LINCOLN ELECTRIC

GENUINE LINCOLN PARTS™

NOTE: This manual will cover most of the troubleshooting and repair procedures for the code numbers listed. Some variances may exist when troubleshooting/repairing later code numbers.

TOMAHAWK® 1000

For use with machines having Code Numbers:

11581

SERVICE MANUAL

SVM229-A | Issue Date 13-Apr

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

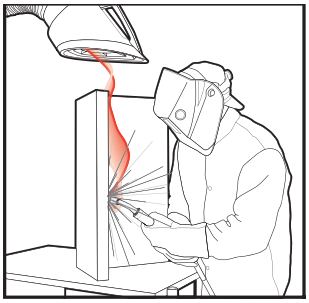
This statement appears where the information must be followed exactly to avoid serious personal injury or loss of life.

⚠ 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 Material Safety Data Sheet (MSDS) 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.

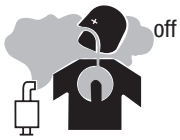
ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

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 with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) 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. In confined spaces or in some circumstances, outdoors, a respirator may 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.

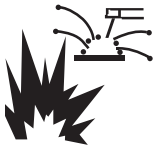
5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

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 material safety data sheet (MSDS) and follow your employer's safety practices. MSDS 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 1235 Jefferson Davis Highway, Arlington, VA 22202.

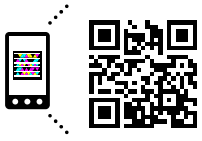
FOR ELECTRICALLY POWERED EQUIPMENT.

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.



Welding Safety Interactive Web Guide for mobile devices

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http://gettag.mobi

Electromagnetic Compatibility (EMC)

Conformance
Products displaying the CE mark are in conformity with European Community Council Directive of 15 Dec 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility, 2004/108/EC. It was manufactured in conformity with a national standard that implements a harmonized standard: EN 60974-10 Electromagnetic Compatibility (EMC) Product Standard for Arc Welding Equipment. It is for use with other Lincoln Electric equipment. It is designed for industrial and professional use.

Introduction
All electrical equipment generates small amounts of electromagnetic emission. Electrical emission may be transmitted through power lines or radiated through space, similar to a radio transmitter. When emissions are received by other equipment, electrical interference may result. Electrical emissions may affect many kinds of electrical equipment; other nearby welding equipment, radio and TV reception, numerical controlled machines, telephone systems, computers, etc. Be aware that interference may result and extra precautions may be required when a welding power source is used in a domestic establishment.

Installation and Use
The user is responsible for installing and using the welding equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user of the welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing (grounding) the welding circuit, see Note. In other cases it could involve construction of an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Note: The welding circuit may or may not be earthed for safety reasons according to national codes. Changing the earthing arrangements should only be authorized by a person who is competent to access whether the changes will increase the risk of injury, e.g., by allowing parallel welding current return paths which may damage the earth circuits of other equipment.

Assessment of Area
Before installing welding equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

a) other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the welding equipment;

b) radio and television transmitters and receivers;

c) computer and other control equipment;

d) safety critical equipment, e.g., guarding of industrial equipment;

e) the health of the people around, e.g., the use of pacemakers and hearing aids;

f) equipment used for calibration or measurement

g) the immunity of other equipment in the environment. The user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures;

h) the time of day that welding or other activities are to be carried out.

Electromagnetic Compatibility (EMC)

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of Reducing Emissions

Mains Supply
Welding equipment should be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently installed welding equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the welding power source so that good electrical contact is maintained between the conduit and the welding power source enclosure.

Maintenance of the Welding Equipment
The welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the welding equipment is in operation. The welding equipment should not be modified in any way except for those changes and adjustments covered in the manufacturers instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Welding Cables
The welding cables should be kept as short as possible and should be positioned close together, running at or close to floor level.

Equipotential Bonding
Bonding of all metallic components in the welding installation and adjacent to it should be considered. However, metallic components bonded to the work piece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of the Workpiece
Where the workpiece is not bonded to earth for electrical safety, not connected to earth because of its size and position, e.g., ships hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

Screening and Shielding
Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire welding installation may be considered for special applications. [1]

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[1] Portions of the preceding text are contained in EN 60974-10: "Electromagnetic Compatibility (EMC) product standard for arc welding equipment."

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TABLE OF CONTENTS-THEORY OF OPERATION SECTION

FIGURE E.1 BLOCK LOGIC DIAGRAM

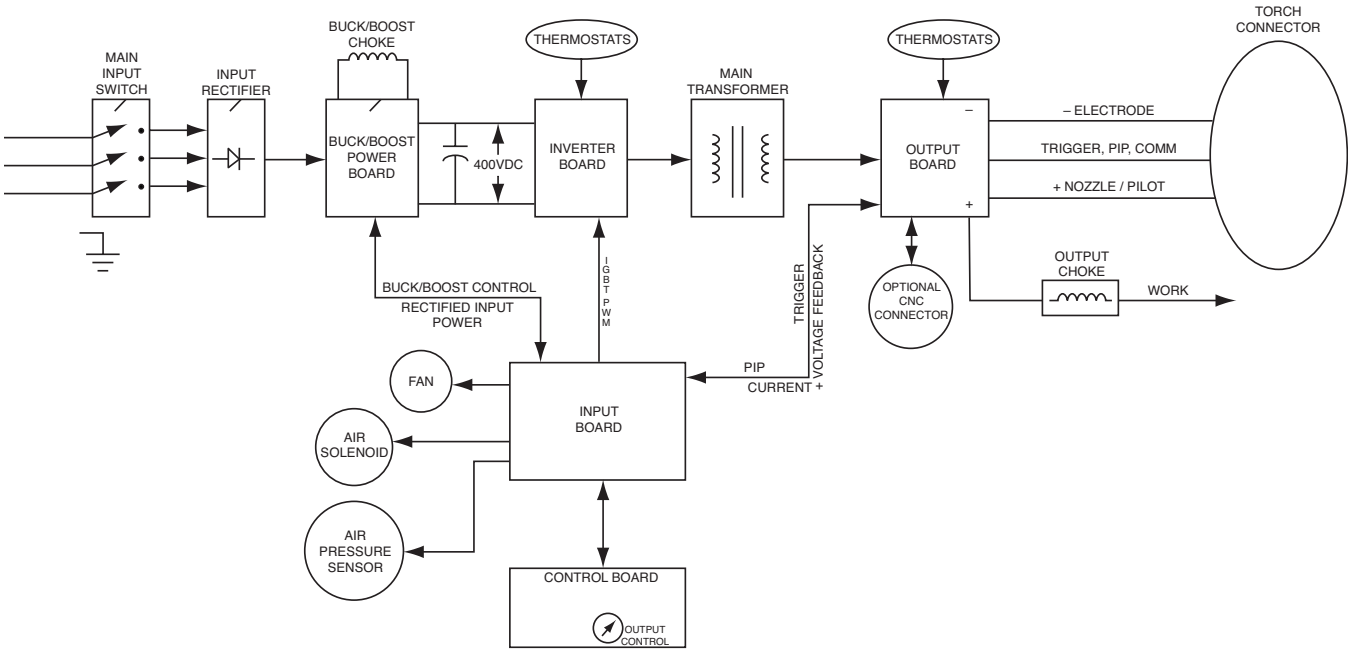
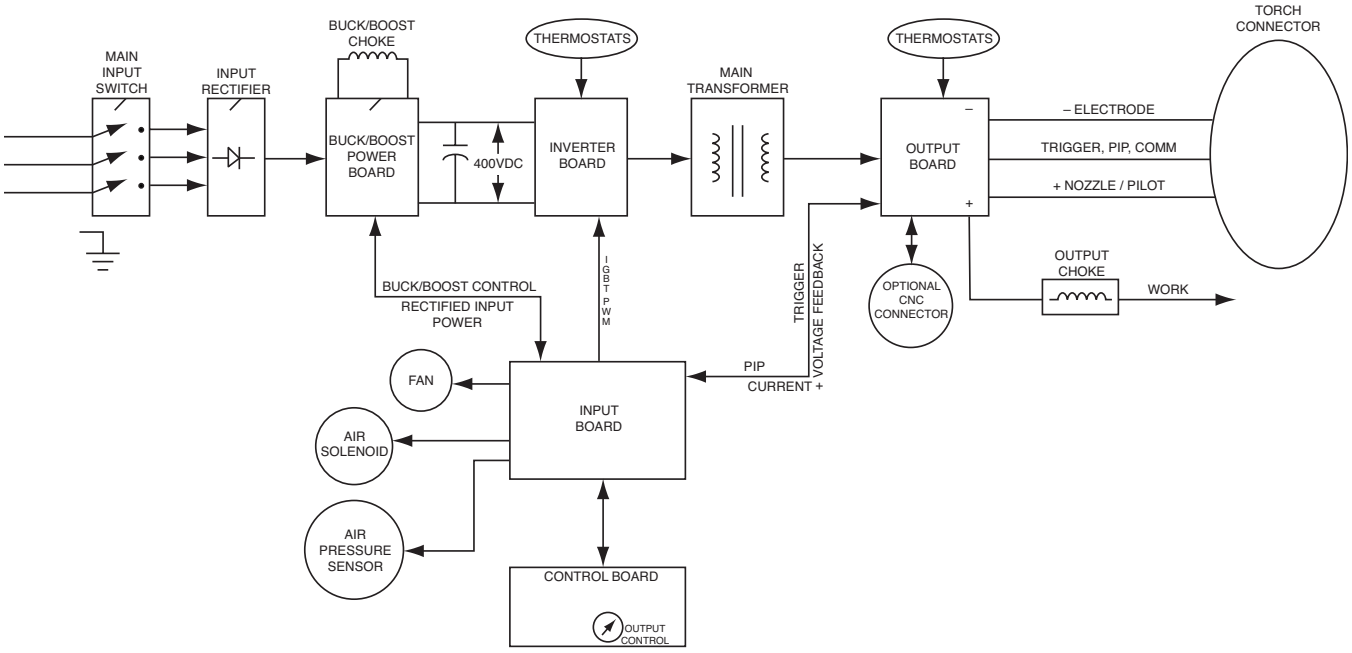


FIGURE E.2 - GENERAL DESCRIPTION



GENERAL DESCRIPTION

The TOMAHAWK® 1000 is a constant current, continuous control plasma cutting power source. Utilizing inverter technology the machine produces 60 amps of output and also allows for a wide range of input voltages from 208VAC to 575VAC single or three phase at 50 or 60 Hertz. The machine is rated at 60 amps, 104VDC @ 40°C at 50% duty cycle and also at 40 amps, 96VDC @ 100% duty cycle. If the duty cycle is exceeded, the thermal protection circuit will shut off the output until the machine cools.

The control circuitry incorporates a safety mechanism to ensure that the torch nozzle and electrode are in place before cutting or gouging can commence. This safety circuit is extremely important because of the high voltages involved in the plasma cutting process.

The output voltage is DC positive on the work piece and torch nozzle with respect to the torch electrode which is negative.

The TOMAHAWK® 1000 has the capabilities to cut metal material such as mild steel, aluminum, or stainless steel up to 1.0 inches thick.

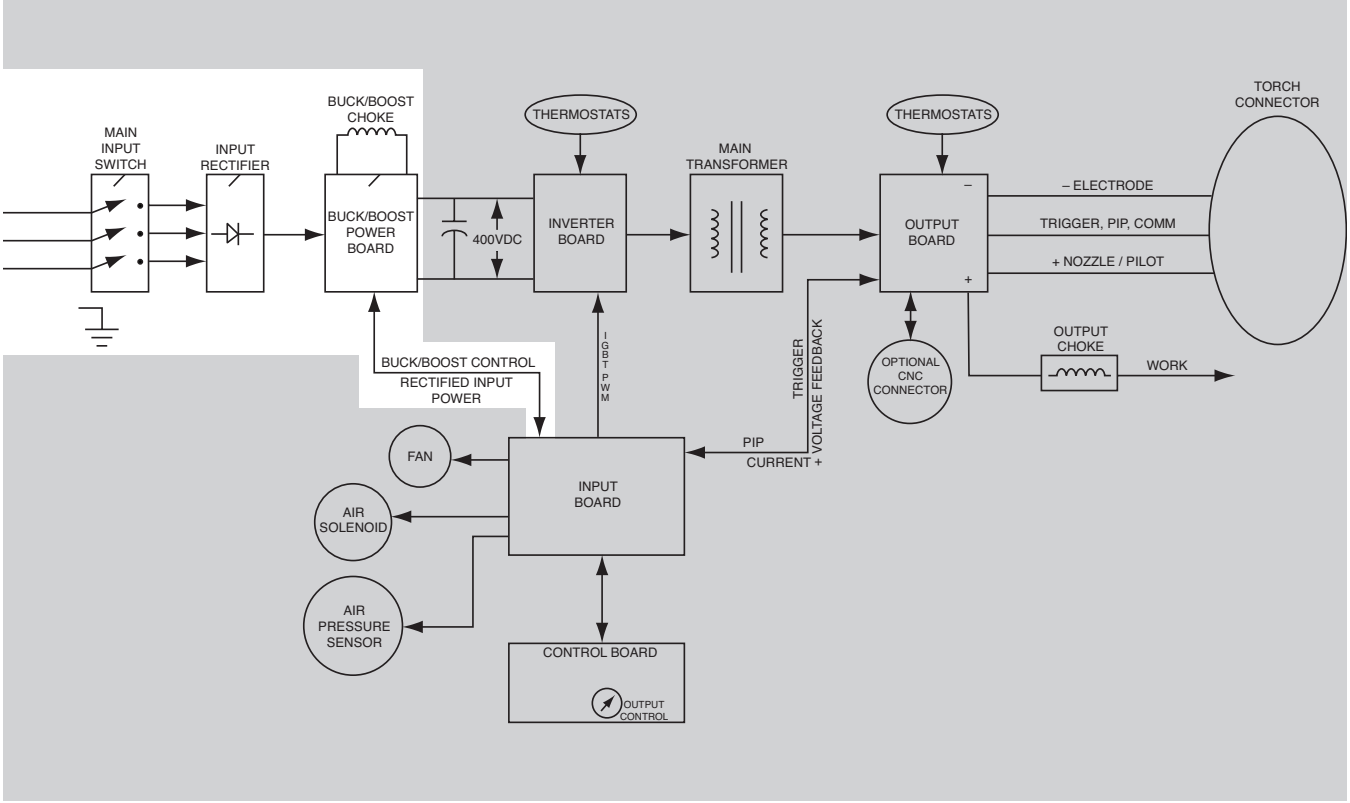
This machine is designed to operate on engine driven generators as long as the generator can supply adequate power as indicated in the ***Technical Specification*** section of the manual. The auxiliary supply of the generator must also meet the following conditions.

- The AC waveform peak voltage is below 900V.
- The AC waveform frequency is between 45 and 65 Hz.

It is important to check these conditions because many engine drive generators produce high voltage spikes. Operation of this machine on engine driven generators not conforming to these conditions is not recommended and may damage the machine.

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

FIGURE E.3 - INPUT SWITCH, RECTIFIER AND BUCK/BOOST POWER BOARD



INPUT SWITCH, RECTIFIER AND BUCK/BOOST POWER BOARD

The single or three phase input power is applied to the TOMAHAWK® 1000 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 input rectifier where it is rectified to a DC voltage. This rectified input voltage (250 – 900VDC dependent on input voltage) is applied to the Buck/Boost Power Board.

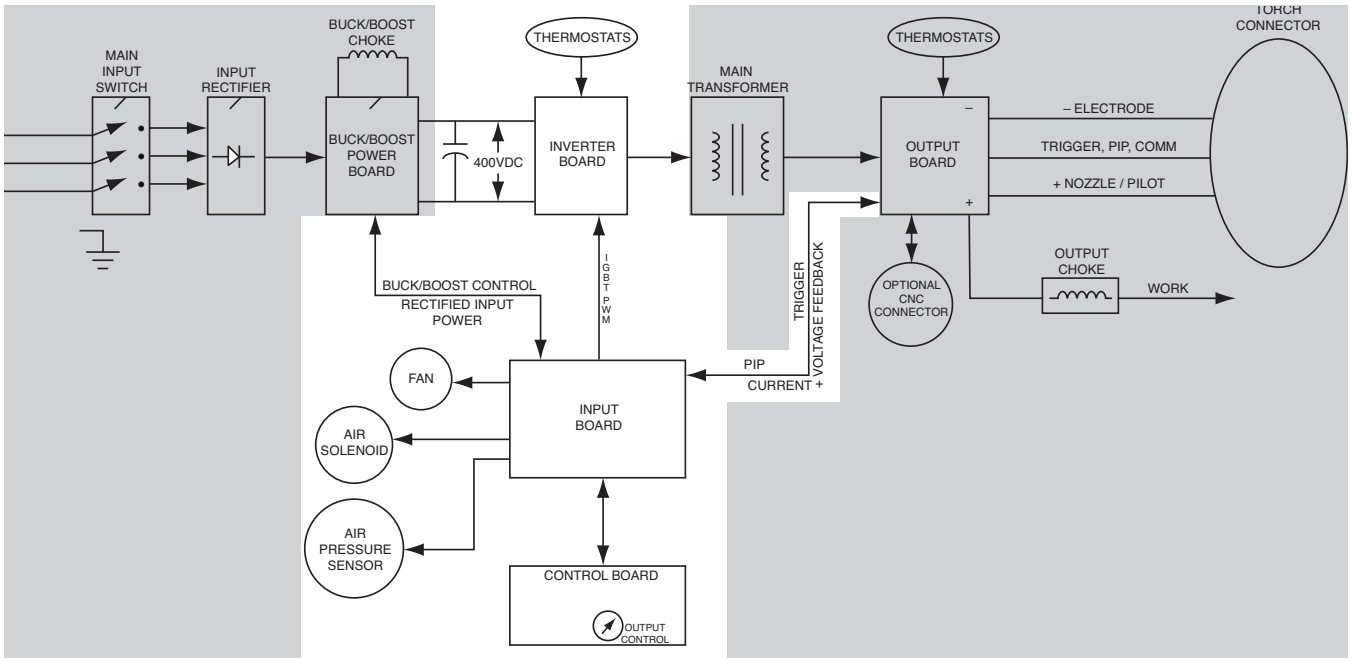
The Buck/Boost Power Board houses a soft-start circuit consisting of a 100 ohm resistor and a DC relay. Initially the DC relay is not activated and the incoming DC voltage is applied to the DC link capacitors via the 100 ohm resistor. The resistor functions as a current limiting device allowing the DC 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 “shorted out” by the relay’s 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 230VAC input or less. Under this condition the Buck switch is held on the entire time. The Buck switch is active when the input voltage is at 325VAC or more. Under this condition the Boost switch is not active for most of the time. The Buck/Boost circuit operates at 20kHz. The Buck/Boost circuit’s output is a 400 volt regulated bus that is filtered and applied to the Inverter Board.

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

FIGURE E.4 - INVERTER BOARD, INPUT BOARD AND CONTROL BOARD



INVERTER BOARD, INPUT BOARD AND CONTROL BOARD

The 400VDC created by the Buck/Boost Power 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 pulse width modulated at 23Khz. via control signals sent from the Input Board. The pulsed DC output of the full wave bridge inverter is coupled to the primary winding of the main transformer.

There are two normally closed thermostats connected to the Inverter Board. If either of these thermostats opens, due to over temperature, the Inverter Board will be turned off and 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 (208VAC to 575VAC rectified) switching converter “flyback” circuit configuration. See Table E.1 for auxiliary supplies.

The Input Board receives current reference commands from the Control Board and compares these to the voltage and current feedback information received from the Output Board. The Input Board then sends the appropriate Pulse Width Modulation (PWM) signals to the Inverter Board. Thus, the output current is controlled and constant.

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.

The buck/boost control signals are sent to the Buck/Boost power board from the Input Board.

The Fan As Needed, air pressure sensing and air solenoid driver circuits are housed on the Input Board.

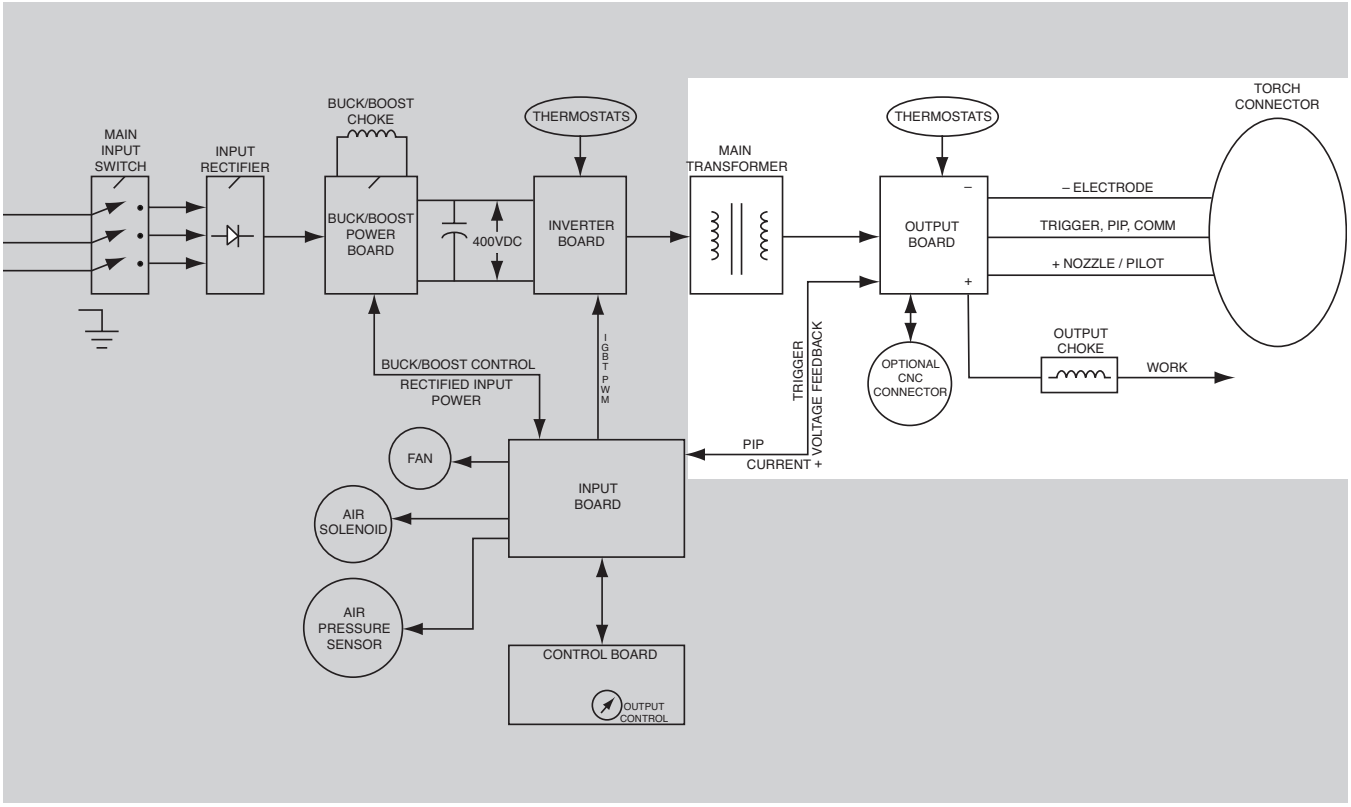
The Control Board receives status and analog signals from the Inverter and Output boards via the Input board and sets the output current reference command. It also manages the error and alarm signals, the LED functions and the user interface functions.

TABLE E.1 – AUXILIARY SUPPLIES

DESCRIPTION	SIDE	VALUE(S)
Buck/Boost Driver Supply	Primary	+15VDC
Post Regulated Generic Supply	Primary	+15VDC, -5VDC
Regulated Supply for Flyback Driver	Primary	+15VDC
Generic Supply	Secondary	+26VDC
Post Regulated Generic Supply	Secondary	+15VDC, +5VDC, -5VDC

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

FIGURE E.5 - 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 the 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.

The secondary winding of the Main Transformer is coupled to the Output Board. The output of the secondary winding is a 270VAC square wave at 23Khz.

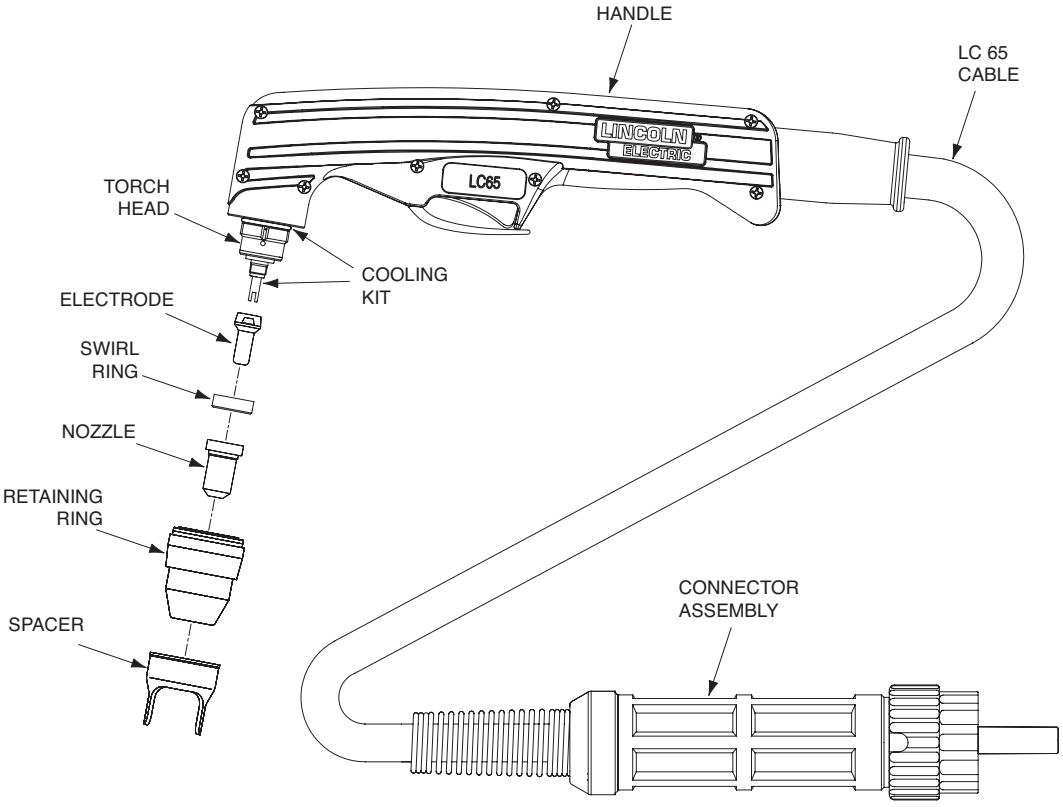
All of the outputs (both pilot and cutting) go through the Output Board. The function of this board is to manage the output currents and signals. Two diode modules, configured as a full wave bridge, rectify the secondary AC output of the Main Transformer to create the DC output. Two current sensors monitor the current that flows through the work piece and the torch electrode. This current feedback information is sent to the Input Board. The Input Board then sends the appropriate PWM signals to the Inverter Board to keep the output current constant and within the output requirements received from the Control Board. The Output Board also receives the parts-in-place and trigger information from the Torch Connector. This information is passed on to the Input Board. The pilot arc (18 amps for 4 seconds) is managed by an IGBT switch located on the Output Board.

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

The optional CNC connector provides interfacing capabilities for “arc voltage”, “cutting arc initiation” and “arc start trigger”.

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

FIGURE E.6 - TORCH ASSEMBLY AND WORK LEAD



TORCH ASSEMBLY AND WORK LEAD

The torch assembly and work lead are connected to the machine via the front panel. This torch is designed to provide the best cutting performance and excellent consumable life.

The torch head components are the cooling kit, electrode, swirl ring, nozzle, retaining cap and spacer. This torch has a lift pilot arc striking system which means that during the idle state the electrode and nozzle are touching and shorted together. As soon as the torch trigger is activated the pilot current flows through the electrode and nozzle. When the air flow arrives at the torch head the electrode is “pulled” back and the pilot arc is established between the electrode and nozzle. As the torch is brought closer to the work the pilot arc transfers to the work piece and the cutting arc is established.

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

TABLE OF CONTENTS - TROUBLESHOOTING AND REPAIR

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and Repair should only be performed by 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 the following categories: output problems and function problems.

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

Step 3. RECOMMENDED COURSE OF ACTION
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 chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the specified 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 tests/repairs safely, contact the Lincoln Electric Service Department for technical 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

- 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.

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the sheet metal cover(s) are removed.	1. Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.	1. Contact the Lincoln Electric Service Department, 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 ***Input Rectifier Bridge Test***. 5. Perform the ***Buck/Boost Power Board Test***. 6. Perform the ***Input Board Test***.

⚠ CAUTION

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

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
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 ***Technical Specifications*** in this 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 ***Technical Specifications*** in this manual.	1. Perform the ***Input Rectifier Bridge Test***. 2. Perform the ***Buck/Boost Power Board Test***. 3. Perform the ***Inverter Board Test***.
Five seconds after the input power switch is turned on, the fan runs but the status indicators do not light. 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 Board Test***. 2. Perform the ***Input Board Test***. 3. Perform the ***Buck/Boost Board Test***.

⚠ CAUTION

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

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The Tomahawk 1000 powers up normally but there is no response (air flow or pilot arc) when the torch trigger is pulled. Only the Power LED is lit.	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. Remove the input power to the machine and carefully remove the handles of the torch and examine all of the connections. 4. Check for proper trigger switch operation. See the Wiring Diagram.	1. Turn the output knob on the front of the Tomahawk 1000 to "purge" (blue zone). If air does NOT flow, the main gas solenoid may be faulty. Perform the ***Gas/Solenoid Test***. 2. Perform the ***Torch Test***. 3. Perform the ***Output Board Test***. 4. The Control Board may be faulty.
The Tomahawk 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 air flow 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***. 2. Perform the ***Inverter Board Test***. 3. Perform the ***Output Board Test***. 4. The Control Board may be faulty.

⚠ CAUTION

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

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The thermal LED is lit after normal use.	1. One of the machine's thermal protection circuits has tripped. Do not turn the Tomahawk 1000 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. The Control Board may be faulty. 4. The Inverter Board may be faulty.
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 air flow in the torch cable.	1. Perform the ***Torch Test***. 2. Perform the ***Inverter Board Test***. 3. Perform the ***Output Board Test***. 4. The Control Board may be faulty.

⚠ CAUTION

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

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The cutting arc starts but sputters badly.	1. Make sure the operating procedure is correct for the process. See the ***Operation Section*** of this 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***. 3. Perform the ***Inverter Board Test***. 4. Perform the ***Output Board Test***. 5. The control board may be faulty.
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 this 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***. 3. Perform the ***Output Board Test***. 4. The control board may be faulty. Replace.

