VRTEX® ENGAGE™

For use with machines having Code Numbers:
12497, 12498, 12499, 12500

SERVICE MANUAL

SVMXXX-X | Issue Date 16-Mar

THE LINCOLN ELECTRIC COMPANY
22801 St. Clair Avenue • Cleveland, OH • 44117-1199 • U.S.A.
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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. 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.

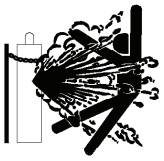
6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This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

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 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.

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 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.

[1] 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 web-site: 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 conned 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 conned 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/m3	PEL mg/m3
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/m3.

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

MASTER TABLE OF CONTENTS FOR ALL SECTIONS

TABLE OF CONTENTS
- THEORY OF OPERATION SECTION -

Figure E.1 - Block logic diagram

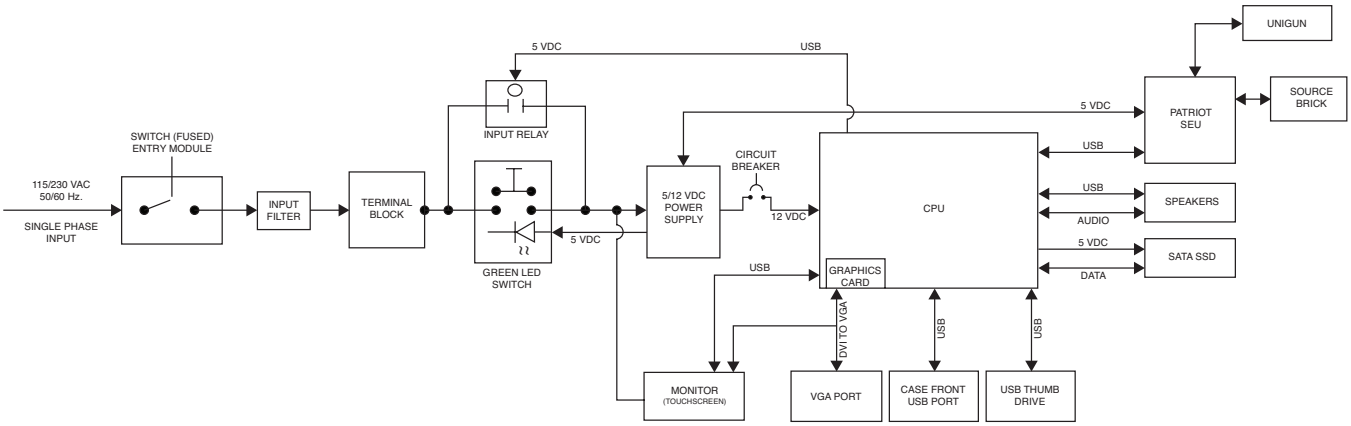
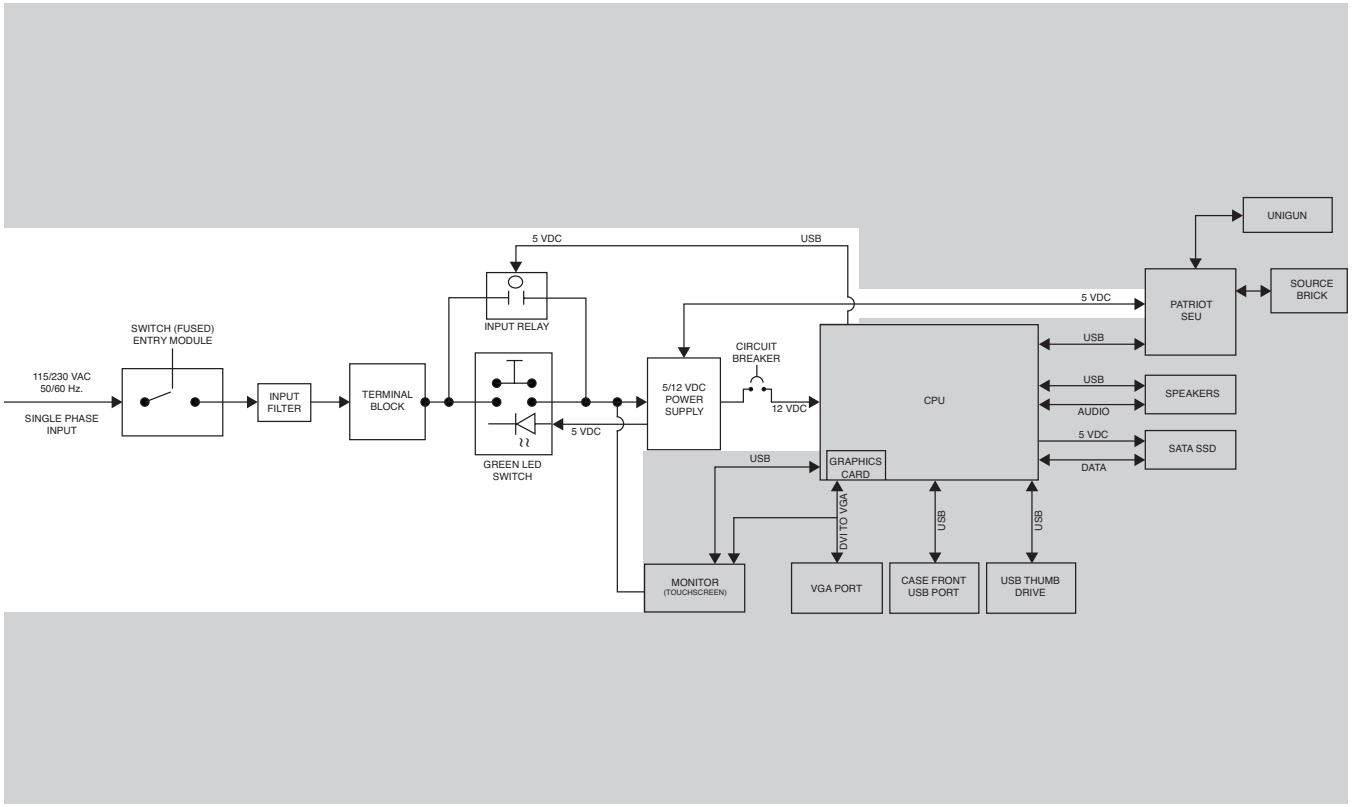


Figure E.2 - Input power and distribution



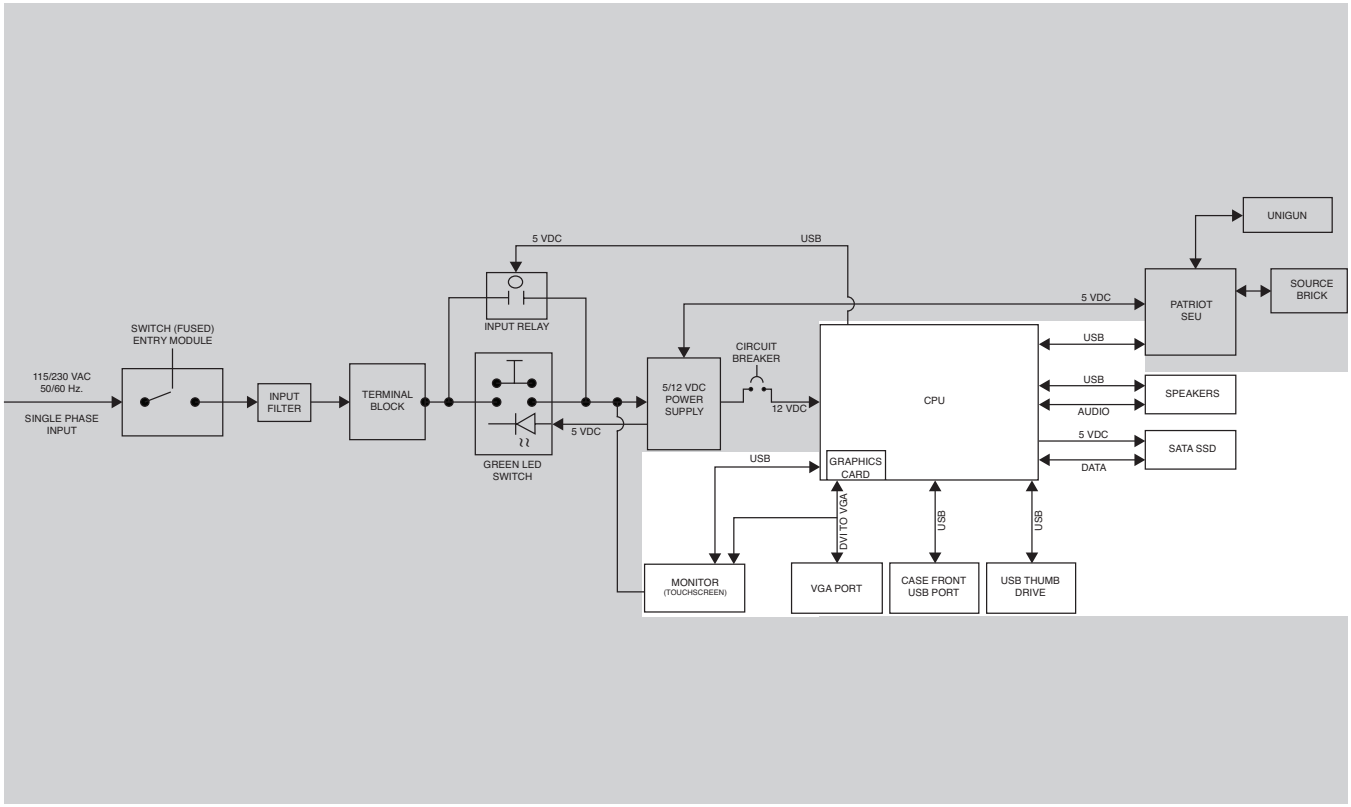
INPUT POWER AND DISTRIBUTION

The single phase input power (120/240 VAC) is applied through a fused input switch, an input filter, a terminal block, an input relay and a momentary switch to two discreet components. When the VRTEX Engage is turned on, the 5/12 VDC power supply and the touchscreen monitor receive the AC input power.

When the momentary switch is activated (for 5 seconds) the AC input power is applied directly to the 5/12 VDC power supply and the touchscreen monitor. The 12 VDC that is created in the 5/12 VDC power supply is applied through a circuit breaker to the CPU. The CPU then creates 5 VDC that is applied to the input relay. The input relay contacts bypass the momentary switch and the momentary switch can be released. The 5 VDC created in the 5/12 VDC power supply is applied to the patriot/polhemus SEU and the green LED located in the momentary switch.

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

Figure E.3 - Touchscreen monitor, CPU, USB thumb drive, USB port, VGA port and speakers

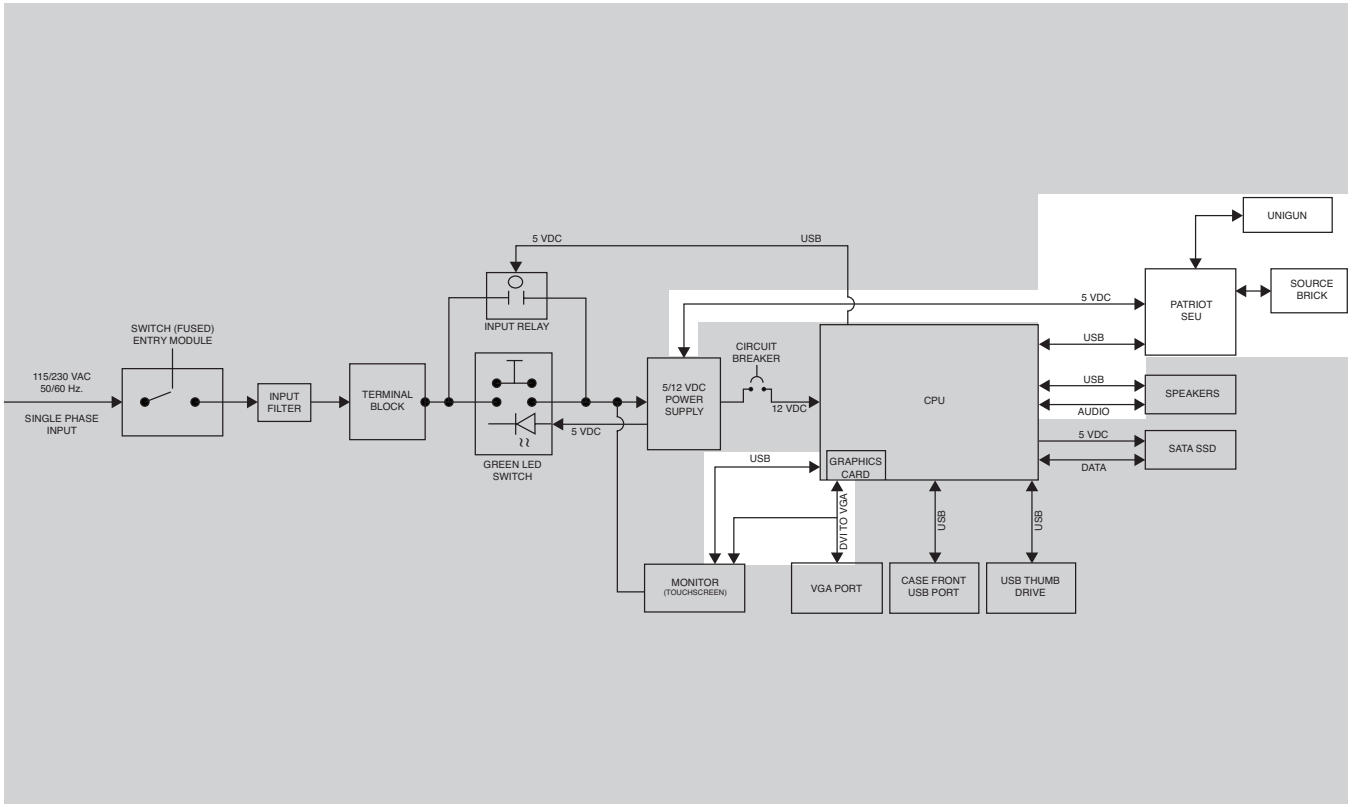


TOUCHSCREEN MONITOR, CPU, USB THUMB DRIVE, USB PORT, VGA PORT AND SPEAKERS

Once the CPU is powered up it becomes the main information processing component of the VRTEX Engage. The touchscreen monitor is the interface between the operator and the CPU. The CPU receives the user commands, via a USB cable, from the touchscreen monitor and sends acceptance information back to the touchscreen monitor via the DVI to VGA adapter and cable. Audio information is sent directly from the CPU to the two speakers. The internal USB thumb drive that is plugged into the CPU motherboard functions as a backup file for students' reports. There is also a case front USB port and a VGA port.

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

Figure E.4 - Unigun, source brick and patriot/polhemus SEU



UNIGUN, SOURCE BRICK AND PATRIOT/ POLHEMUS SEU

The patriot/polhemus SEU is powered by 5 VDC from the 5/12 VDC power supply. The patriot/polhemus SEU receives signals from the unigun and the source brick then transfers this information to the CPU. This feedback information is processed at the CPU and the resulting video and audio is sent to the touchscreen monitor and speakers.

The source brick determines the internal operating frequency of the VRTEX Engage. This internal operating frequency can be different depending on the model and which source brick is used.

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

TABLE OF CONTENTS
- TROUBLESHOOTING AND REPAIR SECTION -

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

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

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

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "PROBLEM" (SYMPTOMS). This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING

ELECTRIC SHOCK can kill.

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

⚠ CAUTION

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

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

PC board can be damaged by static electricity.

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

ATTENTION

Static-Sensitive Devices Handle only at Static-Safe Workstations

Reusable Container Do Not Destroy

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

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

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

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

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

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

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
POWER-UP PROBLEMS		
The VRTEX Engage does not start up when the green circular button is pressed.	1. Make sure the correct input power is being applied to the machine. 2. Make sure the fused entry module switch is in the ON position. 3. Be sure to hold the green circular button in for at least 5 seconds. 4. Check the input cord for loose or faulty connections at the machine and at the plug. 5. Possible drained or faulty CMOS battery.	1. With the entry module switch in the ON position carefully check for input voltage (120/240 VAC) at leads 501A on the red terminal block to lead 601A on the grey terminal block. See the Wiring Diagram. 2. If the correct voltage is not present check the continuity of leads 501A and 601A. See the Wiring Diagram. 3. If the correct voltage is not present at leads 501A to 601A at the terminal block perform the ***Entry Module Test Procedure***. 4. Perform the ***Input Filter Test Procedure***. 5. If the correct voltage is present at leads 501A to 601A at the terminal block check to see if the correct input voltage (120/240 VAC) is present at leads 502D to 601C at the 5/12 VDC power supply when the green circular button is pressed. See the Wiring Diagram. 6. If the correct voltage is not present at leads 502D to 601C (green circular button pressed) at the 5/12 VDC power supply, check the associated wiring and make sure the jumpers are in the correct terminals in the terminal block. See the Wiring Diagram. Also check the functionality of the green circular ON button. 7. If the correct voltage is present at leads 502D to 601C (green circular button pressed) at the 5/12 VDC power supply, perform the ***5/12 VDC Power Supply Test Procedure***. 8. The input relay may be faulty perform the ***Input Relay Test Procedure***. 9. Make sure that 12 VDC is being applied to the CPU on leads 901A(+) to 701B(-). See the Wiring Diagram. If the correct voltage is being applied to the CPU (12 VDC) and the VRTEX Engage does not power-up the CPU may be faulty.

⚠ 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
POWER-UP PROBLEMS		
The VRTEX Engage does not power up when the ON button is pressed. The circular green button does illuminate but does NOT stay on when the ON button is released.	1. Make certain the correct input voltage is being applied to the VRTEX Engage. (115/230 VAC).	1. With the ON button pressed 5 VDC should be present at the input relay. Leads 801B (+) to 701C (-). See the Wiring Diagram. If the 5 VDC is present perform the ***Input Relay Test Procedure***. Also check leads 502B and 501B for loose or faulty connections. 2. If 5 VDC is not present at leads 801B to 701C check the USB connection on the CPU. See the Wiring Diagram. 3. Check to make sure 12 VDC is being applied to the CPU on leads 901A (+) to 701B (-). 4. If 12 VDC is being applied to the CPU but 5 VDC is not being applied to the input relay the CPU may be faulty.
The VRTEX Engage does not power up when the ON button is pushed. The green indicator light comes on and stays on.	1. Check monitor is in ON position. See button on the side of the monitor. 2. Check all cable connections at the monitor and unigun.	1. Check to make sure the monitor is receiving the correct input voltage (120/240 VAC). See the Wiring Diagram. 2. Perform the ***5/12 VDC Power Supply Test Procedure***. 3. Check to make sure the patriot/ polhemus SEU is receiving 5 VDC. See the Wiring Diagram. 4. The graphics card portion of the CPU may be faulty.

⚠ 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
No image on monitor. Monitor does not turn ON.	1. Make sure the monitor power button is ON. 2. Check all cable connections at the monitor, speaker and unigun.	1. If the 12 VDC is present at the monitor and the monitor DOES NOT turn on the monitor may be faulty. 2. Check to make sure that VGA/DVI connections are secured on the CPU.
There is no audio information. All other functions are normal.	1. Make sure the volume is UP in the sound option (instructor mode).	1. Make sure the cables from the CPU to the speakers are plugged in. 2. Speakers may be faulty. 3. The CPU may be faulty.
Pressing the green circular button does not shut down the VRTEX Engage	1. To shut down the VRTEX Engage select Menu and then select shutdown. The green circular button is NOT used for system shutdown.	1. N/A
Some or none of the welding parameters, defects or discontinuities are graphing on the LASER screen.	1. These features may be “turned” off. Touch to select the desired features. Also, make sure that you are on a currently welded pass.	1. If still error, contact Lincoln Electric Automation Department at 1-888-935-3878.
Sometimes the view on the monitor seems to shake or wobble.	1. Make sure there are not other objects or high frequency sources that are interfering with the system. 2. Check the connections between the unigun and the patriot/polhemus SEU. See the Wiring Diagram.	1. Perform the ***Patriot SEU Module Test Procedure***. 2. Contact Lincoln Electric Automation Department at 1-888-935-3878.

⚠ 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
When the check settings are activated the incorrect settings appear.	1. The settings in the Instructor Mode are incorrect. 2. Make sure all of the settings in the tolerance editor are correct for the process and parameters being used. Check the acceptable ranges for the Lincoln defaults.	1. N/A.
Previous weld pass data is not accessible on the LASER screen.	1. "End Pass" must be activated before starting a new pass. If a new coupon is started the data will only be available for the first pass. 2. Use the touch screen to get to pass number and change which pass data you are looking for. Note that some configurations only have one pass capabilities. See the Lincoln default tolerances.	1. N/A.
The user is not sure which tolerance set they are using.	1. The tolerance set displayed in the tolerance editor is the one being used. 2. The tolerance set can be read from the student report. 3. Go to the Instructor Mode to change tolerances. Go to the login screen, select the key symbol, enter password and select tolerances to verify tolerance set.	1. N/A.
The user cannot weld a second pass.	1. The joint configuration may be setup for one pass only. 2. Check the tolerance editor to verify the joint configuration allows for multiple pass welding.	1. N/A.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

VRTEX ENGAGE DISASSEMBLY AND REASSEMBLY 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

This procedure will aid the technician in the disassembly and reassembly of the VRTEX Engage.

