

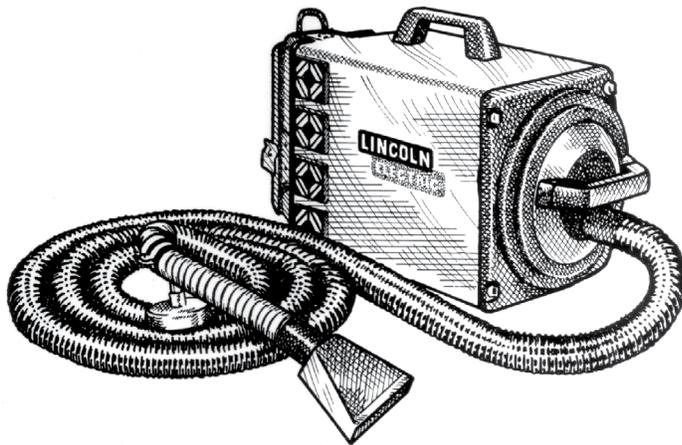
**NOTE:** This manual will cover most of the troubleshooting and repair procedures for the code numbers listed. Some variances may exist when troubleshooting/repairing later code numbers.

## ***X-TRACTOR<sup>®</sup> 1GC***

For use with machines having Code Numbers:

**K652-1, K652-2**

# ***SERVICE MANUAL***



**SAFETY DEPENDS ON YOU**

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

**! 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 Z87.1 standards.
- 4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.
- 4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.



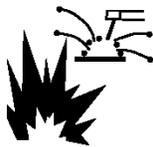
## FUMES AND GASES CAN BE DANGEROUS.



- 5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding 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.



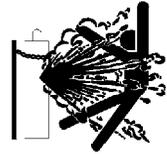
## WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION.



- 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-1, “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

Get the free mobile app at  
<http://gettag.mobi>

# ELECTROMAGNETIC COMPATABILITY (EMC)

## CONFORMANCE

Products displaying the CE mark are in conformity with European Community Council Directive of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (89/336/EEC). 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 assess 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.

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 manufacturer's 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 work piece 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 work piece, 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.

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

As a rule of thumb, for many mild steel electrode, if the air is visibly clear and you are comfortable, then the ventilation is generally adequate for your work. The most accurate way to determine if the worker exposure does not exceed the applicable exposure limit for compounds in the fumes and gases is to have an industrial hygienist take and analyze a sample of the air you are breathing. This is particularly important if you are welding with stainless, hardfacing or Special Ventilation products. All Lincoln MSDS have a maximum fume guideline number. If exposure to total fume is kept below that number, exposure to all fume from the electrode (not coatings or plating on the work) will be below the TLV.

There are steps that you can take to identify hazardous substances in your welding environment. Read the product label and material safety data sheet for the electrode posted in the work place or in the electrode or flux container to see what fumes can be reasonably expected from use of the product and to determine if special ventilation is needed. Secondly, know what the base metal is and determine if there is any paint, plating, or coating that could expose you to toxic fumes and/or gases. Remove it from the metal being welded, if possible. If you start to feel uncomfortable, dizzy or nauseous, there is a possibility that you are being overexposed to fumes and gases, or suffering from oxygen deficiency. Stop welding and get some fresh air immediately. Notify your supervisor and co-workers so the situation can be corrected and other workers can avoid the hazard. Be sure you are following these safe practices, the consumable labeling and MSDS to improve the ventilation in your area. Do not continue welding until the situation has been corrected.

NOTE: The MSDS for all Lincoln consumables is available on Lincoln's website: [www.lincolnelectric.com](http://www.lincolnelectric.com)

Before we turn to the methods available to control welding fume exposure, you should understand a few basic terms:

**Natural Ventilation** is the movement of air through the workplace caused by natural forces. Outside, this is usually the wind. Inside, this may be the flow of air through open windows and doors.

**Mechanical Ventilation** is the movement of air through the workplace caused by an electrical device such as a portable fan or permanently mounted fan in the ceiling or wall.

**Source Extraction** (Local Exhaust) is a mechanical device used to capture welding fume at or near the arc and filter contaminants out of the air.

The ventilation or exhaust needed for your application depends upon many factors such as:

- Workspace volume
- Workspace configuration
- Number of welders
- Welding process and current
- Consumables used (mild steel, hardfacing, stainless, etc.)
- Allowable levels (TLV, PEL, etc.)
- Material welded (including paint or plating)
- Natural airflow

Your work area has adequate ventilation when there is enough ventilation and/or exhaust to control worker exposure to hazardous materials in the welding fumes and gases so the applicable limits for those materials is not exceeded. See chart of TLV and PEL for Typical Electrode Ingredients, the OSHA PEL (Permissible Exposure Limit), and the recommended guideline, the ACGIH TLV (Threshold Limit Value), for many compounds found in welding fume.

## Ventilation

There are many methods which can be selected by the user to provide adequate ventilation for the specific application. The following section provides general information which may be helpful in evaluating what type of ventilation equipment may be suitable for your application. When ventilation equipment is installed, you should confirm worker exposure is controlled within applicable OSHA PEL and/or ACGIH TLV. According to OSHA regulations, when welding and cutting (mild steels), natural ventilation is usually considered sufficient to meet requirements, provided that:

1. The room or welding area contains at least 10,000 cubic feet (about 22' x 22' x 22') for each welder.
2. The ceiling height is not less than 16 feet.
3. Cross ventilation is not blocked by partitions, equipment, or other structural barriers.
4. Welding is not done in a coned space.

Spaces that do not meet these requirements should be equipped with mechanical ventilating equipment that exhausts at least 2000 CFM of air for each welder, except where local exhaust hoods or booths, or air-line respirators are used.

### **Important Safety Note:**

**When welding with electrodes which require special ventilation such as stainless or hardfacing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce hazardous fumes, keep exposure as low as possible and below exposure limit values (PEL and TLV) for materials in the fume using local exhaust or mechanical ventilation. In coned spaces or in some circumstances, for example outdoors, a respirator may be required if exposure cannot be controlled to the PEL or TLV. (See MSDS and chart of TLV and PEL for Typical Electrode Ingredients.) Additional precautions are also required when welding on galvanized steel.**

**BIBLIOGRAPHY AND SUGGESTED READING**

ANSI Z87.1, Practice for Occupational and Educational Eye and Face Protection, American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

Arc Welding and Your Health: A Handbook of Health Information for Welding. Published by The American Industrial Hygiene Association, 2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031-4319.

NFPA Standard 51B, Cutting and Welding Processes, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9146, Quincy, MA 02269-9959.

OSHA General Industry Standard 29 CFR 1910 Subpart Q. OSHA Hazard Communication Standard 29 CFR 1910.1200. Available from the Occupational Safety and Health Administration at <http://www.osha.org> or contact your local OSHA office.

The following publications are published by The American Welding Society, P.O. Box 351040, Miami, Florida 33135. AWS publications may be purchased from the American Welding Society at <http://www.aws.org> or by contacting the AWS at 800-443-9353.

ANSI, Standard Z49.1, Safety in Welding, Cutting and Allied Processes. Z49.1 is now available for download at no charge at <http://www.lincolnelectric.com/community/safety/> or at the AWS website <http://www.aws.org>.

AWS F1.1, Method for Sampling Airborne Particulates Generated by Welding and Allied Processes.

AWS F1.2, Laboratory Method for Measuring Fume Generation Rates and Total Fume Emission of Welding and Allied Processes.

AWS F1.3, Evaluating Contaminants in the Welding Environment: A Strategic Sampling Guide.

AWS F1.5, Methods for Sampling and Analyzing Gases from Welding and Allied Processes.

AWS F3.2, Ventilation Guide for Welding Fume Control.

AWS F4.1, Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances.

AWS SHF, Safety and Health Facts Sheets. Available free of charge from the AWS website at <http://www.aws.org>.

**LISTED BELOW ARE SOME TYPICAL INGREDIENTS IN WELDING ELECTRODES AND THEIR TLV (ACGIH) GUIDELINES AND PEL (OSHA) EXPOSURE LIMITS**

INGREDIENTS	CAS No.	TLV mg/m <sup>3</sup>	PEL mg/m <sup>3</sup>
Aluminum and/or aluminum alloys (as Al)*****	7429-90-5	10	15
Aluminum oxide and/or Bauxite*****	1344-28-1	10	5**
Barium compounds (as Ba)*****	513-77-9	****	****
Chromium and chromium alloys or compounds (as Cr)*****	7440-47-3	0.5(b)	.005(b)
Fluorides (as F)	7789-75-5	2.5	2.5
Iron	7439-89-6	10*	10*
Limestone and/or calcium carbonate	1317-65-3	10	15
Lithium compounds (as Li)	554-13-2	10*	10*
Magnesite	1309-48-4	10	15
Magnesium and/or magnesium alloys and compounds (as Mg)	7439-95-4	10*	10*
Manganese and/or manganese alloys and compounds (as Mn)*****	7439-96-5	0.2	5.0(c)
Mineral silicates	1332-58-7	5**	5**
Molybdenum alloys (as Mo)	7439-98-7	10	10
Nickel*****	7440-02-0	1.5	1
Silicates and other binders	1344-09-8	10*	10*
Silicon and/or silicon alloys and compounds (as Si)	7440-21-3	10*	10*
Strontium compounds (as Sr)	1633-05-2	10*	10*
Zirconium alloys and compounds (as Zr)	12004-83-0	5	5

**Supplemental Information:**

(\*) Not listed. Nuisance value maximum is 10 milligrams per cubic meter. PEL value for iron oxide is 10 milligrams per cubic meter. TLV value for iron oxide is 5 milligrams per cubic meter.

(\*\*) As respirable dust.

(\*\*\*\*) Subject to the reporting requirements of Sections 311, 312, and 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40CFR 370 and 372.

(b) The PEL for chromium (VI) is .005 milligrams per cubic meter as an 8 hour time weighted average. The TLV for water-soluble chromium (VI) is 0.05 milligrams per cubic meter. The TLV for insoluble chromium (VI) is 0.01 milligrams per cubic meter.

c) Values are for manganese fume. STEL (Short Term Exposure Limit) is 3.0 milligrams per cubic meter. OSHA PEL is a ceiling value.

(\*\*\*\*) There is no listed value for insoluble barium compounds. The TLV for soluble barium compounds is 0.5 mg/m<sup>3</sup>.

TLV and PEL values are as of April 2006. Always check Material Safety Data Sheet (MSDS) with product or on the Lincoln Electric website at <http://www.lincolnelectric.com>



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Figure E.1 - Block logic diagram

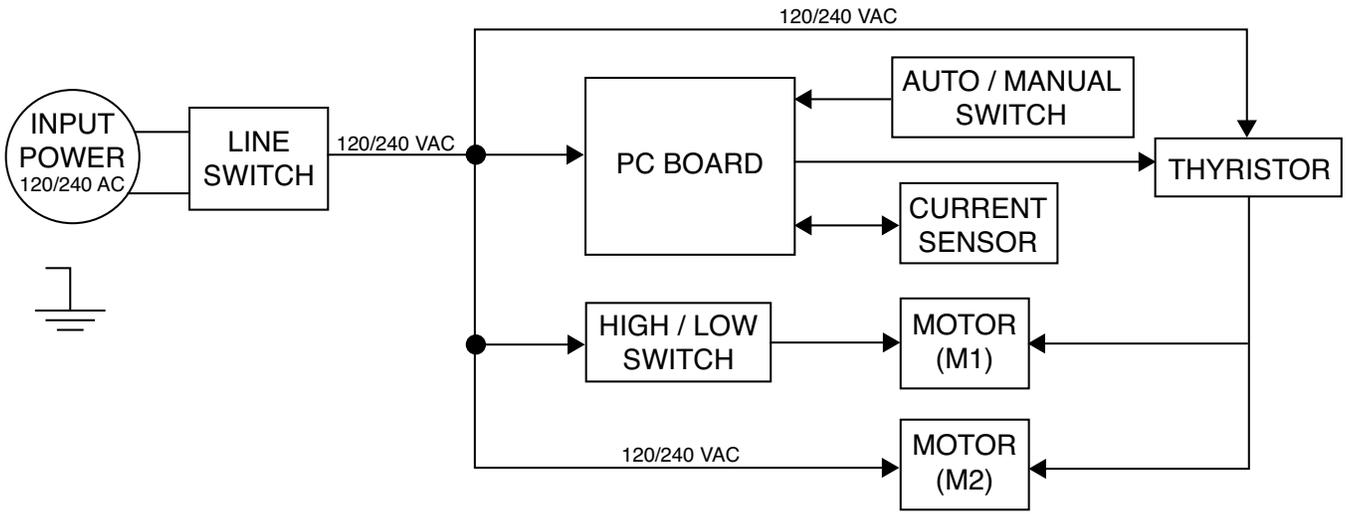
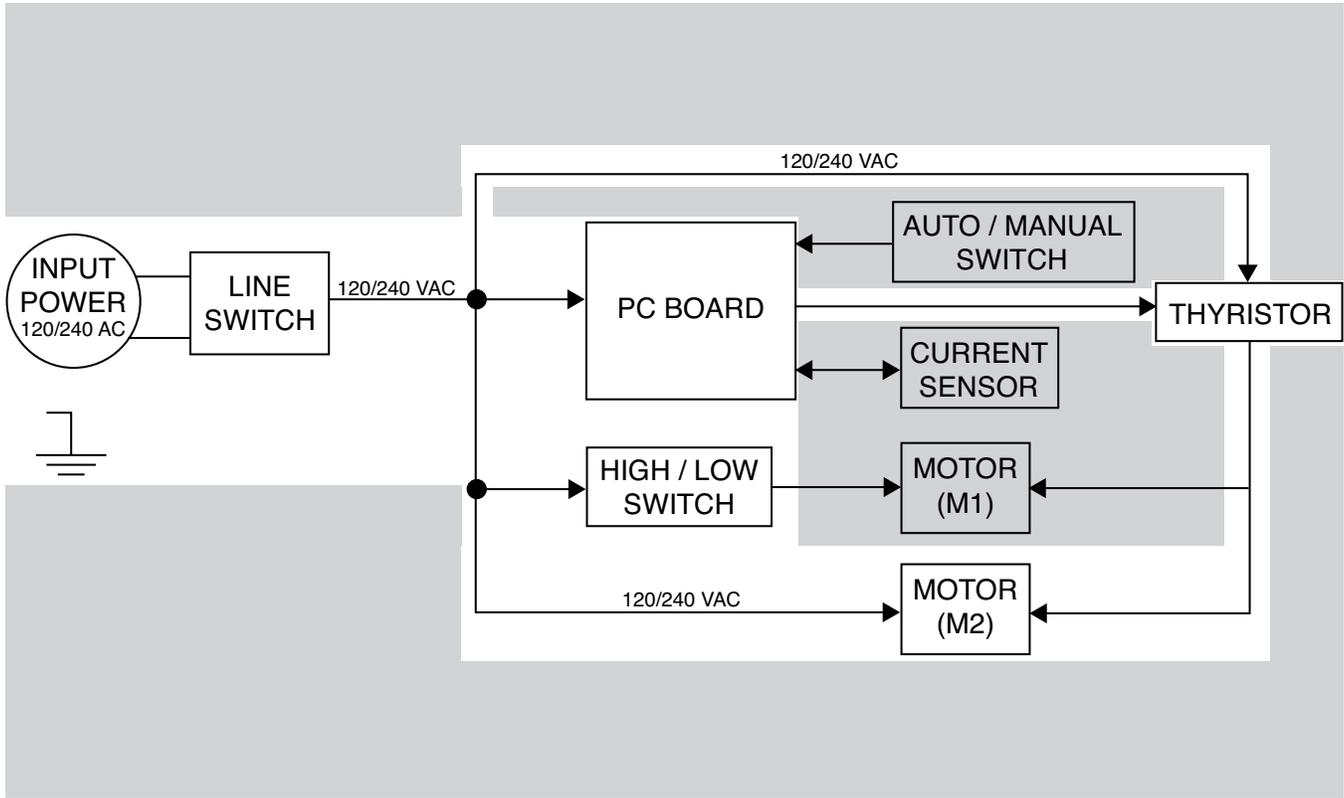


