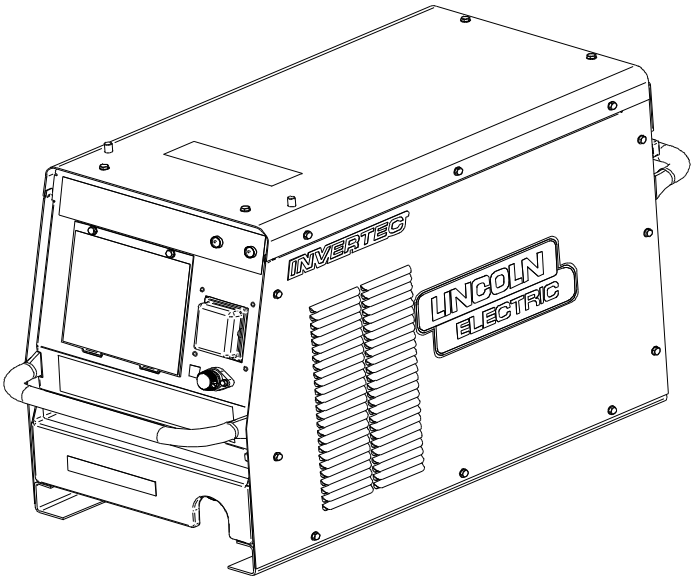
SVM 7001
January, 2009
Rev. 1

INVERTEC™ CV350-R

For use with machine Code 76035

Safety Depends on You

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



SERVICE MANUAL

LINCOLN® ELECTRIC

• World's Leader in Welding and Cutting•
THE SHANGHAI LINCOLN ELECTRIC COMPANY
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⚠ WARNING

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

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

ELECTRIC AND MAGNETIC FIELDS may be dangerous.

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

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

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

1.c.1 Route the electrode and work cables together – Secure them with tape when possible.

1.c.2 Never coil the electrode lead around your body.

1.c.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.

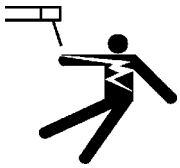
1.c.4 Connect the work cable to the workpiece as close as possible to the area being welded.

ARC RAYS can burn.

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

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

2.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.



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 hand.

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, grating 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 holder to two welders because voltage between the two can be total of the open circuit voltage of both welders.

FUMES AND GASES can be dangerous.

4.a Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of fume. Use enough ventillation 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 below Threshold Limit Values (TLV) 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.**

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

4.c 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.

4.d 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.

FOR ELECTRICALLY powered equipment.

5.a Turn off input power using the disconnect switch at the fuse box before working on the equipment.

5.b Install equipment in accordance with the national standard, all local standards and the manufacturer's recommendations.

5.c Ground the equipment in accordance with the national standards and the manufacturer's recommendations.

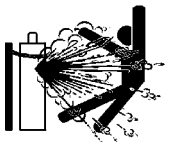
WELDING SPARKS can cause fire or explosion.

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 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.c 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 subtances inside. They can cause an explosion even though they have been "cleaned".

6.d Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trouses, high shoes and a cap over your hair.



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 Cylinder 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.

PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté specifiques qui parraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

   a. Les circuits à l'électrode et à la piéce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vétements mouillés. Porter des gants secs et sans trous pour isoler les mains.
   b. Faire trés attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher metallique ou des grilles metalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
   c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état defonctionnement.
   d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
   e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
   f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces precautions pour le porte-électrode s'applicuent aussi au pistolet de soudage.

2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas ou on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.

3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:

   a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
   b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
   c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.

4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans lateraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de

7. Quand on ne soude pas, poser la pince à une endroit isolé de la masse. Un court-circuit accidental peut provoquer un échauffement et un risque d'incendie.

8. S'assurer que la masse est connectée le plus prés possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaines de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'echauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.

9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particuliérement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumeés toxiques.

10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgéne (gas fortement toxique) ou autres produits irritants.

11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le chassis du poste conformement au code de l'électricité et aux recommendations du fabricant. Le dispositif de montage ou la piece à souder doit être branché à une bonne mise à la terre.

2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.

3. Avant de faires des travaux à l'interieur de poste, la debrancher à l'interrupteur à la boite de fusibles.

4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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TECHNICAL SPECIFICATIONS – INVERTEC™ CV350-R

INPUT – THREE PHASE ONLY		
	Standard Voltage/Phase/Frequency	Input Power at Rated Output
INVERTEC™ CV350-R	380V ~ 415V(±10%)/3/50 or 60 Hz	14kVA @ 60% Duty Cycle

RATED OUTPUT – DC ONLY			
	Duty Cycle	Amperes	Volts at Rated Amperes
INVERTEC™ CV350-R	60% 100%	350A 270A	31.5V 27.5V

OUTPUT			
	Welding Current Range	Open Circuit Voltage	Welding Voltage Range
INVERTEC™ CV350-R	60A ~ 350A	67V	17 V ~ 31.5V

RECOMMENDED INPUT WIRE AND FUSE SIZES						
	Input Voltage/ Frequency (Hz)	Maximum Input Ampere	Maximum Effective Supply Current	60°C Copper Wire in Conduct Sizes	Fuse or Breaker Size (Super Lag)	Grounding Conductor Size
INVERTEC™ CV350-R	342V ~ 456.5V/ 50Hz or 60Hz	21A	17A	12mm^2	30A	10mm^2

PHYSICAL DIMENSIONS				
	Height	Width	Depth	Weight
INVERTEC™ CV350-R	464mm	325mm	823mm	56.2 Kg

Temperature Range	
Operating Temperature Range	Storage Temperature Range
-10°C ~ +40°C	-25°C ~ +55°C

For any maintenance or repair operation it is recommended to contact the nearest technical service center or directly consult machine division of the Shanghai Lincoln Electric. Maintenance or repairs performed by unauthorized service center or personnel will void the manufacturer's warrant.

SAFETY PRECAUTIONS

Read the entire installation section before starting installation.

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Only qualified personnel should perform this installation.**
- **Turn the input power OFF at the main switch or fuse box before working on this equipment. Turn off the input power to any other equipment connected to the welding system at the main switch or fuse box before working on the equipment.**
- **Do not touch electrically "Hot" parts.**
- **Always connect the INVERTEC™ grounding lug (located at the rear of the case) to a proper safety (Earth) ground.** INVERTEC™ is for use on a 4 wire system with earthed neutral.

SELECT SUITABLE LOCATION

This power source should not be subjected to falling water, nor should any parts of it be submerged in water. Doing so may cause improper operation as well as pose a safety hazard. The best practice is to keep the machine in a dry, sheltered area.

⚠ CAUTION

The bottom of machine must always be placed on a firm, secure, level surface. There is a danger of the machine toppling over if this precaution is not taken.

Place the welder where clean cooling air can freely circulate in through the back louvers and out through the case sides. Water,dirt, dust or any foreign material that can be drawn into the welder should be kept to a minimum. Failure to observe these precautions can result in excessive operating temperatures and nuisance shutdowns.

Locate the INVERTEC™ machine away from radio controlled machinery. Normal operation of the welder may adversely affect the operation of RF controlled equipment, which may result in bodily injury or damage to the equipment.

STACKING

The INVERTEC™ machine may be stacked 3 high. Be sure to locate the machines on a firm level surface and align the pins in the roofs of the lower unit with the holes in the base of the upper unit.

INPUT POWER AND GROUNDING CONNECTION

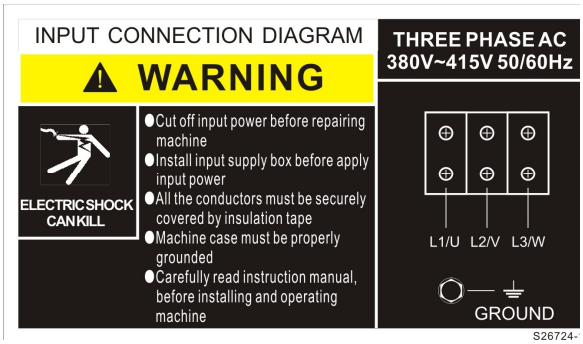
⚠ WARNING

Only a qualified electrician should connect the input leads to the INVERTEC™. Connections should be made in accordance with the connection diagram. Failure to do so may result in bodily injury or death.

Open the input box on the rear of the case. Use a three-phase supply line, the three live wires should go through the three holes of the input wire holder and be securely clamped and fixed. Connect L1, L2, L3 and ground according to the Input Supply Connection Diagram decal, refer to Figure A.1 on this page.

Make sure the amount of power available from the input connection is adequate for normal operation of the machine. Refer to the Technical Specifications at the beginning of this Installation section for recommended fuse and wire sizes. Fuse the input circuit with the recommended super lag fuse or delay type breakers. Using fuses or circuit breakers smaller than recommended may result in "nuisance" shut-offs from welder inrush currents, even if the machine is not being used at high currents.

FIGURE A.1 – Input Supply Connection Diagram



REQUIRED EQUIPMENT

The INVERTEC™ CV350-R requires the use of robotic feeder. The INVERTEC™ CV350-R comes preprogrammed for use with the AutoDrive™ 4R90 wire feeder.

A K1785-[ ] (12, 16 or 25 feet) is required to connect the feeder to INVERTEC™ CV350-R. The K1785-[ ] is a 14-pin to 14-pin control cable.

A K60036-5 communication cable is required to connect the robotic controller to the INVERTEC™ CV350-R.

OUTPUT, WIRE FEEDER AND COMMUNICATION CONNECTIONS

(See Figure A. 2)

Connect a work lead of sufficient size and length (Per Table A.1) between the Negative Output terminal on the power source and the work. Be sure the connection to the work makes tight metal-to-metal electrical contact. To avoid interference problems with other equipment and to achieve the best possible operation, route all cables directly to the work and wire feeder. Avoid excessive lengths and do not coil excess cable.

Minimum work and electrode cable sizes are as follows:

TABLE A.1

Current (60% Duty Cycle)	Minimum Copper Work Cable Size
	Up To 30m Length
200A	30 mm^2
300A	50 mm^2
400A	70 mm^2
500A	95 mm^2

Note: The recommended cable size may need to change depending on its quality. When the rated current flow goes through, the total voltage drop on ground cable and electrode cable must not exceed 4 volts.

WIRE FEEDER CONNECTION

(See Figure A. 2)

- Turn the INVERTEC™ power switch "OFF".
- Connect the K1785 control cable from the feeder to the 14-pin connector.
- Connect the electrode cable to the Positive Output terminal and to the feeder's electrode connection. Refer to the wire feeder instruction manual for details.

ROBOTIC COMMUNICATION CABLE CONNECTION

- Turn the INVERTEC™ power switch "OFF".
- Connect the K60036-5 communication cable from the robotic controller to the 4-pin connector.

Pin Connector	Lead color in	Description
A	White	CAN Low
B	Blue or Orange	CAN High
C	Black	Power -
D	Red	Power +

⚠ CAUTION

For secure electrical connections, the hardware connecting the output terminals and cables must be tight. Damage to output studs and poor performance may occur if this instruction is not followed.

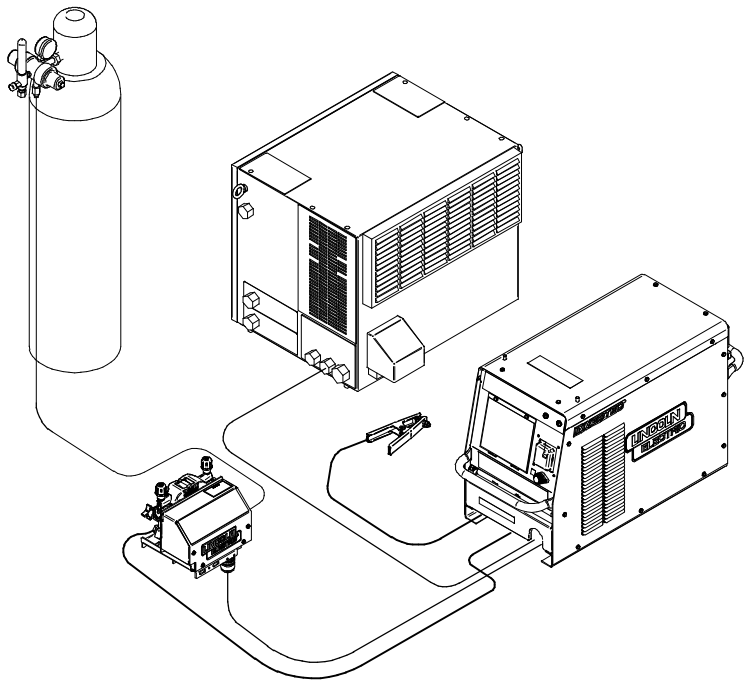
GUN AND CABLE INSTALLATION

Refer to the wire feeder instuction manual for details.

⚠ WARNING

Turn the welder power switch off before installing gun and cable to the wire feeder.

Figure A.2



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SAFETY PRECAUTIONS

Read this entire section of operating instructions before operating the machine.

⚠ WARNING

ELECTRIC SHOCK can kill.
- **Do not touch electrically live parts or electrode with skin or wet clothing.**
- **Insulate yourself from work and ground.**
- **Always wear dry insulating gloves.**

FUMES AND GASES can be dangerous.
- **Keep your head out of fumes.**
- **Use ventilation or exhaust to remove fumes from breathing zone.**

WELDING SPARKS can cause fire or explosion.
- **Keep flammable material away.**
- **Do not weld on closed containers.**

ARC RAYS can burn eyes and skin.
- **Wear eye, ear and body protection.**

PLEASE SEE ADDITIONAL WARNING INFORMATION AT THE FRONT OF THIS OPERATOR'S MANUAL.

GENERAL DESCRIPTION

The INVERTEC™ is a non-synergic robotic arc welding machine supporting DC CV welding. It is rated as follows:

INVERTEC™ CV350-R: 350amps, 31.5volts at 60% duty cycle.

RECOMMENDED PROCESSES

RECOMMENDED PROCESSES

The INVERTEC™ CV350-R is recommended for multiple GMAW welding procedures for a variety of materials.

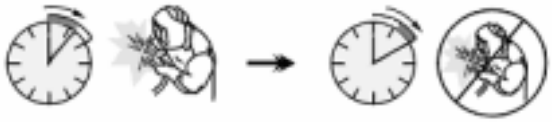
The following non-synergic CV weld modes are included:

Material	Electrode Diameter	Gas
Steel	1.2 mm	80%Ar, 20%CO2
Steel	1.2 mm	100% CO2
Steel	1.0 mm	80%Ar, 20%CO2
Steel	1.0 mm	100% CO2
Steel	0.9 mm	80%Ar, 20%CO2
Steel	0.9 mm	100% CO2
Steel	0.8 mm	80%Ar, 20%CO2
Steel	0.8 mm	100% CO2
Stainless Steel	1.2 mm	98% Ar, 2%O
Stainless Steel	1.0 mm	98% Ar, 2%O
Stainless Steel	0.9 mm	98% Ar, 2%O

DUTY CYCLE

The duty cycle of a welding machine is the percentage of time in a 10 minute cycle at which the welder can operate the machine at rated welding current.

60% duty cycle:



Weld for 6 minutes Break for 4 minutes

Excessive extension of the duty cycle will cause the thermal protection circuit to activate.

THERMAL PROTECTION

The INVERTEC™ machine is equipped with a thermal overheating protection device. When the machine detects overheating, the output will be turned "OFF" and the Thermal Indicator Light will be turned "ON". When the machine has been cooled to a safe temperature, the Thermal Indicator Light will go out and the machine may resume normal operation.

