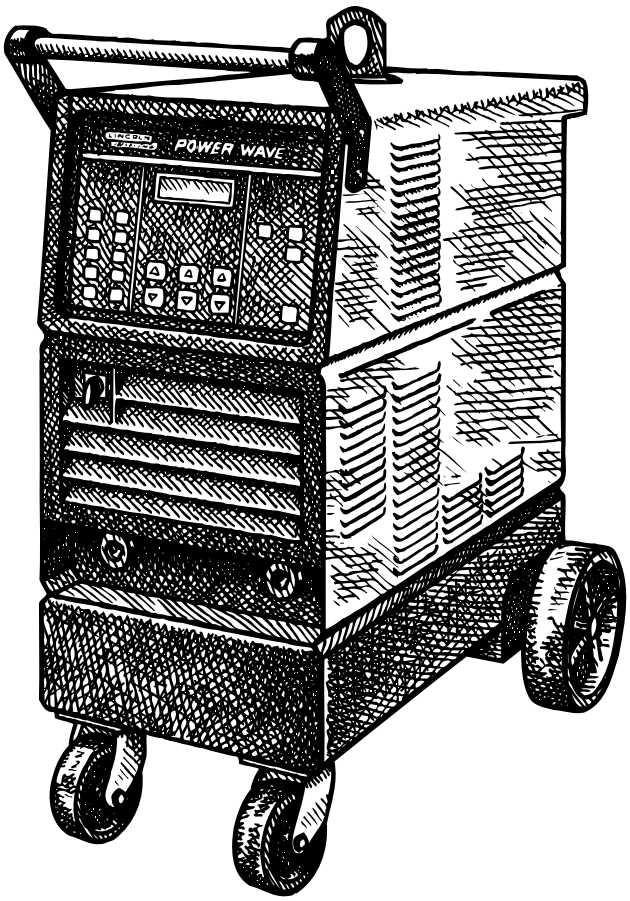
SVM109-B

October, 2012

POWER WAVE® 350/500

For use with machines having Code Numbers: **10104, 10107, 10154, 10155, 10305, 10307**

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



Safety Depends on You

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

SERVICE MANUAL

LINCOLN ELECTRIC

• World's Leader in Welding and Cutting Products • • Sales and Service through Subsidiaries and Distributors Worldwide •
Cleveland, Ohio 44117-1199 USA TEL: 1.216.481.8100 FAX: 1.216.486.1751 WEB SITE: lincolnelectric.com
For Service in the USA and Canada: Call 1.888.935.3877 For Service outside the USA: Email globalservice@lincolnelectric.com

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⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

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

The Above For Diesel Engines

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

The Above For Gasoline Engines

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.

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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.

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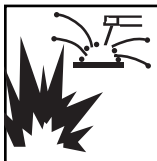

WELDING and CUTTING SPARKS can cause fire or explosion.

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 adjcent 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.

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 prévenir tout risque d'incendie dû aux étincelles.

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.

Electromagnetic Compatibility (EMC)

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

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

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

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

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

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

b) radio and television transmitters and receivers;

c) computer and other control equipment;

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

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

f) equipment used for calibration or measurement

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

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

Electromagnetic Compatibility (EMC)

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

Methods of Reducing Emissions

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

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

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

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

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

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

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

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MASTER TABLE OF CONTENTS FOR ALL SECTIONS

Section A-1

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Installation

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INSTALLATION

TECHNICAL SPECIFICATIONS - POWER WAVE® 350

INPUT - THREE PHASE ONLY			
Input Voltages:	**220**	**400**	**440**
Input Currents @ 350A/33 VDC @ 300A/31VDC	 48 38	 25 20	 23 19

RATED OUTPUT		
Duty Cycle	**Amps**	**Volts at Rated Amperes**
60% Duty Cycle	350	33 VDC
100% Duty Cycle	300	31 VDC

OUTPUT		
Constant Open Circuit Voltage	**Continuous Current Range**	**Process Current Ranges**
75 Volts	5-400 Amps	MIG/MAG 50-400 Amps FCAW 40-400 Amps MMA (STICK) 30-350 Amps

Pulse Current Range	**Pulse Voltage Range**	**Pulse and Background Time Range**	**Pulse Frequency**
5-600 Amps	5-55 Volts	100 Microsec - 3.3 Sec	0.15 - 1000 Hz

RECOMMENDED INPUT WIRE AND FUSE SIZES					
Input Voltage/ Frequency	**Duty Cycle**	**Input Ampere Rating on Nameplate**	**Copper Wire in Conduit AWG[IEC] Sizes (MM^2)**	**Type 75°C Ground Wire in Conduit AWG[IEC] Sizes (MM^2)**	**Type 75°C (Super Lag) or Breaker Size (Amps)**
220/50-60	60%	48	8 (10)	8 (10)	50
400/50-60	60%	25	12 (4)	12 (4)	30
440/50-60	60%	23	12 (4)	12 (4)	25
220/50-60	100%	38	8 (10)	8 (10)	50
400/50-60	100%	20	12 (4)	12 (4)	30
440/50-60	100%	19	12 (4)	12 (4)	30

PHYSICAL DIMENSIONS			
Height	**Width**	**Depth**	**Weight**
905 mm 35.6 in.	515 mm 20.3 in.	1010 mm 39.8 in.	137.9 kg 303.5 lbs.

OPERATING TEMPERATURE RANGE	STORAGE TEMPERATURE RANGE
0° to 40°C	-50° to 85°C

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TECHNICAL SPECIFICATIONS - POWER WAVE® 500

INPUT - THREE PHASE ONLY

Input Voltages:	220	400	440
Input Currents @ 500A/40 VDC @ 400A/36VDC	 76 57	 44 31	 38 28

RATED OUTPUT

Duty Cycle	Amps	Volts at Rated Amperes
60% Duty Cycle	500	40 VDC
100% Duty Cycle	400	36 VDC

OUTPUT

Constant Open Circuit Voltage	Continuous Current Range	Process Current Ranges
75 Volts	5-550 Amps	MIG/MAG 50-540 Amps FCAW 40-540 Amps MMA (STICK) 30-500 Amps

Pulse Current Range	Pulse Voltage Range	Pulse and Background Time Range	Pulse Frequency
5-750 Amps	5-55 Volts	100 Microsec - 3.3 Sec	0.15 - 1000 Hz

RECOMMENDED INPUT WIRE AND FUSE SIZES

Input Voltage/ Frequency	Duty Cycle	Input Ampere Rating on Nameplate	Copper Wire in Conduit AWG[IEC] Sizes (MM^2)	Type 75°C Ground Wire in Conduit AWG[IEC] Sizes (MM^2)	Type 75°C (Super Lag) or Breaker Size (Amps)
220/50-60	60%	76	4 (25)	8 (10)	80
400/50-60	60%	44	8 (10)	8 (10)	45
440/50-60	60%	38	10 (6)	10 (6)	40
220/50-60	100%	57	6 (16)	8 (10)	80
400/50-60	100%	31	8 (10)	8 (10)	45
440/50-60	100%	28	19 (6)	10 (6)	40

PHYSICAL DIMENSIONS

Height	Width	Depth	Weight
905 mm 35.6 in.	515 mm 20.3 in.	1010 mm 39.8 in.	137.9 kg 303.5 lbs.

OPERATING TEMPERATURE RANGE	STORAGE TEMPERATURE RANGE
0° to 40°C	-50° to 85°C

Read this entire installation section before you start installation.

SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.

- Only qualified personnel should perform this installation.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.
- Always connect the POWER WAVE® grounding terminal (located inside the reconnect input access doors).

SELECT SUITABLE LOCATION

Place the welder where clean cooling air can circulate in through the rear louvers and out through the side and front louvers. Dirt, dust, or any foreign material that can be drawn into the welder should be kept at a minimum. Using filters on the air intake to prevent dirt from building up restricts air flow. Do not use such filters. Failure to observe these precautions can result in excessive operating temperatures and nuisance shutdowns.

The POWER WAVE® may be used outdoors. POWER WAVE® power sources carry an IP23 enclosure rating. They are rated for use in damp, dirty environments subject to occasional falling water such as rain. However, the best practice is to keep the machine in a dry, sheltered area, since a wet environment speeds corrosion of parts. Do not place the machine in puddles or otherwise submerge parts of the machine in water. This may cause improper operation and is a possible safety hazard.

STACKING

POWER WAVE® machines cannot be stacked.

TILTING

Each machine must be placed on a secure, level surface. The machine may topple over if this procedure is not followed.

LIFTING

Lift the machine by the lift bail only. Do not attempt to lift the machine by the push handle.

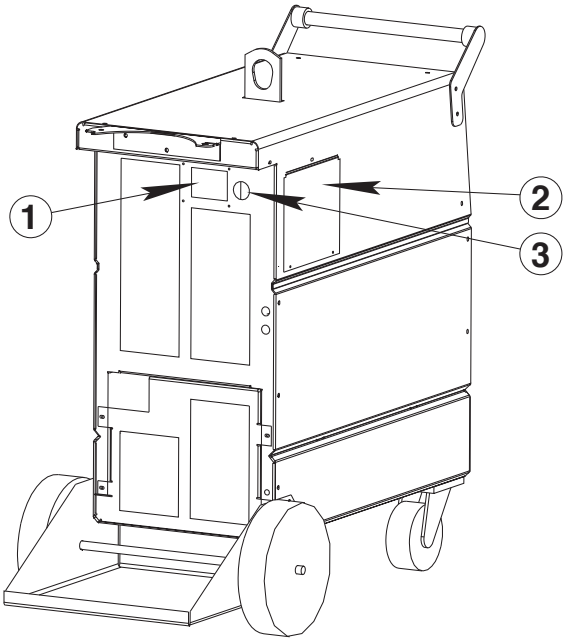
HIGH FREQUENCY PRECAUTIONS

If possible, locate the POWER WAVE® away from radio controlled machinery. The normal operation of the POWER WAVE® may adversely affect the operation of RF controlled equipment, which may result in bodily injury or damage to the equipment.

INPUT CONNECTIONS

Be sure the voltage, phase, and frequency of the input power is as specified on the rating plate, located on the rear of the machine. See Figure A.1 for the location of the rating plate.

FIGURE A.1 - RATING PLATE LOCATION



1. RATING PLATE
2. RECONNECT/INPUT ACCESS DOOR
3. INPUT CORD ACCESS HOLE

⚠ WARNING

Only a qualified electrician should connect the input leads to the POWER WAVE®. Connections should be made in accordance with all local and national electrical codes and the connection diagram located on the inside of the reconnect/input access door of the machine. Failure to do so may result in bodily injury or death.

Use a three-phase supply line. The POWER WAVE® has a 35 mm access hole for the input cord, but the input cord is not supplied.

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⚠ CAUTION

Failure to follow these instructions can cause immediate failure of components within the welder.

GROUND CONNECTIONS

The frame of the welder must be grounded. A ground terminal marked with the symbol is located inside the reconnect/input access door for this purpose. See your local and national electrical codes for proper grounding methods. See Figure A.2 for the location of the reconnect/input access door and related connection diagram.

INPUT POWER CONNECTIONS

Connect L1, L2, L3 according to the Input Supply Connection Diagram decal located on the reconnect/-input access door. See Figure A.2.

INPUT FUSE AND SUPPLY WIRE CONSIDERATIONS

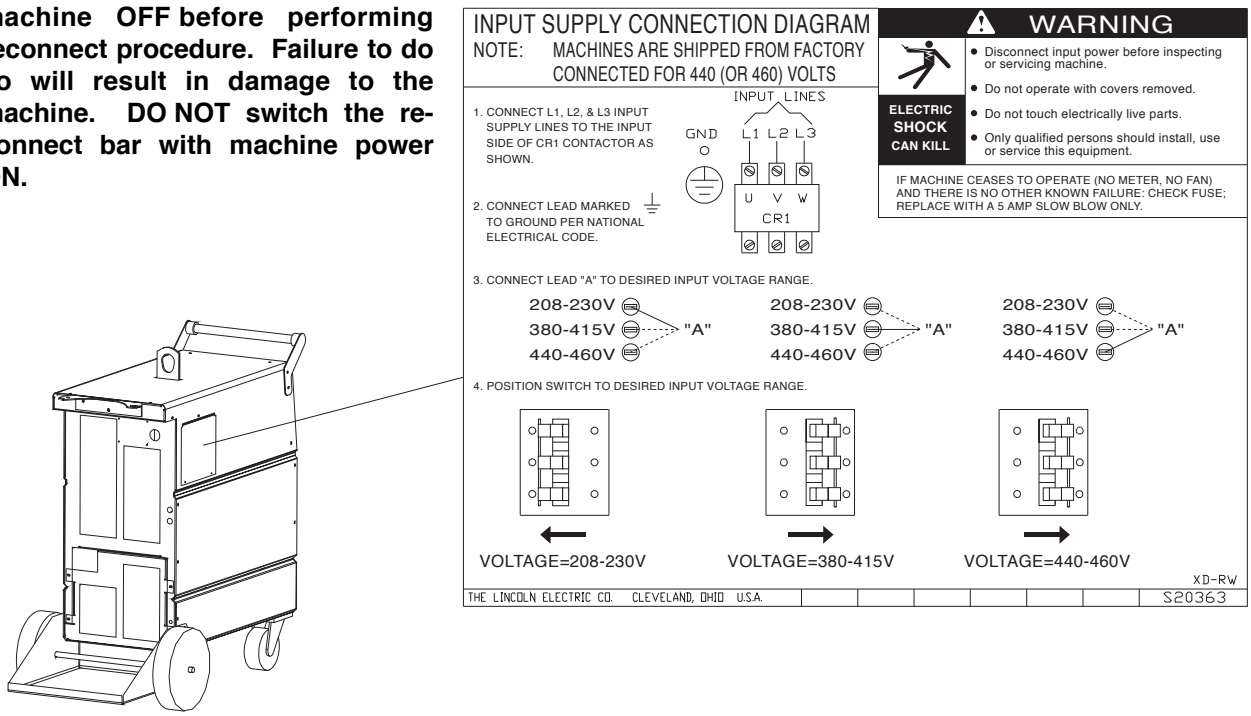
Refer to the ***Technical Specifications*** at the beginning of this Installation section for recommended fuse and wire sizes. Fuse the input circuit with the recommended super lag fuses or delay type* circuit breakers. Choose an input and grounding wire size according to local or national electrical codes. 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.

INPUT VOLTAGE RECONNECT PROCEDURE

Welders are shipped connected for the highest input voltage listed on the rating plate. To change this connection for a different input voltage, refer to reconnect instructions in Figure A.2 and proceed according to the steps that follow for the appropriate voltage.

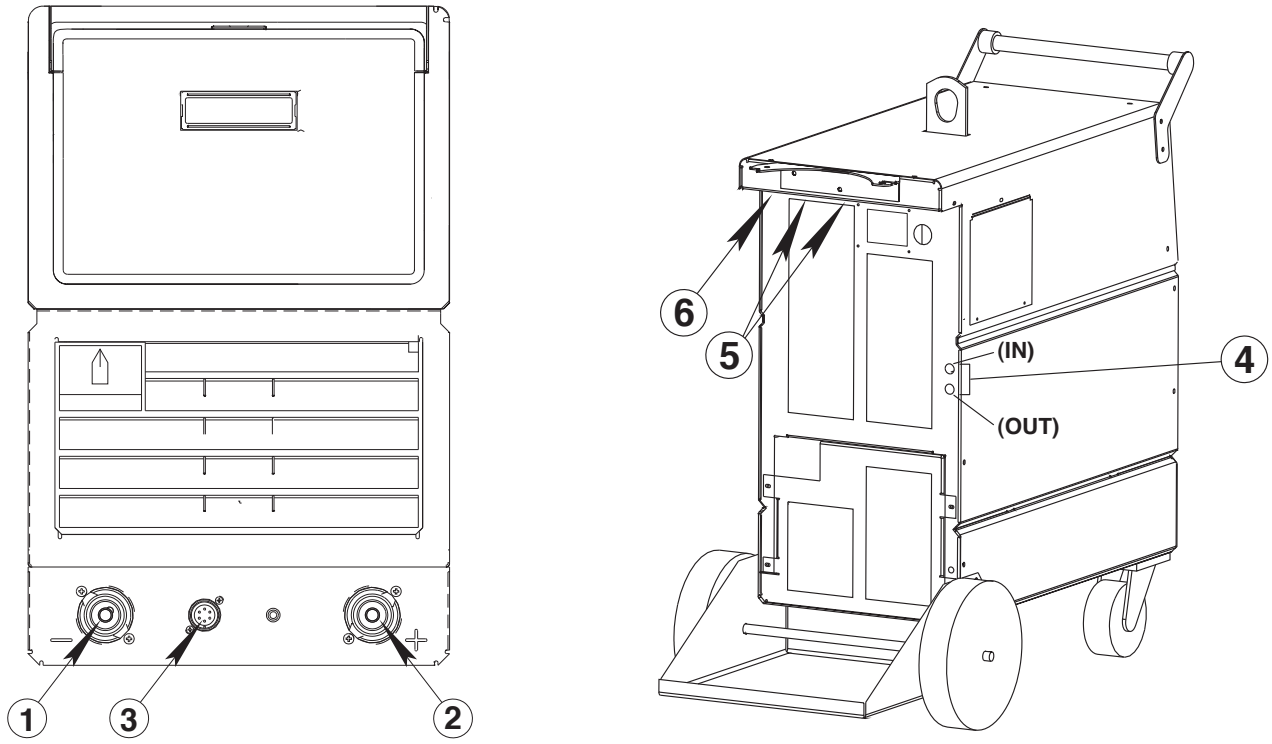
FIGURE A.2 - CONNECTION DIAGRAM ON RECONNECT/INPUT ACCESS DOOR

NOTE: Turn main input power to the machine OFF before performing reconnect procedure. Failure to do so will result in damage to the machine. DO NOT switch the reconnect bar with machine power ON.



Also called "inverse time" or "thermal/magnetic" circuit breakers. These breakers have a delay in tripping action that decreases as the magnitude of the current increases.

FIGURE A.3 – FRONT PANEL/BACK PANEL



1 WORK TERMINAL
2 ELECTRODE TERMINAL
3 REMOTE CONTROL AMPHENOL RECEPTACLE
4 WATER COOLING FITTINGS (ON BACK PANEL)
5 WIRE FEEDER CONNECTIONS (ON BACK PANEL)
6 ELECTRODE TERMINAL

To operate at 208-230 VAC:

1. Open the reconnect/input access door.
2. Move the input voltage switch to Voltage = 208-230V position.
3. Move “A” lead to the 208-230V terminal.

To operate at 380-415 VAC:

1. Open the reconnect/input access door.
2. Move the input voltage switch to Voltage = 380-415V position.
3. Move “A” lead to the 380-415 VAC terminal.

To operate at 440-460 VAC: No setup required. The machine is factory-connected to operate at 440 volts. To verify, do the following:

1. Open the reconnect/input access door.
2. Check that the input voltage switch is set to Voltage = 440-460V position.
3. Check that the “A” lead is at the 440-460V.

OUTPUT CONNECTIONS

See Figure A.3 for the location of the work terminal, electrode terminal, remote control amphenol receptacle, water cooler fittings and wire feeder connections.

WORK AND ELECTRODE CABLE CONNECTIONS

Size

Use the largest welding (electrode and ground) cables possible — at least 70mm² (#2/0) copper wire — even if the output current does not require it. When pulsing, the pulse current often exceeds 550 amps with the POWER WAVE® 350, and 700 amps with the POWER WAVE® 500. Voltage drops can become excessive if undersized welding cables are used.

Routing

To avoid interference problems with other equipment and to achieve the best possible operation, route all cables directly. Avoid excessive lengths, bundle the electrode and ground cables together where practical, and do not coil excess cable.

WATER COOLER CONNECTIONS

The water cooler fittings are a quick-connect type. Refer to the ***Accessories section*** of this manual for water cooler operation and antifreeze mixtures.

WIRE FEEDER CONNECTIONS

Refer to ***Accessory Section*** for Wire Feeder Connections.

Refer to Setup overlay in ***Operation Section*** for Wire Feeder Configuration.

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OPERATION

OPERATING INSTRUCTIONS

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

SAFETY INSTRUCTIONS

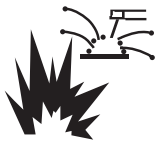
⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the 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 containers that have held combustibles.

ARC RAYS can burn.

- Wear eye, ear, and body protection.

Observe additional Safety Guidelines detailed in the beginning of this manual.

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QUICK START REFERENCE FOR USING THE PROCESS SELECTION OVERLAY

Read and understand the “Controls and Settings” and “Operating Overlays” sections of this manual before using the following Quick Start Reference procedure to operate the POWER WAVE®.

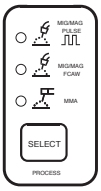
NOTE: Selection of certain options may limit the selection of subsequent options.

Step 1: Select your process information:

a. Install the desired PROCESS OVERLAY.

b. Turn the machine ON.

c. Select the desired welding PROCESS[1].



d. Select MATERIAL TYPE.

e. Select WIRE DIAMETER.

f. Select PROGRAM.

g. Press the WAVE CONTROL UP or DOWN keys to see the present setting. Press the WAVE CONTROL UP or WAVE CONTROL DOWN keys to adjust[2].

Step 2: Adjust the wire feed to speed “WFS” and voltage “V” or arc length “T” (if necessary).

a. Press the DISPLAY RECALL key  to view additional procedure information.

b. Adjust wire feed speed and voltage or arc length trim through the controls on your wire feeder. The new values appear on both the wire feeder and the POWER WAVE® display.

Step 3: Save process information (if desired).

a. Press the INTO MEMORY key  .

b. Press one of the MEMORY LOCATION keys (1-8).

You can recall your procedure later by pressing the RECALL FROM MEMORY key  and the appropriate MEMORY LOCATION key.

[1] The material type, wire diameter, and program you can select for your process will be limited to the machine’s programmed recommendations. Therefore, selecting certain options may limit other option selections.

[2] The wave control scale displayed shows the default setting. (The higher the setting, the softer the arc.) If you change the setting, your new setting will be displayed.

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GENERAL DESCRIPTION

The INVERTEC POWER WAVE® power source is a high performance, digitally controlled inverter welding power source capable of complex, high-speed waveform control. It uses three-phase input power only. The POWER WAVE® is designed to be used as a synergic welding system in conjunction with a wire feeder.

SYNERGIC WELDING

The POWER WAVE® system is designed primarily as a synergic welding system. The word “synergic” comes from the word “synergism,” which means “two or more things working together to achieve an effect which neither can achieve individually.”

The POWER WAVE® and wire feeder operate as a team. Each “knows” what the other is doing at all times. They each also know what process, wire type, wire size, and gas combination are being used. In a synergic system, the wire feeder and power source must “talk” together. This means that only certain wire feeders can work in a synergic setup. A synergic feeder has special circuitry to “talk” with and “listen” to the POWER WAVE® power source.

Welding experts have preprogrammed the system for the best range of process settings according to wire type, wire size, and gas combination. When the wire feed speed is changed, the system automatically adjusts the current and voltage waveforms to give the best weld characteristics. This improves the soundness, appearance, and repeatability of welds.

Refer to the ***Accessories section*** of this manual for available wire feeders.

RECOMMENDED PROCESSES

The POWER WAVE® is designed to be used as a multiple process machine. It comes preprogrammed with MIG/MAG pulse, MIG/MAG (short arc and spray) FCAW (Innershield™ and Outershield™), and MMA (manual metal arc, stick) procedures.

OPERATIONAL FEATURES AND CONTROLS

The POWER WAVE® through use of a keypad overlay system, provides various options and controls such as Multiple Process/Procedure Selection; Memory Storage of Procedures; Weld from Memory Only operation; Dual Process/Dual Feeder capability.

DESIGN FEATURES AND ADVANTAGES

- Designed to IEC-974-1 S Standards.
- 2-line LCD display.
- Easy access for input connections. Connections are simple strip and clamp (no lugs required).
- Modular construction for easy servicing.
- Thermostatically protected.
- Electronic overcurrent protection.
- Overvoltage protection.
- Digital signal processor and microprocessor control.
- RS232 interface for future welding application updates.
- Simple, reliable reconnection for various input voltages.
- New accessories and wire feeders communicate using a digital current loop to transfer information.
- Auto device recognition simplifies accessory cable connections.
- Direct support of two wire feeders.
- Auto-configurable for either metric or English mode.
- Multiprocess control: MMA, short arc, MIG/MAG spray, MIG/MAG pulse, and flux cored arc welding.
- Simple control through use of overlays that limit access to only those keys required for a given application.

WELDING CAPABILITY

The POWER WAVE® 350 is rated at 350 amps, 33 volts at 60% duty cycle based on a ten-minute time period. The POWER WAVE® 500 is rated at 500 amps, 40 volts at 60% duty cycle. Both are on a ten minute time period. Both are capable of higher duty cycles at lower output currents. If the duty cycles are exceeded, a thermostat will shut off the output until the machine cools to a reasonable operating temperature.

LIMITATIONS

- The POWER WAVE® is not recommended for processes other than those specified by available overlays.
- The POWER WAVE® is not recommended for pipe thawing.

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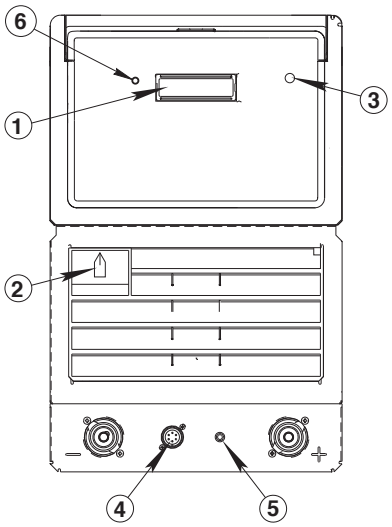
CONTROLS AND SETTINGS

All operator controls and adjustments are located on the case front of the POWER WAVE®. Refer to Figure B.1 and corresponding explanations.

FIGURE B.1 – CASE FRONT CONTROLS



1 LCD DISPLAY
2 POWER SWITCH
3 HIGH TEMPERATURE LIGHT
4 REMOTE CONTROL AMPHENOL RECEPTACLE
5 5 AMP CIRCUIT BREAKER
6 LCD DISPLAY ADJUSTMENT

CASE FRONT CONTROLS

Refer to Figure B.1 for the location of the following controls:

1. LCD DISPLAY: Provides welding procedure information and parameters such as wire type, gas type, WFS, trim, etc.
2. POWER SWITCH: Controls input power to the POWER WAVE®. When the switch is turned to the ON position, the connected wire feeder meters light up and the LCD display on the POWER WAVE® shows the following:

   LINCOLN ELECTRIC
   Version X.X

   This display is shown for a few seconds followed by another display that depends on the overlay placed on the machine. At this point, the machine is ready for operation.
3. HIGH TEMPERATURE LIGHT (thermal overload): A yellow light that comes on when an over temperature situation occurs. Output is disabled until the machine cools down. At that point the light goes out and output is enabled again.

4. REMOTE CONTROL AMPHENOL RECEPTACLE: Allows remote current control during stick welding via a hand or foot Amptrol accessory.
5. 5 AMP CIRCUIT BREAKER: Protects two auxiliary power circuits: the 24V supply used by the trigger circuits and the 42V supply used by the internal machine circuits and the wire feeders.
6. LCD DISPLAY ADJUSTMENT: Use a small flat blade screw driver to adjust the viewing angle of the LCD display.

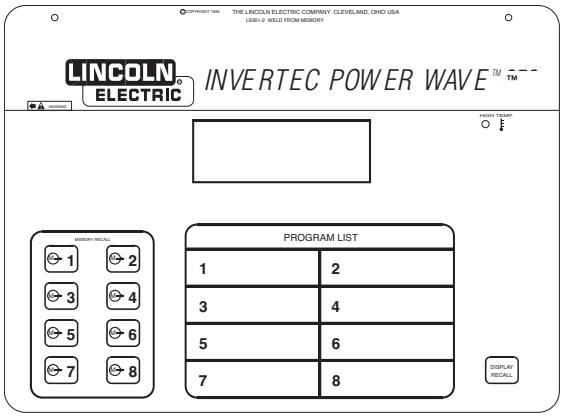
OPERATING OVERLAYS

OVERVIEW

The POWER WAVE® is controlled by a panel of keys (keypad) located on the front of the machine. The operator can access controls by placing an overlay over the keys.

An OVERLAY is a special plastic sheet with a number of keys and symbols printed on one side and a bar code printed on the other. See Figure B.2. The printed keys allow the operator to communicate with the machine for a specific set of functions. The bar code allows the machine to identify the overlay.

FIGURE B.2 – TYPICAL POWER WAVE® OVERLAY

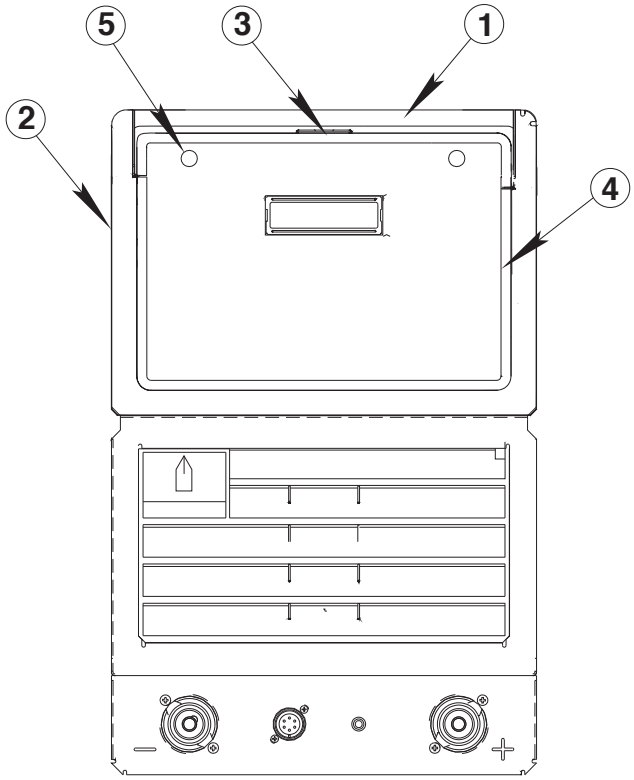


Before the POWER WAVE® is turned ON, the operator selects the desired overlay and mounts it in the overlay frame on the front of the machine. Then, when the machine is turned ON, it reads the overlay bar code and configures the machine accordingly, allowing the operator to access only certain keys. **The machine must be powered up each time an overlay is changed.**

INSTALLING AN OVERLAY

1. Open the ACCESS DOOR by grasping the provided indent on the door and pulling the door forward. See Figure B.3 for door location.

FIGURE B.3 – OVERLAY ACCESS DOOR



1 OVERLAY ACCESS DOOR
2 OVERLAY FRAME
3 ACCESS DOOR INDENT
4 TRACKS
5 LOCATING PINS

2. Select the desired overlay from the storage compartment located behind the access door.
3. Remove any overlay already in the overlay frame and place it in the storage compartment.
4. Slide the new overlay into the overlay frame. Align the overlay with the two tracks on the sides of the frame. Be sure the overlay is seated in the bottom lip of the frame and on the top two locating pins. Close the access door securely.

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OVERLAY TYPES

Four types of overlays can be used with the POWER WAVE®.

1. **Process Overlays.** These overlays are used to create, save and recall specific welding procedures by selecting and adjusting the various welding settings that have been programmed into the POWER WAVE® at the factory.
2. **Weld From Memory Overlays**. These overlays (also called Shop Overlays) provide a simple way for operators to recall and use any of the welding procedures that have been stored in the memory of the POWER WAVE®.
3. **Setup Overlays**. These overlays provide specific machine setup information, such as operating limits for the welding procedures stored in memory.
4. **Special Purpose Overlays.** These are custom overlays for specific customer applications.

Detailed information on how to use currently available POWER WAVE® overlays follows.

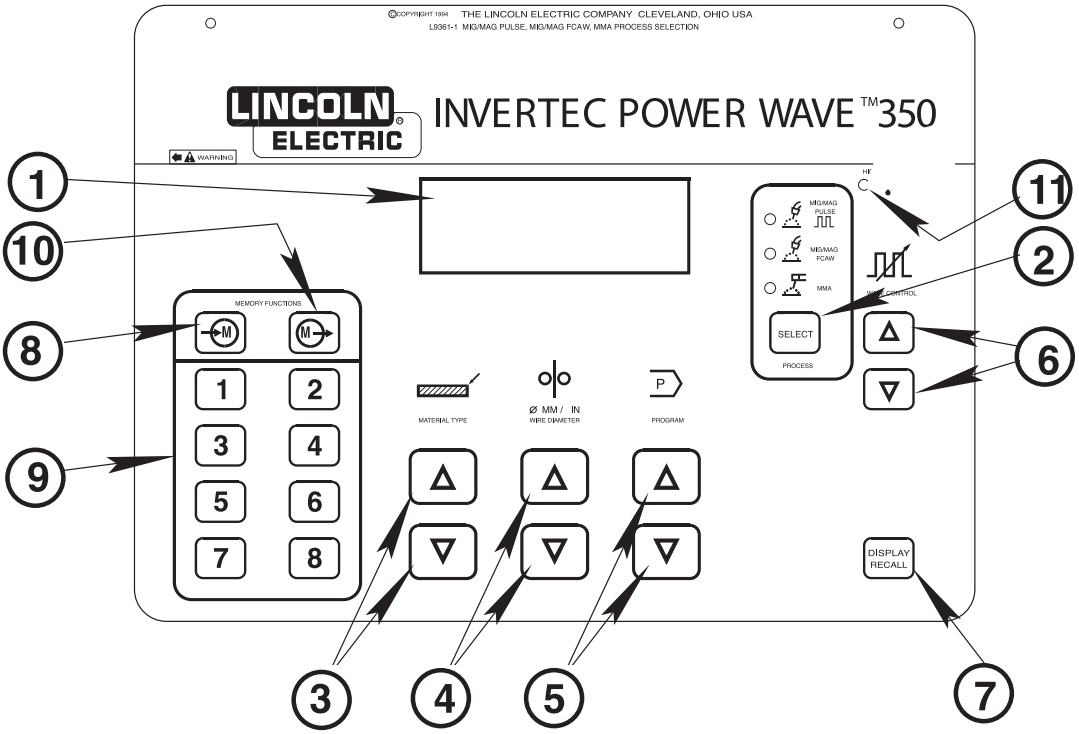
Overlay Type	Overlay Name	Figure No.
1	MIG/MAG PULSE, MIG/MAG, FCAW, MMA PROCESS SELECTION OVERLAY	B.4
2	WELD FROM MEMORY OVERLAY	B.5
2	WELD FROM MEMORY, DUAL PROCEDURE OVERLAY	B.6
2	*DUAL WIRE FEEDERS, DUAL PROCEDURES OVERLAY	B.7
3	*LIMITS OVERLAY	B.8
3	SETUP OVERLAY	B.9

*These overlays are optional. See ***Accessories Section*** for Order Numbers.

MIG/MAG PULSE, MIG/MAG, FCAW MMA PROCESS SELECTION OVERLAY

An operator can use this overlay to create a new welding procedure, save a newly created welding procedure, view an existing welding procedure, recall an existing welding procedure, and clear a memory location. See Figure B.4. The steps for performing each of these functions are given below.

FIGURE B.4 – MIG/MAG Pulse, MIG/MAG, FCAW, MMA PROCESS SELECTION OVERLAY



1 LCD DISPLAY WINDOW
2 PROCESS SELECT KEY
3 MATERIAL UP/DOWN KEYS
4 WIRE DIAMETER UP/DOWN KEYS
5 PROGRAM UP/DOWN KEYS
6 WAVE CONTROL UP/DOWN KEYS
7 DISPLAY RECALL KEY
8 INTO MEMORY KEY
9 MEMORY LOCATION NUMBER KEYS
10 RECALL FROM MEMORY KEY
11 HIGH TEMPERATURE LIGHT

1. **LCD DISPLAY WINDOW**: Power up the machine with this overlay in place. When the POWER WAVE® is turned on, the following message appears on the display for a few seconds:

LINCOLN ELECTRIC
VERSION X.X

This display is followed by:

OVERLAY ID
NUMBER = 1

A welding procedure is made up of seven components: process, material type, wire diameter, program, wire feed speed, voltage or arc length trim, and wave control. A new welding procedure is created by selecting a combination of these components from the ones that have been programmed into the POWER WAVE®. See Figure B.4 for key locations.

NOTE: The following four selections should always be performed in this order: process, material type, wire diameter, program. Selecting a setting for one component narrows your choice of available settings in remaining components. This is why the order of performing the steps is important. However, if you make component selections out of order, the machine will prompt you to make a new selection for any settings that do not apply.

2. **PROCESS SELECT KEY:** Use the PROCESS SELECT key to select from the processes available in the machine. Press the PROCESS SELECT key until the light by the desired process is lit.

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3. **MATERIAL UP/DOWN:** Use the MATERIAL TYPE UP or DOWN keys to select from the material types available for the selected process. Press the MATERIAL TYPE UP or DOWN key until the desired material type is displayed.

   NOTE: Other procedure information is also displayed, such as wire diameter, which can be changed in the next step.

4. **WIRE DIAMETER UP/DOWN:** Use the WIRE DIAMETER UP or DOWN keys to select from the wire diameters available for the selected process and material type. Press the WIRE DIAMETER UP or DOWN key until the desired wire diameter is displayed.

   NOTE: Other procedure information is also displayed.

5. **PROGRAM UP/DOWN KEYS:** Use the PROGRAM UP or DOWN keys to select from the programs available for the selected process, material type, and wire diameter. Press the PROGRAM UP or DOWN Key until the desired program is displayed.

6. **WAVE CONTROL UP/DOWN KEYS:** Press one of the two WAVE CONTROL keys to display the present wave control. This is shown on a scale from LO to HI. Use the WAVE CONTROL UP or WAVE CONTROL DOWN key to change the wave control to the desired level. When this scale is shown, the WAVE CONTROL setting can also be changed while welding (on the fly). Press the DISPLAY RECALL key to exit the wave control function. For a description of how the wave control setting affects the welding procedure, refer to the Overview of Welding Procedures sub-section of the Operation section of this manual.

   The wire feed speed and voltage or arc length trim desired for the new procedure can be changed from the wire feeder.

7. **DISPLAY RECALL KEY:** Since not all the information about the procedure can be seen on the 2-line LCD display window at the same time, use the DISPLAY RECALL key to display and verify all of the selected procedure information. The normal default display window shows the Procedure Description, WFS, and preset voltage or arc length trim values. Press and hold the DISPLAY RECALL key, and the window shows the procedure description and gas type for as long as the key is held depressed. Release the DISPLAY RECALL key, and the window shows wire size, material type, and process description. After a few seconds, the window changes back to the default display.

8. **INTO MEMORY KEY:** This key is used to save a newly created welding procedure. The POWER WAVE® has eight memory locations which can e used to store all the settings of up to eight welding procedures. Once stored in a memory location, a procedure can be recalled for later use with the RECALL FROM MEMORY key. To save a newly created welding procedure:

   Press the INTO MEMORY key  and then one of the MEMORY LOCATION NUMBER keys. Keep a record of this number for future reference.

   Any previously created welding procedure stored in that location will be erased.

   If you press the INTO MEMORY key but decide not to save the procedure, you can exit this function by pressing the DISPLAY RECALL key.

9. **MEMORY LOCATION NUMBER KEYS:** To view information about any stored welding procedure, simply press its MEMORY LOCATION NUMBER key.

   As you hold down the selected key, the procedure description, and gas type of the procedure appear in the display window. The process type is shown by the indicating light opposite the appropriate process symbol.

   When you release the selected key, the wire size, material type and process description appear for a few seconds.

   This function does not display the wire feed speed and voltage or arc length trim settings. To view these, you must recall the procedure from memory with the RECALL FROM MEMORY key.

10. **RECALL FROM MEMORY KEY:** This key is used to recall an existing procedure from memory. You can recall and use any of the previously created welding procedures that are stored in one of the eight memory locations. Simply press the RECALL FROM MEMORY key  and then the appropriate MEMORY LOCATION NUMBER key.

    If you press the RECALL FROM MEMORY key and then change your mind, you can exit this function by pressing the DISPLAY RECALL key. If the memory location you select does not contain a stored welding procedure, this will be indicated in the display window. Select another memory location. It is not necessary to save a procedure back to memory after it is recalled from memory. When a procedure is saved into a memory location, it can be recalled from there until another procedure is stored in that location or the location is cleared.

    The RECALL FROM MEMORY and INTO MEMORY keys can be used to clear a memory location.

    Press the INTO MEMORY key  and then the RECALL FROM MEMORY key  . (Do not press both keys at the same time.) A message in the display window will ask you to press the MEMORY LOCATION NUMBER key of the memory location you want to clear.

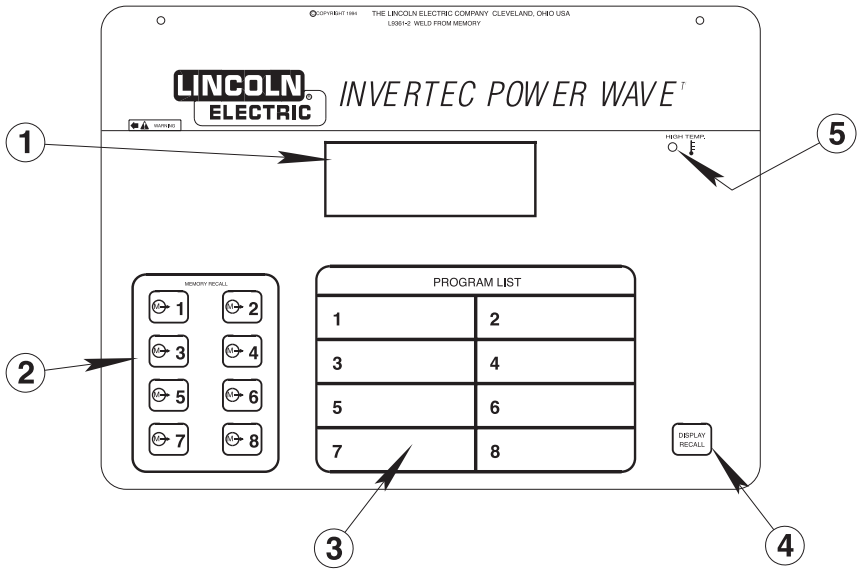
    If you press the INTO MEMORY and RECALL FROM MEMORY keys and then change your mind, you can exit this function by pressing the DISPLAY RECALL key.

11. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

WELD FROM MEMORY OVERLAY

The Weld From Memory Overlay lets an operator recall and use any welding procedure stored in one of eight memory locations. See Figure B.5.

FIGURE B.5 – WELD FROM MEMORY OVERLAY



1 LCD DISPLAY WINDOW
2 MEMORY RECALL KEYS
3 PROGRAM LIST
4 DISPLAY RECALL KEY
5 HIGH TEMPERATURE LIGHT

1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the POWER WAVE® is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 2

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. **MEMORY RECALL NUMBERS:** Select the memory location of the desired welding procedure by pressing the appropriate MEMORY RECALL NUMBER key.

   If no procedure was saved in the selected memory location, the following message appears:

   MEMORY LOCATION
   # IS EMPTY

   Select another memory location.

   When a welding procedure is recalled from memory, the display window will show the procedure description, wire feed speed, and arc length trim or preset voltage.

   With this overlay in place, the wire feed speed and the preset voltage or arc length trim can be changed from the wire feeder. The new values will replace the previous values and become a permanent part of the procedure.

   If limits have been set on the wire feed speed, voltage or arc length trim of the selected procedure, these limits will be active when this overlay is in place. They cannot be overridden from this overlay.

3. **PROGRAM LIST:** The PROGRAM LIST block in the center of this overlay provides a convenient place to record a brief description of each welding procedure stored in memory. A “Dry Erase” marker should be used for this purpose.

4. **DISPLAY RECALL KEY**: To view other information about the selected procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the selected procedure for as long as the key is held depressed. When the key is released, material type, wire size, and process descriptions will be displayed for a few seconds.

5. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

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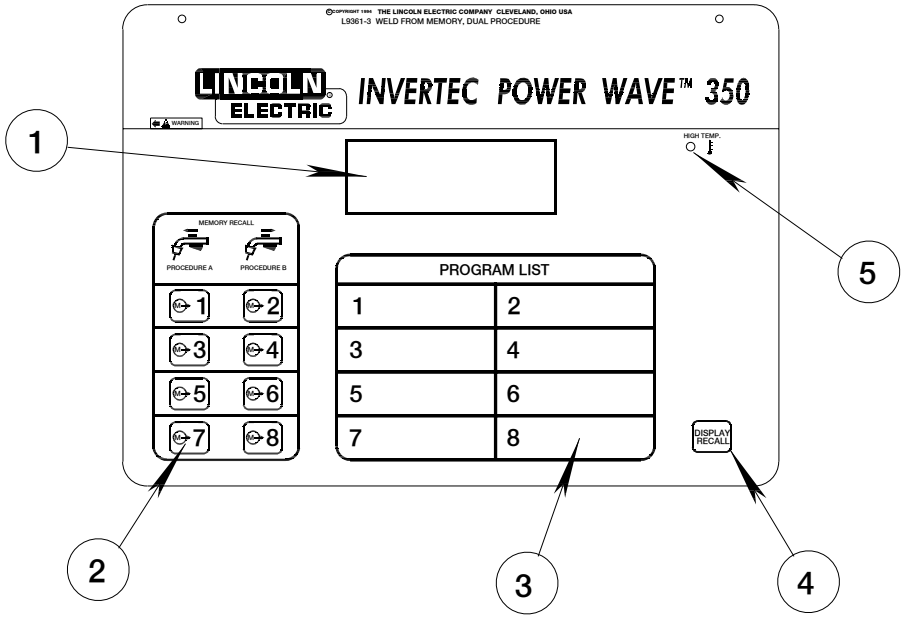
WELD FROM MEMORY, DUAL PROCEDURE OVERLAY

The Weld From Memory, Dual Procedure Overlay lets an operator recall and use dual welding procedures stored in memory. The overlay must be used with a separate dual procedure switch or a gun that has a two position trigger. The switch or trigger selects which procedure will be active. See Figure B.6

FIGURE B.6 – WELD FROM MEMORY, DUAL PROCEDURE OVERLAY



1 LCD DISPLAY WINDOW
2 MEMORY RECALL KEYS
3 PROGRAM LIST
4 DISPLAY RECALL KEY
5 HIGH TEMPERATURE LIGHT

1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the POWER WAVE® is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 3

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. **MEMORY RECALL KEYS:** The following four memory pairs are available on this overlay:
   Memory 1 and Memory 2
   Memory 3 and Memory 4
   Memory 5 and Memory 6
   Memory 7 and Memory 8

   Select a memory location PAIR for the two desired welding procedures by pressing either of the two corresponding MEMORY RECALL NUMBER keys.

   If no procedure was saved to one of the memory pair locations, the following message appears:

   MEMORY LOCATION
   # IS EMPTY

   In this case select another memory pair.

   Set the dual procedure switch or gun trigger to the position for PROCEDURE A or PROCEDURE B. Position A activates the welding procedure from the odd numbered memory locations (1, 3, 5 or 7). Position B activates the welding procedure from the corresponding even numbered memory locations (2, 4, 6 or 8). **For example, if memory location 3 was selected, Position A activates the procedure from memory location 3; Position B activates the procedure from memory location 4.**

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When a pair of welding procedures are recalled from memory, the display window will show the procedure description, wire feed speed, and the preset voltage or arc length trim of the **LAST** procedure welded with.

With this overlay in place, the wire feed speed and the preset voltage or arc length trim can be changed from the wire feeder. The new values will replace the previous values and become a permanent part of the procedure.

If limits have been set on the wire feed speed, voltage or arc length trim of the selected procedures, these limits will be active when this overlay is in place. They cannot be overridden from this overlay.

3. **THE PROGRAM LIST BLOCK:** The PROGRAM LIST block in the center of this overlay provides a convenient place to record a brief description of each welding procedure stored in memory. A “Dry Erase” marker should be used for this purpose.

4. **DISPLAY RECALL KEY:** To view other information about the active procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the active procedure for as long as the key is held depressed. When the key is released, the wire size, material type, and process descriptions display for a few seconds.

5. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high temperature light goes out.

1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the POWER WAVE® is turned on, the following message appears in the display window for a few seconds:

LINCOLN ELECTRIC
VERSION X.X

This display is followed by:

OVERLAY ID
NUMBER = 9

2. **WIRE FEEDERS MEMORY CHART:** The active welding procedure is determined by the active wire feeder and its gun switch position. The welding procedure recall from memory is as follows:

Active Wire Feeder	Gun Trigger Position	Memory Location of Procedure
#1	A	1
#1	B	2
#2	A	3
#2	B	4

Pull the trigger on either wire feeder.

Depending on the gun switch position, the corresponding memory location is automatically recalled. The wire feeders memory chart has no keys; it is simply a chart.

The display window will show the procedure description, wire feed speed, and the preset voltage or arc length trim of the last active welding procedure.

With this overlay in place, the wire feed speed and the preset voltage or arc length trim can be changed from the wire feeder. The new values replace the previous values and become a permanent part of the procedure.

If limits have been set on the wire feed speed, voltage or arc length trim of the selected procedures, these limits will be active when this overlay is in place. They cannot be overridden from this overlay.

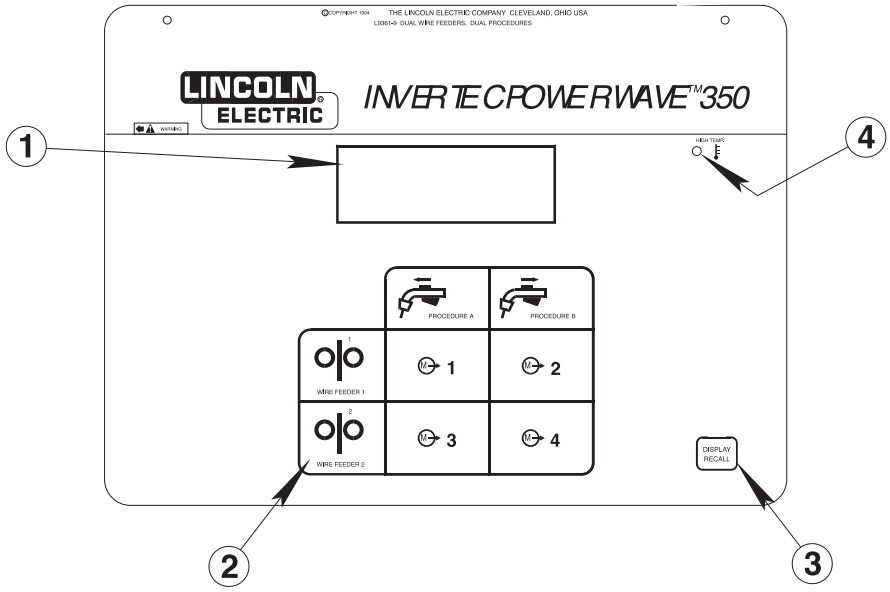
3. **DISPLAY RECALL KEY:**To view other information about the active welding procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the last active procedure for as long as the key is held depressed. When the key is released, the wire size, material type, and process descriptions will be displayed for a few seconds.

