extremely dangerous.

DO NOT WELD OR CUT painted or plated parts unless special precautions with ventilation have been taken. They can release highly toxic fumes or gases.

Additional precautionary measures

PROTECT compressed gas cylinders from excessive heat, mechanical shocks, and arcs; fasten cylinders so they cannot fall.

BE SURE cylinders are never grounded or part of an electrical circuit.

REMOVE all potential fire hazards from welding area.

ALWAYS HAVE FIRE FIGHTING EQUIPMENT READY FOR IMMEDIATE USE AND KNOW HOW TO USE IT.

SECTION A: WARNINGS

CALIFORNIA PROPOSITION 65 WARNINGS

Diesel Engines

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Gasoline Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE POWERED EQUIPMENT.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

1.d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

- 2.d.1. Route the electrode and work cables together - Secure them with tape when possible.
- 2.d.2. Never coil the electrode lead around your body.
- 2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.
- 2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.
- 2.d.5. Do not work next to welding power source.

ELECTRIC SHOCK CAN KILL.

3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- Semiautomatic DC Constant Voltage (Wire) Welder.
- DC Manual (Stick) Welder.
- AC Welder with Reduced Voltage Control.

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

ARC RAYS CAN BURN.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES CAN BE DANGEROUS.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding hardfacing (see instructions on container or SDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and within applicable OSHA PEL and ACGIH TLV limits using local exhaust or mechanical ventilation unless exposure assessments indicate otherwise. In confined spaces or in some circumstances, outdoors, a respirator may also be required. Additional precautions are also required when welding on galvanized steel.**

5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.

5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.d. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.e. Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the Safety Data Sheet (SDS) and follow your employer’s safety practices. SDS forms are available from your welding distributor or from the manufacturer.

5.f. Also see item 1.b.

WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.

6.i. Read and follow NFPA 51B "Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from NFPA, 1 Batterymarch Park, PO box 9101, Quincy, MA 022690-9101.

6.j. Do not use a welding power source for pipe thawing.

CYLINDER MAY EXPLODE IF DAMAGED.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-l, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association, 14501 George Carter Way Chantilly, VA 20151.

FOR ELECTRICALLY POWERED EQUIPMENT.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

Refer to http://www.lincolnelectric.com/safety for additional safety information.

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- THEORY OF OPERATION SECTION -

Figure E.1 - Block logic diagram

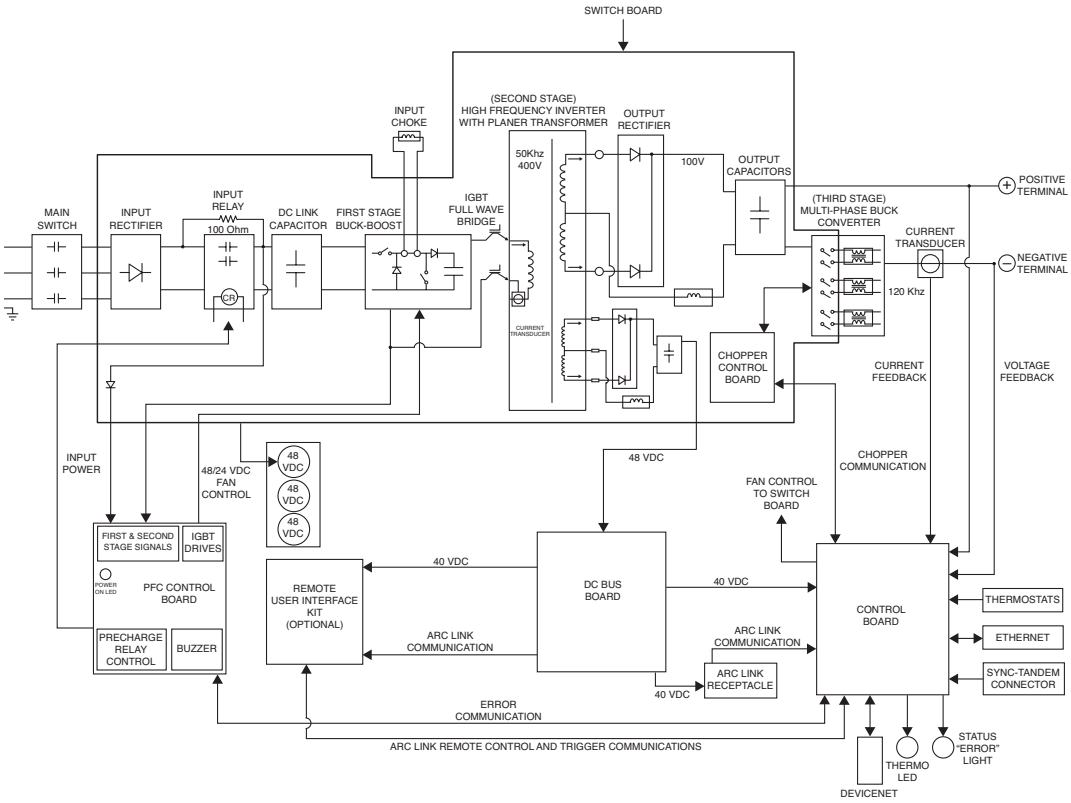
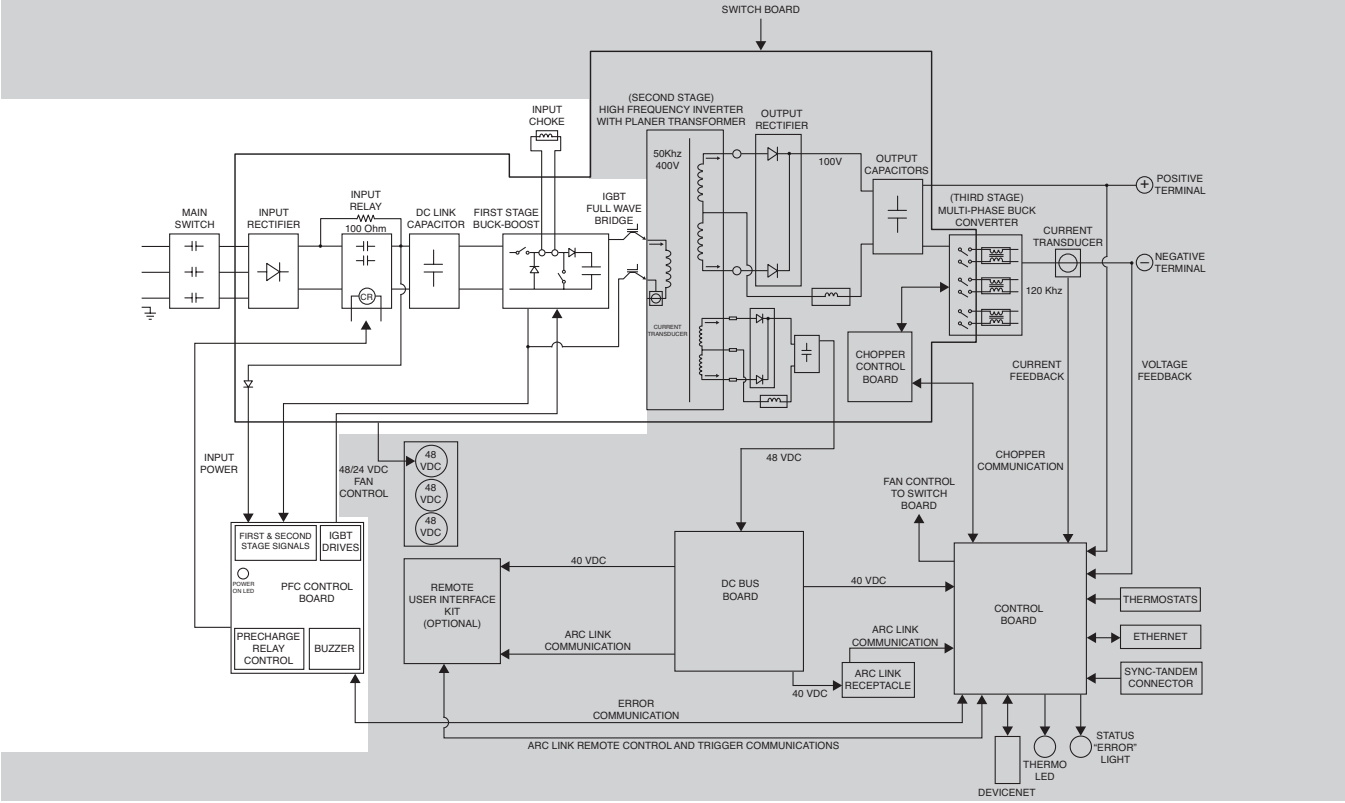


Figure E.2 - Main input switch, input rectifier, soft start/input relay, DC link capacitor, buck-boost and power factor correction control board



MAIN INPUT SWITCH, INPUT RECTIFIER, SOFT START/INPUT RELAY, DC LINK CAPACITOR, BUCK-BOOST AND POWER FACTOR CORRECTION CONTROL BOARD

The Power Wave S350 can be connected to a variety of both three-phase or single phase input voltages. The Power Wave S350 automatically adjusts to operate with different AC input voltages. No reconnect switch settings are required. The initial input power is applied through a line switch located on the lower front panel of the machine. This AC input voltage is applied to an input rectifier where it is rectified to a DC voltage. The DC voltage is then applied to a soft-start circuit consisting of a 100 ohm resistor and a DC relay. The rectified input power is also connected, through a blocking diode, to the power factor correction board.

Initially the DC relay is not activated and the incoming DC voltage is applied to the DC link capacitor via the 100 ohm resistor. This resistor functions as a current limiting device allowing the DC link capacitor to charge slowly. The PFC board uses the incoming DC voltage to create three separate 15VDC supplies. These auxiliary voltages are used to power the circuitry for the control circuits as well as the +15 volts for the buck-boost IGBTs and the soft start relay.

Under normal operating conditions the PFC board activates the soft start relay 50ms after input power is applied to the machine. The 100 ohm resistor will be “shorted out” by the relay’s contacts and the full input potential will be applied to the DC link capacitor. The DC link capacitor also functions as a voltage clamp for the buck-boost circuit.

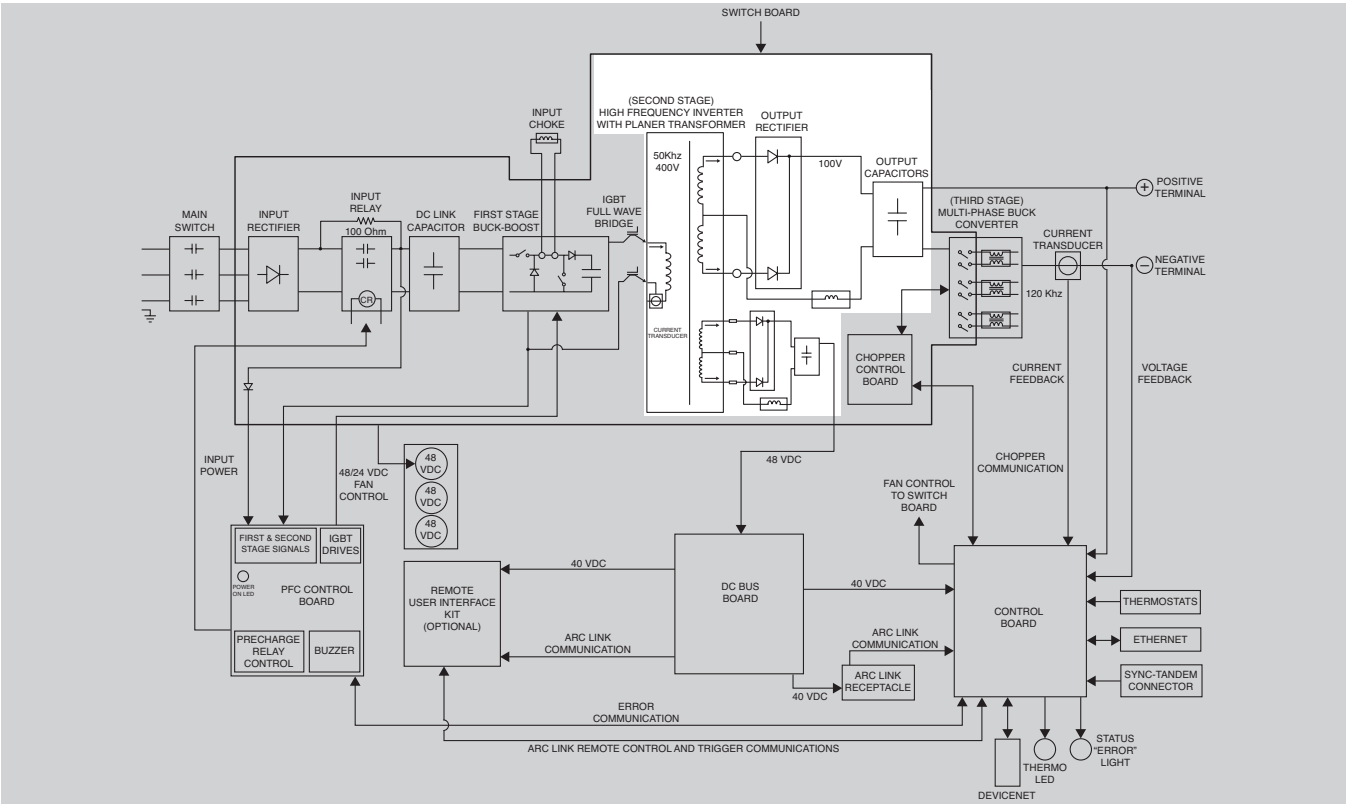
The buck-boost circuit, located on the switch board, consists of a buck converter followed by a boost converter. The boost switch is active when the input voltage is at 230VAC input or less. Under this condition the Buck switch is held on the entire time. The buck switch is active when the input voltage is at 325VAC or more. Under this condition the boost switch is not active for most of the time. The buck-boost circuit operates at 25kHz. The buck-boost circuit’s output is a 400 volt regulated bus.

The output of the buck boost circuit is filtered and applied to an IGBT controlled full wave bridge inverter that is located on the switch board. The resultant 400 volt output is coupled to the primary winding of a planar transformer that is also located on the switch board. The full wave bridge operates at 60kHz. switching frequency with a 99% on time.

The PFC board controls the “firing” of the buck boost circuit and the IGBT full wave bridge circuit. This permits the PFC board to monitor and control the wave shape of the applied input current to provide a optimal power factor correction for the Power Wave S350.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

Figure E.3 - Planar transformation, output rectification and filtering



PLANAR TRANSFORMER, OUTPUT RECTIFICATION AND FILTERING

The planar transformer has two secondary windings. The 100 volt weld winding is center tapped and rectified. The 48 volt auxiliary winding is also center tapped and rectified. The term “Planar” refers to the design and construction of the transformer. The windings are created on printed circuit boards and stacked up to create a transformer.

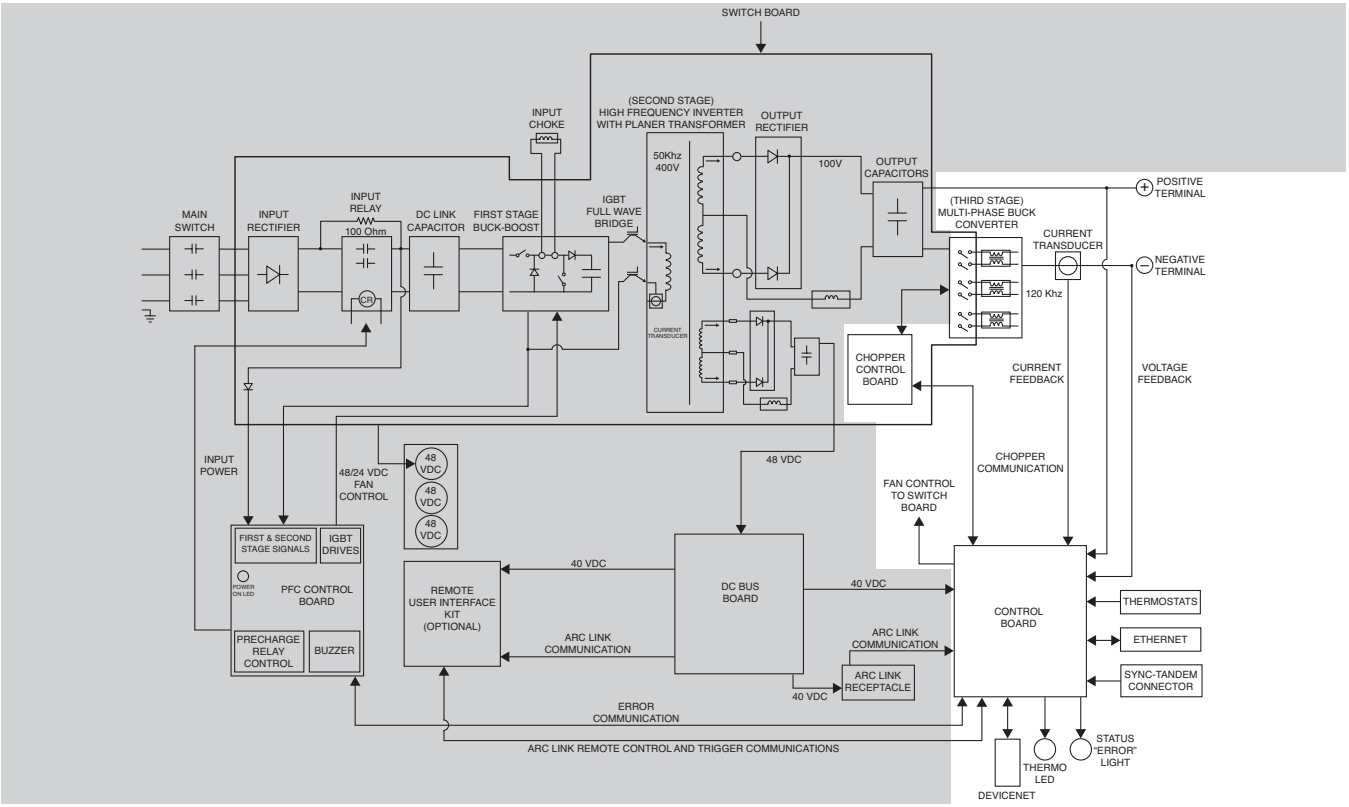
The primary and secondary connections are oriented at opposite ends of the transformer. This type of assembly provides for tighter magnetic coupling between the primary and secondary windings resulting in lower leakage inductance, higher efficiency, cooler operation and reduced size.

The 100 volt output of the weld winding is rectified and filtered by three capacitors and an inductor. This filtered DC voltage is applied to the multi-phase output chopper circuit.

The 48 volt output from the planar transformer’s auxiliary winding is also rectified and filtered and is used to provide power for the fans and the DC bus board.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

Figure E.4 - Multi-phase chopper control board, current transducer and control board



MULTI-PHASE CHOPPER, CHOPPER CONTROL BOARD, CURRENT TRANSDUCER AND CONTROL BOARD

The multi-phase chopper is used to control the welding voltage and current output. It receives the 100 volt DC from the planar transformer and produces a regulated output for welding purposes. It contains six chopper phases in parallel that turn on 60 degrees out of phase. Two or complimentary, phases each conduct 180 degrees out of phase through the same output choke assembly.

The chopper control board, located on the switch board, receives welding output commands from the control board. The chopper control board then determines the on-time of the six chopper IGBTs to meet the requirements set forth from the control board.

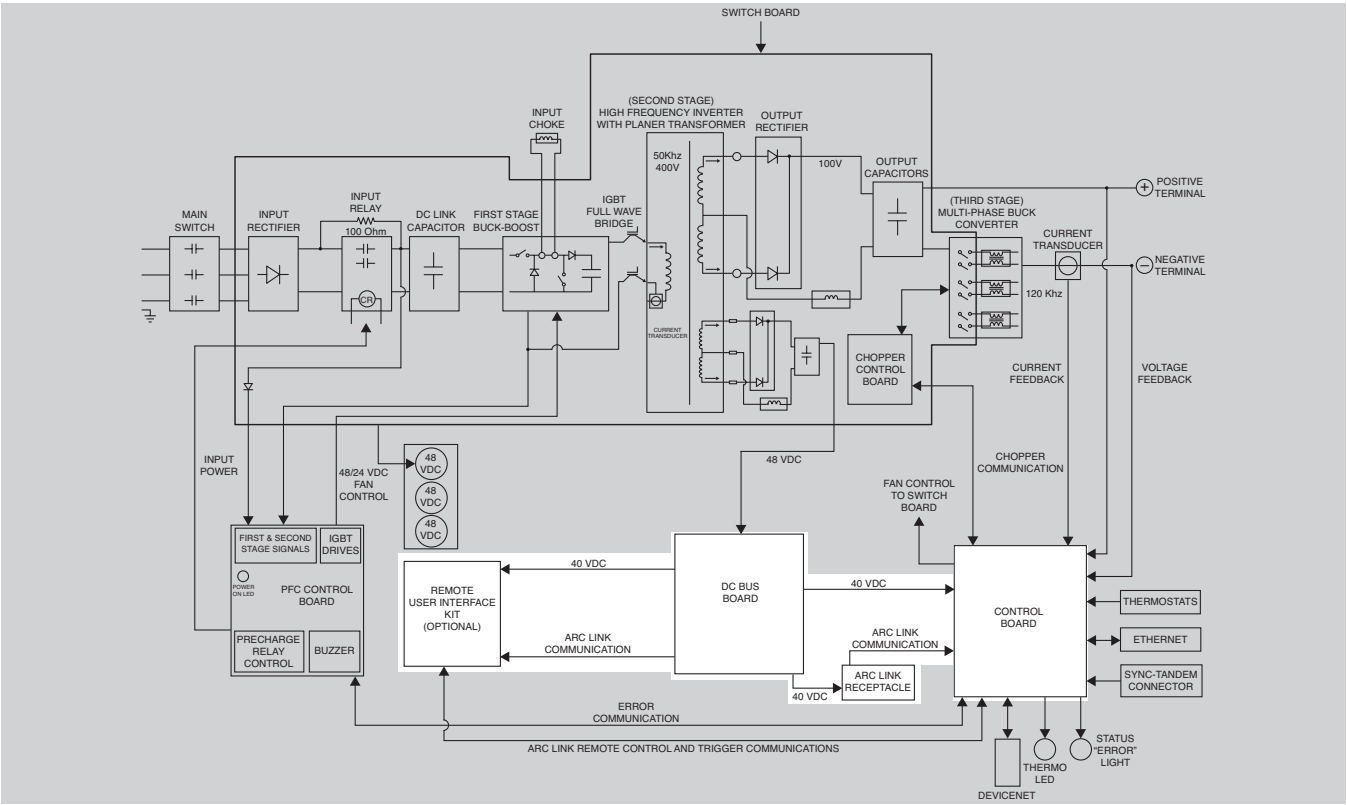
The control board receives commands and feedback information, via Arc-Link communication, from the optional user interface kit, the Arc Link receptacle and the chopper control board. It also receives output current and voltage information from the current transducer and via leads 202 and 206 from the output terminals.

