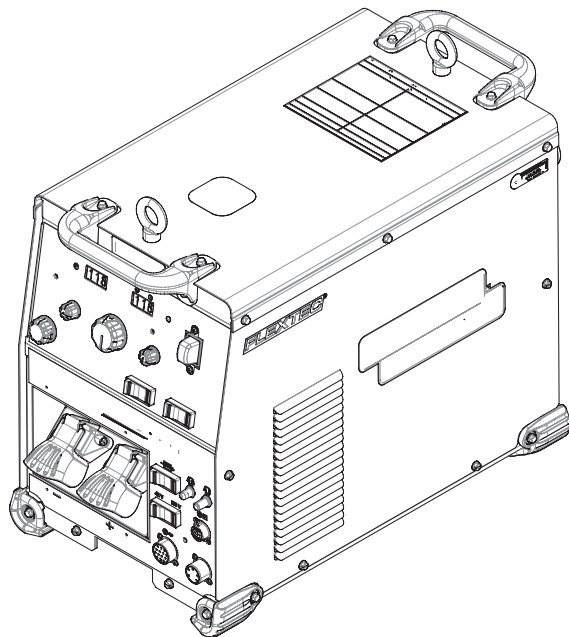


Flextec[®] 650x

For use with machines having Code Numbers:

Flextec 650x: 12596

SERVICE MANUAL



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.

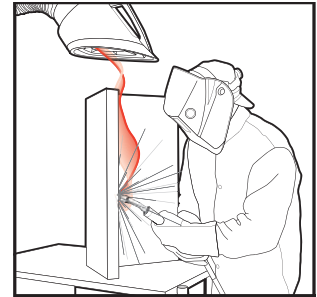
READ and obey the Safety Data Sheet (SDS) and the warning label that appears on all containers of welding materials.

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 Z87.1 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 02269-9101.
- 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-1, "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.

Flextec® 650x

Service Manual

Last update: 2017/08/01

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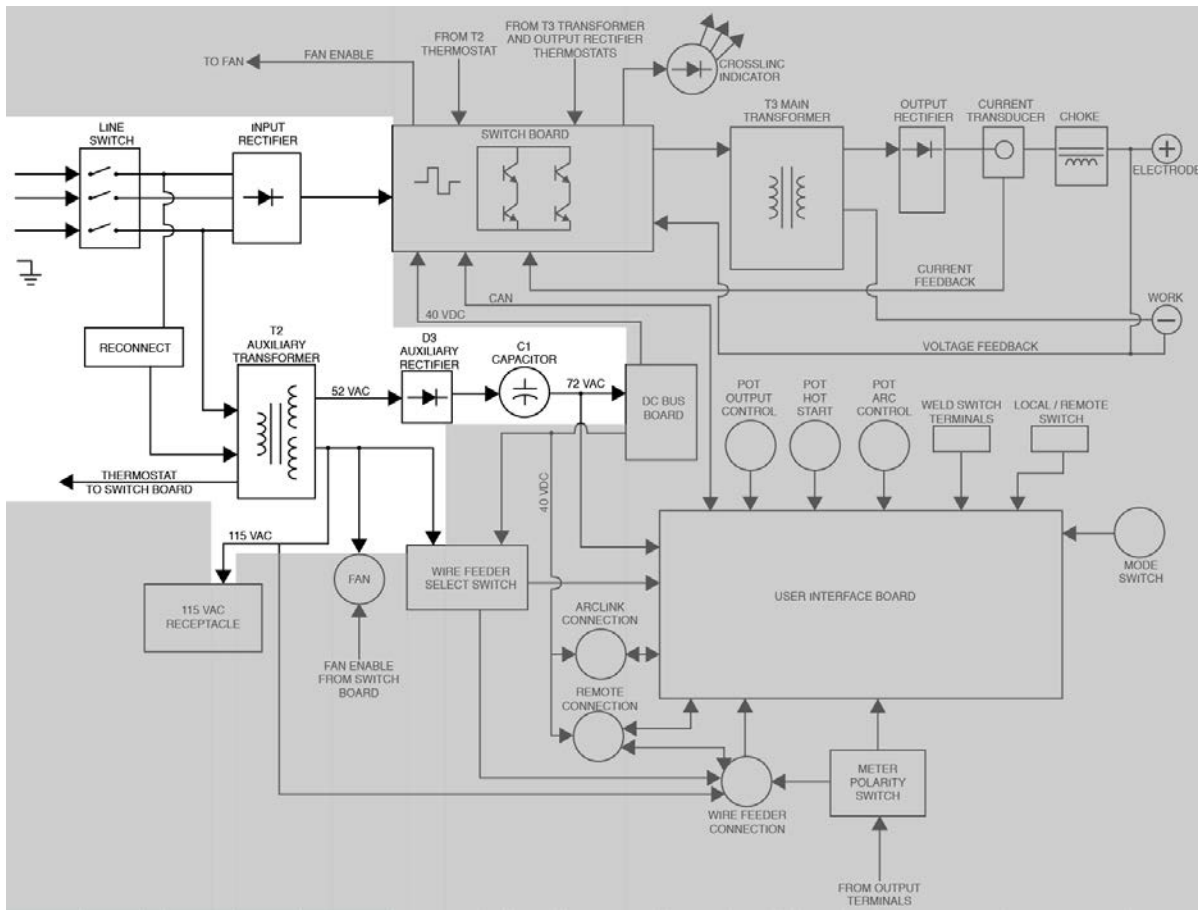
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Theory of Operation

Figure E.1 – Input section

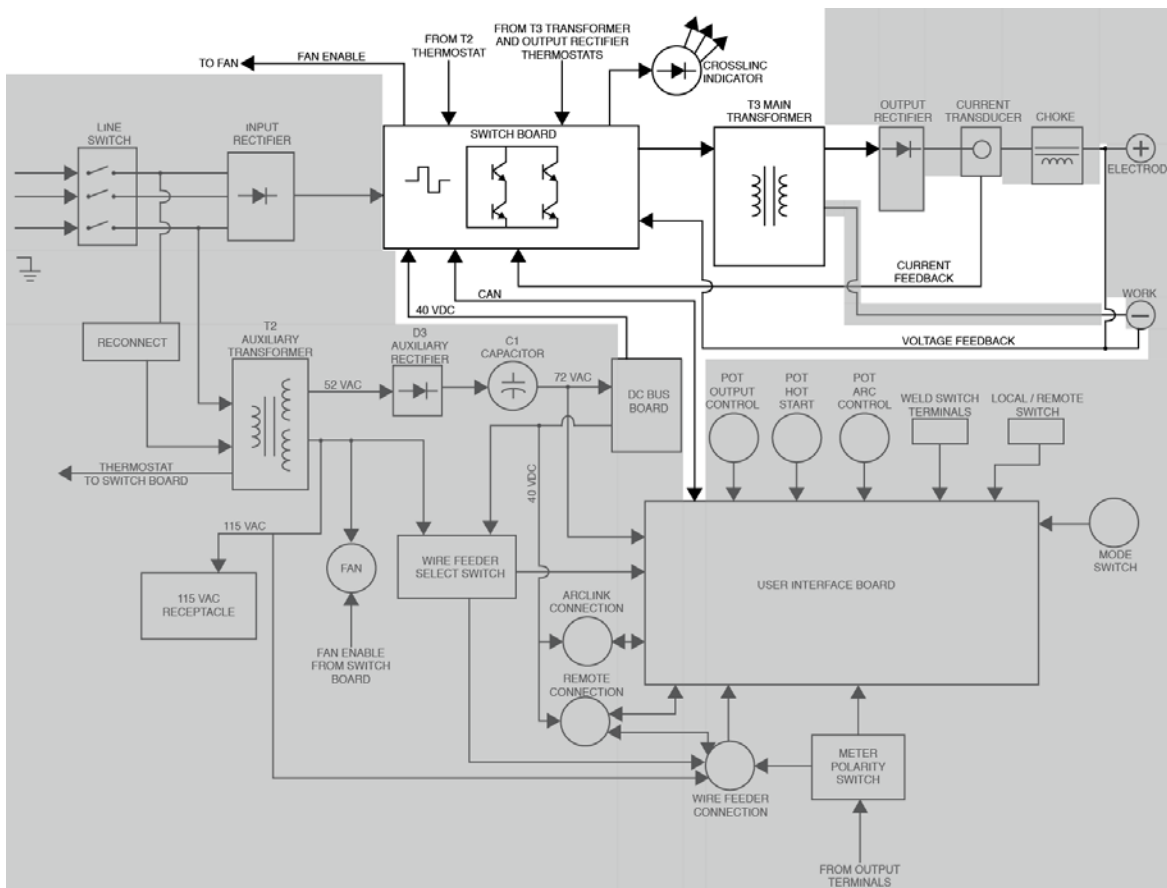


Input Section

The three phase input voltage (380/460/575 VAC) is applied to the Flextec 650x via the line switch. This three phase AC voltage is applied to the three phase input rectifier and two phases are applied to the T2 auxiliary transformer through a reconnect voltage panel. There are two secondary voltages created by the T2 auxiliary transformer. They are 52 VAC and 120 VAC. The 52 VAC is applied to the D3 rectifier bridge where it is changed to a DC voltage and this is filtered by the C1 capacitor. The resultant DC voltage is approximately 72 VDC. The 72 VDC is applied to the DC bus board. The 120 VAC is applied to the 120 VAC receptacle, the wire feeder selector switch, the wire feeder receptacle and via the switch board, to the cooling fan.

The three phase input voltage is applied to the three phase rectifier and the resultant DC volt is then passed on to the switch board.

Figure E.2 – Switch board and main transformer



Switch board And Main Transformer

The main function of the switch board is to receive the DC voltage from the input rectifier and process and convert this rectified primary power. The switch board provides pulse width modulated power to the primary winding of the main welding transformer. The operating frequency is 20kHz.

The switch board also utilizes the 40 VDC received from the DC bus board to create power supplies for the CAN communications (Controller Area Network) and the circuitry on the board.

There are LEDs that indicate the status of the board. They are as follows.

LED 1 indicates the +15Vdc is functioning. (Green)

LED 2 indicates the +5Vdc CAN is functioning. (Green)

LED 3 indicates the +5Vdc isolated supply is functioning. (Green)

LED 4 indicates that the internal DC supplies for the switch board circuitry are functioning. (Green)

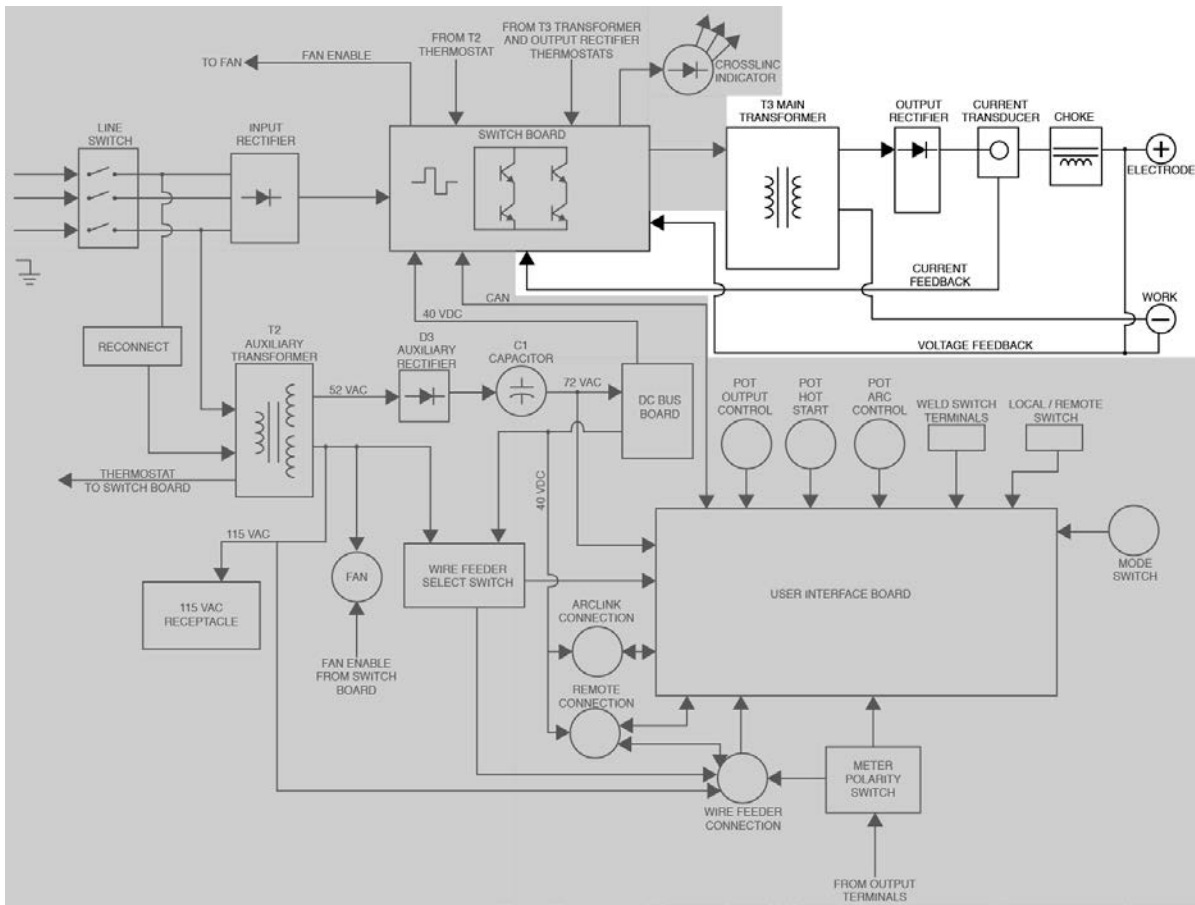
LED 5 indicates power is being applied to the cooling fan. (Green)

LED 6 indicates the status of the switch board. (Green)

In addition, the switch board monitors the voltage and current feedback and compares these to the CAN digital command signals received from the user interface board. The switch board then sends the appropriate pulse width modulated power to the main transformer.

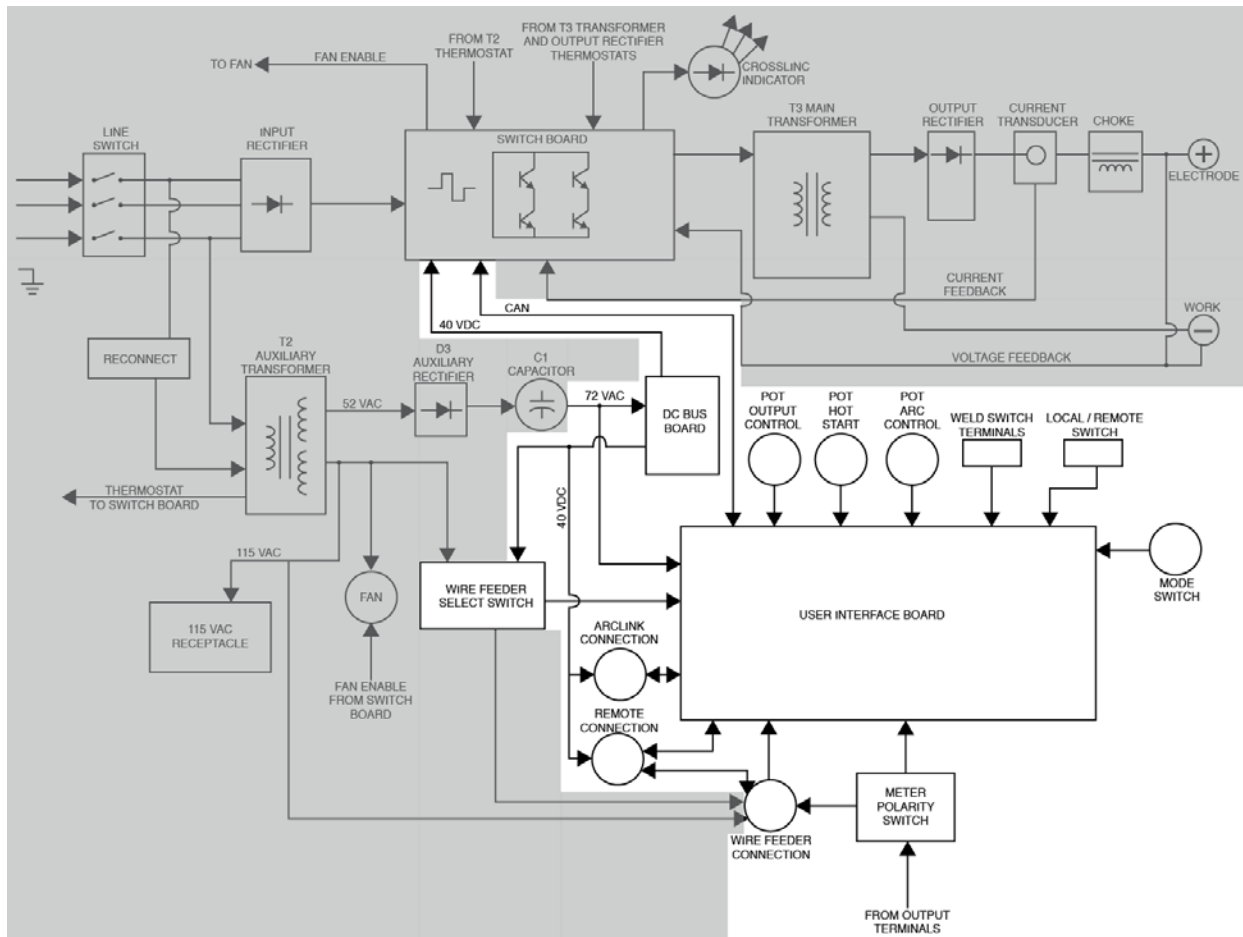
The main welding transformer's (T3) primary windings receive the pulse width modulated power from the switch board. The 20kHz. AC output that is created on the secondary windings is applied to the output rectifier.

Figure E.3 – Output section



Output Section

The 20kHz. AC output from the main welding transformer is applied to the output rectifier bridge. The resultant DC+ power is coupled, through the current transducer and output choke, to the positive output terminal. The edge wound output choke is an inductor that provides current filtering to enhance the arc performance and accurate waveform response. The current transducer provides a low voltage feedback to the switch board that is an accurate indication of the output welding current.

Figure E.4 – DC bus board, user interface board and VRD (voltage reduction device)

DC Bus Board, User Interface Board And VRD (Voltage Reduction Device)

The DC bus board receives an unregulated 72 VDC from the D3 rectifier/ C1 capacitor circuit. The DC bus board regulates this input to a constant 40 VDC supply. This 40 VDC is applied to the switch board, the remote connector and the Arlink connector.

The user interface board houses the two displays, both amps and volts. The thermal indicator LED and the green and red VRD LEDs are also incorporated in the user interface board. The green VRD light indicates the OCV is less than 35 VCD peak. The red VRD light indicates the OCV is at or above 35 VDC peak.

The user controls and the various wire feeder connectors are connected to the user interface board. The commands received from the various controls and connectors are communicated to the switch board along with the feedback information. The user interface and switch boards “talk” to each other via CAN communication.

CrossLinc™ Capability

The Flextec 650x has the ability to communicate with compatible wire feeders such as the LN25x. The two machines communicate directly over the weld cables by pulsing the OCV voltage and wire feeder current draw. This communication only occurs during an open circuit voltage (OCV) condition. Any changes made at the compatible wire feeder are sent to the power source. This functionality enables the user to adjust the welding voltage at the LN25x wire feeder without the need for a separate control cable.

Thermal Protection

Three normally closed (NC) thermostats protect the Flextec 650x.

Two thermostats provide secondary thermal protection, are wired in series and are connected to the switch board. One of these thermostats is located on the output rectifier heat sink and the other is located on the main inverter transformer. These protect the machine against reduced airflow or overload. If excessive operating temperatures should occur, the thermostats will prevent output from the machine. The fan will remain ON, a thermal fault will be logged and the thermal LED will illuminate.

One thermostat provides auxiliary thermal protection. It is located on the auxiliary transformer and is connected to the switch board. It protects the machine against receptacle overload and misconnect overheating. If the thermostat opens, the fan and the output will remain ON. There is no thermal fault logged.

The thermostats are self-resetting once the machine cools sufficiently or any overload is cleared. If the thermostat shutdown was caused by excessive output or duty cycle and the fan is operating normally, the power switch may be left ON and the reset should occur within a 15 minute period. If the fan is not turning or the air intake louvers are obstructed, then the power must be removed from the machine and the fan problem or air obstruction corrected.

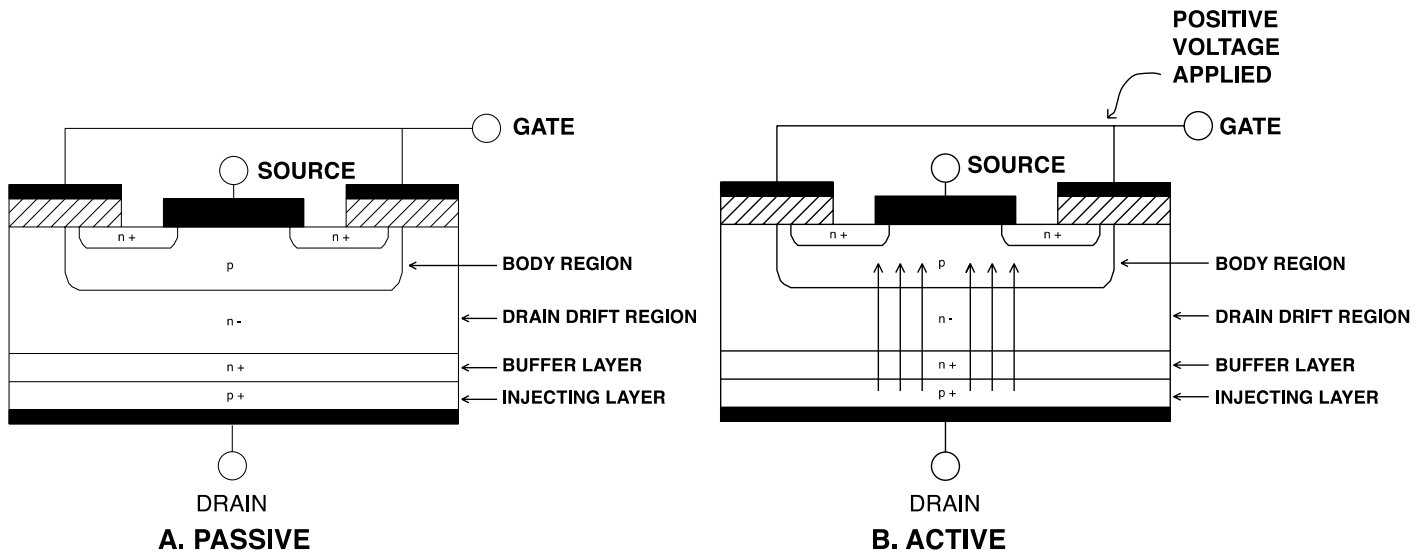
Protective Circuits

Protective circuits are designed into the Flextec 650x to sense trouble and shut down the machine before damage occurs to the machine's internal components.

Under/over voltage protection

The machine is protected from both over and under voltage conditions. If the DC voltage being applied to the switch board is lower than 180 VDC or higher than 1050 VDC the machine's output will be disabled. If the condition persists for more than one second error code 714 will be displayed when supply voltage is too low. 713 will be displayed when supply voltage is too high.

Figure E.5 – Insulated gate bipolar transistor (IGBT) operation



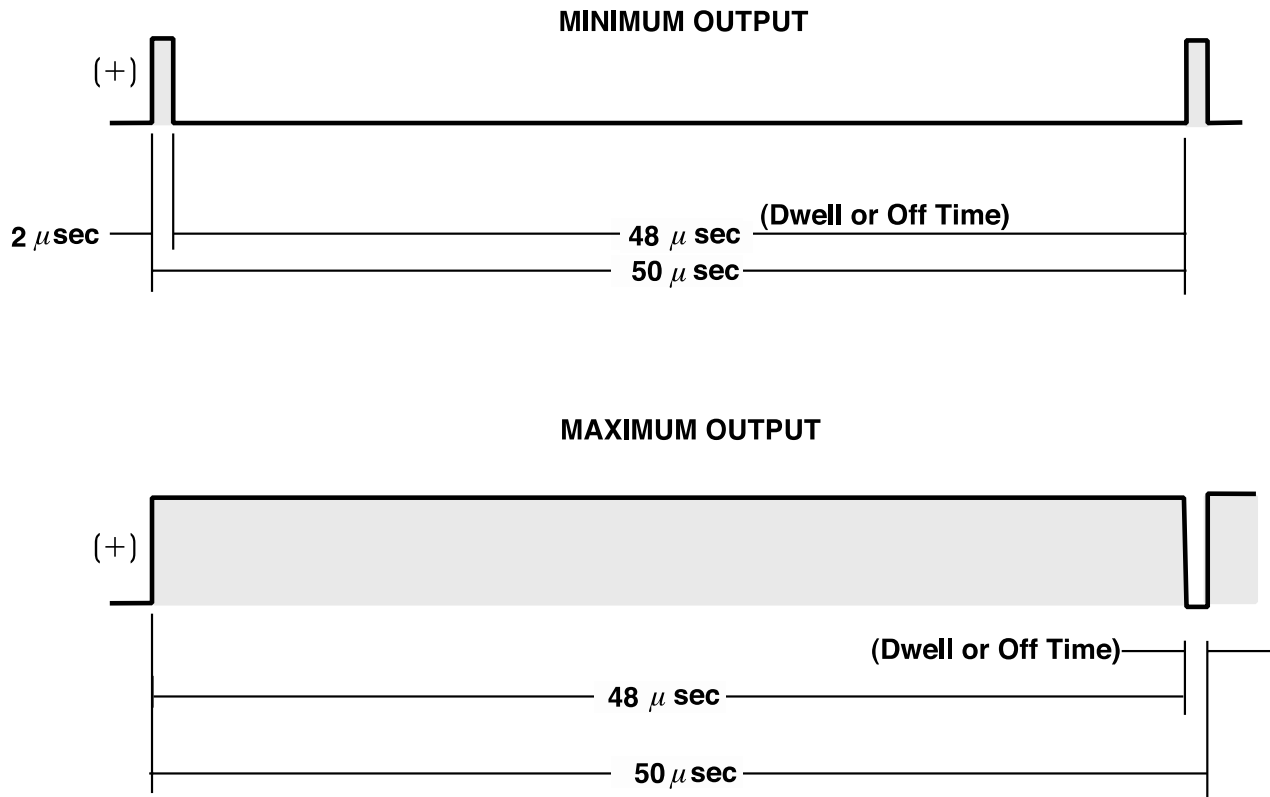
Insulated Gate Bipolar Transistor (IGBT) Operation

The IGBT is a type of transistor. IGBTs are semiconductors well suited for high frequency switching and high current applications.

Drawing A shows an IGBT in a passive mode. There is no gate signal, (zero volts relative to the source) and therefore, no current flow. The drain terminal of the IGBT may be connected to a voltage supply; but since there is no conduction the circuit will not supply current to components connected to the source. The circuit is turned off like a light switch in the OFF position.

Drawing B shows the IGBT in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the IGBT, it is capable of conducting current. A voltage supply connected to the drain terminal will allow the IGBT to conduct and supply current to circuit components coupled to the source. Current will flow through the conducting IGBT to downstream components as long as the positive gate signal is present. This is similar to turning ON a light switch.

Figure E.6 – Pulse width modulation



Pulse Width Modulation

The term PULSE WIDTH MODULATION is used to describe how much time is devoted to conduction in the cycle. Changing the pulse width is known as MODULATION. Pulse Width Modulation (PWM) is the varying of the pulse width over the allowed range of a cycle to affect the output of the machine.

Minimum Output

By controlling the duration of the gate signal, the IGBT is turned on and off for different durations during a cycle. The top drawing shows the minimum output signal possible over a 50-microsecond time period. The positive portion of the signal represents one IGBT group conducting for 2 microseconds. The dwell time (off time) is 48 microseconds. Since only 2 microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

Maximum Output

By holding the gate signals on the 48 microseconds and allowing only 2 microseconds of dwell time (off time) during the 50-microseconds cycle, the output is maximized. The darkened area under the top curve can be compared to the area under the bottom curve. The more darkened area under the curve, the more power is present.

Troubleshooting & Repair

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, Weld And Arc Quality Problems and Function 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 troubleshooting 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.



ATTENTION
 Static-Sensitive
 Devices
 Handle only
 at Static-Safe
 Workstations

Reusable
 Container
 Do Not
 Destroy

- 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.
- 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.