4. **HIGH TEMPERATURE LIGHT:** The high temperature light comes on when the internal machine temperature exceeds the allowed limit. Output is disabled until the machine cools down and the high

DUAL WIRE FEEDERS, DUAL PROCEDURE OVERLAY

The Dual Wire Feeders, Dual Procedures Overlay is used when the POWER WAVE® is equipped with two wire feeders and two guns with two position switches. Any welding procedure stored in memory locations 1, 2, 3, or 4 can be automatically recalled and used. See Figure B.7.

FIGURE B.7 – DUAL WIRE FEEDERS, DUAL PROCEDURE OVERLAY



1 LCD DISPLAY WINDOW
2 WIRE FEEDERS MEMORY CHART
3 DISPLAY RECALL KEY
4 HIGH TEMPERATURE LIGHT

temperature light goes out.

1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the POWER WAVE® is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 4

   This message is then replaced by the following message:

   SELECT A MEMORY
   LOCATION

2. **RECALL FROM MEMORY KEY**:

   AND

3. **MEMORY LOCATION NUMBERS:**

   The RECALL FROM MEMORY key is used to recall a welding procedure from memory.

   Determine the memory location number of the welding procedure for which you want to set limits.Then press the RECALL FROM MEMORY key followed by the MEMORY LOCATION NUMBER key for the selected procedure.

   If no procedure was saved in the selected memory location, the following message appears:

   MEMORY LOCATION
   # IS EMPTY

   Select another memory location.

4. **SET LIMIT KEY:**

   AND

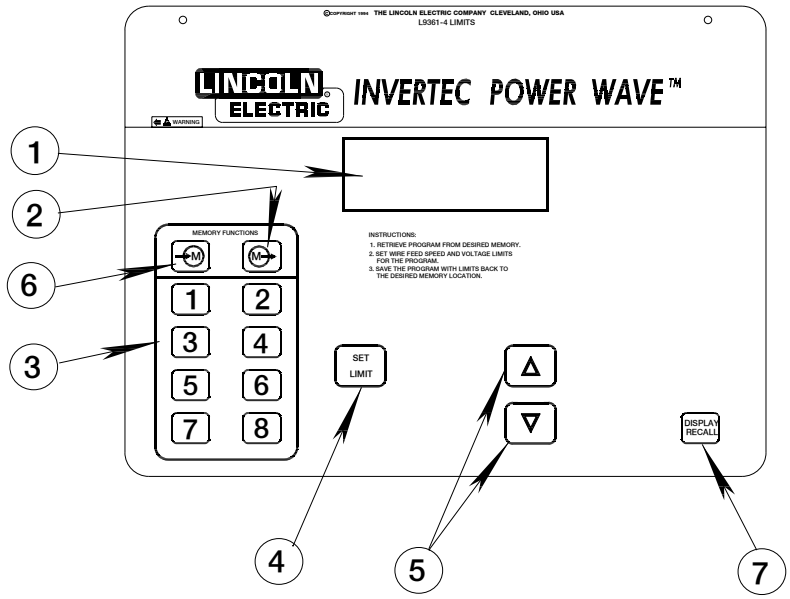
5. **LIMIT UP / DOWN KEYS:**

   The SET LIMIT key and LIMIT UP / LIMIT DOWN keys are used to set the maximum and minimum allowed wire feed speed, and voltage trim or arc length trim values of the procedure that was recalled from memory.

LIMITS OVERLAY

The Limits Overlay is used to set the maximum and minimum limits of the wire feed speed and voltage or arc length trim for any welding procedure stored in memory. See Figure B.8.

FIGURE B.8 – LIMITS OVERLAY



1 LCD DISPLAY WINDOW
2 RECALL FROM MEMORY KEY
3 MEMORY LOCATION NUMBER KEYS
4 SET LIMIT KEY
5 LIMIT UP/DOWN KEYS
6 INTO MEMORY KEY
7 DISPLAY RECALL KEY

Use the LIMIT UP and LIMIT DOWN keys to change the maximum wire feed speed to the desired value.

Press the SET LIMIT key again. The new maximum and old minimum wire feed speeds will be displayed.

Use the LIMIT UP and LIMIT DOWN keys to change the minimum wire feed speed to the desired value.

Press the SET LIMIT key. The present maximum and minimum voltage trim or arc length trim will be displayed. (Refer to Table B.3 to see how voltage trim affects preset voltage. Refer to Table B.6 to see how arc length trim affects preset arc length.)

Use the LIMIT UP and LIMIT DOWN keys to change the maximum value. The maximum for either type is 1.4.

Press the SET LIMIT key. The new maximum and old minimum voltage trim or arc length trim will be displayed. (M→) (→M)

Use the LIMIT UP and LIMIT DOWN keys to change the minimum value. The minimum for either type is 0.6.

6. **INTO MEMORY KEY**: The INTO MEMORY KEY is used to save the procedure with the newly set limits to memory. Press the INTO MEMORY key (M→) followed by the MEMORY LOCATION NUMBER key of the desired memory location. This does not have to be the original location from which the procedure was recalled.

Step 6 can be performed any time during the limit-setting process. You do not have to set all the available limits. When you have set all the desired limits, save the procedure to memory. **When this procedure is recalled from memory on any overlay, with the exception of the MIG/MAG PULSE, MIG/MAG, FCAW, MMA Process Selection overlay, the limits imposed here will be active**. (When a procedure is recalled from memory on the MIG/MAG PULSE, MIG/MAG, FCAW, MMA Process Selection overlay, the full range of wire feed speed and voltage trim or arc length trim values of the procedure are available.)

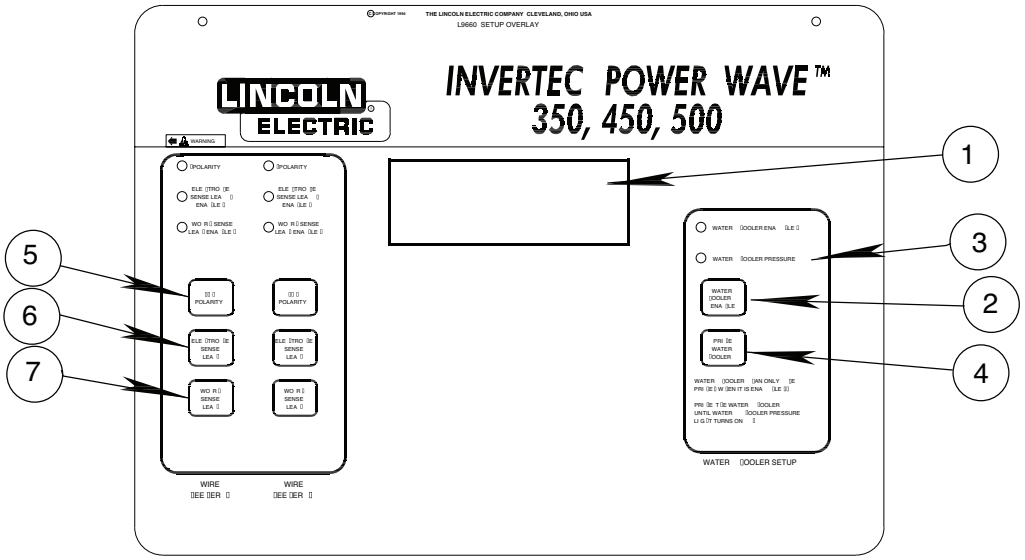
To clear any previously set limits, recall the procedure from memory and change the limits to the maximum range available. Then save the procedure to memory.

7. **DISPLAY RECALL KEY:** To view other information about the active welding procedure, press the DISPLAY RECALL key. The display window will show the procedure description and gas type of the last active procedure for as long as the key is held depressed. When the key is released, the wire size, material type, and process descriptions will be displayed for a few seconds.

SETUP OVERLAY

The Setup Overlay is used to control the water cooler operation (enable/disable and prime the water cooler), to set up the voltage sensing configuration of the machine, and to enable/disable the crater fill control of the wire feeder(s) connected to the POWER WAVE®. See Figure B.9.

FIGURE B.9 – SETUP OVERLAY



1. **LCD DISPLAY WINDOW:** Power up the machine with this overlay in place. When the POWER WAVE® is turned on, the following message appears in the display window for a few seconds:

   LINCOLN ELECTRIC
   Version X.X

   This display is followed by:

   OVERLAY ID
   NUMBER = 0

   This message is then replaced by the following message:

   POWER WAVE®
   SETUP

2. **WATER COOLER ENABLE KEY:** Press this key to toggle the water cooler between being enabled and disabled. The present status of the water cooler is indicated by the “WATER COOLER ENABLED” light.

3. **WATER COOLER PRESSURE LIGHT:** This light indicates whether enough water pressure exists for normal water cooler operation. If the water cooler loses the required pressure it will shut down within a couple of seconds and the water cooler pressure light will turn off.

   If the water cooler does not have enough pressure to operate when enabled, the machine also sounds a buzzer.

4. **PRIME WATER COOLER KEY:** The water cooler may have to be primed if there is not enough pressure in the water cooler hose for operation. Make sure that the water cooler has been enabled before it is primed. (The “WATER COOLER ENABLED” light should be turned on.) To prime the water cooler, hold the “PRIME WATER COOLER” key down. While this key is pressed, the display will show:

   PRIME WATER
   COOLER

When the 'WATER COOLER PRESSURE' light turns on, release the key. If this key has been pressed for 30 seconds and the 'WATER COOLER PRESSURE' light still did not turn on, check the water cooler for adequate fluid level.

5. **WIRE FEEDER 1 +/- POLARITY KEY:** Press this key to change the present voltage sensing polarity of wire feeder 1. The present polarity of wire feeder 1 is indicated by the 'WIRE FEEDER 1+ POLARITY' light. If wire feeder 1 is set for positive voltage sensing polarity, this light is turned on.

6. **WIRE FEEDER 1 ELECTRODE SENSE LEAD KEY:** Press this key to enable or disable the electrode sense lead (lead #67) of wire feeder 1. When enabled, voltage sensing is done by the electrode sense lead. When disabled, voltage sensing is done at the POWER WAVE® output terminal. When enabled, the WIRE WEEDER 1 WORK SENSE LEAD ENABLED LIGHT will be illuminated.

NOTE: WIRE FEEDER 2 keys and lights have the same function as items 5 through 7. However, they apply to wire feeder 2.

WIRE FEEDER SETUP DESCRIPTION

The POWER WAVE® may be set up for either positive or negative arc voltage sensing using any two of the following places:

1. the positive output terminal of the POWER WAVE®

2. the negative output terminal of the POWER WAVE®

3. the electrode sense lead (67 lead) of the wire feeder

4. the work sense lead (21 lead) of the wire feeder

The SETUP Overlay allows you to select between which two places arc voltage will be sensed. Once the selection is made it is not necessary to reconfirm the selection every time a new overlay is used or a wire feeder is replaced with another one. The selection will remain until it is changed with the SETUP Overlay.

When welding with a stick procedure, the arc voltage is automatically measured between the POWER WAVE®'s output studs.

I. Select arc voltage sensing polarity first.

+/- **POLARITY KEY**

A. **Positive Voltage Sensing Polarity:**

In most welding applications the electrode cable is connected to the + output stud and the work cable is connected to the - output stud of the power source. This is the positive voltage sensing polarity, illustrated by ***Figure B.10***. When the POWER WAVE® and the wire feeder(s) are connected in this manner, the arc voltage can be measured in one of four ways. These four ways are shown in Table B.1.

Table B.1: Positive Voltage Sensing Options

Positive Voltage Reference	Negative Voltage Reference
+ Output Terminal	- Output Terminal
+ Output Terminal	Work Sense (21) Lead
Electrode Sense (67) Lead	- Output Terminal
Electrode Sense (67) Lead	Work Sense (21) Lead

Use the **ELECTRODE SENSE LEAD KEY** to select either the + output terminal or the electrode sense (67) lead for the positive voltage reference.

Use the **WORK SENSE LEAD KEY** to select either the - output terminal or the work sense (21) lead for the negative voltage reference.

The K948-1 Break-out box must be connected between the POWER WAVE® and the wire feeder in order to be able to use the work sense (21) lead for voltage sensing.

B. **Negative Voltage Sensing Polarity:**

In some welding applications (such as Innershield®) the electrode cable is connected to the - output stud and the work cable is connected to the + output terminal of the power source. This is the negative voltage sensing polarity, illustrated by ***Figure B.11***. When the POWER WAVE® and the wire feeder(s) are connected in this manner, the arc voltage can be measured in one of four ways. These four ways are shown in Table B.2.

Table B.2: Negative Voltage Sensing Options

Positive Voltage Reference	Negative Voltage Reference
+ Output Terminal	- Output Terminal
+ Output Terminal	Work Sense (21) Lead
Electrode Sense (67) Lead	- Output Terminal
Electrode Sense (67) Lead	Work Sense (21) Lead

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Use the **ELECTRODE SENSE LEAD KEY** to select either the - output terminal or the electrode sense (67) lead for the positive voltage reference.

Use the **WORK SENSE LEAD KEY** to select either the + output terminal or the work sense (21) lead for the negative voltage reference.

The K948-1 Break-out box must be connected between the POWER WAVE® and the wire feeder in order to be able to use the work sense (21) lead for voltage sensing.

The two wire feeders can only be connected in the same manner, either by the Positive Polarity or the Negative Polarity setup.

FIGURE B.10

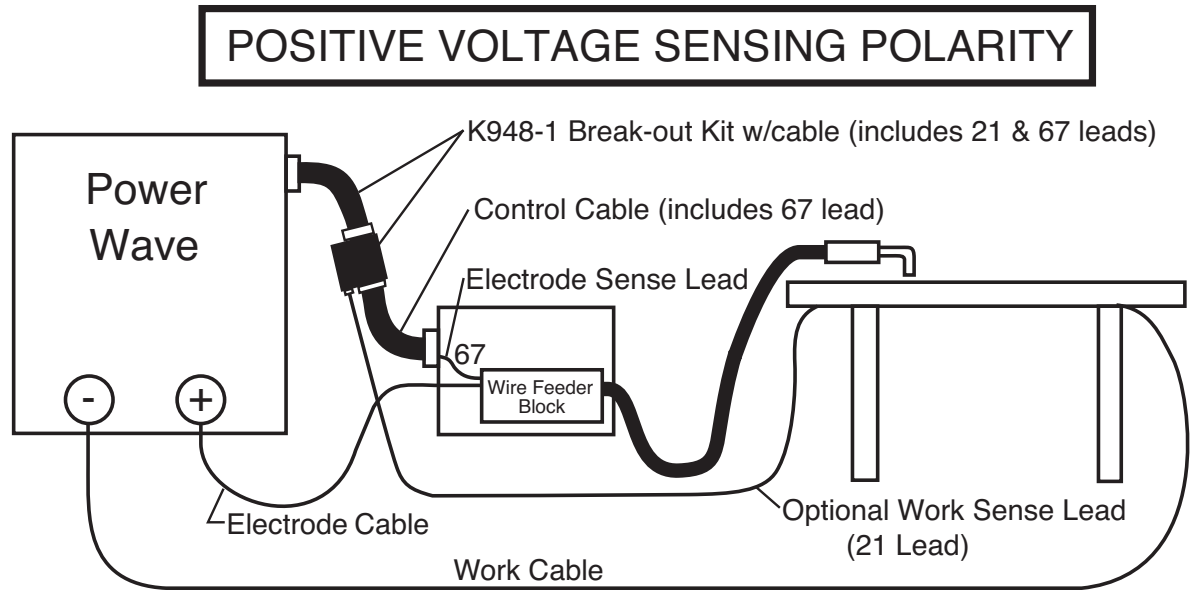
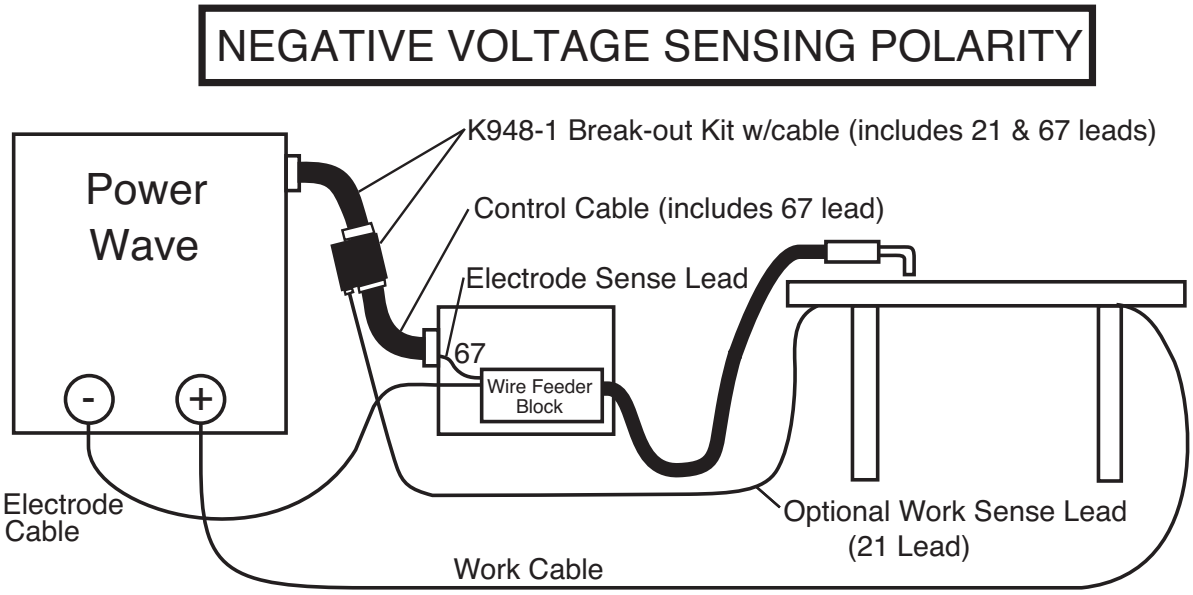


FIGURE B.11



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OVERVIEW OF WELDING PROCEDURES

FLUX CORED ARC WELDING (FCAW) AND MIG/MAG PROCEDURES

For each wire feed speed, a corresponding voltage has been preprogrammed into the machine by welding experts. This preprogrammed voltage is the best average voltage for the procedure at the given wire feed speed. If the wire feed speed is changed on the wire feeder, the voltage automatically changes with it.

In some cases, the operator may want to change the preprogrammed voltages; for example, to compensate for cable and fixture voltage drops. The preset voltages can be adjusted on the wire feeder's Voltage display. When a change is made to the voltage at one wire-feed speed, this change is applied to all other wire feed speed settings. For example, if the operator turns up the voltage by 10 percent, the machine automatically increases the preset voltages at all the other wire feed speeds by 10 percent. In the MIG/MAG FCAW process, the display shows the Procedure Description, WFS and Preset Voltage. The preset voltage which was programmed at the factory, may be changed on the wire feeder voltage display. Note that, if you change the default preset voltage up or down, a respective "Λ or "V" sign will be displayed after the preset value. When the gun trigger is pulled, note that the display changes to show WFS, Actual Arc Voltage and Actual Arc Current. See Table B.5 for display summary.

MIG/MAG PULSE PROCEDURES

In these procedures, the actual voltage greatly depends on the waveform used. The peak currents, background currents, rise times, fall times, and pulse times all affect the actual voltage. The actual voltage for a given wire feed speed is not directly predictable unless the waveform is known. In this case, it is not practical to preset an actual voltage for the procedure. Instead, an arc length adjustment is provided. The machine "knows" what the best arc length is at the given wire feed speed but allows the operator to change it.

The arc length can be adjusted between 0.6 and 1.4 on the wire feeder's Voltage display. An arc length trim of 1.0 means that no adjustments will be made to the preset arc lengths. An arc length trim greater than 1.0 increases the preset arc lengths. An arc length trim less than 1.0 decreases the preset arc lengths. The arc length adjustment is factored in at all wire feed speed settings. Refer to Table B.6 for summary of arc length trim.

Increasing the arc length by 10 percent at a given wire feed speed also increases all the other arc length settings of the procedure by 10 percent. In the MIG/MAG pulse process, the display shows the Procedure Description, WFS and Arc Length Trim. Arc length trim is programmed to a default at the factory and may be adjusted on the wire feeder. When the trigger is pulled, the WFS, Actual Arc Voltage and Actual Arc Current are displayed.

MANUAL METAL ARC (MMA) PROCEDURES

Manual Metal Arc welding is also known as stick welding. Stick welding can be performed with the POWER WAVE® by attaching a remote control kit to the 6-pin amphenol on the front of the machine. The K941-1 remote control kit is recommended. Select the MMA Process from either the MIG/MAG Pulse, MIG/MAG FCAW, MMA process selection overlay, or recall it from a previously stored memory location with a Weld From Memory overlay. When this process is selected, the POWER WAVE® reads the current (amps) setting from the remote control kit. It also controls the output of the machine based on the position of the Output Terminals switch, which is also located on the remote control kit. When this switch is in the ON position, the output terminals of the POWER WAVE® are electrically hot. When the switch is in the OFF position, the output terminals of the POWER WAVE® are electrically cold and the machine cannot produce an output. In the MMA Process, the LCD display shows Procedure Description, and Preset Current (SET=). The Current Trim is always equal to 1 (T=1.00). When the trigger is pulled the Preset Current, Actual Arc Voltage and Actual Arc Current are displayed.

See Tables B.3 through B.6 for a summary of the information discussed above.

WAVE CONTROL

The wave control settings of all procedures can be changed on the POWER WAVE® MIG/MAG Pulse, MIG/MAG, FCAW, MMA Process Selection Overlay. The wave control is a setup parameter that may be adjusted when the welding procedures are set. This feature provides an easy way to change the arc behavior without creating a new procedure. The wave control setting of a procedure limits the speed at which the current waveform of that procedure can change. Typically, each procedure is programmed to have average wave control (at the center of the scale).

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TABLE B.3 – RELATIONSHIP BETWEEN VOLTAGE TRIM AND PRESET VOLTAGE

Voltage Trim	Relationship to Preset Voltage
0.6	60% of preset voltage
0.8	80% of preset voltage
1.0	no change to preset voltage
1.2	120% of preset voltage
1.4	140% of preset voltage

Explanation of Table B.3:

If, for example, the minimum voltage trim is set to 0.8 and the maximum voltage trim is set to 1.4, this means that the voltage for a given wire feed speed can be adjusted to be anywhere between 80% and 140% of the preset voltage of that wire feed speed.

TABLE B.6 – RELATIONSHIP BETWEEN SELECTED ARC LENGTH TRIM AND PRESET ARC LENGTH AS INDICATED BY ARC LENGTH TRIM, MIG/MAG FCAW ONLY

Arc Length Trim	Preset Arc Lenth
0.6	60% of preset length
0.8	80% of preset length
1.0	no change to preset length
1.2	120% of preset length
1.4	140% of preset length

TABLE B.4 – ADJUSTABLE PARAMETERS

Adjustable Parameters	MIG/MAG Pulse	MIG/MAG FCAW	MMA
Wire Feeder WFS Display	Wire Feed Speed	Wire Feed Speed	—
Wire Feeder Voltage Display	Arc Length Trim	Preset Voltage	—
POWER WAVE® Display (with MIG/MAG Pulse, MIG/MAG FCAW, MMA Process Selection Overlay)	Wave Control (Frequency)	Wave Control (Inductance)	Wave Control (Arc Force)

TABLE B.5 – DISPLAYS OF THE POWER WAVE® AND WIRE FEEDERS FOR DIFFERENT PROCESSES IN BOTH TRIGGER POSITIONS

Trigger Position[1]	POWER WAVE®			Wire Feeder	
	MIG/MAG Pulse	MIG/MAG FCAW	MMA[1]	MIG/MAG Pulse	MIG/MAG FCAW
Open	WFS and Arc Length Trim	WFS and Preset Voltage	Preset Current	WFS DISPLAY: Wire Feed Speed VOLTAGE DISPLAY: Arc Length Trim	WFS DISPLAY: Wire Feed Speed VOLTAGE DISPLAY: Preset Voltage
Closed	WFS, Actual Arc Voltage, Actual Arc Current	WFS, Actual Arc Voltage, Actual Arc Current	Preset Current, Actual Arc Voltage, Actual Arc Current	WFS DISPLAY: Wire Feed Speed VOLTAGE DISPLAY: Actual Arc Voltage	WFS DISPLAY: Wire Feed Speed[2] VOLTAGE DISPLAY: Actual Arc Voltage

[1]In MMA, trigger is on Remote Control Kit K941-1.[2]Arc Current, not wire feed speed, is displayed if a Remote Control Kit is attached to the wire feeder.

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In MIG/MAG Pulse processes:

The wave control adjustment allows the frequency setting to vary. Increasing the wave control allows the frequency setting to increase, and decreasing the wave control allows the frequency setting to decrease. Varying the wave control setting affects the droplet transfer and allows fine-tuning for different welding positions.

In MIG/MAG FCAW processes:

The wave control adjusts the inductance. (Inductance is inversely proportional to pinch.) Increasing the wave control setting decreases the inductance, which results in the arc getting colder and pinched tighter. Decreasing the wave control setting increases the inductance, which results in the arc getting wider.

In MMA (stick) processes:

The wave control adjusts the arc force. Increasing the wave control setting increases the arc force, making the arc more harsh but less likely to stick. Decreasing the wave control setting decreases the arc force, making the arc softer and smoother.

MIG/MAG PULSE WELDING

Some people have trouble getting used to the behavior of the pulsing arc. The parameters programmed into the POWER WAVE® have been thoroughly tested for their ability to deliver a sound weld with good appearance. There are, however, a few things to keep in mind when pulse welding.

Spatter levels are often very low with the pulse welding process. Pulsing is often used to eliminate cleaning operations necessary when using other welding processes.

Fume levels are sometimes lower with the pulsing process. Whether or not you will get lower fume levels depends on the pulsing programs used. Certain waveform characteristics are necessary to get low fume levels. Unfortunately, low fume procedures are harder to weld with than procedures designed to optimize the welding process.

The pulsing process is not slower than other processes. The process is sometimes less forgiving when the arc gets on or ahead of the puddle. More attention must be paid to the weld to avoid losing the puddle. Speed is a matter of deposition rate. All things being equal regarding the joint being welded, the speed will depend on the wire feed speed. The travel speed is maximized by maintaining a very short arc. Often the process is "trimmed" down until the arc "crackles." The spatter increases slightly, but many of the advantages of pulsing are retained. When welding steel, the POWER WAVE® is designed to run well in this region between pulse and short arc.

The pulsing process greatly affects the heat input to the workpiece. This can be a valuable tool for either increasing or decreasing the heat input with a given process. For instance, it is possible to greatly increase the heat input when welding steel at high deposition rates. On the other hand, it is possible to reduce the heat input using the pulsing process. For example, heat input is reduced greatly with some of the low current stainless steel procedures using the processes programmed into the POWER WAVE®. In all cases, the POWER WAVE® procedures have been checked for their ability to deliver a sound weld. However, the fusion of the weld metal into the workpiece may be affected. It is the responsibility of the user to determine if the welds produced are suitable and sound.

The POWER WAVE® is optimized for use with a 1.9 cm stickout. The adaptive behavior is programmed to support a stickout range from 1.3 to 3.2 cm. In the low and high end of the wire feed speed ranges of most processes, the adaptive behavior may be restricted. This is a physical restriction due to reaching the edge of the operating range for the process. It is possible to achieve adaptive behavior for longer stickout lengths. However, shielding gas is often lost when the stickout is too long.

A longer electrical stickout is often used with the pulsing process at higher deposition rates. A long stickout will increase the melt-off rate of the wire. In pulse welding, like other wire welding processes, the arc length is determined by the voltage setting. This voltage is programmed at the factory for each process and wire feed speed. It may be changed using the Voltage setting on the wire feeder.

When adaptive processes are used, the voltage will vary with stickout. The machine must change the voltage to keep a stable arc. It is very important to recognize this. "Actual" arc voltage when welding will vary because the stickout will seldom be held at the nominal 1.9 cm value.

OVERLOAD PROTECTION

THERMAL PROTECTION

The POWER WAVE® has thermostatic protection from excessive duty cycles, overloads, loss of cooling, and high ambient temperatures. When the power source is subjected to any of these conditions or any of the conditions mentioned above, a thermostat will open. The yellow high temperature light on the case front comes on. See ***Figure B.1*** for location. Machine output is disabled, and welding is not possible until the machine is allowed to cool and the High Temperature Light goes out.

CURRENT PROTECTION

The POWER WAVE® 350 is limited to producing 600 amps peak current. If the average current exceeds 450 amps, then the peak current will be limited to 100 amps until the average current decreases to under 50 amps.

The POWER WAVE® 500 is limited to producing 725 amps peak current. If the average current exceeds 543 amps, then the peak current will be limited to 100 amps until the average current decreases to under 50 amps.

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OPTIONS/ACCESSORIES

- Synergic 7 wire feeder (K632-1) standard speed,or (K632-2) high speed
- MAGNUM 400 gun (K471-2) or 550 gun (K598)
- Remote control (stick welding) K941-1
- Break-out box (K948-1)
- L9361-4 Limits Overlay (K945-4)
- L9361-9 Dual Wire Feeders, Dual Procedures Overlay (K945-9)

WIRE FEEDER SETUP

The POWER WAVE® must be used with wire feeders listed above. Mount the feeder in a location suitable to your needs.

For most applications, connect the electrode cable between the feeder and the positive (+) connection of the power source. When negative electrode polarity is required, such as in some Innershield™ applications, connect the electrode cable between the feeder and the negative (-) connection of the power source. See Figure C.1.

Connect the control cable between the feeder and power source. The cable has different connectors on each end and will fit in only one way. If only one feeder is used, it must be connected to the Feeder 1 Amphenol located on the back panel in the upper left-hand corner (as you view the machine from the back). If a second feeder is used, it must be plugged into the Feeder 2 Amphenol receptacle located just to the right of the Feeder 1 Amphenol receptacle.

Connect the work cable between the work and the negative (-) connection of the power source. When negative electrode polarity is required, such as in some Innershield™ applications, connect the work cable between the work and the positive (+) connection of the power source. See Figure C.1.

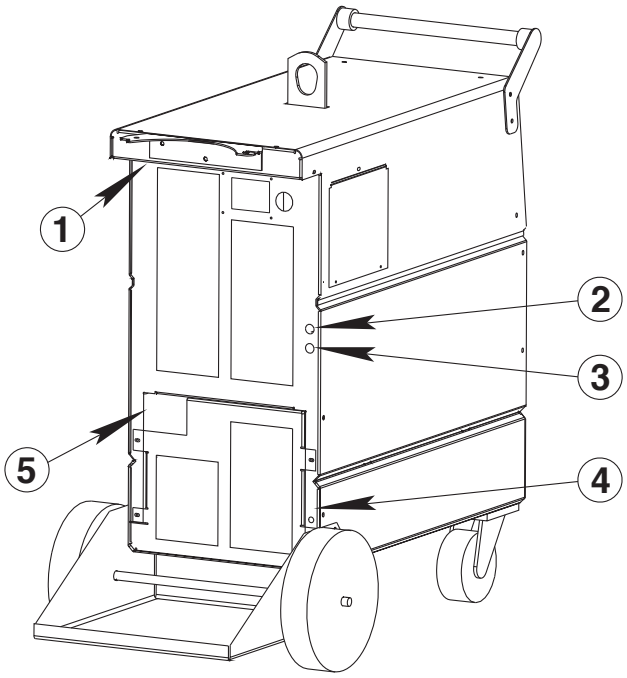
- Connect the feeder to a welding gas supply.
- Load the wire into the feeder and gun.
- Configure wire feeders (Refer to Setup overlay in operation section.

GUNS AND CABLES

Several MAGNUM guns are recommended for use with the POWER WAVE® as shown in Table C.1.

Place the proper liner in the gun and connect the gun to the feeder. Consult the specific instructions supplied with the gun for detailed operating instructions.

FIGURE C.1 – WIRE FEEDER AND WATER COOLER CONNECTIONS



1 WIRE FEEDER CONNECTIONS (LOCATION)
2 WATER COOLER LINE (IN)
3 WATER COOLER LINE (OUT)
4 CIRCUIT BREAKER (WATER COOLER)
5 FILL SPOUT (WATER COOLER)

Using a water-cooled gun is recommended to reduce the size of the gun and improve parts life. The POWER WAVE® comes with a standard internal water cooler. However, an external cooler may also be used.

TABLE C.1 – RECOMMENDED GUNS FOR USE WITH POWER WAVE® 350/500

Gun	Application	Cooling	Product No.
MAGNUM 400	MIG/MAG	Gas	K471-2
MAGNUM 550	MIG/MAG	Gas	K598

[1]Use of the Synergic 7 wire feeder requires appropriate input cable assembly, wire stand, and drive roll kit. Refer to Synergic 7 Operator's Manual for available options.

WATER COOLER USAGE

The POWER WAVE® is equipped with an internal water cooler. We recommend using the water cooler when welding above 300 amps with argon blends on a regular basis. The gun heating from pulsing above 300 amps average current is often excessive and leads to reduced consumable life, reduced gun life, and operator discomfort. Water cooling greatly increases the durability of the gun and parts at high current.

There are two water connections on the rear of the POWER WAVE®. See Figure C.1. Connect the water lines between these connectors and those on the wire feeder. The water is fed through the feeder into the gun.

When a water cooler is used, the water cooler must be enabled by using the Setup Overlay.

The water cooler contains a pressure switch, which is closed when there is adequate pressure in the water cooler hose for normal operation. If this pressure drops, the pressure switch opens. A couple of seconds after the pressure switch opens the water cooler shuts down. If the water cooler is enabled and the pressure switch opens, the machine beeps loudly indicating that there is a problem with the water cooler operation.

When the water-cooled system is turned on for the first time, the coolant lines must be bled. To accomplish this, open the return line at the quick-connect fitting on the back of the POWER WAVE® power source. The return line is the lower of the two coolant fittings. Place the return hose FROM THE FEEDER into a bucket to catch any spilled coolant and turn the machine off and on several times. Pause each time to allow the cooler to run a complete 3-second cycle. After 8 to 15 cycles, coolant will spray from the return hose with some force, indicating that the system is purged of air. Replace the return line into the quick-connect fitting. The system is bled and ready for operation.

To avoid damage from freezing, the water cooler is shipped without coolant. The fill spout for the water cooling unit is located on the back panel of the machine on the left-hand side. See ***Figure C.1***. The water cooler reservoir must be filled with coolant before use.

Use When Ambient Temperature is Above Freezing: Use tap, distilled, deionized, or well water. Do not use salt water.

Use When Ambient Temperature is Below Freezing: Use a mixture of 15% - 30% alcohol added to water.

Do Not Use: Any pre-packed welding industry coolant mixture, such as those offered by Miller, OKI, Bernhard, or Dynaflux. These coolants contain substances which attack plastic components and may shorten the life of the system. Once added, these substances are virtually impossible to purge from the system. DO NOT USE OIL-BASED COOLANTS OF ANY TYPE.

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MAINTENANCE

SAFETY PRECAUTIONS

⚠ WARNING

ELECTRIC SHOCK can kill.

- Only Qualified personnel should perform this maintenance.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

ROUTINE AND PERIODIC MAINTENANCE

Perform the following preventive maintenance at least once every six months.

⚠ WARNING

Prior to performing preventive maintenance it is important to perform the following capacitor discharge procedure to avoid electric shock.

INPUT FILTER CAPACITOR DISCHARGE PROCEDURE

1. Turn off input power and disconnect input power lines.
2. Remove the 14 hex head screws from the top and the sides of the machine. Remove the handle bar and the wrap-around machine cover.
3. Remove the two case sides. There are 5 hex head screws on each side.

⚠ CAUTION

TO PREVENT DAMAGE TO MACHINE, AVOID UNNECESSARY MOVEMENT OF FRONT PANEL.

4. Obtain a high resistance and high wattage resistor (25-1000 ohms and 25 watts minimum). This resistor is not supplied with the machine. Secure this resistor to a piece of insulating material such as a glastic board. ***See Figure D.3***. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.

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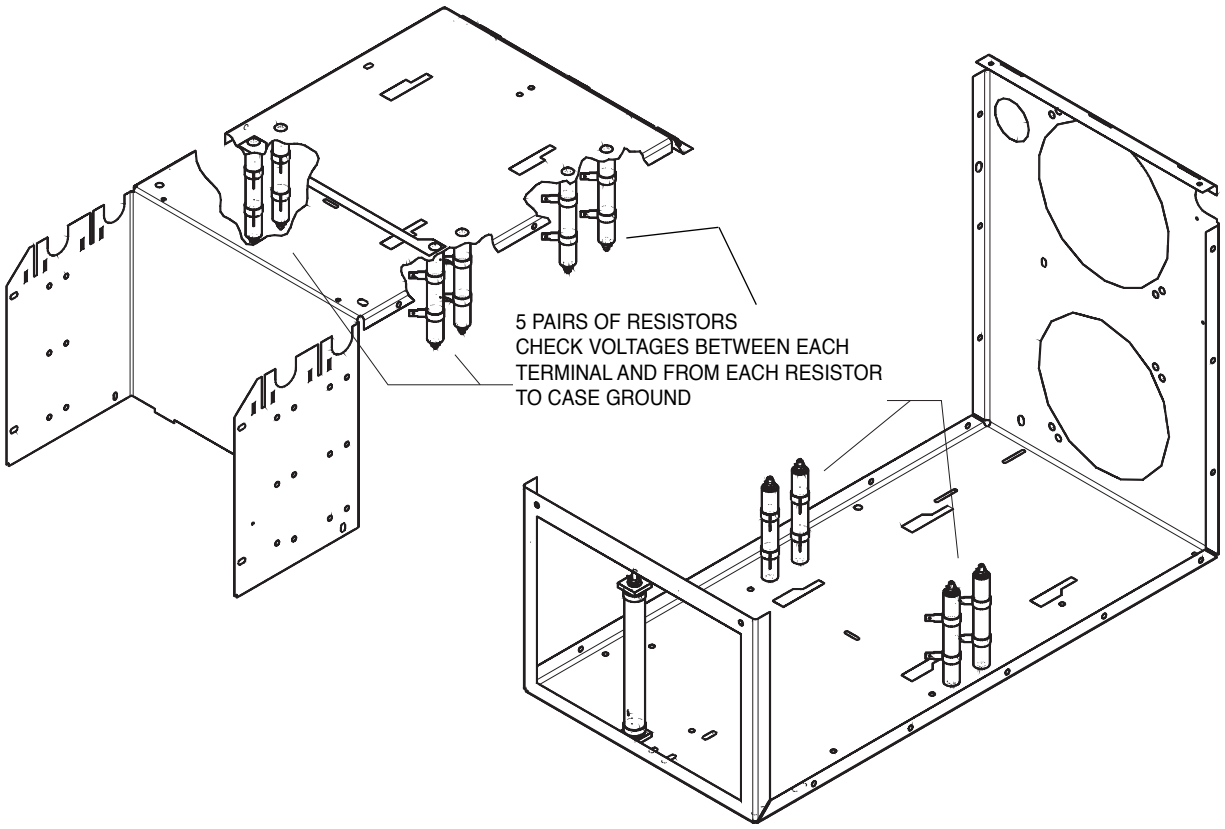
FIGURE D.1 – RESISTOR LOCATIONS



5. Locate two sets of two resistors on the left side of the machine and three sets of two resistors on the right side of the machine. See Figure D.1. Do not touch the resistors or any other internal machine component. Using a DC voltmeter, check for any DC voltage that may be present across the terminals of each resistor and from each resistor to case ground (20 measurements in all). If a voltage is present, be careful not to touch these resistors.

⚠ WARNING

ELECTRIC SHOCK can kill.

- Proceed with caution being careful not to touch any internal machine components during the discharge procedure.

6. Locate the #9 and #12 terminals, identified by the "Discharge" labels, on each of the four Switch Boards. See Figure D.2.
7. Using insulated, needle nose-type jumper leads and insulated gloves, connect one jumper lead to one end of the resistor obtained in step 4. Connect the other jumper lead to the other end of the resistor.
8. Carefully connect the needle nose end of one of the jumper leads to terminal #9. See Figure D.3. Connect the needle nose end of the other jumper lead to terminal #12. Terminals #9 and #12 are indicated by the "Discharge" label. Leave resistor connected for 10 seconds. DO NOT TOUCH TERMINALS, RESISTORS, OR ANY INTERNAL MACHINE COMPONENT DURING THIS PROCEDURE!

FIGURE D.2 – DISCHARGE LABEL

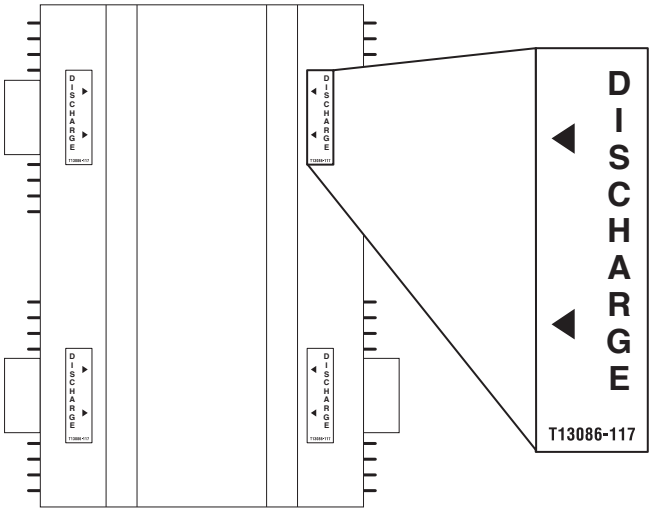
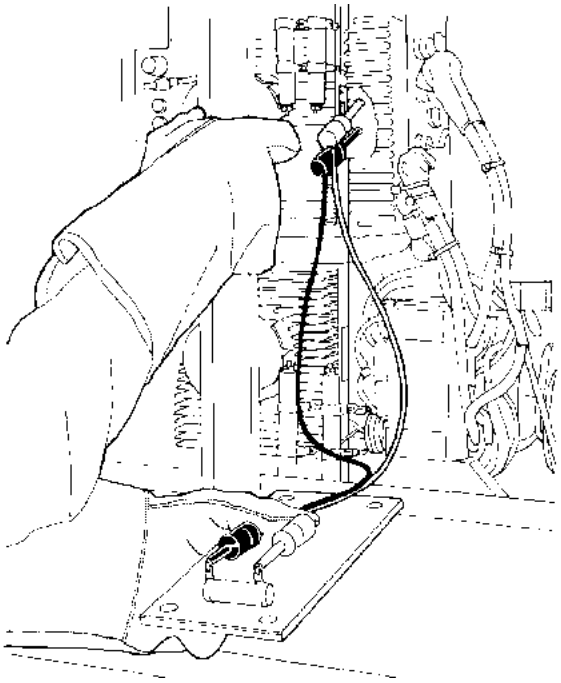


FIGURE D.3 – RESISTORS WITH LEADS CONNECTED



9. Check voltage across terminals (9 and 12) with a DC voltmeter. Terminal 9 has positive polarity and terminal 12 has negative polarity. Voltage should be zero. If any voltage remains, repeat this capacitor discharge procedure.
10. Repeat discharge procedure (steps 7, 8 and 9) for each of the other three Switch Boards.

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PREVENTIVE MAINTENANCE

Perform the following preventive maintenance procedures at least once every six months. It is good practice to keep a preventive maintenance record; a record tag attached to the machine works best.

1. Remove the 14 hex head screws from the sides and top of the machine. Remove the handle bar and the machine wrap-around cover. Remove the two case sides. There are 5 hex head screws on each side.
2. Perform the ***Input Filter Capacitor Discharge Procedure*** described at the beginning of the Maintenance Section.
3. Disconnect the shunt from the negative (-) output terminal. Failure to do this could cause damage to the shunt circuitry.
4. Clean the inside of the machine with a low pressure airstream. Be sure to clean the following components thoroughly (Refer to ***Figure D.4***):
   - Display, Snubber, and Shunt printed circuit boards
   - Power Switch
   - Main Transformer
   - Auxiliary Transformers
   - Input Rectifier
   - Heat Sink Fins
   - Input Filter Capacitors
   - Output Terminals
   - Terminal Strip
5. Examine the capacitors for leakage or oozing. Replace if needed.
6. Examine the wrap-around and side covers for dents and breakage. Repair them as needed. The covers must be kept in good condition to assure that high voltage parts are protected and that correct spacings are maintained.
7. Remove welding cables and check the electrical ground continuity. Use an ohmmeter to measure the resistance between each output terminal and an unpainted surface of the machine case. The meter reading should be 500,000 ohms or more. If the meter reading is less than 500,000 ohms, check for electrical components that are not properly insulated from the case. Correct component insulation, if needed.
8. Reconnect the shunt and wire #467 to the negative (-) output terminal. Make sure the connection is tight.
9. Replace and secure the machine covers and handle bar.
10. Remove the overlay from the front panel of the machine. Clean the plastic case with a low pressure airstream. Wipe the sensors (***Fig D.4*** Item 8) with a clean, soft cloth. Make sure the sensors are not scratched in the process.
11. Check the back of the overlays. If the bar code (black square(s)) on the back of the overlay is scratched, apply a dull black spray finish to the scratched-off areas only. If a large area of the bar code is scratched off, the machine either will not recognize the overlay or will mistake the overlay for another one.
12. Inspect gun and cables for good condition.

