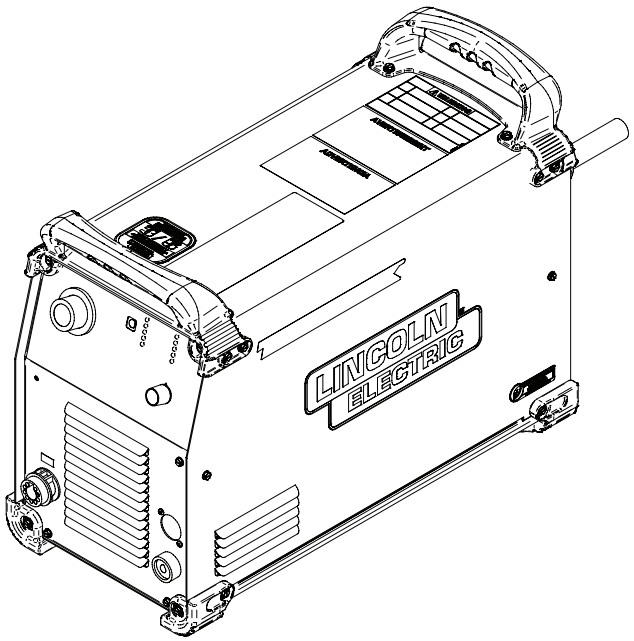
LINCOLN ELECTRIC

Tomahawk® 1500

For use with machines having Code Numbers:

Tomahawk 1500: 12549, 12588

SERVICE MANUAL



SVM274 | Issue Date 17-Mar

THE LINCOLN ELECTRIC COMPANY
22801 St. Clair Avenue • Cleveland, OH • 44117-1199 • U.S.A.
Phone: +1.216.481.8100 • www.lincolnelectric.com

THANK YOU FOR SELECTING A QUALITY PRODUCT BY LINCOLN ELECTRIC.

PLEASE EXAMINE CARTON AND EQUIPMENT FOR DAMAGE IMMEDIATELY

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

SAFETY DEPENDS ON YOU

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

⚠ WARNING

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

⚠ CAUTION

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

KEEP YOUR HEAD OUT OF THE FUMES.

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

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

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

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

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

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

WEAR CORRECT EYE, EAR & BODY PROTECTION

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

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

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

IN SOME AREAS, protection from noise may be appropriate.

BE SURE protective equipment is in good condition.

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

SPECIAL SITUATIONS

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

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

Additional precautionary measures

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

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

REMOVE all potential fire hazards from welding area.

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

SECTION A: WARNINGS

CALIFORNIA PROPOSITION 65 WARNINGS

Diesel Engines

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

Gasoline Engines

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

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

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

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

FOR ENGINE POWERED EQUIPMENT.

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

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

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

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

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

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

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

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

ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS

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

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

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

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

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

ELECTRIC SHOCK CAN KILL.

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

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

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

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

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

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

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

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

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

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

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

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

ARC RAYS CAN BURN.

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

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

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

FUMES AND GASES CAN BE DANGEROUS.

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

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

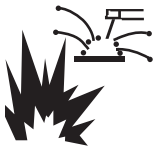
5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

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

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

5.f. Also see item 1.b.

WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION.



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

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

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

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

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

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

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

6.h. Also see item 1.c.

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

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

CYLINDER MAY EXPLODE IF DAMAGED.

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

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

7.c. Cylinders should be located:

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

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

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

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

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-I, "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.

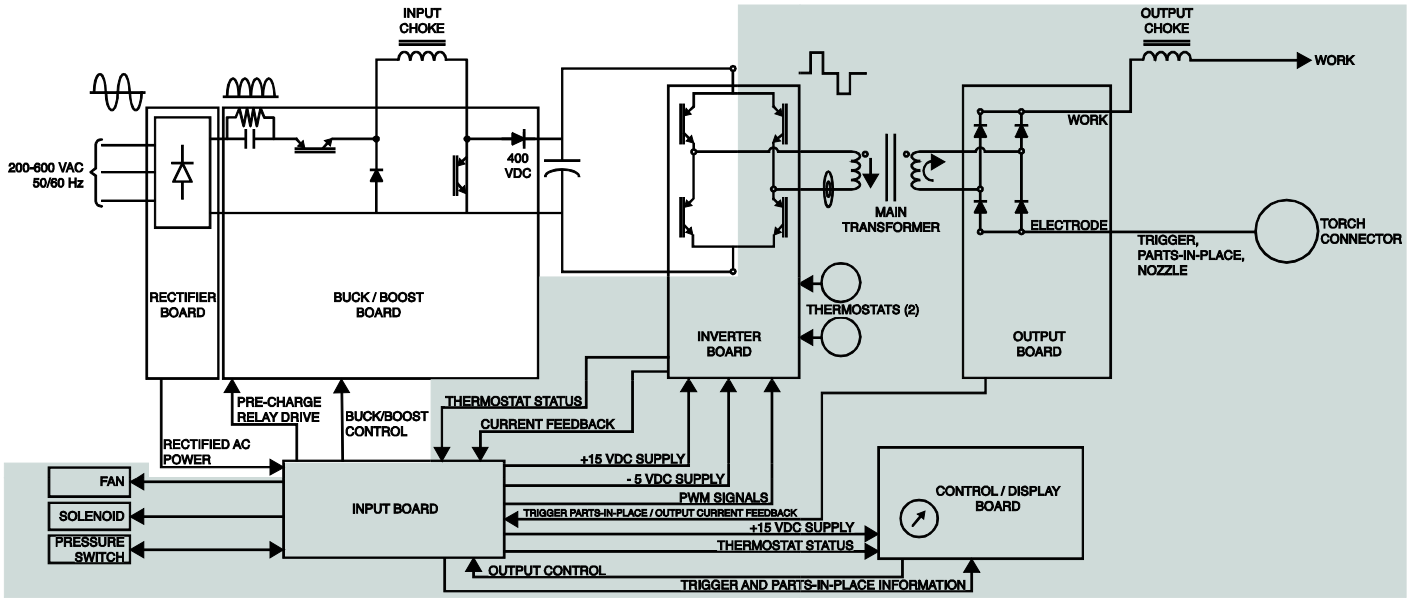
Tomahawk® 1500

Service Manual

Last update: 2017/03/01

Theory of Operation

Figure E.1 – Input switch and buck / boost board



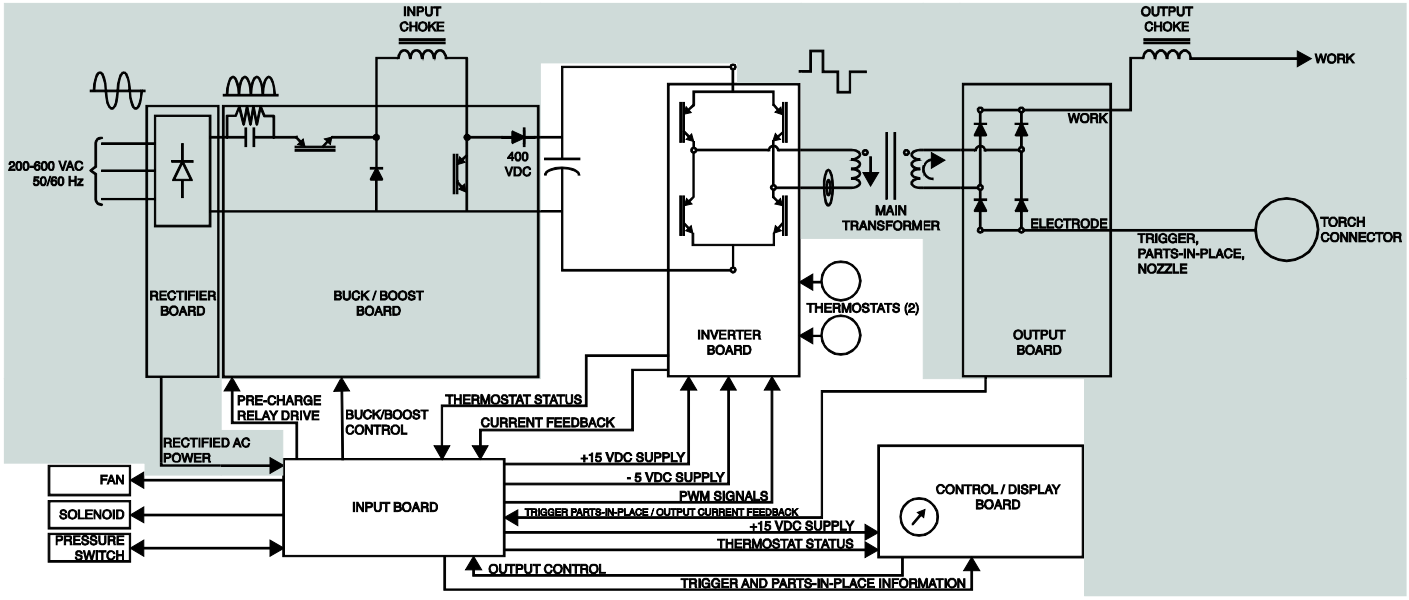
Input Switch and Buck / Boost Board

The single or three phase input power is applied to the Tomahawk 1500 through the main input switch located on the back panel of the machine. When the switch is closed the AC input power is applied to the rectifier board where it is rectified to a DC voltage. This rectified input voltage is applied to the buck / boost board.

The buck / boost board houses a soft-start circuit consisting of a 100 ohm resistor and a DC relay. Initially the DC relay is not activated and the incoming DC voltage is applied to the DC link capacitors via the 100 ohm resistor. The 100 ohm resistor functions as a current limiting device allowing the DC link capacitors to charge slowly. Upon receiving a soft-start command from the input board, the DC relay closes and the 100 ohm resistor is by-passed by the relay contacts and the full input potential is applied to the DC link capacitors. The DC link capacitors also function as voltage clamps for the buck / boost circuit.

The buck / boost circuit consists of a buck converter followed by a boost converter. The boost switch is active when the input voltage is at 230 VAC input or less. Under this condition the buck switch is held on the entire time. The buck switch is active when the input voltage is at 325 VAC or more. Under this condition the boost switch is not active for most of the time. The buck / boost circuit operates at 20 KHz. The buck / boost circuit's output is a 400 VDC regulated bus that is filtered and applied to the inverter board.

Figure E.2 – Inverter board, input board and control / display board



Inverter Board, Input Board and Control / Display Board

The 400 VDC created by the buck / boost board is filtered and applied to an IGBT controlled full wave bridge inverter that is located on the inverter board. The full wave bridge inverter is pulsed width modulated at 20Khz via control signals sent from the input board. Minimum and maximum output is achieved and controlled via the PWM signals from the input board. The pulsed DC output of the full wave bridge inverter is coupled to the primary winding of the main transformer. The transformer primary current is sensed on the inverter board and this current feedback information is sent to the input board. There are two normally closed thermostats connected to the inverter board. One thermostat is located underneath the inverter board and the other thermostat is located in the output choke. If either of these thermostats opens, due to over temperature, the inverter board will be turned off and the cutting output will be disabled to allow the unit to cool.

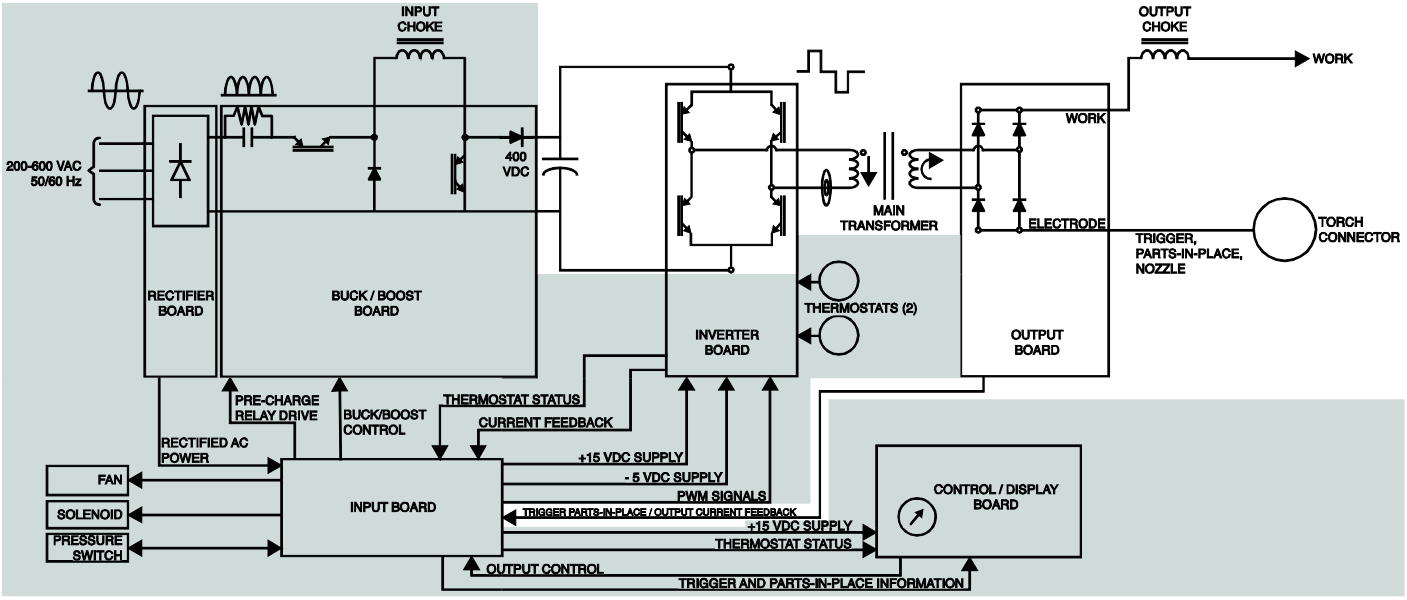
There are several auxiliary supplies created on the input board. These DC supplies are sourced from a wide range of rectified input voltages (208 VAC to 575 VAC rectified). The input board receives current reference commands from the control / display board and compares these to the output voltage and current information received from the output board. The input board then sends the appropriate PWM signals to the inverter board.

The input board also monitors the torch parts-in-place and trigger circuits and will **not** send a PWM signal to the inverter board if the safety circuits are not whole and complete. Thus, no output from the Tomahawk 1500.

The input board also sends control signals to the buck / boost board and powers the gas solenoid and cooling fan.

The control / display board functions as the user interface between the operator and the machine. It receives status and analog signals from the inverter and output boards via the input board and sets the output current reference command. It also manages the error and alarm signs and the LED functions.

Figure E.3 – Main transformer, output board and torch connector



Main Transformer, Output Board and Torch Connector

The 400 volt pulsed DC output of the full wave bridge inverter (located on the inverter board) is coupled to the primary winding of the main transformer. Each IGBT pair on the inverter board acts as a switch assembly. Each switch assembly drives current through the primary winding of main transformer. When the first IGBT pair is on (driving current in one direction) the other IGBT pair is off. When the first IGBT pair is off the second IGBT pair turns on driving primary current in the opposite direction. Thus, the main transformer is receiving AC current in the primary winding.

The secondary winding of the main transformer is coupled to the output board. The output of the secondary winding is a 270 VAC square wave at 20 KHz.

All of the outputs (both pilot and cutting) go through the output board. The function of this board is to manage the output currents and signals. Two diode modules configured as a full wave bridge, rectify the secondary AC output of the main transformer to create the DC output. Two current sensors monitor the current that flows through the work piece and the torch electrode. This feedback information is sent to the input board. The output board also receives the parts-in-place and trigger information from the torch connector. This information is passed onto the input board. The pilot arc (18 amps for 4 seconds) is managed by an IBGT switch located on the output board.

The output choke, that is in series with both the pilot circuit and the cutting circuit, provides current filtering to enhance arc stability.

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 four main categories: Function Problems, Output Problems, Control / Display Board Troubleshooting and Control / Display Board LED Error Codes.

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**
FUNCTION PROBLEMS		
Major physical or electrical damage is evident when the sheet metal covers are removed.	1. Contact your local authorized Lincoln Electric Service Facility.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.
No status indicators are lit and the fan does not operate 5 seconds after the power switch is turned on.	1. Make sure that the input power switch is in the "ON" position. 2. Check for the correct input voltage at the machine. Input voltage must match the rating plate. 3. Check for blown or missing fuses in the input lines.	1. Check the input power switch for proper operation. 2. Check the leads associated with the input power switch for loose or faulty connections. See the Wiring Diagram. 3. Check all connectors and wires for loose or faulty connections. 4. Perform the ***Rectifier Board Test Procedure***. 5. Perform the ***Buck / Boost Board & IGBT Test Procedure***. 6. Perform the ***Input Board Test Procedure***.
The input line circuit breaker repeatedly trips.	1. Make sure the input breakers or fuses are sized correctly for the input voltages being applied. See the machine's rating plate and the Technical Specifications section of the Operators Manual. 2. Make sure the input breakers or fuses are sized correctly for the cutting current and duty cycle of the process. See the machine's rating plate and the Technical Specifications in the Operators Manual.	1. Perform the ***Rectifier Board Test Procedure***. 2. Perform the ***Buck / Boost Board & IGBT Test Procedure***. 3. Perform the ***Inverter Board Test Procedure***.
⚠ 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**
FUNCTION PROBLEMS		
The thermal LED is illuminated after normal use.	1. One of the machine's thermal protection circuits has tripped. Do not turn the Tomahawk 1500 machine off. Allow the machine to cool. The thermal protection circuits will reset themselves. 2. Either the duty cycle has been exceeded, the fan is not functioning or the louvers are blocked.	1. Check the normally closed thermostats for proper operation. See the Wiring Diagram. 2. Check all thermostat connectors and wires for loose or faulty connections. See Wiring Diagram. 3. Perform the ***Control / Display Board Test Procedure***. 4. Perform the ***Inverter Board Test Procedure***.
When the torch trigger is pulled air begins to flow. There is a very brief pilot arc (Normal is 3 seconds). The sequence is repeated with subsequent trigger pulls.	1. Check the input voltage at the machine. The input voltage must match the rating plate. 2. Make sure the air pressure is set correctly. 3. Check the torch consumables to be sure they are not dirty or greasy and are in good condition. 4. Make sure there are no kinks or restrictions for airflow in the torch cable.	1. Perform the ***Torch Test Procedure***. 2. Perform the ***Inverter Board Test Procedure***. 3. Perform the ***Output Board Test Procedure***. 4. Perform the ***Control / Display Board Test Procedure***.

⚠ 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.

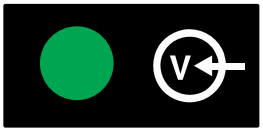
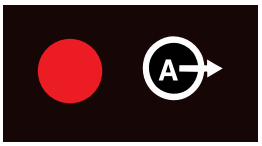
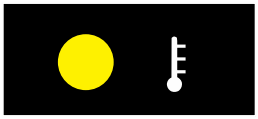
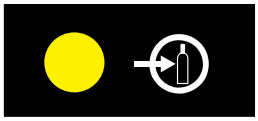
Observe Safety Guidelines detailed in the beginning of this manual.		**TROUBLESHOOTING GUIDE**
PROBLEMS (SYMPTOMS)	**POSSIBLE AREAS OF MISADJUSTMENT(S)**	**RECOMMENDED COURSE OF ACTION**
FUNCTION PROBLEMS		
The yellow parts in place LED is illuminated and steady.	1. Make sure the torch is connected securely to the machine. 2. Verify torch consumables are in good condition and properly installed. If torch and consumables are properly installed, the yellow LED should turn off. The unit may be required to have the input power turned off then back on. Normal cutting or gouging can resume.	1. Check for loose or faulty connections between the output board and the torch connector. 2. Perform the ***Torch Test Procedure***. 3. Perform the ***Output Board Test Procedure***.
The cutting arc starts but sputters badly.	1. Make sure the operating procedure is correct for the process. See the Operation section of the Operator's Manual. 2. Make sure the work clamp is connected tightly to the work piece. 3. Make sure the torch consumable parts are in place and in good condition. Replace if necessary. 4. Make sure the air pressure is set correctly. 5. Make sure the air supply is not contaminated with oil or excessive water.	1. Check all connectors and wires for loose or faulty connections. See Wiring Diagram. 2. Perform the ***Torch Test Procedure***. 3. Perform the ***Inverter Board Test Procedure***. 4. Perform the ***Output Board Test Procedure***. 5. Perform the ***Control / Display Board Test Procedure***.
⚠ 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**
FUNCTION PROBLEMS		
The pilot arc is normal but the arc will not transfer to the work piece to establish a cutting arc.	1. Make sure the operating procedure is correct for the process. See the Operation section of the Operator's Manual. 2. Make sure the work clamp is connected tightly to the work piece. 3. The work piece must be electrically conductive material and the work clamp must make a good electrical connection with the work piece.	1. Check all connectors and wires for loose or faulty connections. See Wiring Diagram. 2. Perform the ***Inverter Board Test Procedure***. 3. Perform the ***Output Board Test Procedure***. 4. Perform the ***Control / Display Board Test Procedure***.
The yellow gas pressure LED is illuminated and steady.	1. Make sure there is at least 80 psi connected to the gas connection at the back of the machine. 2. Turn the output knob to the purge zone and set the regulator to the correct pressure. The pressure may increase when air stops flowing but this is normal. Do not reset the pressure while the air is off.	1. Possible faulty pressure switch. 2. Perform the ***Control / Display Board Test Procedure***.
⚠ 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		
Five seconds after the input power switch is turned on, the fan runs but the status indicators do not illuminate. There is no cutting output when the torch trigger is pulled.	1. Check the input voltage at the machine. Input voltage must match the rating plate.	1. Perform the ***Control / Display Board Test Procedure***. 2. Perform the ***Input Board Test Procedure***. 3. Perform the ***Buck / Boost Board & IGBT Test Procedure***.
The Tomahawk 1500 powers up normally, but there is no response (air flow or pilot arc) when the torch trigger is pulled. Only the power LED is illuminated.	1. Make sure the torch handle or cable is not damaged or pulled from the machine. Replace if necessary. 2. Make sure the air supply is operating properly. 3. Check for proper trigger switch operation. See the Wiring Diagram.	1. Turn the output knob on the front of the Tomahawk 1500 to "purge". If air does NOT flow, the main gas solenoid may be faulty. 2. Perform the ***Air / Gas Solenoid Test Procedure***. 3. Perform the ***Torch Test Procedure***. 4. Perform the ***Output Board Test Procedure***. 5. Perform the ***Control / Display Board Test Procedure***.
The Tomahawk 1500 powers up properly, but air only flows when the torch trigger is pulled. There is no pilot arc established.	1. Make sure the air pressure is set correctly. 2. Check the torch consumables to be sure they are not dirty or greasy and are in good condition. 3. Make sure there are no kinks or restrictions for airflow in the torch cable. 4. If a slight thump cannot be felt in the torch when the trigger is pulled, check for loose connections in the torch head.	1. Perform the ***Torch Test Procedure***. 2. Perform the ***Inverter Board Test Procedure***. 3. Perform the ***Output Board Test Procedure***. 4. Perform the ***Control / Display Board Test Procedure***.

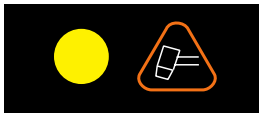
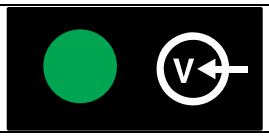
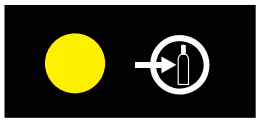
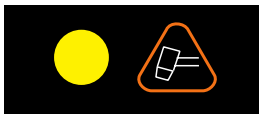
⚠ CAUTION

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**
CONTROL / DISPLAY BOARD TROUBLESHOOTING	
	**Power ON/OFF LED:** It lights up when the machine is ON. **Blinking LED:** The input voltage may be out of range condition. The machine is disabled: when the input voltage returns to the correct range, the machine will restart automatically. **NOTE:** The fan could be automatically switched OFF if the error condition persist for more than two seconds.
	**Output LED:** The cutting torch is energized. **Blinking LED:** Internal auxiliary undervoltage condition. The machine needs to be turned OFF then ON again to restart.
	**Thermal LED:** The machine is overheated and the output has been disabled. This usually occurs when the duty cycle of the machine has been exceeded. Leave the machine ON to allow the internal components to cool. When the thermal LED turns off, normal operation is again possible.
	**Low gas pressure condition LED:** With this LED ON the machine stops cutting or gouging operations. The machine restarts automatically when a correct gas pressure is detected. To check / adjust the primary gas pressure (see recommended values in the Technical Specifications section of the Operators Manual): • When this LED illuminates, for ten seconds the machine automatically enters a Purge mode. • During Purge time check and adjust the inlet gas pressure to the specification in the Operators Manual and verify the outlet gas pressure through the regulator knob.
⚠ 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**

CONTROL / DISPLAY BOARD TROUBLESHOOTING

	**PIP LED:** Part in place condition: the torch retaining cap (or the torch connector) is not properly screwed on the torch head (or in the machine torch connector). **To restore the machine:** • Screw firmly the torch retaining cap (or the torch connector). • After the torch is restored, the machine cannot restart for about five seconds. During this time the PIP LED blinks. **NOTE:** When the LED is blinking, if another PIP error occurs or if the Torch Trigger pushbutton is pressed the machine returns to the error condition: PIP LED returns steady ON and the restoring procedure begins again). • When the PIP LED turns OFF the machine is ready to operate.
No pilot arc established.	 **ON (Green LED)**  **ON (Yellow LED)**  **ON (Yellow LED)** The Torch Trigger pushbutton is pressed. During this period the machine will attempt to start the pilot arc four times. If the pilot arc does not start the machine automatically goes into a safe condition to allow troubleshooting as necessary. **To restore the machine:** • Turn OFF the power switch. • Check the correct placement of the Torch Head consumables and parts. • Check the Torch electrical connections. • Turn the machine ON again.