⚠ CAUTION

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

Observe Safety Guidelines detailed in the beginning of this manual.

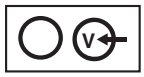
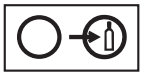
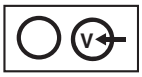
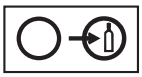
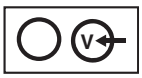
PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
Yellow Gas Pressure LED is lit and steady.	1. Make sure there is at least 80 psi connected to the gas connection at the back of the machine. 2. Turn the output knob to the purge zone and set the regulator 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. The control board may be faulty.
The Yellow Parts In Place LED is lit 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***. 3. Perform the ***Output Board Test***.

⚠ CAUTION

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

Observe Safety Guidelines detailed in the beginning of this manual.

ERROR CONDITION LIST

No pilot arc established	 **On (Green LED)**	 **On (Yellow LED)**	 **On (Yellow LED)**	
	1. The Torch Trigger pushbutton is pressed. During this period the machine will attempt to start the pilot arc for 4 times. If the pilot arc does not start, the machine automatically will enter into a safe status condition that will allow troubleshooting as necessary. 2. 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 ON the machine.			
Trigger Pushed	 **On(Green LED)**	 **On (Yellow LED)**	 **On (Yellow LED)**	 **On (Yellow LED)**
	1. This occurs if the machine is turned ON (or if it is restarted after Thermal reset) with the Torch Trigger pulled. This condition avoids unsafe operating conditions. The machine is disabled such that manual cutting or gouging processes can ONLY be initiated under the direct control of the operator. 2. To restore the machine: • Release the Torch Trigger. • The LED's will return to normal status and cutting or Gouging may resume. 3. If this error condition persists, check for eventual malfunctions of the Torch Trigger pushbutton.			
Torch Head	 **On (Green LED)**	 **Blink (Red LED)**	 **Blink (Yellow)**	
	1. This occurs if after 4 seconds the Pilot Arc isn't transfered to the workpiece. The machine stops the pilot arc to avoid overheating the Torch Head. 2. To restore the machine: • Release the Torch Trigger pushbutton. The blinking LEDs will change to steady ON. • Pull the Torch Trigger and verify correct operation.			

⚠ CAUTION

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

CASE COVER REMOVAL AND CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

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

TEST DESCRIPTION

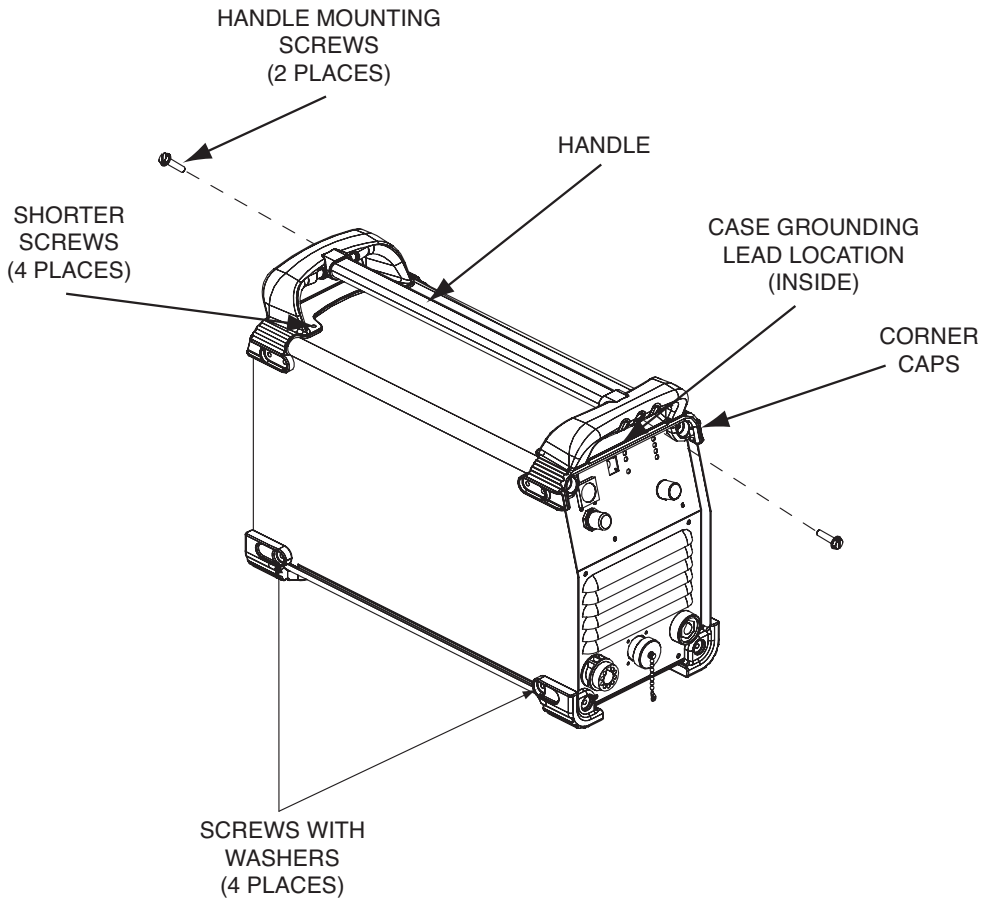
This procedure will aid the technician in the removal and replacement of the Case Cover.

MATERIALS NEEDED

Phillips Screwdriver
25-1000 Ohm Resistor (25 Watts Minimum)
Volt/Ohmmeter (Multimeter)

CASE COVER REMOVAL AND CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.1 – CASE COVER SCREWS AND GROUNDING LEAD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.

- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.

- Do not touch electrically hot parts.

---

1. Disconnect the input power to the Tomahawk 1000 machine.
2. Using the phillips screwdriver, remove the 28 screws from the corner caps. Note washer placement and screw lengths for replacement. See Figure F.1.
3. Carefully remove the wraparound and handle assembly and disconnect the case grounding lead. See Figure F.1.
4. Using a phillips screwdriver, remove the two screws securing the handle.
5. Locate the DC Bus capacitor and carefully check the DC voltage at the terminals. See ***Figure F.2*** and ***Figure F.3***.
6. 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.3***.

CASE COVER REMOVAL AND CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.2 – DC BUS CAPACITOR AND BUCK/BOOST BOARD LOCATION

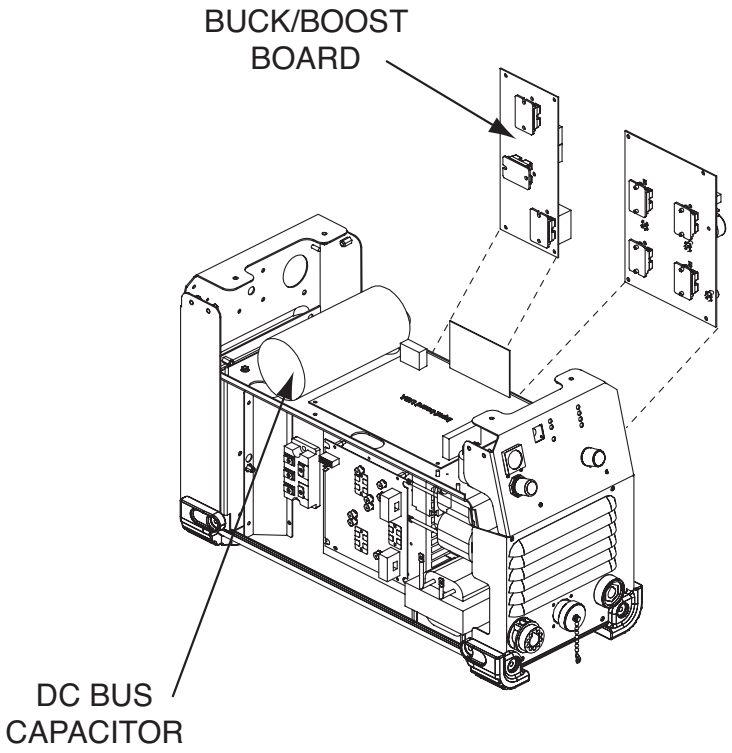
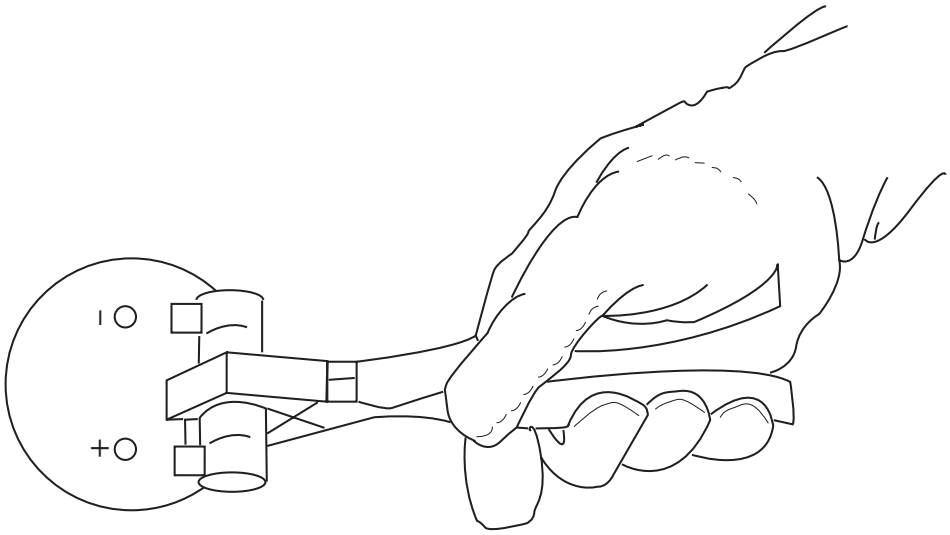
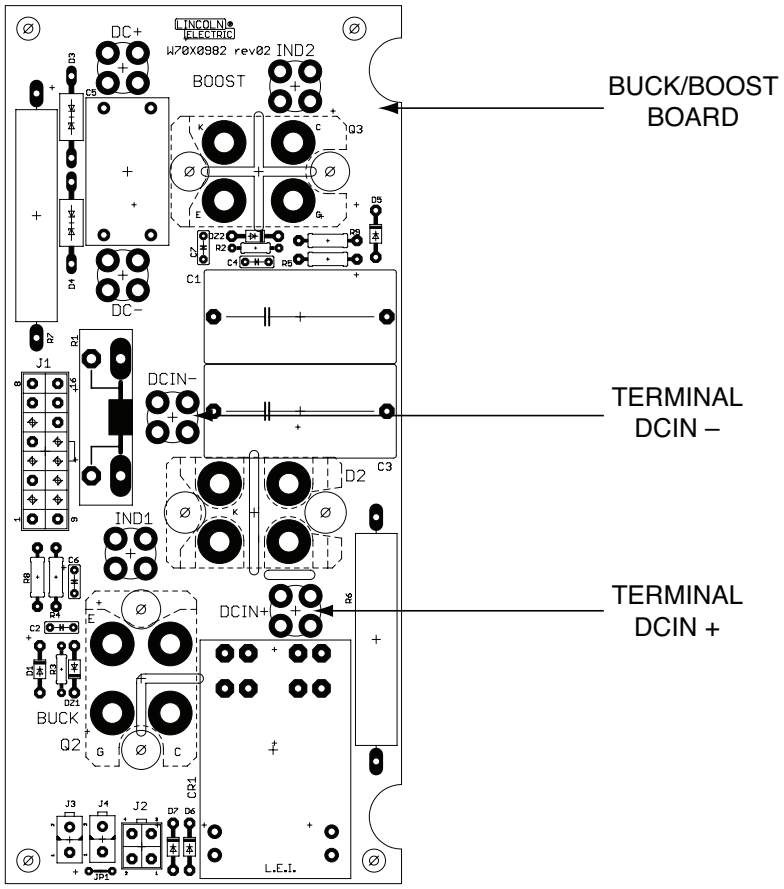


FIGURE F.3 – BUS CAPACITOR TERMINALS



CASE COVER REMOVAL AND CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.4 – DCIN – AND DCIN + TERMINAL LOCATIONS



7. 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.
8. Locate the Buck/Boost board. See ***Figure F.2***.
9. Locate the two terminals labeled DCIN+ and DCIN- on the Buck/Boost board. See Figure F.4. Carefully check for any voltage present at the terminals.
10. 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.
11. 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. Position the case wraparound and handle assembly on to the machine. Be sure to reconnect the case grounding lead previously removed.
2. Using a phillips screwdriver, replace the 28 screws and washers previously removed. See ***Figure F.1***.

INPUT RECTIFIER TEST

⚠ WARNING

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

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

TEST DESCRIPTION

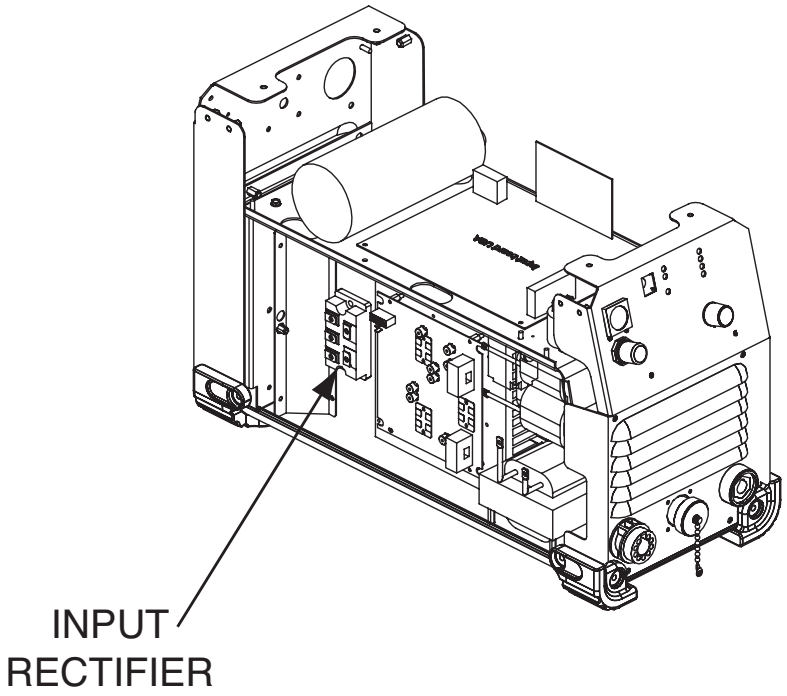
This test will aid the technician to determine if the Input Rectifier has failed.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

INPUT RECTIFIER TEST (continued)

FIGURE F.5 – INPUT BRIDGE RECTIFIER LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

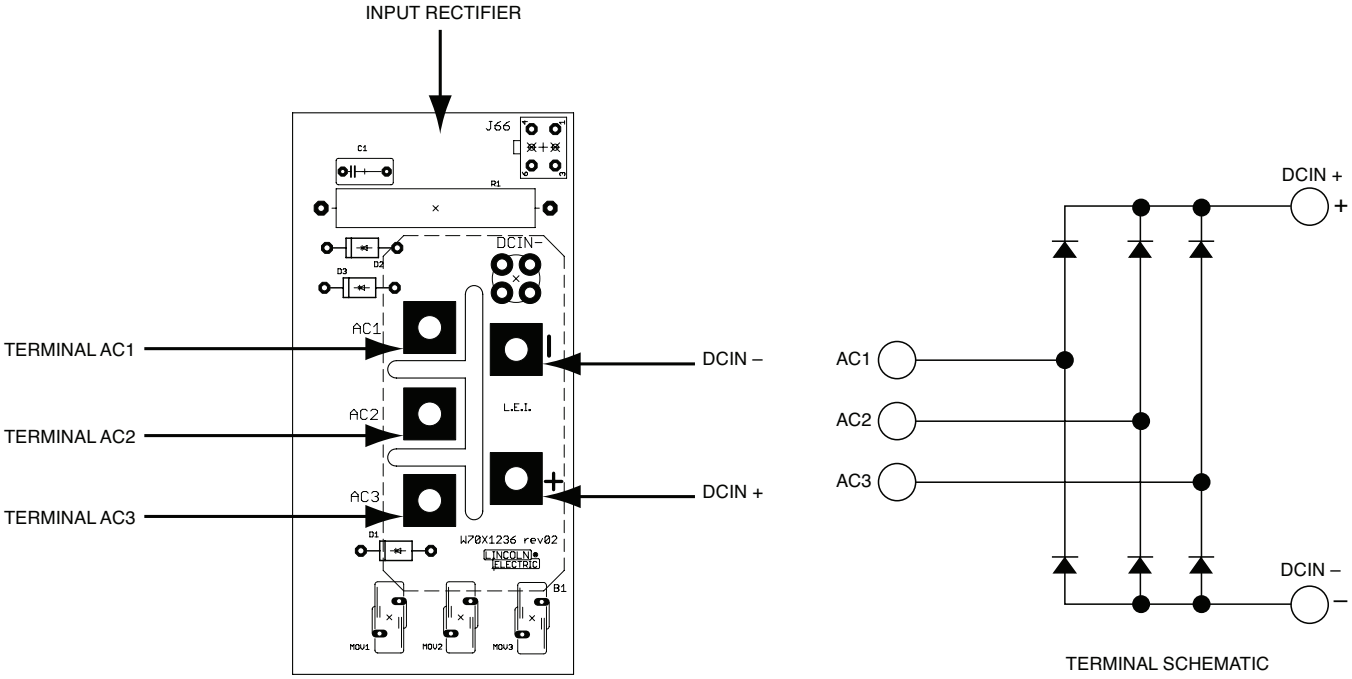
1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Input Rectifier. See Figure. F.5.
4. Perform the tests detailed in ***Table F.1***. Also See ***Figure F.6***.
5. If the tests results are questionable, label and remove all of the leads from the Input Rectifier and re-test. See the Wiring Diagram.
6. If any portion of the test fails, the input rectifier may be faulty. Replace.
7. When testing is complete replace all leads and plugs previously removed. See the Wiring Diagram.
8. Perform the ***Case Cover Replacement Procedure***.

INPUT RECTIFIER TEST (continued)

TABLE F.1 – INPUT RECTIFIER TEST POINTS

POSITIVE TEST PROBE	NEGATIVE TEST PROBE	EXPECTED RESULT
Terminal AC1	Terminal DCIN+	0.3 - 1.0V Forward Diode Drop
Terminal AC2	Terminal DCIN+	0.3 - 1.0V Forward Diode Drop
Terminal AC3	Terminal DCIN+	0.3 - 1.0V Forward Diode Drop
Terminal DCIN-	Terminal AC1	0.3 - 1.0V Forward Diode Drop
Terminal DCIN-	Terminal AC2	0.3 - 1.0V Forward Diode Drop
Terminal DCIN-	Terminal AC3	0.3 - 1.0V Forward Diode Drop

FIGURE F.6 – INPUT RECTIFIER TEST POINT LOCATIONS



NOTES

BUCK/BOOST BOARD TEST

⚠ WARNING

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

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

TEST DESCRIPTION

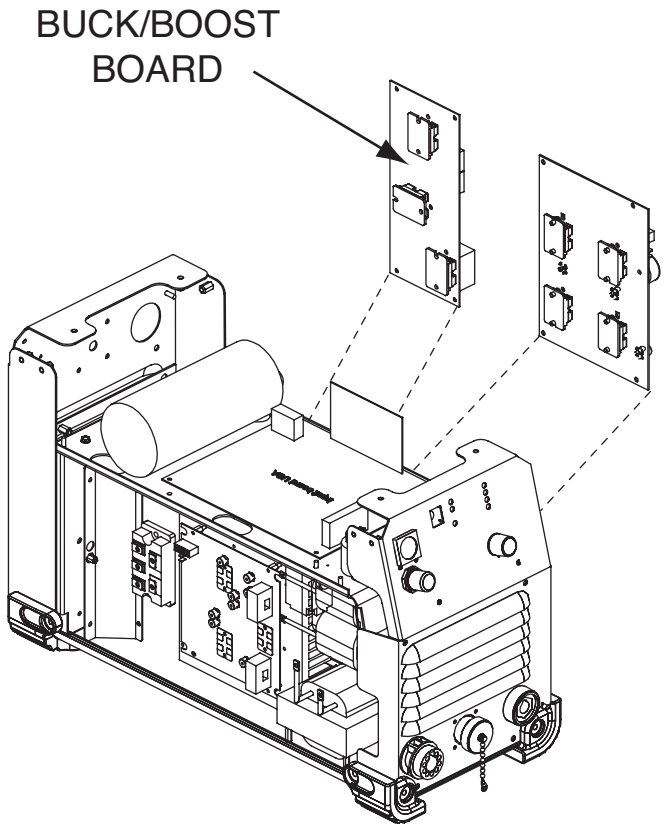
This test will aid the technician to determine if the Buck/Boost Board is receiving the correct input voltages and if the Buck/Boost Board is producing the correct output voltage to the Inverter Board. It will also determine if the soft-start relay coil is good. The outputs and input voltages between the Input Board and the Buck/Boost Board will also be tested. This test will NOT determine the functionality of the entire Board.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Phillips Screwdriver
Wiring Diagram

BUCK/BOOST BOARD TEST (continued)

FIGURE F.7 – BUCK/BOOST BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Buck/Boost board. See Figure F.7.
4. Perform the voltage and resistance checks detailed in ***Table F.2***. and ***Table F.3***. See ***Figure F.8*** and ***F.9***.
5. When testing is complete replace all leads and plugs previously removed. See the Wiring Diagram.
6. Perform the ***Case Cover Replacement Procedure***.

BUCK/BOOST BOARD TEST (continued)

TABLE F.2 – BUCK/BOOST BOARD VOLTAGE CHECKS

AC INPUT VOLTAGE (SINGLE PHASE)	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
250 VAC	DCIN+ to DCIN-	300VDC	Input voltage to buck/boost circuit. Will vary with input voltage applied. Machine at idle-no load, no torch.
250 VAC	DC+ to DC-	400VDC	Filtered output of buck/boost circuit. Should be 400VDC regardless of input voltage applied. Machine at idle-no load, no torch.
250 VAC	Plug J2 Pin 3(+) to Pin 1(-)	25VDC	Present when soft-start is completed. Machine at idle-no load, no torch.
250 VAC	Plug J1 Pin 1(+) to Pin 9(-)	15VDC	Buck drive signal. Machine at idle-no load, no torch.
250 VAC	Plug J1 Pin 8(+) to Pin 7(-)	Less than 1VDC	Boost drive signal. Machine at idle-no load, no torch.

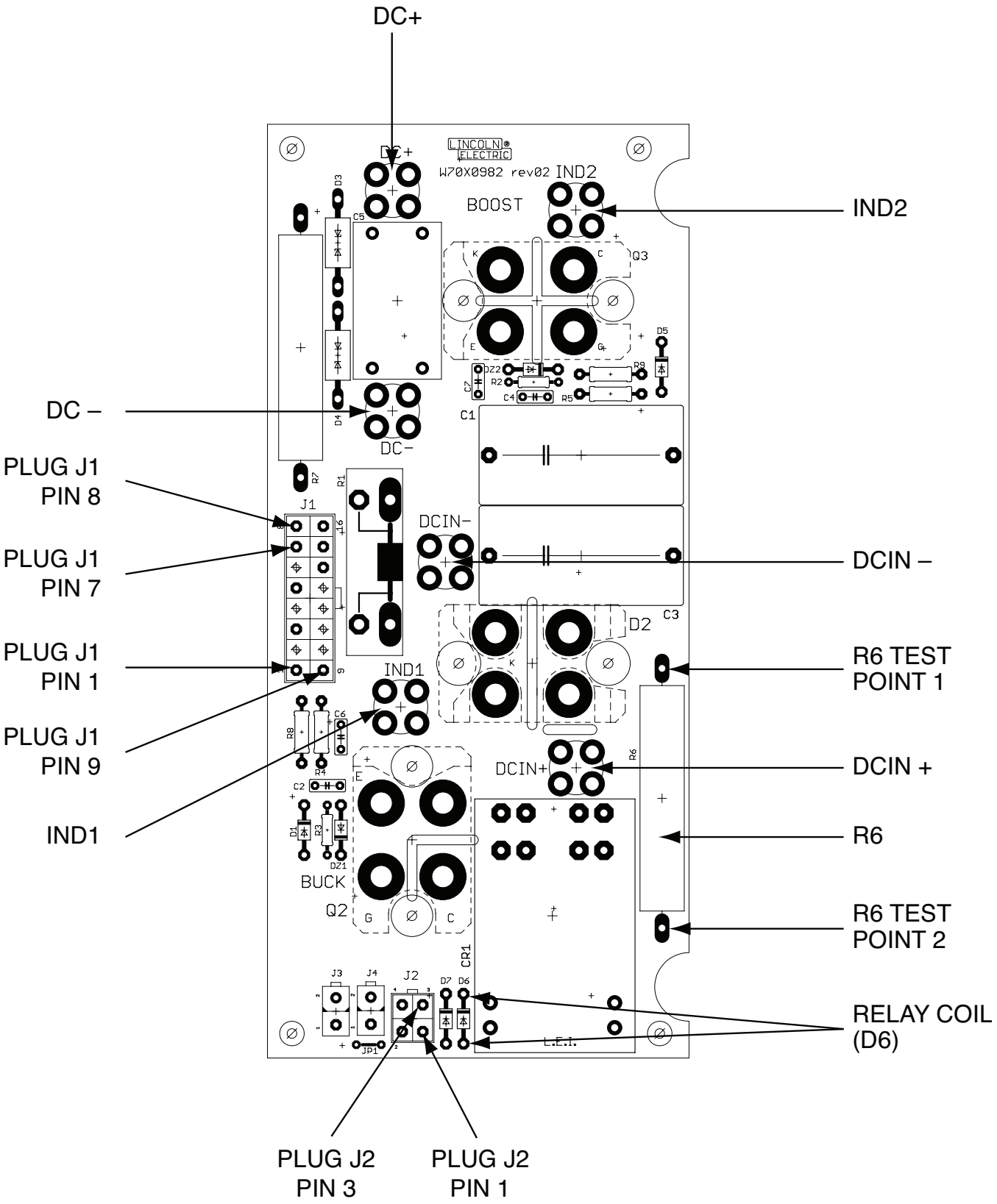
BUCK/BOOST BOARD TEST (continued)

TABLE F.3 – BUCK/BOOST BOARD RESISTANCE CHECKS

AC INPUT VOLTAGE	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
Machine disconnected from input voltage and capacitors discharged.	IND1 to IND2	Zero Ohms	Continuity of input choke.
Machine disconnected from input voltage and capacitors discharged.	R6 Test Point 1 to R6 Test Point 2	90 to 100 Ohms	Soft-Start Resistor. If a very low resistance is indicated the soft start relay contacts may be stuck closed.
Machine disconnected from input voltage and capacitors discharged.	Relay Coil Test Points (D6)	350 Ohms	Soft-Start relay coil resistance check.
Machine disconnected from input voltage and capacitors discharged.	IND2 (positive test probe) to DC- (negative test probe)	Greater than 39K Ohms	Measurement taken with the leads disconnected from test points. If a lower resistance is indicated the boost transistor may be shorted. Replace the Buck/Boost board.
Machine disconnected from input voltage and capacitors discharged.	IND2 (negative test probe) to DC- (positive test probe)	Forward diode drop	Measurement taken with the leads disconnected from test points. If a lower resistance is indicated the boost transistor may be shorted. Replace the Buck/Boost board.
Machine disconnected from input voltage and capacitors discharged.	R6 Test Point 1 (positive test probe) to IND1 (negative test probe)	High resistance. Greater than 100K ohms.	If a lower resistance is indicated the buck transistor may be shorted. Replace the Buck/Boost board.
Machine disconnected from input voltage and capacitors discharged.	R6 Test Point 1 (negative test probe) to IND1 (positive test probe)	Forward diode drop	If a lower resistance is indicated the buck transistor may be shorted. Replace the Buck/Boost board.