Note: For safety reasons the machine's welding output will not come on after a thermal shutdown until the output is disabled and re-enabled.

OPERATIONAL FEATURES AND CONTROLS

FRONT Panel (PLEASE SEE FIGURE B.1)

1. ON/OFF POWER SWITCH

2. 4A FUSE AND FUSE HOLDER
This is a high voltage fuse to protect the control circuitry.

3. THERMAL INDICATOR
This status light illuminates when the power source has been driven into thermal overload. The indicator light also momentarily turns on during start up.

4. STATUS INDICATOR
This light will flash during initialization. Solid green indicates initialization is complete and the power source is ready.

5. PROTECTION DOOR
This door is used to protect the output terminal and wire feeder connector. Turn off the power switch. Open protection door to connect the welding cable and wire feeder control cables.

⚠ WARNING

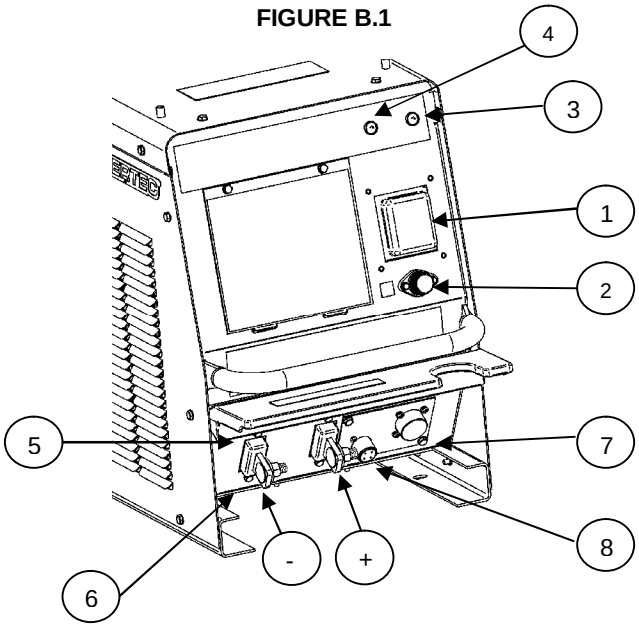
Do NOT operate the machine with this door open.

6. POSITIVE AND NEGATIVE OUTPUT CONNECTIONS
The positive output connection is on the right when looking at the front of the machine.

7. WIRE FEEDER CONNECTION – 14-PIN

8. ROBOTIC COMMUNICATION CONNECTOR
This connector has the communication leads and power leads to power the communication circuit board in the robotic controller.

FIGURE B.1



REAR PANEL (PLEASE SEE FIGURE B.2)

9. GROUND CABLE CONNECTION
Connect the input earth cable to the rear of the case.

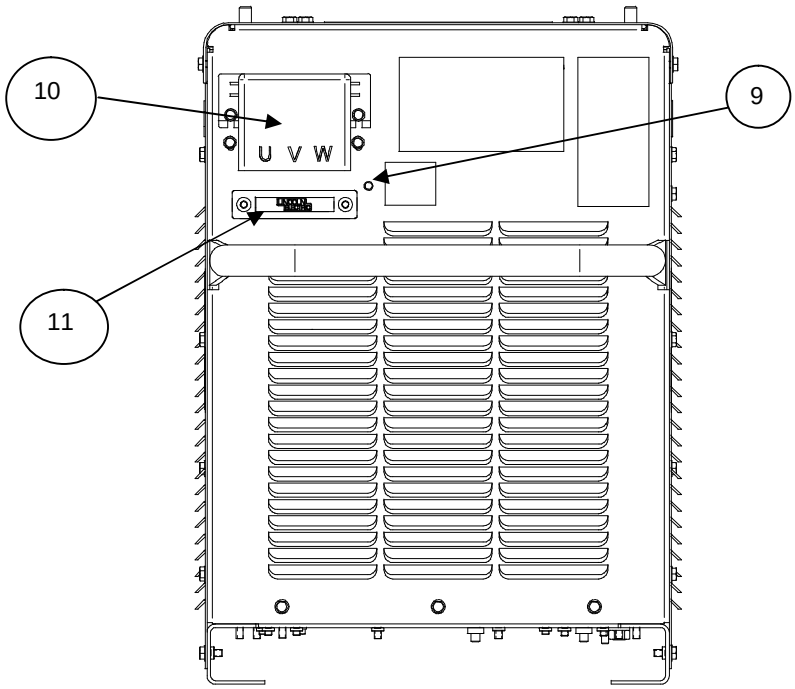
10. INPUT BOX
This insulation box is used to cover the input connections offering insulating protection to the operator.

⚠ WARNING

This insulation box must be installed before turning on the main power supply.

11. INPUT CABLE HOLDING BRACKET
This bracket holds the three phase power cables securely.

FIGURE B.2



MAKING A WELD

⚠ WARNING

The serviceability of a product or structure utilizing the welding programs is and must be the sole responsibility of the builder/user. Many variables beyond the control of The Lincoln Electric Company affect the results obtained in applying these programs. These variable include, but are not limited to, welding procedure, plate chemistry and temperature, weldment design, fabrication methods and service requirements. The available range of welding programs may not be suitable for all applications, and the builder/user is and must be solely responsible for welding program selection.

First, consider the desired welding process and the part to be welded. Choose an electrode material, diameter, shielding gas and process.

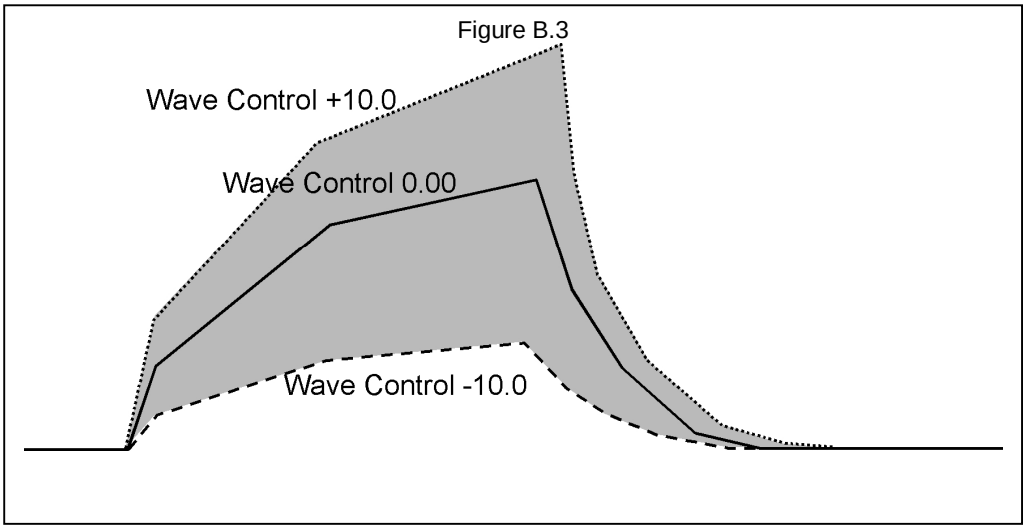
Second, find the program in the welding software that best matches the desired welding process. The standard software shipped with the INVERTEC™ CV350-R encompass many of common processes.

To make a weld, the INVERTEC™ needs to know the desired welding parameters, such as welding voltage and amperage or desired wire feed speed. The INVERTEC™ is designed to operate with a 12mm electrode stick-out. Excessively short or long electrode stick-outs may function only on a limited basis.

WELDING MODE
Selecting a welding mode determines the output characteristics of the INVERTEC™ power source.

WAVE CONTROL
Also known as Inductance or Arc Control allows the operator to vary the arc characteristics from “soft” to “harsh” in all weld modes. It adjusts from -10.0 to +10.0 with a nominal setting of 00.0. See Figure B.3.

Figure B.3



OPTIONAL ACCESSORIES

Factory Installed Options

Instruction Manual

Field Installed Options

K60010-2-XXM
Internal Cable, including welding cable, control cable and gas hose.
"XX" is the length of Internal Cable.

K60010	2	XXM
Internal Cable	$70mm^2$	Can be 2, 5, 10, 30, 40, 55m

K60027-2
Work Cable and Clamp

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SAFETY PRECAUTIONS

Read the entire installation section before starting installation.

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Only qualified personnel should perform this installation.**
- **Turn the input power OFF at the main switch before working on this equipment. Turn off the input power to any other equipment connected to the welding system at the main switch before working on the equipment.**
- **Do not touch electrically "Hot" parts.**
- **Always connect the INVERTEC™ grounding lug (located at the rear of the case) to a proper safety (Earth) ground.**

INVERTEC™ is for use on a 4 wire system with earthed neutral.

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

For any maintenance or repair operations it is recommended to contact the nearest technical service center or Lincoln Electric. Maintenance or repairs performed by unauthorized service centers or personel will null and void the manufacturers warranty.

⚠ WARNING

The machine has internal capacitors which are charged to a high voltage during power-on conditions. This voltage is dangerous and must be discharged before the machine can be serviced. Discharging is done automatically by the machine each time the power is switched off. However, you must allow the machine to sit for at least 5 minutes to allow time for the process to take place.

ROUTINE MAINTENANCE

The frequency of the maintenance operations may vary in accordance with the working environment. Any noticeable damage should be reported immediately.

- **Check cables and connections integrity. Replace, if necessary.**
- **Clean the power source inside by means of lowpressure compressed air.**
- **Keep the machine clean. Use a soft dry cloth to clean the external case, especially the airflow inlet / outlet louvers.**

⚠ WARNING

Do not open this machine and do not introduce anything into it's openings.
Power supply must be disconnected from the machine before each maintenance and service.
Always use gloves in compliance with the safety standards.
After each repair, perform proper tests to ensure safety.

THERMAL PROTECTION

Thermostats protect the machine from excessive operating temperatures. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle and output rating. If excessive operating temperature should occur, the thermostat will prevent output voltage or current.

Thermostats are self-resetting once the machine cools sufficiently. If the thermostat shutdown was caused by excessive output or duty cycle and the fan is operating and normally, the Power Switch may be left on.

MAJOR COMPONENT LOCATIONS

FIGURE D.1 MAJOR COMPONENT LOCATIONS

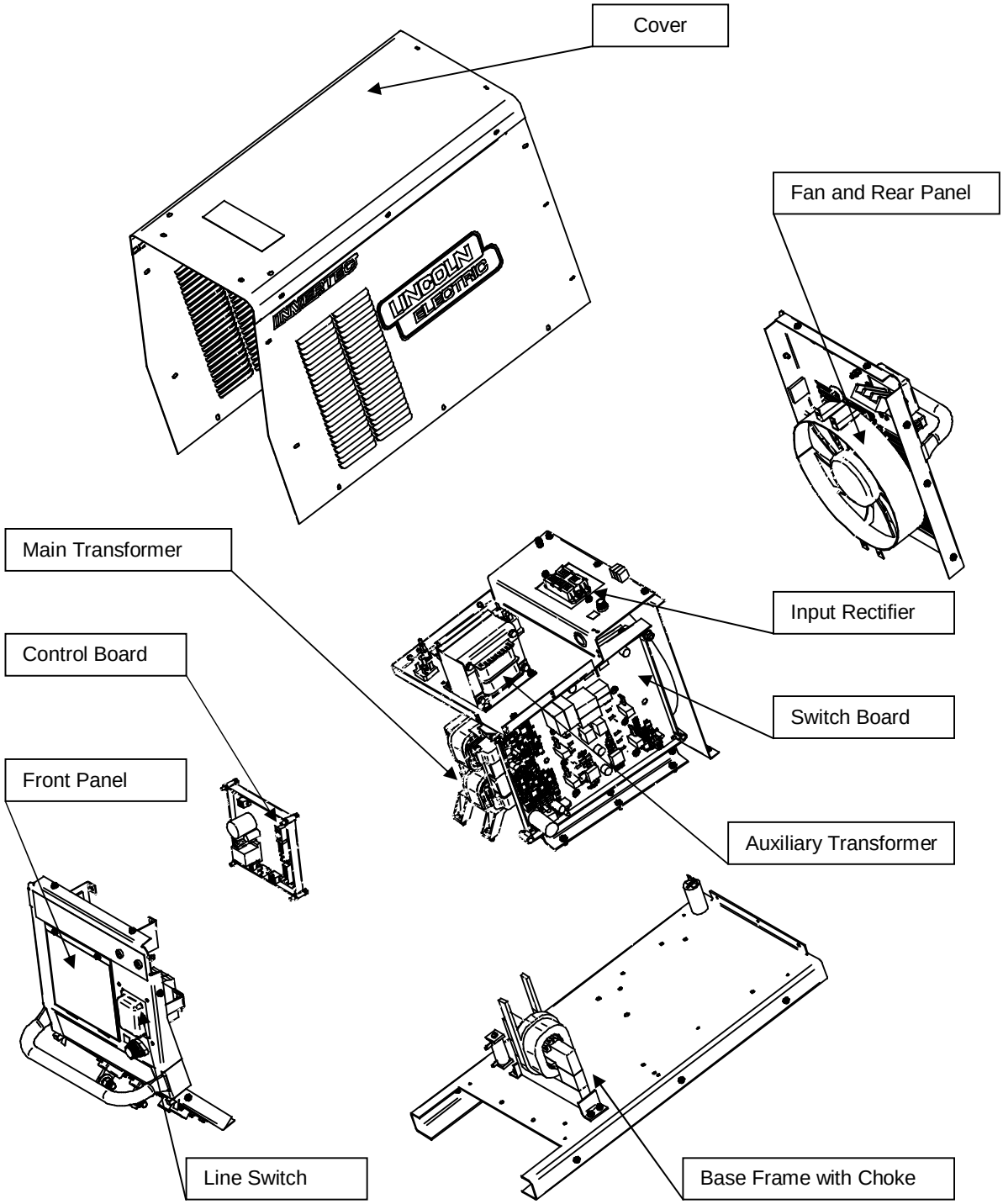
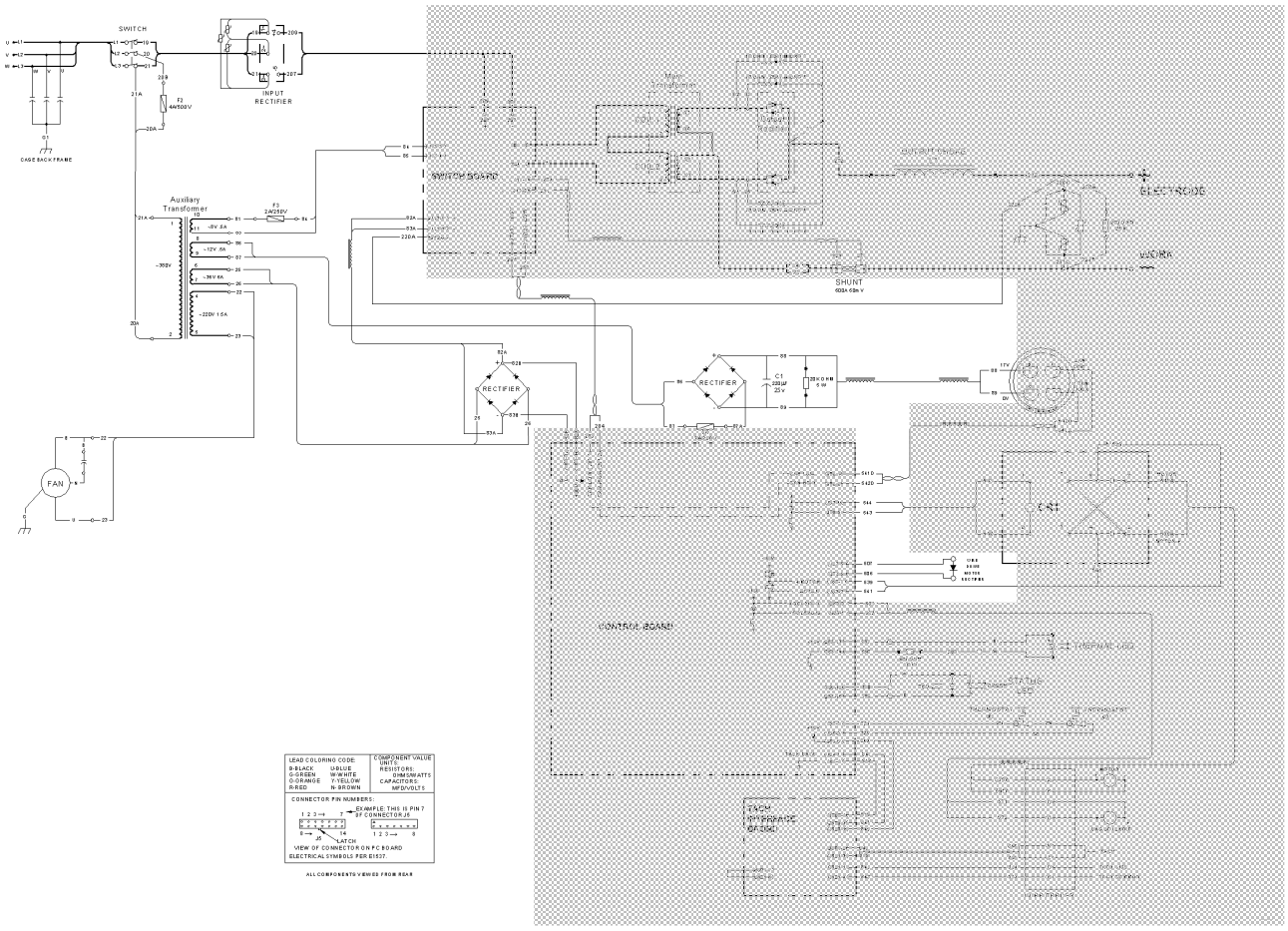