The current transducer monitors the output current and converts that information into a low voltage signal that is sent to the control board (500 Amps = 4.0VDC). The control board uses this current feedback information along with the output voltage feedback to monitor and control the output of the machine. The control board also houses the software welding tables.

In addition, the control board monitors the thermostat circuitry, the shutdown circuitry and controls the two speed fans.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

Figure E.5 - DC bus board and optional user interface board



DC BUS BOARD AND OPTIONAL USER INTERFACE BOARD

The DC bus board receives 48VDC supply voltage from the planar transformer circuitry. This voltage is regulated to 40VDC and is applied to the ArcLink receptacle for wire feeder operation. 40VDC is also applied to the control board.

The optional user interface kit receives the operator commands and via ArcLink communications, sends the appropriate signals to the control board.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

MACHINE PROTECTION

THERMAL PROTECTION

Two normally closed (NC) thermostats protect the machine from excessive operating temperatures. One is connected to the control board. It is located on top of the secondary heat sink. The other thermostat is located and integrated into the switch board and is monitored by the power factor correction board. Excessive temperatures may be caused by a lack of cooling air or by operating the machine beyond its duty cycle or output rating. If excessive operating temperatures should occur, the thermostats will prevent output from the machine. The yellow thermal light, located on the front of the machine, will be illuminated. The thermostats are self-resetting once the machine cools sufficiently. If the thermostat shutdown was caused by excessive output or duty cycle and the fans are operating normally, the power switch may be left on and the reset should occur within a 15-minute period. If the fans are not turning or the intake air louvers are obstructed, the power must be removed from the machine and the fan condition or air obstruction corrected.

PROTECTIVE CIRCUITS

Protective circuits are designed into the Power Wave S350 to sense trouble and shut down the machine before damage occurs to the machine's internal components. Error Codes will be flashed out by the light on the control board and will help identify the reason for the shutdown. They should all be steady green. See the ***Troubleshooting Section*** for more information regarding Error Codes. Fault codes can also be seen by using the diagnostic software.

OVER CURRENT PROTECTION

If the average weld current exceeds 400 amps the machine's output will be disabled.

TABLE OF CONTENTS
- TROUBLESHOOTING AND REPAIR SECTION -

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "PROBLEM" (SYMPTOMS). This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into three main categories: Output Problems, Welding Problems and Ethernet Problems.

Step 2. PERFORM EXTERNAL TESTS. The second column, labeled "POSSIBLE AREAS OF MISADJUSTMENT(S)", lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case cover.

Step 3. PERFORM COMPONENT TESTS. The last column, labeled "Recommended Course of Action" lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this section. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to test points, components, terminal strips, etc., can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Have an electrician install and service this equipment. Turn the input power OFF at the fuse box before working on equipment. Do not touch electrically hot parts.**

⚠ CAUTION

Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when trouble-shooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board to assure that the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures:

PC board can be damaged by static electricity.

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an un-painted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.

ATTENTION

Static-Sensitive Devices Handle only at Static-Safe Workstations

Reusable Container Do Not Destroy

- Tools which come in contact with the PC board must be either conductive, anti-static or static-dissipative.
- Remove the PC board from the static-shielding bag and place it directly into the equipment. Don't set the PC board on or near paper, plastic or cloth which could have a static charge. If the PC board can't be installed immediately, put it back in the static-shielding bag.
- If the PC board uses protective shorting jumpers, don't remove them until installation is complete.
- If you return a PC board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: It is desirable to have a spare (known good) PC board available for PC board troubleshooting.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
    a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks and terminal strips.
    b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was followed when warranty reports are to be submitted.

NOTE: Following this procedure and writing on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM," will help avoid denial of legitimate PC board warranty claims.

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the S350 case is removed.	1. Contact your local authorized Lincoln Electric Service Facility.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.
The input fuses repeatedly fail or the input circuit breakers keep tripping.	1. Make certain the fuses or breakers are properly sized. 2. The welding procedure may be drawing too much input current or the duty cycle may be too high. Reduce the welding current and/or reduce the duty cycle. 3. Check for error codes. See ***Status LED Troubleshooting*** in this section.	1. Perform the ***Input Rectifier Test***. 2. Perform the ***Switch Board Test***. 3. Perform the ***Power Factor Correction Control Board Test***.
The machine will not power up. No lights or displays. The machine appears to be off.	1. Make sure the proper input voltage is being applied to the machine (check fuses or breakers). 2. Make sure the input supply disconnect has been turned ON. 3. Make certain the input power switch (SW1) is in the ON position. 4. Check for error codes. See ***Status LED Troubleshooting*** in this section.	1. Check the input switch SW1 for proper operation. Also check the associated leads for loose or faulty connections. See the Wiring Diagram. 2. Check to make sure that 40VDC is being applied to the optional user interface board at leads 52D(+) to lead 51D(-). See the Wiring Diagram. 3. Perform the ***DC Bus Board Test***. 4. Perform the ***Input Rectifier Test***. 5. Perform the ***Power Factor Correction Control Board Test***.
The Power Wave S350 does not have welding output.	1. Make sure the input voltage is correct. 2. If the symptom is accompanied by an error code , see ***Status LED Troubleshooting*** in this section. 3. There may be an external “short” in the external output circuitry. Remove all loads from the output terminals and restart the machine. 4. If the thermal LED is lit the unit may be overheated. Adjust the welding load and/or duty cycle to coincide with the output limits of the Power Wave S350. Also see the symptom “The thermal LED is ON” in this section.	1. Perform the ***Input Rectifier Test***. 2. Perform the ***Switch Board Test***. 3. Perform the **Planar Transformer Resistance Test**. 4. Perform the ***Control Board Test***. 5. Perform the ***Optional User Interface Board Test***. 6. Perform the ***Output Rectifier Test***. 7. Perform the ***DC Bus Board Test***.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The thermal LED is ON. The machine regularly overheats. There is no welding output.	1. The welding application may be exceeding the recommended duty cycle and/or current limits of the machine. 2. Dirt and dust may have clogged the cooling channels inside the machine. See the ***Maintenance*** section of the Operators Manual. 3. The air intake and exhaust louvers may be blocked due to inadequate clearance around the machine. 4. Make sure the fans are functioning correctly. The fans should run in a low speed setting when the machine is at idle and a high speed when welding output is activated. The fans should also run if a thermostat has tripped.	1. Check the thermostats and associated wiring for loose or faulty connections. See the Wiring Diagram. 2. Check the DC voltages being applied to the fans at lead 351(-) to lead 353(+). At the low speed setting the voltage should be 24VDC. At the high speed setting the voltage should be 48VDC. See the Wiring Diagram.
The “Real Time Clock” no longer functions.	1. The control board battery may be faulty. Replace if necessary (type BS2032).	2. The control board may be faulty.
The Power Wave S350 will not produce full output.	1. The input voltage may be too low. See the Check for error codes. See ***Status LED Troubleshooting*** in this section. 2. Make certain the input voltage is correct for the machine.	1. Perform the ***Current Transducer Test***. 2. Perform the Power Wave Verification And Calibration Procedures, see ***SVM251***. 3. The control board may be faulty. Perform the ***Control Board Test***.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
General degradation of the welding performance.	1. Check for proper wire feeding. Make certain that the actual speed is the same as the preset. 2. Verify that the correct wire drive and gear ratio have been selected. 3. Check the welding cables for loose or faulty connections. 4. Check for adequate gas shielding. 5. Make sure the welding process is correct for the wire feed and voltage settings.	1. Perform the Power Wave Verification And Calibration Procedures, see ***SVM251***.
The wire burns back to the tip at the end of the weld.	1. Reduce the burnback time. 2. Reduce the workpoint.	1. N/A.
During a weld the machine shuts down.	1. The secondary current limit has been exceeded and the machine shuts down to protect itself. Adjust the procedure to reduce the load and lower the output current draw.	1. A non-recoverable internal fault will interrupt the welding output. This condition will also result in a status light blinking. Check for error codes. See ***Status LED Troubleshooting*** in this section.
The arc is excessively long and erratic.	1. In the wire feeder, make certain the correct wire drive and gear ratio have been selected for the welding process being used. 2. Make sure the shielding gas is correct for the welding process being used. Also make sure the flow rate is correct.	1. Perform the Power Wave Verification And Calibration Procedures, see ***SVM251***.
The welding starting is poor.	1. Make sure the driver roll tension on the wire feeder is adjusted correctly. Also the welding wire should travel freely through wire feeding path. Check the welding tip for blockage.	1. N/A.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ETHERNET PROBLEMS		
The system will not connect.	1. Make sure that the correct patch cable or cross over cable is being used. 2. Make sure the software is not blocking the connection. See the on line diagnostic utility. 3. Verify that the cables are fully inserted into the bulk head connector. 4. Verify that the network device connected to the Power Wave is either a 10-baseT device or a 10/100-base-T device. 5. The LED located under the PC board ethernet connector will be lit when the machine is connected to another network device.	1. Use Weld Manager (included on the Power Wave Utilities and Service Navigator CD's or available at ***www.powerwavesoftware.com*** to verify the correct IP address information has been entered. 2. Verify that no duplicate IP addresses exist on the network.
The ethernet connection drops out while welding.	1. Make sure all of the connections are tight and secure.	2. Make certain that the network cable is not located next to any heavy current carrying conductors. This would include input power cables and welding output cables.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

USING THE STATUS LED TO TROUBLESHOOT SYSTEM PROBLEMS

Not all of the Power Wave S350 errors will be displayed on the user interface (if it is installed). There are two status lights that display error codes. If a problem occurs it is important to note the condition of the status lights. **Therefore, prior to cycling power to the system, check the power source status light for error sequences as noted below**.

There is one externally mounted status lights located on the case front of the machine. This status light corresponds to the main control board's status. A second status light is internal and is located on the input control board and can be seen by looking through the left case side louvers.

There is an audible beeper associated with this input control board's status light. So the error codes on the input board can be detected through either the status light or the status beeper.

Included in this section is information about the Status Lights and some basic troubleshooting charts for both machine and weld performance.

The status lights for the main control board is a dual-color LED's. Normal operation for each is steady green. Where as the status light on the input control board is one color. Normal operation is for the status light to be off (and the buzzer to be off).

Error conditions are indicated in the following chart Table F.1.

Table F.1 - Status light indication

LIGHT CONDITION	MAIN CONTROL BOARD	INPUT CONTROL BOARD
STEADY GREEN	System OK. Power source is operational and is communicating normally with all healthy peripheral equipment connected to its ArcLink network.	NOT APPLICABLE.
BLINKING GREEN	Occurs during power up or a system reset, and indicates the Power Wave S350 is mapping (identifying) each component in the system. Normal for first 1-10 seconds after power is turned on or if the system configuration is changed during operation.	NOT APPLICABLE.
FAST BLINKING GREEN	Indicates auto-mapping has failed.	NOT APPLICABLE.
ALTERNATING GREEN AND RED	Non-recoverable system fault. If the status lights are flashing any combination of red and green, errors are present. **Read the error code(s) before the machine is turned off**.	NOT APPLICABLE.
	Error Code interpretation through the status light is detailed in this service manual. Individual code digits are flashed in red with a long pause between digits. If more than one code is present, the codes will be separated by a green light. Only active error conditions will be accessible through the status light.	
	Error codes can also be retrieved with the **Diagnostics Utility** (referred to on the **Service Navigator** DVD or available at **www.powerwavesoftware.com**). This is the preferred method, since it can access historical information contained in the error logs.	
	To clear the active error(s), turn power source off and back on to reset.	
STEADY RED	Not applicable.	NOT APPLICABLE.
BLINKING RED	Not applicable.	**Error Code interpretation** - Individual code digits are flashed in RED with a long pause between digits. These error codes are three digit codes that all start with a number three.
STATUS LED OFF	Not applicable.	SYSTEM OK.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Observe Safety Guidelines detailed in the beginning of this manual.

ERROR CODES FOR THE POWER WAVE S350

The following is a list of possible error codes for the Power Wave S350.

MAIN CONTROL BOARD ("STATUS" LIGHT)		
ERROR CODE #		**INDICATION**
36	THERMAL ERROR	Indicates over temperature. Usually accompanied by thermal LED. Check fan operation. Be sure process does not exceed duty cycle limit of the machine.
54	SECONDARY (OUTPUT) OVER CURRENT ERROR	The long term average secondary (weld) current limit has been exceeded. **NOTE:** The long term average secondary current limit is 325 amps.
56	CHOPPER COMMUNICATION ERROR	Indicates communication link between main control board and chopper has errors. If cycling the input power on the machine does not clear the error, contact the Lincoln Electric service department at 1-888-935-3877.
58	PRIMARY FAULT ERROR	Review error code from input board status light or status beeper. Most likely caused by an over power condition which caused an under voltage on the primary bus. If cycling the input power on the machine does not clear the error, contact the Lincoln Electric service department at 1-888-935-3877.
OTHER		Error codes that contain three or four digits are defined as fatal errors. These codes generally indicate internal errors on the power source control board. If cycling the input power on the machine does not clear the error, contact the Lincoln Electric service department at 1-888-935-3877.

INPUT CONTROL BOARD		
ERROR CODE #		**INDICATION**
331	PEAK INPUT CURRENT LIMIT	Input current limit has been exceeded. Typically indicates short term power overload. If problem persists, contact the Lincoln Electric service department at 1-888-935-3877.
333	UNDER-VOLTAGE LOCKOUT	+15 VDC supply on input control board too low. Verify input voltage is within the acceptable range. If problem persists, contact the Lincoln Electric service department at 1-888-935-3877.
336	THERMAL FAULT	Thermostat on primary module tripped. Typically caused by bottom fan not working.
337	PRE-CHARGE TIMEOUT	Problem with start-up sequence. If problem persists, contact the Lincoln Electric service department at 1-888-935-3877.
346	TRANSFORMER PRIMARY OVER CURRENT	Transformer current too high. Typically indicates short term power overload. If problem persists, contact the Lincoln Electric service department at 1-888-935-3877.
OTHER		Contact the Lincoln Electric service department at 1-888-935-3877.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

CASE COVER REMOVAL AND REPLACEMENT AND DC LINK CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

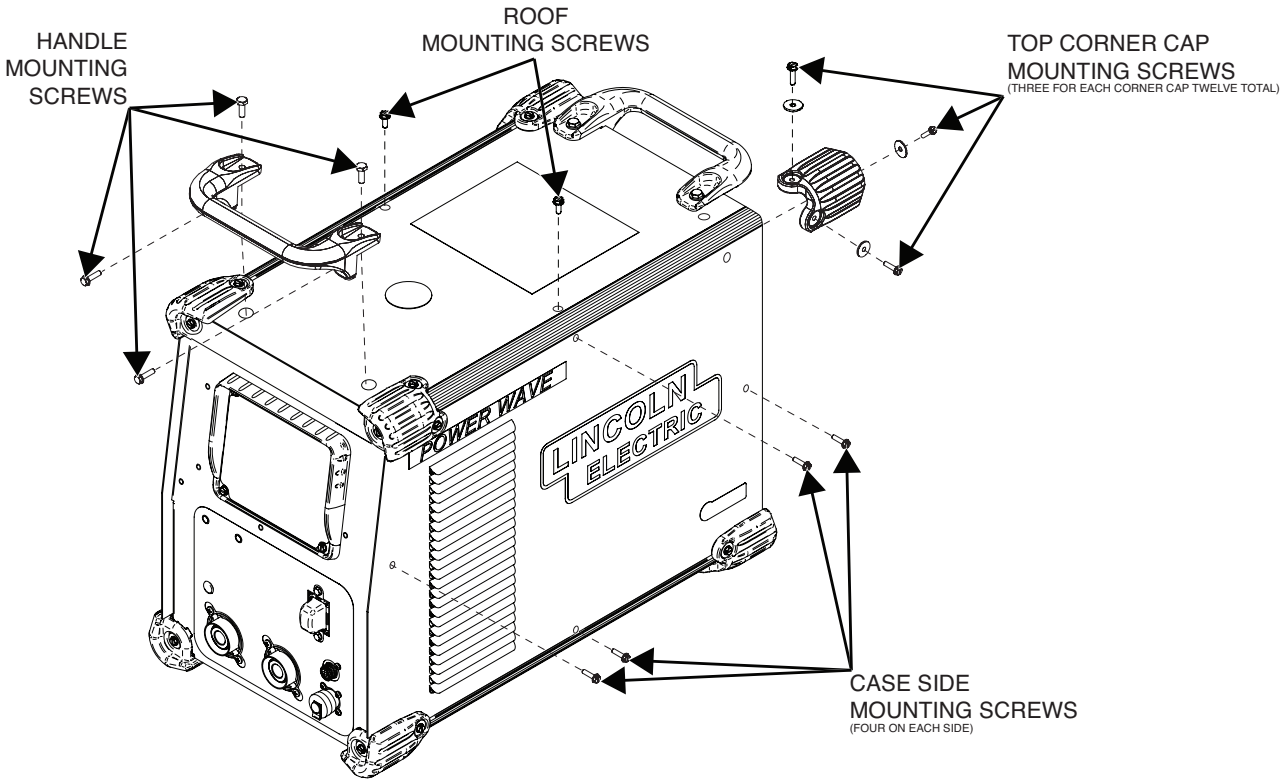
This procedure will aid the technician in the removal and replacement of the Case Covers.

MATERIALS NEEDED

5/16” Nutdriver
7/16” Nutdriver
Volt/Ohmmeter
High Wattage Resistor (25-1000 Ohms @ 25 Watts Minimum)
Electrically Insulated Gloves
Pliers
Wiring Diagram

CASE COVER REMOVAL AND REPLACEMENT AND DC LINK CAPACITOR DISCHARGE PROCEDURE *(continued)*

Figure F.1 – Case cover removal procedure



REMOVAL PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Using the 5/16" nutdriver, remove the three screws and flat washers securing each of the four (top) corner end caps (twelve screws and flat washers total) to the machine. See Figure F.1. Note washer placement for reassembly.
3. Using the 5/16" nutdriver, remove the four screws securing the left case side to the machine. See Figure F.1.
4. Using a 5/16" nutdriver, remove the four screws securing the right case side to the machine. See Figure F.1.
5. Using a 7/16" nutdriver, remove the four screws and washers securing each handle to the machine (eight screws and washers total). See Figure F.1.
6. Using a 5/16" nutdriver, remove the two screws securing the roof to the machine. See Figure F.1.

CAPACITOR DISCHARGE PROCEDURE

7. Locate the DC link capacitor. See ***Figure F.2***.
8. Using a volt/ohmmeter, check the voltage across the terminals of the DC link capacitor. See ***Figure F.3***. See Wiring Diagram.
9. If any voltage is present, using the high wattage resistor (25-1000 ohms @ 25 watts minimum), electrically insulated gloves and pliers, discharge the capacitor by holding the resistor terminals on the capacitor terminals for 10 seconds. See ***Figure F.3***. See Wiring Diagram.

NOTE: DO NOT TOUCH THE CAPACITOR TERMINALS WITH YOUR BARE HANDS. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.

10. Using a volt/ohmmeter, recheck the voltage across the capacitor terminals. See ***Figure F.3***. See Wiring Diagram. The voltage should be zero.
11. If any voltage remains, repeat the discharge procedure.

NOTE: Any voltage present after discharge has been performed, is an abnormal condition and may indicate a switch board problem.

12. Using a volt/ohmmeter, carefully check for DC voltage at B48 - B49 on the switch board. See ***Figure F.3***. See Wiring Diagram.
13. If voltage is present, wait for voltage to decay before proceeding.

CASE COVER REMOVAL AND REPLACEMENT AND DC LINK CAPACITOR DISCHARGE PROCEDURE *(continued)*

Figure F.2 – DC capacitor location

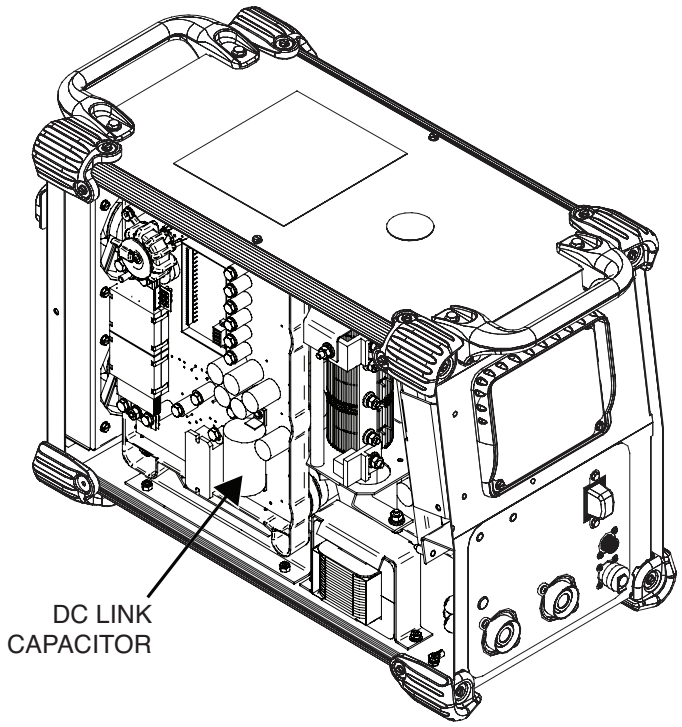
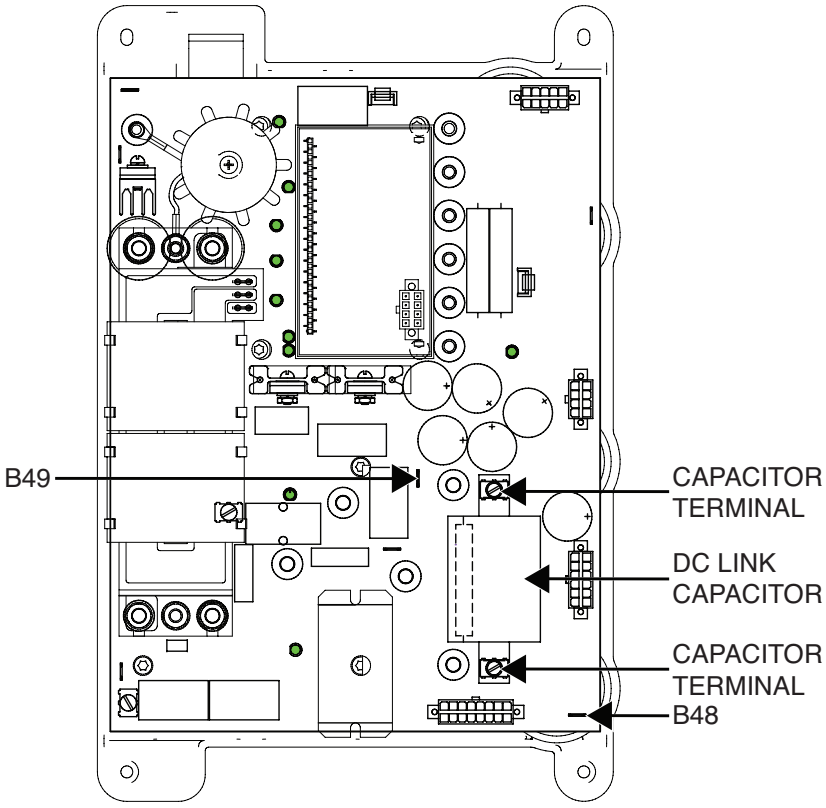


Figure F.3 – Capacitor terminals and associated locations



CASE COVER REMOVAL AND REPLACEMENT AND DC LINK CAPACITOR DISCHARGE PROCEDURE *(continued)*

REPLACEMENT PROCEDURE

1. Carefully position the roof onto the top of the machine.
2. Using a 5/16” nutdriver, attach the two screws securing the roof to the machine.
3. Carefully position each handle onto the top of the machine.
4. Using a 7/16” nutdriver, attach the four screws and washers securing each handle to the machine (eight screws and washers total).
5. Carefully position the right side onto the machine.
6. Using a 5/16” nutdriver, attach the four screws securing the right case side to the machine.
7. Carefully position the left case side onto the machine.
8. Using the 5/16” nutdriver, attach the four screws securing the left case side to the machine.
9. Carefully position the four (top) corner end caps onto the machine.
10. Using the 5/16” nutdriver, attach the three screws and flat washers securing each of the four (top) corner end caps (twelve screws and flat washers total) to the machine.