⚠ CAUTION

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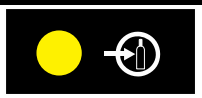
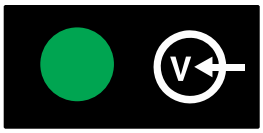
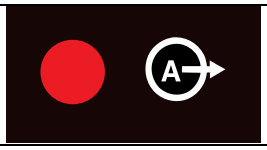
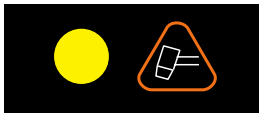
Observe Safety Guidelines detailed in the beginning of this manual.	**TROUBLESHOOTING GUIDE**

CONTROL / DISPLAY BOARD TROUBLESHOOTING

Trigger Pushed.				
	ON	**ON**	**ON**	**ON**
	This occurs if the machine is switched ON (or if it restarts after Thermal reset) with the Torch Trigger pushbutton hold. This status avoids unsafe operating conditions: manual cutting or gouging processes must be started ONLY under the direct control of the operator. **To restore the machine:** • Release the Torch Trigger pushbutton. • Press again the Torch Trigger pushbutton. If this error condition persists check for eventual malfunctions of the Torch Trigger pushbutton.			
No Pilot Arc Transferred.				
	ON (Green LED)	**BLINK (Red LED)**	**BLINK (Yellow)**	
	This occurs if after four seconds the Pilot Arc isn't transferred to the workpiece. The machine stops the pilot arc to avoid overheating on the Torch Head. **To restore the machine:** • Release the Torch Trigger pushbutton. The blinking LEDs are now permanently ON. • Press again the release the Torch Trigger pushbutton.			

⚠ CAUTION

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Observe Safety Guidelines detailed in the beginning of this manual.	**TROUBLESHOOTING GUIDE**

CONTROL / DISPLAY BOARD LED ERROR CODES

LED →	POWER ON	OUTPUT ENERGIZED	THERMAL ERROR	GAS ERROR	P.I.P. ERROR
ERROR ↓					
Input voltage out of range	BLINKING	OFF	OFF	OFF	OFF
No Pilot Arc Transfer	ON	BLINKING	N.I.	N.I.	BLINKING
No Pilot Arc Initiation	ON	OFF	OFF	ON	ON
Trigger Locked	ON	OFF	ON	ON	ON
Internal Power Supply Error	ON	BLINKING	OFF	OFF	OFF
Thermal Error	ON	OFF	ON	OFF	OFF
Gas Error	ON	OFF	OFF	ON	OFF
Parts In Place Error	ON	OFF	OFF	OFF	ON

⚠ CAUTION

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Test Procedures

CASE COVER REMOVAL AND REPLACEMENT AND CAPACITOR DISCHARGE PROCEDURE

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TEST DESCRIPTION

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

MATERIALS NEEDED

5/16” Nutdriver
25 – 1000 Ohm Resistor (25 Watts Minimum)
Insulated gloves
Insulated Pliers
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Using a 5/16” nutdriver, remove the eight (sixteen total) screws and washers securing each of the handles to the machine. See ***Figures F.1***.
3. Carefully remove both handles.
4. Using a 5/16” nutdriver, remove the four screws and washers securing each of the corner caps to the case cover. See ***Figure F.1***.
5. Using a 5/16” nutdriver, remove the four screws securing the case cover. See ***Figure F.2***.
6. The case cover can now be removed.
7. Locate the capacitor and carefully check the DC voltage at the terminals. See ***Figure F.3*** and ***Figure F.4***.
8. If any voltage is present, discharge the capacitor using the high wattage resistor (25-1000 Ohms @ 25 watts minimum), electrically insulated gloves and pliers. Hold the resistor on the capacitor terminals for 10 seconds. See ***Figure F.4***.
9. Recheck the voltage across the capacitor terminals. The voltage should be zero. If any voltage remains repeat the discharge procedure until the voltage is zero.
10. Locate the buck / boost board. See ***Figure F.5***.

11. Locate the two terminals labeled DCIN+ and DCIN- on the buck / boost board. See ***Figure F.6***. Carefully check for any voltage present at the terminals.
12. If any voltage is present, discharge the capacitors using the high wattage resistor (25-1000 Ohms @ 25 watts minimum), electrically insulated gloves and pliers. Hold the resistor on the DCIN+ and DCIN- terminals for 10 seconds.
13. Recheck the voltage across the terminals. The voltage should be zero. If any voltage remains, repeat the discharge procedure until the voltage is zero.

REPLACEMENT PROCEDURE

1. Carefully position the case cover on to the machine.
2. Using a 5/16” nutdriver, attach the four screws securing the case cover.
3. Using a 5/16” nutdriver, attach the four screws and washers securing each of the corner caps to the case cover.
4. Place each handle onto the machine.
5. Using a 5/16” nutdriver, attach the eight (sixteen total) screws and washers securing each of the handles to the machine.

Figure F.1 – Handle and corner cap mounting screw locations

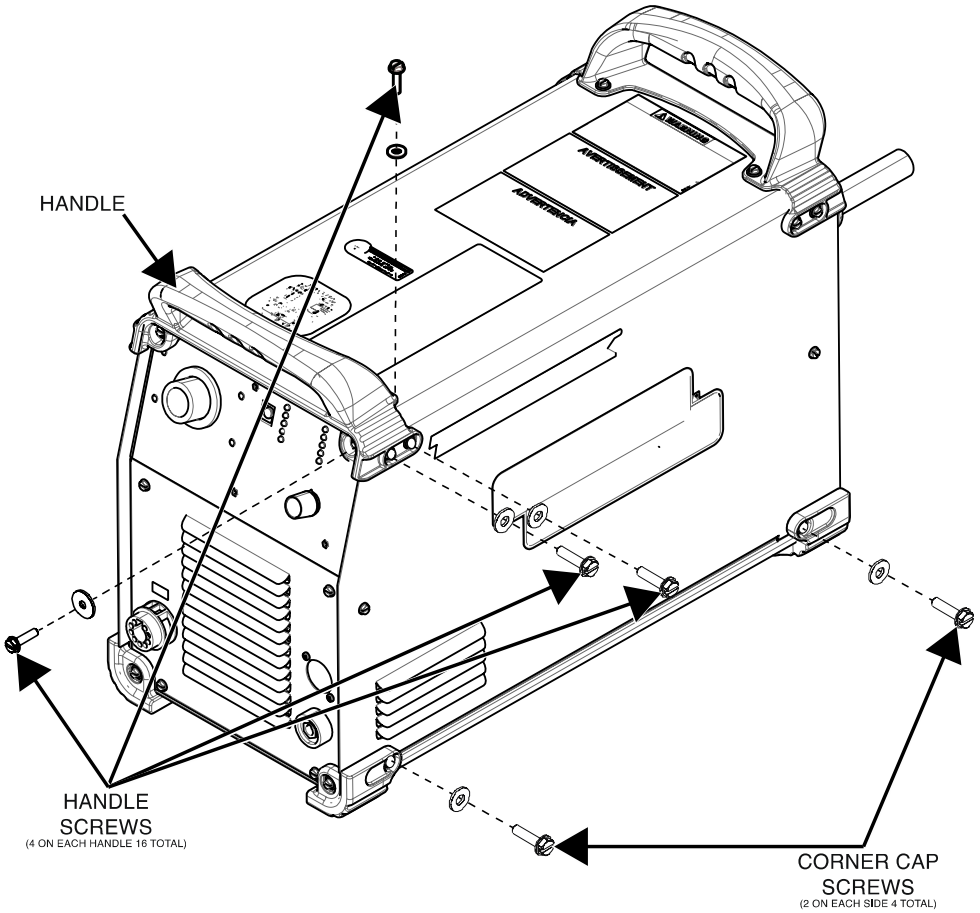


Figure F.2 – Case cover mounting screw locations

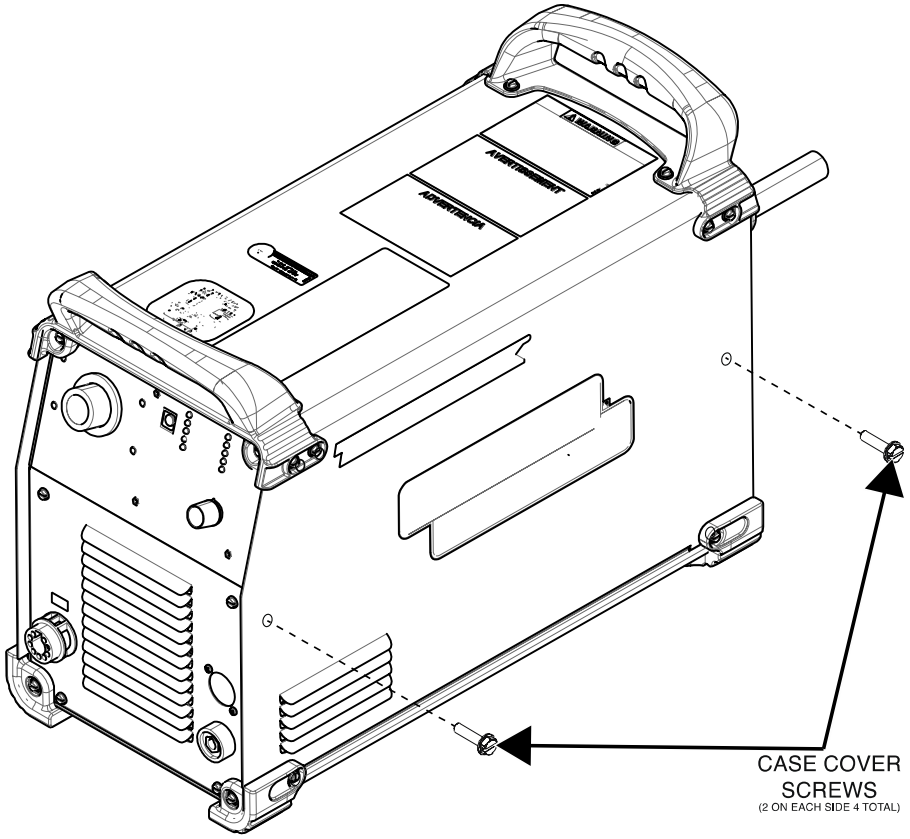


Figure F.3 – Capacitor location

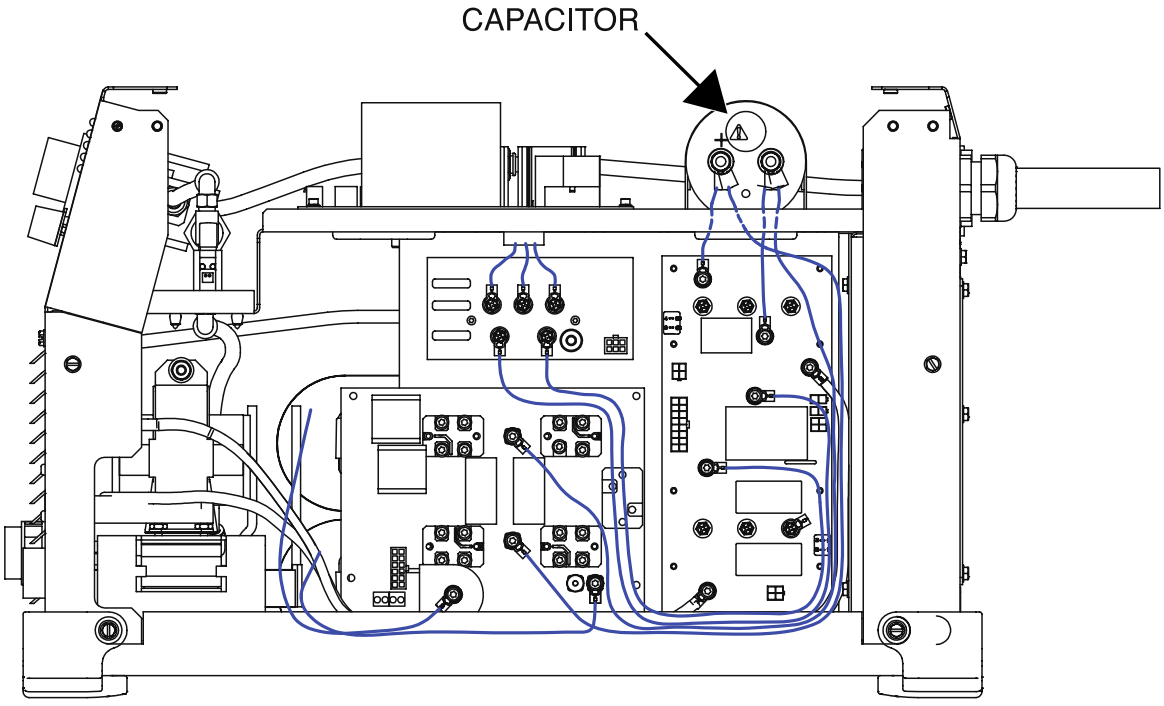


Figure F.4 – Capacitor discharge procedure

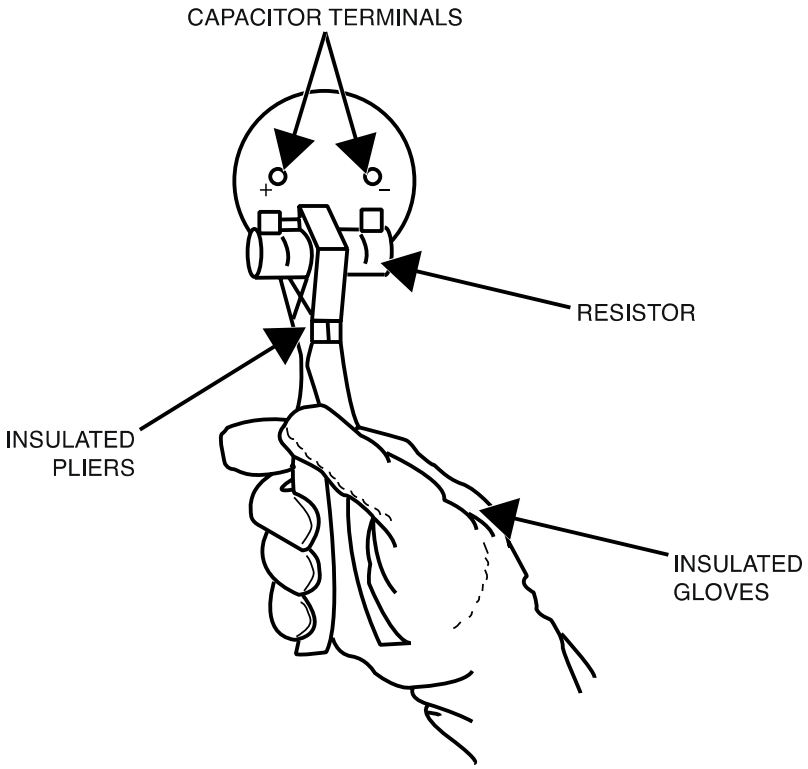


Figure F.5 – Buck / boost board location

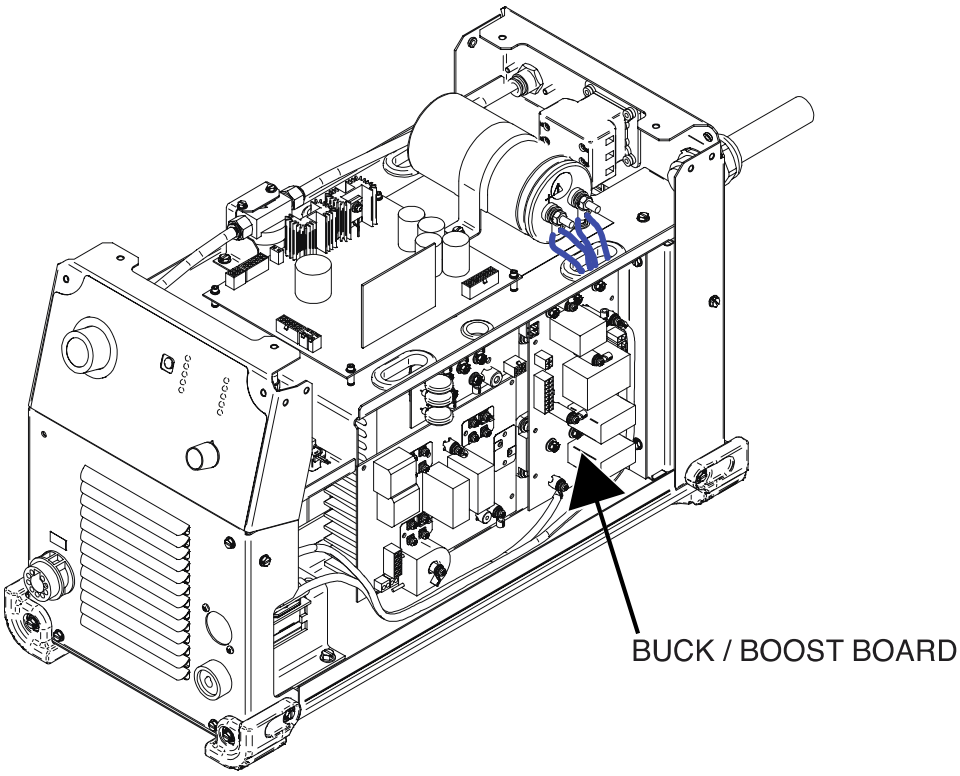
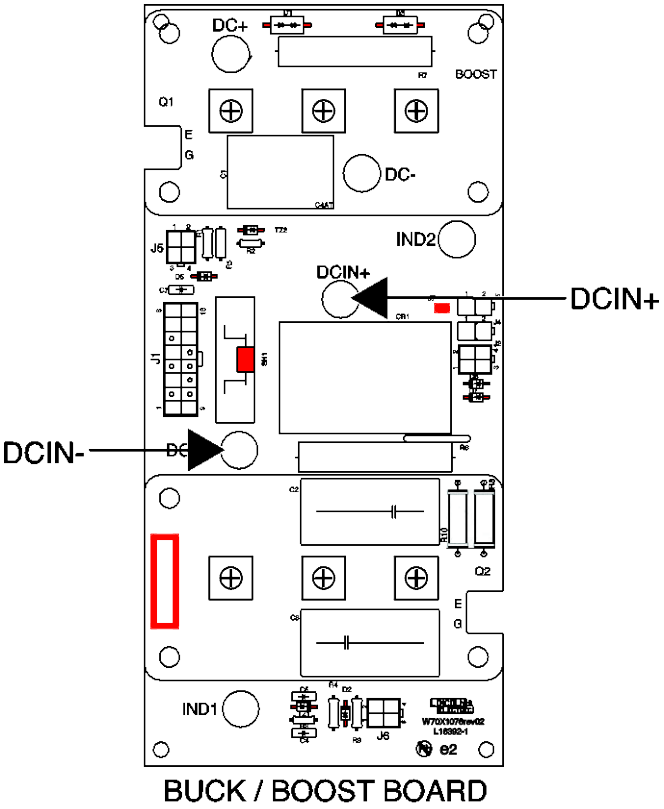


Figure F.6 – Buck / boost board discharge



RECTIFIER 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 procedure will help determine if the Rectifier Board is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Locate the rectifier board. See ***Figure F.7***.
4. Using a volt/ohmmeter, perform the tests outlined in ***Table F.1***. See ***Figure F.8***. See Wiring Diagram.
   NOTE: It may be necessary to remove some of RTV compound to gain access to test points.
5. If the tests results are questionable, label and disconnect all of the leads from the rectifier board and re-test. See the Wiring Diagram.
6. If any portion of the test fails, the rectifier board may be faulty.
7. When testing is complete connect all leads and plugs previously removed. See the Wiring Diagram.
8. If faulty, perform the ***Rectifier Board Removal And Replacement Procedure***.
9. Perform the ***Case Cover Replacement Procedure***.

Table F.1 – Rectifier board resistance tests

POSITIVE TEST PROBE	NEGATIVE TEST PROBE	EXPECTED RESULT
AC1	DCIN+	0.3V – 0.7V
AC2	DCIN+	0.3V – 0.7V
AC3	DCIN+	0.3V – 0.7V
DCIN+	AC1	OPEN
DCIN+	AC2	OPEN
DCIN+	AC3	OPEN
DCIN-	AC1	0.3V – 0.7V
DCIN-	AC2	0.3V – 0.7V
DCIN-	AC3	0.3V – 0.7V
AC1	DCIN-	OPEN
AC2	DCIN-	OPEN
AC3	DCIN-	OPEN
AC1	J66 PIN 3	0.3V – 0.7V
AC2	J66 PIN 3	0.3V – 0.7V
AC3	J66 PIN 3	0.3V – 0.7V

Figure F.7 – Rectifier board location

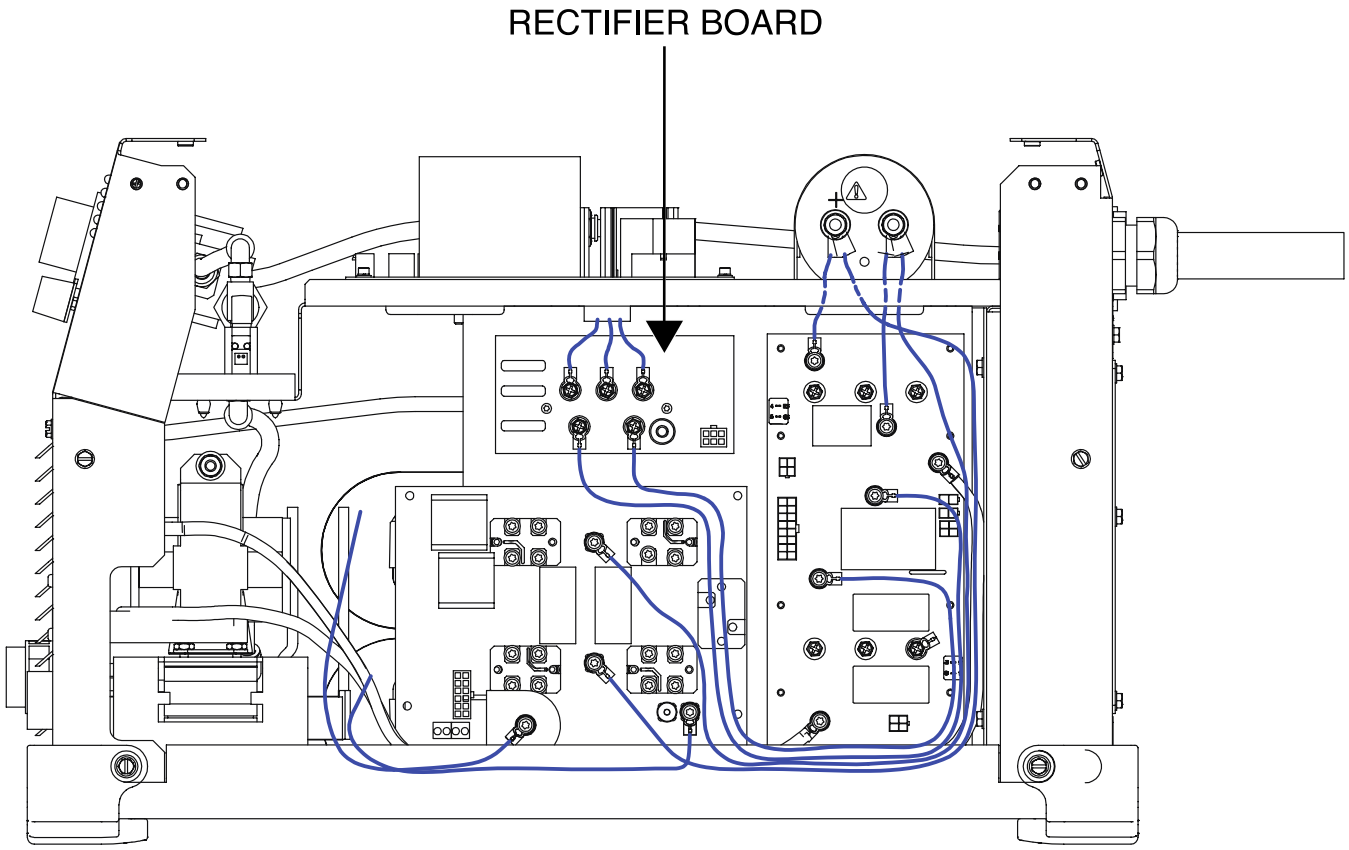
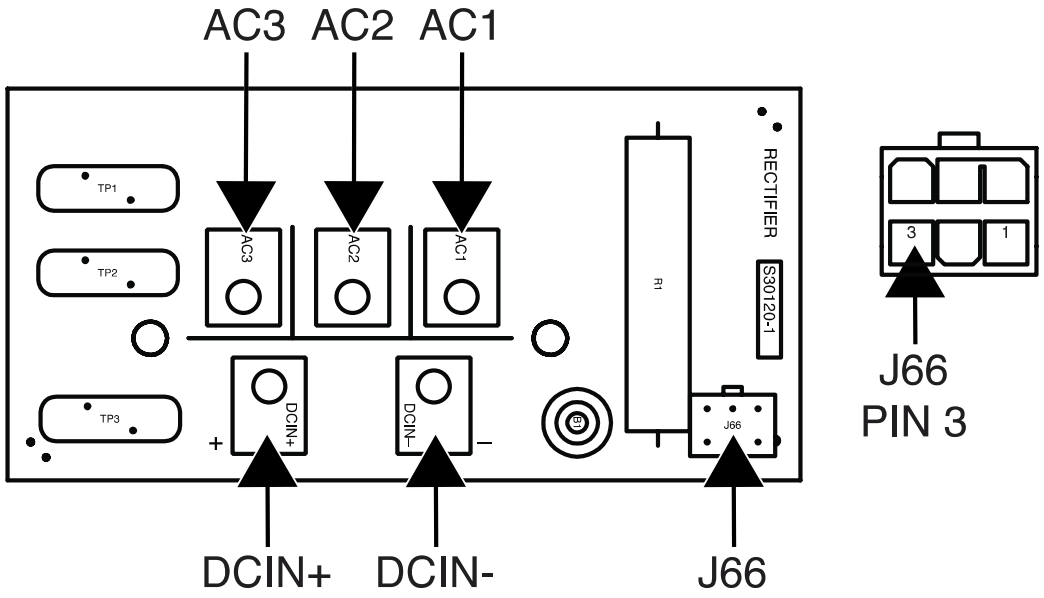


Figure F.8 – Rectifier board test point locations



INPUT 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 aid the technician to determine if the Input Board is receiving the correct input voltages and is producing the correct output voltages. This test will NOT determine the functionality of the entire board.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Locate the input board. See ***Figure F.9***. See Wiring Diagram.
4. Apply the correct input power to the machine and carefully check the status LED lights on the input board. See ***Table F.2*** and ***Figure F.10***.
5. Carefully perform the voltage checks detailed in ***Table F.3***. See ***Figures F.10*** and ***F.11***.
6. When testing is complete, replace all leads and plugs previously removed. See the Wiring Diagram.
7. If any of the tests fail, the input board may be faulty.
8. Remove the input power from the Tomahawk 1500 machine.
9. If faulty, perform the ***Input Board Removal And Replacement Procedure***.
10. Perform the ***Case Cover Replacement Procedure***.