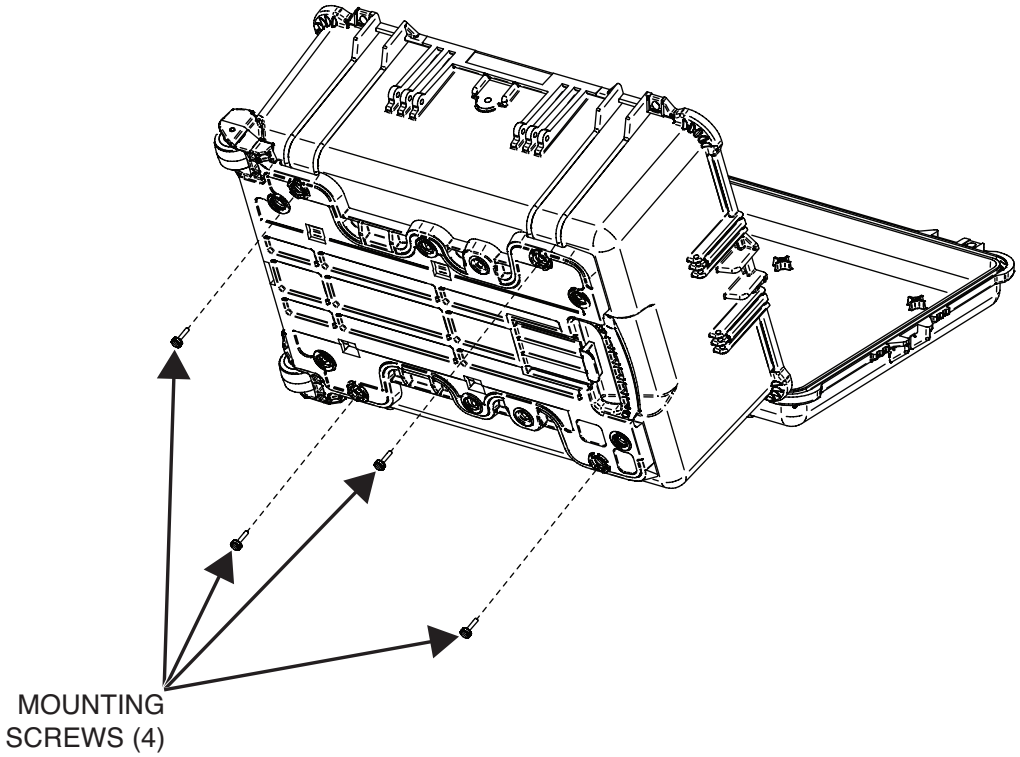
MATERIALS NEEDED

3/8” Nutdriver
Wiring Diagram

VRTEX ENGAGE DISASSEMBLY AND REASSEMBLY PROCEDURE

(continued)

Figure F.1 – Insert assembly mounting screw locations



DISASSEMBLY PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Using a 3/8" nutdriver, remove the four screws securing the complete insert assembly to the case assembly. See Figure F.1.
3. Carefully lift the complete insert assembly slightly "up and forward" from the case assembly.

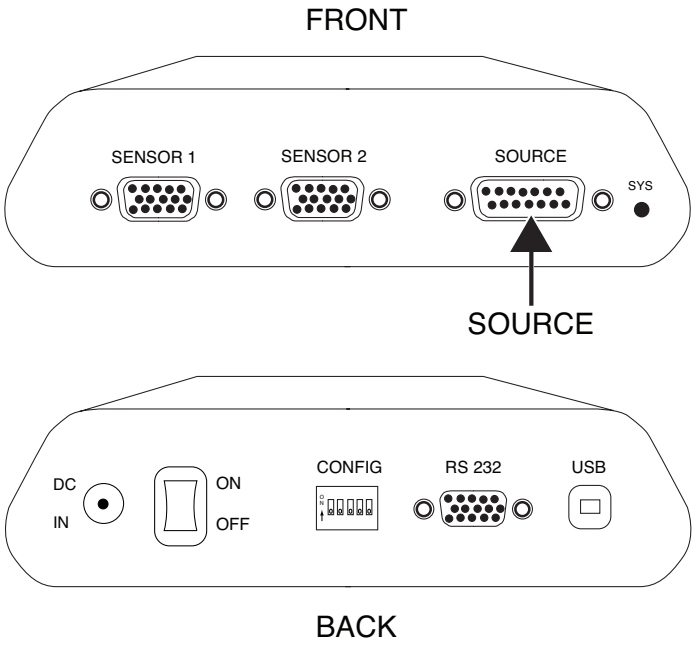
NOTE: Do not attempt to completely remove the insert assembly at this time, as the three cables for the source brick and unigun are still attached.

4. Label and disconnect the source cable from the rear of the patriot SEU module. See ***Figure F.2***. See Wiring Diagram.
5. Label and disconnect the SEN1A and SEN1B cables from the SEN1 Y-adapter. See Wiring Diagram.
6. The insert assembly can now be completely removed from the case assembly.

VRTEX ENGAGE DISASSEMBLY AND REASSEMBLY PROCEDURE

(continued)

Figure F.2 – Source cable connection location



ASSEMBLY PROCEDURE

1. Carefully position the complete insert assembly partially into the case assembly keeping enough clearance to connect the source cable into the patriot SEU.
2. Connect the SEN1A and SEN1B cables to the SEN1 Y-adapter. See Wiring Diagram.
3. Connect the source cable to the rear of the patriot SEU module. See Wiring Diagram.
4. The insert assembly can now be filly inserted into the case assembly.
5. Using a 3/8” nutdriver, attach the four screws securing the insert assembly to the case assembly.

5/12 VDC POWER SUPPLY TEST 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

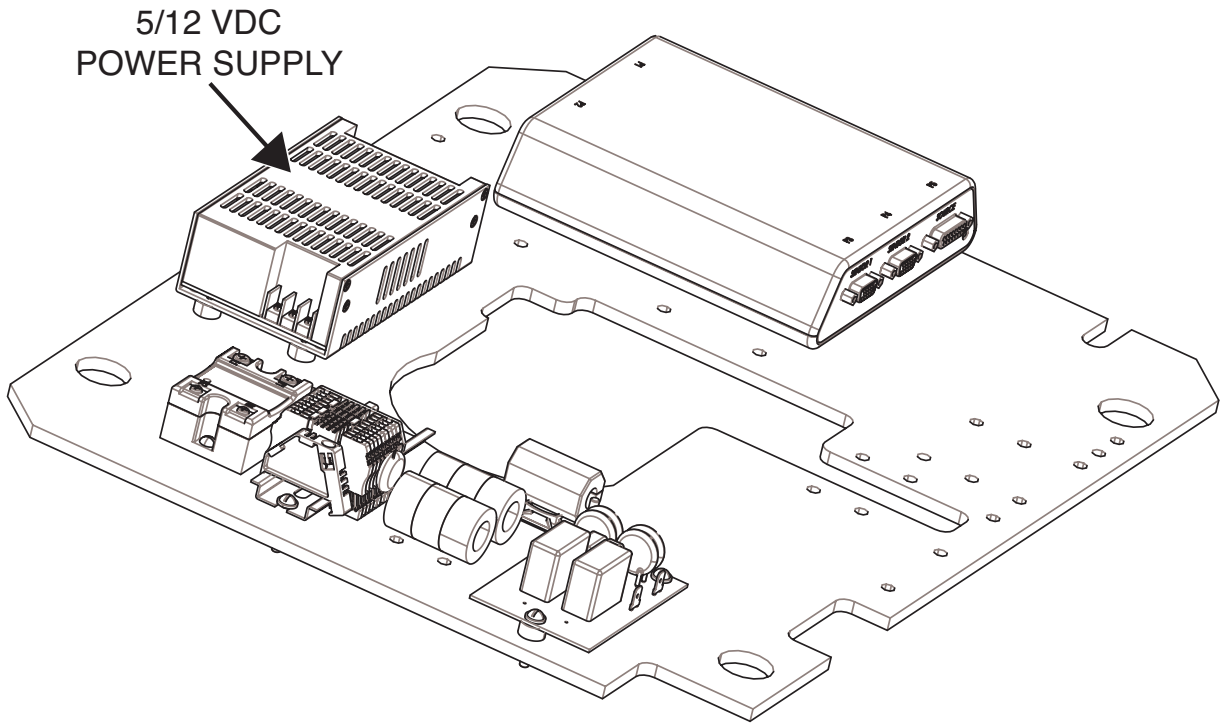
This procedure will aid the technician in determining if the 5/12 VDC Power Supply is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

5/12 VDC POWER SUPPLY TEST PROCEDURE *(continued)*

Figure F.3 – 5/12 VDC power supply location



PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Locate the 5/12 VDC power supply. See Figure F.3.
4. Carefully apply the correct input voltage to the machine.
5. Locate leads 601C and 502D at the 5/12 VDC power supply. See ***Figure F.4***. See Wiring Diagram.
6. Using a volt/ohmmeter, check for the presence of input line voltage (120/240 VAC) at leads 601C and 502D. See ***Figure F.4***. See Wiring Diagram.

NOTE: Voltage should be present when the green "ON" button is pressed. This is the input power to the machine. If voltage is not present, check the voltage at the terminal blocks and the Green "ON" button. See Wiring Diagram.

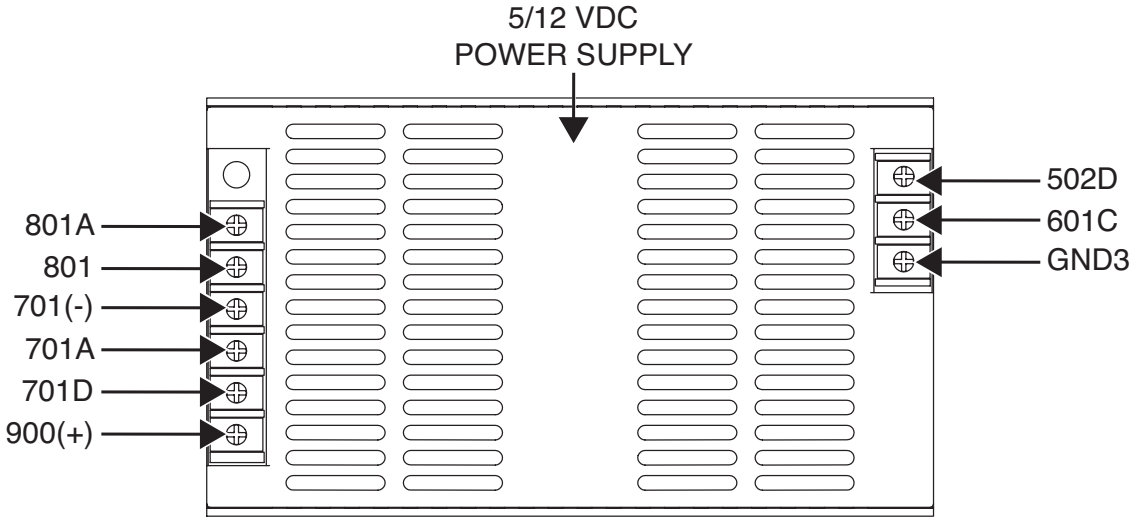
7. Perform the ***Entry Module Test Procedure***.
8. Using a volt/ohmmeter, check the 12 VDC from leads 701D(-) to lead 900(+). See ***Figure F.4***. See Wiring Diagram.

NOTE: Check continuity between leads 900 and 901. The circuit breaker may be tripped.

9. Using a volt/ohmmeter, check for 5 VDC from leads 701(-) to lead 801(+). See ***Figure F.4***. See Wiring Diagram.
10. Using a volt/ohmmeter, check for 5 VDC from leads 801A(+) to 701A(-). See ***Figure F.4***. See Wiring Diagram.
11. If the input voltage to the power supply is present from leads 601C to 502D and either the 5 VDC or the 12 VDC is not present, the 5/12 VDC power supply may be faulty. Label and disconnect leads 801A, 801, 701, 701A, 900 and 701D and retest. If voltages are correct there may be an external "load" on the power supply.
12. Reconnect all leads when testing is complete.
13. If faulty, perform the ***5/12 VDC Power Supply Removal And Replacement Procedure***.
14. Perform the ***VRTEX Engage Reassembly Procedure***.
15. Perform ***Retest After Repair Procedure***.

5/12 VDC POWER SUPPLY TEST PROCEDURE *(continued)*

Figure F.4 – 5/12 VDC power supply lead locations



INPUT FILTER TEST 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

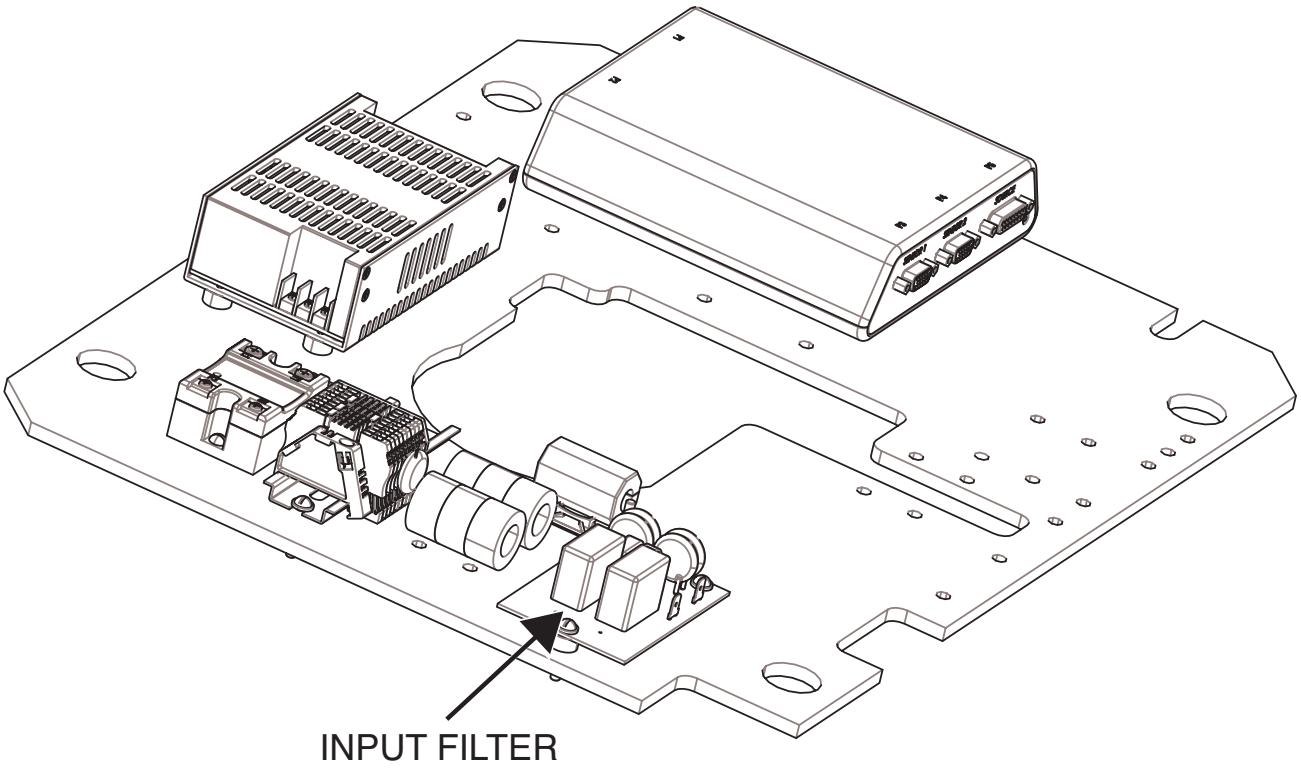
This procedure will aid the technician in determining if the Input Filter is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

INPUT FILTER TEST PROCEDURE *(continued)*

Figure F.5 – Input filter board location



PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Make certain that the switched fused entry module (on/off switch) is in the off (O) position.
3. Perform the ***VRTEX Engage Disassembly Procedure***.
4. Locate the input filter board. See Figure F.5.

NOTE: Make certain that the PC board mounting screws and the GND2 lead are tight. See Wiring Diagram.

5. Label and disconnect the four leads connected to terminals B1, B2, B3 and B4 of the input filter board. See ***Figure F.6***.
6. Using a volt/ohmmeter, check the resistance from B1 or B4 to B2 or B3. It should be 530k Ohms. See ***Figure F.6***.
7. Using a volt/ohmmeter, check the resistance B2 to B3. It should be 0 Ohms. See ***Figure F.6***.
8. Using a volt/ohmmeter, check the resistance from B1 to B4. It should be 0 Ohms. See ***Figure F.6***.
9. Use a capacitance meter that meter the following requirements:

Full scale accuracy:	Less than 1% ±1 digit
Resolution:	Minimum 3 digits
nF range display:	Minimum of 3 significant digits

10. Using a capacitance meter perform the capacitance and resistance test in ***Table F.1***.
11. If any of resistance/capacitance tests fail, the input filter board may be faulty.
12. If faulty, perform the ***Input Filter Removal And Replacement Procedure***.
13. When testing is complete, reattach the four previously removed leads to terminals B1, B2, B3 and B4.
14. Perform the ***VRTEX Engage Reassembly Procedure***.
15. Perform the ***Retest After Repair Procedure***.

INPUT FILTER TEST PROCEDURE *(continued)*

Figure F.6 – Input filter board test points

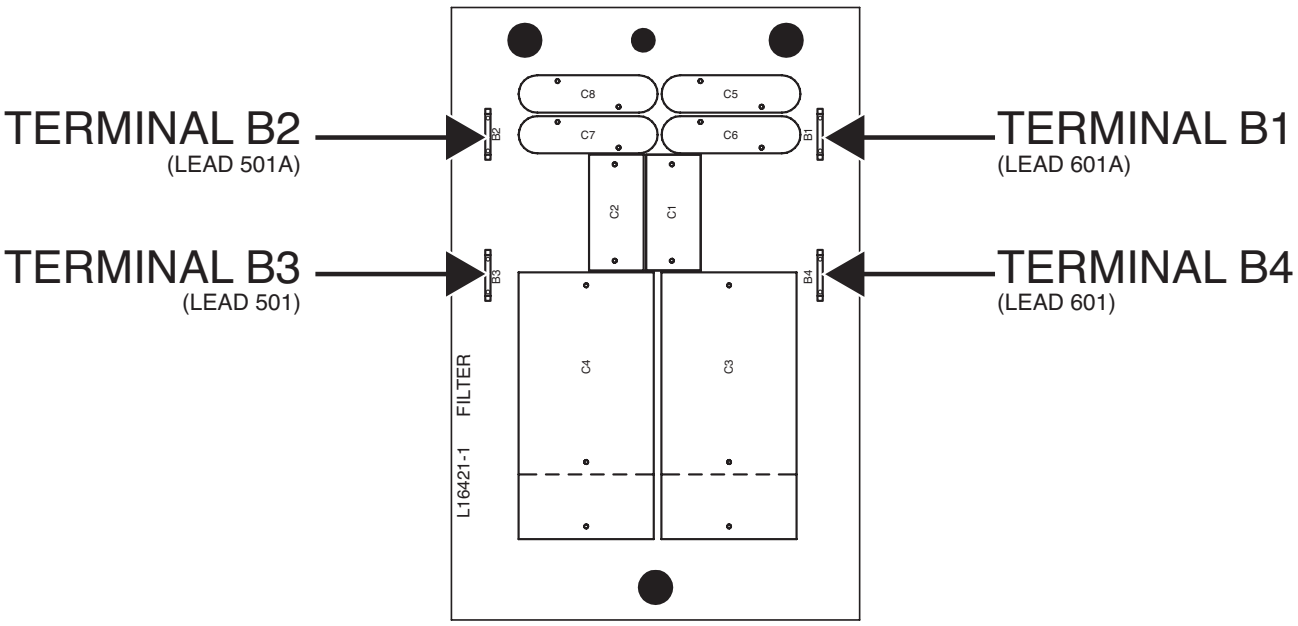


Table F.1 – Capacitance and resistance tests

DESCRIPTION	TEST POINT	TEST POINT	EXPECTED READING
RESISTANCE MEASUREMENT	B1 OR B4	B2 OR B3	530,000
RESISTANCE MEASUREMENT	B2	B3	0 OHMS
RESISTANCE MEASUREMENT	B1	B4	0 OHMS
CAPACITANCE MEASUREMENT	B1 OR B4	GROUND PAD AT MOUNTING SCREW	39nF - 59nF
CAPACITANCE MEASUREMENT	B2 OR B3	GROUND PAD AT MOUNTING SCREW	39nF - 59nF
CAPACITANCE MEASUREMENT	B1 OR B4	B2 OR B3	.880uF - 1.32uF

INPUT RELAY TEST 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

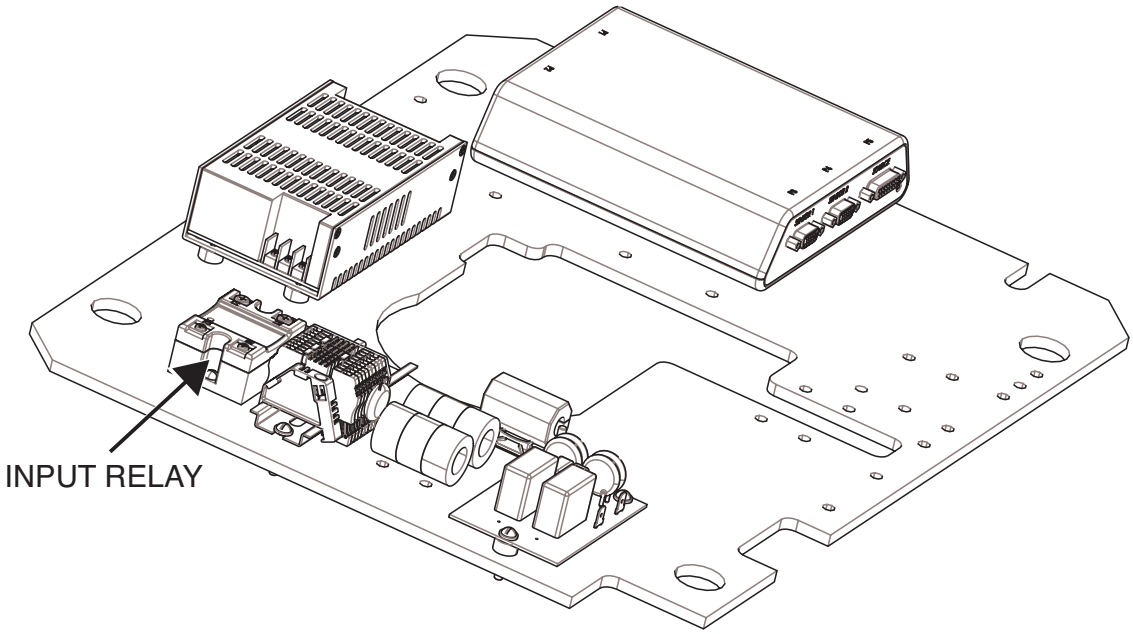
This procedure will aid the technician in determining if the Input Relay is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