POWER FACTOR CORRECTION CONTROL BOARD TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

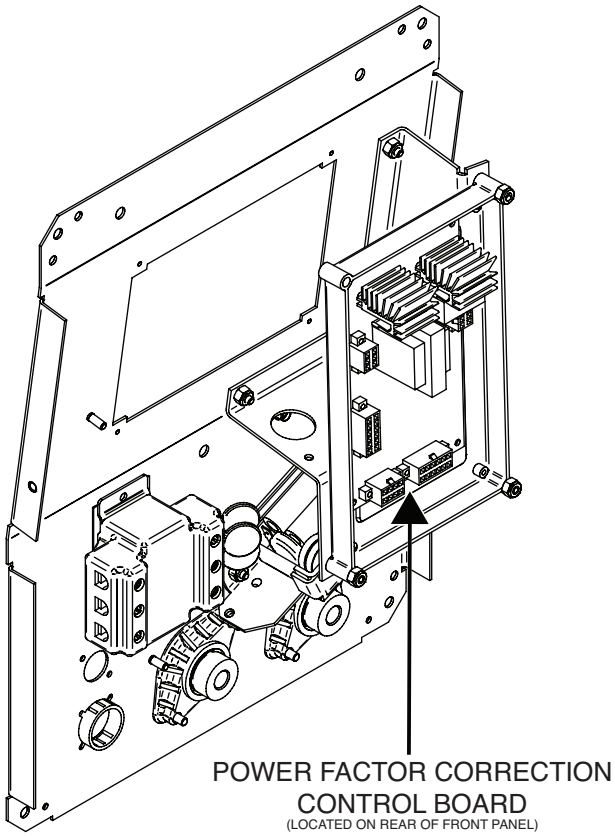
This test will help determine if the Power Factor Correction Control Board is functioning correctly. There are very high voltages present on the PFC Control Board. This test will be limited to LED and audio error codes and also resistance checks with the input power removed from the machine.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

POWER FACTOR CORRECTION CONTROL BOARD TEST *(continued)*

Figure F.4 – PFC control board location

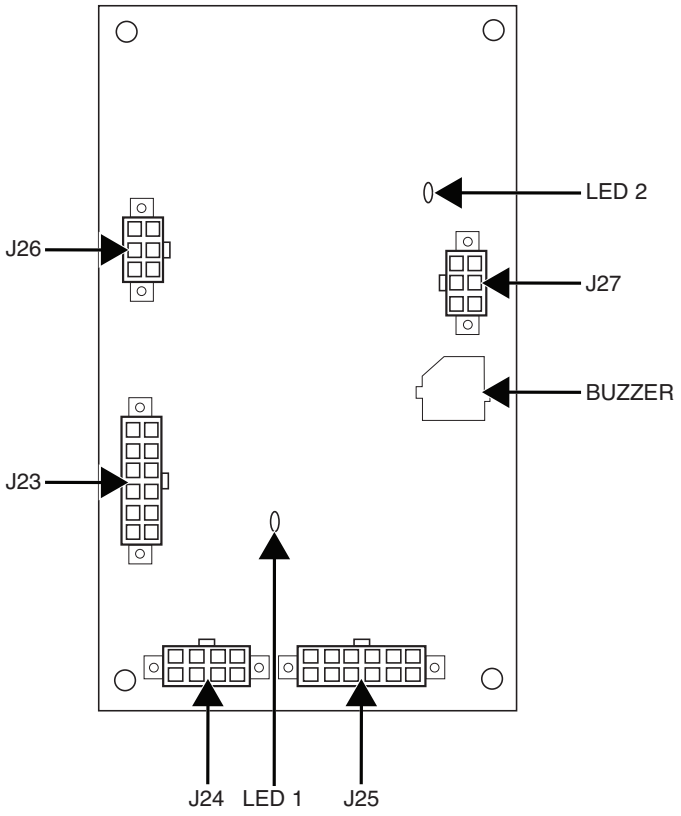


PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the PFC control board. See Figure F.4.
4. Apply the correct input power to the Power Wave S350 machine.
5. Locate LED 2 on the PFC control board. See ***Figure F.5***.
6. LED 2 should be on and green during proper operation of the PFC control board.
7. Locate LED 1 and the audio buzzer on the PFC control board. See ***Figure F.5***.
8. If there is a problem with the PFC control board LED 1 and the buzzer will provide an error code. See ***Figure F.5*** for error codes. LED 2 will also be OFF or blinking.
9. If further testing is required remove the input power to the machine and perform the resistance checks in ***Table F.2***. See ***Figure F.5***, ***Figure F.6***, ***Figure F.7*** and ***Figure F.8*** for test point locations. See Wiring Diagram. To access some of the test points the PFC control board may have to be removed from its mounting studs. See the ***Power Factor Correction Control Board Removal Procedure***.
10. When testing is complete replace all previously removed plugs.
11. If any of the tests fail, perform the ***Power Factor Correction Control Board Removal and Replacement Procedure***.
12. Perform the ***Case Cover Replacement Procedure***.

POWER FACTOR CORRECTION CONTROL BOARD TEST *(continued)*

Figure F.5 – PFC control board plugs



G5915 PFC CONTROL BOARD		
LED #	**COLOR**	**FUNCTION**
2	GREEN	15 VDC power supply function properly when on.
1	RED	Error code (LED will flash error and buzzer will sound). See table below for details.

- Pause before repeating the code: 3.5 seconds.
- Pause between digits of the code: 1.5 seconds.
- Pause between sounds/flashes indicating a specific digit: 0.5 seconds.

ERROR CODE	
ERROR	**EXPLANATION**
331	Peak input current limit.
334	Start up current check failure.
335	Start up voltage check failure.
336	Thermal fault (no first stage fan).
337	Precharge timeout.
346	Transformer primary overcurrent.

POWER FACTOR CORRECTION CONTROL BOARD TEST *(continued)*

Table F.2 – Power factor correction control board resistance checks

DESCRIPTION	METER TEST POINTS AND POLARITY	EXPECTED READINGS	CONDITIONS
AUXILIARY POWER INPUT CIRCUIT	RECEPTACLE J27 PIN 3 (-) TO RECEPTACLE J27 PIN 4 (+)	VERY HIGH RESISTANCE. GREATER THAN 50,000 OHMS.	INPUT POWER REMOVED. REMOVE PLUG J27 FROM THE PFC BOARD. TYPICAL FAILURE IS A SHORT.
AUXILIARY POWER DIODE CIRCUIT ON SWITCH BOARD	B48 (-) TO PLUG J27 PIN 4 (+)	VERY HIGH RESISTANCE. GREATER THAN 50,000 OHMS.	INPUT POWER REMOVED. TYPICAL FAILURE IS A SHORT. IF SHORTED PERFORM THE ***SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE***.
AUXILIARY POWER DIODE CIRCUIT ON SWITCH BOARD	B12 (-) TO PLUG J27 PIN 4 (+)	VERY HIGH RESISTANCE. GREATER THAN 50,000 OHMS.	INPUT POWER REMOVED. TYPICAL FAILURE IS A SHORT. IF SHORTED PERFORM THE ***SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE***.
PRE-CHARGE RELAY DRIVE CIRCUIT	PLUG J23 PIN 3 (-) TO PLUG J23 PIN 4 (+)	VERY HIGH RESISTANCE. GREATER THAN 30,000 OHMS.	INPUT POWER REMOVED. REMOVE PLUG J41 FROM THE SWITCH BOARD. TYPICAL FAILURE IS A SHORT.
FULL BRIDGE GATE DRIVE CIRCUIT	PLUG J23 PIN 6 (+) TO PLUG J23 PIN 5 (-)	HIGH RESISTANCE. GREATER THAN 5,000 OHMS.	INPUT POWER REMOVED. REMOVE PLUG J41 FROM THE SWITCH BOARD. TYPICAL FAILURE IS A SHORT.
MAIN BUCK GATE DRIVE CIRCUIT	PLUG J23 PIN 11 (-) TO PLUG J23 PIN 12 (+)	RESISTANCE SHOULD BE GREATER THAN 500 OHMS.	INPUT POWER REMOVED. REMOVE PLUG J41 FROM THE SWITCH BOARD. TYPICAL FAILURE IS A SHORT.
AUXILIARY BUCK GATE DRIVE	PLUG J23 PIN 2 (-) TO PLUG J23 PIN 1 (+)	RESISTANCE SHOULD BE GREATER THAN 500 OHMS.	INPUT POWER REMOVED. REMOVE PLUG J41 FROM THE SWITCH BOARD. TYPICAL FAILURE IS A SHORT.
MAIN BOOST GATE DRIVE	PLUG J23 PIN 8 (-) TO PLUG J23 PIN 7 (+)	RESISTANCE SHOULD BE GREATER THAN 500 OHMS.	INPUT POWER REMOVED. REMOVE PLUG J43 FROM THE SWITCH BOARD. TYPICAL FAILURE IS A SHORT.
AUXILIARY BOOST GATE CIRCUIT	PLUG J23 PIN 9 (-) TO PLUG J23 PIN 10 (+)	RESISTANCE SHOULD BE GREATER THAN 500 OHMS.	INPUT POWER REMOVED. REMOVE PLUG J43 FROM THE SWITCH BOARD. TYPICAL FAILURE IS A SHORT.

POWER FACTOR CORRECTION CONTROL BOARD TEST *(continued)*

Figure F.6 – PFC control board plugs J23 and J27

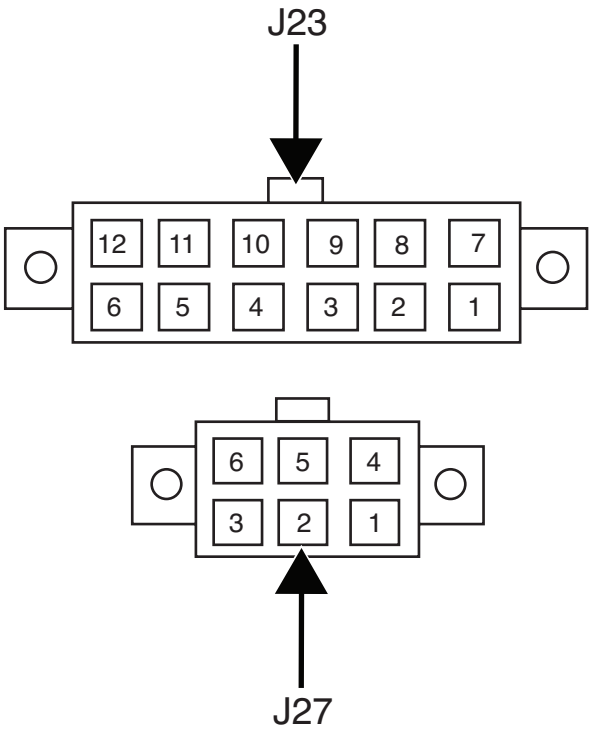
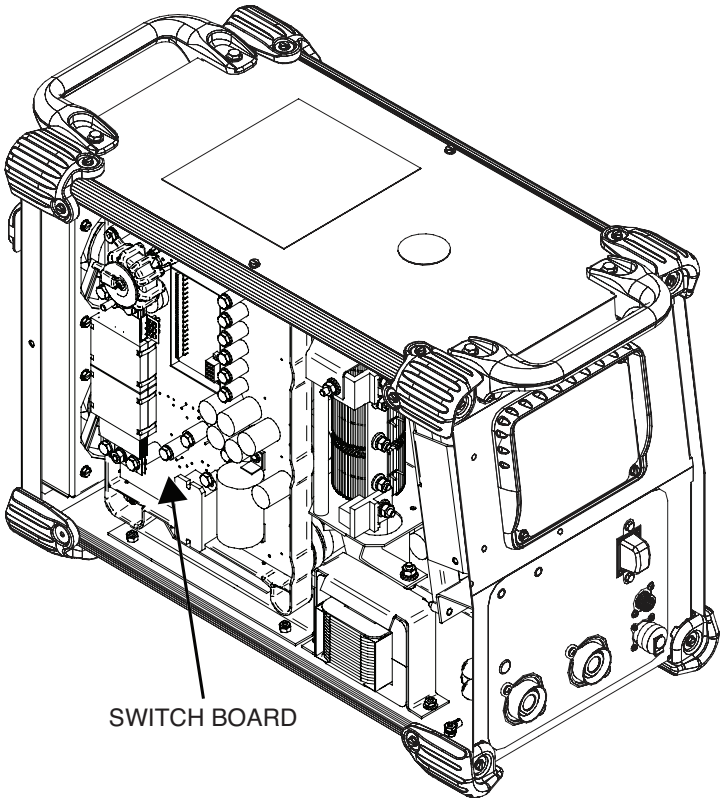
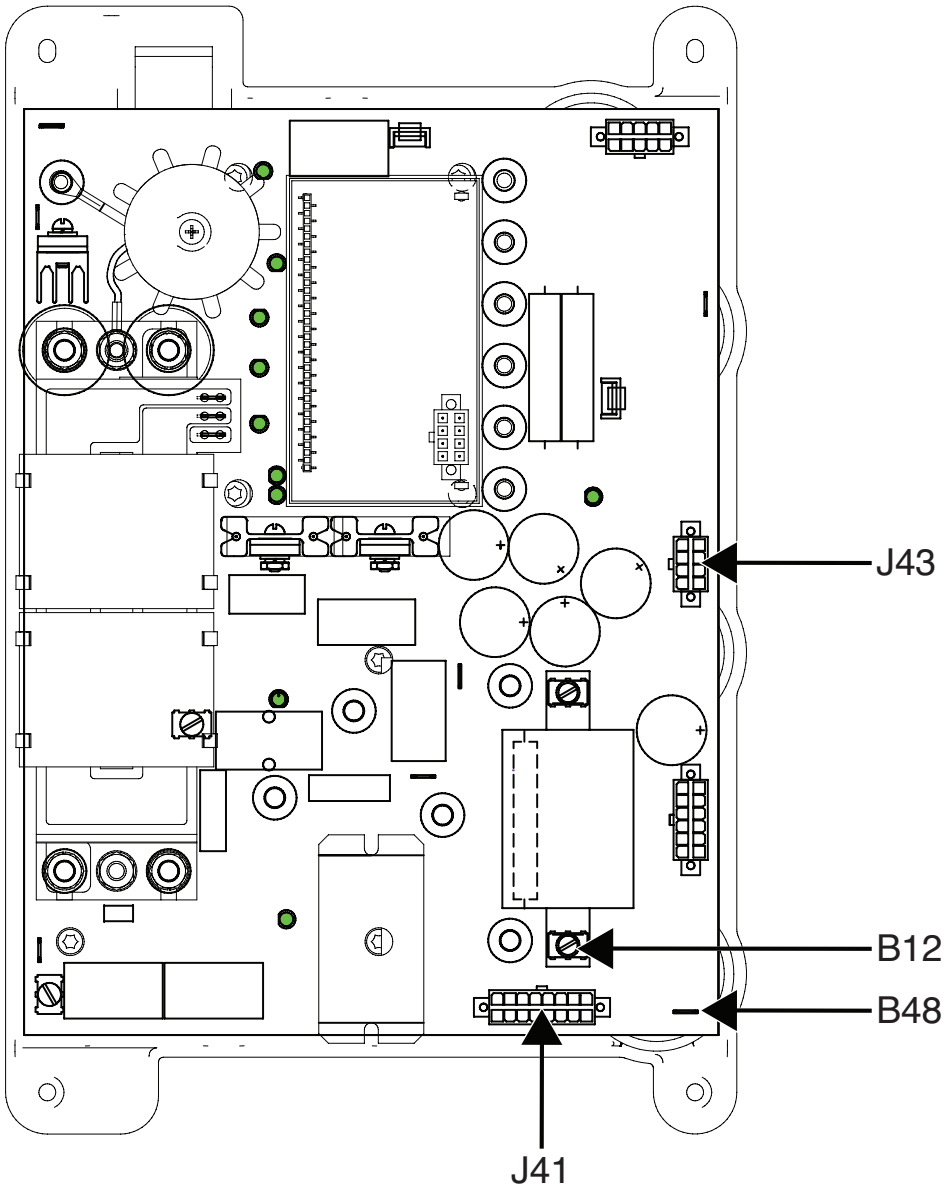


Figure F.7 – Switch board location



POWER FACTOR CORRECTION CONTROL BOARD TEST *(continued)*

Figure F.8 – Switch board test points



CONTROL BOARD TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

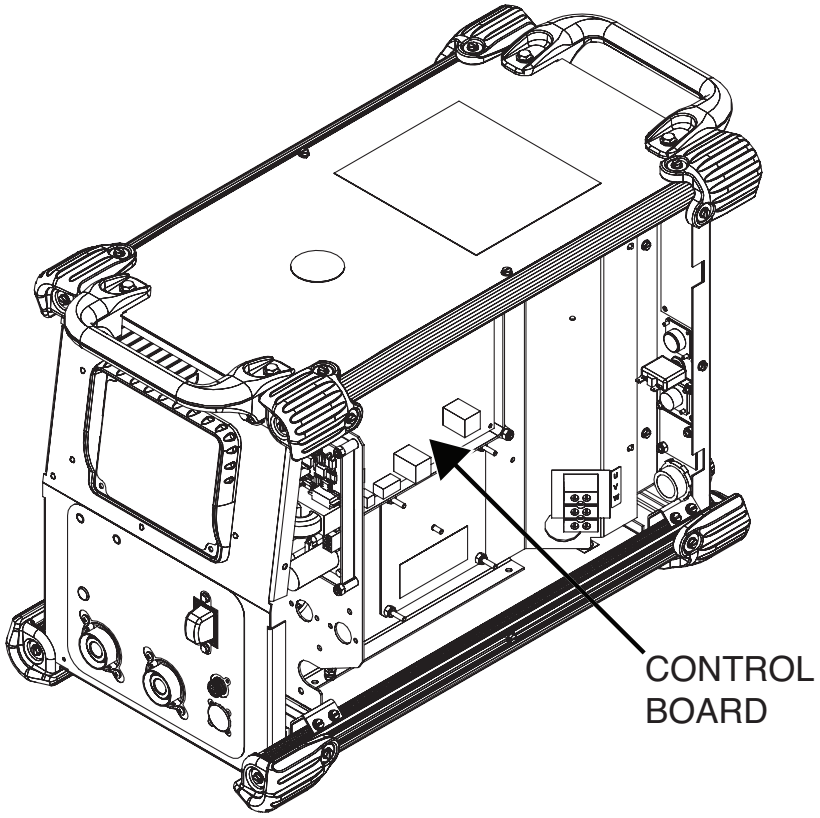
This test will help determine if the Control Board is receiving the correct supply voltages and creating the correct output voltages to various circuits. Also the LED's status chart will provide information as to the Control Board's functionality.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

CONTROL BOARD TEST *(continued)*

Figure F.9 – Control board location



PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the control board on the right side of the machine. See Figure F.9.
4. Carefully apply the correct input voltage to the Power Wave S350 machine.
5. For LEDs status and functions, see ***Figure F.10***. If Led #9 is green the proper input voltage is being applied to the control board. If LED #1 is green the control board's functioning status is "OK".
6. If further testing is required proceed to Step #7.
7. Using the voltmeter, carefully check the voltages per ***Table F.3***. See ***Figure F.11*** for test point locations and ***Figure F.12*** for lead locations. See Wiring Diagram.
8. Using the ohmmeter, check the resistances per ***Table F.4***. See ***Figure F.11*** for test point locations and ***Figure F.12*** for lead locations. See Wiring Diagram.
9. Remove the input power to the Power Wave S350 machine.
10. If any of these tests fail, perform the ***Control Board Removal And Replacement Procedure***.
11. Perform the ***Case Cover Replacement Procedure***.