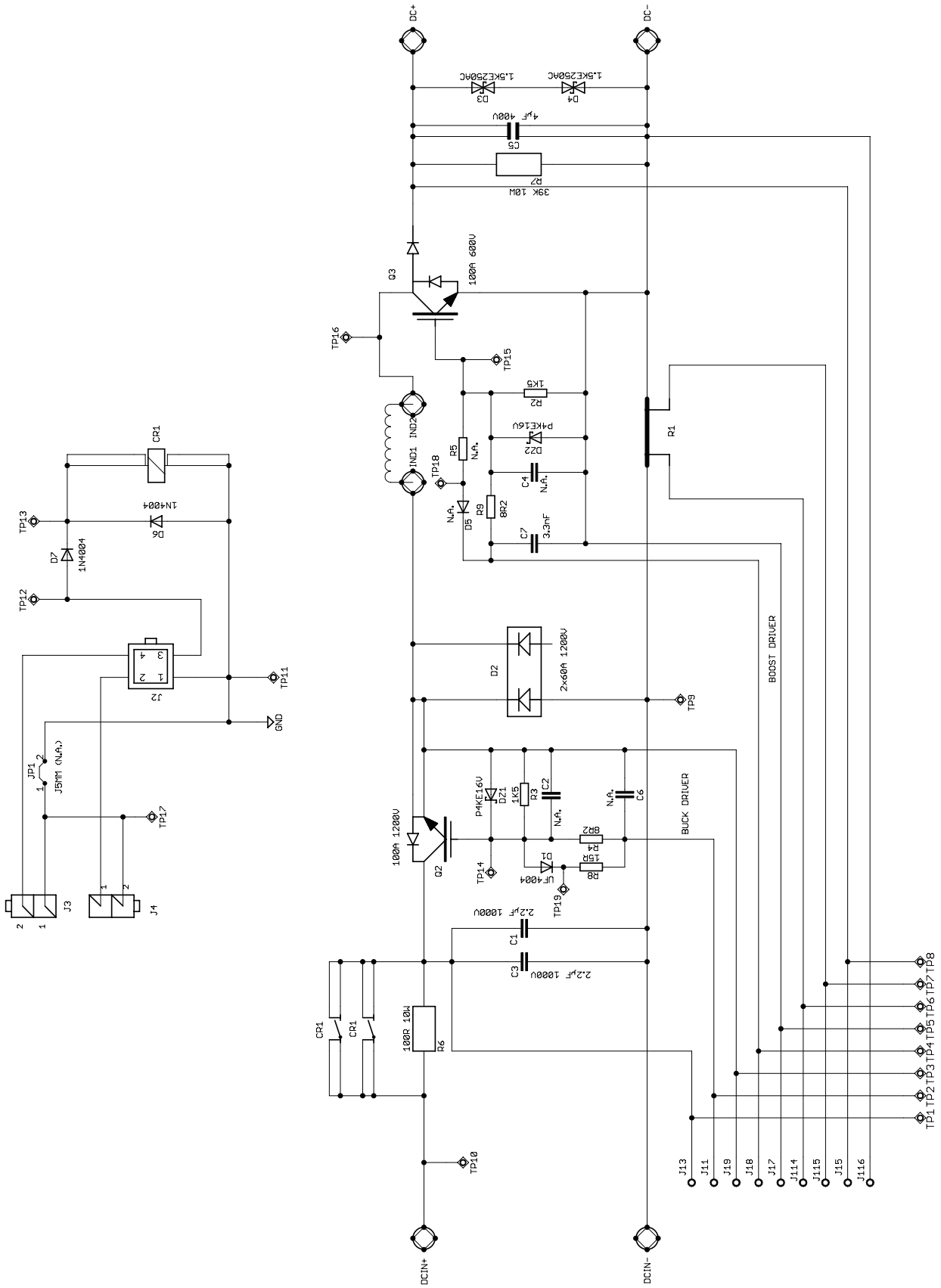
BUCK/BOOST BOARD TEST (continued)

FIGURE F.8 – BUCK/BOOST BOARD TEST POINT LOCATIONS



BUCK/BOOST BOARD TEST (continued)

FIGURE F.9 – BUCK/BOOST BOARD SCHEMATIC



INPUT BOARD TEST

⚠ WARNING

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

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

TEST DESCRIPTION

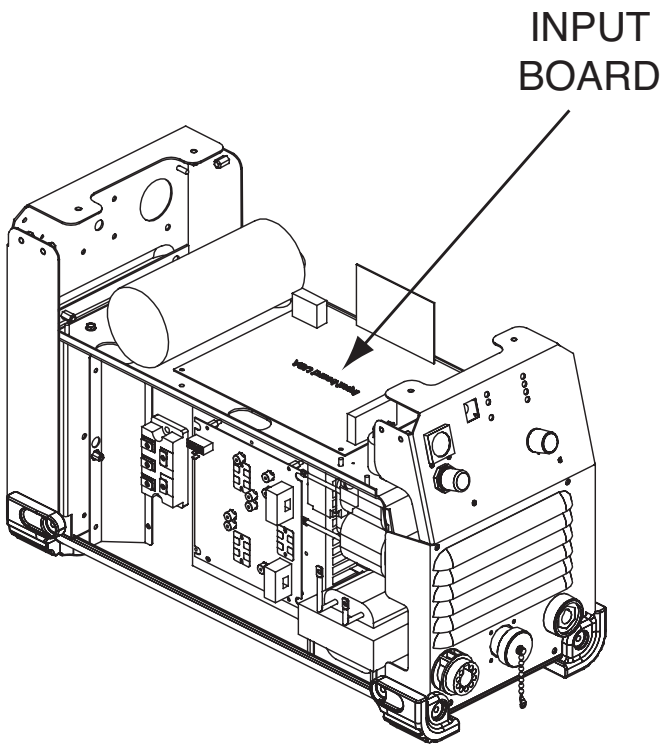
This test will aid the technician to determine if the Input Board is receiving the correct input voltages and if the Input Board is producing the correct output voltages. This test will NOT determine the functionality of the entire Board.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

INPUT BOARD TEST (continued)

FIGURE F.10 – INPUT BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

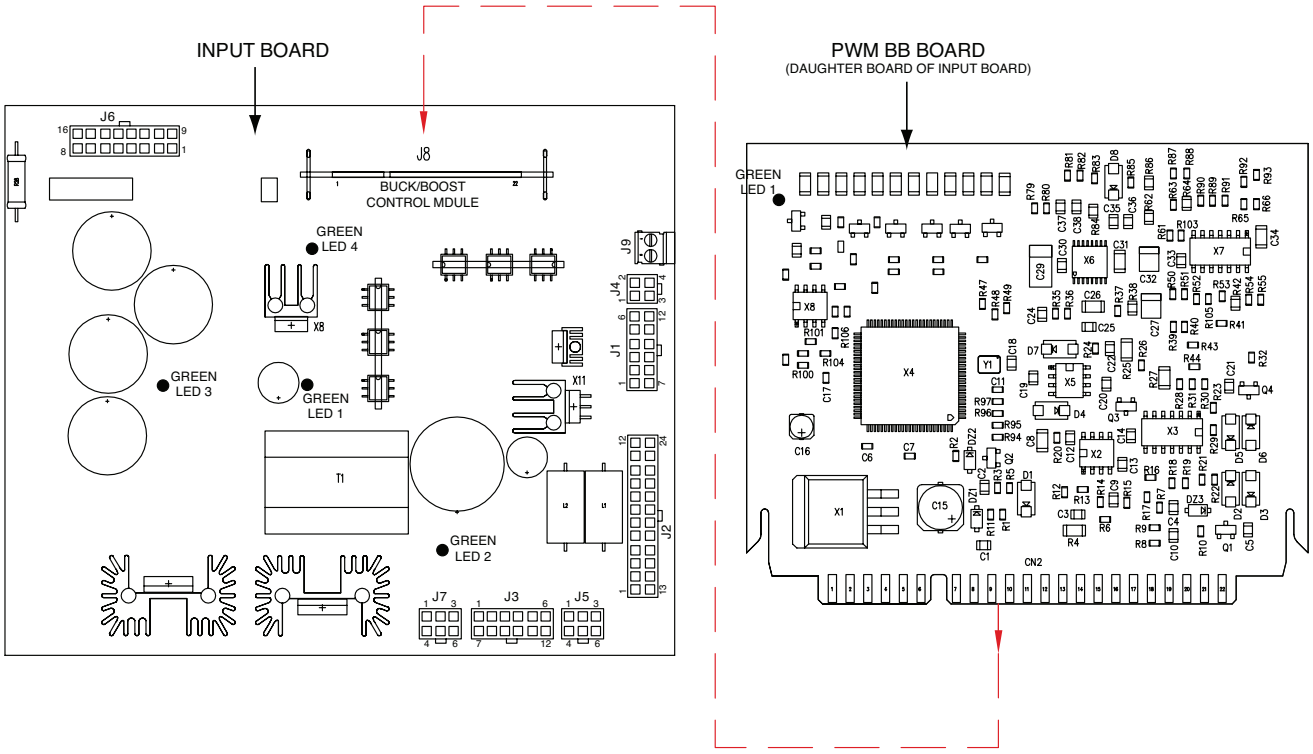
1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Input Board. See Figure F.10.
4. Apply the correct input power to the machine and carefully check the status LED lights on the Input Board. See ***Table F.4*** and ***Figure F.11***.
5. Carefully perform the voltage checks detailed in ***Table F.5***. See ***Figure F.11***.
6. When testing is complete, replace all leads and plugs previously removed. See the Wiring Diagram.
7. Perform the ***Case Cover Replacement Procedure***.

INPUT BOARD TEST (continued)

TABLE F.4 – INPUT BOARD STATUS LED LIGHT TABLE

AC INPUT VOLTAGE SINGLE PHASE	LED NUMBER	EXPECTED STATUS	COMMENTS/CONDITIONS
250 VAC	LED #1	ON-Green	+15VDC primary is present
250 VAC	LED #2	ON-Green	+15VDC secondary is present
250 VAC	LED #3	ON*-Green	When “buck” signal is operating. *Dependent on input voltage.
250 VAC	LED #4	ON*-Green	When “boost” signal is operating. *Dependent on input voltage.
250 VAC	LED #1	ON*-Green	*Located on buck/boost control module. + 15VDC present on control module.

FIGURE F.11 – INPUT BOARD TEST POINT LOCATIONS



INPUT BOARD TEST (continued)

TABLE F.5 – INPUT BOARD VOLTAGE CHECKS

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
250 VAC	Plug J6 Pin 3(+) to Pin 7(-)	225VDC	Machine at idle no load. Rectified AC input line. Will vary with input voltage.
250 VAC	Plug J6 Pin 5(+) to Pin 7(-)	400VDC	Machine at idle no load. DC Bus Line.
250 VAC	Plug J6 Pin 1(+) to Pin 9(-)	15VDC	Machine at idle no load. Buck Driver.
250 VAC	Plug J3 Pin 3(+) to Pin 5(-)	-5VDC	Machine at idle no load. Sec. Aux. supply.
250 VAC	Plug J3 Pin 11(+) to Pin 5(-)	15VDC	Machine at idle no load. Sec. Aux. supply.
250 VAC	Plug J1 Pin 4(+) to Pin 6(-)	-5VDC	Machine at idle no load. Sec. Aux. supply.
250 VAC	Plug J1 Pin 12(+) to Pin 6(-)	15VDC	Machine at idle no load. Sec. Aux. supply.
250 VAC	Plug J1 Pin 8(+) to Pin 6(-)	15VDC	Machine at idle no load. Inverter signal. 15VDC = Off.
250 VAC	Plug J2 Pin 1(+) to Pin 6(-)	15VDC	Machine at idle no load. Sec. Aux. supply.
250 VAC	Plug J2 Pin 18(+) to Pin 6(-)	15VDC	Machine at idle no load. Fan signal.
250 VAC	Plug J2 Pin 16(+) to Pin 6(-)	15VDC	Machine at idle no load-no torch-no trigger.
250 VAC	Plug J5 Pin 1(+) to Pin 5(-)	15VDC	Machine at idle no load. Sec. Aux. supply.
250 VAC	Plug J4 Pin 4(+) to Pin 1(-)	26VDC	Fan Motor Supply.
250 VAC	Terminal J9 Pin 2(+) to Pin 1(-)	26VDC	Supply to Fan Motor.

CONTROL BOARD TEST

⚠ WARNING

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

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

TEST DESCRIPTION

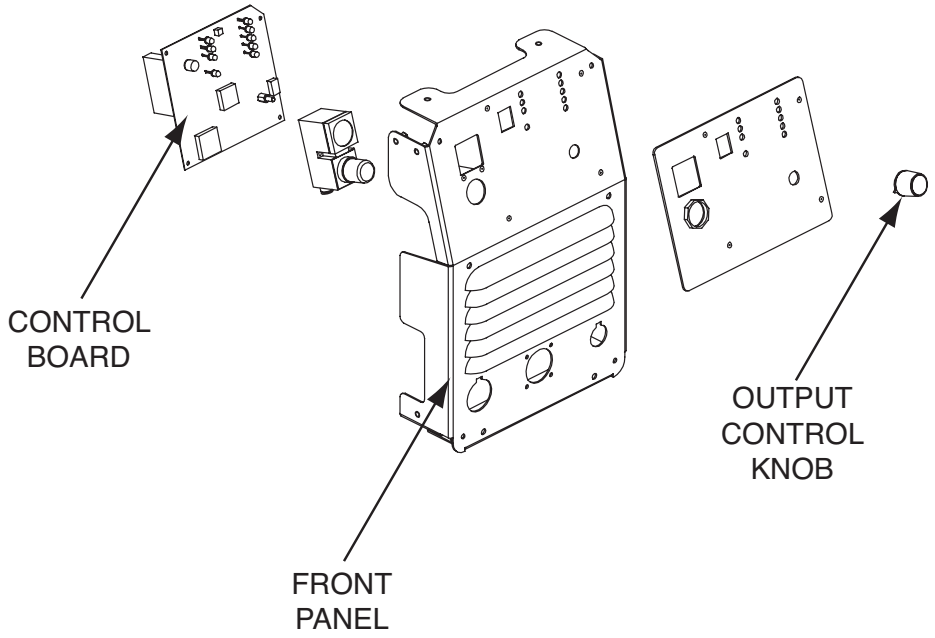
This test will aid the technician to determine if the Control Board is receiving the correct input voltages and if the Control Board is producing the correct output signals. This test will NOT determine the functionality of the entire Board.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

CONTROL BOARD TEST (continued)

FIGURE F.12 – CONTROL BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Control Board. See Figure. F.12.
4. Apply the correct input power to the machine and carefully check the status LED lights on the Control Board. Make certain all of the dip switches (SW2) are in the Off position. See ***Table F.6*** and ***Figure F.13***.
5. Carefully perform the voltage checks detailed in ***Table F.7***. See ***Figure F.13***.
6. When testing is complete replace all leads and plugs previously removed. See the Wiring Diagram.
7. Perform the ***Case Cover Replacement Procedure***.

CONTROL BOARD TEST (continued)

TABLE F.6 – CONTROL BOARD STATUS LED LIGHT TABLE

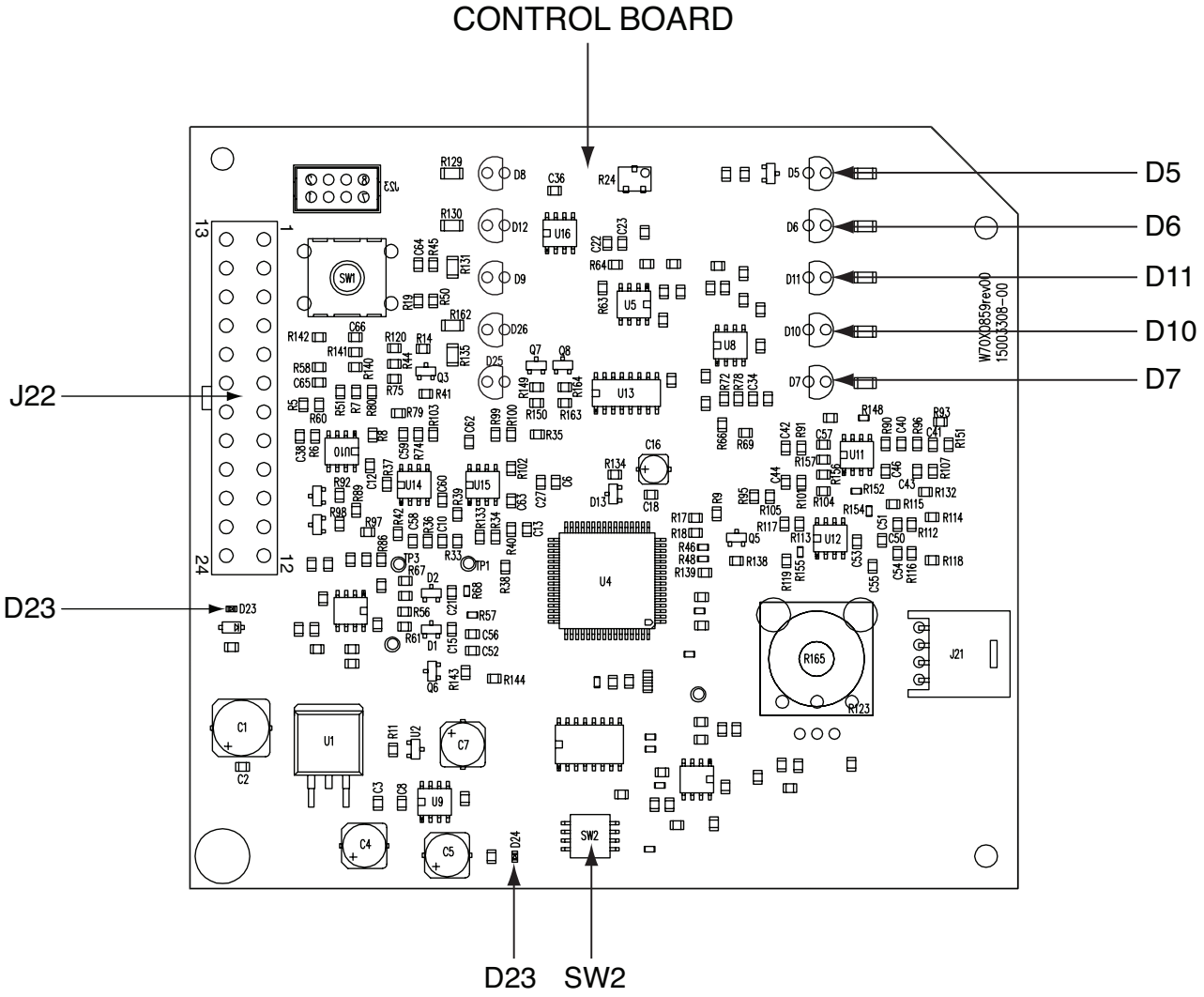
LED IDENTITY	NORMAL STATUS	FAULT STATUS	COMMENTS/CONDITIONS
Power ON D5	Green	Blinking	Input voltage out of range (below 208VAC or above 575VAC)
Torch Energized Output Enabled D6	Red	Blinking	Internal Aux. voltage is low. Turn input power off and then on again to reset.
Thermal D11	Off	Yellow	The machine is overheated and the output is disabled.
Gas Pressure D10	Off	Yellow	The input gas pressure is out of range. (below 87PSI or above 109PSI)
Torch Parts-in-Place D7	Off	Yellow or Blinking	Torch consumables are not attached correctly.
D23	ON-Green	Off	Indication of 15VDC Sec. supply is present.
D24	ON-Green	Off	Indication of 5VDC Sec. supply is present.

TABLE F.7 – CONTROL BOARD VOLTAGE CHECKS

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
250 VAC	Plug J22 Pin 1(+) to Pin 2(-)	15VDC	Machine at idle no load. Sec. Aux. supply.
250 VAC	Plug J22 Pin 3(+) to Pin 2(-)	10VDC	Air pressure signal. No air supplied to machine.
250 VAC	Plug J22 Pin 3(+) to Pin 2(-)	0VDC	Air pressure signal. Correct air pressure applied to machine.
250 VAC	Plug J22 Pin 17(+) to Pin 2(-)	0.75VDC	Air Solenoid Valve signal.
250 VAC	Plug J22 Pin 11(+) to Pin 2(-)	0VDC	Thermostat signal. No errors-thermostats closed.
250 VAC	Plug J22 Pin 11(+) to Pin 2(-)	15VDC	Thermostat signal. Error-thermostat open.
250 VAC	Plug J22 Pin 13(+) to Pin 2(-)	0VDC	Torch Parts-in-Place signal.
250 VAC	Plug J22 Pin 13(+) to Pin 2(-)	13VDC	Torch Parts-NOT in-Place signal.
250 VAC	Plug J22 Pin 18(+) to Pin 2(-)	15VDC	Fan Motor signal.

CONTROL BOARD TEST (continued)

FIGURE F.13 – CONTROL BOARD TEST POINT LOCATIONS



INVERTER BOARD TEST

⚠ WARNING

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

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

TEST DESCRIPTION

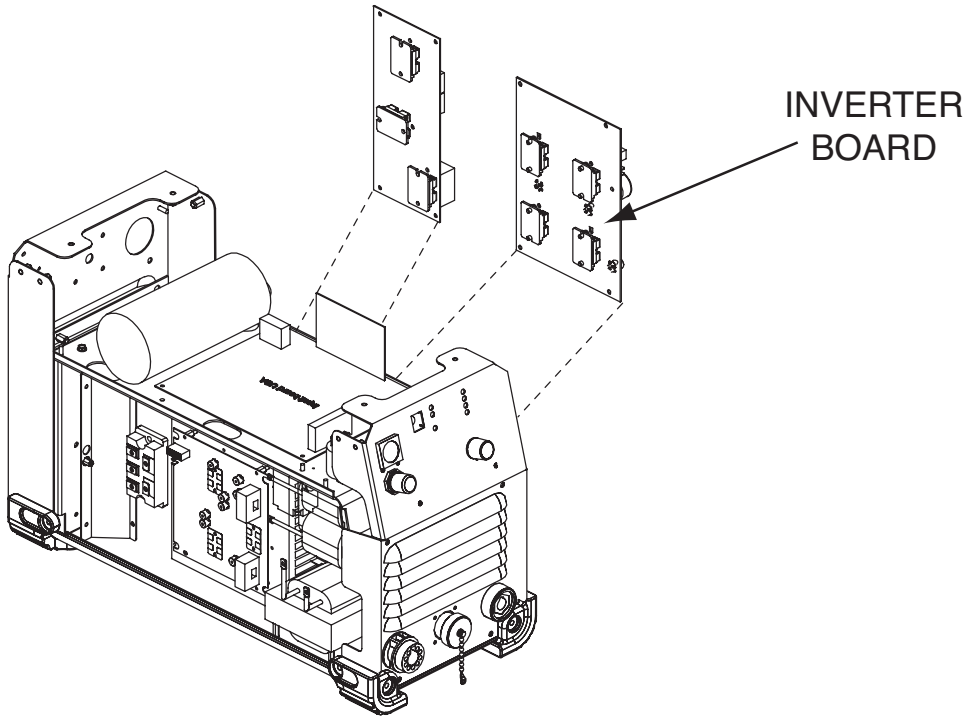
This test will aid the technician to determine if the Inverter Board is receiving the correct input voltages and if the Inverter Board is producing the correct output signals. This test will NOT determine the functionality of the entire Board.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram
Phillips Screwdriver

INVERTER BOARD TEST (continued)

FIGURE F.14 – INVERTER BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

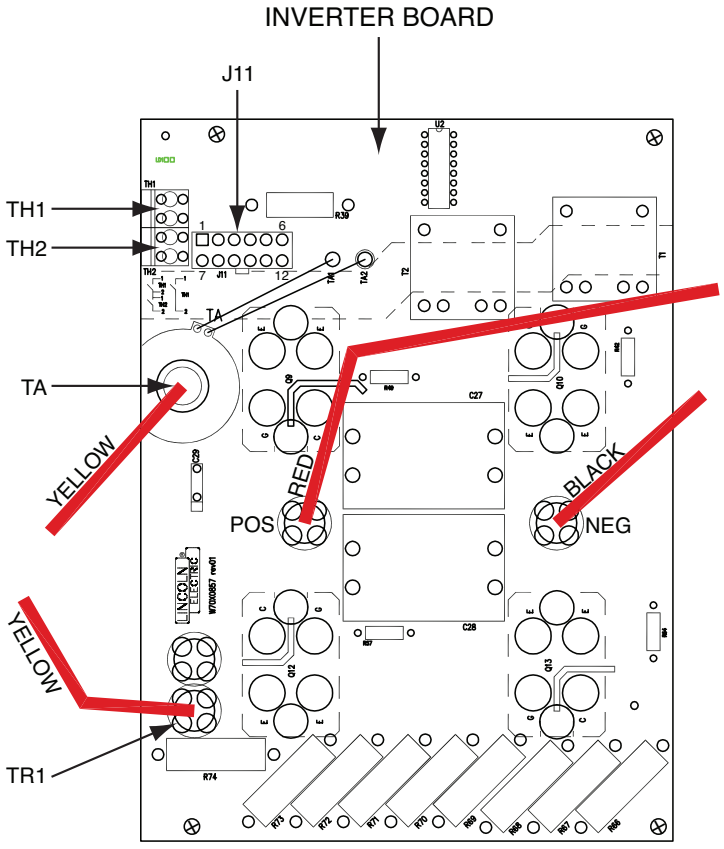
1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Inverter Board. See Figure. F.14.
4. Apply the correct input power to the machine and carefully check the status LED light on the Inverter Board. See ***Figure F.15***. It should be on, indicating 15VDC is present to power the circuit components.
5. Carefully perform the voltage checks detailed in ***Table F.8***. See ***Figure F.15***.
6. Remove the input power and perform the resistance checks detailed in ***Table F.9***. See ***Figure F.15***.
7. When testing is complete, replace all leads and plugs previously removed. See the Wiring Diagram.
8. Perform the ***Case Cover Replacement Procedure***.

INVERTER BOARD TEST (continued)

TABLE F.8 – INVERTER BOARD VOLTAGE CHECKS

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
250 VAC	Positive Terminal (Red Lead) to Negative Terminal (Black Lead)	400VDC	Filtered DC from Buck/Boost Board Machine at idle - no load.
250 VAC	TR1 (Yellow Lead) to TA (Yellow Lead)	0VDC	Main transformer primary connections-Machine at idle - no load - no torch trigger.
250 VAC	J11 Pin 4(+) to J11 Pin 6(-)	-5VDC	-5VDC sec. side auxiliary supply.
250 VAC	J11 Pin 12(+) to J11 Pin 6(-)	15VDC	15VDC sec. side auxiliary supply.
250 VAC	J11 Pin 11(+) to J11 Pin 6(-)	0VDC	Thermostat circuit closed-no error.
250 VAC	J11 Pin 11(+) to J11 Pin 6(-)	15VDC	Thermostat circuit open-error
250 VAC	J11 Pin 1(+) to J11 Pin 6(-)	5VDC	5VDC sec. side auxiliary supply.

FIGURE F.15 – INVERTER BOARD TEST POINT LOCATIONS



INVERTER BOARD TEST (continued)

TABLE F.9 – INVERTER BOARD RESISTANCE CHECKS

Using the phillips screwdriver, carefully remove the following leads from the Inverter Board. See ***Figure F.15*** and the Wiring Diagram. Make sure the input capacitors are discharged.

- Red lead from positive terminal
- Black lead from negative terminal
- Yellow transformer lead from terminal TA
- Yellow transformer lead from terminal TR1

When testing is complete reconnect all leads previously removed.

AC INPUT VOLTAGE	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
Machine disconnected from input voltage and capacitors discharged.	Positive Terminal (positive test probe) to Terminal TR1 (negative test probe)	High resistance - Greater than 100,000 Ohms	Checking Q12 for a “fault” condition
Machine disconnected from input voltage and capacitors discharged.	Terminal TR1 (positive test probe) to Positive Terminal (negative test probe)	Low resistance - (forward diode drop)	Checking Q12 for a “fault” condition
Machine disconnected from input voltage and capacitors discharged.	Position Terminal (positive test probe) to Terminal TA (negative test probe)	High resistance - Greater than 100,000 Ohms	Checking Q9 for a “fault” condition
Machine disconnected from input voltage and capacitors discharged.	Terminal TA (positive test probe) to Positive Terminal (negative test probe)	Low resistance - (forward diode drop)	Checking Q9 for a “fault” condition
Machine disconnected from input voltage and capacitors discharged.	Positive Terminal TR1 (positive test probe) to Negative Terminal (negative test probe)	High resistance - Greater than 100,000 Ohms	Checking Q13 for a “fault” condition
Machine disconnected from input voltage and capacitors discharged.	Negative Terminal (positive test probe) to Terminal TR1 (negative test probe)	Low resistance - (forward diode drop)	Checking Q13 for a “fault” condition
Machine disconnected from input voltage and capacitors discharged.	Terminal TA (positive test probe) to Negative Terminal (negative test probe)	High resistance - Greater than 100,000 Ohms	Checking Q10 for a “fault” condition
Machine disconnected from input voltage and capacitors discharged.	Negative Terminal (positive test probe) to Terminal TA (negative test probe)	Low resistance - (forward diode drop)	Checking Q10 for a “fault” condition

OUTPUT BOARD TEST

⚠ WARNING

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

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

TEST DESCRIPTION

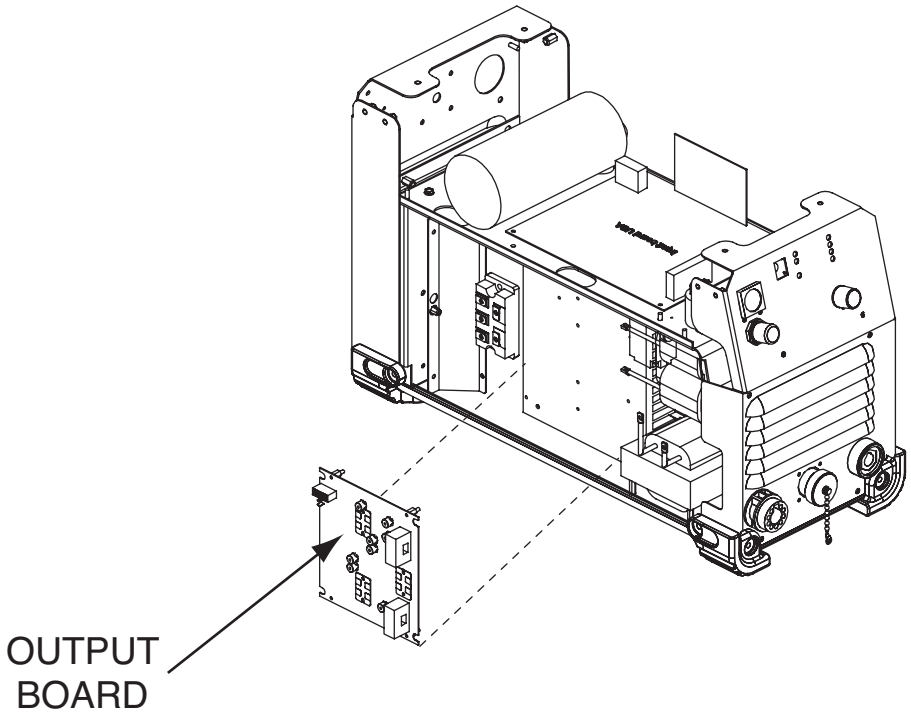
This test will aid the technician to determine if the Output Board is receiving the correct input voltages and if the Output Board is producing the correct output signals. This test will NOT determine the functionality of the entire Board.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram
Phillips Screwdriver

OUTPUT BOARD TEST (continued)

FIGURE F.16 – OUTPUT BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

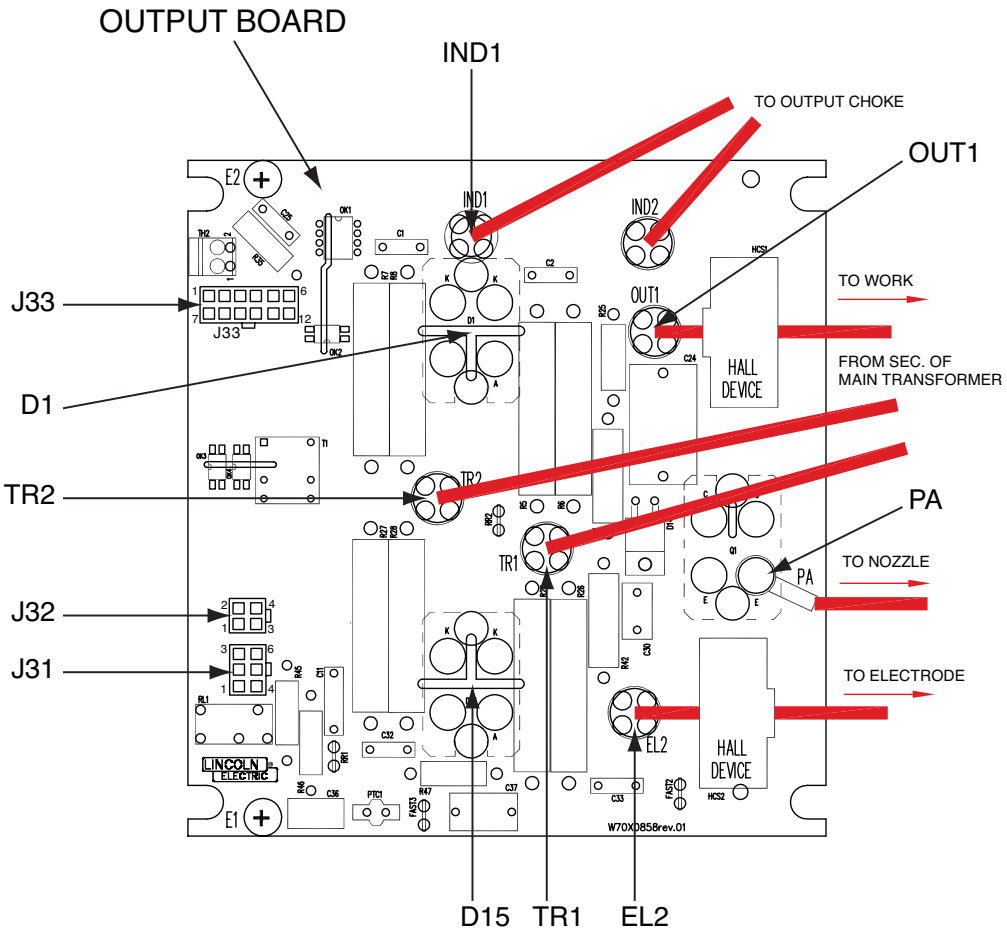
1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Output Board. See Figure F.16.
4. Apply the correct input power to the machine and carefully perform the voltage checks detailed in ***Table F.10***. See ***Figure F.17***.
5. Remove the input power and perform the resistance checks detailed in ***Table F.11***. See ***Figure F.17***.
6. When testing is complete replace all leads and plugs previously removed. See the Wiring Diagram.
7. Perform the ***Case Cover Replacement Procedure***.