INPUT RELAY TEST PROCEDURE *(continued)*

Figure F.7 – Input relay location



PROCEDURE

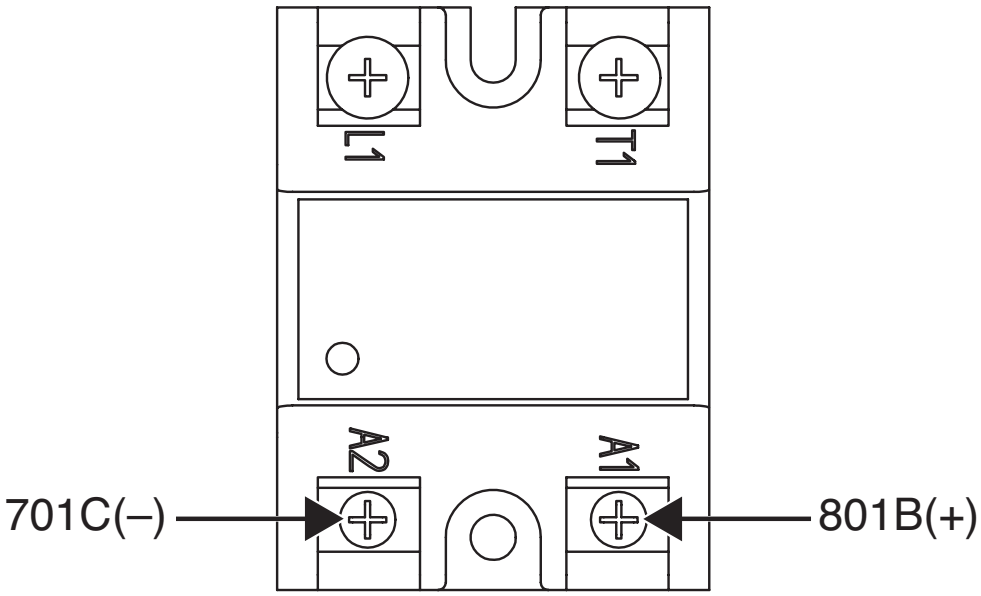
1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Carefully apply input power to the machine.
4. Press and hold the green "ON" button. Hold for five seconds to start system.

NOTE: If green "ON" button does not remain ON, it must be held in when testing voltages.

5. Locate the input relay. See Figure F.7.
6. Using a volt/ohmmeter, check for the presence of 5 VDC from lead 801B(+) to lead 701C(-) at the input relay. If 5 VDC is not present, check to make sure the CPU is receiving 12 VDC from the 5/12 VDC power supply. Check the circuit breaker. See Wiring Diagram. See ***Figure F.8***.
7. If the CPU is receiving 12 VDC but not creating the 5 VDC for the input relay, the CPU may be faulty. Perform the ***CPU Test Procedure***.
8. If the 5 VDC is present and the input relay does not activate, it may be faulty.
9. If faulty, perform the ***Input Relay Removal And Replacement Procedure***.
10. Perform the ***VRTEX Engage Reassembly Procedure***.
11. Perform the ***Retest After Repair Procedure***.

INPUT RELAY TEST PROCEDURE *(continued)*

Figure F.8 – Input relay test points



PATRIOT SEU MODULE TEST 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

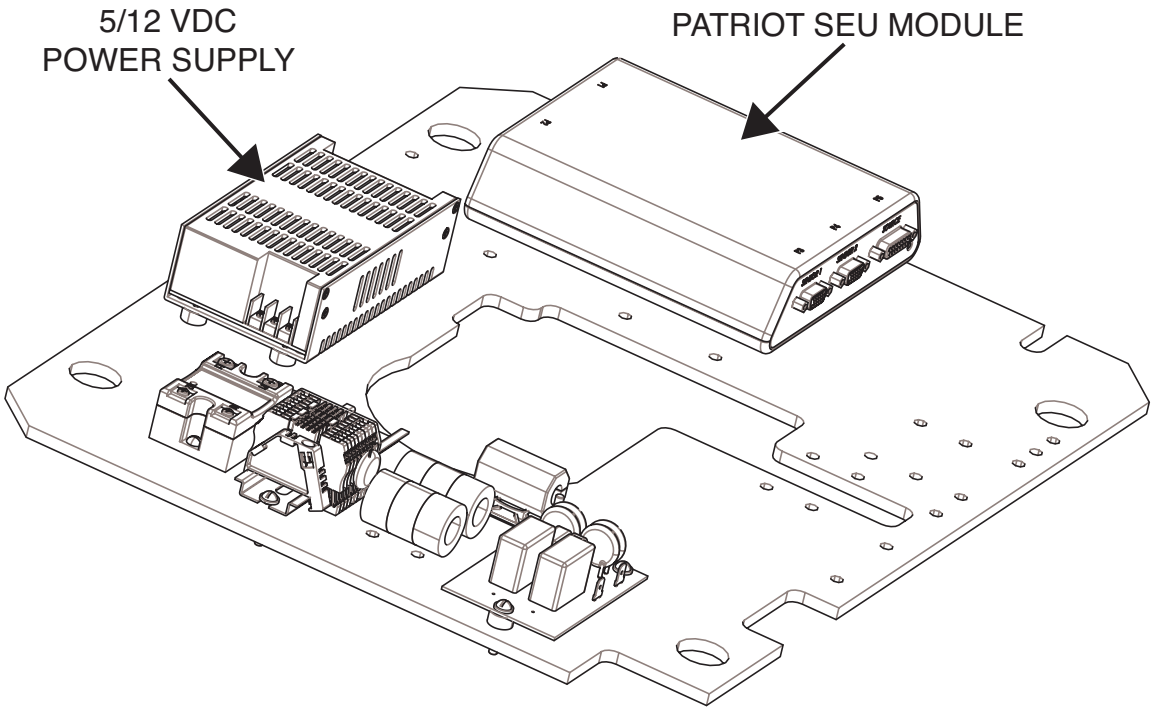
This procedure will aid the technician in determining if the Patriot SEU Module is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
USB Keyboard
USB Mouse
Wiring Diagram

PATRIOT SEU MODULE TEST PROCEDURE *(continued)*

Figure F.9 – Patriot SEU module location



PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Locate the patriot SEU module. See Figure F.9.
4. Carefully apply input power to the machine.
5. Make sure the switch on the patriot is in the "ON" position. See ***Figure F.10***.
6. Visually check to make sure the LED light is illuminated on the patriot SEU module. See ***Figure F.10***.
7. Check for loose or faulty connections at the patriot SEU module and all other connected components.
8. Using a volt/ohmmeter, check for the presence of 5 VDC from lead 801(+) to 701(-) at the 5/12 VDC power supply. See Figure F.9 and ***Figure F.11***. See Wiring Diagram. Check to see if the LED is illuminated.
9. If the 5 VDC is being applied to the patriot and the LED does not illuminate, the patriot may be faulty.
10. If faulty, perform the ***Patriot SEU Module Removal And Replacement Procedure***.
11. Perform the ***VRTEX Engage Reassembly Procedure***.
12. Perform the ***Retest After Repair Procedure***.

PATRIOT SEU MODULE TEST PROCEDURE *(continued)*

Figure F.10 – Patriot SEU module LED and switch locations

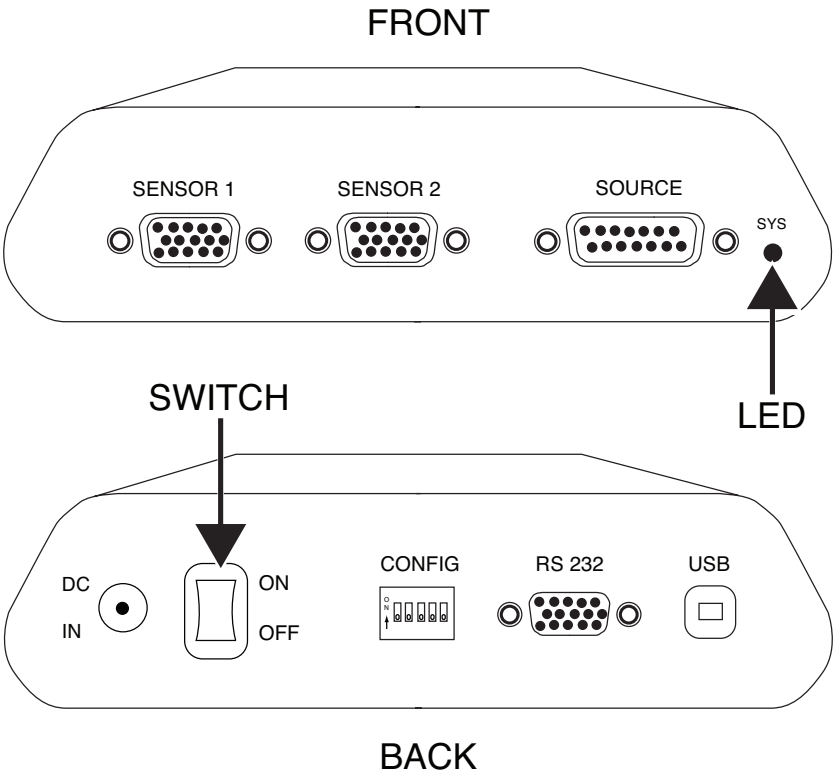
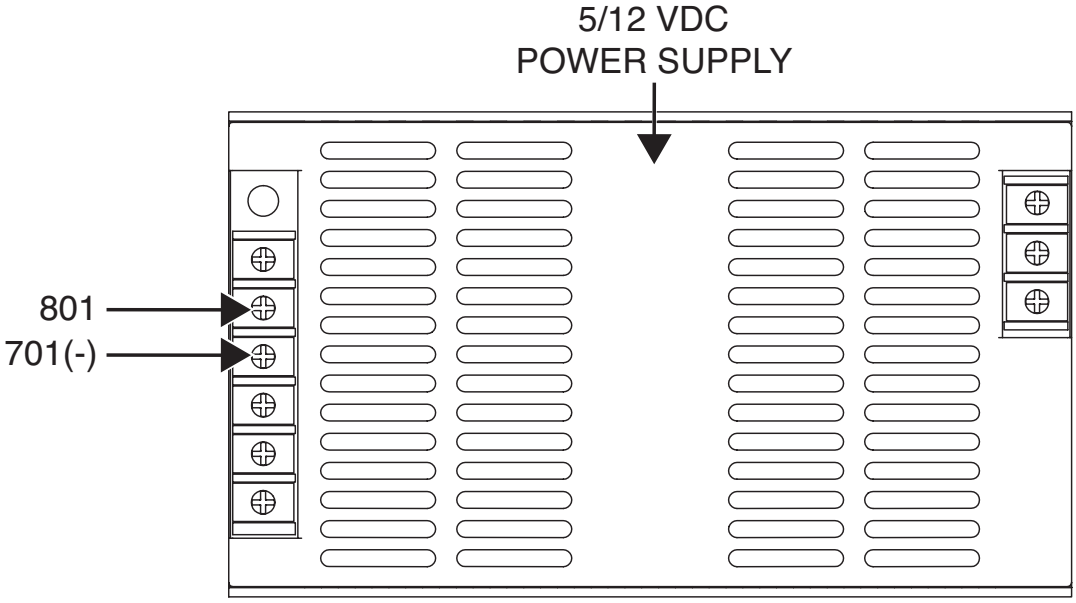


Figure F.11 – 5/12 VDC power supply lead locations



PATRIOT SEU MODULE TEST PROCEDURE *(continued)*

HARDWARE INITIALIZATION (PIMAN.EXE)

If necessary,

1. Before the VRTEX Engage is powered on, connect the USB mouse and USB keyboard to the USB port.
2. Allow the CPU to power up and the VRTEX Engage log on screen to appear.
3. Press the Windows key (next to the spacebar) and the letter D (on the keyboard) to allow the Windows desktop to appear.
4. Move the mouse to the bottom of screen to display the Windows Task Bar.
5. Using the USB mouse, move the cursor towards the right side of the monitor until the taskbar appears.
6. Using the USB mouse, right click on Crosstrainer.exe and close all windows.

NOTE: If necessary, select close program when prompted by the alert box for the crosstrainer.exe.

7. Using the USB mouse, move the cursor towards the right side of the monitor until the taskbar appears.
8. Using the USB mouse, right click on CMD.exe and close all windows.
9. Right-click mouse on the START icon, select EXPLORE, Go to “C:SimWelder/VRplugins”. Double click on “piman.exe”. Click “Flush”. Click “OK”. Double click on “piman.exe” again. Click “Rescan”.
10. Close all open windows.
11. Power off the CPU by selecting Start> Shutdown> from the drop down box, select Shutdown.
12. Once the CPU powers off, disconnect the mouse and keyboard.
13. Power on the VRTEX and verify operation.

ENTRY MODULE TEST 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

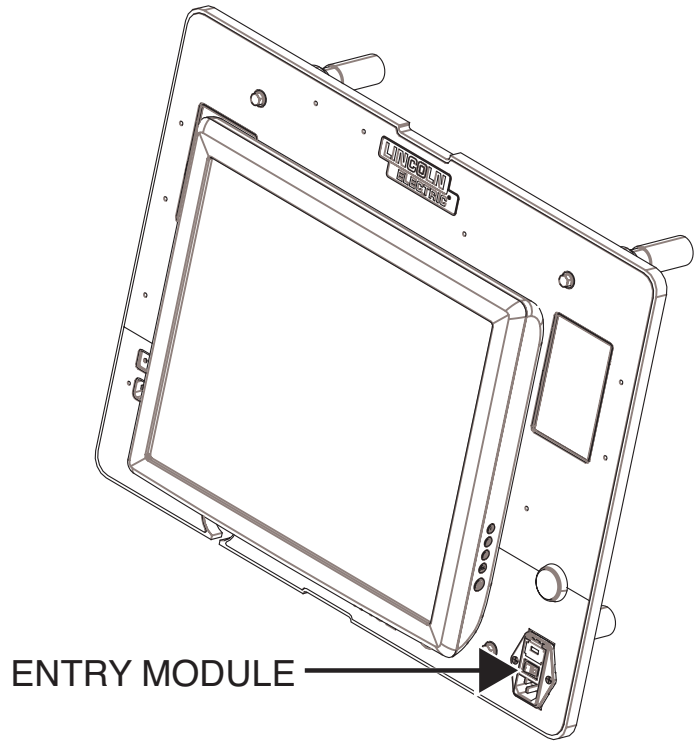
This procedure will aid the technician in determining if the Entry Module is functioning correctly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

ENTRY MODULE TEST PROCEDURE *(continued)*

Figure F.12 – Entry module location



PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Locate the entry module. See Figure F.12.
4. Label and disconnect leads 501, 601 and GND leads from the rear of the entry module. See ***Figure F.13***. See Wiring Diagram.
5. Using a volt/ohmmeter, perform the resistance test outlined in ***Table F.2***. See ***Figure F.13***. See Wiring Diagram.
6. If any of the tests fail, the entry module may be faulty.
7. If faulty, perform the ***Entry Module Removal And Replacement Procedure***.
8. Connect previously removed leads to the entry module. See Wiring Diagram.
9. Perform the ***VRTEX Engage Reassembly Procedure***.
10. Perform the ***Retest After Repair Procedure***.

ENTRY MODULE TEST PROCEDURE *(continued)*

Figure F.13 – Entry module test points

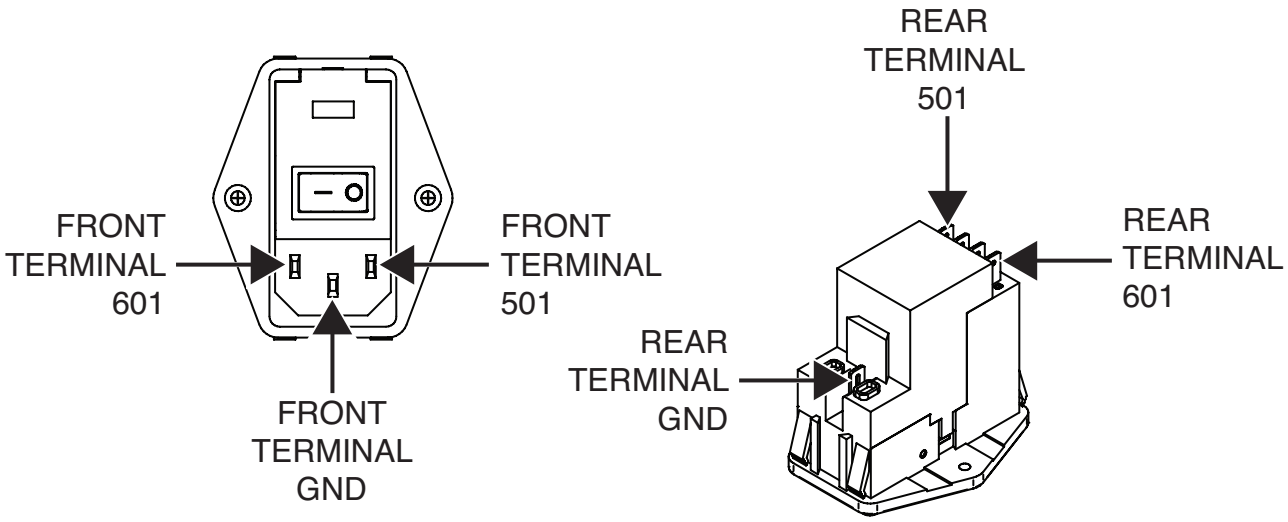


Table F.2 – Entry module test points

TEST TERMINALS	CONDITIONS	EXPECTED RESULTS
FRONT TERMINAL 501 TO REAR TERMINAL 501	SWITCH OFF	OPEN - INFINITE RESISTANCE
FRONT TERMINAL 501 TO REAR TERMINAL 501	SWITCH ON	LOW RESISTANCE - LESS THAN ONE OHM
FRONT TERMINAL 601 TO REAR TERMINAL 601	SWITCH OFF	OPEN - INFINITE RESISTANCE
FRONT TERMINAL 601 TO REAR TERMINAL 601	SWITCH ON	LOW RESISTANCE - LESS THAN ONE OHM
FRONT TERMINAL GND TO REAR TERMINAL GND	SWITCH OFF	LOW RESISTANCE - LESS THAN ONE OHM
FRONT TERMINAL GND TO REAR TERMINAL GND	SWITCH ON	LOW RESISTANCE - LESS THAN ONE OHM

UNIGUN TEST 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

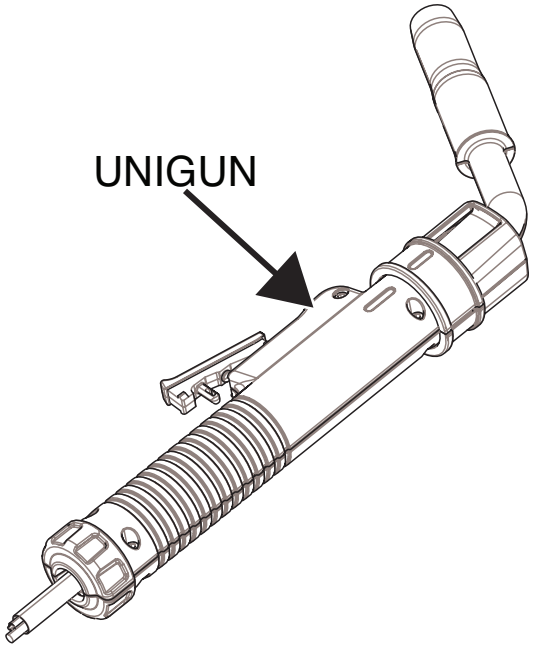
This procedure will aid the technician in determining if the Unigun is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
Wiring Diagram

UNIGUN TEST PROCEDURE *(continued)*

Figure F.14 – Unigun



PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Locate the unigun. See Figure F.14.
4. Check for loose or faulty connections on the cable.
5. Locate the in-line RCA type plug at the "Y" adapter. See ***Figure F.15***. See Wiring Diagram.
6. With the trigger pulled, the resistance should be less than 1 ohm. See ***Figure F.16***.
7. If resistance is greater than 1 ohm, the unigun may be faulty.
8. If faulty, perform the ***Unigun Removal And Replacement Procedure***.
9. Perform the ***VRTEX Engage Reassembly Procedure***.
10. Perform the ***Retest After Repair Procedure***.