CONTROL BOARD TEST *(continued)*

Table F.3 – Control board voltage tests

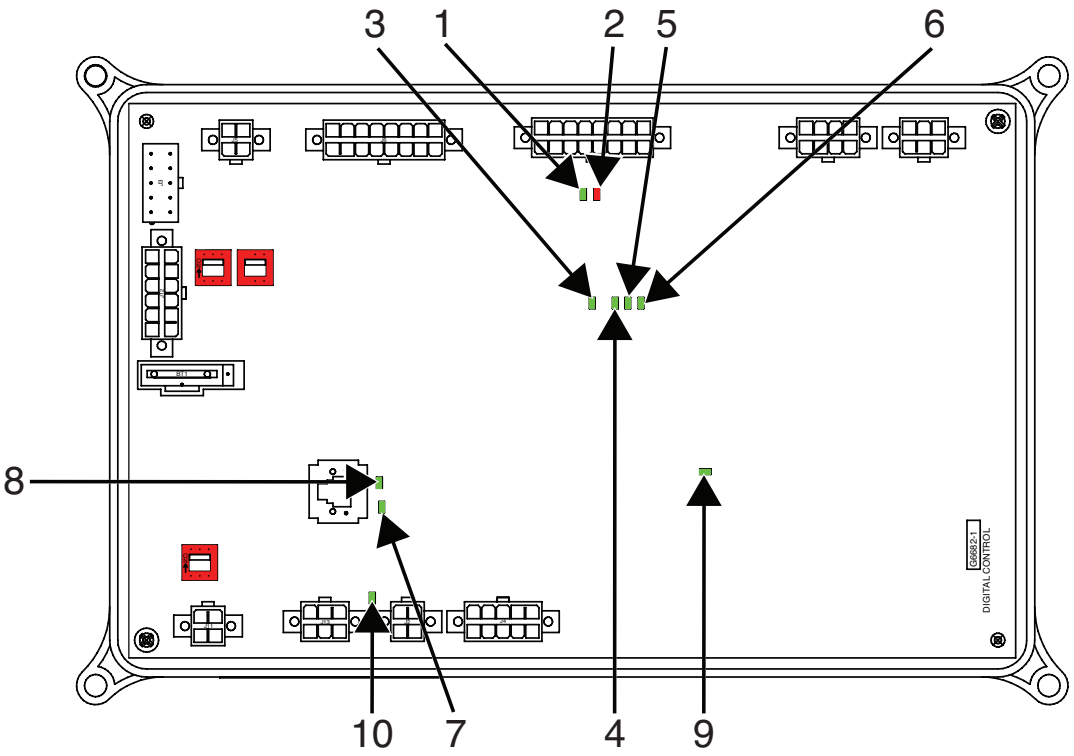
DESCRIPTION	TEST POINTS	LEAD NUMBERS	EXPECTED READING	CONDITIONS
INPUT SUPPLY TO BOARD	J4 PIN 2 TO J4 PIN 1	LEAD 356 (-) TO LEAD 358 (+)	+40 VDC	INPUT POWER APPLIED TO MACHINE.
POWER FROM CONTROL BOARD TO CHOPPER BOARD	J12 PIN 12 TO J12 PIN 3	LEAD 342 (-) TO LEAD 341 (+)	+5 VDC	INPUT POWER APPLIED TO MACHINE.
SECONDARY VOLTAGE FROM PFC BOARD	J6 PIN 10 TO J7 PIN 14	LEAD 404 (-) TO LEAD 406 (+)	+15 VDC	INPUT POWER APPLIED TO MACHINE.
FAN CONTROL SIGNAL	J7 PIN 16 TO J7 PIN 6	LEAD 350 (-) TO LEAD 355 (+)	0 VDC (LOW SPEED) 10 VDC (HIGH SPEED)	INPUT POWER APPLIED. OUTPUT ENABLED FOR HIGH FAN SPEED SIGNAL.
POWER SUPPLY TO CURRENT TRANSDUCER	J8 PIN 6 TO J8 PIN 2	LEAD 214 (-) TO LEAD 212 (+)	+15 VDC	INPUT POWER APPLIED TO MACHINE.
POWER SUPPLY TO CURRENT TRANSDUCER	J8 PIN 6 TO J8 PIN 3	LEAD 214 (-) TO LEAD 213 (+)	-15 VDC	INPUT POWER APPLIED TO MACHINE.
SUPPLY TO OPTIONAL SOLENOID	J4 PIN 10 TO J6 PIN 12	LEAD 553 (+) TO LEAD 554 (-)	+15 VDC	INPUT POWER APPLIED TO MACHINE. OUTPUT ENABLED.

Table F.4 – Control board associated resistance

DESCRIPTION	TEST POINTS	LEAD NUMBERS	EXPECTED READING	CONDITIONS
CONNECTION TO OUTPUT TERMINALS	J9 PIN 3 TO NEGATIVE OUTPUT TERMINAL	LEAD 202 TO NEGATIVE OUTPUT TERMINAL	ZERO OHMS	NO INPUT POWER APPLIED TO MACHINE.
	J9 PIN 1 TO POSITIVE OUTPUT TERMINAL	LEAD 206 TO POSITIVE OUTPUT TERMINAL	ZERO OHMS	
CONNECTIONS TO NORMALLY CLOSED THERMOSTAT	J5 PIN 2 TO J5 PIN 3	LEAD 410 TO LEAD 409	ZERO OHMS	NO INPUT POWER APPLIED TO MACHINE.

CONTROL BOARD TEST *(continued)*

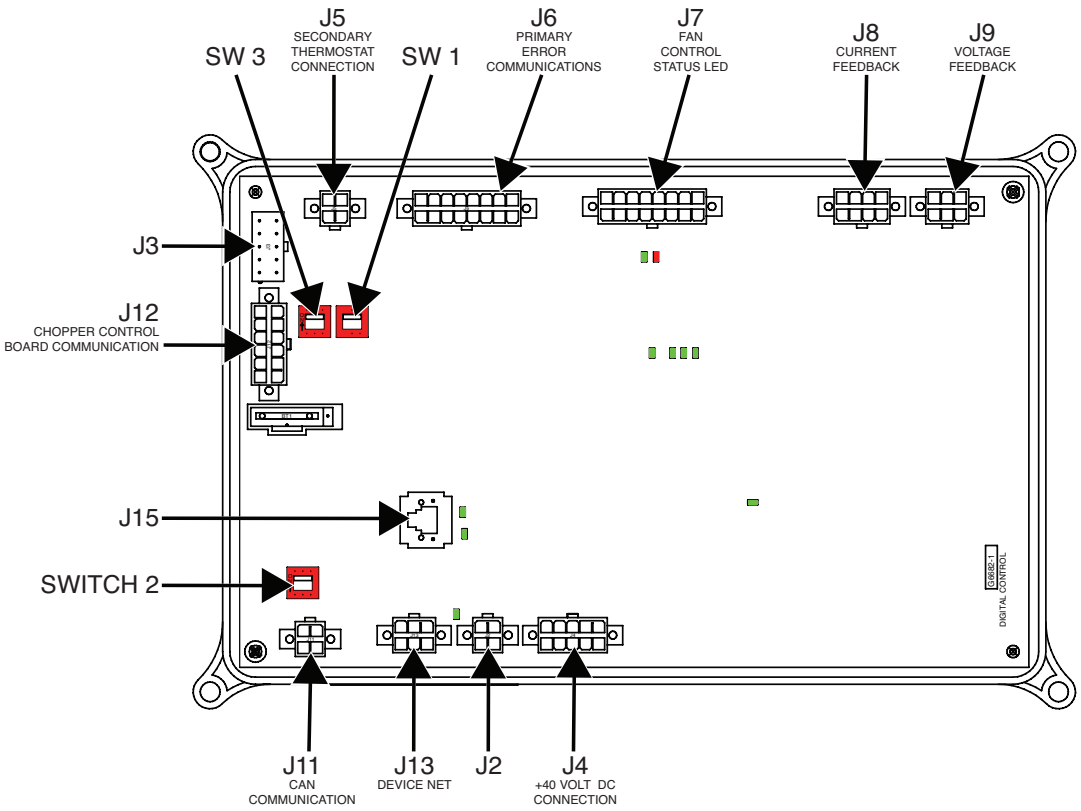
Figure F.10 – Control board LED locations



G6682 CONTROL P.C. BOARD LED'S		
LED #	**COLOR**	**FUNCTION**
1	GREEN	STATUS "OK"
2	RED	STATUS "ERROR" (CHECK CODE FOR SPECIFIC ERROR)
3	GREEN	OUTPUT ENABLE
4	GREEN	SINGLE PHASE DETECT
5	GREEN	67 SENSE (ELECTRODE)
6	GREEN	21 SENSE (WORK)
7	GREEN	ETHERNET STATUS
8	GREEN	ETHERNET SPEED STATUS
9	GREEN	INPUT SUPPLY 30 VDC TO 55 VDC
10	GREEN	DEVICENET EXTERNAL 24VDC PRESENT

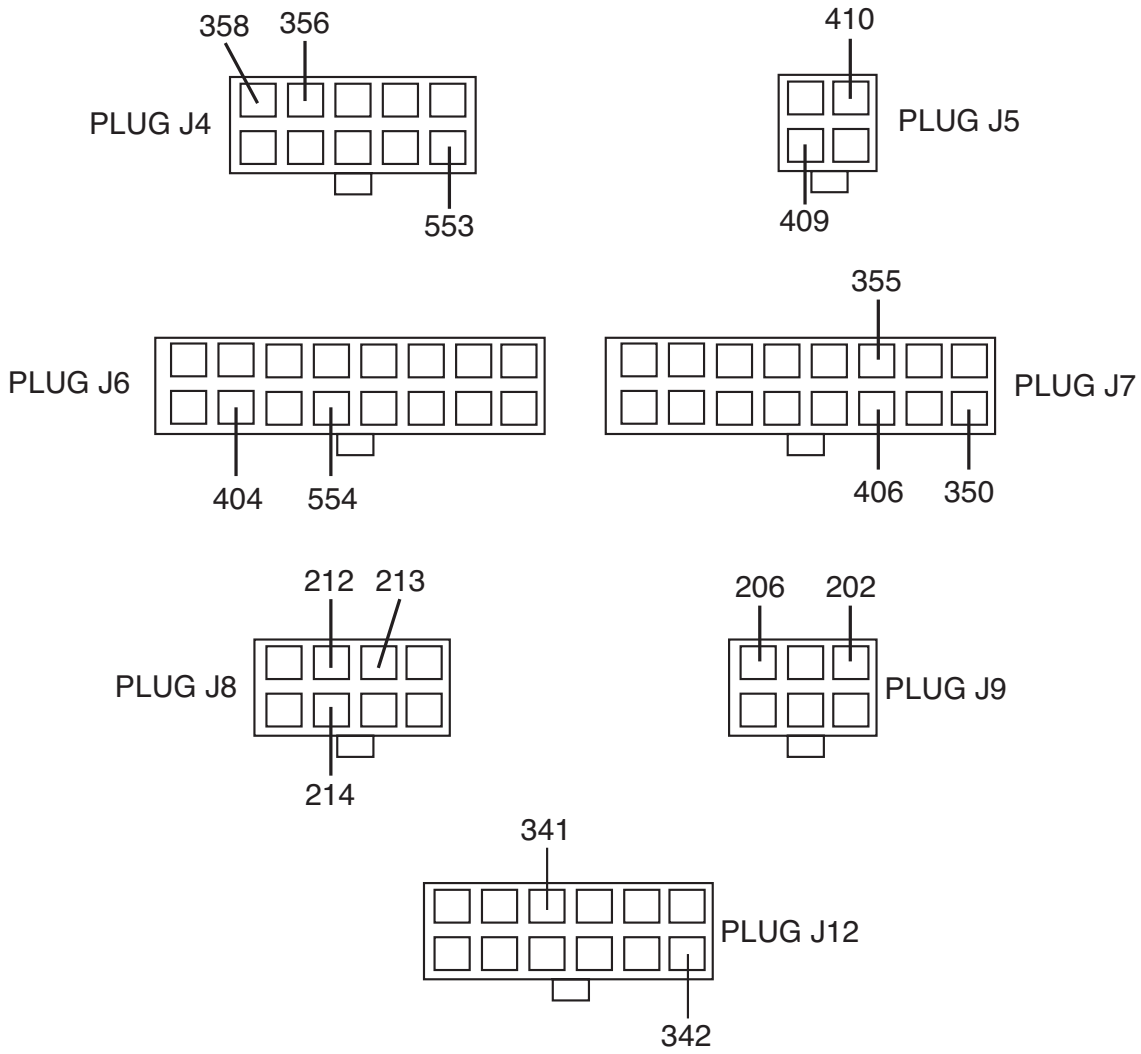
CONTROL BOARD TEST *(continued)*

Figure F.11 – Control board test point locations



CONTROL BOARD TEST *(continued)*

Figure F.12 – Control board plug and lead locations



SWITCH BOARD TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

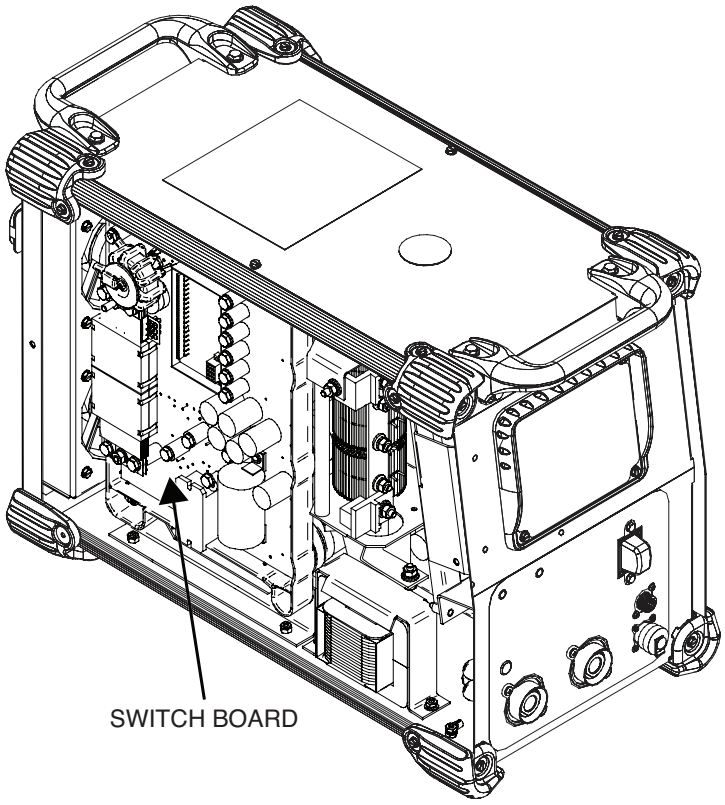
This test will help determine if the Switch Board is receiving the correct voltages and also if the Switch Board is functioning properly. The Switch Board has many functions and components. Testing of the Planar Transformer, the Input Rectifier and the Output Diodes are addressed with individual testing procedures. See the Troubleshooting and Repair Section Table of Contents.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
7/16” Wrench
Wiring Diagram

SWITCH BOARD TEST *(continued)*

Figure F.13 – Switch board location



PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the switch board on the left side of the machine. See Figure F.13.
4. Carefully apply the correct input power to the Power Wave S350. Check the LEDs per ***Table F.5***. See ***Figure F.14*** for LED locations.
5. If the LEDs are not indicating a properly functioning switch board (per ***Table F.5***) proceed with the following steps.
6. Using a volt/ohmmeter, check the voltages per ***Table F.6***. See ***Figure F.15***, for test point locations. See Wiring Diagram.
7. Using a volt/ohmmeter, check the switch board resistances per ***Table F.7***. See ***Figure F.15***, for test point locations. See Wiring Diagram.
8. If any of the test results are not correct, perform the ***Switch Board Removal And Replacement Procedure***.
9. Replace all previously removed plugs and leads.
10. Perform the ***Case Cover Replacement Procedure***.

SWITCH BOARD TEST *(continued)*

Figure F.14 – Switch board LED locations

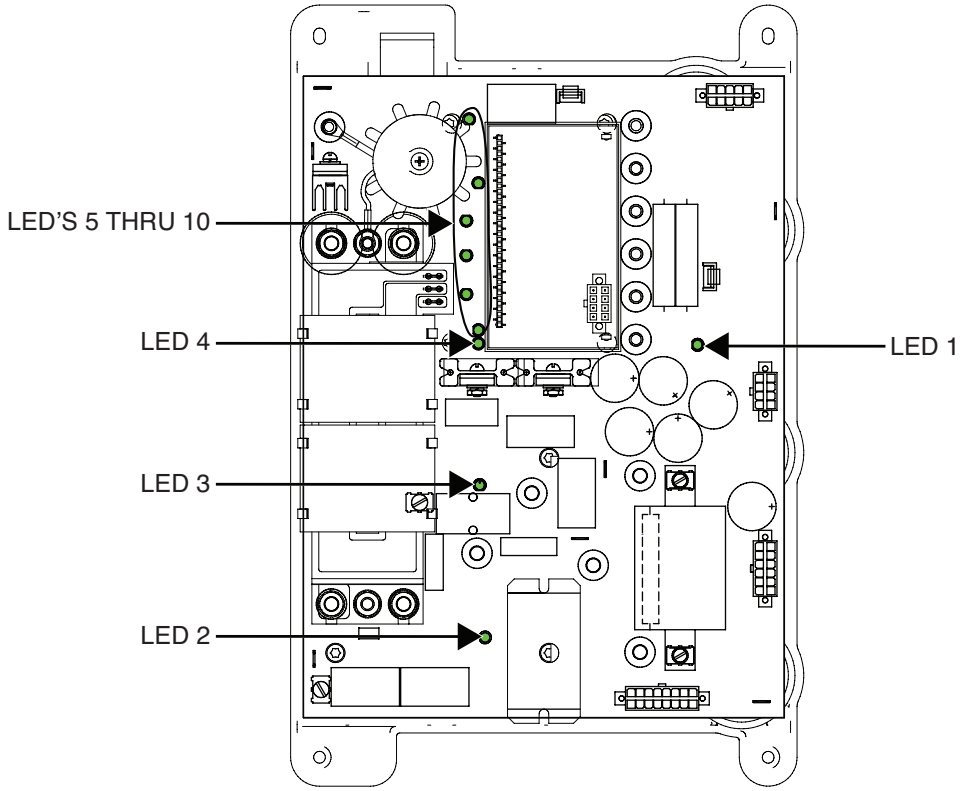


Table F.5 – Switch board LED's

DESCRIPTION	INDICATES	LIGHT	CONDITIONS
LED 1	+48 VDC SUPPLY	ON	POWER APPLIED TO POWER WAVE S350
LED 4	+15 VDC SUPPLY	ON	POWER APPLIED TO POWER WAVE S350
LED 3	BOOST CIRCUIT ACTIVE	ON*	* WHEN HIGH INPUT VOLTAGE IS APPLIED (460 AND HIGHER) LED 3 MAY BE VERY DIM OR OFF.
LED 2	BUCK CIRCUIT ACTIVE	ON**	** BRILLIANCE MAY VARY WITH LOAD.
LED's 5 THRU 10	CHOPPER IGBTs ACTIVATED	ON***	*** BRILLIANCE WILL VARY WITH LOAD AND OUTPUT.

LED'S 5 Thru 10

These six LED's are used to indicate a turn-on of a chopper phase. Intensity of each LED is related to the on-time of each of the IGBT's .

LED 4

+15 Volt DC power supply for secondary control circuits.

LED 1

+48 Volt DC auxiliary power supply indicator.

LED 3

Boost IGBT drive.

LED 2

Buck IGBT drive.

SWITCH BOARD TEST *(continued)*

Table F.6 – Switch board voltage measurements

DESCRIPTION	TEST POINTS	EXPECTED READING	CONDITIONS
PRE-CHARGE RELAY COIL VOLTAGE	PLUG J41 PIN 6 (-) TO PLUG J41 PIN 5 (+)	15 VDC	CORRECT INPUT POWER APPLIED TO MACHINE AND PRE-CHARGE COMPLETED. IF NOT CORRECT PERFORM THE ***POWER FACTOR CORRECTION CONTROL BOARD TEST***. SEE WIRING DIAGRAM.
400 VDC FROM BUCK/BOOST AND DC LINK CAPACITOR	B48 (+) TO B49 (-)	400 VDC	CORRECT INPUT POWER APPLIED TO MACHINE AND PRE-CHARGE COMPLETED. IF NOT CORRECT PERFORM THE ***INPUT RECTIFIER TEST***.
48 VAC FROM THE PLANAR TRANSFORMER WINDING	B7 TO B9 ALSO B7 TO B8	50 VAC	CORRECT INPUT POWER APPLIED TO MACHINE AND PRE-CHARGE COMPLETED. IF NOT CORRECT PERFORM THE ***PLANAR TRANSFORMER TEST***.
100 VAC FROM PLANAR TRANSFORMER WINDING	B38 TO B40	100 VAC	CORRECT INPUT POWER APPLIED TO MACHINE AND PRE-CHARGE COMPLETED. IF NOT CORRECT PERFORM THE ***PLANAR TRANSFORMER TEST***.
100 VDC FROM OUTPUT RECTIFIER	B52 (-) TO B51 (+)	100 VDC	CORRECT INPUT POWER APPLIED TO MACHINE AND PRE-CHARGE COMPLETED. IF NOT CORRECT PERFORM THE ***OUTPUT RECTIFIER TEST***.