Figure E.2 - Input power and line switch



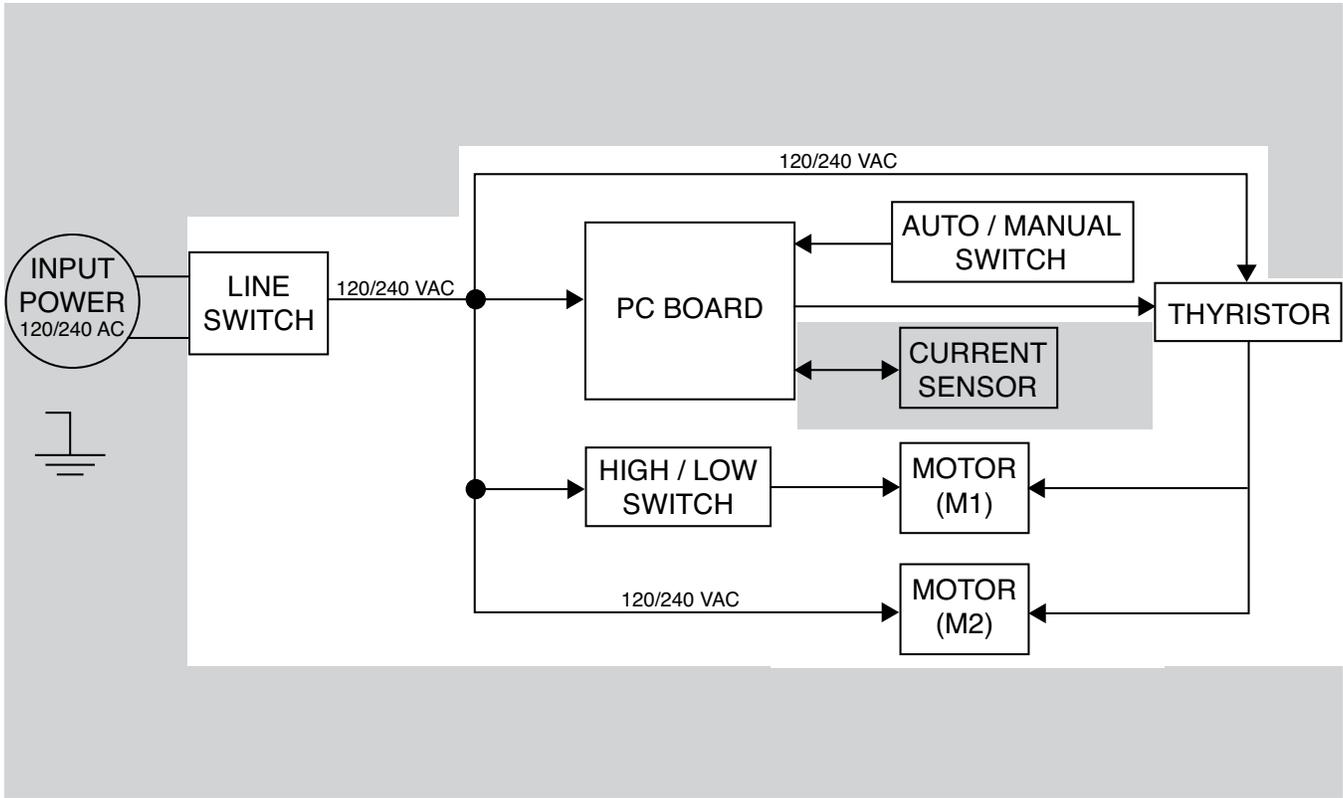
### INPUT POWER AND LINE SWITCH

The X-Tractor 1GC is supplied with single phase 120 VAC or 240 VAC input power through the input line switch. 120 VAC or 240 VAC is then applied to the PC board, the high/low switch, the motor M2 and the thyristor module.

**NOTE:**

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

Figure E.3 - High/Low switch, PC board, thyristor module & motors M1 and M2



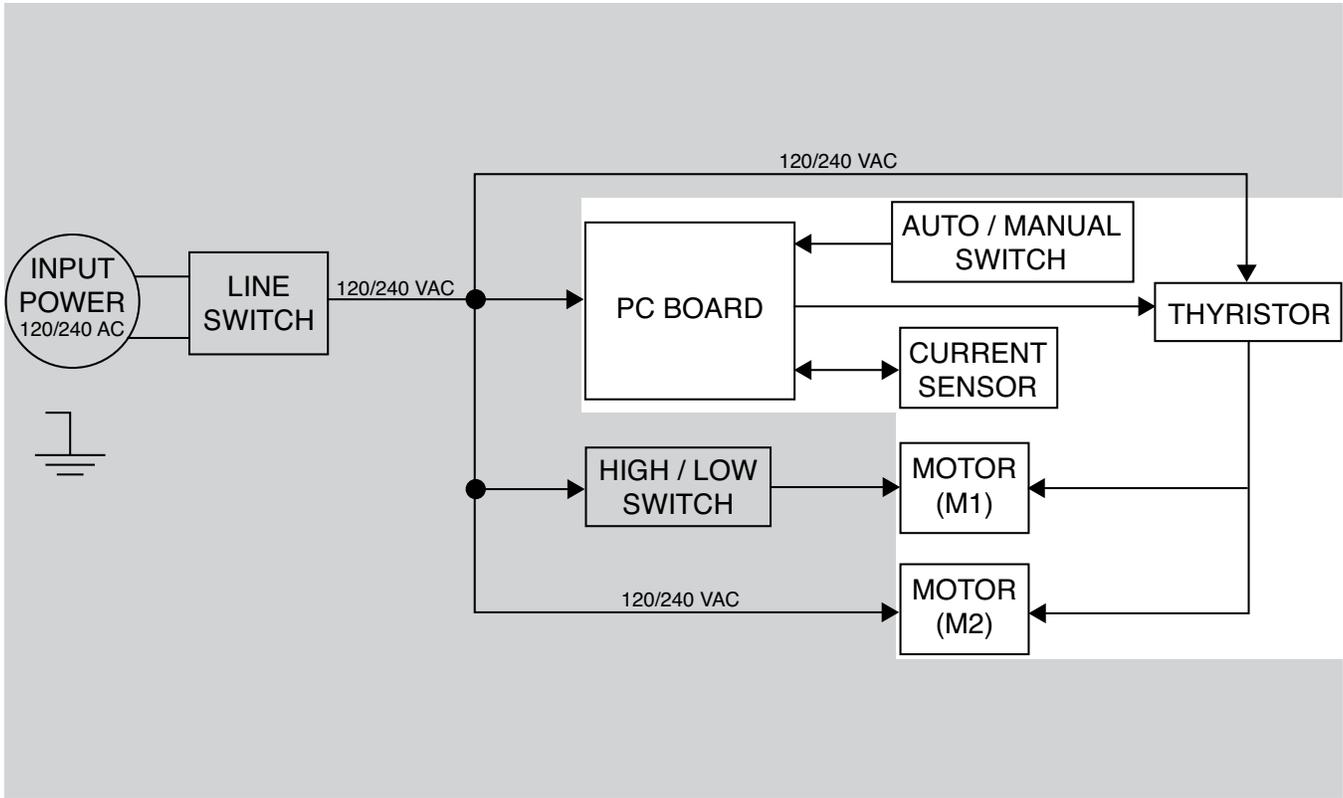
**HIGH/LOW SWITCH, PC BOARD, THYRISTOR MODULE & MOTORS M1 AND M2**

When the input line switch is energized and the auto/manual switch is in the manual position, the PC board sends a gate firing signal to the thyristor module. The thyristor module turns on and completes the 120/240 VAC circuit to motors M1 and M2. If the high/low switch is in the high position, both motors will be energized. If the high/low switch is in the low position, only motor M2 will be energized.

**NOTE:**

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

Figure E.4 - Auto/Manual switch & current sensor



### AUTO/MANUAL SWITCH & CURRENT SENSOR

When the auto/manual switch is in the auto position, the PC board will not send a gate firing signal to the thyristor module until welding current is sensed by the current sensor. With welding current flowing, the current sensor sends a signal to the PC board, the PC board sends a gate firing signal to the thyristor module and the motors are energized.

**NOTE:**

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

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## HOW TO USE TROUBLESHOOTING GUIDE

### WARNING

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

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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 two main categories: Power Up Problems and Function Problems.

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

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

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

### CAUTION

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

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## 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.
- 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.

**TROUBLESHOOTING GUIDE**

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>POWER UP PROBLEMS</b>		
Major physical or electrical damage is evident when the case is removed.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.
Machine will not power up.	1. No input power. 2. Mode switch set to 'Auto'. 3. Possible faulty line switch. 4. Circuit breaker may be tripped. 5. Motor brushes may be worn.	1. Check for loose or faulty connections. 2. Set mode switch to 'Manual'. 3. Perform the <b>Line Switch Test</b> . 4. Check brushes, replace if worn.
Machine operates in 'Low' mode, but not in 'High' mode.	1. Loose or faulty connections. 2. Possible faulty mode switch. 3. Possible faulty motor M1.	1. Check for loose or faulty connections. 2. Perform the <b>Mode Switch Test</b> . 3. Perform the <b>Motor M1 (High) Test</b> .
Neither motor operates, machine has power.	1. Mode switch in the 'Auto' position.	1. Check for loose or faulty connections. 2. Perform the <b>Thyristor Test</b> . 3. Perform the <b>PC Board Test</b> . 4. Perform the <b>Motor M1 (High) Test</b> . 5. Perform the <b>Motor M2 (Low) Test</b> .



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

Observe Safety Guidelines detailed in the beginning of this manual.

**TROUBLESHOOTING GUIDE**

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS</b>		
<p>Poor suction.</p>	<ol style="list-style-type: none"> <li>1. Leakage.</li> <li>2. Filter too dirty.</li> <li>3. Improper application.</li> <li>4. Filter blocked.</li> <li>5. Brushes worn in one of the motors.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check for loose or faulty connections and/or hoses.</li> <li>2. Clean the filter, check for oily conditions.</li> <li>3. Check the hose for proper diameter and length.</li> <li>4. Replace the filter.</li> <li>5. Replace the brushes in both motors.</li> </ol>
<p>Cover will not fasten to case.</p>	<ol style="list-style-type: none"> <li>1. Fasteners not lined up.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check procedure in 'Emptying the canister and heavy particle trap' (Step 7) in <b>Operator's</b> manual.</li> </ol>
<p>Will not sense current.</p>	<ol style="list-style-type: none"> <li>1. Operating current too low.</li> <li>2. Loop cable in hook two or three times.</li> <li>3. Possible faulty current sensor.</li> <li>4. Possible faulty PC board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b>Current Sensor Test</b>.</li> <li>2. Perform the <b>PC Board Test</b>.</li> <li>3. Perform the <b>Mode Switch Test</b>.</li> </ol>



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



## CASE COVER REMOVAL AND REPLACEMENT PROCEDURE

### **WARNING**

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

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

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### **TEST DESCRIPTION**

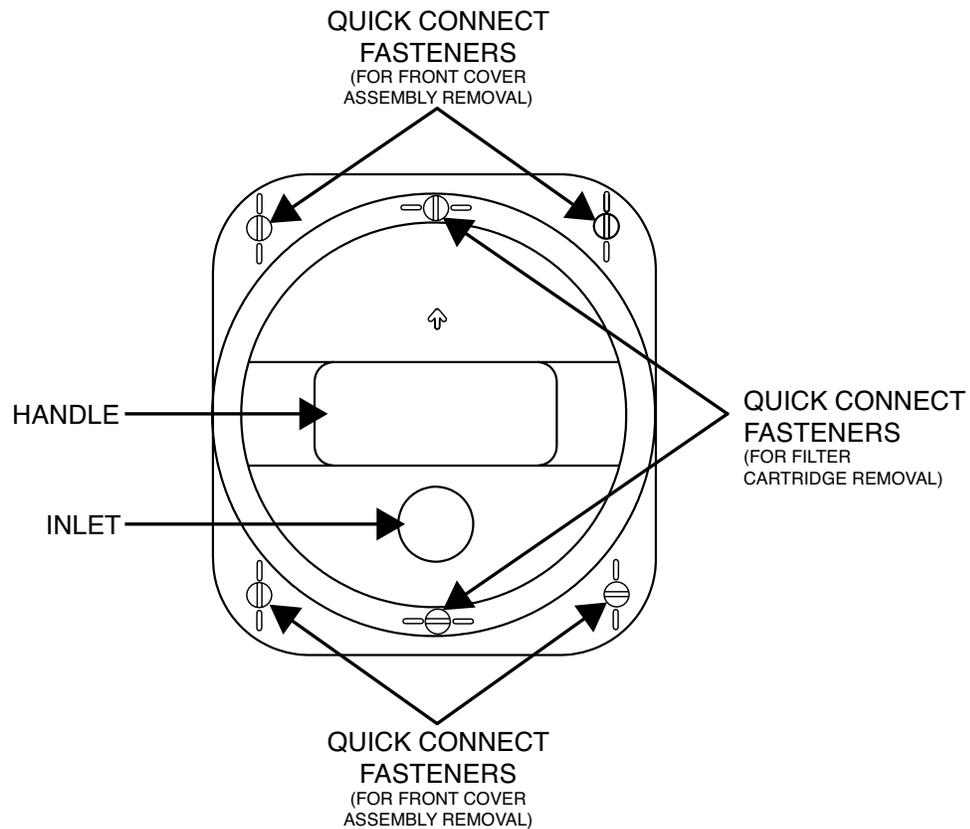
This procedure will aid the technician in the removal and replacement of the Case Covers.