FIGURE D.4 – GENERAL COMPONENT LOCATIONS

1 DISPLAY BOARD (BACK OF PANEL)
2 POWER SWITCH
3 MAIN TRANSFORMER
4 AUXILIARY TRANSFORMER
5 INPUT RECTIFIER
6 HEAT SINK FINS
7 OUTPUT TERMINALS
8 OVERLAY BAR CODE SENSORS
9 TERMINAL STRIP (LOCATION)

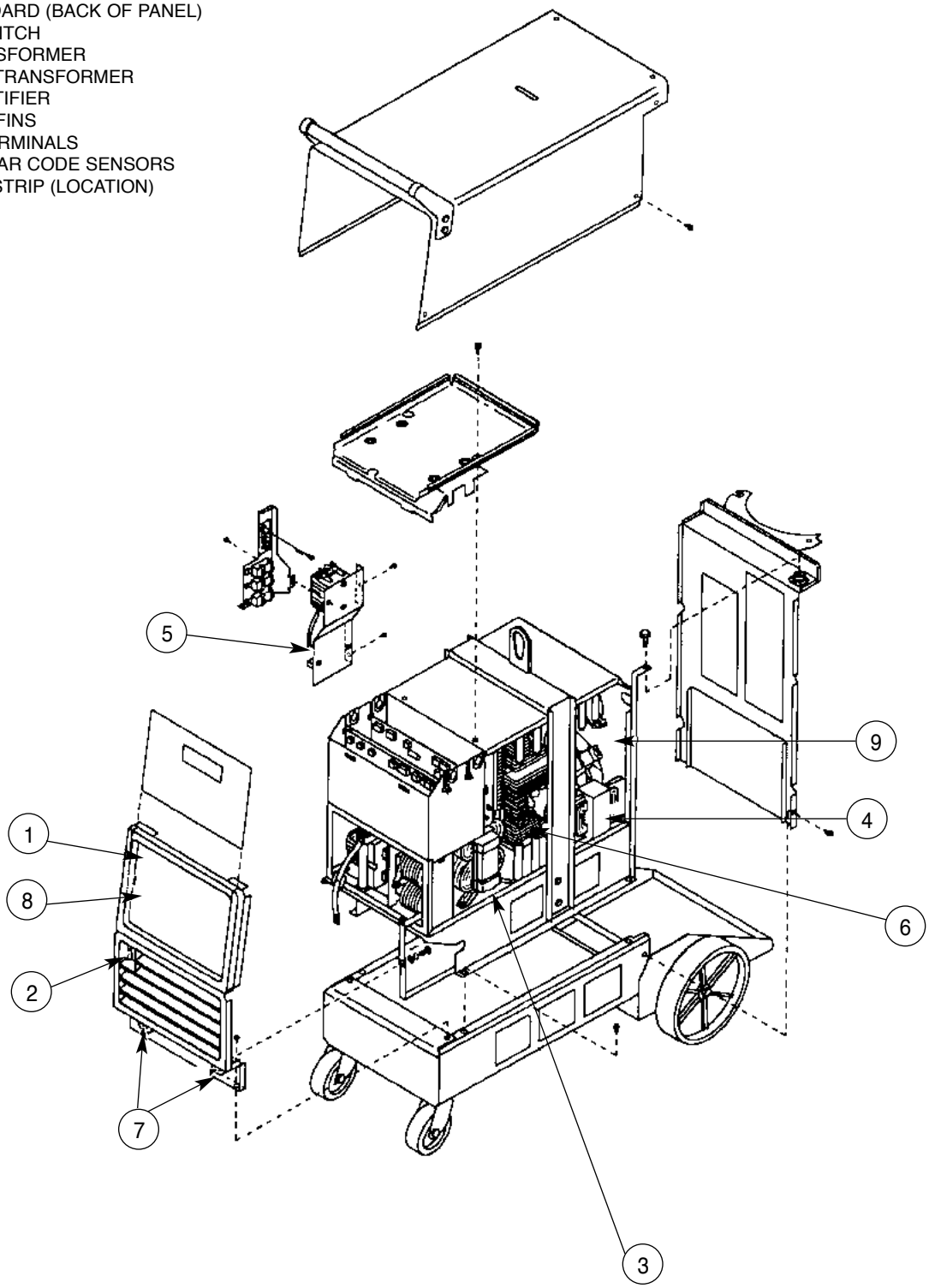

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FIGURE E.1 – POWER WAVE® BLOCK LOGIC DIAGRAM

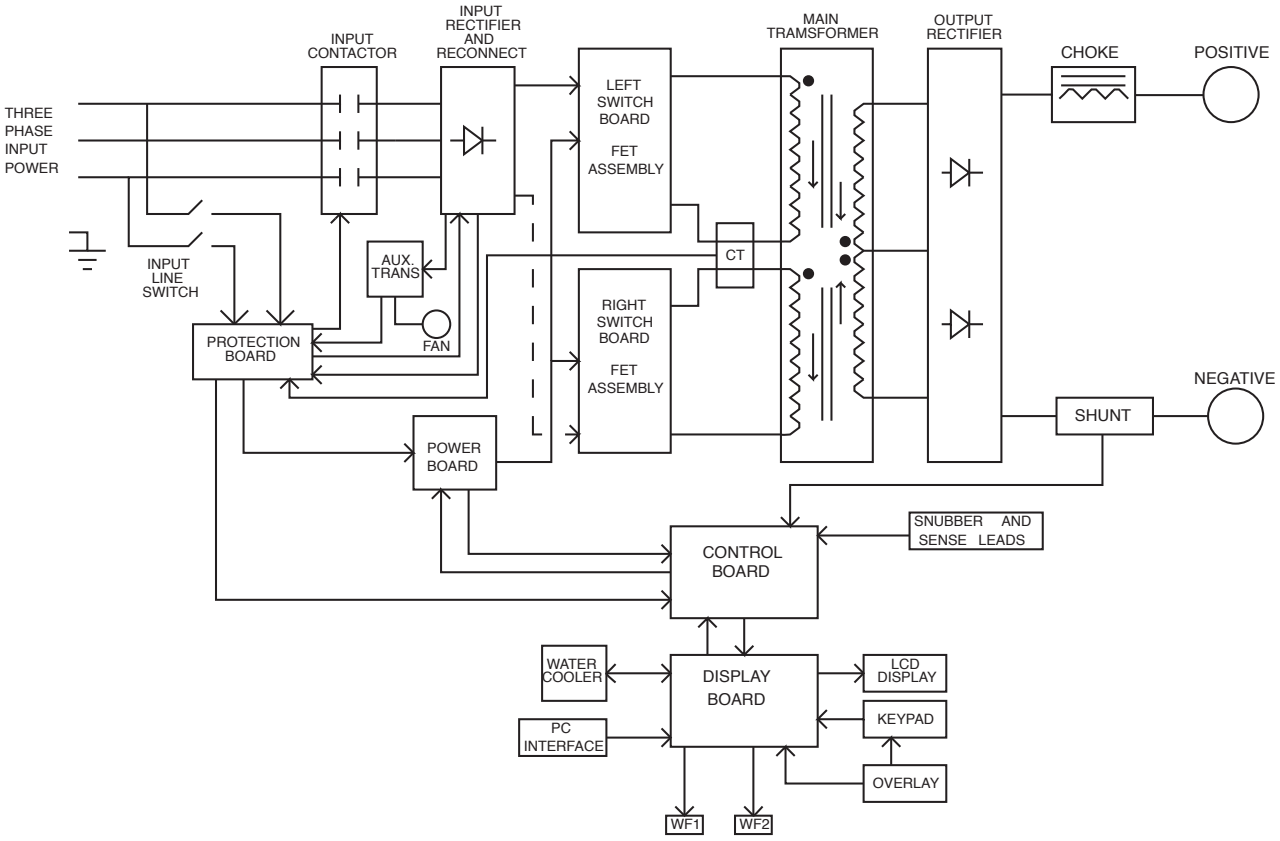

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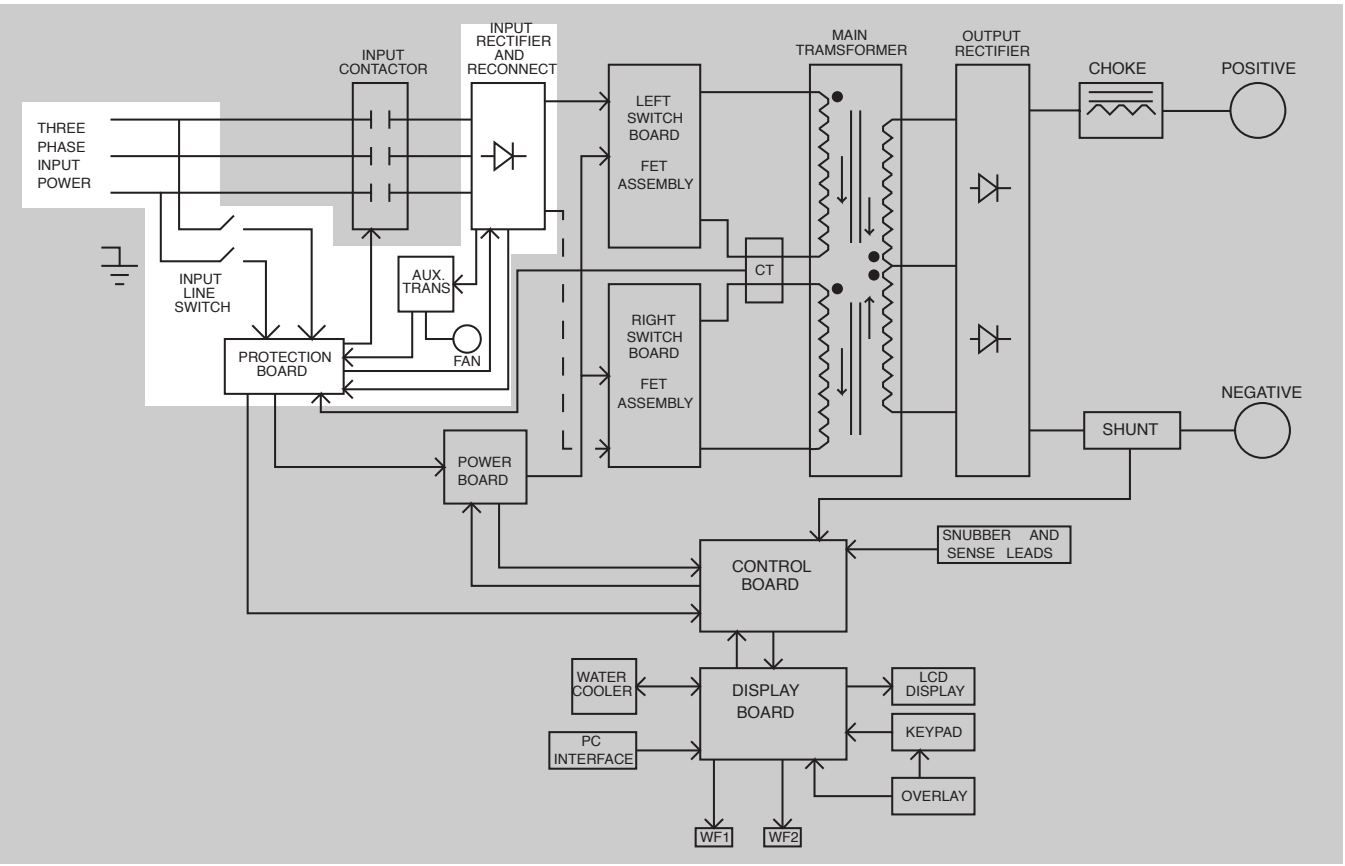
FIGURE E.2 – INPUT VOLTAGE CIRCUIT



GENERAL DESCRIPTION

The POWER WAVE® is an inverter type power source that can support most welding procedures. It is modeled after a P.C. (Personal Computer). There are no specific welding characteristics designed into the power portion of the machine. All welding characteristics are programmed into the software package.

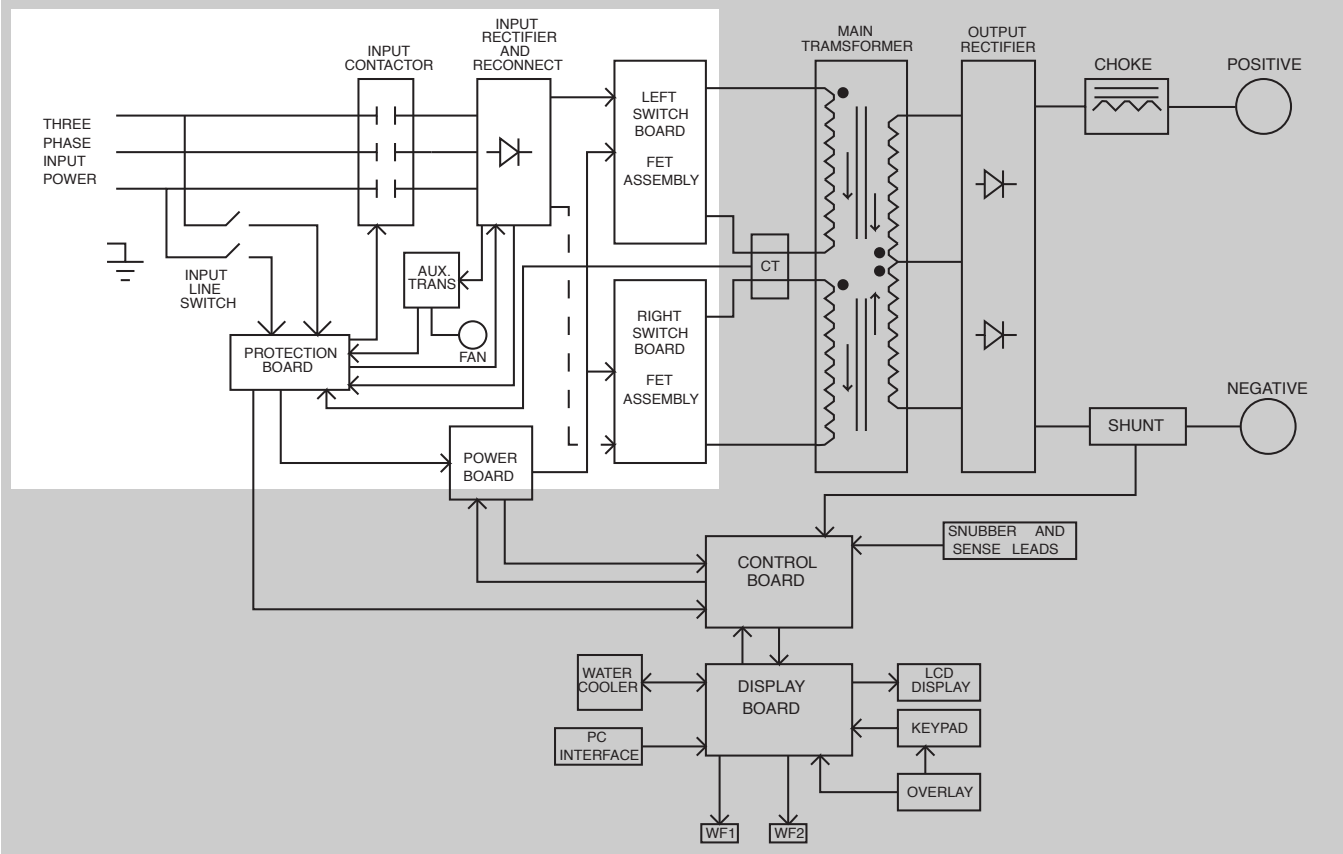
INPUT VOLTAGE

The POWER WAVE® can be connected for a variety of three phase voltages. The initial input power is applied to the POWER WAVE® through a line switch located on the front of the machine. The voltage is connected to the Protection Board where it is current limited before being passed on to the input rectifier and reconnect switches. The reconnect panel allows the user to switch to low or high voltage and connect the Auxiliary Transformer to the appropriate input voltage. The Auxiliary Transformer supplies power to the fan motors and, through the Protection Board, to the printed circuit boards and wire feeder(s).

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

THEORY OF OPERATION

FIGURE E.3 – PRECHARGE CIRCUIT



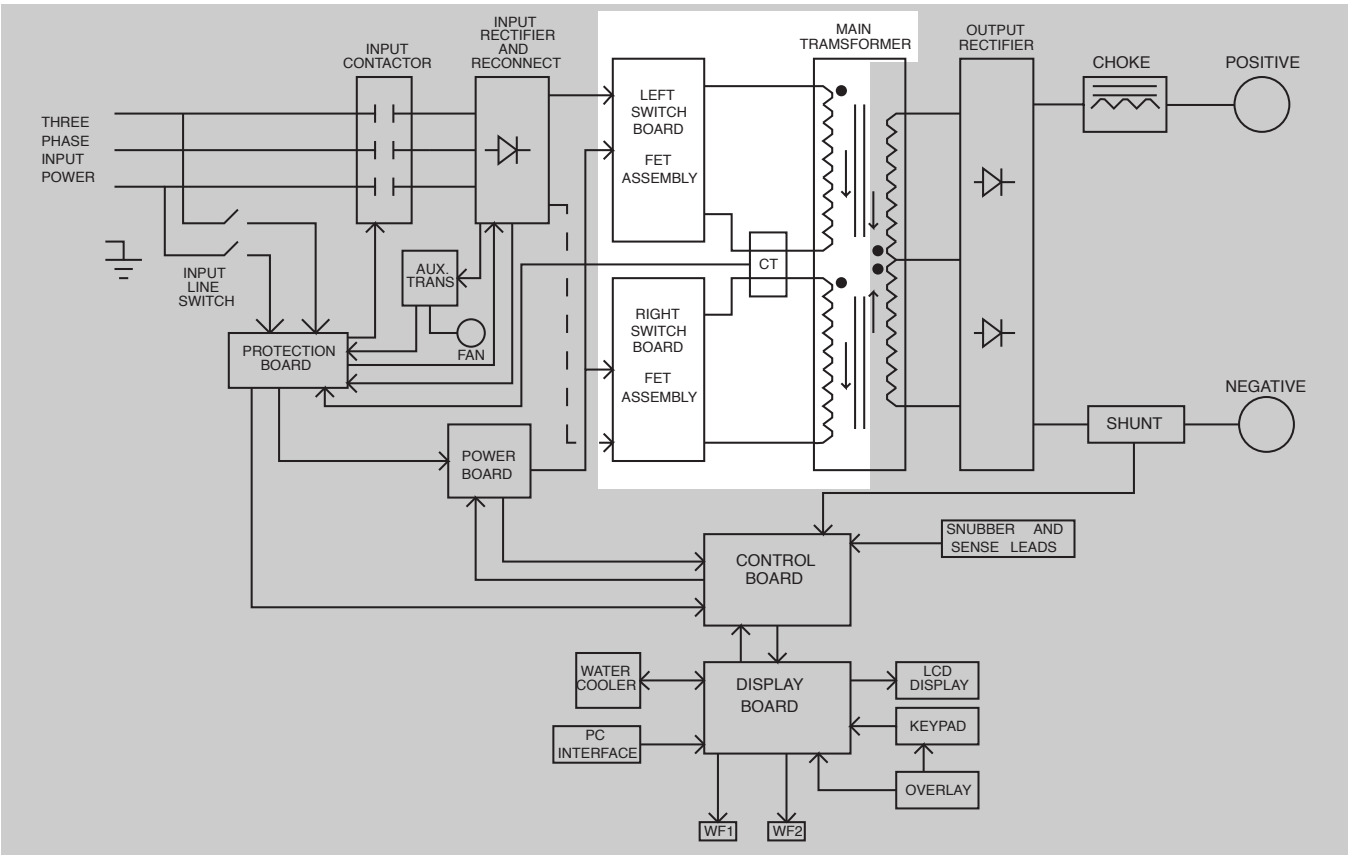
PRECHARGE (SOFT START)

The Protection Board contains a “soft Start” circuit, which is powered by the Auxiliary Transformer. During precharge or “soft start” only two phases of the input power, with current limiting, are connected to the input rectifier. This AC input voltage is rectified, and the DC voltage is applied through the Reconnect Switches to the input capacitors located on the Switch Boards. The Protection Board monitors the voltage across the capacitors. When the capacitors have charged to an acceptable level, the Protection Board energizes the Main Input Contactor, making all three phases of input power available to the input capacitors. At this point the POWER WAVE® is in the “Run Mode” of operation. If the capacitors become under- or overvoltaged, the Protection Board will de-energize the Main Input Contactor, and the machine output will be disabled.

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

THEORY OF OPERATION

FIGURE E.4 – SWITCH BOARD CIRCUIT



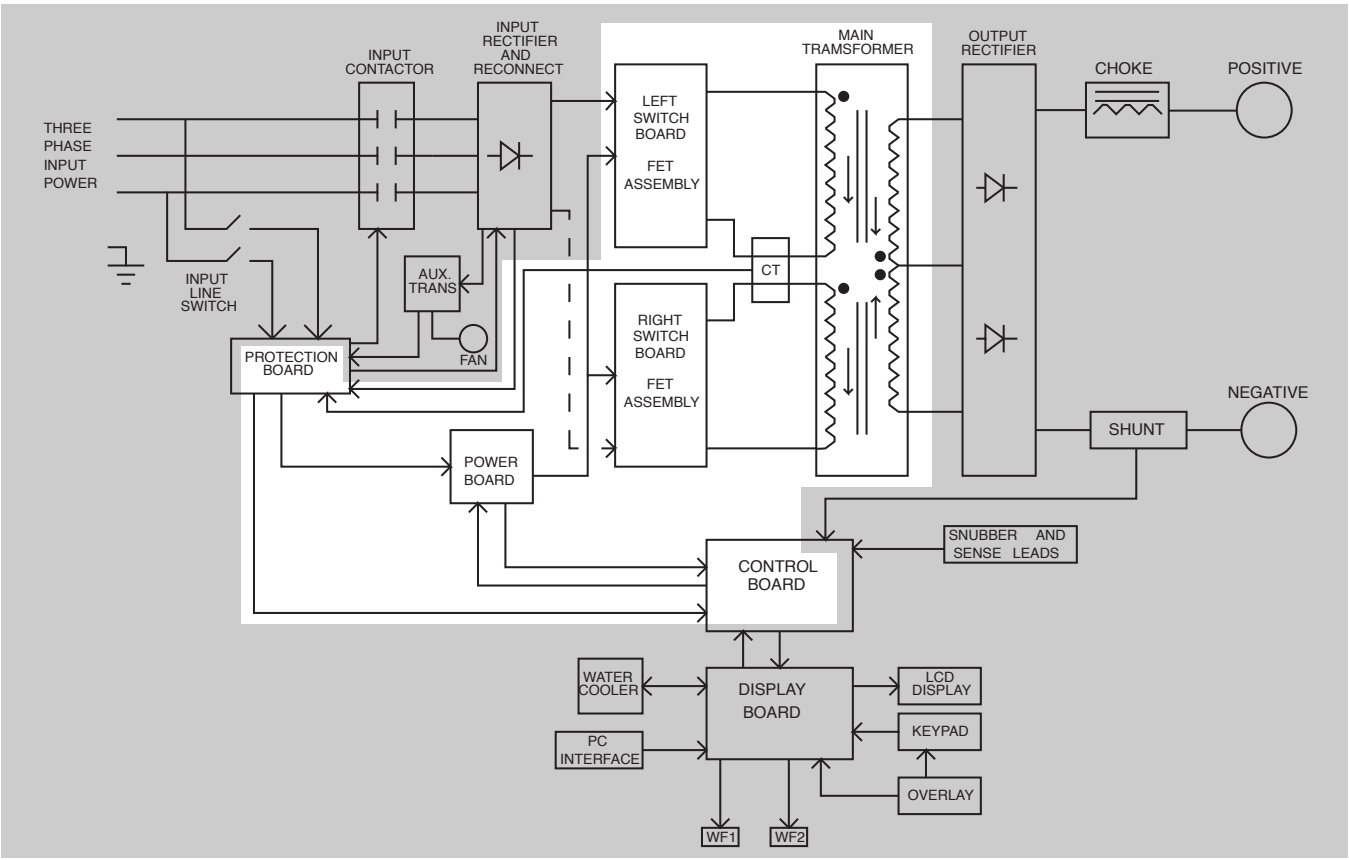
SWITCH BOARDS

There are four Switch Boards in the POWER WAVE®, each containing an input capacitor. The capacitors on Switch Boards #1 and #2 are always in parallel, and the capacitors on Switch Boards #3 and #4 are always in parallel. When the filter capacitors are fully charged, they act as power supplies for the Switch Boards. The Switch Boards contain the Field Effect Transistors (FETs) which, when switched on, supply the Main Transformer primary windings with DC current flow. See FET operation discussion and diagrams (***Figures E.10 and E11***).

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

THEORY OF OPERATION

FIGURE E.5 – MAIN TRANSFORMER



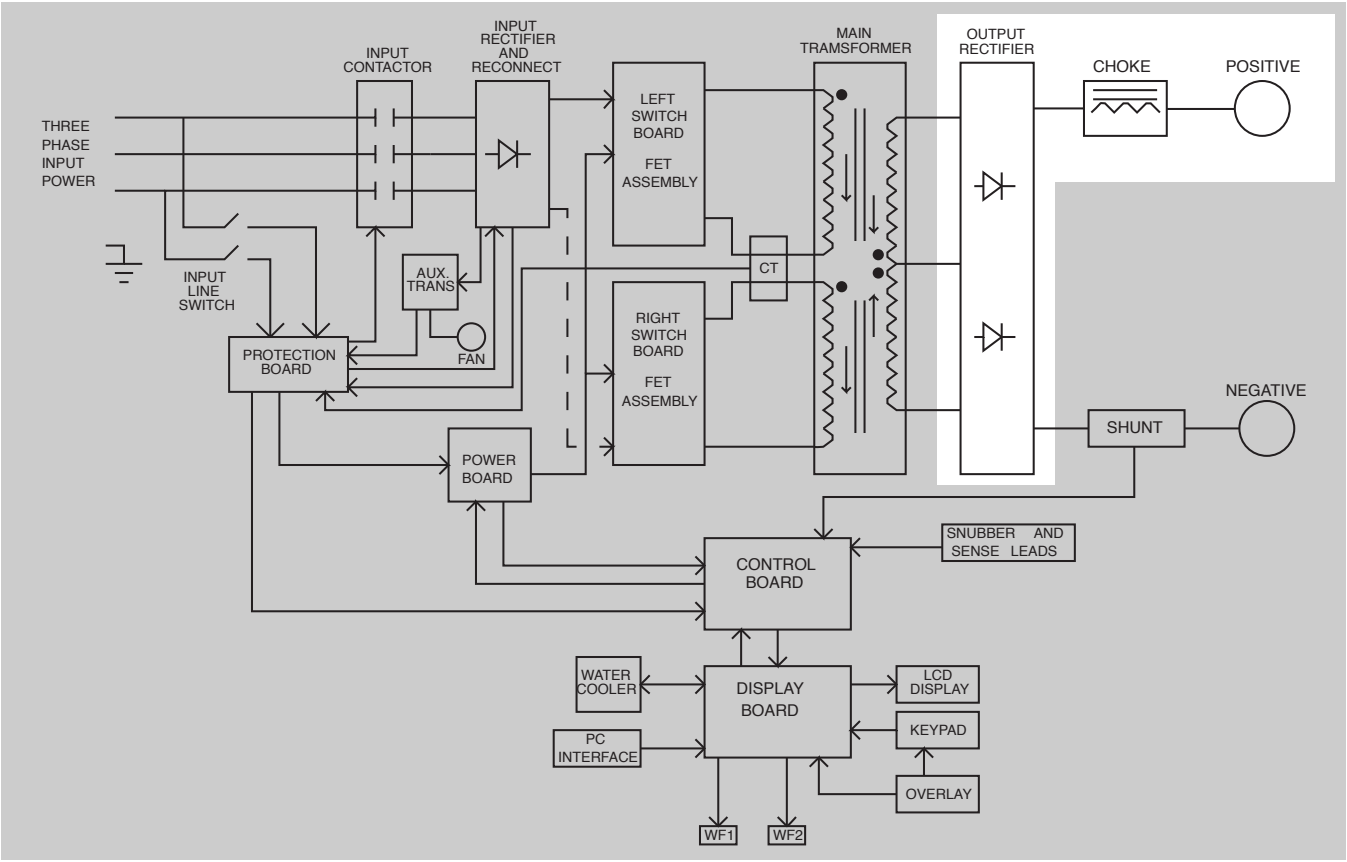
MAIN TRANSFORMER

Each Switch Board assembly works as a switch pair. Each board feeds current to a primary winding of the Main Transformer. These primary currents are monitored by the Current Transformer (CT). The CT sends a signal through the Protection Board to the Control Board. If the primary currents become abnormally high, the Control Board will shut off the FETs, thus disabling machine output. The right and left sides of the transformer are isolated from each other. The right side of the transformer is supplied from Switch Boards #1 and #2, while the left side of the transformer is supplied from Switch Boards #3 and #4. The DC current flow through each primary winding is clamped back to each respective input capacitor when the FETs are turned off. The firing of the four Switch Board pairs occurs during halves of a 50 microsecond interval, creating two constant 20 kHz square waves on the primary side of the transformer. The current flow through the Main Transformer primaries induces a 40 kHz AC square wave output signal at the secondary of the Main Transformer.

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

THEORY OF OPERATION

FIGURE E.6 – OUTPUT RECTIFIER AND CHOKE



OUTPUT RECTIFIER AND CHOKE

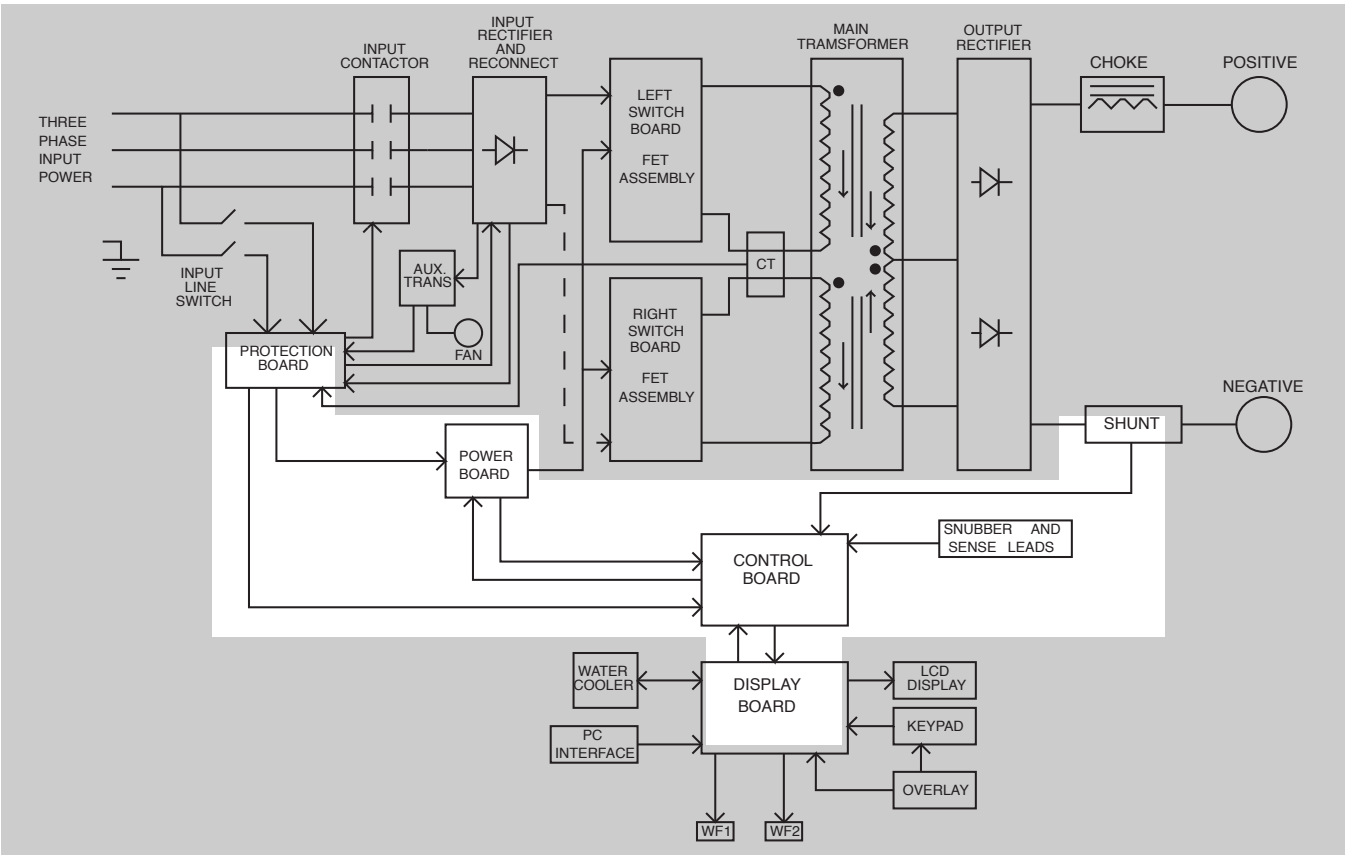
The Output Rectifier receives the AC output from the Main Transformer secondary and rectifies it to a DC level with a 40 kHz ripple.

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 output terminals.

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

THEORY OF OPERATION

FIGURE E.7 – CONTROL BOARD



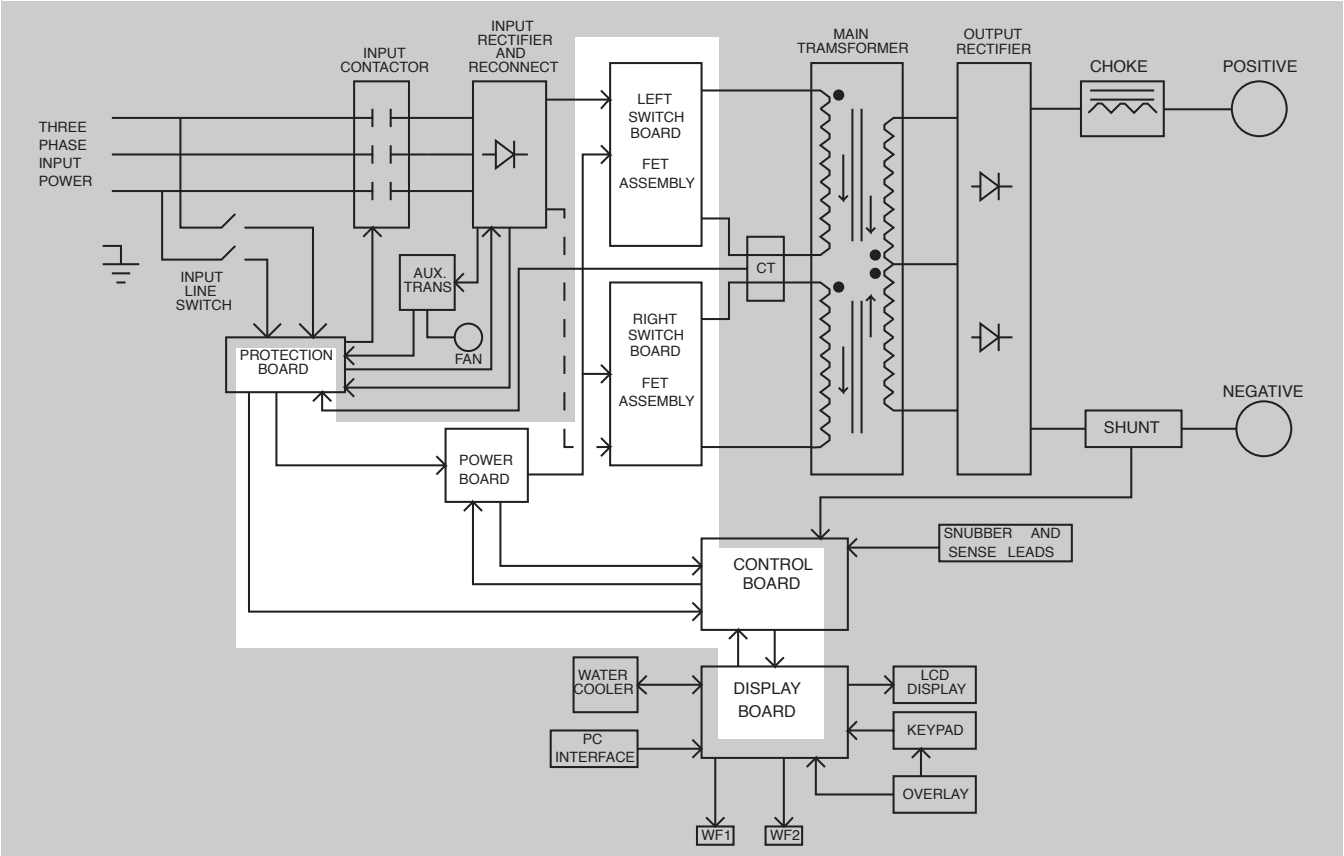
CONTROL BOARD

The Control Board is at the heart of controlling the output of the machine. With the information it receives from the Shunt (current feedback), the voltage sensing leads, the wire feeder(s), and the other printed circuit boards, the Control Board optimizes the welding results by regulating the FETs' switching times, which in turn control the output of the machine. The Control Board also monitors the thermal protection devices and the regulation and fault signals produced on the Protection Board.

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

THEORY OF OPERATION

FIGURE E.8 – POWER BOARD

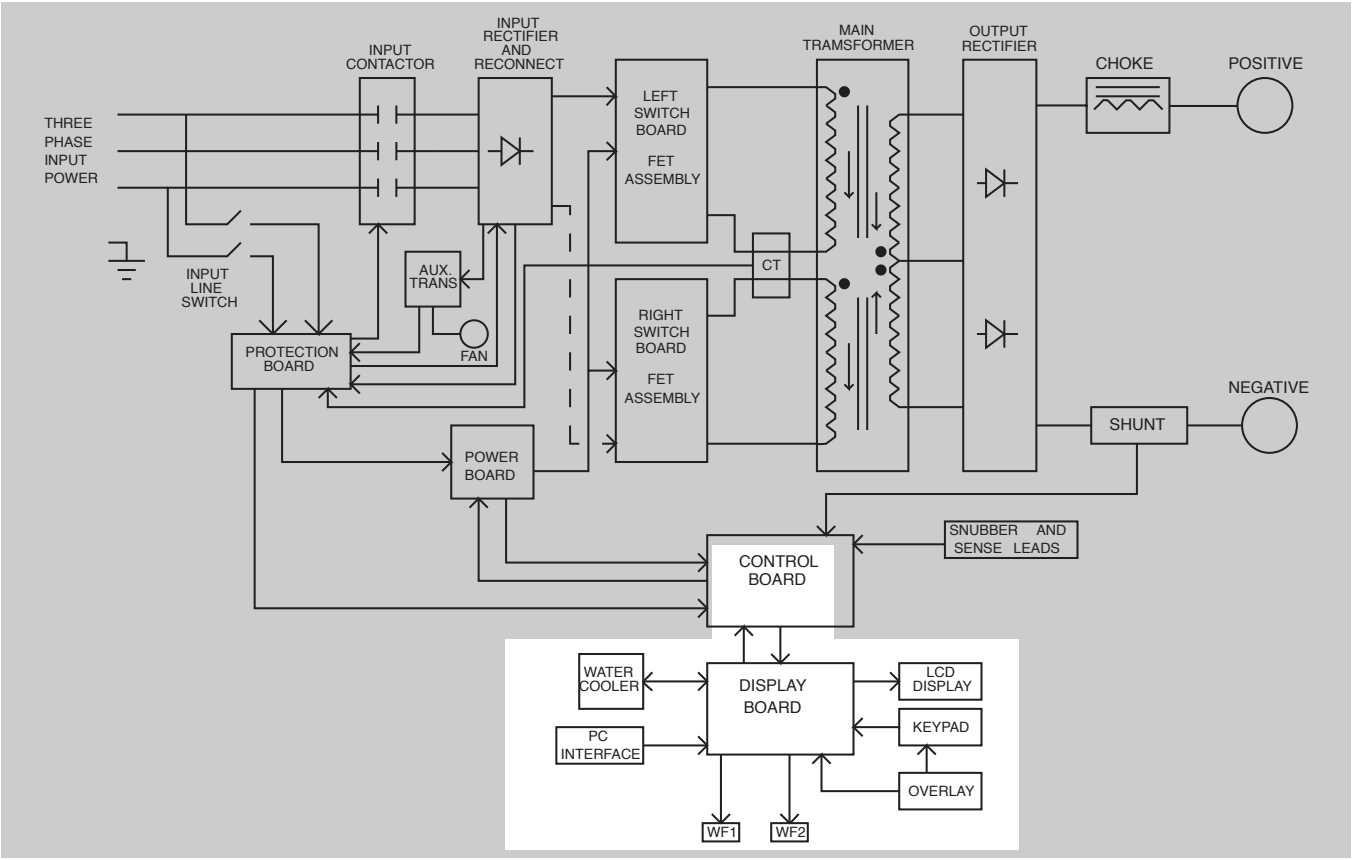


POWER BOARD

The Power Board provides gate drives for the FETs on the Switch Boards. It does so based on the “turn-on” signals it receives from the Control Board. One function of the Power Board is to isolate the Control Board from the Switch Boards. The Power Board also provides the other printed circuit boards with the DC voltage supply they require.

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

FIGURE E.9 – DISPLAY BOARD



DISPLAY BOARD

The Display Board allows the operator to select from the procedures that are programmed into the machine, and it lets the Control Board know which procedure was selected. These procedures are programmed into the machine's software package. The Display Board is used to communicate with the operator. It determines what Overlay is installed in the machine and which buttons are active on the keypad. It also controls the LCD display, the lights on the front of the machine, the Piezo Buzzer and the water cooler. Through the use of a current serial loop, the Display Board and Control Board communicate (or talk) to the wire feeder(s). The Display Board can also communicate with a computer through the RS232 interface.

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

THEORY OF OPERATION

THERMAL PROTECTION

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 a switch board, and the other is located on the main choke. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle or output rating. If excessive operating temperatures should occur, the thermostats will prevent output from the machine. The displays will remain on during this time; and the yellow Thermal light, located of the front of the machine, will be illuminated. The thermostats are self-resetting once the machine cools sufficiently. If the thermostat shutdown was caused by excessive output or duty cycle and the fans are operating normally, the Power Switch (SW1) may be left on and the reset should occur within a 15-minute period. If one or both of the fans are not turning or the air intake louvers are obstructed, then the power must be removed from the machine, and the fan problem air obstruction must be corrected.

PROTECTIVE CIRCUITS

Protective circuits are designed into the POWER WAVE® to sense trouble and shut down the machine before damage occurs to the machine's internal components.

OVER CURRENT PROTECTION

The POWER WAVE® 350 is limited to producing 600 amps peak current. If the average current exceeds 450 amps, then the peak current will be limited to 100 amps until the average current decreases to under 50 amps.

The POWER WAVE® 500 is limited to producing 725 amps peak current. If the average current exceeds 543 amps, then the peak current will be limited to 100 amps until the average current decreases to under 50 amps.

OVER VOLTAGE PROTECTION

A protective circuit is included on the Protection Board to monitor the voltage across the input capacitors. In the event that a capacitor voltage is too high, the protection circuit will prevent output. Also, in the event that a capacitor voltage is too low, the machine output is disabled and the "soft start" mode is repeated. The protection circuit may prevent output if any of the following circumstances occur:

1. Capacitor condition is required. (Required if machine has been off for a long period of time and is connected for high input voltage operation.)
2. Voltage across a capacitor exceeds 370 volts. (High line surges or improper input voltage connections.)
3. Voltage across a capacitor is under 170 volts. (Due to improper input voltage connections.)
4. Internal component damage.

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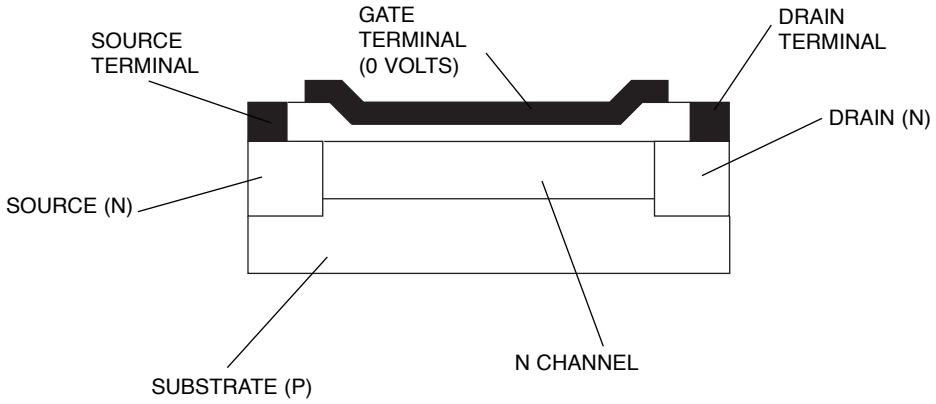
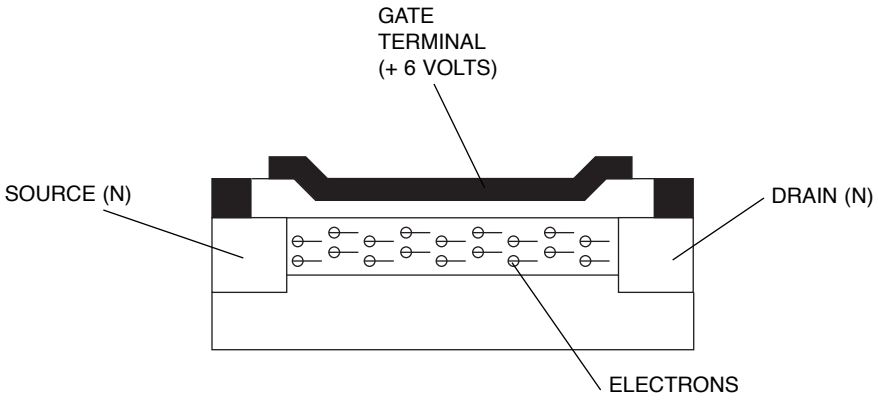
FIELD EFFECT TRANSISTOR (FET) OPERATION

FIGURE E.10 – FIELD EFFECT TRANSISTOR OPERATION



A. PASSIVE



B. ACTIVE

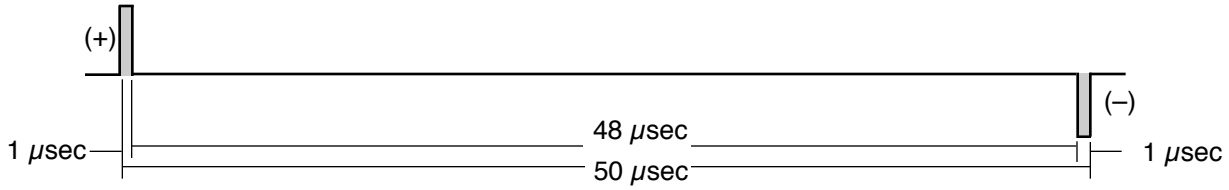
An FET is a type of transistor. FETs are semiconductors well suited for high-frequency switching.

Drawing A above shows an FET in a passive mode. There is no gate signal (zero volts) from the source and, therefore, no current flow. The drain terminal of the FET may be connected to a voltage supply. But since there is no conduction, the circuit will not supply current to downstream components connected to the source. The circuit is turned off like a light switch in the OFF position.

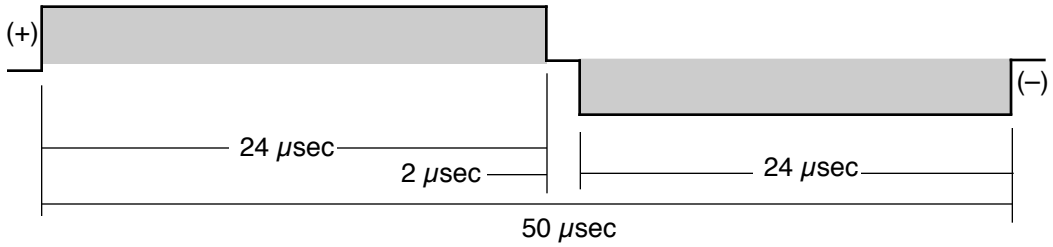
Drawing B above shows the FET in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the FET, it can't conduct current. A voltage supply connected to the drain terminal will allow the FET to conduct and henceforth supply current to downstream components. Current will flow through the conducting FET to downstream components as long as the gate signal is present. This is similar to turning on a light switch.

PULSE WIDTH MODULATION

FIGURE E.11 – TYPICAL FET OUTPUTS



MINIMUM OUTPUT



MAXIMUM OUTPUT

The term PULSE WIDTH MODULATION is used to describe how much time is devoted to conduction in the positive and negative portions of 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 FET is turned on and off for different durations during a cycle. The top drawing above shows the minimum output signal possible over a 50-microsecond time period.

The positive portion of the signal represents one FET group[1] conducting for 1 microsecond. The negative portion is the other FET group[1]. The dwell time (off time) is 48 microseconds (both FET groups off). Since only 2 microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT

By holding the gate signals on for 24 microseconds each and allowing only 2 microseconds of dwell time (off time) during the 50-microsecond cycle, the output is maximized. The darkened area under the top curve can be compared to the area under the bottom curve. The more dark area under the curve, the more power is present.

[1]A FET group consists of the sets of FET modules grouped onto one switch board.

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TROUBLESHOOTING & REPAIR

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

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

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

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "PROBLEM (SYMPTOMS). This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into 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 these 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 1-888-935-3877.

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PC BOARD TROUBLESHOOTING PROCEDURES AND REPLACEMENT

⚠ WARNING

ELECTRIC SHOCK can kill.

Have an electrician install and service this equipment. Turn the machine OFF before working on equipment. Do not touch electrically hot parts.

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.

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

Reusable Container
Do Not Destroy

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 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. Perform any necessary PC Board calibration procedures. See the flow chart on the next page.
5. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

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

6. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem. Recalibrate if required.
    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, recalibrate if required, and test the machine.
7. 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.