UNIGUN TEST PROCEDURE *(continued)*

Figure F.15 – "Y" adapter and RCA plug location

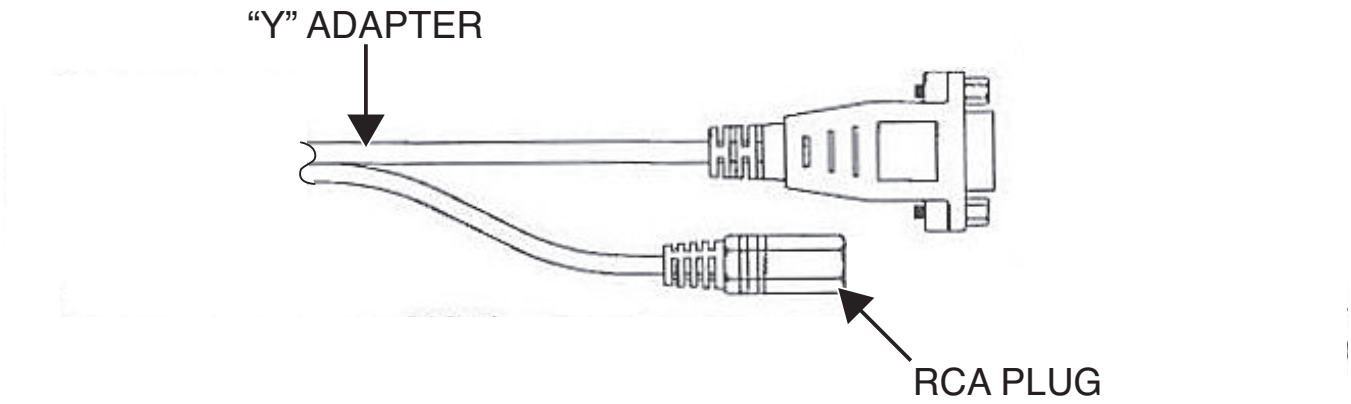
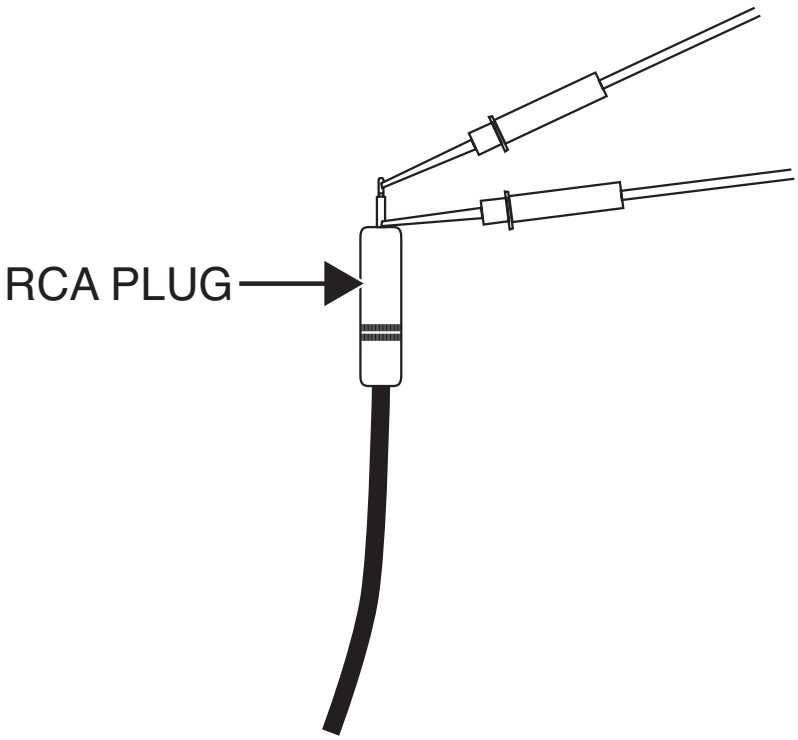


Figure F.16 – RCA plug test points



MOUNT PANEL 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

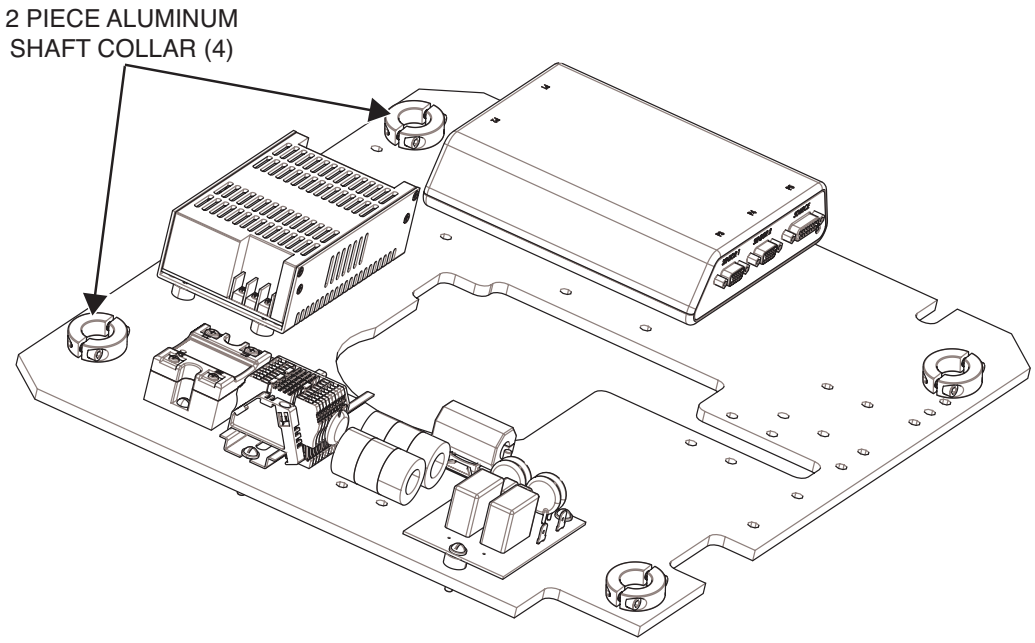
This procedure will aid the technician in the removal and replacement of the Mount Panel Assembly.

MATERIALS NEEDED

3/16” Allen Wrench
Wiring Diagram

MOUNT PANEL ASSEMBLY
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.17 – 2 Piece aluminum collar locations



REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Using a 3/16" allen wrench, remove the four 2-piece aluminum shaft collars. See Figure F.17.
4. Carefully remove the green lamp holder from the bezel assembly by gently rotating counter-clockwise. See ***Figure F.18***.
5. Label and disconnect leads 900 and 901 from the circuit breaker. See Wiring Diagram.
6. Label and disconnect leads 501, 601 and GND from the entry module. See ***Figure F.19***. See Wiring Diagram.
7. Locate lead 701 and separate at the quick connect lugs. See Wiring Diagram.
8. Label and disconnect the input cord from the rear of the monitor. See Wiring Diagram.
9. Cut the cable ties securing the VGA6 cable to the mount panel and gently release the VGA6 cable from the hook and loop pad. See Wiring Diagram.
10. Clear the VGA6 cable assembly from the mount panel so that the mount panel can be separated from the insert panel.
11. Label and disconnect USB1 and USB5 cables from the CPU assembly. See ***Figure F.20***.
12. Gently lift the mount panel away from the insert panel and mounting legs.

MOUNT PANEL ASSEMBLY
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.18 – Green lamp holder removal

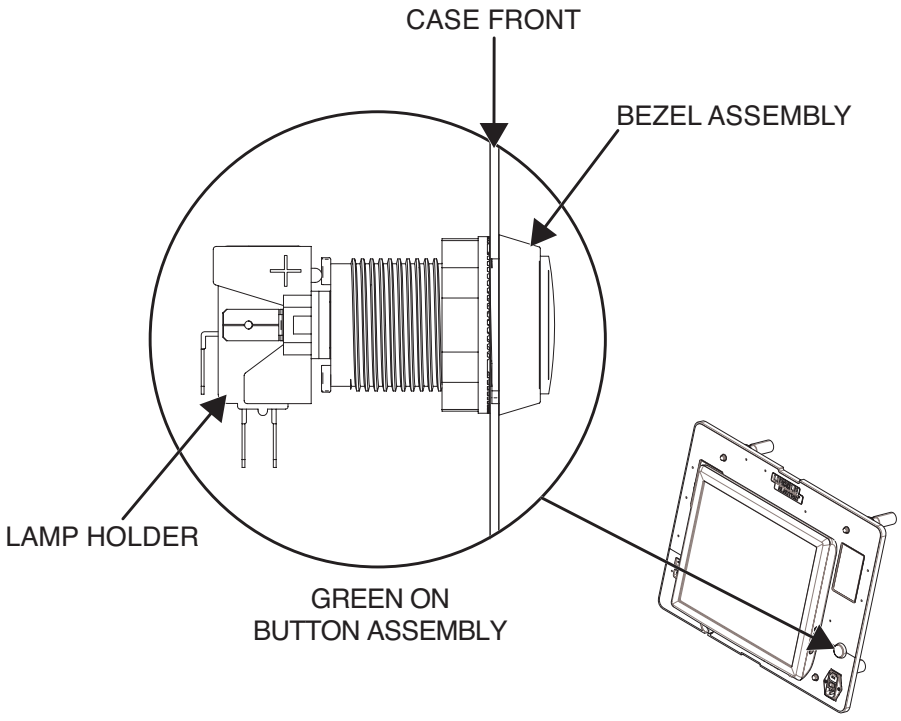
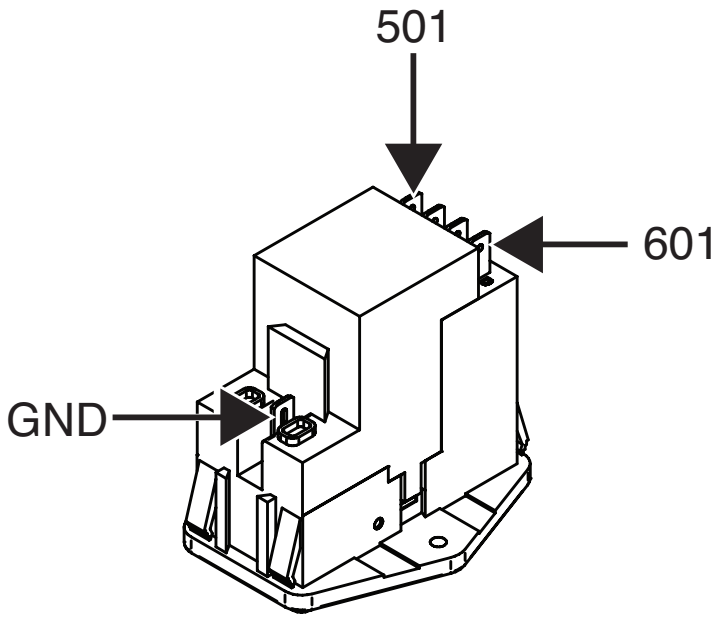


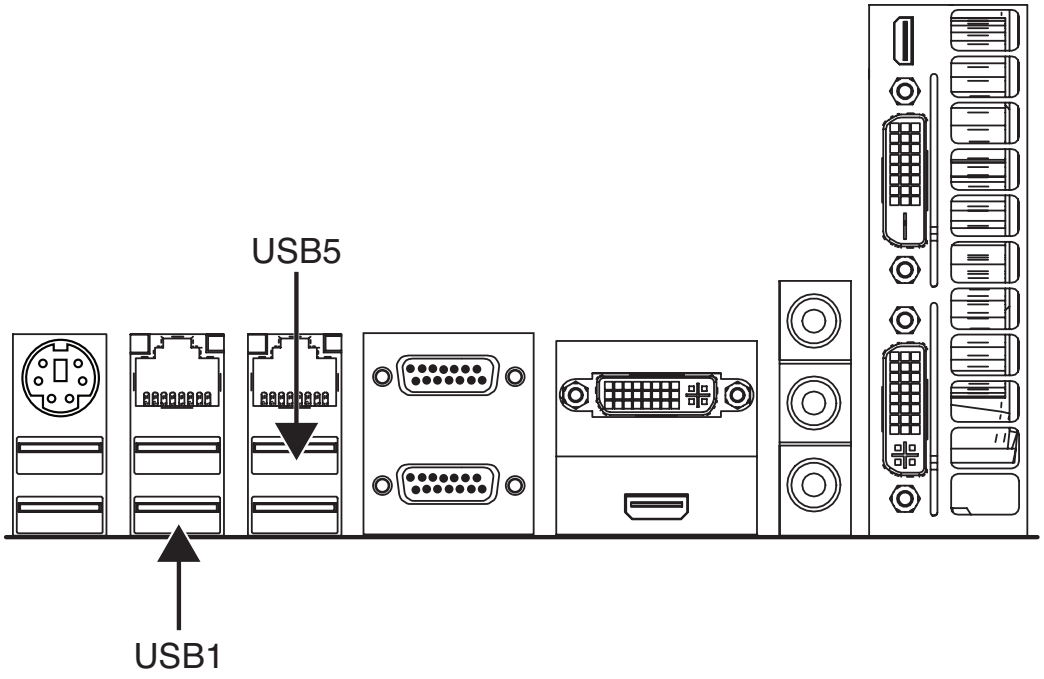
Figure F.19 – Entry module lead locations



MOUNT PANEL ASSEMBLY

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.20 – USB 1 and USB 5 connection points



REPLACEMENT PROCEDURE

1. Carefully position the mount panel onto the mounting legs.
2. Connect USB1 and USB5 cables to the CPU assembly.
3. Position VGA6 cable onto the hook and loop pad and secure with two cable ties.
4. Connect the input cord to the rear of the monitor.
5. Connect lead 701 at the quick connect lugs.
6. Connect leads 501, 601 and GND to the entry module. See Wiring Diagram.
7. Connect leads 900 and 901 to the circuit breaker. See Wiring Diagram.
8. Carefully place the green lamp holder into the bezel assembly.
9. Replace any previously removed cable ties.
10. Using a 3/16” allen wrench, attach the four two-piece aluminum shaft collars.
11. Perform the ***VRTEX Engage Reassembly Procedure***.
12. Perform the ***Retest After Repair Procedure***.

5/12 VDC POWER SUPPLY 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

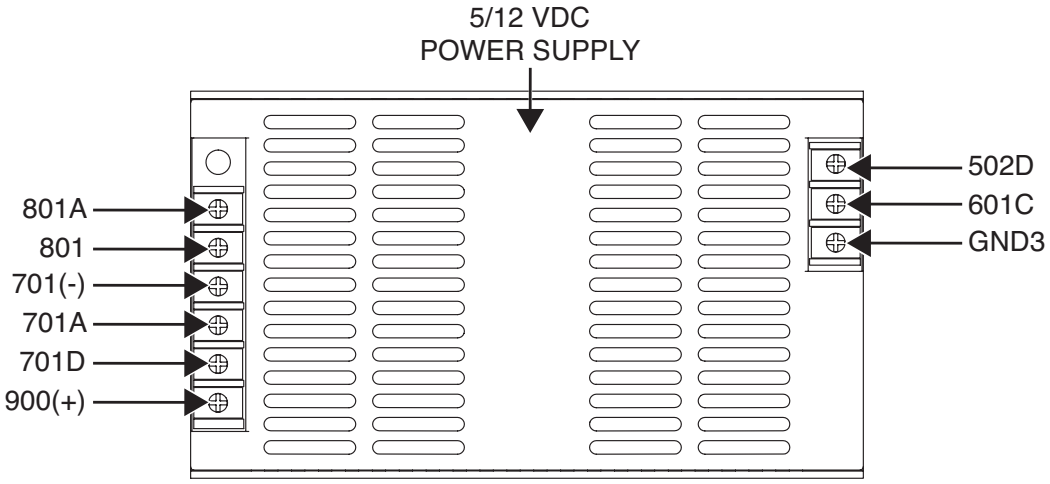
This procedure will aid the technician in the removal and replacement of the 5/12 VDC Power Supply.

MATERIALS NEEDED

Phillips Screwdriver (Off-set)
Small Phillips Screwdriver
Wiring Diagram

5/12 VDC POWER SUPPLY
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.21 – 5/12 VDC power supply lead locations

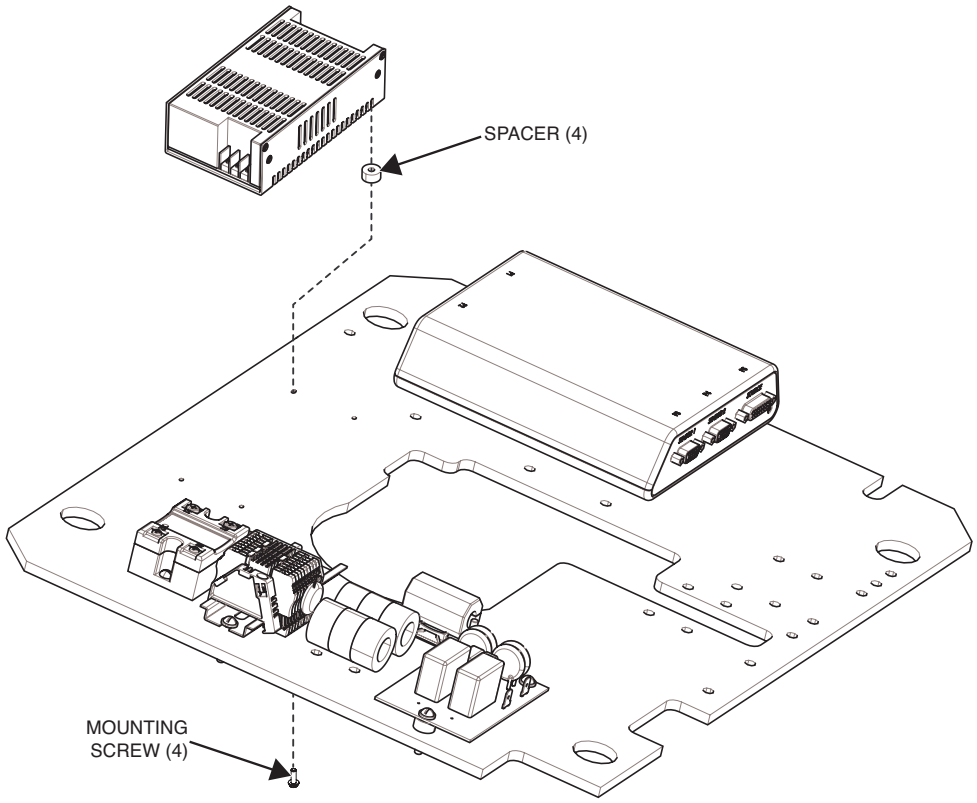


REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Using a phillips screwdriver, label and disconnect leads 502D, 601C, GND3, 801A, 801, 701, 701A, 701D and 900 from the 5/12 VDC power supply. See Figure F.21. See Wiring Diagram.
4. Using a small off-set phillips screwdriver, remove the four screws and spacers securing the 5/12 VDC power supply to the mount panel. See ***Figure F.22***.
5. The 5/12 VDC power supply can now be removed and replaced.

5/12 VDC POWER SUPPLY
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.22 – 5/12 VDC power supply mounting hardware location



REPLACEMENT PROCEDURE

1. Carefully position the new 5/12 VDC power supply onto the mount panel.
2. Using a small off-set phillips screwdriver, attach the four screws, spacers and washers securing the 5/12 VDC power supply to the mount panel.
3. Using a phillips screwdriver, connect leads 502D, 601C, GND3, 801A, 801, 701, 701A, 701D and 900 to the 5/12 VDC power supply. See Wiring Diagram.
4. Perform the ***VRTEX Engage Reassembly Procedure***.
5. Perform the ***Retest After Repair Procedure***.