### **MATERIALS NEEDED**

- Adjustable wrench
- Phillips Screwdriver
- Wiring Diagram

## CASE COVER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.1 – Front cover assembly



### REMOVAL PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
  2. Disconnect the hose from the inlet on the front cover assembly, if necessary. See Figure F.1.
  3. Place inlet plug into the inlet on the front cover assembly. See Figure F.1.
  4. Rotate the four quick release fasteners, at the corners of the front cover assembly, 1/4 turn to release the front cover assembly from the machine. See Figure F.1.
  5. Using the handle on the front cover, slide the front cover assembly out and away from the machine.
  6. Rotate the two quick release fasteners on the front cover assembly (one on the top and one on the bottom) 1/4 turn to release the front cover assembly from the filter container assembly. See Figure F.1.
  7. Using an adjustable wrench, brace the compressed air valve at the rear of the machine. See **Figure F.2**.
  8. While holding the compressed air valve in place, rotate the cleaning device in the machine counter clockwise (when viewed from front of the machine) to loosen the compressed air valve.
  9. Remove the compressed air valve and leave the cleaning device in the machine.
  10. Using a phillips screwdriver, remove the ten screws securing the case rear assembly to the case sides. See **Figure F.3**.
- NOTE:** Do not remove the four screws securing the end cover to the case rear assembly.
11. Carefully separate the case rear assembly from the case sides.
  12. Label and disconnect the current sensor plug from the PC board. See Wiring Diagram.
- NOTE:** Do not rotate the cleaning unit using the arms as this may cause damage to the cleaning unit. Grasp the cleaning unit as near to the rear of the machine as possible to avoid damaging the arms.

# CASE COVER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.2– Compressed air fitting removal

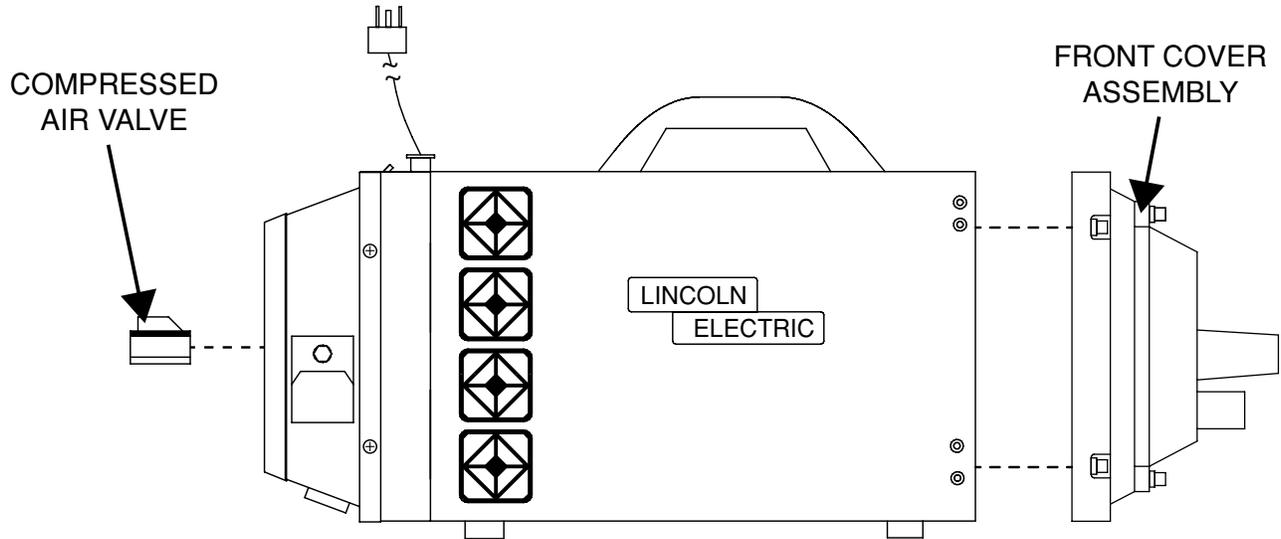
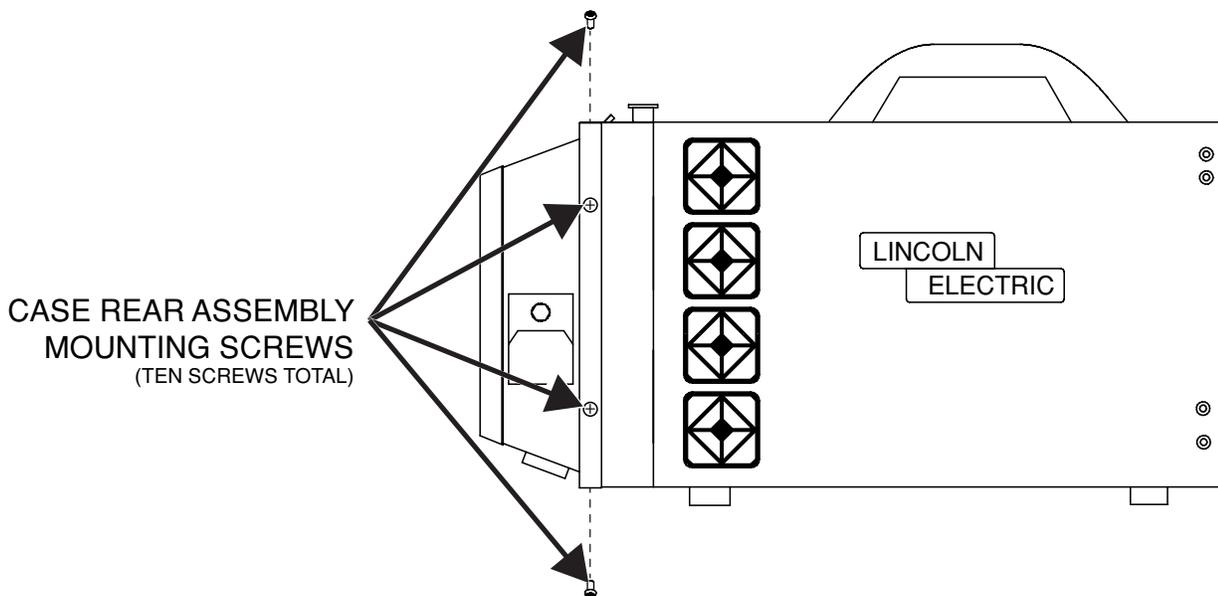


Figure F.3 – Case rear assembly mounting screws



## CASE COVER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

### REPLACEMENT PROCEDURE

1. Connect the current sensor plug to the PC board. See Wiring Diagram.
2. Carefully position the case rear assembly over the case sides.  
**NOTE:** The motors must be positioned properly to allow for the proper fit of the case rear assembly and the filter cleaning unit.
3. Using a phillips screwdriver, attach the ten screws securing the case rear assembly to the case sides.
4. Attach the compressed air valve to the threaded end of the filter cleaning unit.
5. Using an adjustable wrench, secure the compressed air valve at the rear of the machine.
6. While holding the compressed air valve in place, rotate the filter cleaning device in the machine clockwise (when viewed from front of the machine) to secure the compressed air valve.  
**NOTE:** Do not rotate the cleaning unit using the arms as this may cause damage to the cleaning unit. Grasp the cleaning unit as near to the rear of the machine as possible to avoid damaging the arms.
7. Carefully position front cover assembly over the top of the filter and press front cover assembly into filter assembly until the quick release fasteners snap into the brackets.
8. Using the handle on the front cover, slide the filter assembly and front cover assembly in to the machine.
9. Press the front cover assembly in to the machine until the quick release fasteners snap into the brackets.
10. Remove inlet plug from the inlet on the front cover assembly.
11. Connect the hose to the inlet on the front cover assembly.

## CURRENT SENSOR TEST

### **WARNING**

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

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

---

### **TEST DESCRIPTION**

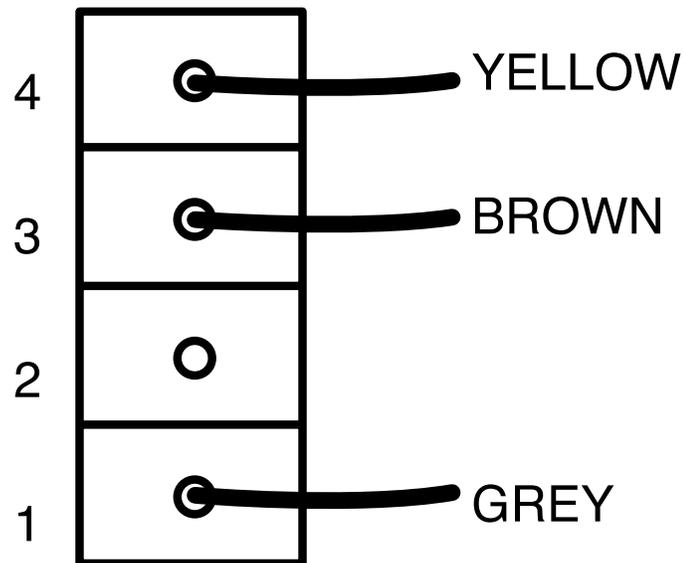
This test will help determine if the Current Sensor is functioning properly.

### **MATERIALS NEEDED**

Volt/Ohmmeter  
Wiring Diagram

## CURRENT SENSOR TEST *(continued)*

Figure F.4 – Current sensor plug lead locations



### PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Check for any loose or faulty connections and/or damaged components.
4. Using a volt/ohmmeter, check voltage from Pin 3(+) to Pin 4(-) on the plug attached to the current sensor board. See Figure F.4. See Wiring Diagram. Reading should be 14 VDC\*. If test fails, perform the **PC Board Test**.
5. Using a volt/ohmmeter, check voltage from Pin 1(+) to Pin 4(-) on the plug attached to the current sensor board. See Figure F.4. See Wiring Diagram. Reading should be 0 VDC\* with welding current flowing. If test fails perform the **Current Sensor Removal And Replacement Procedure**.

\* Voltage supply from PC board to the current sensor board.

6. Perform the **Case Cover Replacement Procedure**.

## THYRISTOR TEST

### **WARNING**

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

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

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### **TEST DESCRIPTION**

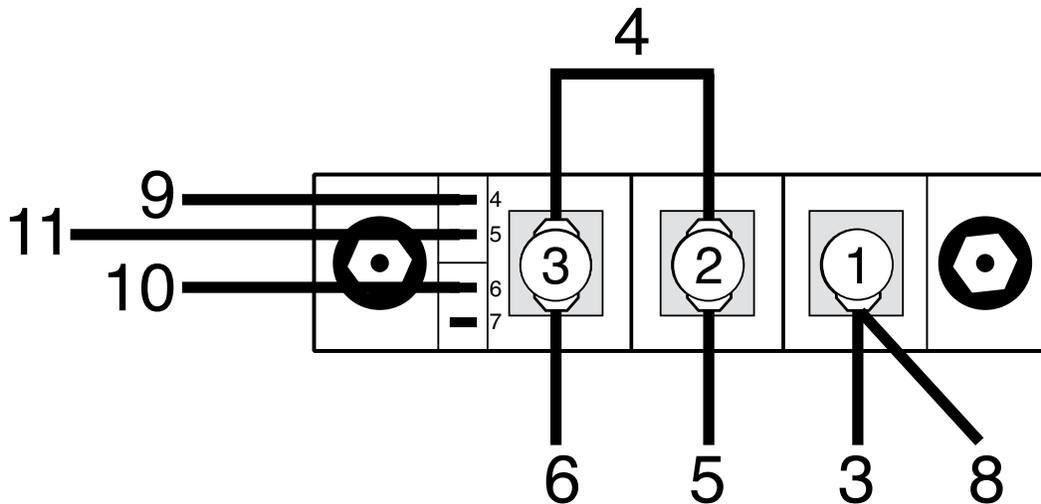
This test will help determine if the Thyristor is functioning properly.

### **MATERIALS NEEDED**

- Phillips Screwdriver
- Volt/Ohmmeter
- Wiring Diagram

## THYRISTOR TEST *(continued)*

Figure F.5 – Thyristor terminal and lead locations

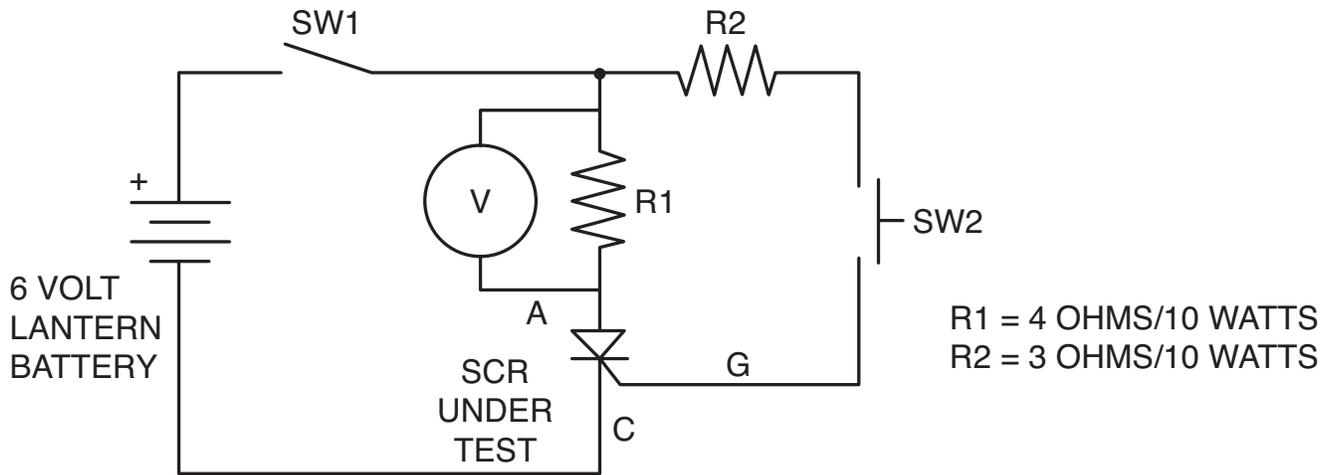


### PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Check for any loose or faulty connections and/or damaged components.
4. Using a phillips screwdriver, label and disconnect the leads connected to terminals 1, 2 and 3 of the thyristor. See Figure F.5. See Wiring Diagram.
5. Label and disconnect the leads connected to terminals 4, 5 and 6 of the thyristor. See Figure F.5. See Wiring Diagram.
6. Using a volt/ohmmeter, perform the test in **Figure F.6**. See Wiring Diagram. If the test fails, perform the **Thyristor Removal And Replacement Procedure**.
7. Using a phillips screwdriver, connect the previously removed leads to terminals 1, 2 and 3 of the thyristor. See Wiring Diagram.
8. Connect the previously removed leads to terminals 4, 5 and 6 of the thyristor. See Wiring Diagram.
9. Perform the **Case Cover Replacement Procedure**.