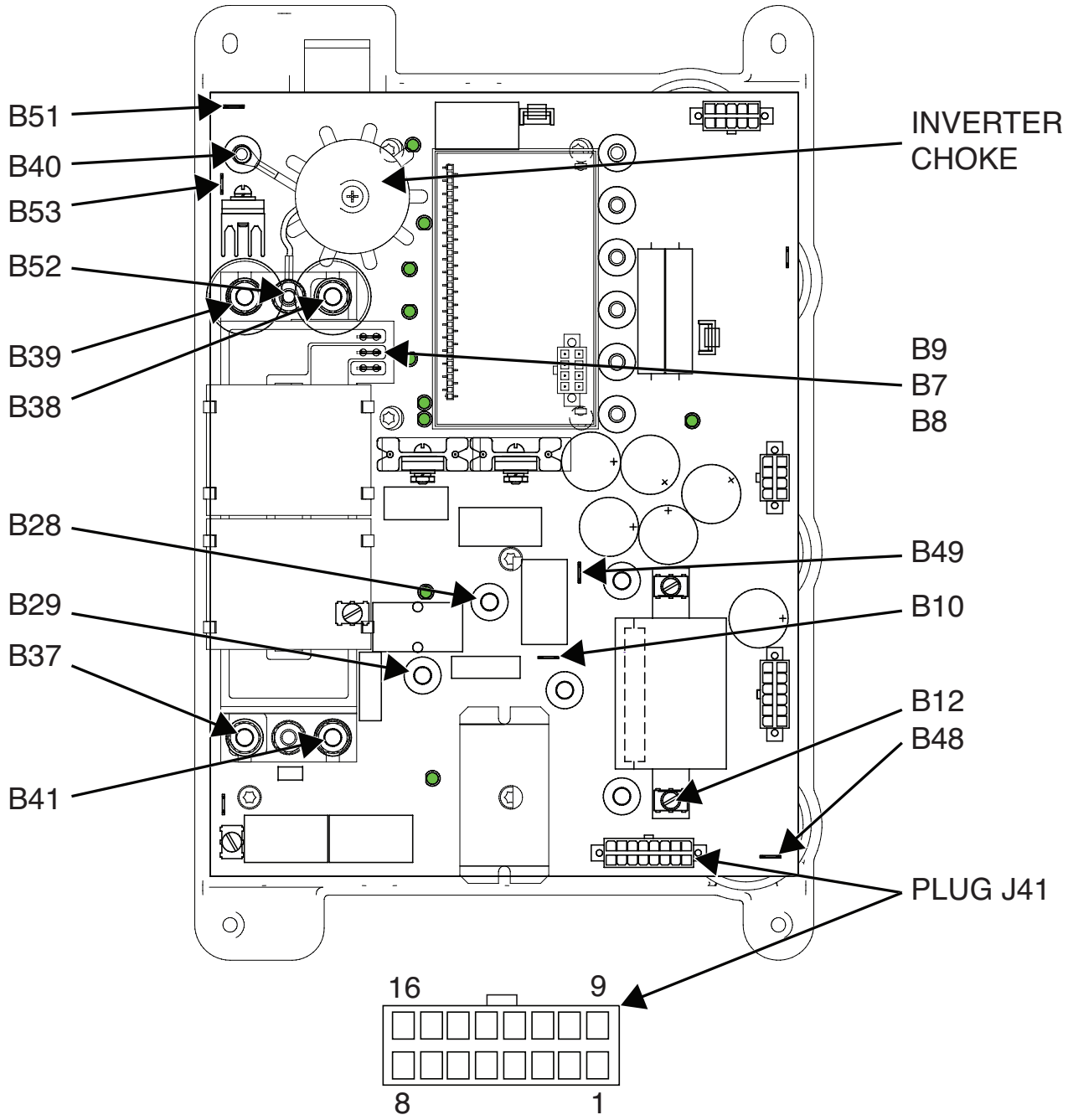
SWITCH BOARD TEST *(continued)*

Table F.7 – Switch board resistance measurements

DESCRIPTION	METER TEST POINTS AND POLARITY	EXPECTED READINGS	CONDITIONS
100 OHM PRE-CHARGE RESISTOR	B10 (+) TO B12 (-)	100 OHM	MACHINE “OFF” NO INPUT POWER APPLIED.
PRE-CHARGE RELAY COIL RESISTANCE	J41 PIN 5 (+) RECEPTACLE ON SWITCH BOARD TO J41 PIN 6 (-) RECEPTACLE ON SWITCH BOARD	15,000 TO 30,000 OHMS DEPENDANT ON METER BEING USED. TWO DIODES ARE IN THE CIRCUIT PATH TO THE RELAY COIL.	MACHINE “OFF” NO INPUT POWER APPLIED. PLUG J41 REMOVED FROM THE SWITCH BOARD.
“BUCK” CONVERTER IGBTs	B12 (+) TO B28 (-)	HIGH RESISTANCE. GREATER THAN 100,000 OHMS. TYPICAL FAILURE IS A “SHORT”.	MACHINE “OFF” NO INPUT POWER APPLIED. THE INPUT CHOKE DISCONNECTED FROM THE SWITCH BOARD B28.
“BUCK” CONVERTER DIODE	B28 (+) TO B49 (-)	HIGH RESISTANCE. GREATER THAN 100,000 OHMS. TYPICAL FAILURE IS A “SHORT”.	MACHINE “OFF” NO INPUT POWER APPLIED. THE INPUT CHOKE DISCONNECTED FROM THE SWITCH BOARD B28.
“BOOST” CONVERTER IGBTs	B29 (+) TO B49 (-)	HIGH RESISTANCE. GREATER THAN 10,000 OHMS. TYPICAL FAILURE IS A “SHORT”.	MACHINE “OFF” NO INPUT POWER APPLIED. THE INPUT CHOKE DISCONNECTED FROM THE SWITCH BOARD B28.
“BOOST” CONVERTER DIODE	B48 (+) TO B29 (-)	HIGH RESISTANCE. GREATER THAN 10,000 OHMS. TYPICAL FAILURE IS A “SHORT”.	MACHINE “OFF” NO INPUT POWER APPLIED. THE INPUT CHOKE DISCONNECTED FROM THE SWITCH BOARD B28.
FULL BRIDGE HIGH SIDE IGBTs	B48 (+) TO B37 (-) ALSO B48 (+) TO B41 (-)	HIGH RESISTANCE. GREATER THAN 10,000 OHMS. TYPICAL FAILURE IS A “SHORT”.	MACHINE “OFF” NO INPUT POWER APPLIED. THE PLANAR TRANSFORMER ELECTRICALLY ISOLATED FROM THE SWITCH BOARD AT TEST POINTS B37 AND B41.
FULL BRIDGE LOW SIDE IGBTs	B37 (+) TO B49 (-) ALSO B41 (+) TO B49 (-)	HIGH RESISTANCE. GREATER THAN 10,000 OHMS. TYPICAL FAILURE IS A “SHORT”.	MACHINE “OFF” NO INPUT POWER APPLIED. THE PLANAR TRANSFORMER ELECTRICALLY ISOLATED FROM THE SWITCH BOARD AT TEST POINTS B37 AND B41.

SWITCH BOARD TEST *(continued)*

Figure F.15 – Switch board test points



OPTIONAL USER INTERFACE BOARD TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the Optional User Interface Board is functional.

MATERIALS NEEDED

5/16” Nutdriver
Volt/Ohmmeter (Multimeter)
Wiring Diagram

OPTIONAL USER INTERFACE BOARD TEST *(continued)*

Table F.8 – Description of LED functions

OPTIONAL USER INTERFACE BOARD		
LED #	**COLOR**	**FUNCTION**
2	RED	PROCESS SELECT
3	RED	WAVE CONTROL SELECT
6	RED	PRE-WELD SELECT
7	RED	POST-WELD SELECT
9	RED	SETUP MENU ENABLED
10	RED	THERMAL FAULT MEASURED
11	RED	WIRE FEED SPEED SELECT
12	RED	AMPS SELECT
13	RED	VOLTS SELECT
14	RED	TRIM SELECT

PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Using a 5/16” nutdriver, remove the four screws securing the front display panel, to gain access to the optional user interface board test points. Carefully remove the optional user interface board leaving the four pin connector in place.
3. Carefully apply the correct input power to the Power Wave S350 machine.
4. If the displays illuminate, on the front of the machine, the user interface board is receiving the correct input voltage (40VDC).
5. See Table F.8 and ***Figure F.16***, for the description of the LED functions on the user interface board.
6. If the displays do not illuminate, carefully check to make sure the user interface board is receiving the correct input supply voltage. See ***Figure F.17***. See the Wiring Diagram. If the supply voltage (40VDC) is present and the user interface board **does not** illuminate up, the board may be faulty. If the correct supply voltage is not present, proceed to the next step.
7. Remove the input power to the Power Wave S350 machine.
8. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
9. Using a volt/ohmmeter, check the continuity of the supply leads (51D and 52D) between Plug J31 on the user interface board and Plug J47 on the DC bus board. See ***Figure F.17***. See Wiring Diagram.
10. Using a volt/ohmmeter, check the continuity of the CAN communication leads (153D and 154D) between Plug J31 and Plug J11 on the power factor correction control board. See Wiring Diagram.
11. Make sure the green ground lead is securely connected to the user interface board. See Wiring Diagram.
12. Replace any previously removed plugs and P.C. Boards.
13. Using a 5/16” nutdriver, attach the four screws securing the front display panel.
14. If any of the tests fail, replace the optional user interface board.
15. Perform the ***Case Cover Replacement Procedure***.

OPTIONAL USER INTERFACE BOARD TEST *(continued)*

Figure F.16 – User interface front view (G4760 series)

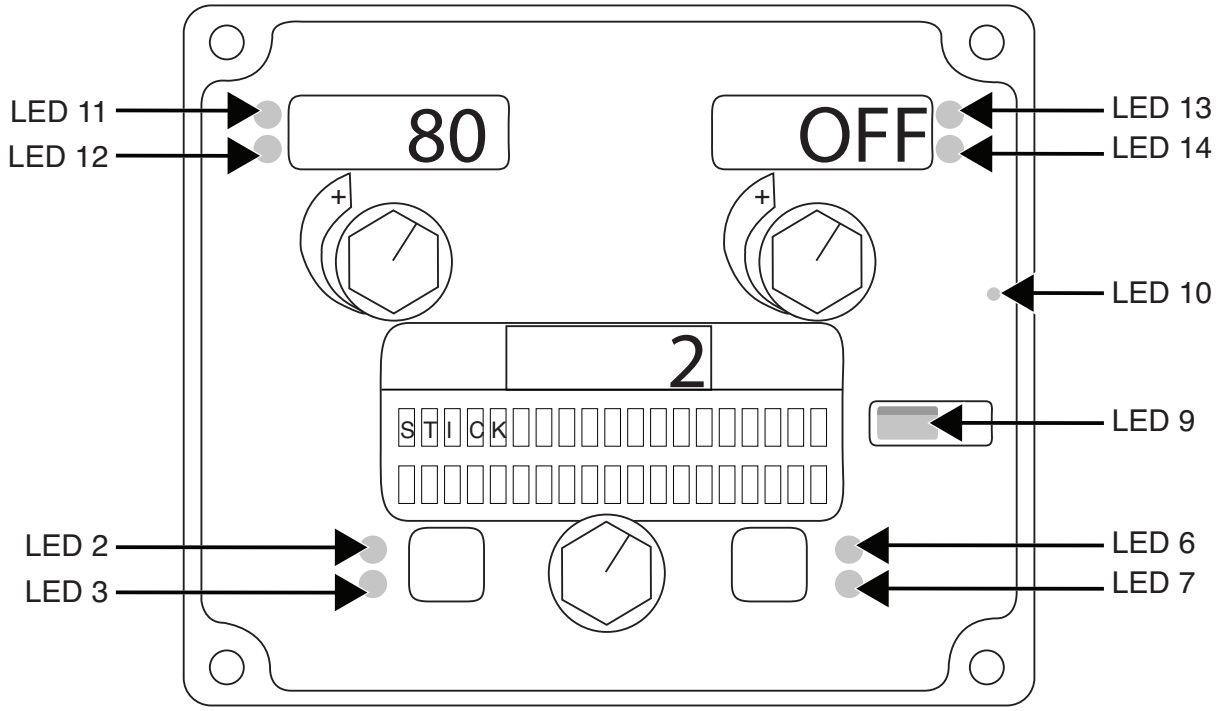
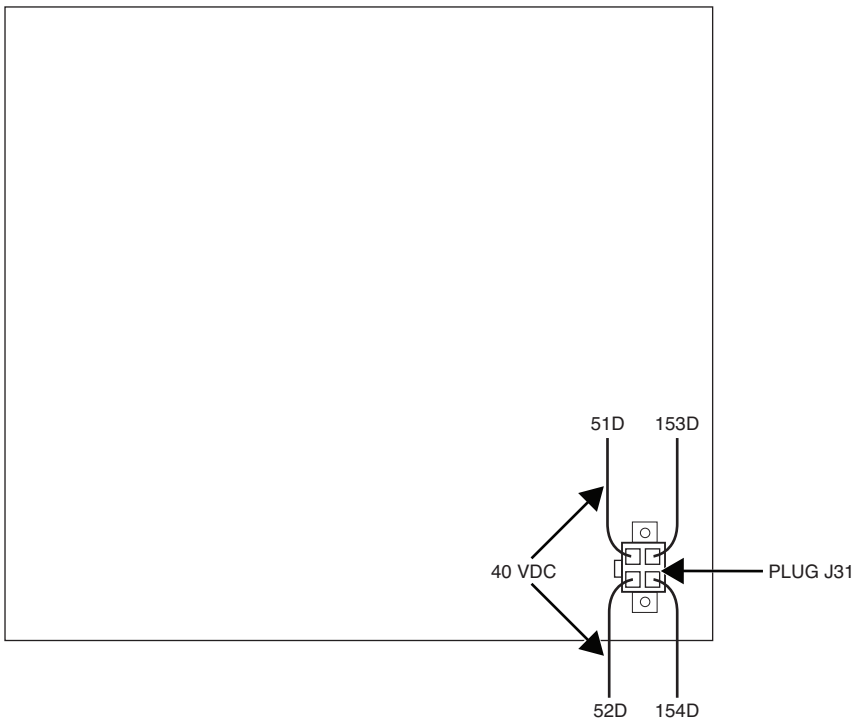


Figure F.17 – Plug J31 location on user interface board (rear view)



NOTE: LEADS CONNECT TO USER INTERFACE HARNESS.
(4 PIN CONNECTION TO 6 PIN CONNECTION)

INPUT RECTIFIER TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

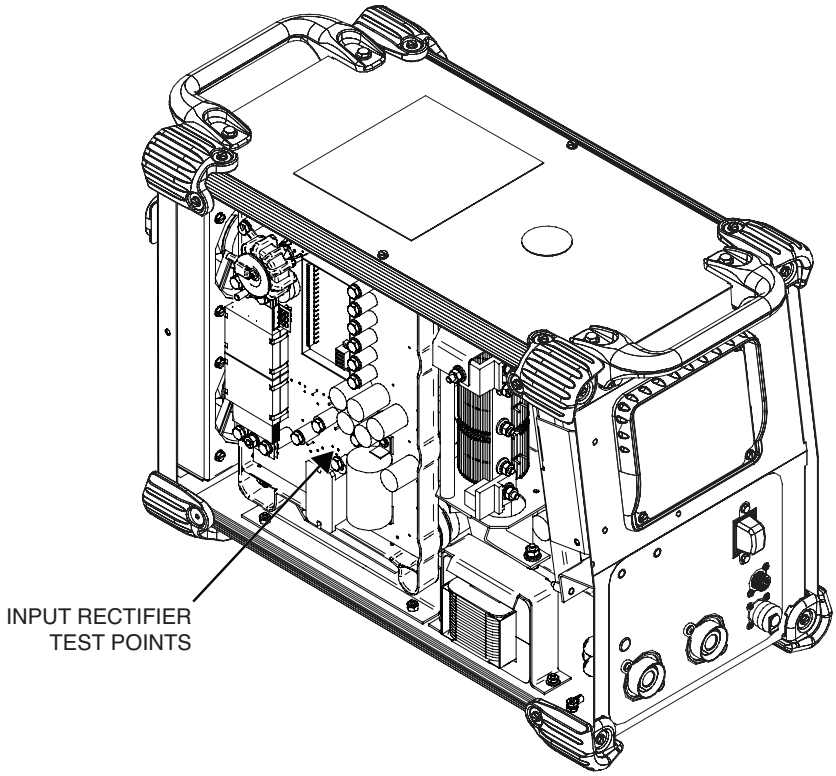
This test will help determine if the Input Rectifier has “shorted” or “open” diodes.

MATERIALS NEEDED

Digital Volt/Ohmmeter (DVM)
Wiring Diagram

INPUT RECTIFIER TEST *(continued)*

Figure F.18 – Input rectifier location



PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the input rectifier and associated leads. See Figure F.18 and ***Figure F.19***. See Wiring Diagram.
4. Using a digital voltmeter (DVM) set to diode test mode, perform the tests detailed in ***Table F.9***. See Wiring Diagram.
5. If the input rectifier does not meet the expected readings, perform the ***Switch Board Removal And Replacement Procedure***.
6. Perform the ***Case Cover Replacement Procedure***.

INPUT RECTIFIER TEST *(continued)*

Figure F.19 – Input rectifier lead locations

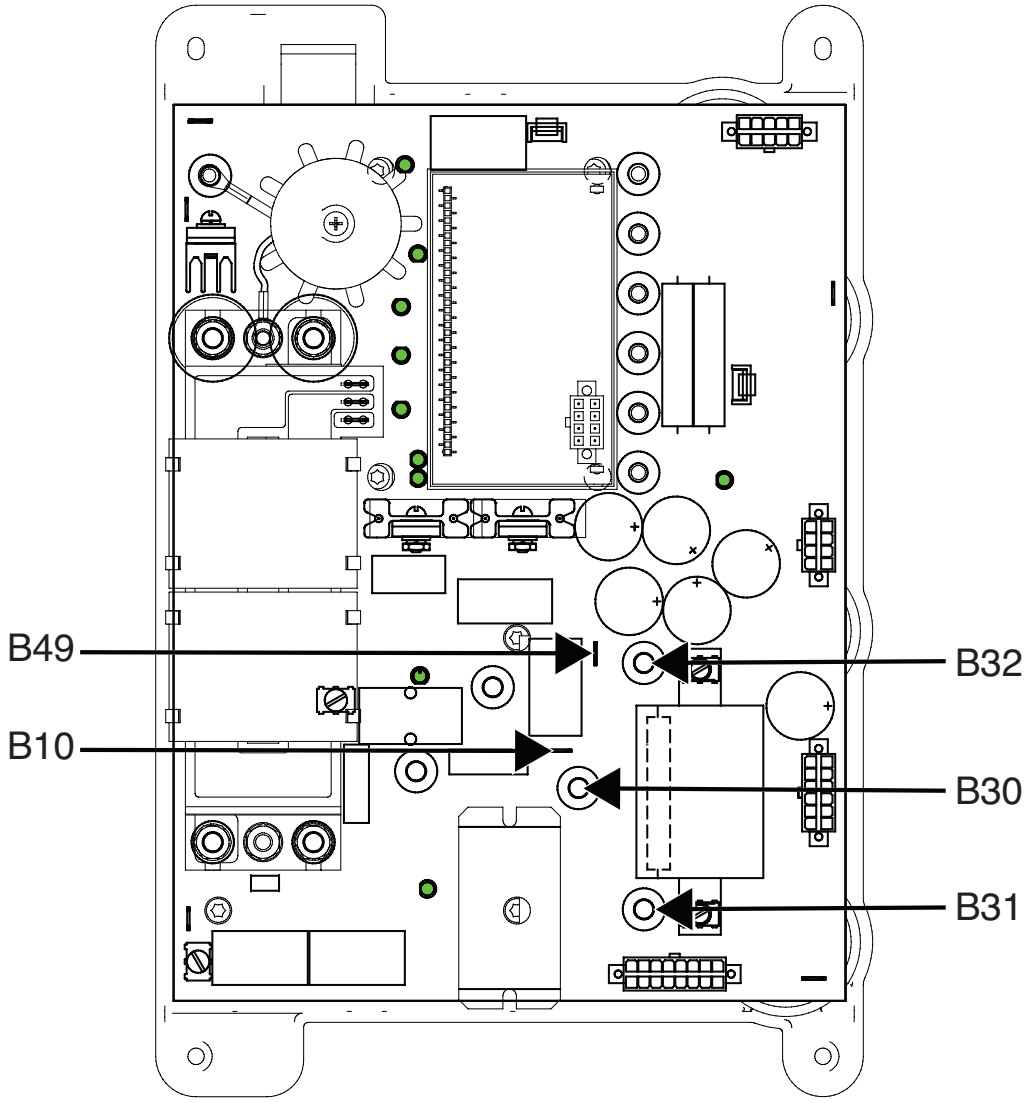


Table F.9 – Probe readings

+PROBE (RED)	-PROBE (BLACK)	RESULT
TERMINAL B32	TERMINAL B10	0.3V - 1.0V
TERMINAL B31	TERMINAL B10	0.3V - 1.0V
TERMINAL B30	TERMINAL B10	0.3V - 1.0V
TERMINAL B49	TERMINAL B32	0.3V - 1.0V
TERMINAL B49	TERMINAL B31	0.3V - 1.0V
TERMINAL B49	TERMINAL B30	0.3V - 1.0V

PLANAR TRANSFORMER RESISTANCE TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

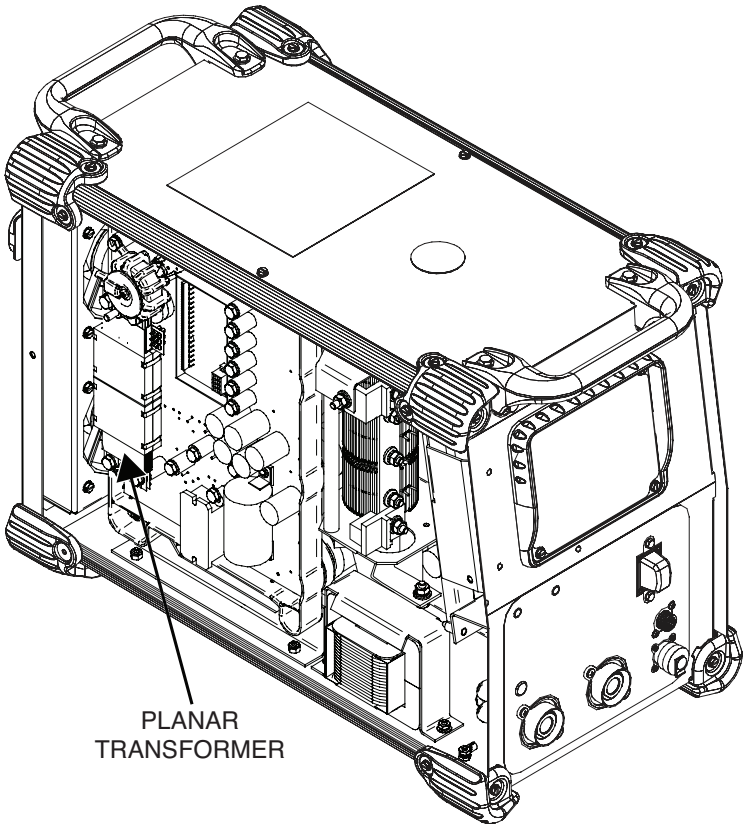
This test will help determine if the Planar Transformer Windings are good and not shorted to each other or to ground.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

PLANAR TRANSFORMER RESISTANCE TEST *(continued)*

Figure F.20 – Planar transformer location



PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the planar transformer. See Figure F.20.
4. See ***Figure F.21*** for test point locations. See Wiring Diagram.
5. Using the ohmmeter, check the resistances per ***Table F.10***. See Wiring Diagram.
6. If the resistances are correct per ***Table F.10*** then the planar transformer is OK.
7. If any of the tests fail, perform the ***Switch Board Removal And Replacement Procedure***.
8. Perform the ***Case Cover Replacement Procedure***.