TABLE OF CONTENTS - Theory of Operation

FIGURE E.1 – INPUT LINE VOLTAGE AND AUXILIARY TRANSFORMER



GENERAL DESCRIPTION

The INVERTEC™ CV350-R is an inverter based welding power source that offers constant voltage (CV) welding and is rated at 350 amps at a 60% duty cycle. The INVERTEC™ CV350-R is designed special for working together with Welding Robot by means of CAN bus.

INPUT LINE VOLTAGE AND AUXILIARY TRANSFORMER

The INVERTEC™ CV350-R is connected with 380VAC, 50/60Hz three-phase power supply. The initial power is applied to the CV-350R through a combination line switch/circuit breaker located on the front of the machine.

Two phases of the input voltage are applied to the auxiliary transformer. The auxiliary transformer develops four different secondary voltages. The 220VAC is used to power the fan motor only.

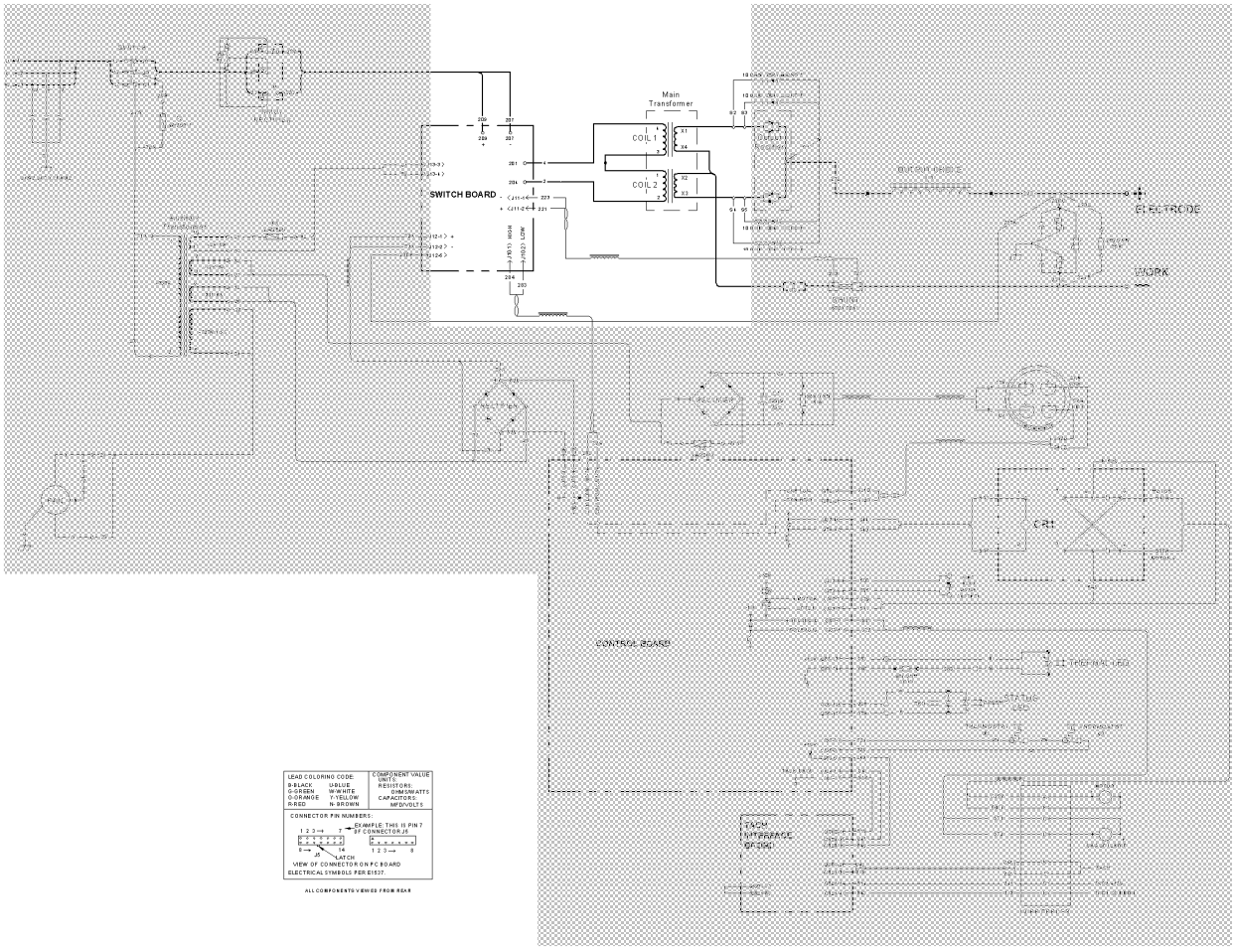
NOTE: The fan motor will start to run once the line switch is switched ON, and will not stop until it is switched OFF.

There are three rectifiers located on the middle panel of CV350-R which are used together with auxiliary transformer to power related circuitry. The 36VAC is rectified by the first rectifier and the resultant 50VDC is applied to both the Control PC Board and the Switch Board. The 12VAC is rectified by the second one and applied to four-pin CAN bus connector. The 8VAC is applied to Switch Board directly to power the circuitry that checks the input voltage. Only one diode of the third rectifier is used in motor drive control circuit.

The input voltage is rectified by Input Rectifier and the resultant DC voltage is applied to the Switch Board.

NOTE: Unshaded areas of Wiring Diagram are the subject of discussion.

FIGURE E.2 – SWITCH BOARD AND MAIN TRANSFORMER



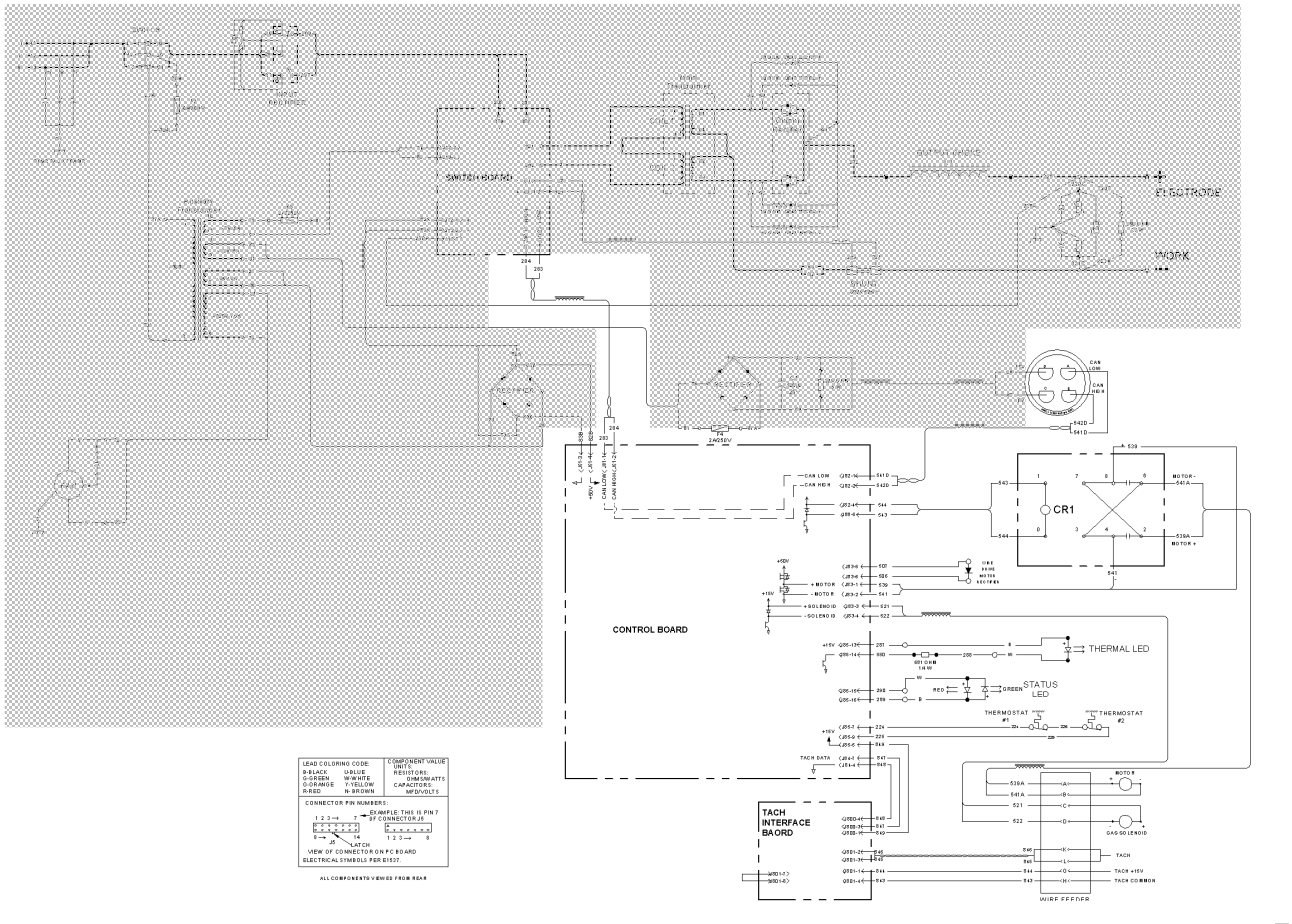
SWITCH BOARD AND MAIN TRANSFORMER

- Switch Board: The Switch Board controls the welding output based on information received from the Control PC Board.
Through the use of Insulated Gate Bipolar Transistors (IGBTs) the high voltage input current is switched ON and OFF at a frequency of 30KHz and fed to the primary of the main transformer. The current is regulated via Pulse Width Modulation (PWM). The width of each pulse is determined by a “gate” signal. (See ***IGBT Operation*** and ***Pulse Width Modulation*** in this section).
The Switch Board detects welding voltage and current feedback and uses them to regulate the welding output. At the same time, both actual arc voltage and current are sending back to the Control PC Board.

- Main Transformer: The primary function of the main transformer is to reduce the high voltage input to the proper voltage for welding. It also serves to insulate the operator from the input line.

NOTE: Unshaded areas of Wiring Diagram are the subject of discussion.

FIGURE E.3 – CONTROL BOARD, COMMUNICATIONS AND THERMOSTATS



CONTROL BOARD, COMMUNICATIONS, MOTOR DIRECTION AND THERMOSTATS

Control Board and Communications

The Control Board is the interface to the robot controller over 4-pin control cable, all welding information such as weld mode and welding parameters such as voltage and wire feeding speed entered on the robotic pendent are sent to the CV350-R over the 4 pin communication cable.
The Control Board also communicates to the Switch Board, sends weld parameter settings and thermostat status to the Switch Board, and receives actual arc voltage and current from it. These actual arc voltage and current value will be sent to robotic controller finally.
The Control Board controls the PF10R motor with a pulse width modulated signal (Similar to the main welding control). This control is closed loop meaning that motor voltage is adjusted by reading the motor speed. The motor speed is fed back to the Control Board by the Tach Interface Board.
Control Board drives the status LED.

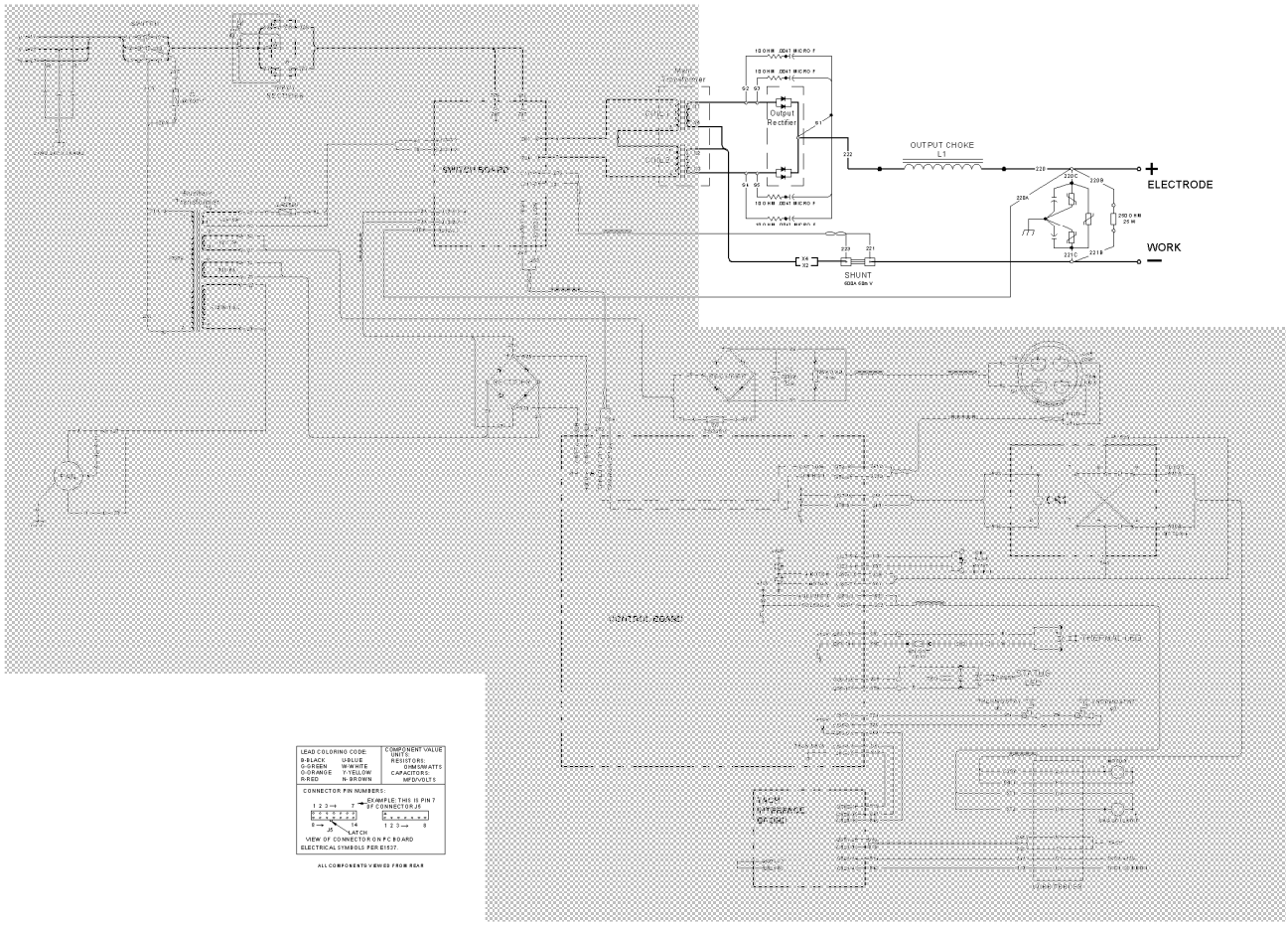
Motor Direction

The direction of the motor is controlled by the Control Board turning on and off CR1. CR1 off – Forward; CR1 on – Reverse.