### THYRISTOR TEST *(continued)*

Figure F.6 – Thyristor test



To test SCRs construct the circuit outlined above. Resistors values are plus or minus ten percent. The voltmeter scale should be low, approximately 0-5 or 0-10 volts DC.



## PC BOARD TEST

### **WARNING**

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

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### **TEST DESCRIPTION**

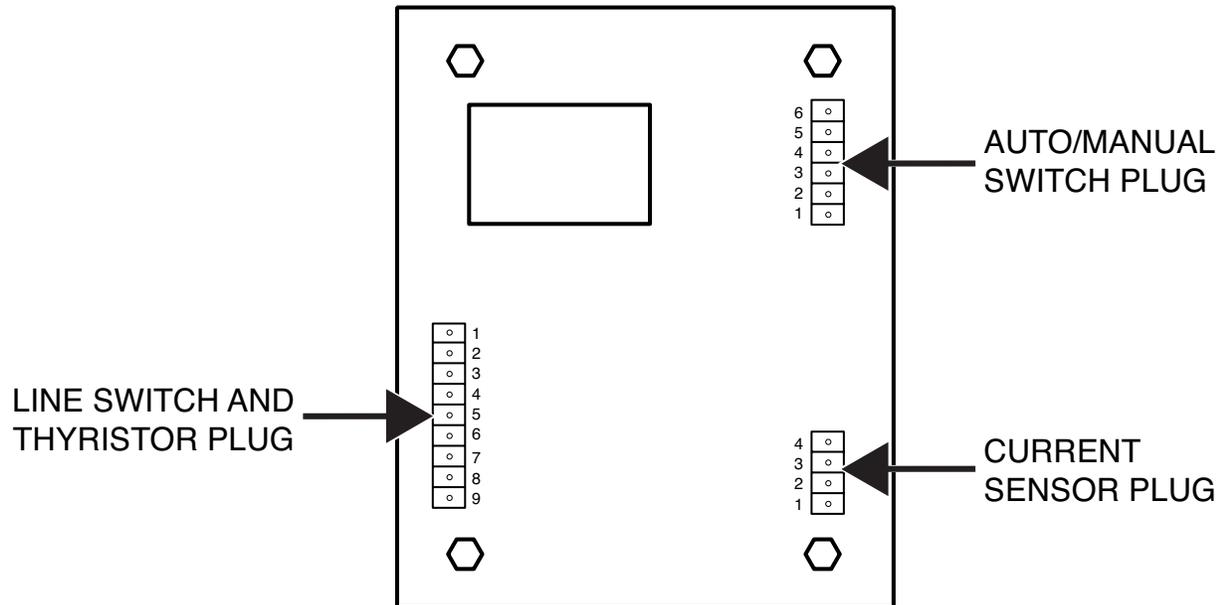
This test will help determine if the PC Board is functioning properly.

### **MATERIALS NEEDED**

Volt/Ohmmeter  
Wiring Diagram

## PC BOARD TEST *(continued)*

Figure F.7 – PC board plug locations



### PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the ***Case Cover Removal Procedure***.
3. Check for any loose or faulty connections and/or damaged components.
4. Carefully apply input power to the machine.
5. Using a volt/ohmmeter, perform the test in ***Table F.1***. See Figure F.7. See Wiring Diagram.

**NOTE:** Relay must activate to apply gate voltage to the thyristor.

6. If any of the tests fail, perform the ***PC Board Removal And Replacement Procedure***.
7. Remove the input power to the X-Tractor 1GC.
8. Perform the ***Case Cover Replacement Procedure***.

## PC BOARD TEST *(continued)*

Table F.1 – PC board tests

TEST POINT (PLUG)	TEST POINT (PLUG)	EXPECTED READING	CONDITION
AUTO/MANUAL PIN 5	AUTO/MANUAL PIN 6	27 VDC	POWER ON, MODE SWITCH IN 'AUTO' POSITION.
CURRENT SENSOR PIN 3	CURRENT SENSOR PIN 4	18 VDC	POWER ON, MODE SWITCH IN 'AUTO' POSITION.
CURRENT SENSOR PIN 1	CURRENT SENSOR PIN 4	14 VDC	POWER ON, MODE SWITCH IN 'AUTO' POSITION.
LINE SWITCH/THYRISTOR PIN 5	LINE SWITCH/THYRISTOR PIN 3	120 VAC	POWER ON, MODE SWITCH IN 'AUTO' POSITION.
AUTO/MANUAL PIN 5	AUTO/MANUAL PIN 6	0 VAC	POWER ON, MODE SWITCH IN 'LOW/MANUAL' POSITIONS. MOTOR M2 RUNNING.
CURRENT SENSOR PIN 3	CURRENT SENSOR PIN 4	18 VDC	POWER ON, MODE SWITCH IN 'LOW/MANUAL' POSITIONS. MOTOR M2 RUNNING.
CURRENT SENSOR PIN 1	CURRENT SENSOR PIN 4	14 VDC	POWER ON, MODE SWITCH IN 'LOW/MANUAL' POSITIONS. MOTOR M2 RUNNING.
LINE SWITCH/THYRISTOR PIN 8(-)	LINE SWITCH/THYRISTOR PIN 9(+)	0.4 VDC	MOTOR RUNNING. GATE SIGNAL APPLIED.
LINE SWITCH/THYRISTOR PIN 8(-)	LINE SWITCH/THYRISTOR PIN 6(+)	0.4 VDC	MOTOR RUNNING. GATE SIGNAL APPLIED.
CURRENT SENSOR PIN 1(-)	CURRENT SENSOR PIN 4(+)	0 VDC	WITH WELDING CURRENT FLOWING.



## LINE SWITCH TEST

### **WARNING**

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

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

---

### **TEST DESCRIPTION**

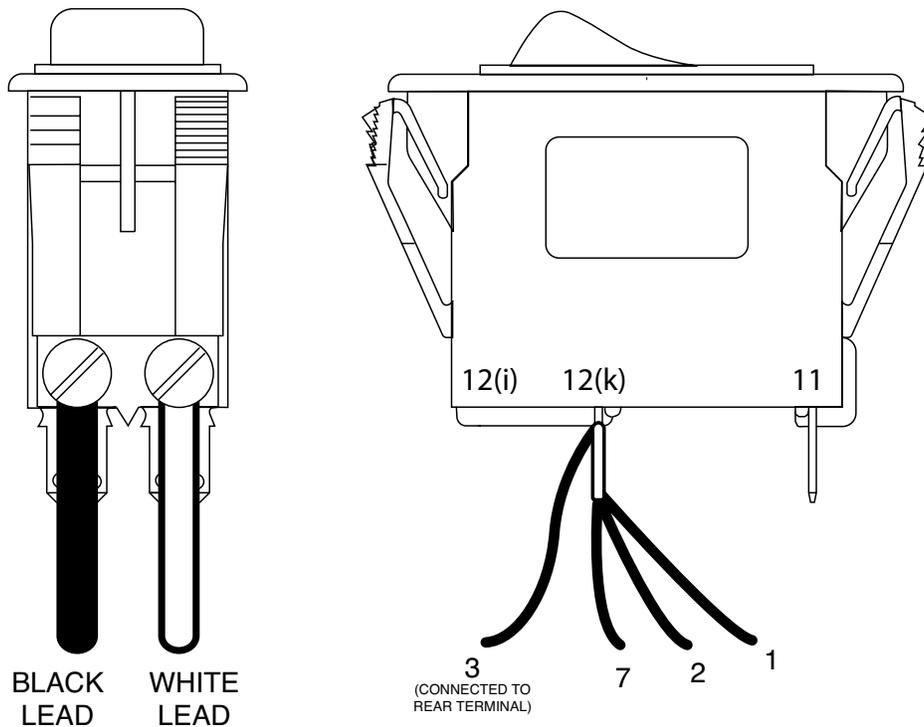
This test will help to determine if the Line Switch is functioning properly.

### **MATERIALS NEEDED**

- Slotted Screwdriver
- Volt/Ohmmeter
- Wiring Diagram

## LINE SWITCH TEST *(continued)*

Figure F.8 – Line switch lead locations

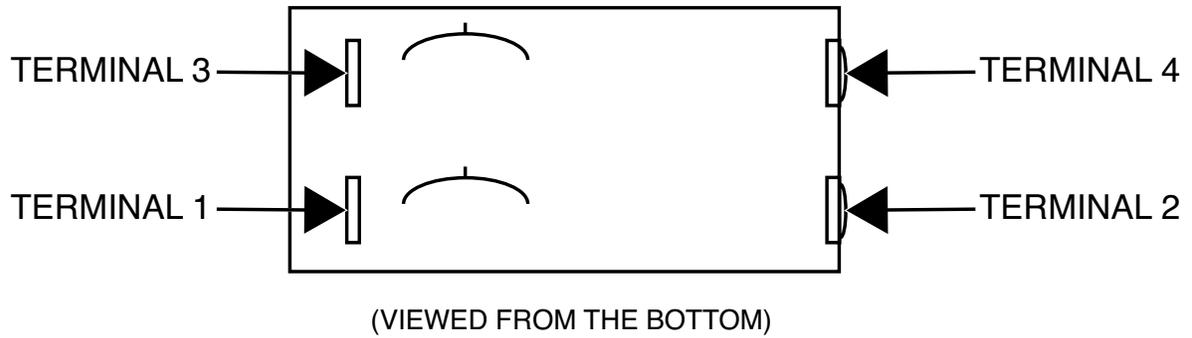


### PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Check for any loose or faulty connections and/or damaged components.
4. Using a slotted screwdriver, label and disconnect the black and white input power leads from the line switch. See Figure F.8. See Wiring Diagram.
5. Label and disconnect the remaining leads from the line switch. See Wiring Diagram.
6. Using an ohmmeter, check resistance between terminals 3 and 4 on the line switch. With the switch in the OFF position resistance should read high (500,000 Ohms or greater). With the switch in the ON position resistance should read low (close to zero Ohms). See **Figure F.9**. See Wiring Diagram.
7. Using an ohmmeter, check resistance between terminals 1 and 2 on the line switch. With the switch in the OFF position resistance should read high (500,000 Ohms or greater). With the switch in the ON position resistance should read low (close to zero Ohms). See **Figure F.9**. See Wiring Diagram.
8. If either test fails, perform the **Line Switch Removal And Replacement Procedure**.
9. Using a slotted screwdriver, connect the black and white input power leads to the proper terminals of the line switch. See Figure F.8. See Wiring Diagram.
10. Connect the remaining leads to the line switch. See Wiring Diagram.
11. Remove the input power to the X-Tractor 1GC.
12. Perform the **Case Cover Replacement Procedure**.

### LINE SWITCH TEST *(continued)*

Figure F.9 – Line switch terminal location





## MODE SWITCH TEST

### **WARNING**

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

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

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### **TEST DESCRIPTION**

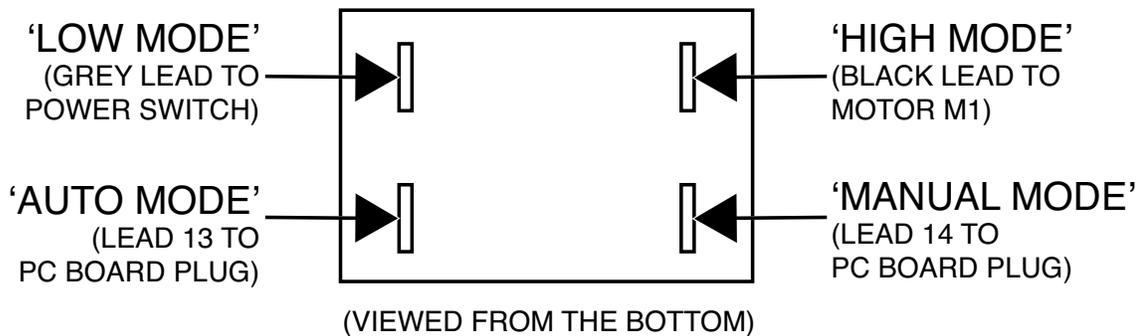
This test will help to determine if the Mode Switch is functioning properly.

### **MATERIALS NEEDED**

Volt/Ohmmeter  
Wiring Diagram

## MODE SWITCH TEST *(continued)*

Figure F.10 – Mode switch terminals



### PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Check for any loose or faulty connections and/or damaged components.
4. Label and disconnect leads from the mode switch. See Figure F.10.
5. Using an ohmmeter, check resistance between High and Low terminals. When mode switch is in the Low position resistance is high (500K Ohms). When mode switch is in the High position resistance will read low (close to zero Ohms). See Figure F.10. See Wiring Diagram.
6. Using an ohmmeter, check resistance between manual and auto terminals. When mode switch is in the Auto position resistance is high (500K Ohms). When mode switch is in the Manual position resistance will read low (close to zero Ohms). See Figure F.10. See Wiring Diagram.
7. If any of these tests fail, perform the **Mode Switch Removal And Replacement Procedure**.
8. Connect the previously removed leads to the line switch. See Wiring Diagram.
9. Perform the **Case Cover Replacement Procedure**.