PLANAR TRANSFORMER RESISTANCE TEST *(continued)*

Figure F.21 – Planar transformer test points

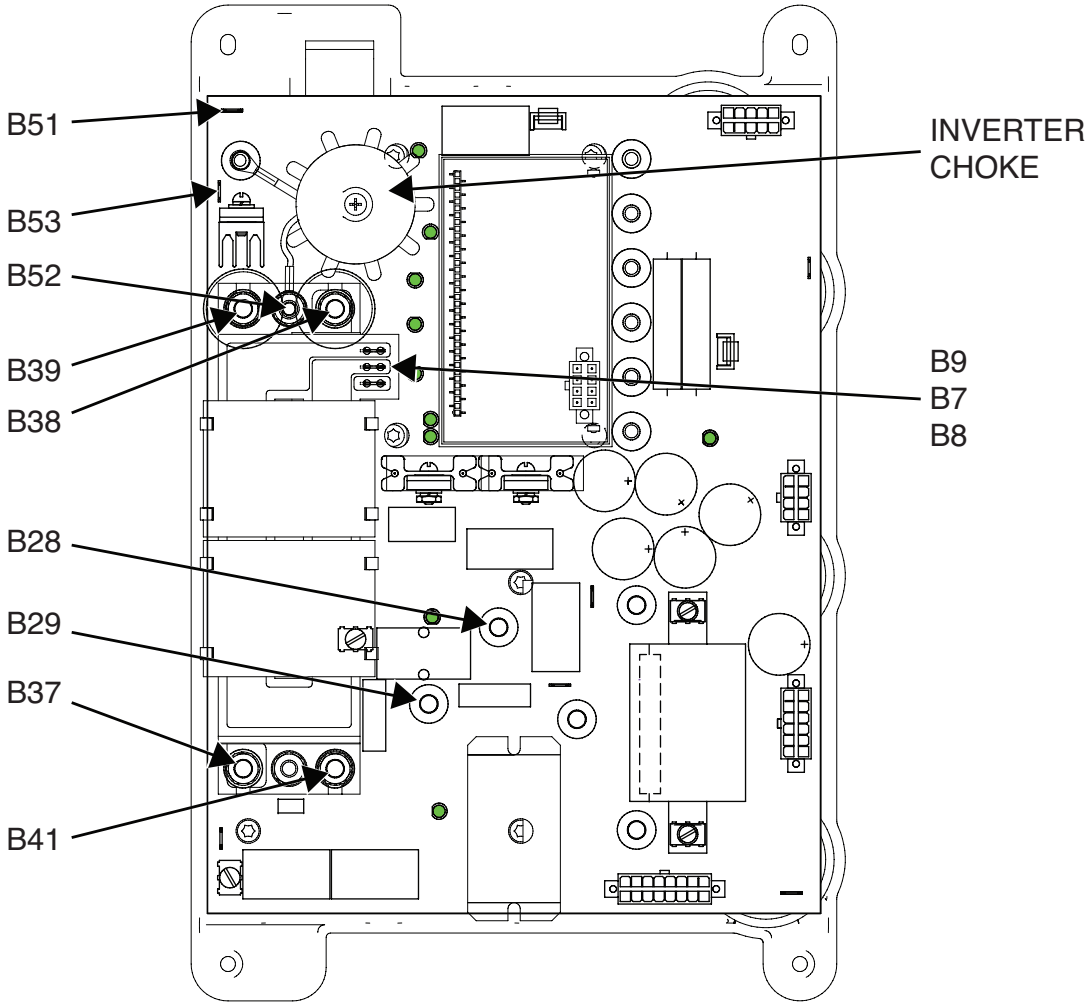


Table F.10 – Planar transformer resistance checks

TEST POINTS	EXPECTED RESISTANCE	COMMENTS
B37 TO B41	ZERO OHMS	CONTINUITY OF PRIMARY WINDING.
B39 TO B40	ZERO OHMS	CONTINUITY OF 1/2 OF SECONDARY WINDING.
B40 TO B38	ZERO OHMS	CONTINUITY OF 1/2 OF SECONDARY WINDING.
B8 TO B7	ZERO OHMS	CONTINUITY OF 1/2 OF 48V WINDING.
B7 TO B9	ZERO OHMS	CONTINUITY OF 1/2 OF 48V WINDING.
B37 TO B40	INFINITY	ISOLATION BETWEEN PRIMARY AND SECONDARY WINDING.
B37 TO B7	INFINITY	ISOLATION BETWEEN PRIMARY AND 48V WINDING.
B40 TO B7	INFINITY	ISOLATION BETWEEN SECONDARY AND 48V WINDINGS.
ALL TEST POINTS TO CHASSIS GROUND	INFINITY	ISOLATION FROM ALL WINDINGS TO CHASSIS GROUND.

OUTPUT RECTIFIER TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

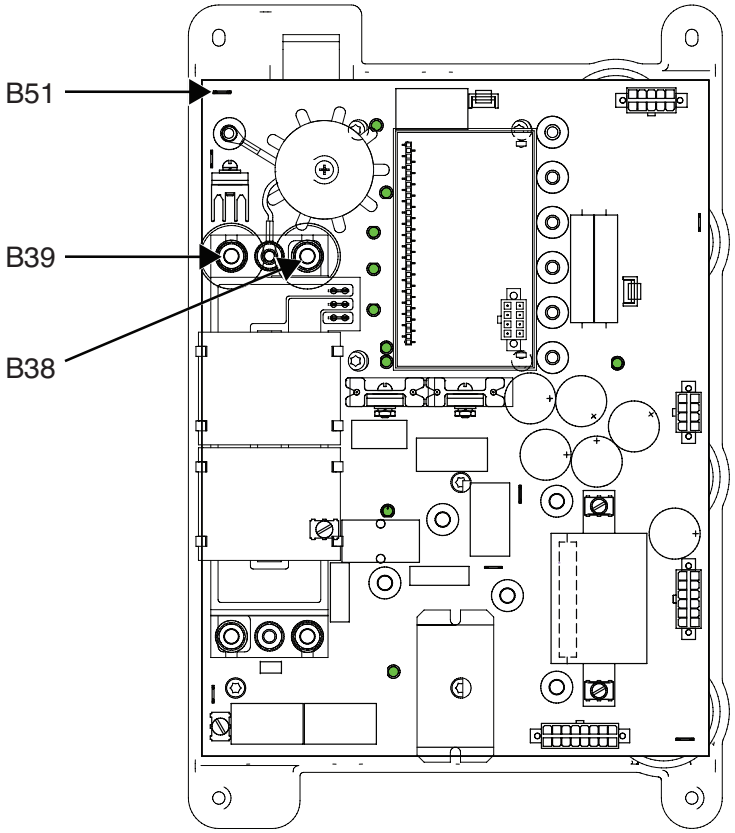
This test will determine if the Output Rectifier is “open” or “shorted”.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

OUTPUT RECTIFIER TEST *(continued)*

Figure F.22 – Output rectifier test points



PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate test points B51, B38 and B39. See Figure F.22. See Wiring Diagram.
4. Disconnect lead #207 from the 200 ohm 100 watt output resistor. See Wiring Diagram.
5. Using the ohmmeter, check the resistances from B51 to B38/B39. Polarity of the ohmmeter is important. See Wiring Diagram.
6. With the positive meter probe on B51 and the negative meter probe on B38/B39 the resistance reading should be very high. See Wiring Diagram.
7. With the positive meter probe on B38/B39 and the negative probe on B51 the resistance reading should be very low. Thus a forward diode drop. See Wiring Diagram.
8. If the meter readings indicate a very low resistance in both directions, the output rectifier may be shorted.
9. If the meter readings indicate a very high resistance in both directions, the output rectifier may be open.
10. If the output rectifier is faulty, the entire switch board must be replaced.
11. If faulty, perform the ***Switch Board Removal And Replacement Procedure***.
12. Connect the previously removed lead #207 to the 200 ohm 100 watt output resistor. See Wiring Diagram.
13. Perform the ***Case Cover Replacement Procedure***.

CURRENT TRANSDUCER TEST

⚠ WARNING

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If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the Current Transducer and associated wiring is functioning correctly.

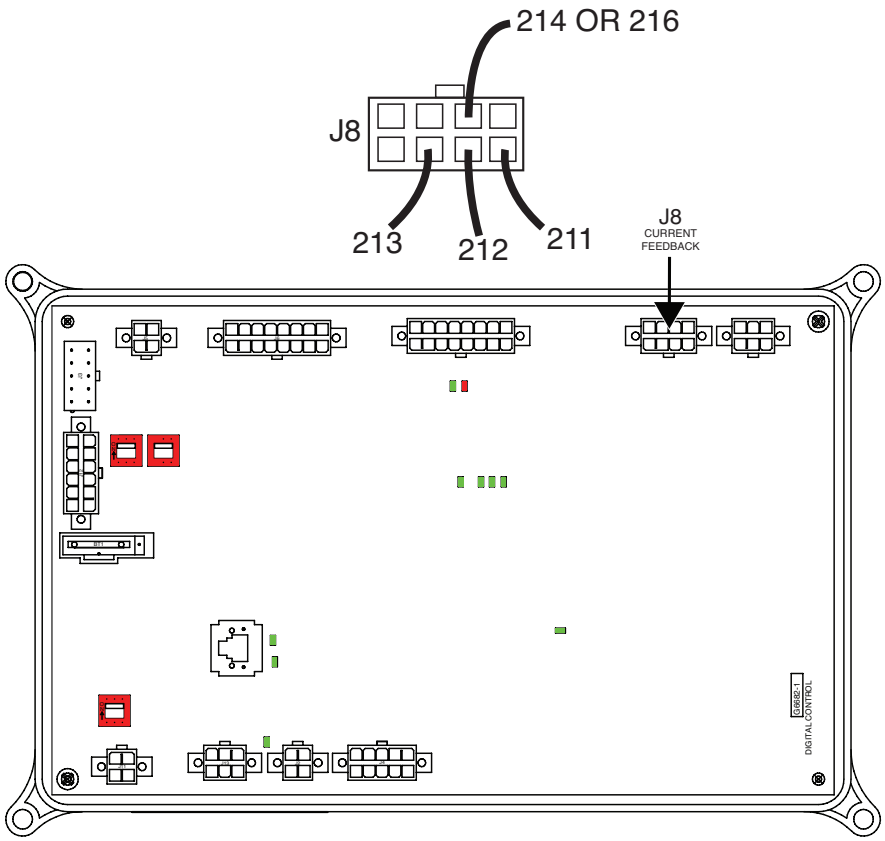
MATERIALS NEEDED

Laptop Computer
Diagnostic Utilities Software
Ethernet Cross Connect Cable (LE Co.#M19969-7)
Resistive Load Bank (Optional 50 ft. 4/0 Weld Cable)
Calibrated Ammeter
Volt/Ohmmeter
Wiring Diagram

NOTE: The Diagnostic Utility Software is on the Utilities Disc that was shipped with the machine. It can also be accessed from the Lincoln Service Navigator or down-loaded from the “web” at www.Powerwavemanager.com.

CURRENT TRANSDUCER TEST *(continued)*

Figure F.23 – Plug locations on control board



PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate plug J8 on the control board. See Figure F.23. To gain access to the control board remove the right case side.
4. Locate the current transducer. See ***Figure F.24***.
5. Carefully apply the correct input power to the Power Wave S350.
6. Check for the correct DC supply voltage to the current transducer. See Figure F.23 for Plug J8. See Wiring Diagram.
   A. Pin 2 (lead 212+) to Pin 6 (lead 214- or 216) should read +15VDC.
   B. Pin 3 (lead 213-) to pin 6 (lead 214+ or 216) should read -15VDC.

NOTE: Do not attempt to check the voltages at the current transducer connector. The terminals are small and delicate and may be damaged if probed with meter leads.

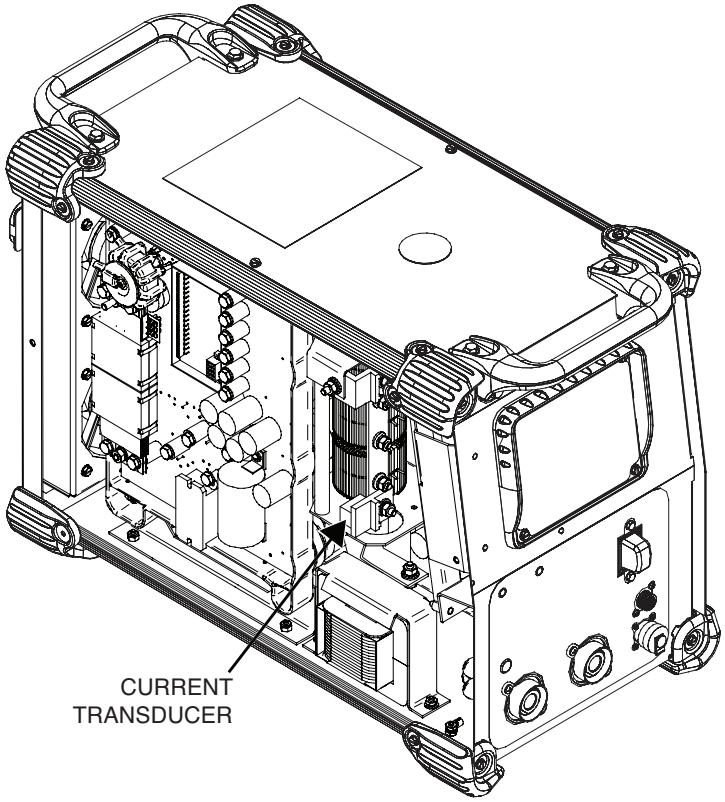
7. If the DC supply voltages are not present, the control board may be faulty. If the supply voltages are correct, proceed to Step 8.

For Steps 8 through 14 refer to the information in the Diagnostic Utility found on the Lincoln Service Navigator or at www.Powerwavemanager.com.

8. Using the ethernet cross connect cable, connect a laptop computer to the Power Wave S350 via the ethernet port located at the top rear of the machine. See ***Figure F.25***.
9. Connect a load bank (or 50 ft. weld cable) to the positive and negative output terminals on the Power Wave S350. See Wiring Diagram.
10. Using the “Diagnostic Utility Software”:
    A. Establish Communication with the Power Wave S350.
    B. Select the “Calibrate” tab.
    C. Select the “50 amp” current set point.
    D. Select “Turn Output On”.
    E. Use an external calibrated ammeter that is not affected by inverter noise to read the actual current.
11. Check the current transducer’s feedback voltage at the control board plug J8 per ***Table F.11***. Pin 1 (lead 211+) to pin 6 (lead 214- or 216). See Figure F.23, for pin locations. See Wiring Diagram.

CURRENT TRANSDUCER TEST *(continued)*

Figure F.24 – Current transducer location



12. Repeat the test at several other current levels. If the transducer feedback voltage is correct for the actual current, the current transducer is functioning properly. If there is no feedback voltage, check the wiring from the control board to the current transducer. See Wiring Diagram.

⚠ CAUTION

If using a weld cable across the output terminals instead of a load bank, do not exceed the current rating of the cable.

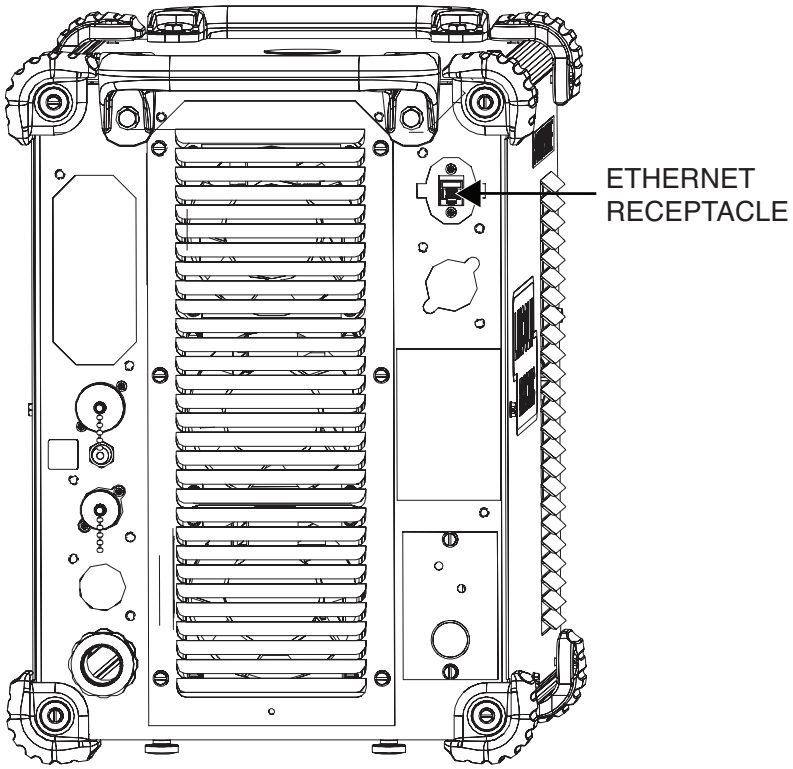
13. If the supply voltages are correct but the current transducer feedback voltages are incorrect, the current transducer or wiring from the current transducer to the control board may be defective. See Wiring Diagram.
14. Click on "Turn Output Off".
15. Disconnect the laptop computer.
16. If any of the tests fail, perform the ***Current Transducer Removal And Replacement Procedure***.
17. Remove the input power to the Power Wave S350 machine.
18. Perform the ***Case Cover Replacement Procedure***.

CURRENT TRANSDUCER TEST *(continued)*

Table F.11 – Current transducer voltage tests

OUTPUT CURRENT (ACTUAL)	TRANSDUCER FEEDBACK VOLTAGE
500	4.0
450	3.6
400	3.2
350	2.8
300	2.4
250	2.0
200	1.6
150	1.2
100	0.8
50	0.4

Figure F.25 – Ethernet receptacle



DC BUS BOARD TEST

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

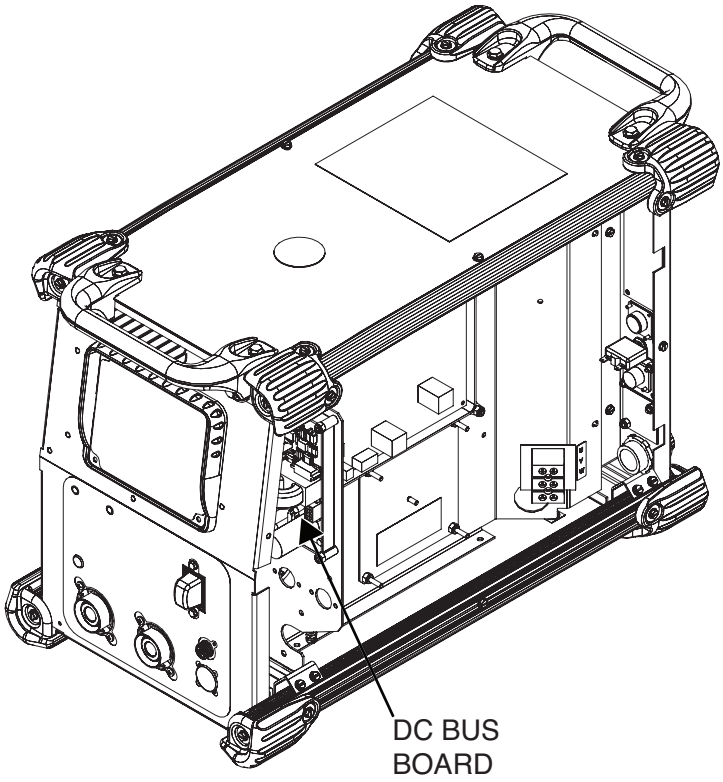
The procedure will aid the technician in determining if the DC Bus Board is functional.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

DC BUS BOARD TEST *(continued)*

Figure F.26 – DC bus board location

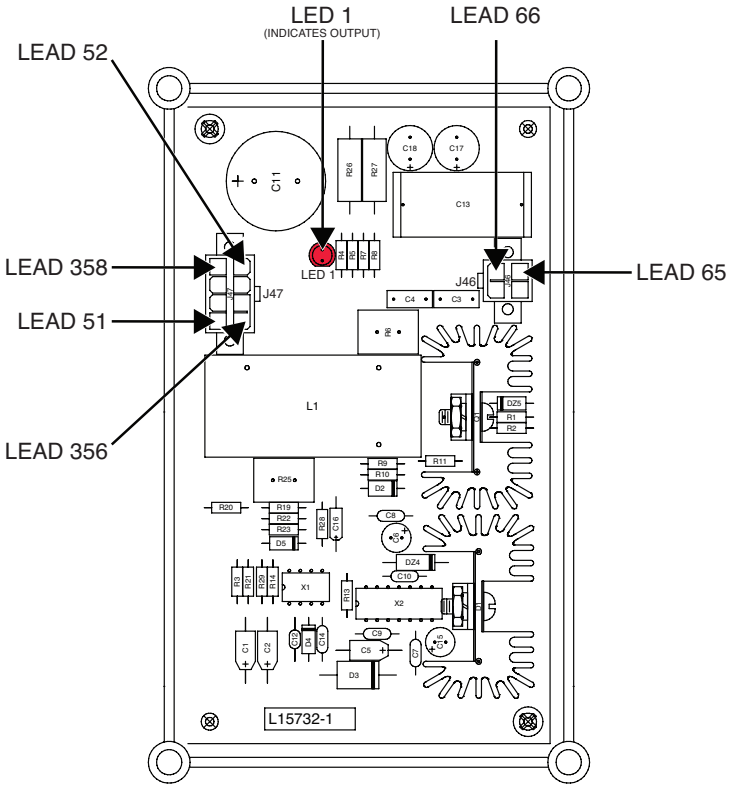


PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the DC bus board. See Figure F.26.
4. Carefully apply the correct input voltage to the Power Wave S350 machine.
5. Locate LED 1 on the DC bus board. See ***Figure F.27***. If LED 1 is bright red and steady, the DC bus board is OK. If the LED 1 is dim or not steady, remove the input power and disconnect Plug J47. See ***Figure F.27***. When power is reapplied, if the LED 1 is bright and steady, check leads 356 - 358 for a heavy load or short on leads 51-52. See Wiring Diagram.
6. If LED 1 is **NOT** ON proceed to the next steps.
7. Carefully check to ensure that the correct input voltage (48VDC) is being applied to the DC bus board. Plug J46 Pin 1 (lead 65+) to Plug J46 Pin 3 (lead 66-). See ***Figure F.27***. See Wiring Diagram.
8. If the correct input voltage (48VDC) is not present, check the circuit breaker and associated wiring between the DC bus board and the switch board. See Wiring Diagram.
9. If the correct input voltage is being applied to the DC bus board, check for the correct output voltages.
10. Check for the presence of 40VDC at Plug J47 Pin1 (Lead 51-) to Plug J47 Pin 8 (Lead 52+). See ***Figure F.27***. See Wiring Diagram.
11. Check for the presence of 40VDC at Plug J47 Pin5 (Lead 356-) to Plug J47 Pin4 (Lead 358+). See ***Figure F.27***. See Wiring Diagram.
12. If the correct input voltage is being applied to the DC bus board and the output voltages are not correct or missing, the DC bus board may be faulty.
13. Remove the input power to the Power Wave S350 machine.
14. If faulty, perform the ***DC Bus Board Removal And Replacement Procedure***.
15. Perform the ***Case Cover Replacement Procedure***.