OUTPUT BOARD TEST (continued)

TABLE F.10 – OUTPUT BOARD VOLTAGE CHECKS

AC INPUT VOLTAGE SINGLE PHASE	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
250 VAC	Plug J33 Pin 3 to Plug J33 Pin 5	-5VDC	Secondary side auxiliary supply
250 VAC	Plug J33 Pin 11 to Plug J33 Pin 5	+15VDC	Secondary side auxiliary supply
250 VAC	Plug J33 Pin 8 to Plug J33 Pin 5	0VDC	Torch connected and parts-in-place. No fault.
250 VAC	Plug J33 Pin 8 to Plug J33 Pin 5	14VDC	Torch parts NOT in place. Fault condition.
250 VAC	Plug J33 Pin 10 to Plug J33 Pin 5	0VDC	Thermostat closed. No fault.
250 VAC	Plug J33 Pin 10 to Plug J33 Pin 5	15VDC	Thermostat open. Fault condition.

FIGURE F.17 – OUTPUT BOARD TEST POINT LOCATIONS



OUTPUT BOARD TEST (continued)

TABLE F.11 – OUTPUT BOARD RESISTANCE CHECKS

Using the phillips screwdriver, carefully remove the following leads from the Output Board. See ***Figure F.17*** and the Wiring Diagram. Label leads for reconnection. Make sure the input capacitors are discharged.

- Two Output Choke leads from terminals IND1 and IND2
- Two transformer leads from terminals TR1 and TR2

When testing is complete reconnect all leads previously removed.

AC INPUT VOLTAGE	TEST POINTS	EXPECTED READING	COMMENTS/CONDITIONS
Machine disconnected from input voltage and capacitors discharged.	TR1 (positive test probe) to IND1 (negative test probe)	Low resistance - forward diode drop	Checking diode module D1
Machine disconnected from input voltage and capacitors discharged.	TR1 (negative test probe) to IND1 (positive test probe)	High resistance - Greater than 100,000 Ohms	Checking diode module D1
Machine disconnected from input voltage and capacitors discharged.	TR2 (positive test probe) to IND1 (negative test probe)	Low resistance - forward diode drop	Checking diode module D1
Machine disconnected from input voltage and capacitors discharged.	TR2 (negative test probe) to IND1 (positive test probe)	High resistance - Greater than 100,000 Ohms	Checking diode module D1
Machine disconnected from input voltage and capacitors discharged.	EL2 (positive test probe) to TR1 (negative test probe)	Low resistance - forward diode drop	Checking diode module D15
Machine disconnected from input voltage and capacitors discharged.	EL2 (negative test probe) to TR1 (positive test probe)	High resistance - Greater than 100,000 Ohms	Checking diode module D15
Machine disconnected from input voltage and capacitors discharged.	EL2 (positive test probe) to TR2 (negative test probe)	Low resistance - forward diode drop	Checking diode module D15
Machine disconnected from input voltage and capacitors discharged.	EL2 (negative test probe) to TR2 (positive test probe)	High resistance - Greater than 100,000 Ohms	Checking diode module D15
Machine disconnected from input voltage and capacitors discharged.	Plug J32 Pin 1 to Plug J32 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 Plug J32 Pin 3	High resistance - Much greater than one Ohm	Torch not connected or parts are not in place correctly
Machine disconnected from input voltage and capacitors discharged.	Plug J32 Pin 2 to Plug J32 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 Plug J32 Pin 3	High resistance - Much greater than one Ohm	Torch connected and torch trigger not activated

AIR/GAS SOLENOID TEST

⚠ WARNING

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

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

TEST DESCRIPTION

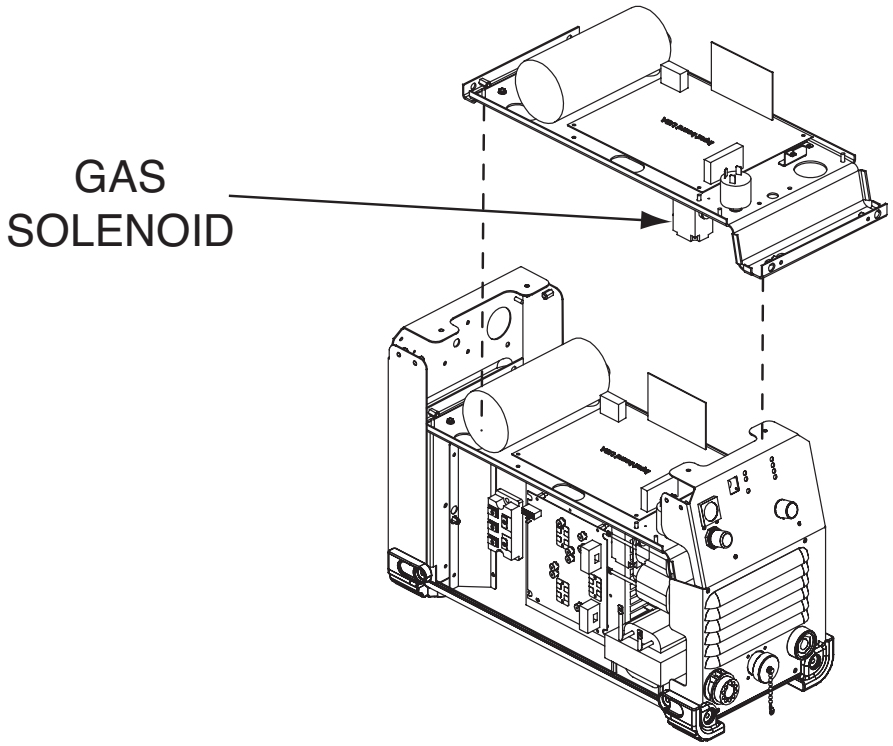
This test will aid the technician to determine if the Air/Gas Solenoid is receiving the correct input voltage and if the Solenoid is operational.

MATERIALS NEEDED

Volt/ohmmeter (Multimeter)
Wiring Diagram

AIR/GAS SOLENOID TEST (continued)

FIGURE F.18 – AIR/GAS SOLENOID LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

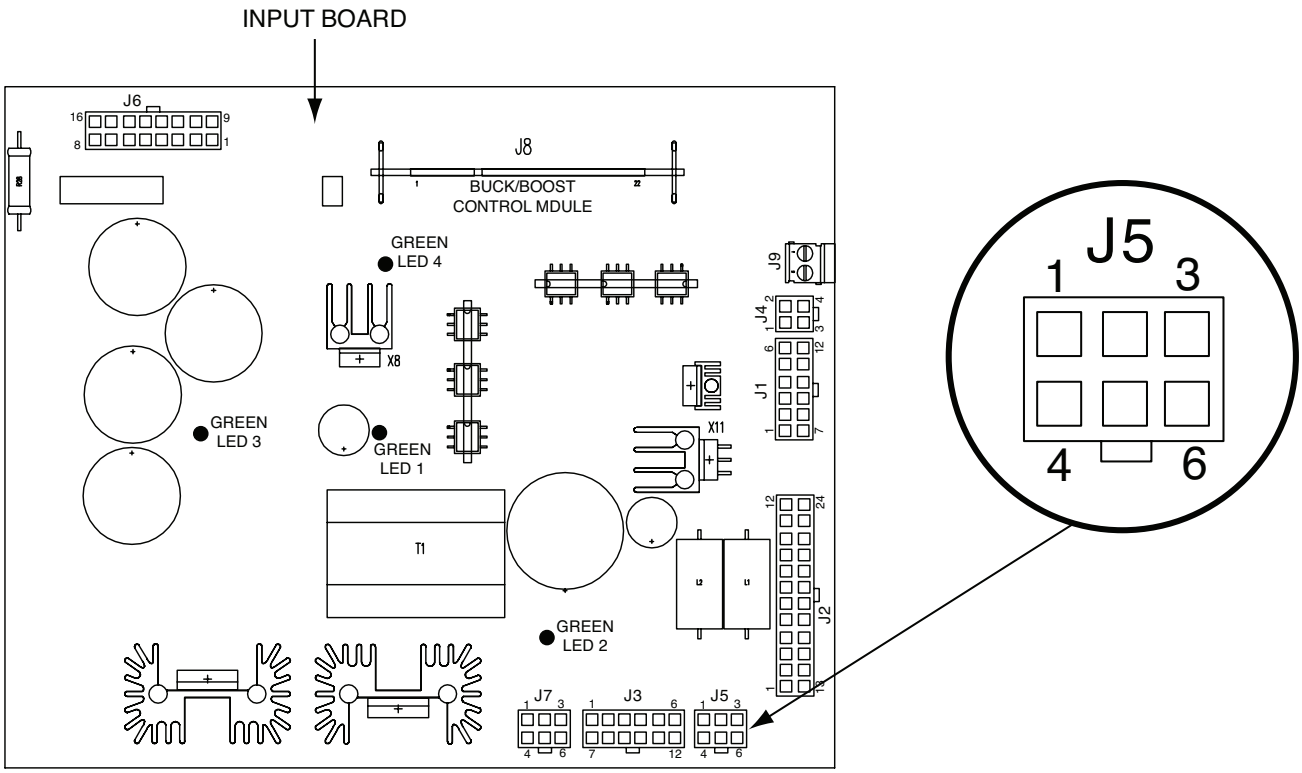
- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Air/Gas Solenoid. See Figure F.18.
4. Apply the correct input power and air pressure to the machine.
5. At the Input Board carefully check for 12VDC at plug J5 Pin 1(red lead +) to plug J5 Pin 4 (black lead -). These are the solenoid leads. See ***Figure F.19***. Note the torch trigger must be activated and the correct air pressure applied. If the 12VDC is not present, the output 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 12VDC is present at plug J5 Pin 1(red lead +) to plug J5 Pin 4 (black lead -) and the solenoid does not activate, check the solenoid resistance.

AIR/GAS SOLENOID TEST (continued)

FIGURE F.19 – PLUG J5 TEST POINT LOCATIONS



7. Remove the input power from the Tomahawk 1000 machine. Perform the ***Capacitor Discharge Procedure***.
8. Remove plug J5 from the Input Board.
9. Check the solenoid coil resistance. Normal coil resistance is approximately 9K ohms. The positive test probe must be at the red lead and the negative test probe at the black lead.
10. If the coil resistance is very high or very low, the Air/Gas Solenoid may be faulty. Replace.
11. When testing is complete, replace all leads and plugs that may have been removed. See the Wiring Diagram.
12. Perform the ***Case Cover Replacement Procedure***.

NOTES

TORCH TEST

⚠ WARNING

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

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

TEST DESCRIPTION

This test will aid the technician to determine if the Torch Assembly leads are intact and functional.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Wiring Diagram

TORCH TEST (continued)

FIGURE F.20 – TORCH ASSEMBLY AND COLLAR LOCATIONS

PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

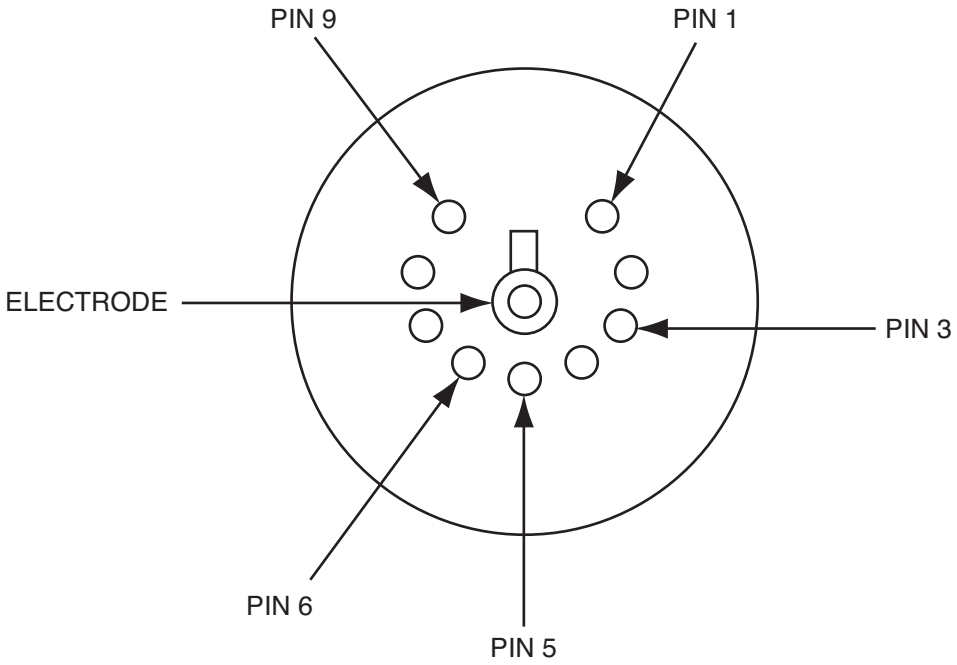
1. Remove the input power from the Tomahawk 1000 machine.
2. Locate and remove the Torch Assembly from the Tomahawk 1000 machine by turning the torch collar counter-clockwise. See Figure F.20.
3. Perform the torch resistance checks detailed in ***Table F.12***. Also see ***Figures F.21*** and ***F.22***.
4. If any of the resistance readings are questionable, the Torch Assembly must be repaired or replaced.

TORCH TEST (continued)

TABLE F.12 – TORCH ASSEMBLY RESISTANCE CHECKS

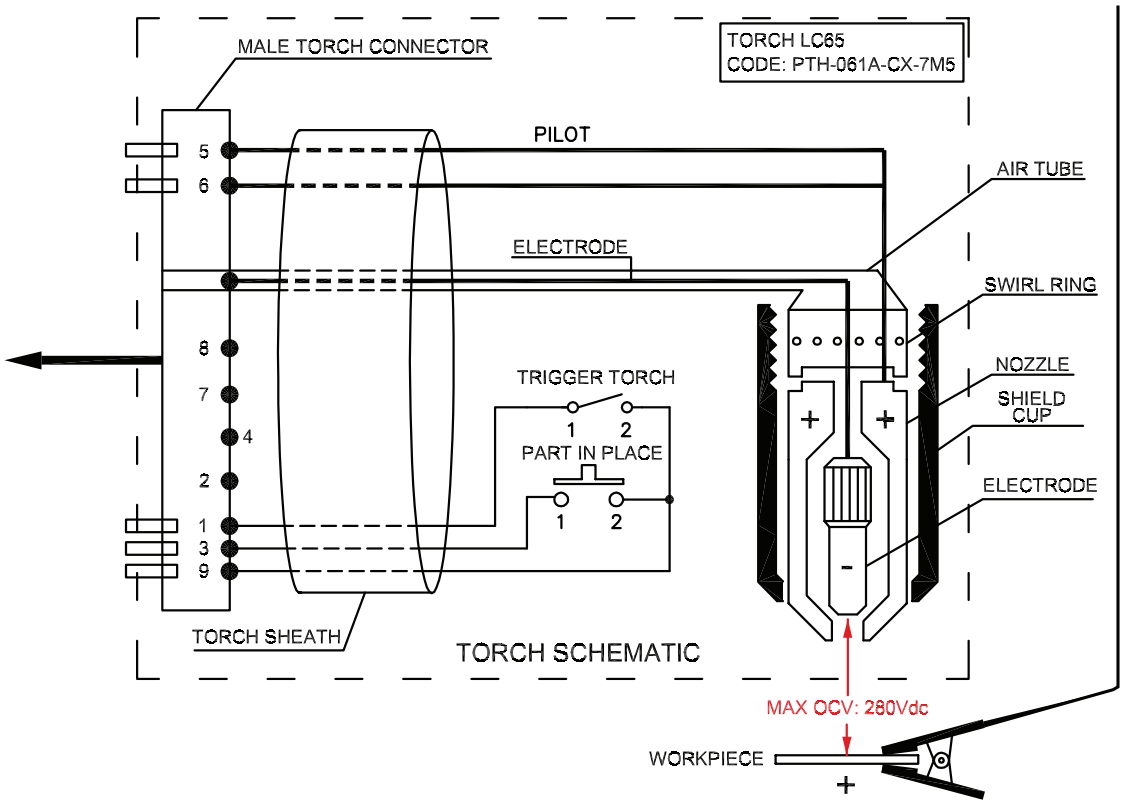
TORCH TEST POINTS	EXPECTED READING	CONDITIONS/COMMENTS
Torch Connector Pin 1 to Pin 9	Open	Torch trigger **NOT** activated
Torch Connector Pin 1 to Pin 9	Less than 1 ohm	Torch trigger activated
Torch Connector Pin 3 to Pin 9	Less than 1 ohm	All torch parts in place
Torch Connector Pin 3 to Pin 9	Open	Torch parts **NOT** in place error
Torch Connector Pin 5 to Pin 6	Less than 1 ohm	Pilot circuit
Torch Connector Pin 5 to Electrode	Less than 1 ohm	Torch parts in place
Torch Connector Pin 5 to Electrode	Open	Torch parts **NOT** in place error

FIGURE F.21 – TORCH PIN LOCATIONS



TORCH TEST (continued)

FIGURE F.22 – TORCH SCHEMATIC



LINE SWITCH
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

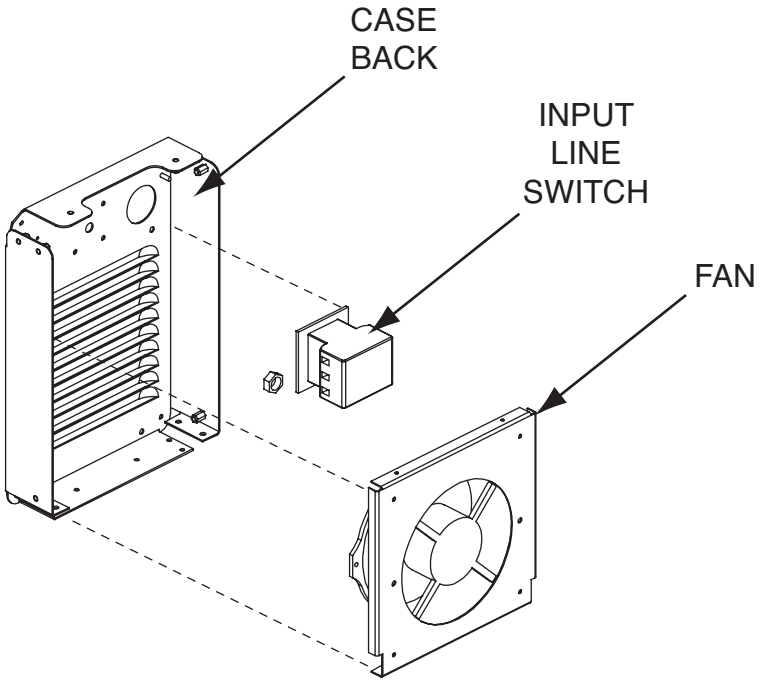
This procedure will aid the technician in the removal and replacement of the Line Switch.

MATERIALS NEEDED

Small Screwdriver or Knife
Phillips Screwdriver (Small and Medium)
Wiring Diagram

LINE SWITCH
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.23 – LINE SWITCH LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Input Line Switch. See Figure F.23.
4. Locate the switch handle, nameplate and mounting bracket. See ***Figure F.24*** and ***Figure F.25***.
5. Using the small phillips screwdriver, remove the switch handle.
6. Using the knife or small screwdriver blade, gently pry off the nameplate.
7. Using the medium size phillips screwdriver, remove the four screws from the outer mounting bracket. Take note of the mounting bracket position. Tab at the top. See ***Figure F.25***.

LINE SWITCH
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.24 – INPUT LINE SWITCH HANDLE AND NAMEPLATE LOCATION

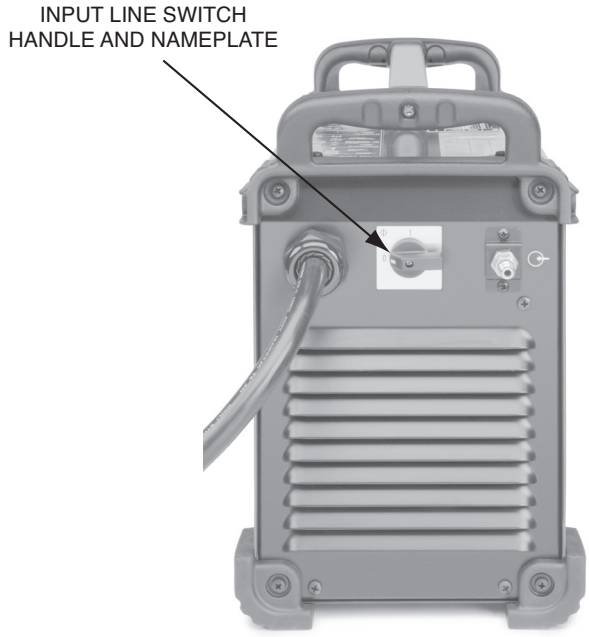
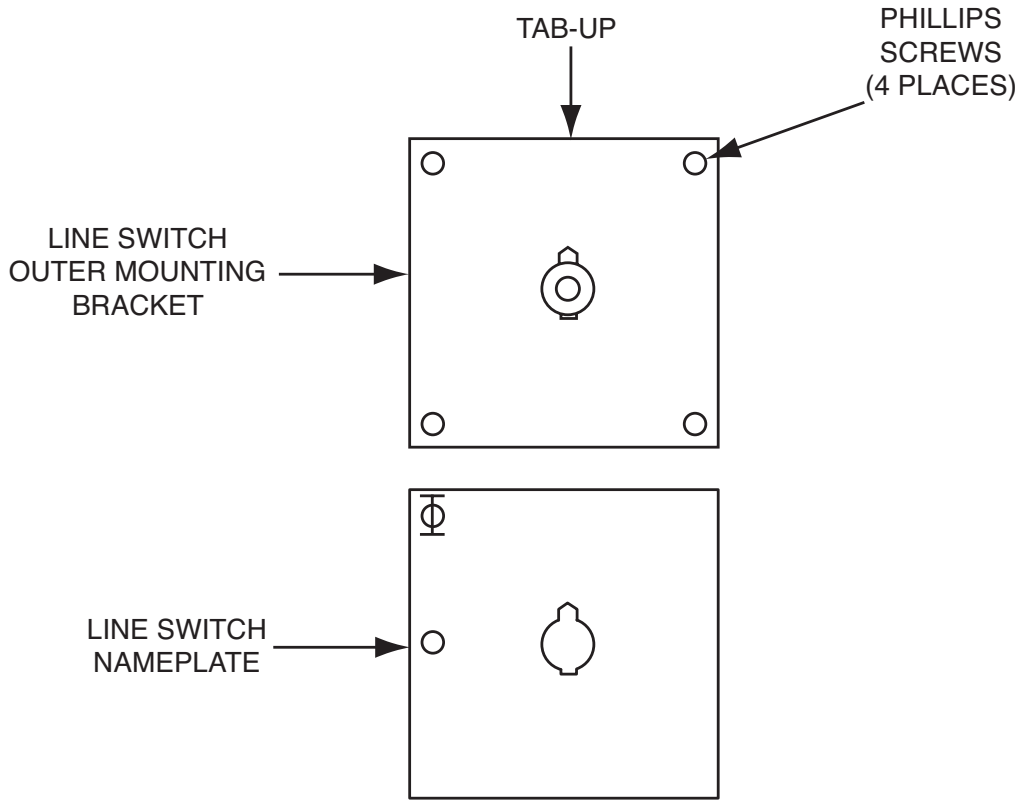


FIGURE F.25 – MOUNTING BRACKET POSITION



LINE SWITCH
REMOVAL AND REPLACEMENT PROCEDURE (continued)

8. Using the medium size phillips screwdriver, locate, label and remove the three input line cord leads (red, black and white). Note lead placement.
9. Using the medium size phillips screwdriver, locate, label and remove the three black leads connecting the line switch to the input rectifier assembly. Note lead placement. See the Wiring Diagram.
10. Carefully remove the line switch from the machine.

REPLACEMENT PROCEDURE

1. Carefully position the new line switch into the machine.
2. Connect the three black leads to the line switch. Note lead placement. See Wiring Diagram.
3. Connect the three input cord leads (red black and white) to the line switch. Note lead placement.
4. Mount the new line switch using the outer mounting bracket and the four phillips screws previously removed. Take note of the mounting bracket position. Tab at the top. See ***Figure F.25***.
5. Carefully “snap” the nameplate on to the mounting bracket.
6. Using the small phillips screwdriver, assemble the handle on to the switch shaft.
7. Perform the ***Case Cover Replacement Procedure***.

INPUT RECTIFIER
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

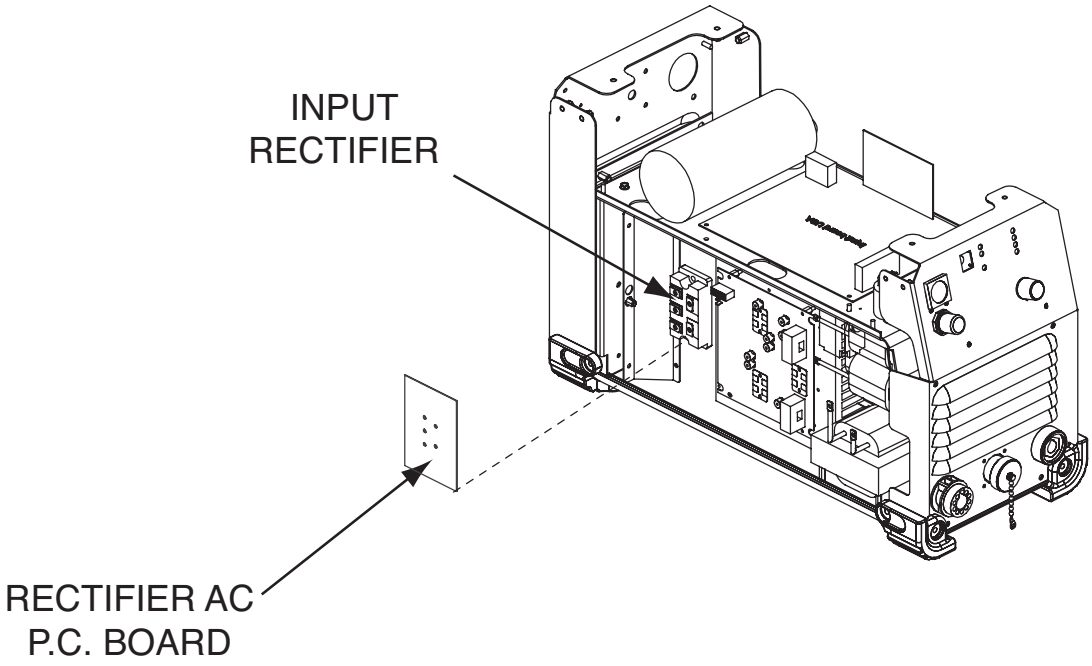
This procedure will aid the technician in the removal and replacement of the Input Rectifier.

MATERIALS NEEDED

Phillips Screwdriver
Silicon Sealer
Wiring Diagram
Dow Corning 340 Heat Sink Compound (Lincoln Part T12837)
Torque Wrench

INPUT RECTIFIER
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.26 – INPUT RECTIFIER LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

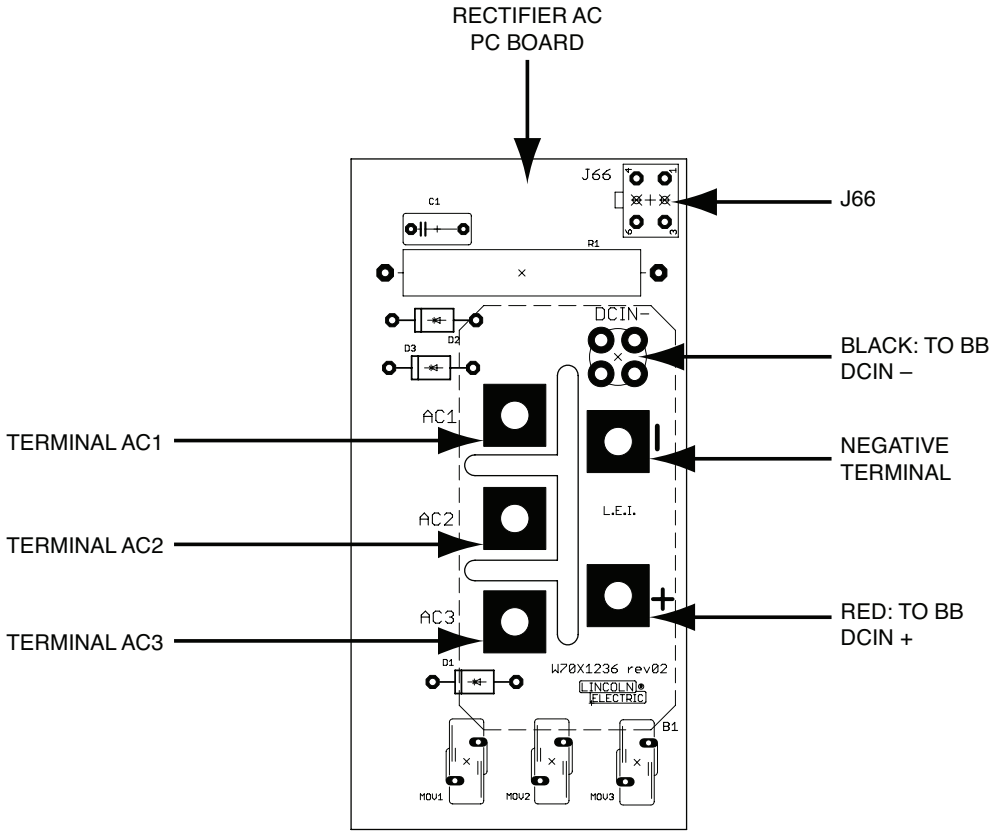
- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Input Rectifier and the Rectifier AC P.C. Board. See Figure F.26.
4. Locate and remove Plug J66 from the Rectifier AC P.C. Board. See ***Figure F.27***.
5. Using the phillips screwdriver, label and remove the Red DCIN+ lead and the Black DCIN- leads from the Rectifier AC P.C. Board. Note the longer screw is used in the DCIN- terminal. The silicon sealant will have to be removed to access the mounting screws. See ***Figure F.27***. Take note of lead placement.