## MOTOR M2 (LOW) TEST

### **WARNING**

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

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

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### **TEST DESCRIPTION**

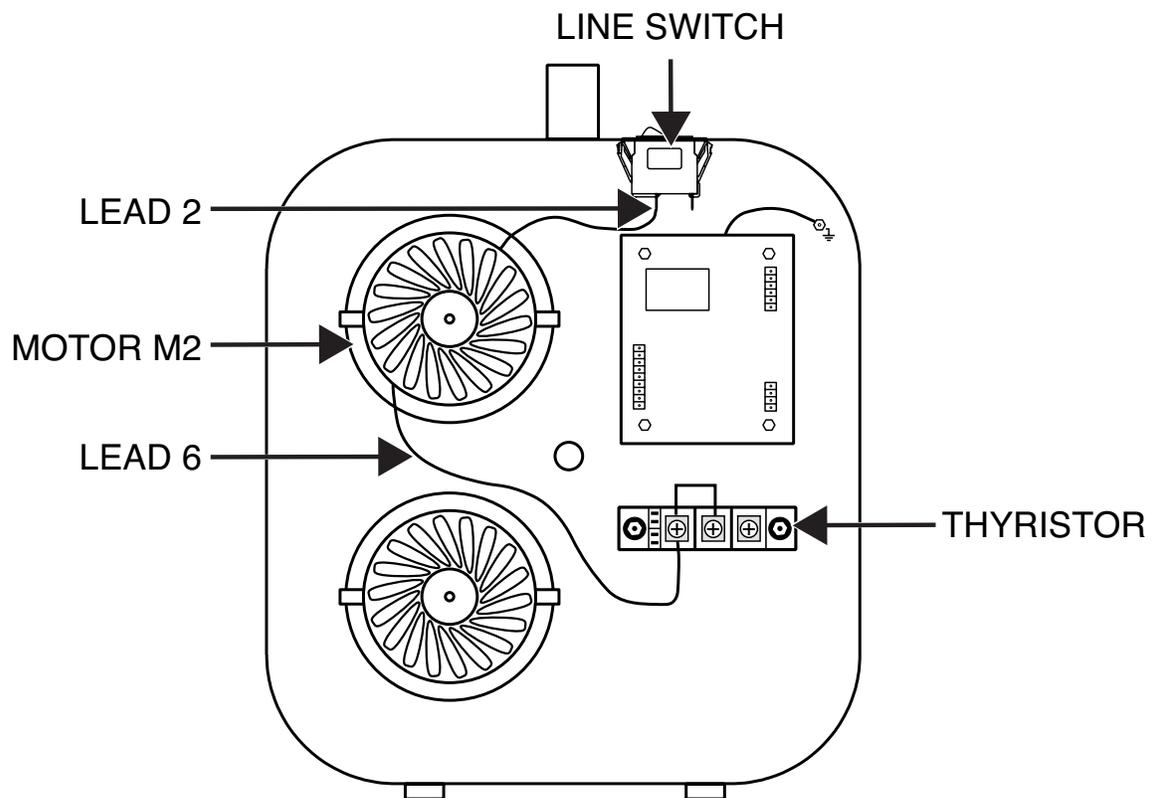
This test will help to determine if the Motor M2 (Low) is functioning properly.

### **MATERIALS NEEDED**

Phillips Screwdriver  
Volt/Ohmmeter  
Wiring Diagram

## MOTOR M2 (LOW) TEST *(continued)*

Figure F.11 – Motor M2 lead connections



### PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Check for worn brushes.
4. Locate lead 2 at the line switch and lead 6 at the thyristor. See Figure F.11. See Wiring Diagram.
5. Carefully apply input power to the machine.
6. Start machine in Low/Manual mode.
7. Using a voltmeter, check for 120/240 VAC between lead 2 and lead 6. See Figure F.11. See Wiring Diagram.
8. Remove the input power to the X-Tractor 1GC.
9. Label and disconnect lead 2 from the line switch to electrically isolate motor M2. See Figure F.11. See Wiring Diagram.
10. Using a phillips screwdriver, label and disconnect lead 6 from terminal 3 on the thyristor to electrically isolate motor M2. See Figure F.11. See Wiring Diagram.
11. Using an ohmmeter, check continuity between leads 2 and 6. See Figure F.11. See Wiring Diagram. Approximately 2.3 Ohms should be present. If resistance is high, perform the **Motor Removal And Replacement Procedure**.
12. Check resistance from either lead 2 or lead 6 to the motor case. See Figure F.11. See Wiring Diagram. Resistance should be a minimum of 500k Ohms. If test fails, perform the **Motor Removal And Replacement Procedure**.
13. Connect previously removed lead 2 to the line switch. See Wiring Diagram.
14. Using a phillips screwdriver, connect previously removed lead 6 to the thyristor. See Wiring Diagram.
15. Perform the **Case Cover Replacement Procedure**.

## MOTOR M1 (HIGH) TEST

### **WARNING**

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

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

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### **TEST DESCRIPTION**

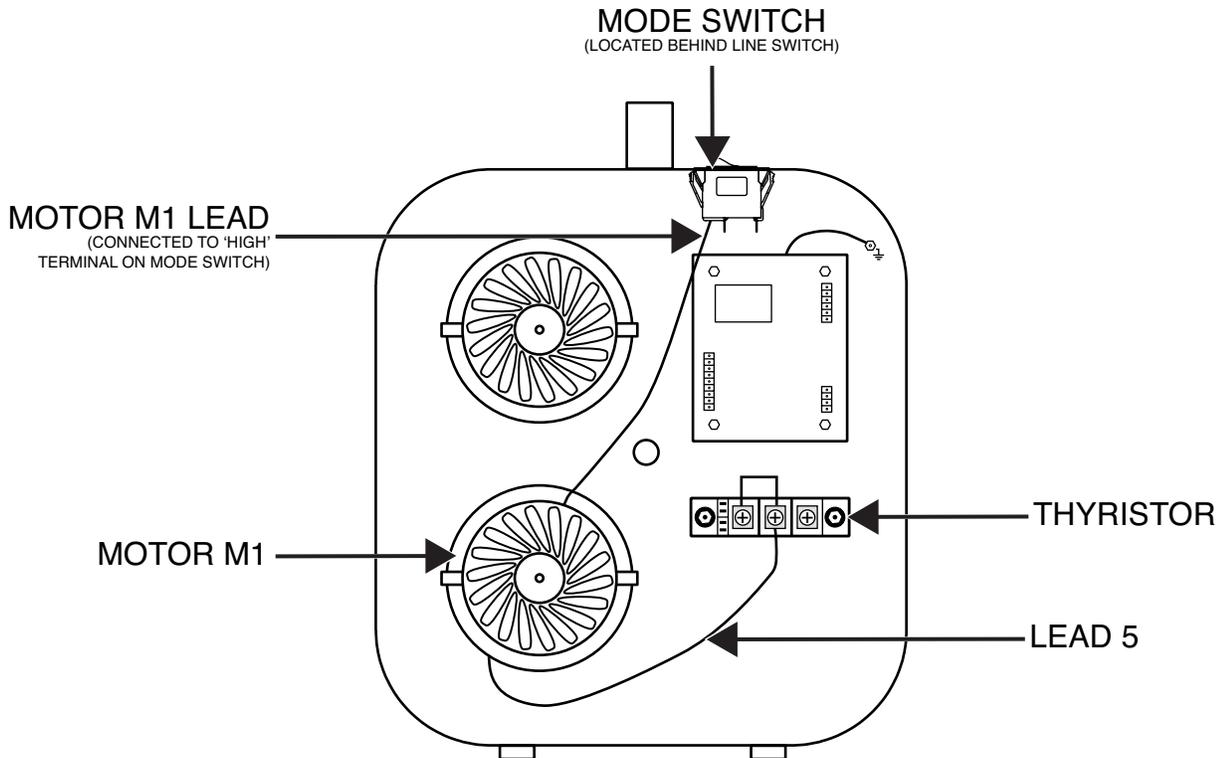
This test will help to determine if the Motor M1 (High) is functioning properly.

### **MATERIALS NEEDED**

Phillips Screwdriver  
Volt/Ohmmeter  
Wiring Diagram

## MOTOR M1 (HIGH) TEST *(continued)*

Figure F.12 – Motor M1 lead connections



### PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Check for worn brushes.
4. Locate motor M1 lead connected to 'High' terminal on the mode switch and lead 5 at thyristor terminal 2. See Figure F.12. See Wiring Diagram.
5. Carefully apply input power to the machine.
6. Start machine in 'High/Manual' mode.
7. Using a voltmeter, check for 120/240 VAC between motor M1 lead connected to 'High' terminal on the mode switch and lead 5 at thyristor terminal 2. See Wiring Diagram.
8. Remove the input power to the X-Tractor 1GC.
9. Label and disconnect motor M1 lead from the 'High' terminal on the mode switch to electrically isolate motor M1. See Figure F.12. See Wiring Diagram.
10. Using a phillips screwdriver, label and disconnect lead 5 from thyristor terminal 2 to electrically isolate motor M1. See Figure F.12. See Wiring Diagram.
11. Using an ohmmeter, check continuity between motor M1 lead and lead 5. See Figure F.12. See Wiring Diagram. Approximately 2.3 Ohms should be present. If resistance is high (500K Ohms), perform the **Motor Removal And Replacement Procedure**.
12. Check resistance from either motor M1 lead or lead 5 to motor case. See Wiring Diagram. See Figure F.12. See Wiring Diagram. Resistance should read a minimum of 500k Ohms. If test fails, perform the **Motor Removal And Replacement Procedure**.
13. Connect previously removed motor M1 lead to the 'High' terminal on the mode switch and lead 5 to the thyristor terminal 2. See Wiring Diagram.
14. Perform the **Case Cover Replacement Procedure**.

## CURRENT SENSOR 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.

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### **TEST DESCRIPTION**

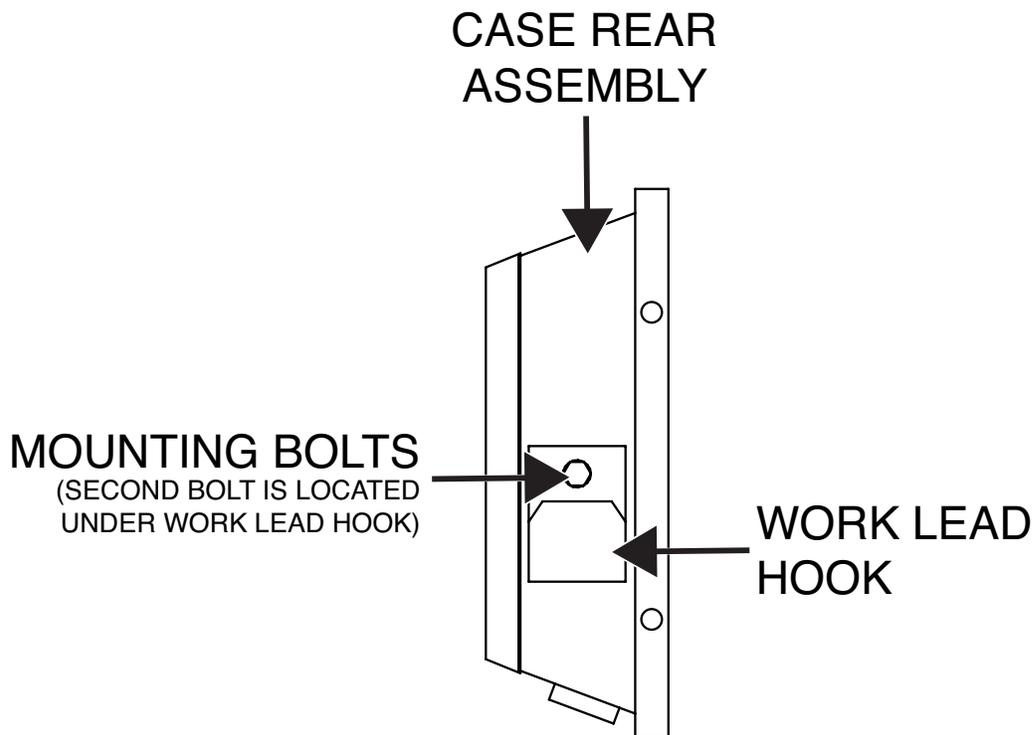
This procedure will aid the technician in the removal and replacement of the Current Sensor.

### **MATERIALS NEEDED**

- 8mm Nutdriver
- 8mm Open End Wrench
- Wiring Diagram

## CURRENT SENSOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.13 – Current sensor removal



### REMOVAL PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the ***Case Cover Removal Procedure***.
3. Using a 8mm nutdriver and a 8mm open end wrench, remove the two bolts and associated washers securing the current sensor to the case rear assembly. See Figure F.13. Note washer placement for reassembly.
4. The current sensor can now be removed from the case rear assembly and replaced.

## CURRENT SENSOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

### REPLACEMENT PROCEDURE

1. Carefully position the new current sensor into the case rear assembly.
2. Using a 8mm nutdriver and a 8mm open end wrench, attach the two bolts and associated washers securing the current sensor to the case rear assembly.
3. Perform the ***Case Cover Replacement Procedure***.



## THYRISTOR REMOVAL AND REPLACEMENT PROCEDURE

### **WARNING**

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

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

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### **TEST DESCRIPTION**

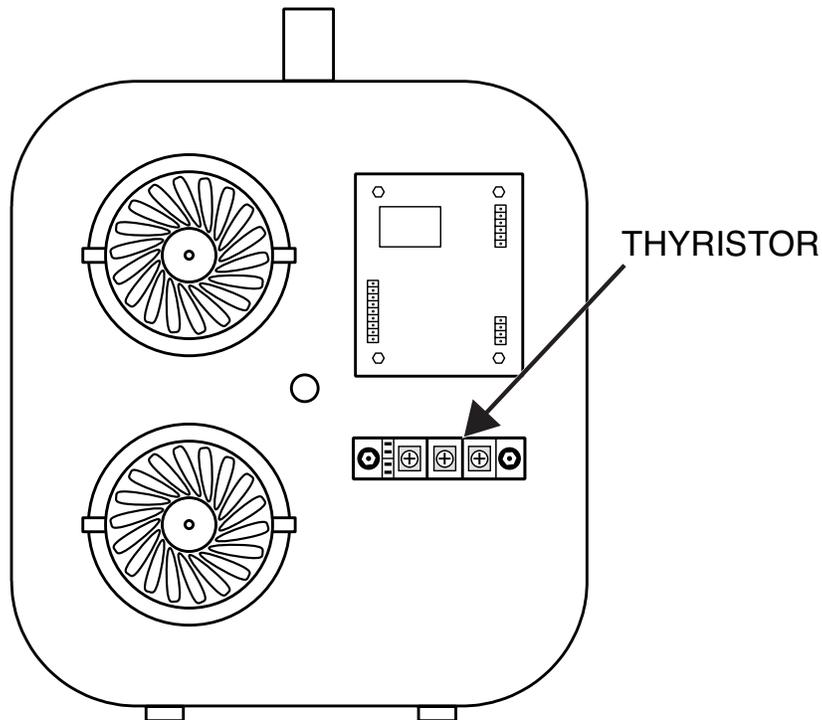
This procedure will aid the technician in the removal and replacement of the Thyristor.