INPUT FILTER
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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

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

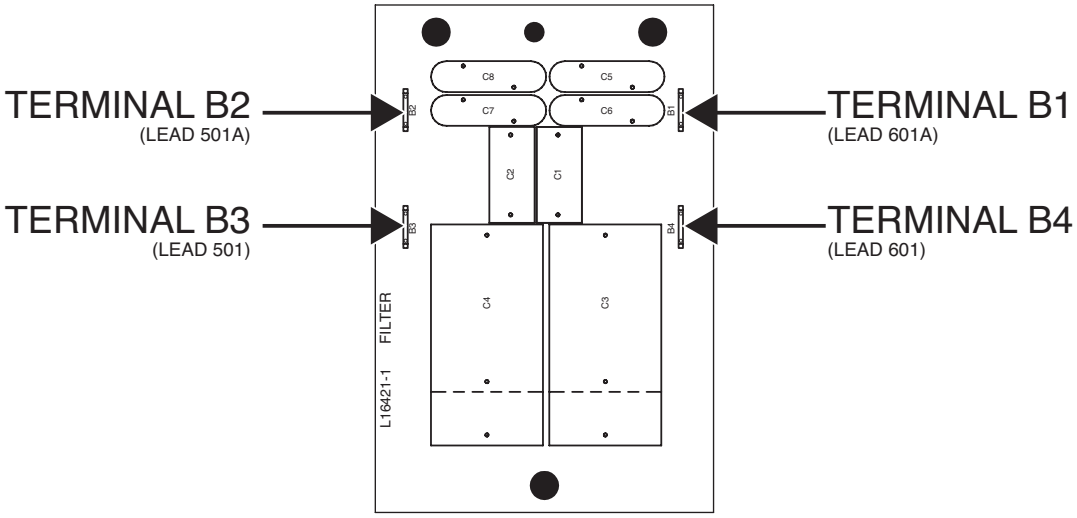
MATERIALS NEEDED

Slotted Screwdriver
11/32” Nutdriver
Wiring Diagram

INPUT FILTER

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.23 – Input filter lead locations



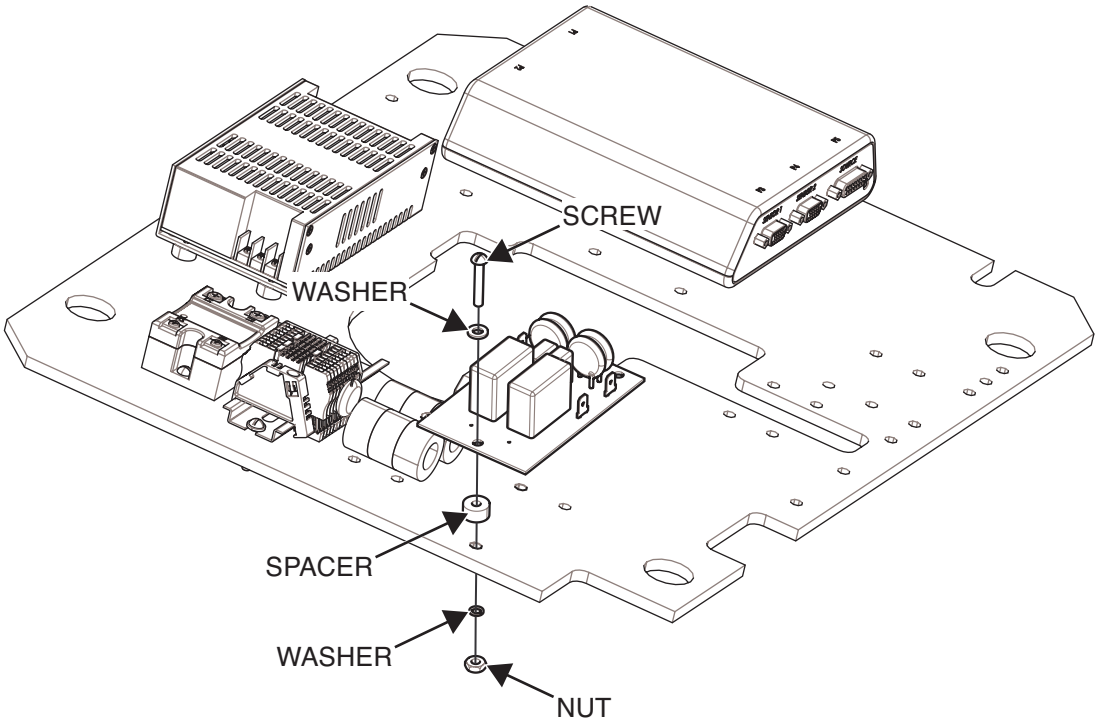
REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Label and disconnect leads 501, 601, 601A and 501A from the input filter. See Figure F.23. See Wiring Diagram.
4. Using a slotted screwdriver, remove the two screws, spacers, nuts and washers securing the input filter to the mount panel. See ***Figure F.24***.
5. Using a 11/32" nutdriver, remove the nut, washer and screw securing the GND lead to the underside of the input filter. See Wiring Diagram.
6. The input filter can now be removed and replaced.

INPUT FILTER

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.24 – Input filter mounting hardware locations



REPLACEMENT PROCEDURE

1. Carefully position the new input filter onto the mount panel.
2. Using a 11/32" nutdriver, attach the nut, washer and screw securing the GND lead to the underside of the input filter. See Wiring Diagram.
3. Using a slotted screwdriver, attach the two screws, spacers, nuts and washers securing the input filter to the mount panel.
4. Connect leads 501, 601, 601A and 501A to the input filter. See Wiring Diagram.
5. Perform the ***VRTEX Engage Reassembly Procedure***.
6. Perform the ***Retest After Repair Procedure***.

INPUT RELAY
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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

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

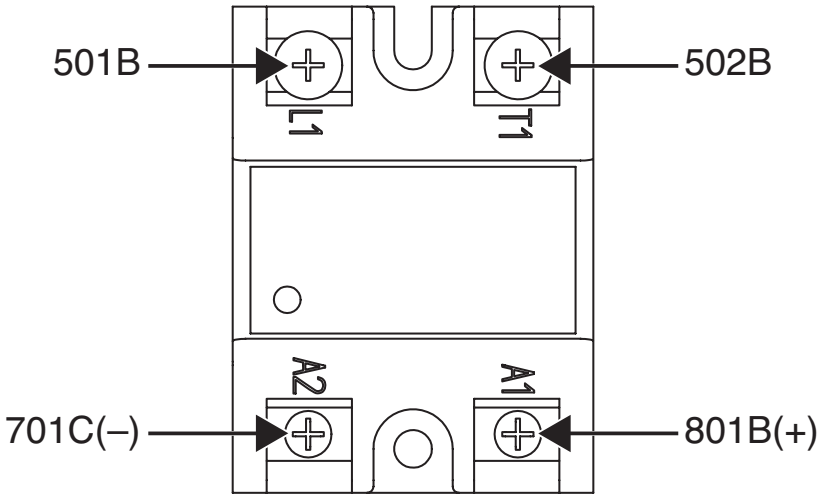
MATERIALS NEEDED

Phillips Screwdriver
Wiring Diagram

INPUT RELAY

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.25 – Input relay lead locations



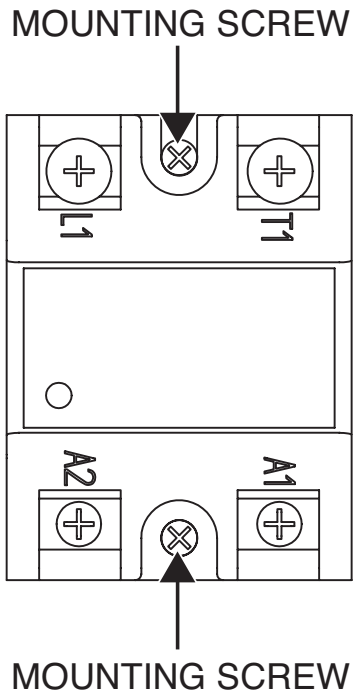
REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Using a phillips screwdriver, label and disconnect leads 801B, 701C, 501B and 502B from terminals A1, A2, T1 and L1 on the input relay. See Figure F.25. See Wiring Diagram.
4. Using a phillips screwdriver, remove the two mounting screws and washers securing the input relay to the mount panel. See ***Figure F.26***.
5. The input relay can now be removed and replaced.

INPUT RELAY

REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.26 – Input relay mounting screw locations



REPLACEMENT PROCEDURE

1. Carefully position the new input relay onto the mount panel.
2. Using a phillips screwdriver, attach the two mounting screws and washers securing the input relay to the mount panel.
3. Using a phillips screwdriver, connect leads 801B, 701C, 501B and 502B to terminals A1, A2, T1 and L1 of the input relay. See Wiring Diagram.
4. Perform the ***VRTEX Engage Reassembly Procedure***.
5. Perform the ***Retest After Repair Procedure***.

PATRIOT SEU MODULE
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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

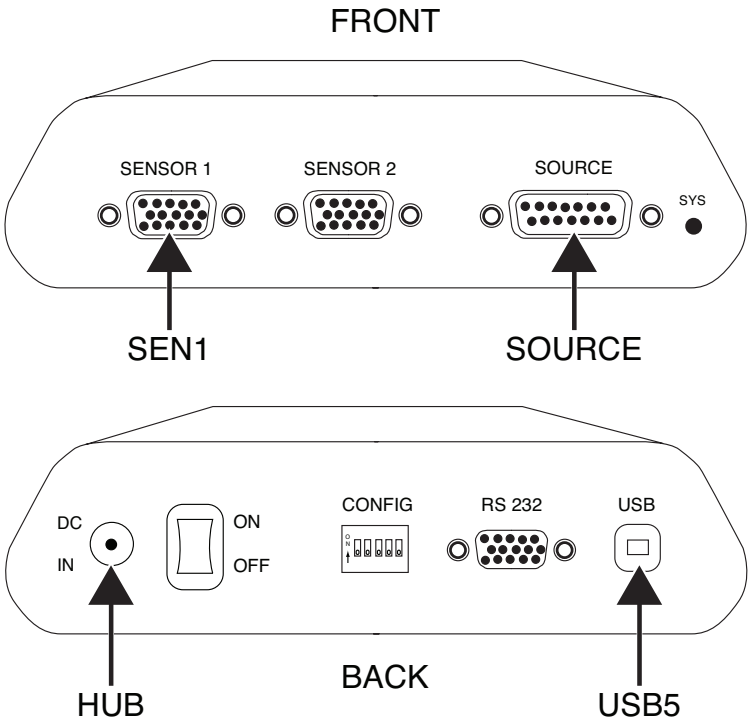
This procedure will aid the technician in the removal and replacement of the Patriot SEU Module.

MATERIALS NEEDED

Cable Ties
Wiring Diagram

PATRIOT SEU MODULE
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.27 – Patriot SEU module cable locations

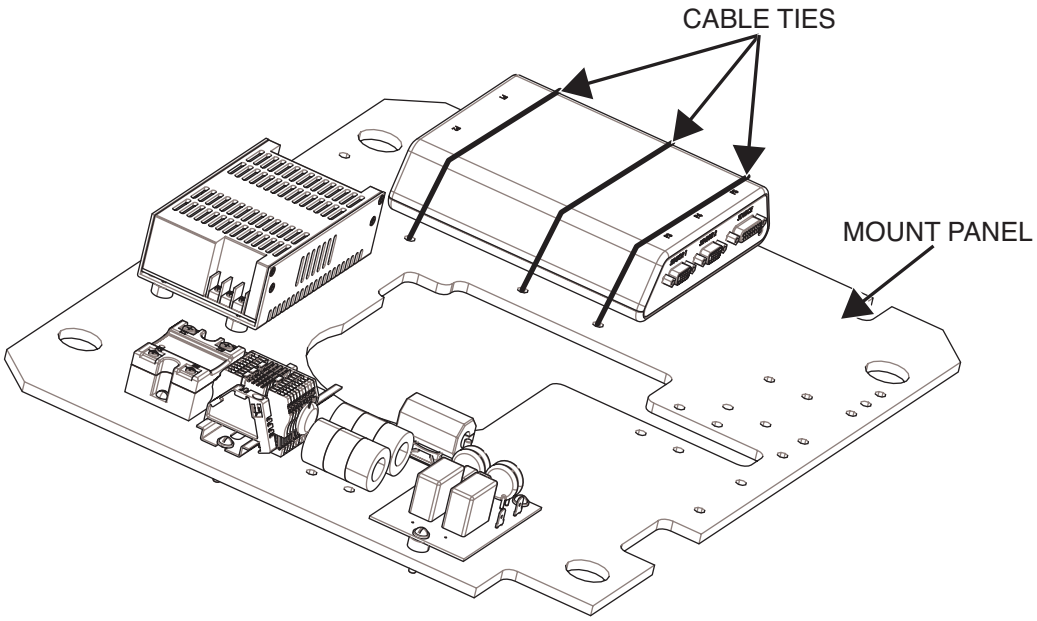


REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Label and disconnect the SEN1, source, hub and USB5 cables from to the patriot SEU module. See Figure F.27. See Wiring Diagram.
4. Carefully remove the cable ties securing patriot SEU module to the mount panel. See ***Figure F.28***.
5. The patriot SEU module can now be removed and replaced.

PATRIOT SEU MODULE
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.28 – Cable tie location



REPLACEMENT PROCEDURE

1. Carefully position the new patriot SEU module onto the mount panel.
2. Connect the SEN1, source, hub and USB5 cables to the patriot SEU module. See Wiring Diagram.
3. **Make certain that the on/off switch is in the ON position**.
4. Using cable ties, secure the patriot SEU module to the mount panel.
5. Perform the ***VRTEX Engage Reassembly Procedure***.
6. Perform the ***Hardware Initialization (PIMAN.EXE) Procedure***, located in the Patriot SEU Module Test.
7. Perform the ***Retest After Repair Procedure***.

ENTRY MODULE 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

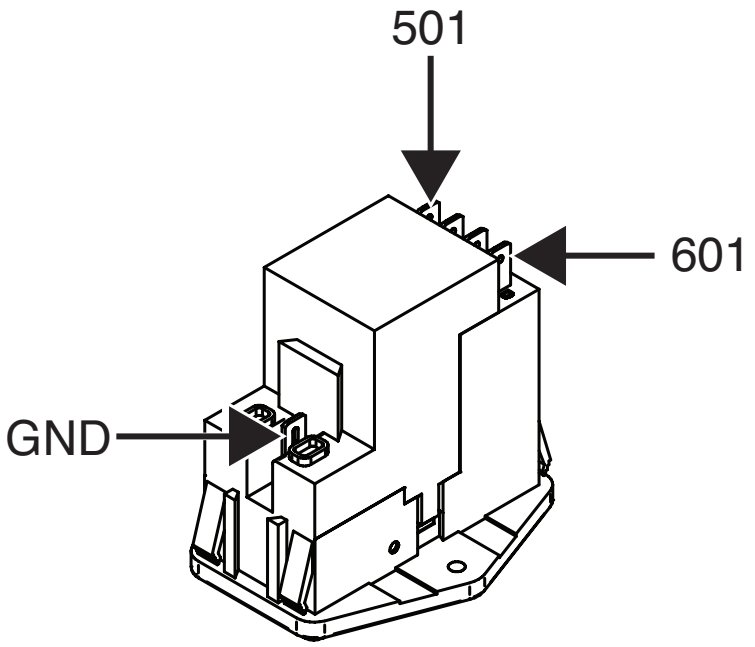
This procedure will aid the technician in the removal and replacement of the Entry Module.

MATERIALS NEEDED

Phillips Screwdriver
Wiring Diagram

ENTRY MODULE REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.29 – Entry module lead locations

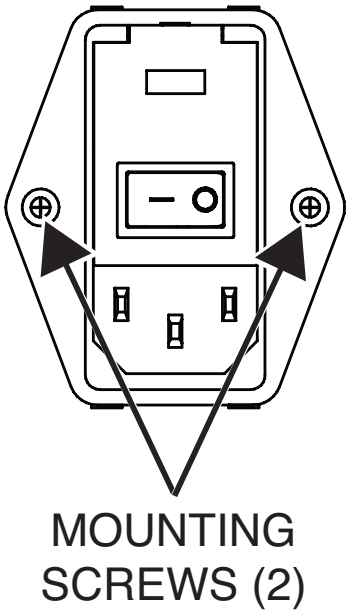


REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Label and disconnect leads 501, 601 and the GND lead from the entry module. See Figure F.29. See Wiring Diagram.
4. Remove the two protective connectors on the center two terminals of the entry module. See Figure F.29.
5. Using a phillips screwdriver, remove the two screws securing the entry module to the insert panel.
6. The entry module can now be carefully removed thru the front of the insert panel.

ENTRY MODULE REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.30 – Entry module mounting screw location



REPLACEMENT PROCEDURE

1. Carefully position the new entry module into the insert panel.
2. Using a phillips screwdriver, attach the two screws securing the entry module to the insert panel.
3. Attach the two protective connectors to the center two terminals of the entry module.
4. Connect leads 501, 601 and the GND lead to the entry module. See Wiring Diagram.
5. Perform the ***VRTEX Engage Reassembly Procedure***.
6. Perform the ***Retest After Repair Procedure***.

UNIGUN 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

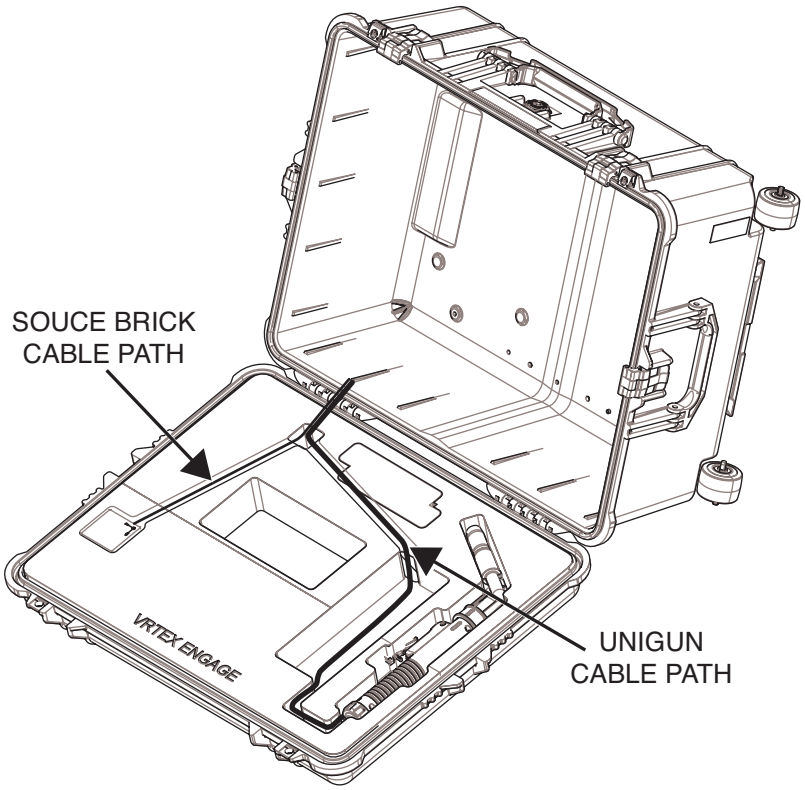
This procedure will aid the technician in the removal and replacement of the Unigun Assembly.

MATERIALS NEEDED

String
Wiring Diagram

UNIGUN REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.31 – Unigun and source brick cable paths



REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Remove the plastic grommet from the unigun cables.
4. Remove any cable ties securing the source brick cable to the unigun cable assembly. See Wiring Diagram.
5. Tie a length of string to the end of the unigun cable assembly. See Figure F.31.

NOTE: The string can later be used to maneuver the new unigun cable assembly behind the foam insert and decal.

6. Carefully maneuver the unigun cable assembly from behind the foam insert & decal. See Figure F.31.
7. The unigun assembly can now be removed and replaced.

UNIGUN REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

REPLACEMENT PROCEDURE

1. Carefully position the new unigun assembly into the case.
2. Attach the string to the unigun cable assembly.
3. Carefully maneuver the unigun cable assembly behind the foam insert & decal.
4. Using cable ties, secure the source brick cable to the unigun cable assembly.
5. Attach the plastic grommet to the unigun and source brick cable assemblies.
6. Perform the ***VRTEX Engage Reassembly Procedure***.
7. Perform the ***Retest After Repair Procedure***.

CPU 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

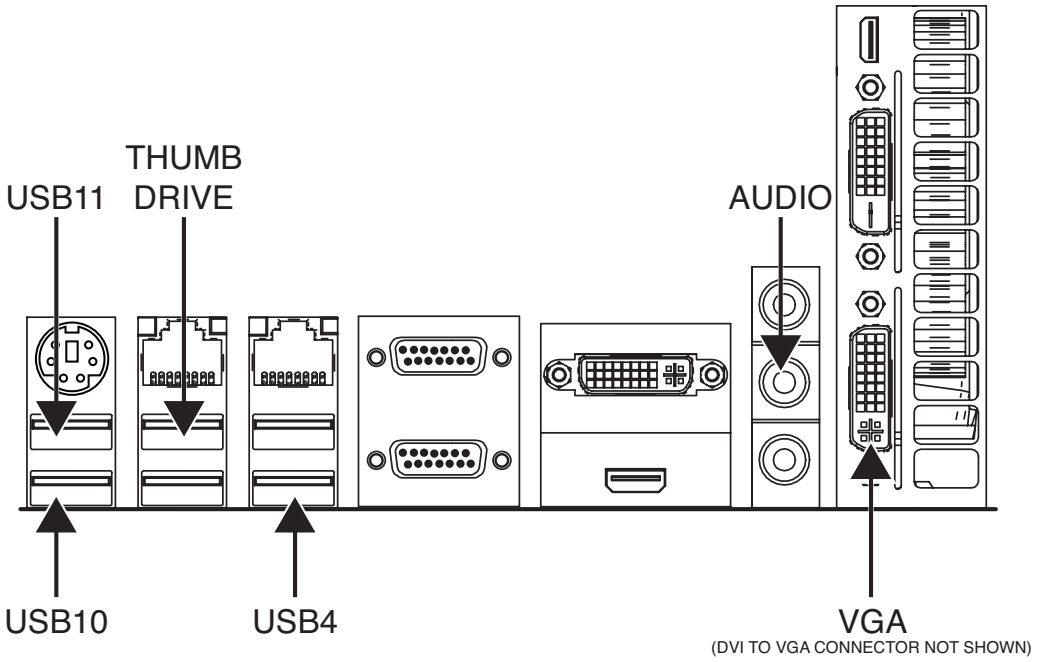
This procedure will aid the technician in the removal and replacement of the CPU Assembly.

MATERIALS NEEDED

Phillips Screwdriver
Anti-static Wristband
Wiring Diagram

CPU REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.32 – CPU cable connections



REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Perform the ***Mount Panel Removal Procedure***.

NOTE: To prevent damage to the CPU assembly be certain to wear a anti-static wristband when working on or near the electronic components.

4. Label and disconnect the VGA cable from the DVI to VGA adapter on the CPU video card. See Figure F.32. See Wiring Diagram.
5. Label and disconnect USB4, USB10 and USB11 cables from the CPU. See Figure F.32. See Wiring Diagram.
6. Disconnect the USB thumb drive from CPU assembly. See Figure F.32. See Wiring Diagram.
7. Label and disconnect the audio cable from the green audio port of the CPU. See Figure F.32. See Wiring Diagram.
8. Using a phillips screwdriver, remove the four mounting screws securing the CPU motherboard to the insert panel. Retain the round bumpers located between the CPU motherboard and the insert panel. See ***Figure F.33***.