INPUT RECTIFIER
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.27 – INPUT RECTIFIER LEAD LOCATIONS



6. Using the phillips screwdriver, label and remove the three black leads from the input terminals AC1, AC2 and AC3. The silicon sealant will have to be removed to access the mounting screws. See Figure F.27. Take note of lead placement.
7. Using the phillips screwdriver, remove the mounting screw from the negative terminal. The silicon sealant will have to be removed to access the mounting screw. See Figure F.27.
8. Carefully remove the Rectifier AC P.C. Board from the Input Rectifier Module.
9. Using the phillips screwdriver, remove the two screws mounting the Input Rectifier Module to the heat sink.
10. Carefully remove the Input Rectifier Module.

REPLACEMENT PROCEDURE

1. Clean the heat sink mounting surface.
2. When installing a new Input Rectifier Module apply a thin coating of Dow Corning 340 Heat Sink Compound (Lincoln Part T12837) to the mating surfaces.
3. Assemble the Input Rectifier Module to the heat sink using the two screws previously removed and torque to 12 IN-LBS.
4. Carefully assemble the Rectifier AC P.C. Board and the five leads previously removed to the Input Rectifier Module using the six screws previously removed. Make sure to use the longer screw in the DCIN- terminal. Torque the screws to 12 IN-LBS. Take note of lead placement.
5. Connect Plug J66 to the Rectifier AC P.C. Board
6. Replace the silicon sealant as required.
7. Perform the ***Case Cover Replacement Procedure***.

NOTES

CONTROL BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

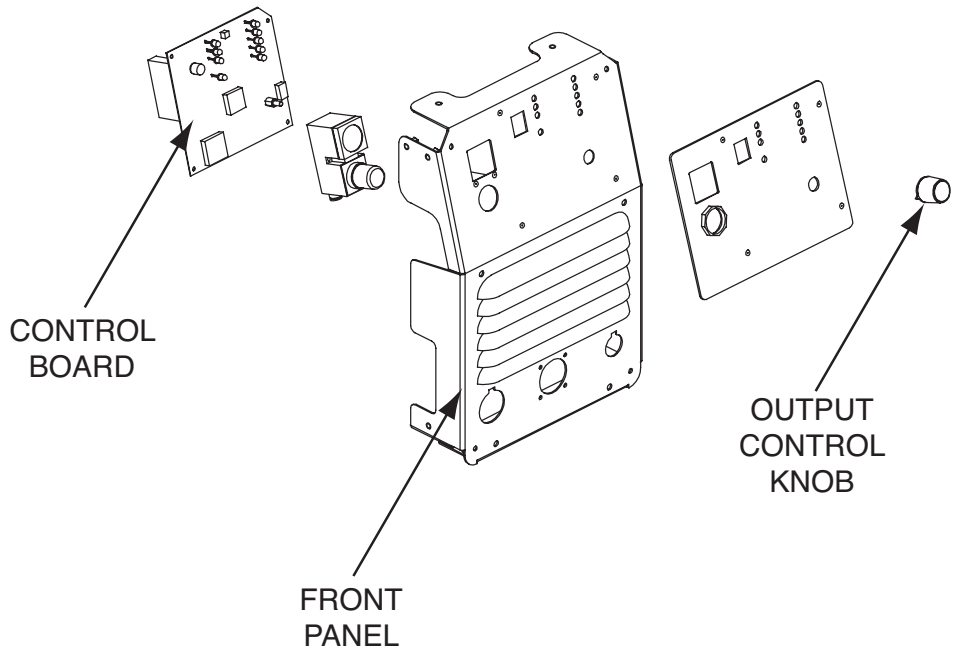
This procedure will aid the technician in the removal and replacement of the Control Board.

MATERIALS NEEDED

Phillips Screwdriver
6 mm Wrench
Wiring Diagram

CONTROL BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.28 – CONTROL BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

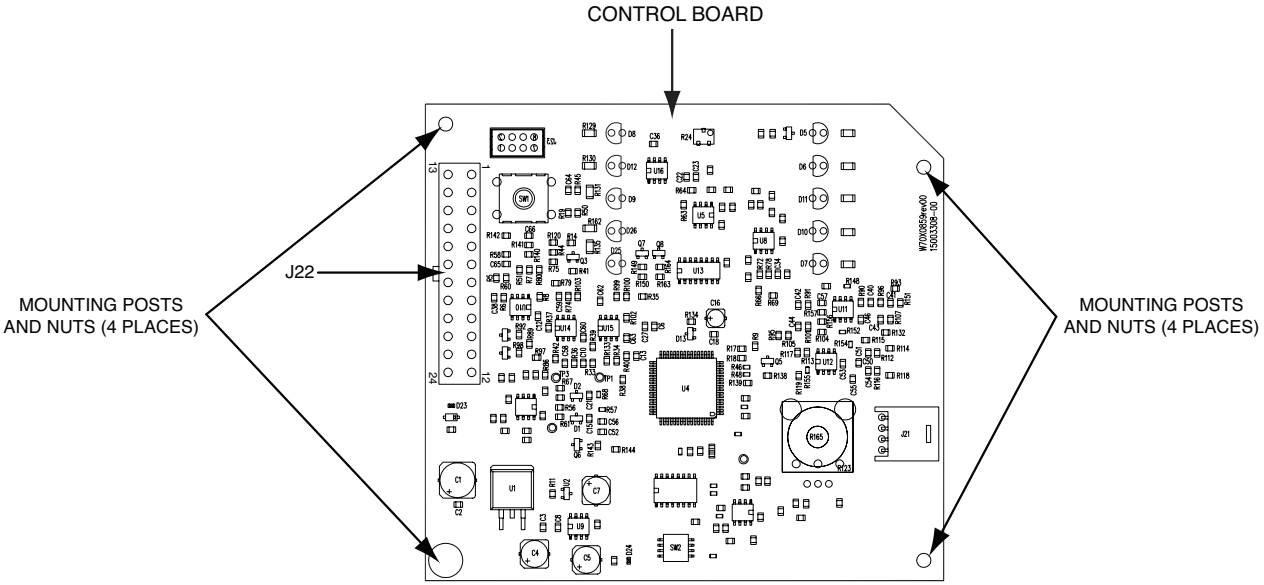
- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Control Board. See Figure F.28.
4. Locate the Output Control Knob. See Figure F.28.
5. Using a knife blade, carefully remove the red cap from the knob.
6. Using a 6 mm wrench, loosen the retaining nut from the control knob. Note position of the knob for reassembly. Remove the knob from the output control shaft.
7. Locate and remove Plug J22 from the Control Board. See ***Figure F.29***.

CONTROL BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.29 – PLUG J22 AND CONTROL BOARD MOUNTING POST LOCATIONS



8. Using the 6 mm wrench, remove the four nuts and lock washers from mounting posts. See Figure F.29.
9. Take note of the placement of the flat washers and spacers located behind the Control Board on the mounting posts.
10. The front panel assembly may have to be loosened and brought forward to gain access to the bottom two mounting nuts.
11. Carefully remove the Control Board from the machine.

REPLACEMENT PROCEDURE

1. Position the new Control Board on to the mounting posts making sure the spacers and flat washers are positioned correctly.
2. Secure the new Control Board on to the mounting posts using the four nuts and lock washers previously removed.
3. Connect Plug J22 to the Control Board.
4. Position the output control knob on to the output control shaft and tighten the nut. Note knob position.
5. Put the red cap back into place on the control knob.
6. Perform the ***Case Cover Replacement Procedure***.

NOTES

INPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

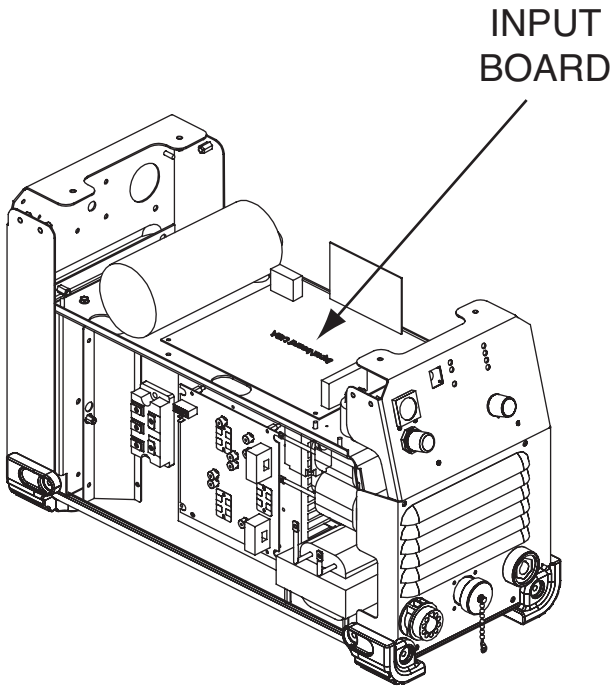
This procedure will aid the technician in the removal and replacement of the Input Board.

MATERIALS NEEDED

Phillips Screwdriver
Small Slot Head Screwdriver
Wiring Diagram
Silicon Sealer

INPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.30 – INPUT BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

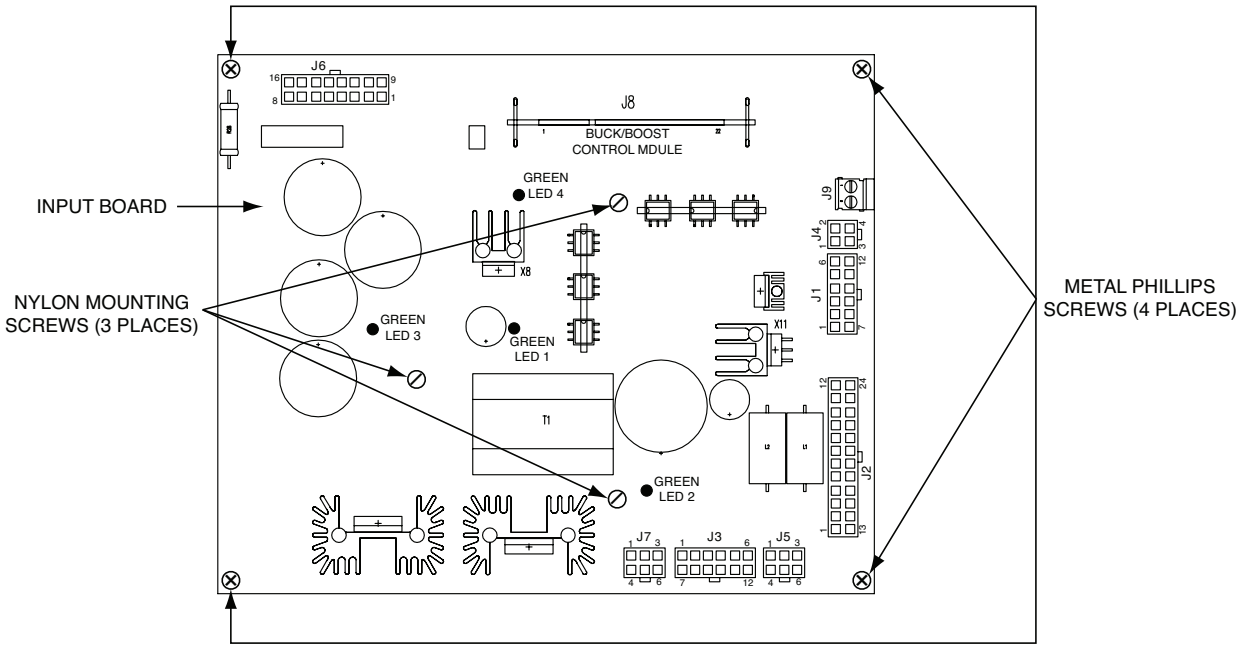
- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Input Board. See Figure F.30.
4. Locate and carefully remove plugs J1, J2, J3, J4, J5 and J6 from the Input Board. See ***Figure F.31***.
5. Locate J9 and using the small slot head screwdriver, remove the red and black leads. Label for reconnection. See ***Figure F.31***.
6. Using the phillips screwdriver, remove the four metal mounting screws from the corners of the Input Board. See ***Figure F.31***.

INPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.31 – INPUT BOARD MOUNTING SCREW LOCATIONS



7. Locate the three nylon mounting screws. These may be covered by a drop of silicon sealant. See Figure F.31.
8. Using the small slot head screwdriver, carefully remove the three nylon mounting screws.
9. Carefully remove the Input Board from the machine.

REPLACEMENT PROCEDURE

1. Position the new Input Board on to the mounting posts.
2. Secure the new Input Board on to the mounting posts using the three nylon screws previously removed. Seal with a drop of silicon sealant.
3. Replace the four metal mounting screws previously removed.
4. Replace the red and black leads in J9. Make certain the leads are in the correct terminals. Red is positive.
5. Replace plugs J1, J2, J3, J4, J5 and J6.
6. Perform the ***Case Cover Replacement Procedure***.

NOTES

OUTPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

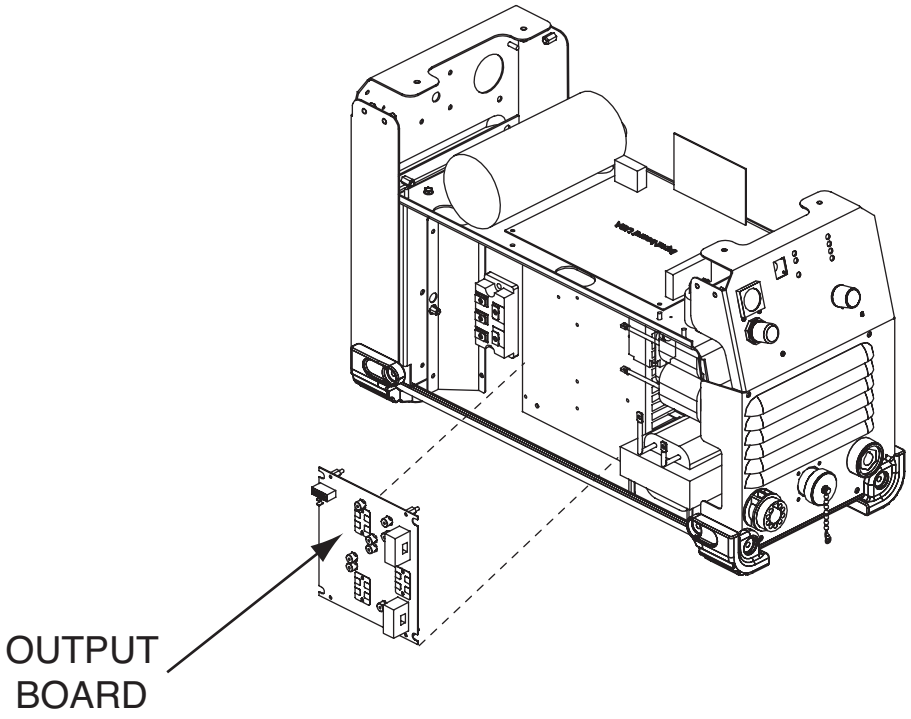
This procedure will aid the technician in the removal and replacement of the Output Board.

MATERIALS NEEDED

Phillips Screwdriver
Small Slot Head Screwdriver
Silicon Sealer
Wiring Diagram
Dow Corning 340 Heat Sink Compound (Lincoln Part T12837)
Torque Wrench

OUTPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.32 – OUTPUT BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

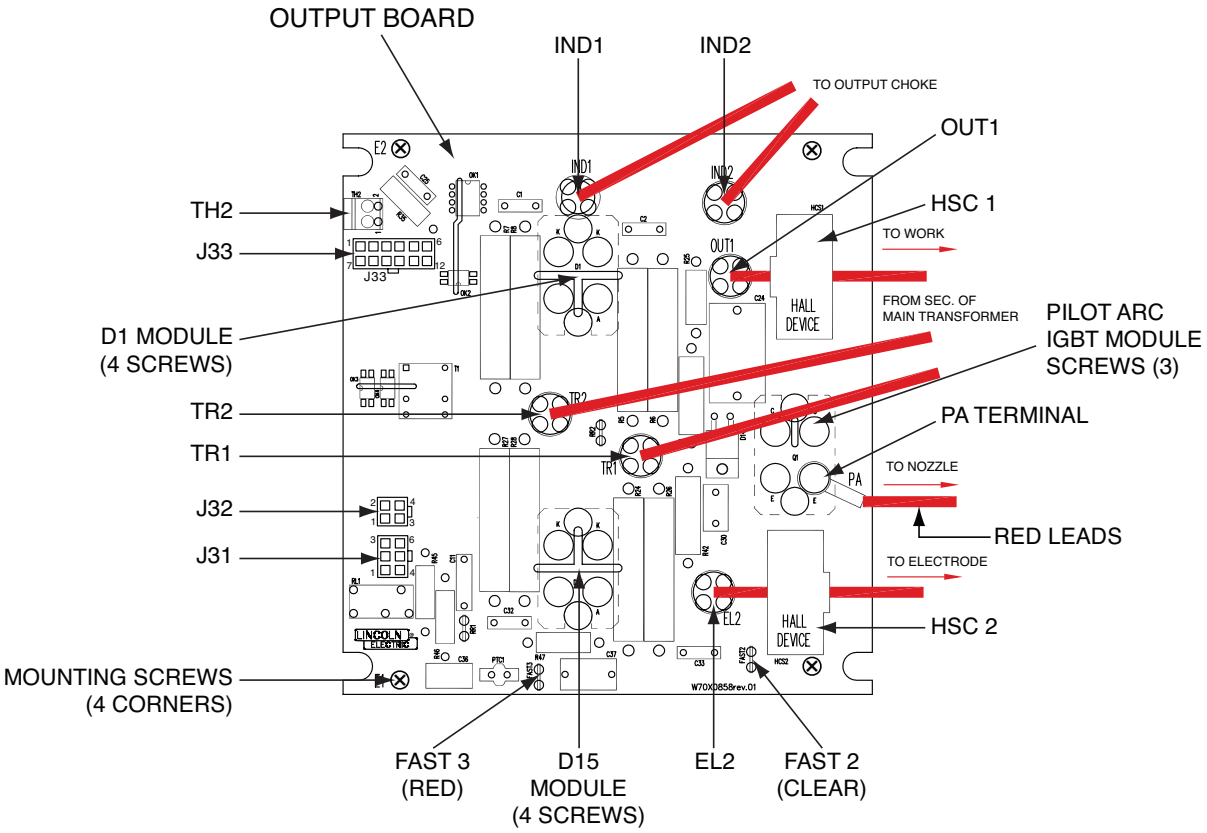
- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Output Board. See Figure F.32.
4. Locate and carefully remove plugs J31, J32 and J33 from the Output Board. See ***Figure F.33***.
5. Locate Terminal TH2 and using the small slot head screwdriver, remove the two yellow thermostat leads. Label for reconnection. See ***Figure F.33***.
6. Locate and remove the lead from the FAST3 connection terminal (Red). See ***Figure F.33***.
7. Locate and remove the lead from the FAST2 connection terminal (Clear). See ***Figure F.33***.

OUTPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.33 – OUTPUT BOARD CONNECTION LOCATIONS

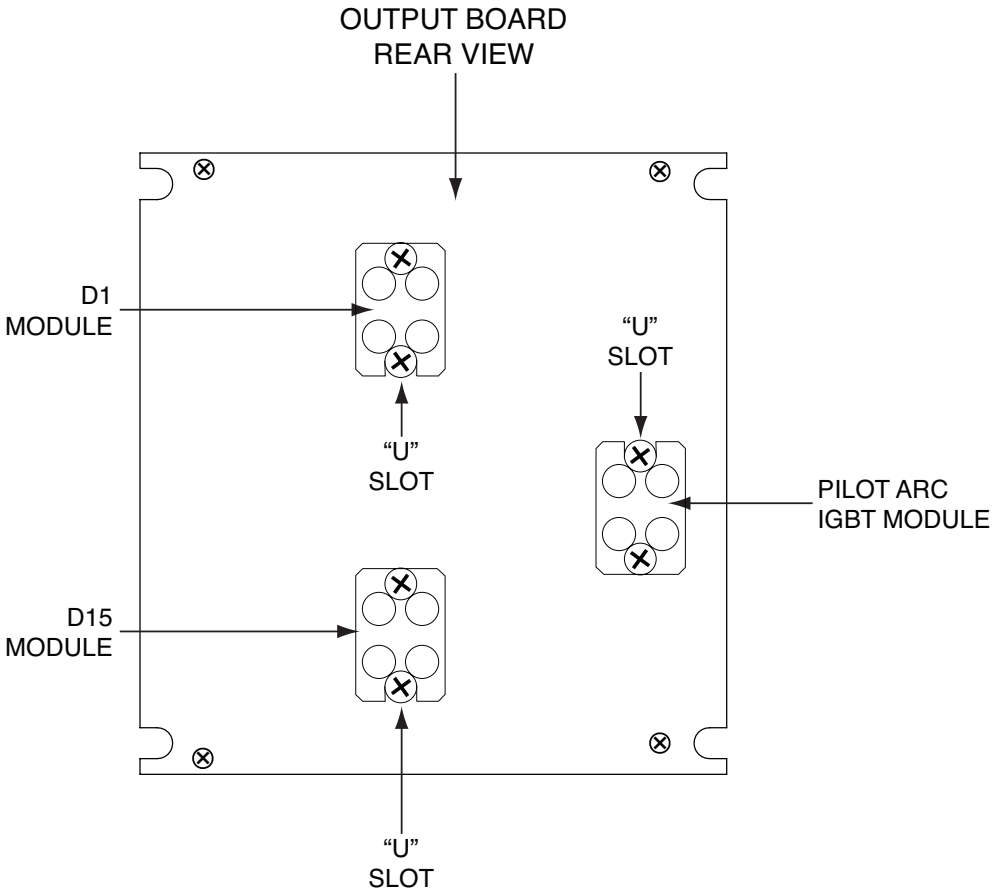


NOTE: Before performing the following steps take note of the size and type of screws being removed and associated washers. Upon reassembly the same type and size screw and washers MUST be used.

8. Using the phillips screwdriver, locate and remove the two output choke leads from terminals IND1 and IND2. See Figure F.33. Label leads for reconnection.
9. Using the phillips screwdriver, locate and remove the two main transformer secondary leads from terminals TR1 and TR2. See Figure F.33. Label leads for reconnection.
10. Using the phillips screwdriver, locate and remove the output work lead from terminal OUT1. See Figure F.33. Label lead for reconnection. Note the disconnected lead will have to be passed through the Hall Device HSC1 module.
11. Using the phillips screwdriver, locate and remove the output ELECTRODE lead from terminal EL2. See Figure F.33. Label lead for reconnection. Note the disconnected lead will have to be passed through the Hall Device HSC2 module.
12. Using the phillips screwdriver, locate and remove the Red nozzle leads from the PA connection terminal. The silicon sealant will have to be carefully removed to access the phillips screw. See Figure F.33.
13. Locate and remove the remaining three screws from the pilot arc IGBT module. The silicon sealant will have to be carefully removed to access the phillips screws. See Figure F.33.

OUTPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.34 – OUTPUT BOARD MODULE LOCATIONS



14. Using the phillips screwdriver, locate and remove the four screws from the D1 module. The silicon sealant will have to be carefully removed to access the phillips screws. See ***Figure F.33***.
15. Using the phillips screwdriver, locate and remove the four screws from the D15 module. The silicon sealant will have to be carefully removed to access the phillips screws. See ***Figure F.33***.
16. Locate the four corner mounting screws and using the phillips screwdriver, remove the mounting screws and associated washers. See ***Figure F.33***.
17. Carefully remove the Output Board from the machine.
18. Note the placement and location of the following components: Diode Module D1, Diode Module D15 and the Pilot Arc IGBT Module. See Figure F.34.
19. Carefully remove the mounting screws and associated washers from the module(s) to be replaced. Take note of type and size of mounting screws.

NOTE: Carefully remove the old module(s) taking note of placement, component type and polarity. One end has a mounting hole and the other end has a "U" mounting slot. **The new module(s) must be mounted in the same configuration.** See Figure F.34.

OUTPUT BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Carefully clean the heat sink.
2. Apply a thin layer of Dow Corning 340 heat sink compound (Lincoln Part T12837) on the new module(s).
3. Carefully fasten the new module(s) to the heat sink using the screws and washers previously removed. Observe polarity and mounting position. See ***Figure F.34***. Torque the mounting screws to 12 Inch Pounds.
4. Carefully install the new Output Board on to the four mounting posts using the four corner mounting screws and washers previously removed. Do not tighten the mounting screws yet.
5. Mount the Output Board on to Diode Module D1 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.33***. Seal screw heads with a drop of silicon sealant.
6. Mount the Output Board on to Diode Module D15 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.33***. Seal screw heads with a drop of silicon sealant.
7. Mount the Output Board on to The Pilot Arc IGBT Module using the three screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.33***. Seal screw heads with a drop of silicon sealant.
8. Attach the Red Nozzle leads to the PA connection. See ***Figure F.33***. Torque the screw to 12 Inch Pounds. Seal screw head with a drop of silicon sealant.
9. Finish tightening the four corner mounting screws to 12 Inch Pounds.
10. Using the screw and associated washers previously removed, reconnect the output ELECTRODE lead to terminal EL2. Make sure the lead passes through the Hall Device HSC2. See ***Figure F.33***. Torque the screw to 12 Inch Pounds.
11. Using the screw and associated washers previously removed, reconnect the output Work lead to terminal OUT1. Make sure the lead passes through the Hall Device HSC1. See ***Figure F.33***. Torque the screw to 12 Inch Pounds.
12. Using the two screws and washers previously removed, reconnect the two main transformer secondary leads to terminals TR1 and TR2. See ***Figure F.33***. Torque the screws to 12 Inch Pounds.
13. Using the two screws and washers previously removed, reconnect the two output choke leads to terminals IND1 and IND2. See ***Figure F.33***. Torque the screws to 12 Inch Pounds.
14. Reconnect the lead (clear) to the FAST2 terminal. See ***Figure F.33***.
15. Reconnect the lead (Red) to the FAST3 terminal. See ***Figure F.33***.
16. Reconnect the two yellow thermostat leads to the TH2 terminal. See ***Figure F.33***.
17. Connect Plugs J31, J32 and J33 to the Output Board. See ***Figure F.33***.
18. Clear and position all leads for reassembly.
19. Perform the ***Case Cover Replacement Procedure***.

NOTES

BUCK/BOOST BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

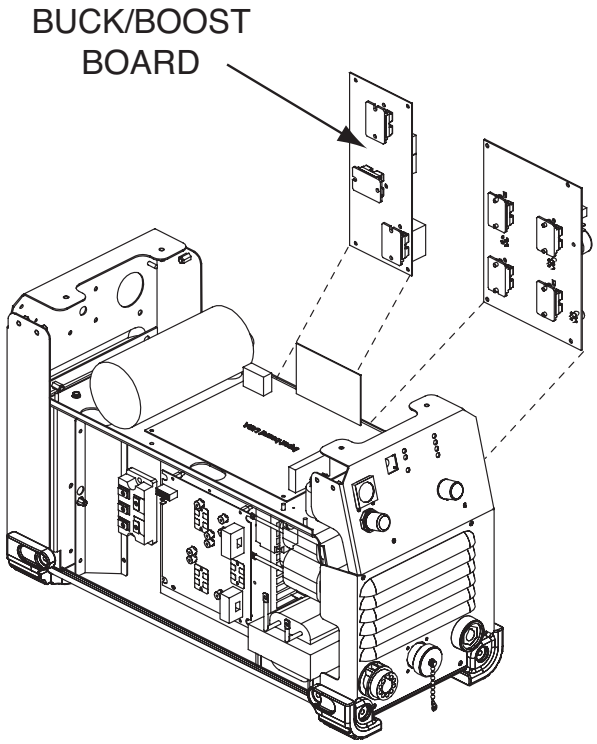
This procedure will aid the technician in the removal and replacement of the Buck/Boost Board.

MATERIALS NEEDED

Phillips Screwdriver
Small Slot Head Screwdriver
Silicon Sealer
Wiring Diagram
Dow Corning 340 Heat Sink Compound (Lincoln Part T12837)
Torque Wrench

BUCK/BOOST BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.35 – BUCK/BOOST BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

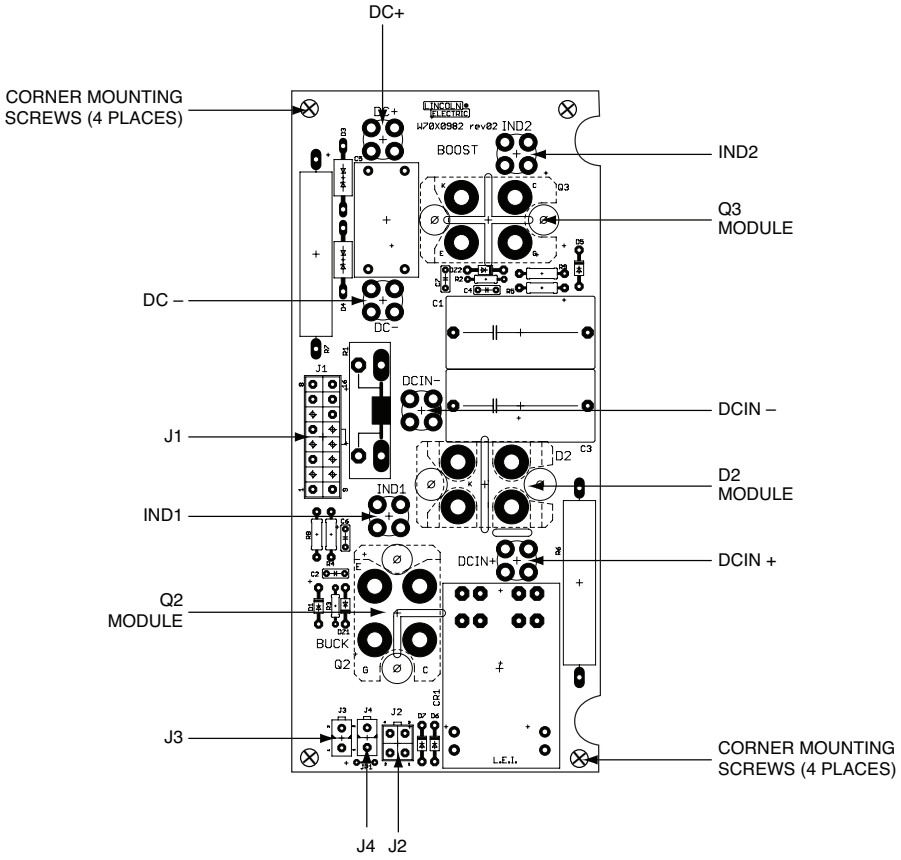
- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Buck/Boost Board. See Figure F.35.
4. Locate and carefully remove plugs J1, J2, J3 and J4 from the Buck/Boost Board. Label J3 and J4 for reconnection. See ***Figure F.36***.