### **MATERIALS NEEDED**

- 8mm Nutdriver
- Phillips Screwdriver
- Wiring Diagram
- Dow Corning 340 Joint Compound (Lincoln Part T12837)

## THYRISTOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.14 – Thyristor location

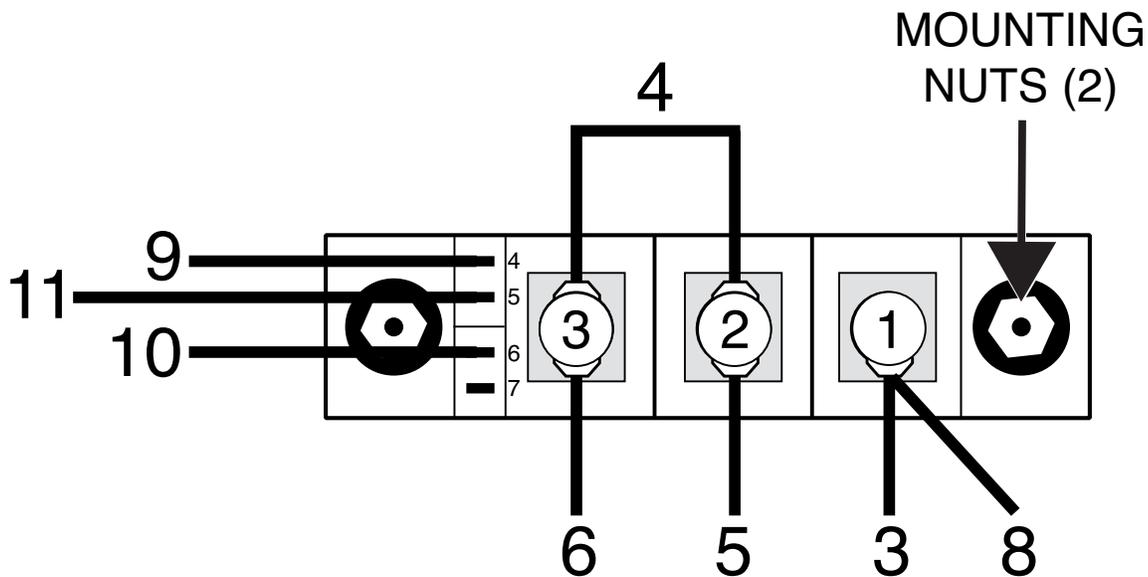


### REMOVAL PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the thyristor. See Figure F.14.
4. Using a phillips screwdriver, label and disconnect leads 3, 4, 5, 6 and 8 from terminals 1, 2 and 3 of the thyristor. See **Figure F.15**. See Wiring Diagram.
5. Label and disconnect leads 9, 11 and 10 from terminals 4, 5 and 6 of the thyristor. See **Figure F.15**. See Wiring Diagram.
6. Using a 8mm nutdriver, remove the two nuts and associated washers securing the thyristor to the machine. See **Figure F.15**. Note placement of Dow Corning 340 joint compound on the rear of the thyristor for reassembly.
7. The thyristor can now be removed and replaced.

## THYRISTOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.15 – Thyristor leads, terminals and mounting nut locations



### REPLACEMENT PROCEDURE

1. Apply a small amount of Dow Corning 340 joint compound to the mounting surface of the new thyristor.
2. Carefully position the new thyristor onto the machine.
3. Using a 8mm nutdriver, attach the two nuts and associated washers securing the thyristor to the machine.
4. Connect leads 9, 11 and 10 to terminals 4, 5 and 6 of the thyristor. See Wiring Diagram.
5. Using a phillips screwdriver, Connect leads 3, 4, 5, 6 and 8 to terminals 1, 2 and 3 of the thyristor. See Wiring Diagram.
6. Perform the **Case Cover Replacement Procedure**.



## PC BOARD REMOVAL AND REPLACEMENT PROCEDURE

### **WARNING**

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

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

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### **TEST DESCRIPTION**

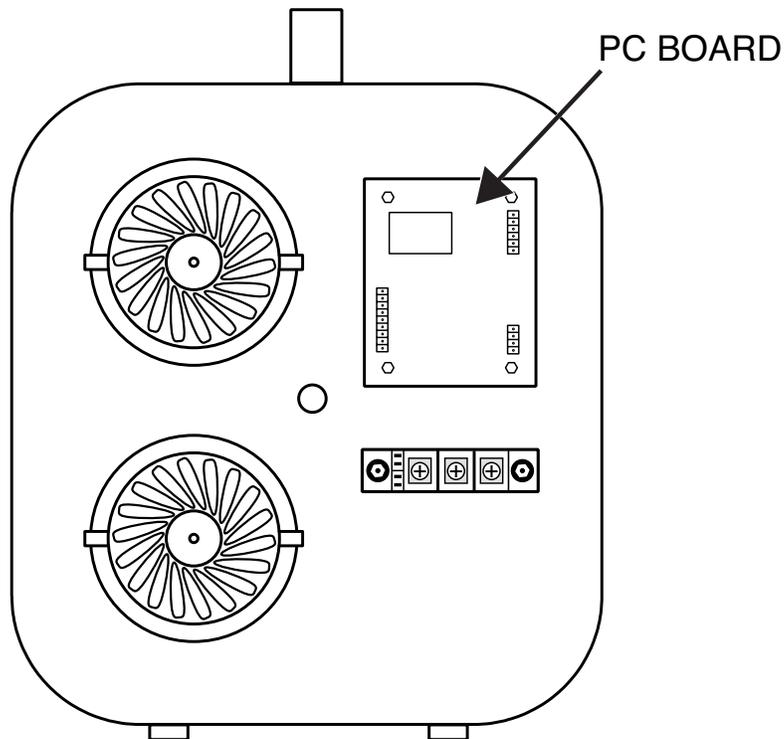
This procedure will aid the technician in the removal and replacement of the PC Board.

### **MATERIALS NEEDED**

7mm Nutdriver  
Wiring Diagram

## PC BOARD REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.16 – PC board location

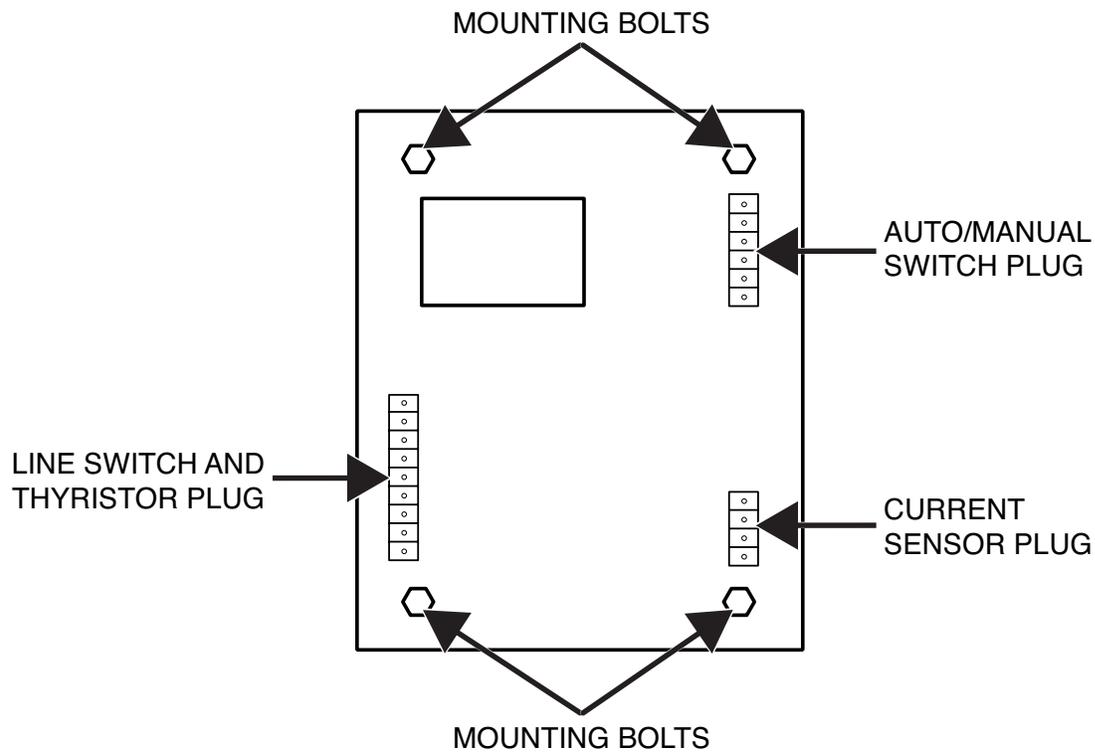


### REMOVAL PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the PC board. See Figure F.16.
4. Label and disconnect the plug connecting the line switch and the thyristor to the PC board. See **Figure F.17**. See Wiring Diagram.
5. Label and disconnect the plug connecting the auto/manual switch to the PC board. See **Figure F.17**. See Wiring Diagram.
6. Squeeze the tabs of the line switch and push the switch slightly out of the case side to allow access to the PC board mounting bolts.
7. Using a 7mm nutdriver, remove the four bolts securing the PC board to the nylon stand-offs. See **Figure F.17**.
8. The PC board can now be removed and replaced.

## PC BOARD REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.17 – PC board plug and mounting bolt locations



### REPLACEMENT PROCEDURE

1. Carefully position the new PC board in the machine.
2. Using a 7mm nutdriver, attach the four bolts securing the PC board to the nylon stand-offs.
3. Press down on the line switch until it snaps into position in the case side.
4. Connect the line switch and thyristor plug to the PC board.
5. Connect the auto/manual switch plug to the PC board.
6. Perform the **Case Cover Replacement Procedure**.



## 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 troubleshooting assistance before you proceed. Call 1-888-935-3877.

---

### **TEST DESCRIPTION**

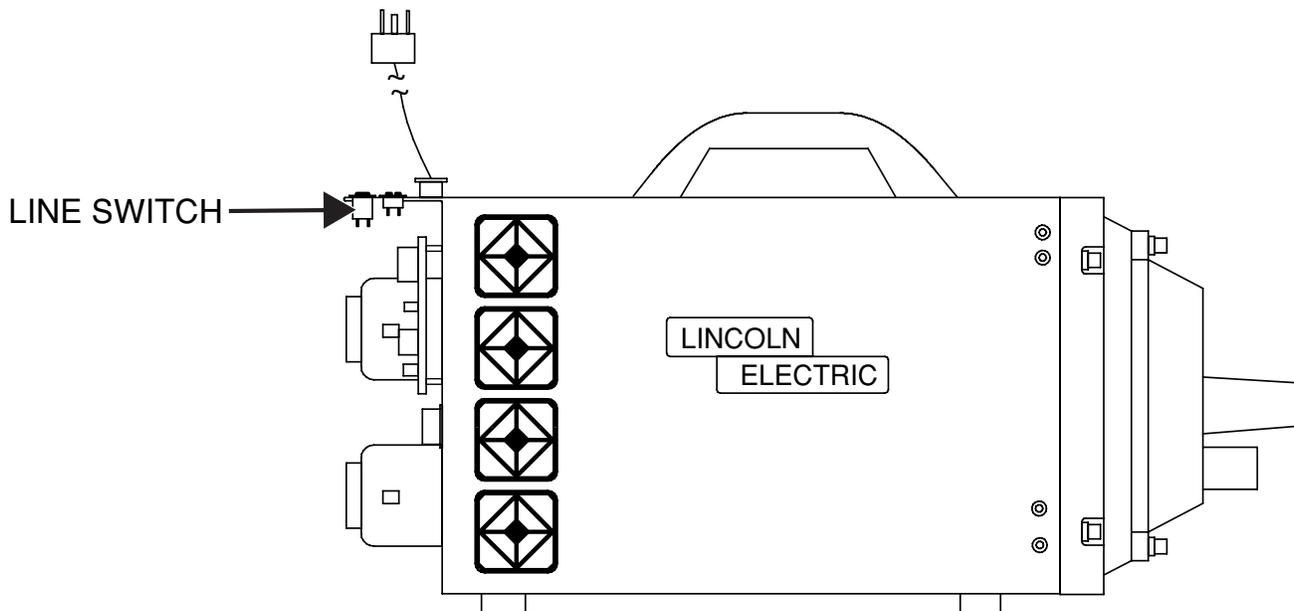
This procedure will aid the technician in the removal and replacement of the Line Switch.

### **MATERIALS NEEDED**

Wiring Diagram

## LINE SWITCH REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.18 – Line switch location

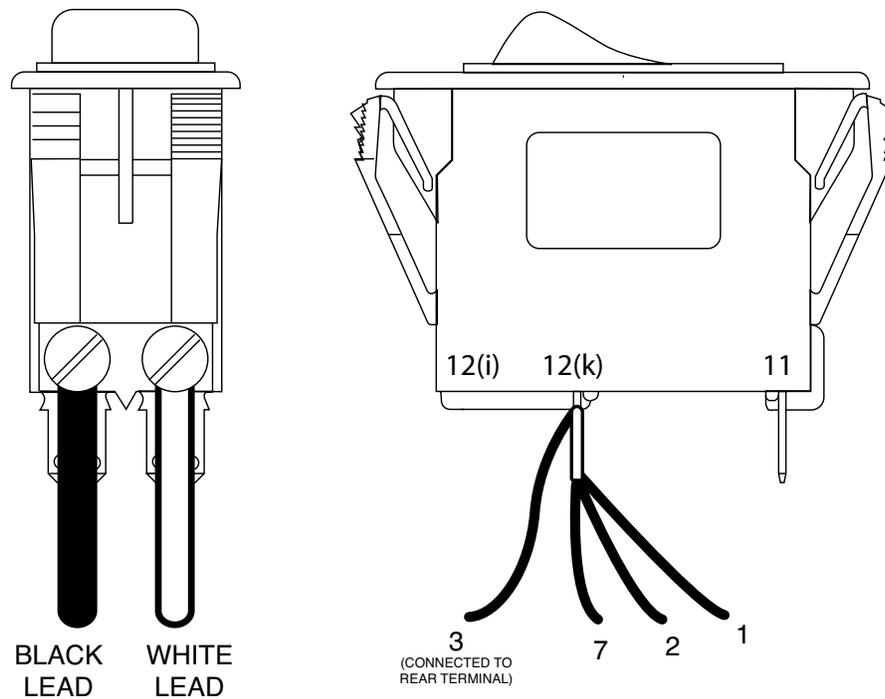


### REMOVAL PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the line switch. See Figure F.18.
4. Using a slotted screwdriver, label and disconnect the black and white leads from terminals 2 and 4 of the line switch. See **Figure F.19**. See Wiring Diagram.
5. Label and disconnect leads 1, 2 and 7 from terminal 3 of the line switch. See **Figure F.19**. See Wiring Diagram.
6. Label and disconnect lead 3 from terminal 1 of the line switch. See **Figure F.19**. See Wiring Diagram.
7. Squeeze the tabs on the side of the line switch and push line switch outward and through case side.
8. The line switch can now be replaced.