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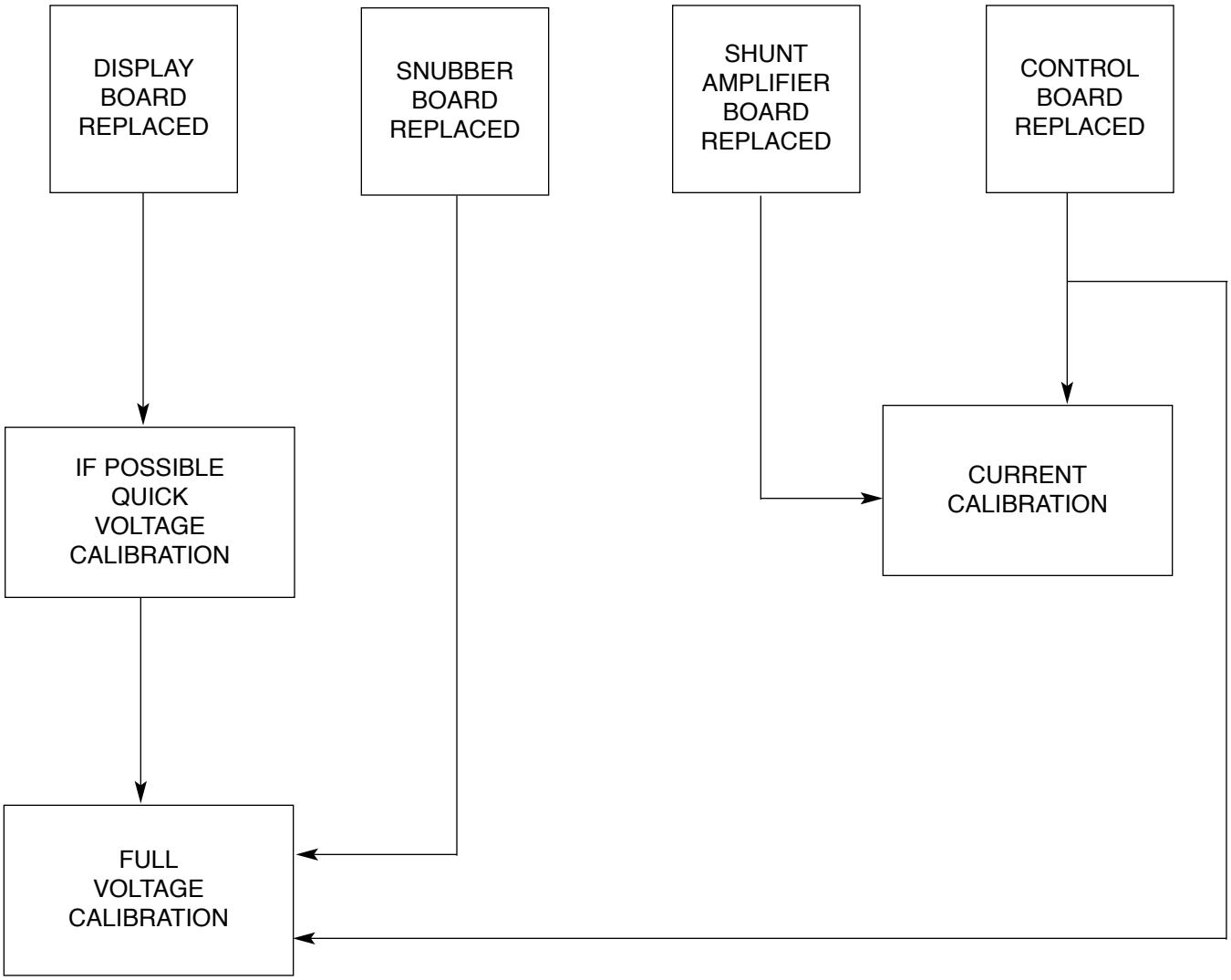
PC BOARD REPLACEMENT CALIBRATION REQUIREMENTS



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OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the sheet metal cover(s) are removed.	1. Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.	
Machine is dead – no output – no fans – no displays.	1. Check the main input fuses. If open, replace. 2. Make certain that the input power switch (S1) is in the "ON" position. 3. Check for proper input voltage – must match the rating on the machine nameplate. 4. Make certain the reconnect panel is configured properly for the applied voltage. 5. Check fuse (F1) in the reconnect panel. If faulty, replace with 5-amp slow-blow fuse.	1. If fuse (F1) quickly fails, perform the ***Auxiliary Transformer Primary Wiring Harness Test***. 2. If fuse (F1) does not fail, perform the ***Auxiliary Transformer Test #1***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has no output – fans are running – display is on – a "clicking" sound is heard coming from the machine.	1. Turn power OFF immediately. 2. Check for proper input voltage (per machine nameplate). 3. Make certain the reconnect panel is configured properly for the applied voltage.	1. Perform the ***Auxiliary Transformer Test #1***. 2. Perform the ***Main Contactor Test***. 3. Perform the ***Reconnect Switch Test #1***. 4. Perform the ***Reconnect Switch Test #2***. 5. Perform the ***Input Rectifier Test***. 6. Perform the ***Switch Board Test***. 7. Perform the ***Snubber and Bleeder Resistor Test***. 8. The protection board may be faulty. Replace. 9. The input filter capacitors may be faulty. Replace.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Fans run slow or intermittently – display is very dim – no weld output.	1. Make certain the reconnect panel and fuse (F1) jumper "A" is configured properly for the input voltage being applied.	1. Perform the ***Auxiliary Transformer Test #1***.
Machine has no output – no display – fans run – circuit breaker (5 amp) repeatedly trips.	1. Make sure that not more than 5 amps of auxiliary power are being drawn. 2. Remove the wire feeder control cable from the POWER WAVE®. If the symptom disappears, the wire feeder or control cable is faulty.	1. The circuit breaker (5 amp) may be faulty. Test or replace. 2. Perform the ***Auxiliary Transformer #1 Secondary*** and ***Wiring Harness Test***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has no output – no fans – no display. Main input fuses are open indicating excessive input current draw.	1. Check for proper input voltage connections. 2. Make certain the reconnect panel is configured properly for the applied voltage. 3. Replace the input fuses with proper size and ratings.	1. Perform the ***Input Power*** and ***Wiring Harness Test***. 2. Perform the ***Input Rectifier Test***. 3. Perform the ***Reconnect Switch Test #1***. 4. Perform the ***Switch Board Tests***. 5. Perform the ***Snubber and Bleeder Resistor Test***.
Machine has no output – no display – fans run.	1. Check circuit breaker (5 amp) located on the front panel. Reset if necessary.	1. Perform the ***Auxiliary Transformer Test #1***. 2. Perform the ***Internal and Auxiliary Supply Voltage Test***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Circuit breaker (5 amp) trips when gun trigger is pulled – fans run.	1. Make sure that not more than 5 amps of auxiliary power are being used. 2. Remove the wire feeder's control cable(s) from the POWER WAVE®. If the symptoms disappear, replace the wire feeder and cables with known good equipment. If the problem is solved, the wire feeder or control cable is faulty.	1. The 5 amp circuit breaker may be faulty. Test or replace. 2. Perform the ***Trigger Circuit and Wiring Harness Test***.
The machine intermittently loses output. The wire feeder still feeds wire.	1. If after a few seconds the contactor "pulls" back in, then check for high input line voltage.	1. Perform the ***Static Capacitor Balance Test***. 2. Perform the ***Welding Feedback Test***. 3. The control board may be faulty. Replace. 4. The shunt board assembly may be faulty. Replace.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has no welding output – fans run – display is on.	1. Make sure that the machine was powered up with a properly installed overlay. Without an overlay installed in the POWER WAVE®, or an invalid overlay installed, the machine will not have welding output. 2. Check to see if the Limits or Setup overlay is installed on the front panel. These two overlays cannot be used for welding. 3. Check for proper input voltage per machine nameplate. 4. Make certain the reconnect panel is configured properly. 5. Check to see that when the trigger is pulled on the wire feeder the wire feeder's voltage display changes to indicate arc voltage. If this does not happen, the feeder or control cable may be faulty. 6. Check wire feeder control cable for loose or faulty connections. 7. If the machine is connected for 380VAC or higher and has not been used for a long period of time, the capacitors may require "conditioning." Let the POWER WAVE® run at an idle state for 30 minutes.	1. Perform the ***Wire Feeder Trigger Circuit Test (#1 or #2)*** for the appropriate wire feeder receptacle (amphenol). 2. If a K941-1 Remote Control Kit is attached to the POWER WAVE®, then perform the ***K941-1 Remote Control Kit Trigger Circuit Test***. 3. Perform the ***Reconnect Switch Test #1***. 4. Perform the ***Output Rectifier Diodes Test***. 5. Perform the ***Switch Board Tests***. 6. Perform the ***Snubber and Bleeder Resistor Test***. 7. Perform the ***Static Capacitor Balance Test***. 8. Perform the ***Dynamic Capacitor Balance Test***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine regularly overheats-yellow light (LED) on the front panel glows, indicating a thermal overload. The fans run and the display is on.	1. Welding application may exceed recommended duty cycle. 2. Dirt and dust may have clogged the cooling channels inside the machine. Refer to the ***Maintenance Section*** of this manual. 3. Air intake and exhaust louvers may be blocked due to inadequate clearance around machine.	1. One of the thermostats located on the choke or FET heat sink may be faulty. Test or replace.
Machine does not appear to overheat, but yellow light turns on and off intermittently. Output is disabled whenever yellow light is on.	NONE	1. Check thermostats on output choke and switch board #1. These thermostats are normally closed. 2. Check leads from thermal switches to molex plug J23 on the control board for loose or faulty connections. 3. The control board may be faulty. Replace, and perform ***Voltage Calibration and Current Calibration Procedures***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The voltage and or wire feed speed will not adjust to user satisfaction.	1. Certain limits may have been imposed on the welding parameters. Refer to the Limits Overlay section of this manual.	NONE
The voltage and or wire feed speed can be adjusted on the wire feeder, but the changes are not shown on the POWER WAVE® display.	1. When the Limits Overlay or the Setup Overlay is installed in the POWER WAVE®, the machine and wire feeder displays do not match. These overlays cannot be used for welding. 2. If two wire feeders are connected to the POWER WAVE®, only one of the feeder's settings can be displayed on the POWER WAVE® at one time. Pull the trigger of the wire feeder whose settings you want displayed on the POWER WAVE®.	1. Try the other wire feeder receptacle. If the problem is solved, the initial receptacle or associated wiring is faulty. 2. If the problem persists with both wire feeder receptacles, check or replace the wire feeder and control cable. 3. If the wire feeder and control cable are OK, then perform the ***Serial Loop Wiring Harness Test***. 4. The display board may be faulty. Replace and perform ***Voltage Calibration***. 5. The control board may be faulty. Replace and perform ***Voltage Calibration and Current Calibration***.
The Dual Procedure overlay is installed, and the user cannot change from procedure "A" to procedure "B" or vice versa.	1. Check for proper installation of the Dual Procedure overlay. 2. Check the Dual Procedure Gun Trigger or separate dual procedure switch.	1. Perform the ***Serial Loop Wiring Harness Test***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The display cannot be seen clearly or cannot be seen at all.	1. Adjust the viewing angle of the display. Follow the instructions provided in the ***OPERATION Section*** of this manual. (Look under the "LCD DISPLAY ADJUSTMENTS" in the "CONTROLS AND SETTINGS" subsection of the ***OPERATION Section.***)	1. Perform the ***LCD Display Test***.
Machine does not respond to keys being pressed, or the machine has improper displays.	1. Each time an overlay is changed, make certain that the machine is powered-up with the new overlay in place. 2. Make certain that the correct overlay ID number is displayed on power-up. Refer to the ***OPERATION Section*** of this manual for the overlay description. 3. In some cases, some of the keys on the overlay may be locked out. Refer to the OPERATION Section of this manual for the overlay descriptions.	1. Perform the ***Serial Loop Wiring Harness Test***. 2. Replace the control board and perform ***Voltage Calibration and Current Calibration***. 3. Replace the display board and perform ***Voltage Calibration***. 4. Replace the power board.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
Machine display reads “Error Invalid Overlay,” or it displays an invalid ID number on power-up.	1. Make certain the overlay is installed properly. 2. Inspect the infrared sensors on the front panel. If they are dirty, blow them out with low pressure air and clean with a soft cloth. 3. Inspect for damage to the Bar Code(s) (black squares) on the back of the overlay.	1. Perform the ***Sensor Calibration Test***.
Machine displays “ERROR: S.L. NOT INITIALIZED” on power-up.	1. Contact your local Lincoln Authorized Field Service Facility for technical assistance.	1. Perform the ***Serial Loop Wiring Harness Test***. 2. The control board may be faulty. Replace and perform ***Voltage Calibration and Current Calibration***. 3. The display board may be faulty. Replace and perform ***Voltage Calibration***. 4. The power board may be faulty. Replace.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The Beeper (Piezoelectric Buzzer) cannot be heard – machine operating normally.	1. Background noise may be too loud for user to hear beeper.	1. Perform the ***Piezoelectric Buzzer Test***. 2. The display board may be faulty. Replace and perform voltage calibration.
The welding parameters that were saved in memory are different when recalled.	1. Make certain that a remote control unit is NOT connected. When a remote control unit is used, the weld parameters are set by the remote control potentiometers.	NONE
The water cooler does not turn on.	1. Make sure that the water cooler has been enabled. Refer to the Setup Overlay description in the ***OPERATION Section*** of the manual. 2. If the water cooler is enabled but there is insufficient pressure in the water cooler hose, the POWER WAVE® will beep loudly, and the water cooler will shut down. Prime the water cooler. Refer to the Setup Overlay description in the ***OPERATION Section*** of this manual.	1. Perform the ***Auxiliary Transformer #2 Test***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The machine beeps without the keys being pressed.	If the water cooler is enabled and the pressure switch inside the water cooler opens (due to inadequate pressure in the water cooler hose), the machine indicates this by beeping. This happens regardless of the overlay placed on the machine. In this case, do the following: 1. Turn the machine off and on a couple of times and see if the beeping ceases. If so, then check the water hoses for kinks and other causes for momentary reduced water flow. 2. Check the water cooler fluid level. Low fluid level could cause the pressure to drop. 3. Prime the water cooler. Refer to the Setup Overlay section for instructions.	1. Perform the ***Auxiliary Transformer #2 Test***. 2. The water cooler may be defective. Replace.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
Foreign characters are shown on the POWER WAVE® display.	Contact your local Lincoln Authorized Field Service Facility.	1. Make sure molex plug J19 is plugged into the Display board securely and the pins are secure in the plug body. 2. The display board may be faulty. Replace and perform ***Voltage Calibration***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The control knob on the Remote Control Kit (K941-1) does not change the preset current on the POWER WAVE® display.	1. Make sure that a stick welding procedure is selected on the POWER WAVE®. 2. Make certain that the (K941-1) remote control is securely plugged into the POWER WAVE® 6 pin amphenol receptacle.	1. Perform the ***(K941-1) Remote Control Kit Troubleshooting Test*** or install a new K941-1. 2. Perform the ***Internal Remote Control Test***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
Machine loses output while welding. Fans and display are functioning properly.	1. Check the yellow High Temperature light on the front-panel. If the light is "ON," then refer to the Output Problems section in this table relating to this condition. 2. Check for proper input voltages (per machine nameplate). 3. Check for balanced three-phase input supply voltages. 4. Check electrode and work cables for loose or poor connections.	1. Perform the ***Welding Feedback Test***. 2. Perform the ***Switch Board Tests***. 3. Perform the ***Snubber and Bleeder Resistor Test***. 4. Perform the ***Static Capacitor Balance Test***. 5. Perform the ***Dynamic Capacitor Test***. 6. Perform the appropriate ***Wire Feeder Trigger Circuit Test***. If a K941-1 Remote Control Kit is used, perform the ***K941-1 Remote Control Kit Trigger Circuit Test***.

⚠ CAUTION

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

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
For no apparent reason the weld characteristics have changed.	1. Check for proper wire feed speed setting. In the MIG/MAG and FCAW Modes, check for proper voltage settings. In the MIG/MAG Pulse Modes, check the arc length trim setting. These controls are on the wire feeder. In the Stick Mode, check for proper preset current setting. 2. Check for proper shielding gas and gas flow. 3. Check for loose or faulty welding cables.	1. If zero arc voltage is displayed while welding, the voltage sense leads may be broken. Check the following molex plugs and associated wiring for loose or faulty connections: J60, J62 on the snubber board J20 on the control board 2. Perform the ***Welding Feedback Test***. 3. The control board may be faulty. Replace and perform ***Voltage Calibration and Current Calibration***.
The arc is “too hot,” and cannot be adjusted.	1. Perform the ***Full Voltage Calibration***.	1. Check plugs J60, J62 and J20 for loose or faulty connections. See Wiring Diagram. 2. The snubber board may be faulty. Replace. 3. The control board may be faulty. Replace.

⚠ CAUTION

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

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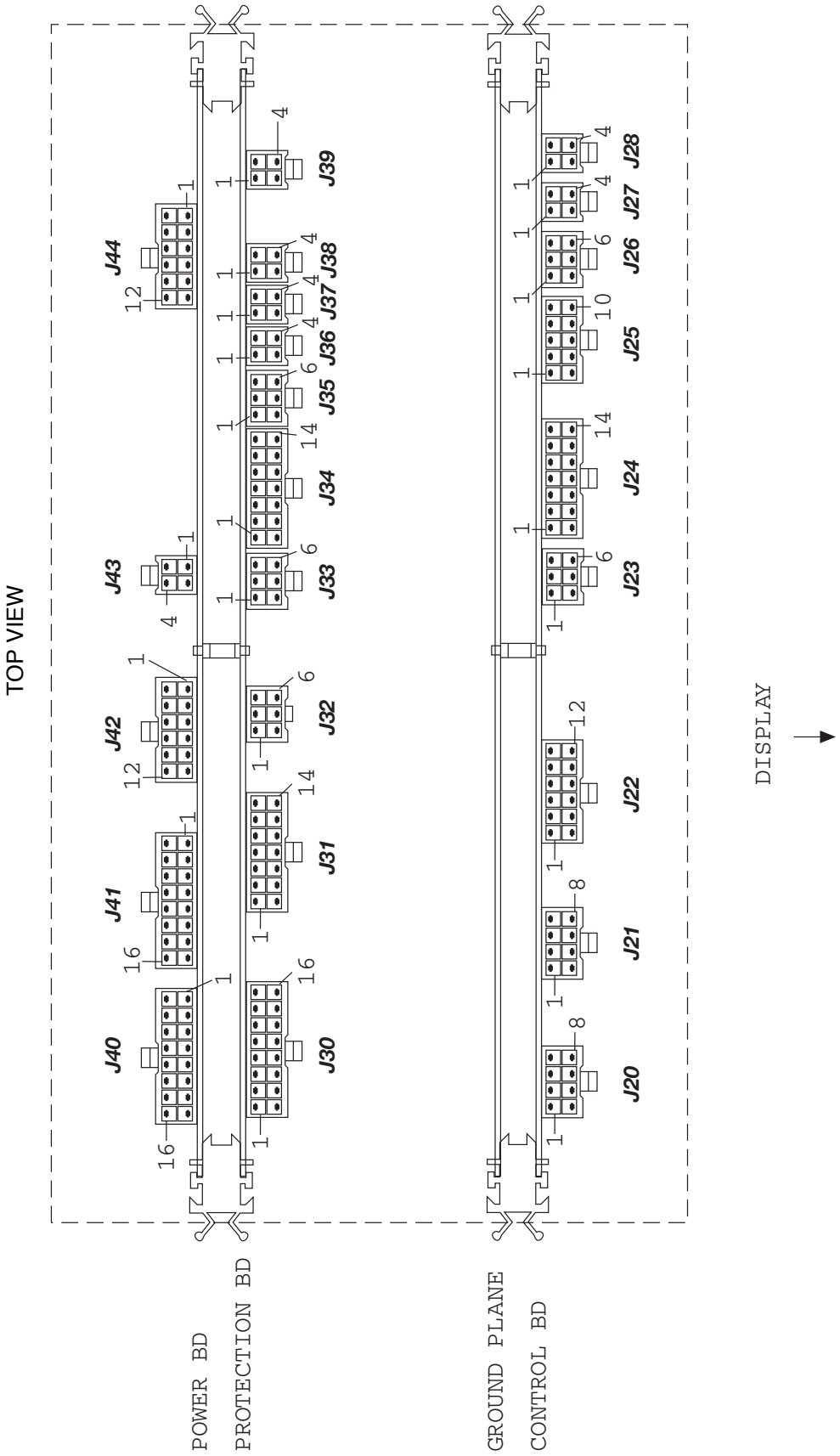
PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
Machine often “noodle welds” with a particular procedure.	1. The machine may be trying to deliver too much power. When the average output current exceeds a maximum limit, the peak current is drastically cut back. Lower the welding parameter settings and/or increase the stickout length to eliminate this problem. POWER WAVE® 350 – When the average output current exceeds 450 amps, the peak output current is folded back to 100 amps. POWER WAVE® 500 – When the average output current exceeds 540 amps, the peak output current is folded back to 100 amps.	NONE

⚠ CAUTION

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

PC BOARD CONNECTOR LOCATIONS

FIGURE F.1 – PC BOARD CONNECTOR LOCATIONS



CAPACITOR DISCHARGE 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 1-888-935-3877 .

PURPOSE FOR THE PROCEDURE

This procedure will drain off any charge stored in the four large capacitors that are part of the FET switch board assembly. This procedure MUST be performed, as a safety precaution, before conducting any test or repair procedure that requires you to touch internal components of the machine.

MATERIALS NEEDED

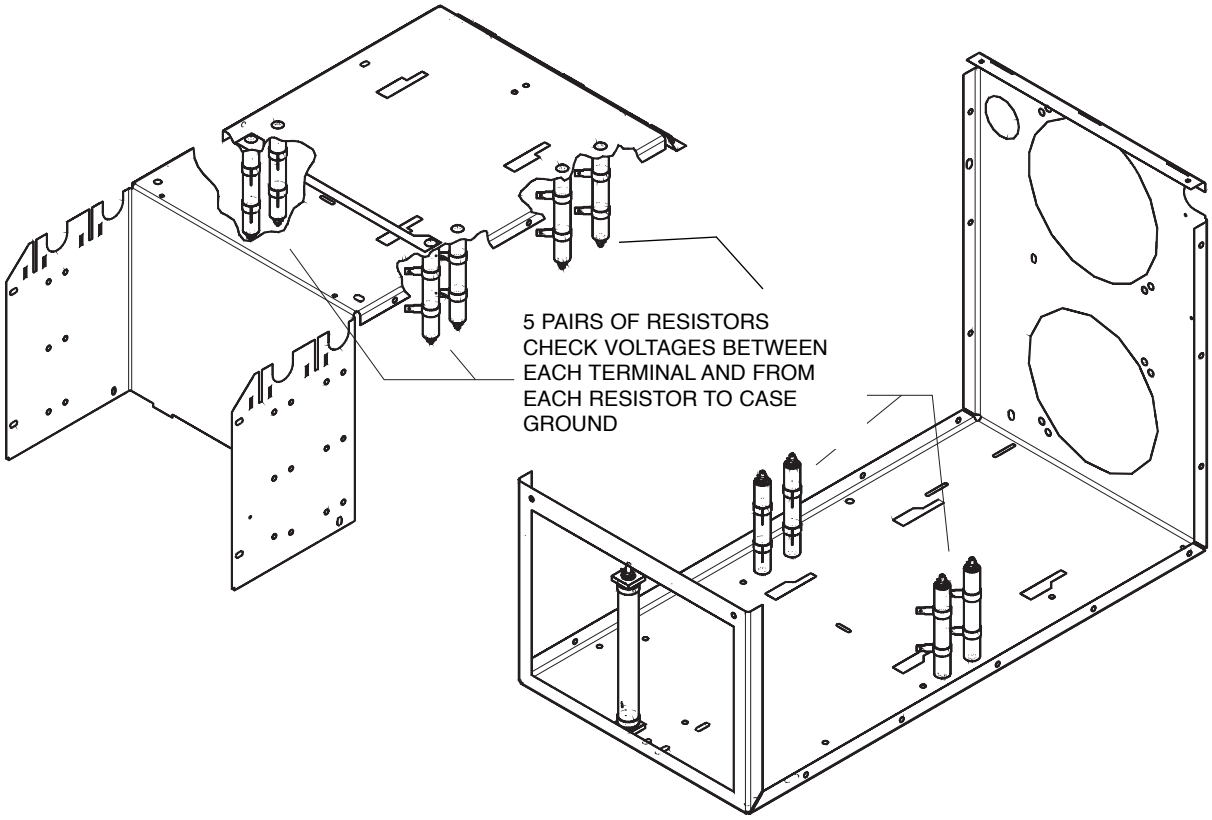
Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Insulated gloves
Jumper wire with insulated leads and needle-nose ends
High wattage resistor - 25 to 1000 ohms, 25 watts minimum
Piece of glastic board or similar insulating materials on which to secure the resistor

CAPACITOR DISCHARGE PROCEDURE *(continued)*

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Obtain a high resistance and high wattage resistor (25 - 1000 ohms, 25 watts minimum). This resistor is not supplied with the machine. Secure this resistor to a piece of insulating material such as a glastic board. ***See Figure F.4***. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.
7. Locate the two sets of two resistors on the left side of the machine and three sets of two resistors on the right side of the machine. See Figure F.2. Do not touch the resistors or any other internal machine component. Using a DC voltmeter, check for any DC voltage that may be present across the terminals of each resistor and from each resistor to case ground (20 measurements in all). If a voltage is present, be careful not to touch these resistors.
8. Locate terminals #9 and #12 on the switch boards. They can be identified by the "Discharge" labels, which are located on each of the four switch boards. ***See Figure F.3***.

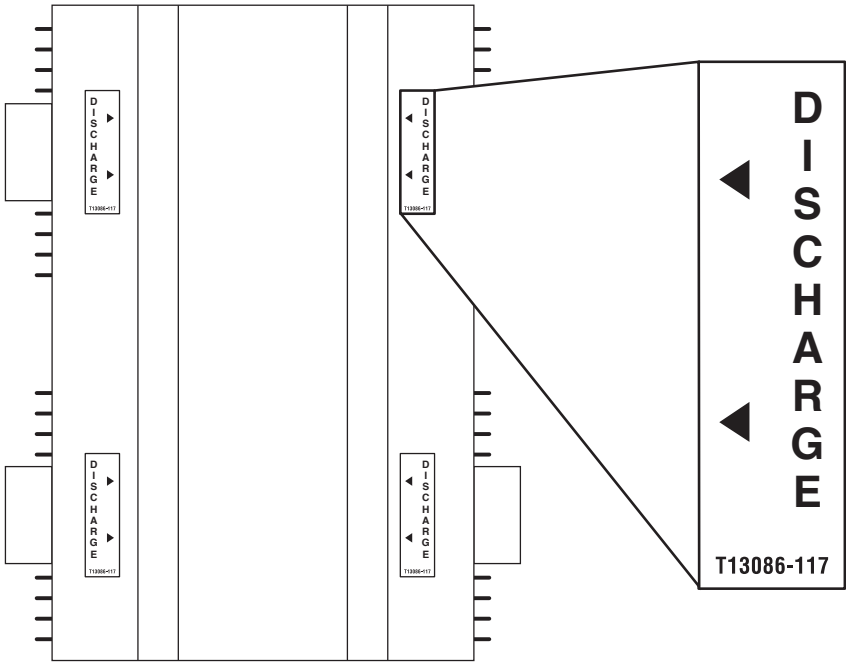
FIGURE F.2 – RESISTOR LOCATIONS



Return to Section TOC
Return to Master TOC

CAPACITOR DISCHARGE PROCEDURE *(continued)*

FIGURE F.3 – DISCHARGE LABEL



⚠ WARNING

ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the discharge procedure.

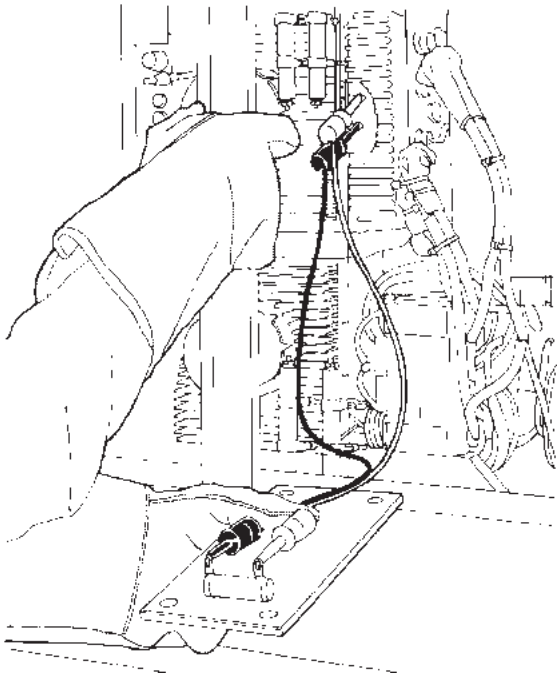
9. Using the insulated, needle nose type jumper leads and insulated gloves, connect one jumper lead to one end of the resistor obtained in step 6. Connect the other jumper lead to the other end of the resistor.

10. Carefully connect the needle nose end of one of the jumper leads to terminal #9. ***See Figure F.5***. Connect the needle nose end of the other jumper lead to terminal #12. Terminals #9 and #12 are indicated by the "Discharge" label. Leave the resistor connected for 10 seconds. DO NOT TOUCH TERMINALS, RESISTORS, OR ANY INTERNAL MACHINE COMPONENTS DURING THIS PROCEDURE!

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

CAPACITOR DISCHARGE PROCEDURE *(continued)*

FIGURE F.4 - RESISTOR WITH LEADS CONNECTED.



11. Check the voltage across terminals #9 and #12 with the DC voltmeter. Terminal #9 has positive polarity and terminal #12 has negative polarity. Voltage should be zero. If any voltage remains, repeat this capacitor discharge procedure.

12. Repeat discharge procedure steps 9, 10, and 11 for each of the other three switch boards of the FET switch board assembly.

AUXILIARY TRANSFORMER TEST #1

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

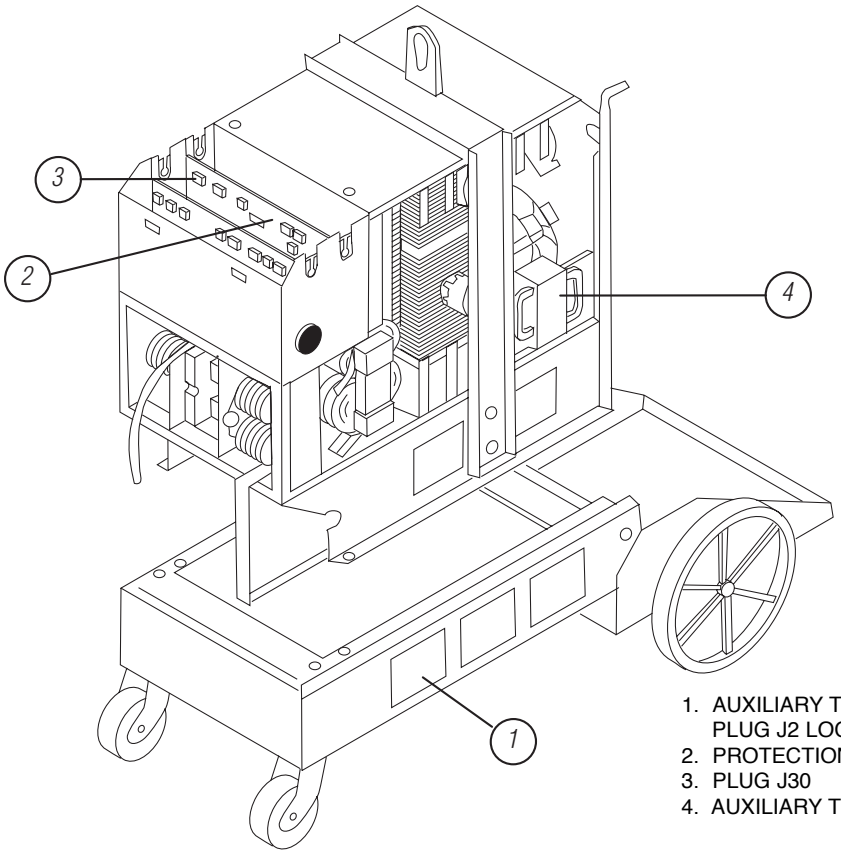
This test will determine if the correct voltage is being applied to the primary of Auxiliary Transformer #1 and also if the correct voltages are being induced on the secondary windings of the transformer.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.6.

AUXILIARY TRANSFORMER TEST #1 *(continued)*

FIGURE F.5 - TRANSFORMER T1 AND T2 LOCATION



1. AUXILIARY TRANSFORMER T1, PLUG J2 LOCATED IN BASE
2. PROTECTION BOARD
3. PLUG J30
4. AUXILIARY TRANSFORMER T1

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J2 from the T2 transformer located in the machine base assembly. This is a 6-pin molex plug with 4 wires; see Figure F. 5 for location. T2 is connected in parallel with T1. Leaving the two transformers connected in parallel for the test might result in incorrect readings; therefore plug J2 should be disconnected.
9. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.
10. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

AUXILIARY TRANSFORMER TEST #1 *(continued)*

11. Remove plugs J32 and J33 from the protection board.
12. Turn the main input supply power to the machine back ON.

⚠ WARNING

ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the remainder of the test procedure.

13. Check for the correct AC voltage at plugs J32 and J33 as follows. (DO NOT CHECK THE VOLTAGE ON THE PROTECTION BOARD!)

    Test A: J33 - pin 1 (lead 32A) to J33 - pin 3 (lead 333) = 42 VAC

    Test B: J33-1 (32A) to J33-4 (334) = 24 VAC

    Test C: J32-1 (321) to J32-3 (323) = 24 VAC

If the voltage checks are good, then Auxiliary Transformer #1 is good.

If Test C is good but Tests A and B are not correct, check the 5 amp circuit breaker (located on the front panel of the machine). See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.6***.

If all the secondary voltages are wrong or missing, check the associated wiring to the transformer primary. These voltages are most easily checked at the terminal strip. The correct voltages are as follows:

H1 to H2 = 220 - 230 VAC

H1 to H3 = 380 - 415 VAC

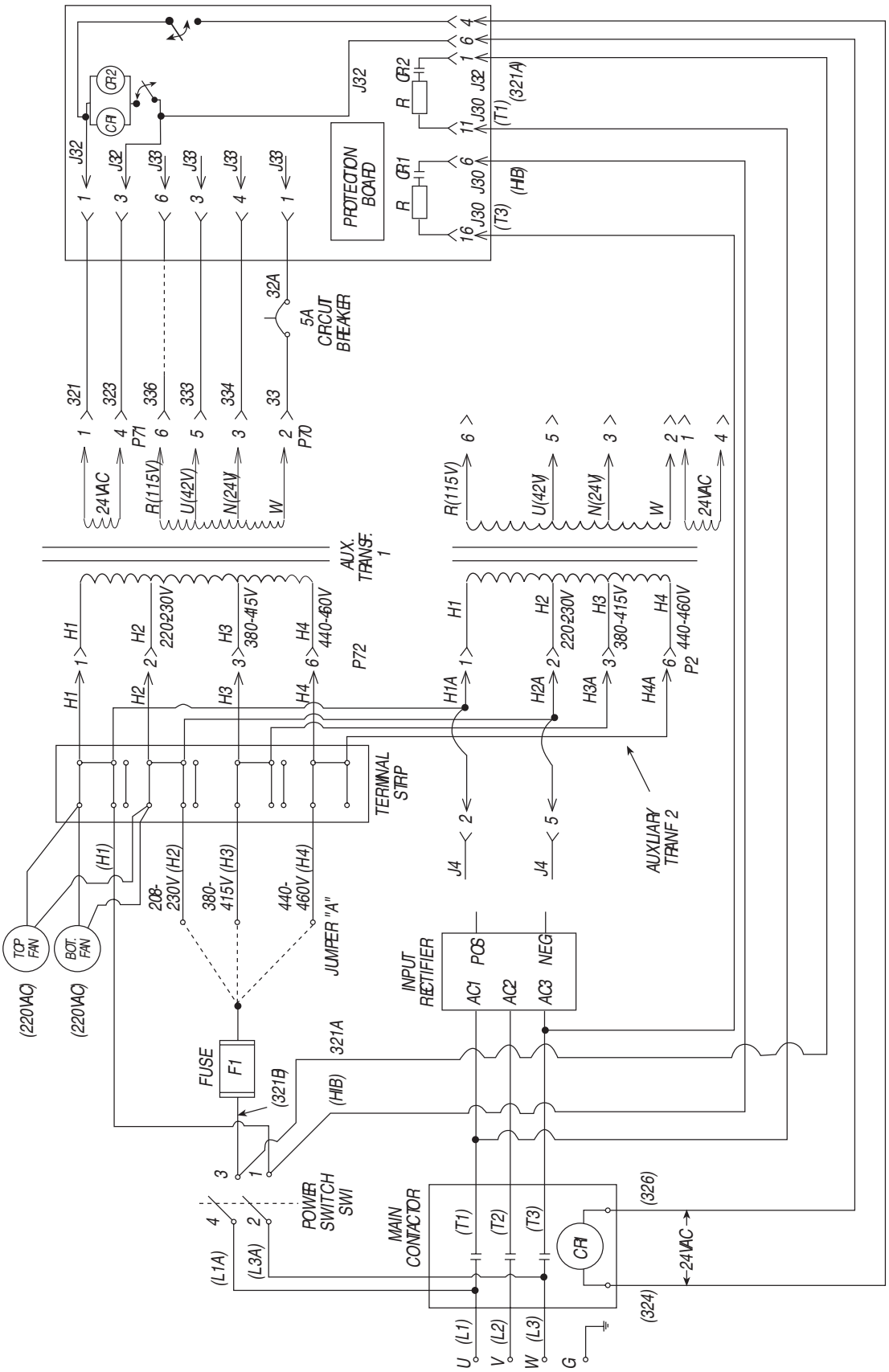
H1 to H4 = 440 - 460 VAC

If these voltages are wrong or missing, check the associated wiring to the transformer primary. Check the leads at power switch S1. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.6***.

If the correct voltages are applied to the primary and the secondary voltages are incorrect, the transformer may be faulty. Replace the transformer. Refer to the T1 Auxiliary Transformer Removal and Replacement procedure in this section of the manual.

14. After the test is completed and the problem successfully repaired, reconnect plugs J30, J32 and J33 to the protection board.
15. Reconnect plug J2 to the T2 transformer.
16. Reconnect the 5 leads to the main contactor CR1.
17. Install the PC board cover.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

FIGURE F.6 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER TEST #2

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

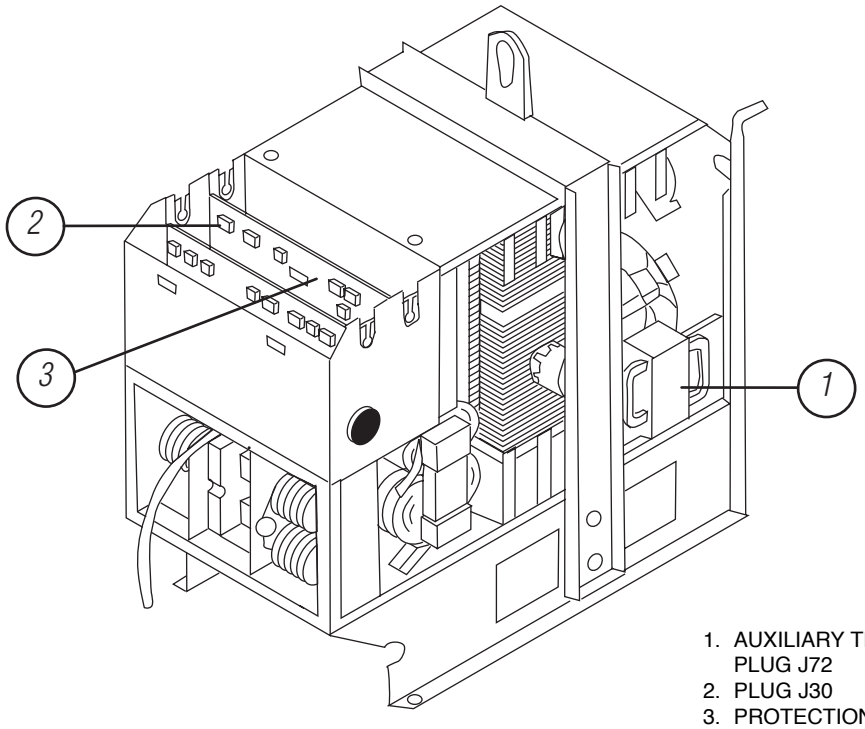
This test will determine if the correct voltage is being applied to the primary of Auxiliary Transformer #2 and also if the correct voltages are being induced on the secondary windings of the transformer.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.8

AUXILIARY TRANSFORMER TEST #2 *(continued)*

FIGURE F.7 - TRANSFORMER T1 AND T2 LOCATION



1. AUXILIARY TRANSFORMER T1 WITH PLUG J72
2. PLUG J30
3. PROTECTION BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J72 from the T1 transformer. T2 is connected in parallel with T1. Leaving the two transformers connected in parallel for the test might result in incorrect readings; therefore plug J72 should be disconnected.
9. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.
10. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

AUXILIARY TRANSFORMER TEST #2 *(continued)*

11. To conduct this test, you will be measuring the voltage between pin 2 and pin 5 of plug J4. The plug is located in the machine undercarriage and is somewhat difficult to reach. It is probably easiest to disconnect the plug and insert the probes of your voltmeter alongside pins 2 and 5 before turning on input power, which is the next step.
12. Turn the main input supply power to the machine back ON.

⚠ WARNING

ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the remainder of the test procedure.

13. Check for the correct AC voltage between plug J4 - pin 2 and J4 - pin 5. It should be 220 - 230 VAC.

If the voltage is correct, then Auxiliary Transformer #2 is good.

If the voltage is wrong or missing, check the associated wiring to the transformer primary. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.8***. These voltages are most easily checked at the terminal strip. The correct voltages are as follows:

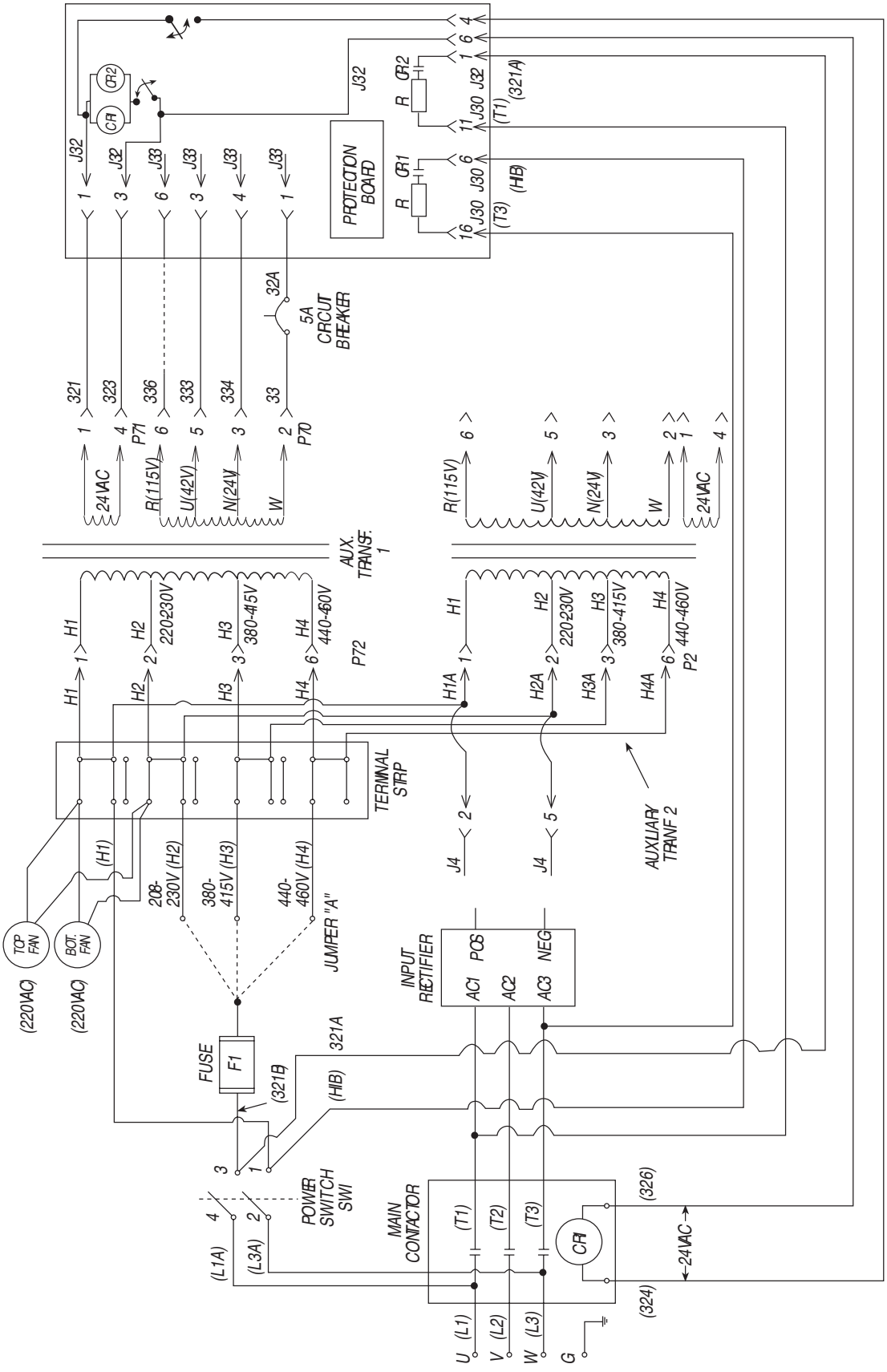
H1A to H2A = 220 - 230 VAC

If this voltage is wrong or missing, check the associated wiring to the transformer primary.

If the correct voltage IS applied to the primary but the voltage at H1A to H2A is not correct, the transformer may be faulty. Replace the transformer. Refer to the T2 Auxiliary Transformer Removal and Replacement procedure in this section of the manual.

14. After the test is completed and the problem successfully repaired, reconnect plug J30 to the protection board.
15. Reconnect plug J72 to the T1 transformer.
16. Reconnect the 5 leads to the main contactor CR1.
17. Install the PC board cover.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

FIGURE F.8 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



AUXILIARY TRANSFORMER PRIMARY WIRING HARNESS 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 1-888-935-3877 .

TEST DESCRIPTION

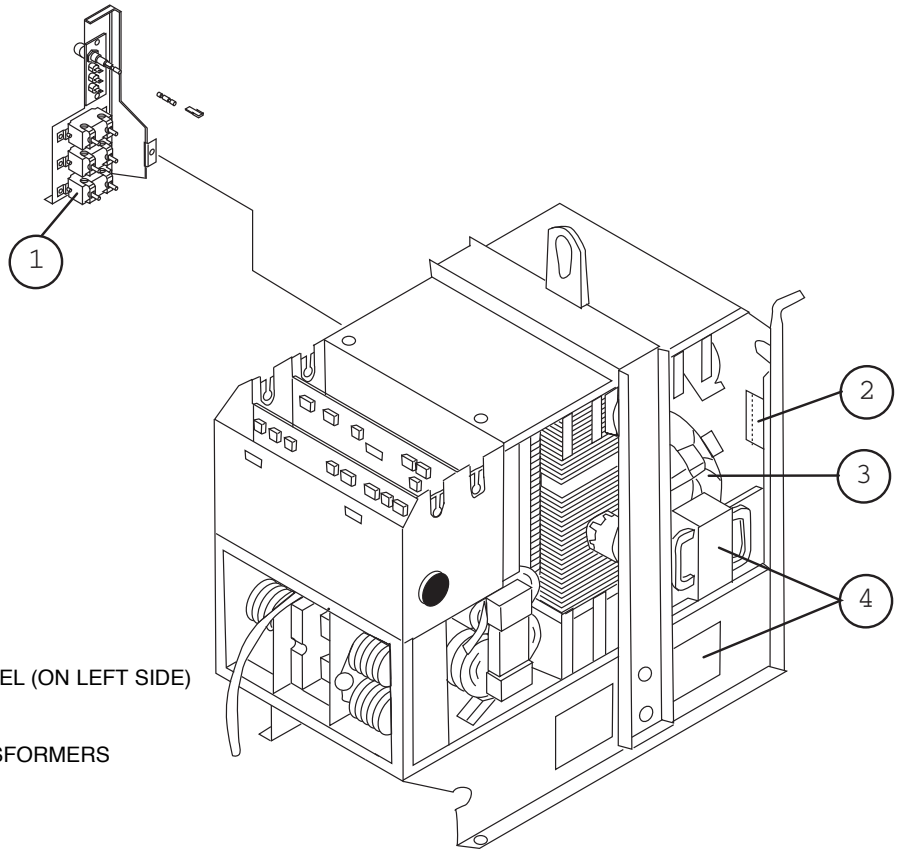
This test will determine if there are any short circuits or other problems in the circuit feeding the primary windings of the auxiliary transformers, which would cause the fuse (F1) on the reconnect panel to blow.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.10
Machine Wiring Diagram in the Electrical Diagrams section of this manual
Protection PC Board Schematic in the Electrical Diagrams section of this manual

AUXILIARY TRANSFORMER PRIMARY WIRING HARNESS TEST *(continued)*

FIGURE F.9 - RECONNECT PANEL/TERMINAL STRIP LOCATION



1. RECONNECT PANEL (ON LEFT SIDE)
2. TERMINAL STRIP
3. FAN MOTORS
4. AUXILIARY TRANSFORMERS

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.

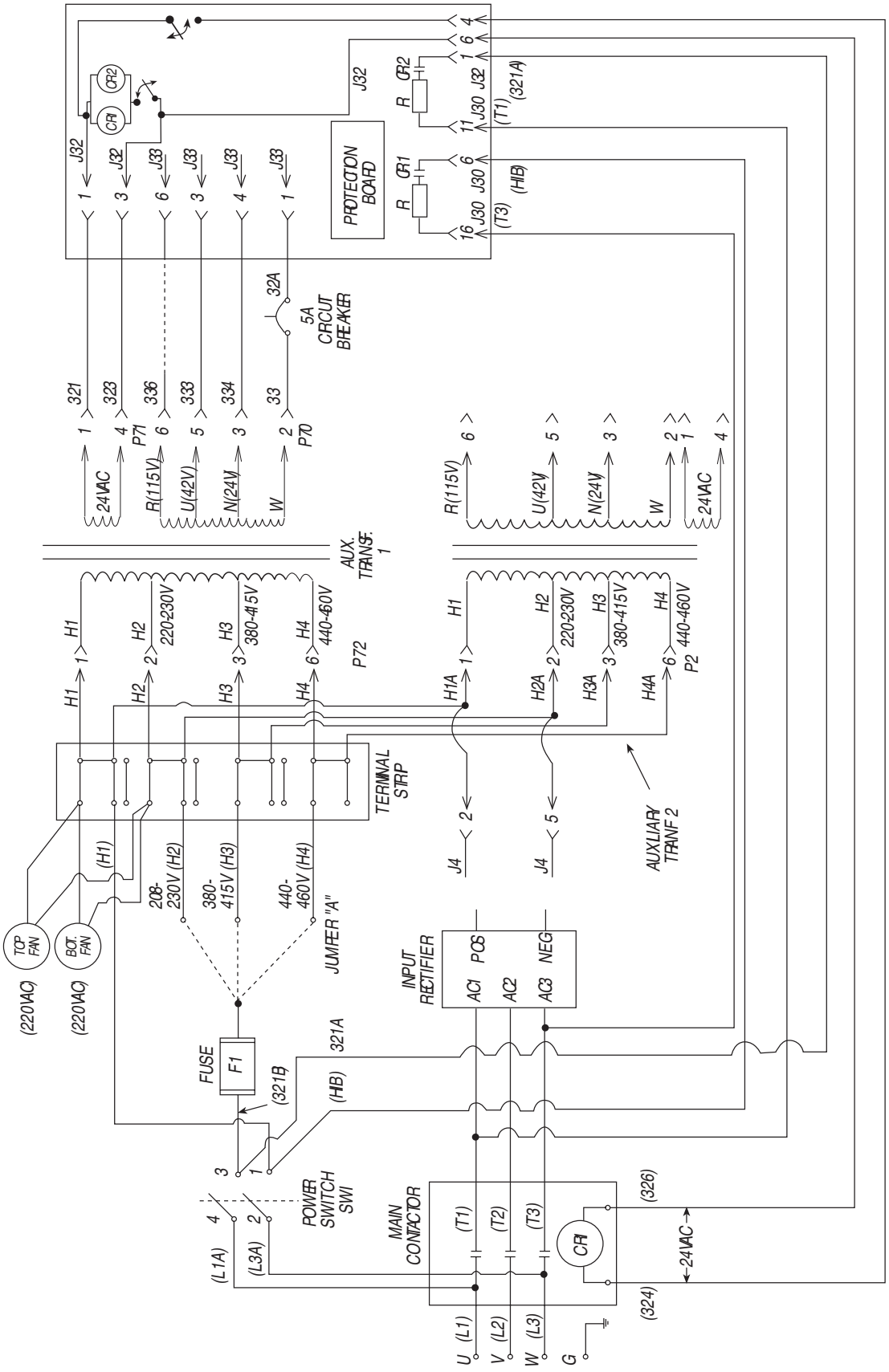
NOTE: If removing plug J30 solves the problem, check for a short circuit or a fault in the 24 VAC circuit (plug P71) and the main contactor coil. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.10***.

Return to Section TOC
Return to Master TOC

AUXILIARY TRANSFORMER PRIMARY WIRING HARNESS TEST *(continued)*

10. Check the wires that run from the reconnect panel to the terminal strip. Look for shorts between wires caused by broken or burned insulation. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.10***.
11. Check for shorts in the wires that run from the terminal strip to the auxiliary transformers and to the fan motors.
12. The fan motors or the auxiliary transformer may be faulty. Disconnect these components one at a time and see if fuse F1 blows when input power is applied. The internal resistance of the fan motors should be about 16 ohms.
13. Remove plug P70 from the transformer. If this solves the problem, check for a short in the secondary circuit. See the machine Wiring Diagram and the Protection PC Board Schematic in the Electrical Diagrams section of this manual.
14. After the test is completed and the problem successfully repaired, reconnect plug J30 to the protection board.
15. Reconnect plugs P70 and P71 to the T1 transformer.
16. Reconnect the 5 leads to the main contactor CR1.
17. Install the PC board cover.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

FIGURE F.10 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



AUXILIARY TRANSFORMER #1 SECONDARY AND WIRING HARNESS 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 1-888-935-3877 .

TEST DESCRIPTION

This test will determine if there are any short circuits or other problems in the load circuits fed by the secondary windings of the auxiliary transformer, which would cause the transformer to overheat or the fuse (F1 - primary side) on the reconnect panel to blow.