Thermostats

Two normally closed (NC) thermostats protect the machine from excessive operating temperatures. These thermostats are wired in series and are connected to the control board. One of the thermostats is located on the heat sink of the Output Rectifier and the other is located inside the output choke.

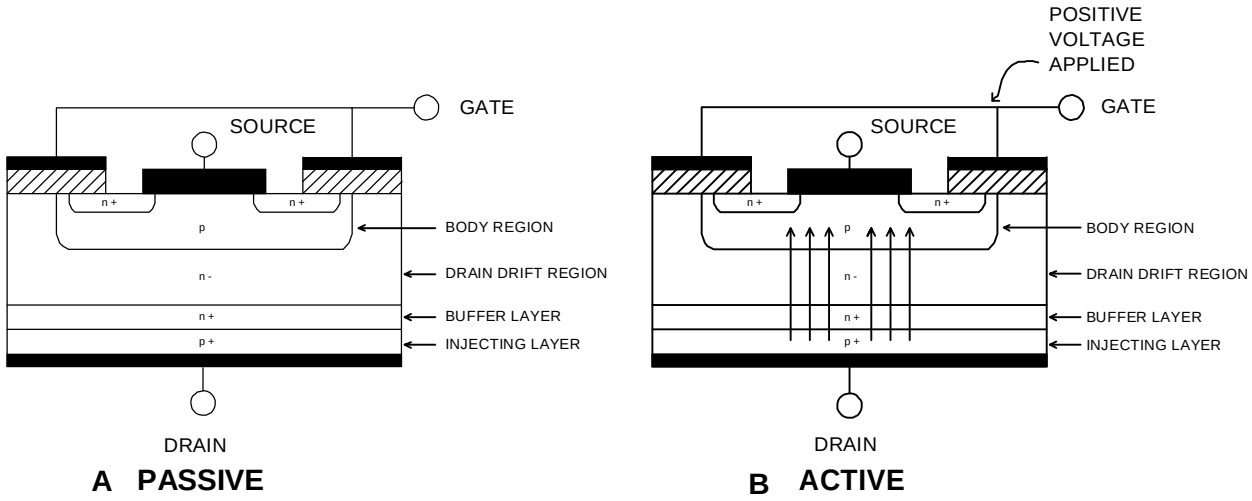
FIGURE E.4 – OUTPUT RECTIFIER AND CHOKE



OUTPUT RECTIFIER AND CHOKE

The output rectifier receives the AC output from the main transformer secondary and rectifies it to a DC voltage level. Since the output choke is in series with the positive leg of the output rectifier and also in series with the welding load, a filtered DC output is applied to the machine's output terminals.

FIGURE E.5 – IGBT OPERATION



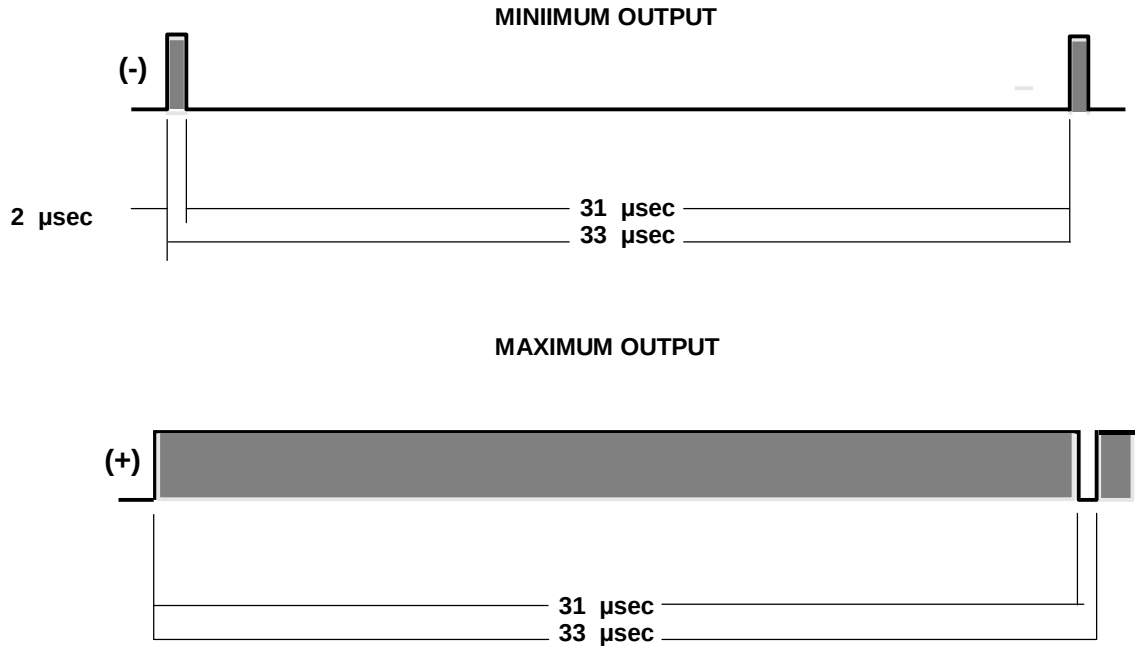
INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

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

Drawing A in Figure E-4 shows an IGBT in passive mode. There is no gate signal, zero volts relative to the source, and therefore, no current flow. The drain terminal of the IGBT may be connected to a voltage supply; but since there is no conduction, the circuit will not supply current to components connected to the source. The circuit is turned OFF like a light switch.

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

FIGURE E.6 – PULSE WIDTH MODULATION



PULSE WIDTH MODULATION

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

MINIMUM OUTPUT

By controlling the duration of the gate signal, the IGBT is turned on and off for different durations during a cycle. The top drawing shows the minimum output signal possible over a 33 microsecond time period.

The shaded portion of the signal represents the IGBT, conducting for 2 microseconds. Since only 2 microseconds of the 33 microsecond time period is devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT

By holding the gate signal on for 31 microseconds and allowing only 2 microseconds of off time during the 33 microseconds cycle, the output is maximized. The darkened area under the min. curve can be compared to the darkened area under the max. curve. The more darkened area, the more power is present.

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 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.

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

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "PROBLEM (SYMPTOMS)". This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into three main categories: Output Problems. Function Problems, and Welding 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 hese tests/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around 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.

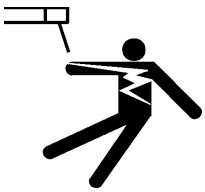
All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to test points, components, terminal strips, etc., can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

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING



ELECTRIC SHOCK can kill.

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

⚠ CAUTION

Sometimes machine failures appear to be due to PC Board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC Boards, please use the following procedure:

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

PC board can be damaged by static electricity.

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

- Remove your body's static charge before opening the static-shielding bag. Wear an antistatic 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 unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up.Be sure not to touch any electrically live parts at the same time.

-Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.

- Remove the PC Board from the static-shielding bag and place it directly into the equipment. Don't set the PC Board on or near paper, plastic or cloth which could have a static charge. If the PC Board can't be installed immediately, put it back in the static-shielding bag.

- If the PC Board uses protective shorting jumpers, don't remove them until installation is complete.

- If you return a PC Board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

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

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

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

5. Remove the replacement PC Board and substitute it with the original PC Board to recreate the original problem.
   d. 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.
   e. If the original problem is recreated by the substitution of the original board, then the PC Board was the problem. Reinstall the replacement PC Board and test the machine.
6. Always indicate that this procedure was followed when warranty reports are to be submitted.

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

Observe Safety Guidelines detailed in the beginning of this manual.

Problems (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
Output Problems		
Major physical or electrical damage is evident when the sheet metal covers are removed	None	Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.
Input fuses keep blowing, or input breaker keeps tripping	1. Make certain that fuses or breakers are properly sized. See Installation section of this manual for recommended fuse and breaker sizes. 2. Welding procedure is drawing too much output current, or duty cycle is too high. Reduce output current, duty cycle, or both. 3. There is internal damage to the power source.	If there are internal damage, contact an authorized Lincoln Electric Service Facility for technical assistance.
Machine will not power up (no lights, no fan, etc.)	1. There is no power supply, or the power supply is not proper, or at least one phase is lost. 2. 4-amp fuse on the front may have opened.	Make certain that the power to the CV350-R is energized and is within the CV350-R's operating range. The 4-amp fuse protects the Fan and controls etc. Check Auxiliary Transformer and it's loads for possible failures, see the Wiring Diagram.
Thermal LED is lit.	1. Check for proper fan operation. (Fan should run whenever ON/OFF switch is on.) Check for material blocking intake or exhaust louvers. 2. Machine may have been operated above it's duty cycle..	Clear obstruction or repair fan After machine has been cooled, reduce load, duty cycle, or both.
Machine won't weld, can't get any output.	1. Input voltage is too low or too high. 2. If an error code is also present (Error codes are displayed as a series of red and green flashes by the status light.)	Correct the input voltage level. Contact your local authorized Lincoln Electric Field Service facility for technical assistance.
Machine won't produce full output.	1. Input voltage may be too low, or one phase lost, limiting output capability of the power source. Make certain that the input voltage is proper, according to the Rating Plate. 2. Secondary current or voltage is not properly calibrated.	Correct input voltage level. Contact your local authorized Lincoln Electric Field Service facility for technical assistance.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

Problems (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
Weld and Arc Quality Problems		
Machine often “noodle” welds (output is limited to approximately 100 amps)	Secondary current limit has been exceeded, and the machine has phased back to protect itself.	Adjust procedure or reduce load to lower current draw from the machine.
General degradation of the weld performance	1. Check for feeding problems, bad connections, excessive loops in cabling, etc.. 2. Verify weld mode is correct for processes. 3. The power source may require calibration.	
Excessively long and erratic arc.	Check for proper configuration and propper electrode stick-out.	
Arc loss fault on robot	1. Possibly caused by wire feeding problem 2. Conduit leading to the wire feeder has bends or twists, which can reduce the wire feed speed	Remove bends and twists in conduit leading to the feeder Use a shorter piece of conduit.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

CASE COVER REMOVAL PROCEDURE

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

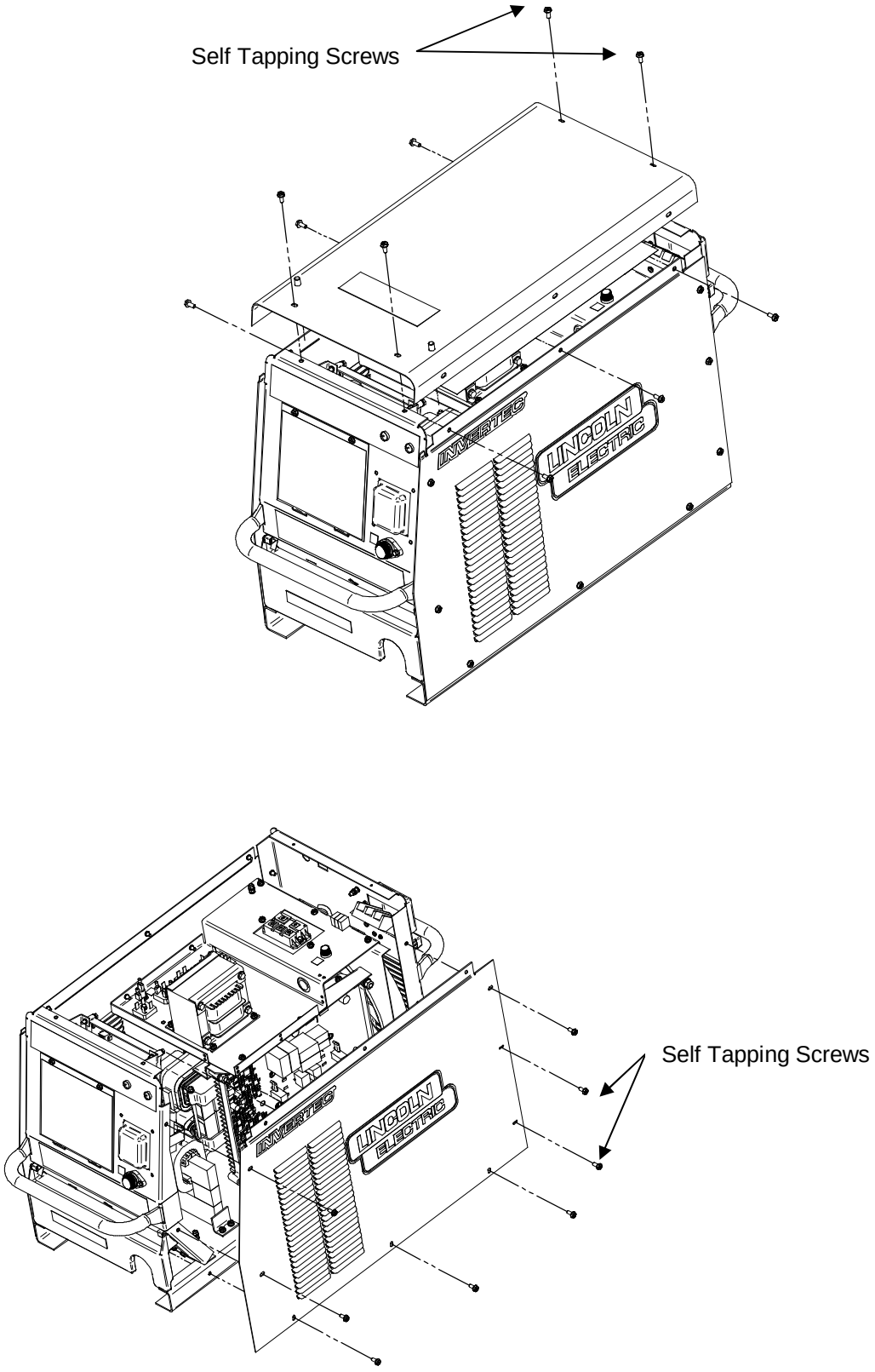
This procedure will aid the technician in the removal and replacement of the case cover(s).