## LINE SWITCH REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.19 – Line switch lead locations



### REPLACEMENT PROCEDURE

1. Carefully position the new line switch in the machine.
2. Press firmly on the line switch until it snaps into position.
3. Connect lead 3 to terminal 1 of the line switch. See Wiring Diagram.
4. Connect leads 1, 2 and 7 to terminal 3 of the line switch. See Wiring Diagram.
5. Using a slotted screwdriver, connect the black and white leads to terminals 2 and 4 of the line switch. See Wiring Diagram.
6. Perform the **Case Cover Replacement Procedure**.



## MODE 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 troubleshooting assistance before you proceed. Call 1-888-935-3877.

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### **TEST DESCRIPTION**

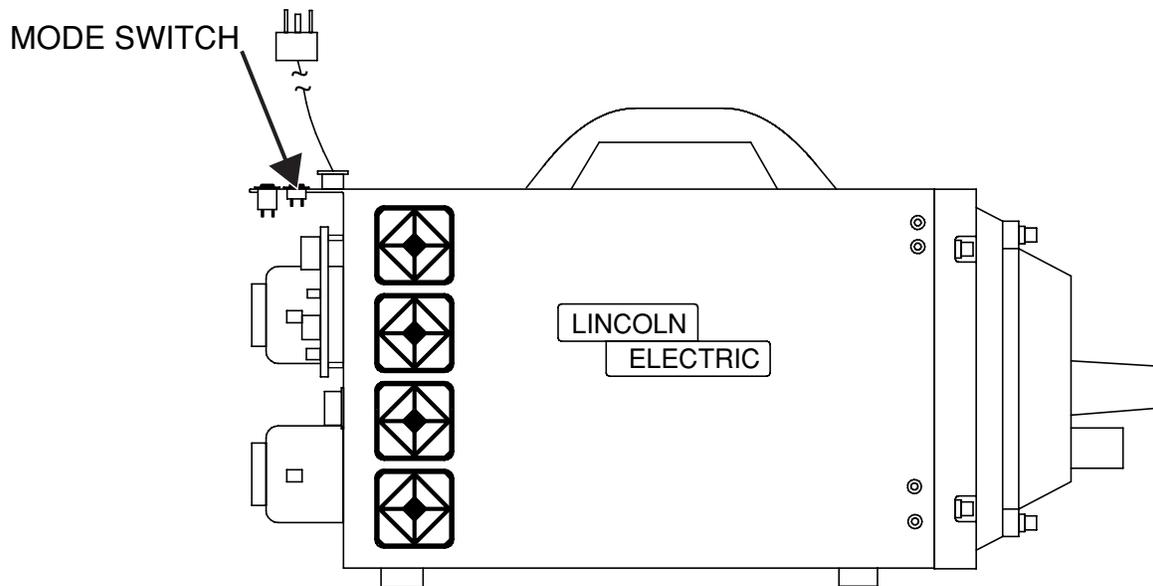
This procedure will aid the technician in the removal and replacement of the Mode Switch.

### **MATERIALS NEEDED**

Wiring Diagram

**MODE SWITCH REMOVAL AND REPLACEMENT PROCEDURE** *(continued)*

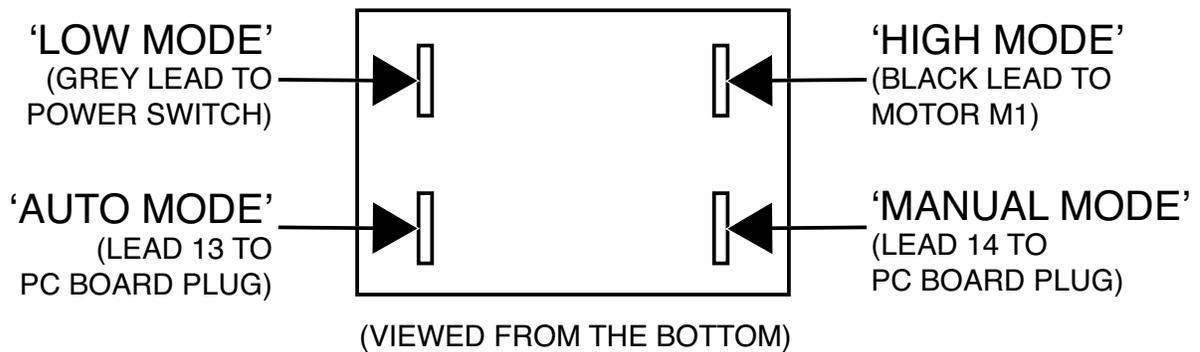
Figure F.20 – Mode switch location

**REMOVAL PROCEDURE**

1. Remove the input power to the X-Tractor 1GC.
2. Perform the **Case Cover Removal Procedure**.
3. Locate the mode switch. See Figure F.20.
4. Label and disconnect the four leads from the mode switch terminals. See **Figure F.21**. See Wiring Diagram.
5. Squeeze the tabs on the side of the mode switch and push mode switch outward and through case top.
6. The mode switch can now be replaced.

**MODE SWITCH REMOVAL AND REPLACEMENT PROCEDURE** *(continued)*

Figure F.21 – Mode switch terminals

**REPLACEMENT PROCEDURE**

1. Carefully position the new mode switch in the machine.
2. Press firmly on the mode switch until it snaps into position.
3. Connect the four previously removed leads to the mode switch terminals. See Wiring Diagram.
4. Perform the **Case Cover Replacement Procedure**.



## MOTOR REMOVAL AND REPLACEMENT PROCEDURE

### **WARNING**

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

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

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### **TEST DESCRIPTION**

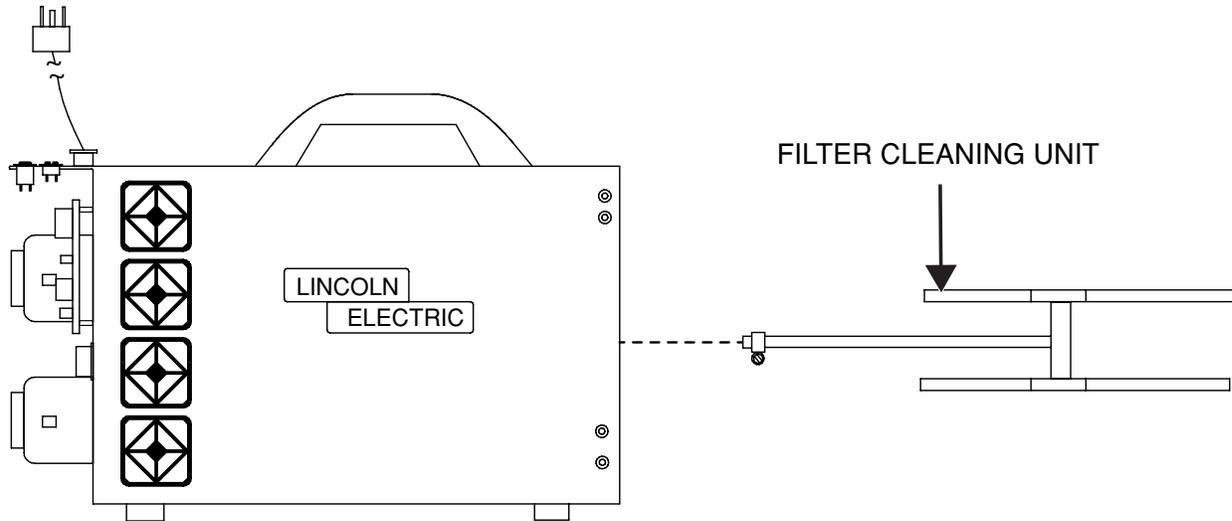
This procedure will aid the technician in the removal and replacement of the Motor M1 and/or Motor M2.

### **MATERIALS NEEDED**

- 8mm Nutdriver
- Phillips Screwdriver
- Slotted Screwdriver
- Hammer
- Wiring Diagram

## MOTOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.22 – Filter cleaning unit removal



### REMOVAL PROCEDURE

1. Remove the input power to the X-Tractor 1GC.
  2. Perform the **Case Cover Removal Procedure**.
  3. Remove the filter cleaning unit. See Figure F.22.
  4. Using a phillips screwdriver, label and disconnect motor leads connected to terminals 3 and 2 of the thyristor. See **Figure F.23**. See Wiring Diagram.
  5. Label and disconnect motor lead connected to terminal 3 of the line switch. See **Figure F.24**. See Wiring Diagram.
- NOTE:** There are two leads connected to terminal 3 of the line switch. To disconnect the black motor lead first remove the leads from the terminal and gently bend the lead connector so it is flat and pull the leads apart.
6. Label and disconnect the motor lead from the High terminal of the mode switch. See **Figure F.25**. See Wiring Diagram.
  7. Perform the **Line Switch Removal Procedure**.
  8. Perform the **Mode Switch Removal Procedure**.
  9. Using a 8mm nutdriver, label and disconnect ground lead. See **Figure F.26** and **F.27**. See Wiring Diagram. Note washer placement for reassembly.

10. Using a hammer and a slotted screwdriver, remove the nut securing the input power cord to the case of the machine and carefully route cord and leads out of machine. See **Figure F.26**.
  11. Using a 8mm nutdriver, remove the three nuts and washers from the inside of the rear panel. See **Figure F.28** and **F.29**. Note washer placement for reassembly.
  12. Carefully slide rear panel out of the case.
- NOTE:** Motors are held in position by the rear panel and will move freely once the rear panel begins to be removed. It may be necessary to hold motors in place while sliding rear panel out of machine to avoid damage to the motors.
13. Either motor can now be removed and replaced.

### MOTOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.23 – Thyristor lead locations

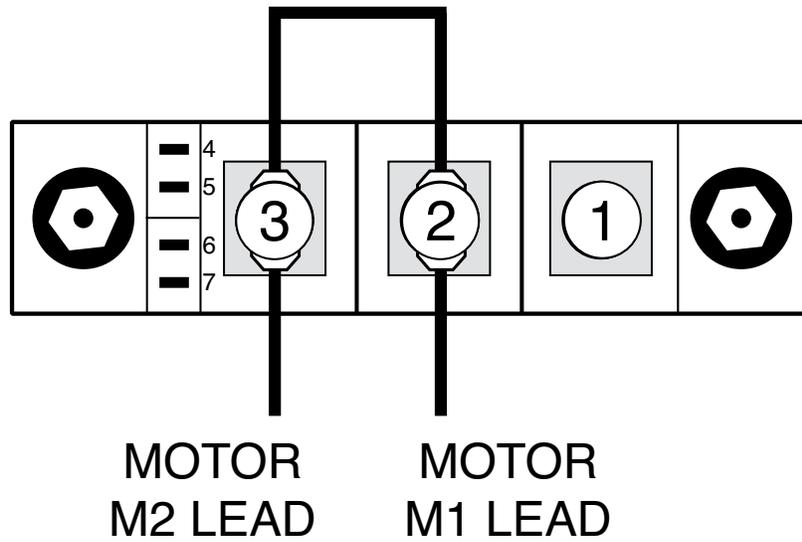
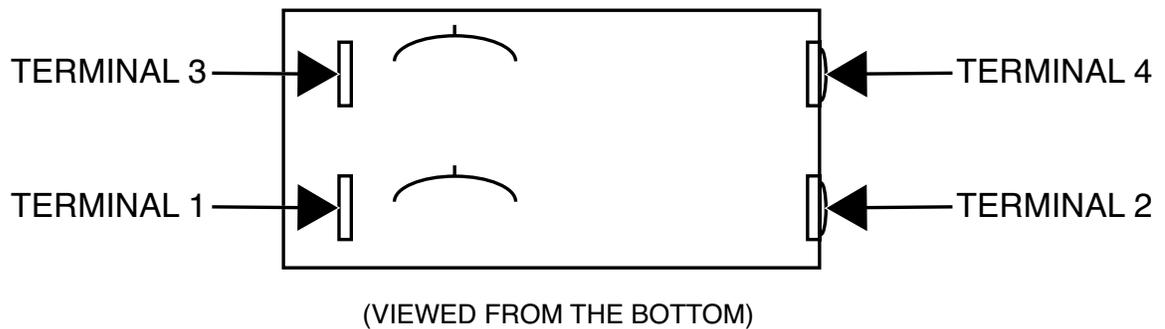


Figure F.24 – Line switch terminal locations



# MOTOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.25 – Mode switch terminal locations

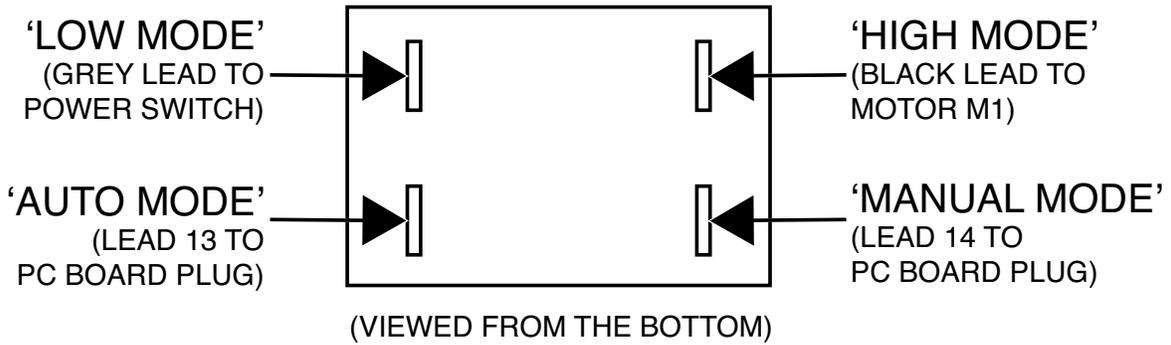
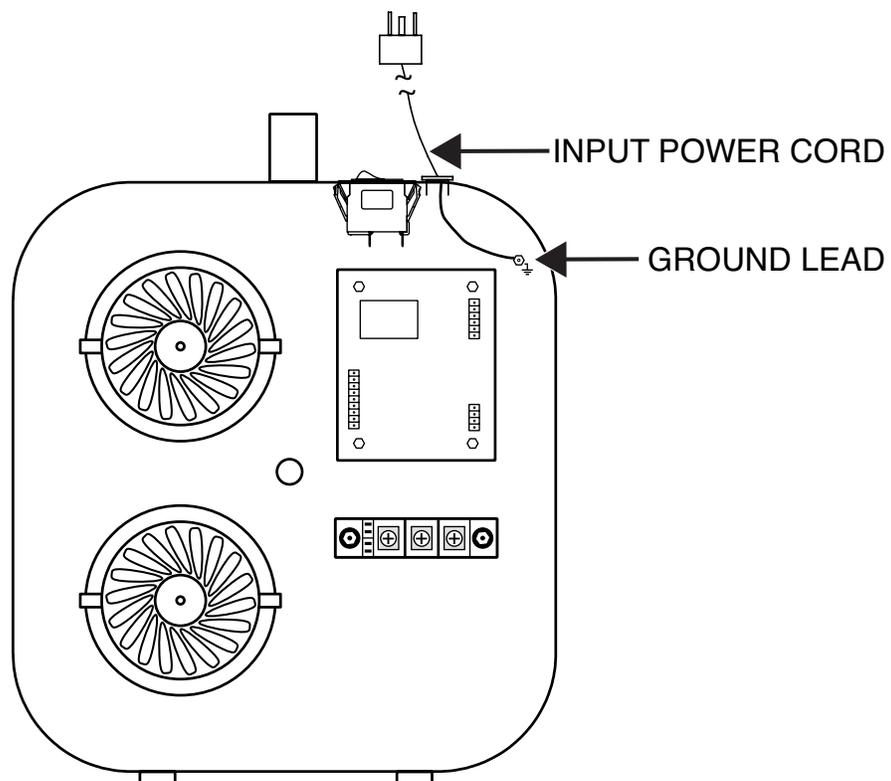