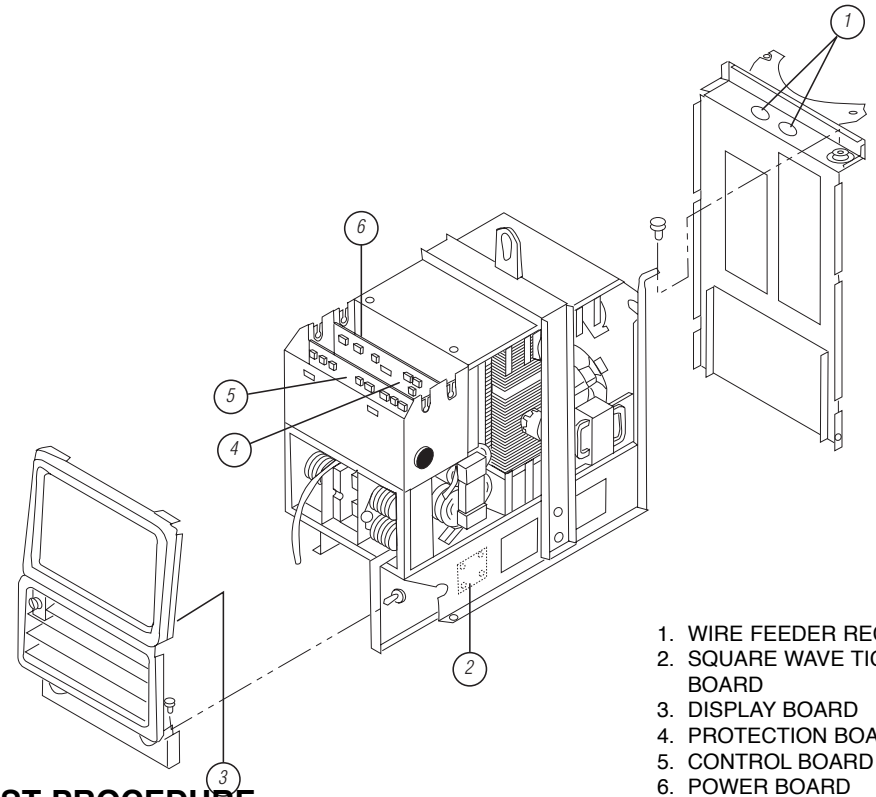
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Auxiliary Transformer #1 Secondary Circuit Wiring Diagram – Figure F.12

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

AUXILIARY TRANSFORMER #1 SECONDARY AND WIRING HARNESS TEST *(continued)*

FIGURE F.11 - PLUG AND RECEPTACLE INSPECTION POINTS



1. WIRE FEEDER RECEPTACLES
2. SQUARE WAVE TIG PROTECTION BOARD
3. DISPLAY BOARD
4. PROTECTION BOARD
5. CONTROL BOARD
6. POWER BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

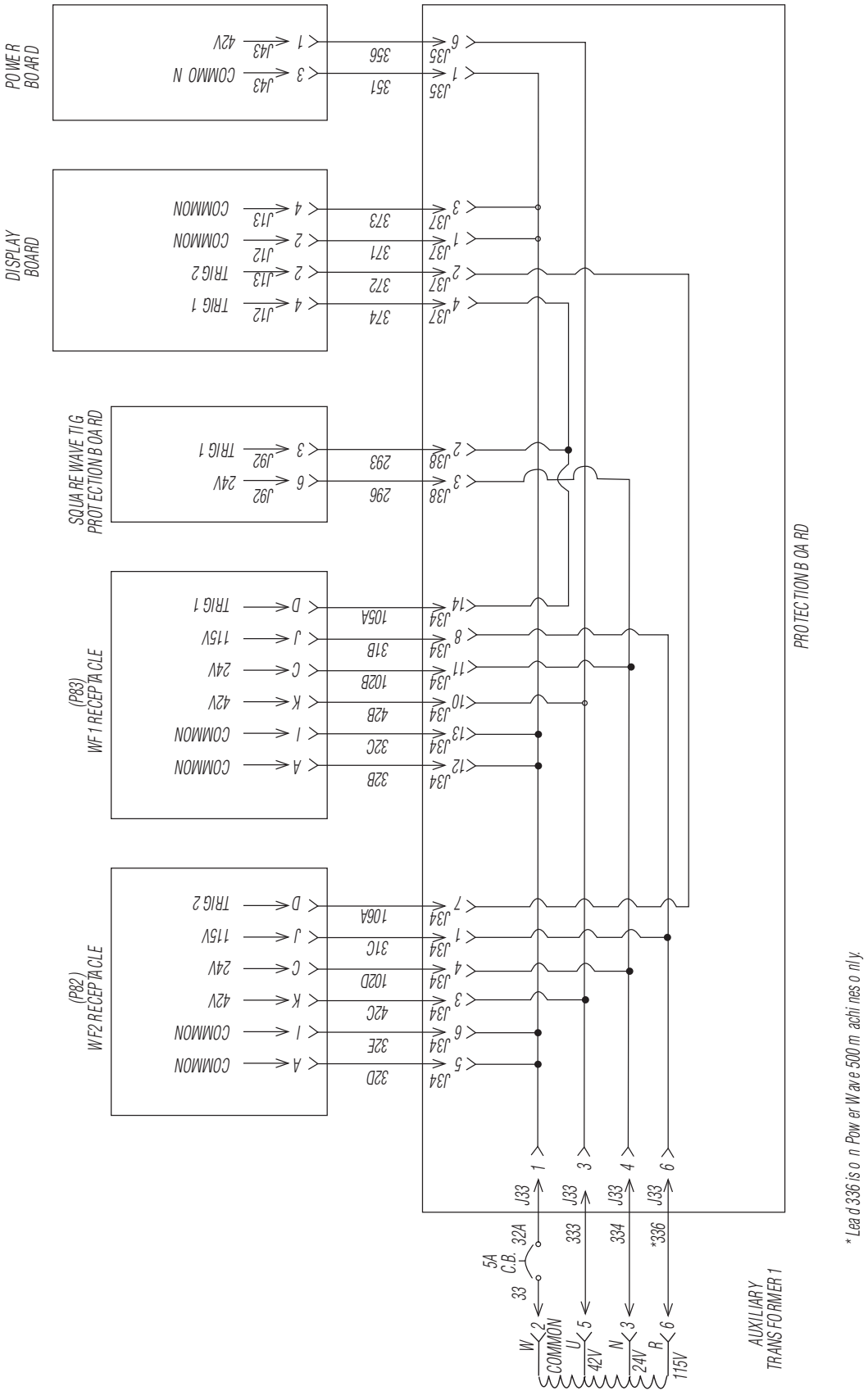
Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Disconnect all plugs and wirefeeder receptacles associated with the auxiliary transformer secondary. This is done to isolate the machine electrically. Inspect all the disconnected plugs and receptacles, looking for shorted pins and wires. See the Auxiliary Transformer #1 Secondary Circuit Wiring Diagram, ***Figure F.12***, for the specific plugs and receptacles to check, which include:
   - WF2 Receptacle
   - WF1 Receptacle
   - Square Wave TIG Protection Board
   - Display Board
   - Power Board
   - Protection Board
9. Check for shorts on the associated PC boards. See the Auxiliary Transformer #1 Secondary Circuit Wiring Diagram, ***Figure F.12***.

AUXILIARY TRANSFORMER #1 SECONDARY AND WIRING HARNESS TEST *(continued)*

10. Check for shorts at plugs J33, J34, J35, J37, and J38 on the protection board. Inspect the board for evidence of arcing.
11. After the test is completed and the problem successfully repaired, reconnect all plugs disconnected for the test.
12. Install the PC board cover.
13. Install the machine case sides and top.
14. Install the handle and the lift bail rubber gasket.

FIGURE F.12
AUXILIARY TRANSFORMER #1 SECONDARY CIRCUIT WIRING DIAGRAM



INPUT POWER AND WIRING HARNESS 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 1-888-935-3877 .

TEST DESCRIPTION

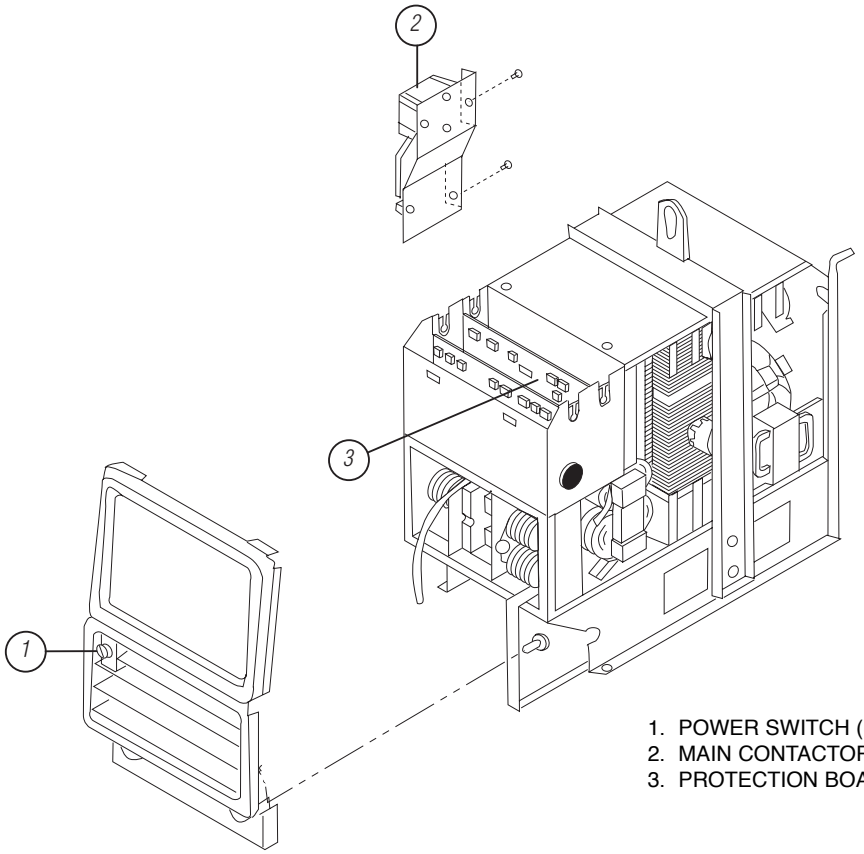
This test will determine if there are any short circuits or other problems on the input power circuit that would cause the input fuses to repeatedly blow.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Auxiliary Circuit Wiring Diagram – Figure F.14

INPUT POWER AND WIRING HARNESS TEST

FIGURE F.13 - INPUT POWER INSPECTION POINTS



1. POWER SWITCH (S1)
2. MAIN CONTACTOR INPUT LEADS (TOP)
3. PROTECTION BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

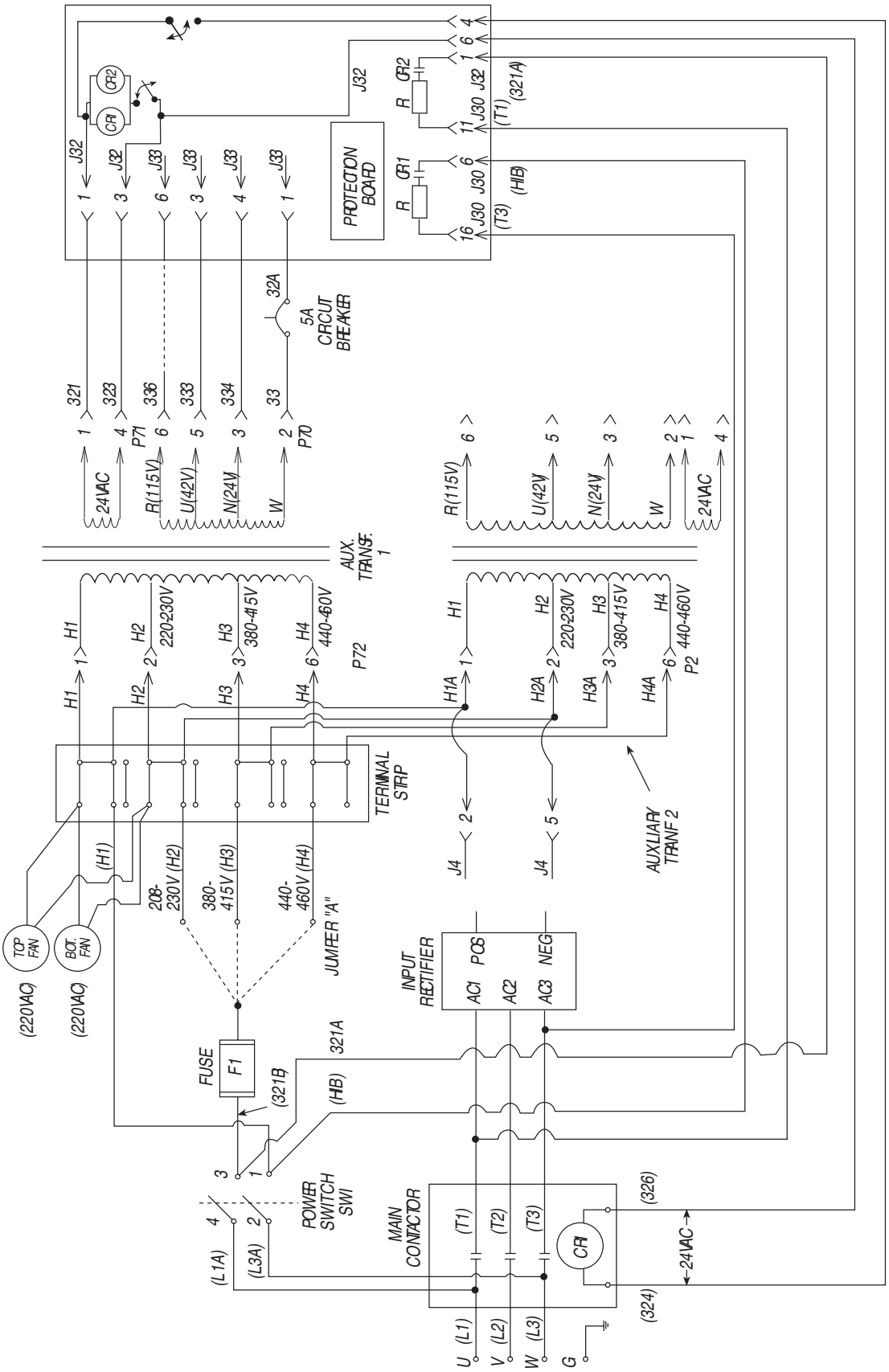
Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Manually check the power switch (S1) for proper operation by turning it back and forth. At the back of the front panel where the switch is mounted, make a visual inspection. Be sure the input and output leads are not shorted together. Make sure the switch contacts are not fused together or shorted to another phase. (Because of the high input voltage involved, you should be able to see physical evidence if any of these problems exist.) Remove the tape covering the switch and check the switch with an ohmmeter. High resistance should be present.

INPUT POWER AND WIRING HARNESS TEST *(continued)*

9. Check for shorts or fusing at the input (top) leads to the main contactor.
10. Remove plug J30 from the protection board. Check the resistance on the J30 header (the plug mounted on the board) between pin 1 and pin 6. Resistance should be very high. If resistance is low or zero ohms, the protection board is faulty.
11. Check plug J30 and associated wires for shorts or damaged connections. See the Input and Auxiliary Circuit Wiring Diagram, ***Figure F.14***.
12. If any of the tests reveal signs of heavy current flow, check the switch boards and the input rectifier. Refer to the Switch Board Test and the Input Rectifier Resistance Test in the section of the manual.
13. After the test is completed and the problem successfully repaired, reconnect all plugs disconnected for the test.
14. Install the PC board cover.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

FIGURE F.14 – INPUT AND AUXILIARY CIRCUIT WIRING DIAGRAM



INPUT RECTIFIER RESISTANCE 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 1-888-935-3877 .

TEST DESCRIPTION

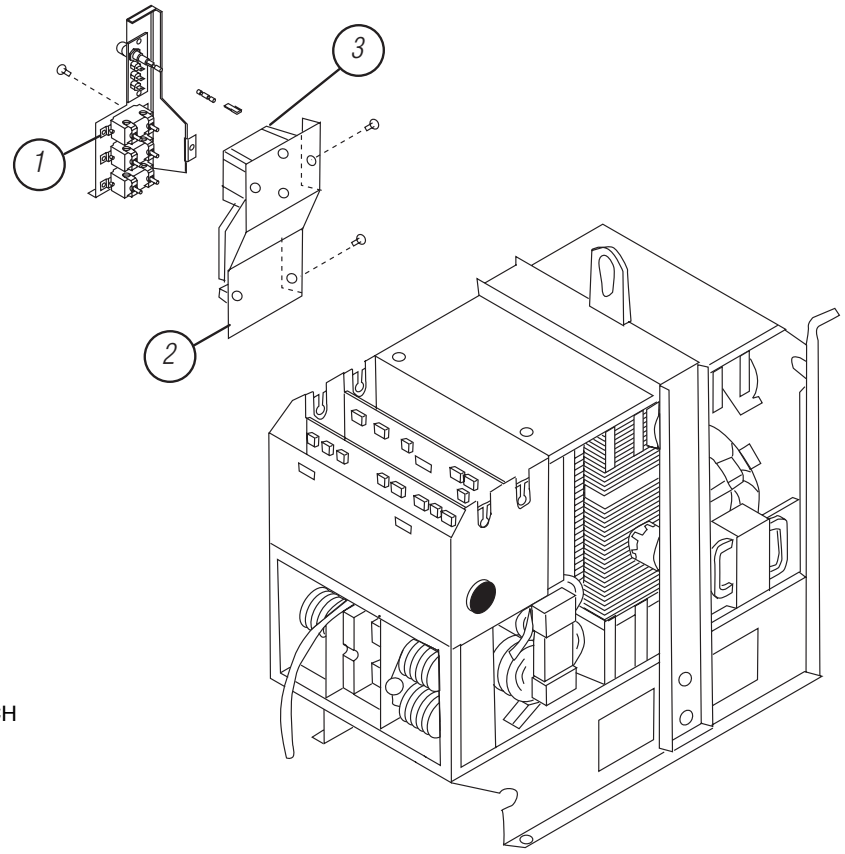
This test will determine if any of the internal diodes in the three-phase rectifier are shorted or open.

MATERIALS NEEDED

Analog Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

INPUT RECTIFIER RESISTANCE TEST *(continued)*

FIGURE F.15 - RECONNECT SWITCH LOCATION



1. RECONNECT SWITCH
2. INPUT RECTIFIER
3. MAIN CONTACTOR

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two 5/16" sheet metal screws holding the reconnect switch assembly. Twist the reconnect switch out to access the lead connections on the back.
8. Use the 3/8" wrench to disconnect the two negative leads from the reconnect switch. By disconnecting the leads at the reconnect switch, you will not have to disturb the silicon applied to the input rectifier. Electrically isolate the leads from all other leads.

INPUT RECTIFIER RESISTANCE TEST *(continued)*

9. Check all leads connected to the input rectifier. Check for looseness or shorted wires.
10. Using an analog type meter, perform the resistance test Steps A through L according to the Table F.1.

NOTE: If terminals AC1, AC2, and AC3 of the input rectifier are not easily accessible, use terminals T1, T2, and T3, respectively, of main contactor CR1 for the resistance measurements. Similarly, if terminals POS and NEG of the input rectifier are not easily accessible, use terminals POS and NEG of the reconnect switch for the resistance measurements.

11. After the test is completed and the problem successfully repaired, reconnect the negative leads to the reconnect switch. Fasten the reconnect switch assembly back into position on the machine.

NOTE: If input rectifier was shorted, other components may be faulty. Perform ***Field Effect Transistor/ Switch Board Test*** and ***Static Capacitor Balance Test***.

12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

TABLE F.1 – INPUT RECTIFIER RESISTANCE VALUES

Step (See Note)	Test for	Place + Lead on . . .	Place - Lead on . . .	If . . .	Then . . .
A	1K Ohms	POS	AC1	>1K Ohms <100 Ohms	Go to step B. Tested failed.
B	1K Ohms	POS	AC2	>1K Ohms <100 Ohms	Go to step C. Tested failed.
C	1K Ohms	POS	AC3	>1K Ohms <100 Ohms	Go to step D. Tested failed.
D	1K Ohms	AC1	NEG	>1K Ohms <100 Ohms	Go to step E. Tested failed.
E	1K Ohms	AC2	NEG	>1K Ohms <100 Ohms	Go to step F. Tested failed.
F	1K Ohms	AC3	NEG	>1K Ohms <100 Ohms	Go to step G. Tested failed.
G	<100 Ohms	AC1	POS	<100 Ohms >1K Ohms	Go to step H. Test failed.
H	<100 Ohms	AC2	POS	<100 Ohms >1K Ohms	Go to step I. Test failed.
I	<100 Ohms	AC3	POS	<100 Ohms >1K Ohms	Go to step J. Test failed.
J	<100 Ohms	NEG	AC1	<100 Ohms >1K Ohms	Go to step K. Test failed.
K	<100 Ohms	NEG	AC2	<100 Ohms >1K Ohms	Go to step L. Test failed.
L	<100 Ohms	NEG	AC3	<100 Ohms >1K Ohms	Input Rectifier OK Test failed.

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Return to Master TOC

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

WELDING FEEDBACK 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 1-888-935-3877 .

TEST DESCRIPTION

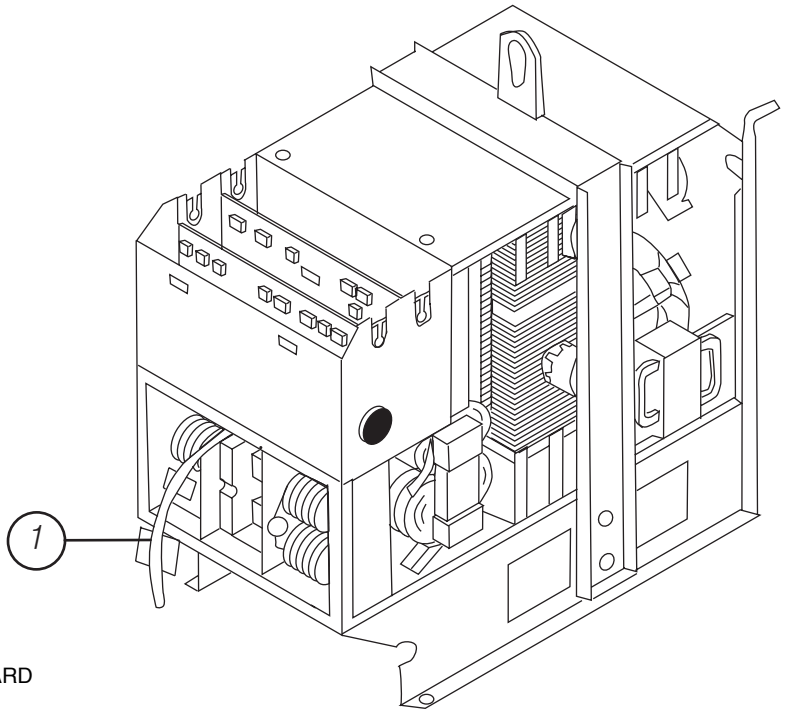
The following procedure will determine whether the shunt amplifier board is receiving the correct supply voltage from the control board and providing the correct feedback voltage.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

WELDING FEEDBACK TEST

FIGURE F.16 - SHUNT AMPLIFIER BOARD LOCATION



1. SHUNT AMPLIFIER BOARD

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, locate plug J50 at the shunt amplifier board. Locate the plug and insert your voltmeter positive (+) probe into pin 3 and negative probe (-) into pin 1. Right-angle probes are recommended.
8. Turn supply power to the machine ON.

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Return to Master TOC

WELDING FEEDBACK TEST *(continued)*

⚠ WARNING

ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the remainder of the test procedure.

9. Check for +15 VDC between plug J50 - pin 3+ and J50 - pin 1-.
10. Carefully move the probes, placing the negative probe (-) at plug J50 - pin 6 and the positive (+) probe at J50 - pin 1. Check for -15 VDC.
11. If the voltage readings are NOT correct, check the associated wiring to the control board. If the wiring is okay, the control board may be faulty. Replace the control board. Refer to the ***Printed Circuit Board Removal and Replacement procedure*** in this section of the manual.
12. If the supply voltage readings are correct, load the machine to 400 amps.
13. Use a current probe to check for 5 ma of current through lead #218 (plug J50 - pin 4). This also reads approximately 1 VDC if you use a voltmeter.
14. If the current reading is NOT correct, the shunt amplifier board may be faulty. Replace the shunt amplifier assembly and perform current calibration.
15. If the current reading IS correct, the control board may be faulty. Replace the control board. Refer to the ***Printed Circuit Board Removal and Replacement procedure*** in this section of the manual.
16. After the test is completed and the problem successfully repaired, install the machine case sides and top.
17. Install the handle and the lift bail rubber gasket.

PIEZO-ELECTRIC ALARM BUZZER 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 1-888-935-3877 .

DESCRIPTION

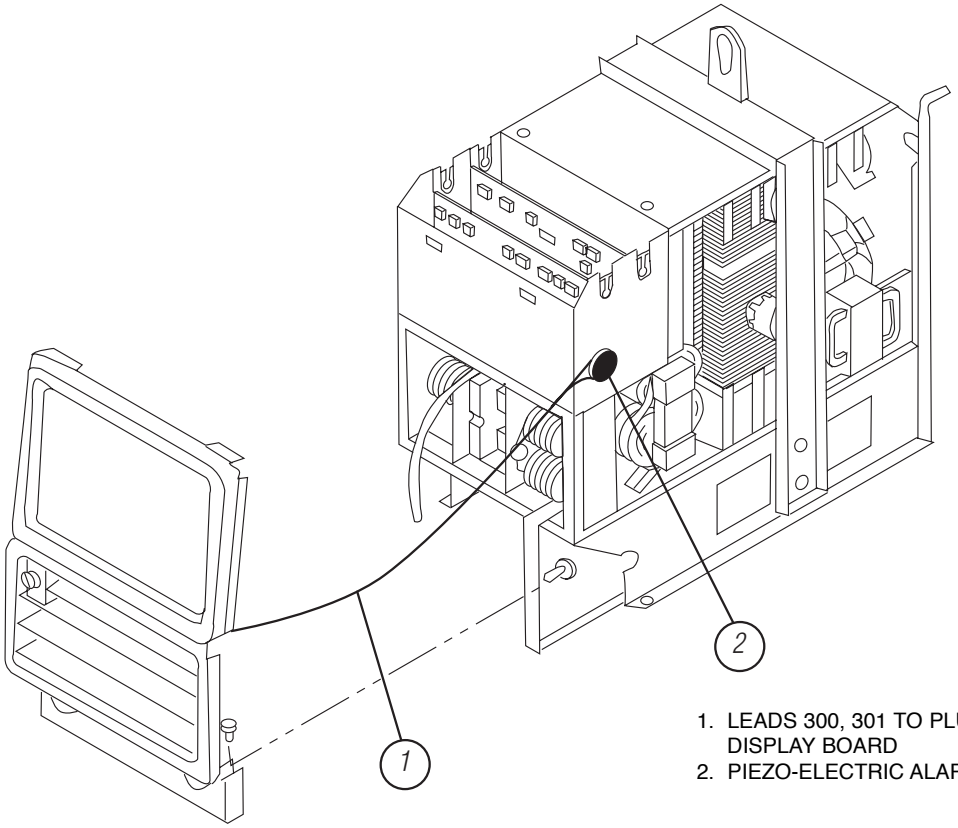
The following procedure will determine whether the piezo-electric alarm buzzer is functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

PIEZO-ELECTRIC ALARM BUZZER TEST

FIGURE F.17 - ALARM BUZZER LOCATION



1. LEADS 300, 301 TO PLUG J15 ON DISPLAY BOARD
2. PIEZO-ELECTRIC ALARM BUZZER

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, locate and remove plug J15 from the display board. See Figure F.17 for location.
8. Using lead #300 as positive (+) and lead #301 as negative (-), apply 12 to 15 VDC to the piezo-electric buzzer.
9. If the buzzer does not work, replace it.
10. If the buzzer does work, the display board may be faulty. Replace the display board. Refer to the Display Board Replacement procedure in this section of the manual.
11. After the test is completed and the problem successfully repaired, reconnect plug J15 to the display board.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

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

OUTPUT RECTIFIER DIODES 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 1-888-935-3877 .

TEST DESCRIPTION

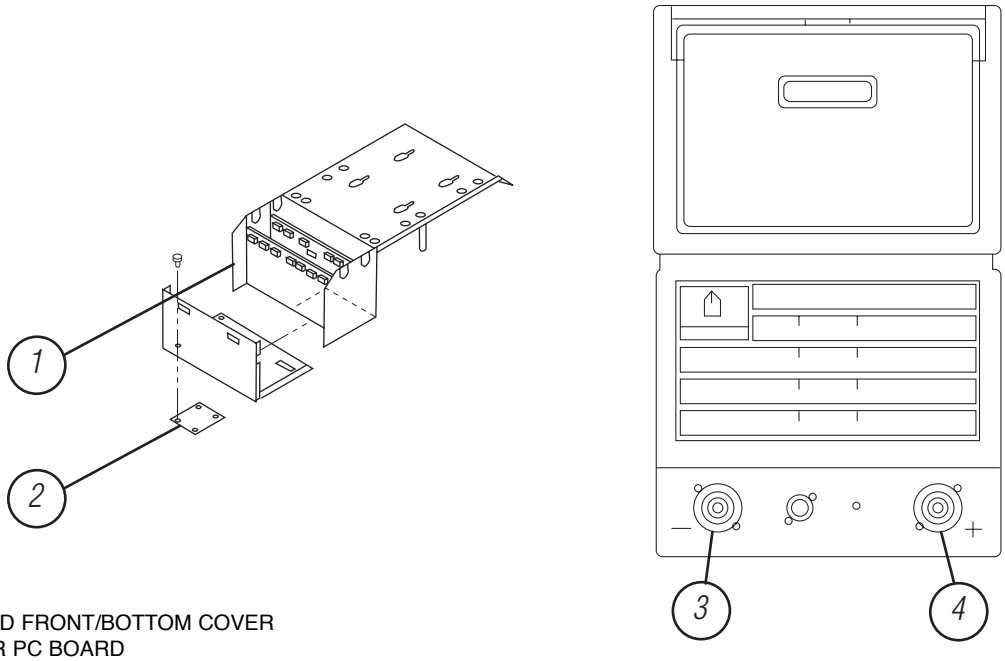
The following procedure will determine whether one of the output rectifier diodes is shorted. If one of the diodes is shorted, the output rectifier assembly must be replaced.

MATERIALS NEEDED

Analog Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

OUTPUT RECTIFIER DIODES TEST

FIGURE F.18 - SNUBBER BOARD, OUTPUT TERMINAL LOCATION



1. PC BOARD FRONT/BOTTOM COVER
2. SNUBBER PC BOARD
3. NEGATIVE OUTPUT TERMINAL
4. POSITIVE OUTPUT TERMINAL

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, disconnect plug J62 from the snubber board. See Figure F.18 for location.
8. Remove any output load that may be connected to the machine.
9. With the volt/ohmmeter, measure the resistance between the positive and negative output terminals. **IMPORTANT: The positive (+) probe must be attached to the positive (+) output terminal and the negative probe (-) must be attached to the negative (-) output terminal.**
10. If the reading is more than 200 ohms, the output rectifier diodes are good. If the reading is less than 200 ohms, replace the output rectifier. Refer to the ***Output Rectifier Replacement procedure*** in this section of the manual.
11. After the test is completed and the problem successfully repaired, reconnect plug J62 to the snubber board.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

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FIELD EFFECT TRANSISTOR/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 1-888-935-3877 .

DESCRIPTION

The following procedure will determine if the four switch boards and their related circuitry are functioning properly. This is a resistance test, not a voltage test. The machine does not have to be powered up to perform the test, which is both safer for the technician and less likely to result in accidental damage to the switch boards.

MATERIALS NEEDED

Analog Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

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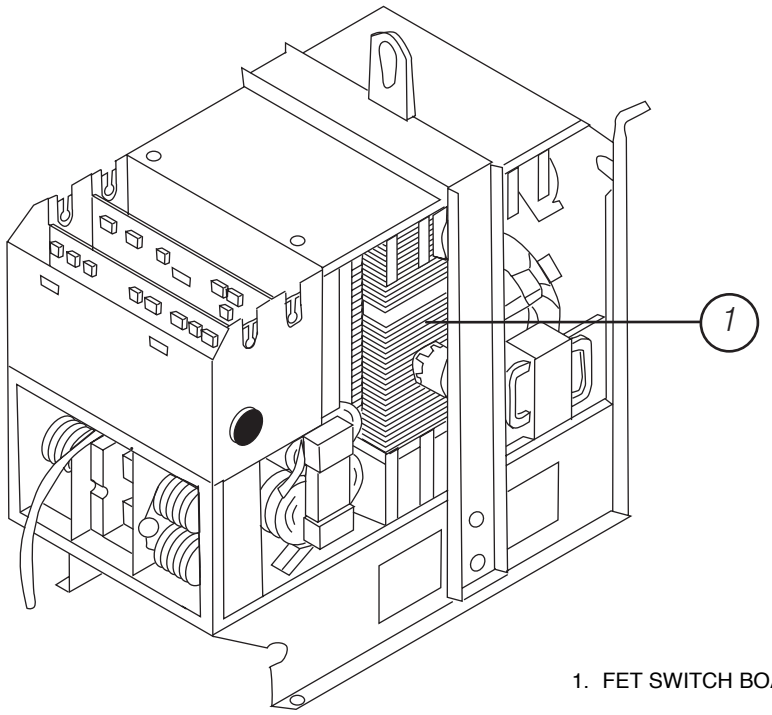
FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST

FIGURE F.19 – F.E.T. SWITCH BOARD LOCATION



1. FET SWITCH BOARD ASSEMBLY

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.

⚠ WARNING

Before continuing with the test procedure, perform the following ***Capacitor Discharge Procedure*** to avoid electric shock.

6. Obtain a high resistance and high wattage resistor (25 - 1000 ohms and 25 watts minimum). This resistor is not supplied with the machine. Secure this resistor to a piece of insulating material such as a glastic board. See ***Figure F.22***. NEVER USE A SHORTING STRAP FOR THIS PROCEDURE.

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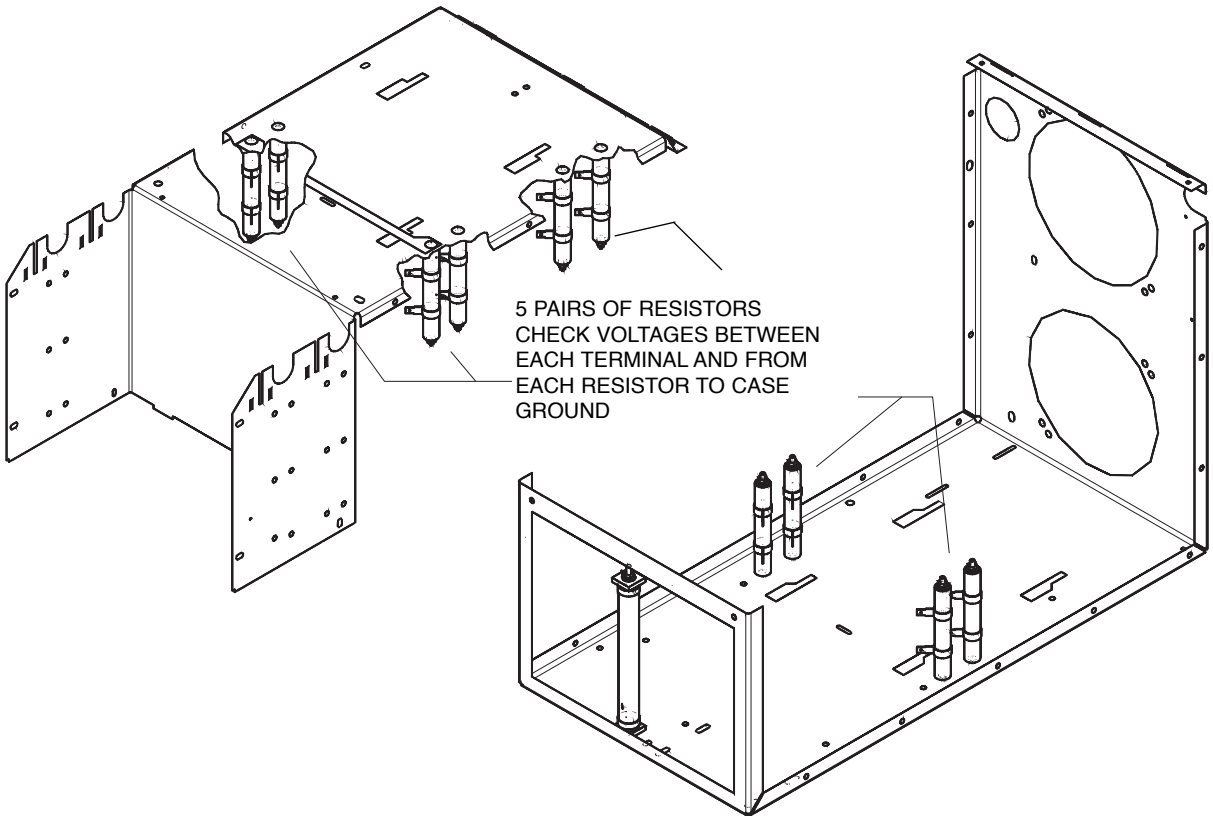
FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.20 - RESISTOR LOCATIONS



7. Locate the two sets of two resistors on the left side of the machine and three sets of two resistors on the right side of the machine. See Figure F.20. Do not touch the resistors or any other internal machine component. Using a DC voltmeter, check for any DC voltage that may be present across the terminals of each resistor and from each resistor to case ground (20 measurements in all). If a voltage is present, be careful not to touch these resistors.

⚠ WARNING

ELECTRIC SHOCK can kill.

Proceed with caution. Be careful not to touch any internal machine components during the discharge procedure.

8. Locate terminals #9 and #12 on the switch boards. They can be identified by the "Discharge" labels, which are located on each of the four switch boards. ***See Figure F.21***.

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FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.21 - DISCHARGE LABEL

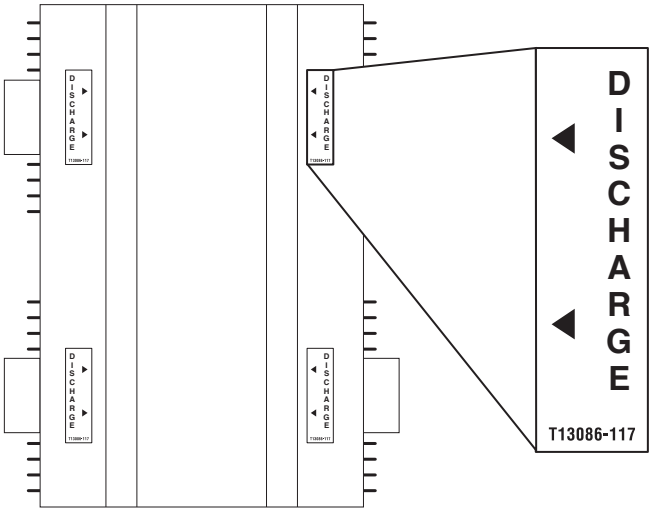
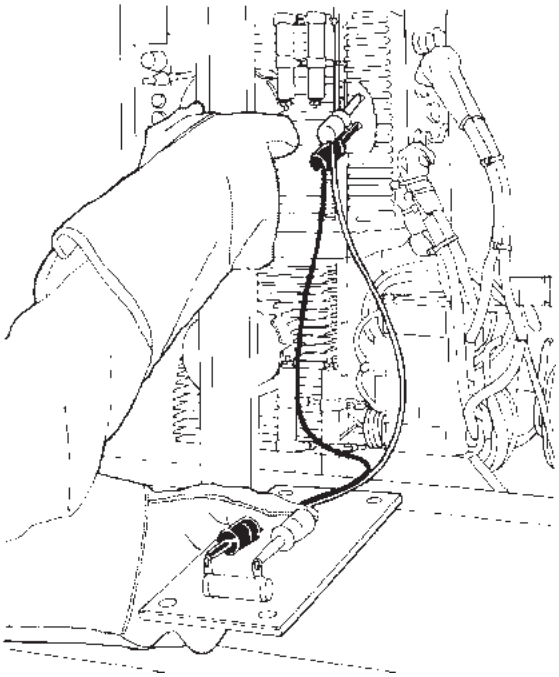


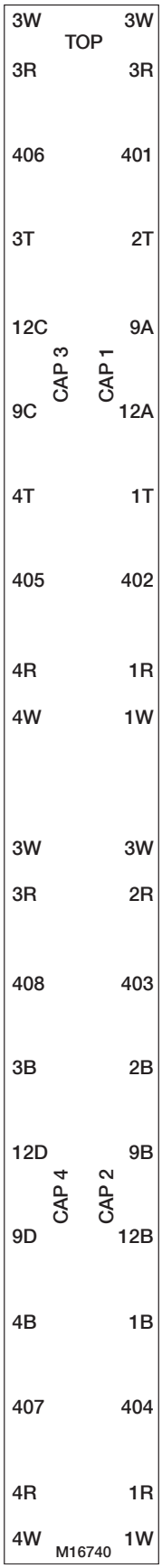
FIGURE F.22
RESISTOR WITH LEADS CONNECTED



9. Using insulated, needle nose type jumper leads and insulated gloves, connect one jumper lead to one end of the resistor obtained in step 6. Connect the other jumper lead to the other end of the resistor.
10. Carefully connect the needle nose end of one of the jumper leads to terminal #9. See Figure F.22. Connect the needle nose end of the other jumper lead to terminal #12. Terminals #9 and #12 are indicated by the "Discharge" label. Leave the resistor connected for 10 seconds. DO NOT TOUCH TERMINALS, RESISTORS, OR ANY INTERNAL MACHINE COMPONENTS DURING THIS PROCEDURE!
11. Check the voltage across terminals #9 and #12 with the DC voltmeter. Terminal #9 has positive polarity and terminal #12 has negative polarity. Voltage should be zero. If any voltage remains, repeat this capacitor discharge procedure.
12. Repeat discharge procedure steps 9, 10, and 11 for each of the other three switch boards.
13. After you have completed the capacitor discharge procedure for all four switch boards, visually inspect the switch boards. If any of them appear burned or overheated, replace all four switch boards and input filter capacitors C1, C2, C3, and C4. Refer to the ***FET Module Assembly Removal and Replacement procedure*** in this section of the manual.
14. If none of the switch boards shows physical damage, test each switch board according to the procedures given below. If any test shows that one of the switch boards is damaged, replace all four switch boards and input filter capacitors C1, C2, C3, and C4. Refer to the ***FET Module Assembly Removal and Replacement procedure*** in this section of the manual.

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.23 - SWITCH BOARD ASSEMBLY CONNECTION DECAL



FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

Switch Board Test 1: (For Switch Board Marked CAP 1 on the Switch Board Assembly Connection Decal - *See Figure F.23*.)

A. Disconnect all wiring harness leads from switch board 1. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to ***Table F. 2***. ***See Figure F.23*** for the locations of the terminals. If any test fails, replace all four switch boards. Refer to the ***FET Module Assembly Removal and Replacement procedure*** in this section of the manual.

If none of the tests fails, reconnect the wiring harness leads to switch board 1 and perform switch board test 2.

Switch Board Test 2: (For Switch Board Marked CAP 2 on the Switch Board Assembly Connection Decal - *See Figure F.23*.)

A. Disconnect all wiring harness leads from switch board 2. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to ***Table F. 3***. If any test fails, replace all four switch boards. Refer to the ***FET Module Assembly Removal and Replacement procedure*** in this section of the manual.

If none of the tests fails, reconnect the wiring harness leads to switch board 2 and perform switch board test 3.

Switch Board Test 3: (For Switch Board Marked CAP 3 on the Switch Board Assembly Connection Decal - *See Figure F.23*.)

A. Disconnect all wiring harness leads from switch board 3. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to ***Table F. 4***. If any test fails, replace all four switch boards. Refer to the ***FET Module Assembly Removal and Replacement procedure*** in this section of the manual.

If none of the tests fail, reconnect the wiring harness leads to switch board 3 and perform switch board test 4.

Switch Board Test 4: (For Switch Board Marked CAP 4 on the Switch Board Assembly Connection Decal - *See Figure F.23*.)

A. Disconnect all wiring harness leads from switch board 4. Fold the leads up so that they do not interfere with the exposed PC board terminals.

B. With the volt/ohmmeter, measure the resistance between terminals according to ***Table F. 5***. If any test fails, replace all four switch boards. Refer to the ***FET Module Assembly Removal and Replacement procedure*** in this section of the manual.

If none of the tests fail, reconnect the wiring harness leads to switch board 4.

15. After the test is completed and the problem successfully repaired, install the machine case sides and top.

16. Install the handle and the lift bail rubber gasket.

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.2 – SWITCH BOARD 1 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
2T	12A	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12A	2T	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9A	1T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
1T	9A	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
2T	9A	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9A	2T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.2 – SWITCH BOARD 1 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12A	1T	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
1T	12A	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12A	401	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
401	12A	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9A	402	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
402	9A	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.3 – SWITCH BOARD 2 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
2B	12B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12B	2B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9B	1B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
1B	9B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
2B	9B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9B	2B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

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Return to Section TOC
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FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.3 – SWITCH BOARD 2 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12B	1B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
1B	12B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12B	403	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
403	12B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9B	404	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
404	9B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.4 – SWITCH BOARD 3 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
4T	12C	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12C	4T	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9C	3T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
3T	9C	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
4T	9C	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9C	4T	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

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

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.4 – SWITCH BOARD 3 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12C	3T	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
3T	12C	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12C	405	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
405	12C	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9C	406	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
406	9C	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.5 – SWITCH BOARD 4 RESISTANCE TEST TABLE

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
4B	12D	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12D	4B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9D	3B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
3B	9D	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
4B	9D	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9D	4B	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

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

FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

TABLE F.5 – SWITCH BOARD 4 RESISTANCE TEST TABLE *(Continued)*

Apply Positive Test Probe to Terminal	Apply Negative Test Probe to Terminal	Test Result	Conclusion	Repair Action	Next Procedure
12D	3B	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
3B	12D	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
12D	407	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch Boards	Snubber Resistor Test
407	12D	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
9D	408	Less than 100 ohms	OK	None	Continue
		Greater than 1K ohm	Open	Replace 4 Switch Boards	Snubber Resistor Test
408	9D	Greater than 1K ohm	OK	None	Continue
		Less than 100 ohms	Shorted	Replace 4 Switch boards	Snubber Resistor Test

NOTE: K ohm = ohm reading multiplied by 1000.

NOTE: Always make sure that all four Switch Boards are changed at the same time. Never mix an old style (different part number) Switch Board with a new style (new part number).

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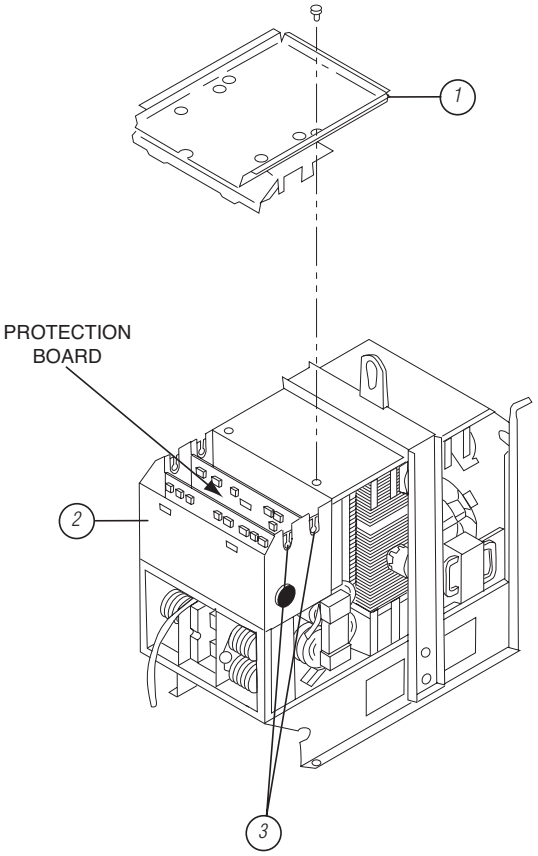
FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.24 - PROTECTION BOARD LOCATION



1. PC BOARD COVER
2. PC BOARD ASSEMBLY
3. RETAINER CLIPS

PRIMARY CURRENT SENSOR TEST

Current Transformers (CT) Test Description

Both of the main transformer's primary circuits are passed through the one primary current sensor. See the wiring diagram. The output of the primary current sensor is sent to the protection board for processing. If the primary current feedback signals (output of the current sensor) are not balanced the power board will adjust the pulse width modulation (PWM) signal sent to the switch boards to keep the FETs balanced. Also, if either of the four switch boards is supplying too much current to the main transformer the control board will remove the PWM signal and the inverter will be shut off to protect the switch board.

The best way to test a current sensor is by measuring the inductance. The sensor is not mounted on the FET switch boards. The measurements should always be made without removing or disturbing the sensor. The measurement should always be made inside the machine by disconnecting the current sensor leads from the protection board. Polarity is also very important. Always check the wiring diagram to make certain the current sensor leads are connected properly.

MATERIALS NEEDED

Volt-Ohmmeter with inductance measuring capabilities (Amprobe Model 37XR-A)
Wiring Diagram
5/16" Nutdriver

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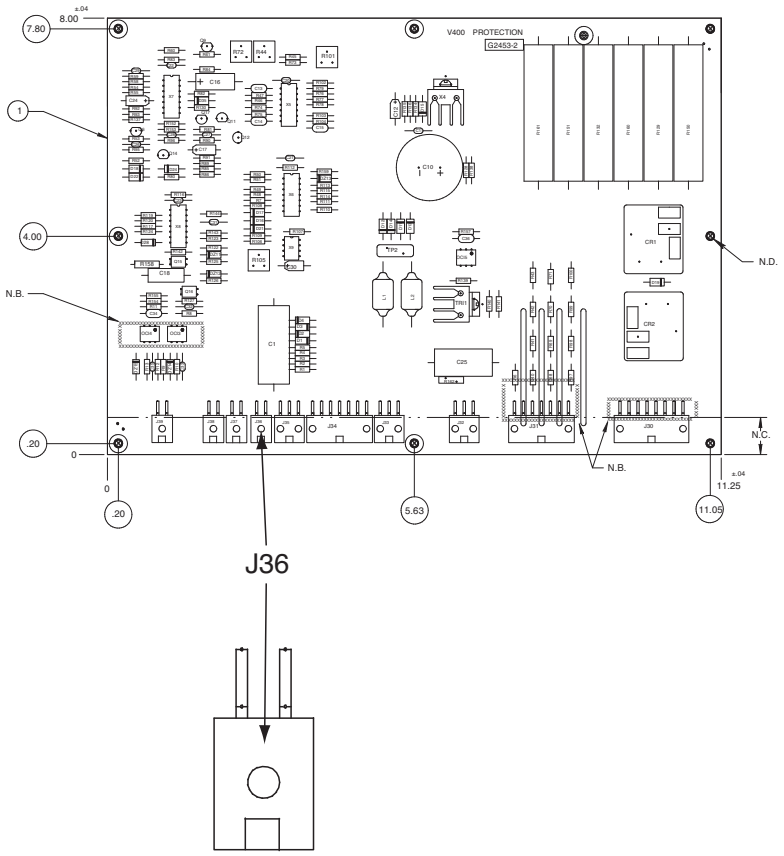
FIELD EFFECT TRANSISTOR/SWITCH BOARD TEST *(continued)*

FIGURE F.25 - PLUG J36 LOCATION



TEST PROCEDURE

1. Remove the input power to the POWER WAVE® 350/500 machine.
2. Perform the ***Input Filter Capacitor Discharge Procedure***.
3. Locate and carefully remove plug J36 from the protection board. ***See Figure F.24*** and Figure F.25.
4. Using the Volt-Ohmmeter with inductance measuring capabilities check the inductance of the current sensor at plug J36 pin 1 (lead 361) to plug J36 pin 2 lead 362). Normal inductance is approximately 213mH. +/- 20%. See Figure F.25. These measurements must be made at plug J36. Not on the protection board.
5. If the inductance reading is not correct replace the current sensor.
6. When testing is complete replace plug J36 into the correct receptacle. See Figure F.25.
7. Replace the case covers.