Table F.2 – Input board status LED light table

AC INPUT VOLTAGE SINGLE PHASE	LED NUMBER	EXPECTED STATUS	COMMENTS / CONDITIONS
250 VAC	LED #1	ON-GREEN	+15VDC IS PRESENT.
250 VAC	LED #2	ON-GREEN	+15VDC SECONDARY IS PRESENT.
250 VAC	LED #3	ON*-GREEN	WHEN “BUCK” SIGNAL IS OPERATING. *DEPENDANT ON INPUT VOLTAGE.
250 VAC	LED #4	ON*-GREEN	WHEN “BOOST” SIGNAL IS OPERATING. *DEPENDANT ON INPUT VOLTAGE.
250 VAC	LED #1	ON*-GREEN	*LOCATED ON BUCK/BOOST CONTROL MODULE. +15VDC PRESENT ON BUCK/BOOST CONTROL MODULE.

Table F.3 – Input board voltage checks

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS / CONDITIONS
240 VAC	PLUG J6 PIN 3(+) TO PIN 7(-)	225 VDC	MACHINE AT IDLE NO LOAD. RECTIFIED AC INPUT LINE. WILL VARY WITH INPUT VOLTAGE.
240 VAC	PLUG J6 PIN 5(+) TO PIN 7(-)	400 VDC	MACHINE AT IDLE NO LOAD. DC BUS LINE.
240 VAC	PLUG J6 PIN 1(+) TO PIN 9(-)	15 VDC	MACHINE AT IDLE NO LOAD.BUCK DRIVER.
240 VAC	PLUG J3 PIN 3(+) TO PIN 5(-)	-5 VDC	MACHINE AT IDLE NO LOAD. SEC. AUX. SUPPLY.
240 VAC	PLUG J3 PIN 11(+) TO PIN 5(-)	15 VDC	MACHINE AT IDLE NO LOAD. SEC. AUX. SUPPLY.
240 VAC	PLUG J1 PIN 4(+) TO PIN 6(-)	-5 VDC	MACHINE AT IDLE NO LOAD. SEC. AUX. SUPPLY.
240 VAC	PLUG J1 PIN 12(+) TO PIN 6(-)	15 VDC	MACHINE AT IDLE NO LOAD. SEC. AUX. SUPPLY.
240 VAC	PLUG J1 PIN 8(+) TO PIN 6(-)	7.5 VDC	MACHINE AT IDLE NO LOAD. INVERTER SIGNAL.
240 VAC	PLUG J2 PIN 1(+) TO PIN 6(-)	15 VDC	MACHINE AT IDLE NO LOAD. SEC. AUX. SUPPLY.
240 VAC	PLUG J2 PIN 18(+) TO PIN 6(-)	15 VDC	MACHINE AT IDLE NO LOAD. FAN SIGNAL.
240 VAC	PLUG J2 PIN 16(+) TO PIN 6(-)	14 VDC	MACHINE AT IDLE NO LOAD, NO TORCH, NO TRIGGER.
240 VAC	PLUG J5 PIN 1(+) TO PIN 5(-)	15 VDC	MACHINE AT IDLE NO LOAD. SEC. AUX. SUPPLY.
240 VAC	PLUG J5 2(+) TO PIN 5(-)	12.5 VDC	MACHINE AT IDLE NO LOAD. PRESSURE SWITCH, NO AIR PRESSURE APPLIED.
240 VAC	PLUG J9 PIN 2(+) TO PIN 1(-)	26 VDC	SUPPLY TO FAN MOTOR. HIGH SPEED.
240 VAC	PLUG J9 PIN 2(+) TO PIN 1(-)	14 VDC	SUPPLY TO FAN MOTOR. LOW SPEED.

Figure F.9 – Input board location

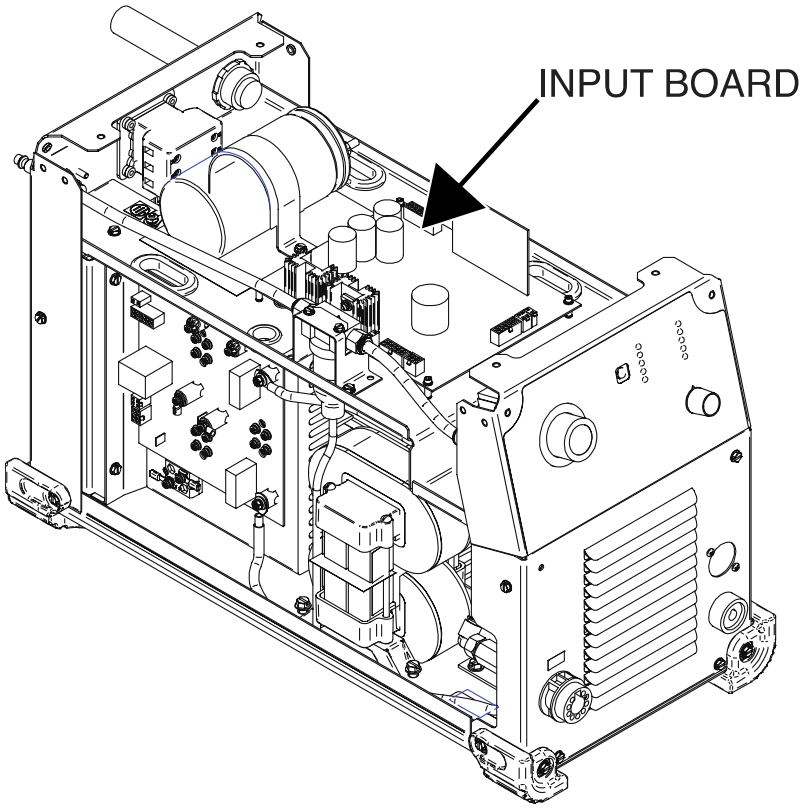


Figure F.10 – Input board LED and plug locations

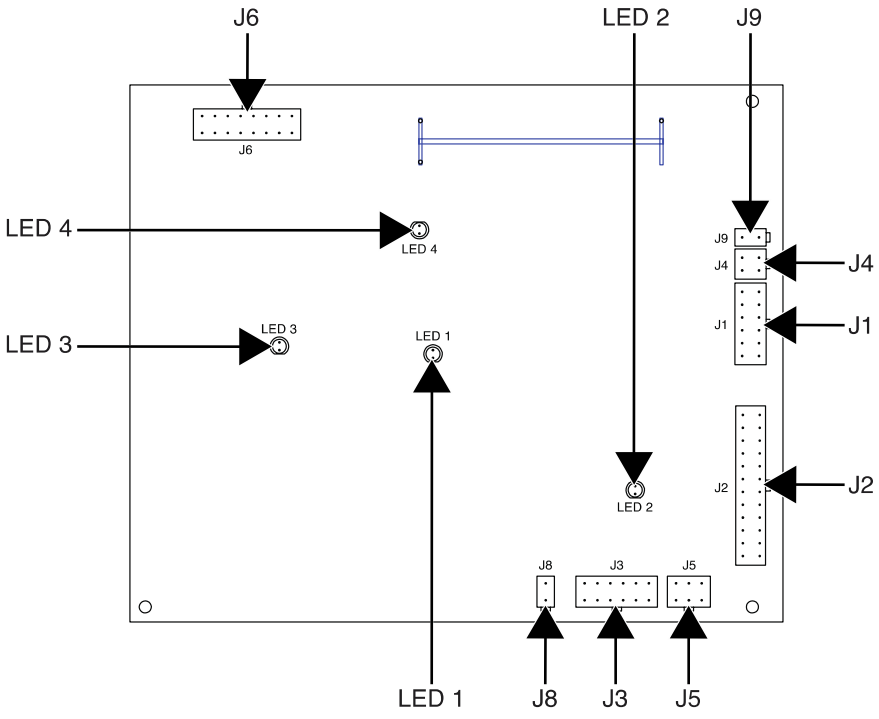
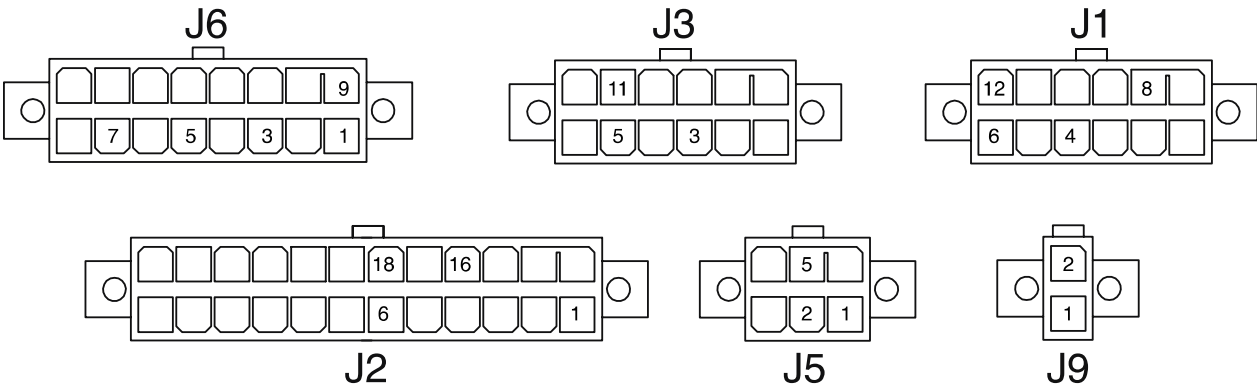


Figure F.11 – Input board lead locations



CONTROL / DISPLAY 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 aid the technician to determine if the Control / Display Board is receiving the correct input voltages and if the Control / Display Board is producing the correct output signals. This test will NOT determine the functionality of the entire Board.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Locate the control / display board. See ***Figure F.12***. See Wiring Diagram.
4. Apply the correct input power to the machine and carefully check the status LED lights on the control / display board. Make certain all of the dip switches (SW2) are in the Off position. See ***Table F.4*** and ***Figure F.13***.
5. Carefully perform the voltage checks detailed in ***Table F.5***. See ***Figures F.13*** and ***F.14***.
6. When testing is complete replace all leads and plugs previously removed. See the Wiring Diagram.
7. If any tests fail, the control / display board may be faulty.
8. If faulty, perform the ***Control / Display Board Removal And Replacement Procedure***.
9. Perform the ***Case Cover Replacement Procedure***.

Table F.4 – Control / display board status LED light table

LED IDENTITY	NORMAL STATUS	FAULT STATUS	COMMENTS / CONDITIONS
D23	ON-GREEN	OFF	INDICATION OF 15VDC SEC. SUPPLY IS PRESENT.
D24	ON-GREEN	OFF	INDICATION OF 5VDC SEC. SUPPLY IS PRESENT.
D25	ON-GREEN		INDICATION OF SINGLE PHASE INPUT SUPPLY.

Table F.5 – Control / display board voltage tests

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS / CONDITIONS
240 VAC	PLUG J22 PIN 1(+) TO PIN 2(-)	15 VDC	MACHINE AT IDLE NO LOAD. SEC. AUX. SUPPLY.
240 VAC	PLUG J22 PIN 3(+) TO PIN 2(-)	12 VDC	AIR PRESSURE SIGNAL. NO AIR SUPPLIED TO MACHINE.
240 VAC	PLUG J22 PIN 3(+) TO PIN 2(-)	0 VDC	AIR PRESSURE SIGNAL. CORRECT AIR SUPPLIED TO MACHINE.
240 VAC	PLUG J22 PIN 11(+) TO PIN 2(-)	0 VDC	THERMOSTAT SIGNAL. NO ERRORS-THERMOSTAT OPEN.
240 VAC	PLUG J22 PIN 11(+) TO PIN 2(-)	15 VDC	THERMOSTAT SIGNAL. ERROR-THERMOSTAT OPEN.
240 VAC	PLUG J22 PIN 13(+) TO PIN 2(-)	0 VDC	TORCH PARTS-IN-PLACE SIGNAL.
240 VAC	PLUG J22 PIN 13(+) TO PIN 2(-)	13 VDC	TORCH PARTS-NOT-IN PLACE SIGNAL.
240 VAC	PLUG J22 PIN 18(+) TO PIN 2(-)	15 VDC	FAN MOTOR SIGNAL.

Figure F.12 – Control / display board location

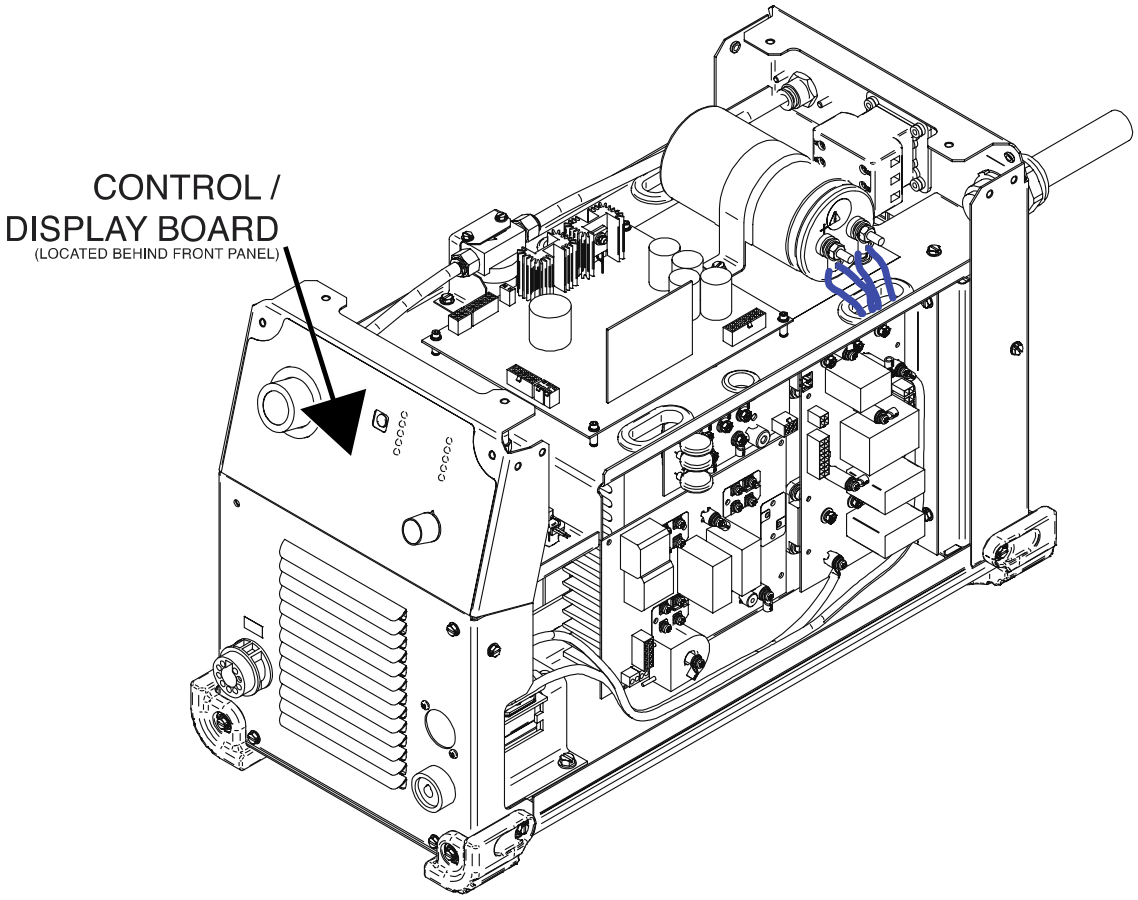
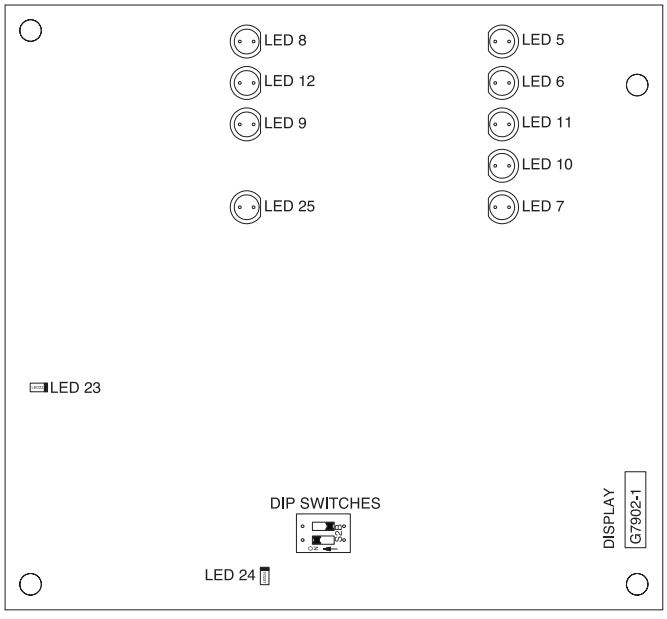
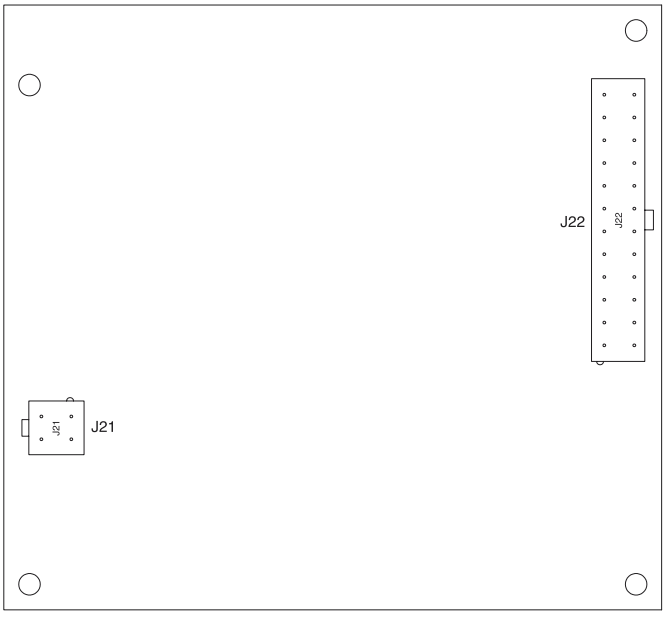


Figure F.13 – Control / display board plug and LED locations

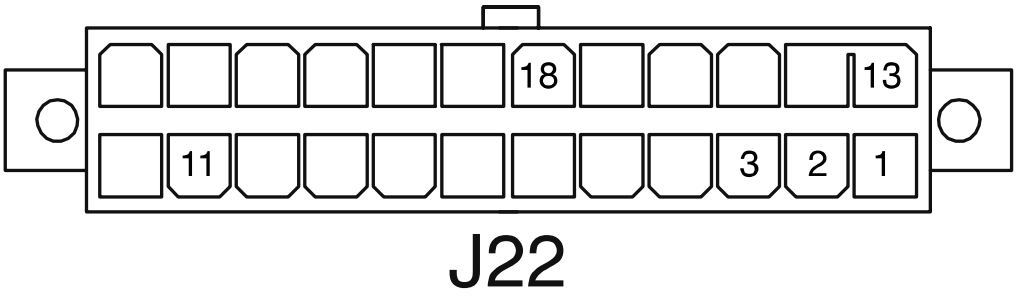


TOP SIDE



BOTTOM SIDE

Figure F.14 – Control / display board plug J22 test point locations



INVERTER 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 aid the technician to determine if the Inverter Board is receiving the correct input voltages and if the Inverter Board is producing the correct output signals. This test will NOT determine the functionality of the entire Board.

MATERIALS NEEDED

Volt/Ohmmeter
Torx Nutdriver (Size T-20)
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Locate the inverter board. See ***Figure F.15***. See Wiring Diagram.
4. Apply the correct input power to the machine and carefully check the status LED light on the inverter board. See ***Figure F.16***. It should be illuminated, indicating 15 VDC is present to power the circuit components.
5. Carefully perform the voltage checks detailed in ***Table F.6***. See ***Figures F.16*** and ***F.17***.
6. Remove the input power to the machine.
7. Using the Torx nutdriver (size T-20), carefully remove the following leads from the inverter board. See ***Figure F.16***. See Wiring Diagram. Make sure the capacitors are discharged.
   - Lead from positive terminal
   - Lead from negative terminal
   - Lead from terminal TR3
   - Transformer lead from terminal TR1
8. Perform the diode tests detailed in ***Table F.7***. See ***Figure F.16***.
9. When testing is complete, remove input power and replace all leads and plugs previously removed. See the Wiring Diagram.
10. If any of the tests fail, the inverter board may be faulty.
11. If faulty, perform the ***Inverter Board Removal And Replacement Procedure***.
12. Perform the ***Case Cover Replacement Procedure***.

Table F.6 – Inverter board voltage tests

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS / CONDITIONS
240 VAC	POSITIVE TEMINAL TO NEGATIVE TERMINAL	400 VDC	FILTERED DC FROM BUCK/BOOST BOARD. MACHINE AT IDLE – NO LOAD.
240 VAC	TERMINAL TR1 TO TERMINAL TR3	0 VDC	MAIN TRANSFORMER PRIMARY CONNECTIONS-MACHINE AT IDLE – NO LOAD – NO TORCH TRIGGER.
240 VAC	PLUG J11 PIN 4(+) TO PIN 6(-)	-5 VDC	-5VDC SEC. SIDE AUXILLIARY SUPPLY.
240 VAC	PLUG J11 PIN 12(+) TO PIN 6(-)	15 VDC	15VDC SEC. SIDE AUXILLIARY SUPPLY.
240 VAC	PLUG J11 PIN 11(+) TO PIN 6(-)	0 VDC	THERMOSTAT CIRCUIT CLOSED-NO-ERROR.
240 VAC	PLUG J11 PIN 11(+) TO PIN 6(-)	10 VDC	THERMOSTAT CIRCUIT OPEN-ERROR.
240 VAC	PLUG J11 PIN 1(+) TO PIN 6(-)	5 VDC	5VDC SEC. SIDE AUXILLIARY SUPPLY.