Figure F.26 – Ground lead disconnection and input power cord removal



# MOTOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.27 – Ground lead connection

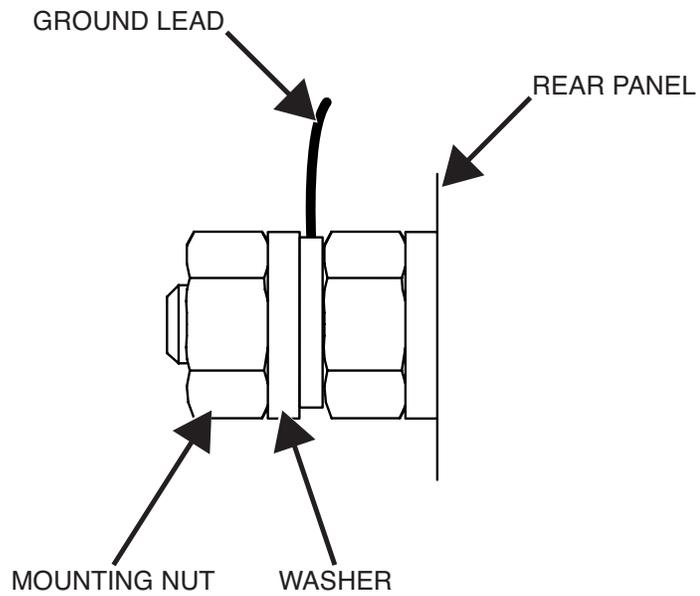
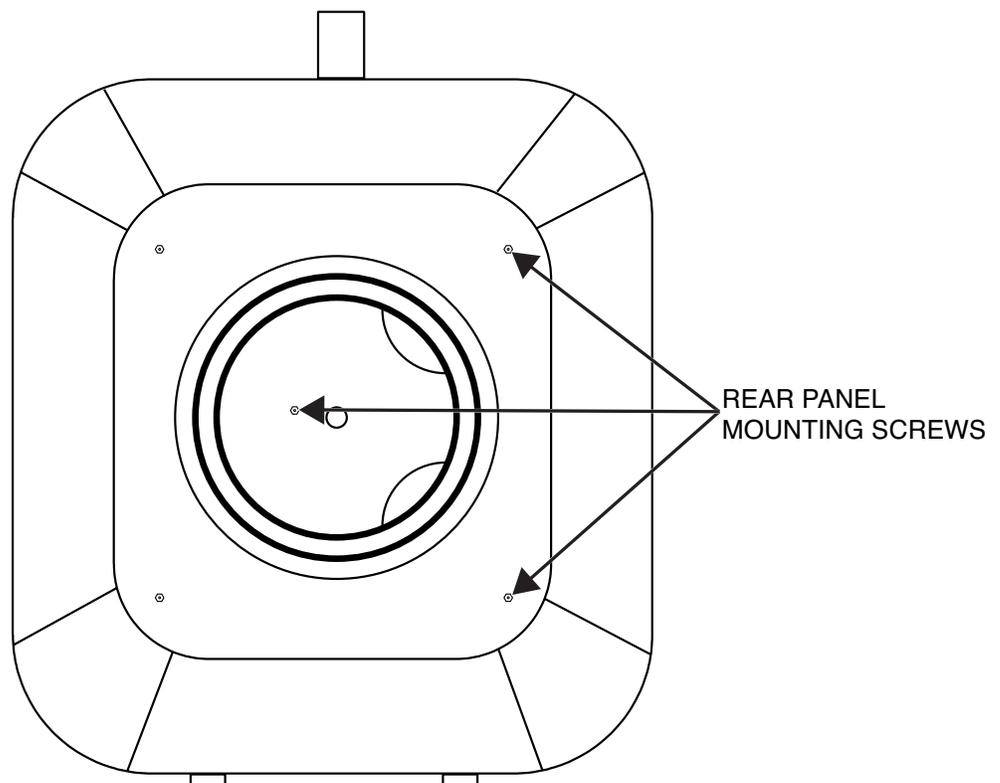
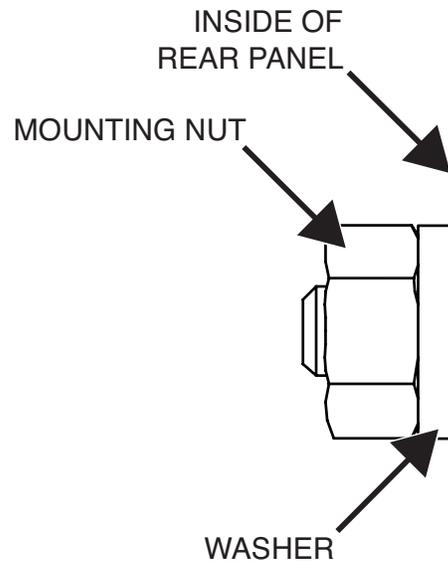


Figure F.28 – Rear panel mounting locations



## MOTOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.29 – Washer and mounting nut locations



### REPLACEMENT PROCEDURE

1. Carefully position machine face down on table. This will allow for easy access to the rear of the machine.
2. Carefully position new motors into the machine.

**NOTE:** The motors must be positioned properly to allow for the proper fit of the case rear assembly and the filter cleaning unit.

3. Slide rear panel in to position on the machine. Be sure panel fits flush with rear of the case.
4. Carefully place the machine in to the normal position (on it's feet) to gain access to the inside of the machine.
5. Using a 8mm nutdriver, attach the three nuts and washers to the inside of the rear panel. It may be necessary to hold the motors in the proper position while securing the nuts and washers to the machine.

**NOTE:** Do not over tighten the nuts as this will cause the case rear assembly mounting holes to become misaligned.

6. Route the leads and input power cable into the machine.
7. Using a hammer and a slotted screwdriver, attach the nut securing the input power cord to the case of the machine.
8. Using a 8mm nutdriver, connect the ground lead and washer. See Wiring Diagram.
9. Perform the **Mode Switch Replacement Procedure**.
10. Perform the **Line Switch Replacement Procedure**.

11. Place the filter cleaning unit back into the machine.
12. Perform the **Case Cover Replacement Procedure**.

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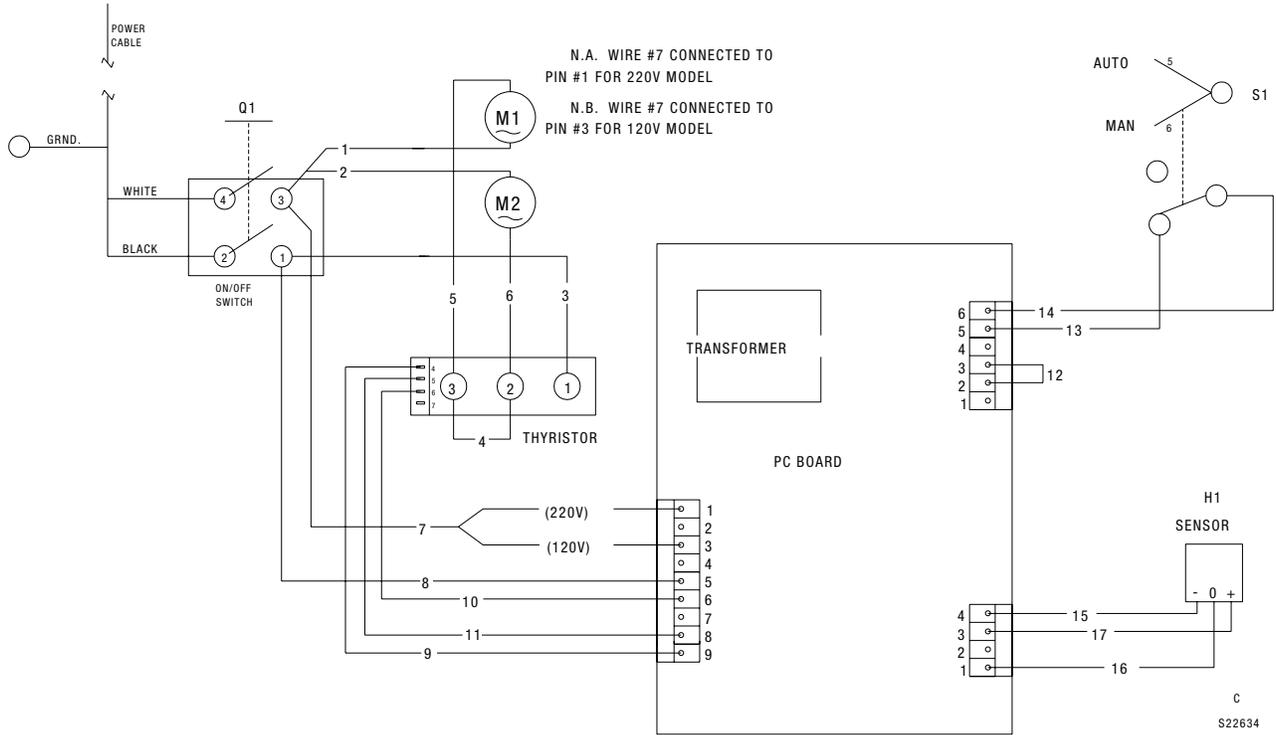
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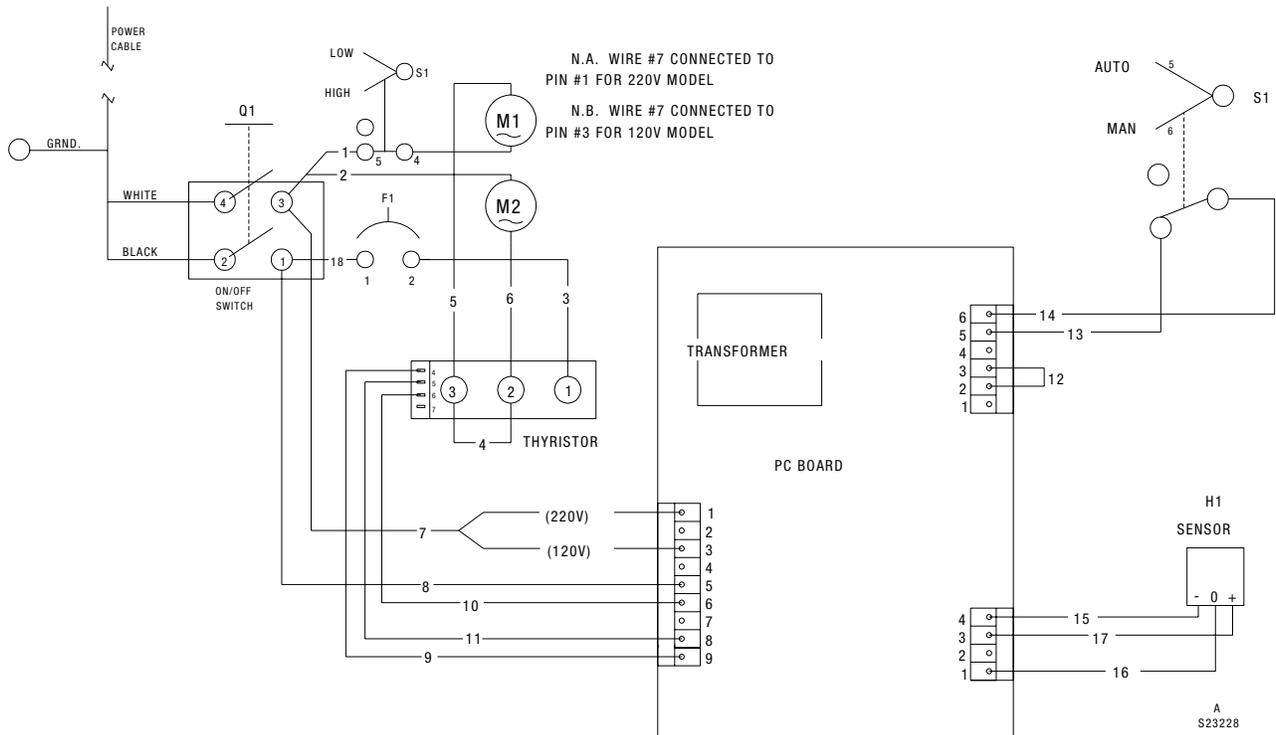
Diagrams.....Section G

Diagrams..... G-2

**WIRING DIAGRAM FOR X-TRACTOR 1GC MANUFACTURED BEFORE MAY, 1997**  
**(Machines without a Low/High Switch)**



**WIRING DIAGRAM FOR X-TRACTOR 1GC MANUFACTURED MAY, 1997 THRU APRIL 1999**  
**(Machines with Low/High Switch and Circuit Breaker located under rear cover)**



**WIRING DIAGRAM FOR X-TRACTOR 1GC MANUFACTURED AFTER APRIL 1999**  
**(Machines with Low/High Switch and no Circuit Breaker under rear cover)**