NOTE: It may be necessary to remove the video card assembly in order to get access to the fourth mounting screw. To remove the video card assembly, using a phillips screwdriver, remove the two screws and washers securing the fan assembly to the insert panel. Release the white locking tab and gently remove the video/fan assembly.

9. Using a phillips screwdriver, remove the four screws and washers securing the SSD drive to the insert panel. See ***Figure F.34***.
10. Cut any cable ties securing the CPU motherboard and SATA drive to the insert panel.
11. The CPU motherboard and SSD drive assembly can now be removed and replaced.

CPU REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.33 – CPU motherboard mounting hardware locations

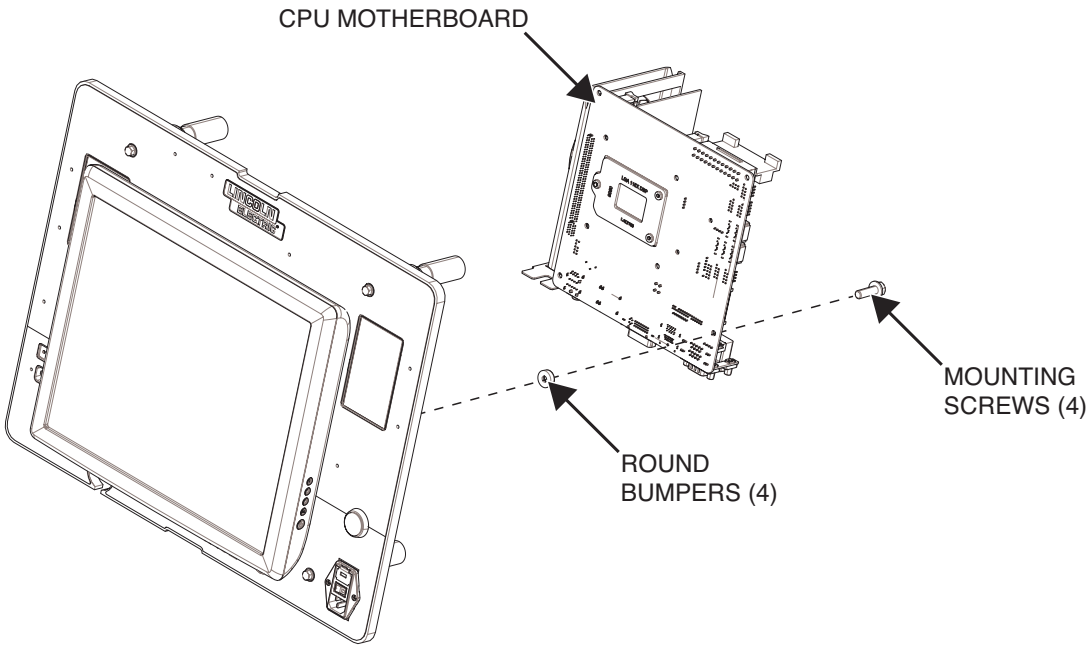
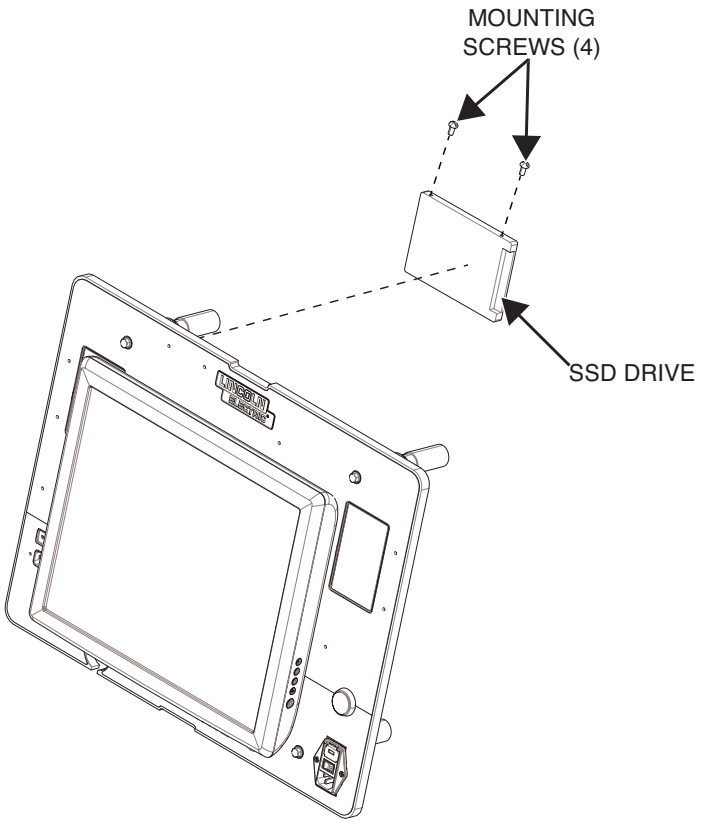


Figure F.34 – SSD drive mounting hardware location



CPU REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

REPLACEMENT PROCEDURE

NOTE: To prevent damage to the CPU assembly be certain to wear a anti-static wristband when working on or near the electronic components.

1. Carefully position the new SSD drive onto the insert panel.
2. Using a phillips screwdriver, attach the four screws securing the SSD drive to the insert panel.
3. Carefully position the new CPU motherboard onto the insert panel.
4. Using a phillips screwdriver, attach the four mounting screws and round bumpers securing the CPU motherboard to the insert panel.
5. Carefully position the video card / fan assembly into the CPU motherboard.
6. Using a phillips screwdriver, attach the two screws securing video card / fan assembly.
7. Connect the audio cable to the green audio port on the CPU motherboard. See Wiring Diagram.
8. Connect the USB thumb drive to the CPU assembly. See Wiring Diagram.
9. Connect the USB4, USB10 and USB11 cables into the CPU. See Wiring Diagram.
10. Connect the VGA cable to the video card. See Wiring Diagram.
11. Perform the ***Mount Panel Replacement Procedure***.
12. Perform the ***VRTEX Engage Reassembly Procedure***.
13. Perform the ***Retest After Repair Procedure***.

GREEN ON BUTTON
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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

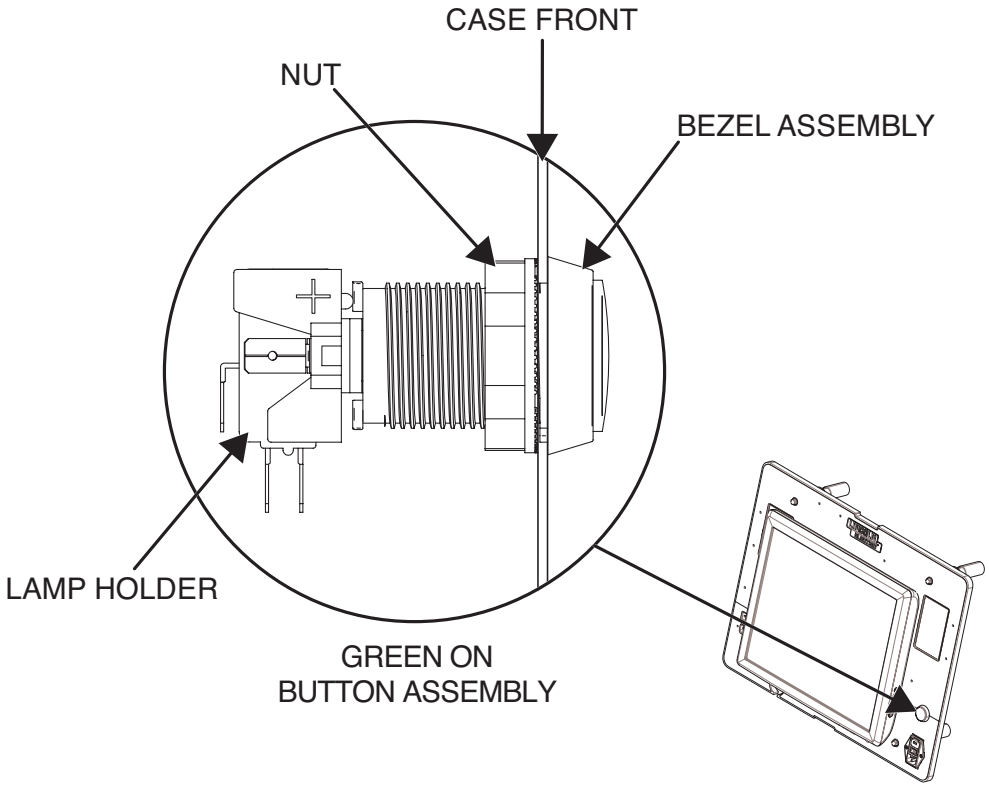
This procedure will aid the technician in the removal and replacement of the Green ON Button.

MATERIALS NEEDED

Crescent Wrench
Wiring Diagram

GREEN ON BUTTON
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.35 – Green start button mounting detail



REMOVAL PROCEDURE

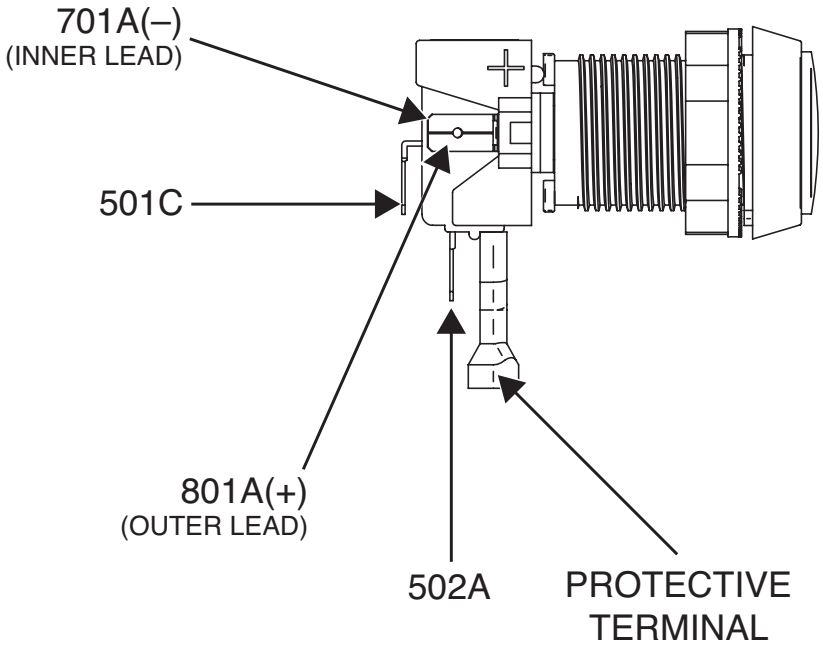
1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Take hold of the lamp holder assembly and gently rotate (counter-clockwise) and remove from the bezel assembly. See Figure F.35.

NOTE: The mount panel may have to be slightly separated from the insert panel to obtain clearance for the removal of the lamp holder.

4. Label and disconnect leads 502A, 501C, 801A and 701A from the lamp holder assembly. See ***Figure F.36***. See Wiring Diagram.
5. Using an adjustable wrench, remove the nut securing the bezel assembly to the insert panel. See Figure F.35.
6. Remove the black bezel assembly from the insert panel. See Figure F.35.
7. The green ON button can now be removed and replaced.

GREEN ON BUTTON
REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.36 – Green start button lead locations



REPLACEMENT PROCEDURE

1. Secure the bezel assembly to the insert panel.
2. Connect leads 502A, 501C, 801A and 701A to the lamp holder assembly. See Wiring Diagram.
3. Assure the protective terminal is in place on the new lamp holder assembly. Failure to do so may cause electric shock. All terminals must be covered prior to machine start-up.
4. Install the lamp holder assembly by gently pushing and rotate clockwise into position in the bezel assembly.
5. Perform the ***VRTEX Engage Reassembly Procedure***.
6. Perform the ***Retest After Repair Procedure***.

MONITOR 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

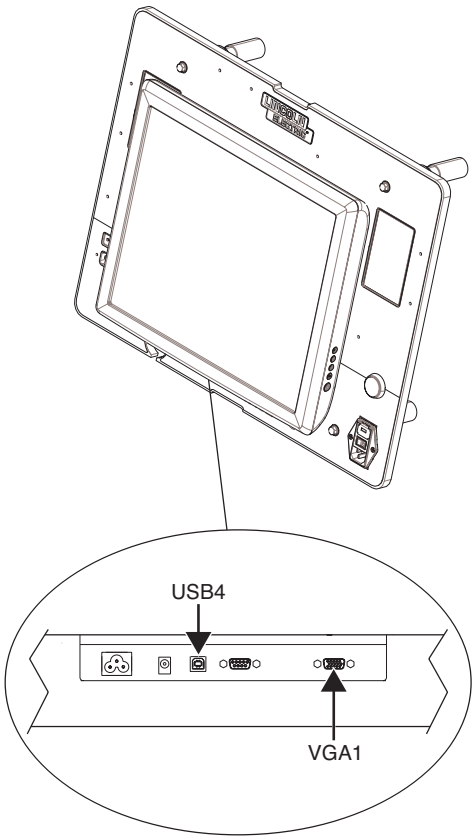
This procedure will aid the technician in the removal and replacement of the Monitor.

MATERIALS NEEDED

3/8” Nutdriver
Small Foam Pad
Wiring Diagram

MONITOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.37 – Monitor lead connections

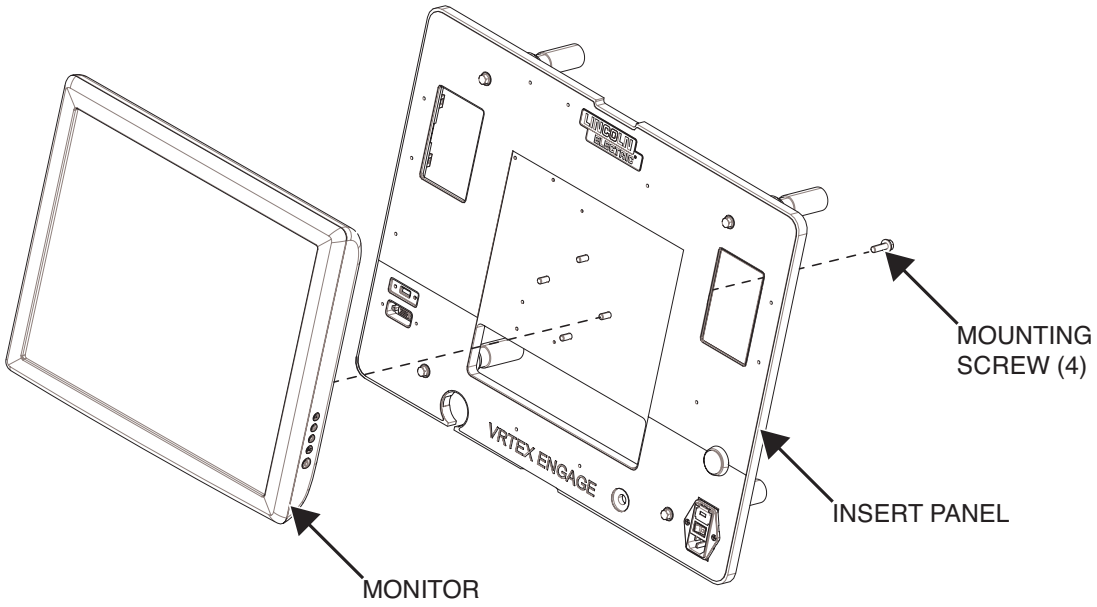


REMOVAL PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Perform the ***VRTEX Engage Disassembly Procedure***.
3. Perform the ***Mount Panel Removal Procedure***.
4. Perform the ***CPU Removal Procedure***.
5. Label and disconnect the VGA1 and USB4 cables from the monitor. See Figure F.37. See Wiring Diagram.
6. Using a 3/8” nutdriver, remove the four screws securing the monitor to the insert panel. See ***Figure F.38***.
7. Carefully remove the insert panel from the monitor.
8. The monitor can now be removed and replaced.

MONITOR REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

Figure F.38 – Monitor mounting hardware location



REPLACEMENT PROCEDURE

1. Place the new monitor face down on a soft foam pad.
2. Carefully position the insert panel on the back of the monitor and align the four mounting holes.
3. Using a 3/8" nutdriver, attach the four screws securing the insert panel to the monitor.
4. Connect the VGA1 and USB4 cables to the monitor. See Wiring Diagram.
5. Perform the ***CPU Replacement Procedure***.
6. Perform the ***Mount Panel Replacement Procedure.***
7. Perform the ***VRTEX Engage Assembly Procedure***.
8. Perform the ***Retest After Repair***.

TOUCHSCREEN MONITOR CALIBRATION 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

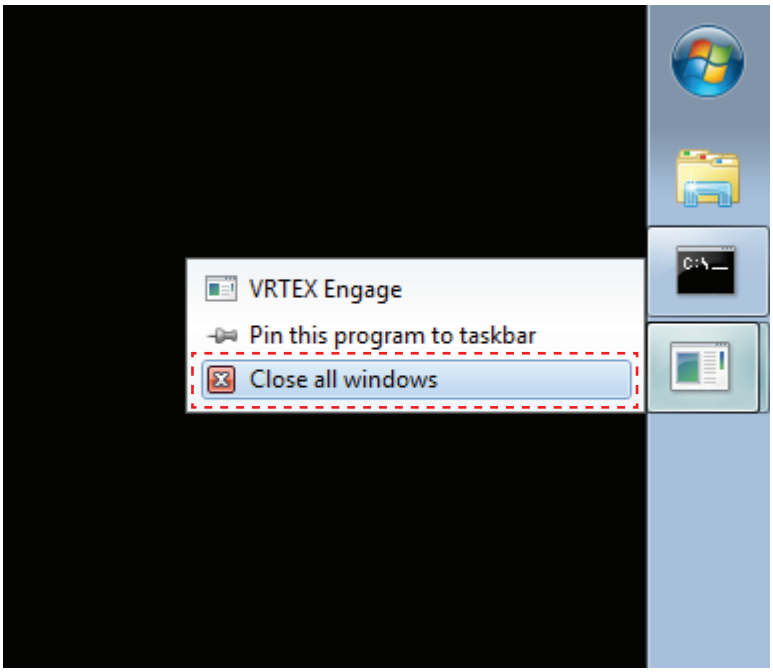
This procedure will aid the technician in the calibration of the Touchscreen Monitor.

MATERIALS NEEDED

USB Mouse
USB Keyboard

TOUCHSCREEN MONITOR CALIBRATION PROCEDURE *(continued)*

Figure F.39 – Close all windows



CALIBRATION PROCEDURE

1. Remove the input power to the VRTEX Engage.
2. Connect a USB mouse and USB keyboard to the USB port on the machine. See Wiring Diagram.
3. Apply input power and start up the machine by pressing and holding the green ON button for 5 seconds.

NOTE: Allow the machine to start up the simulation software until the keyboard login screen appears.

4. Press "WINDOWS" key + letter "D" to allow the Windows desktop to appear.
5. Move the mouse cursor to the right side of the screen to display the Windows Task Bar.
6. Right click the mouse and close all programs. If prompted, select "Close all windows" in the message box that may appear. See Figure F.39.
7. Left click the arrow icon near the bottom of task bar. Double-click the "ELO" icon and select "Align." See ***Figure F.40*** and ***F.41***.
8. Three separate targets will appear on the screen. Touch target icons to calibrate accordingly. See ***Figure F.42***.
9. Select the "Sound" tab and uncheck "Beep on touch." Select "Apply" and click "OK." Close program. See ***Figure F.43***.
10. Navigate the mouse cursor to the right side of the screen to display the task bar and shutdown the machine.
11. Disconnect the USB mouse and keyboard.
12. Perform the ***Retest After Repair Procedure***.