Table F.7 – Inverter board diode tests

+ PROBE (RED)	- PROBE (BLACK)	RESULT
NEG	TR3	0.3V – 0.7V
NEG	TR1	0.3V – 0.7V
TR1	NEG	OPEN
TR3	NEG	OPEN
TR3	POS	0.3V – 0.7V
TR1	POS	0.3V – 0.7V
POS	TR1	OPEN
POS	TR3	OPEN

Figure F.15 – Inverter board location

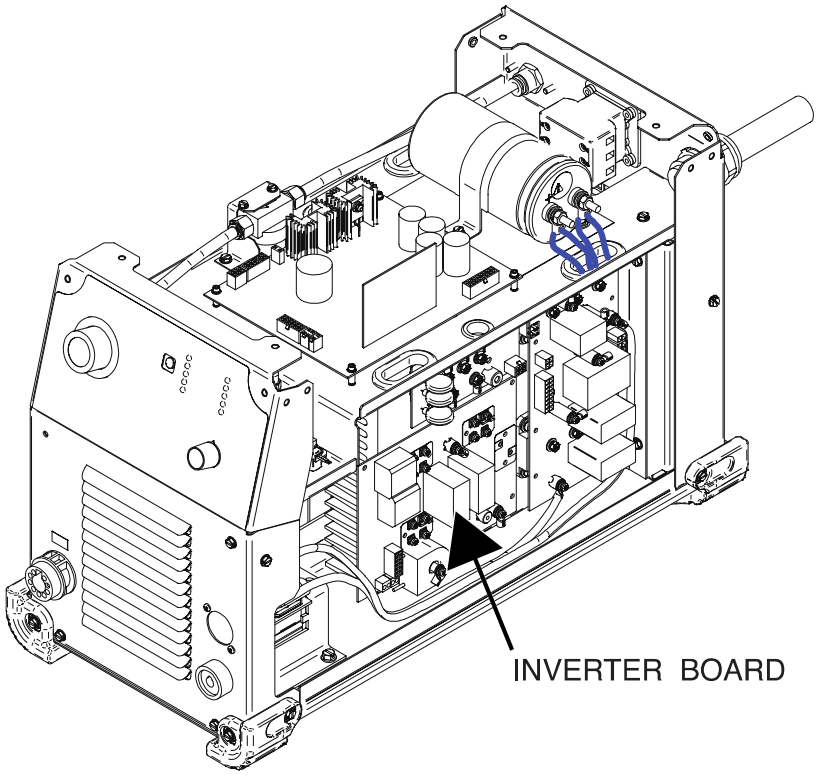


Figure F.16 – Inverter board test point locations

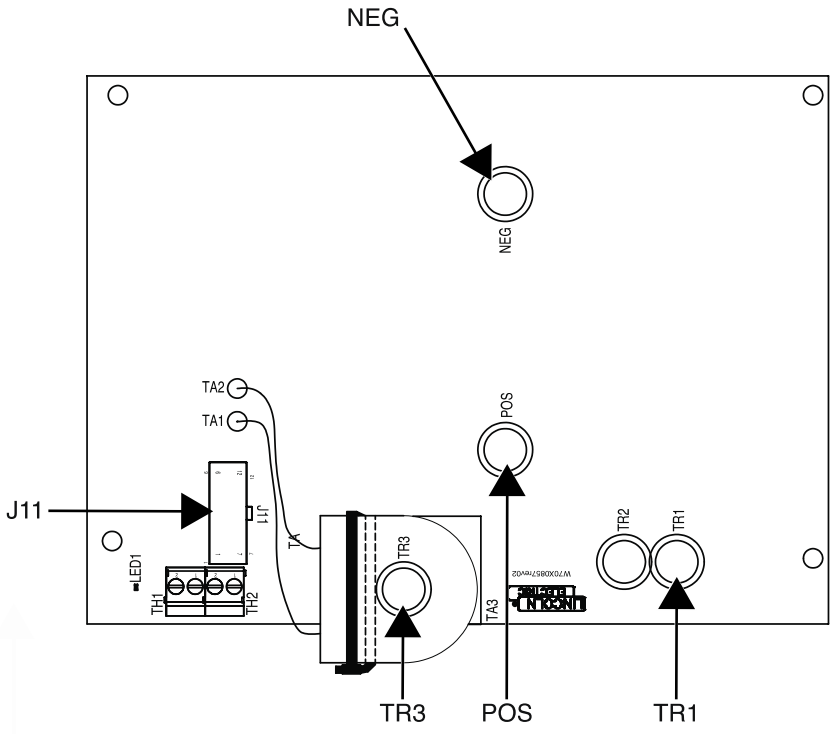
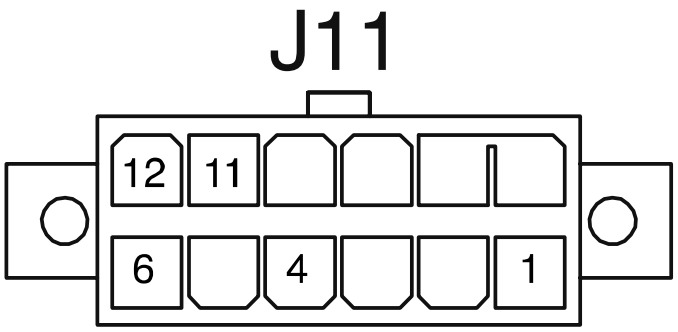


Figure F.17 – Inverter board plug J11 test point locations



OUTPUT 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 aid the technician to determine if the Output Board is receiving the correct input voltages and if the Output Board is producing the correct output signals. This test will NOT determine the functionality of the entire board.

MATERIALS NEEDED

Volt/Ohmmeter
Torx Nutdriver (Size T-20)
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Locate the output board. See ***Figure F.18***. See Wiring Diagram.
4. Apply the correct input power to the machine and carefully perform the voltage checks detailed in ***Table F.8***. See ***Figure F.19*** and ***F.20***.
5. Visually verify that LED 1 is illuminated. See ***Figure F.19***. See Wiring Diagram. This is the 15 VDC supply from the input board. If 15 VDC is not present, check connections from input board and perform ***Input Board Test procedure***.
6. Remove the input power to the machine.
7. Using a Torx nutdriver (size T-20), carefully remove the following leads from the output board. See ***Figure F.19***. See Wiring Diagram. Label leads for reconnection. Make sure the input capacitor is discharged.
   - Two output choke leads from terminals B7 and B8.
   - Two transformer leads from terminals B6 and B5.
8. Perform the tests detailed in ***Tables F.9*** and ***F.10***. See ***Figures F.19*** and ***F.20***.
9. Disconnect the leads from terminals B1 and B2 of the output board. See ***Figure F.19***. See Wiring Diagram.
10. Using a volt/ohmmeter, check the resistance across the resistor module; it should be approximately 100 ohms. See ***Figure F.19***. See Wiring Diagram.
11. When testing is complete, remove input power and replace all leads and plugs previously removed. See the Wiring Diagram.

12. If any of the tests fail, the output board may be faulty.
13. If faulty, perform the ***Output Board Removal And Replacement Procedure***.
14. Perform the ***Case Cover Replacement Procedure***.

Table F.8 – Output board voltage tests

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS / CONDITIONS
240 VAC	PLUG J33 PIN 3 TO PIN 5	-5 VDC	SECONDARY SIDE AUXILLIARY SUPPLY.
240 VAC	PLUG J33 PIN 11 TO PIN 5	+15 VDC	SECONDARY SIDE AUXILLIARY SUPPLY.
240 VAC	PLUG J33 PIN 8 TO PIN 5	0 VDC	TORCH CONNECTED AND PARTS-IN-PLACE. NO FAULT.
240 VAC	PLUG J33 PIN 8 TO PIN 5	14 VDC	TORCH PARTS NOT IN PLACE. FAULT CONDITION.

Table F.9 – Output board forward voltage drop tests

POSITIVE TEST PROBE	NEGATIVE TEST PROBE	EXPECTED RESULT
B5	B10	0.3V – 0.7V
B6	B10	0.3V – 0.7V
B10	B6	OPEN
B10	B5	OPEN
B9	B5	0.3V – 0.7V
B9	B6	0.3V – 0.7V
B6	B9	OPEN
B5	B9	OPEN

Table F.10 – Output board resistance tests

AC INPUT VOLTAGE	TEST POINTS	EXPECTED READING	COMMENTS / CONDITIONS
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B5 (POSITIVE TEST PROBE) TO B7 (NEGATIVE TEST PROBE)	LOW RESISTANCE – FORWARD DIODE DROP	CHECKING DIODE MODULE A1.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B5 (NEGATIVE TEST PROBE) TO B7 (POSITIVE TEST PROBE)	HIGH RESISTANCE – GREATER THAN 100,000 OHMS	CHECKING DIODE MODULE A1.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B6 (POSITIVE TEST PROBE) TO B7 (NEGATIVE TEST PROBE)	LOW RESISTANCE – FORWARD DIODE DROP	CHECKING DIODE MODULE A1.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B6 (NEGATIVE TEST PROBE) TO B7 (POSITIVE TEST PROBE)	HIGH RESISTANCE – GREATER THAN 100,000 OHMS	CHECKING DIODE MODULE A1.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B9 (POSITIVE TEST PROBE) TO B5 (NEGATIVE TEST PROBE)	LOW RESISTANCE – FORWARD DIODE DROP	CHECKING DIODE MODULE A2.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B9 (NEGATIVE TEST PROBE) TO B5 (POSITIVE TEST PROBE)	HIGH RESISTANCE – GREATER THAN 100,000 OHMS	CHECKING DIODE MODULE A2.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B9 (POSITIVE TEST PROBE) TO B6 (NEGATIVE TEST PROBE)	LOW RESISTANCE – FORWARD DIODE DROP	CHECKING DIODE MODULE A2.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	B9 (NEGATIVE TEST PROBE) TO B6 (POSITIVE TEST PROBE)	HIGH RESISTANCE – GREATER THAN 100,000 OHMS	CHECKING DIODE MODULE A2.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	PLUG J32 PIN 1 TO PIN 3	LOW RESISTANCE – LESS THAN ONE OHM	TORCH CONNECTED AND ALL PARTS ARE IN PLACE.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	PLUG J32 PIN 1 TO PIN 3	HIGH RESISTANCE – MUCH GREATER THAN ONE OHM	TORCH NOT CONNECTED.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	PLUG J32 PIN 2 TO PIN 3	LOW RESISTANCE – LESS THAN ONE OHM	TORCH CONNECTED AND TORCH TRIGGER ACTIVATED.
MACHINE DISCONNECTED FROM INPUT VOLTAGE AND CAPACITORS DISCHARGED.	PLUG J32 PIN 2 TO PIN 3	HIGH RESISTANCE – MUCH GREATER THAN ONE OHM	TORCH CONNECTED AND TORCH TRIGGER NOT ACTIVATED.

Figure F.18 – Output board location

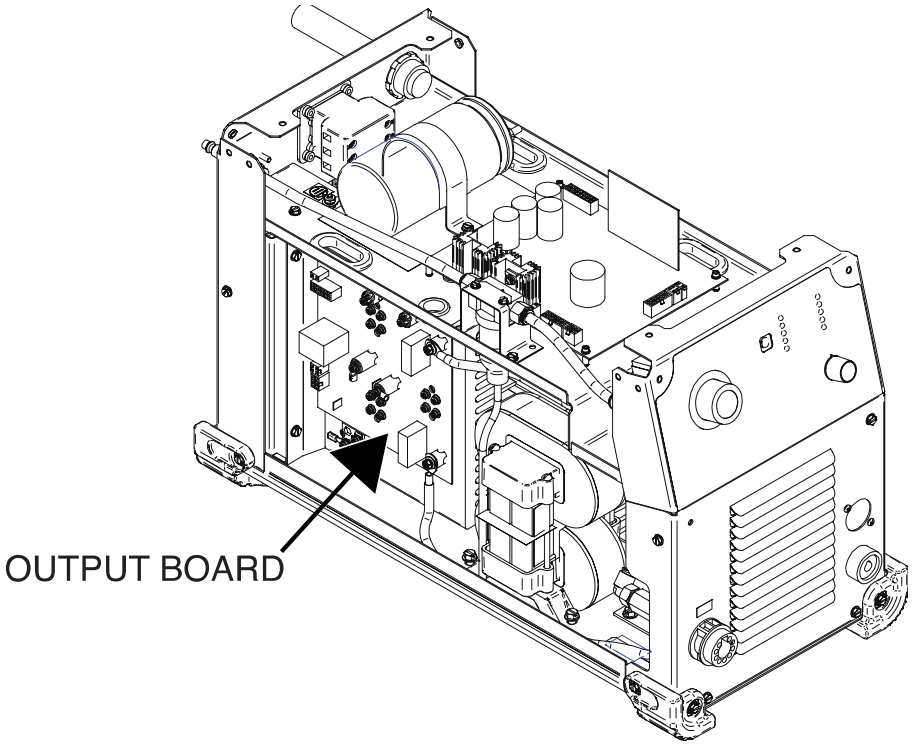


Figure F.19 – Output board test point and resistor module location

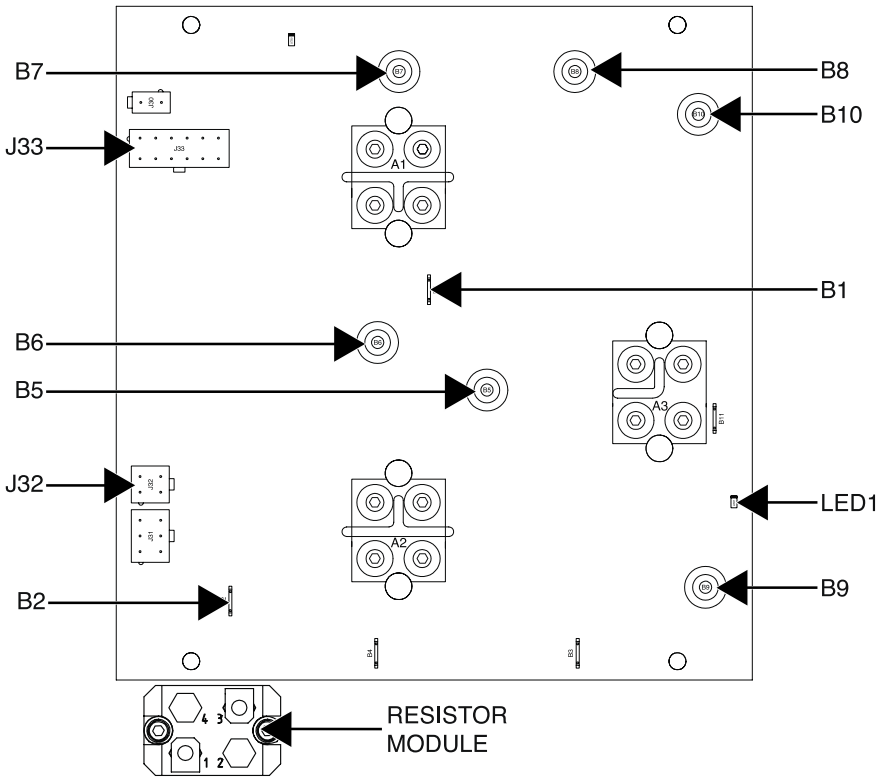
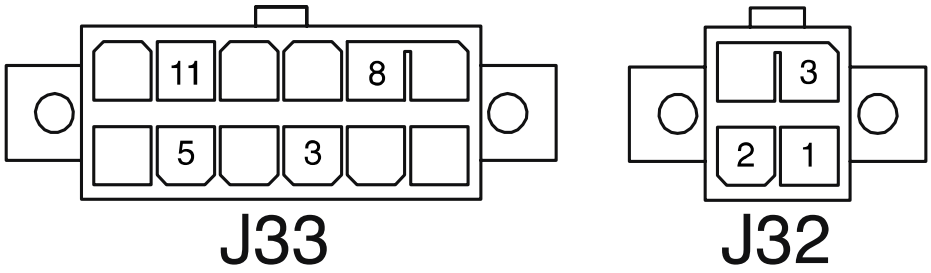


Figure F.20 – Output board lead locations



TORCH 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 procedure will aid the technician to determine if the Torch Assembly leads are intact and functional.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Disconnect the torch assembly from the Tomahawk 1500 machine by turning the torch collar counter-clockwise. See ***Figure F.21***. See Wiring Diagram.
3. Using a volt/ohmmeter, perform the torch resistance checks detailed in ***Table F.11***. See ***Figures F.22***.
4. If any of the resistance readings are questionable, the torch assembly must be repaired or replaced.

Table F.11 – Torch assembly resistance tests

TORCH TEST POINTS	EXPECTED READING	CONDITIONS / COMMENTS
TORCH CONNECTOR PIN 1 TO PIN 9	OPEN	TORCH TRIGGER **NOT** ACTIVATED.
TORCH CONNECTOR PIN 1 TO PIN 9	LESS THAN 1 OHM	TORCH TRIGGER ACTIVATED
TORCH CONNECTOR PIN 3 TO PIN 9	LESS THAN 1 OHM	ALL TORCH PARTS IN PLACE.
TORCH CONNECTOR PIN 3 TO PIN 9	OPEN	TORCH PARTS **NOT** IN PLACE ERROR.
TORCH CONNECTOR PIN 5 TO PIN 6	LESS THAN 1 OHM	PILOT CIRCUIT.
TORCH CONNECTOR PIN 5 TO PIN ELECTRODE	LESS THAN 1 OHM	TORCH PARTS IN PLACE.
TORCH CONNECTOR PIN 5 TO PIN ELECTRODE	OPEN	TORCH PARTS **NOT** IN PLACE ERROR.

Figure F.21 – Torch connection point

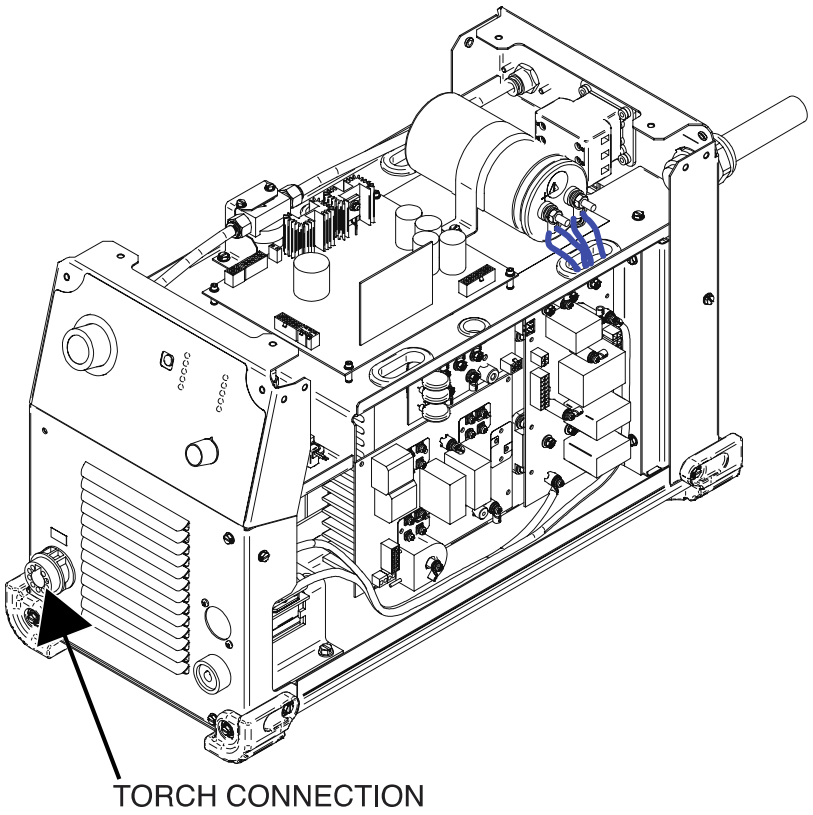
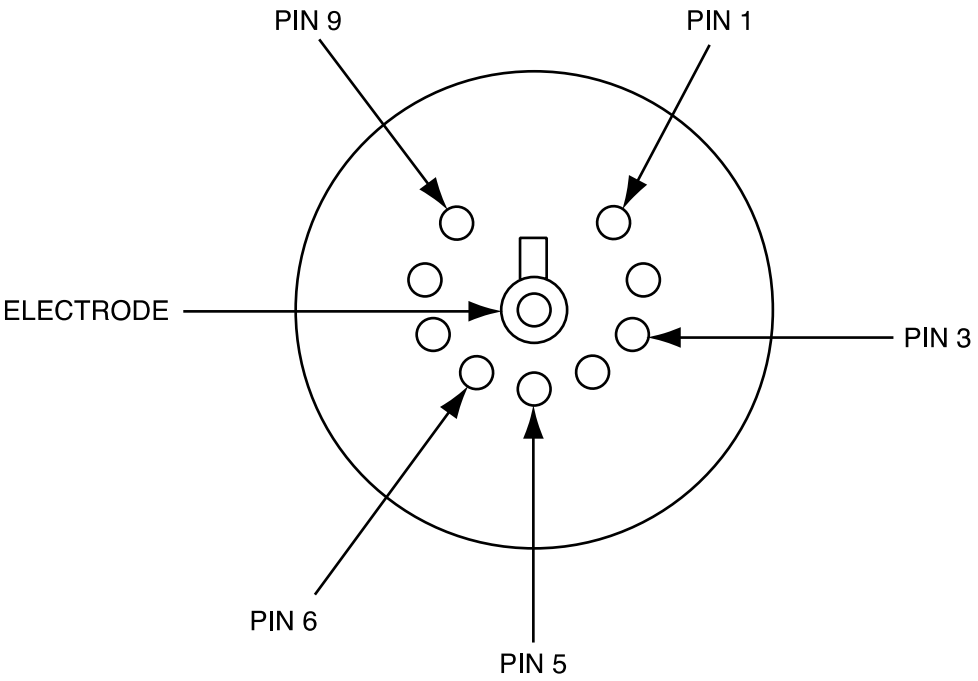


Figure F.22 – Torch pin locations



BUCK / BOOST BOARD & IGBT 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 procedure will help determine if the Buck / Boost Board and its IGBT's are functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Locate the buck / boost board. See ***Figure F.23***.
4. Do a visual inspection of the board. Look for any damaged, burnt, exploded electrical components or board damage.
5. Using a digital volt/ohmmeter (set to diode test mode), perform the forward voltage drop tests for each of the four module sections. See ***Table F.12***. See ***Figure F.24*** and ***F.25***.
6. If the forward voltage drop of the internal diode indicates out of spec (open or shorted), both modules and buck / boost board may be faulty.
7. Carefully apply the input power to the Tomahawk 1500 machine.
8. A relay on this board should emit an audible click. See ***Figure F.24***.
9. Using a digital volt/ohmmeter set for DC volts, test for +400 VDC at DC+ and DC- test points on the buck / boost board. See ***Figure F.25***. See Wiring Diagram.
10. Using a digital volt/ohmmeter set for DC volts, test for typical rectified input and the DC+ and DC- test points. See ***Table F.13***. See ***Figure F.25***. See Wiring Diagram.
11. Using a digital volt/ohmmeter, test for typical frequency and voltage readings at terminals IND1 and IND2 on the buck / boost board. See ***Table F.14***. See ***Figure F.25***.
    NOTE: These readings will vary depending on input voltage.
12. If any of the tests fail, the buck / boost board may be faulty.
13. If faulty, perform the ***Buck / Boost Board Removal And Replacement Procedure***.
14. Perform the ***Case Cover Replacement Procedure***.

Table F.12 - Forward voltage drop tests

SECTION TO BE MEASURED	TEST POINTS	EXPECTED READING	+/- 10% TOLERANCE
SECTION A	POSITIVE TO NEGATIVE	.355 VDC +/- 10%	.320 TO .391
SECTION B	POSITIVE TO NEGATIVE	.305 VDC +/- 10%	.275 TO .336
SECTION C	POSITIVE TO NEGATIVE	.305 VDC +/- 10%	.275 TO .336
SECTION D	POSITIVE TO NEGATIVE	.408 VDC +/- 10%	.367 TO .449

Table F.13 – Typical rectified input

AC INPUT	DC
208 VAC	235 VDC
240 VAC	270 VDC
460 VAC	518 VDC
575 VAC	650 VDC

Table F.14 – Typical frequency and voltage readings

TEST POINT	TEST POINT	EXPECTED FREQUENCY READING	EXPECTED VOLTAGE READING	MACHINE CONDITION
IND1	IND2	50 KHZ	256 VDC	230 V SINGLE PHASE INPUT TO MACHINE. OCV (NO LOAD).