DC BUS BOARD TEST *(continued)*

Figure F.27 – DC bus board locations



POWER FACTOR CORRECTION CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

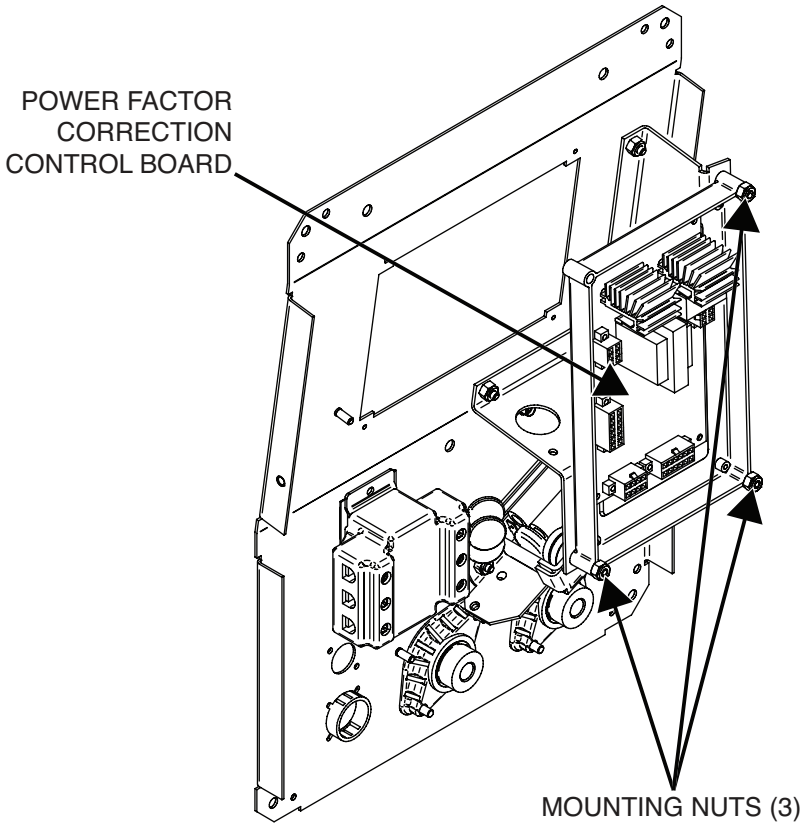
This procedure will aid the technician in the removal and replacement of the Power Factor Correction Control Board.

MATERIALS NEEDED

3/8” Nutdriver
Wiring Diagram

POWER FACTOR CORRECTION CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.28 – Power factor correction control board and mounting nuts location

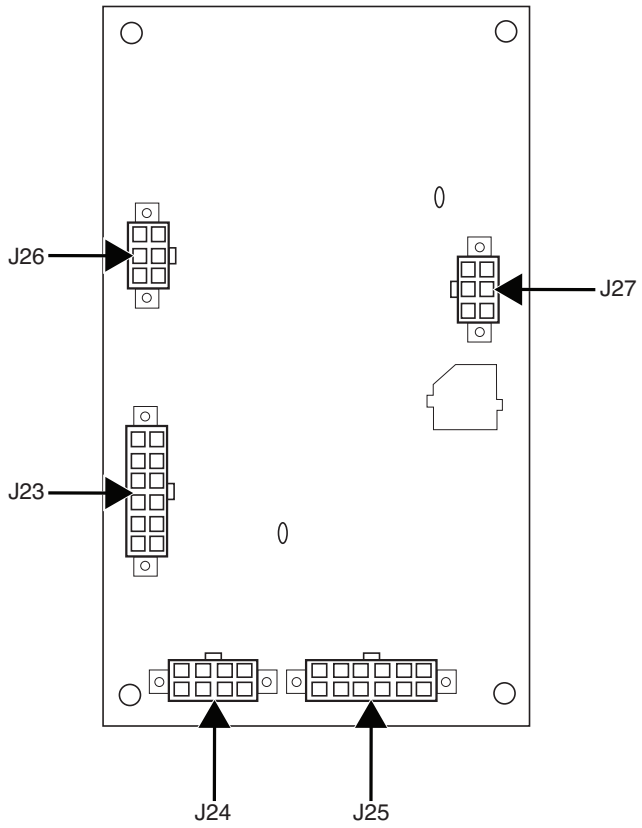


REMOVAL PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the power factor correction control board. See Figure F.28.
4. Using a 3/8" nutdriver, remove the three nuts securing the power factor correction control board to the machine. See Figure F.28.
5. Carefully slide the power factor correction control board off of the mounting studs.
6. Carefully label and disconnect plugs J23, J24, J25, J26 and J27 from the power factor correction control board. See ***Figure F.29***. See Wiring Diagram.
7. The power factor correction control board can now be removed and replaced.

POWER FACTOR CORRECTION CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.29 – Power factor correction control board plug locations



REPLACEMENT PROCEDURE

1. Carefully connect plugs J23, J24, J25, J26 and J27 to the new power factor correction control board. See Wiring Diagram.
2. Carefully position the power factor correction control board on to the mounting posts.
3. Using a 3/8" nutdriver, attach the three nuts securing the power factor correction control board to the machine.
4. Perform the ***Case Cover Replacement Procedure***.
5. Perform the ***Retest After Repair Procedure***.

CONTROL BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Control Board.

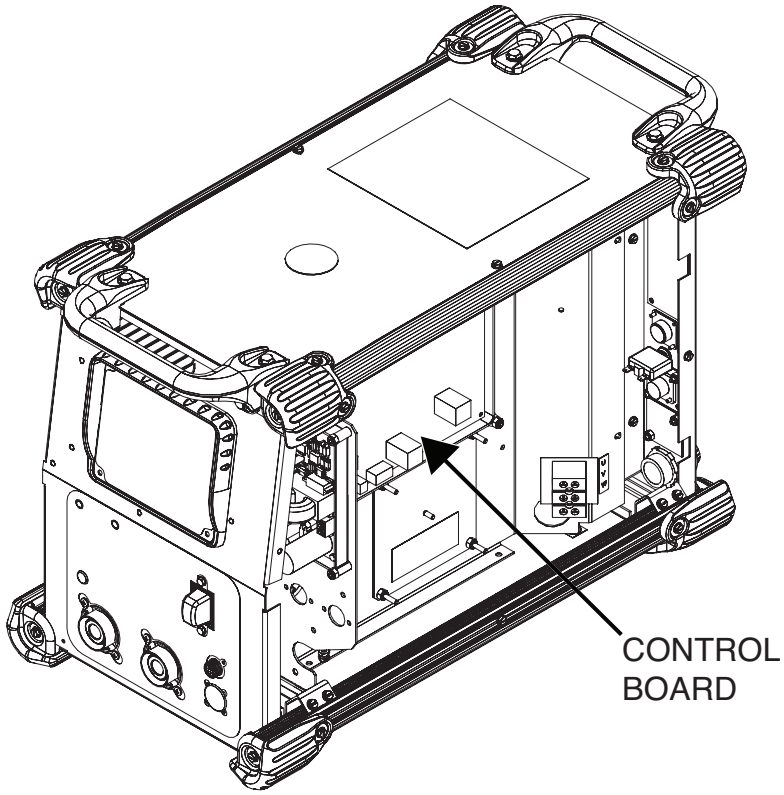
MATERIALS NEEDED

3/8” Nutdriver
Wiring Diagram

CONTROL BOARD

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.30 – Control board location



REMOVAL PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the control board on the right side of the machine. See Figure F.30.
4. Label and disconnect the ethernet cable from J15 on the control board. See ***Figure F.31***. See Wiring Diagram.
5. Label and disconnect plugs J4, J11, J12, J5, J6, J7, J8 and J9 from the control board. See ***Figure F.31***. See Wiring Diagram.
6. Using a 3/8" nutdriver, remove the three nuts securing the control board to the machine. See ***Figure F.32***.
7. Carefully slide the control board off of the mounting studs.
8. The control board can now be replaced.

CONTROL BOARD

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.31 – Control board plug locations

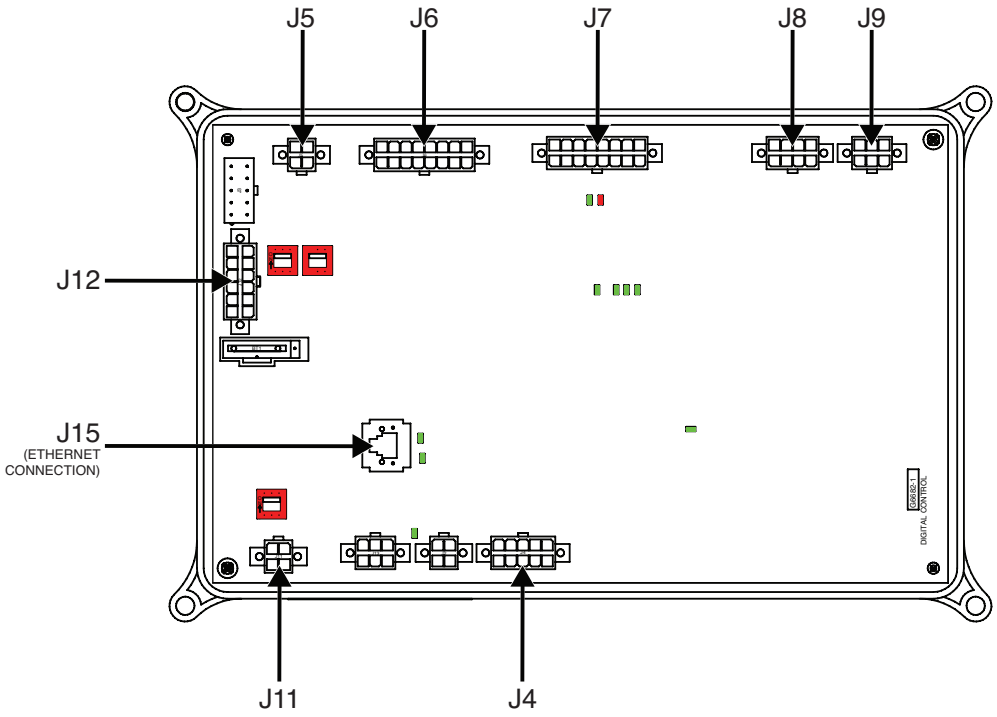
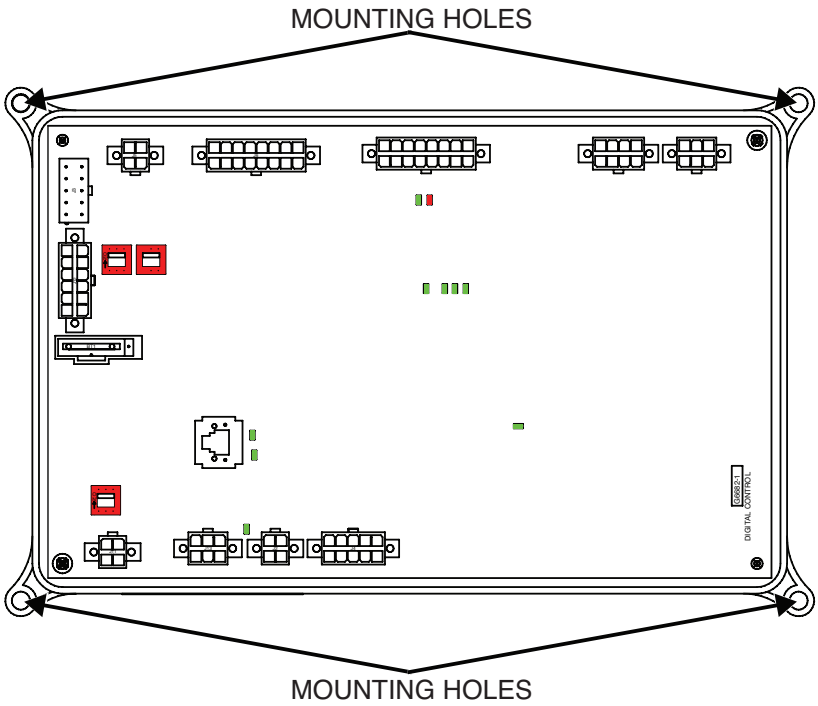


Figure F.32 – Mounting hole location



CONTROL BOARD
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

REPLACEMENT PROCEDURE

1. Carefully position the new control board onto the mounting studs.
2. Using a 3/8" nutdriver, attach the three nuts securing the control board to the machine.
3. Connect plugs J4, J11, J12, J5, J6, J7, J8 and J9 to the control board. See Wiring Diagram.
4. Connect the ethernet cable to J15 on the control board. See Wiring Diagram.
5. Perform the ***Case Cover Replacement Procedure***.
6. Perform the ***Retest After Repair Procedure***.

SWITCH BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Switch Board.

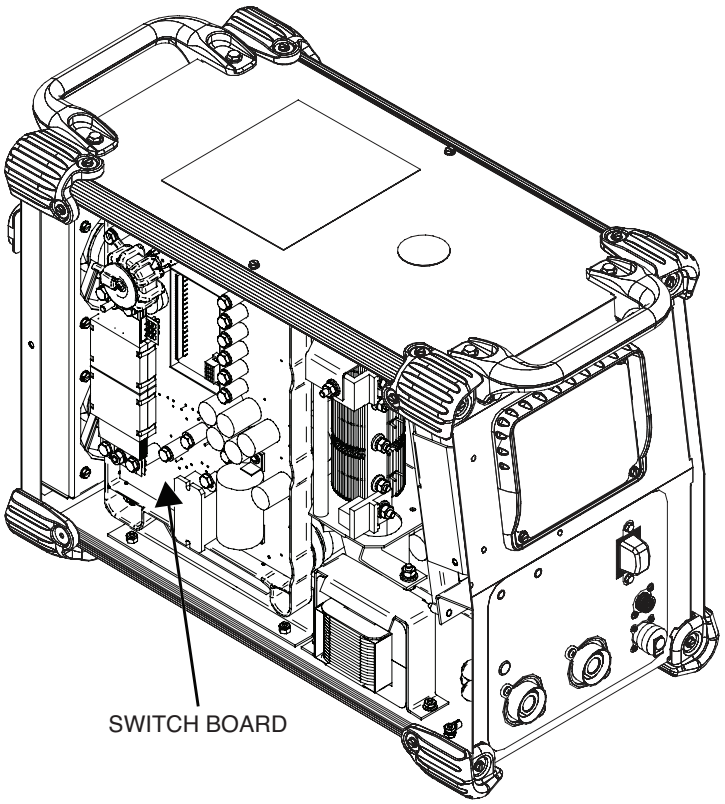
MATERIALS NEEDED

7/16” Socket
Two 7/16” Open End Wrenches
5/16” Nutdriver
Wiring Diagram

SWITCH BOARD

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.33 – Switch board location



REMOVAL PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the switch board. See Figure F.33.
4. Label and disconnect plugs J41, J42, J43, J45 and J28 from the switch board. See ***Figure F.34***. See Wiring Diagram.
5. Using a 7/16" socket, label and disconnect the six output choke leads from switch board terminals BL1, BL2, BL3, BL4, BL5 and BL6. See ***Figure F.34***. See Wiring Diagram.
6. Using two 7/16" open end wrenches, label and disconnect the positive output cable from the switch board. See ***Figure F.34***. See Wiring Diagram. Note washer placement for reassembly.
7. Using a 7/16" socket, label and disconnect the two input choke leads from switch board terminals B28 and B29. See ***Figure F.34***. See Wiring Diagram.
8. Using a 7/16" socket, label and disconnect the three input power leads from switch board terminals B30 (lead 2A), B31 (lead 1A) and B32 (lead 3A). See ***Figure F.34***. See Wiring Diagram.
9. Label and disconnect leads 410 and 409 from the switch board heatsink thermostat. See ***Figure F.34***. See Wiring Diagram.
10. Using a 5/16" nutdriver, remove the four screws and washers securing the switch board to the chassis frame. See ***Figure F.35***.

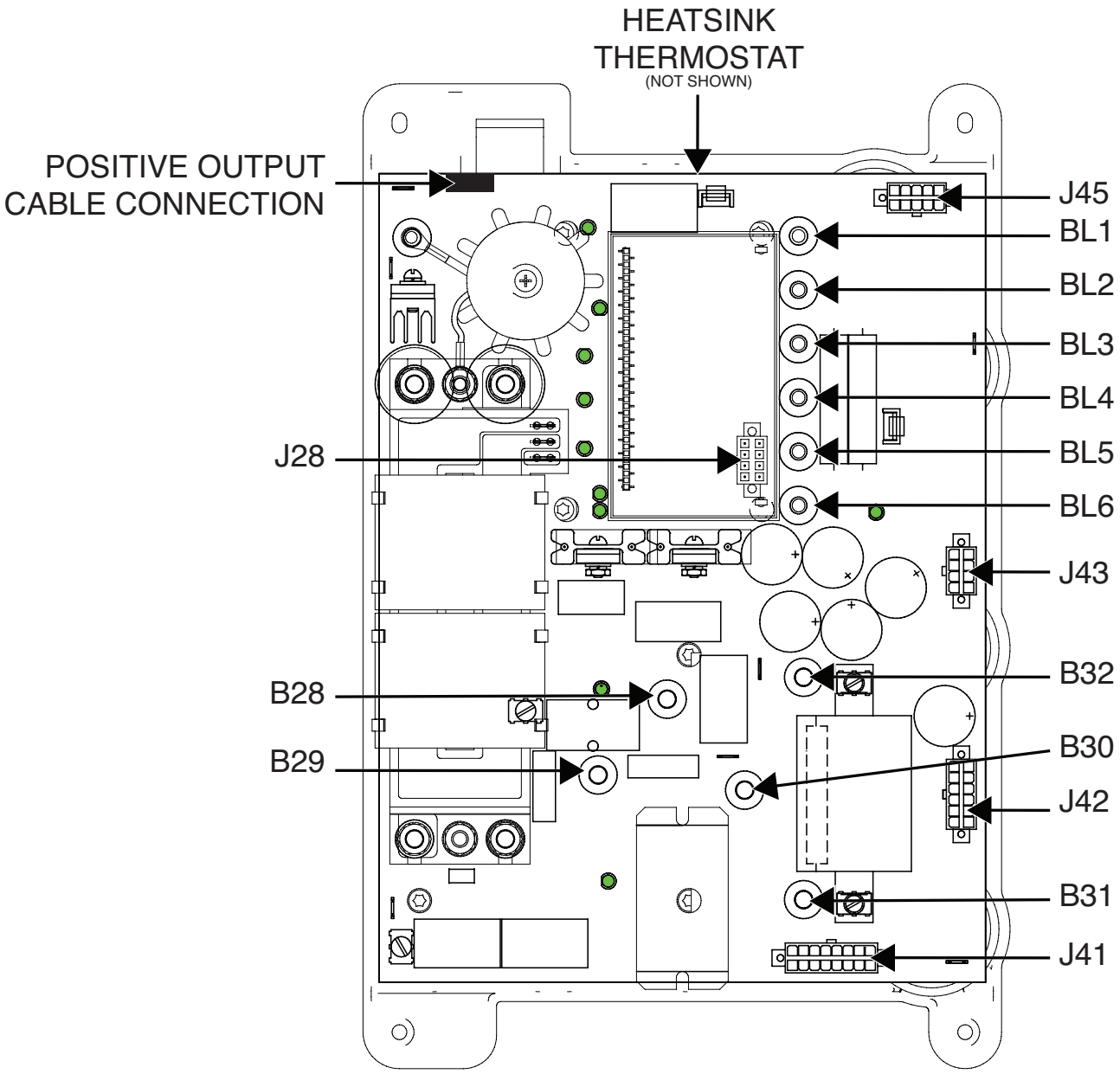
NOTE: It may be necessary to remove the air baffle to access the rear mounting screws.

11. The switch board can now be removed and replaced.

SWITCH BOARD

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

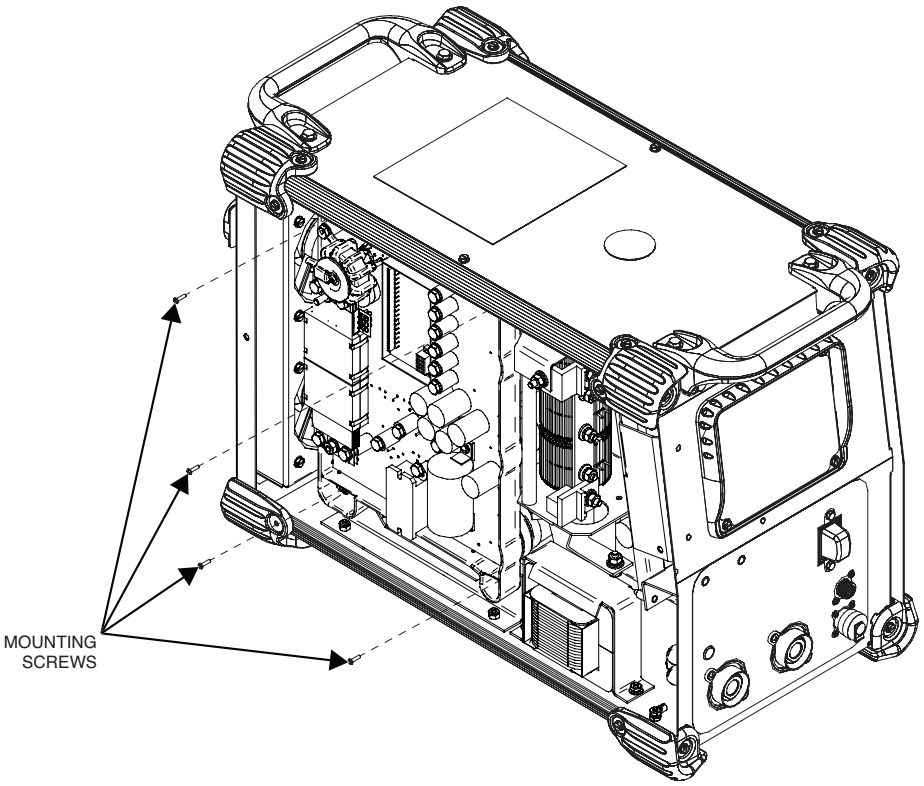
Figure F.34 – Switch board lead and plug locations



SWITCH BOARD

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.35 – Switch board mounting screw locations



REPLACEMENT PROCEDURE

1. Carefully position the new switch board onto the mounting studs.
2. Using a 5/16” nutdriver, attach the four screws securing the switch board to the chassis frame.

NOTE: Attach air baffle if previously removed.

3. Connect leads 410 and 409 to the switch board heatsink thermostat. See Wiring Diagram.
4. Using a 7/16” socket, connect the three input power leads to switch board terminals B30 (lead 2A), B31 (lead 1A) and B32 (lead 3A). See Wiring Diagram.
5. Using a 7/16” socket, connect the two input choke leads from switch board terminals B28 and B29. See Wiring Diagram.
6. Using two 7/16” open end wrenches, connect the positive output cable to the switch board. See Wiring Diagram. Note washer placement for reassembly.
7. Using a 7/16” socket, connect the six output choke leads to switch board terminals BL1, BL2, BL3, BL4, BL5 and BL6. See Wiring Diagram.
8. Connect plugs J41, J42, J43, J45 and J28 to the switch board. See Wiring Diagram.
9. Perform the ***Case Cover Replacement Procedure***.
10. Perform the ***Retest After Repair Procedure***.