Troubleshooting guide

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.	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 sure the input fuses or circuit breakers are properly sized.	1. Perform the <i>Input Rectifier Test Procedure</i> . 2. Perform the <i>Switch Board Test Procedure</i> .
The machine is 'dead'. No light, no output, the machine appears to have no input power.	1. Make sure the input power switch is in the ON position. 2. Check the main input fuses or breakers to make sure all three phases of the correct input power is present at the machine. 3. Check lead 'A' located at the reconnect block. Make certain it is connected to the proper input voltage position.	1. Check the input switch SW1 for proper operation. Also check the associated leads for loose or faulty connections. See Wiring Diagram. 2. Perform the <i>Input Switch Test Procedure</i> . 3. Perform the <i>Auxiliary Transformer (T2) Test Procedure</i> . 4. Perform the <i>Auxiliary Rectifier (D3) Test Procedure</i> .
There is no welding output from the Flextec 650x machine. NOTE: This problem may be accompanied by an error code.	1. Make sure the weld terminals switch (S3) is in the "ON" position. 2. Make certain the correct three phase input power is being applied to the machine. The input may be too high or too low. If this is the case error 711 will be displayed. 3. There may be a thermal shutdown. Check the thermal LED.	1. Perform the <i>Auxiliary Transformer (T2) Test Procedure</i> . 2. Perform the <i>Input Rectifier Test Procedure</i> . 3. Perform the <i>Switch Board Test Procedure</i> . 4. Perform the <i>Output Rectifier Test Procedure</i> . 5. Perform the <i>Auxiliary Rectifier (D3) Test Procedure</i> . 6. Perform the <i>Fan And F.A.N. Circuit Test Procedure</i> .
⚠ 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.	<ol style="list-style-type: none"> 1. The welding application may be exceeding the recommended duty cycle and/or limits of the machine. 2. Dirt or dust may have clogged the cooling channels inside the machine. 3. Air intake and exhaust louvers may be blocked due to inadequate clearance around the machine. 4. Make sure the fan is functioning correctly. The Flextec 650x is equipped with F.A.N. (fan as needed) circuitry. The fan runs whenever the output current is established and will continue running for approximately five minutes after the output current is disabled. 	<ol style="list-style-type: none"> 1. Perform the <i>Thermal Protection Thermostat Test Procedure.</i> 2. Perform the <i>Thermostat 3 Test Procedure.</i> 3. Perform the <i>Fan And F.A.N. Circuit Test Procedure.</i>
The machine turns on but the display is not visible, flickers or has missing digits.	<ol style="list-style-type: none"> 1. Turn the machine off and then back on to re-boot. 2. Check for loose or faulty connections to the user interface board. See Wiring Diagram. 	<ol style="list-style-type: none"> 1. Perform the <i>User Interface Board Test Procedure.</i>
The fan is running at all times.	<ol style="list-style-type: none"> 1. Check for 115 volt overload and/or misconnect overheating. 	<ol style="list-style-type: none"> 1. Perform the <i>Auxiliary Transformer (T2) Test Procedure.</i> 2. Perform the <i>Thermal Protection Thermostat Test Procedure.</i> 3. Perform the <i>Switch Board Test Procedure.</i>
 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
WELD AND ARC QUALITY PROBLEMS		
There is a general degradation of the welding performance.	<ol style="list-style-type: none"> 1. Make sure the correct three phase input is being applied to the machine. 2. Make sure the machine’s controls are set correctly for the welding process being used. 3. Check for poor connections or “loops” in the welding cables. 4. If using a wire feeder, check for the correct and consistent wire feed speed at the wire feeder. 	<ol style="list-style-type: none"> 1. Perform the <i>Choke Test Procedure.</i> 2. Perform the <i>Switch Board Test Procedure.</i> 3. Perform the <i>Current Transducer (LEM) Test Procedure.</i> 4. Perform the <i>Main Transformer Test Procedure.</i> 5. Perform the <i>40VDC Bus Board Test Procedure.</i>
The machine loses output during a weld.	<ol style="list-style-type: none"> 1. A secondary over-current may have occurred. The welding application may have exceeded the current limitations of the machine. 2. Make sure the correct three phase input power is being applied to the machine. 	<ol style="list-style-type: none"> 1. Perform the <i>Input Rectifier Test Procedure.</i>
 CAUTION		
<p>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.</p>		

Observe Safety Guidelines detailed in the beginning of this manual.		TROUBLESHOOTING GUIDE
PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
CrossLinc™ function does not work.	<ol style="list-style-type: none"> 1. Make sure a compatible wire feeder (LN-25X) is connected to Flextec 650x. 2. The weld voltage can only be adjusted from the LN-25X when the Flextec 650x is in an OCV condition, not welding. 3. The green CrossLinc™ LEDs on both machines must be illuminated. 	<ol style="list-style-type: none"> 1. Check the cables between the power source and the feeder. The voltage drop must be less than 10 VDC.
<div style="background-color: black; color: white; padding: 5px; display: inline-block;">  CAUTION </div>		
<p>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.</p>		

USING THE STATUS LED TO TROUBLESHOOT SYSTEM PROBLEMS

Errors are displayed on the amperage and voltage display meters. In addition, there are status lights on the user interface board and the switch board that contain error sequences. Included in this section is information about the fault codes indicated on the status lights and some basic troubleshooting charts for both machine and weld performance.

The status lights on the user interface board and the switch board are dual-color LED's. Normal operation for each is steady green.

Observe Safety Guidelines detailed in the beginning of this manual.		ERROR CODES	
ERROR CODE #	DESCRIPTION	POSSIBLE CAUSE	CORRECTIVE ACTION
21	Device that controls sequence of the welding operation halted due to an error.		Weld Terminals Remote: Re-trigger to recover from error. Weld Terminals Local: Toggle Remote/Local switch to recover from error.
31	Primary Over Current.	Check the input power (voltage and frequency). Verify the primary reconnect is properly configured for the input voltage.	Machine needs to be turned off and back on to reset.
36	Thermal Fault.	Machine shut off output due to elevated internal temperatures.	<ol style="list-style-type: none"> 1. Check for material blocking intake or exhaust louvers. <ul style="list-style-type: none"> • Blow air in the rear louvers to clear dirt from the fan. <p>NOTE: The Fan As Needed circuitry automatically shuts off the fan five minutes after welding has stopped.</p> 2. Welding output ratings may have been exceeded. Allow the machine to cool down and reset.

 **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	
ERROR CODE #	DESCRIPTION	POSSIBLE CAUSE	CORRECTIVE ACTION
45	VRD™ Voltage limit exceeded.	During OCV, the voltage exceeded allowable VRD™ levels. • Verify dipswitch settings are correct for the input voltage.	Machine needs to be turned off and back on to reset.
712	Communication Fault.	CAN communication between the control PCB and switch PCB has been interrupted.	Inspect harness for damage/loose connections.
713	Input Power Misconnect. Supply Voltage is too high.	Occurs upon power up when the supply voltage to the switch PCB exceeded acceptable levels.	Verify the primary reconnect is properly configured for the input voltage. Machine needs to be turned off and back on to reset.
714	Input Power Misconnect. Supply Voltage is too low.	Occurs upon power up when the supply voltage to the switch PCB is below acceptable levels.	Verify the primary reconnect is properly configured for the input voltage. Machine needs to be turned OFF and back ON to reset.
715	Under Voltage Lockout.	The supply voltage to the switch PCB is below acceptable levels.	Machine needs to be turned OFF and back ON to reset.
719	Switch PCB Error.		Machine needs to be turned OFF and back ON to reset.
⚠ 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.			

Test Procedures

CASE COVER REMOVAL AND REPLACEMENT PROCEDURE

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 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

3/8" Nutdriver

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650X machine.
2. Remove the two lifting eyelets from the roof of the machine. See **Figure F.1**.
3. Using a 3/8" nutdriver remove the six long screws securing the roof panel onto the machine. See **Figure F.1**.
4. Using a 3/8" nutdriver, remove the four screws securing the right case side to the machine. See **Figure F.2**.
5. Using a 3/8" nutdriver, remove the four screws securing the left case side to the machine. See **Figure F.2**.
6. Perform any tests /replacement procedures.

REPLACEMENT PROCEDURE

1. Carefully position the left case side panel onto the machine.
2. Using a 3/8" nutdriver, attach the four screws securing the left case side panel to the machine.
3. Carefully position the right case side panel onto the machine.
4. Using a 3/8" nutdriver, attach the four screws securing the right case side panel to the machine.
5. Carefully position the roof panel onto the machine.
6. Using a 3/8" nutdriver, attach the six screws securing the roof panel to the machine.
7. Attach the two lifting eyelets to the roof of the machine.

Figure F.1 – Fuel cap, lift bail cover seal, rain cap, door slide rail, engine service access door, roof panel and fuel trough locations

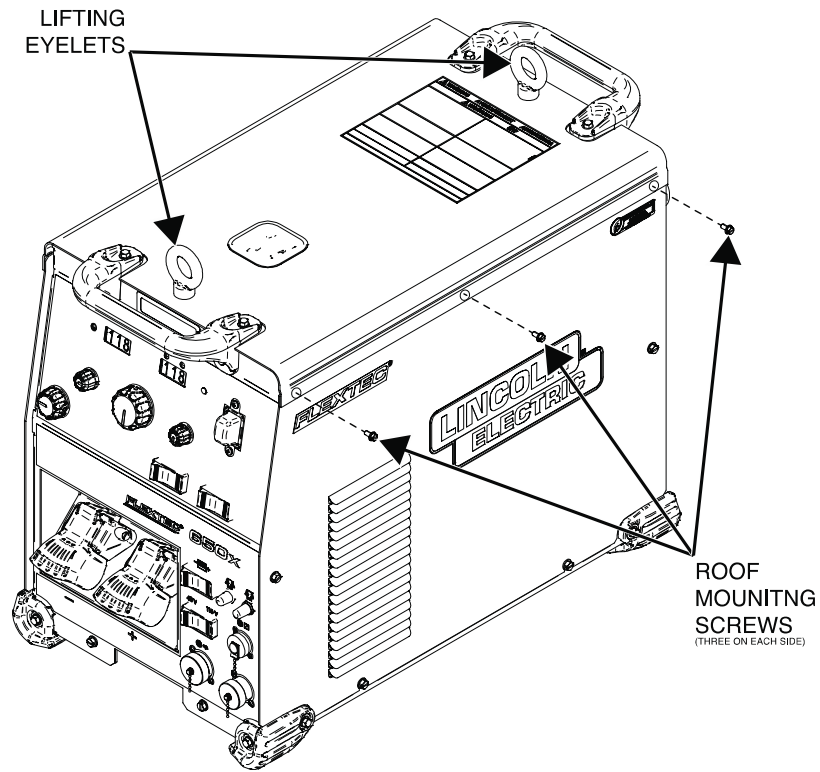
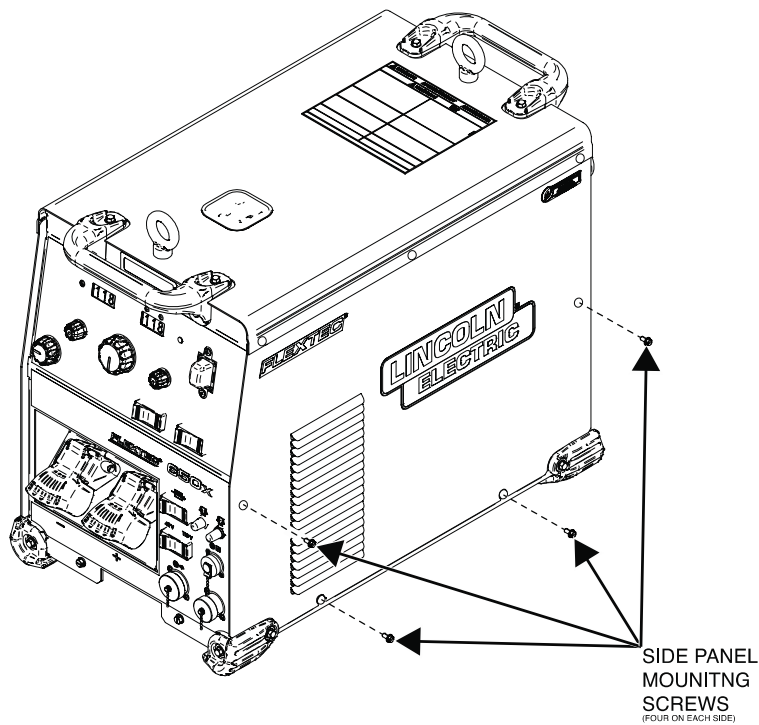


Figure F.2 – Case side mounting hardware locations



CAPACITOR DISCHARGE PROCEDURE

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 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 help determine if the Capacitors are discharged.

MATERIALS NEEDED

Resistor (25-1000 ohms and 25 watts minimum) Lincoln Part #S01404-114 Works Well For This Purpose
Electrically Insulated Gloves
Electrically Insulated Pliers
Jumper Leads
Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the two large bolted connections on the switch board labeled "207" and "209". See **Figure F.3**. See Wiring Diagram.
4. Using a 25 watt or more resistor (25 to 1000 ohm) connected to two test leads, carefully discharge the capacitors.
5. Using a digital volt/ohmmeter, ensure the capacitors are discharged by connecting the positive meter probe to "209" and the negative meter probe to "207" on the switch board. The voltage should be zero, if not repeat the discharge procedure. See Wiring Diagram.
6. Locate the capacitor C1 on the front of the divider panel. See **Figure F.4**. See Wiring Diagram.
7. Using a 25 watt or more resistor (25 to 1000 ohm) connected to two test leads, carefully discharge the capacitor (C1). See **Figure F.4**.
8. Using a digital volt/ohmmeter, ensure the capacitor (C1) is discharged by connecting the positive meter probe to positive terminal and the negative meter probe to the negative terminal of the capacitor (C1). The voltage should be zero, if not repeat the discharge procedure. See Wiring Diagram.

Figure F.3 – Switch board connections 207 and 209 location

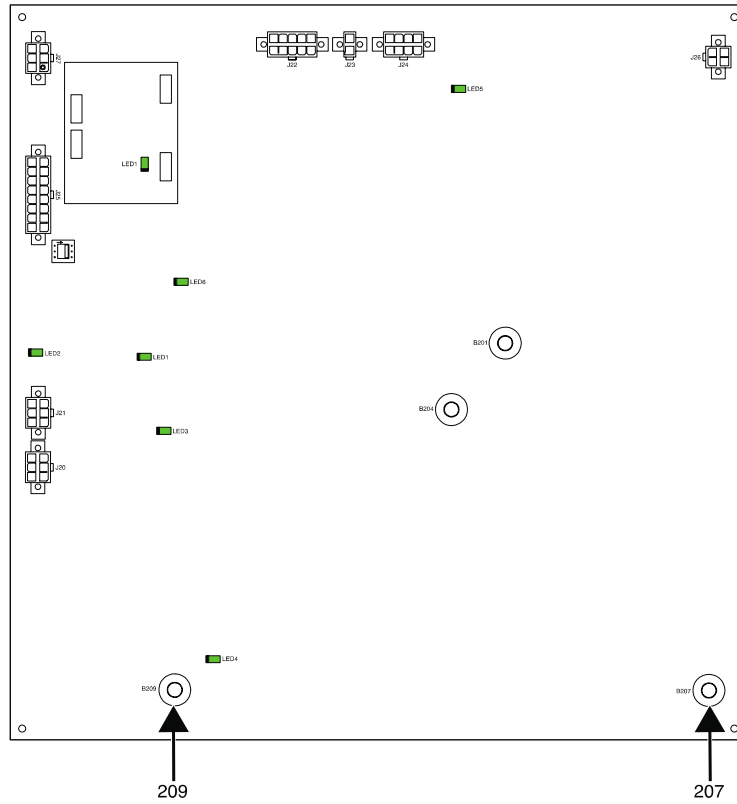
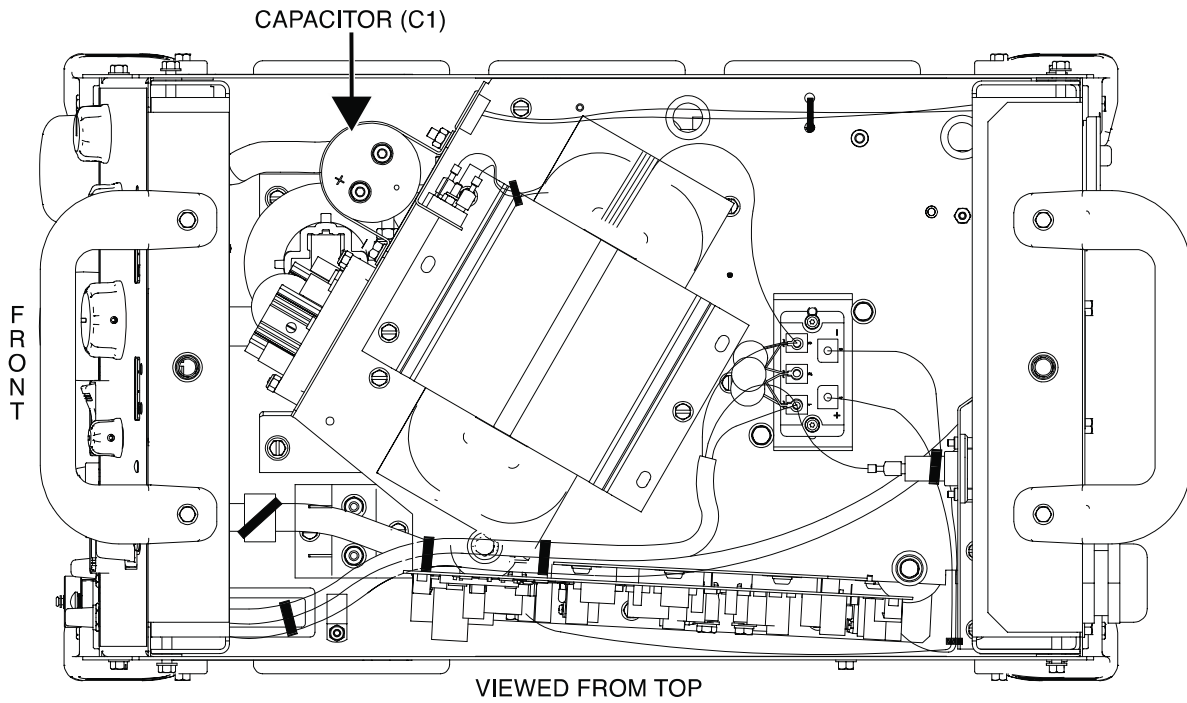


Figure F.4 – Capacitor (C1) location



THERMOSTAT 3 (AUXILIARY TRANSFORMER THERMOSTAT) TEST PROCEDURE

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 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 Thermostat 3 (Auxiliary Transformer Thermostat) is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Thermostat 3 is part of the auxiliary transformer. See **Figure F.5**. See Wiring Diagram.
5. Locate plug J25 on the switch board. See **Figure F.6**. See Wiring Diagram. Label and disconnect plug J25 from the switch board.
6. Using a volt/ohmmeter, measure the resistance between pin 10 (lead 226) and pin 2 (lead 227) on plug J25. See **Figure F.7**. See Wiring Diagram. The resistance should be very low (less than one ohm).
7. If the resistance is greater than one ohm, thermostat 3 may be faulty.
8. When testing is complete, attach plug J25 to the switch board. See Wiring Diagram.
9. Perform the **Case Cover Replacement Procedure**.

Figure F.5 – Auxiliary transformer location

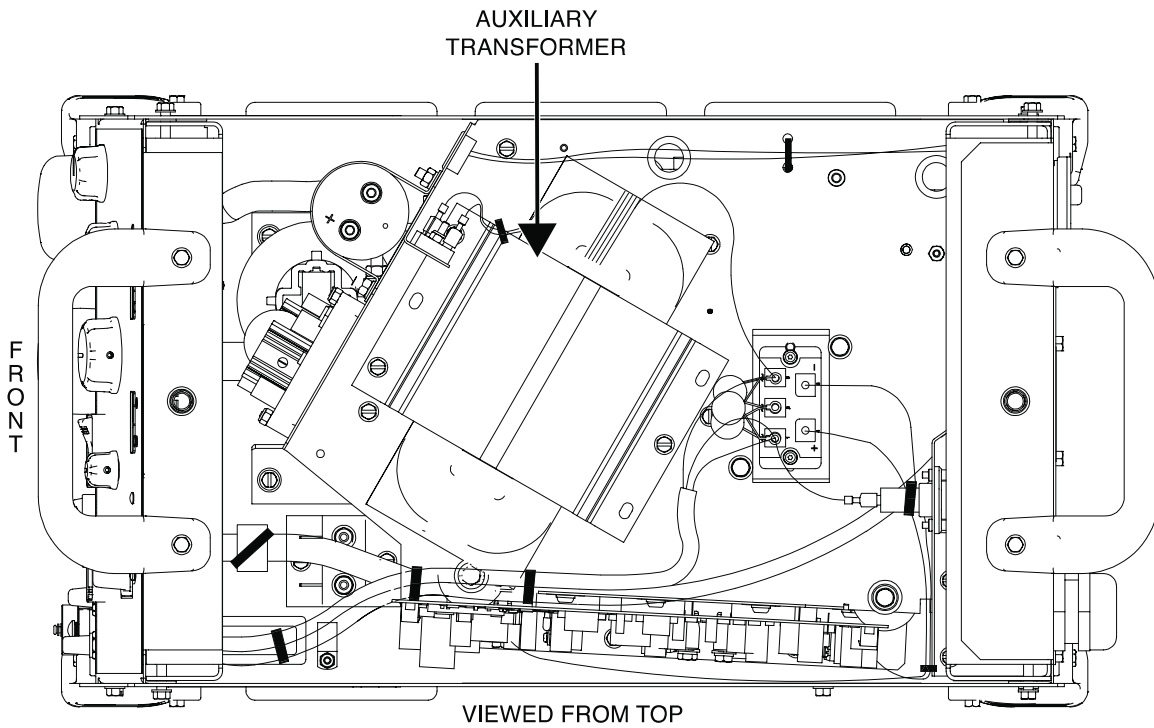


Figure F.6 – Switch board plug J25 location

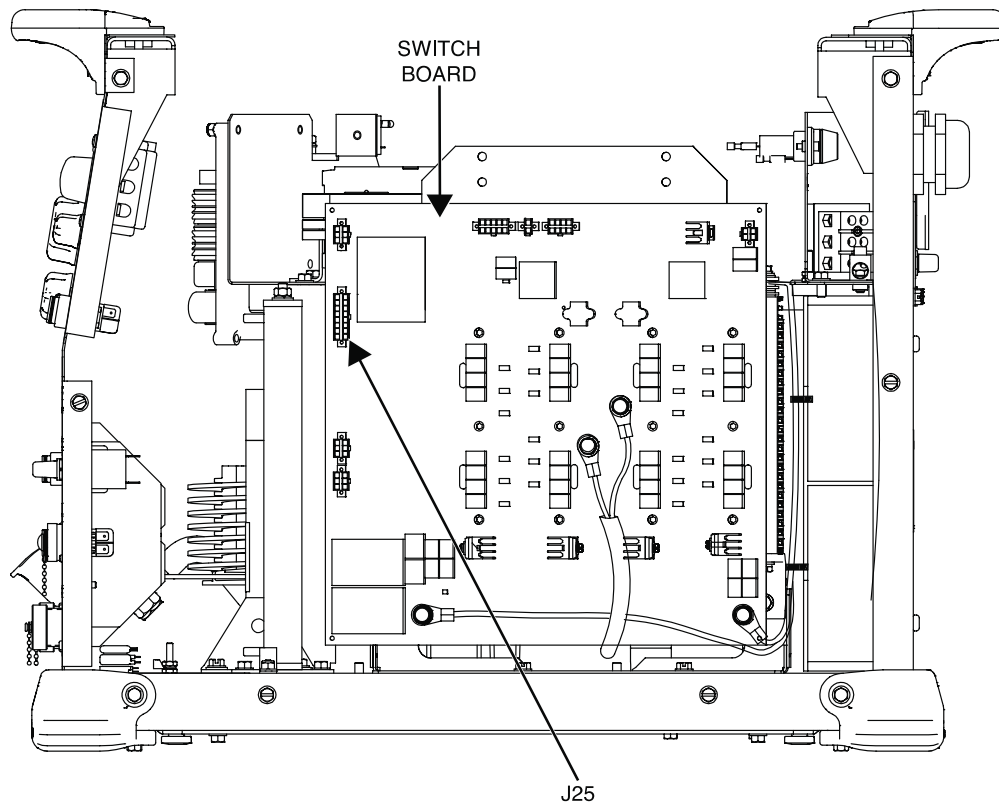
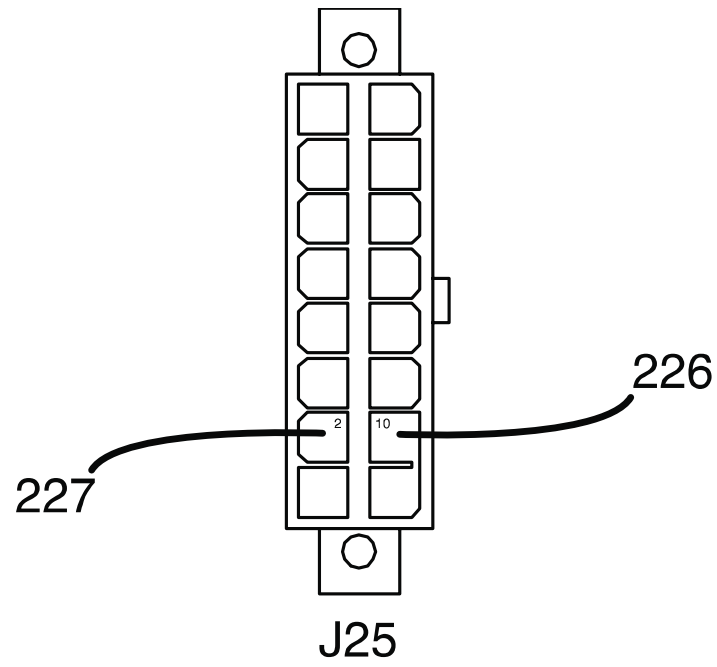


Figure F.7 – Plug J20 lead locations



THERMAL PROTECTION THERMOSTAT TEST PROCEDURE

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 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 Thermostats 1 and 2 are intermittently opening or is fully open.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate plug J25 on the switch board. See **Figure F.8**. See Wiring Diagram. Label and disconnect plug J25 from the switch board.
5. Using a volt/ohmmeter, measure the resistance between pin 13 (lead 225) and pin 5 (lead 224) on plug J25. See **Figures F.8** and **F.9**. See Wiring Diagram. Resistance should be very low (less than one ohm).
6. If the resistance is greater than one ohm, check the leads, connections to the two thermostats.
7. Label and disconnect leads from thermostats and retest thermostats 1 and 2 individually. See Wiring Diagram.
8. If thermostat 2 is faulty, perform the **Thermostat 2 Removal And Replacement Procedure**.
9. When testing is complete, connect plug J25 to the switch board. See Wiring Diagram.
10. Perform the **Case Cover Replacement Procedure**.