Figure F.23 – Buck / boost board location

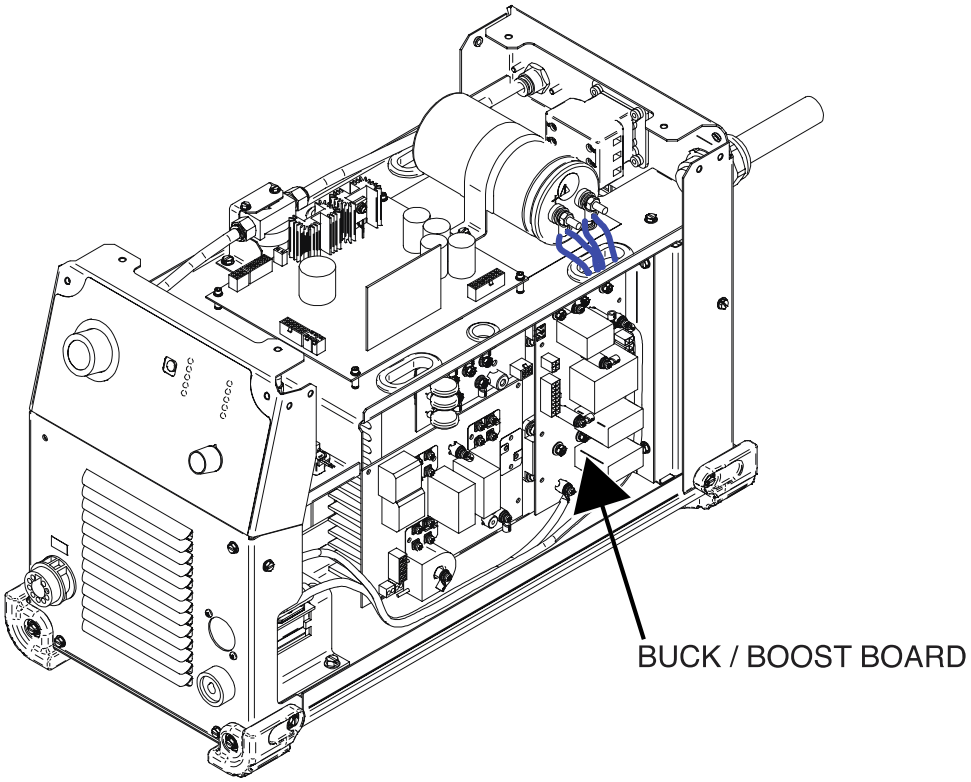


Figure F.24 – Forward voltage drop test points

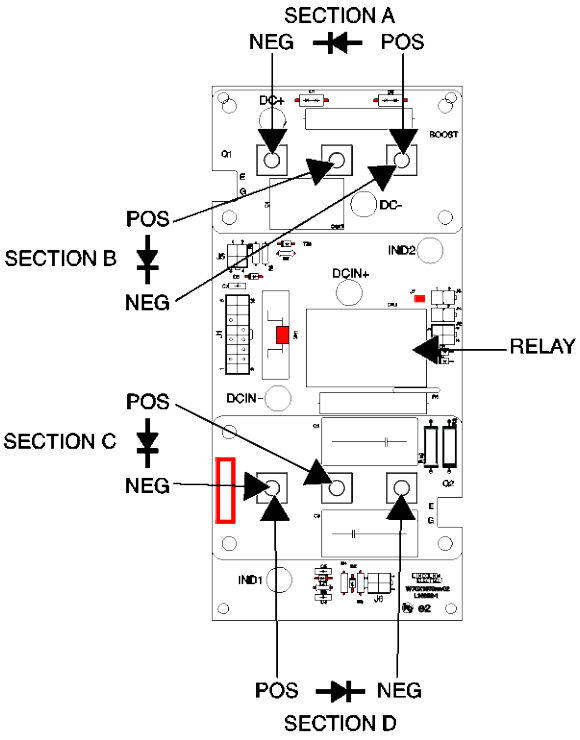
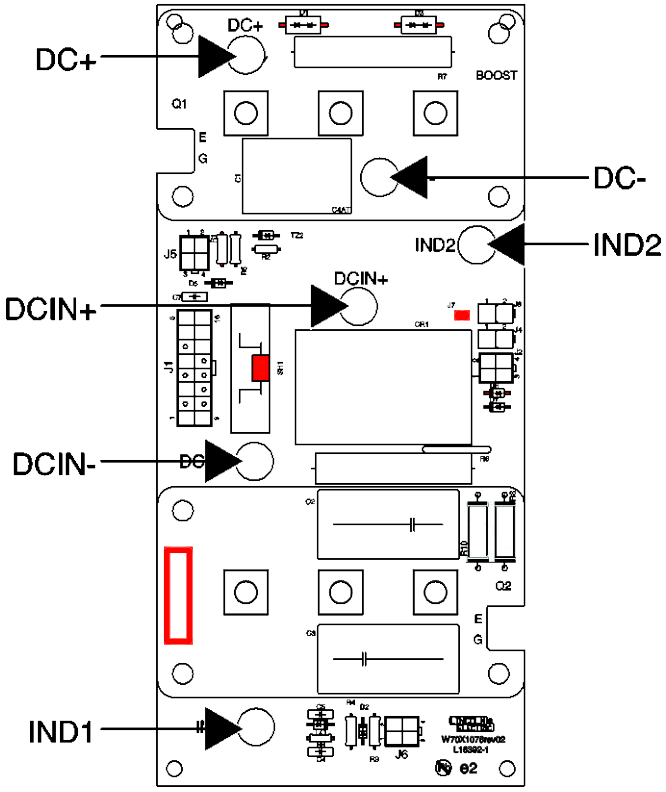


Figure F.25 – DC voltage test points



AIR / GAS SOLENOID 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 procedure will help determine if the Air / Gas Solenoid is receiving the correct input voltage and if the Solenoid is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

TEST PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Locate the air / gas solenoid. See ***Figure F.26***.
4. Apply the correct input power and air pressure to the machine.
5. At the input board carefully check for 12 VDC at plug J8 Pin 1 (red lead +) to plug J8 Pin 2 (black lead -). These are the solenoid leads. See ***Figure F.27*** and ***F.28***. Note the torch trigger must be activated and the correct air pressure applied. If the 12 VDC is not present, the input board is not sending the activation voltage to the air / gas solenoid. There may be a problem with the air regulator, the air pressure switch or the input board. See the Wiring Diagram.
6. If the 12 VDC is present at plug J8 Pin 1 (red lead +) to plug J8 Pin 2 (grey lead -) and the solenoid does not activate, the solenoid may be faulty.
7. When testing is complete, replace all leads and plugs that may have been removed. See Wiring Diagram.
8. If any of the tests fail, the air / gas solenoid may be faulty.
9. If faulty, perform the ***Air / Gas Solenoid Removal And Replacement Procedure***.
10. Perform the ***Case Cover Replacement Procedure***.

Figure F.26 – Air / gas solenoid location

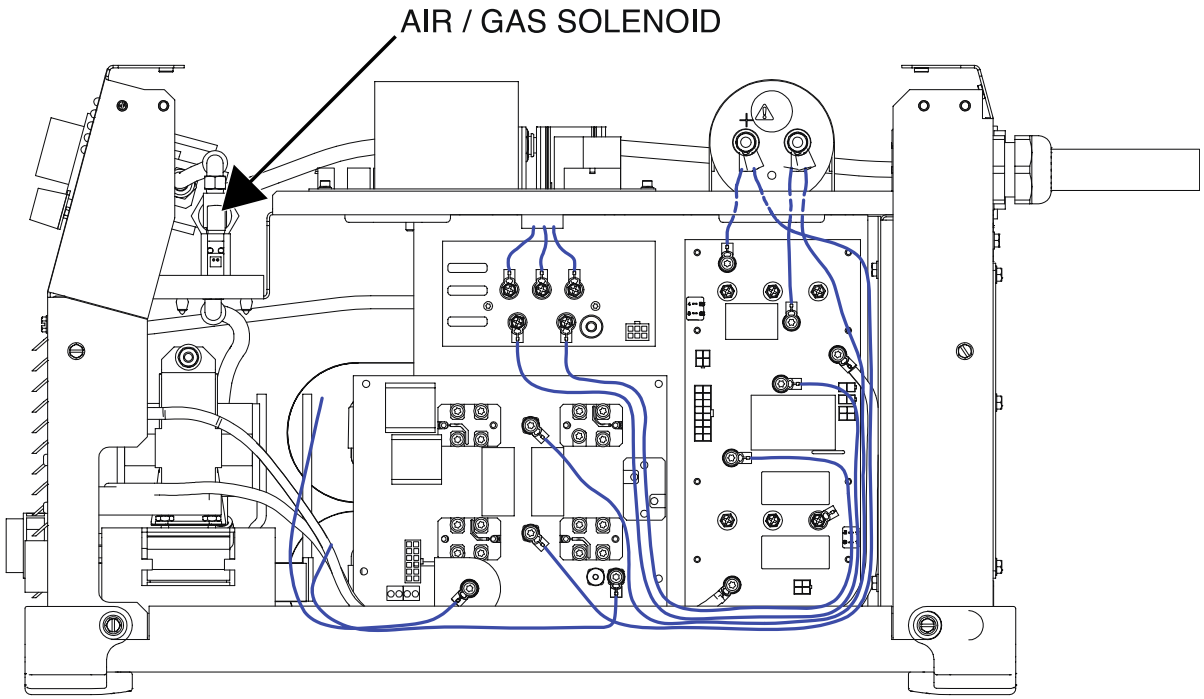


Figure F.27 – Input board location

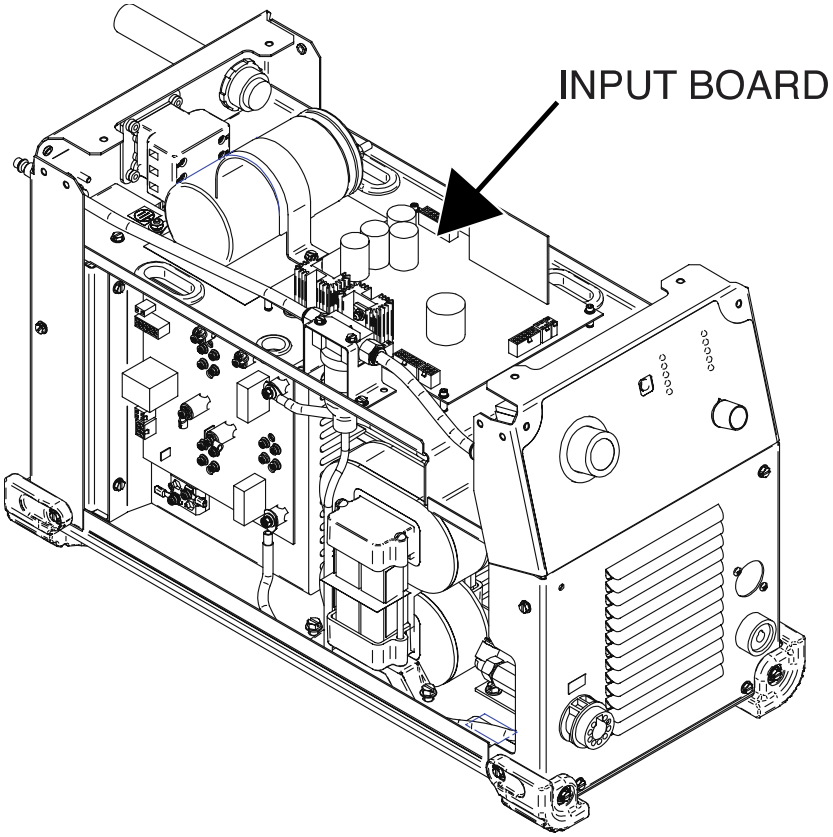
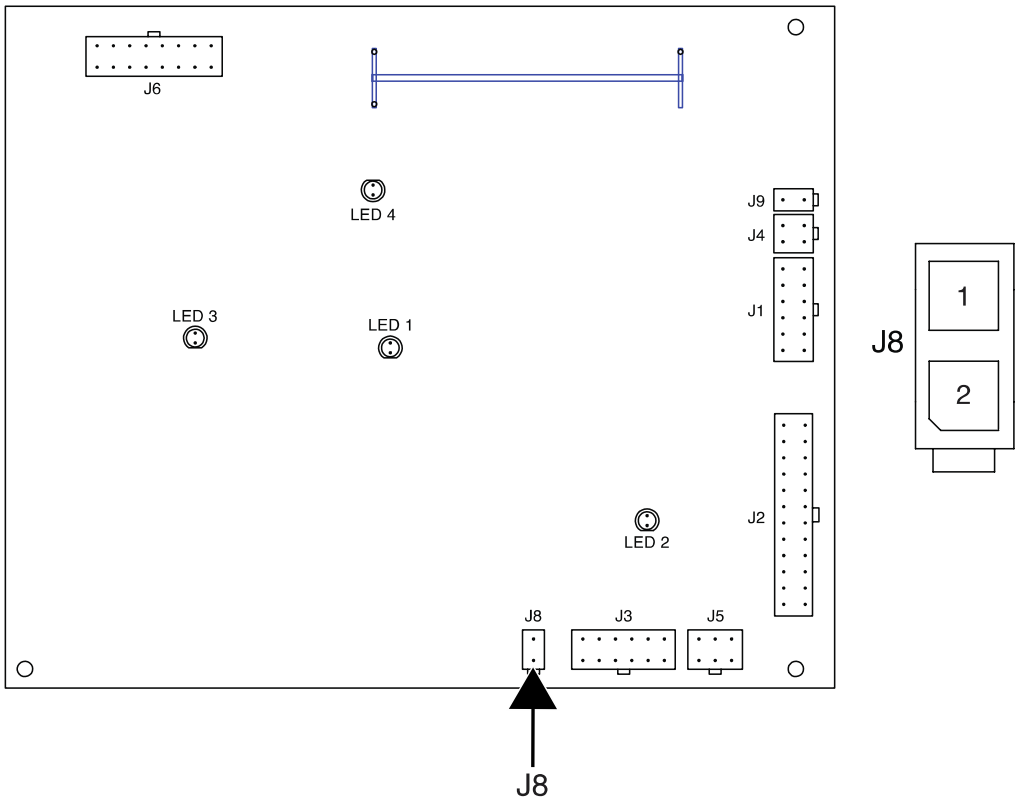


Figure F.28 – Input board plug and lead locations



Removal And Replacement Procedures

RECTIFIER 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 Rectifier Board.

MATERIALS NEEDED

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

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Label and disconnect plug J66 from the rectifier board. See ***Figure F.29***. See Wiring Diagram.
4. Carefully remove the RTV compound from the terminals.
5. Using a Phillips screwdriver, remove the five screws, lock washer, flat washer securing the leads to terminals DCIN+, DCIN-, AC1, AC2 and AC3 of the rectifier board. See ***Figure F.29***.
6. The rectifier board can now be removed and replaced.
7. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing the input rectifier module to the heat sink. See ***Figure F.30***.
8. The input rectifier module can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Clean the heat sink surface.
2. Apply a coating of Dow Corning 340 heat sink compound to the mating surface of the input rectifier module and the heat sink.
3. Carefully position the new input rectifier module into the machine.
4. Using a Torx nutdriver (size T-20), attach the two screws, lock washers and flat washers securing the input rectifier module to the heat sink. Torque to 18-25 in/lbs.

5. Carefully position new rectifier board into the machine.
6. Using a Phillips screwdriver, connect the five screws, lock washers and flat washers securing the leads to terminals DCIN+, DCIN-, AC1, AC2 and AC3 to the rectifier board. See Wiring Diagram. Torque to 20 -25 in/lbs.
7. Carefully apply a liberal coating of RTV compound to the lead/terminal connections.
8. Connect plug J66 to the rectifier board. See Wiring Diagram.
9. Perform the ***Case Cover Replacement Procedure***.
10. Perform the ***Retest After Repair Procedure***.

Figure F.29 – Rectifier board plug and lead locations

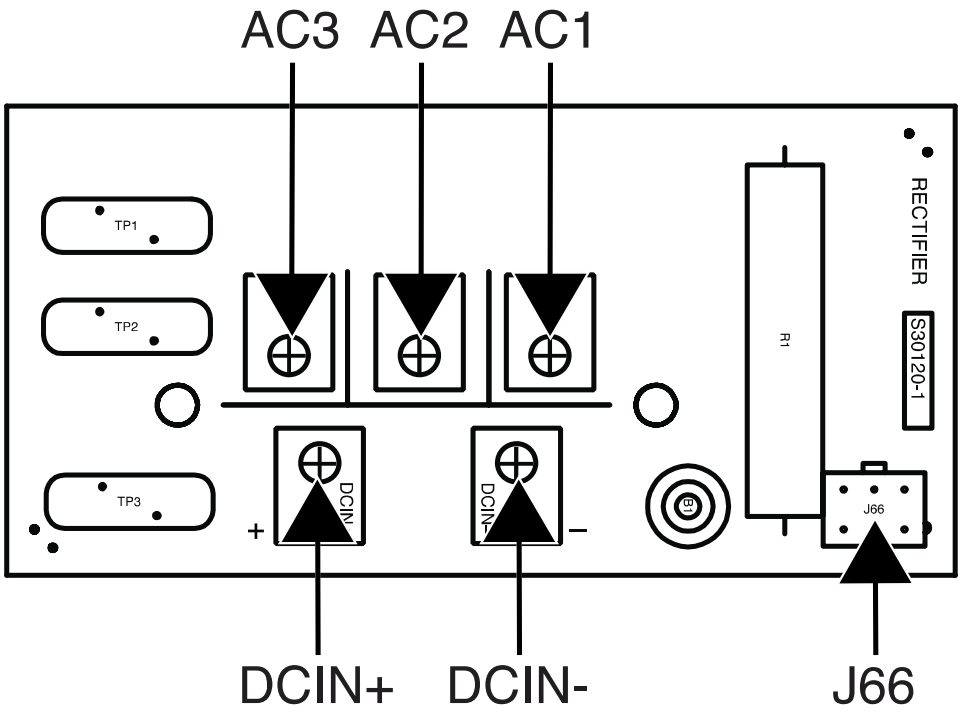
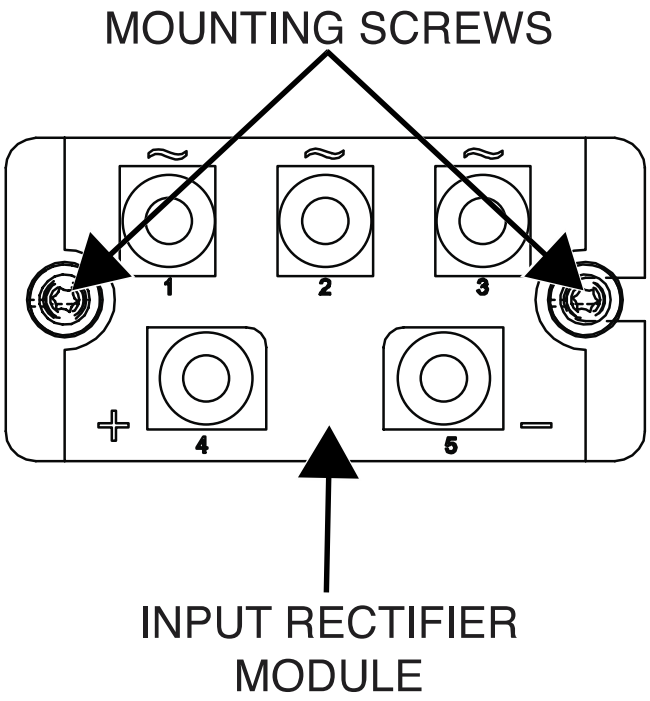


Figure F.30 – Input rectifier module mounting screw locations



INPUT 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 Input Board.

MATERIALS NEEDED

7/64" Allen Wrench
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Label and disconnect plugs J1, J2, J3, J4, J5, J6, J8 and J9 from the input board. See ***Figure F.31***. See Wiring Diagram.
4. Using a 7/64" Allen wrench, remove the four screws, lock washers and flat washers securing the board to the mounting posts. See ***Figure F.32***.
5. The input board can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the input board into the machine.
2. Using a 7/64" Allen wrench, attach the four screws, lock washers and flat washers securing the input board to the mounting posts.
3. Connect plugs J1, J2, J3, J4, J5, J6, J8 and J9 to the input board. See Wiring Diagram.
4. Perform the ***Case Cover Replacement Procedure***.
5. Perform the ***Retest After Repair Procedure***.

Figure F.31 – Input board lead locations

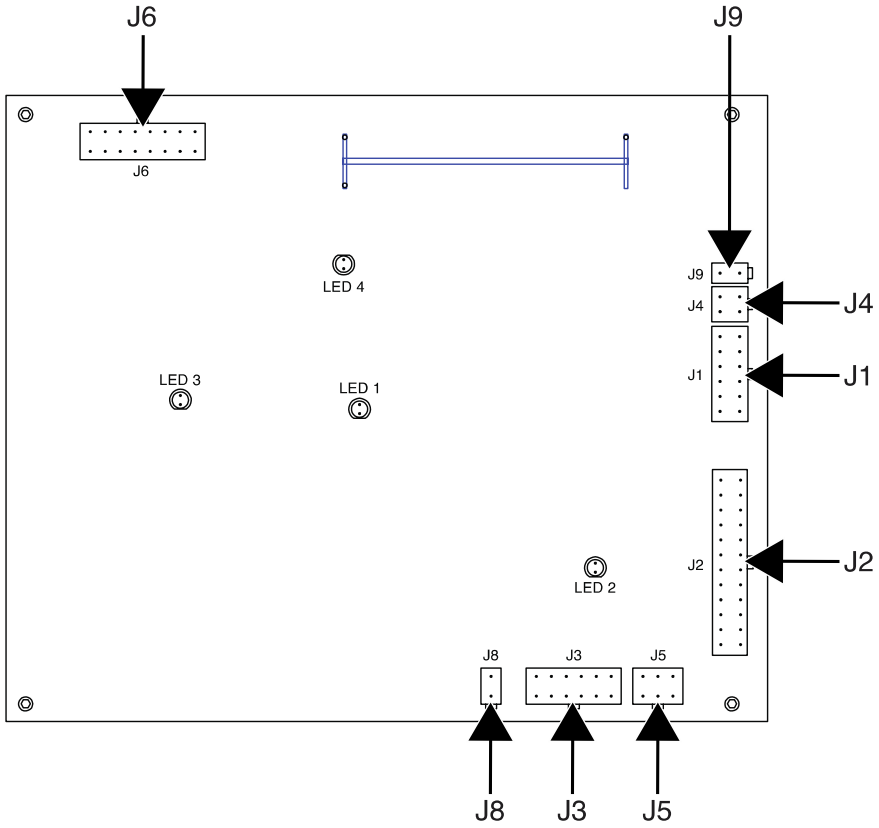
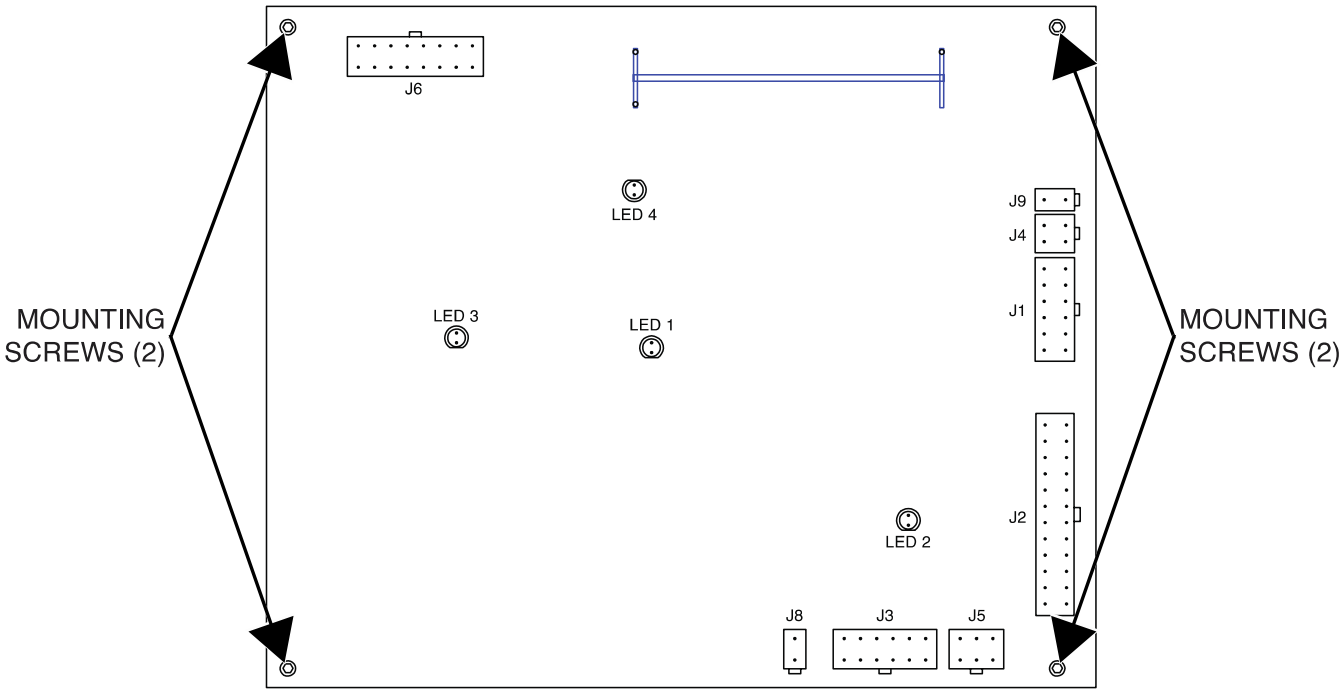


Figure F.32 – Input board mounting screw locations



CONTROL / DISPLAY 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 Control / Display Board.

MATERIALS NEEDED

1/4” Nutdriver
Phillips Screwdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Label and disconnect plug J22 from the control / display board. See ***Figure F.33***. See Wiring Diagram.
4. Carefully remove the red cover from the knob on the front of the machine. See ***Figure F.34***.
5. Using a 1/4” nutdriver, remove the nut and washer securing the knob to the board. See ***Figure F.34***.
6. Using a Phillips screwdriver, remove the four screws and washers securing the board to the machine. See ***Figure F.35***.
7. The control / display board can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the new control / display board into the machine.
2. Using a Phillips screwdriver, attach the four screws and washers securing the board to the machine.
3. Carefully position the knob onto the shaft of the control board. Make sure to rotate the knob all the way to the left and position the knob point accordingly.
4. Using a 1/4” nutdriver, attach the nut and washer securing the knob to the board.
5. Place the red knob cover onto the knob.
6. Connect plug J22 to the control / display board. See Wiring Diagram.
7. Perform the ***Case Cover Replacement Procedure***.
8. Perform the ***Retest After Repair Procedure***.