MATERIALS NEEDED

M5 Philips Head Screwdriver

CASE COVER REMOVAL PROCEDURE *(CONTINUED)*

FIGURE F.1 – TOP AND RIGHT PANEL SCREW LOCATIONS



CASE COVER REMOVAL PROCEDURE *(CONTINUED)*

PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Using a Philips head screwdriver removes the four screws on top panel, and the six screws on both side, see Figure F.1.

Note: The type of two top rear side screws is self tapping.

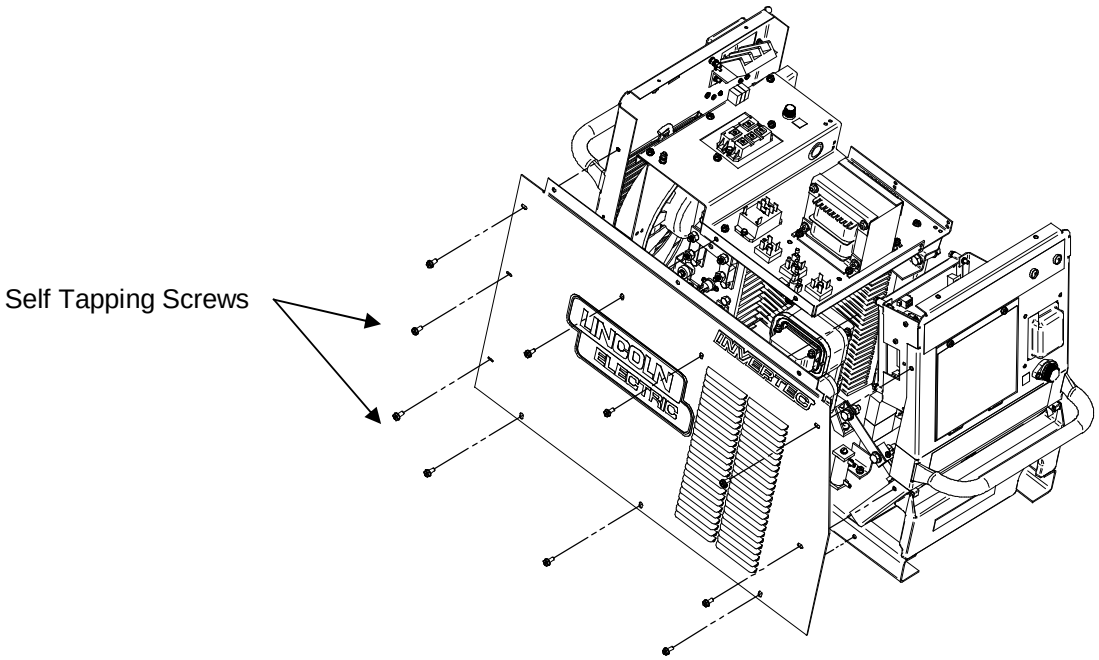
3. Then remove the eight screws on right panel, also see Figure F.1.

Note: The type of two rear down side screws is self tapping.

4. At last, remove the ten screws on left panel, see Figure F.2.

Note: The type of two rear down side screws is self tapping.

FIGURE F.2 – LEFT PANEL SCREW LOCATIONS



INPUT RECTIFIER REMOVAL PROCEDURE

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

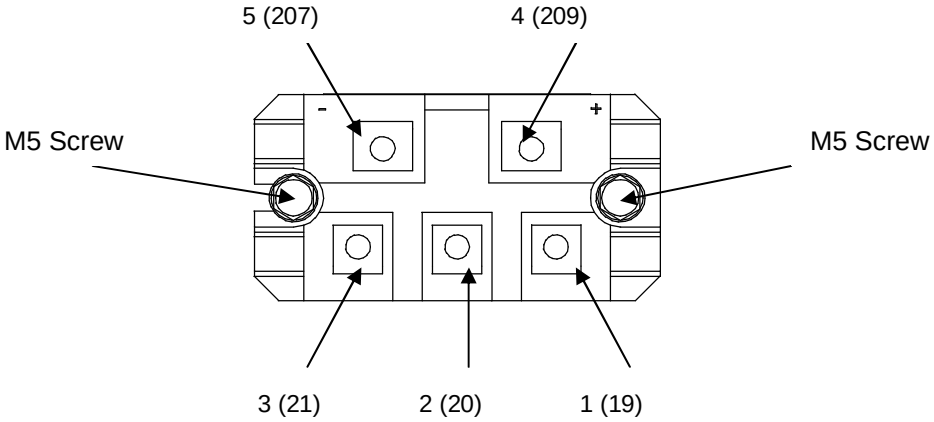
This procedure will aid the technician in the removal and replacement of the Input Rectifier.

MATERIALS NEEDED

M5 Philips Screwdriver

INPUT RECTIFIER REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.3 – INPUT RECTIFIER LEADS LOCATION



PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. Locate the Input Rectifier and input/output leads. See Figure F.3.
4. Use M5 Phillips screw driver to disconnect snubber assembly from input terminals 1, 2, 3.

NOTE: RTV is applied to snubber and terminals as environmental protection, after reconnecting the input rectifier and snubber, RTV needs to be reapplied.

5. Disconnect input power lead 19, 20 and 21 first, and then disconnect output leads 207 and 209 by using M5 Phillips screw driver. See Figure F.3.

NOTE: Don't mix up 207 and 209, otherwise will cause main switch board faulty. Re-label them if necessary.

6. Loosen two hex head screws at both sides of the module by using M5 Phillips screw driver or 8mm nut driver. See Figure F.3.

NOTE: When a new input rectifier is used as replacement, 0.88CC electrical joint compounds E2529 should be used between the rectifier and heat-sink. To tighten the rectifier onto heat-sink, 5N.M torque is needed.

⚠ WARNING

High voltage is present at primary of Auxiliary Transformer.

SWITCH BOARD REMOVAL PROCEDURE

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

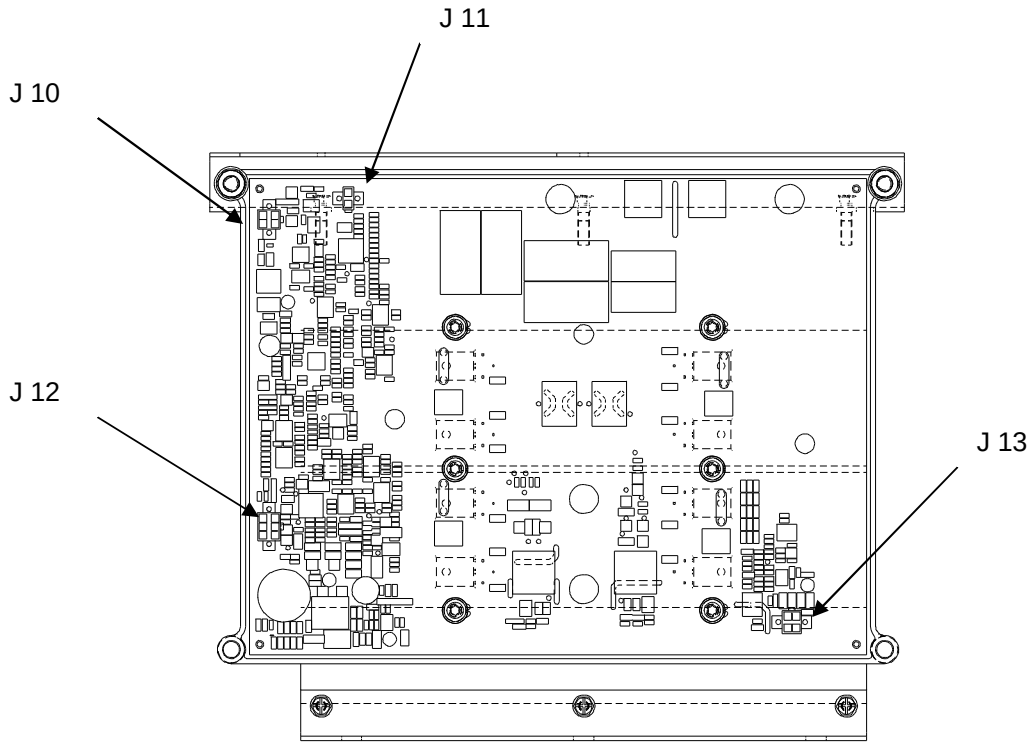
This procedure will aid the technician in the removal and replacement of the Switch Board.

MATERIALS NEEDED

M5 Philips Screwdriver

SWITCH BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.4 – SWITCH BOARD SOCKETS



PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. Pull out harness plugs from socket J12, J13, J10 and J11 one by one. See Figure F.4.

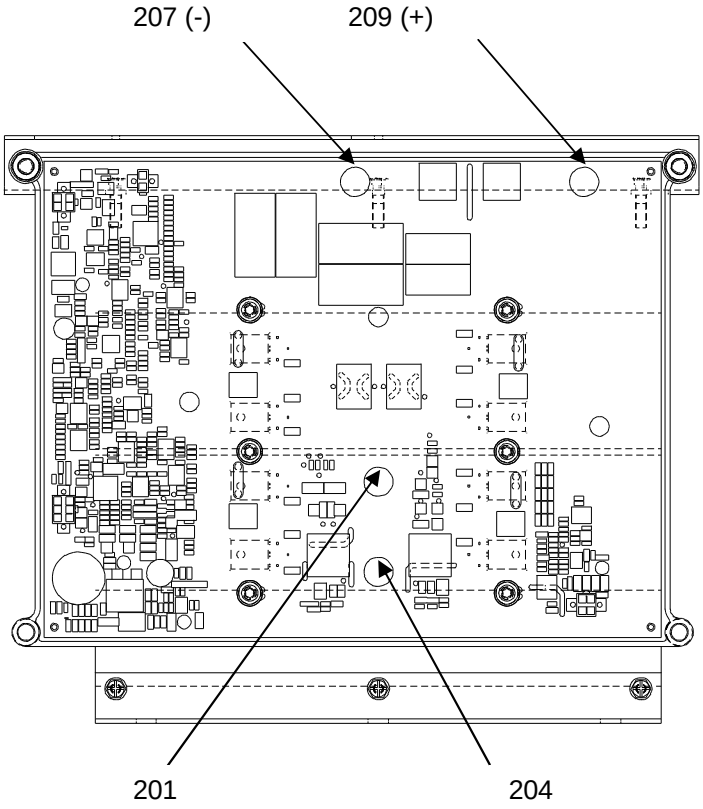
Note: Make sure leads are routed the same way when replace the Switch Board.

⚠ WARNING

High voltage is present at primary of Auxiliary Transformer.

SWITCH BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.5 – SWITCH BOARD TERMINALS



4. Using a Philips Screwdriver to disconnect cable 207 and 209 from Switch Board as shown in Figure F.5.

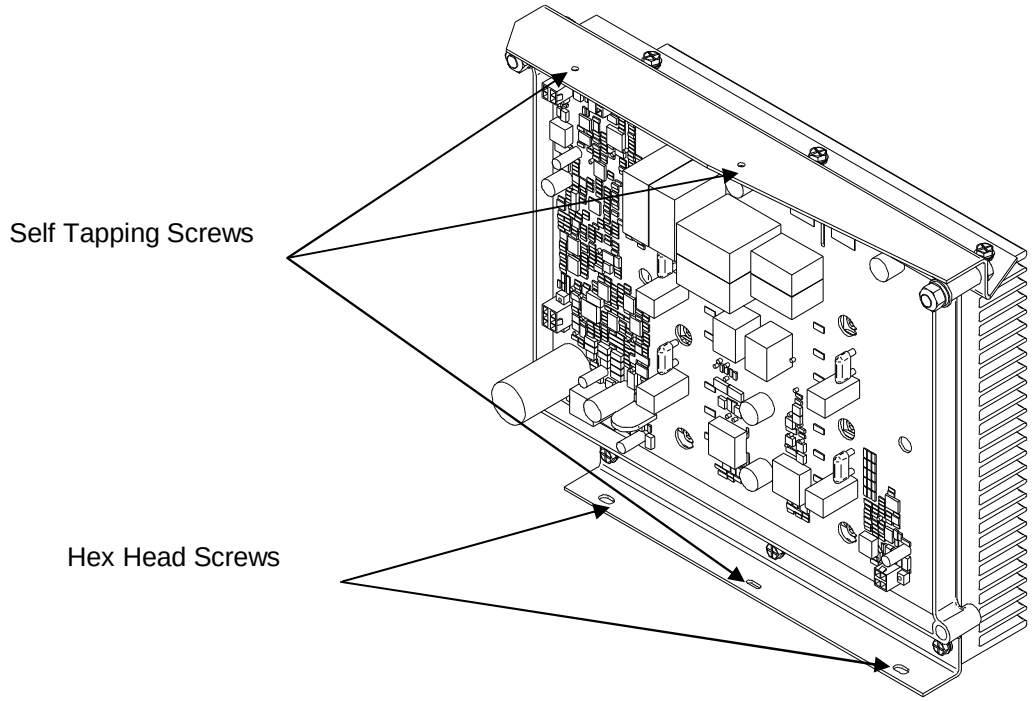
Note: Pay attention to cable label which shows the cable number, never mix them up when reconnect the board back to the machine.

5. Then disconnect cable 201 and 204 from Switch Board by using the same Philips Screwdriver, see Figure F. 5.

Note: When reconnect cable 201, 204, 207 and 209 back to Switch Board, 5.0 N/M torque is needed.

SWITCH BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.6 – SWITCH BOARD REMOVAL



6. Using a Philips Screwdriver to loosen the two screws on top of Switch Board Assembly as shown in Figure F.6.

Note: The type of these two top screws is self tapping.

7. To loosen the other three screws on bottom of Switch Board Assembly by using the same Philips Screwdriver, see Figure F. 6. The middle of these three screws is self tapping screw too. When reconnect the module back to the base, 3.6 N/M torque is needed.

8. Then the Switch Board Assembly can be taken out of the machine.

9. Whenever replace with a new Switch Board Assembly or shunt, it is necessary to perform *The Voltage and Current Calibration Procedure.*

Note: It is strong recommended that don't disconnect the Switch Board from the Heat sink in the field, it's better to deliver and replace this part as an assembly.