TOUCHSCREEN MONITOR CALIBRATION PROCEDURE *(continued)*

Figure F.40 – ELO and arrow icon locations

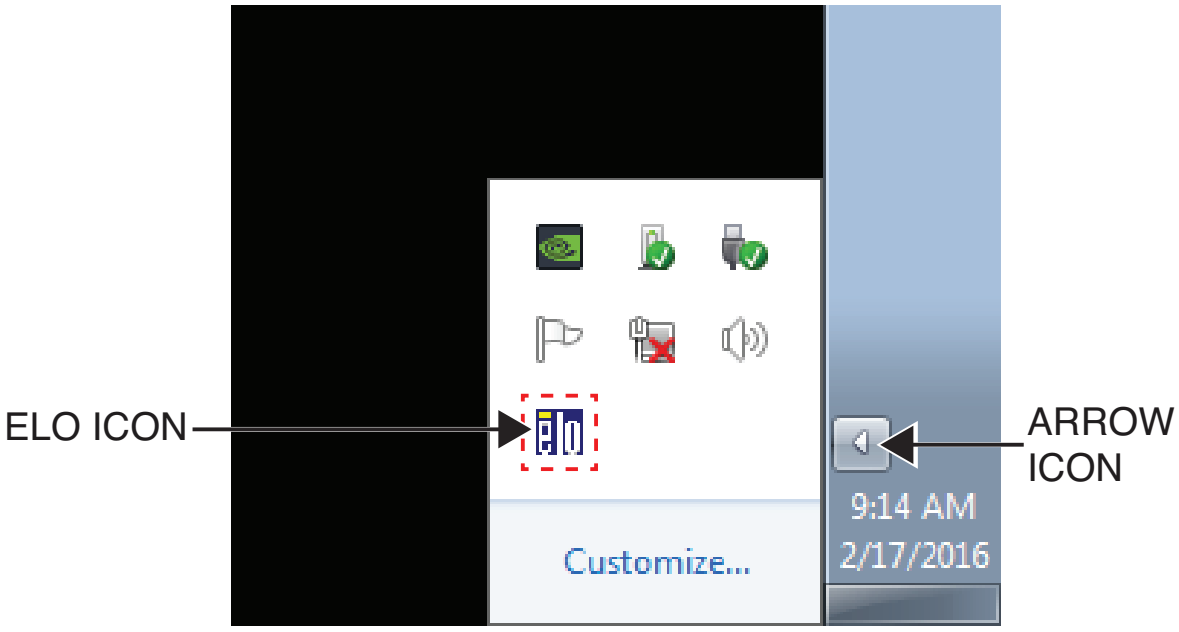
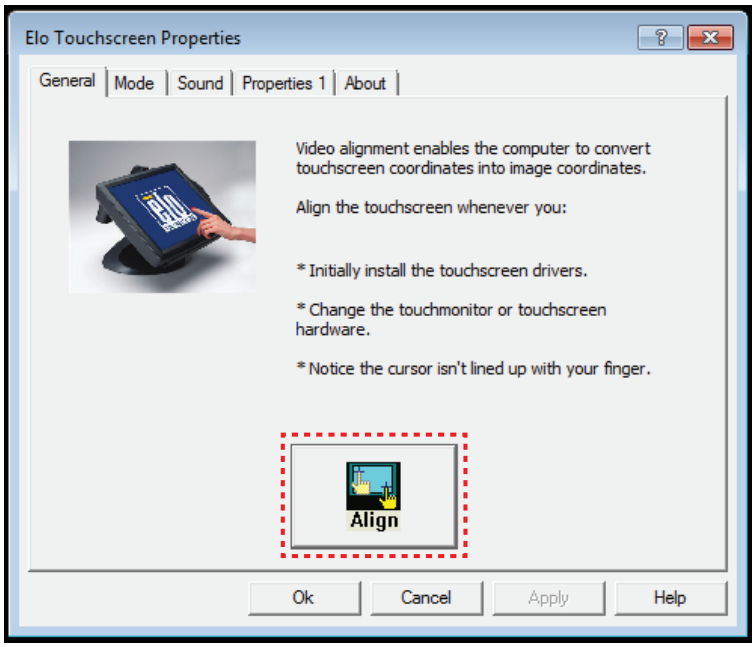


Figure F.41 – Align



TOUCHSCREEN MONITOR CALIBRATION PROCEDURE *(continued)*

Figure F.42 – Calibration target

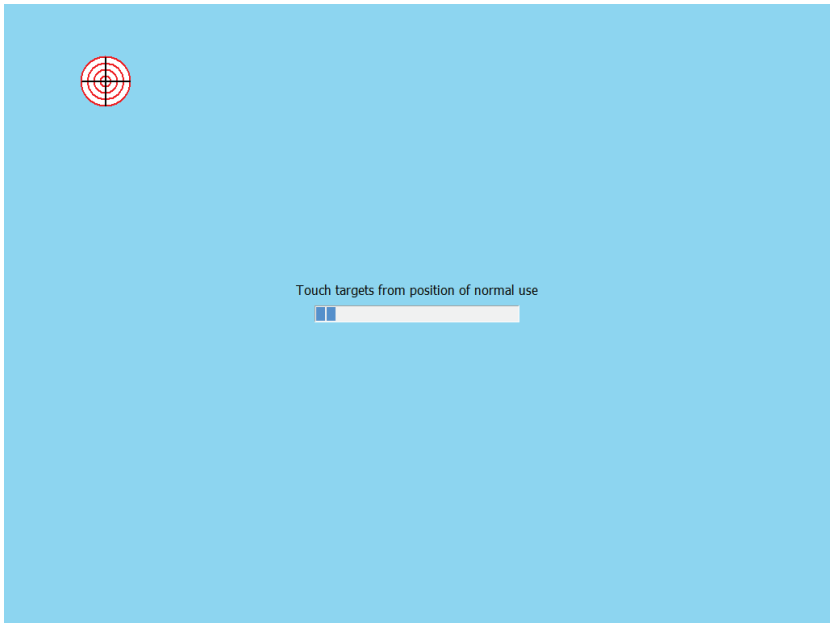
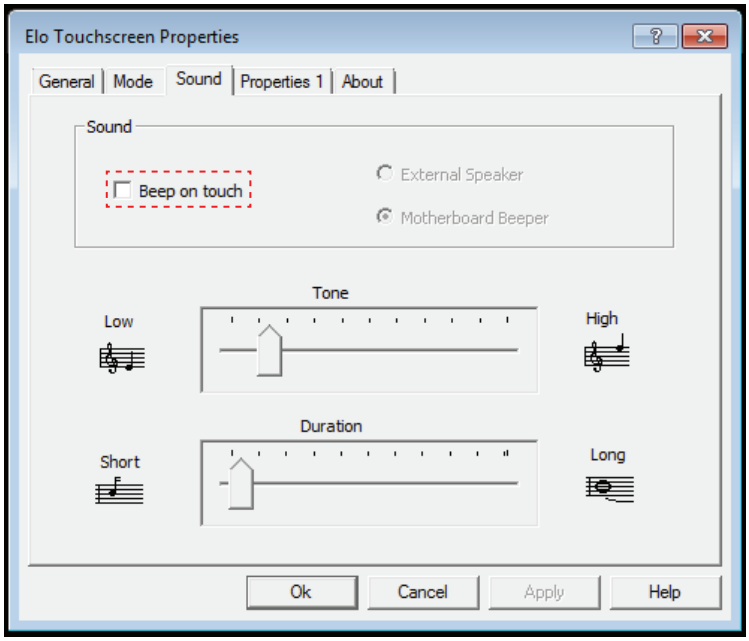


Figure F.43 – Beep on touch



BIOS SETUP 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 Automation Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3878.

TEST DESCRIPTION

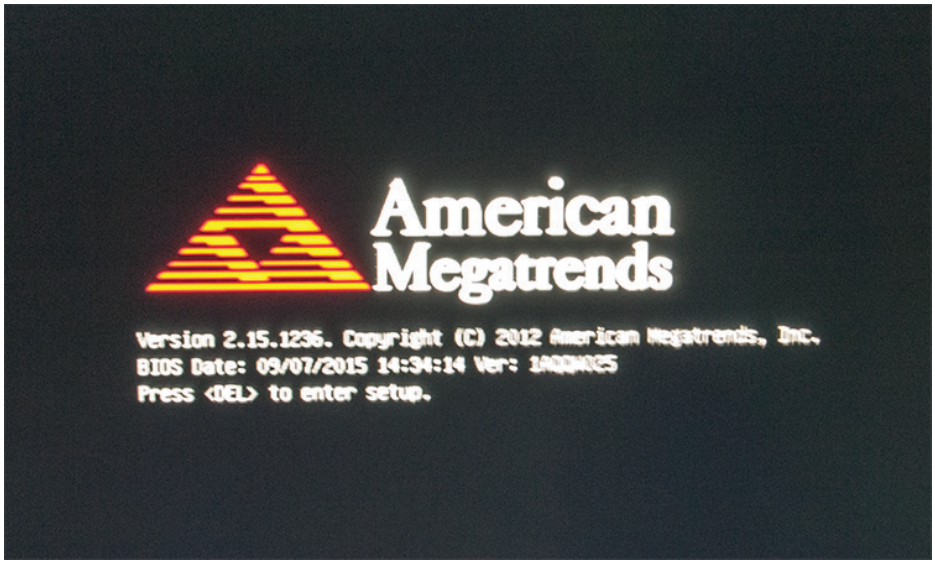
This procedure will aid the technician in the setup of the BIOS software.

MATERIALS NEEDED

USB Keyboard
USB Mouse
Wiring Diagram

BIOS SETUP PROCEDURE *(continued)*

Figure F.44 – Door removal



SETUP PROCEDURE

1. Connect the USB keyboard and mouse to the USB port on the machine.
2. Turn machine on by pressing the green circular button.

NOTE: If after performing above step the machine continues to turn off, repeat above step and continue to hold the green button until the machine turns on.

NOTE: Using the USB keyboard, immediately press the delete key until the BIOS setup utility appears or until the boot screen appears. See Figure F.44.

3. To navigate the BIOS setup utility, use the keys shown in ***Figure F.45***.
4. Once in the BIOS setup utility, if requested to "Load Previous Values?" appears on the screen, select Yes.
5. Using the USB keyboard, set the System Date and System Time to the current date and time. See ***Figure F.46***.
6. Using the USB keyboard, navigate to the "Advanced" tab. Navigate to "SATA Configuration". See ***Figure F.47***.
7. Using the USB keyboard, set the "SATA Mode Selection" to "AHCI". See ***Figure F.48***.
8. Using the USB keyboard, navigate to the "Boot" tab. See ***Figure F.49***.
9. In the Boot tab under "Boot Option Priorities", ensure that Boot Option #1 is set to "SanDisk Cruzer Fit..." and Boot Option #2 is set to "UEFI: SanDisk Cruze...". See ***Figure F.49***.
10. Using the USB keyboard, press the F4 key to save configuration. Press the enter key for Yes. See ***Figure F.50***.
11. The machine should now boot up to the VRTEX environment.
12. Perform the ***Retest After Repair Procedure***.

BIOS SETUP PROCEDURE *(continued)*

Figure F.45 – BIOS setup navigation keys

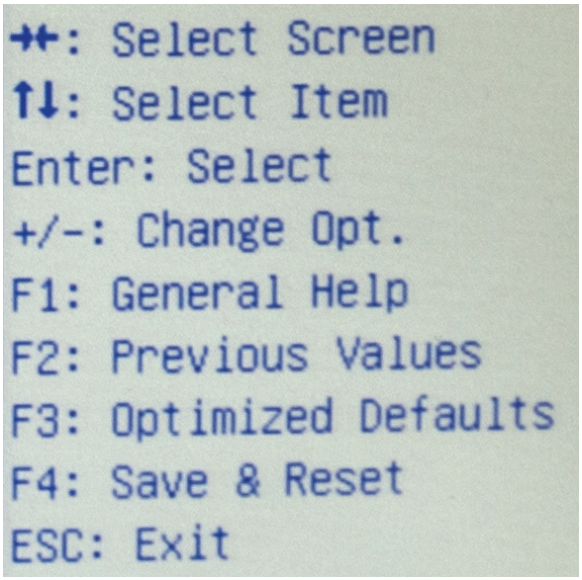
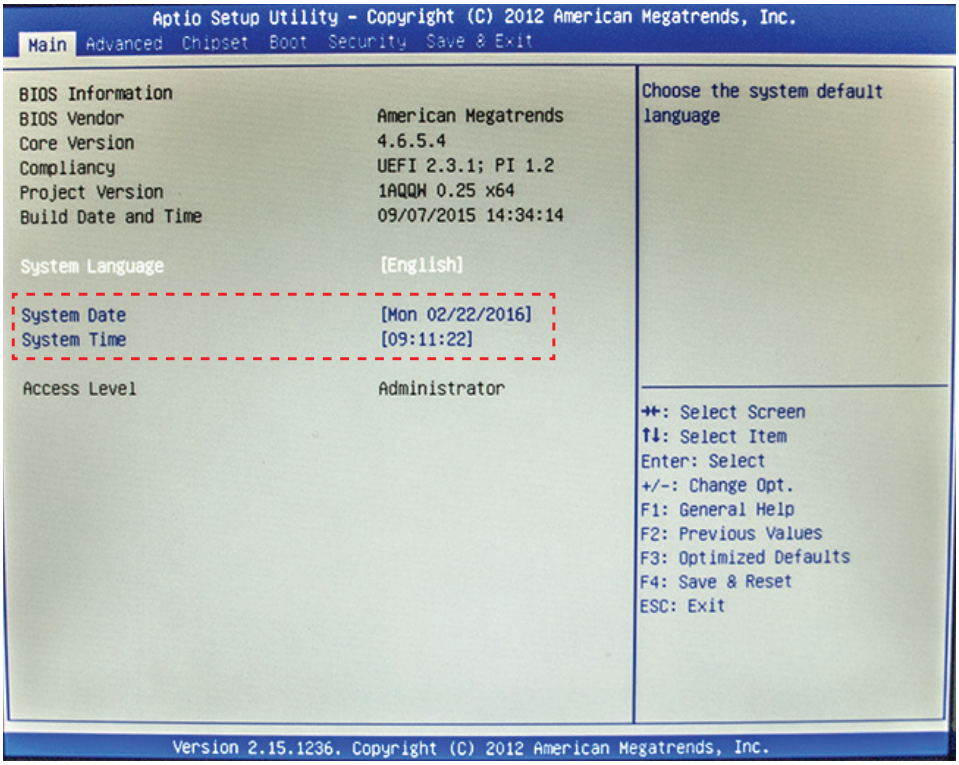


Figure F.46 – Set system date and time



BIOS SETUP PROCEDURE *(continued)*

Figure F.47 – SATA configuration

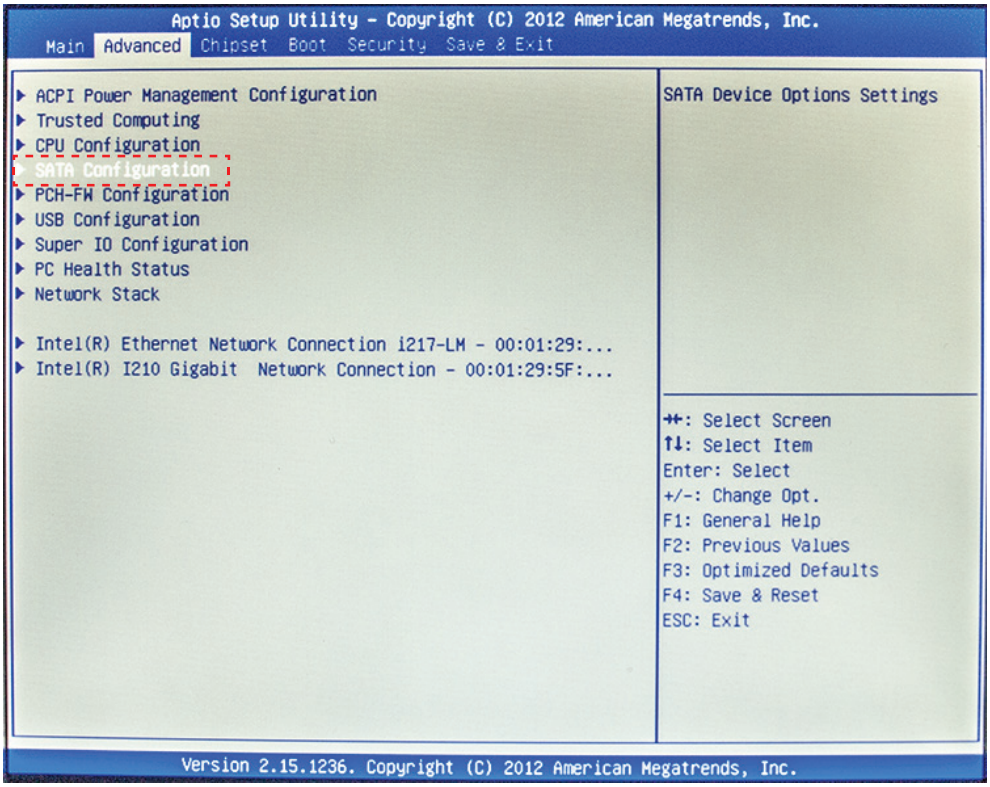
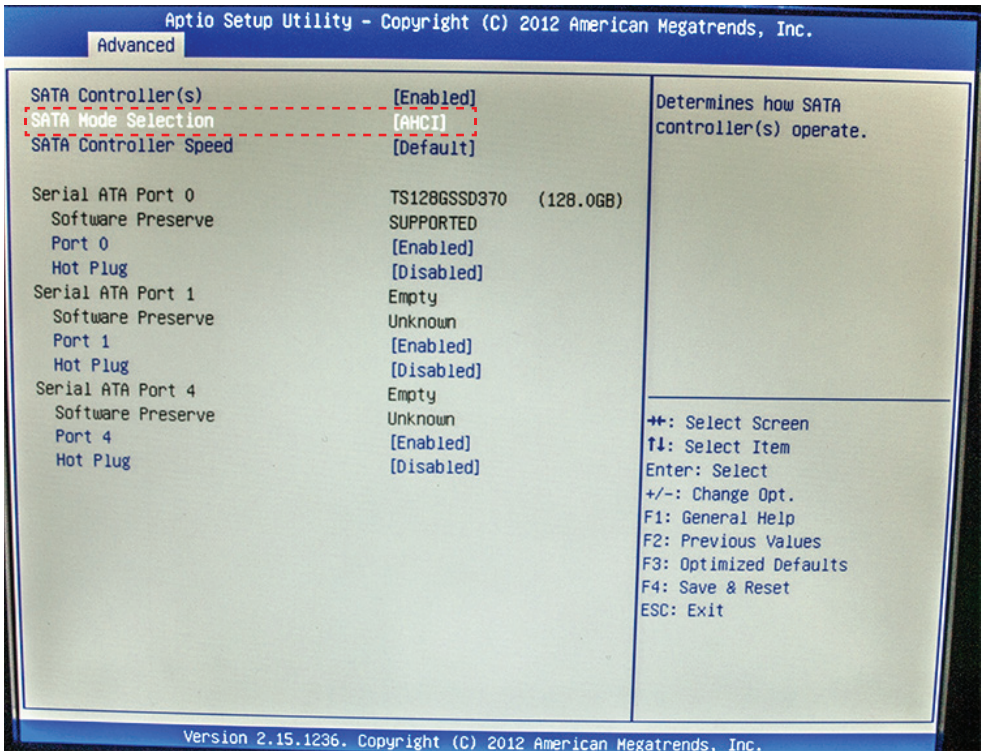


Figure F.48 – SATA mode selection



BIOS SETUP PROCEDURE *(continued)*

Figure F.49 – Boot Option Priorities

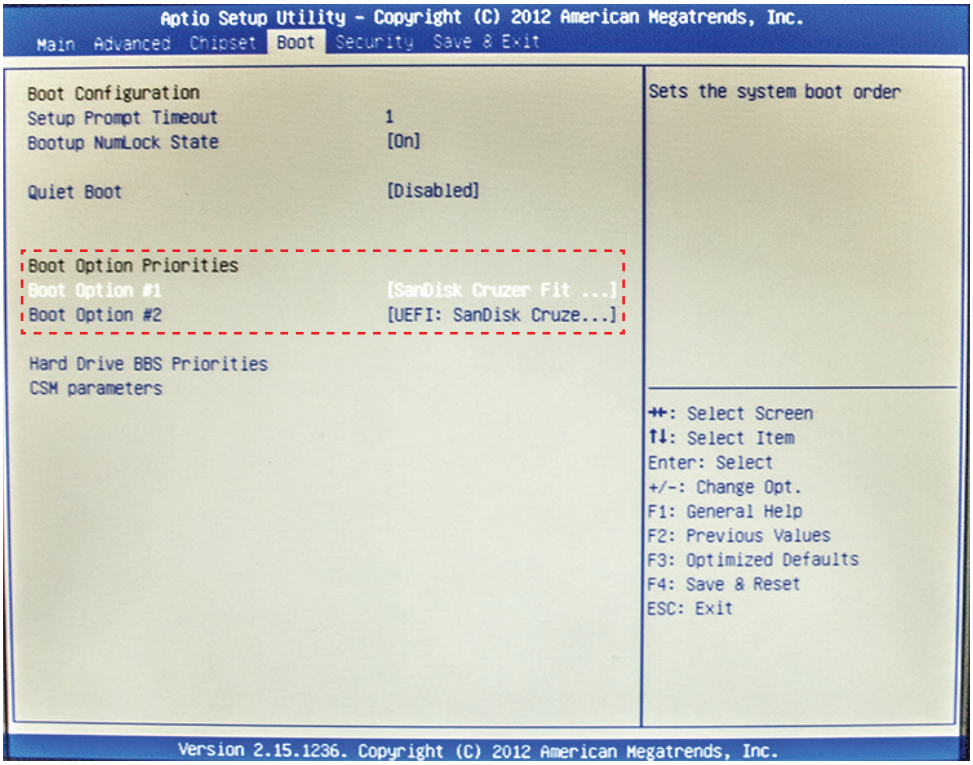
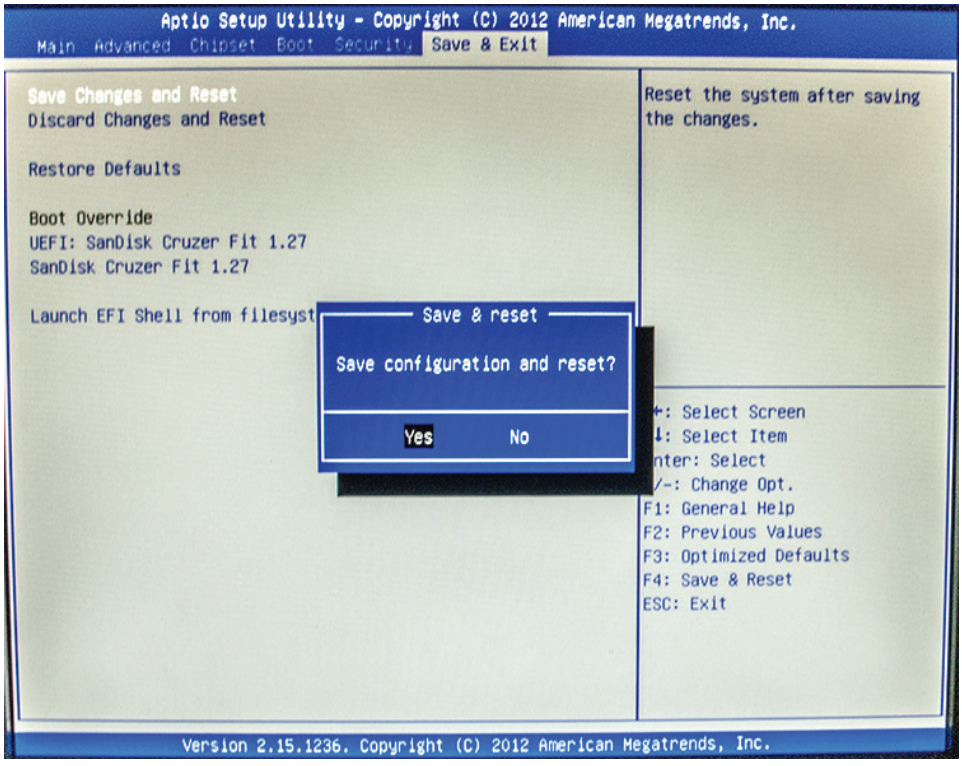


Figure F.50 – Save configuration



UNINSTALL AND REINSTALL NVIDIA PROGRAMS 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 Uninstalling and reinstalling the NVIDIA programs.