BUCK/BOOST BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.36 – BUCK/BOOST BOARD CONNECTION LOCATIONS

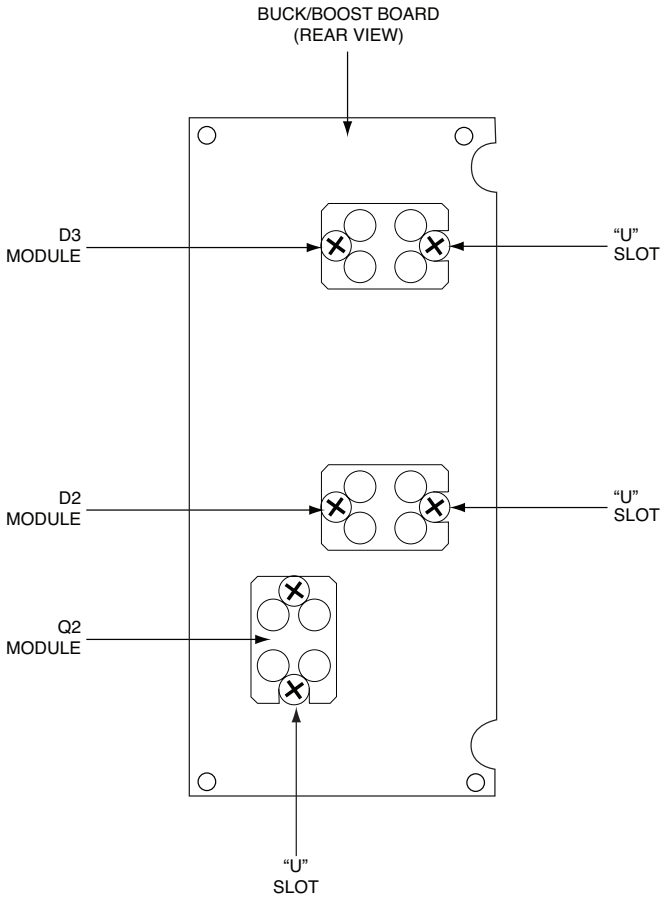


NOTE: Before preforming the following steps take note of the size and type of screws being removed and associated washers. Upon reassembly the same type and size screw and washers MUST be used.

5. Locate and label the lead connected to terminal DCIN-. See Figure F.36.
6. Using the phillips screwdriver, remove the lead from terminal DCIN-. See Figure F.36.
7. Locate and label the lead connected to terminal DCIN+. See Figure F.36.
8. Using the phillips screwdriver, remove the lead from terminal DCIN+. See Figure F.36.
9. Locate and label the lead connected to terminal IND1. See Figure F.36.
10. Using the phillips screwdriver, remove the lead from terminal IND1. See Figure F.36.
11. Locate and label the lead connected to terminal IND2. See Figure F.36.
12. Using the phillips screwdriver, remove the lead from terminal IND2. See Figure F.36.
13. Locate and label the lead connected to terminal DC-. See Figure F.36.
14. Using the phillips screwdriver, remove the lead from terminal DC-. See Figure F.36.
15. Locate and label the lead connected to terminal DC+. See Figure F.36.
16. Using the phillips screwdriver, remove the lead from terminal DC+. A cable tie may have to be removed to gain access to the screw. See Figure F.36.
17. Using the phillips screwdriver, locate and remove the four screws from the D2 module. The silicon sealant will have to be carefully removed to access the phillips screws. See Figure F.36.

BUCK/BOOST BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.37 – BUCK/BOOST BOARD MODULE LOCATIONS



18. Using the phillips screwdriver, locate and remove the four screws from the Q2 module. The silicon sealant will have to be carefully removed to access the phillips screws. See ***Figure F.36***.
19. Using the phillips screwdriver, locate and remove the four screws from the Q3 module. The silicon sealant will have to be carefully removed to access the phillips screws. See ***Figure F.36***.
20. Locate the four corner mounting screws and using the phillips screwdriver, remove the mounting screws and associated washers. See ***Figure F.36***.
21. Carefully remove the Buck/Boost Board from the machine.
22. Note the placement and location of the following components: Module D2, Module Q2 and Module Q3. See Figure F.37.
23. Carefully remove the mounting screws and associated washers from the module(s) to be replaced. Take note of type and size of mounting screws.

Carefully remove the old module(s) taking note of placement, component type and polarity. One end has a mounting hole and the other end has a "U" mounting slot. The new module(s) must be mounted in the same configuration. See Figure F.37.

BUCK/BOOST BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Carefully clean the heat sink.
2. Apply a thin layer of Dow Corning 340 heat sink compound (Lincoln Part T12837) on the new module(s).
3. Carefully assemble the new module(s) to the heat sink using the screws and washers previously removed. Observe polarity and mounting position. See ***Figure F.37***. Torque the mounting screws to 12 Inch Pounds.
4. Carefully install the new Buck/Boost Board into the four mounting posts using the four corner mounting screws and washers previously removed. Do not tighten the mounting screws yet.
5. Mount the Buck/Boost Board on to Module D2 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.36***. Seal screw heads with a drop of silicon sealant.
6. Mount the Buck/Boost Board on to Module Q2 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.36***. Seal screw heads with a drop of silicon sealant.
7. Mount the Buck/Boost Board on to Module Q3 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.36***. Seal screw heads with a drop of silicon sealant.
8. Finish tightening the four corner mounting screws to 12 Inch Pounds.
9. Using the screw and associated washers previously removed, reconnect the lead to the DC+ terminal. See ***Figure F.36***. Torque the screw to 12 Inch Pounds. Replace the cable tie if necessary.
10. Using the screw and associated washers previously removed, reconnect the lead to the DC- terminal. See ***Figure F.36***. Torque the screw to 12 Inch Pounds
11. Using the screw and associated washers previously removed, reconnect the lead to the IND2 terminal. See ***Figure F.36***. Torque the screw to 12 Inch Pounds.
12. Using the screw and associated washers previously removed, reconnect the lead to the IND1 terminal. See ***Figure F.36***. Torque the screw to 12 Inch Pounds.
13. Using the screw and associated washers previously removed, reconnect the lead to the DCIN+ terminal. See ***Figure F.36***. Torque the screw to 12 Inch Pounds.
14. Using the screw and associated washers previously removed, reconnect the lead to the DCIN- terminal. See ***Figure F.36***. Torque the screw to 12 Inch Pounds.
15. Reconnect plugs J1, J2, J3 and J4 into the correct receptacles on the Buck/Boost Board. See ***Figure F.36***.
16. Clear and position all leads for reassembly.
17. Perform the ***Case Cover Replacement Procedure***.

NOTES

INVERTER BOARD
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

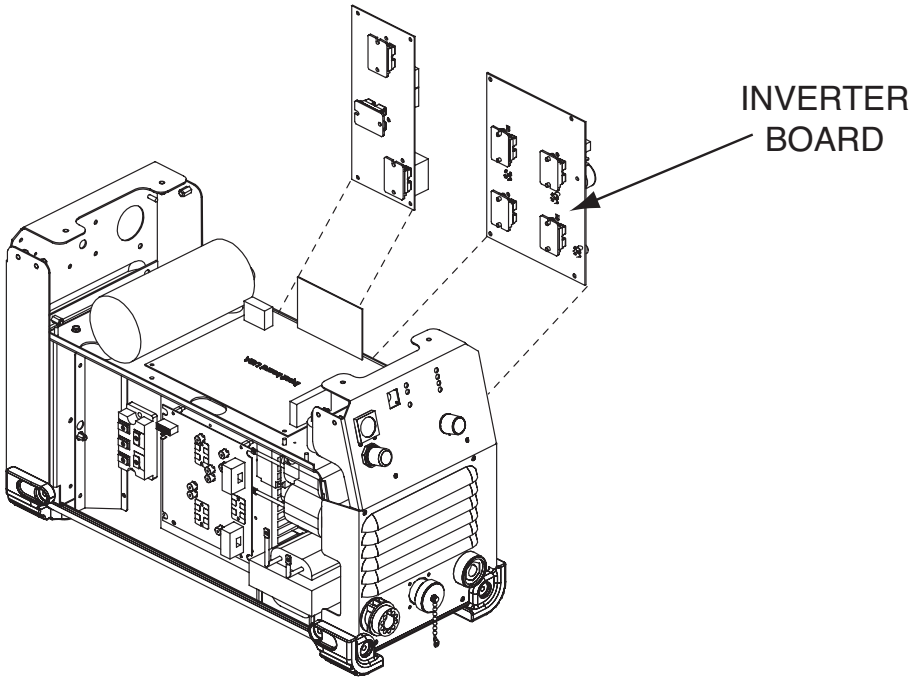
This procedure will aid the technician in the removal and replacement of the Inverter Board.

MATERIALS NEEDED

Phillips Screwdriver
Small Slot Head Screwdriver
Silicon Sealer
Wiring Diagram
Dow Corning 340 Heat Sink Compound (Lincoln Part T12837)
Torque Wrench

INVERTER BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.38 – INVERTER BOARD LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

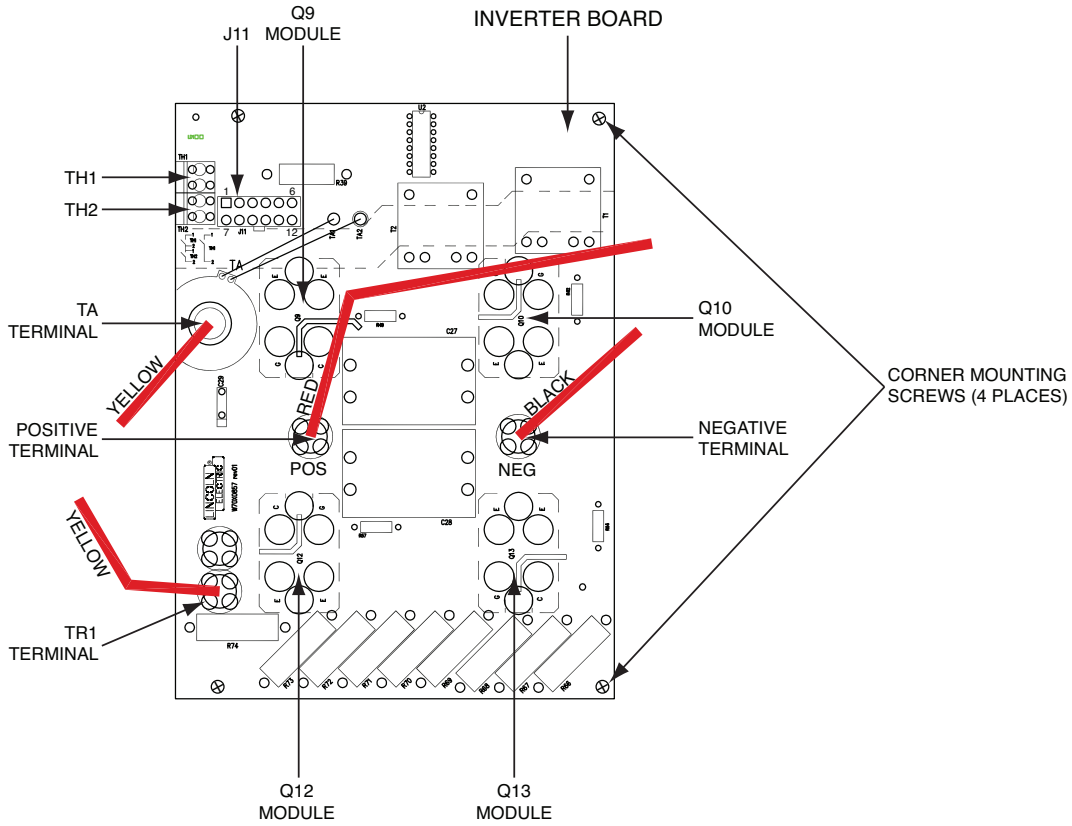
- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Inverter Board. See Figure F.38.
4. Locate and carefully remove plug J11 from the Inverter Board. See ***Figure F.39***.
5. Locate terminals TH1 and TH2. See ***Figure F.39***.
6. Using the small slot head screwdriver, remove the leads from terminals TH1 and TH2. Label the leads for reassembly. See ***Figure F.39***.

INVERTER BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.39 – INVERTER BOARD CONNECTION LOCATIONS

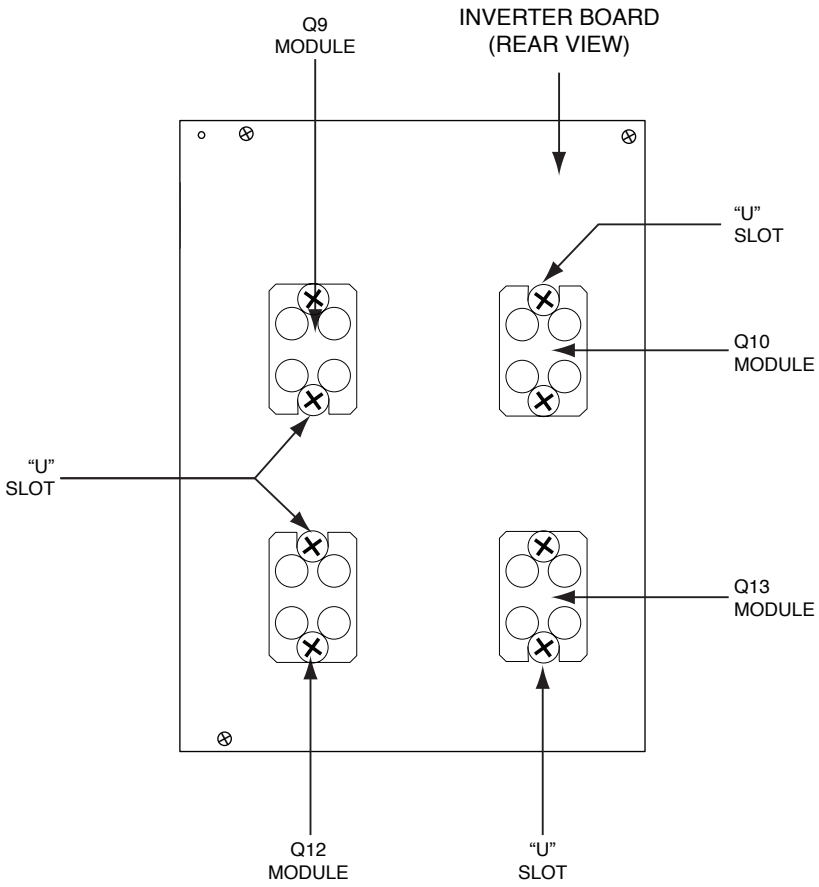


NOTE: Before preforming the following steps take note of the size and type of screws being removed and associated washers. Upon reassembly the same type and size screw and washers MUST be used.

7. Locate and label the main transformer lead connected to the TA terminal. See Figure F.39.
8. Using the phillips screwdriver, remove the main transformer primary lead from the TA terminal. Note placement of the white insulator. See Figure F.39.
9. Locate and label the other main transformer primary lead connected to the TR1 terminal. See Figure F.39.
10. Using the phillips screwdriver, remove the other main transformer lead from the TR1 terminal. See Figure F.39.
11. Locate and label the red positive capacitor lead connected to the positive terminal. See Figure F.39.
12. Using the phillips screwdriver, remove the red positive capacitor lead from the positive terminal. See Figure F.39.
13. Locate and label the black negative capacitor lead connected to the negative terminal. See Figure F.39.
14. Using the phillips screwdriver, remove the black negative capacitor lead from the negative terminal. See Figure F.39.
15. Using the phillips screwdriver, locate and remove the four screws from the Q9 module. The silicon sealant will have to be carefully removed to access the phillips screws. See Figure F.39.

INVERTER BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.40 – INVERTER BOARD MODULE LOCATIONS



16. Using the phillips screwdriver, locate and remove the four screws from the Q10 module. The silicon sealant will have to be carefully removed to access the phillips screws. See ***Figure F.39***.
17. Using the phillips screwdriver, locate and remove the four screws from the Q12 module. The silicon sealant will have to be carefully removed to access the phillips screws. See ***Figure F.39***.
18. Using the phillips screwdriver, locate and remove the four screws from the Q13 module. The silicon sealant will have to be carefully removed to access the phillips screws. See ***Figure F.39***.
19. Using the phillips screwdriver, locate and remove the four corner mounting screws and associated washers. See ***Figure F.39***.
20. Carefully remove the Inverter Board from the machine.
21. Note the placement and location of the following components. Module Q9, Module Q10, Module Q12 and Module Q13. See Figure F.40.
22. Carefully remove the mounting screws and associated washers from the module(s) to be replaced. Take note of type and size of mounting screws.

NOTE: Carefully remove the old module(s) taking note of placement, component type and polarity. One end has a mounting hole and the other end has a "U" mounting slot. **The new module(s) must be mounted in the same configuration**. See Figure F.40.

INVERTER BOARD
REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Carefully clean the heat sink.
2. Apply a thin layer of Dow Corning 340 heat sink compound (Lincoln Part T12837) on the new module(s).
3. Carefully fasten the new module(s) to the heat sink using the screws and washers previously removed. Observe polarity and mounting position. See ***Figure F.40***. Torque the mounting screws to 12 Inch Pounds.
4. Carefully install the new Inverter Board on to the four mounting posts using the four corner mounting screws and washers previously removed. Do not tighten the mounting screws yet.
5. Mount the Inverter Board on to Module Q9 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.39***. Seal screw heads with a drop of silicon sealant.
6. Mount the Inverter Board on to Module Q10 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.39***. Seal screw heads with a drop of silicon sealant.
7. Mount the Inverter Board on to Module Q12 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.39***. Seal screw heads with a drop of silicon sealant.
8. Mount the Inverter Board on to Module Q13 using the four screws and associated washers previously removed. Torque the screws to 12 Inch Pounds. See ***Figure F.39***. Seal screw heads with a drop of silicon sealant.
9. Finish tightening the four corner mounting screws to 12 Inch Pounds.
10. Using the screw and associated washers previously removed, reconnect the black negative capacitor lead to the negative terminal. See ***Figure F.39***. Torque the screw to 12 Inch Pounds.
11. Using the screw and associated washers previously removed, reconnect the red positive capacitor lead to the positive terminal. See ***Figure F.39***. Torque the screw to 12 Inch Pounds.
12. Using the screw and associated washers previously removed, reconnect the main transformer lead to the TR1 terminal. See ***Figure F.39***. Torque the screw to 12 Inch Pounds.
13. Using the screw and associated washers previously removed, reconnect the main transformer lead to the TA terminal. Make sure the white insulator is in place. See ***Figure F.39***. Torque the screw to 12 Inch Pounds.
14. Reconnect plug J11 into the correct receptacle on the Inverter Board. See ***Figure F.39***.
15. Reconnect the previously removed leads into terminal TH1. See ***Figure F.39***.
16. Reconnect the previously removed leads into terminal TH2. See ***Figure F.39***.
17. Clear and position all leads for reassembly.
18. Perform the ***Case Cover Replacement Procedure***.

NOTES

AIR FILTER ASSEMBLY
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

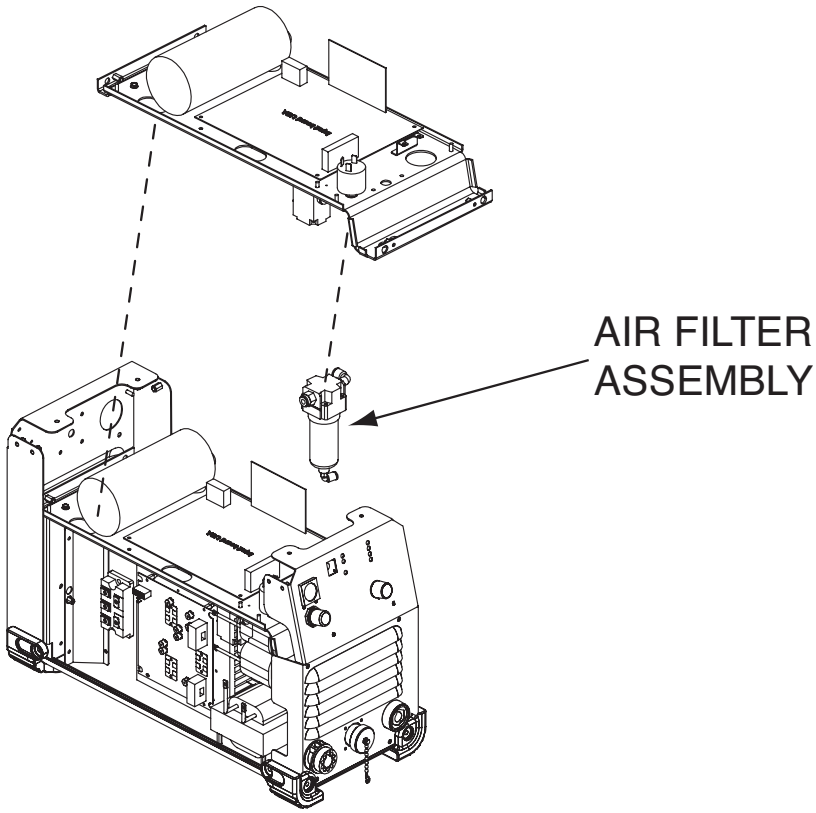
This procedure will aid the technician in the removal and replacement of the Air Filter Assembly.

MATERIALS NEEDED

Phillips Screwdriver (Small or Medium)

AIR FILTER ASSEMBLY
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.41 – AIR FILTER ASSEMBLY LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

---

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Air Filter assembly. See Figure F.41.
4. Carefully remove the two gas hoses from the top portion of the Air Filter assembly by depressing the locking collars and carefully extracting the gas hoses.
5. Carefully remove the one small drain hose from the bottom of the Air Filter assembly by depressing the locking collar and carefully extracting the drain hose.
6. Using the phillips screwdriver, remove the screw securing the Air Filter Assembly and mounting bracket to the horizontal panel.
7. Carefully remove the Air Filter assembly from the machine.
8. Remove the two screws and associated washers securing the mounting bracket to the Air Filter assembly. Save the two screws, washers and mounting bracket for assembly to the new Air Filter.

AIR FILTER ASSEMBLY
REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Using the two screws and washers previously removed, attach the mounting bracket to the new Air Filter.
2. Carefully position the new Air Filter assembly into the machine.
3. Attach the mounting bracket to the horizontal panel using the screw previously removed.
4. Reconnect the two gas hoses into the Air Filter assembly.
5. Reconnect the small drain hose into the Air Filter assembly.
6. Perform the ***Case Cover Replacement Procedure***.

NOTES

PRESSURE GUAGE AND REGULATOR REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

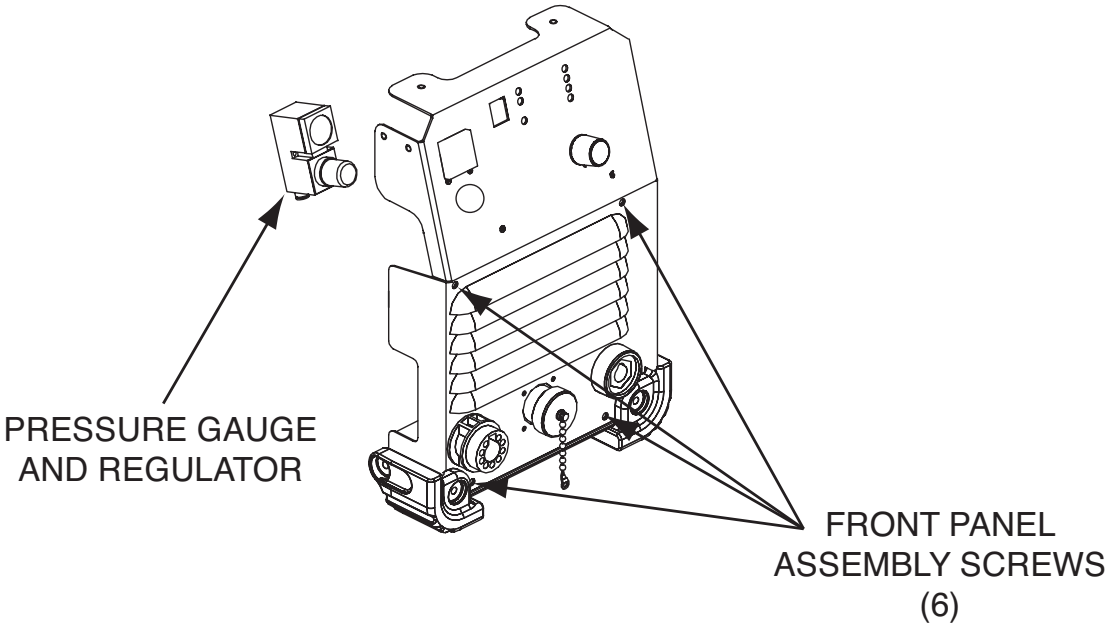
This procedure will aid the technician in the removal and replacement of the Pressure Gauge and Regulator.

MATERIALS NEEDED

Phillips Screwdriver (Small and Medium)
6 mm Wrench
Adjustable Wrench

PRESSURE GUAGE AND REGULATOR REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.42 – PRESSURE GUAGE AND REGULATOR LOCATION



PROCEDURE

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Pressure Gauge and Regulator assembly. See Figure F.42.
4. Using the adjustable wrench, remove the large locking nut securing the Pressure Gauge and Regulator to the front panel.
5. Using the phillips screwdriver, locate and remove the six screws from the front panel assembly. By carefully “pulling” the front panel forward this will allow access to the mounting nuts and air hoses. See Figure F.42.

PRESSURE GUAGE AND REGULATOR REMOVAL AND REPLACEMENT PROCEDURE (continued)

6. Carefully remove the two gas hoses from the Pressure Gauge and Regulator by depressing the locking collars and carefully extracting the gas hoses.
7. Using the 6 mm wrench, remove the three nuts and washers securing the Pressure Gauge and Regulator assembly to the front panel assembly. Take note of the grounding lead connection.
8. Carefully remove the Pressure Gauge and Regulator assembly from the machine.

REPLACEMENT PROCEDURE

1. Carefully position the new Pressure Gauge and Regulator assembly into the machine.
2. Mount the Pressure Gauge and Regulator assembly on to the front panel using the three nuts and washers previously removed. Be sure to connect the grounding lead.
3. Reconnect the two gas hoses into the Pressure Gauge and Regulator assembly.
4. Replace the large locking nut previously removed.
5. Replace the six phillips screws previously removed from the front panel.
6. Perform the ***Case Cover Replacement Procedure***.

NOTES

GAS SOLENOID
REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

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

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

TEST DESCRIPTION

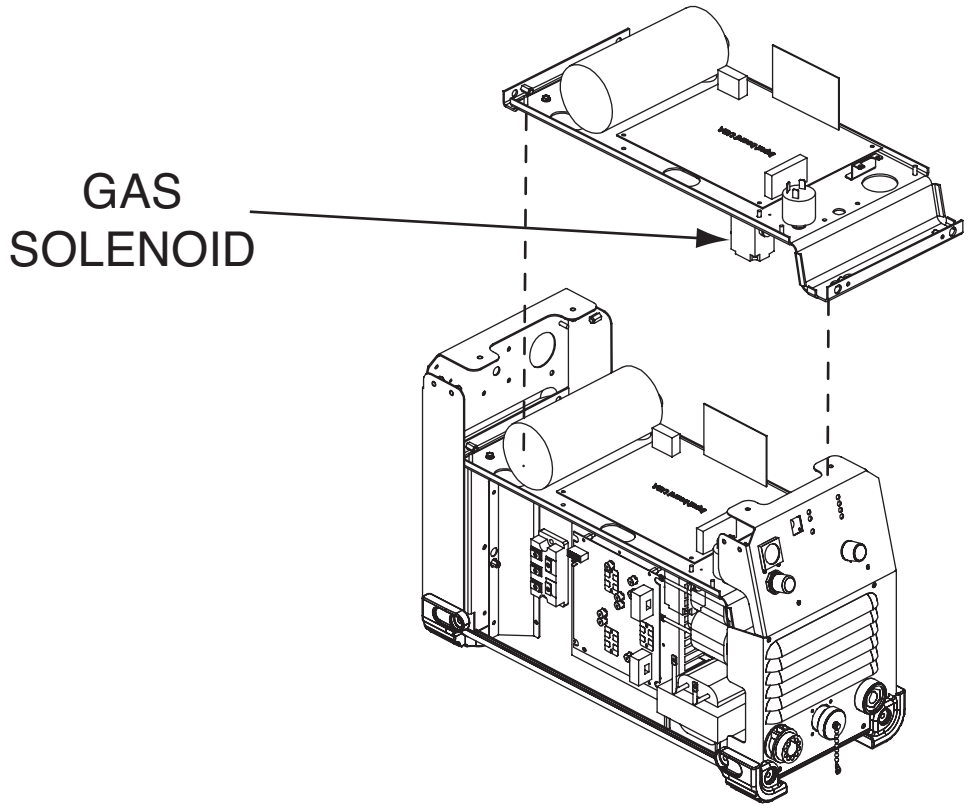
This procedure will aid the technician in the removal and replacement of the Gas Solenoid.