OUTPUT RECTIFIER REMOVAL PROCEDURE

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

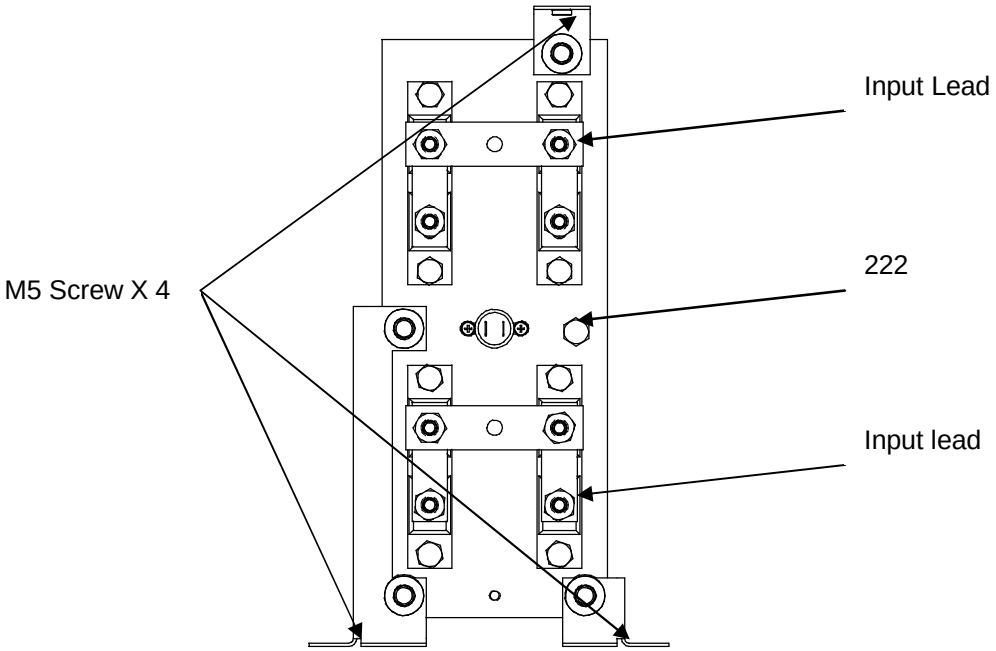
This procedure will aid the technician in the removal and replacement of the output Rectifier.

MATERIALS NEEDED

M6 Nut Driver
M5 Philips Screwdriver

OUTPUT RECTIFIER REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.7 – OUTPUT RECTIFIER LEADS LOCATION



PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. Locate the output Rectifier and input/output leads. See Figure F.7.
4. Use M6 nut driver to disconnect input power leads coming from main transformer first (5 N/M torque), and then disconnect output lead 222 (8 N/M torque). See Figure F.7.

NOTE: Don't mix up input and output leads. Re-label them if necessary.

5. Loosen four hex head screws as show in Figure F.7 by using M5 Phillips screw driver and take the module assembly out of the machine. When reconnect the module back to machine, 3.6 N/M torque is needed.

Note: It is strong recommended that don't disconnect the Diodes from the Heat sink in the field, it's better to deliver and replace this part as an assembly.

CONTROL PC BOARD REMOVAL PROCEDURE

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

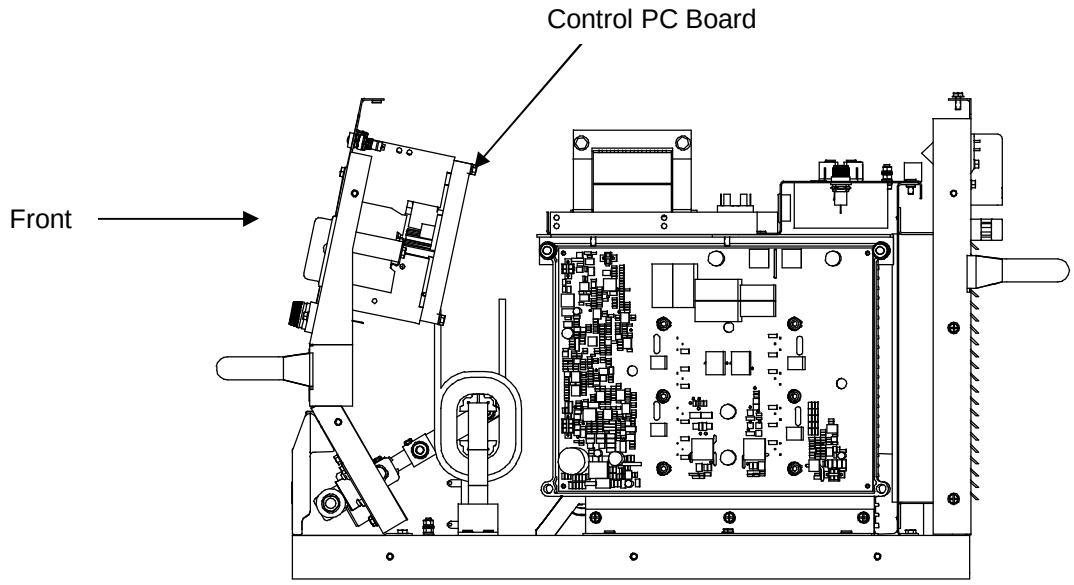
This procedure will aid the technician in the removal and replacement of the Control PC Board.

MATERIALS NEEDED

M5 Nut driver

CONTROL PC BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.8 – CONTROL PC BOARD LOCATION

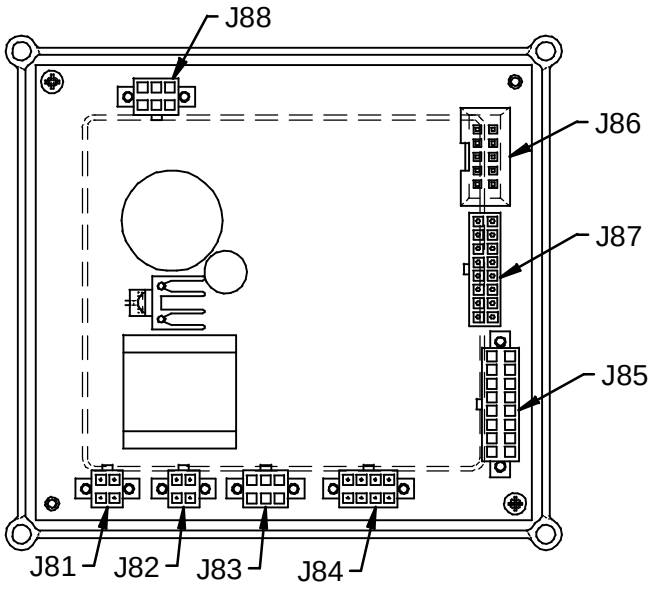


PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. The control PC board is located behind front plate, and only can be accessed from internal. See Figure F.8.

CONTROL PC BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.9 – CONTROL PC BOARD SOCKETS



4. Disconnect harness plugs from socket J81, J82, J83, J84, J85 and J88 one by one, there is nothing plug in J86 and J87 during normal operation. See Figure F. 9.

Note: Pay attention to the label of harness plugs; don't mix them up while replacing another control PC board. Make sure the leads routed the same way after replacing a new Control Board.

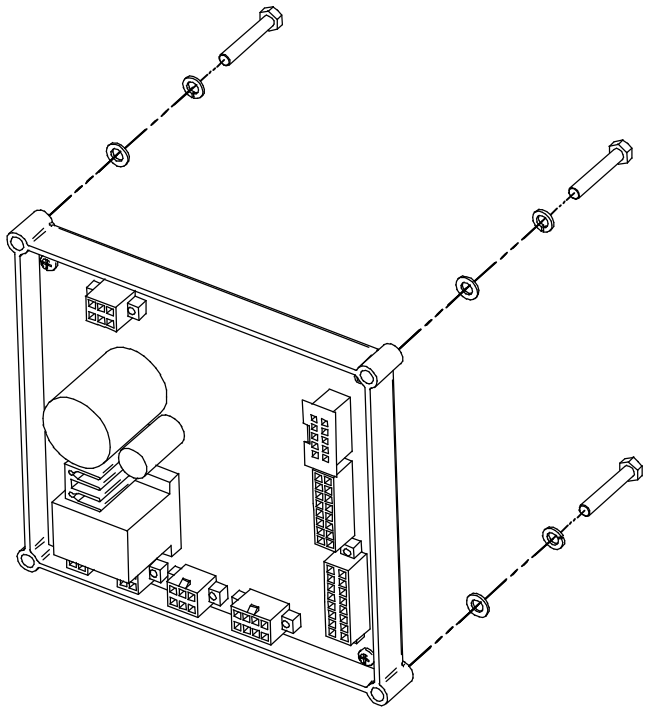
5. Using a M5 nut driver to loosen four screws from backside of the board on the cross in turns. See Figure F.10.

6. Then the control PC board can be taken out of the machine. When reconnect the board back to the machine, 3.6 N/M torque is needed.

Note: The Molex connectors have electrical grease to prevent corrosion. Do not clean it off during the procedure!

CONTROL PC BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.10 – CONTROL PC BOARD REMOVAL



TACH INTERFACE BOARD REMOVAL PROCEDURE

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

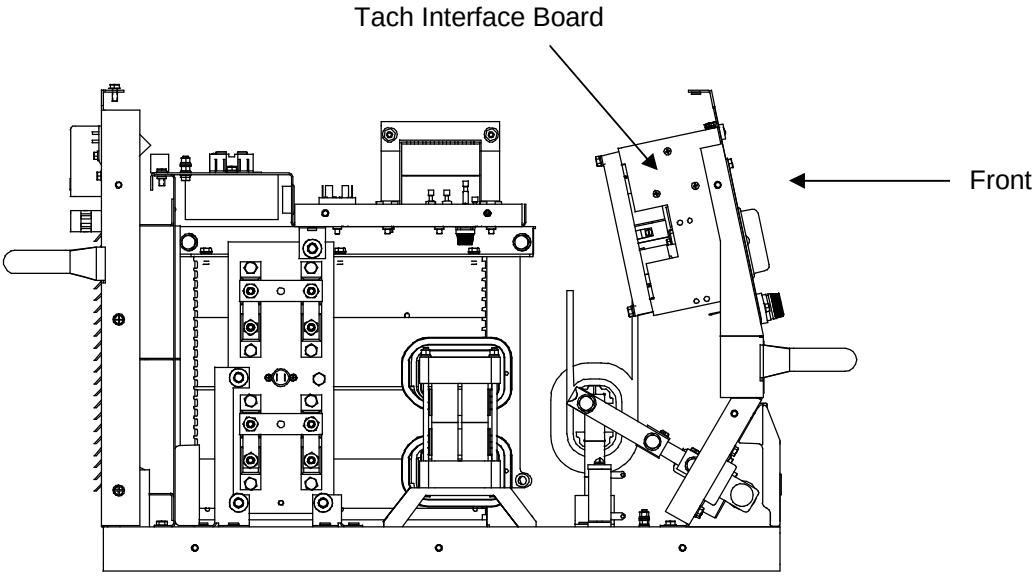
This procedure will aid the technician in the removal and replacement of the Tach Interface Board.

MATERIALS NEEDED

M5 Nut driver

TACH INTERFACE BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.11 – TACH INTERFACE BOARD LOCATION

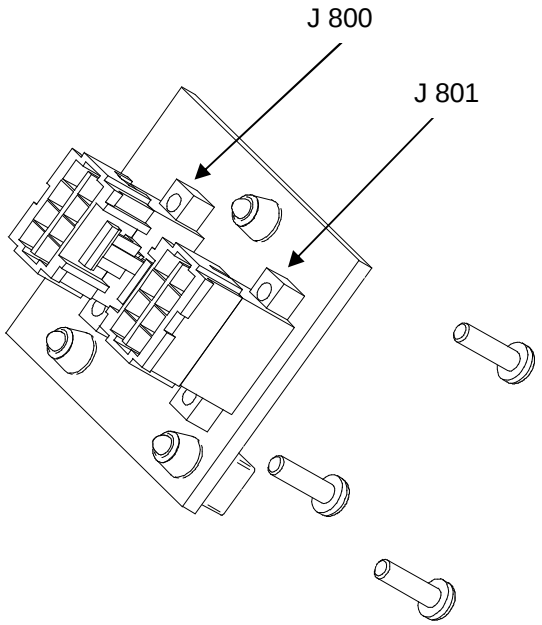


PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. The Tach Interface Board is located behind front plate, and only can be accessed from internal. See Figure F.11.

TACH INTERFACE BOARD REMOVAL PROCEDURE *(CONTINUE)*

FIGURE F.12 – TACH INTERFACE BOARD REMOVAL



4. Pull out harness plugs from socket J800 and J801. Be care for not mix them up while reconnect the plugs back to the board. See Figure F.12.

5. Using Philips screwdriver to loosen three M5 hex head screws from backside of the board. The Tach Interface Board then can be taken out of the machine. See Figure F.12.

INPUT RECTIFIER TEST

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

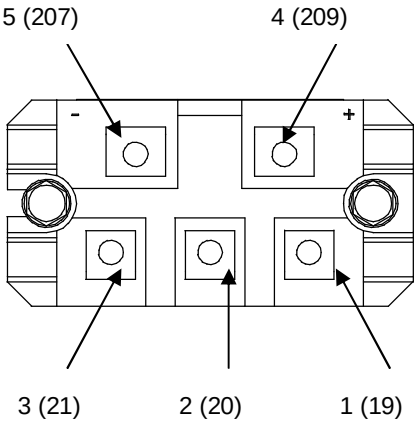
This procedure will help determine if the input rectifier has “shorted” or “open” diodes.

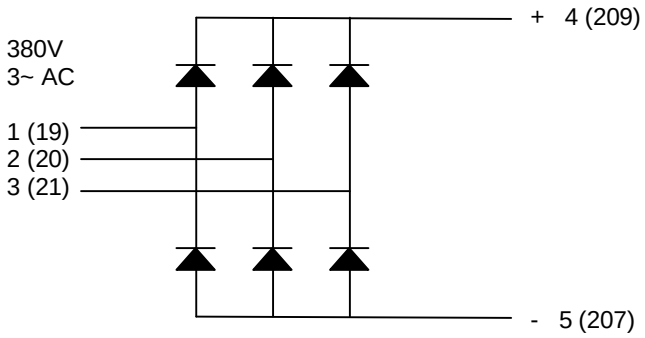
MATERIALS NEEDED

Digital Multi-meter
M5 Philips Screwdriver
Wiring Diagram

INPUT RECTIFIER TEST *(CONTINUE)*

FIGURE F.13 – TERMINAL SCHEMATIC





PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. Locate the input rectifier. See Figure F.13.
4. Carefully remove the silicone sealant from output lead terminals 5 (207), 4 (209).
5. Using a Phillips head screwdriver, remove leads 207 and 209 from the input rectifier.

INPUT RECTIFIER TEST *(CONTINUE)*

TABLE F.1 – INPUT RECTIFIER TEST POINT

TEST POINT TERMINALS		DIGITAL MULTI-METER DIODE MODE
+ PROBE	- PROBE	ACCEPTABLE READINGS
1 (19)	4 (209)	0.43 ± 0.1V
2 (20)		0.43 ± 0.1V
3 (21)		0.43 ± 0.1V
4 (209)	1 (19)	None
	2 (20)	None
	3 (21)	None
5 (207)	1 (19)	0.43 ± 0.1V
	2 (20)	0.43 ± 0.1V
	3 (21)	0.43 ± 0.1V
1 (19)	5 (207)	None
2 (20)		None
3 (21)		None

6. Use the digital multi-meter in diode check mode to perform the tests detailed in Table F.1. See the wiring diagram.

7. Visually inspect the three MOVs for damage. Replace if necessary.

8. If the input rectifier does not meet the acceptable readings outlined in Table F.1, the component may be faulty, replace. See ***Input Rectifier Removal Procedure***.

   Note: Before replacing the input rectifier, check the Input Power Switch and Main Switch Board.