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Return to Section TOC
Return to Master TOC

SNUBBER AND BLEEDER RESISTOR 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 1-888-935-3877 .

TEST DESCRIPTION

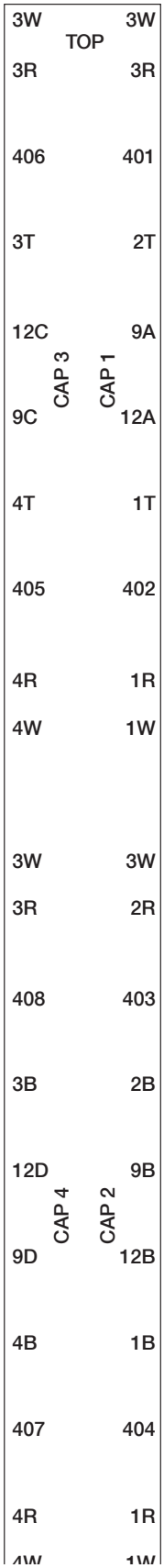
This test will determine if the eight snubber resistors and two bleeder resistors are of the proper value and their associated leads intact.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Snubber and Bleeder Resistor Wiring Diagram – Figure F.27

SNUBBER AND BLEEDER RESISTOR TEST

FIGURE F.26 - SWITCH BOARD ASSEMBLY CONNECTION DECAL



SNUBBER AND BLEEDER RESISTOR TEST *(continued)*

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. Perform the following tests on the four switch boards:

Switch Board 1: (Switch Board 1 is Marked CAP 1 on the Switch Board Assembly Connection Decal - *See Figure F.26*.)

A. Remove quick connect terminals #401, #402, #9, and #12 from switch board 1.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #401 and #12E.

If the measurement reads between 20 and 30 ohms, resistor R1 and leads #401 and #12E are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #401 and #12E. Then test for 25 ohms resistance across R1 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R1.

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #402 and #9E.

If the measurement reads between 20 and 30 ohms, resistor R2 and leads #402 and #9E are okay. Go to step D.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #402 and #9E. Then test for 25 ohms resistance across R2 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R2.

D. With the volt/ohmmeter, check for 7.5 K ohms resistance between lead #12L (12E) and #9L (9E).

If the measurement reads between 6.75 and 8.25 K ohms, resistor R9 and leads #12L(12E) and #9L (9E) are okay. Go to step E.

If the measurement does not read between 6.75 and 30 K ohms, check for continuity in leads #12L (12E) and #9L(9E). Then test for 7.5 K ohms resistance across R9 directly. If the measurement does not read between 6.75 and 8.25 K ohms, replace resistor R9.

E. Reconnect quick connect terminals #401, #402, #9, and #12 on switch board 1.

Switch Board 2: (Switch Board 2 is Marked CAP 2 on the Switch Board Assembly Connection Decal - *See Figure F.26*.)

A. Remove quick connect terminals #403, #404, #9, and #12.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #403 and #12F.

If the measurement reads between 20 and 30 ohms, resistor R3 and leads #403 and #12F are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #403 and #12F. Then test for 25 ohms resistance across R3 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R3.

SNUBBER AND BLEEDER RESISTOR TEST *(continued)*

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #404 and #9F.

If the measurement reads between 20 and 30 ohms, resistor R4 and leads #404 and #9F are okay. Go to step D.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #404 and #9F. Then test for 25 ohms resistance across R4 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R4.

D. Reconnect quick connect terminals #403, #404, #9, and #12 on switch board 2.

Switch Board 3: (Switch Board 3 is Marked CAP 1 on the Switch Board Assembly Connection Decal - *See Figure F.26*.)

A. Remove quick connect terminals #405, #406, #9, and #12 from switch board 3.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #405 and #12G.

If the measurement reads between 20 and 30 ohms, resistor R5 and leads #405 and #12G are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #405 and #12G. Then test for 25 ohms resistance across R5 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R5.

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #406 and #9G.

If the measurement reads between 20 and 30 ohms, resistor R6 and leads #406 and #9G are okay. Go to step D.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #406 and #9G. Then test for 25 ohms resistance across R5 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R5.

D. With the volt/ohmmeter, check for 7.5 K ohms resistance between lead #12G (12M) and #9G (9M).

If the measurement reads between 6.75 and 8.25 K ohms, resistor R10 and leads #12G (12M) and #9G (9M) are okay. Go to step E.

If the measurement does not read between 6.75 and 30 K ohms, check for continuity in leads #12G (12M) and #9G (9M). Then test for 7.5 K ohms resistance across R10 directly. If the measurement does not read between 6.75 and 8.25 K ohms, replace resistor R10.

E. Reconnect quick connect terminals #405, #406, #9, and #12 on switch board 3.

Switch Board 4: (Switch Board 4 is Marked CAP 4 on the Switch Board Assembly Connection Label - *See Figure F.26*.)

A. Remove quick connect terminals #407, #408, #9, and #12 from switch board 4.

B. With the volt/ohmmeter, check for 25 ohms resistance between lead #407 and #12H.

If the measurement reads between 20 and 30 ohms, resistor R7 and leads #407 and #12H are okay. Go to step C.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #407 and #12H. Then test for 25 ohms resistance across R3 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R7.

C. With the volt/ohmmeter, check for 25 ohms resistance between lead #408 and #9H.

If the measurement reads between 20 and 30 ohms, resistor R8 and leads #408 and #9H are okay. Go to step D.

If the measurement does not read between 20 and 30 ohms, check for continuity in leads #408 and #9H. Then test for 25 ohms resistance across R8 directly. If the measurement does not read between 20 and 30 ohms, replace resistor R8.

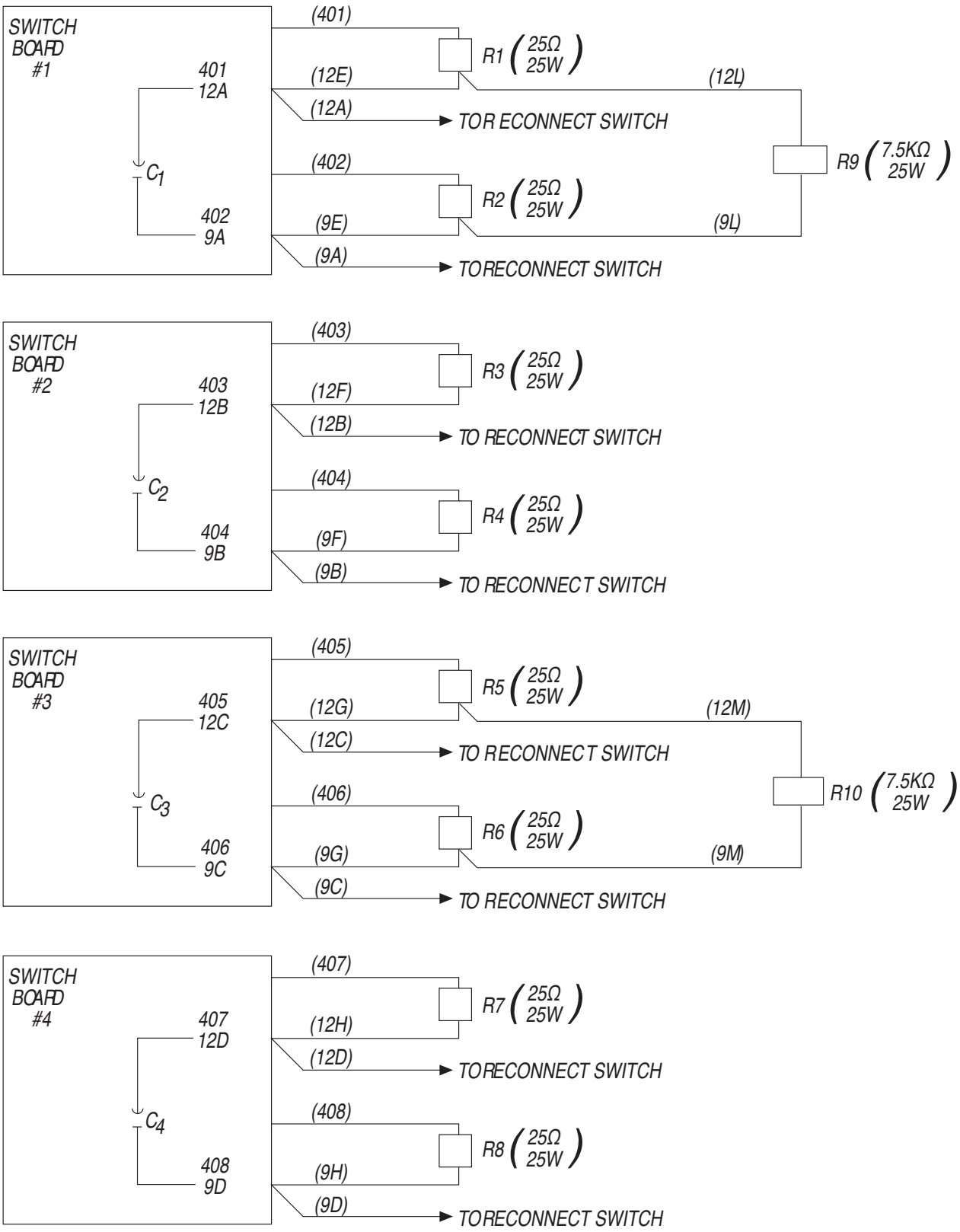
D. Reconnect quick connect terminals #407, #408, #9, and #12 on switch board 4.

8. Install the machine case sides and top.

9. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

FIGURE F.27 – SNUBBER AND BLEEDER RESISTOR WIRING DIAGRAM



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Return to Master TOC

RECONNECT SWITCH TEST 1

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

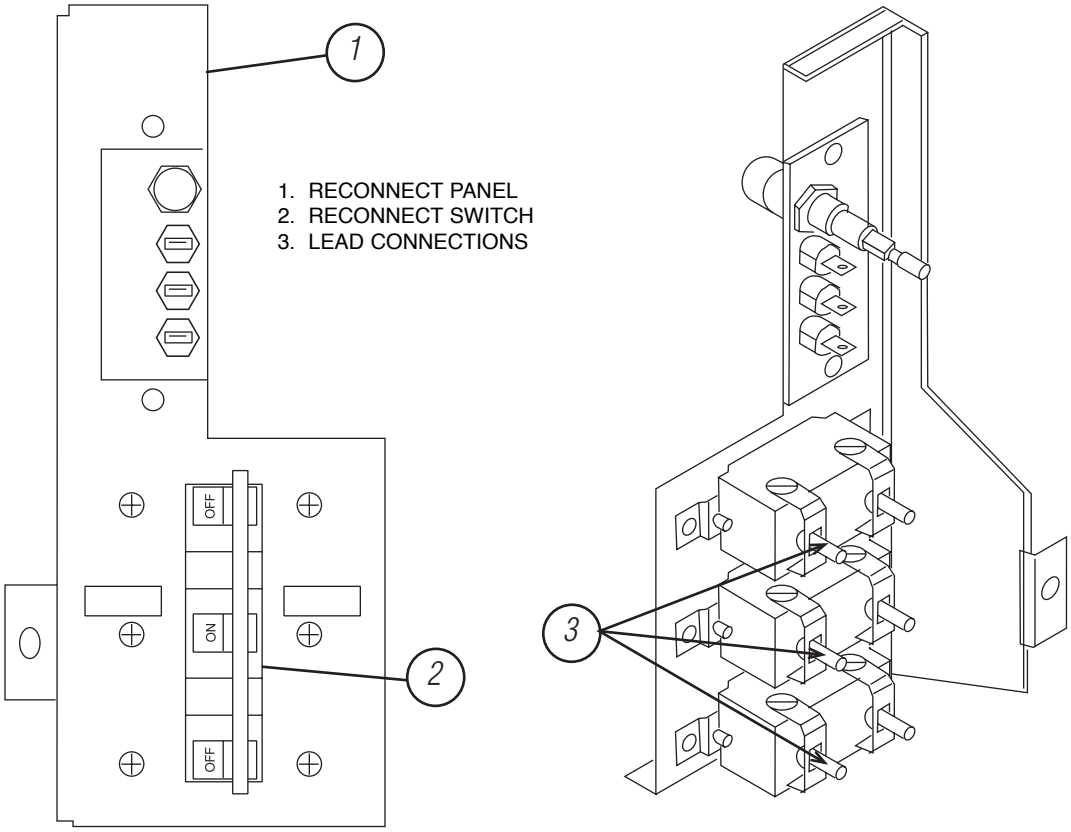
This test will determine if there are any short circuits between the leads connected to the reconnect switch.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Phillips head screw driver
Input and Reconnect Wiring Diagram – Figure F.29

RECONNECT SWITCH TEST 1

FIGURE F.28 - RECONNECT SWITCH



1. RECONNECT PANEL
2. RECONNECT SWITCH
3. LEAD CONNECTIONS

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. Test the reconnect switch for short circuits according to the voltage for which the machine is wired:

For 230 VAC:

A. Check that the following leads are connected together at the reconnect switch: #9A, #9B, #9C, #9D, #9K, #9J, and POS.

B. Check that the following leads are connected together at the reconnect switch: #12A, #12B, #12C, #12D, #12K, #12J, and NEG.

C. With the volt/ohmmeter, check that there is no continuity between the two groups of leads in A and B above.

RECONNECT SWITCH TEST 1 *(continued)*

For 380 or 460 VAC:

A. Check that the following leads are connected together at the reconnect switch: #9A, #9B, #9K, and POS.

B. Check that the following leads are connected together at the reconnect switch: #9C, #9D, #9J, #12A, #12B, and #12J.

C. Check that the following leads are connected together at the reconnect switch: #12C, #12D, #12K and NEG.

D. With the volt/ohmmeter, check that there is no continuity between the three groups of leads in A, B, and C above.

8. If any of the leads tested above are shorted, go to step 9. If none of the leads are shorted, the test is complete. Install the machine case sides, top, handle and the lift bail rubber gasket.

9. Perform the following steps:

A. With the 5/16" nut driver, remove the screws that hold the PC board cover. Remove the cover.

B. Disconnect plug J31 from the protection board. If this eliminates the short, the protection board may be faulty. Replace the protection board. If the short persists, go to step 9C.

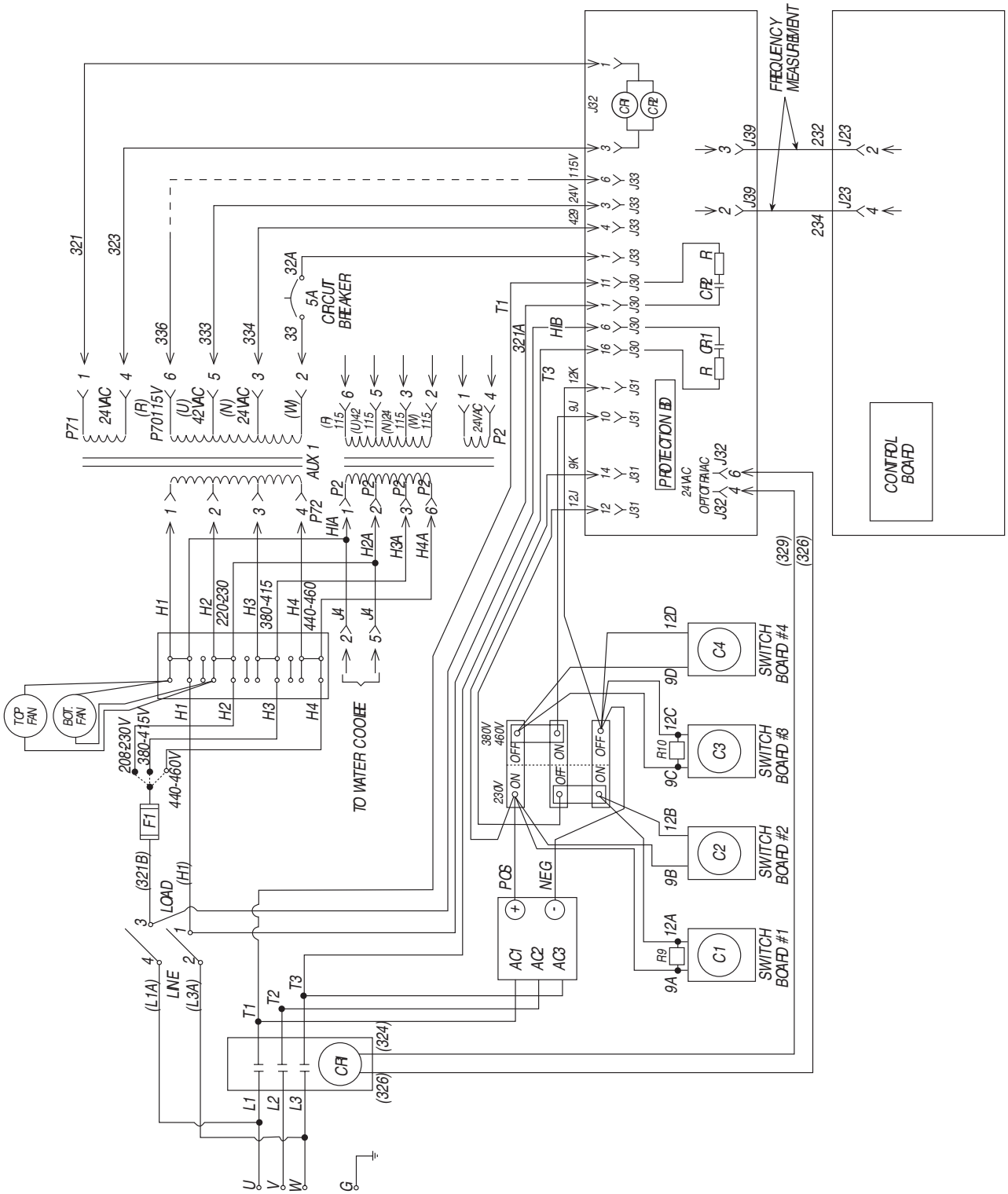
C. With the Phillips head screw driver, remove the POS and NEG leads from the reconnect switch. If this eliminates the short, either the input rectifier or the harness (leads POS and NEG) between the input rectifier and the reconnect switch is faulty. Check the harness and if it is not faulty, perform the ***Input Rectifier Test***. Reconnect leads POS and NEG to the input rectifier. If the short persists, go to step 9D.

D. Remove leads #9A, #9B, #9C, #9D, #12A, #12B, #12C, and #12D from the four switch boards. If this eliminates the short, check these leads to make sure they are not exposed, damaged, or shorted. If the leads are okay, perform the ***Switch Board Test*** and the ***Snubber and Bleeder Resistor Test*** to find the cause of the short. Reconnect leads #9A, #9B, #9C, #9D, #12A, #12B, #12C, and #12D to the four switch boards before conduction these tests.

10. Replace the PC board cover and install the machine case sides and top.

11. Install the handle and the lift bail rubber gasket.

FIGURE F.29 – INPUT AND RECONNECT WIRING DIAGRAM



RECONNECT SWITCH TEST 2

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

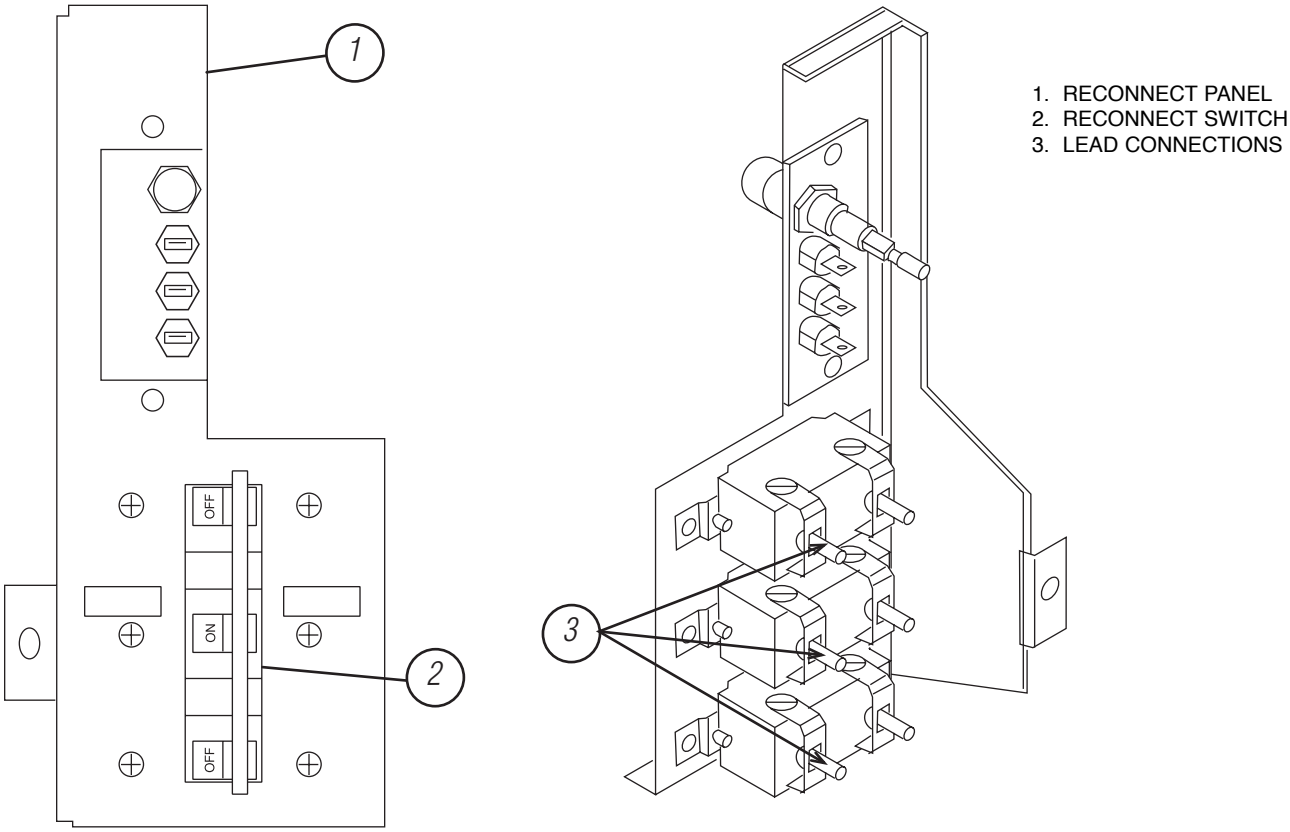
This test will determine if any leads connected to the reconnect switch are damaged.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Input and Reconnect Wiring Diagram – Figure F.31

RECONNECT SWITCH TEST 2 *(continued)*

FIGURE F.30 - RECONNECT SWITCH



1. RECONNECT PANEL
2. RECONNECT SWITCH
3. LEAD CONNECTIONS

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. Visually check that the following leads are not damaged or exposed. With the volt/ohmmeter, also test the leads for continuity:

RECONNECT SWITCH TEST 2 *(continued)*

- Lead #9A between the reconnect switch and switch board #1.
- Lead #9B between the reconnect switch and switch board #2.
- Lead #9C between the reconnect switch and switch board #3.
- Lead #9D between the reconnect switch and switch board #4.
- Lead #9J between the reconnect switch and plug J31 - pin 10 of the protection board.
- Lead #9K between the reconnect switch and plug J31 - pin 14 of the protection board.

- Lead #12A between the reconnect switch and switch board #1.
- Lead #12B between the reconnect switch and switch board #2.
- Lead #12C between the reconnect switch and switch board #3.
- Lead #12D between the reconnect switch and switch board #4.
- Lead #12J between the reconnect switch and plug J31 - pin 12 of the protection board.
- Lead #12K between the reconnect switch and plug J31 - pin 1 of the protection board.

- Lead POS between the reconnect switch and the input rectifier.
- Lead NEG between the reconnect switch and the input rectifier.

8. With the volt/ohmmeter, test THAT THERE IS CONTINUITY between the leads in the following groups according to the voltage for which the machine is wired:

For 230 VAC:

A. Test for continuity between leads #9A, #9B, #9C, #9D, #9K, #9J, and POS connected together at the reconnect switch.

B. Test for continuity between leads #12A, #12B, #12C, #12D, #12K, #12J, and NEG connected together at the reconnect switch.

For 380 or 460 VAC:

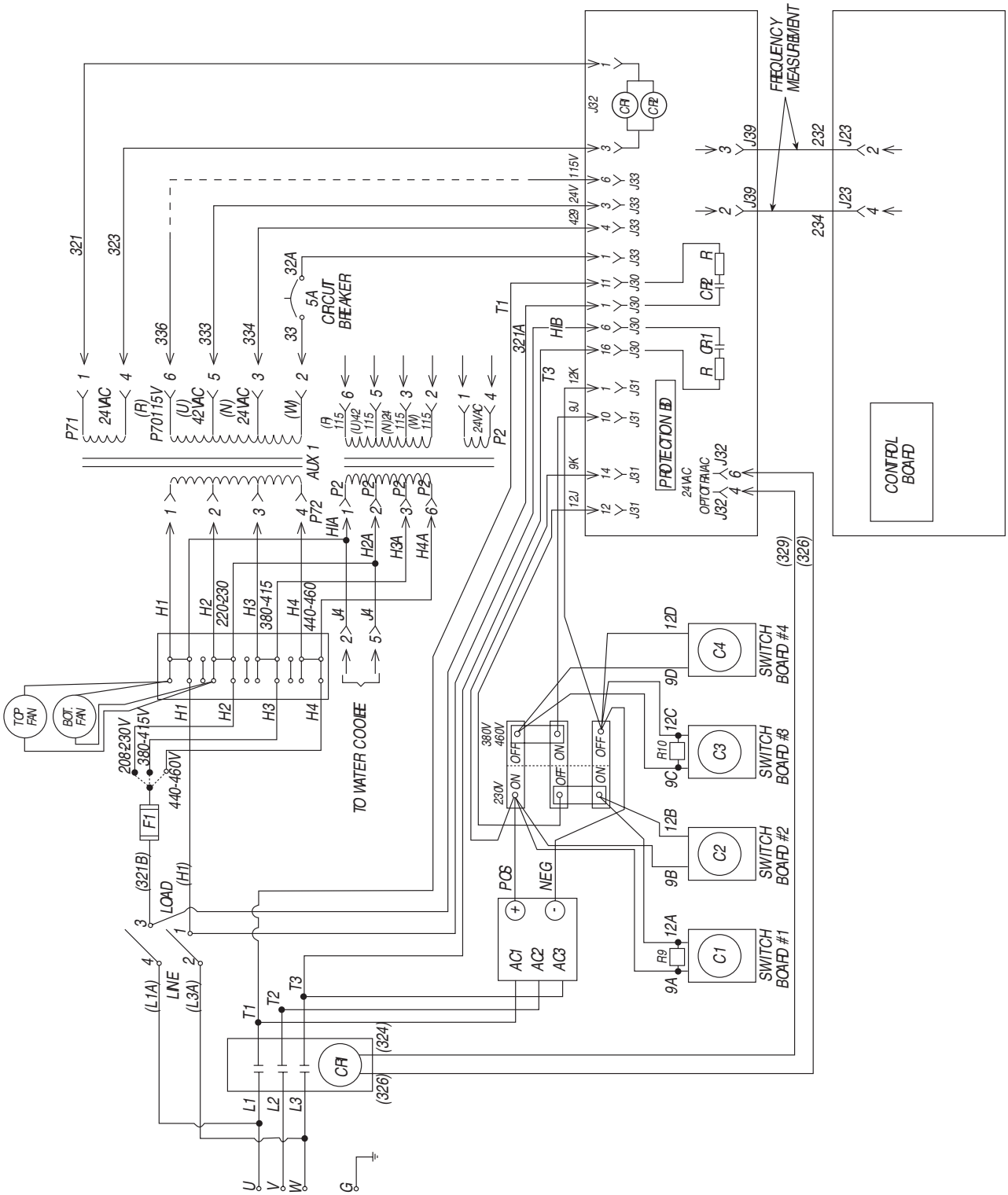
A. Test for continuity between leads #9A, #9B, #9K, and POS connected together at the reconnect switch.

B. Test for continuity between leads #9C, #9D, #9J, #12A, #12B, and #12J connected together at the reconnect switch.

C. Test for continuity between leads #12C, #12D, #12K and NEG connected together at the reconnect switch.

9. If there is continuity within the groups of leads tested, the test is complete. Install the machine case sides, top, handle and the lift bail rubber gasket.

FIGURE F.31 – INPUT AND RECONNECT WIRING DIAGRAM



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STATIC CAPACITOR BALANCE 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 1-888-935-3877 .

TEST DESCRIPTION

This test will determine if, with no machine output, the input capacitors are balanced.

Before conducting this test, perform the following tests:

Switch Board Test - to ensure that none of the switch boards are faulty.

Snubber and Bleeder Resistance Test - to ensure that the bleeder resistors are properly connected to the switch boards.

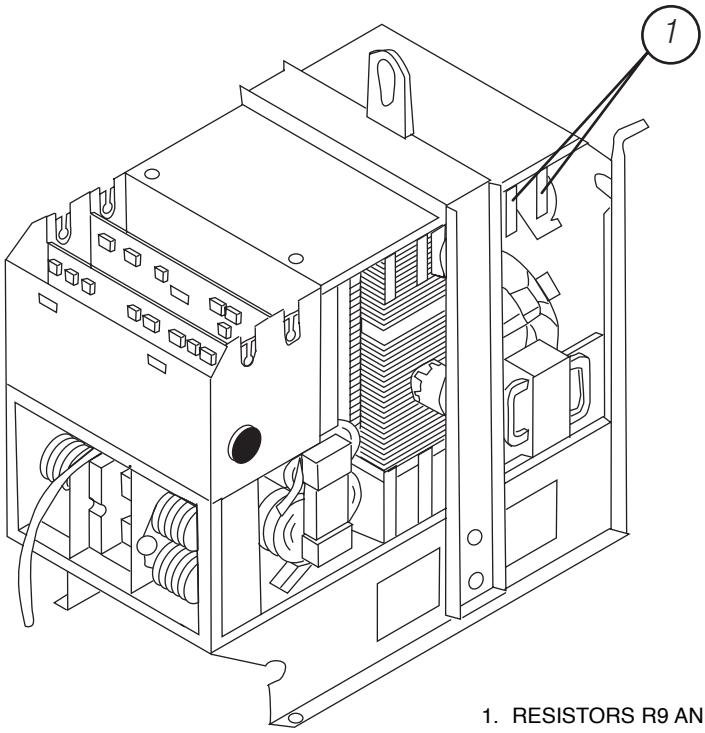
Reconnect Switch Test 1 and Reconnect Switch Test 2 - to ensure that input power is properly connected to the switch boards.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Snubber and Bleeder Resistor Wiring Diagram – Figure F.33

STATIC CAPACITOR BALANCE TEST *(continued)*

FIGURE F.32 - BLEEDER RESISTORS R9 AND R10 LOCATION



1. RESISTORS R9 AND R10 (BLEEDER RESISTORS)

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws holding the PC board cover. Remove the cover.
8. If possible, set the machine up for 380 VAC or above by setting the reconnect switch and Jumper A to 380 VAC. If only 220 VAC is available, perform the test that way. Turn the machine on but have no output.

Return to Section TOC
Return to Master TOC

STATIC CAPACITOR BALANCE TEST *(continued)*

⚠ WARNING

ELECTRIC SHOCK can kill.

With input supply power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal part of the machine, including resistors R9 and R10. Use insulated gloves to measure the resistance across these resistors.

9. Turn input supply power to the machine ON. Machine output must be OFF.
10. Measure and record the DC voltage across bleeder resistors R9 and R10. Compare the voltage recorded to the desired values in Table F.6, depending on the input supply voltage setup.
11. Determine the difference between the two bleeder resistor voltages.

For 380 VAC Input Voltage or Higher:

If the difference is less than 75 VDC, static capacitive balance is okay.

If the difference is more than 75 VDC, static capacitive balance is not okay. Perform the ***Input Rectifier Test***. Also visually check input filter capacitors C1, C2, C3, and C4 for any signs of damage; replace the FET assembly.

For 220 VAC Input Voltage:

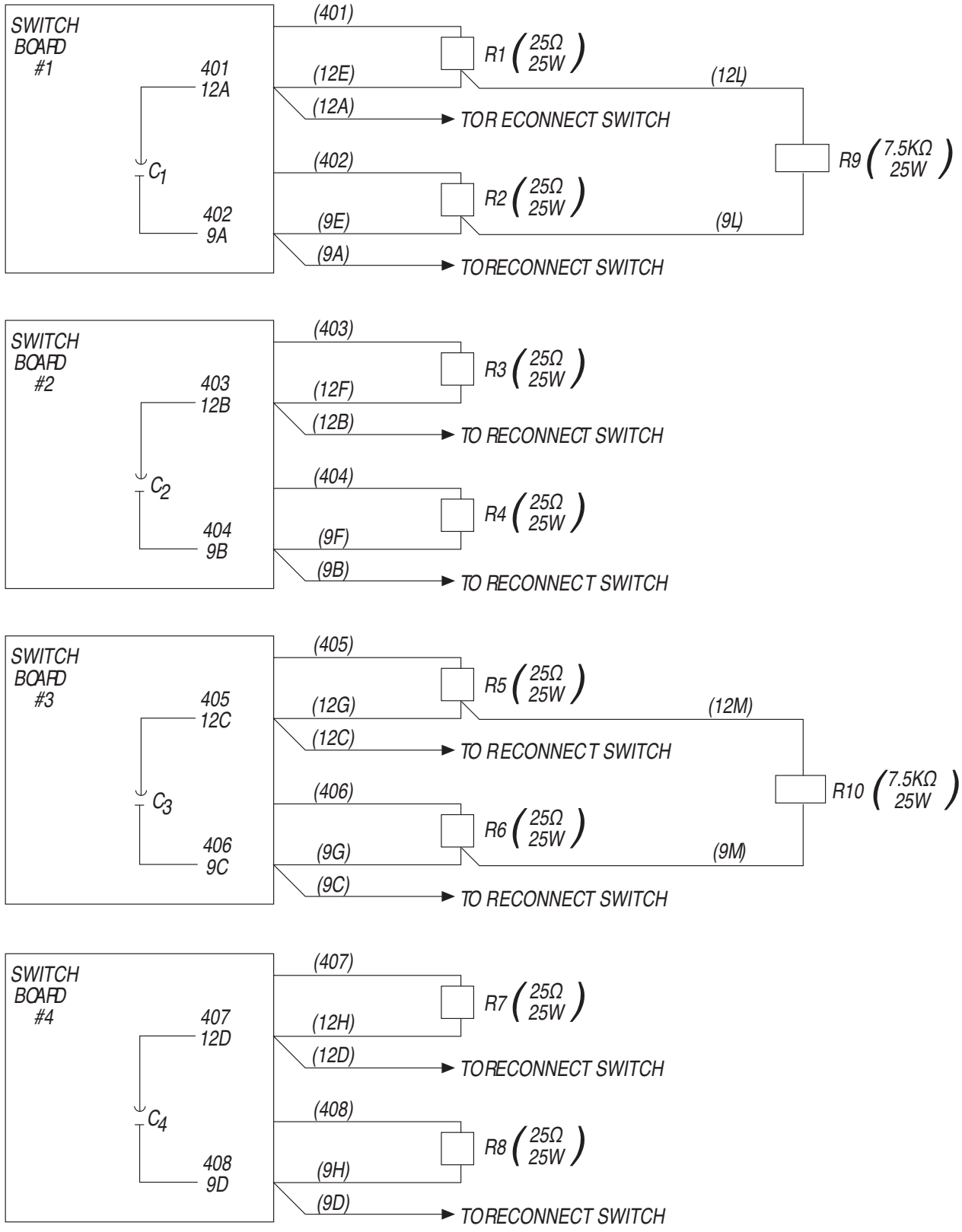
The two resistance measurements should be the same. If one or both is less than 175 VDC, perform the ***Main Contactor Test*** and the ***Input Rectifier Test***. Also visually check input filter capacitors C1, C2, C3, and C4 for any signs of damage; replace the FET assembly.

12. After the test is completed and the problem successfully repaired, install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

TABLE F.6
BLEEDER RESISTOR R9 AND R10 VOLTAGE VALUES

VAC INPUT	VDC ACROSS BLEEDER RESISTORS R9 AND R10
460 VAC	325 VDC
440 VAC	311 VDC
415 VAC	293 VDC
380 VAC	269 VDC
230 VAC	325 VDC
208 VAC	294 VDC

Figure F.33 – SNUBBER AND BLEEDER RESISTOR WIRING DIAGRAM



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Return to Master TOC

DYNAMIC CAPACITOR BALANCE 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 1-888-935-3877 .

TEST DESCRIPTION

This test will determine if, with no machine output, the control board is receiving the correct frequency signal from the protection board.

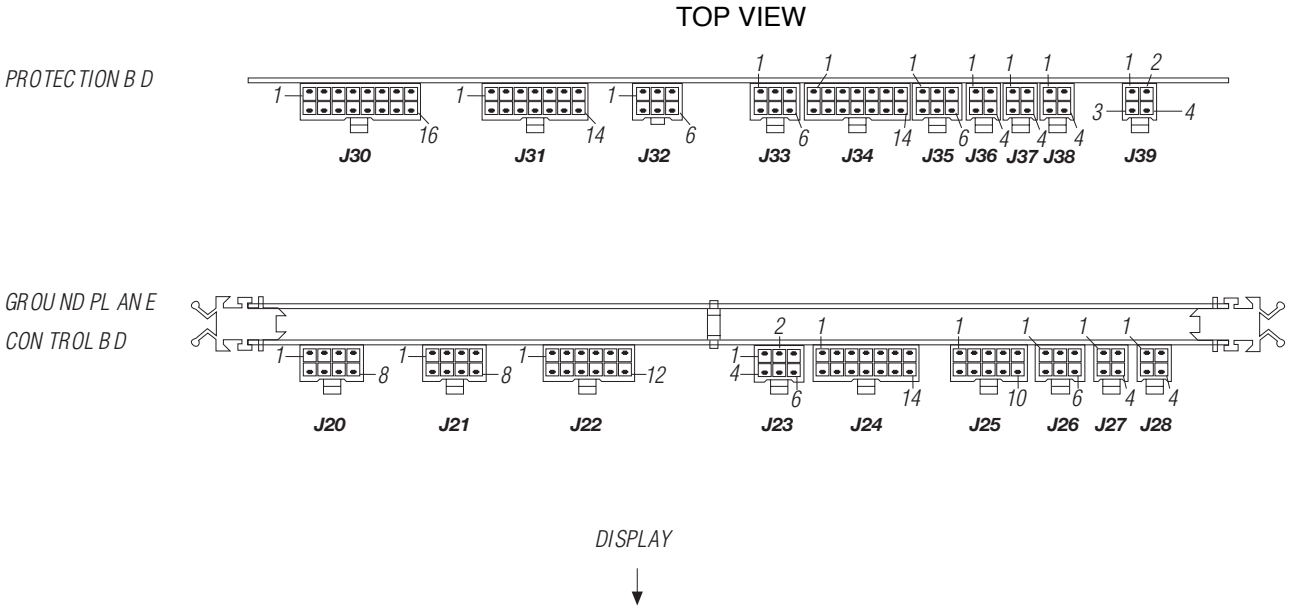
NOTE: Conduct this test after the Static Capacitor Balance Test has been performed successfully. The reconnect switch and Jumper A must be set for 380 VAC input voltage or higher. The selected input voltage must be the actual voltage applied.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Oscilloscope
5/16" Nut driver
3/8" Nut driver
Input and Reconnect Wiring Diagram – Figure F.35

DYNAMIC CAPACITOR BALANCE TEST *(continued)*

FIGURE F.34 - CONTROL BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws that hold the PC board cover. Remove the cover.
8. Connect the machine negative (-) output terminal to earth ground. Connect the oscilloscope case ground to earth ground.
9. Connect the oscilloscope to plug J23 - pin 4 (positive side) and plug J23 - pin 2 (negative side) on the control board. ***See Figure F.23*** for location. If these connections are reversed, you will not be able to see the frequency train on the oscilloscope. Set the oscilloscope to be DC coupled with 2

DYNAMIC CAPACITOR BALANCE TEST *(continued)*

⚠ WARNING

ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal part of the machine while power is ON.

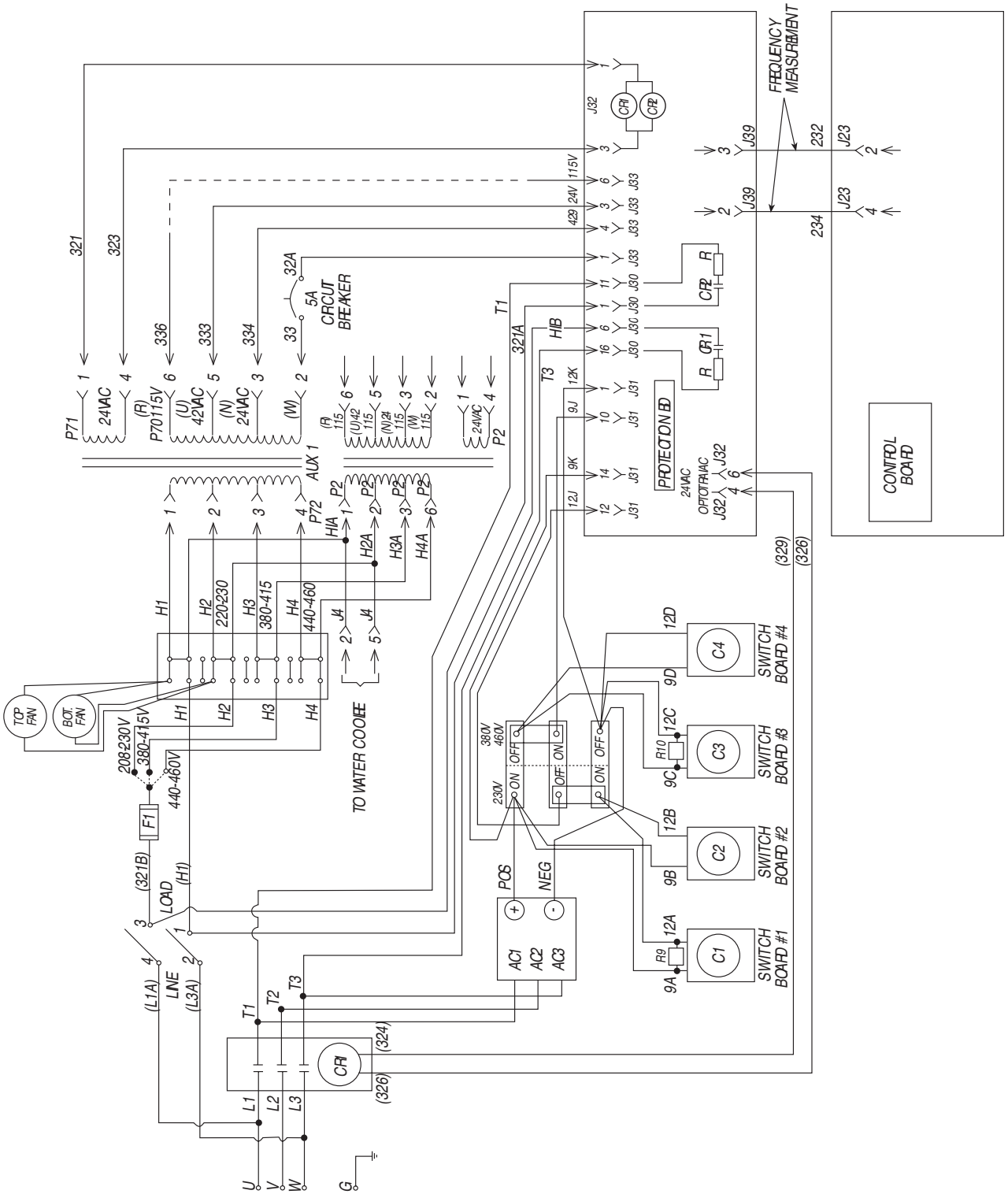
10. Turn input power ON. Machine output must be OFF.
11. Measure the frequency between J23 - pin 4 and J23 - pin 2 on the control board. You should see between 3.2 and 5.3 divisions per cycle (950 to 1550 Hz.). If you do see this, the test is completed. If you do not see this, go to the next step.
12. Turn the power switch SW1 to the OFF position, disconnect input power to the machine, and perform the capacitor discharge procedure.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

13. After you have completed the capacitor discharge procedure for all four switch boards, with the volt/ohmmeter, test leads 9J, 9K, 12J, and 12K for continuity between the between the reconnect switch and the protection board.
14. Test leads #232 and #234 for continuity. These leads are between the protection board and the control board. Lead #232 is between J39 - pin 3 and J23 - pin 2. Lead #234 is between J39 - pin 2 and J23 - pin 4. These leads must be intact for the frequency signal to be measured, because the transistor side of the optocoupler needs the power from the control board.
15. If all the leads tested in step 14 are okay, make sure that the molex plugs are all plugged in correctly and pushed far enough into their headers. Check the frequency again on the oscilloscope.
16. If the frequency is still incorrect, the protection board may be faulty. Replace the protection board and perform the ***Dynamic Capacitor balance Test*** again.
17. If the frequency is still incorrect, the control board may be faulty. Replace the control board.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

FIGURE F.35 – INPUT AND RECONNECT WIRING DIAGRAM



INTERNAL AND AUXILIARY SUPPLY VOLTAGE 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 1-888-935-3877 .

TEST DESCRIPTION

This test will determine if the proper voltages are present at the protection board, the power board, the control board, and the display board.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Internal Auxiliary Supply Wiring Diagram – Figure F.36

INTERNAL AND AUXILIARY SUPPLY VOLTAGE TEST *(continued)*

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.
10. Make sure that none of the pins are loose or open on the following molex plugs: J33, J34, J35, J37, J38 (on the protection board), J12, J13, J16 (on the display board), J22 (on the control board), J42, J43, and J44 (on the power board). See the Internal Auxiliary Supply Wiring Diagram, ***Figure F.36***.

⚠ WARNING

ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine, including plug J30 and the protection board. Do not reach into the machine or touch any internal part of the machine while power is ON.

11. Turn input power ON. Machine output must be OFF.
12. Verify the following voltage measurements:

A. Protection Board:

115 VAC	Between J33 - pin 6 and J33 - pin 1 (POWER WAVE® 450 only)
42 VAC	Between J33 - pin 3 and J33 - pin 1
24 VAC	Between J33 - pin 4 and J33 - pin 1

If any of these voltages are not present on the protection board, and the Auxiliary Transformer 1 Test has been completed successfully, do the following: Turn the power switch SW1 OFF and disconnect input power to the machine. Check the pins of plug J33 to be sure they are not loose or broken. Since Auxiliary Transformer 1 Test determined that voltages are present at plug J33, the fault must be that these signals are not getting to header J33.

B. Protection Board:

115 VAC	Between J34 - pin 1 and J34 - pin 5 (POWER WAVE® 450 only)
42 VAC	Between J34 - pin 3 and J34 - pin 5
24 VAC	Between J34 - pin 4 and J34 - pin 5

If any of these voltages are not present on the protection board (and the voltages in part A, above, were present, replace the protection board.

INTERNAL AND AUXILIARY SUPPLY VOLTAGE TEST *(continued)*

C. Protection Board:

115 VAC	Between J34 - pin 8 and J34 - pin 12 (POWER WAVE® 450 only)
42 VAC	Between J34 - pin 10 and J34 - pin 12
24 VAC	Between J34 - pin 11 and J34 - pin 12

If any of these voltages are not present on the protection board (and the voltages in part A, above, were present, replace the protection board.

D. Power Board:

42 VAC	Between J43 - pin 1 and J43 - pin 3

If this voltage is not present (and the voltages in part A, above, were present), disconnect plug J35 from the protection board and check for 42 VAC at header J35 between pin 1 and pin 6. If this voltage is NOT present, replace the protection board. If this voltage IS present, check the wiring between the boards. Then replace the power board.

E. Display Board:

+5 VDC	Between J16 - pin 2 and J16 - pin 3
+15 VDC	Between J16 - pin 10 and J16 - pin 7
+5 VDC	Between J16 - pin 1 and J16 - pin 7
-5 VDC	Between J16 - pin 9 and J16 - pin 7
-8 VDC	Between J16 - pin 6 and J16 - pin 7

If any of these voltages are not present (and the voltages in part D, above, were present), disconnect plug J44 from the power board and check the following voltages at header J44 on the power board:

+5 VDC	Between J44 - pin 3 and J44 - pin 2
+15 VDC	Between J44 - pin 10 and J44 - pin 12
+5 VDC	Between J44 - pin 11 and J44 - pin 12
-5 VDC	Between J44 - pin 9 and J44 - pin 12
-8 VDC	Between J44 - pin 6 and J44 - pin 12

If any of these voltages are NOT present, replace the power board. If these voltages ARE present, check the wiring first. Then replace the display board.

F. Control Board:

+15 VDC	Between J22 - pin 10 and J22 - pin 12
-15 VDC	Between J22 - pin 6 and J22- pin 12
+5 VDC	Between J22 - pin 11 and J22 - pin 12

If any of these voltages are not present (and the voltages in part D, above, were present), disconnect plug J42 from the power board and check the following voltages at header J42 on the power board:

+15 VDC	Between J42 - pin 10 and J42 - pin 12
-15 VDC	Between J42 - pin 6 and J42 - pin 12
+5 VDC	Between J42 - pin 11 and J42 - pin 12

If any of these voltages are NOT present, replace the power board. If these voltages ARE present, check the wiring. Then replace the control board.