Figure F.8 – Switch board plug J25 location

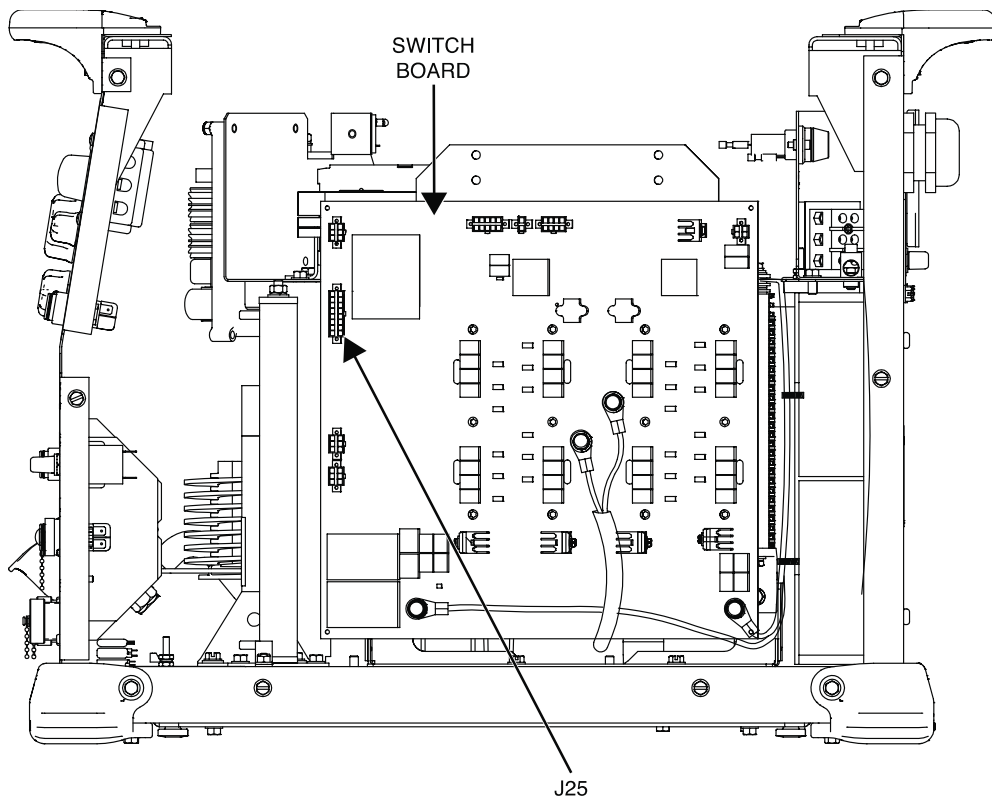
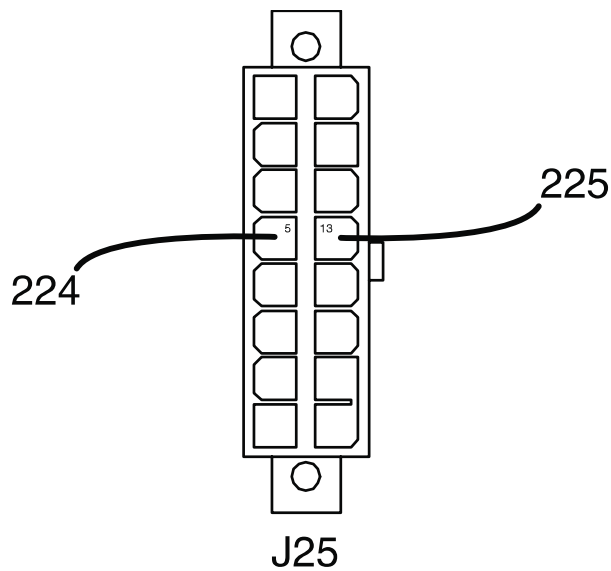


Figure F.9 – Plug J25 lead locations



OUTPUT RECTIFIER TEST PROCEDURE

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 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 functioning properly.

MATERIALS NEEDED

1/2" Nutdriver
Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the output rectifier. See **Figure F.10**. See Wiring Diagram.
5. Using a 1/2" nutdriver, remove the two nuts, lock washers and flat washers securing transformer leads X1 and X3 to the output rectifier. See **Figure F.11**. See Wiring Diagram. Label and disconnect transformer leads X1 and X3.
6. Using a 1/2" nutdriver, remove the bolt, lock washer and flat washer securing choke lead 220 to the output rectifier heat sink. See **Figure F.11**. See Wiring Diagram. Label and disconnect choke lead 220.
7. Using a volt/ohmmeter, perform the diode drop tests outlined in **Table F.1**. See **Figure F.10**. See Wiring Diagram.
8. If the tests determine that the diodes are shorted or open the output rectifier may be faulty.
9. If faulty, perform the **Output Rectifier Removal And Replacement Procedure**.
10. Using a 1/2" nutdriver, attach the bolt, lock washer and flat washer securing choke lead 220 to the output rectifier heat sink. See Wiring Diagram.
11. Using a 1/2" nutdriver, attach the two nuts, lock washers and flat washers securing transformer leads X1 and X3 to the output rectifier. See Wiring Diagram.
12. Perform the **Case Cover Replacement Procedure**.

Table F.1 – Output rectifier diode drop tests

TEST POINT (POS)	TEST POINT (NEG)	EXPECTED READING
TOP OUTPUT RECTIFIER TERMINAL (X1)	OUTPUT RECTIFIER HEAT SINK	0.2V – 0.7V
BOTTOM OUTPUT RECTIFIER TERMINAL (X3)	OUTPUT RECTIFIER HEAT SINK	0.2V – 0.7V

Figure F.10 – Output rectifier location

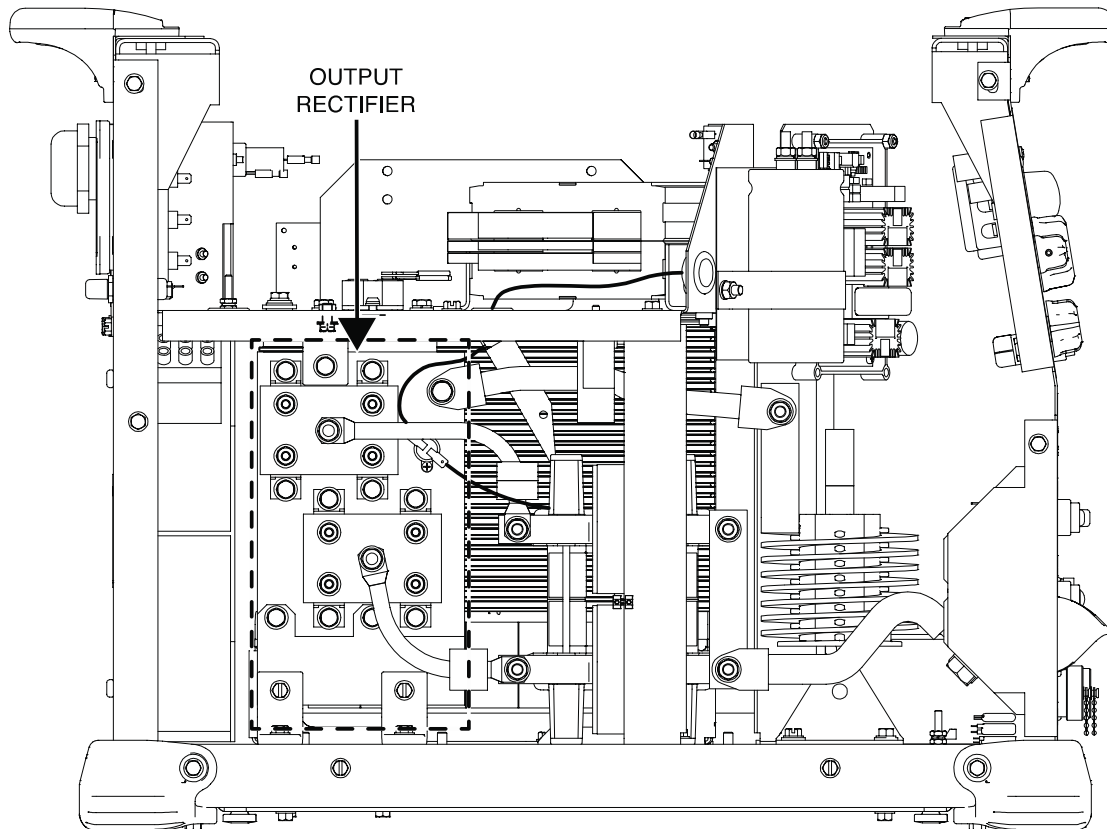
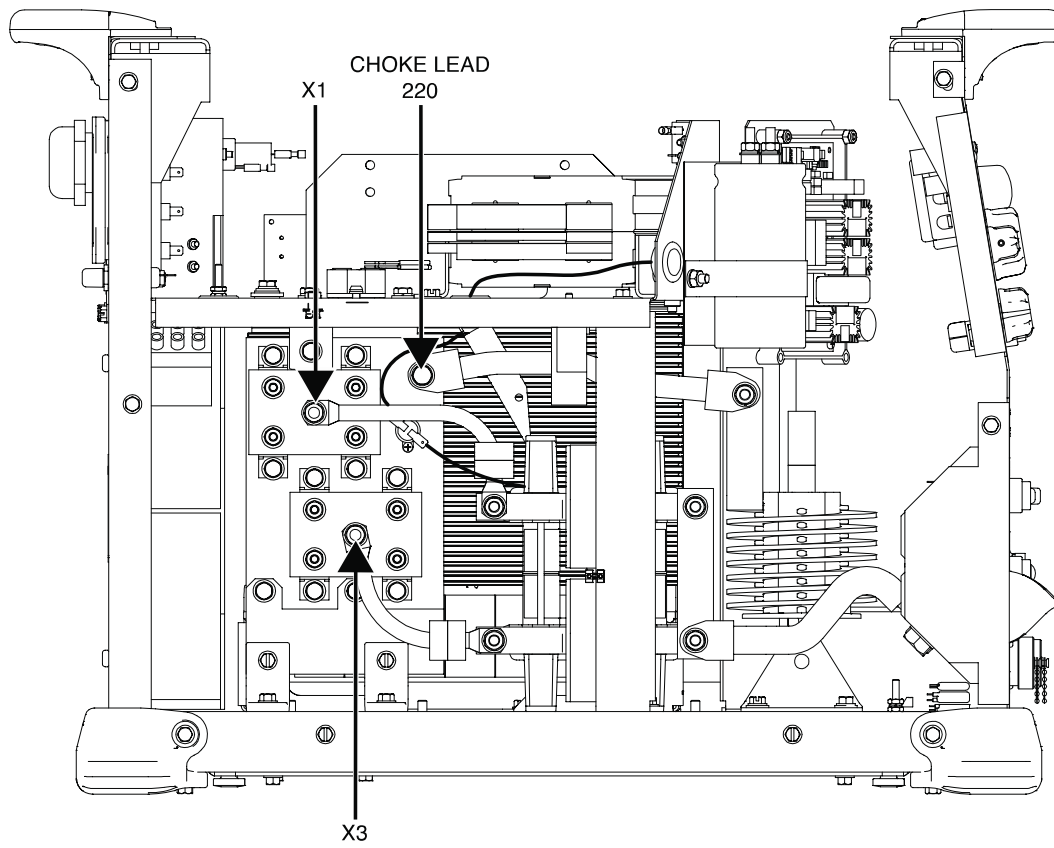


Figure F.11 – Output rectifier lead location



USER INTERFACE BOARD TEST PROCEDURE

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 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 User Interface Board is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter

Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the user interface board. See **Figure F.12**. See Wiring Diagram.
5. Carefully apply the correct input power to the Flextec 650x machine and turn ON the machine.
6. Check the LEDs per **Tables F.2** and **F.3**. See **Figures F.13** and **F.14** for LED locations.
7. Using a volt/ohmmeter, perform the voltage tests outlined in **Table F.4**. See **Figures F.13** and **F.14**. See Wiring Diagram.
8. If any of the tests fail, the user interface board may be faulty.
9. If faulty, perform the **User Interface Board Removal And Replacement Procedure**.
10. Perform the **Case Cover Replacement Procedure**.

Table F.2 – User interface board LED tests

LED #	COLOR	FUNCTION
1	AMBER	THERMAL LED
2	GREEN	VRD LED VOLTAGE REDUCED
3	RED	VRD LED VOLTAGE NOT REDUCED
4	GREEN	STATUS "OK"
4	RED	STATUS "ERROR" (CHECK CODE FOR SPECIFIC ERROR)
5	GREEN	+15 VDC POWER SUPPLY "OK"

Table F.3 – User interface board LED status

LIGHT CONDITION	MEANING
STEADY GREEN	SYSTEM OK.
ALTERNATING GREEN AND RED	A SYSTEM FAULT HAS OCCURRED. IF THE USER INTERFACE BOARD STATUS LED IS FLASHING ANY COMBINATION OF RED AND GREEN, ERRORS ARE PRESENT. 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. SEE ERROR CODES IN TROUBLE SHOOTING GUIDE.

Table F.4 – User interface board voltage tests

DESCRIPTION	METER TEST POINTS AND POLARITY	EXPECTED READINGS	CONDITIONS
INPUT SUPPLY VOLTAGE	PLUG J4 PIN 4(+) TO PLUG J4 PIN 3(-)	65 – 75 VDC NOMINAL	CORRECT INPUT POWER APPLIED TO MACHINE. IF NOT CORRECT, CHECK THE AUXILIARY TRANSFORMER AND AUXILIARY RECTIFIER FOR PROPER OPERATION.
LOCAL/REMOTE SWITCH INPUT	PLUG J3 PIN 3 (+) TO PLUG J3 PIN 10 (-)	15 VDC	CORRECT INPUT POWER APPLIED TO MACHINE. LOCAL/REMOTE SWITCH OPEN.
WELD TERMINAL SWITCH INPUT	PLUG J3 PIN 4 (+) TO PLUG J3 PIN 9 (-)	15 VDC	CORRECT INPUT POWER APPLIED TO MACHINE. WELD TERMINAL SWITCH IN 'REMOTE' POSITION.
POWER SUPPLY TO OUTPUT CONTROL KNOB	PLUG J1 PIN 8 (+) TO PLUG J1 PIN 3 (-)	10 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.
POWER SUPPLY TO HOT START POT	PLUG J1 PIN 7 (+) TO PLUG J1 PIN 2 (-)	10 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.
POWER SUPPLY TO ARC CONTROL POT	PLUG J1 PIN 7 (+) TO PLUG J1 PIN 1 (-)	10 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.
REMOTE TRIGGER	PLUG J2 PIN 9 (+) TO PLUG J2 PIN 10 (-)	+15 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.
CAN COMMUNICATION	PLUG J4 PIN 1 (+) TO PLUG J4 PIN 2 (-)	2 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.

Figure F.12 – User interface board location

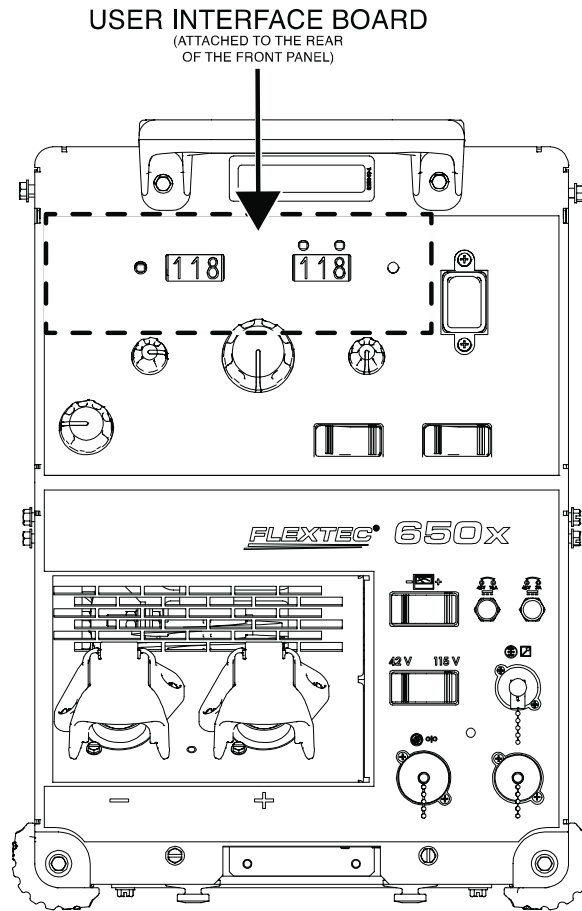


Figure F.13 – User interface board plug and LED locations

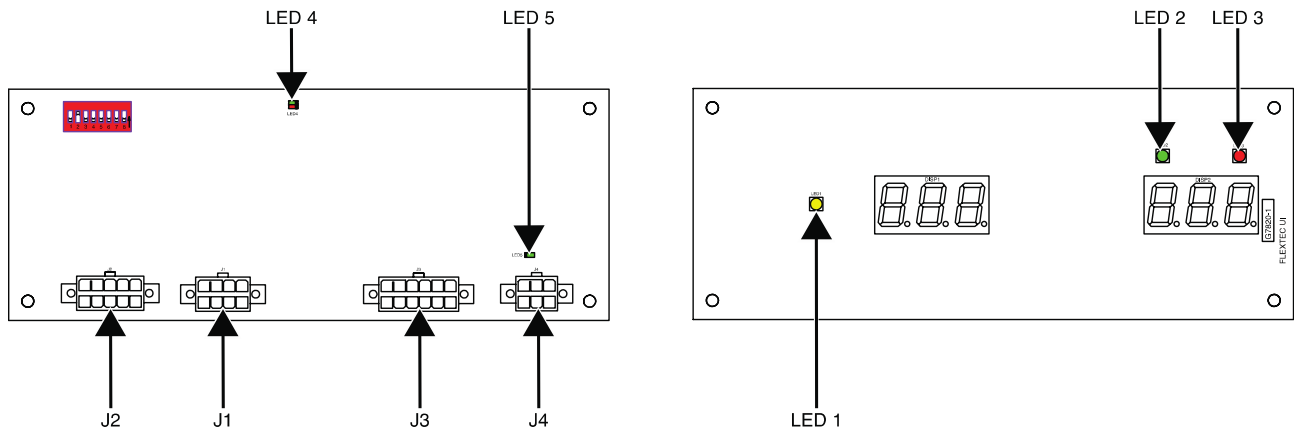
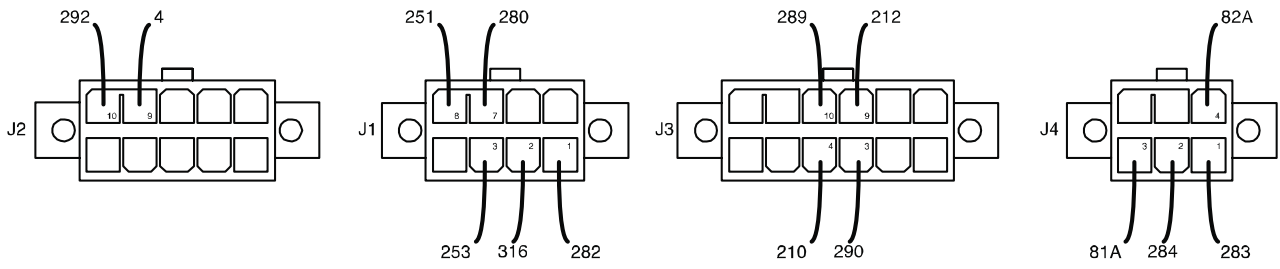


Figure F.14 – User interface board lead locations



SWITCH BOARD TEST PROCEDURE

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 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 Switch Board has many functions and components. This test will determine if the Switch Board is receiving the correct voltages and also if the Switch Board is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the switch board on the right side of the machine. See **Figure F.15**.
5. Carefully apply the correct input power to the machine. Check the LEDs per **Tables F.5** and **F.6**. See **Figure F.16** for LED locations.
6. If the LEDs are not indicating a properly functioning switch board (per **Table F.X**) proceed with the following steps.
7. Check the switch board voltages per **Table F.7**. See **Figure F.16** for test point locations.
8. Remove the input power and check the switch board resistances per **Table F.8**. See **Figures F.16** and **F.17** for test point locations.
9. If any of the above tests are not correct the switch board may be faulty.
10. If faulty, perform the **Switch Board Removal and Replacement Procedure**.
11. Replace all plugs and leads that may have been disconnected.
12. Perform the **Case Cover Replacement Procedure**.

Table F.5 – Switch board LED tests

LED #	COLOR	FUNCTION
1	GREEN	+ 15V POWER SUPPLY "OK"
2	GREEN	+5V CAN POWER SUPPLY "OK"
3	GREEN	+5V ISOLATED POWER SUPPLY "OK"
4	GREEN	DC BUS VOLTAGE EXCEEDS 50V
5	GREEN	FAN "ON"
6	GREEN	STATUS "OK"
1	GREEN	STATUS (LOCATED ON INVERTER CONTROL MODULE)

Table F.6 – Switch board LED status

LIGHT CONDITION	MEANING
STEADY GREEN	SYSTEM OK.
BLINKING GREEN	OCCURS DURING STARTUP OR RESET AND INDICATES THAT THE SWITCH BOARD IS WAITING FOR COMMUNICATION FROM THE CONTROL BOARD. NORMAL FOR THE FIRST 1-10 SECONDS AFTER POWER IS TRUNED ON.
ALTERNATING GREEN AND RED	A SYSTEM FAULT HAS OCCURRED. IF THE SWITCH BOARD STATUS LED IS FLASHING ANY COMBINATION OF RED AND GREEN, ERROR ARE PRESENT. INDIVIDUAL CODE DIGITS ARE FLASHED IN RED WITH A LONG PAUSE BETWEEN DIGITS. IF MORE THAT ONE CODE IS PRESENT, THE CODES WILL BE SEPARATED BY A GREEN LIGHT. SEE ERROR CODES IN TROUBLE SHOOTING GUIDE.

Table F.7 – Switch board resistance tests

TEST POINTS (POS)	TEST POINTS (NEG)	EXPECTED READINGS	MACHINE CONDITION
201	209	0.2 – 0.7 VDC	MACHINE "OFF" NO INPUT POWER APPLIED.
207	204	0.2 – 0.7 VDC	MACHINE "OFF" NO INPUT POWER APPLIED.
207	201	0.2 – 0.7 VDC	MACHINE "OFF" NO INPUT POWER APPLIED.
PLUG J22 PIN 1 (LEAD 220A)	POSITIVE OUTPUT TERMINAL	LESS THAN ONE OHM	MACHINE "OFF" NO INPUT POWER APPLIED.
PLUG J23 PIN 2 (LEAD 220F)	POSITIVE OUTPUT TERMINAL	LESS THAN ONE OHM	MACHINE "OFF" NO INPUT POWER APPLIED.
PLUG J22 PIN 2 (LEAD 221)	NEGATIVE OUTPUT TERMINAL	LESS THAN ONE OHM	MACHINE "OFF" NO INPUT POWER APPLIED.
PLUG J23 PIN 1 (LEAD 221F)	NEGATIVE OUTPUT TERMINAL	LESS THAN ONE OHM	MACHINE "OFF" NO INPUT POWER APPLIED.

Table F.8 – Switch board voltage tests

DESCRIPTION	METER TEST POINTS AND POLARITY	EXPECTED READINGS	CONDITIONS
RECTIFIED AND FILTERED INPUT VOLTAGE	B209(+) TO B207(-)	535 VDC TO 815 VDC DEPENDING UPON THE INPUT VOLTAGE (380 VAC TO 575 VAC)	CORRECT INPUT POWER APPLIED TO MACHINE. IF NOT CORRECT, PREFORM THE INPUT RECTIFIER TEST PROCEDURE .
INPUT SUPPLY VOLTAGE FROM DC BUS BOARD	PLUG J21 PIN 4 (+) TO PLUG J21 PIN 3 (-)	40 VDC	CORRECT INPUT POWER APPLIED TO MACHINE. IF NOT CORRECT, PERFORM THE 40VDC BUS BOARD TEST PROCEDURE . ALSO CHECK THE AUXILIARY TRANSFORMER AND AUXILIARY RECTIFIER FOR PROPER OPERATION.
FAN SUPPLY VOLTAGE FROM AUXILIARY TRANSFORMER	PLUG J26 PIN 2 (+) TO PLUG J26 PIN 1 (-)	115 VAC WHEN FAN IS NOT ENERGIZED	CORRECT INPUT POWER APPLIED TO MACHINE. THE FAN SHOULD BE ENERGIZED WHEN WELDING CURRENT IS DETECTED BY THE OUTPUT CURRENT TRANSDUCER. SEE WIRING DIAGRAM.
CROSSLINC LED	PLUG J25 PIN 4 (+) TO PLUG J25 PIN 12 (-)	15 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.
POSITIVE VOLTAGE SUPPLY TO CURRENT TRANSDUCER	PLUG J22 PIN 4 (+) TO PLUG J22 PIN 9 (-)	+15 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.
NEGATIVE VOLTAGE SUPPLY TO CURRENT TRANSDUCER	PLUG J22 PIN 5 (+) TO PLUG J22 PIN 9 (-)	-15 VDC	CORRECT INPUT POWER APPLIED TO MACHINE.

Figure F.15 – Switch board location

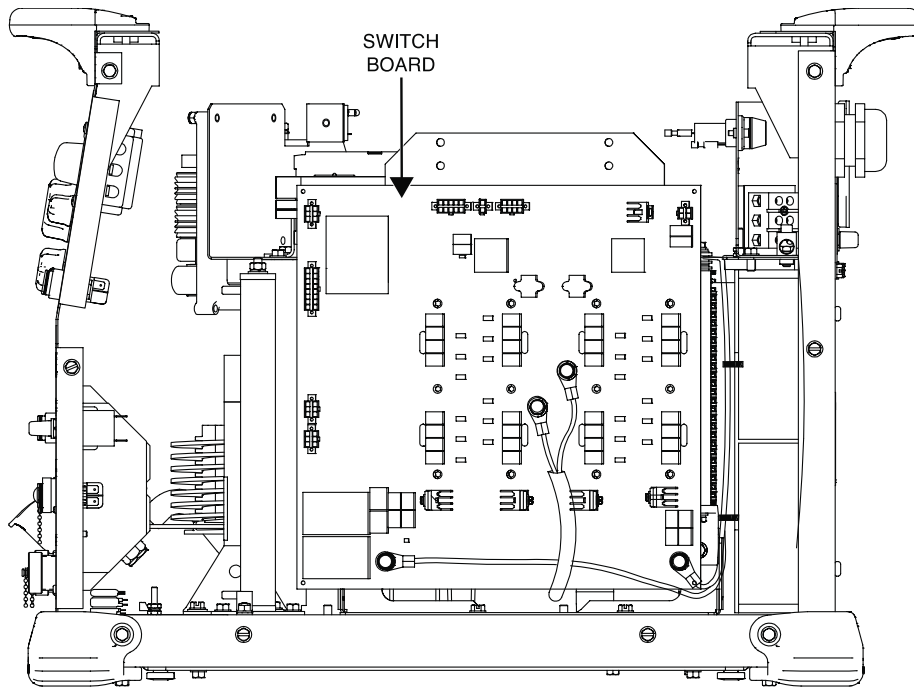


Figure F.16 – Switch board plug, terminal and LED locations

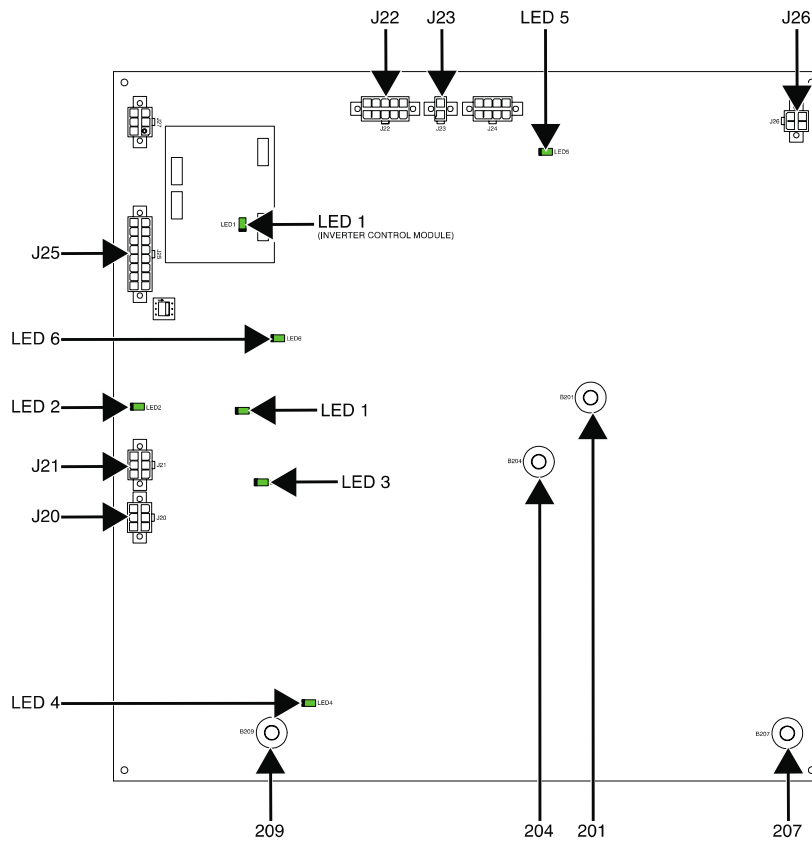
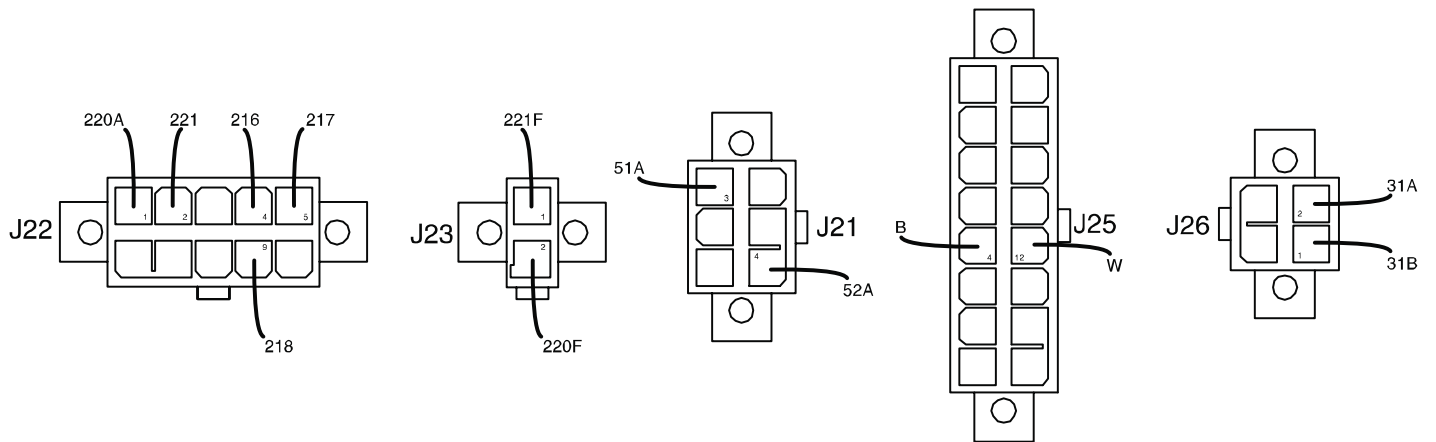


Figure F.17 – Switch board lead locations



CURRENT TRANSDUCER (LEM) TEST PROCEDURE

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 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 Current Transducer (LEM) is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Load Bank
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the current transducer. See **Figure F.18**. See Wiring Diagram.
5. Locate plug J22 on the switch board. See **Figure F.19**. See Wiring Diagram.
6. Carefully apply the correct input power to the Flextec 650x machine and turn ON the machine.
7. Using a volt/ohmmeter, carefully check for the DC supply voltages to the current transducer per **Table F.9**. See **Figures F.19** and **F.20**. See Wiring Diagram.
NOTE: Do not attempt the check the voltages at the current transducer connector. The terminals are small and delicate and may be damaged if probed with meter leads.
8. If the correct voltages are NOT present at the switch board, perform the **Switch Board Test Procedure**.
9. Place the machine into a constant current output mode. Using a load bank, load the machine according to **Table F.10**.
10. Using a volt/ohmmeter, test the current transducer feedback versus actual output current. See **Table F.10**. See **Figures F.19** and **F.20**. See Wiring Diagram.
11. If the DC supply voltages are correct but the feedback voltages are incorrect the current transducer may be faulty.
12. If faulty, perform the **Current Transducer Removal And Replacement Procedure**.
13. Perform the **Case Cover Replacement Procedure**.