CURRENT TRANSDUCER REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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TEST DESCRIPTION

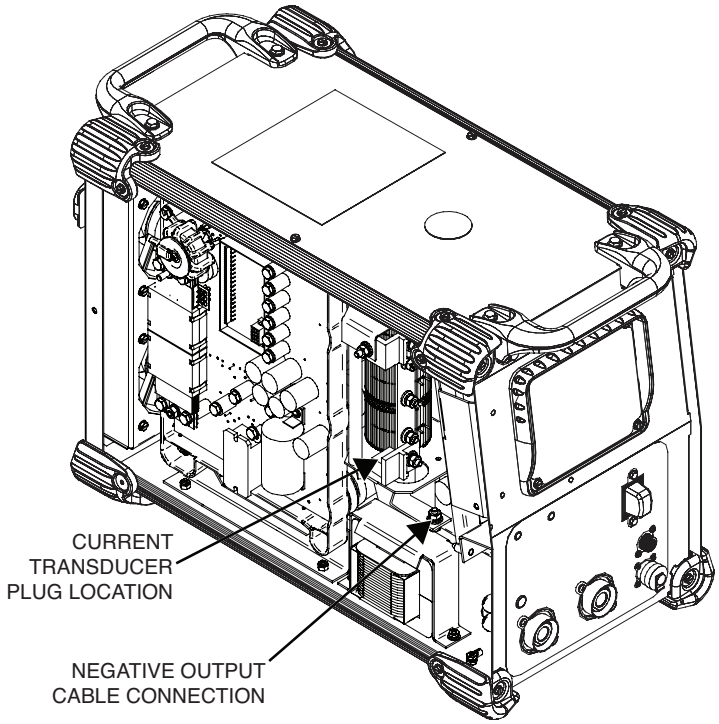
This procedure will aid the technician in the removal and replacement of the Current Transducer.

MATERIALS NEEDED

Two 7/16” Open End Wrenches
Slotted Screwdriver
Wiring Diagram

CURRENT TRANSDUCER
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.36 – Current transducer plug location



REMOVAL PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Label and disconnect the small plug from the top of the current transducer. See Figure F.36. See Wiring Diagram.
4. Using two 7/16" open end wrenches, remove the bolt and washers securing the negative output cable to the bus bar. See Figure F.36. See Wiring Diagram. Label lead for reassembly. Note washer placement for reassembly.
5. Using two 7/16" open end wrenches, remove the bolts and washers securing the three pairs of leads to the bus bar. See ***Figure F.37***. See Wiring Diagram. Label leads for reassembly. Note washer placement for reassembly.
6. Using two 7/16" open end wrenches, remove the bolt and washers securing the bus bar to the bottom choke bracket. See ***Figure F.37***.
7. Using two 7/16" open end wrenches, remove the bolt and washers securing the bus bar to the top choke bracket. See ***Figure F.37***.
8. Carefully slide the bus bar out of the bottom choke bracket.
9. Using a slotted screwdriver, remove the screw securing the current transducer to the bottom choke bracket. See ***Figure F.38***.
10. The current transducer can now be removed and replaced.

CURRENT TRANSDUCER
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.37 – Current transducer removal

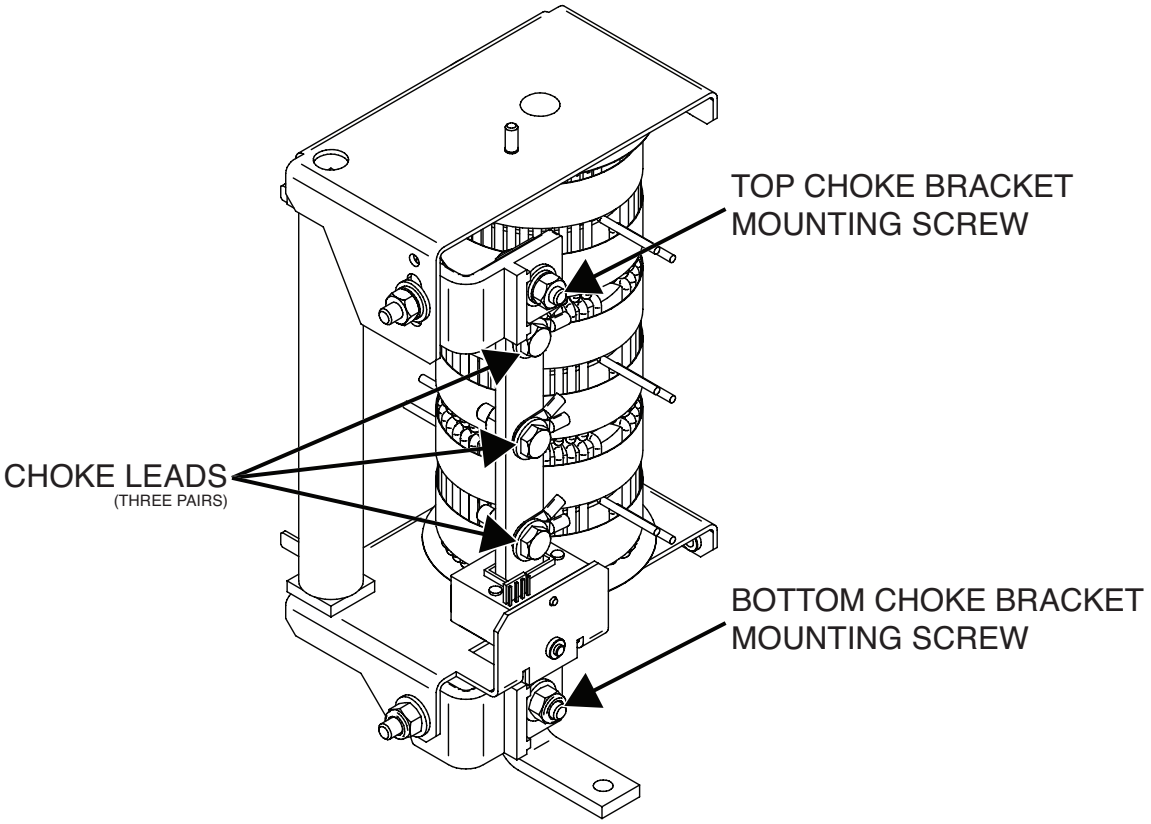
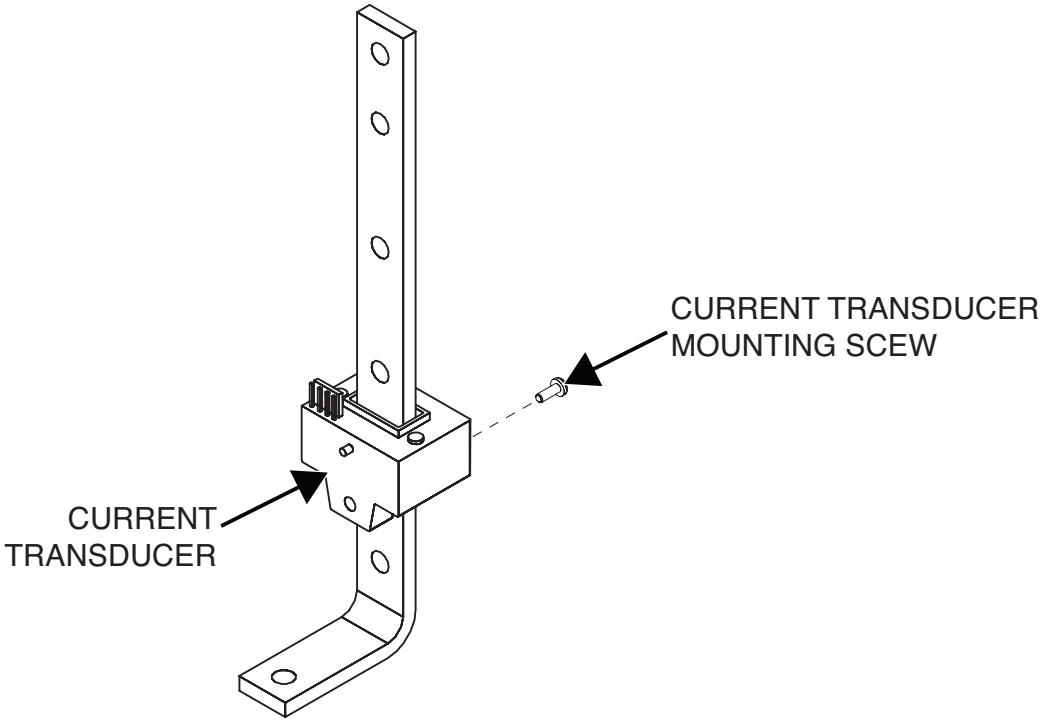


Figure F.38 – Current transducer mounting screw location



CURRENT TRANSDUCER
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

REPLACEMENT PROCEDURE

1. Carefully position the new current transducer into the machine.
2. Using a slotted screwdriver, attach the screw securing the current transducer to the bottom choke bracket.
3. Carefully slide the bus bar into the position through the bottom choke bracket and current transducer.
4. Using two 7/16" open end wrenches, attach the bolt and washers securing the bus bar to the top choke bracket.
5. Using two 7/16" open end wrenches, attach the bolt and washers securing the bus bar to the bottom choke bracket.
6. Using two 7/16" open end wrenches, attach the bolts and washers securing the three pairs of leads to the bus bar. See Wiring Diagram.
7. Using two 7/16" open end wrenches, attach the bolt and washers securing the negative output cable to the bus bar. See Wiring Diagram.
8. Connect the small plug to the top of the current transducer. See Wiring Diagram.
9. Perform the ***Case Cover Replacement Procedure***.
10. Perform the ***Retest After Repair Procedure***.

DC BUS BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the DC Bus Board.

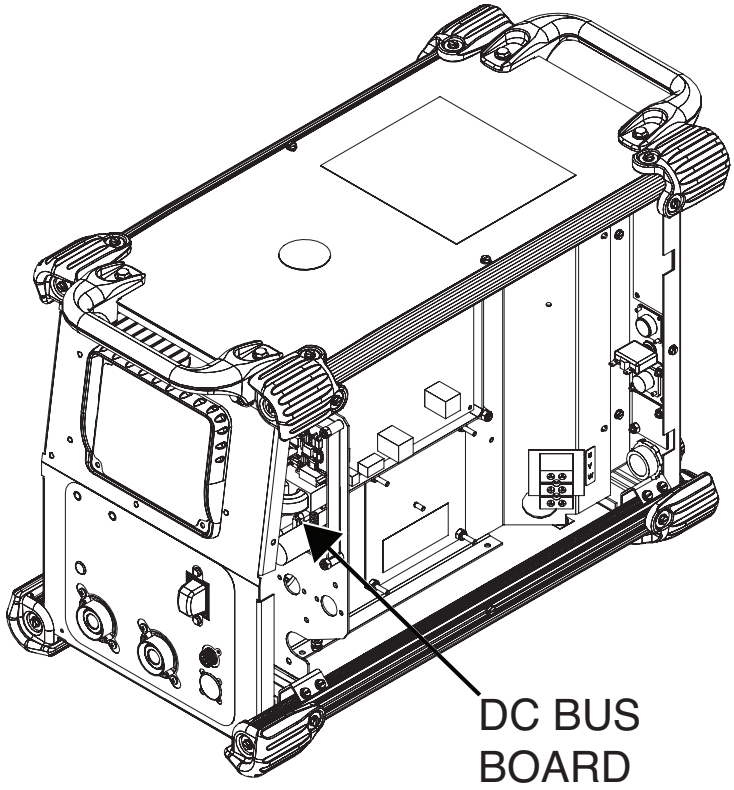
MATERIALS NEEDED

3/8” Nutdriver
Wiring Diagram

DC BUS BOARD

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.39 – DC bus board location



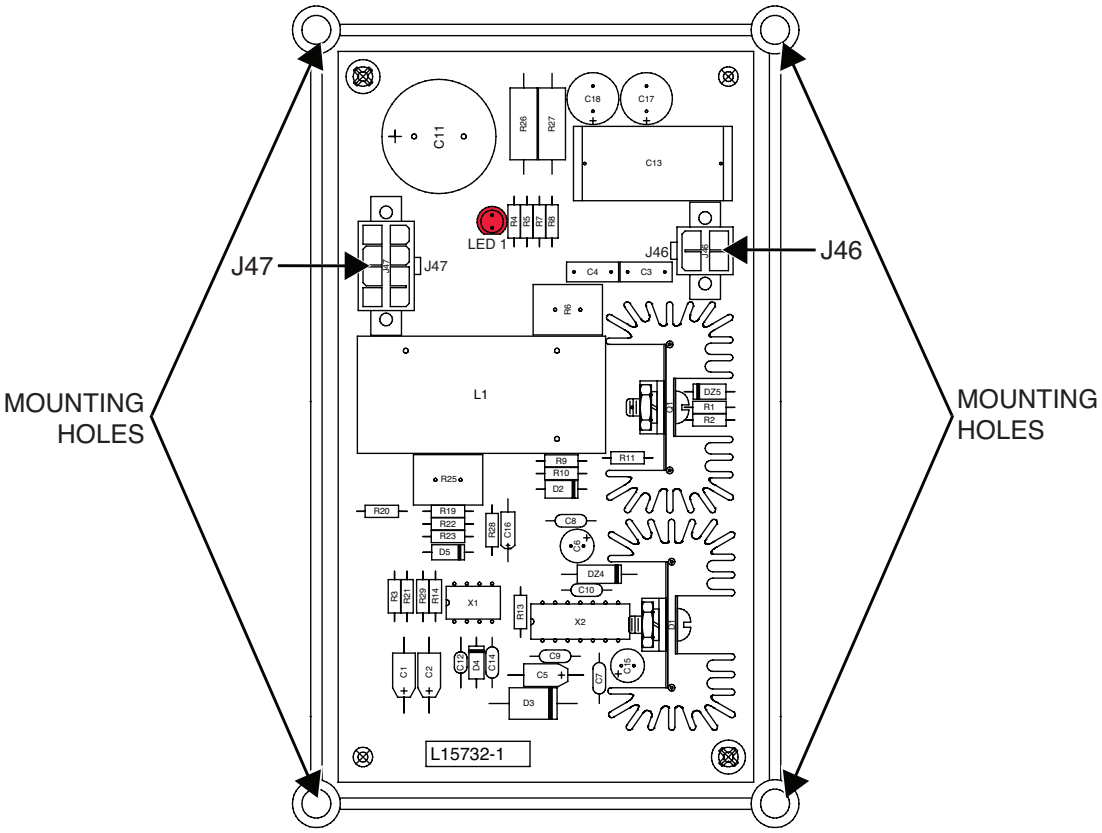
REMOVAL PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the DC bus board. See Figure F.39.
4. Label and disconnect plugs J46 and J47 from the DC bus board. See ***Figure F.40***. See Wiring Diagram.
5. Using a 3/8" nutdriver, remove the four nuts securing the DC bus board to the vertical divider. See ***Figure F.40***.
6. Carefully remove the DC bus board form the mounting studs.
7. The DC bus board can now be removed and replaced.

DC BUS BOARD

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.40 – DC bus board plug and mounting hole location



REPLACEMENT PROCEDURE

1. Carefully position the new DC bus board onto the mounting studs.
2. Using a 3/8” nutdriver, attach the four nuts securing the DC bus board to the vertical divider.
3. Connect plugs J46 and J47 to the DC bus board. See Wiring Diagram.
4. Perform the ***Case Cover Replacement Procedure***.
5. Perform the ***Retest After Repair Procedure***.

AUXILIARY POWER BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

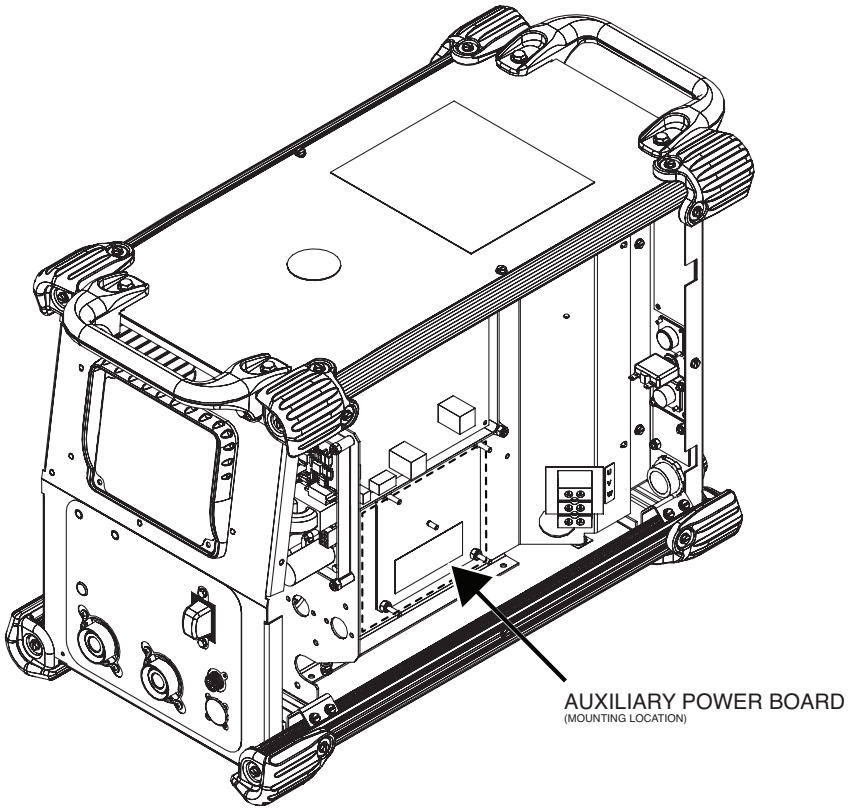
This procedure will aid the technician in the removal and replacement of the optional Auxiliary Power Board.

MATERIALS NEEDED

3/8” Nutdriver
Wiring Diagram

OPTIONAL AUXILIARY POWER BOARD
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.41 – Auxiliary power board location



DISCONNECT PROCEDURE

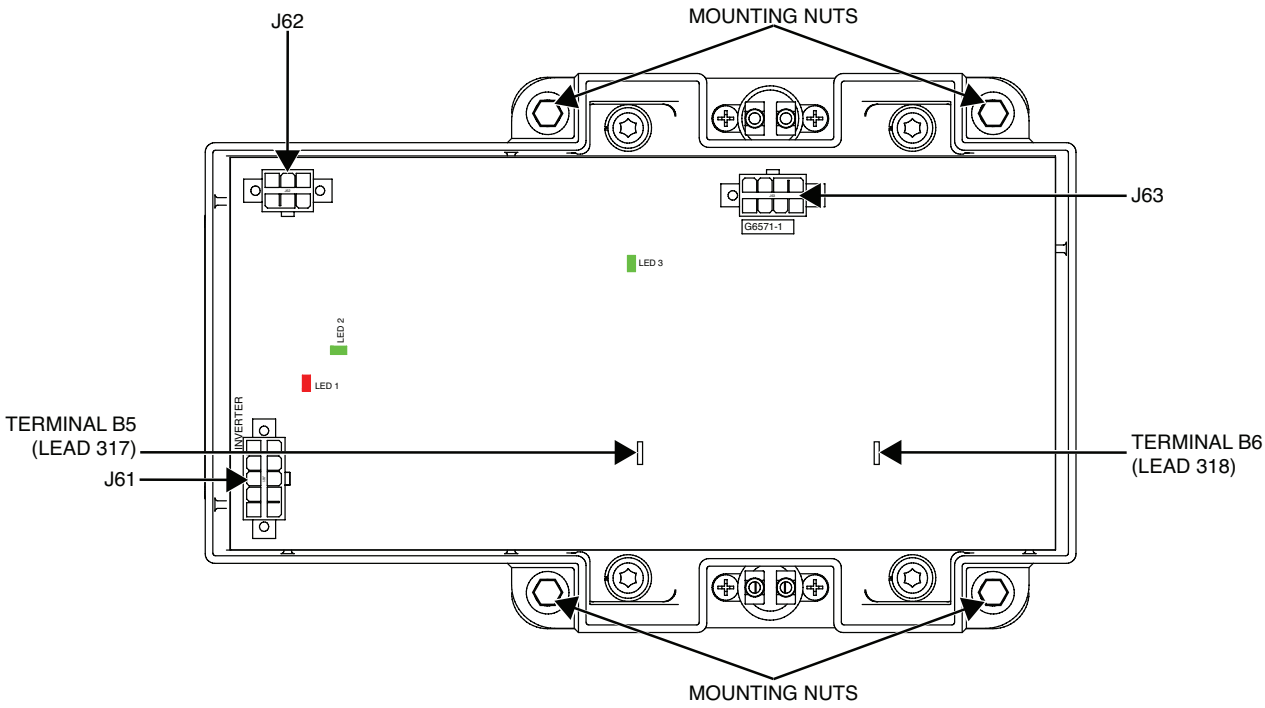
1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the optional auxiliary power board. See ***Figure F.41***.
4. Label and disconnect plug J62 form the auxiliary power board. See ***Figure F.42***. See Wiring Diagram.
5. Label and disconnect leads 317 and 318 from terminals B5 and B6 of the auxiliary power board. See ***Figure F.42***. See Wiring Diagram.
6. Tape the ends of the quick connect terminals (leads 317 and 318) with electrical tape to operate the machine without the auxiliary power board active/installed.
7. Perform the ***Case Cover Replacement Procedure***.

REMOVAL PROCEDURE

1. Remove the input power to the Power Wave S350 machine.
2. Perform the ***Case Cover Removal and DC Link Capacitor Discharge Procedure***.
3. Locate the auxiliary power board. See ***Figure F.41***.
4. Label and disconnect plugs J62 and J63 from the auxiliary power board. See ***Figure F.42***. See Wiring Diagram.
5. Label and disconnect leads 317 and 318 from terminals B5 and B6 of the auxiliary power board. See ***Figure F.42***. See Wiring Diagram.
6. Using a 3/8” nutdriver, remove the four mounting nuts securing the auxiliary power board to the mounting studs. See ***Figure F.42***.
7. The auxiliary power board can now be removed and replaced.

OPTIONAL AUXILIARY POWER BOARD
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.42 – Auxiliary power board plug locations



REPLACECMENT PROCEDURE

1. Carefully position the new auxiliary power board into the machine.
2. Using a 3/8” nutdriver, attach the four mounting nuts securing the auxiliary power board to the mounting studs.
3. Connect leads 317 and 318 to terminals B5 and B6 of the auxiliary power board. See Wiring Diagram.
4. Connect plugs J62 and J63 to the auxiliary power board. See Wiring Diagram.
5. Perform the ***Case Cover Replacement Procedure***.
6. Perform the ***Retest After Repair Procedure***.

RETEST AFTER REPAIR

⚠ WARNING

Service and repair should be performed only by Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in testing the PowerWave S350 output after the repair and/or replacement of a part or PC board.

MATERIALS NEEDED

Diagnostic Utilities Software
Laptop Or Other Suitable Computer
Ethernet Cross Connect Cable (LE Co. #M19969-7)
Resistive Load Bank
Two Welding Cables - 20Ft. -4/0
Calibrated Ammeter And Voltmeter

RETEST AFTER REPAIR *(continued)*

PROCEDURE

1. Be certain the machine is properly connected for the input voltage being applied.
2. Turn the power switch ON and see that the machine goes through the Start-up routine and the status light is steady green.
3. Turn the power switch OFF and connect a resistive load across the output studs and a computer to the ethernet.
4. Perform the Power Wave Verification And Calibration Procedures, see ***SVM251***.

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