MAIN SWITCH BOARD TEST

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

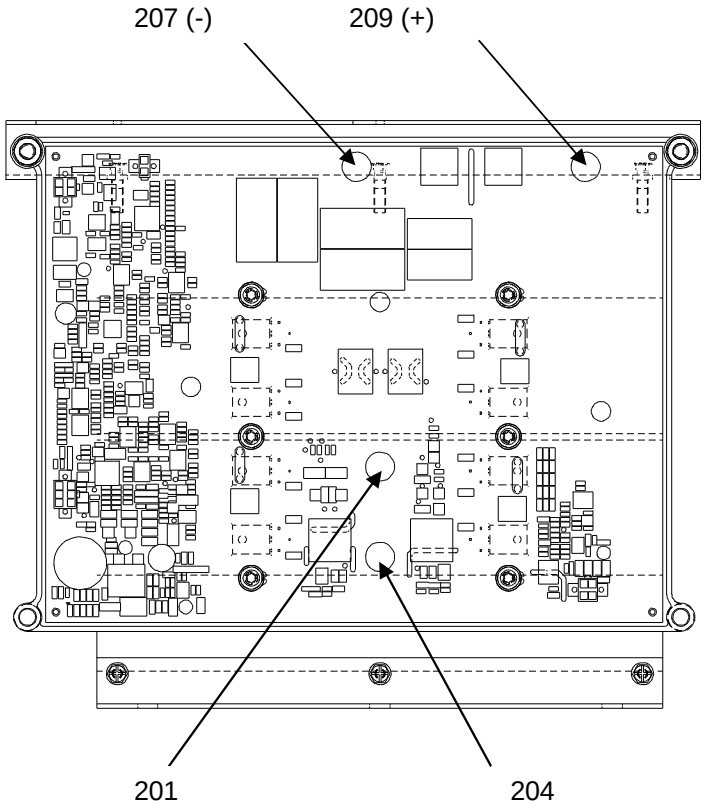
This procedure will help determine if the “power section” of the main switch board is functioning properly. This test will NOT determine if the entire PC board is functional.

MATERIALS NEEDED

Digital Multi-meter
M5 Philips Screwdriver
Wiring Diagram

MAIN SWITCH BOARD TEST *(CONTINUE)*

FIGURE F.14 – MAIN SWITCH BOARD LEAD LOCATION



PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. Locate the Main Switch Board. See Figure F.14.
4. Using a Phillips head screwdriver, remove leads 201, 204, 207, 209 from the main switch board.

MAIN SWITCH BOARD TEST *(CONTINUE)*

TABLE F.2 – MAIN SWITCH BOARD TEST POINT

TEST POINT TERMINALS		DIGITAL MULTI-METER DIODE MODE
+ PROBE	- PROBE	ACCEPTABLE READINGS
207	204	0.35 ± 0.1V
209		None
204	207	None
	209	0.35 ± 0.1V
201	207	None
	209	0.35 ± 0.1V
207	201	0.35 ± 0.1V
209		None

5. Use the digital multi-meter in diode check mode to perform the tests detailed in Table F.2. See the wiring diagram.
6. If the IGBT does not meet the acceptable readings outlined in Table F.2, the switch board may be faulty. Replace.
7. If the main switch board is faulty, replace. See ***Switch Board Removal Procedure.***

OUTPUT RECTIFIER TEST

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

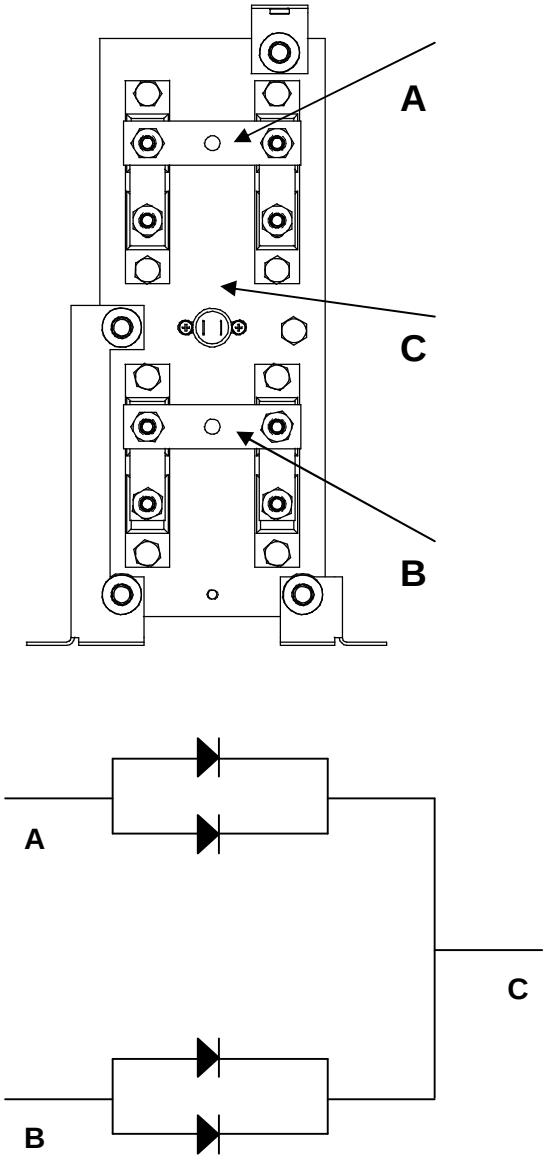
This procedure will help determine if any of the output diodes are “shorted”.

MATERIALS NEEDED

Digital Multi-meter
8mm Nut Driver
Wiring Diagram

OUTPUT RECTIFIER TEST *(CONTINUE)*

FIGURE F.15 – OUTPUT RECTIFIER LEAD LOCATION



PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. Locate the output rectifier. See Figure F.15.
4. Carefully remove all the snubbers and RTV on the module.

NOTE: RTV is applied to snubber and terminals as environmental protection, after reconnecting the output rectifier and snubber, RTV needs to be reapplied.

5. Using a nut driver, remove all input/output leads from the module.

OUTPUT RECTIFIER TEST *(CONTINUE)*

TABLE F.3 – OUTPUT RECTIFIER TEST POINT

TEST POINT TERMINALS		DIGITAL MULTI-METER DIODE MODE
+ PROBE	- PROBE	ACCEPTABLE READINGS
A	C	0.2 ± 0.1V
B		0.2 ± 0.1V
C	A	None
	B	None

6. Use the digital multi-meter in diode check mode to perform the tests detailed in Table F.3. See the wiring diagram.

7. If the output rectifier does not meet the acceptable readings outlined in Table F.3, the component may be faulty. Replace.

8. If the output rectifier is faulty, replace. See ***Output Rectifier Removal Procedure.***

   Note: Before replacing the output rectifier, check the Main Switch Board.

AUXILIARY TRANSFORMER TEST

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

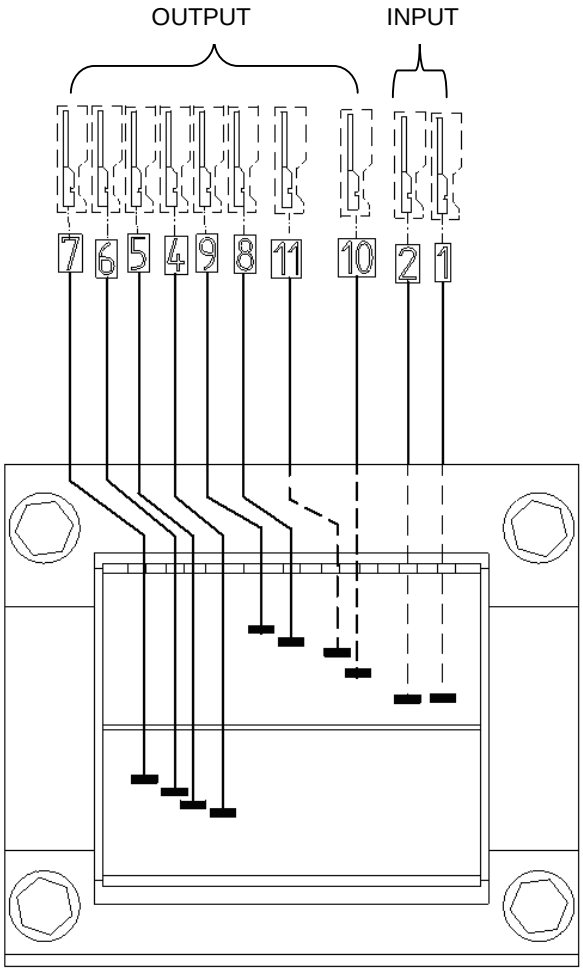
This procedure will help determine if any output coil of the auxiliary transformer is damaged.

MATERIALS NEEDED

Digital Multi-meter
8mm Nut Driver
Wiring Diagram

AUXILIARY TRANSFORMER TEST *(CONTINUE)*

FIGURE F.15 – AUXILIARY TRANSFORMER LEADSLOCATION



PROCEDURE

1. Disconnect power to the INVERTEC™ CV350-R.
2. Perform the ***Case Cover Removal Procedure.***
3. Locate the Auxiliary Transformer. See Figure F.15.
4. Locates the second leads 4, 5, 6, 7, 8, 9, 10 and 11.

⚠ WARNING

High voltage is present at primary of Auxiliary Transformer.

AUXILIARY TRANSFORMER TEST *(CONTINUE)*

TABLE F.4 – AUXILIARY TRANSFORMER TEST POINT

INPUT VOLTAGE/FREQUENCY: AC 400V ±10%, 50Hz

LEAD IDENTIFICATION	NOMAL EXPECTED OCV
4 to 5	230 ± 3 V
6 to 7	38.2 ± 1 V
8 to 9	12.6 ± 1 V
10 to 11	8.7 ± 1V

5. Carefully apply the correct input voltage to the CV350-R and check for the correct secondary voltages per table F. 4. Make sure circuit switch is functioning properly.

Note: The secondary voltages will vary if the input line voltage varies.

6. If the correct secondary voltages are present, the auxiliary transformer is functioning properly. If any of the secondary voltages are missing or low, check to make certain the primary input voltage is correctly applied. See Wiring Diagram.

7. If the correct input voltage is applied to the primary, and the secondary voltages are not correct, the auxiliary transformer may be faulty.

8. Remove the input power to the CV350-R.

VOLTAGE AND CURRENT CALIBRATION PROCEDURE

⚠ 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 or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 86-21-6673-4530.

TEST DESCRIPTION

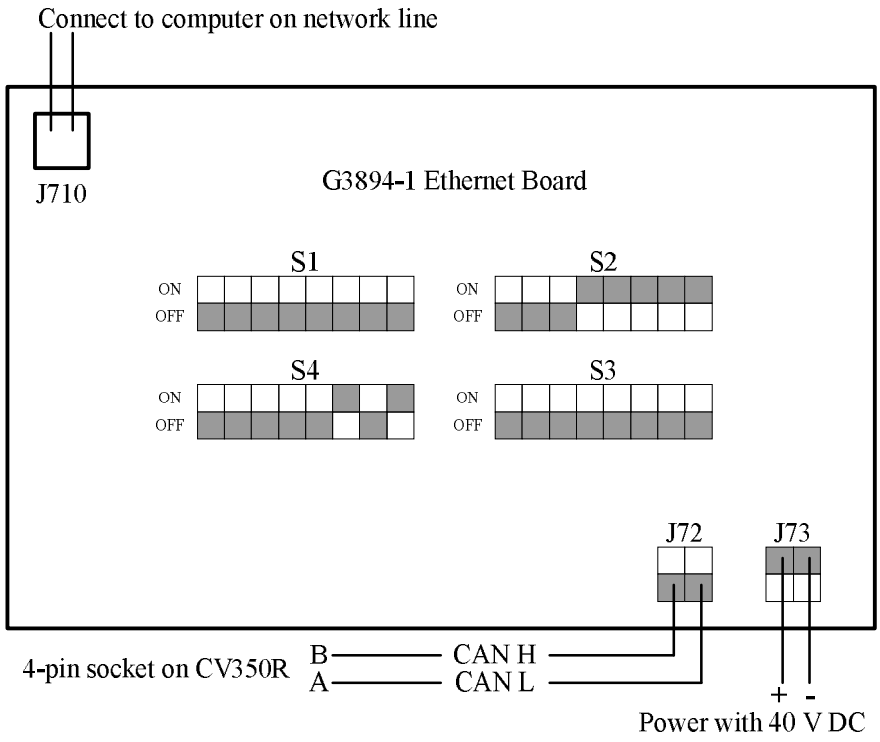
This procedure will help determine if the machine is capable of producing welding output and to check and adjust, if necessary, the voltage and or current calibration.

MATERIALS NEEDED

Resistive Load Bank
Calibration Toolkit (G3894-1 and harness)
Calibrated Test Voltmeter
Calibrated Test Ammeter
Personal Computer with test software S25216-12

VOLTAGE AND CURRENT CALIBRATION PROCEDURE *(CONTINUE)*

FIGURE F.16 – CONNECTION PATH FOR CALIBRATION

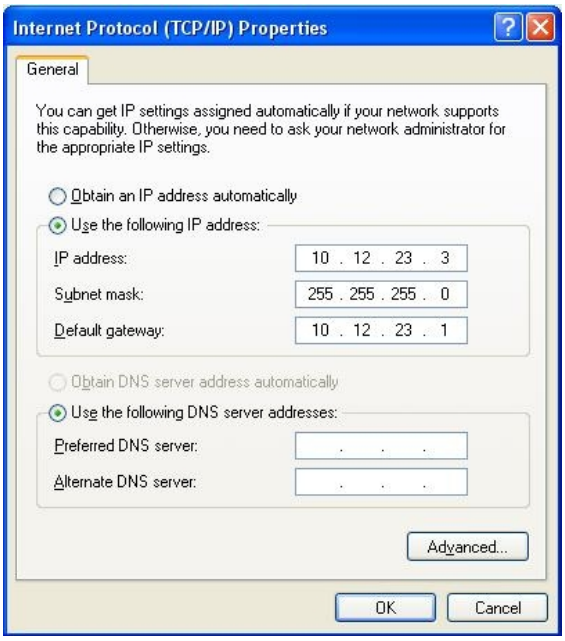


1. Connection Path

Please refer to FIGURE F. 16.