Table F.9 – DC supply voltages form switch board

DESCRIPTION	TEST POINT (+)	TEST POINT (-)	EXPECTED READING
POSITIVE VOLTAGE SUPPLY	PLUG J22 PIN 4 (LEAD 216)	PLUG J22 PIN 9 (LEAD 218)	+15 VDC
NEGATIVE VOLTAGE SUPPLY	PLUG J22 PIN 5 (LEAD 217)	PLUG J22 PIN 9 (LEAD 218)	-15 VDC

Table F.10 – Current transducer feedback versus actual output current

ACTUAL OUTPUT CURRENT (AMPS)	TEST POINT (POS)	TEST POINT (NEG)	CURRENT TRANSDUCER FEEDBACK VOLTAGE
500	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	4.0 VDC
450	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	3.6 VDC
400	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	3.2 VDC
350	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	2.8 VDC
300	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	2.4 VDC
250	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	2.0 VDC
200	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	1.6 VDC
150	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	1.2 VDC
100	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	0.8 VDC
50	PLUG J22 PIN 10 (LEAD 215)	PLUG J22 PIN 9 (LEAD 218)	0.4 VDC

Figure F.18 – Current transducer location

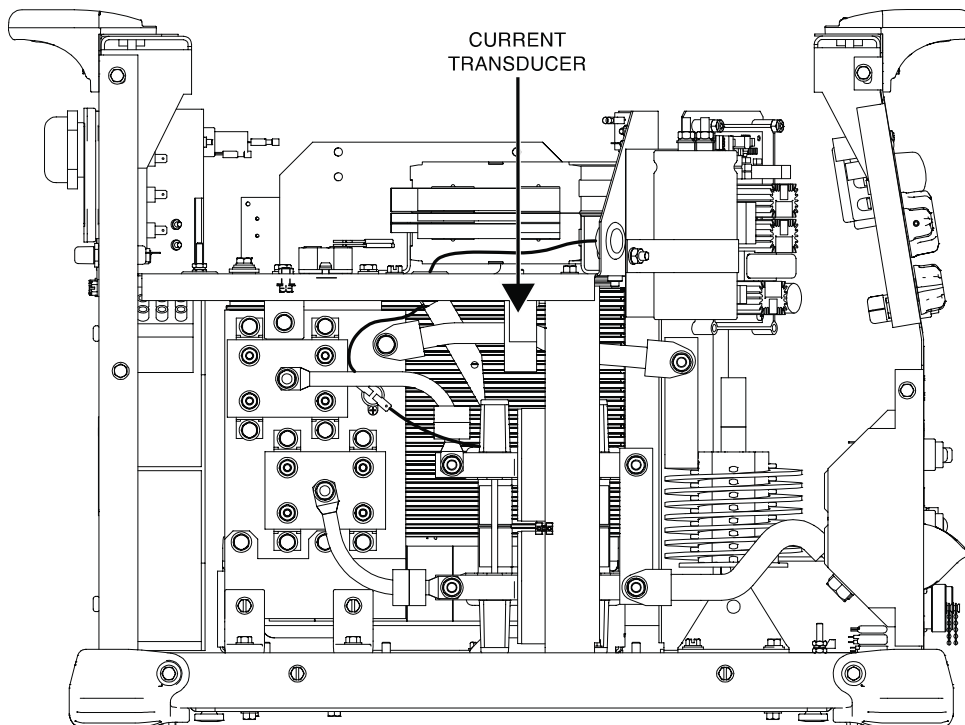


Figure F.19 – Switch board plug J22 location

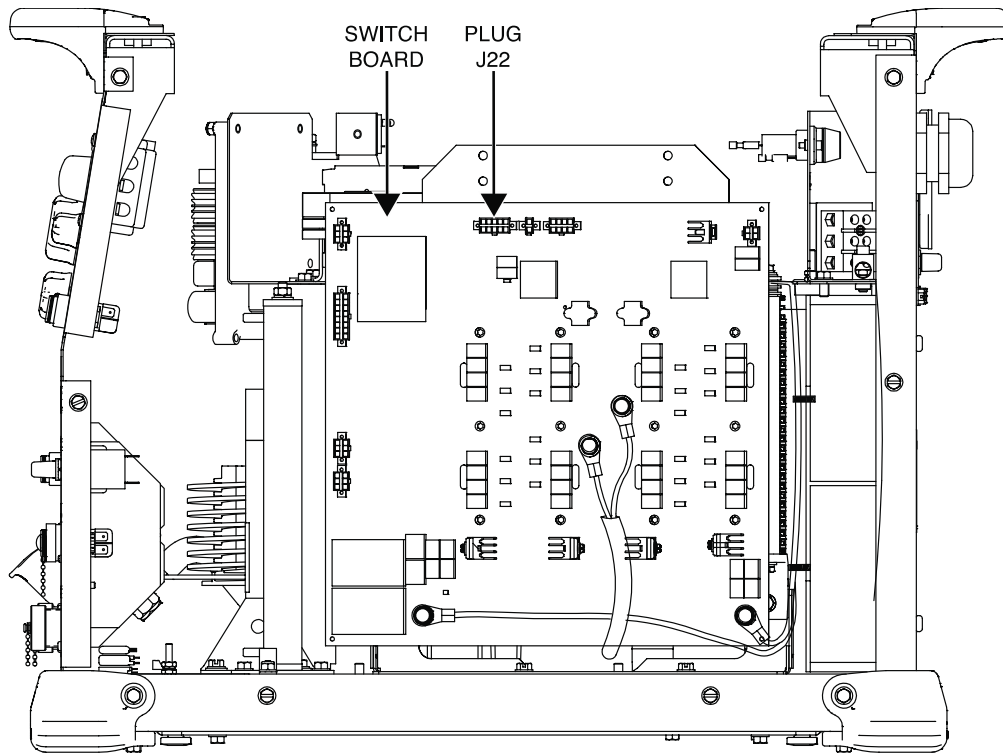
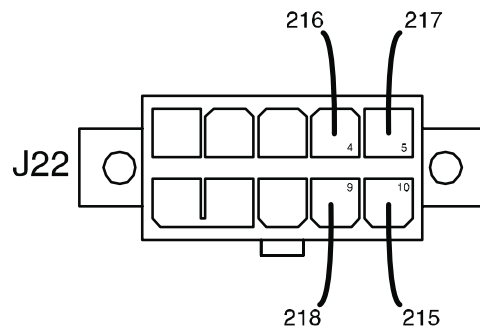


Figure F.20 – Switch board plug J22 lead locations



40VDC BUS BOARD TEST PROCEDURE

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 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 40VDC Bus Board is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Turn off the engine on the Cross Country 300 machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Carefully apply the correct input power to the Flextec 650X and turn ON the machine.
5. Locate the 40VDC bus board. See **Figure F.21**.
6. Locate the Red LED on the 40VDC bus board. See **Figure F.22**.
7. If the Red LED is illuminated the 40VDC bus board is receiving input voltage from the auxiliary rectifier (D3).
8. If the Red LED is blinking, carefully remove plug J2 from the 40VDC bus board. See **Figure F.22**. If the blinking stops and the Red LED stays illuminated and steady, this is an indication of a heavy load on the 40VDC output line. See Wiring Diagram.
9. If the Red LED is not illuminated, perform the **Auxiliary Transformer (T2) Test Procedure** and the **Auxiliary Rectifier (D3) Test Procedure**. See Wiring Diagram.
10. Using a digital volt/ohmmeter, perform the voltage tests outlined in **Table F.11**. See **Figure F.23**. See Wiring Diagram.
11. If the correct input voltage is being applied to the 40VDC bus board and the correct output voltages are not being generated, the 40VDC bus board may be faulty.
12. If faulty, perform the **40VDC Bus Board Removal And Replacement Procedure**.
13. Perform the **Case Cover Replacement Procedure**.

Table F.11 – 40VDC bus board voltage tests

DESCRIPTION	TEST POINT	TEST POINT	EXPECTED READING
INPUT FROM AUXILIARY RECTIFIER (D3)	PLUG J1 PIN 1 (+)	PLUG J1 PIN 4 (-)	65 – 75 VDC
INPUT FROM AUXILIARY RECTIFIER (D3)	PLUG J1 PIN 2 (+)	PLUG J1 PIN 4 (-)	65 – 75 VDC
OUTPUT TO SWITCH BOARD	PLUG J2 PIN 1 (+)	PLUG J2 PIN 3 (-)	40 VDC
OUTPUT TO REMOTE RECEPTACLES	PLUG J2 PIN 2 (+)	PLUG J2 PIN 8 (-)	40 VDC
OUTPUT TO REMOTE RECEPTACLES	PLUG J2 PIN 6 (+)	PLUG J2 PIN 8 (-)	40 VDC

Figure F.21 – 40VDC bus board location

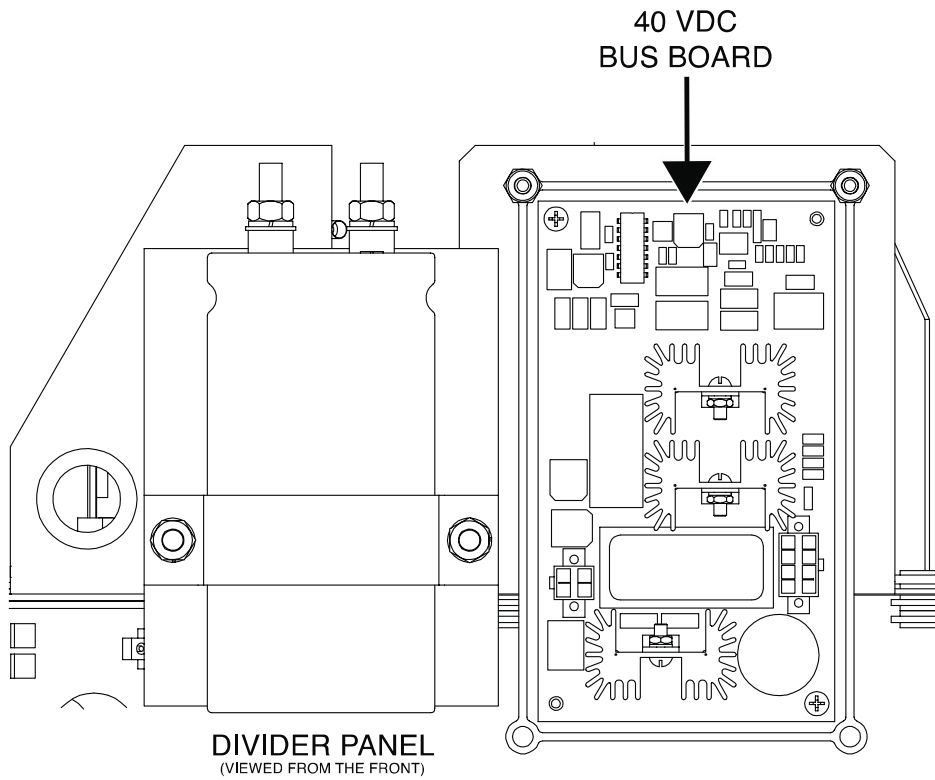


Figure F.22 – 40VDC bus board plug and LED locations

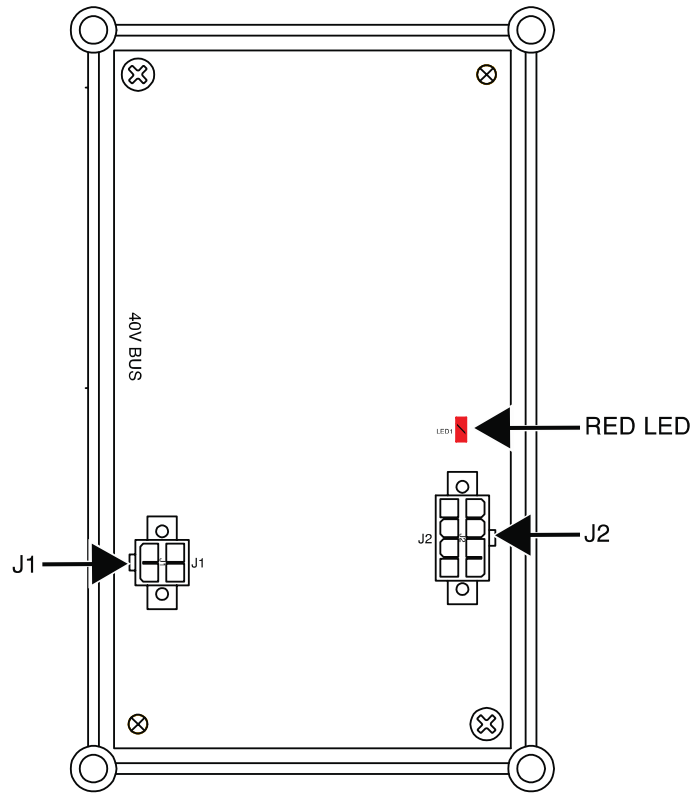
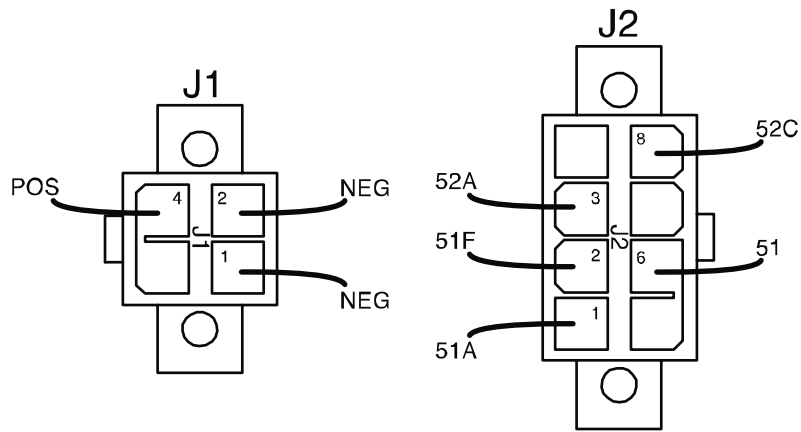


Figure F.23 – 40VDC bus board lead locations



MAIN TRANSFORMER TEST PROCEDURE

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 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 Main Transformer (T3) is functioning properly.

MATERIALS NEEDED

7/16" Nutdriver
Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the main transformer (T3). See **Figure F.24**. See Wiring Diagram.
5. Using a 7/16" nutdriver, remove the two bolts, lock washers and flat washers securing the secondary transformer leads (X1 and X3) to the output rectifier. See **Figure F.24**. See Wiring Diagram. Label and disconnect leads X1 and X3.
6. Using a 7/16" nutdriver, remove the two bolts, lock washers and flat washers securing the primary transformer leads (201 and 204) to the switch board. See **Figure F.25**. See Wiring Diagram. Label and disconnect leads 201 and 204.
7. Using a digital volt/ohmmeter, perform the resistance tests outlined in **Table F.12**. See Wiring Diagram.
8. If any of the tests fail, the main transformer may be faulty.
9. If faulty, perform the **Main Transformer Removal And Replacement Procedure**.
10. Using a 7/16" nutdriver, attach the two bolts, lock washers and flat washers securing the primary transformer leads (201 and 204) to the switch board. See Wiring Diagram.
11. Using a 7/16" nutdriver, attach the two bolts, lock washers and flat washers securing the secondary transformer leads (X1 and X3) to the output rectifier. See Wiring Diagram.
12. Perform the **Case Cover Replacement Procedure**.

Table F.12 – Main transformer resistance tests

DESCRIPTION	TEST POINT	TEST POINT	EXPECTED READING
SECONDARY WINDING	SECONDARY WINDING LEAD X1 (DISCONNECTED FROM OUTPUT RECTIFIER)	SECONDARY WINDING LEAD X3 (DISCONNECTED FROM OUTPUT RECTIFIER)	VERY LOW RESISTANCE (LESS THAN ONE OHM)
PRIMARY WINDING	LEAD #201 (DISCONNECTED FROM THE SWITCH BOARD)	LEAD #204 (DISCONNECTED FROM THE SWITCH BOARD)	VERY LOW RESISTANCE (LESS THAN ONE OHM)

Figure F.24 – Main transformer location

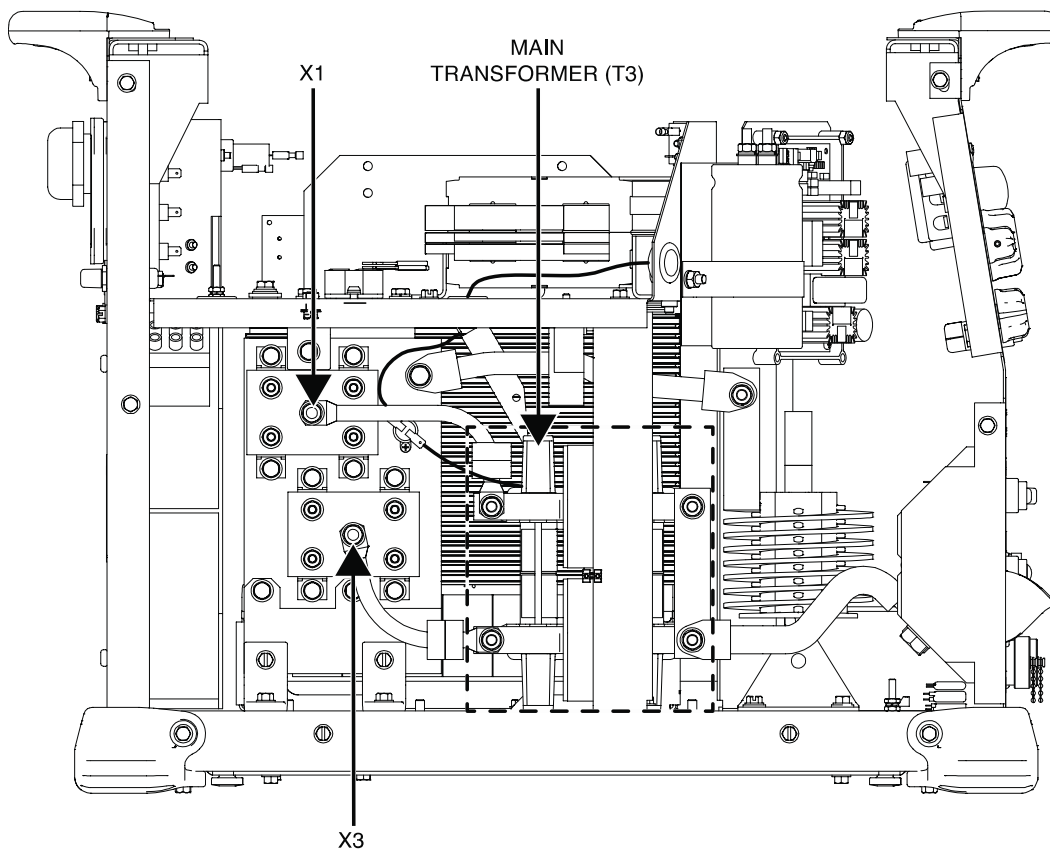
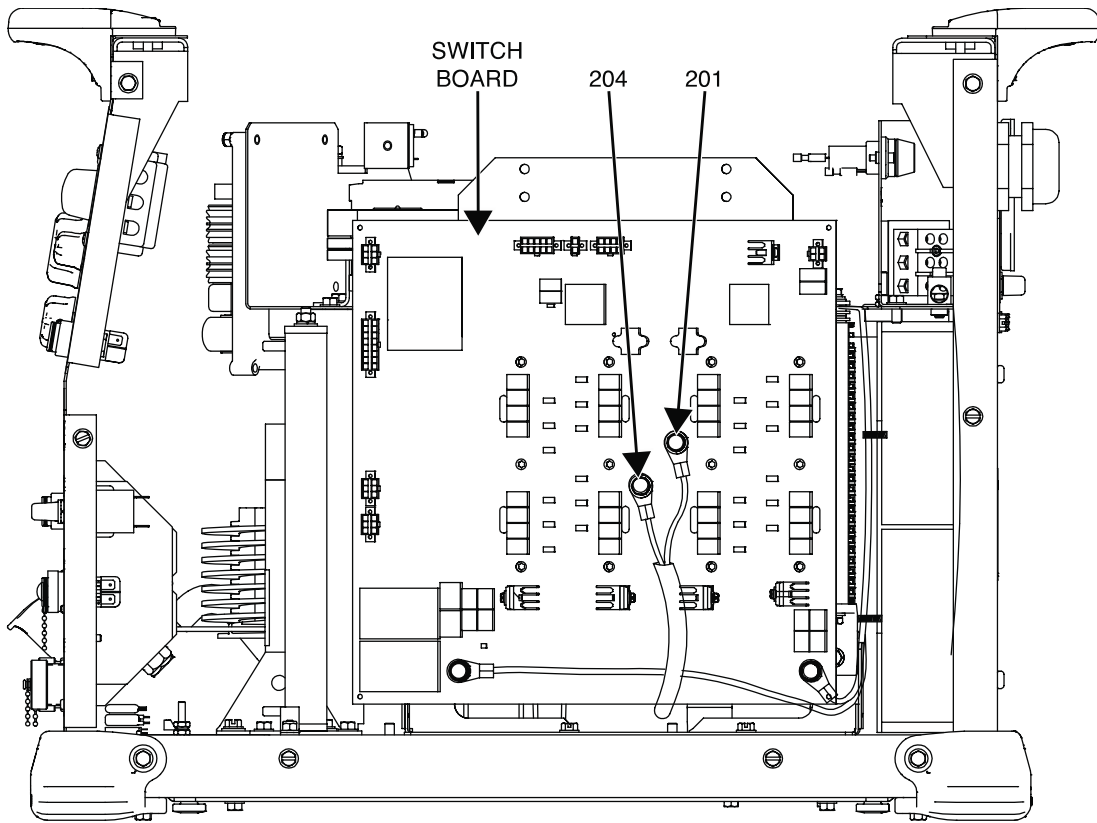


Figure F.25 – Main transformer secondary lead locations



INPUT RECTIFIER TEST PROCEDURE

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 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 Input Rectifier is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Phillips Screwdriver
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the input rectifier. See **Figure F.26**. See Wiring Diagram.
5. Using a digital volt/ohmmeter, perform the forward diode drop tests in **Table F.13**. See **Figures F.26** and **F.27**. See Wiring Diagram.
6. If the test results are questionable, using a Phillips screwdriver, label and disconnect all leads and MOVs from the input rectifier and retest. See Wiring Diagram.
7. If any portion of the test fails, the input rectifier may be faulty.
8. If faulty, perform the **Input Rectifier Removal And Replacement Procedure**.
9. Connect any previously disconnected leads to the input rectifier.
10. Perform the **Case Cover Replacement Procedure**.

Table F.13 – Forward diode drop tests

TEST POINT (POSITIVE)	TEST POINT (NEGATIVE)	EXPECTED RESULTS
Terminal A	Positive Terminal	.03V – 1.0V
Terminal B	Positive Terminal	.03V – 1.0V
Terminal C	Positive Terminal	.03V – 1.0V
Negative Terminal	Terminal A	.03V – 1.0V
Negative Terminal	Terminal B	.03V – 1.0V
Negative Terminal	Terminal C	.03V – 1.0V

Figure F.26 – Input rectifier location

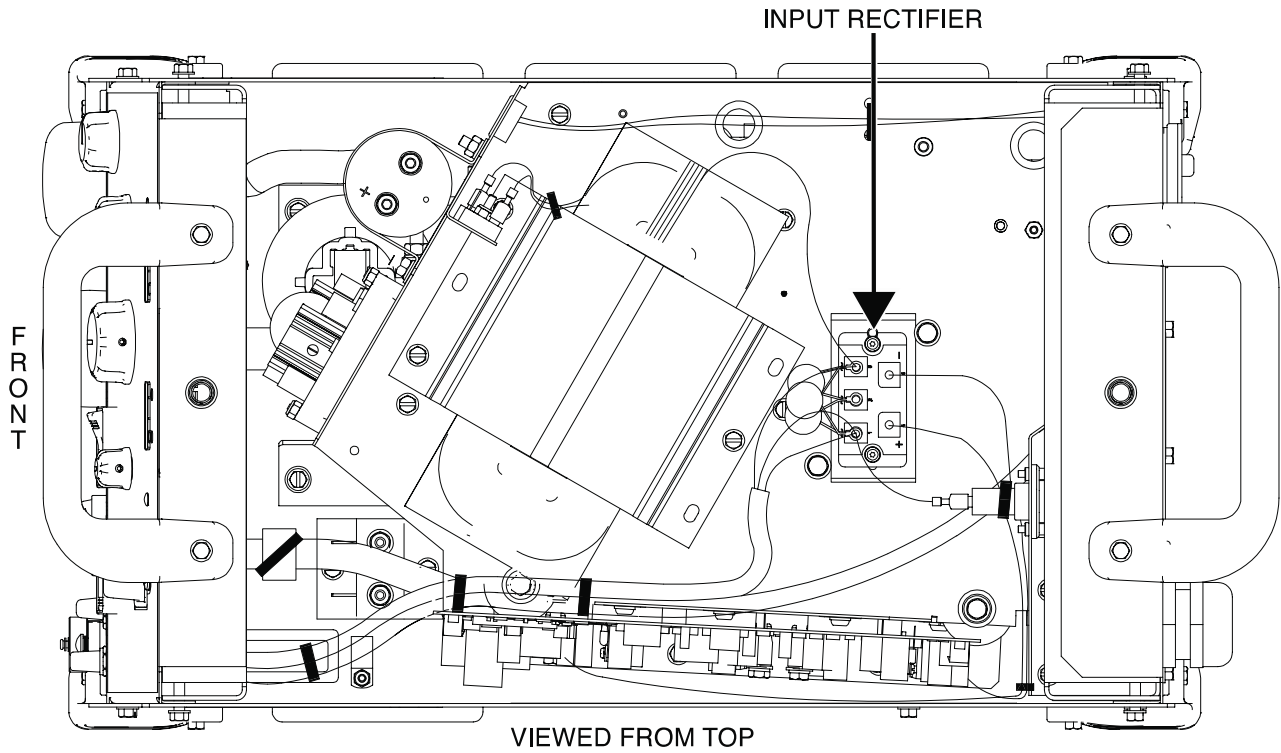
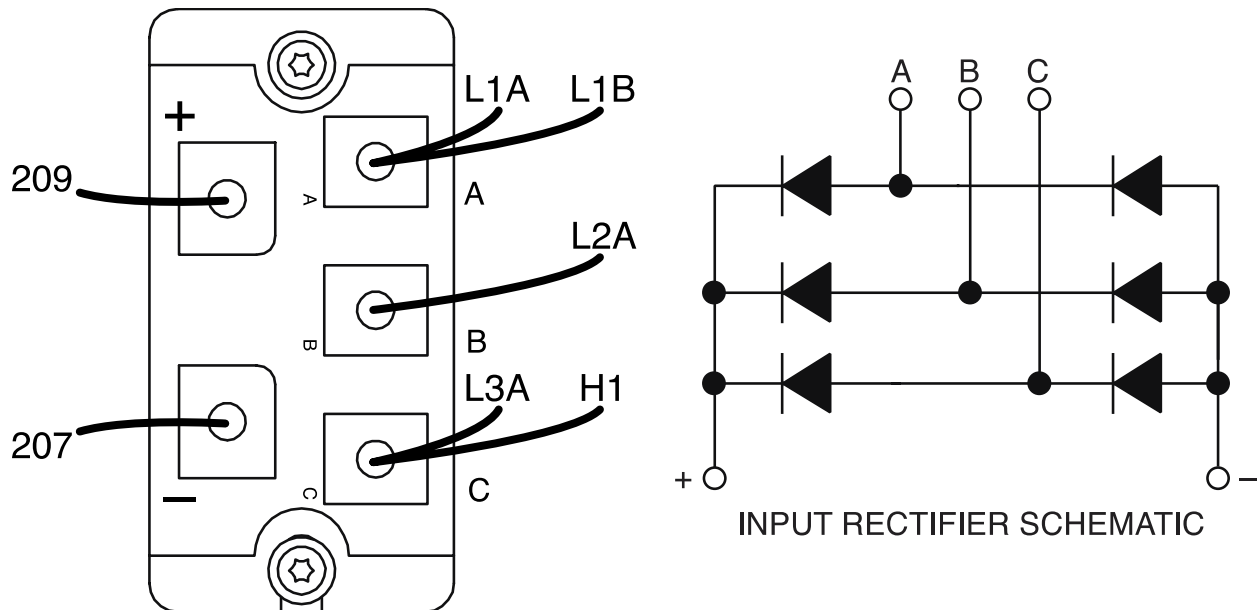


Figure F.27 – Input rectifier detail



AUXILIARY TRANSFORMER (T2) TEST PROCEDURE

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 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 Auxiliary Transformer (T2) is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the auxiliary transformer (T2). See **Figure F.28**. See Wiring Diagram.
5. Carefully apply the correct input power to the machine and turn ON the machine.
6. Using a digital volt/ohmmeter, test for the correct primary voltages at the reconnect panel. See **Table F.14**. See **Figure F.28**. See Wiring Diagram.
NOTE: The reconnect jumper must be in the correct position for the supply voltage being used.
7. If the correct primary voltages are NOT present, check all input power leads, reconnect jumper, fuse and connections. See Wiring Diagram.
8. If the correct primary voltages are present continue testing.
9. Using a digital volt/ohmmeter, test for the correct secondary voltages at the auxiliary rectifier (D3) and circuit breaker (CB2). See **Table F.14**. See **Figures F.29** and **F.30**. See Wiring Diagram.
10. If the primary voltages are correct and the secondary voltages are low or not present, label and disconnect the AC leads (X13 and X14) from the auxiliary rectifier and retest. If the AC secondary voltages are still low or not present the auxiliary transformer may be faulty.
11. If faulty, perform the **Auxiliary Transformer Removal And Replacement Procedure**.
12. When testing is complete, reconnect any previously disconnected leads. See Wiring Diagram.
13. Perform the **Case Cover Replacement Procedure**.