Figure F.33 – Control / display board plug J22 location

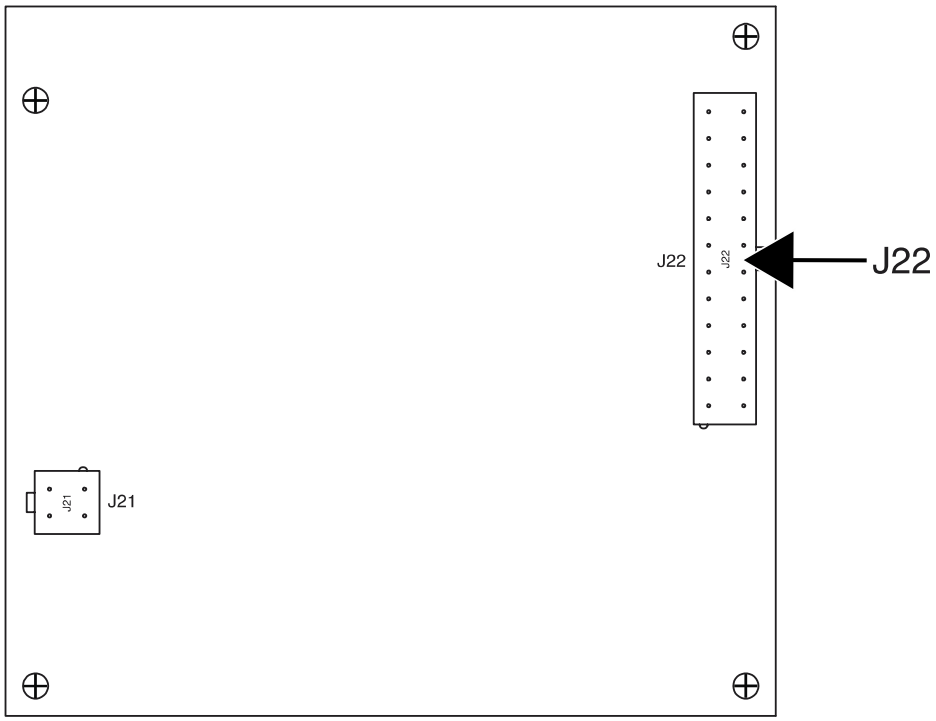


Figure F.34 – Output control knob location

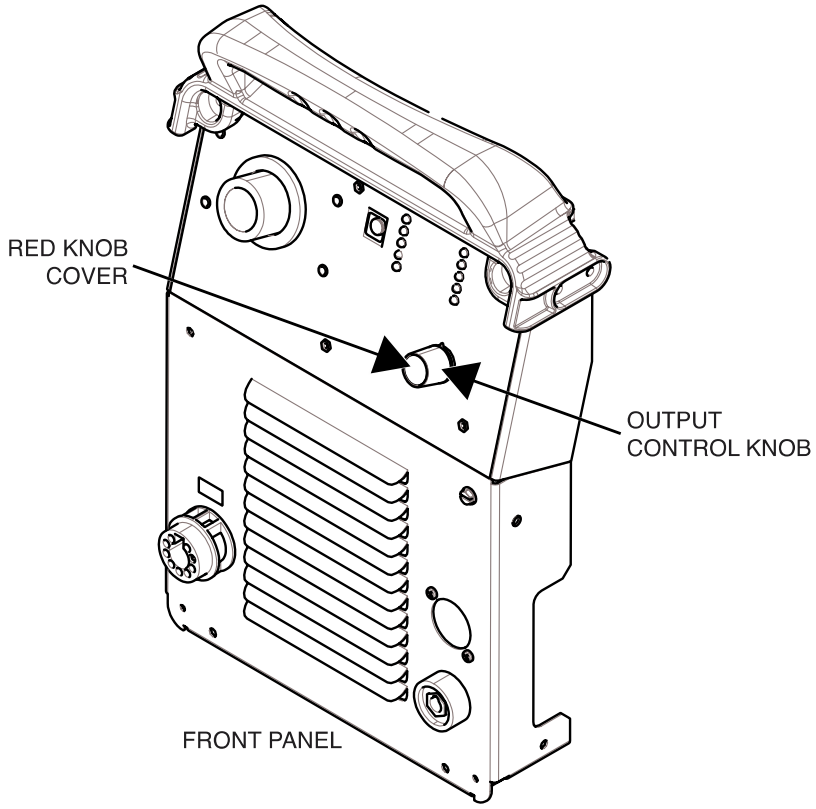
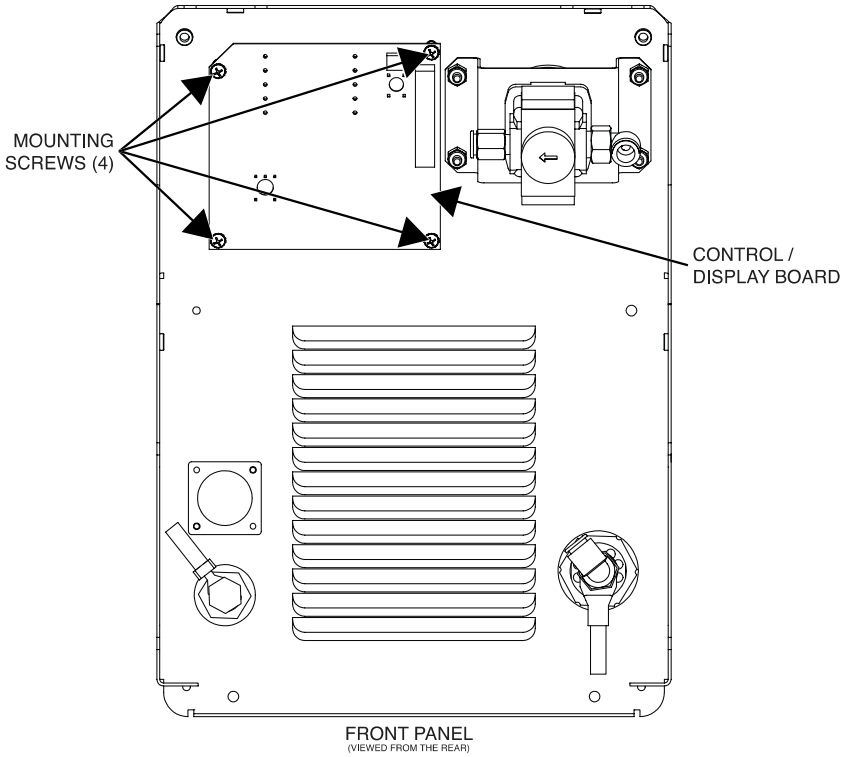


Figure F.35 – Control / display board mounting screw locations



INVERTER 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 Inverter Board.

MATERIALS NEEDED

Torx Nutdriver (Size T-20)
Small Slotted Screwdriver
RTV Compound
Dow Corning 340 Heat Sink Compound (Lincoln Part #T12837)
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500 machine.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Label and disconnect plug J11 from the inverter board. See ***Figure F.36***. See Wiring Diagram.
4. Using a Torx nutdriver (size T-20), remove the screws, lock washers and flat washers securing leads 201 & 204 to terminals TR1 & TR3 on the inverter board. See ***Figure F.36***. See Wiring Diagram.
5. Using a Torx nutdriver (size T-20), remove the screws, lock washers and flat washers securing leads to terminals POS & NEG on the inverter board. See ***Figure F.36***. See Wiring Diagram.
6. Using a small slotted screwdriver, loosen the screws securing leads 414, 413, 412 and 411 from terminals TH2 & TH1. See ***Figure F.36***. See Wiring Diagram. Label leads for reassembly.
7. Carefully remove the RTV compound covering the sixteen inverter board mounting screws. See ***Figure F.37***.
8. Using a Torx nutdriver (size T-20), remove the sixteen screws, lock washers and flat washers securing the inverter board to the modules. See ***Figure F.37***.
9. The inverter board can now be removed and replaced.
10. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing each IGBT module to the heat sink. Repeat this step for each module as necessary. See ***Figure F.38***. Note the orientation of the IGBT module for reassembly.
11. The IGBT module(s) can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Clean the heat sink.
2. Apply a coating of Dow Corning 340 heat sink compound to the mating surface of the IGBT module and the heat sink.
3. Carefully position the new IGBT module into the machine. Make sure the IGBT module slot is facing the correct direction. See ***Figure F.39***.
4. Using a Torx nutdriver (size T-20), attach the two screws, lock washers and flat washers securing each IGBT module to the heat sink. Torque to 11 – 13 in/lbs. Repeat this step for each module as necessary.
5. Carefully position the new inverter board into the machine.
6. Using a Torx nutdriver (size T-20), attach the sixteen screws, lock washers and flat washers securing the inverter board to the modules. Torque to 11 – 13 in/lbs.
7. Carefully apply a liberal amount of RTV compound to cover the sixteen inverter board mounting screws.
8. Using a small slotted screwdriver, tighten the screws securing leads 414, 413, 412 and 411 to terminals TH2 & TH1. See Wiring Diagram.
9. Using a Torx nutdriver (size T-20), attach the screws, lock washers and flat washers securing leads to terminals POS & NEG on the inverter board. See Wiring Diagram. Torque to 11 – 13 in/lbs.
10. Using a Torx nutdriver (size T-20), attach the screws, lock washers and flat washers securing leads 201 & 204 to terminals TR1 & TR3 on the inverter board. See Wiring Diagram. Torque to 11 – 13 in/lbs.
11. Connect plug J11 to the inverter board. See Wiring Diagram.
12. Perform the ***Case Cover Replacement Procedure***.
13. Perform the ***Retest After Repair Procedure***.

Figure F.36 – Inverter board plug and lead locations

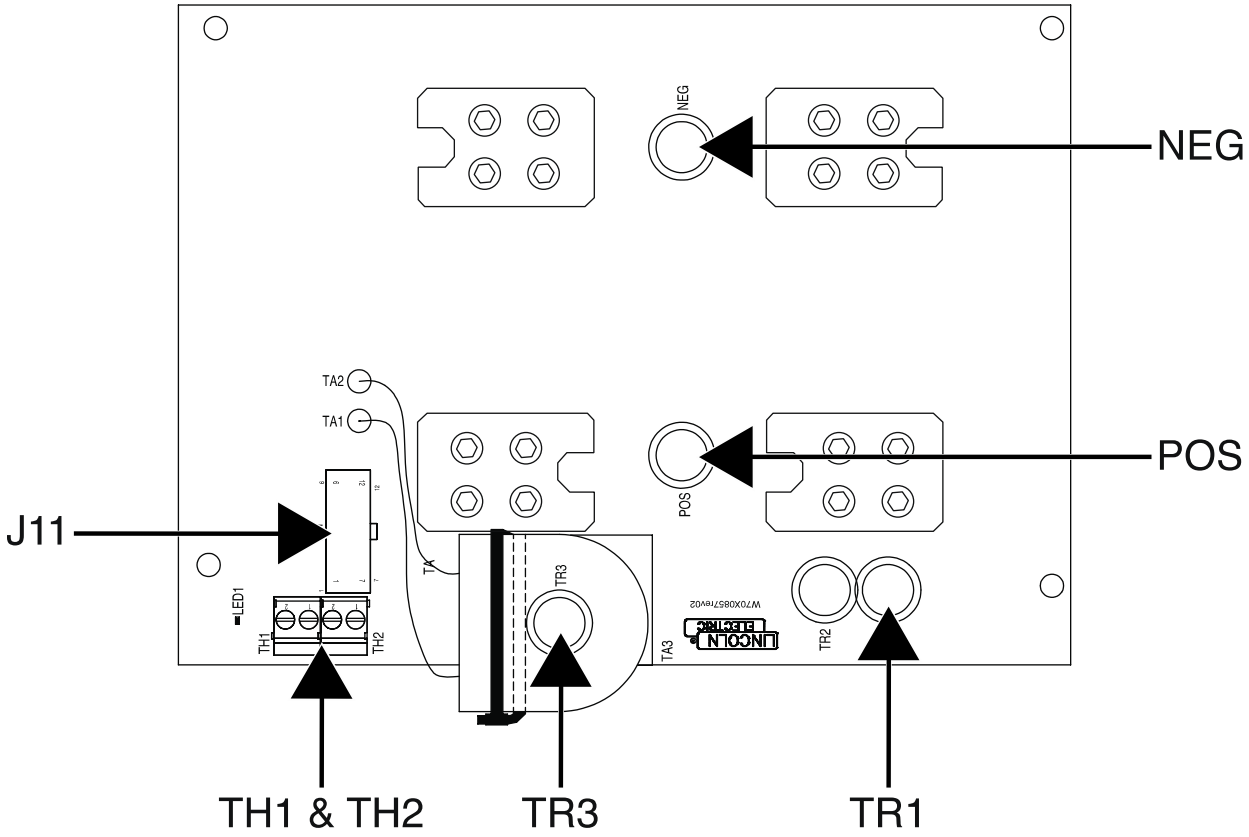


Figure F.37 – Inverter board mounting screws location

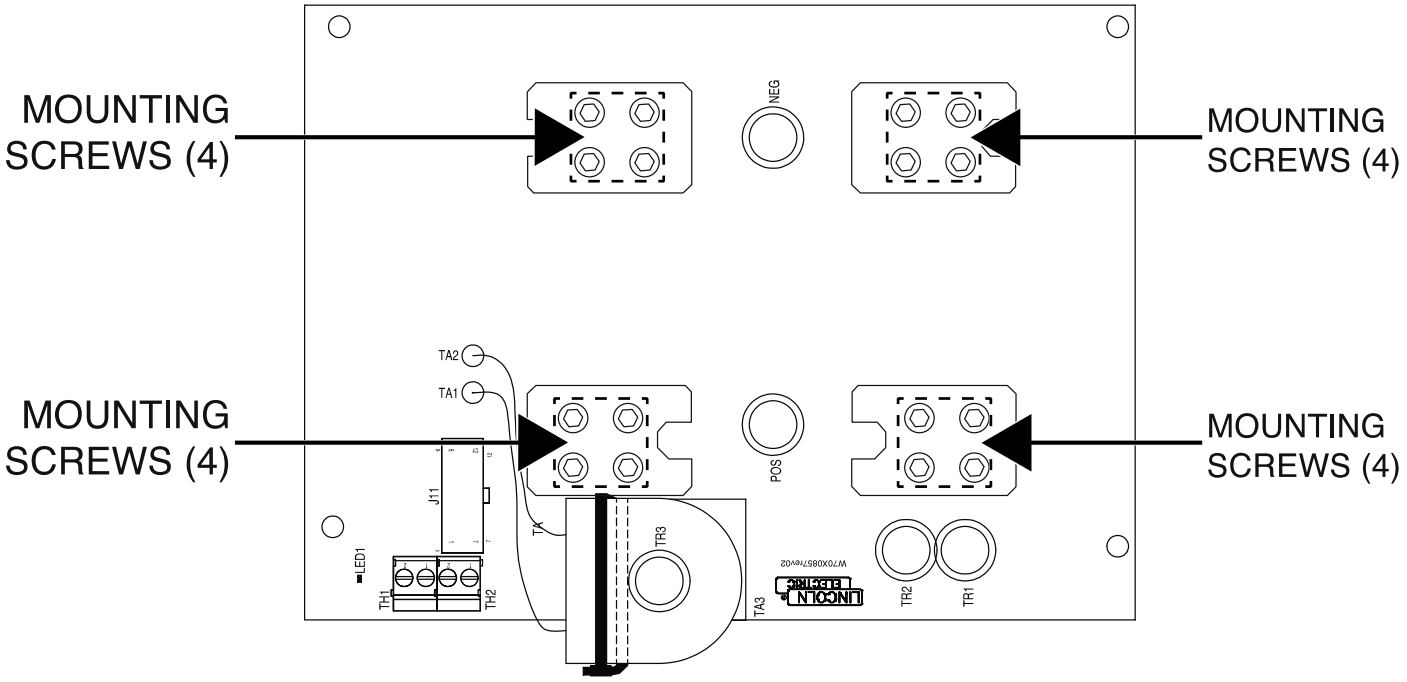


Figure F.38 – IGBT module mounting screw locations

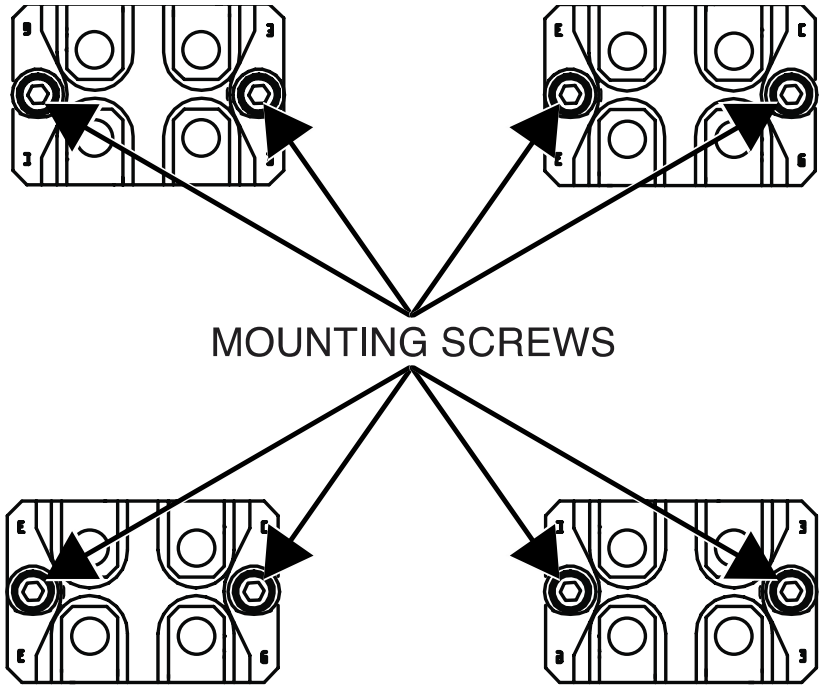
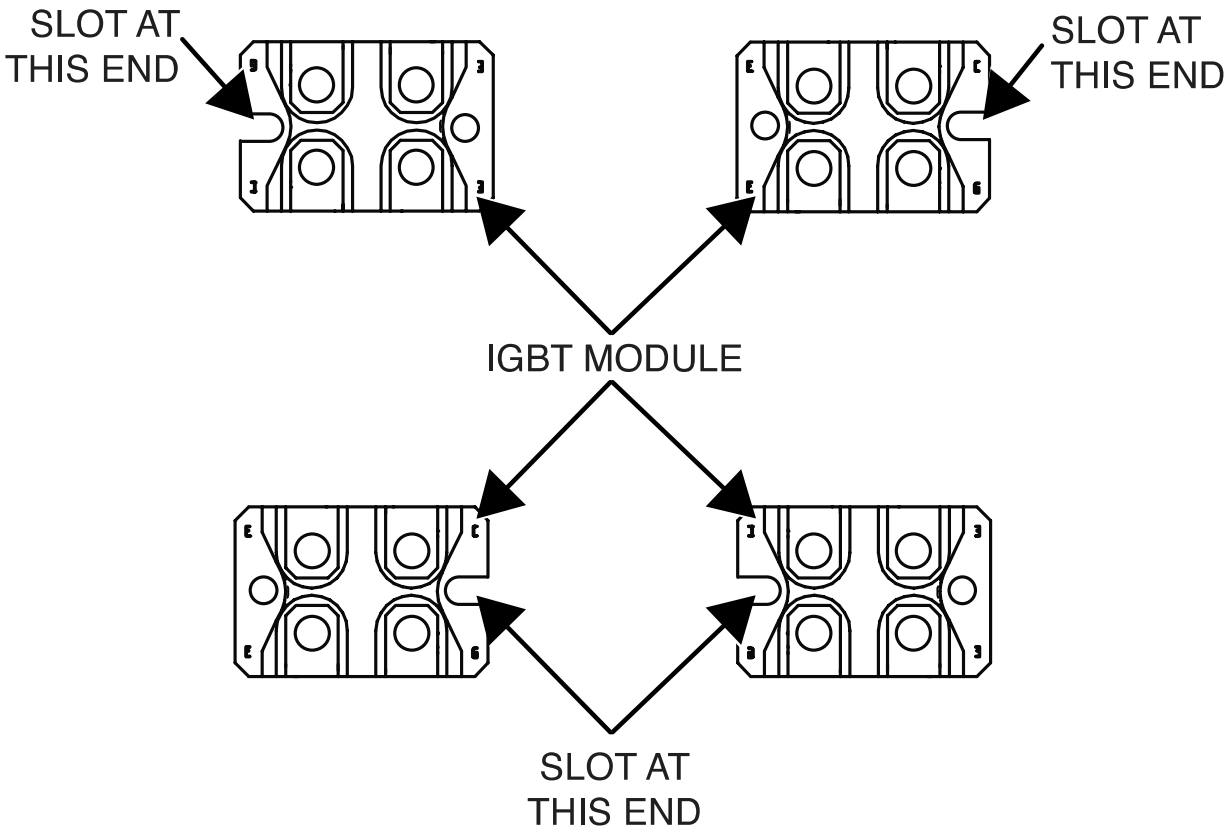


Figure F.39 – IGBT module slot orientation



OUTPUT 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 Output Board.

MATERIALS NEEDED

Torx Nutdriver (Size T-20)
RTV Compound
7/64” Allen Wrench
Dow Corning 340 Heat Sink Compound (Lincoln Part #T12837)
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Label and disconnect plugs J32 and J33 from the output board. See ***Figure F.40***. See Wiring Diagram.
4. Label and disconnect leads from terminals B1, B2 and B11 on the output board. See ***Figure F.40***. See Wiring Diagram.
5. Using a Torx nutdriver (size T-20), remove the six screws, lock washers and flat washers securing leads to the board. Label and disconnect leads from terminals B5, B6, B7, B8, B9 and B10 from the output board. See ***Figure F.40***. See Wiring Diagram.
6. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing leads to terminals 1 and 3 of the resistor module. See ***Figure F.40***. See Wiring Diagram.
7. Carefully remove the RTV compound from the twelve output board mounting screws.
8. Using a Torx nutdriver (size T-20), remove the twelve screws, lock washers and flat washers securing the output board to the modules. See ***Figure F.41***.
9. The output board can now be removed and replaced.
10. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing each module to the heat sink. Note the orientation of the slot for reassembly. See ***Figure F.42***. Repeat for each module, as necessary.
11. Using a 7/64” Allen wrench, remove the two screws, lock washers and flat washers securing the resistor module to the heat sink. Note the orientation of the slot for reassembly. See ***Figure F.42***.
12. The output modules can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Clean the heat sink surface.
2. Apply a coating of Dow Corning 340 heat sink compound to the mating surface of the modules to be replaced and the heat sink.
3. Carefully position the module into the machine. Make sure the mounting slot is facing the correct direction. See ***Figure F.43***.
4. Using a Torx nutdriver (size T-20), attach the two screws, lock washers and flat washers securing each module to the heat sink. Repeat for each module. Torque to 11 – 13 in/lbs.
5. Using a 7/64" Allen wrench, attach the two screws, lock washers and flat washers securing the resistor module to the heat sink. Torque to 11 – 13 in/lbs.
6. Carefully position the new output board into the machine.
7. Using a Torx nutdriver (size T-20), attach the twelve screws, lock washers and flat washers securing the output board to the modules. Torque to 11 – 13 in/lbs.
8. Carefully apply a liberal amount of RTV compound to cover the twelve output board mounting screws.
9. Using a Torx nutdriver (size T-20), connect the two screws, lock washers and flat washers securing the previously removed leads to terminals 1 and 3 of the resistor module. See Wiring Diagram. Torque to 11 – 13 in/lbs.
10. Using a Torx nutdriver (size T-20), connect the six screws, lock washers and flat washers securing the previously removed leads to terminals B5, B6, B7, B8, B9 and B10 of the output board. See Wiring Diagram. Torque to 11 – 13 in/lbs.
11. Connect the previously removed leads to terminals B1, B2 and B11 of the output board. See Wiring Diagram.
12. Connect plugs J32 and J33 to the output board. See Wiring Diagram.
13. Perform the ***Case Cover Replacement Procedure***.
14. Perform the ***Retest After Repair Procedure***.