MATERIALS NEEDED

Phillips Screwdriver (Small and Medium)
Wiring Diagram

GAS SOLENOID
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.43 – GAS SOLENOID LOCATION



PROCEDURE

⚠ WARNING

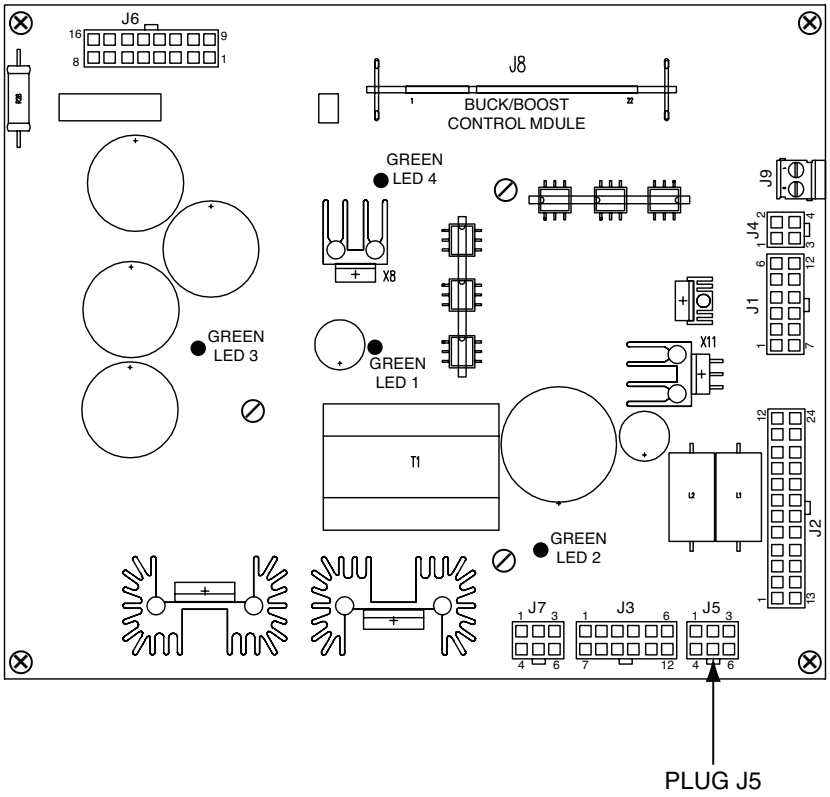
ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

1. Remove the input power from the Tomahawk 1000 machine.
2. Perform the ***Case Cover Removal and Capacitor Discharge Procedure***.
3. Locate the Gas Solenoid. See Figure F.43.
4. Label and cut the red and black wires connecting the gas solenoid to plug J5 on the Input Board. See ***Figure F.44***. Leave enough wire length to splice and attach the new gas solenoid wires.
5. Carefully remove the two gas hoses from the gas solenoid by depressing the locking collars and carefully extracting the gas hoses.
6. Using the phillips screwdriver, remove the two mounting screws securing the gas solenoid to the horizontal panel.
7. Remove the gas solenoid from the machine.

GAS SOLENOID
REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.44 – PLUG J5 ON INPUT BOARD LOCATION



REPLACEMENT PROCEDURE

1. Carefully position the new gas solenoid into the machine.
2. Mount the gas solenoid on to the horizontal panel using the two screws previously removed.
3. Reconnect the two gas hoses into the gas solenoid.
4. Splice the red and black wires into plug J5 on the input board.
5. Perform the ***Case Cover Replacement Procedure***.

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
230/1/60HZ ±10%	24.3 Amps	40A @ 100% Duty Cycle
230/1/60HZ ±10%	34.3 Amps	60A @ 50% Duty Cycle

Output Current Range	20 - 60 Amps DC

Maximum Open Circuit Range	270 Volts DC

Pilot Current	20 Amps

1. Connect the machine to 208/230VAC 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 lit on the front nameplate.
3. Test the pressure switch in the following way:
   - Turn the output control knob to the blue purge area till the air starts flowing from torch.

   NOTE: If left in Purge, Purge will shut off after 5 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 to cut area of dial (RED) then pull the trigger on the torch. Verify that a pilot arc does NOT occur. Release the trigger.

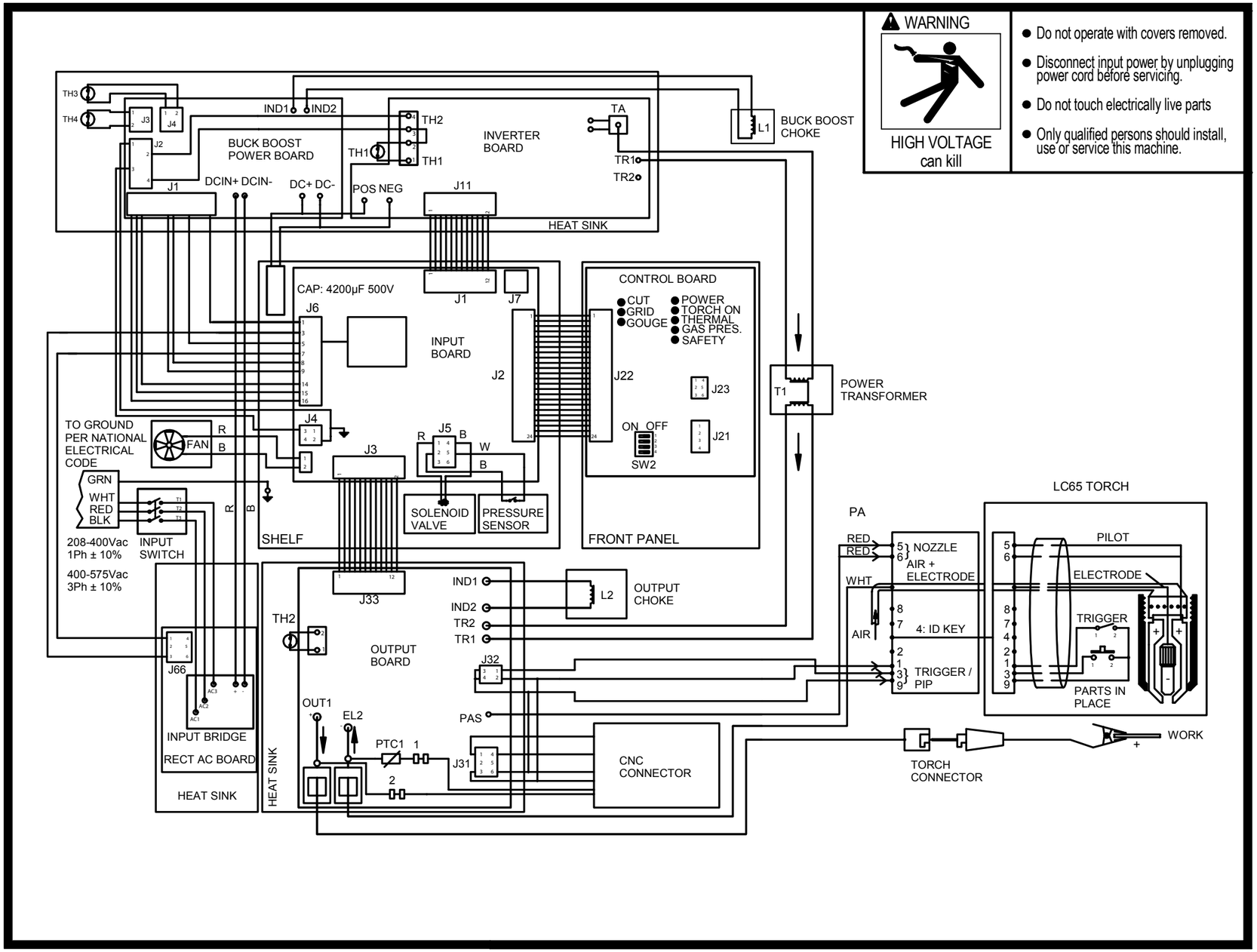
   While in Purge mode increase the regulator back to the blue arrow above gauge for proper air pressure for cutting levels, 80 psi (.55MPa).

   Move dial out of Purge area.
4. Test the Purge safety function by dialing into Purge blue 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 comes on. 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 at its maximum material thickness with 1.0" steel max. Turn current dial to maximum.
8. Turn the Tomahawk off. Test complete.

TABLE OF CONTENTS - DIAGRAM SECTION

*** NOTE:** Many PC Board Assemblies are now totally encapsulated, surface mounted and or multi-layered and are therefore considered to be unserviceable. Assembly drawings of these boards are no longer provided.

TOMAHAWK 1000 WIRING DIAGRAM



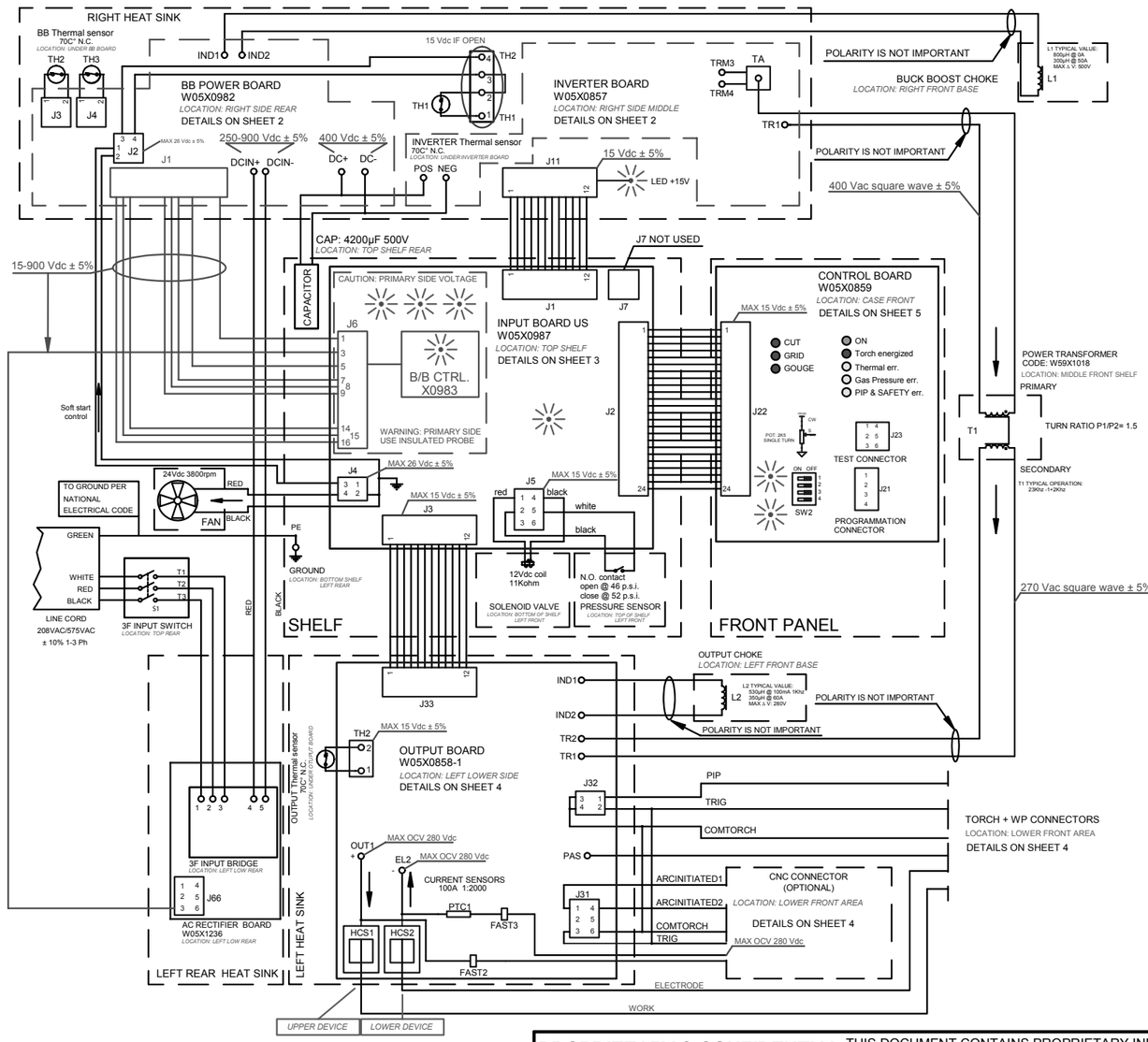
M22322 A.04

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

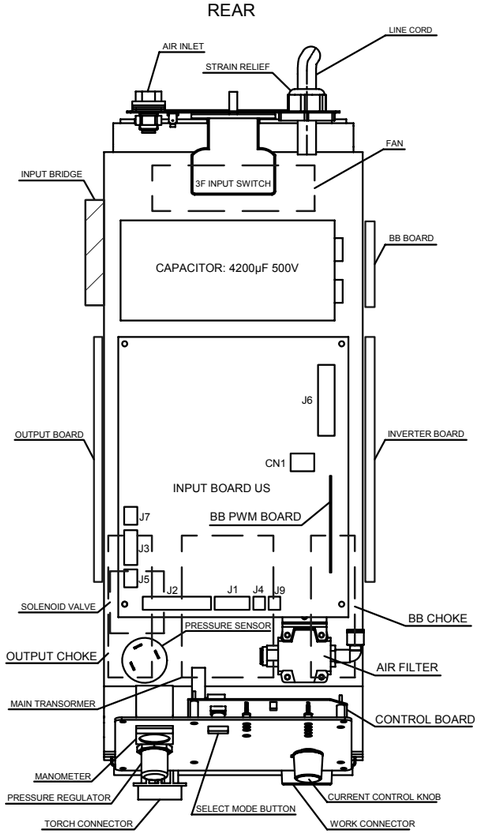
Return to Section TOC
Return to Master TOC

SCHEMATIC TOMAHAWK® 1000 - COMPLETE MACHINE - (CODE 11581) (M22293) PG 1

M22293 | ENGINEERING CONTROLLED MANUFACTURER: No | CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND PAGES 2, 3, 4, 5, 6 AND 7.



TOMAHAWK 1000
COMPONENT LAYOUT

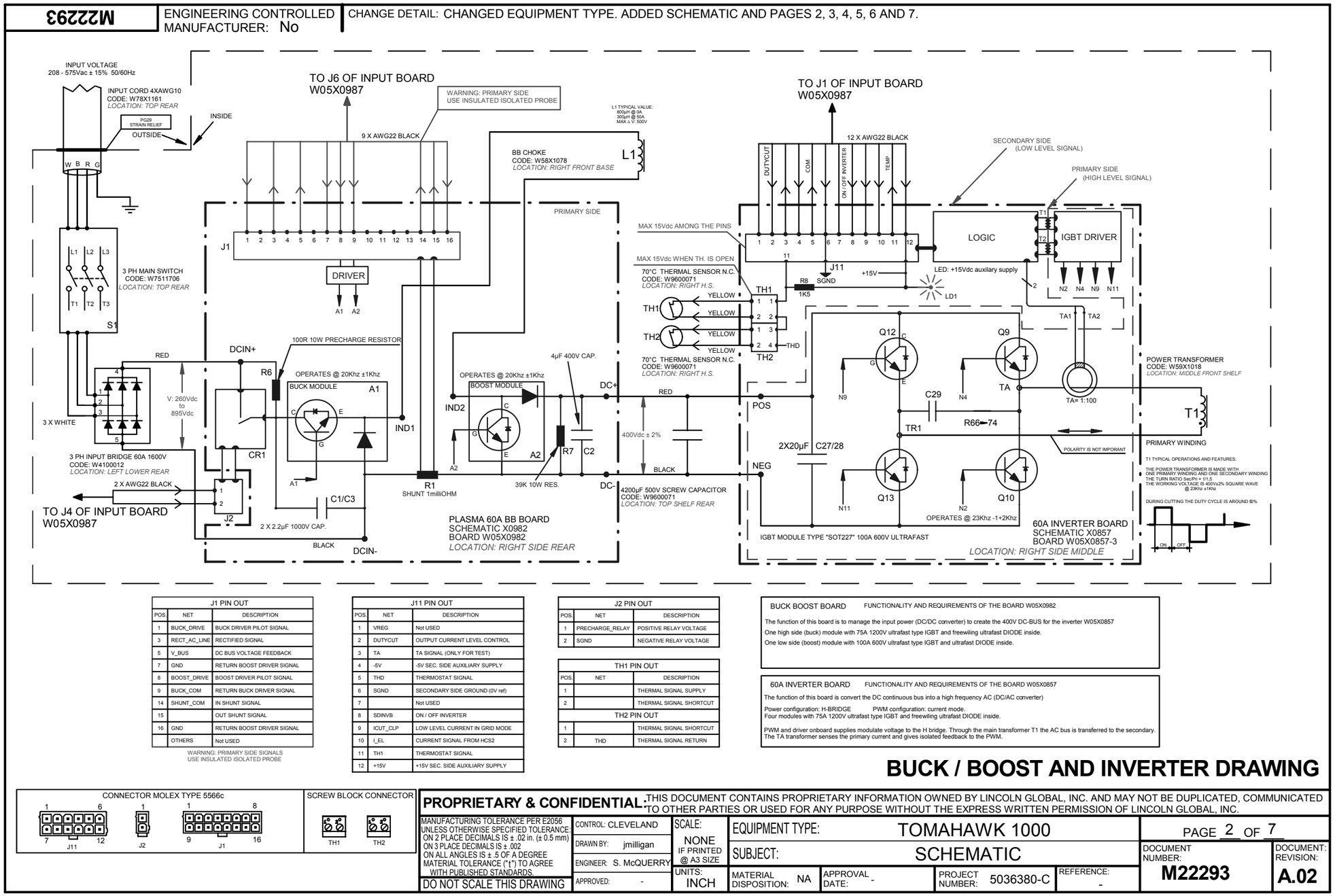


GENERAL VIEW DRAWING

MANUFACTURING TOLERANCE PER E2056 UNLESS OTHERWISE SPECIFIED TOLERANCE: ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm) ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS. DO NOT SCALE THIS DRAWING	CONTROL: CLEVELAND DRAWN BY: jmilligan ENGINEER: S. McQUERRY APPROVED: -	SCALE: NONE IF PRINTED @ A3 SIZE UNITS: INCH	EQUIPMENT TYPE: TOMAHAWK 1000 SUBJECT: SCHEMATIC MATERIAL DISPOSITION: NA APPROVAL DATE: - PROJECT NUMBER: 5036380-C REFERENCE: -	PAGE 1 OF 7 DOCUMENT NUMBER: M22293 DOCUMENT: REVISION: A.02			

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

SCHEMATIC TOMAHAWK 1000 - COMPLETE MACHINE - (CODE 11581) (M22293) PG 2



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

SCHEMATIC TOMAHAWK 1000 - COMPLETE MACHINE - (CODE 11581) (M22293) PG 3

M22293

ENGINEERING CONTROLLED
MANUFACTURER: No

CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND PAGES 2, 3, 4, 5, 6 AND 7.

CN1 PIN OUT (JTAG SIGNAL FOR CPLD)		
POS.	NET	DESCRIPTION
1	TDO	Test Data Output
2	TDI	Test Data Input
3	TCK	Test Clock
4	TMS	Test mode select
5	+3.3V	Supply for JTAG
6	COM	RETURN OF NOT INSULATED SUPPLY (0V ref)

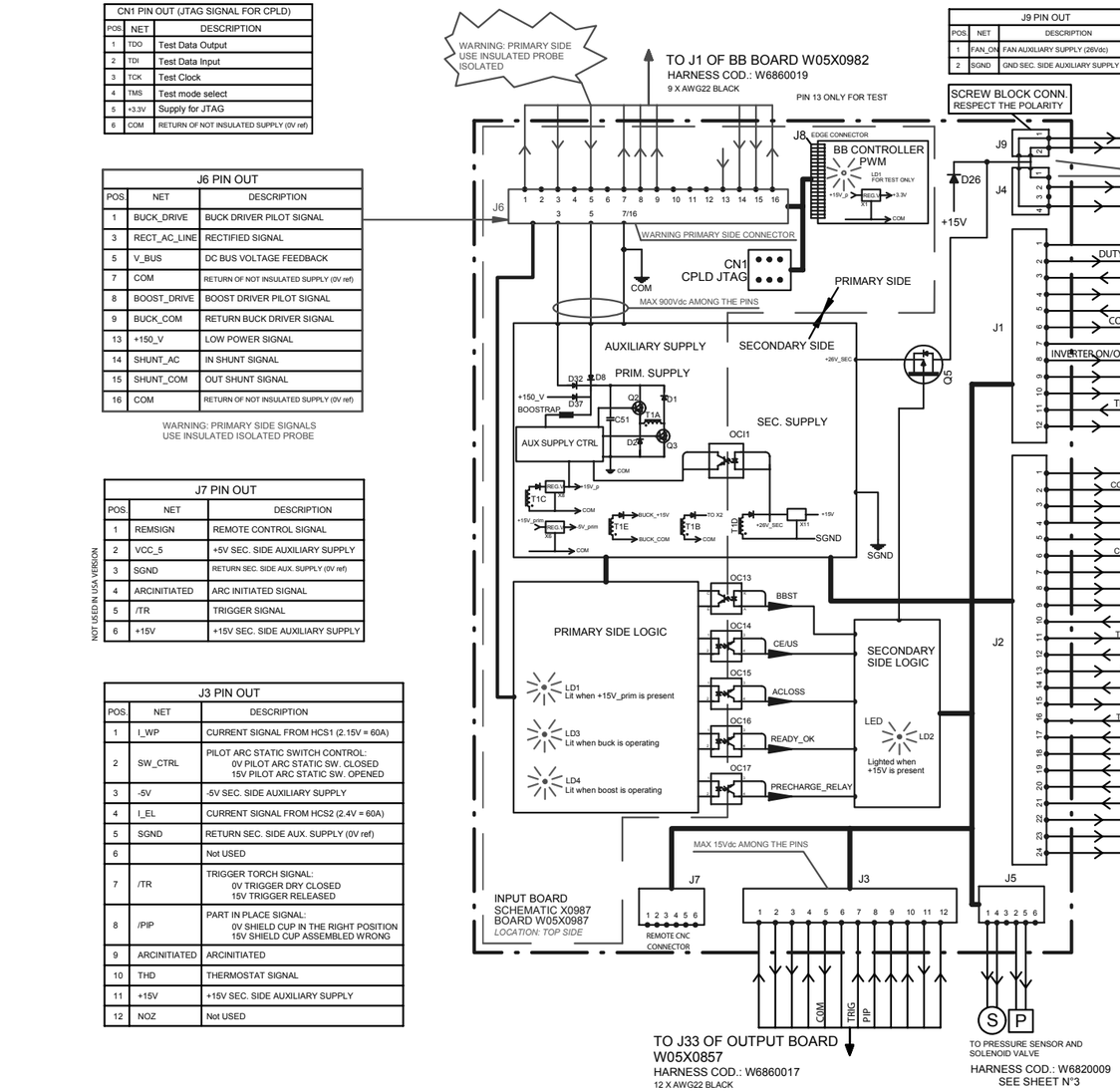
J6 PIN OUT		
POS.	NET	DESCRIPTION
1	BUCK_DRIVE	BUCK DRIVER PILOT SIGNAL
3	RECT_AC_LINE	RECTIFIED SIGNAL
5	V_BUS	DC BUS VOLTAGE FEEDBACK
7	COM	RETURN OF NOT INSULATED SUPPLY (0V ref)
8	BOOST_DRIVE	BOOST DRIVER PILOT SIGNAL
9	BUCK_COM	RETURN BUCK DRIVER SIGNAL
13	+150_V	LOW POWER SIGNAL
14	SHUNT_AC	IN SHUNT SIGNAL
15	SHUNT_COM	OUT SHUNT SIGNAL
16	COM	RETURN OF NOT INSULATED SUPPLY (0V ref)

WARNING: PRIMARY SIDE SIGNALS
USE INSULATED ISOLATED PROBE

J7 PIN OUT		
POS.	NET	DESCRIPTION
1	REMSIGN	REMOTE CONTROL SIGNAL
2	VCC_5	+5V SEC. SIDE AUXILIARY SUPPLY
3	SGND	RETURN SEC. SIDE AUX. SUPPLY (0V ref)
4	ARCINITIATED	ARC INITIATED SIGNAL
5	/TR	TRIGGER SIGNAL
6	+15V	+15V SEC. SIDE AUXILIARY SUPPLY

NOT USED IN USA VERSION

J3 PIN OUT		
POS.	NET	DESCRIPTION
1	I_WP	CURRENT SIGNAL FROM HCS1 (2.15V = 60A)
2	SW_CTRL	PILOT ARC STATIC SWITCH CONTROL: 0V PILOT ARC STATIC SW. CLOSED 15V PILOT ARC STATIC SW. OPENED
3	-5V	-5V SEC. SIDE AUXILIARY SUPPLY
4	I_EL	CURRENT SIGNAL FROM HCS2 (2.4V = 60A)
5	SGND	RETURN SEC. SIDE AUX. SUPPLY (0V ref)
6		Not USED
7	/TR	TRIGGER TORCH SIGNAL: 0V TRIGGER DRY CLOSED 15V TRIGGER RELEASED
8	/PIP	PART IN PLACE SIGNAL: 0V SHIELD CUP IN THE RIGHT POSITION 15V SHIELD CUP ASSEMBLED WRONG
9	ARCINITIATED	ARCINITIATED
10	THD	THERMOSTAT SIGNAL
11	+15V	+15V SEC. SIDE AUXILIARY SUPPLY
12	NOZ	Not USED



J9 PIN OUT		
POS.	NET	DESCRIPTION
1	FAN_ON	FAN AUXILIARY SUPPLY (26Vdc)
2	SGND	GND SEC. SIDE AUXILIARY SUPPLY (0V ref)

FAN OPERATION

When the unit is energized the fan starts to run at "High speed".

FAN AS NEEDED FUNCTIONALITY

After five minute from when the machine has been turned on and no current flow to the output the fan goes from high speed to low speed.

If the high temperature error comes from the thermal sensor (TH1) the µC puts the fan in High speed status until the error disappears. After that the process starts again from the beginning.

J4 PIN OUT		
POS.	NET	DESCRIPTION
1	SGND	GND SEC. SIDE AUXILIARY SUPPLY (0V ref)
2	SGND	GND SEC. SIDE AUXILIARY SUPPLY (0V ref)
3	RELAY	POSITIVE RELAY VOLTAGE SUPPLY
4	FAN_ON	POSITIVE FAN VOLTAGE SUPPLY

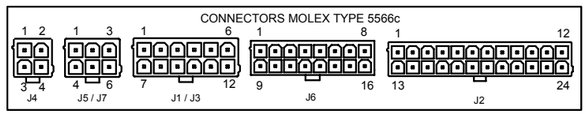
J1 PIN OUT		
POS.	NET	DESCRIPTION
1	VREG	Not USED
2	DUTYCUT	OUTPUT CURRENT LEVEL CONTROL
3	TA	TA SIGNAL (ONLY FOR TEST)
4	-5V	-5V SEC. SIDE AUXILIARY SUPPLY
5	THD	THERMOSTAT SIGNAL
6	SGND	RETURN SEC. SIDE AUX. SUPPLY (0V ref)
7		Not USED
8	SDINVB	ON / OFF INVERTER
9	ICUT_CLP	LOW LEVEL CURRENT IN GRID MODE
10	I_EL	CURRENT SIGNAL FROM HCS2
11	TH1	THERMOSTAT SIGNAL
12	+15V	+15V SEC. SIDE AUXILIARY SUPPLAY

J2 PIN OUT		
POS.	NET	DESCRIPTION
1	+15V	+15V SEC. SIDE AUXILIARY SUPPLY
2	SGND	RETURN SEC. SIDE AUX. SUPPLY (0V ref)
3	GASERR	AIR PESSURE SIGNAL: 0V PRESSURE OK 15V PRESSURE OUT OF RANGE
4	I_EL	CURRENT SIGNAL FROM HCS2 (2.4V=60A)
5	I_WP	CURRENT SIGNAL FROM HCS1 (2.15V = 60A)
6	SGND	GND SEC. SIDE AUXILIARY SUPPLY (0V ref)
7	NOZ	NOT USED
8	REMSIGN	REMOTE CONTROL SIGNAL: 0-4.28V = 0-60A
9	READY_OK	SIGNAL "READY OK" TO START CUTTING: 0V = NO ERROR -> OK TO START 15V = ERROR -> WAITING NO ERROR TO START
10	SW_CTRL	PILOT ARC STATIC SWITCH SIGNAL: 0V = STATIC SWITCH CLOSE 15V = STATIC SWITCH OPEN
11	TH1	THERMOSTAT SIGNAL: 0V= NO ERROR; 15V= ERROR
12	DUTYCUT	CURRENT SET SIGNAL 9.6V = 60A
13	/PIP	PART IN PLACE SECONDARY SIDE SIGNAL: 0V= shield cup in the right position 15V= shield cup wrong assembled
14	SDINVB	SHUT DOWN INVERTER SIGNAL: 0V = inverter ON 15V = inverter OFF
15	TH2	NOT USED
16	/TR	TRIGGER TORCH SECONDARY SIDE SIGNAL: 0V = trigger dry close 15V = trigger released
17	SOL	SOLENOID VALVE SIGNAL: 0V= SOL. ON; 15V= SOL. OFF
18	FAN	FAN SIGNAL: 0V= FAN OFF; 15V= FAN ON
19	ARCINITIATED	ARC INITIATED: 0V= ARC ON; 15V= ARC OFF
20	ICUT_CLP	LOW LEVEL GRID MODE: 0V= NO CLAMP; 15V= CLAMP
21	BBST	SWITCH OFF BB: 0V= BB ON; 15V= BB OFF
22	CE/US	HIGH LEVEL = CE VERSION, LOW LEVEL = US
23	ACLOSS	LOSS OF WAVE SIGNAL: 0V=OK, 15V=ERROR
24	TA	TA SIGNAL (ONLY FOR TEST)

J5 PIN OUT		
POS.	NET	DESCRIPTION
1		POSITIVE SOLENOID SIGNAL
2	GASERR	AIR PESSURE "OK" SIGNAL
3		NOT USED
4	VALVE	NEGATIVE SOLENOID SIGNAL
5	SGND	RETURN SEC. SIDE AUX. SUPPLY (0V ref)
6		NOT USED

FUNCTIONALITY OF THE BOARD:
1) PROVIDE FAN MOTOR DRIVE SUPPLY
2) MANAGE AIR SOLENOID VALVE
3) MANAGE BUCK AND BOOST POWER MODULE (PWM + DRIVER) ON THE BOARD IN PRESENT THE AUXILIARY SUPPLY FOR PRIMARY AND SECONDARY SIDE NEEDS.