Table F.14 – Primary and secondary voltage tests

DESCRIPTION	TEST POINT	TEST POINT	EXPECTED READING
PRIMARY VOLTAGE (460 VAC H1 to H3)	H1	H2	380 VAC
PRIMARY VOLTAGE (460 VAC H1 to H3)	H1	H3	460 VAC
PRIMARY VOLTAGE (460 VAC H1 to H3)	H1	H4	575 VAC
SECONDARY VOLTAGE	X11	X12	115 VAC
SECONDARY VOLTAGE	X13	X14	52 VAC

Figure F.28 – Auxiliary transformer (T2), auxiliary rectifier and reconnect panel locations

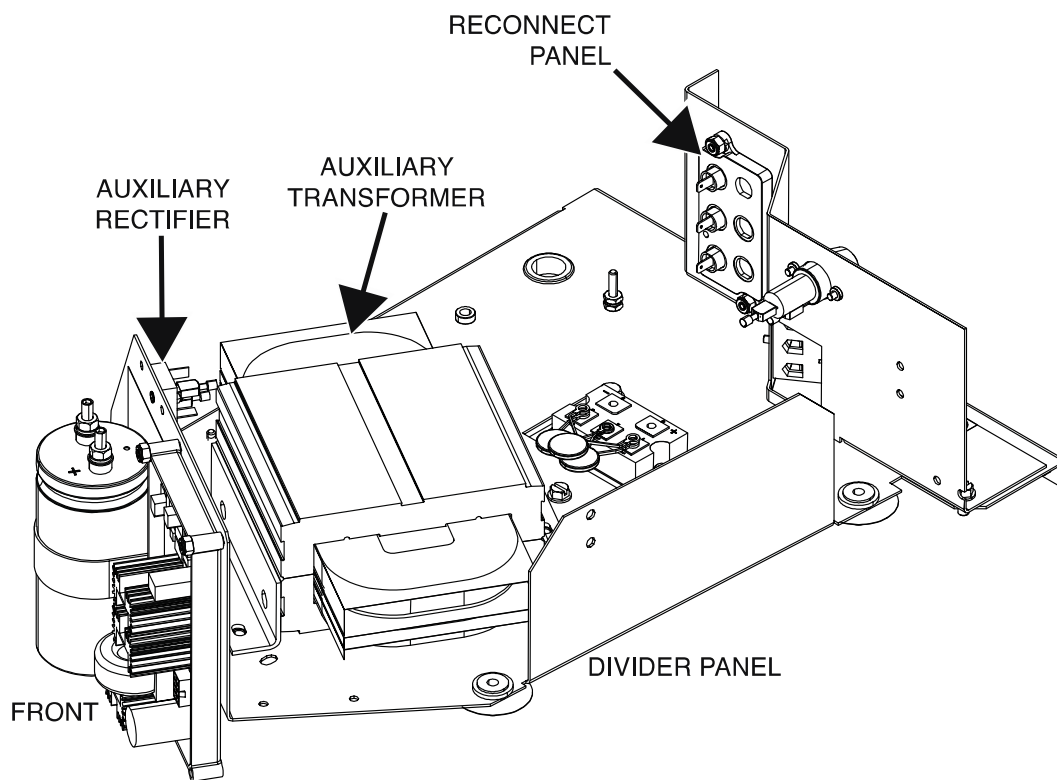


Figure F.29 – Circuit breaker (CB2) location

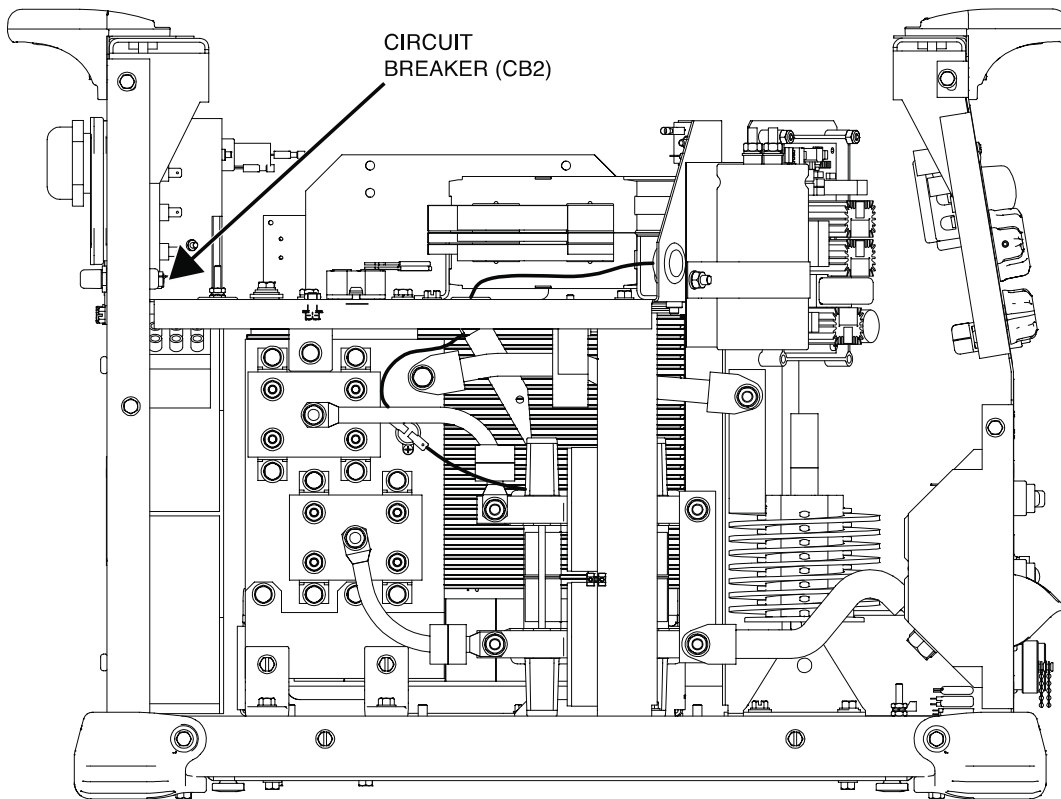
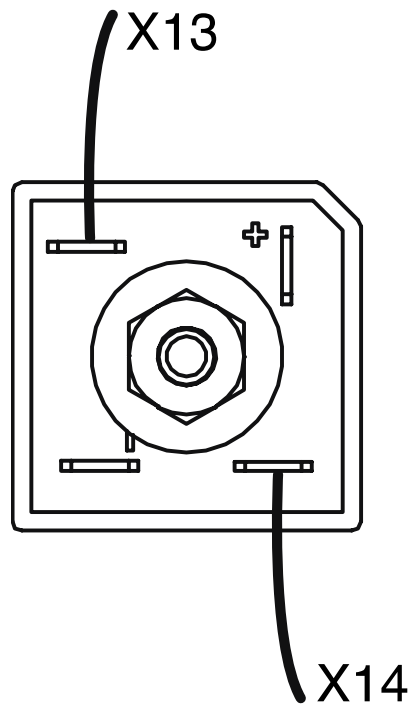


Figure F.30 – Auxiliary rectifier lead locations



FAN AND F.A.N. CIRCUIT TEST PROCEDURE

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 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 Fan and F.A.N. Circuit are functioning properly.

MATERIALS NEEDED

Jumper Wire
Wiring Diagram

TEST PROCEDURE

NOTE: The fan should turn ON briefly when the machine is turned on. The fan turns on during welding and remains on for five minutes after output is disabled. The fan also turns on during a thermal fault.

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate plug J26 on the switch board. See **Figure F.31**. See Wiring Diagram.
5. Label and disconnect plug J26 from the switch board and insert a jumper wire into the end of the connector to short leads 31B and 31A together. See **Figure F.32**. See Wiring Diagram.
6. Carefully apply the correct input power to the machine.
7. When the machine is turned on, the fan should start and run as long as the power is on. If this test results in the fan operating properly, all components of the fan circuit are OK with the possible exception of the switch board.
8. If the test fails to start the fan, check the 115 volt primary of the auxiliary transformer (T2) and the fan itself. Perform the **Auxiliary Transformer Test Procedure**. If the transformer produces the required 115 volts and the plug J26 leads are jumped, the fan and/or fan capacitor are suspect. See Wiring Diagram.
9. If the test results in a running fan, remove the jumper wire from between leads 31B and 31A. Connect plug J26 to the switch board. Label and disconnect one lead from the thermostat. See **Figure F.33**. See Wiring Diagram.
10. If removing the lead from the thermostat causes the switch board to flash error 36 and the thermo LED (on the user interface) turns on but the fan still does not start, the switch board may be faulty. Perform the **Switch Board Test Procedure**.

11. If no error 36 flashes and the thermo LED does not turn on, the user interface board may be faulty. Perform the **User Interface Board Test Procedure**.
12. If any component tests faulty, replace the suspect component.
13. Connect any previously removed leads and plugs.
14. Perform the **Case Cover Replacement Procedure**.

Figure F.31 – Switch board plug J26 location

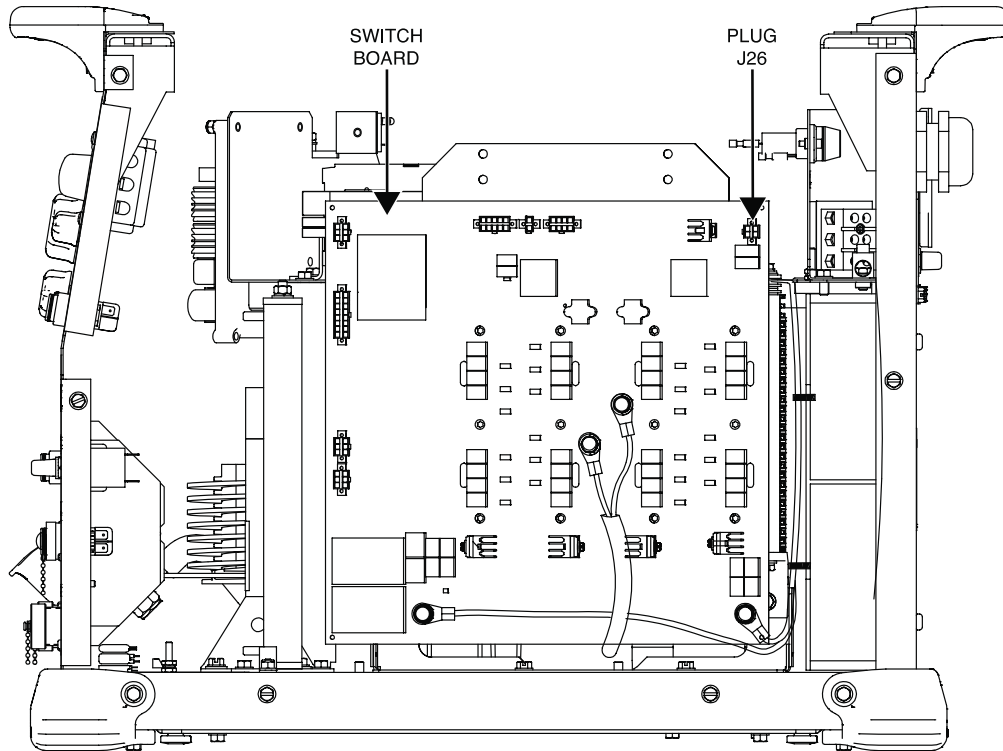


Figure F.32 – Plug J26 lead locations

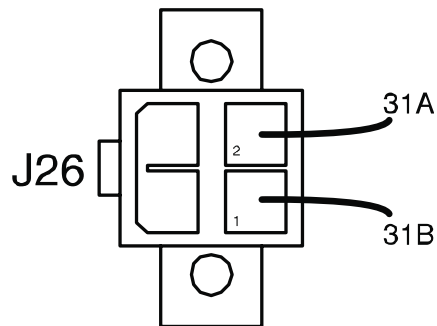
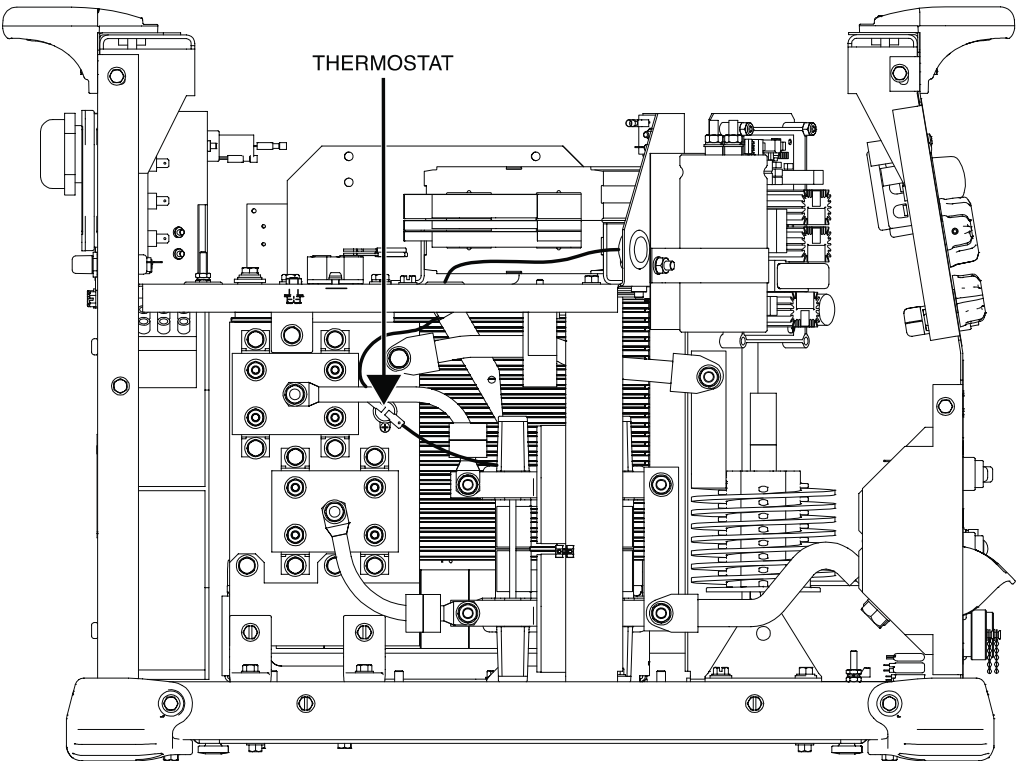


Figure F.33 – Thermostat location



AUXILIARY RECTIFIER (D3) TEST PROCEDURE

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 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 Auxiliary Rectifier (D3) is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter

Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the auxiliary rectifier (D3), on the horizontal divider closest to the left case side. See **Figure F.34**. See Wiring Diagram.
5. Label and disconnect leads POS, NEG, X13 and X14 from the auxiliary rectifier. See **Figure F.35**. See Wiring Diagram.
6. Using a digital volt/ohmmeter, perform the diode drop tests outlined in **Table F.15**. See **Figure F.35**. See Wiring Diagram.
7. If any of the tests fail, the auxiliary rectifier may be faulty.
8. If faulty, perform the **Auxiliary Rectifier Removal And Replacement Procedure**.
9. Connect leads POS, NEG, X13 and X14 to the auxiliary rectifier. See Wiring Diagram.
10. Perform the **Case Cover Replacement Procedure**.

Table F.15 – Rectifier diode drop tests

TEST POINTS (POS)	TEST POINTS (NEG)	EXPECTED READING
TOP AC TERMINAL	POSITIVE TERMINAL	.2VDC – 0.7VDC
BOTTOM AC TERMINAL	POSITIVE TERMINAL	.2VDC – 0.7VDC
NEGATIVE TERMINAL	TOP AC TERMINAL	.2VDC – 0.7VDC
NEGATIVE TERMINAL	BOTTOM AC TERMINAL	.2VDC – 0.7VDC

Figure F.34 – Auxiliary rectifier location

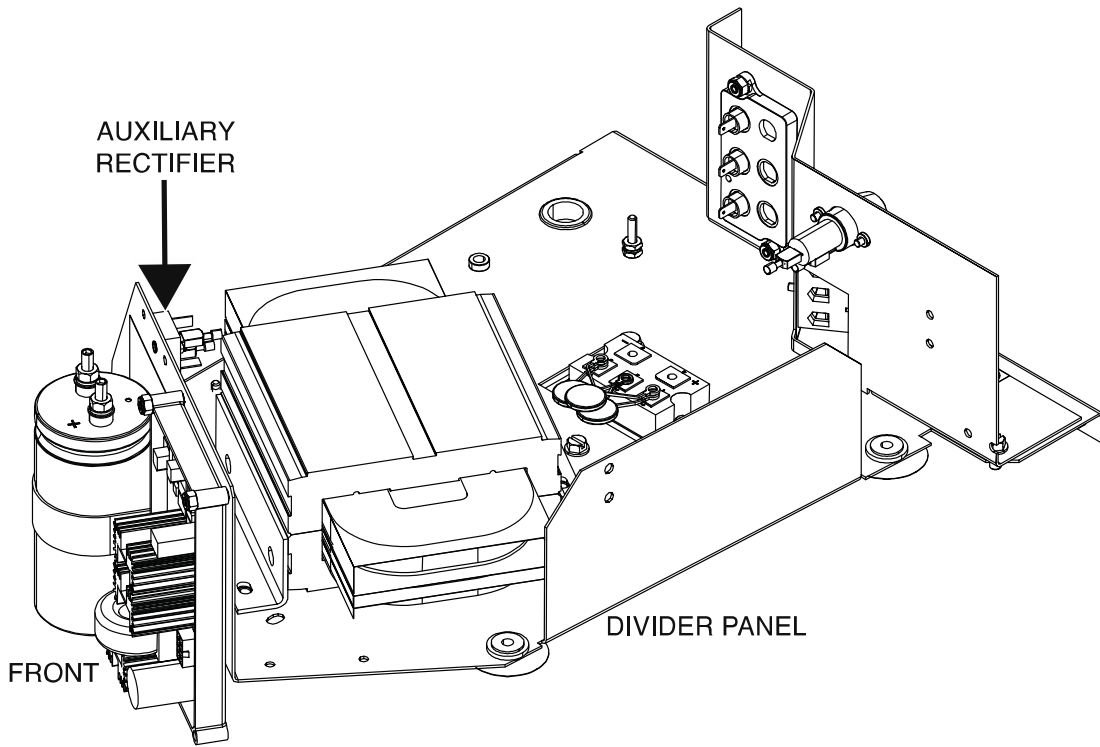
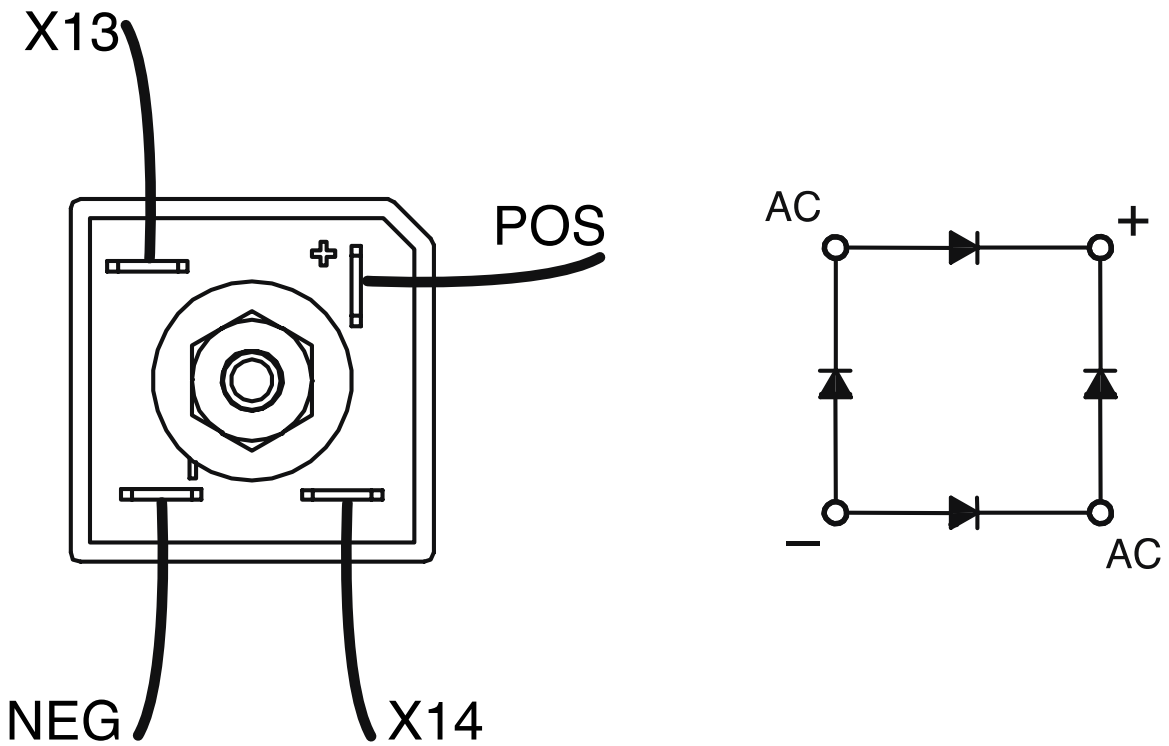


Figure F.35 – Auxiliary rectifier test points



CHOKE TEST PROCEDURE

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 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 Choke is open, shorted (turn to turn) or grounded.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the choke assembly. See **Figure F.36**. See Wiring Diagram.
5. **Open:** No weld output. Using a digital volt/ohmmeter, test the resistance from the choke lead 220 connection on the output rectifier heat sink to the positive output stud. See **Figures F.36** and **F.37**. See Wiring Diagram. Typical resistance is less than one ohm.
6. **Turn To Turn Short:** Reduced inductance, arc instability, excessive heating of the choke. Check for any physical signs of arcing within the choke assembly. See Wiring Diagram.
7. **Choke Coil Grounded:** Reduced inductance, alternate weld current path. Electrically isolate the choke coil by disconnecting the choke lead on the output rectifier heat sink to and the choke from the rear of the positive output stud. Using a digital volt/ohmmeter, check the resistance from choke coil to chassis ground. Resistance should be at least 500,000 ohms. See Wiring Diagram.
8. If any of the tests fail, the choke may be faulty.
9. If faulty, perform the **Choke Removal And Replacement Procedure**.
10. Connect any previously disconnected leads. See Wiring Diagram.
11. Perform the **Case Cover Replacement Procedure**.

Figure F.36 – Choke and choke lead 220 locations

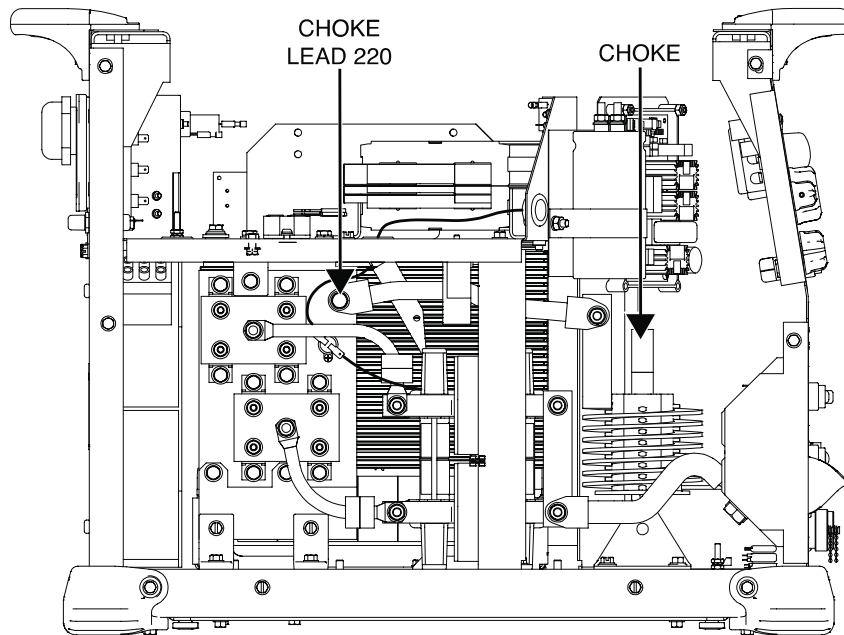
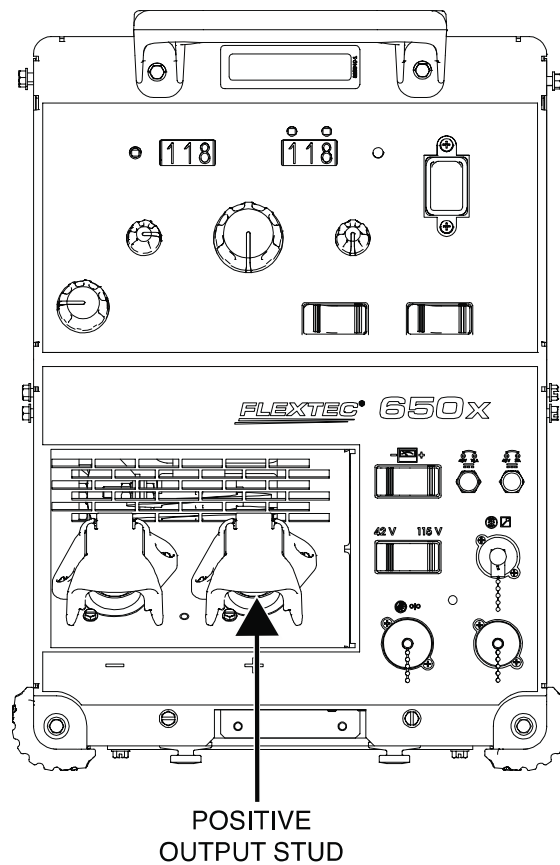


Figure F.37 – Positive output stud location



INPUT SWITCH TEST PROCEDURE

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 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 Input Switch is functioning properly.