MATERIALS NEEDED

USB Keyboard
USB Mouse
Wiring Diagram

UNINSTALL AND REINSTALL NVIDIA PROGRAMS PROCEDURE *(continued)*

Figure F.51 – Taskbar location

UNINSTALL PROCEDURE

1. Connect the USB keyboard and mouse to the USB port on the machine.
2. Turn machine on by pressing the green circular button.

NOTE: If after performing above step the machine continues to turn off, repeat above step and continue to hold the green button until the machine turns on.

3. When the VRTEX login image appears on the monitor, press and hold the Windows key and then press the D key, the desktop will now be visible.

NOTE: There are no visible icons on the desktop.

4. Using the USB mouse, move the cursor towards the right side of the monitor until the taskbar appears. See Figure F.51.
5. Using the USB mouse, right click on Crosstrainer.exe and close all windows. See ***Figure F.52***.

NOTE: If necessary, select close program when prompted by the alert box for the crosstrainer.exe. See ***Figure F.53***.

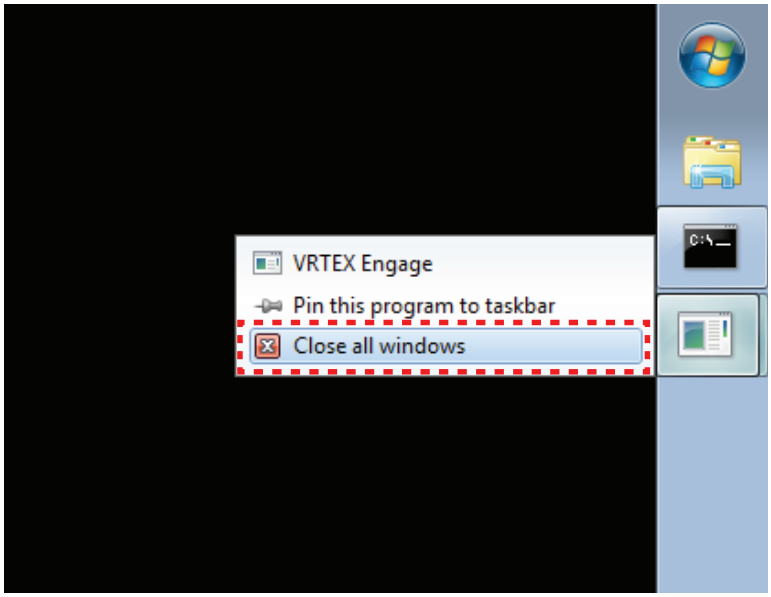
6. Using the USB mouse, move the cursor towards the right side of the monitor until the taskbar appears.
7. Using the USB mouse, right click on CMD.exe and close all windows. See ***Figure F.54***.
8. Using the USB mouse, left click the start icon, select all programs, select startup, right click the StartUpSim shortcut and select delete. See ***Figure F.55***.
9. Using the USB mouse, open the control panel by left clicking the start icon and selecting control panel. See ***Figure F.56***.
10. Using the USB mouse, select programs and features (icon view) or uninstall a program (category view). See ***Figure F.57***. If necessary, scroll so that all NVIDIA programs are present.
11. Uninstall all NVIDIA programs from top to bottom by right clicking the program, select uninstall and follow all screen prompts. See ***Figure F.58***.

NOTE: Several restarts will be needed. DO NOT choose to restart later. After restarts, default drivers will be installed.

12. When all NVIDIA programs are uninstalled, close the control panel.
13. Using the USB keyboard and mouse, select start and then select shutdown to shut the machine down.

UNINSTALL AND REINSTALL NVIDIA PROGRAMS PROCEDURE *(continued)*

Figure F.52 – Close crosstrainer.exe



REINSTALL PROCEDURE

1. Turn machine on by pressing the green circular button.

NOTE: If after performing above step the machine continues to turn off, repeat above step and continue to hold the green button until the machine turns on.

2. Using the USB mouse, right click the desktop, select view and left click show desktop icons. See ***Figure F.59***.
3. Place StartUpSim shortcut into startup folder by left clicking the start icon, select all programs, select startup, right click and select open. Copy and paste StartUpSim shortcut (from the desktop) into the open explorer window. Close the window. See ***Figure F.60***.

NOTE: Do not drag and drop StartUpSim shortcut into window.

4. Install the NVIDIA drivers by left clicking the start icon, select computer, select local disc (C:), select LEC_Welders, select NVIDIA and double click “347.52-desktop...” application, select OK, select agree and continue, select next and restart now. See ***Figure F.61***. The machine will now restart.
5. Disconnect the USB mouse and keyboard from the machine.
6. Perform the ***Retest After Repair Procedure***.

UNINSTALL AND REINSTALL NVIDIA PROGRAMS PROCEDURE *(continued)*

Figure F.53 – Crosstrainer.exe alert

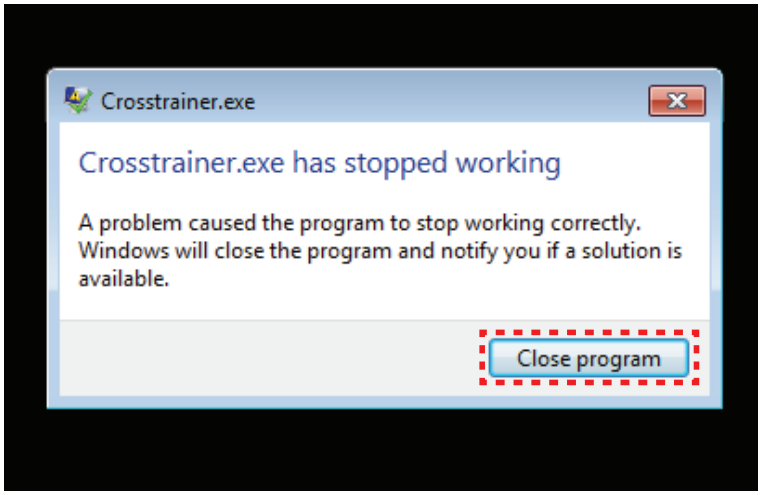
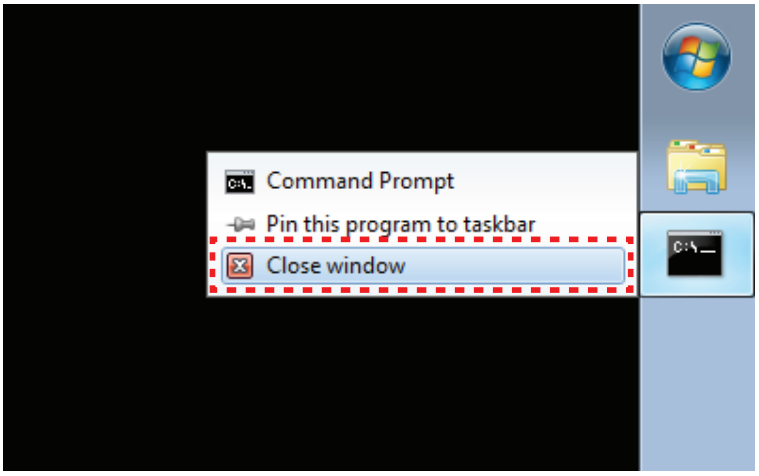


Figure F.54 – Close CMD.exe



UNINSTALL AND REINSTALL NVIDIA PROGRAMS PROCEDURE *(continued)*

Figure F.55 – Delete StartUpSim shortcut

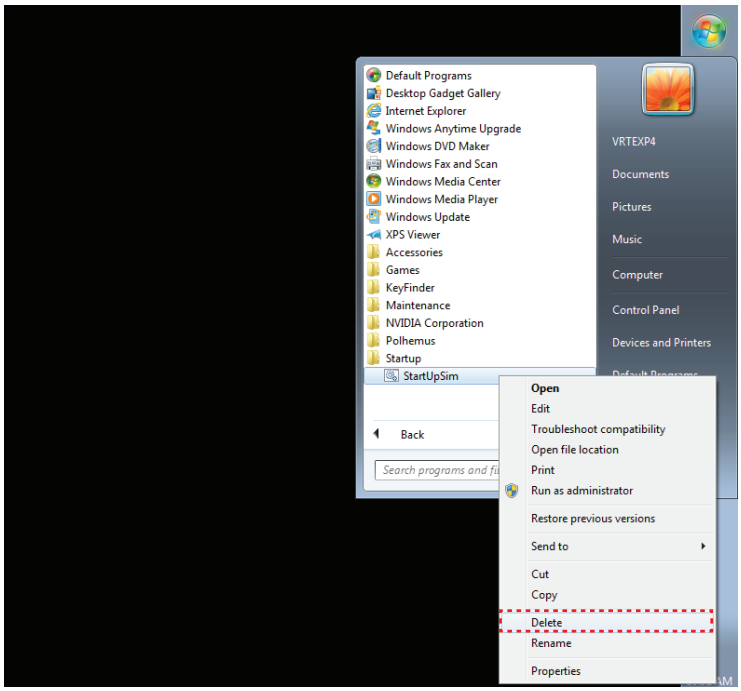
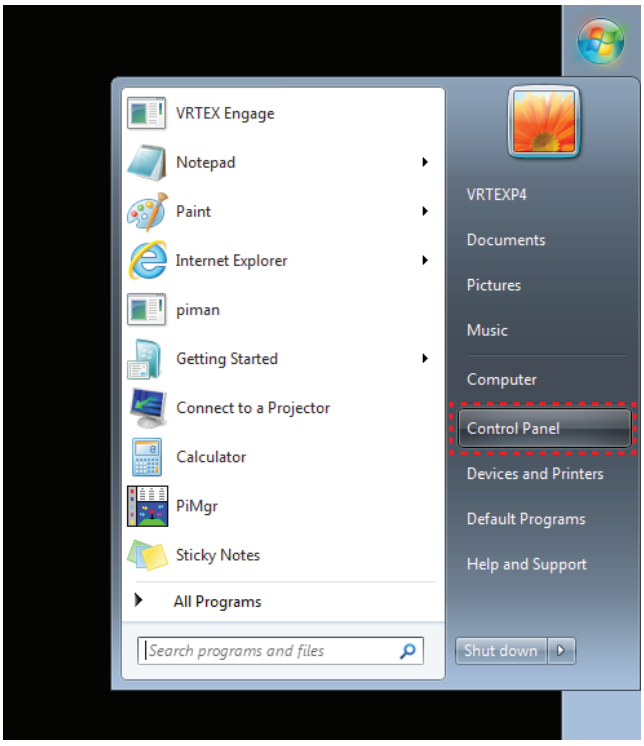


Figure F.56 – Open control panel



UNINSTALL AND REINSTALL NVIDIA PROGRAMS PROCEDURE *(continued)*

Figure F.57 – Uninstall a program

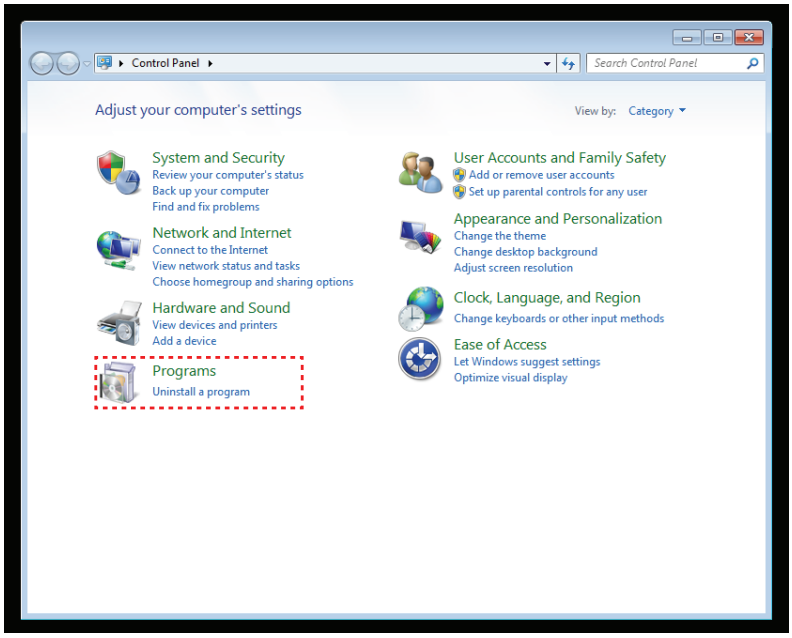
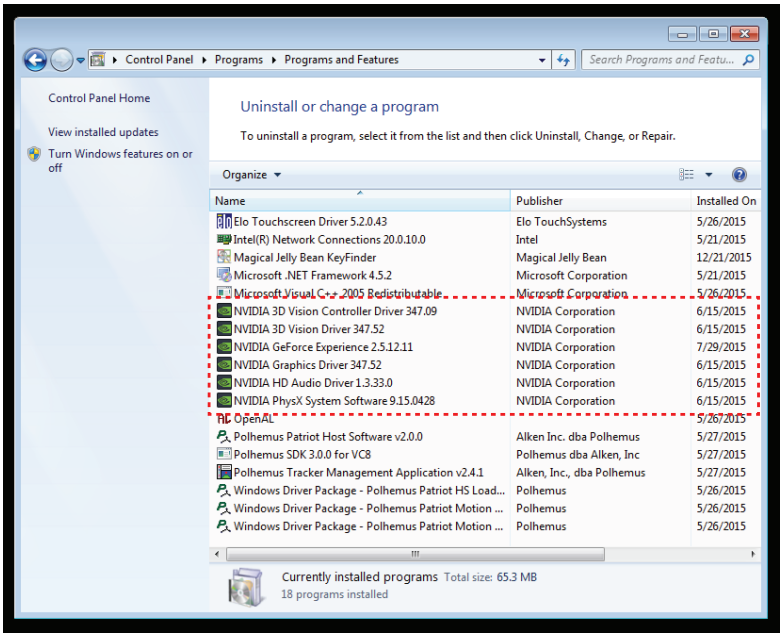


Figure F.58 – Delete NVIDIA programs



UNINSTALL AND REINSTALL NVIDIA PROGRAMS PROCEDURE *(continued)*

Figure F.59 – Show desktop icons

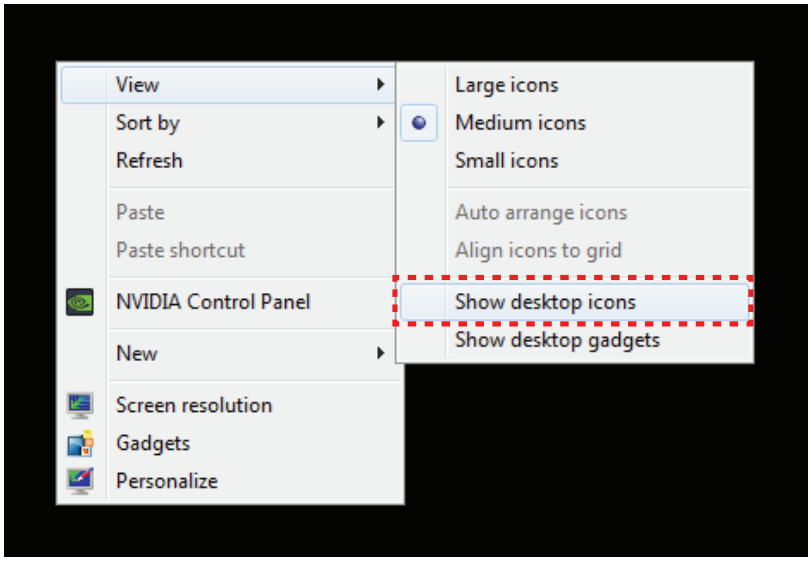
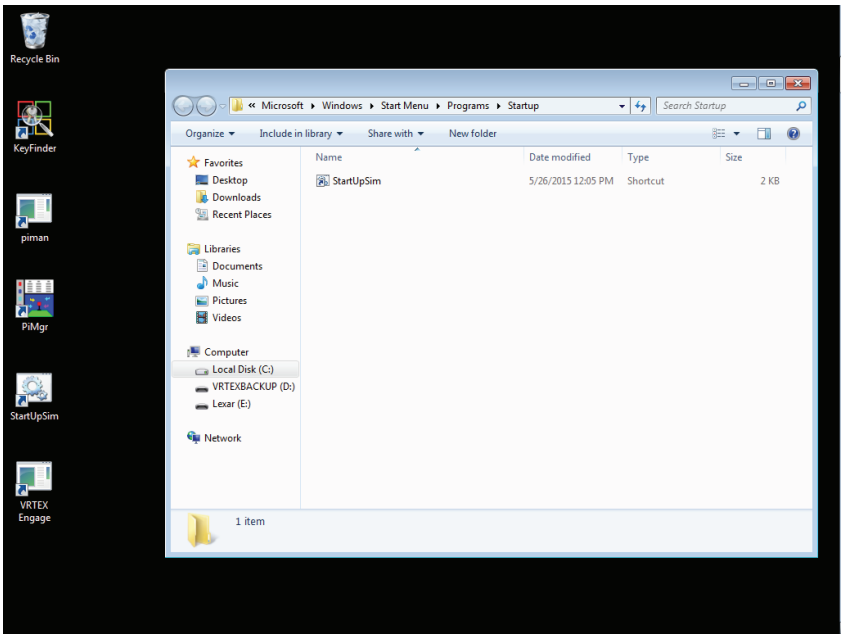
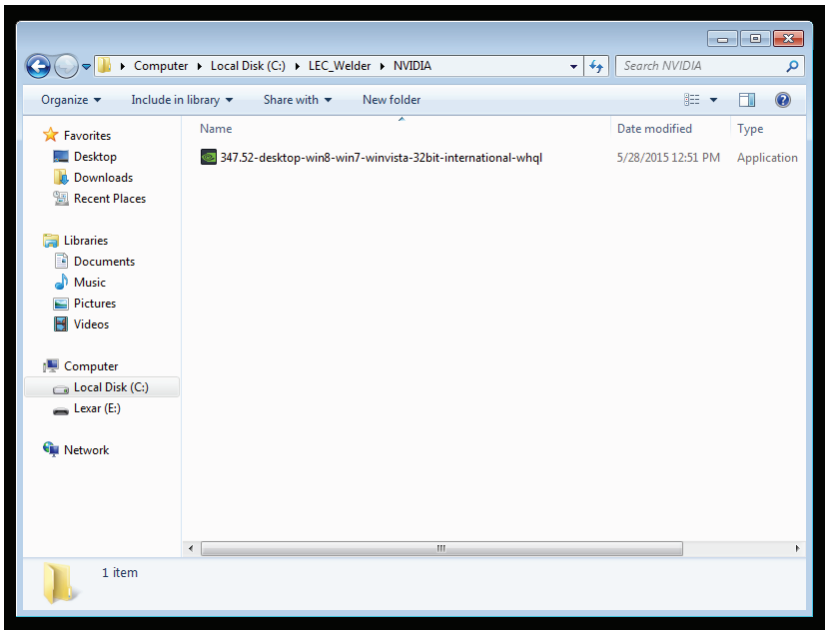


Figure F.60 – Copy StartUpSim shortcut



UNINSTALL AND REINSTALL NVIDIA PROGRAMS PROCEDURE *(continued)*

Figure F.61 – Install NVIDIA programs



RETEST AFTER REPAIR

DESCRIPTION

This procedure will aid the technician in testing the basic operations of the VRTEX Engage after any repair or replacement procedure has been completed.

1. Turn machine on by pressing the green circular button.

NOTE: If after performing above step the machine continues to turn off, repeat above step and continue to hold the green button until the machine turns on.

2. When the unit has “booted-up” proceed with login. See Operation section of the Operators Manual.
3. Insert a USB memory device into the USB port on the front of the machine.
4. At the login screen select Freeweld mode.
5. Navigate through the following: See the Operation section of the Operators Manual.
    A. Select coupon - (i.e., 3/8” plate must show when selected).
    B. Using the process selector icon, select GMAW.
    C. Proceed with weld settings.
6. Check the functionality of all icons. They must function as labeled. Listen for an audible signal when icons are pressed.
7. Check the functionality of the unigun with all weld modes and processes.
8. Check both camera views are functioning properly.
9. Make certain that weld pass information can be saved in the USB memory device.
10. Select menu, logout, then “Yes”. Login screen with keyboard appears.
11. Press the key icon and enter the pass code. The instructor mode screen should appear. Press back button.

NOTE: If no pass code available, call Lincoln Electric Automation Department at 1-888-935-3878.

12. Select menu, then “Shutdown”. Select “Yes”. The machine should now shutdown.

TABLE OF CONTENTS
- DIAGRAMS SECTION -