CONNECTORS MOLEX TYPE 5566c



INPUT BOARD AND BB PWM DRAWING

MANUFACTURING TOLERANCE PER E2056
UNLESS OTHERWISE SPECIFIED TOLERANCE
ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm)
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

CONTROL: CLEVELAND
DRAWN BY: jmilligan
ENGINEER: S. McQUERRY
APPROVED: -

SCALE: NONE IF PRINTED @ A3 SIZE
UNITS: INCH

EQUIPMENT TYPE: TOMAHAWK 1000
SUBJECT: SCHEMATIC
MATERIAL DISPOSITION: NA
APPROVAL DATE: -
PROJECT NUMBER: 5036380-C
REFERENCE: -

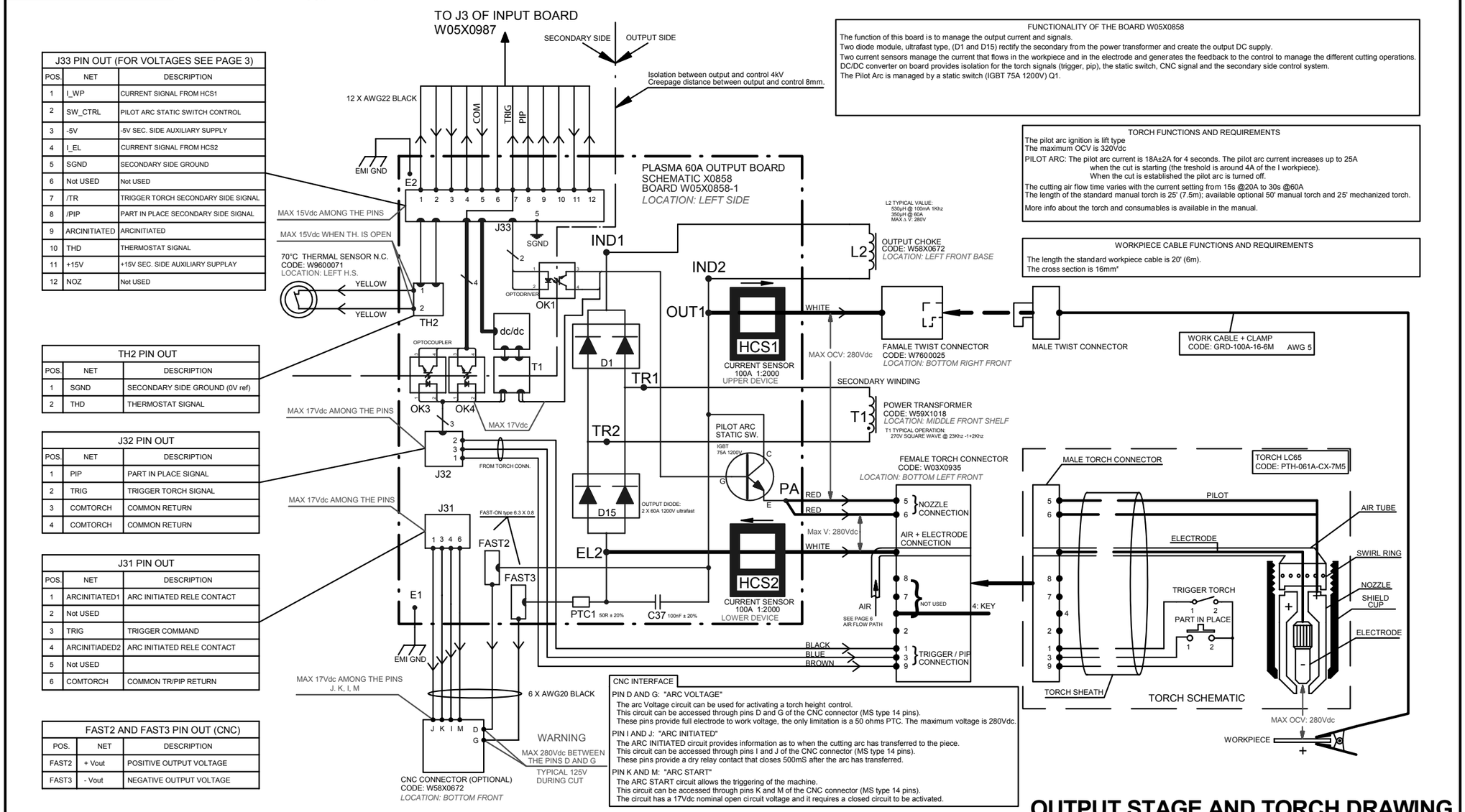
PAGE 3 OF 7

DOCUMENT NUMBER: M22293
DOCUMENT REVISION: A.02

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

SCHEMATIC TOMAHAWK 1000 - COMPLETE MACHINE - (CODE 11581) (M22293) PG 4

M22293 | ENGINEERING CONTROLLED MANUFACTURER: No | CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND PAGES 2, 3, 4, 5, 6 AND 7.



J33 PIN OUT (FOR VOLTAGES SEE PAGE 3)

POS.	NET	DESCRIPTION
1	I_WP	CURRENT SIGNAL FROM HCS1
2	SW_CTRL	PILOT ARC STATIC SWITCH CONTROL
3	-5V	-5V SEC. SIDE AUXILIARY SUPPLY
4	I_EL	CURRENT SIGNAL FROM HCS2
5	SGND	SECONDARY SIDE GROUND
6	Not USED	Not USED
7	/TR	TRIGGER TORCH SECONDARY SIDE SIGNAL
8	/PIP	PART IN PLACE SECONDARY SIDE SIGNAL
9	ARCINITIATED	ARCINITIATED
10	THD	THERMOSTAT SIGNAL
11	+15V	+15V SEC. SIDE AUXILIARY SUPPLAY
12	NOZ	Not USED

TH2 PIN OUT

POS.	NET	DESCRIPTION
1	SGND	SECONDARY SIDE GROUND (0V ref)
2	THD	THERMOSTAT SIGNAL

J32 PIN OUT

POS.	NET	DESCRIPTION
1	PIP	PART IN PLACE SIGNAL
2	TRIG	TRIGGER TORCH SIGNAL
3	COMTORCH	COMMON RETURN
4	COMTORCH	COMMON RETURN

J31 PIN OUT

POS.	NET	DESCRIPTION
1	ARCINITIATED1	ARC INITIATED RELE CONTACT
2	Not USED	
3	TRIG	TRIGGER COMMAND
4	ARCINITIADED2	ARC INITIATED RELE CONTACT
5	Not USED	
6	COMTORCH	COMMON TR/PIP RETURN

FAST2 AND FAST3 PIN OUT (CNC)

POS.	NET	DESCRIPTION
FAST2	+ Vout	POSITIVE OUTPUT VOLTAGE
FAST3	- Vout	NEGATIVE OUTPUT VOLTAGE

FUNCTIONALITY OF THE BOARD W05X0858

The function of this board is to manage the output current and signals.
Two diode module, ultrafast type, (D1 and D15) rectify the secondary from the power transformer and create the output DC supply.
Two current sensors manage the current that flows in the workpiece and in the electrode and generates the feedback to the control to manage the different cutting operations.
DC/DC converter on board provides isolation for the torch signals (trigger, pip), the static switch, CNC signal and the secondary side control system.
The Pilot Arc is managed by a static switch (IGBT 75A 1200V) Q1.

TORCH FUNCTIONS AND REQUIREMENTS

The pilot arc ignition is lift type
The maximum OCV is 320Vdc
PILOT ARC: The pilot arc current is 18A±2A for 4 seconds. The pilot arc current increases up to 25A when the cut is starting (the treshold is around 4A of the I workpiece). When the cut is established the pilot arc is turned off.
The cutting air flow time varies with the current setting from 15s @20A to 30s @60A
The length of the standard manual torch is 25' (7.5m); available optional 50' manual torch and 25' mechanized torch.
More info about the torch and consumables is available in the manual.

WORKPIECE CABLE FUNCTIONS AND REQUIREMENTS

The length the standard workpiece cable is 20' (6m).
The cross section is 16mm²

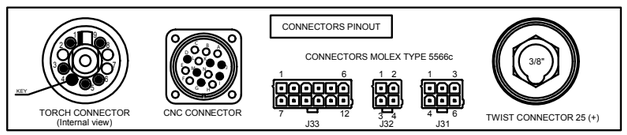
CNC INTERFACE

PIN D AND G: "ARC VOLTAGE"
The arc Voltage circuit can be used for activating a torch height control.
This circuit can be accessed through pins D and G of the CNC connector (MS type 14 pins).
These pins provide full electrode to work voltage, the only limitation is a 50 ohms PTC. The maximum voltage is 280Vdc.

PIN I AND J: "ARC INITIATED"
The ARC INITIATED circuit provides information as to when the cutting arc has transferred to the piece.
This circuit can be accessed through pins I and J of the CNC connector (MS type 14 pins).
These pins provide a dry relay contact that closes 500mS after the arc has transferred.

PIN K AND M: "ARC START"
The ARC START circuit allows the triggering of the machine.
This circuit can be accessed through pins K and M of the CNC connector (MS type 14 pins).
The circuit has a 17Vdc nominal open circuit voltage and it requires a closed circuit to be activated.

OUTPUT STAGE AND TORCH DRAWING



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MANUFACTURING TOLERANCE PER E2056
UNLESS OTHERWISE SPECIFIED TOLERANCE:
ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm)
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

CONTROL: CLEVELAND
DRAWN BY: jmilligan
ENGINEER: S. McQUERRY
APPROVED: -
SCALE: NONE IF PRINTED @ A3 SIZE
UNITS: INCH

EQUIPMENT TYPE: TOMAHAWK 1000
SUBJECT: SCHEMATIC
MATERIAL DISPOSITION: NA
APPROVAL DATE: -
PROJECT NUMBER: 5036380-C
REFERENCE: -
PAGE 4 OF 7
DOCUMENT NUMBER: M22293
DOCUMENT: REVISION: A.02

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

SCHEMATIC TOMAHAWK 1000 - COMPLETE MACHINE - (CODE 11581) (M22293) PG 5

M22293

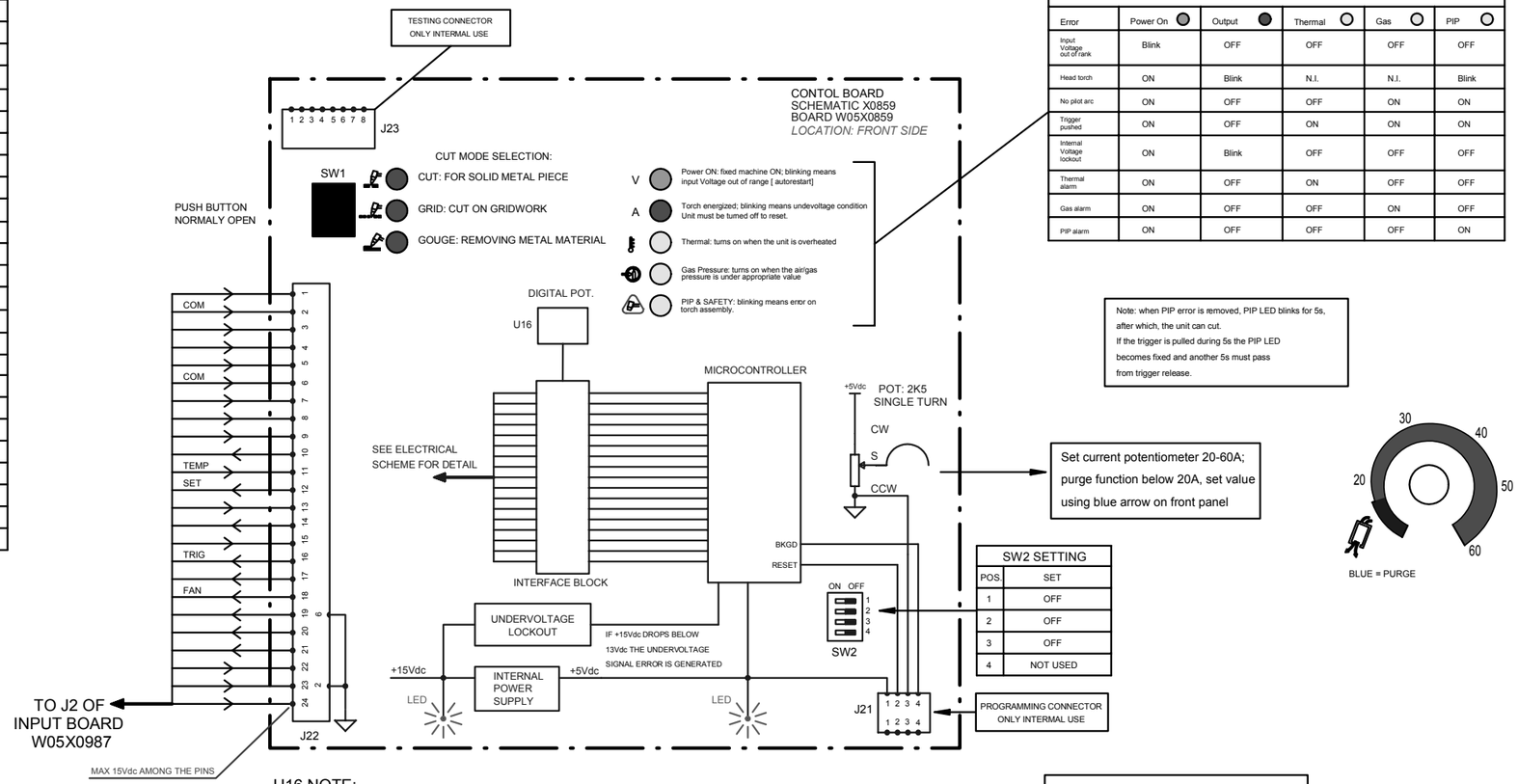
ENGINEERING CONTROLLED
MANUFACTURER: No

CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND PAGES 2, 3, 4, 5, 6 AND 7.

J22 PIN OUT for voltages see page 3.		
POS.	NET	DESCRIPTION
1	+15V	+15V SEC. SIDE AUXILIARY SUPPLY
2	SGND	GND SEC. SIDE AUXILIARY SUPPLY (0V ref)
3	GASERR	AIR PESSURE SIGNAL
4	I_EL	CURRENT SIGNAL FROM HCS2
5	I_WP	CURRENT SIGNAL FROM HCS1
6	SGND	GND SEC. SIDE AUXILIARY SUPPLY (0V ref)
7	NOZ	NOT USED
8	REMSIGN	REMOTE CONTROL SIGNAL
9	READY_OK	SIGNAL "READY OK" TO START CUTTING
10	SW_CTRL	PILOT ARC STATIC SWITCH SIGNAL
11	TH1	THERMOSTAT SIGNAL: 0= NO ERROR; 1= ERROR
12	DUTYCUT	CURRENT SET SIGNAL
13	/PIP	PART IN PLACE SECONDARY SIDE SIGNAL
14	SDINVB	SHUT DOWN INVERTER SIGNAL
15	TH2	NOT USED
16	/TR	TRIGGER TORCH SECONDARY SIDE SIGNAL
17	SOL	SOLENOID VALVE SIGNAL
18	FAN	FAN SIGNAL
19	ARCINITIATED	ARC INITIATED
20	ICUT_CLP	LOW LEVEL GRID MODE
21	BBST	SWITCH OFF BB
22	CE\US	HIGH LEVEL = CE VERSION
23	ACLOSS	LOSS OF WAVE SIGNAL
24	TA	TA SIGNAL (ONLY FOR TEST)

J23 PIN OUT see note at connector		
POS.	NET	DESCRIPTION
1	TA	CURRENT SIGNAL FROM TA
2	SGND	SECONDARY SIDE GROUND
3	FAN	GND THE PIN TO PUT THE FAN OFF
4	THER	THERMAL LED SIGNAL
5	READY_OK	SIGNAL READY OK
6	SGND	SECONDARY SIDE GROUND
7	RX	RX rs232 (FROM PIN14 / U2)
8	TX	TX rs232 (FROM PIN 13 / U2)

J21 PIN OUT see note at connector		
POS.	NET	DESCRIPTION
1	+5Vdc	SEC. SIDE +5V AUXILIARY SUPPLY
2	RESET	PROGRAMMING SIGNAL TO PIN 3 / U2
3	SGND	SECONDARY SIDE GROUND
4	BKGD	PROGRAMMING SIGNAL TO PIN 56 / U2



LEDS INDICATION TABLE					
Error	Power On	Output	Thermal	Gas	PIP
Input Voltage out of rank	Blink	OFF	OFF	OFF	OFF
Head torch	ON	Blink	N.I.	N.I.	Blink
No plot arc	ON	OFF	OFF	ON	ON
Trigger pushed	ON	OFF	ON	ON	ON
Internal Voltage lockout	ON	Blink	OFF	OFF	OFF
Thermal alarm	ON	OFF	ON	OFF	OFF
Gas alarm	ON	OFF	OFF	ON	OFF
PIP alarm	ON	OFF	OFF	OFF	ON

Note: when PIP error is removed, PIP LED blinks for 5s, after which, the unit can cut.
If the trigger is pulled during 5s the PIP LED becomes fixed and another 5s must pass from trigger release.

Set current potentiometer 20-60A; purge function below 20A, set value using blue arrow on front panel

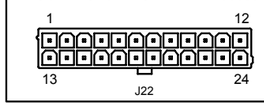
SW2 SETTING	
POS.	SET
1	OFF
2	OFF
3	OFF
4	NOT USED

U16 NOTE:
THE DIGITAL POTENTIOMETER IS FOR FACTORY USE ONLY:
DURING FINAL TEST IT IS USED TO SET THE UNIT.

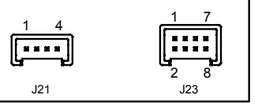
CONTROL BOARD FUNCTIONS.
User interface and main CPU board for cutting grid and gouging process.
Managing of the pilot arc functionality for grid and gouge processes.
Managing of all errors and alarms of the unit.
CE / USA interface for managing BB errors or alarms
Automatic calibration of the unit

CONNECTORS PINOUT

CONNECTOR MOLEX TYPE 5566c



CONNECTORS AMP MODU2



CONTROL BOARD DRAWING

MANUFACTURING TOLERANCE PER E2056 UNLESS OTHERWISE SPECIFIED TOLERANCE:
ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm)
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE (*I*) TO AGREE WITH PUBLISHED STANDARDS.
DO NOT SCALE THIS DRAWING

CONTROL: CLEVELAND
DRAWN BY: jmilligan
ENGINEER: S. McQUERRY
APPROVED: -

SCALE: NONE IF PRINTED @ A3 SIZE
UNITS: INCH

EQUIPMENT TYPE: TOMAHAWK 1000
SUBJECT: SCHEMATIC
MATERIAL DISPOSITION: NA
APPROVAL DATE: -
PROJECT NUMBER: 5036380-C
REFERENCE: -

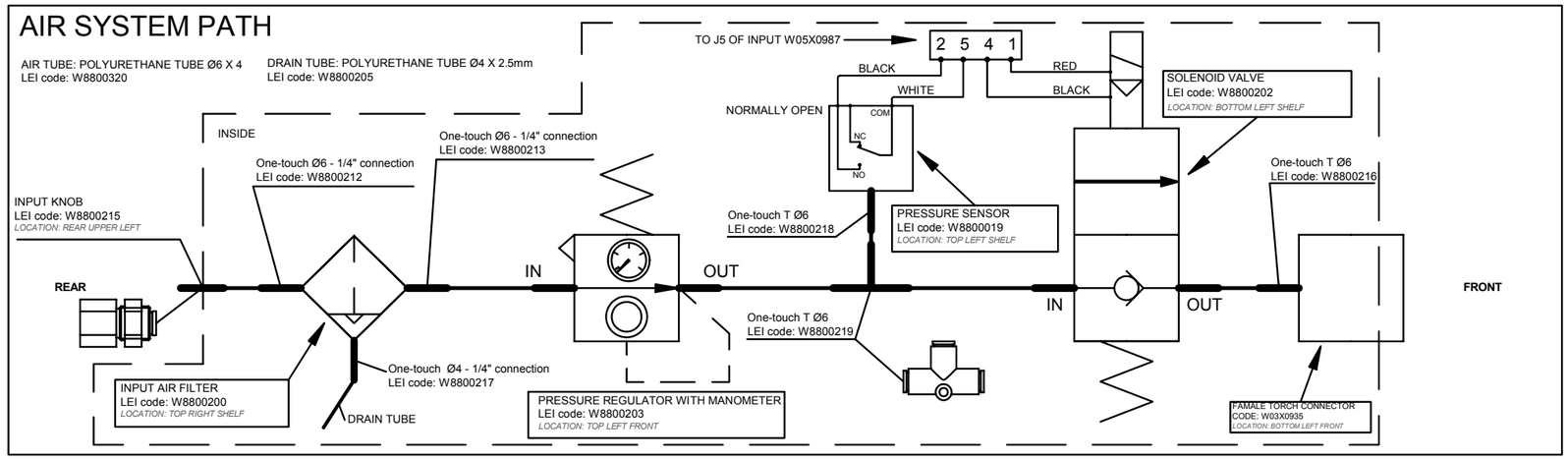
PAGE 5 OF 7
DOCUMENT NUMBER: M22293
DOCUMENT: REVISION: A.02

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

SCHEMATIC TOMAHAWK 1000 - COMPLETE MACHINE - (CODE 11581) (M22293) PG 6

M22293	ENGINEERING CONTROLLED MANUFACTURER: No	CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND PAGES 2, 3, 4, 5, 6 AND 7.



INPUT FILTER FUNCTIONS AND REQIREMENTS

Nominal filtration rating: 5µm
Maximun input pressure: 1Mpa (145 psi); set pressure range: 0.05 - 0.8Mpa (7.2 - 116 psi)

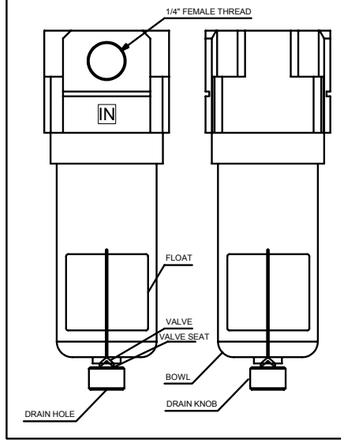
Drain off; normally close type (see below)

The input filter has a double function: filters the dust and removes the water present in the air supply, auto drain system.

Working principle: floating type auto drain. When there is an accumulation of condensation inside the bowl the FLOAT rises due to buoyancy and the seal at valve seat is interrupted. The condensation inside the bowl drains out through the knob.

Turning knob manually cow lowers it causing the sealing action of valve seat to be interrupted, thus allowing the condensate to drain off.

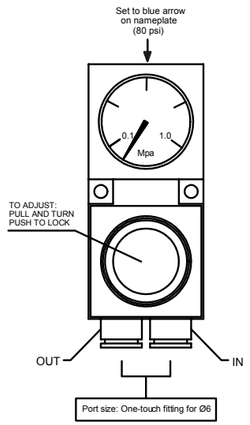
IN and OUT exits are printed on the casting.



PRESSURE REGULATOR FUNCTIONS AND REQUIREMENTS

Compact mainfold regulator with adj. relief mechanism and manometer
Maximun input pressure: 1Mpa (145 psi); set pressure range: 0.05 - 0.7Mpa (7.2 - 101 psi)
Ambient and operating fluid temperature: +5 to 60°C
Typical flow rate with inlet 0.7Mpa (101 psi): outlet: 0.4Mpa (58 psi) @ 115 l/min
Mpa = Mega Pascal
PSI = pound per square inch

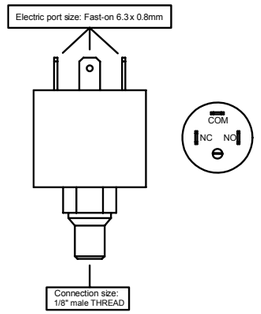
Mpa = PSI see page1 for conversion



Mpa	psi
0.1	19.5
0.2	29.0
0.3	43.5
0.4	58.0
0.5	72.5
0.6	87.0
0.7	101.5
0.8	116.0
0.9	130.5
1.0	145.0

PRESSURE SWITCH FUNCTIONS AND REQUIREMENTS

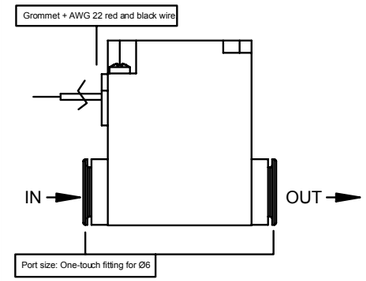
Type: N.O. and N.C. contacts - USED COM + N.O.
Max. electric ratings: N.C. 15A 250Vac N.O. 9A 250Vac
Electrical entry: FAST-ON 6.3 X 0.8 mm
Max. working temperature: + 90°C (UL)
Pressure range: 0.2 - 0.8 Mpa (29 - 116 psi)
High setting pressure: 0.36 Mpa (52 psi) ± 5%
Low setting pressure: 0.32 Mpa (46 psi) ± 5%



SOLENOID VALVE FUNCTIONS AND REQUIREMENTS

Type: 2 way
Nominal electric ratings: 12Vdc, Inrush: 2.9W, Holding: 0.6W
Electrical entry: Grommet + AWG 22 red and black wire
Coil value: 10 kOhm +/-1 kOhm (taking care the correct polarity)
Ambient and fluid temperature working: -10 + 50°C

Min. operating pressure: 001Mpa (1.45 PSI)
Max. operating pressure: 0.6 Mpa (87 PSI)



AIR SYSTEM DRAWING

MANUFACTURING TOLERANCE PER E2056 UNLESS OTHERWISE SPECIFIED TOLERANCE: ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm) ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.	CONTROL: CLEVELAND	SCALE: NONE IF PRINTED @ A3 SIZE	EQUIPMENT TYPE: TOMAHAWK 1000			PAGE 6 OF 7	
	DRAWN BY: jmilligan		SUBJECT: SCHEMATIC			DOCUMENT NUMBER: M22293	DOCUMENT: REVISION: A.02
	ENGINEER: S. McQUERRY	UNITS: INCH	MATERIAL DISPOSITION: NA	APPROVAL DATE: -	PROJECT NUMBER: 5036380-C	REFERENCE: -	
DO NOT SCALE THIS DRAWING	APPROVED: -						

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

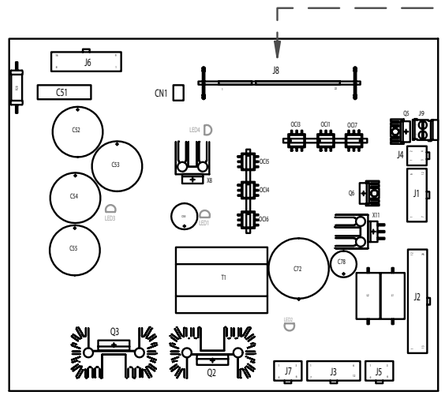
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

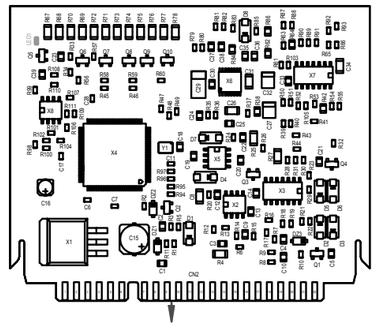
SCHEMATIC TOMAHAWK 1000 - COMPLETE MACHINE - (CODE 11581) (M22293) PG 7

M22293	ENGINEERING CONTROLLED MANUFACTURER: No	CHANGE DETAIL: CHANGED EQUIPMENT TYPE. ADDED SCHEMATIC AND PAGES 2, 3, 4, 5, 6 AND 7.

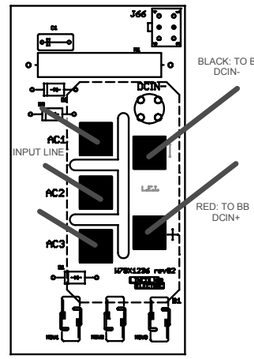
INPUT BOARD W05X0987
PWM BB BOARD W05X0983



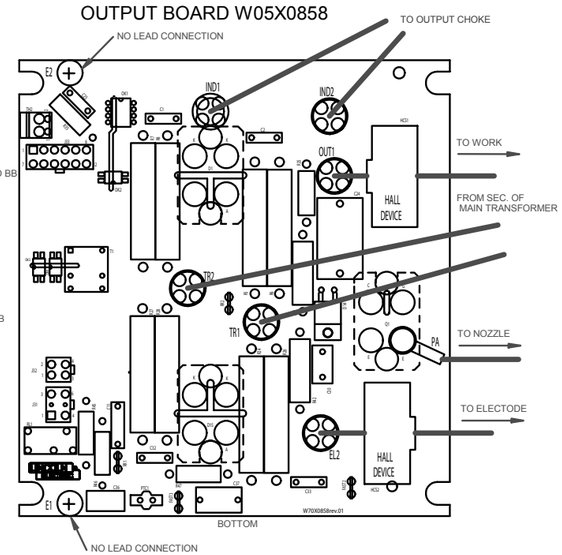
PWM BB BOARD W05X0983
(daughter board of Input board)



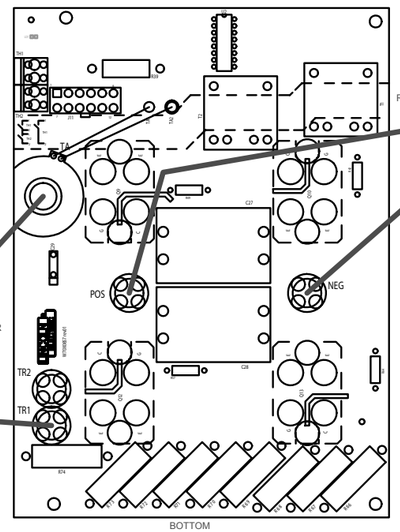
AC RECTIFIER
BOARD W05X1236



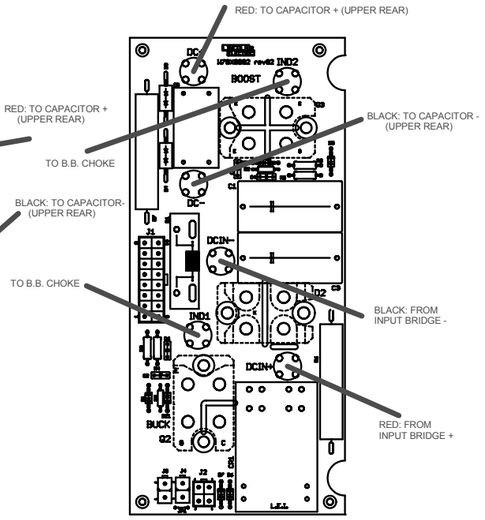
OUTPUT BOARD W05X0858



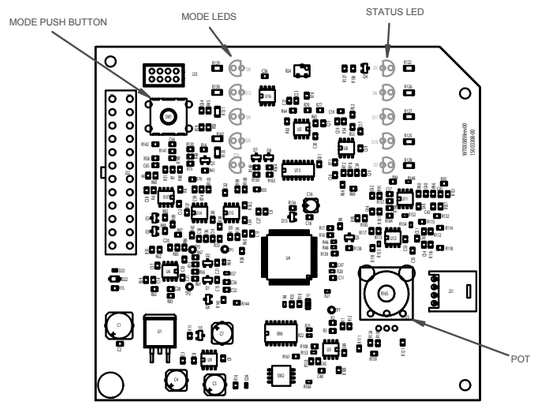
INVERTER BOARD W05X0857



BB BOARD W05X0982



CONTROL BOARD W05X0859



BOARD LAYOUT DRAWING

MANUFACTURING TOLERANCE PER E2056 UNLESS OTHERWISE SPECIFIED TOLERANCE ON 2 PLACE DECIMALS IS ± .02 in. (± 0.5 mm) ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS. DO NOT SCALE THIS DRAWING	CONTROL: CLEVELAND DRAWN BY: jmilligan ENGINEER: S. McQUERRY APPROVED: -	SCALE: NONE IF PRINTED @ A3 SIZE UNITS: INCH	EQUIPMENT TYPE: TOMAHAWK 1000 SUBJECT: SCHEMATIC MATERIAL DISPOSITION: NA APPROVAL DATE: -	PROJECT NUMBER: 5036380-C	REFERENCE: -	PAGE 7 OF 7 DOCUMENT NUMBER: M22293	DOCUMENT: REVISION: A.02	

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.