MATERIALS NEEDED

Offset Phillips Screwdriver
Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Locate the input switch on the rear of the front panel. See **Figure F.38**. See Wiring Diagram.
5. Using an offset Phillips screwdriver, remove the six screws securing the leads L1, L2, L3, L1A, L2A and L3A to the input switch. See **Figure F.39**. See Wiring Diagram. Label and disconnect leads from the input switch.
6. Using a volt/ohmmeter, perform the resistance test outlined in **Table F.16**. See **Figure F.39**. See Wiring Diagram.
7. If any of the tests fail, the input switch may be faulty.
8. If faulty, perform the **Input Switch Removal And Replacement Procedure**.
9. Using an offset Phillips screwdriver, attach the six screws securing the leads L1, L2, L3, L1A, L2A and L3A to the input switch. See Wiring Diagram.
10. Perform the **Case Cover Removal And Replacement Procedure**.

Table F.16 – Input switch resistance tests

TEST POINT	TEST POINT	EXPECTED READING	SWITCH POSITION
L1	L1A	VERY LOW RESISTANCE (LESS THAN ONE OHM)	“ON” POSITION
L2	L2A	VERY LOW RESISTANCE (LESS THAN ONE OHM)	“ON” POSITION
L3	L3A	VERY LOW RESISTANCE (LESS THAN ONE OHM)	“ON” POSITION
L1	L1A	HIGH RESISTANCE (GREATER THAN 500K OHMS)	“OFF” POSITION
L2	L2A	HIGH RESISTANCE (GREATER THAN 500K OHMS)	“OFF” POSITION
L3	L3A	HIGH RESISTANCE (GREATER THAN 500K OHMS)	“OFF” POSITION

Figure F.38 – Input switch location

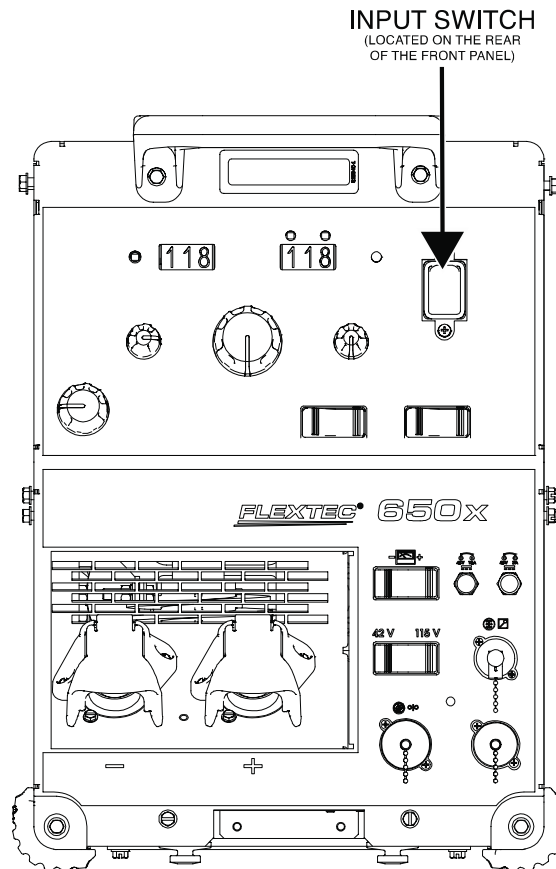
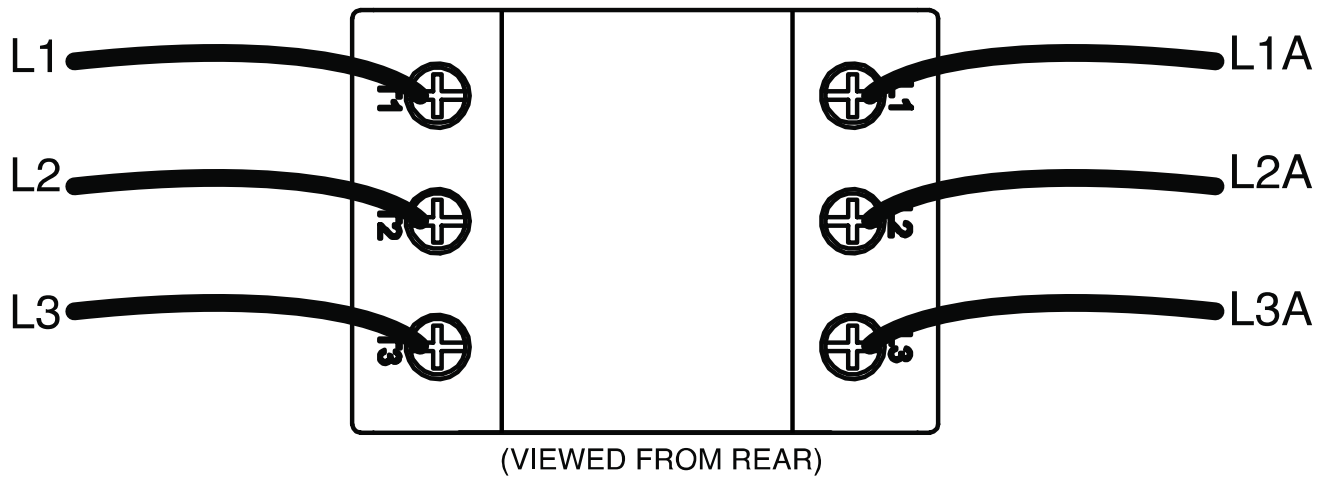


Figure F.39 – Input switch lead location



Removal And Replacement Procedures

THERMOSTAT 2 REMOVAL AND REPLACEMENT PROCEDURE

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 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 Thermostat 2.

MATERIALS NEEDED

Phillips Screwdriver
Dow Corning 340 Heat Sink Compound (Lincoln Part #T12837)
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Label and disconnect leads P1 and 224 from the thermostat terminals. See **Figure F.40**. See Wiring Diagram.
5. Using a Phillips screwdriver, remove the two screws securing thermostat 2 to the output rectifier heat sink. See **Figure F.41**.
6. Thermostat 2 can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully apply a coating of Dow Corning 340 heat sink compound to the mating surface of the thermostat and heat sink.
2. Carefully position thermostat 2 onto the output rectifier heat sink.
3. Using a Phillips screwdriver, attach the two screws securing thermostat 2 to the output rectifier heat sink.
4. Connect leads P1 and 224 to the thermostat terminals. See Wiring Diagram.
5. Perform the **Case Cover Replacement Procedure**.
6. Perform the **Retest After Repair Procedure**.

Figure F.40 – Thermostat 2 lead locations

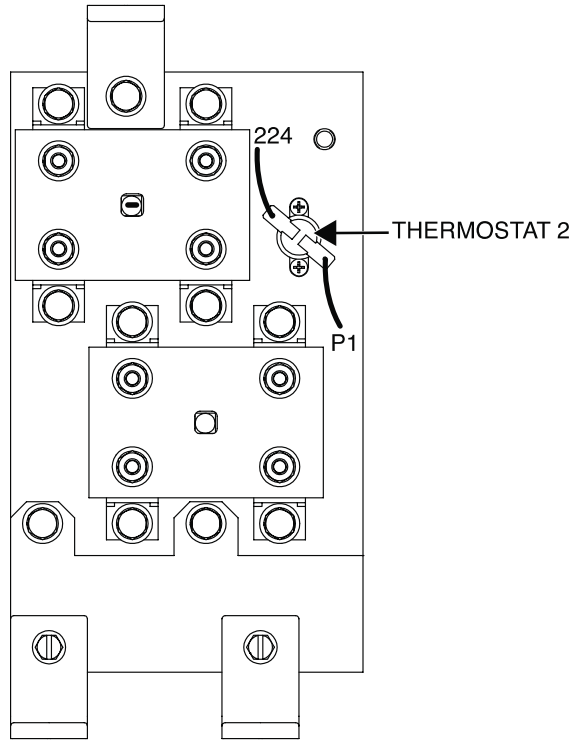
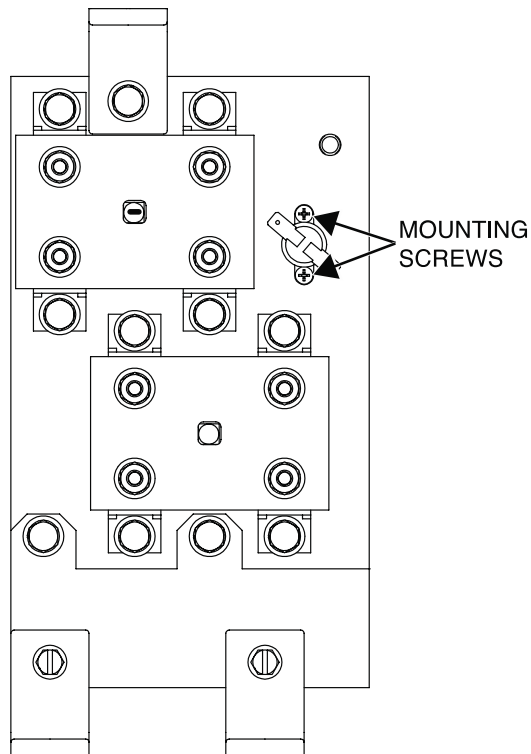


Figure F.41 – Thermostat 2 mounting screw locations



OUTPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE

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 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 Output Rectifier.

MATERIALS NEEDED

1/2" Nutdriver
7/16" Nutdriver
9/64" Allen Wrench
Penetrox Heat Sink Compound (Lincoln Part #T12837-1)
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Using a 1/2" nutdriver, remove the two nuts, lock washers and flat washers securing leads X1 and X3 to the output rectifier assembly. See **Figure F.42**. See Wiring Diagram.
5. Using a 7/16" nutdriver, remove the four nuts, lock washers and flat washers securing the copper plate to the output rectifier modules. See **Figure F.42**. Repeat this step for the other copper plate.
6. Using a 7/16" nutdriver, remove the two screws, lock washers and flat washers securing each diode module to the heat sink. See **Figure F.43**. Repeat this step for each diode module.
7. Using a 9/64" Allen wrench, remove the screw securing each diode module to the heat sink. See **Figure F.43**. Repeat this step for each diode module.
8. The output rectifier diode modules can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Apply a coating of Penetrox heat sink compound to the mating surfaces of each diode module and the heat sink.
2. Carefully position the diode module onto the heat sink. Repeat this step for each diode module.
3. Using a 9/64" Allen wrench, attach the screw securing each diode module to the heat sink. Repeat this step for each diode module.

4. Using a 7/16" nutdriver, attach the two screws, lock washers and flat washers securing each diode module to the heat sink. Repeat this step for each diode module.
5. Using a 7/16" nutdriver, attach the four nuts, lock washers and flat washers securing the copper plate to the output rectifier modules. Repeat this step for the other copper plate.
6. Using a 1/2" nutdriver, attach the two nuts, lock washers and flat washers securing leads X1 and X3 to the output rectifier assembly. See Wiring Diagram.
7. Perform the **Case Cover Replacement Procedure**.
8. Perform the **Retest After Repair Procedure**.

Figure F.42 – Lead X1 and X3 and copper plate locations

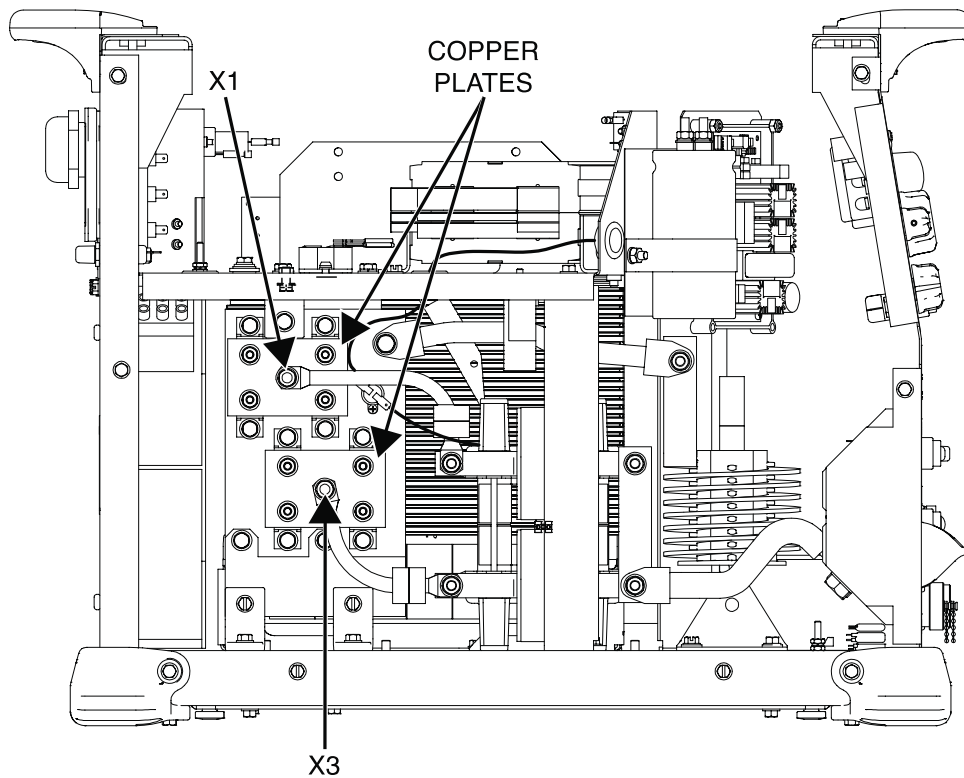
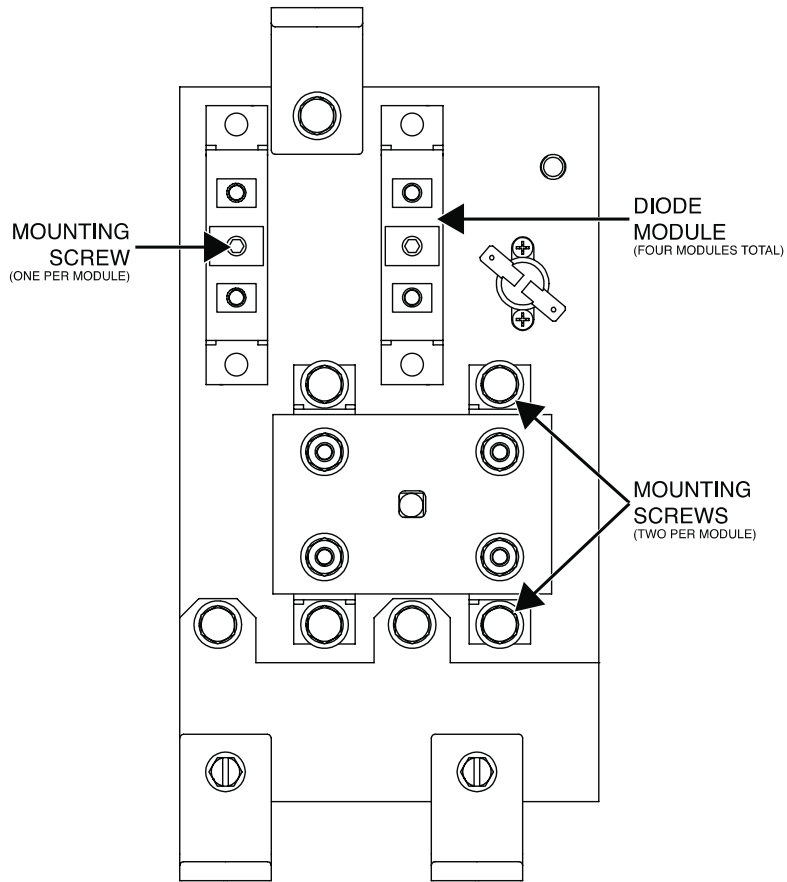


Figure F.43 – Output rectifier diode module mounting screw locations



USER INTERFACE BOARD REMOVAL AND REPLACEMENT PROCEDURE

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 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 User Interface Board.

MATERIALS NEEDED

Phillips Screwdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the ***Case Cover Removal Procedure***.
3. Perform the ***Capacitor Discharge Procedure***.
4. Label and disconnect plugs J1, J2, J3 and J4 from the user interface board. See ***Figure F.44***. See Wiring Diagram.
5. Using a Phillips screwdriver, remove the four screws and washers securing the user interface board to the front panel. See ***Figure F.45***.
6. The user interface board can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the new user interface board into the machine.
2. Using a Phillips screwdriver, remove the four screws and washers securing the user interface board to the front panel.
3. Connect plugs J1, J2, J3 and J4 to the user interface board. See Wiring Diagram.
4. Perform the ***Case Cover Replacement Procedure***.
5. Perform the ***Retest After Repair Procedure***.

Figure F.44 – User interface board plug locations

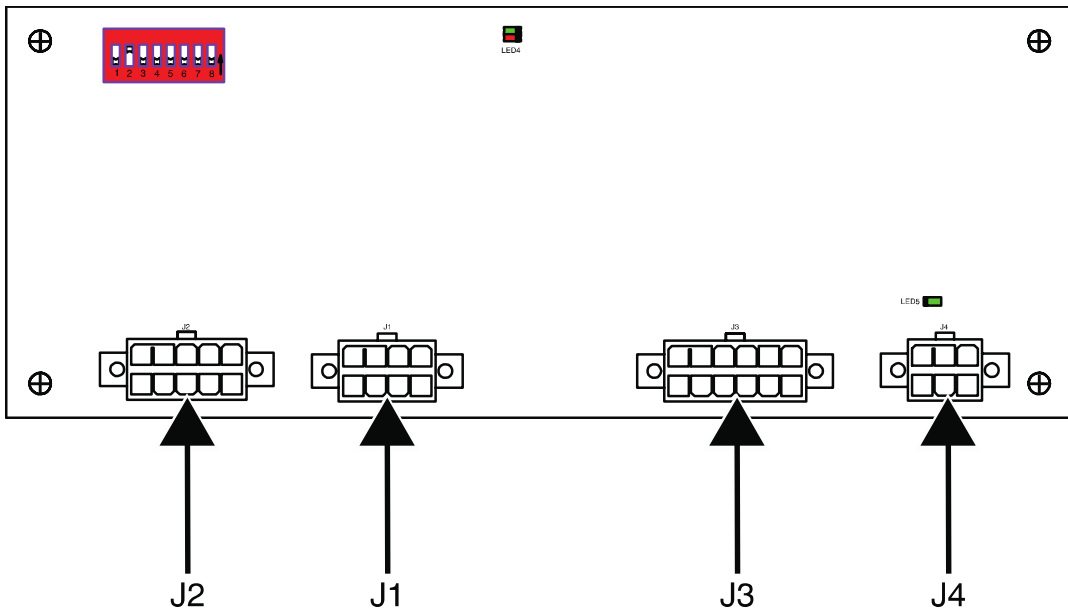
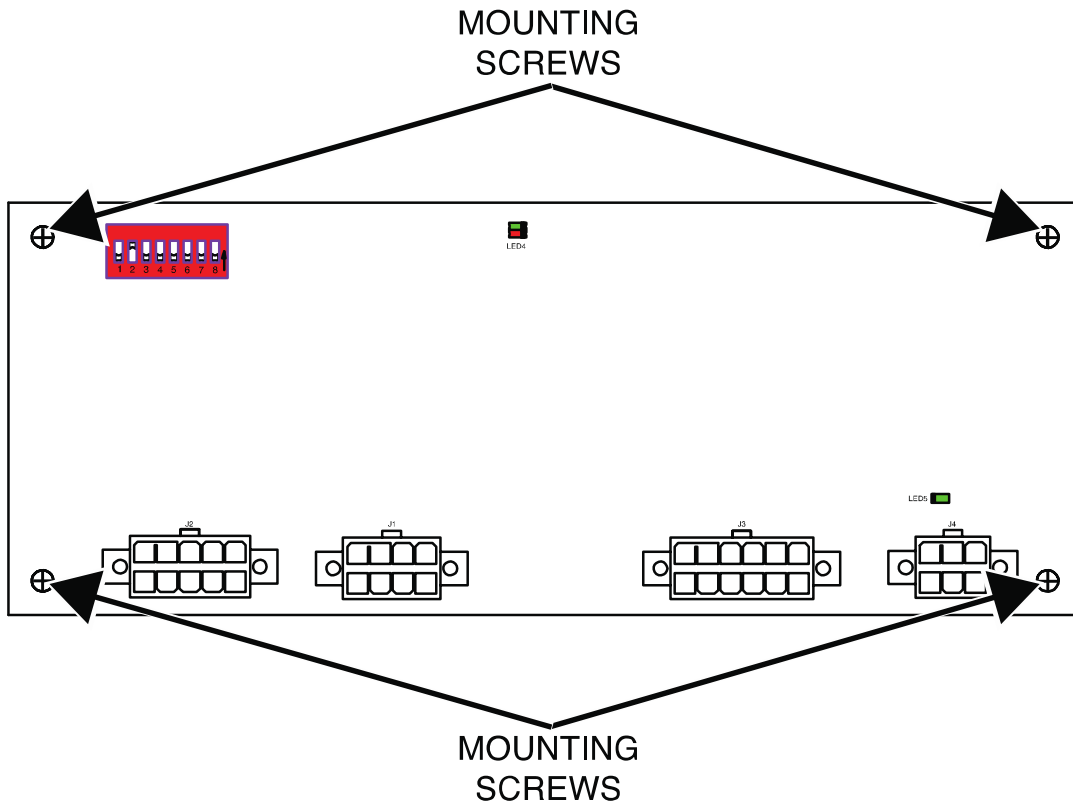


Figure F.45 – User interface board mounting screw locations



SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE

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 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" Nutdriver
Torx Nutdriver (Size T-25)
Dow Corning 340 Heat Sink Compound (Lincoln Part #T12837)
Penetrox Heat Sink Compound (Lincoln Part #T12837-1)
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Label and disconnect plugs J20, J21, J22, J23, J25 and J26 from the switch board. See **Figure F.46**. See Wiring Diagram.
5. Using a 7/16" nutdriver, remove the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 from the switch board. See **Figure F.46**. See Wiring Diagram.
6. Using a Torx nutdriver (size T-25), remove the twelve screws and lock washers securing the switch board to the heat sink. See **Figure F.47**.
7. The switch board can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Apply a coating of Dow Corning 340 heat sink compound to the mating surface of the heat sink and the switch board.
2. Carefully position the new switch board onto the heat sink.
3. Using a Torx nutdriver (size T-25), attach the twelve screws and lock washers securing the switch board to the heat sink.
4. Using a 7/16" nutdriver, attach the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 from the switch board. See Wiring Diagram. Apply a coating of Penetrox heat sink compound to the connections.

5. Connect plugs J20, J21, J22, J23, J25 and J26 to the switch board. See Wiring Diagram.
6. Perform the **Case Cover Replacement Procedure**.
7. Perform the **Retest After Repair Procedure**.

Figure F.46 – Switch board plug and lead locations

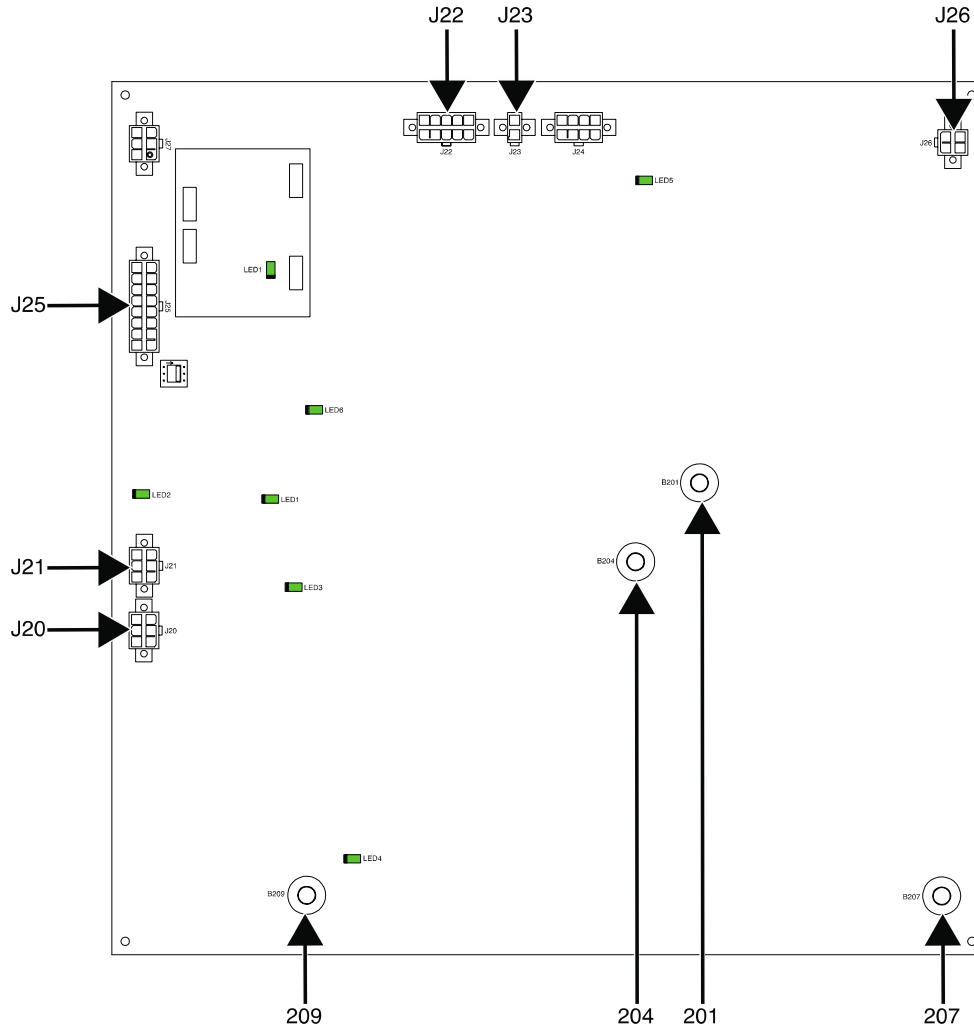
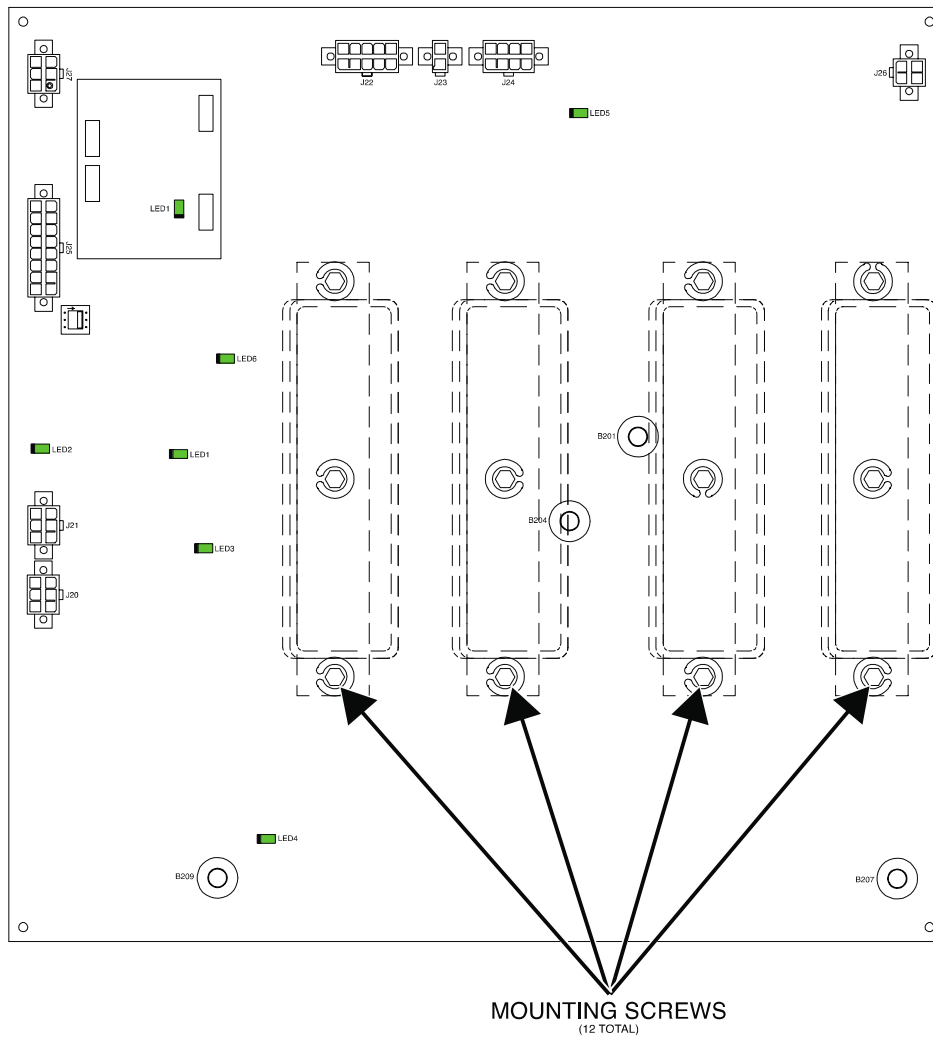


Figure F.47 – Switch board mounting hardware locations



CURRENT TRANSDUCER (LEM) REMOVAL AND REPLACEMENT PROCEDURE

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 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 Current Transducer (LEM).