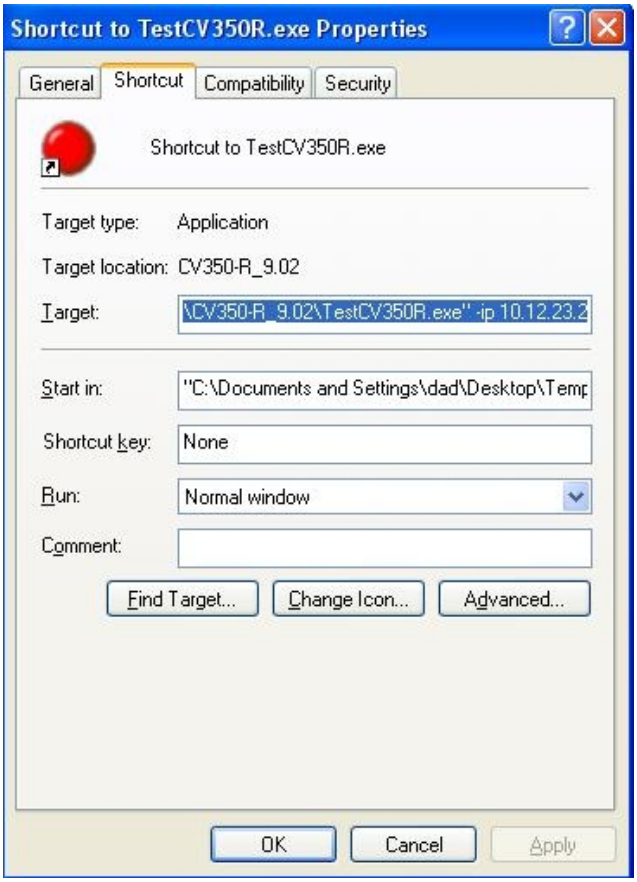
2. Setting steps:

- **Program G3894-1 Ethernet board with "S25216-12_Ethernet" software including setting up IP address such as *10.12.23.2*.**
- **Set up local IP address as following:**

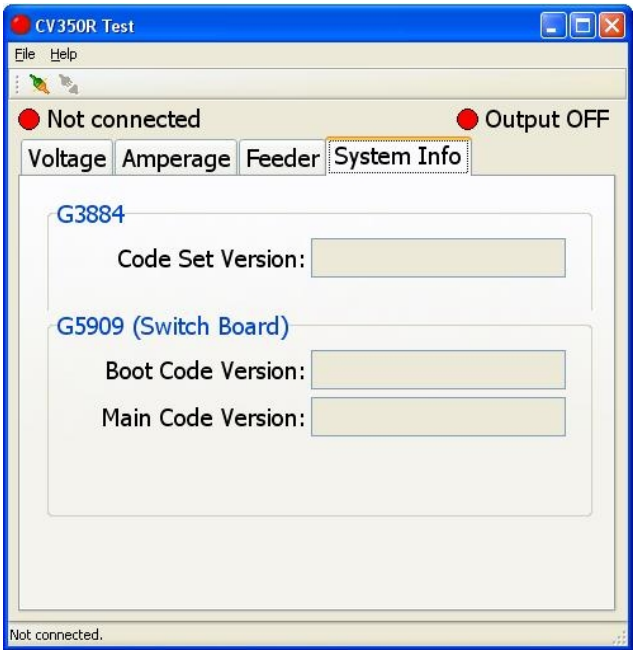


VOLTAGE AND CURRENT CALIBRATION PROCEDURE *(CONTINUE)*

- **Set up the shortcut of test software including inputting the IP address of G3894-1 Ethernet board.**



- **Run the shortcut of the test software.**



VOLTAGE AND CURRENT CALIBRATION PROCEDURE *(CONTINUE)*

3. Operation instruction

Click  to start connection;
Tap " System Info " to verify software version;
Tap " Feeder" to test feeder:
Setting up the WFS in " Cold Inch Speed ", and tap "Inch Forward " or " Inch Back " to watch the feeder run;
Tap " Gas Purge " to listen the voice of gas solenoid in the feeder for testing gas solenoid work.

Tap "Amperage " and get into CC work mode;
Tap " Voltage " and get into CV work mode.

4. Calibration process

1. Turn power on, then run the CV350R test program. Make sure that the machine connection is made.
2. Click on the System Info tab.
3. The information shown for G3884 code set, G5909 boot code version, and G5909 main code version should be used to verify that the correct code has been programmed into the machine.
4. Click on the *Amperage* tab.
5. Change the *Amperage Setpoint* to 100.
6. Press the *Output On* button and adjust the grid load to 19 +/- 1V.
7. Press the Calibration *Start* button.
8. Adjust the *Amperage AD Low* value until the *Actual Amperage* screen display equals the amperage on the external meter +/-1A.
9. Turn output off, then change the *Amperage Setpoint* to 300A. Turn output on and adjust the grid load to a load point of 29V +/-2V.
10. Adjust the *Amperage AD High* value until the *Actual Amperage* screen display equals the amperage on the external meter +/-1A.
11. Press the *Output Off* button.
12. Press the Calibration *Finish* button
13. Change the *Amperage Setpoint* to 150 amps.
14. Press the *Output On* button.
15. Adjust the grid load to a load point of 21.5V +/- 1V.
16. Click on the Calibration *Start DAC* button.
17. The test will be automated and step through several load points as it completes the DAC calibration. Output will turn on and off into a grid load during this test.
18. Click on the *Voltage* tab.
19. Adjust the *Voltage Setpoint* to 15V.
20. Press the Calibration *Start* button.
21. Press the *Output On* button and adjust the grid load to 100 +/-1A.
22. Adjust the *Voltage AD Low* value until the *Actual Voltage* display on the screen equals the external meter +/- 0.1V.
23. Change the *Voltage Setpoint* to 29V and adjust the grid load to 300 +/-5A.
24. Adjust the *Voltage AD High* value until the *Actual Voltage* display on the screen equals the external meter +/- 0.1V.
25. Press the *Output Off* button.
26. Press the Calibration *Finish* button.
27. Cycle power to the machine and verify that the test utility remembers the calibration values that have just been stored. *(Amperage DAC High, Amperage DAC Low, Amperage AD Low, Amperage AD High, Voltage AD Low, Voltage AD High)*

RETEST AFTER REPAIR

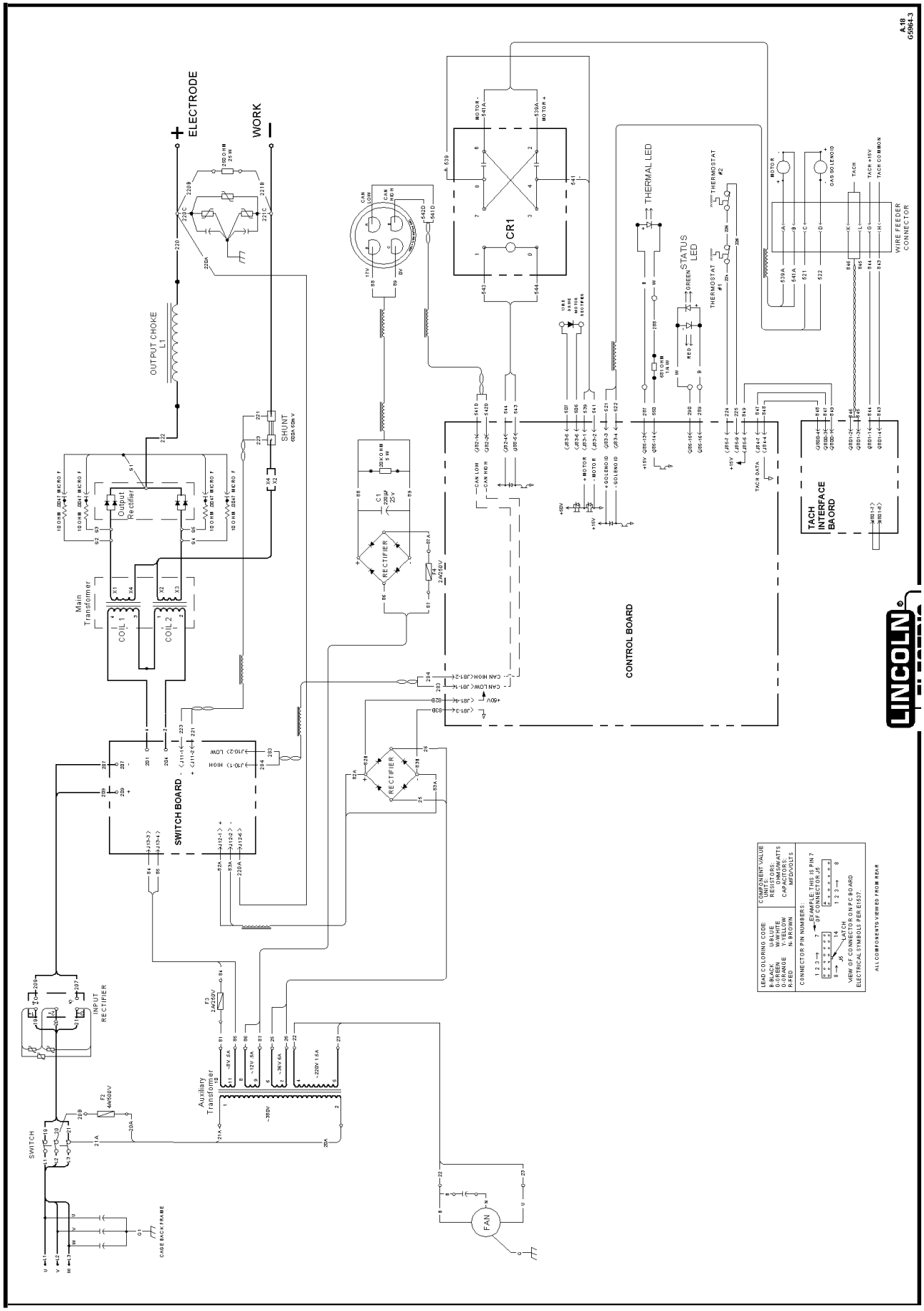
Should a machine under test be rejected for any reason requiring the removal of any mechanical part that could affect the machine's electrical characteristics, or if any electrical components are repaired or replaced, the machine must be retested.

INPUT – THREE PHASE ONLY		
	Standard Voltage/Phase/Frequency	Input Power at Rated Output
INVERTEC™ CV350-R	380V ~ 415V(±10%)/3/50 or 60 Hz	14kVA @ 60% Duty Cycle

RATED OUTPUT – DC ONLY			
	Duty Cycle	Amperes	Volts at Rated Amperes
INVERTEC™ CV350-R	60% 100%	350A 270A	31.5V 27.5V

OUTPUT			
	Welding Current Range	Open Circuit Voltage	Welding Voltage Range
INVERTEC™ CV350-R	60A ~ 350A	67V	17 V ~ 31.5V

WIRING DIAGRAM FOR INVERTEC™ CV350-R CODE 76035



NOTE: This diagram is for reference only. It may not be accurate for all machines coved by this manual. The specific diagram for a particular code is pasted inside the machine on one of the enclosure panels. If the diagram is illegible, contact the Lincoln Electric Service Department for a replacement.

FIGURE H.1 - MAIN PARTS LIST

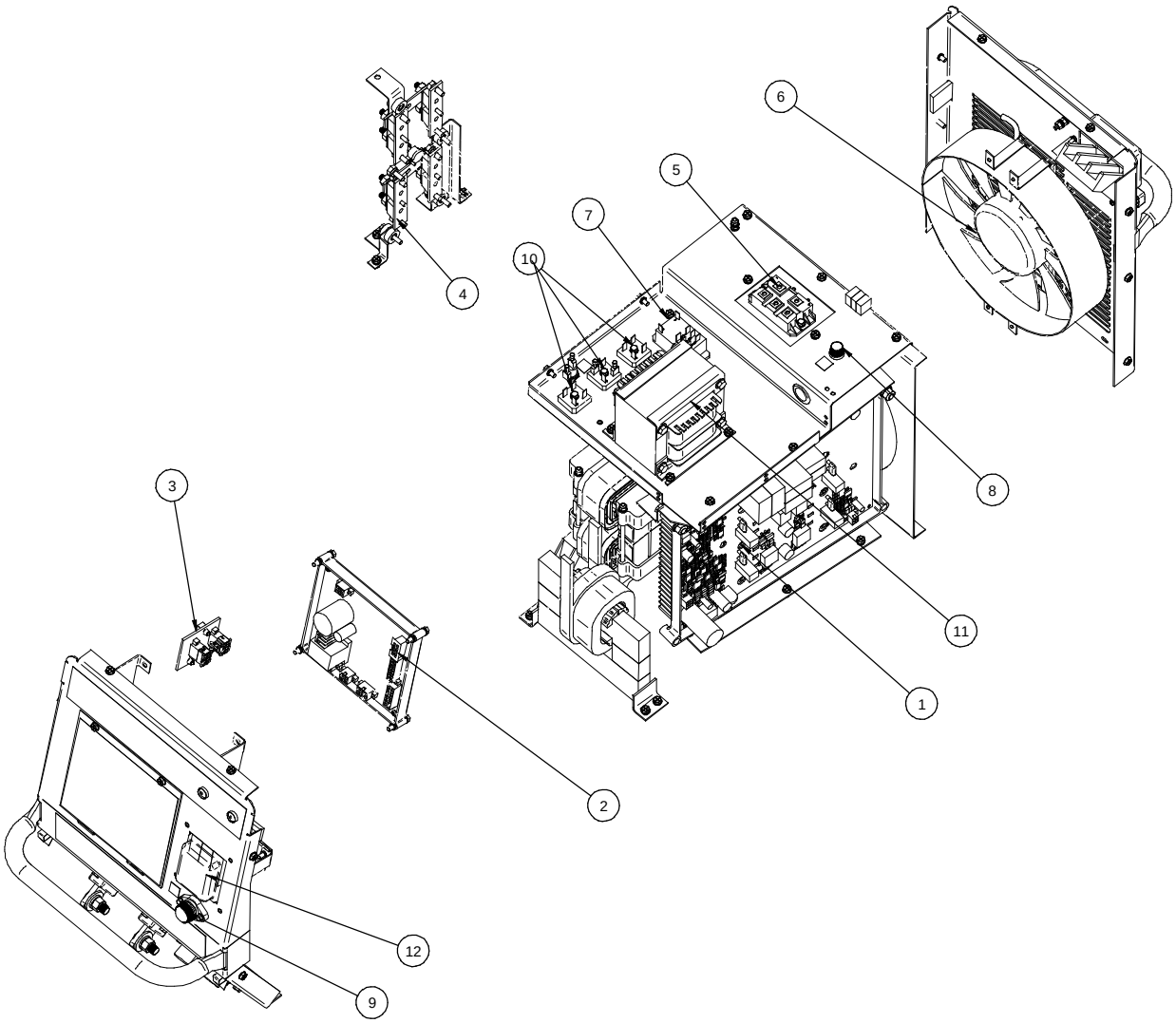


TABLE H.1 – MAIN SPARE PARTS LIST

Item	Description	Part Number	QTY Used per Production Unit
1A	Switch PC Board	S27344-1	1
1B	PZ Drive Screw	S25930-8	4
1C	Lock Washer	S26339-11	4
2A	Control PC Board	S27357-04	1
2B	Hex Head Screw (M5)	S26641-6	4
2C	Plain Washer (M5)	S26638-3	4
2D	Lock Washer (M5)	S26639-3	4
3	Tach Interface Board	L13853-1	1
4A	Output Diode	S25520-3	4
4B	Hex Head Bolt (M6)	S26641-14	8
4C	Hex Nut (M6)	S26640-8	8
4D	Lock Washer (M6)	S26639-11	16
5A	Input Rectifier	M15454-14	1
5B	Plain Washer (M5)	S26638-3	2
5C	Lock Washer (M5)	S26639-3	2
5D	Hex Head Screw (M5)	S26641-4	2
6A	Fan	M20737-1	1
6B	Bolt (M4)	S26641-18	6
6C	Plain Washer (M4)	S26638-2	4
6D	Lock Washer (M4)	S26639-2	5
7	Relay	S15122-14	1
8	Fuse (2A)	T10728-48	1
9	Fuse (4A, 500V)	T10728-61	1
10A	Rectifier	T13637-6	1
10B	Hex Head Screw (M5)	S26641-5	1
10C	Plain Washer (M5)	S26638-3	1
10D	Lock Washer (M5)	S26639-3	1
11A	Auxiliary Transformer	M21437-3	1
11B	Hex Head Screw (M5)	S26641-4	4
11C	Plain Washer (M5)	S26638-3	4
11D	Lock Washer (M5)	S26639-3	4
12A	Line Switch	S27016	1
12B	Din Rail	S27200	1
12C	Hex Head Screw (M5)	S26641-4	2

Note: When replacing components on heat sinks, thermal compound E2529 (for Input and output rectifier) or E1868 (for main switch board) needs to be applied to the parts before installing.

Note

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