Figure F.40 – Output board plug and lead locations

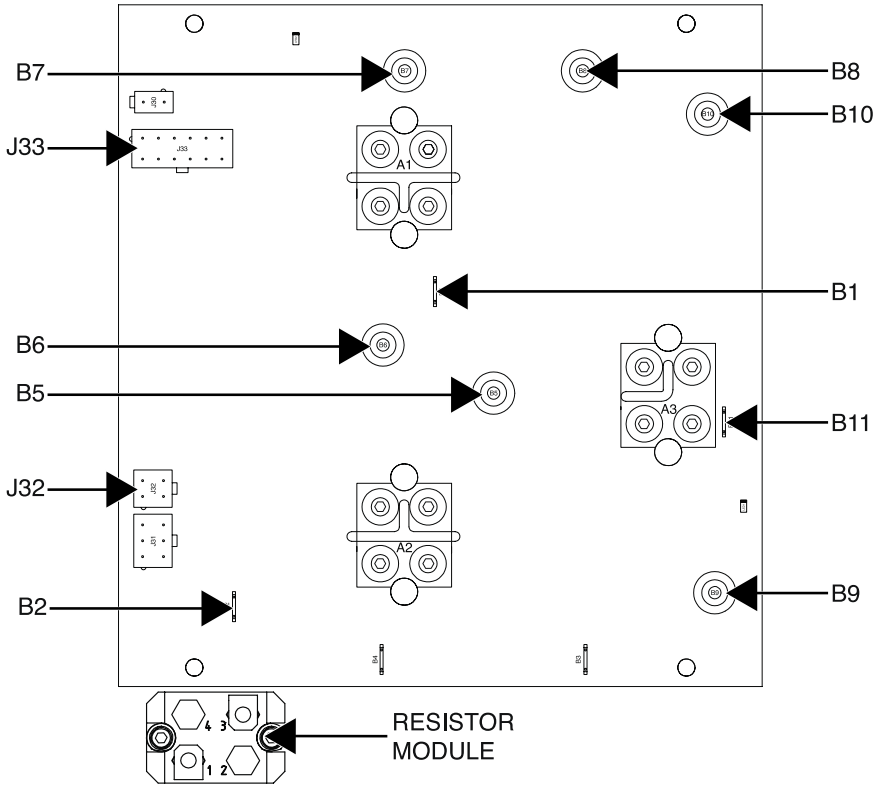


Figure F.41 – Output board mounting screw locations

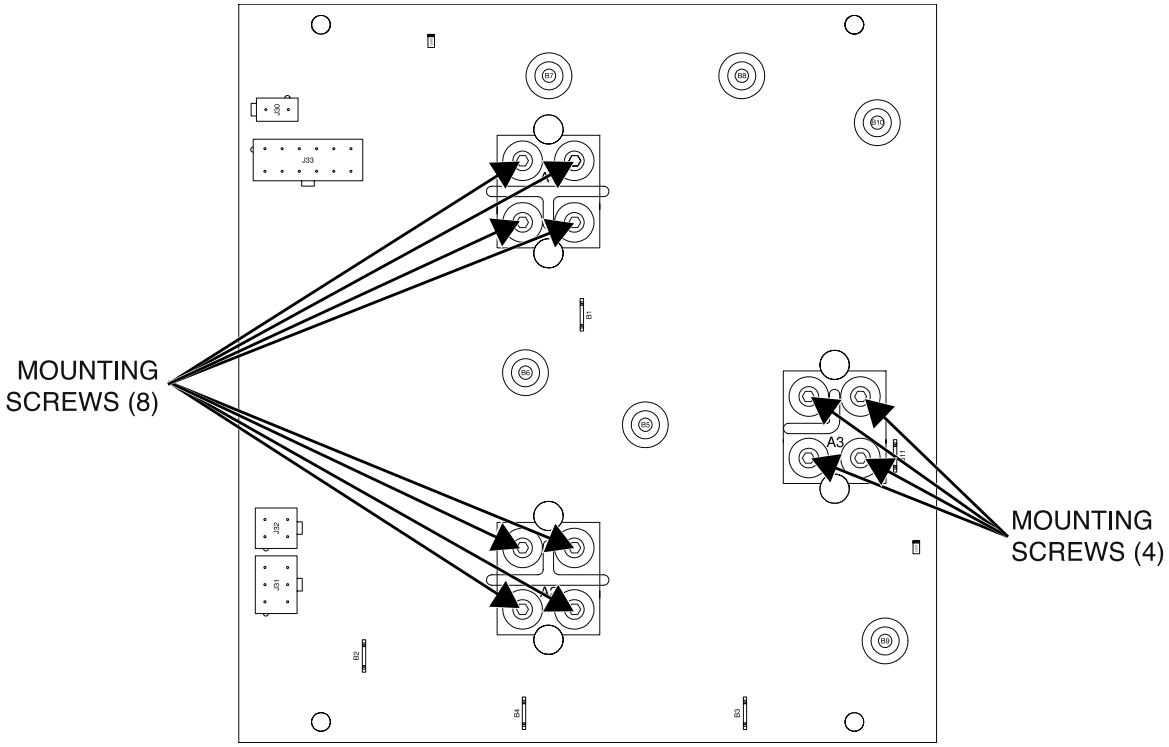


Figure F.42 – Output module mounting screw locations

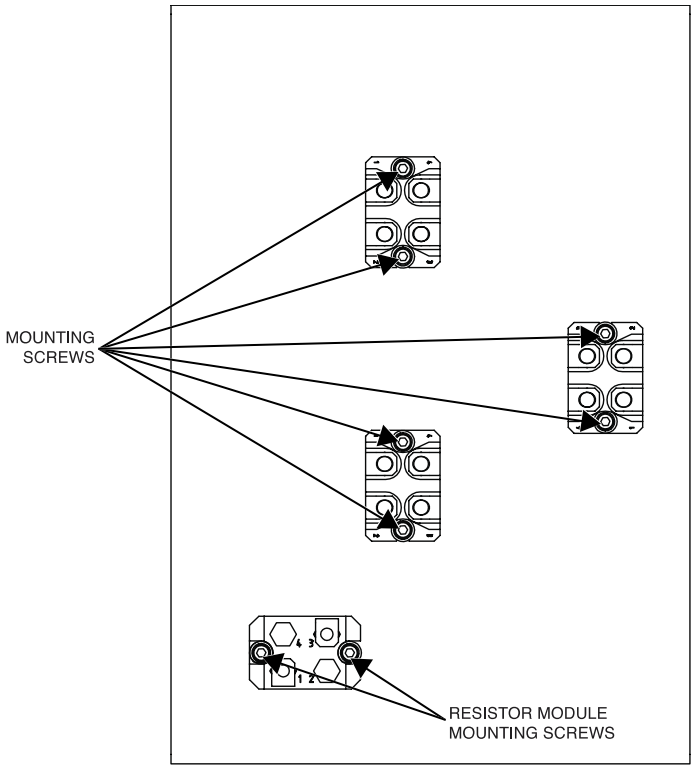
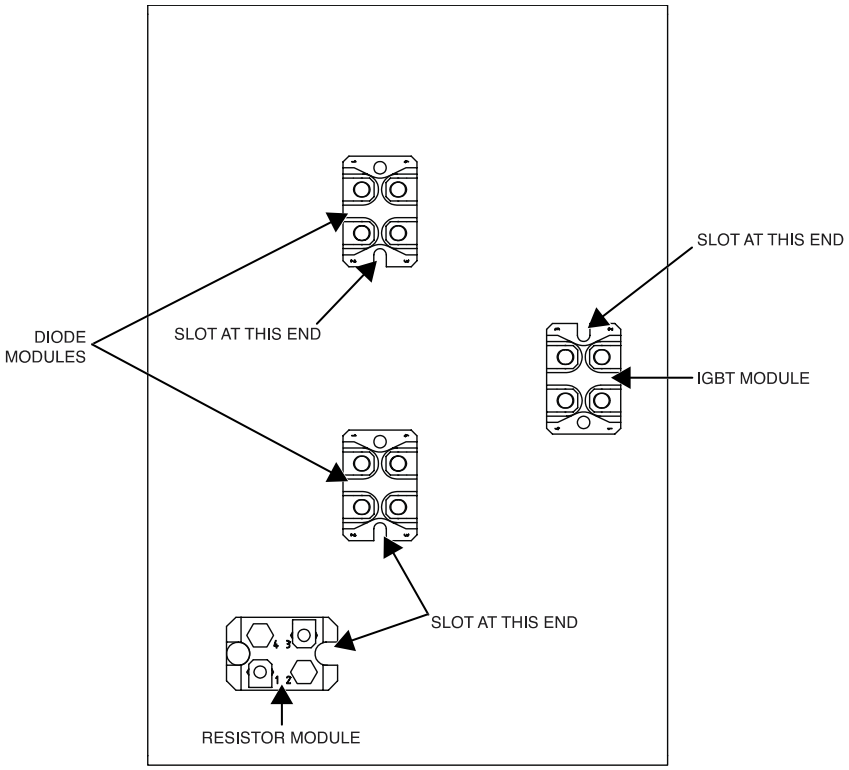


Figure F.43 – Output module slot orientation



BUCK / BOOST 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 Buck / Boost Board.

MATERIALS NEEDED

Torx Nutdriver (Size T-20)
Dow Corning 340 Heat Sink Compound (Lincoln Part #T12837)
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Label and disconnect plugs J1, J2, J5 and J6 from the buck / boost board. See ***Figure F.44***. See Wiring Diagram.
4. Using a Torx nutdriver (size T-20), remove the six screws, lock washers and flat washers securing the leads to the buck / boost board. Label and disconnect leads from terminals IND1, IND2, DCIN+, DCIN-, DC+ and DC- of the buck / boost board. See ***Figure F.44***. See Wiring Diagram.
5. Using a Phillips screwdriver, remove the six screws, lock washers and flat washers securing the buck / boost board to the modules. See ***Figure F.45***.
6. The buck / boost board can now be removed and replaced.
7. Label and disconnect leads 2G and 1E from the buck and boost modules. See ***Figure F.46***. See Wiring Diagram.
8. Using a Torx nutdriver (size T-20), remove the four screws (eight total) securing each module to the heat sink. See ***Figure F.47***.
9. The buck and/or boost modules can now be removed. Note the position and orientation of the module(s) being removed. The module must be replaced in the same position and orientation. The modules have different part numbers and functions but look very similar.

REPLACEMENT PROCEDURE

1. Clean the heat sink mounting surface.
2. Apply a coating of Dow Corning 340 heat sink compound to the mating surface of each module and the heat sink.

3. Carefully position each module into the machine. **NOTE:** Both modules look the same but have different functions and part numbers. Verify that the proper module has been installed in the correct location. See ***Figure F.47***.
4. Using a Torx nutdriver (size T-20), attach the four screws (eight total) securing each module to the heat sink. Torque to 18 – 25 in/lbs.
5. Carefully position the new buck / boost board into the machine.
6. Using a Phillips screwdriver, attach the six screws, lock washers and flat washers securing the buck / boost board to the modules. Torque to 20 – 25 in/lbs.
7. Using a Torx nutdriver (size T-20), connect the six screws, lock washers and flat washers securing the previously disconnected leads to terminals IND1, IND2, DCIN+, DCIN-, DC+ and DC- of the buck / boost board. See Wiring Diagram. Torque to 17 – 21 in/lbs.
8. Connect plugs J1, J2, J5 and J6 to the buck / boost board. See Wiring Diagram.
9. Perform the ***Case Cover Replacement Procedure***.
10. Perform the ***Retest After Repair Procedure***.

Figure F.44 – Buck / boost board plug and lead locations

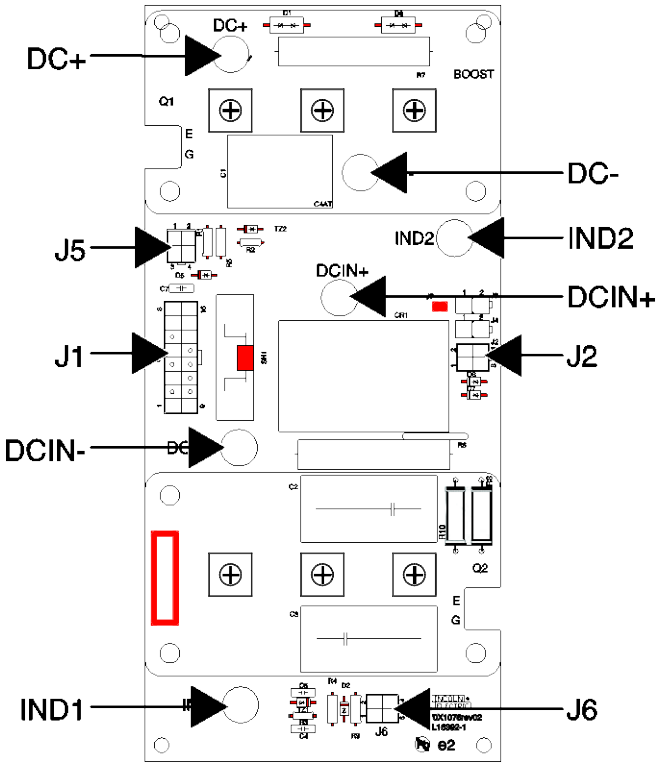


Figure F.45 – Buck / boost board mounting screw locations

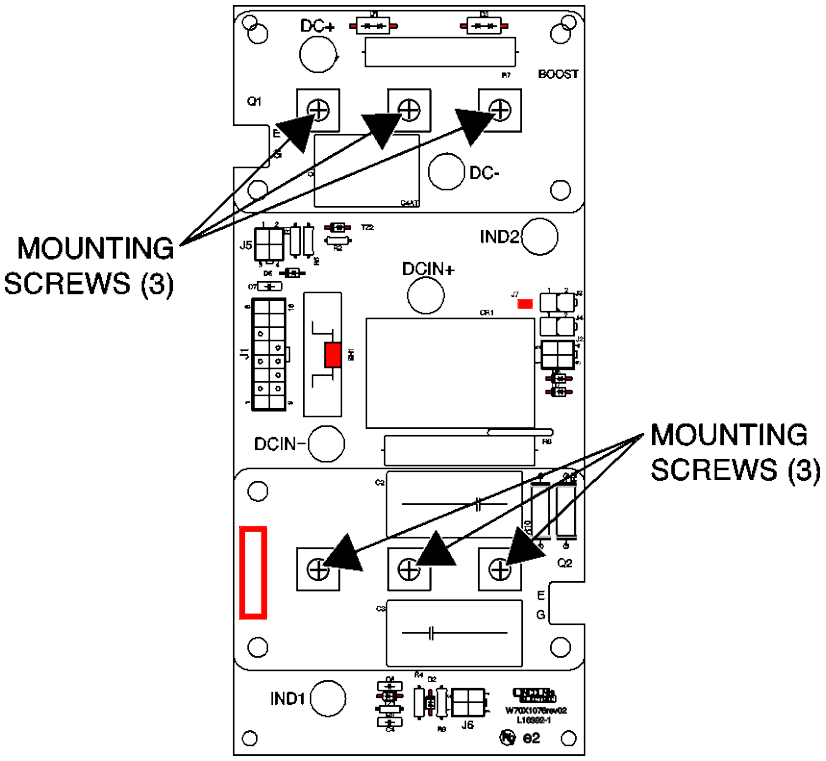
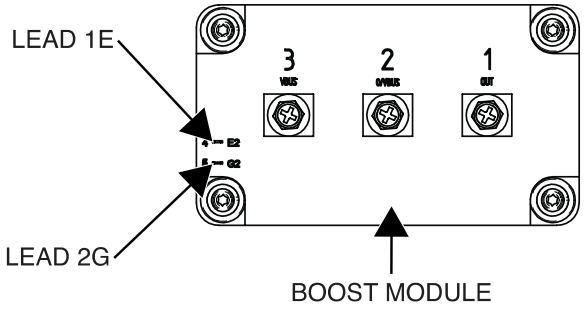


Figure F.46 – Buck / boost module lead locations



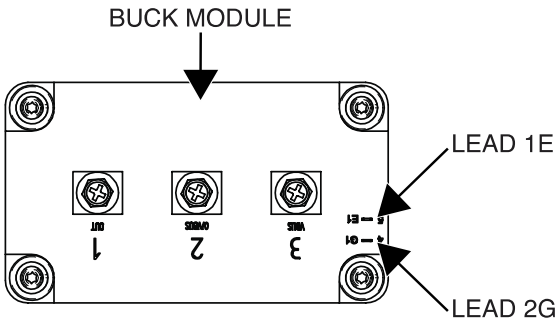
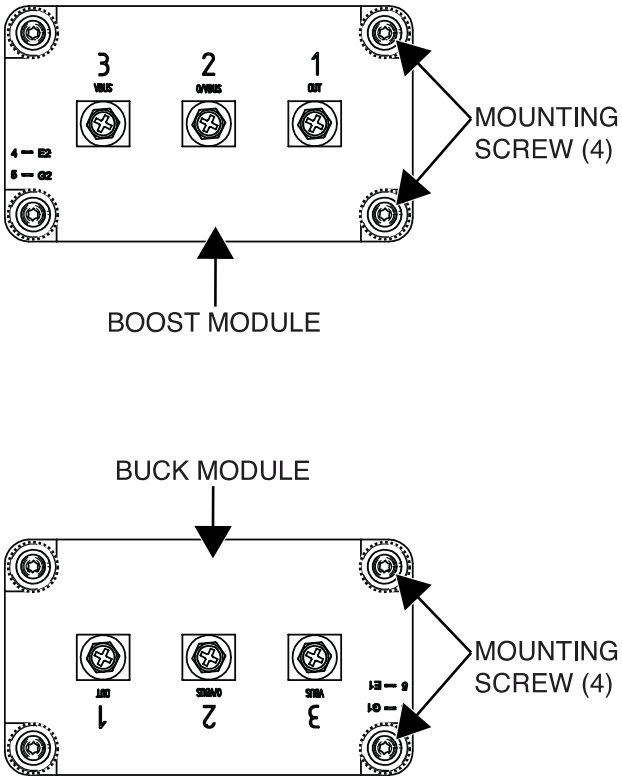


Figure F.47 – Buck / boost module mounting orientation and mounting screw locations



CHOKE ASSEMBLY 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 Assembly.

MATERIALS NEEDED

Torx Nutdriver (Size T-20)
3/8” Nutdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Label and disconnect leads 413 and 414 from the quick-connect terminals. See Wiring Diagram.
4. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing the leads to terminals IND1 and IND2 of the buck / boost board. Label and disconnect the leads from terminals IND1 and IND2 of the buck / boost board. See ***Figures F.48*** and ***F.49***. See Wiring Diagram.
5. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing the leads to terminals B7 and B8 of the output board. Label and disconnect the leads from terminals B7 and B8 of the output board. See ***Figures F.50*** and ***F.51***. See Wiring Diagram.
6. Using a 3/8” nutdriver, remove the four screws securing the choke assembly to the machine. See ***Figure F.52***.
7. Clear any leads necessary for removal and the choke assembly can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the new choke assembly into the machine.
2. Using a 3/8” nutdriver, attach the four screws securing the choke assembly to the machine.
3. Using a Torx nutdriver (size T-20), connect the two screws, lock washers and flat washers securing the previously disconnected leads to terminals B7 and B8 of the output board. See Wiring Diagram. Torque to 11 – 13 in/lbs.

4. Using a Torx nutdriver (size T-20), connect the two screws, lock washers and flat washers securing the previously disconnected leads to terminals IND1 and IND2 of the buck / boost board. See Wiring Diagram. Torque to 17 – 21 in/lbs.
5. Connect leads 413 and 414 to the quick-connect terminals. See Wiring Diagram.
6. Perform the ***Case Cover Replacement Procedure***.
7. Perform the ***Retest After Repair Procedure***.

Figure F.48 – Buck / boost board location

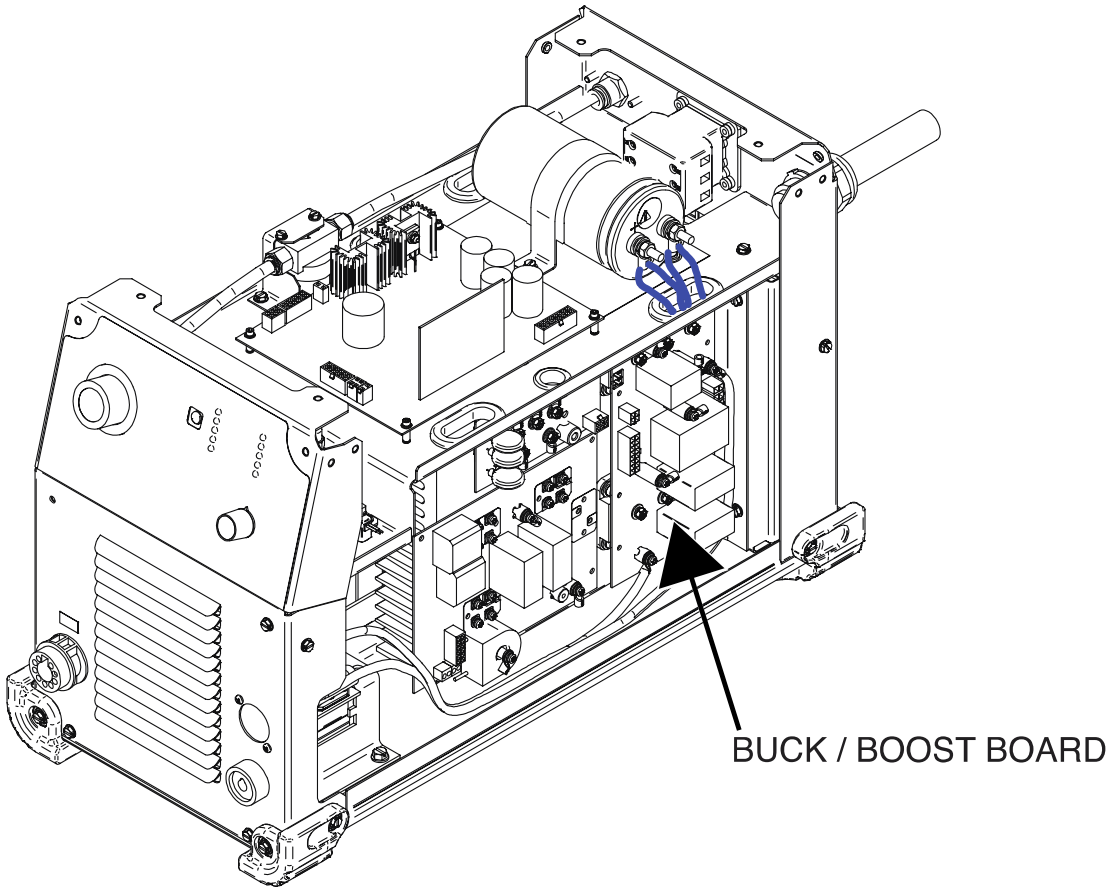


Figure F.49 – Buck / boost board terminal IND1 and IND2 locations

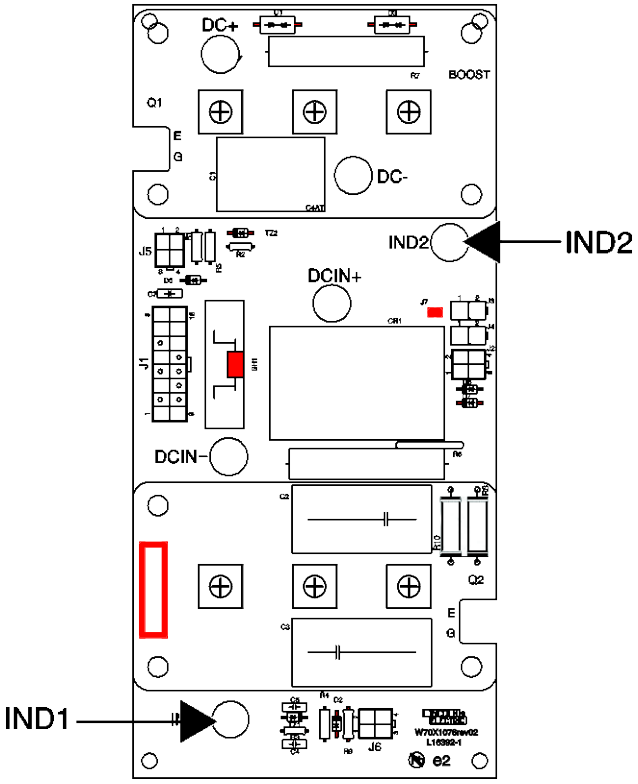


Figure F.50 – Output board location

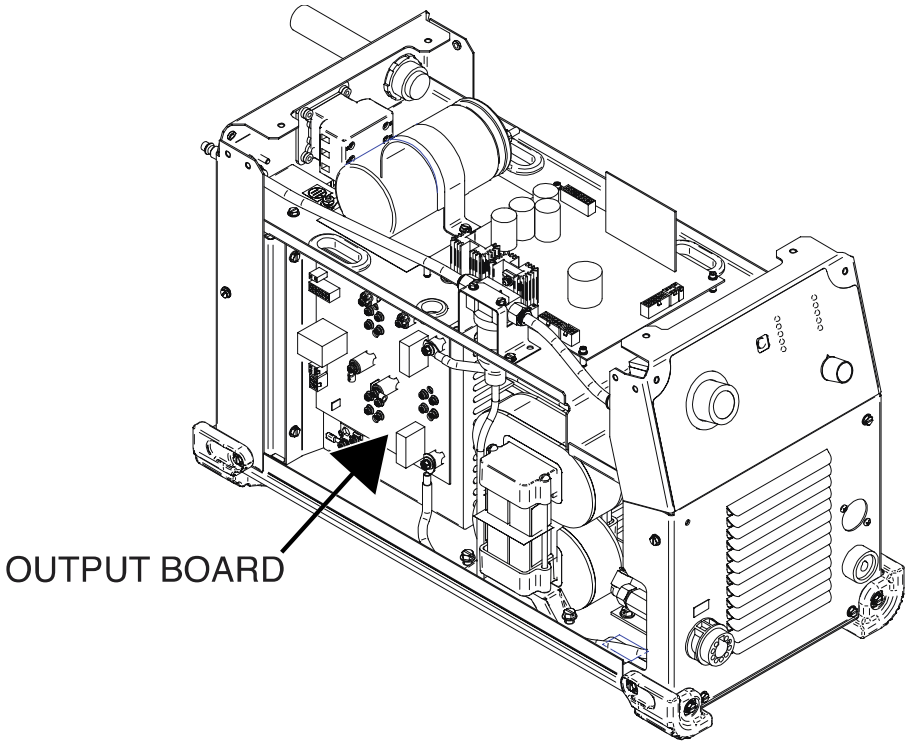


Figure F.51 – Output board terminal B7 and B8 location

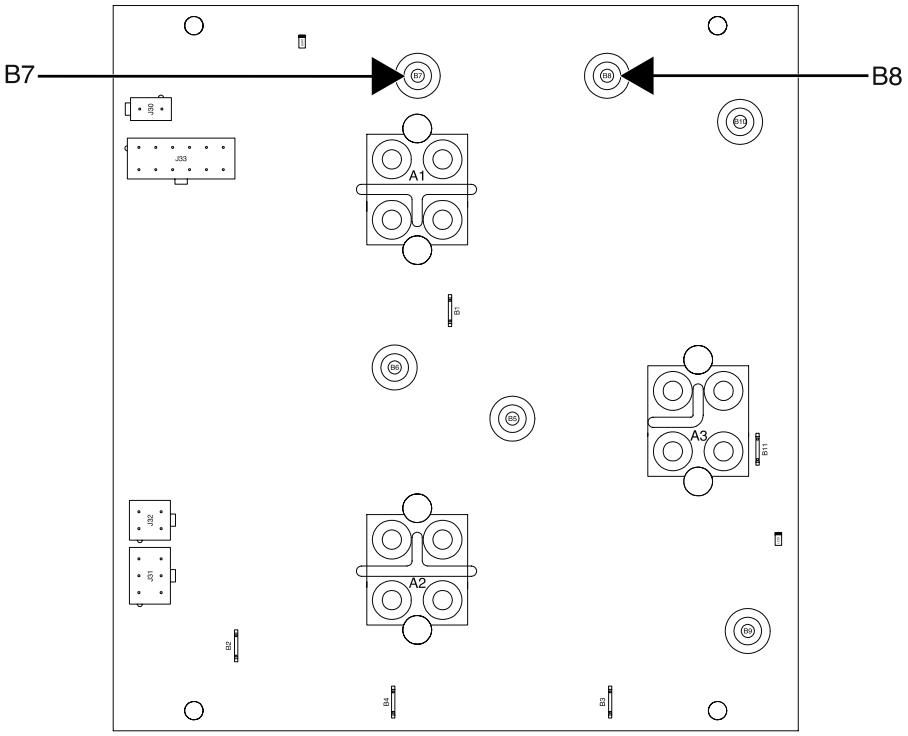
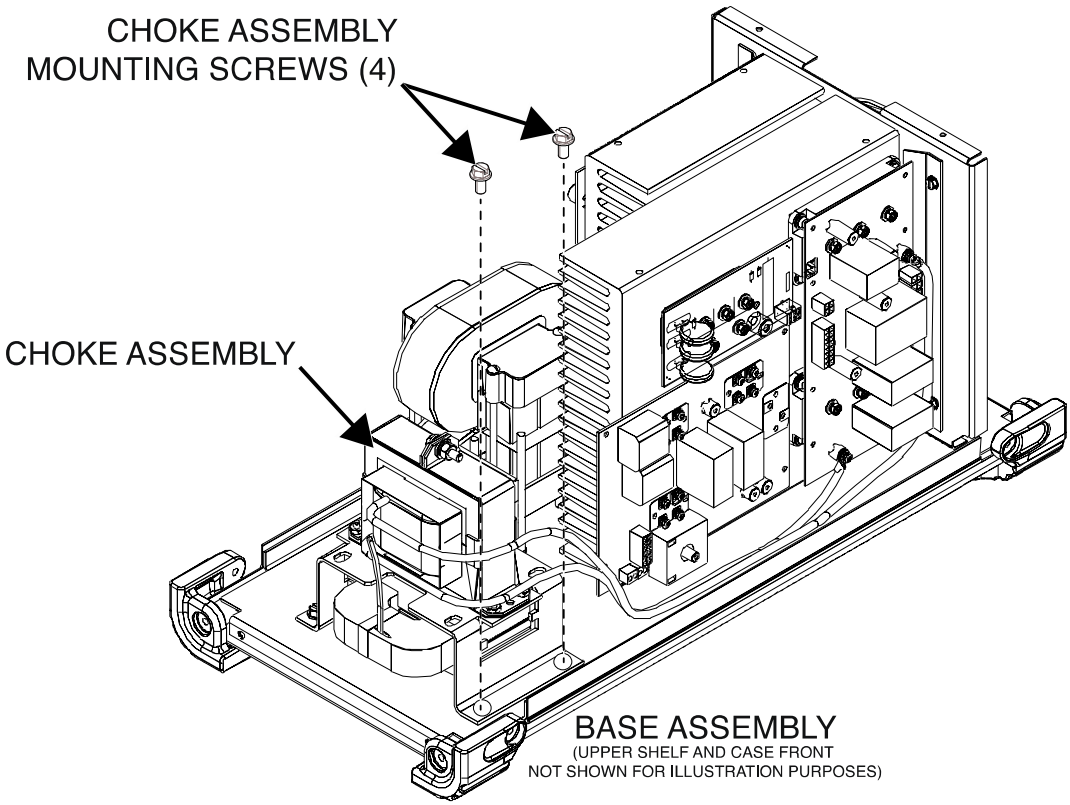


Figure F.52 – Choke assembly mounting screw locations



TRANSFORMER ASSEMBLY 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 Transformer Assembly.