MATERIALS NEEDED

7/16" Nutdriver
3/8" Nutdriver
11/32" Nutdriver
1/2" Nutdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Label and disconnect plugs J20, J21, J22, J23, J25 and J26 from the switch board. See **Figure F.48**. See Wiring Diagram.
5. Using a 7/16" nutdriver, remove the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 to the switch board. See **Figure F.48**. See Wiring Diagram.
6. Using a 7/16" nutdriver, remove the two screws, lock washers and flat washers securing the heat sink to the divider panel. See **Figure F.49**.
7. Using a 3/8" nutdriver, remove the two screws securing the heat sink bracket to the base of the machine. See **Figure F.49**.
8. Carefully remove the switch board and heat sink assembly from the machine.
9. Label and disconnect plug P91 from the current transducer. See Wiring Diagram.
10. Using a 1/2" nutdriver, remove the screw, lock washer and flat washer securing choke lead 220 to the output rectifier heat sink. See **Figure F.50**. See Wiring Diagram.
11. Using a 11/32" nutdriver, remove the two nuts and washers securing the current transducer to the divider panel. See **Figure F.50**.
12. The current transducer can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Rout choke lead 220 thru the current transducer. See Wiring Diagram.
2. Carefully position the new current transducer into the machine.
3. Using a 11/32" nutdriver, attach the two nuts and washers securing the current transducer to the divider panel.
4. Using a 1/2" nutdriver, attach the screw, lock washer and flat washer securing choke lead 220 to the output rectifier heat sink. See Wiring Diagram.
5. Connect plug P91 to the current transducer. See Wiring Diagram.
6. Carefully position the switch board and heat sink assembly into the machine.
7. Using a 3/8" nutdriver, attach the two screws securing the heat sink bracket to the base of the machine.
8. Using a 7/16" nutdriver, attach the two screws, lock washers and flat washers securing the heat sink to the divider panel.
9. Using a 7/16" nutdriver, attach the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 to the switch board. See Wiring Diagram.
10. Connect plugs J20, J21, J22, J23, J25 and J26 to the switch board. See Wiring Diagram.
11. Perform the **Case Cover Replacement Procedure**.
12. Perform the **Retest After Repair Procedure**.

Figure F.48 – Switch board plug and lead locations

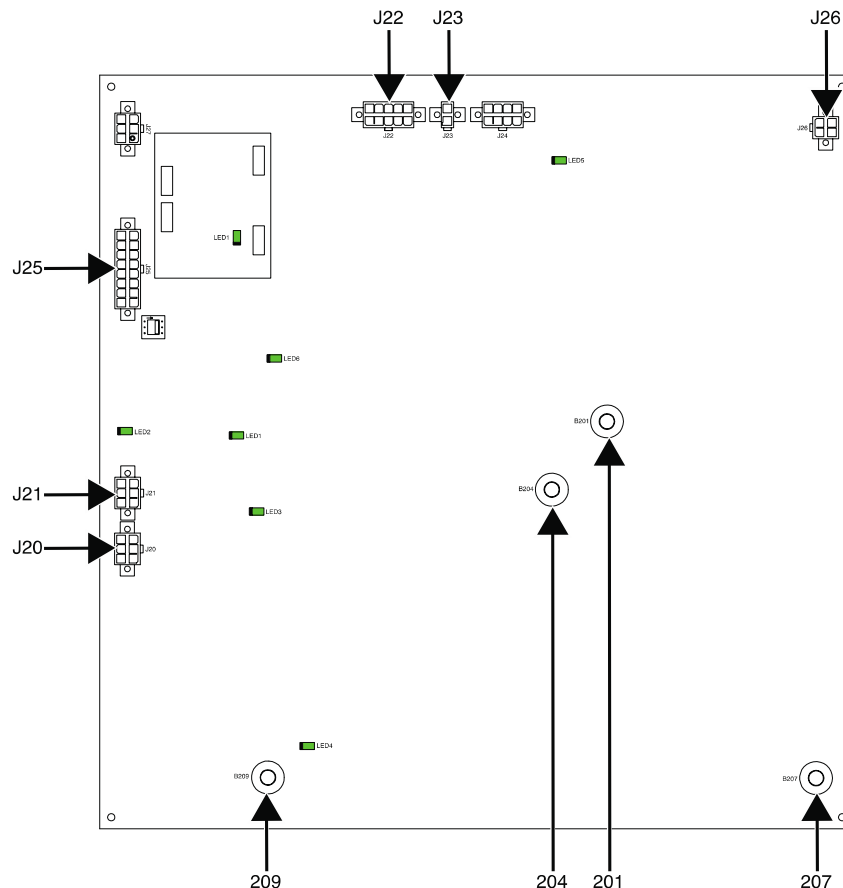


Figure F.49 – Switch board and heat sink assembly mounting screw locations

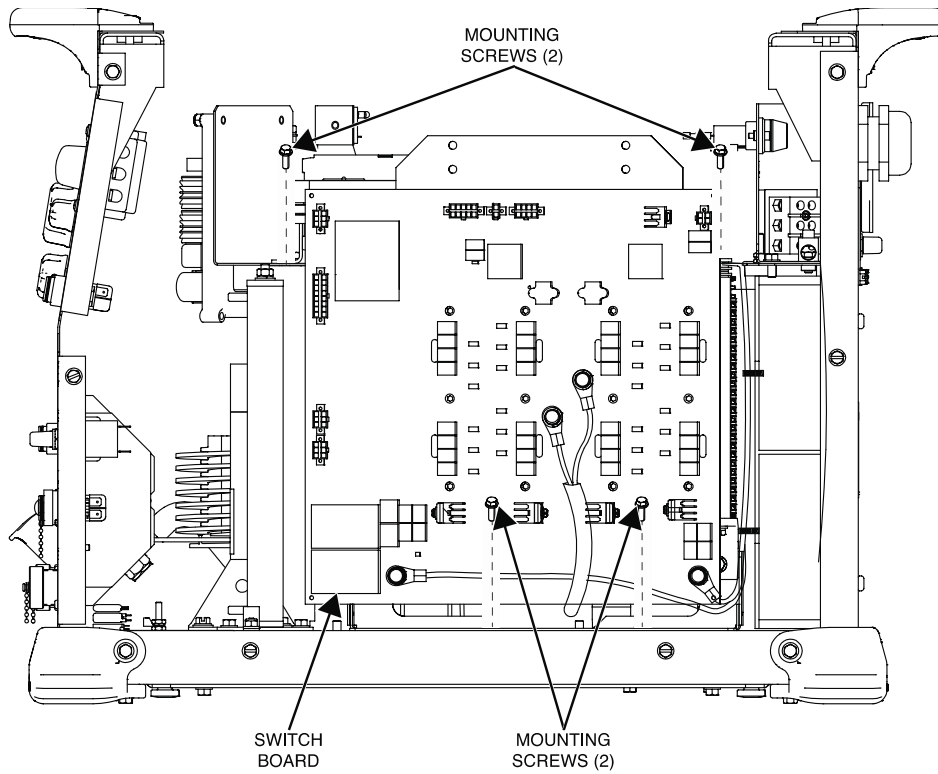
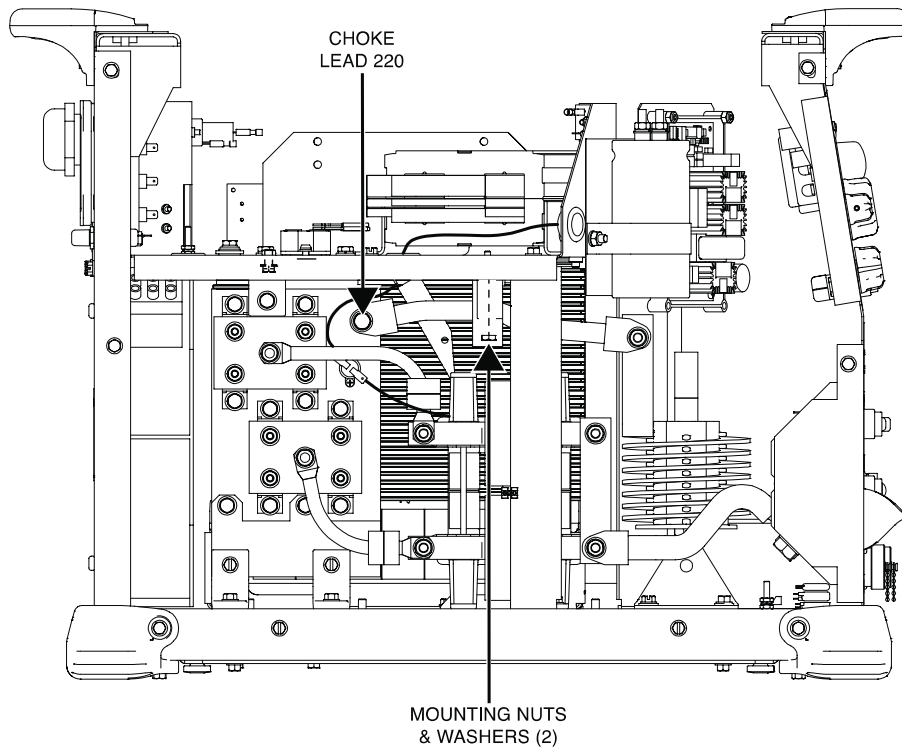


Figure F.50 – Choke lead 220 and current transducer mounting hardware locations



40VDC BUS BOARD REMOVAL AND REPLACEMENT PROCEDURE

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 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 40VDC Bus Board.

MATERIALS NEEDED

3/8" Nutdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the ***Case Cover Removal Procedure***.
3. Perform the ***Capacitor Discharge Procedure***.
4. Label and disconnect plugs J1 and J2 from the 40VDC bus board. See ***Figure F.51***. See Wiring Diagram.
5. Using a 3/8" nutdriver, remove the two mounting nuts securing the 40VDC bus board to the divider panel. See ***Figure F.52***.
6. Cut cable ties as necessary.
7. The 40VDC bus board can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the new 40VDC bus board onto the mounting posts.
2. Using a 3/8" nutdriver, attach the two mounting nuts securing the 40VDC bus board to the divider panel.
3. Connect plugs J1 and J2 to the 40VDC bus board. See Wiring Diagram.
4. Perform the ***Case Cover Replacement Procedure***.
5. Perform the ***Retest After Repair Procedure***.

Figure F.51 – 40VDC bus board plug locations

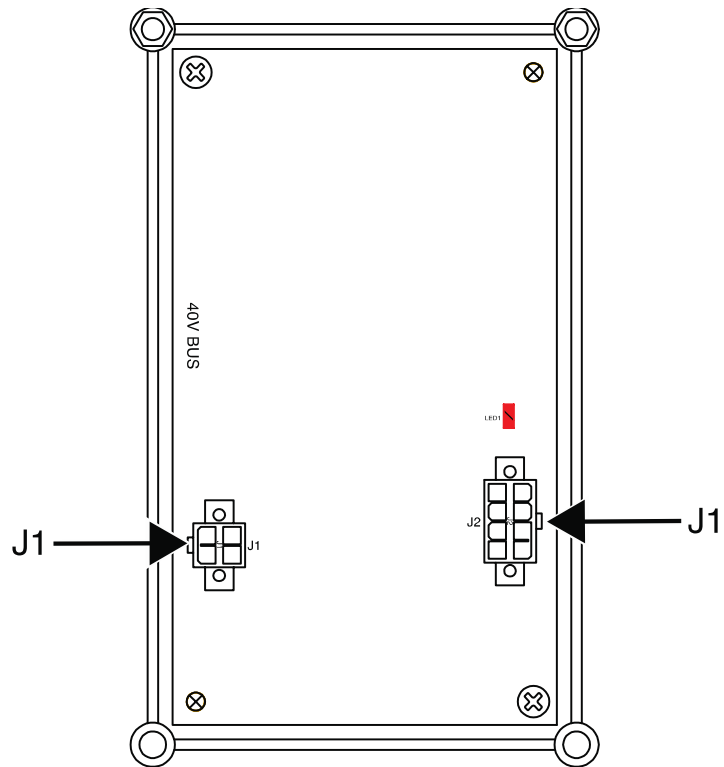
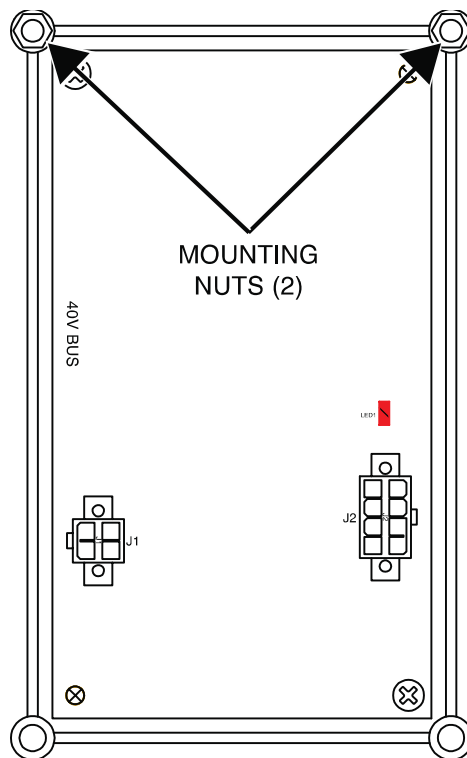


Figure F.52 – 40VDC mounting nut locations



MAIN TRANSFORMER REMOVAL AND REPLACEMENT PROCEDURE

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 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 Main Transformer.

MATERIALS NEEDED

7/16" Nutdriver
3/8" Nutdriver
1/2" Nutdriver
Two 1/2" Open-End Wrenches
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Label and disconnect plugs J20, J21, J22, J23, J25 and J26 from the switch board. See **Figure F.53**. See Wiring Diagram.
5. Using a 7/16" nutdriver, remove the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 to the switch board. See **Figure F.53**. See Wiring Diagram.
6. Using a 7/16" nutdriver, remove the two screws, lock washers and flat washers securing the heat sink to the divider panel. See **Figure F.54**.
7. Using a 3/8" nutdriver, remove the two screws securing the heat sink bracket to the base of the machine. See **Figure F.54**.
8. Carefully remove the switch board and heat sink assembly from the machine.
9. Label and disconnect the two thermostat leads from the quick connect terminals. See Wiring Diagram. Cut cable ties as necessary.
10. Using a 1/2" nutdriver, remove the two screws, lock washers and flat washers securing leads X1 and X3 to the output rectifier heat sink. See **Figure F.55**. See Wiring Diagram.
11. Using two 1/2" open-end wrenches, remove the nut, lock washer, bolt and two flat washers securing the NEG lead to the main transformer. See **Figure F.55**. See Wiring Diagram.
12. Using a 3/8" nutdriver, remove the three screws securing the main transformer to the base of the machine. See **Figure F.55**.
13. The main transformer can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the new main transformer into the machine.
2. Using a 3/8" nutdriver, attach the three screws securing the main transformer to the base of the machine.
3. Using two 1/2" open-end wrenches, attach the nut, lock washer, bolt and two flat washers securing the NEG lead to the main transformer. See Wiring Diagram.
4. Using a 1/2" nutdriver, attach the two screws, lock washers and flat washers securing leads X1 and X3 to the output rectifier heat sink. See Wiring Diagram.
5. Connect the two thermostat leads to the quick connect terminals. See Wiring Diagram. Replace cable ties as necessary.
6. Carefully position the switch board and heat sink assembly into the machine.
7. Using a 3/8" nutdriver, attach the two screws securing the heat sink bracket to the base of the machine.
8. Using a 7/16" nutdriver, attach the two screws, lock washers and flat washers securing the heat sink to the divider panel.
9. Using a 7/16" nutdriver, attach the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 to the switch board. See Wiring Diagram.
10. Connect plugs J20, J21, J22, J23, J25 and J26 to the switch board. See Wiring Diagram.
11. Perform the **Case Cover Replacement Procedure**.
12. Perform the **Retest After Repair Procedure**.

Figure F.53 – Switch board plug and lead locations

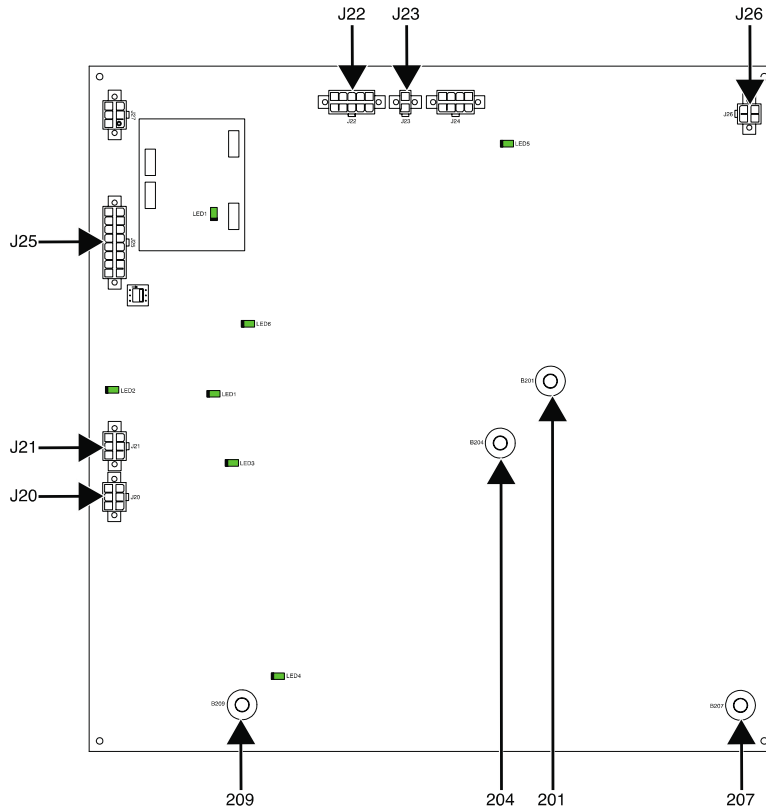


Figure F.54 – Switch board and heat sink assembly mounting screw locations

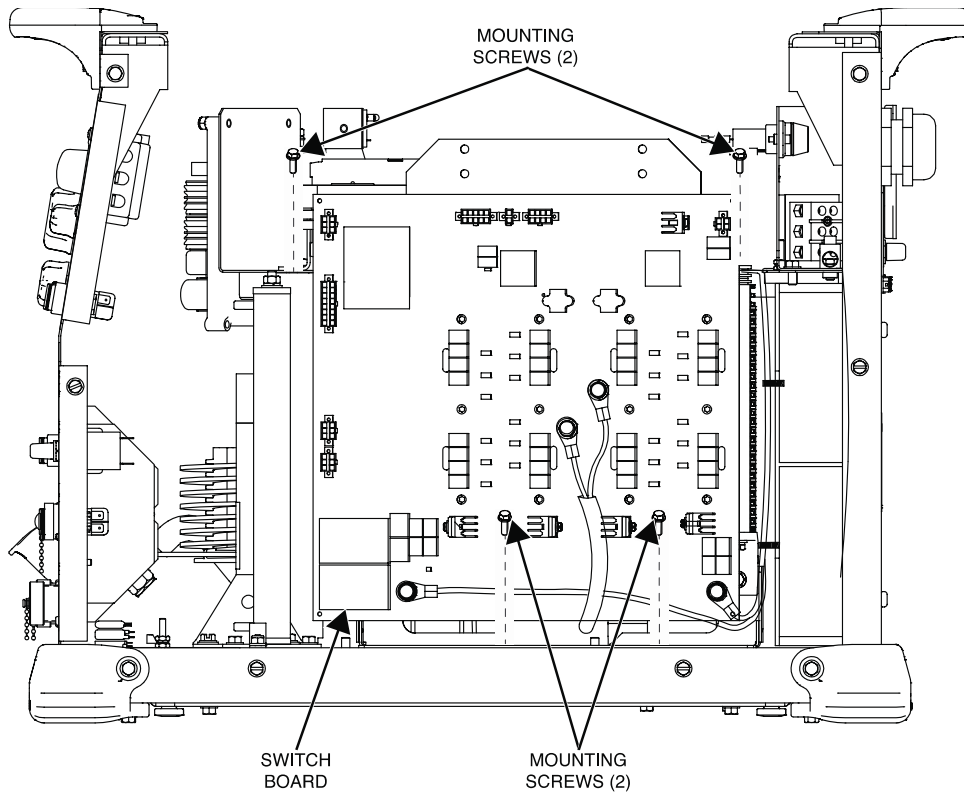
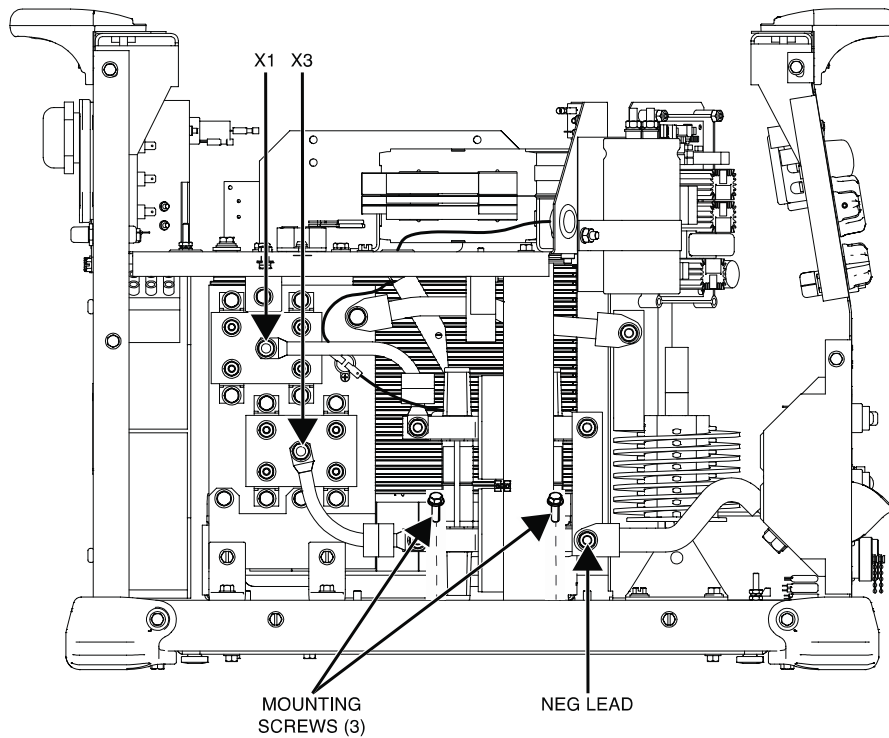


Figure F.55 – Main transformer lead and mounting screw locations



INPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE

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 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 Input Rectifier.

MATERIALS NEEDED

5/16" Nutdriver
Torx Nutdriver (Size T-25)
Dow Corning 340 Heat Sink Compound (Lincoln Part #T12837)
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Using a 5/16" nutdriver, remove the five screws, lock washers and flat washers securing leads L1A, L1B, L2A, L3A, H1, 207 and 209 to the input rectifier. See **Figure F.56**. See Wiring Diagram.
5. Using a Torx nutdriver (size T-25), remove the two screws and lock washers securing the input rectifier to the heat sink. See **Figure F.57**.
6. The input rectifier can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Apply a coating of Dow Corning 340 heat sink compound to the mating surfaces of the heat sink and input rectifier.
2. Carefully position the new input rectifier onto the heat sink.
3. Using a Torx nutdriver (size T-25), remove the two screws and lock washers securing the input rectifier to the heat sink.
4. Using a 5/16" nutdriver, attach the five screws, lock washers and flat washers securing leads L1A, L1B, L2A, L3A, H1, 207 and 209 to the input rectifier. See Wiring Diagram.
5. Perform the **Case Cover Replacement Procedure**.
6. Perform the **Retest After Repair Procedure**.

Figure F.56 – Input rectifier lead locations

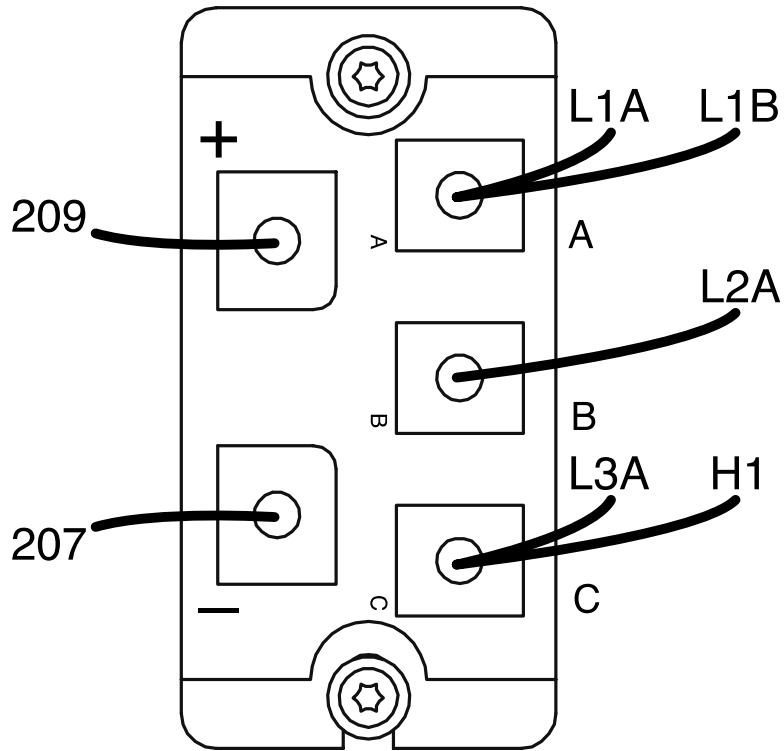
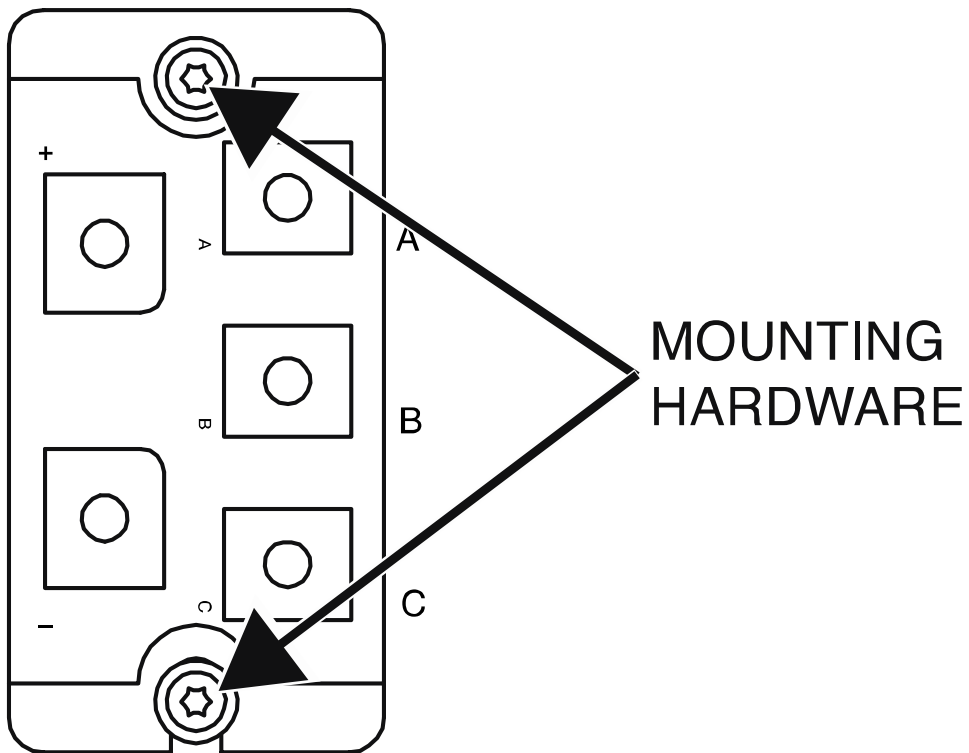


Figure F.57 – Input rectifier mounting hardware locations



AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT PROCEDURE

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 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 Auxiliary Transformer.