INTERNAL AND AUXILIARY SUPPLY VOLTAGE TEST *(continued)*

13. With the Volt/ohmmeter, check the following leads for continuity:

A. Between the Protection Board and Wire Feeder 2 Receptacle:

Lead #32D	Between J34 - pin 5 and P82 - pin A
Lead #32E	Between J34 - pin 6 and P82 - pin I
Lead #42C	Between J34 - pin 3 and P82 - pin K
Lead #102D	Between J34 - pin 4 and P82 - pin C
Lead #31C	Between J34 - pin 1 and P82 - pin J
Lead #106A	Between J34 - pin 7 and P82 - pin D

B. Between the Protection Board and Wire Feeder 1 Receptacle:

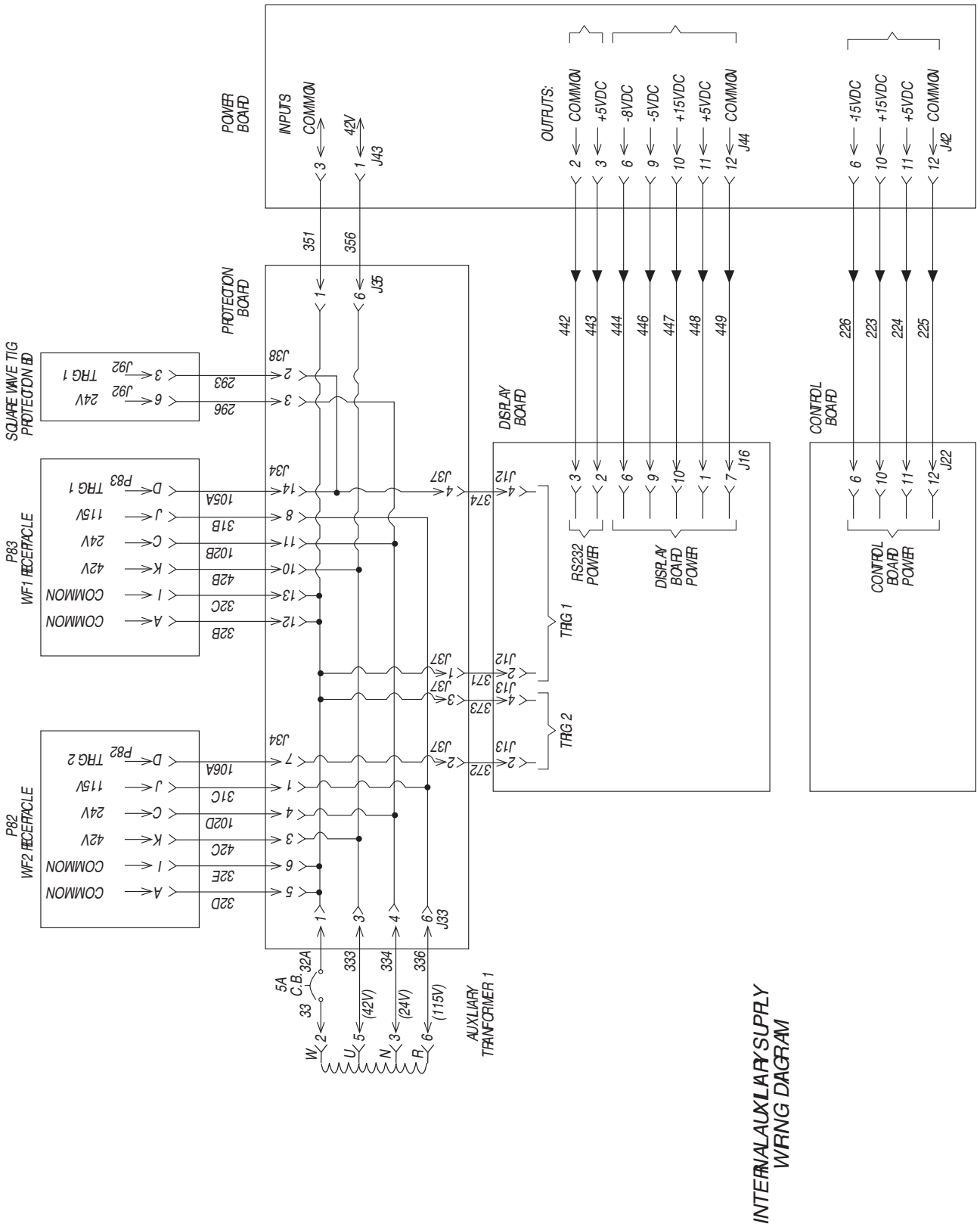
Lead #32B	Between J34 - pin 12 and P83 - pin A
Lead #32C	Between J34 - pin 13 and P83 - pin I
Lead #42B	Between J34 - pin 10 and P83 - pin K
Lead #102B	Between J34 - pin 11 and P83 - pin C
Lead #31B	Between J34 - pin 8 and P83 - pin J
Lead #105A	Between J34 - pin 14 and P83 - pin D

C. Between the protection board and the square wave TIG protection board:

Lead #296	Between J38 - pin 3 and J92 - pin 6

14. After the test is completed and the problem successfully repaired, disconnect input power to the machine.
15. Connect the five leads to main input contactor CR1 and insert plug J30 into the protection board.
16. Install the machine case sides and top.
17. Install the handle and the lift bail rubber gasket.

FIGURE F.36 – INTERNAL AUXILIARY SUPPLY WIRING DIAGRAM



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MAIN CONTACTOR 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 1-888-935-3877 .

TEST DESCRIPTION

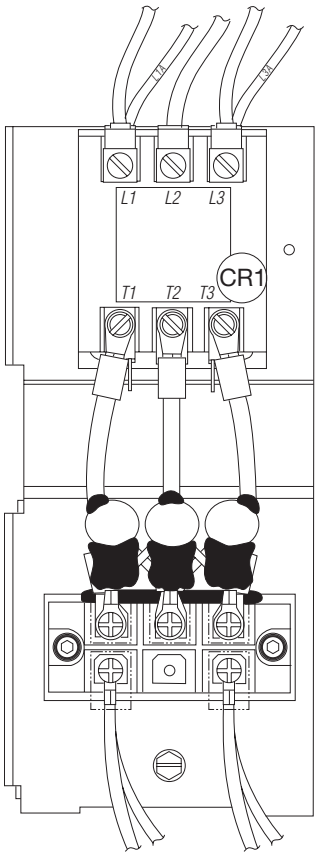
This test will determine if main input contactor CR1 and its associated wiring and components are faulty or damaged.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Slot head screw driver
Input and Reconnect Wiring Diagram – Figure F.38

MAIN CONTACTOR TEST *(continued)*

FIGURE F.37 - MAIN CONTACTOR



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, visually inspect the input terminals L1, L2, and L3 of the main contactor. Make sure they are not shorted together. If they are shorted, go to step 8. If they are not shorted, go to step 9.
8. With the slot head screw driver, remove leads L1A and L3A from the main contactor.

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Return to Master TOC

MAIN CONTACTOR TEST *(continued)*

A. With the power switch SW1 OFF, check to see if leads L1A and L3A are shorted together. If they are shorted, visually inspect the leads. If the leads are okay, then power switch SW1 is faulty and must be replaced.

B. Remove leads L1, L2, and L3 from the main contactor. Check if the terminals of the main contactor are still shorted. If they are, the main contactor is faulty and must be replaced. If the terminals are not shorted, the input lines themselves are shorted. Reconnect leads L1, L2, L3, L1A, and L3A to the main contactor.

9. Visually inspect terminals T1, T2, and T3 of the main contactor. Make sure they are not shorted together in any way. If they are not shorted, go to step 11. If they are shorted, go to step 10.

10. Remove leads T1, T2, and T3 from the main contactor.

A. Check if the terminals of the main contactor are still shorted. If they are, the main contactor is faulty and must be replaced.

B. Reconnect leads T1, T2, and T3 to the main contactor. Remove plug J30 from the protection board. Make sure that leads T1 and T3 of plug J30 between the main contactor and the protection board are not damaged, exposed, or shorted together. Check again for shorts across the contacts of the main contactor. If the terminals are not shorted now, the protection board is faulty. Replace the protection board.

C. Visually inspect leads T1, T2, and T3 between the main contactor and the input rectifier and between the main contactor and the protection board. If these leads are not damaged or exposed, then the input rectifier may be faulty and should be checked. Perform the ***Input Rectifier Test*** described in this section of the manual.

11. With the volt/ohmmeter, check for continuity between the following terminals of the main contactor:

L1 and T1
L2 and T2
L3 and T3

If any of these measurements shows continuity, replace the main contactor. If no continuity is shown, go to step 12.

12. Visually check the following leads for damage, then check for continuity as described:

Lead #324	Between the main contactor and plug J32 - pin 4 of the protection board
Lead #326	Between the main contactor and plug J32 - pin 6 of the protection board
Lead #321	Between plug J71 - pin 1 of auxiliary Transformer 1 and plug J32 - pin 1 of the protection board
Lead #323	Between plug J71 - pin 4 of auxiliary Transformer 1 and plug J32 - pin 3 of the protection board
Lead T1	Between the main contactor and the protection board plug J30 - pin 1
Lead T3	Between the main contactor and the protection board plug J30 - pin 16

Put the power switch SW1 in the ON position for the next two continuity tests:

Lead H1B	Between terminal L3 of the main contactor and plug J30 - pin 6 of the protection board
Lead #321A	Between terminal L1 of the main contactor and plug J30 - pin 1 of the protection board

Put the power switch SW1 in the OFF position.

Replace any broken or damaged leads discovered by these tests.

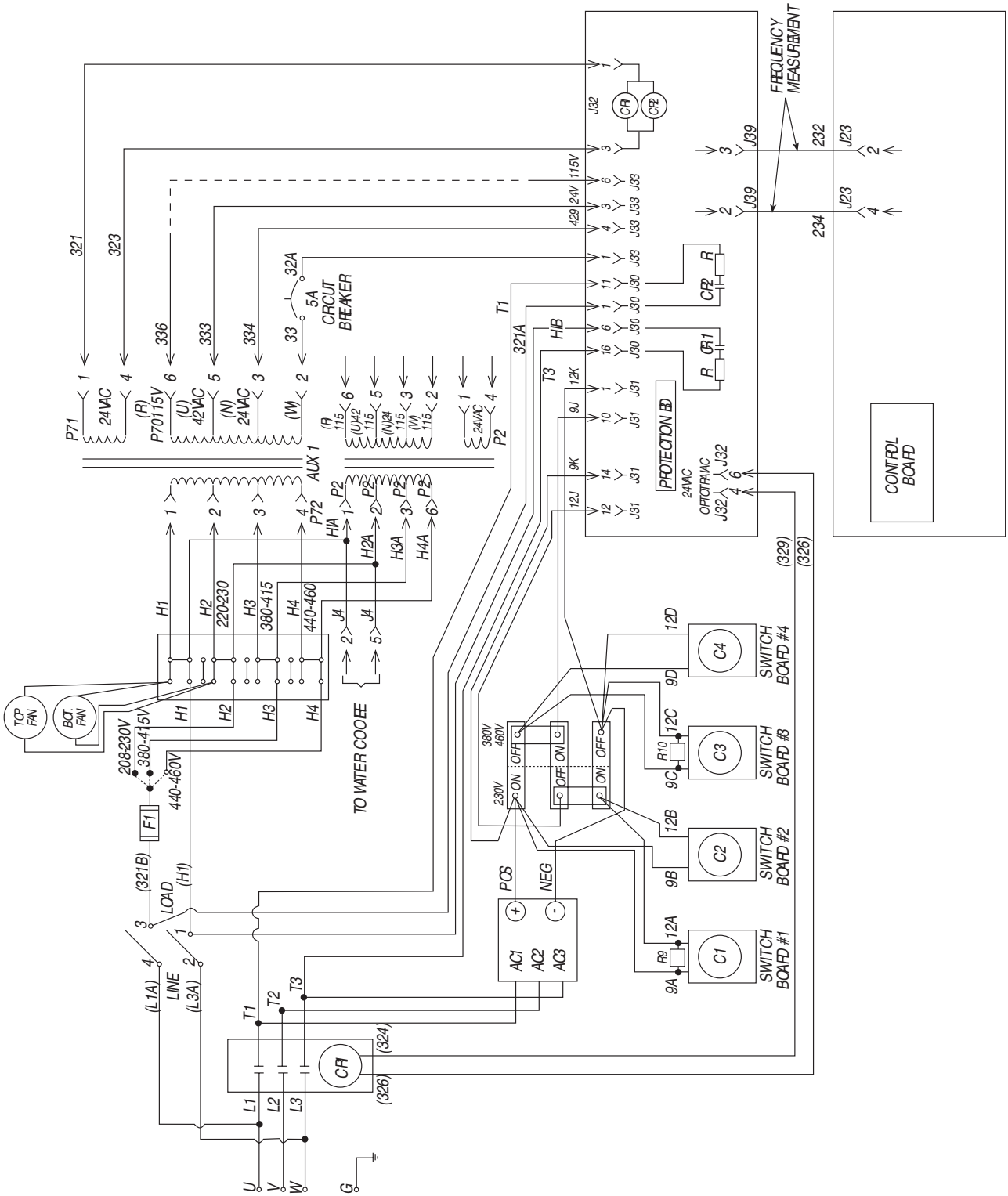
13. Connect any plugs disconnected for the tests. Replace the PC board cover with two sheet metal screws.

14. Install the machine case sides and top.

15. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

FIGURE F.38 – INPUT AND RECONNECT WIRING DIAGRAM



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Return to Master TOC

SERIAL LOOP WIRING HARNESS 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 1-888-935-3877 .

TEST DESCRIPTION

This test will determine if there are any short circuits or other problems in the serial loop wiring between the power board, the control board, the display board, wire feeder 1 amphenol (P83) and wire feeder 2 amphenol (P82).

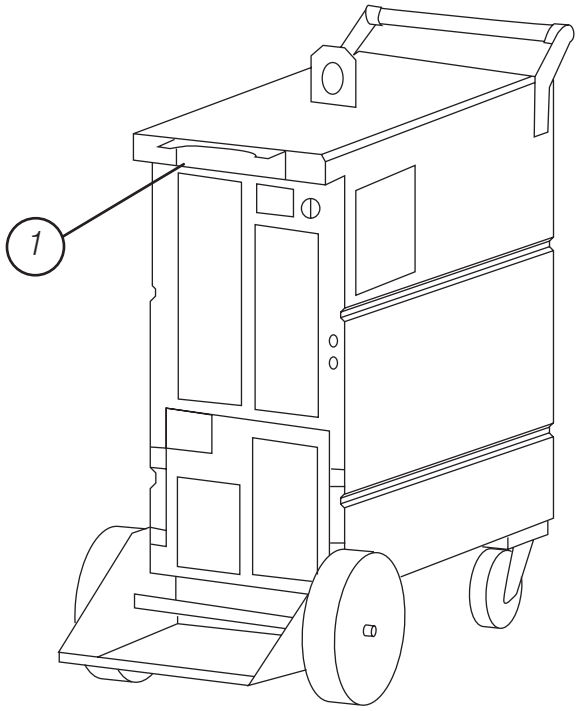
MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Serial Loop Wiring Diagram Figure – F.40

TROUBLESHOOTING & REPAIR

SERIAL LOOP WIRING HARNESS TEST *(continued)*

FIGURE F.39 - WIRE FEEDER AMPHENOL LOCATIONS



1. WIRE FEEDER CONNECTIONS (ON BACK PANEL)

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Perform the following test for faults on the serial loop circuitry between wire feeder 1 amphenol (P83) and the control board.

A. Disconnect the wire feeder from the wire feeder 1 amphenol (P83).

Return to Section TOC
Return to Master TOC

SERIAL LOOP WIRING HARNESS TEST *(continued)*

B. Check for loose or broken leads between the following pins:

P83 - pin L and J27 - pin 1 on the control board (lead #111A)

P83 - pin M and J27 - pin 4 on the control board (lead #112A)

C. Make sure that plug J27 is plugged into the control board securely and that none of its pins are loose.

D. Reconnect the wire feeder to the wire feeder 1 amphenol (P83).

9. Perform the following test for faults on the serial loop circuitry between wire feeder 2 amphenol (P82) and the control board.

A. Disconnect the wire feeder from the wire feeder 2 amphenol (P82).

B. Check for loose or broken leads between the following pins:

P82 - pin L and J28 - pin 1 on the control board (lead #117A)

P82 - pin M and J28 - pin 4 on the control board (lead #118A)

C. Make sure that plug J28 is plugged into the control board securely and that none of its pins are loose.

D. Reconnect the wire feeder to the wire feeder 2 amphenol (P82).

10. Perform the following test for faults on the serial loop circuitry between the display board and the control board.

A. Check for loose or broken leads between the following pins:

J26 - pin 3 on the control board and J14 - pin 6 on the display board (lead #263)

J26 - pin 4 on the control board and J14 - pin 3 on the display board (lead #264)

B. Make sure that plug J26 is plugged into the control board securely and that none of its pins are loose. Also make sure that plug J14 is securely plugged into the display board and that none of its pins are loose.

11. Perform the following test for faults on the serial loop circuitry 40 mA current supply.

A. Check for loose or broken leads between the following pins:

J22 - pin 5 on the control board and J44 - pin 5 on the power board (lead #5R)

J22 - pin 4 on the control board and J44 - pin 4 on the power board (lead #5W)

B. Make sure that plug J22 is plugged into the control board securely and that none of its pins are loose. Also make sure that plug J44 is securely plugged into the power board and that none of its pins are loose.

With the DC voltmeter, check for 30 VDC between plug J44 - pin 5 and pin 4 on the power board. This is the voltage source for the 40 mA current for the serial loop. If the voltage is low or not present, the power board may be faulty. Replace the power board.

12. After the test is completed and the problem successfully repaired, replace the PC board cover with two sheet metal screws.

13. Install the machine case sides and top.

14. Install the handle and the lift bail rubber gasket.

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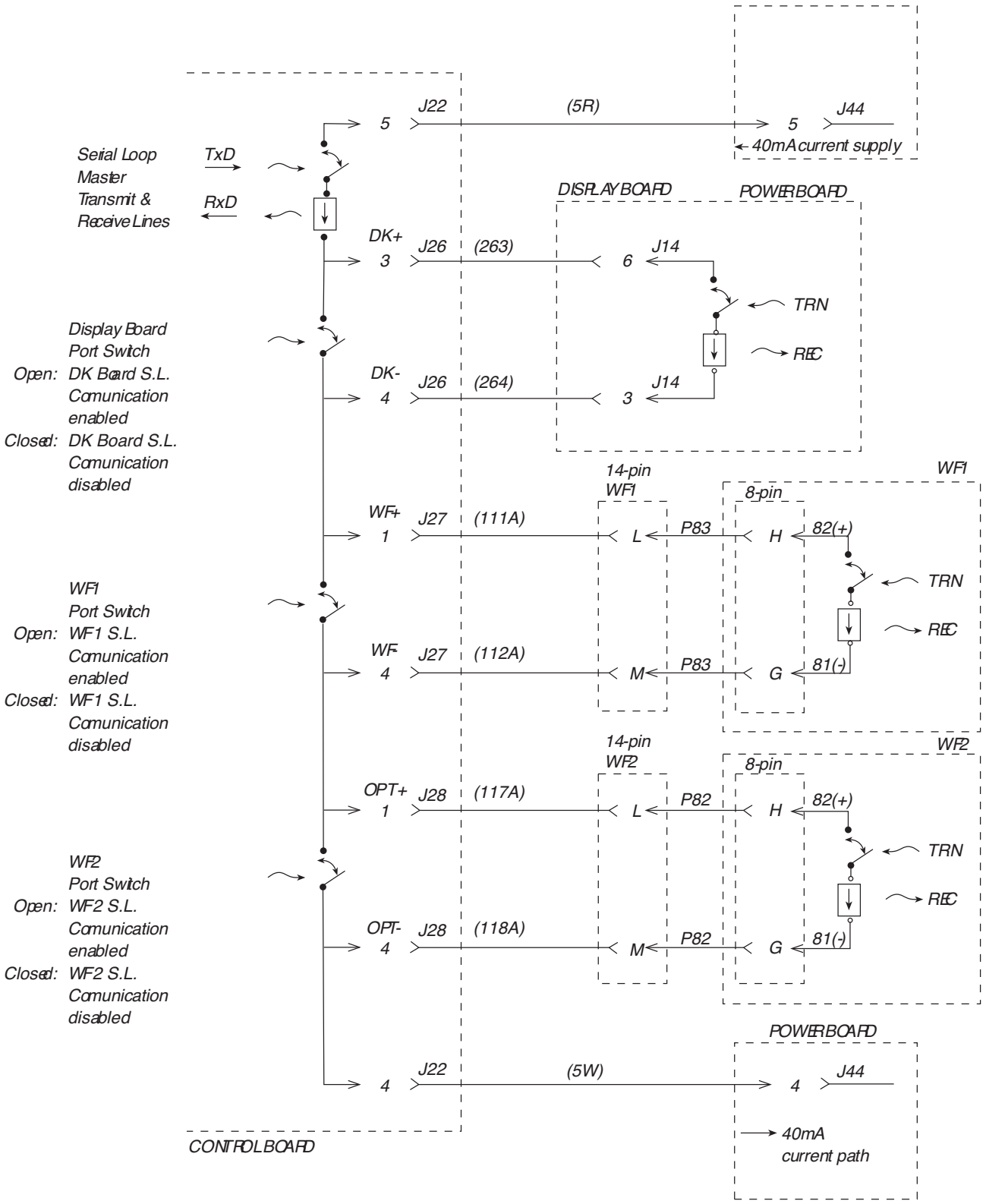
Return to Master TOC
Return to Section TOC
Return to Master TOC

FIGURE F.40 – SERIAL LOOP WIRING DIAGRAM



Return to Section TOC
Return to Master TOC

WIRE FEEDER 1 TRIGGER CIRCUIT 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 1-888-935-3877 .

TEST DESCRIPTION

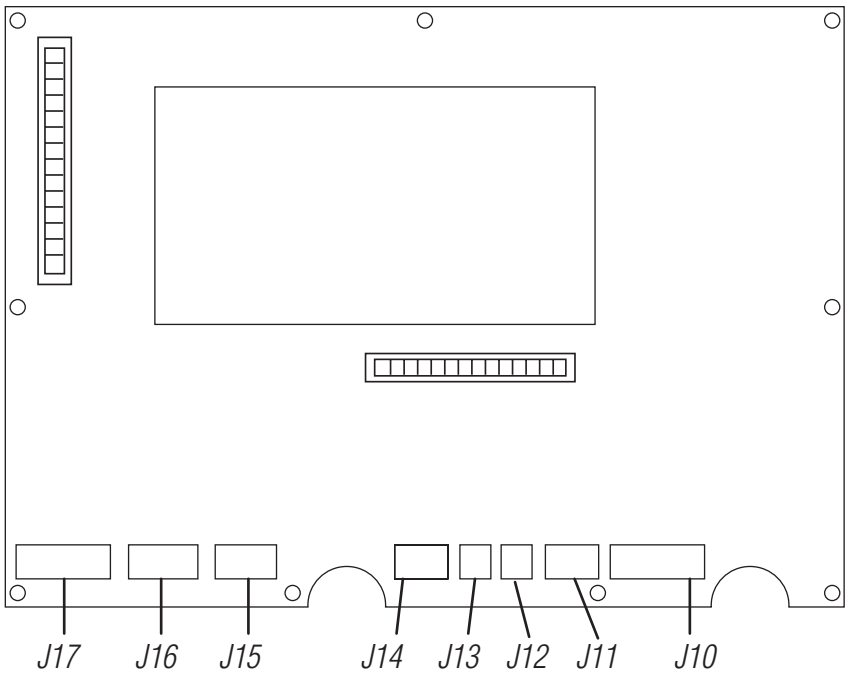
This test will determine if there are any faults in the 24 VAC trigger circuit integral to the POWER WAVE® and the wire feeder 1 amphenol (P83).

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Trigger Circuit Wiring Diagram – Figure F.42

WIRE FEEDER 1 TRIGGER CIRCUIT TEST *(continued)*

FIGURE F.41 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J12 from the display board.
9. Place a jumper wire between pins C and D of wire feeder receptacle #1.
10. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

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

WIRE FEEDER 1 TRIGGER CIRCUIT TEST *(continued)*

11. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal parts.

12. Turn input power ON.
13. With the volt/ohmmeter, check for 24 VAC between plug J12 - pin 2 and pin 4.

A. If 24 VAC IS present, go to step 14.

NOTE: A voltage of 5 to 10 VDC is normal between these pins without the C to D jumper installed in the wirefeeder receptacle.

B. If 24 VAC is NOT present, check for 24 VAC between plug J33 - pin 4 and pin 1. See the Trigger Circuit Wiring Diagram, ***Figure F.42***.

C. If 24 VAC IS present between plug J33 pin 4 and pin 1, check the continuity and integrity of leads #371, 374, 102B, and 105A and their associated pin connectors. See the Trigger Circuit Wiring Diagram. If the continuity checks are good, the protection board may be faulty. Replace the protection board.

D. If 24 VAC is NOT present between plug J33 pin 4 and pin 1, check Auxiliary Transformer #1, the 5 amp circuit breaker, and the associated wiring. See the Trigger Circuit Wiring Diagram, ***Figure F.42***.

14. Turn input power to the machine OFF and perform the capacitor discharge procedure.
15. Remove plug J26 from the protection board. Attach a 150 ohm resistor between plug J26 - pin 1 and J26 - pin 2 (the J26 plug, not the header on the control board).
16. Replace plug J12 into the display board.

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal parts.

17. Turn input power ON. The LCD display will read: ERROR: S.L. NOT INITIALIZED. Disregard this; the test can still be performed.
18. Remove the jumper between pins C and D of wire feeder #1 receptacle.
19. With the volt/ohmmeter, measure the voltage drop across the 150 ohm resistor between J26 - pins 1 and 2. With the jumper removed, the reading should be zero volts (NO voltage drop).
20. Replace the jumper between pins C and D of wire feeder #1 receptacle. Measure the voltage drop with the jumper installed. The reading should be about 2 VDC across the resistor.

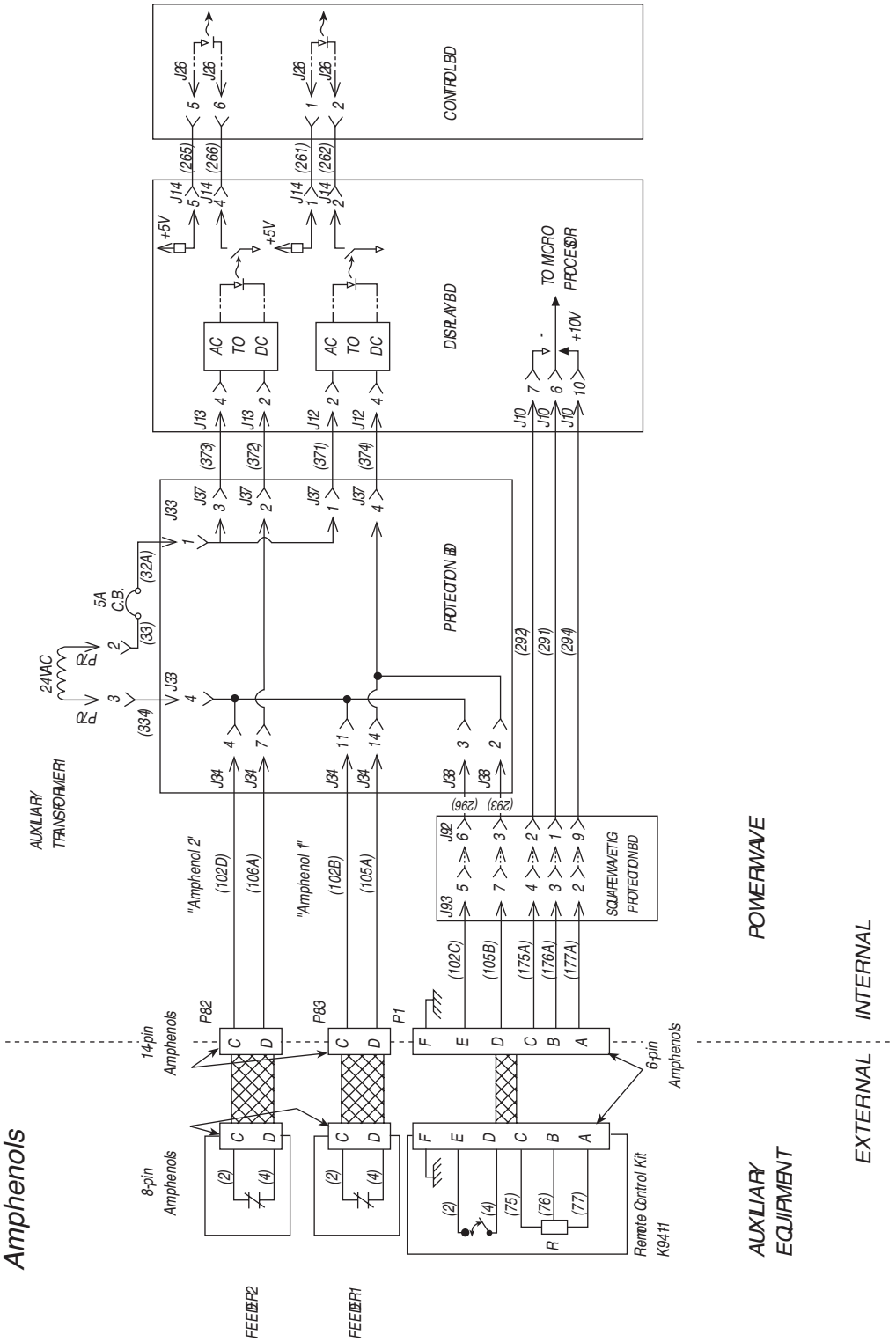
A. If 2 VDC is NOT present, check the continuity and integrity of leads #262 and 261 and their associated pins and connectors. The display board may be faulty -- replace the display board.

B. If 2 VDC IS present across the resistor, the control board may be faulty -- replace the control board.

21. Turn input power to the machine OFF and connect the five leads to the main contactor. Connect all molex plugs to the PC boards and replace the cover with two sheet metal screws. Install the machine case sides, top, handle, and lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

FIGURE F.42 – TRIGGER CIRCUIT WIRING DIAGRAM



Return to Section TOC
Return to Master TOC

WIRE FEEDER 2 TRIGGER CIRCUIT 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 1-888-935-3877 .

TEST DESCRIPTION

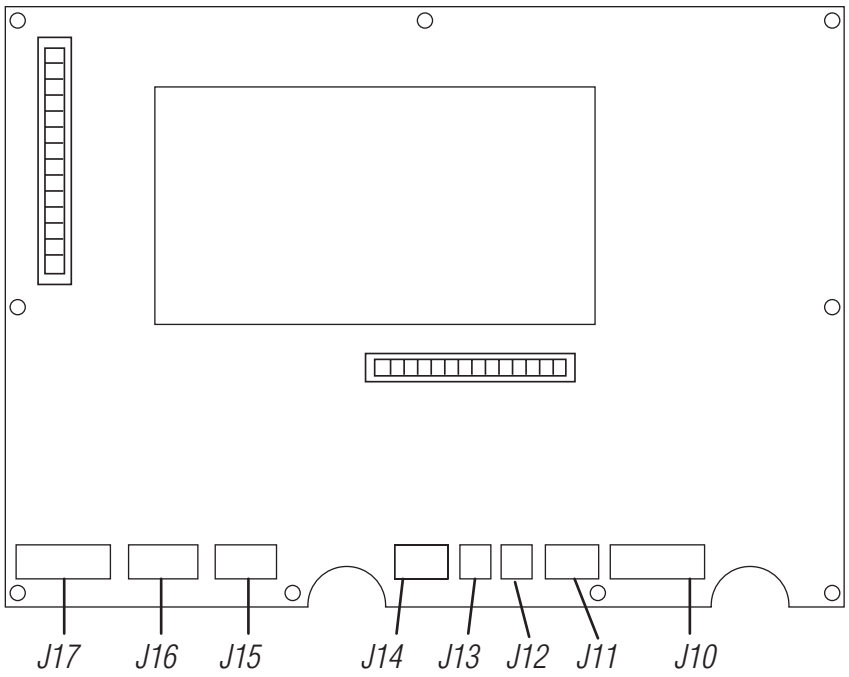
This test will determine if there are any faults in the 24 VAC trigger circuit integral to the POWER WAVE® and the wire feeder 2 amphenol (P82).

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Trigger Circuit Wiring Diagram – Figure F.44.

WIRE FEEDER 2 TRIGGER CIRCUIT TEST *(continued)*

FIGURE F.43 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J13 from the display board.
9. Place a jumper wire between pins C and D of wire feeder receptacle #2.
10. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

WIRE FEEDER 2 TRIGGER CIRCUIT TEST *(continued)*

11. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal parts.

12. Turn input power ON.
13. With the volt/ohmmeter, check for 24 VAC between plug J13 - pin 2 and pin 4.

A. If 24 VAC IS present, go to step 14.

NOTE: A voltage of 5 to 10 VDC is normal between these pins without the C to D jumper installed in the wirefeeder receptacle.

B. If 24 VAC is NOT present, check for 24 VAC between plug J33 - pin 4 and pin 1. See the Trigger Circuit Wiring Diagram, ***Figure F.44***.

C. If 24 VAC IS present between plug J33 pin 4 and pin 1, check the continuity and integrity of leads #373, 372, 102D, and 106A and their associated pin connectors. See the Trigger Circuit Wiring Diagram. If the continuity checks are good, the protection board may be faulty. Replace the protection board.

D. If 24 VAC is NOT present between plug J33 pin 4 and pin 1, check Auxiliary Transformer #1, the 5 amp circuit breaker, and the associated wiring. See the Trigger Circuit Wiring Diagram, ***Figure F.44***.

14. Turn input power to the machine OFF and perform the ***Capacitor Discharge Procedure***.
15. Remove plug J26 from the protection board. Attach a 150 ohm resistor between plug J26 - pin 5 and J26 - pin 6 (the J26 plug, not the header on the control board).
16. Replace plug J13 into the display board,

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal parts.

17. Turn input power ON. The LCD display will read: ERROR: S.L. NOT INITIALIZED. Disregard this; the test can still be performed.
18. Remove the jumper between pins C and D of wire feeder #2 receptacle.
19. With the volt/ohmmeter, measure the voltage drop across the 150 ohm resistor between J26 - pins 1 and 2. With the jumper removed, the reading should be zero volts (NO voltage drop).
20. Replace the jumper between pins C and D of wire feeder #2 receptacle. Measure the voltage drop with the jumper installed. The reading should be about 2 VDC across the resistor.

A. If 2 VDC is NOT present, check the continuity and integrity of leads #265 and 266 and their associated pins and connectors. The display board may be faulty -- replace the display board.

B. If 2 VDC IS present across the resistor, the control board may be faulty -- replace the control board.

21. Turn input power to the machine OFF and connect the five leads to the main contactor. Connect all molex plugs to the PC boards and replace the cover with two sheet metal screws. Install the machine case sides, top, handle, and lift bail rubber gasket.

Return to Section TOC
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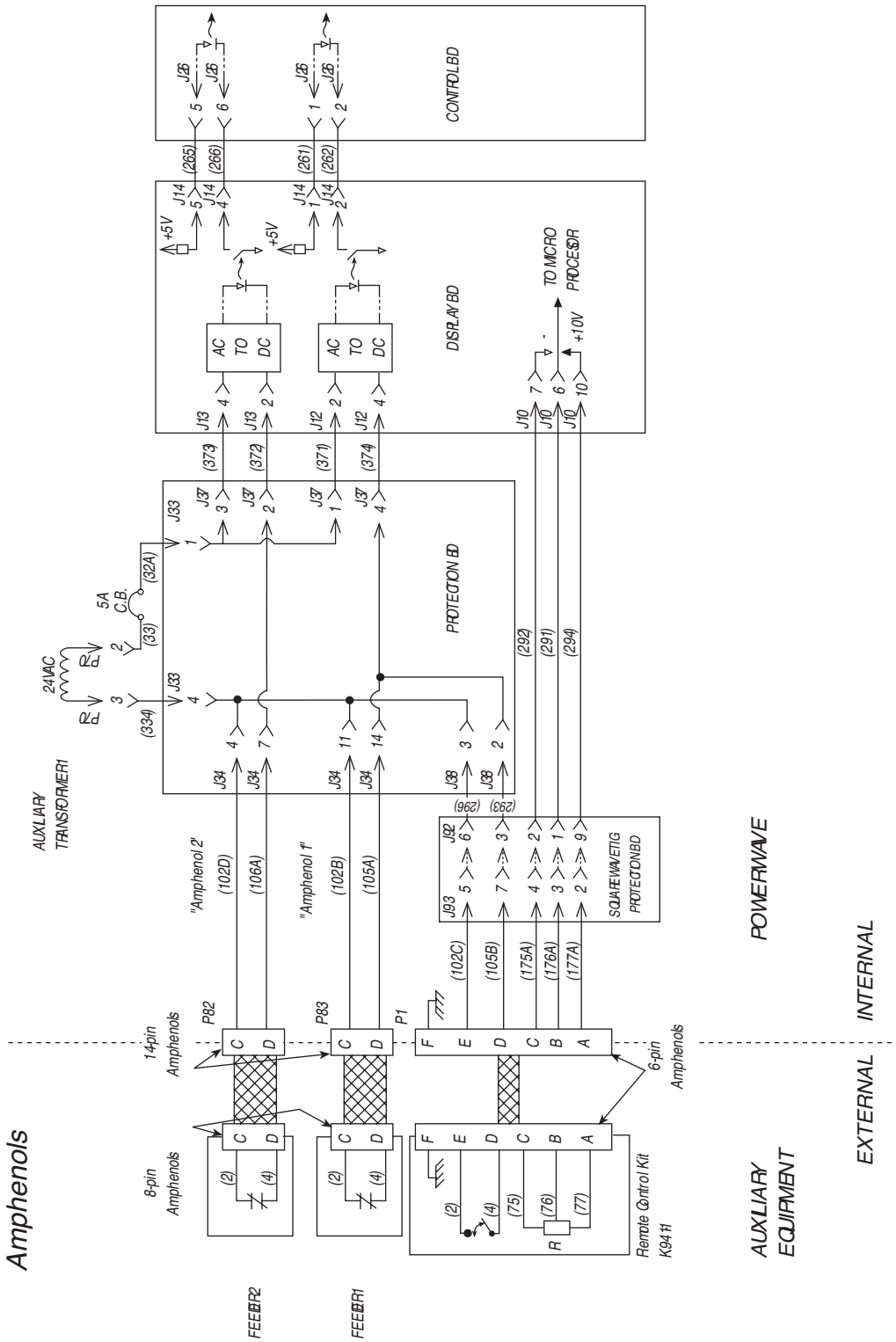
FIGURE F.44 – TRIGGER CIRCUIT WIRING DIAGRAM



TRIGGER CIRCUIT AND WIRING HARNESS 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 1-888-935-3877 .

TEST DESCRIPTION

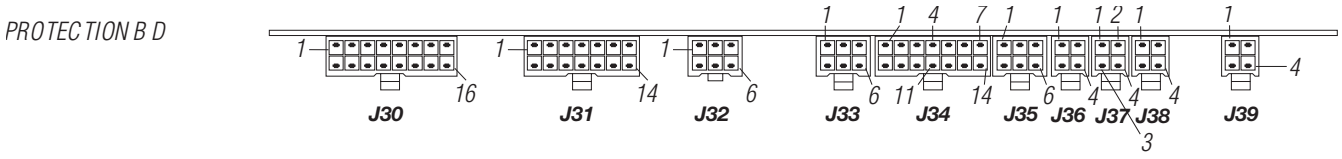
This test will determine if there are any short circuits or other problems in the trigger circuit wiring or if there are any faulty PC boards, which would cause the 5 amp circuit breaker to trip repeatedly.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Auxiliary Transformer #1 Secondary Circuit Wiring Diagram – Figure F.46.

TRIGGER CIRCUIT AND WIRING HARNESS TEST *(continued)*

FIGURE F.45 - PROTECTION BOARD PLUG/HEADER LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plugs J34, J37, and J38 from the protection board. ***See Figure F.1*** for location. Continue with the following checks:

NOTE: Do not remove plug J33 from the protection board.

A. With the volt/ohmmeter, check for continuity between J37 - pin 1 and J37 - pin 4 of header J37. There should be no continuity.

B. Connect a jumper between J34 - pin 11 and J34 - pin 14 of header J34 of the protection board. This simulates the closing of the trigger on wire feeder 1 or the remote.

C. With the volt/ohmmeter, check for continuity again between J37 - pin 1 and J37 - pin 4 of header J37. There should be continuity now. Remove the jumper.

D. With the volt/ohmmeter, check for continuity between J37 - pin 2 and J37 - pin 3 of header J37. There should be no continuity.

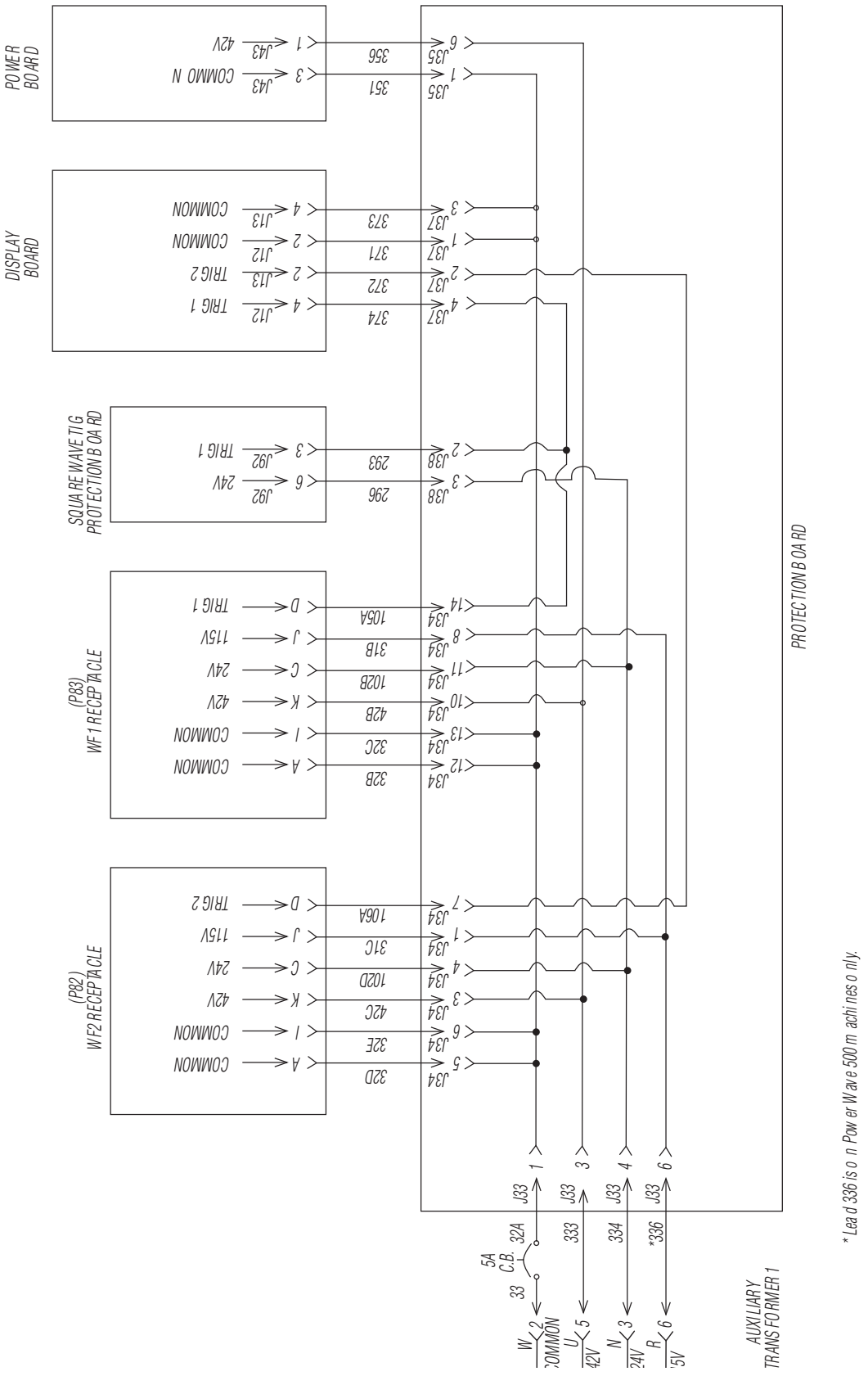
E. Connect a jumper between J34 - pin 4 and J34 - pin 7 of header J34 on the protection board. This simulates the closing of the trigger on wire feeder 2.

F. With the volt/ohmmeter, check for continuity again between J37 - pin 2 and J37 - pin 3 of header J37. There should be continuity now. Remove the jumper and connect plugs J34, J37, and J38 back into the protection board.

If the continuity tests above detect a fault, replace the protection board.

9. Remove plug J37 from the protection board and inspect its pins and leads. Make sure that the TRIG 1, TRIG 2, and COMMON pins of plug J37 are not shorted together (pins 1, 2, 3, 4, respectively). Make sure that leads #371, #372, #373, and #374 are not exposed. See the Auxiliary Transformer #1 Secondary Circuit Wiring Diagram, ***Figure F.46***.
10. Connect plug J37 to the Protection board. If you found no problem with plug J37 pins and leads, replace the display board.
11. After the tests are completed and the problem successfully repaired, reconnect all plugs to their respective boards. Replace the PC board cover with the two sheet metal screws.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

FIGURE F.46
AUXILIARY TRANSFORMER #1 SECONDARY CIRCUIT WIRING DIAGRAM



INTERNAL REMOTE CONTROL 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 1-888-935-3877 .

TEST DESCRIPTION

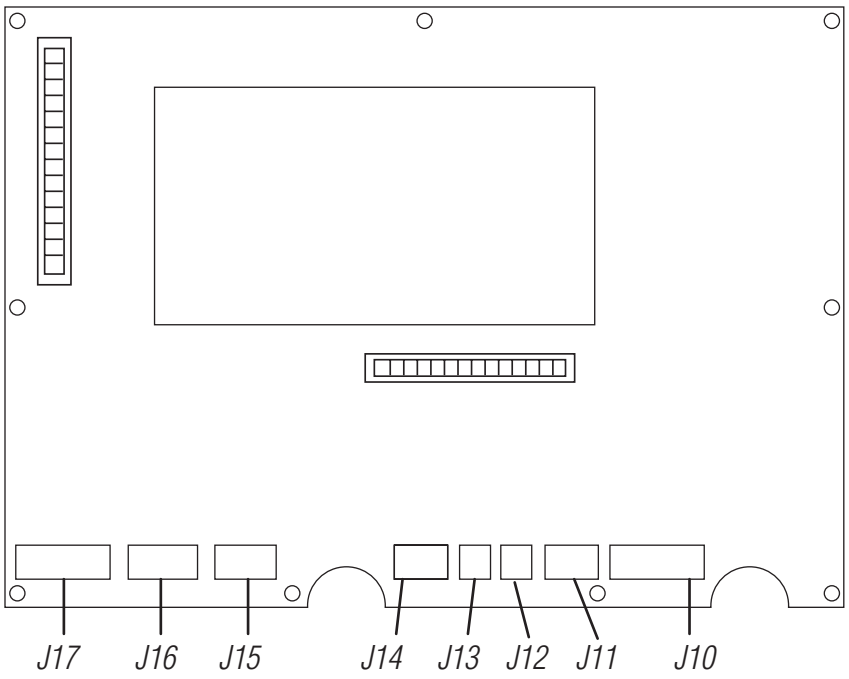
This test will determine if there is a fault in the circuitry that reads the control knob commands of the K941-1 Remote Control Kit.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Trigger Circuit Wiring Diagram – Figure F.48

INTERNAL REMOTE CONTROL TEST *(continued)*

FIGURE F.47 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.

INTERNAL REMOTE CONTROL TEST *(continued)*

⚠ WARNING

ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal part.

10. Turn input power ON.
11. Turn the knob on the Remote Control Kit all the way counterclockwise.
12. With the volt/ohmmeter, check the voltage between plug J10 - pin 6 (positive) and J10 - pin 7 (negative) on the display board. It should be about zero volts.
13. With the POWER WAVE® set in the SMAW (CC) mode of operation, turn the knob on the Remote Control Kit clockwise. The voltage between plug J10 - pin 6 and J10 - pin 7 should increase smoothly to about 10.25 volts. If this happens but the display shows no change in the preset current value (SET =), replace the display board. If the voltage between pins 6 and 7 does not increase smoothly, test the associated wiring as follows:

A. Turn power switch SW1 to the OFF position and disconnect input power to the machine.

B. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

C. Remove plug J10 from the display board. Check for continuity between the following pins:

J10 - pin 10 and P1 - pin A (of the remote amphenol)

J10 - pin 6 and P1 - pin B (of the remote amphenol)

J10 - pin 7 and P1 - pin C (of the remote amphenol)

14. If you find no continuity between any of these pins, do the following:

A. No continuity between J10 - pin 10 and P1 - pin A (of the remote amphenol):

- Check lead #177A between the remote amphenol and the square wave TIG protection board for continuity.
- Check lead #294 between the square wave TIG protection board and the display board for continuity.
- Check plugs J10, J92, and J93 to make sure the pins are seated properly and not opened up or loose.
- Replace the square wave TIG protection board.

B. No continuity between J10 - pin 6 and P1 - pin B (of the remote amphenol)

- Check lead #176A between the remote amphenol and the square wave TIG protection board for continuity.
- Check lead #291 between the square wave TIG protection board and the display board for continuity.
- Check plugs J10, J92, and J93 to make sure the pins are seated properly and not opened up or loose.
- Replace the square wave TIG protection board.

C. No continuity between J10 - pin 7 and P1 - pin C (of the remote amphenol)

- Check lead #175A between the remote amphenol and the square wave TIG protection board for continuity.
- Check lead #292 between the square wave TIG protection board and the display board for continuity.
- Check plugs J10, J92, and J93 to make sure the pins are seated properly and not opened up or loose.
- Replace the square wave TIG protection board.