MATERIALS NEEDED

Torx Nutdriver (Size T-20)
3/8” Nutdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing the leads to terminals TR3 and TR1 of the inverter board. Label and disconnect the leads from terminals TR3 and TR1 of the inverter board. See ***Figures F.53*** and ***F.54***. See Wiring Diagram.
4. Using a Torx nutdriver (size T-20), remove the two screws, lock washers and flat washers securing the leads to terminals B5 and B6 of the output board. Label and disconnect the leads from terminals B5 and B6 of the output board. See ***Figures F.55*** and ***F.56***. See Wiring Diagram.
5. Using a 3/8” nutdriver, remove the four screws securing the transformer assembly to the machine. See ***Figure F.57***.
6. The transformer assembly can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the new choke assembly into the machine.
2. Using a 3/8” nutdriver, attach the four screws securing the transformer assembly to the machine.
3. Using a Torx nutdriver (size T-20), connect the two screws, lock washers and flat washers securing the previously disconnected leads to terminals B5 and B6 of the output board. See Wiring Diagram. Torque to 17 – 21 in/lbs.
4. Using a Torx nutdriver (size T-20), connect the two screws, lock washers and flat washers securing the previously disconnected leads to terminals TR3 and TR1 of the inverter board. See Wiring Diagram. Torque to 11 – 13 in/lbs.
5. Perform the ***Case Cover Replacement Procedure***.
6. Perform the ***Retest After Repair Procedure***.

Figure F.53 – Inverter board location

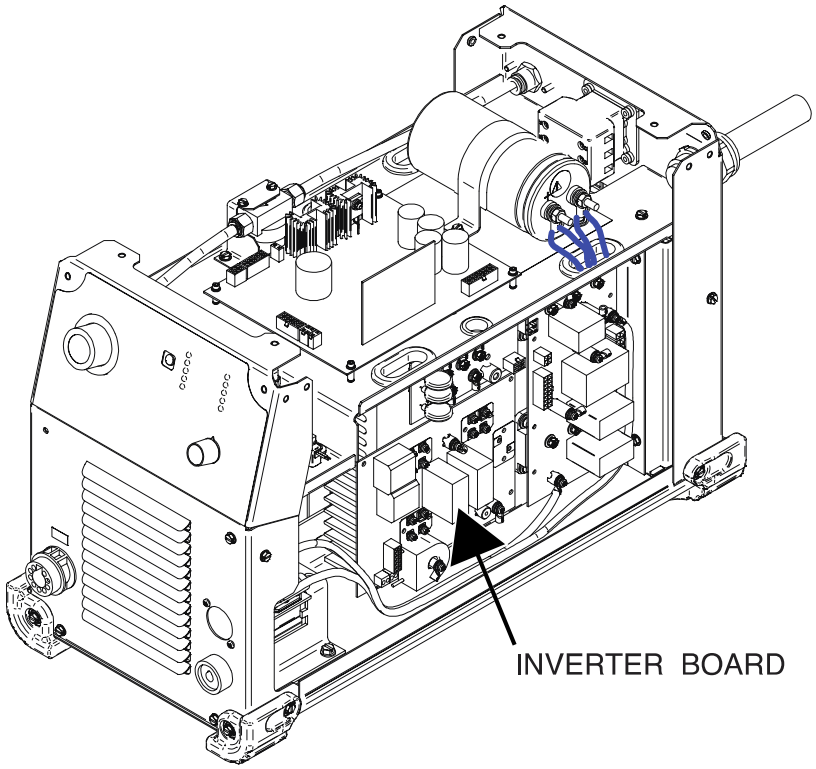


Figure F.54 – Inverter board terminal TR3 and TR1 locations

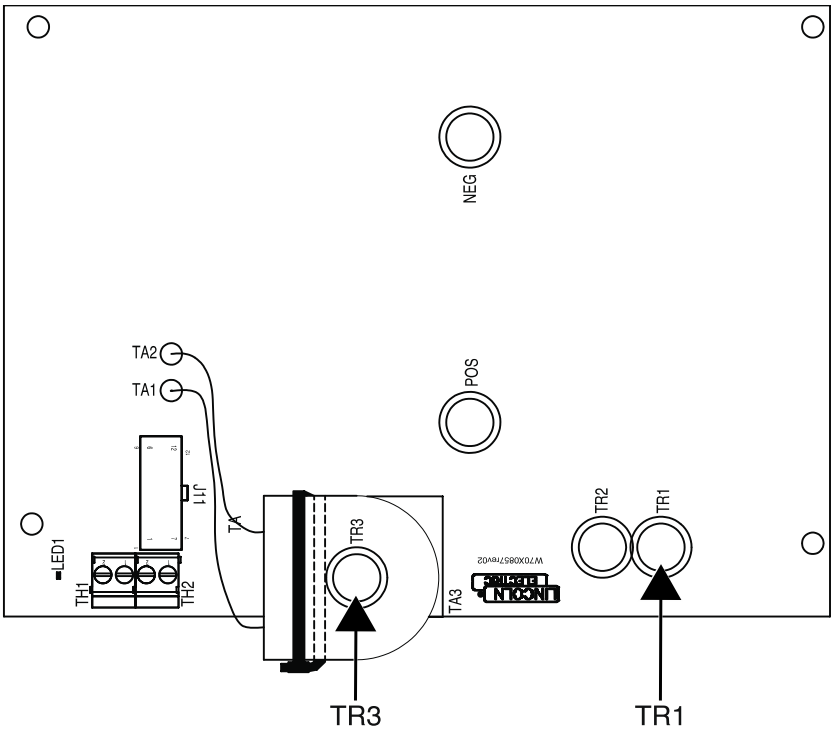


Figure F.55 – Output board location

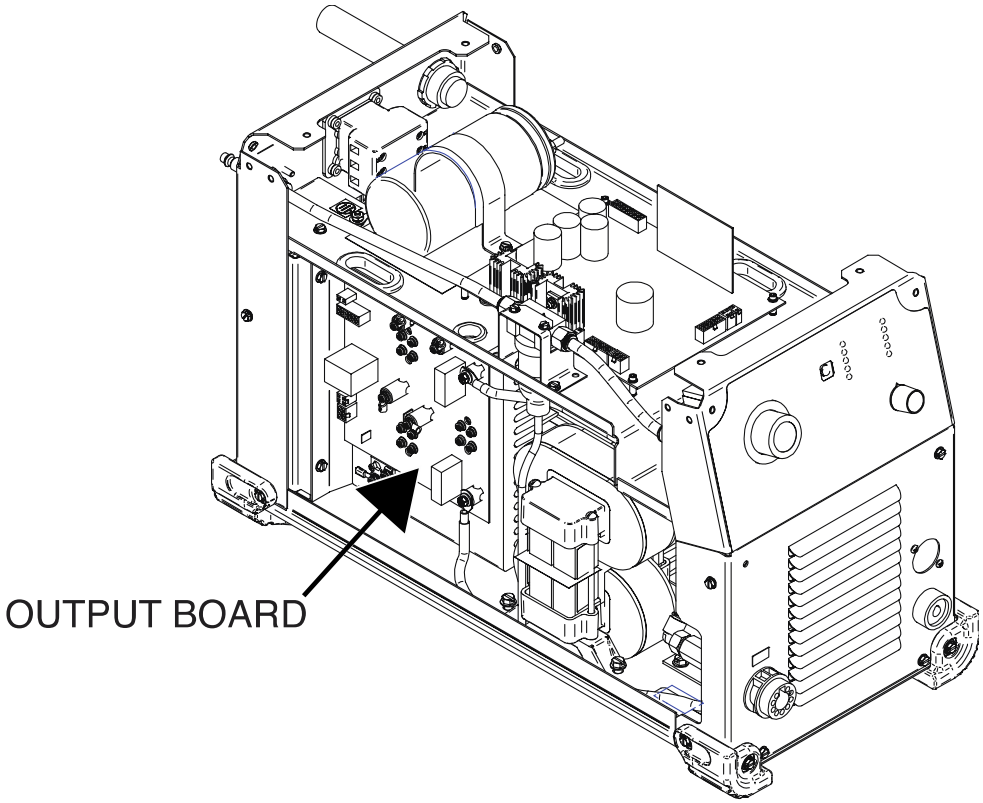


Figure F.56 – Output board terminal B5 and B6 location

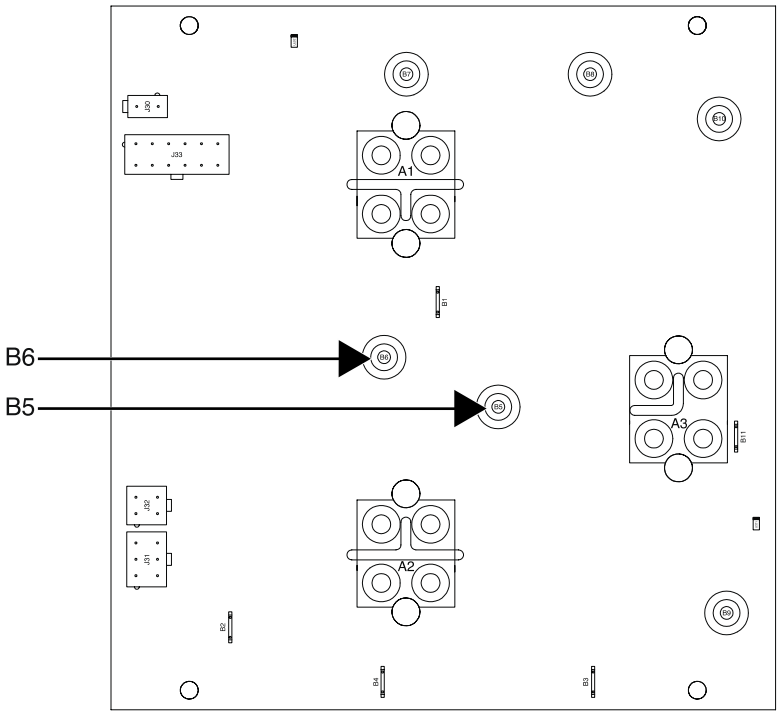
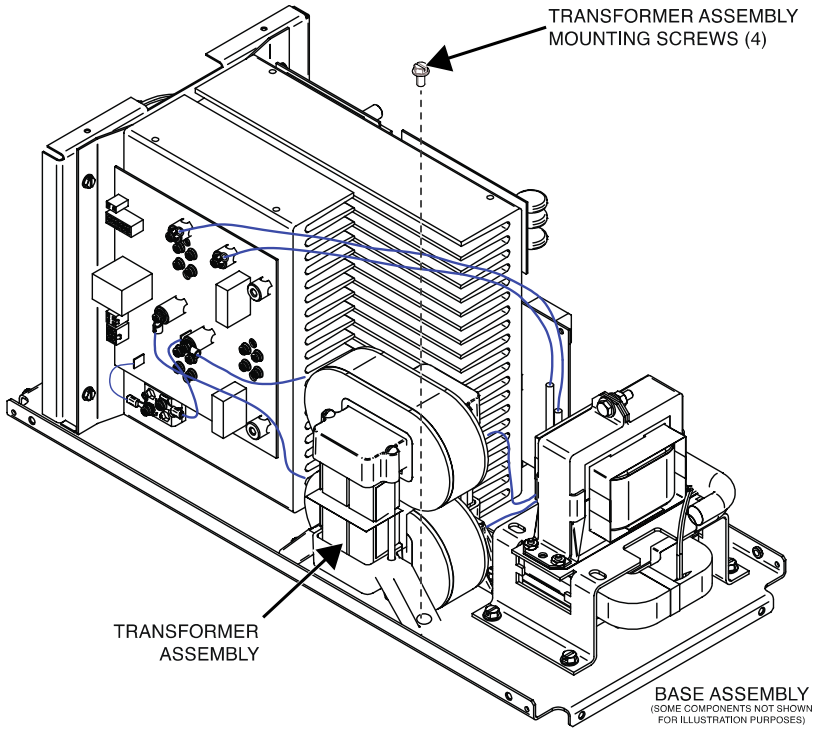


Figure F.57 – Transformer assembly mounting screw locations



AIR / GAS SOLENOID 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 Air / Gas Solenoid.

MATERIALS NEEDED

Phillips screwdriver
Wiring Diagram

REMOVAL PROCEDURE

1. Remove the input power from the Tomahawk 1500.
2. Perform the ***Case Cover Removal And Capacitor Discharge Procedure***.
3. Disconnect the air hoses at the top and bottom of the air / gas solenoid. See ***Figure F.58***.
4. Label and disconnect plugs J5 and J8 from the input board. See ***Figures F.59*** and ***F.60***. See Wiring Diagram.
5. Using a Phillips screwdriver, remove the three screws securing the air / gas solenoid to the upper shelf. See ***Figure F.58***. See Wiring Diagram.
6. The air / gas solenoid can now be removed and replaced.

REPLACEMENT PROCEDURE

1. Carefully position the air / gas solenoid into the machine.
2. Using a Phillips screwdriver, attach the three screws securing the air / gas solenoid to the upper shelf.
3. Connect plugs J5 and J8 to the input board. See Wiring Diagram.
4. Attach the two previously disconnected air hoses to the air / gas solenoid.
5. Perform the ***Case Cover Replacement Procedure***.
6. Perform the ***Retest After Repair Procedure***.

Figure F.58 – Air / gas solenoid mounting screw and air hose connection locations

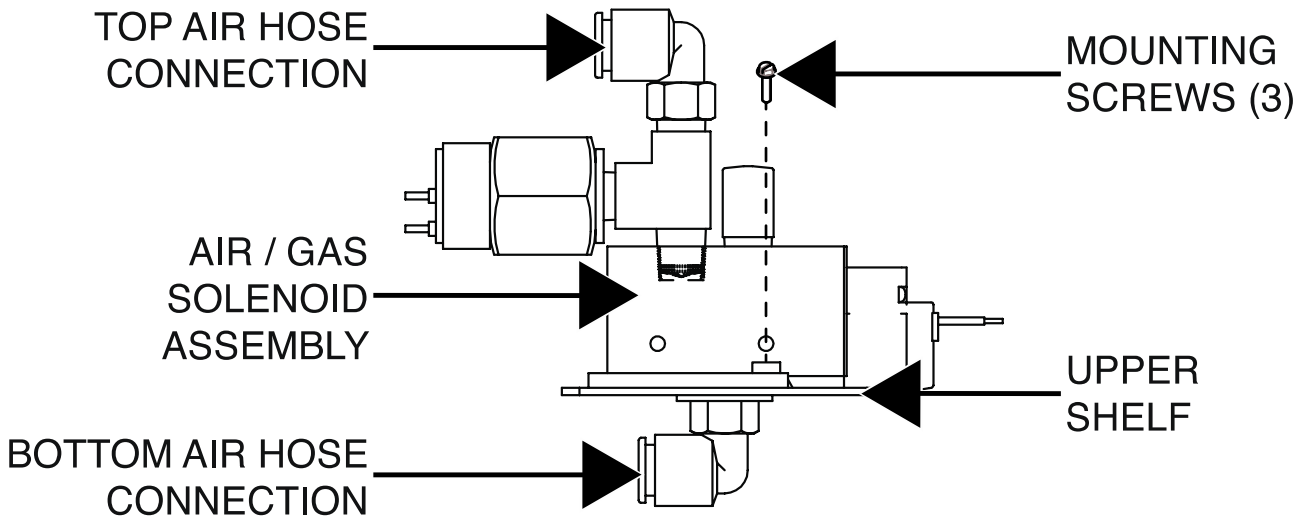


Figure F.59 – Input board location

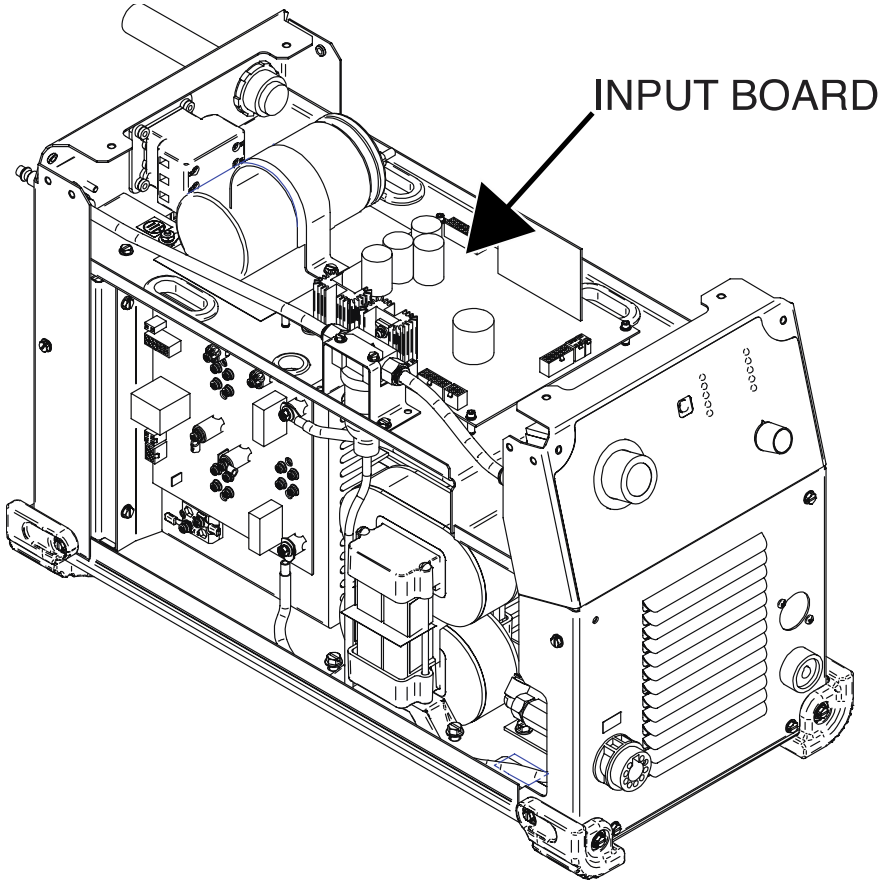
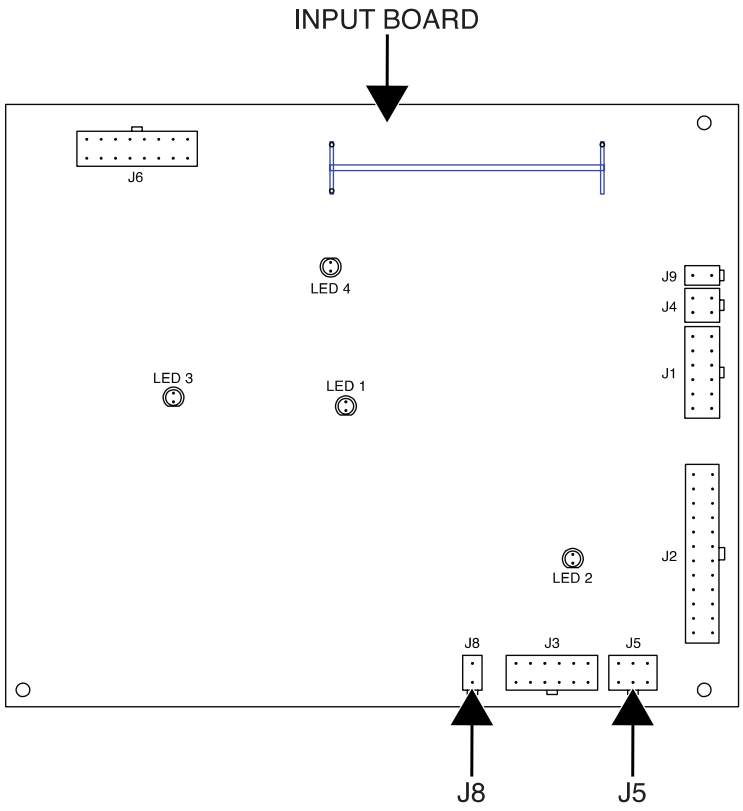


Figure F.60 – Input board plugs J5 and J8 location



RETEST AFTER REPAIR

Should a machine under test be rejected for any reason requiring the removal of any mechanical part that could affect the machine's electrical characteristics, or if any electrical components are repaired or replaced, the machine must be retested.

MACHINE INPUT AND OUTPUT

INPUT VOLTS / HERTZ	INPUT CURRENT	RATED OUTPUT
230/3/60HZ ±10%	37.0 AMPS	80A @ 80% DUTY CYCLE

OUTPUT CURRENT RANGE	25 – 100 AMPS DC

MAXIMUM OPEN CIRCUIT RANGE	270 VOLTS DC

PILOT CURRENT	20 AMPS

1. Connect the machine to 208/230VAC three phase input power and an air supply (80psi minimum).
2. Turn on the machine and verify the following:
   • The fan is functional.
   • The green power LED is illuminated on the front nameplate.
3. Test the pressure switch in the following manner:
   • Turn the output control knob to the purge area until the air starts flowing from torch.
   NOTE: If left in Purge, Purge will shut off after five minutes.
   Using the regulator on the machine, slowly lower the air pressure and verify that the output red LED turns on blinking at approximately 45 to 48 psi. ≈ (.31MPa to .33MPa).
   With the output red LED blinking on, move from Purge on dial (RED) then pull the trigger on the torch. Verify that a pilot arc does NOT occur. Release the trigger.
   While in Purge mode increase the regulator back to the proper air pressure for cutting levels, 80 psi (.55MPa).
   Move dial out of Purge area.
4. Test the Purge safety function by dialing into Purge region and get air flowing from torch and then pull the trigger on the torch. Verify that a pilot arc does NOT occur. Release the trigger and move from Purge on dial to the red area to turn off air flow.
5. With no air flowing (postflow), pull the trigger on the torch. Verify that the air flows and the pilot arc is initiated. While continuing to hold the trigger, verify that the pilot arc remains lit for 4 to 6 seconds then turns off automatically. Release the trigger and verify that the air continues to flow for approximately 20 seconds (postflow).
6. Unscrew the shield cup from the torch and verify that the yellow parts-in-place LED illuminates. When the torch trigger is pulled the pilot arc should not occur. Re-tighten the shield cup on the torch and verify that the yellow LED blinks for about five seconds and then goes out. After the yellow LED goes out pull the torch trigger and verify that a pilot arc does occur. **NOTE:** There may be a delay in re-strike during the post flow time.
7. Test cut with Tomahawk 1500 at its maximum recommended cut thickness with 1.25" steel max. Turn current dial to maximum.
8. Turn the machine off. Test complete.