MATERIALS NEEDED

5/16" Nutdriver
3/8" Nutdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Label and disconnect leads X13 and X14 from the auxiliary rectifier. See **Figure F.58**. See Wiring Diagram.
5. Label and disconnect leads H2, H3, H4, X11, X12, 226 and 227 from the quick-connect terminals. See **Figure F.58**. See Wiring Diagram.
6. Using a 5/16" nutdriver, remove the screw, lock washer and flat washer securing lead H1 to the input rectifier. See **Figures F.58** and **F.59**. See Wiring Diagram. Cut cable ties as necessary.
7. Using a 3/8" nutdriver, remove the three screws and lock washers securing the auxiliary transformer to the divider panel. See **Figure F.59**.
8. The auxiliary transformer can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the new auxiliary transformer onto the divider panel.
2. Using a 3/8" nutdriver, attach the three screws and lock washers securing the auxiliary transformer to the divider panel.
3. Using a 5/16" nutdriver, attach the screw, lock washer and flat washer securing lead H1 to the input rectifier. See Wiring Diagram. Replace cable ties as necessary.
4. Connect leads H2, H3, H4, X11, X12, 226 and 227 to the quick-connect terminals. See Wiring Diagram.
5. Connect leads X13 and X14 to the auxiliary rectifier. See Wiring Diagram.

- 6. Perform the **Case Cover Replacement Procedure**.
- 7. Perform the **Retest After Repair Procedure**.

Figure F.58 – Auxiliary transformer lead locations

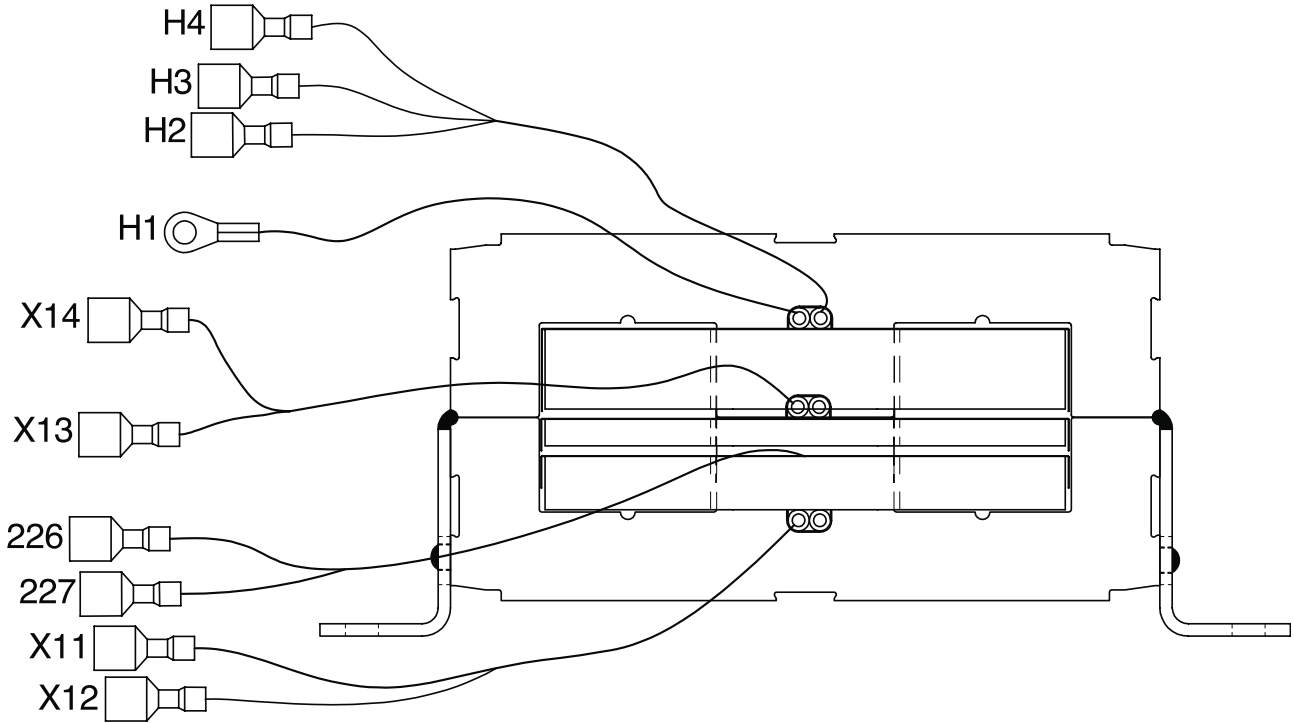
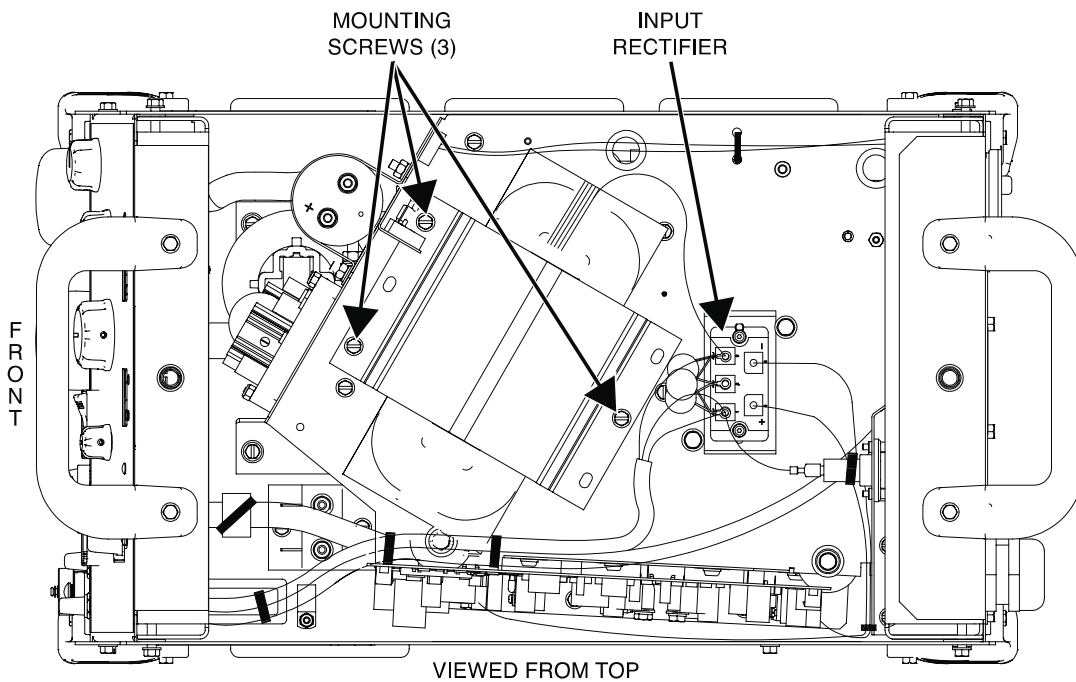


Figure F.59 – Mounting hardware and input rectifier locations



AUXILIARY RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE

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 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 Auxiliary Rectifier.

MATERIALS NEEDED

3/8" Nutdriver
Dow Corning 340 Heat Sink Compound (Lincoln Part #T12837)
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Label and disconnect leads X13, X14, POS and NEG from the auxiliary rectifier. See **Figure F.60**. See Wiring Diagram.
5. Using a 3/8" nutdriver, remove the nut securing the rectifier to the divider panel. See **Figure F.61**.
6. The auxiliary rectifier can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Apply a coating of Dow Corning 340 heat sink compound to the rear of the auxiliary rectifier.
2. Carefully position the new auxiliary rectifier onto the divider panel.
3. Using a 3/8" nutdriver, attach the nut securing the rectifier to the divider panel.
4. Connect leads X13, X14, POS and NEG from the auxiliary rectifier. See Wiring Diagram.
5. Perform the **Case Cover Replacement Procedure**.
6. Perform the **Retest After Repair Procedure**.

Figure F.60 – Auxiliary rectifier lead locations

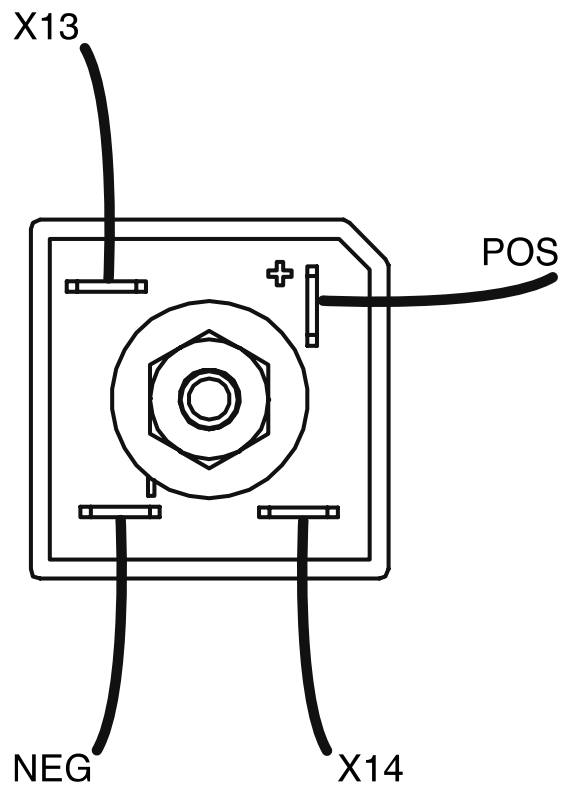
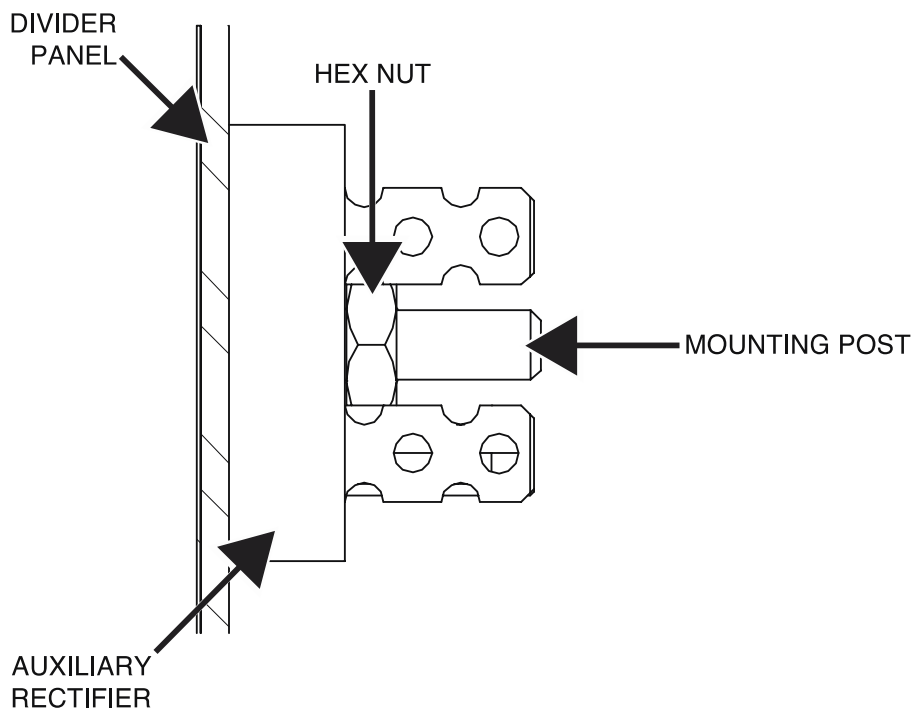


Figure F.61 – Auxiliary rectifier mounting nut location



CHOKE REMOVAL AND REPLACEMENT PROCEDURE

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 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 Choke.

MATERIALS NEEDED

7/16" Nutdriver
3/8" Nutdriver
Two 1/2" Open-End Wrenches
3/4" Open-End Wrench
Wiring Diagram

REMOVAL PROCEDURE

1. Carefully remove input power from the Flextec 650x machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Capacitor Discharge Procedure**.
4. Label and disconnect plugs J20, J21, J22, J23, J25 and J26 from the switch board. See **Figure F.62**. See Wiring Diagram.
5. Using a 7/16" nutdriver, remove the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 to the switch board. See **Figure F.62**. See Wiring Diagram.
6. Using a 7/16" nutdriver, remove the two screws, lock washers and flat washers securing the heat sink to the divider panel. See **Figure F.63**.
7. Using a 3/8" nutdriver, remove the two screws securing the heat sink bracket to the base of the machine. See **Figure F.63**.
8. Carefully remove the switch board and heat sink assembly from the machine.
9. Using two 1/2" open-end wrenches, remove the bolt, nut, lock washer and two flat washers securing lead 220 to the top choke terminal. See **Figure F.64**. See Wiring Diagram.
10. Using a 3/4" open-end wrench, remove the bolt, lock washer and flat washer securing the choke lead to the positive output stud. See **Figure F.63**. See Wiring Diagram.
11. Using a 3/8" nutdriver, remove the four screws and washers securing the choke to the base of the machine. See **Figure F.65**.
12. Using a 3/4" open-end wrench, disconnect the NEG lead from the rear of the negative output stud. See **Figure F.63**. See Wiring Diagram. Label lead for reassembly.
13. The choke can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the choke assembly into the machine.
2. Using a 3/8" nutdriver, attach the four screws and washers securing the choke to the base of the machine.
3. Using a 3/4" open-end wrench, connect the NEG lead from the rear of the negative output stud. See Wiring Diagram.
4. Using a 3/4" open-end wrench, remove the bolt, lock washer and flat washer securing the choke lead to the positive output stud. See Wiring Diagram.
5. Using two 1/2" open-end wrenches, remove the bolt, nut, lock washer and two flat washers securing lead 220 to the top choke terminal. See Wiring Diagram.
6. Carefully position the switch board and heat sink assembly into the machine.
7. Using a 3/8" nutdriver, attach the two screws securing the heat sink bracket to the base of the machine.
8. Using a 7/16" nutdriver, attach the two screws, lock washers and flat washers securing the heat sink to the divider panel.
9. Using a 7/16" nutdriver, attach the four screws, lock washers and flat washers securing leads 201, 204, 207 and 209 to the switch board. See Wiring Diagram.
10. Connect plugs J20, J21, J22, J23, J25 and J26 to the switch board. See Wiring Diagram
11. Perform the **Case Cover Replacement Procedure**.
12. Perform the **Retest After Repair Procedure**.

Figure F.62 – Switch board plug and lead locations

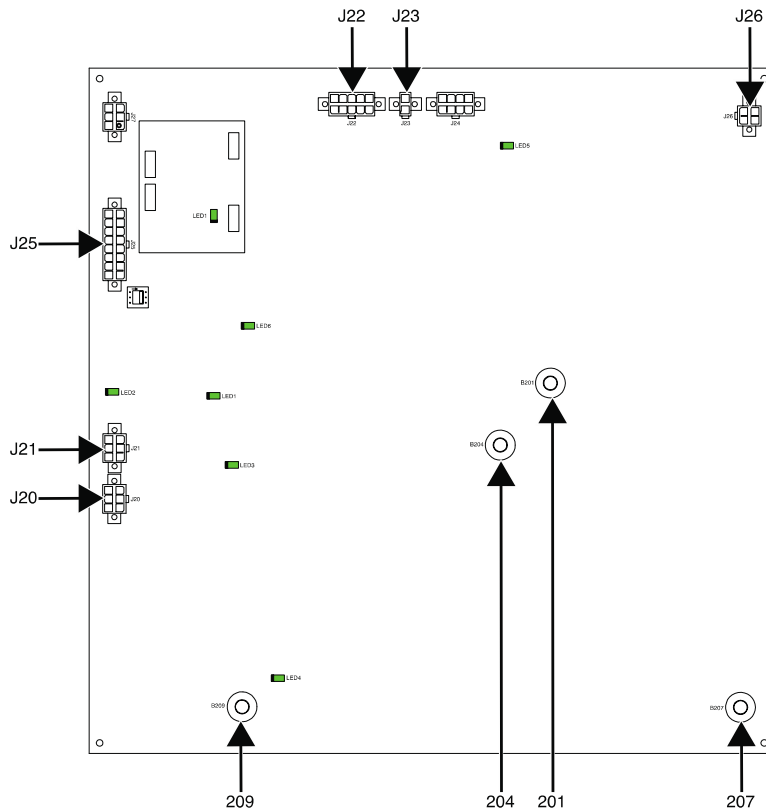


Figure F.63 – Switch board and heat sink assembly mounting screw locations

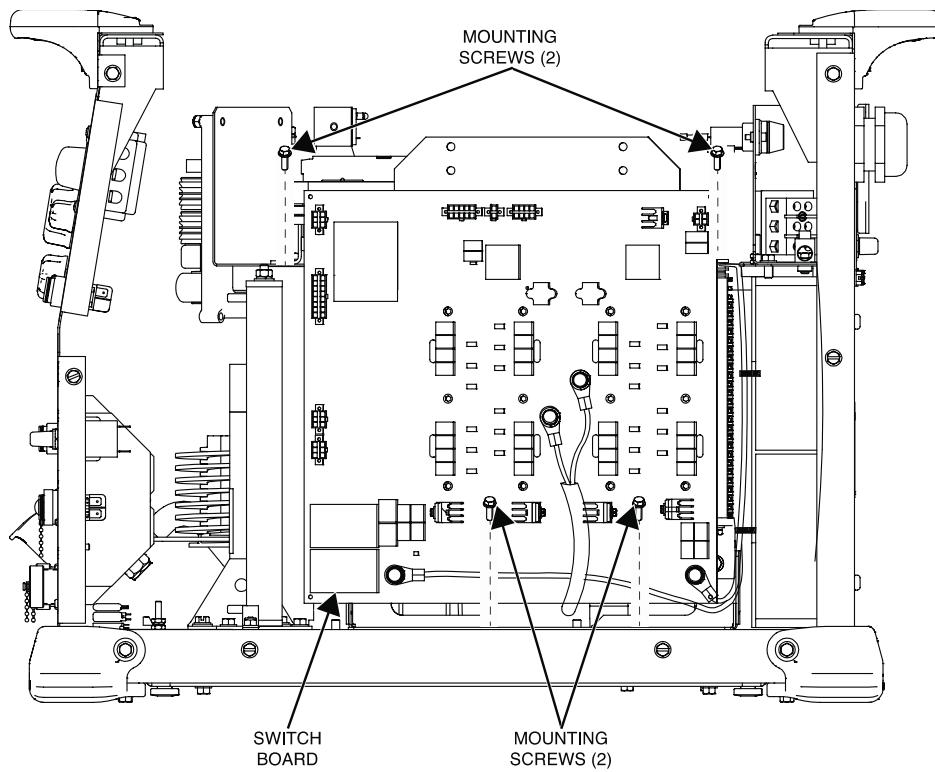


Figure F.64 – Choke lead 220 and NEG lead locations

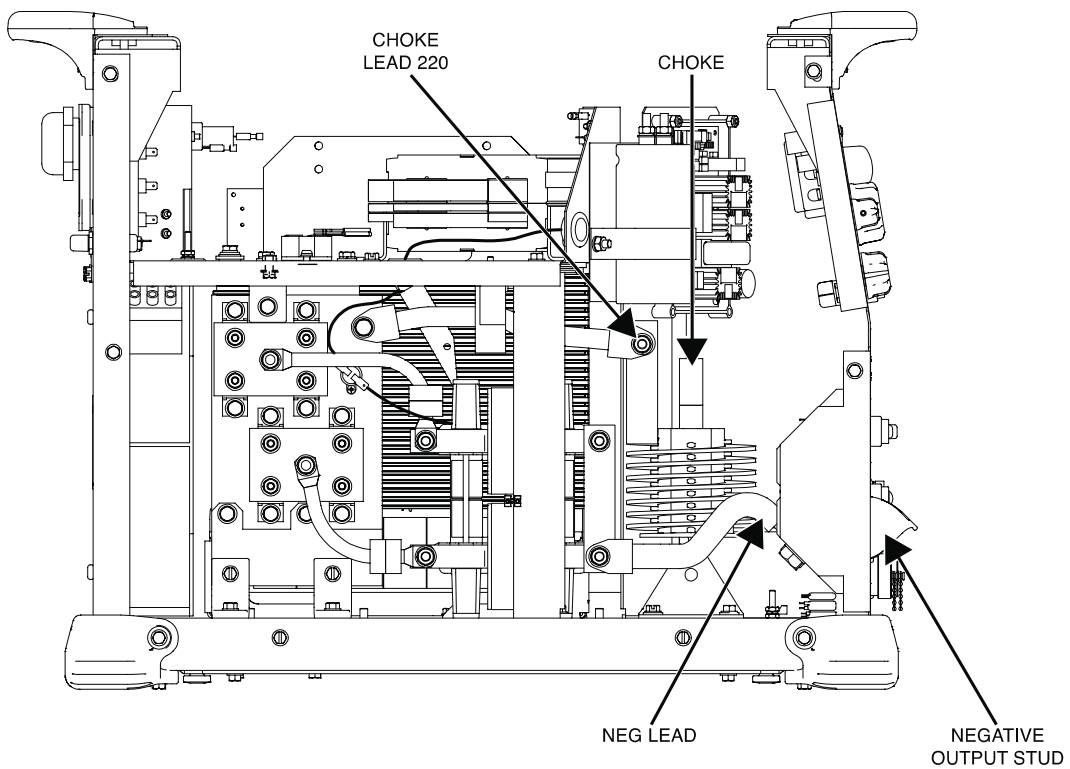
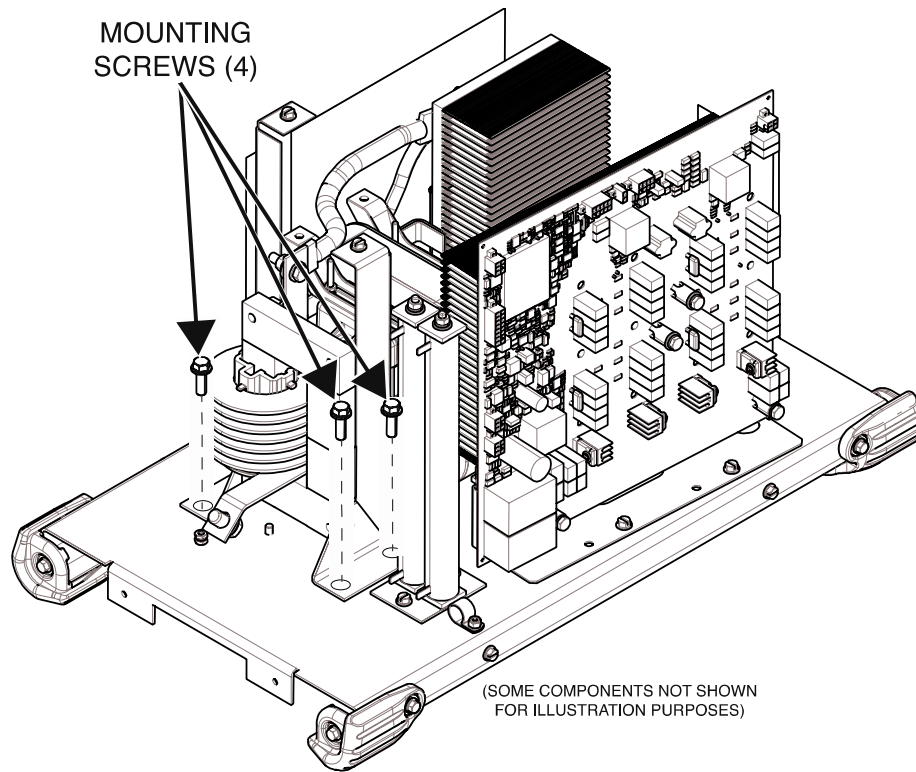


Figure F.65 – Choke assembly mounting screw locations



RETEST AFTER REPAIR

Retest a machine:

- If it is rejected under test for any reason that requires you to remove any part which could affect the machine’s electrical characteristics.

OR

- If you repair or replace any electrical components.

POWER SOURCE – INPUT VOLTAGE AND CURRENT					
MODEL	DUTY CYCLE	INPUT VOLTAGE ± 10%	INPUT AMPERES EFFECTIVE	IDLE POWER (W)	POWER FACTOR @ RATED OUTPUT
K3425-1	60% RATING	380 / 460 / 575 / 3 / 50 / 60	61 / 50 / 40	230 MAX. (FAN ON) 100 MAX. (FAN OFF)	88%
	100% RATING		57 / 47 / 38		

RATED OUTPUT*			
PROCESS	DUTY CYCLE	AMPERES	VOLTA AT RATED AMPERES
GMAW (CV)	60%	750 *	44V
	100%	650 *	
GTAW (CC)	60%	750	34V
	100%	650	
SMAW (CC)	60%	750 *	44V
	100%	650 *	
FCAW-G (CV)	60%	750 *	
	100%	650 *	
FCAW-S (CV)	60%	750 *	
	100%	650 *	
SAW (CV)	60%	750 *	
	100%	650 *	

* Output is limited to 600A / 100% and 700A / 60% when used with K3091-1 Multi-Process Switch.

CURRENT CALIBRATION

1. Connect a resistive load bank to the machine configured for 300A/20V (750A/50V equivalent).
2. Connect a certified calibrated current probe or current meter and shunt to the output circuit.
3. Disconnect input power from the machine being calibrated; remove the right case side to provide access to the User Interface. Set position “1” on the dip switch to “ON”. **(NOTE:** additional dip switch positions may be different depending on the configuration of your machine. Refer to INTERNAL CONTROLS– ENABLING VRD, MULTI-WELD sections of the operator’s manual). Replace the right case side.
4. Rotate the Hot Start control and Arc Control knobs completely counter-clockwise.

5. Replace the right case side; reconnect input power to the machine and energize.
 6. The display should read "Cur CAL".
 7. Rotate the Hot Start knob clockwise to enable the output which will be indicated by the scrolling message "Adj Pot So rEAL Cur = 300A" on the display.
 8. The actual output current should be 300 +/- 2 A. If the actual output current is within the specified limits, skip to step 11. If the actual output current is not accurate perform the following:
 9. Adjust the output control knob until the actual output current reading is within the specified range.
 10. Toggle the Local/Remote switch to save the calibration. The display should flash "CAL Set".
 11. Rotate the Hot Start knob counter-clockwise to disable the output.
 12. Disconnect input power from the machine being calibrated; remove the right case side to provide access to the User Interface. Set position "1" on the dip switch back to "OFF".
- CURRENT CALIBRATION COMPLETE

VOLTAGE CALIBRATION

1. Connect a resistive load bank to the machine configured for 300A/20V (750A/50V equivalent).
 2. Connect a certified calibrated voltmeter to the output circuit. **NOTE:** High speed voltage transients associated with inverter welders output can adversely affect the accuracy of some metering equipment. The M25303 low pass filter supplied with the K4171-1 Power Wave Calibration Kit is strongly recommended between the meter and the power source to reduce this effect.
 3. Disconnect input power from the machine being calibrated; remove the right case side to provide access to the User Interface. Set position "1" on the dip switch to "ON". (**NOTE:** additional dip switch positions may be different than pictured below depending on the configuration of your machine. Refer to INTERNAL CONTROLS – ENABLING VRD, MULTI-WELD sections of the manual).
 4. Rotate the Hot Start control and Arc Control knobs completely counter-clockwise.
 5. Replace the right case side; reconnect input power to the machine and energize.
 6. The display should read "Cur CAL".
 7. Rotate the Arc Control knob until the display reads "VoL CAL".
 8. Rotate the Hot Start knob clockwise to enable the output which will be indicated by the scrolling message "Adj Pot So rEAL VoL = 20 VoL" on the display.
 9. The actual output voltage should be 20 +/- 0.5 V. If the actual output voltage is within the specified limits, skip to step 12. If the actual output voltage is not accurate perform step 10.
 10. Adjust the output control knob until the actual output voltage reading is within the specified range.
 11. Toggle the Local/Remote switch to save the calibration. The display should flash "CAL Set".
 12. Rotate the Hot Start knob counter-clockwise to disable the output.
 13. Disconnect input power from the machine being calibrated; remove the right case side to provide access to the User Interface. Set position "1" on the dip switch back to "OFF".
- VOLTAGE CALIBRATION COMPLETE