15. Connect all the plugs disconnected for the tests above.
16. Connect plug J30 into the protection board and replace the PC board cover with two sheet metal screws.
17. Connect the five leads to the main contactor.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber

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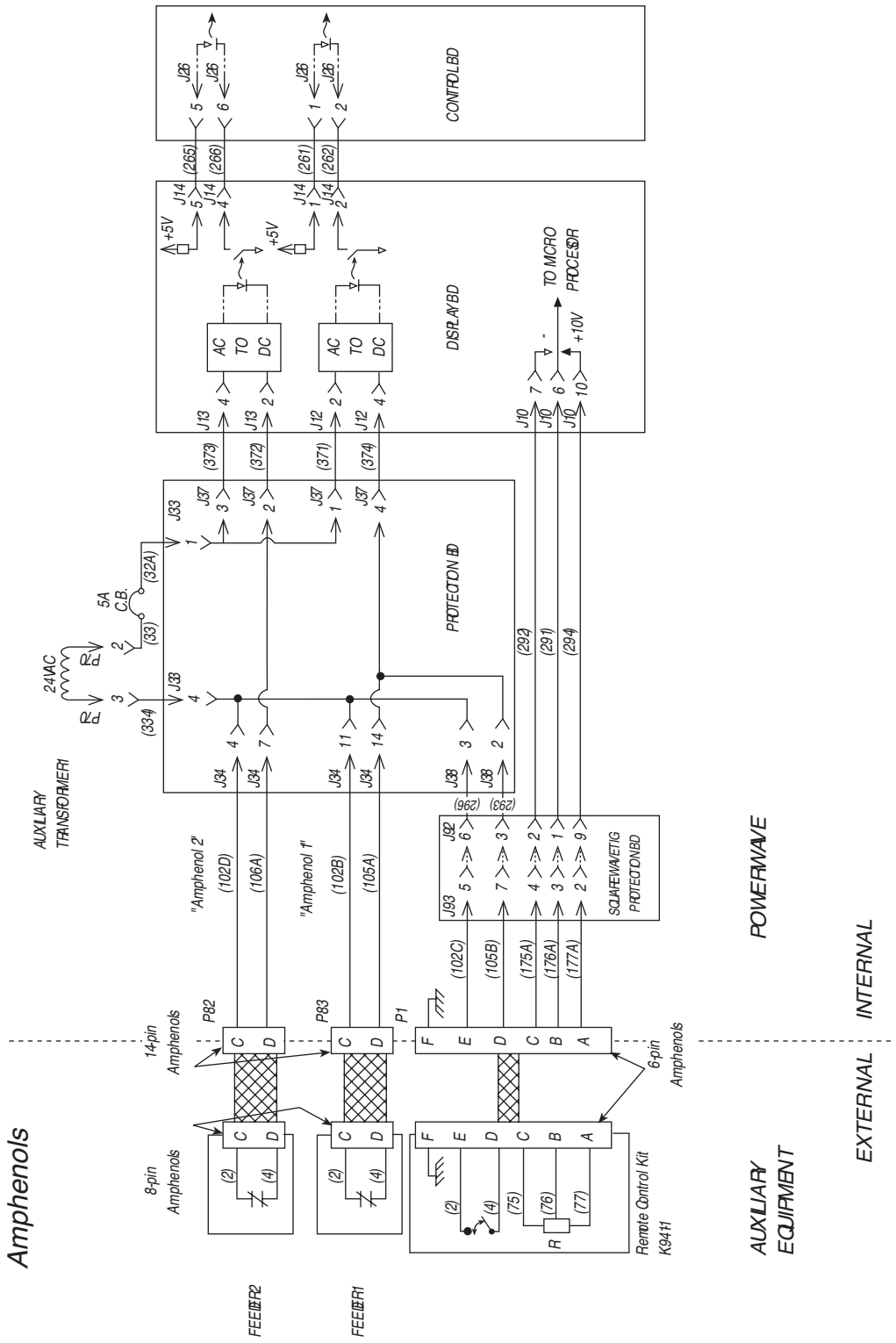
Return to Section TOC
Return to Master TOC

FIGURE F.48 – TRIGGER CIRCUIT WIRING DIAGRAM



K941-1 REMOTE CONTROL KIT 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 1-888-935-3877 .

TEST DESCRIPTION

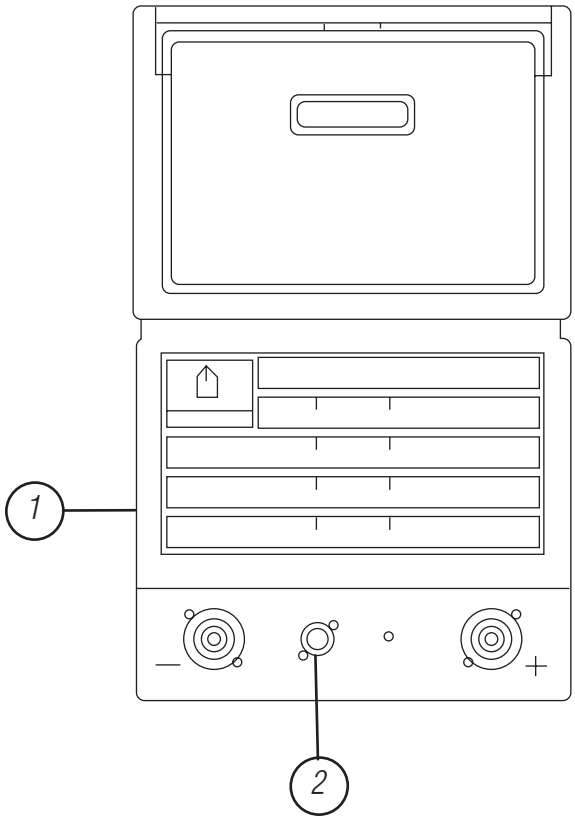
This test will determine if the K941-1 Remote Control Kit is faulty.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
Trigger Circuit Wiring Diagram – Figure F.50

K941-1 REMOTE CONTROL KIT TEST *(continued)*

FIGURE F.49 - 6-PIN AMPHENOL LOCATION



1. MACHINE FRONT PANEL
2. REMOTE CONTROL AMPHENOL RECEPTACLE (6-PIN)

TEST PROCEDURE

1. Remove the Remote Control Kit from the power source.
2. Perform the following tests. If any test fails, the Remote Control Kit is faulty and should be replaced.

A. With the volt/ohmmeter, check the continuity between pin F of the 6-pin amphenol and the case of the Remote Control Kit. The reading should be zero ohms.

B. With the volt/ohmmeter, check the continuity between pin F and the other five pins of the 6-pin amphenol. The reading should be open (no continuity).

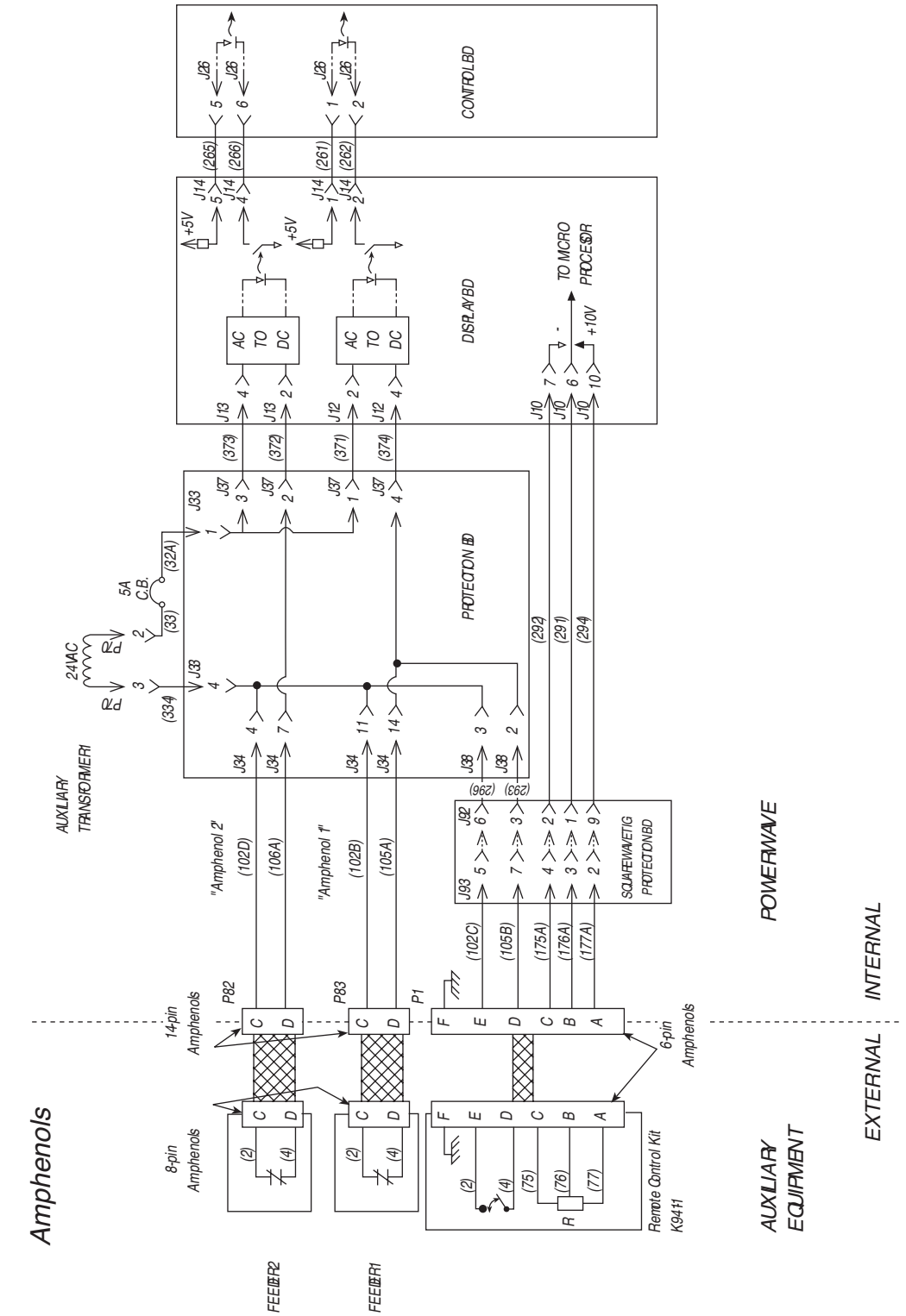
C. Set the Output Terminals switch to the ON position. With the volt/ohmmeter, check the continuity between pins D and E of the amphenol. There SHOULD BE continuity (zero ohms).

D. Set the Output Terminals switch to the OFF position. With the volt/ohmmeter, check the continuity between pins D and E of the amphenol. There should be NO continuity.

E. With the volt/ohmmeter, check the resistance between pins A and C of the amphenol. There should be 10 K ohm (+/- 10%) resistance between these pins at all times.

F. Turn the knob of the Remote Control Kit all the way counterclockwise. With the volt/ohmmeter, check the resistance between pins A and B of the amphenol. There should be 10 K ohm (+/- 10%) resistance between these pins now. Turn the knob clockwise. The resistance between pins A and B should smoothly decrease to zero ohms (+/- 10%).

FIGURE F.50 – TRIGGER CIRCUIT WIRING DIAGRAM



K941-1 REMOTE CONTROL KIT TRIGGER CIRCUIT 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 1-888-935-3877 .

TEST DESCRIPTION

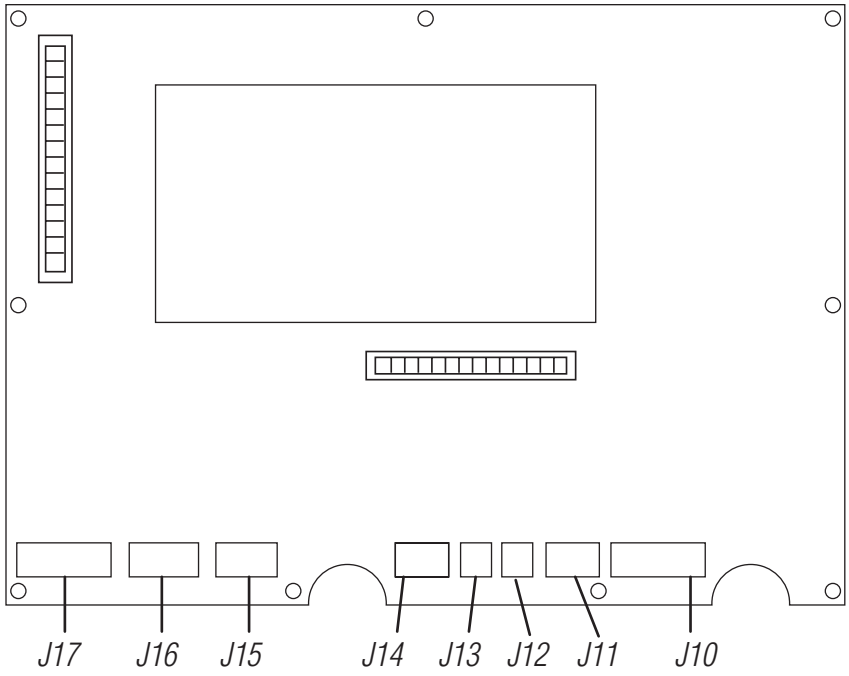
This test will determine if there are any faults in the 24 VAC trigger circuit between the POWER WAVE® and the K941-1 Remote Control Kit.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Short piece of jumper wire
Trigger Circuit Wiring Diagram – Figure F.52

K941-1 REMOTE CONTROL KIT TRIGGER CIRCUIT TEST *(continued)*

FIGURE F.51 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

NOTE: Before troubleshooting the remote control trigger circuit, troubleshoot the remote control kit itself. Refer to the K941-1 Remote Control Kit Test in this section of the manual. If that test is successful, perform the trigger circuit test below.

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove plug J12 from the display board.
9. Place a jumper wire between pins D and E of the six-pin amphenol.
10. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.

K941-1 REMOTE CONTROL KIT TRIGGER CIRCUIT TEST *(continued)*

11. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal parts.

12. Turn input power ON.
13. With the volt/ohmmeter, check for 24 VAC between plug J12 - pin 2 and pin 4.

A. If 24 VAC IS present, go to step 14.

NOTE: A voltage of 5 to 10 VDC is normal between these pins without the D to E jumper installed in the six-pin amphenol receptacle.

B. If 24 VAC is NOT present, check for 24 VAC between plug J33 - pin 4 and pin 1. See the Trigger Circuit Wiring Diagram, ***Figure F.52***.

C. If 24 VAC IS present between plug J33 pin 4 and pin 1, check the continuity and integrity of leads #371, 374, 102C, 105B, 296, and 293 and their associated pin connectors. See the Trigger Circuit Wiring Diagram. If the continuity checks are good, check the square wave TIG protection board by checking the continuity through the following pins. See the Trigger Circuit Wiring Diagram, ***Figure F.52***.

Plug J92 - pin 6 to plug J93 - pin 5. Normal resistance is 4 ohms.

Plug J92 - pin 3 to plug J93 - pin 7. Normal resistance is 4 ohms.

If the square wave TIG protection board is good, then the protection board may be faulty. Replace the protection board.

D. If 24 VAC is NOT present between plug J33 pin 4 and pin 1, check Auxiliary Transformer #1, the 5 amp circuit breaker, and the associated wiring. See the Trigger Circuit Wiring Diagram, ***Figure F.52***.

14. Turn input power to the machine OFF and perform the ***Capacitor Discharge Procedure***.
15. Remove plug J26 from the protection board. Attach a 150 ohm resistor between plug J26 - pin 1 and J26 - pin 2 (the J26 plug, not the header on the control board).
16. Replace plug J12 into the display board,

⚠ WARNING

ELECTRIC SHOCK can kill.

With the input power ON, there are high voltages inside the machine, including the protection board. Do not reach into the machine or touch any internal parts.

17. Turn input power ON. The LCD display will read: ERROR: S.L. NOT INITIALIZED. Disregard this; the test can still be performed.
18. Remove the jumper between pins D and E of the six-pin amphenol receptacle.
19. With the volt/ohmmeter, measure the voltage drop across the 150 ohm resistor between J26 - pins 1 and 2. With the jumper removed, the reading should be zero volts (NO voltage drop).
20. Replace the jumper between pins D and E of the six-pin amphenol receptacle. Measure the voltage drop with the jumper installed. The reading should be about 2 VDC across the resistor.

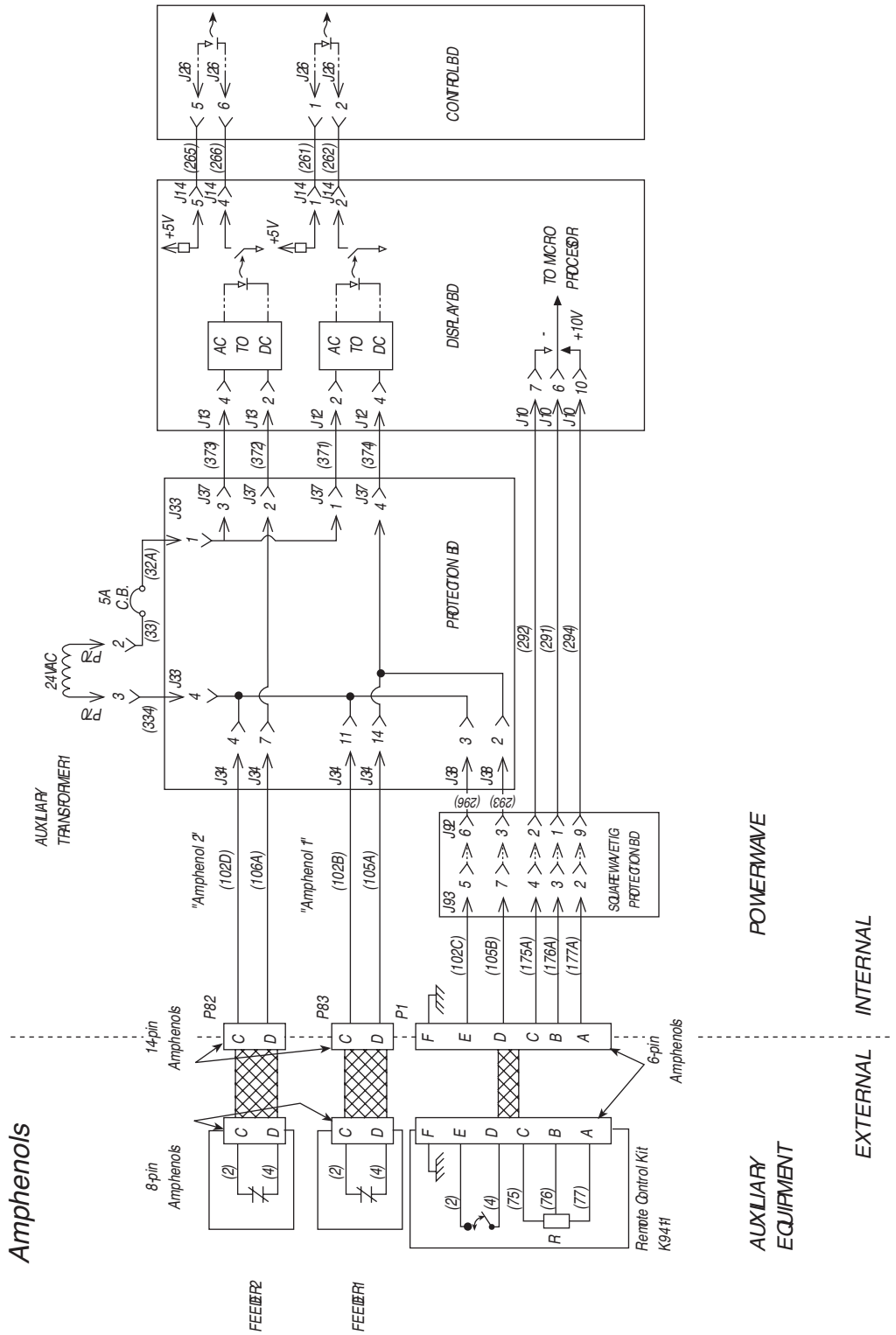
A. If 2 VDC is NOT present, check the continuity and integrity of leads #262 and 261 and their associated pins and connectors. The display board may be faulty -- replace the display board.

B. If 2 VDC IS present across the resistor, the control board may be faulty -- replace the control board.

21. Turn input power to the machine OFF and connect the five leads to the main contactor. Connect all molex plugs to the PC boards and replace the cover with two sheet metal screws. Install the machine case sides, top, handle, and lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

FIGURE F.52 – TRIGGER CIRCUIT WIRING DIAGRAM



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

LCD DISPLAY 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 1-888-935-3877 .

TEST DESCRIPTION

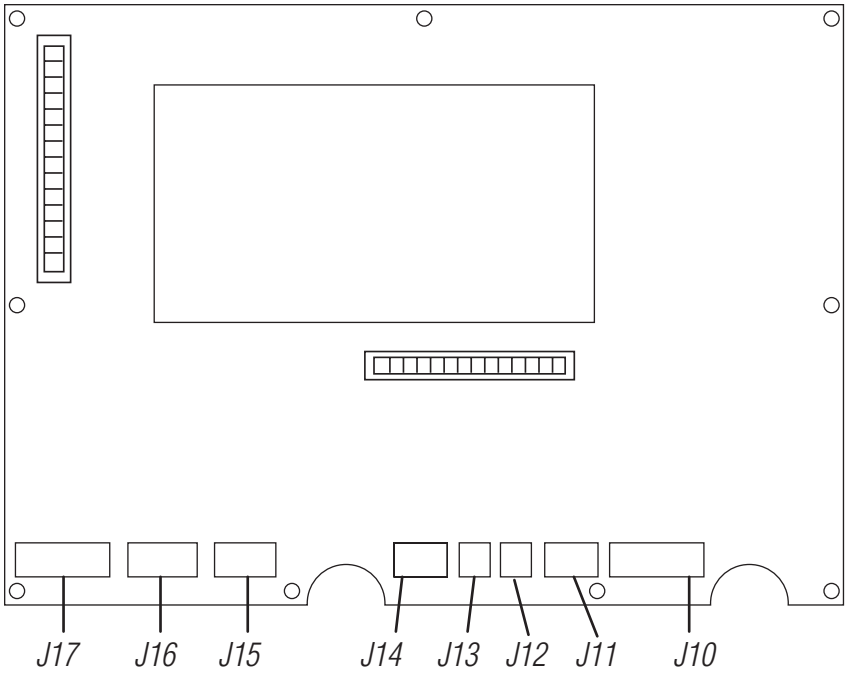
This test will determine if there are any faults in the LCD display on the front panel or in the associated hardware and wiring harness.

MATERIALS NEEDED

Volt/Ohmmeter (Multimeter)
5/16" Nut driver
3/8" Nut driver
Internal Auxiliary Supply Wiring Diagram – Figure F.54

LCD DISPLAY TEST *(continued)*

FIGURE F.53 - DISPLAY BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, remove the PC board cover. Use the 5/16" nut driver.
8. Remove the 5 leads (3 heavy and 2 small) from main input contactor CR1. This is a safety precaution. It prevents high voltage from being put on the machine during the test. Wrap tape around the lead ends to insulate them and prevent them from touching.
9. Remove plug J30 from the protection board. ***See Figure F.1*** for location of the board and plug J30.

LCD DISPLAY TEST *(continued)*

⚠ WARNING

ELECTRIC SHOCK can kill.

With input power ON, there are high voltages inside the machine. Do not reach into the machine or touch any internal part.

10. Turn input power ON.
11. With the volt/ohmmeter, check the following voltages between plug J16 pins at the display board (without removing plug J16 from the display board):

+5 VDC	Between J16 - pin 2 and J16 - pin 3
+15 VDC	Between J16 - pin 10 and J16 - pin 7
+5 VDC	Between J16 - pin 1 and J16 - pin 7
-5 VDC	Between J16 - pin 9 and J16 - pin 7
-8 VDC	Between J16 - pin 6 and J16 - pin 7

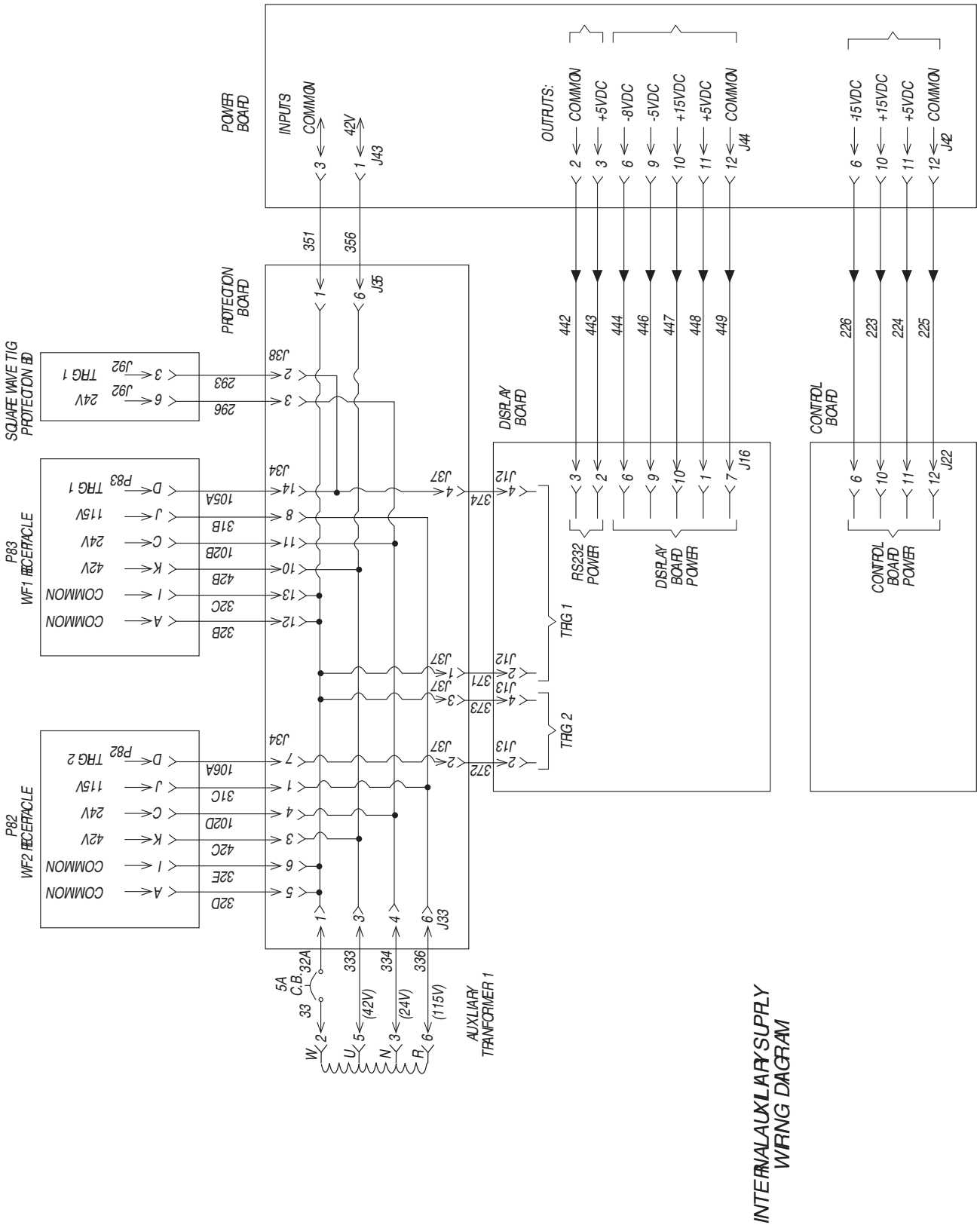
12. Turn power switch SW1 to the OFF position and disconnect input power to the machine. Connect plug J30 into the protection board. Connect the five leads to the main contactor.

If the voltages checked in step 11 were correct, go to step 14.

If any of the voltages in step 11 were not correct, go to step 13.

13. Perform the following tests to locate the problem: ***Auxiliary Transformer 1 Test*** and ***Internal and Auxiliary Voltage Supply Test***. If these tests show no component failures, go to step 14.
14. Make sure plug J19 is plugged into the display board securely and that none of its pins are loose or broken. If the pins are all okay, replace the LCD display.
15. If the problem persists after replacing the LCD display, replace the display board.
16. After the problem has be repaired, install the machine case sides and top. Install the handle and the lift bail rubber gasket.

FIGURE F.54 – INTERNAL AUXILIARY SUPPLY WIRING DIAGRAM



INTERNAL AUXILIARY SUPPLY WIRING DIAGRAM

SENSOR CALIBRATION TEST (FOR DISPLAY BOARD)

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

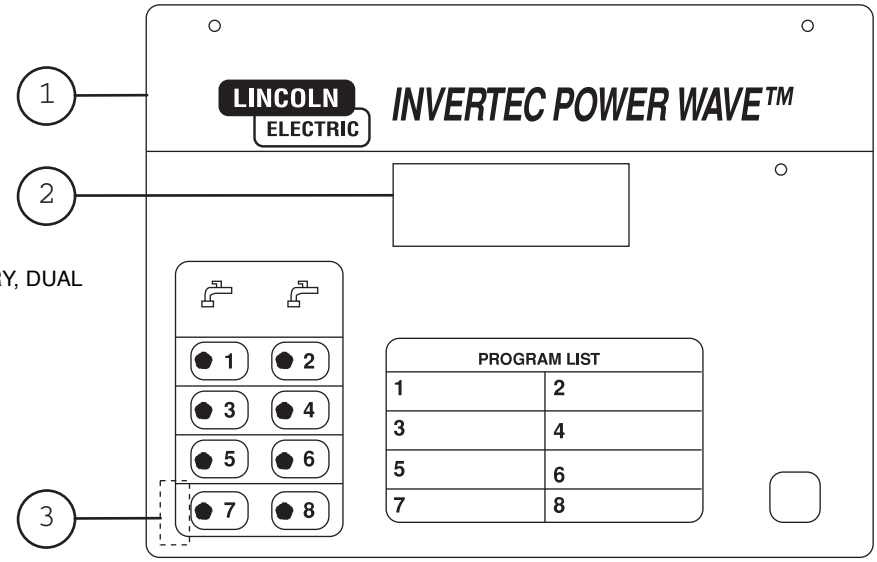
This procedure recalibrates the eight overlay sensors of the POWER WAVE®.

MATERIALS NEEDED

POWER WAVE® Test and Calibration Overlay – L9660-255

SENSOR CALIBRATION TEST (FOR DISPLAY BOARD) *(continued)*

FIGURE F.55 - SENSOR LOCATION BEHIND OVERLAY



1. OVERLAY (WELD FROM MEMORY, DUAL PROCEDURE)
2. LCD DISPLAY WINDOW
3. SENSOR LOCATION

PROCEDURE

1. Turn the machine ON with no overlay in place. The overlay ID number displayed should be 255.
2. When the display reads SELECT A FUNCTION, place the TEST overlay on the machine.
3. Press key #34 - OVERLAY CALIBRATE. The OVERLAY CALIBRATE light turns on and for a few seconds the display reads:

   OVERLAY SENSOR
   CALIBRATION

Then the display changes to read:

   INSERT REF OVRLY
   PRESS ENTER . . .

4. Press key #133 - ENTER. The machine will begin to calibrate the eight overlay sensors.
5. If one of the sensors could not be calibrated, the display reads:

   SENSOR X FAILED
   ENTER TO RETRY

Make sure the overlay is lined up properly and press key #133 - ENTER. This will cause the machine to try to calibrate the sensor again. If a particular sensor continues to fail, replace it.

6. If the calibration procedure is successful, the display reads:

   CALIBRATION
   SUCCESSFUL

After a few seconds the display changes to read:

   INSERT CAL OVRLY
   PRESS ENTER . . .

7. Press key #133 - ENTER. The OVERLAY CALIBRATE LED turns on, the machine exits the OVERLAY CALIBRATE function and the display reads:

SELECT A FUNCTION

8. Turn the power switch SW1 to the OFF position. To use the machine, place the appropriate overlay in position and turn power switch SW1 to the ON position.

NOTE: Turn power switch SW1 to the OFF position and get the overlay that was not recognized by the POWER WAVE®. Replace the TEST overlay with this overlay and turn the machine ON. The machine should recognize the overlay now. If it does not, the overlay is faulty.

QUICK VOLTAGE CALIBRATION

⚠ 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 1-888-935-3877 .

PROCEDURE DESCRIPTION

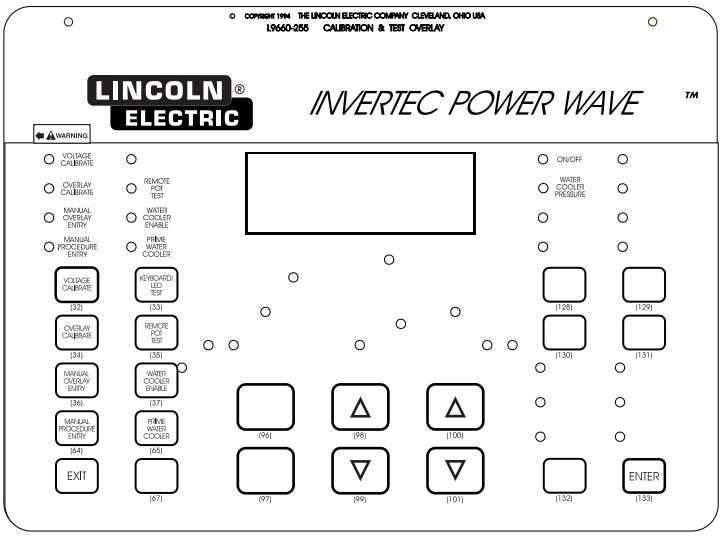
This procedure is a quick way of calibrating the voltage sensing points (leads), provided that the existing display board is capable of displaying the calibration numbers that are stored in the display board.

MATERIALS NEEDED

A known “good” replacement display board
A Test and Calibration overlay L9660-255

QUICK VOLTAGE CALIBRATION *(continued)*

FIGURE F.56 - TEST AND CALIBRATION OVERLAY



PROCEDURE

1. Before changing or disturbing the display board, power up the machine with the L9660-255 Test and Calibration overlay in place. See Figure F.56.
2. Press the Voltage Calibration function (32). The machine should display the following:

   VOLTAGE WIRE
   + POLARITY (+67A)

3. Press the Enter Key (133) on the lower right side of the overlay. The machine should display the following:

   ADJUST TO 30V
   CALIBRATION #=XX

NOTE: Here "XX" indicates a particular calibration number for a given voltage sensing point.

⚠ WARNING

The machine's output terminals will be electrically "HOT" when the Enter Key is pressed.

4. Record the number displayed for the +67 wire and press the Enter Key (133) again.
5. Repeat the process by pressing the Voltage Calibration function again. The next sensing lead may be selected by pressing the down Arrow Key (101). The above procedure must be repeated six times to obtain and record the calibration number for six different voltage sensing points. These points are the following:

   + Polarity (+67A)
   + Polarity (+67B)
   - Polarity (+21A)
   - Polarity (+21B)
   + Polarity
   - Polarity

6. Install the "new" replacement display board.
7. With the L9660-255 overlay installed, apply power to the machine. Press the Voltage Calibration function (32). Enter the recorded calibration numbers for each of the six voltage sensing points. The calibration numbers are entered by selecting the proper sensing point (lead), pressing the Enter Key (133) and obtaining the display that reads:

   ADJUST TO 30V
   CALIBRATION #=XX

   The calibration number is changed using the up/down Arrow Keys (100, 101). Press the Enter Key when the desired number is displayed.

8. Repeat the process for all six sensing points (leads).
9. Perform the ***Sensor Calibration Test***.

Return to Section TOC
Return to Master TOC

FULL VOLTAGE CALIBRATION

⚠ 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 1-888-935-3877 .

PROCEDURE DESCRIPTION

This procedure is necessary if the display board is replaced and the Quick Voltage Calibration is NOT possible. The Full Voltage Calibration is also necessary if the snubber and/or control boards are replaced.

MATERIALS NEEDED

A Test and Calibration Overlay L9660-255
A 300 amp, 30 volt resistive grid load. (A MIG welding load may be used if a grid load is not available. Choose an argon rich 30 volt spray procedure.)
A calibrated DC voltmeter accurate to 30.0 volts +/- 0.1 volt.
A set of jumper leads to access the remote voltage sensing leads in the wire feeder amphenol receptacles.

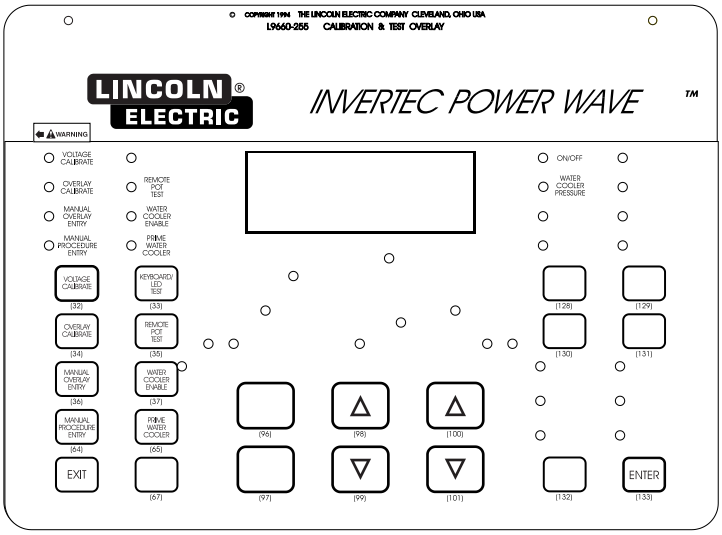
SETUP PROCEDURE

1. Using the jumper leads, connect 21A (H) and 67A (N), located in wire feeder receptacle #1, to the machine's positive output terminal.
2. Using the jumper leads, connect 21B (H) and 67B (N), located in wire feeder receptacle #2, to the machine's positive output terminal.
3. Connect the resistive grid load (or wire feeder) to the machine's output terminals.
4. Connect the DC voltmeter to the machine's output terminals. Do not connect the voltmeter to the load. This avoids erroneous readings due to cable drop.

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

FULL VOLTAGE CALIBRATION *(continued)*

FIGURE F.57 - TEST AND CALIBRATION OVERLAY



PROCEDURE

1. The voltage calibration numbers are stored in the display board. They are programmable from the front panel using the Test and Calibration Overlay.
2. Change the PC board in question.
3. Install the Test and Calibration Overlay L9660-255 and power up the machine. See Figure F.57.
4. Press the Voltage Calibration function (32). The machine should display the following:

   VOLTAGE WIRE
   + POLARITY (+67A)

5. Press the Enter Key (133) on the lower right side of the overlay. The machine should display the following:

   ADJUST TO 30V
   CALIBRATION #=XX

NOTE: Here "XX" indicates a particular calibration number for a given voltage sensing point.

⚠ WARNING

The machine's output terminals will be electrically "HOT" when the Enter Key is pressed.

6. With the machine loaded, monitor the reference voltage only (external voltmeter). It is the only important reading. Adjust the voltage using the Arrow Keys (100 and 101) until the reference voltmeter reads 30.0 volts. Press the Enter Key.

⚠ CAUTION

WHEN LOADING THE MACHINE WITH THE CASE PARTS REMOVED, BE CAREFUL NOT TO OVERHEAT THE MACHINE.

7. Repeat the process by pressing the Voltage Calibration function again. The next voltage sensing point (lead) may be selected by pressing the down Arrow Key (101). The above procedure must be repeated six times to set the six sensing points (leads) to 30.0 volts. The six test points (leads) are the following:

   + Polarity (+67A)
   + Polarity (+67B)
   - Polarity (+21A)
   - Polarity (+21B)
   + Polarity
   - Polarity

8. If the display board is replaced or disturbed, perform the ***Sensor Calibration Test***.

Return to Section TOC
Return to Master TOC

CURRENT CALIBRATION

⚠ 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 1-888-935-3877 .

PROCEDURE DESCRIPTION

This procedure is necessary if the control and/or the shunt amplifier boards are replaced. The current control is the most critical function in the POWER WAVE® machine.

MATERIALS NEEDED

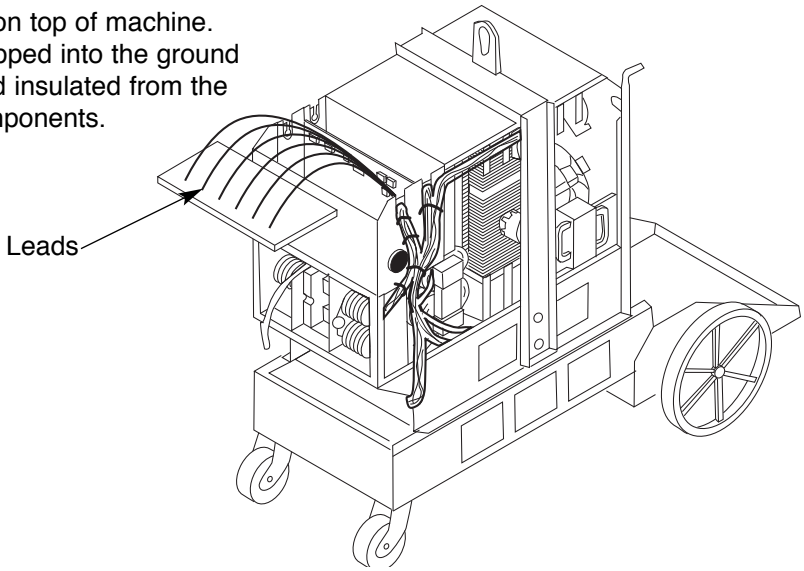
Test and Calibration Overlay L9660-255
A 300 amp, 30 volt resistance grid load
A small trimmer screwdriver
A calibrated DC ammeter accurate to read 300.0 amps +/- 1.0 amps.
A machine output triggering device such as the K941-1 Remote Control Kit.

SETUP PROCEDURE

1. Remove and install the replacement board in question.

FIGURE F.58 – PC BOARD REMOVED BUT STILL CONNECTED

Lay Control Board on top of machine. Make sure it is snapped into the ground plane assembly and insulated from the case and other components.



CURRENT CALIBRATION *(continued)*

2. Locate the 10 turn trimmer potentiometer located on the control board. It is the only trimmer on the board. If the trimmer is not accessible with the control board installed, then the board must be removed and laid on the top of the PC board compartment. Be sure the control board is insulated from the other boards and the case parts. All wiring plugs must be connected to the control board. ***See Figure F.58***.

⚠ WARNING

WHEN THE MACHINE CASE IS REMOVED HIGH VOLTAGE POINTS ARE EXPOSED.

STAND DIRECTLY IN FRONT OF MACHINE UNDER TEST.

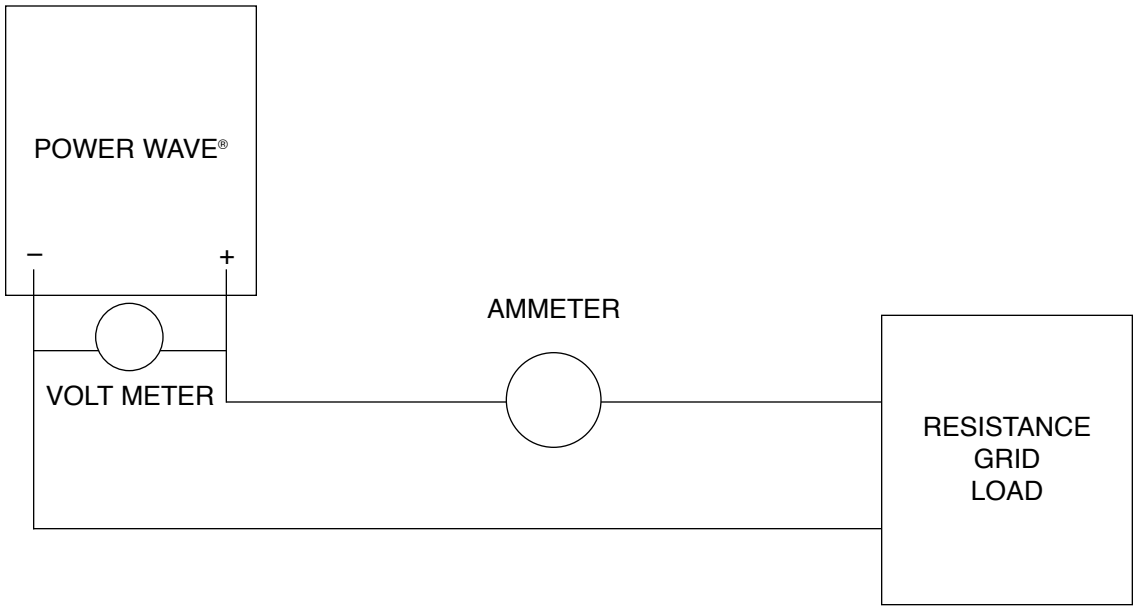
EXPLODING PARTS CAN CAUSE INJURY. FAILED PARTS CAN EXPLODE OR CAUSE OTHER PARTS TO EXPLODE WHEN POWER IS APPLIED. ALWAYS WEAR A FACE SHIELD AND LONG SLEEVES WHEN SERVICING.

⚠ CAUTION

WHEN LOADING THE MACHINE WITH THE CASE PARTS REMOVED. BE CAREFUL NOT TO OVER HEAT THE MACHINE.

3. **NOTE:** If a wire feeder is NOT connected to the POWER WAVE® the machine may not display output volts.
4. Connect the resistance grid load to the machine's output terminals. Connect the reference ammeter in series with the grid load. See Figure F.59.

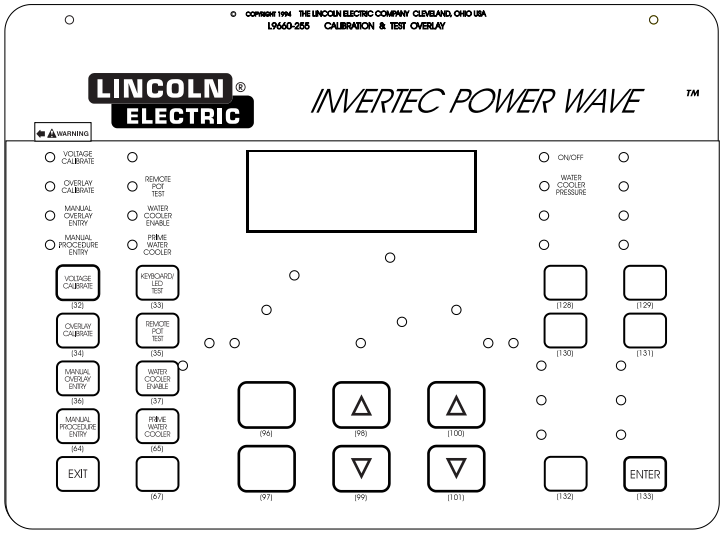
FIGURE F.59 – RESISTANCE GRID LOAD CONNECTIONS



TROUBLESHOOTING & REPAIR

CURRENT CALIBRATION *(continued)*

FIGURE F.60 – TEST AND CALIBRATION OVERLAY



PROCEDURE

1. Install the Test and Calibration Overlay and apply power to the machine. See Figure F.60.
2. Press the Manual Procedure Entry Key (64). The machine should display the following:

   PROCESS 1 SETUP
   1-0

3. Toggle the Arrow Keys (100 and 101) until the display reads:

   PROCESS 1 SETUP
   1-6

4. Activate the external trigger device. (K941-1) and load the machine.

⚠ WARNING

The machine's output terminals will be electrically "HOT" when the trigger circuit is activated.

5. Adjust the potentiometer until the reference (external ammeter) reads 304 amps +/- 1.0 amps. The load voltage should be greater than 15 volts but less than 35 volts.
6. Remove power to the machine.
7. If necessary re-install the control board.
8. Replace the machine case parts.

Return to Section TOC
Return to Master TOC

T1 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

DESCRIPTION

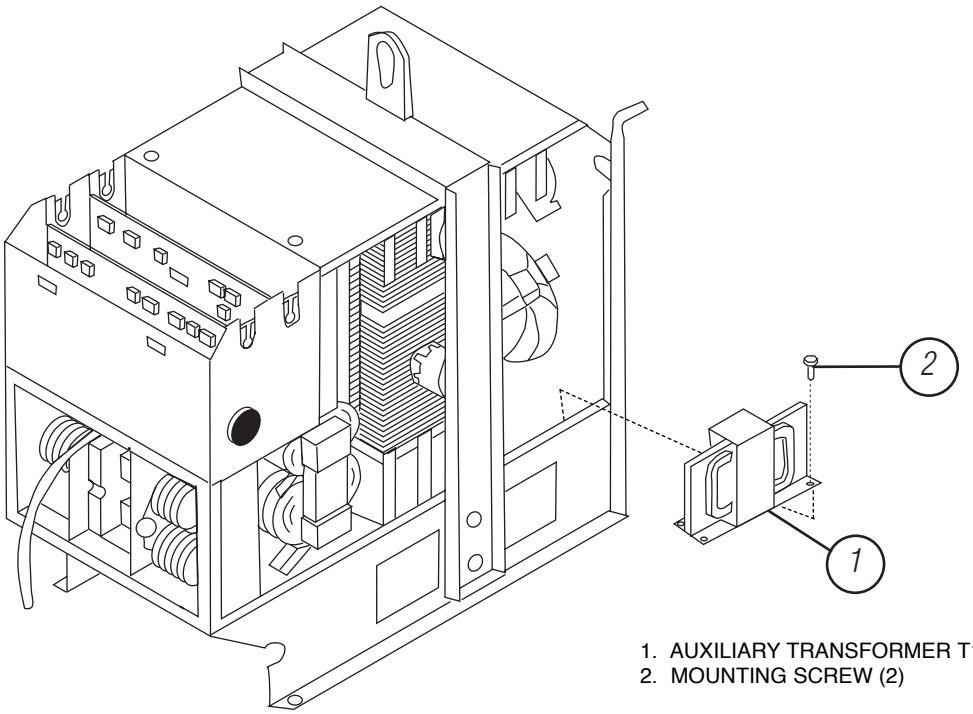
The following procedure will aid the technician in removing the T1 auxiliary transformer for maintenance or replacement.

MATERIALS NEEDED

5/16" Nut driver
3/8" Nut driver or socket wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

T1 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.61 - T1 AUXILIARY TRANSFORMER LOCATION



1. AUXILIARY TRANSFORMER T1
2. MOUNTING SCREW (2)

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, disconnect plugs P70, P71, and P72 that attach to the transformer. See Figure F.61 for location.
8. With the wirecutters, cut any necessary cable ties (necessary for removal of the transformer). Note the location of these cable ties for reassembly.
9. With the 3/8" nut driver or socket wrench, remove the two screws that mount the transformer to the machine base. Remove the T1 auxiliary transformer.
10. To install the T1 auxiliary transformer, carefully position it onto the machine base and tighten the two mounting screws. Connect plugs P70, P71, and P72 to their respective receptacles on the transformer.
11. Install the machine case sides and top.
12. Install the handle and the lift bail rubber gasket.

WATER COOLER REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

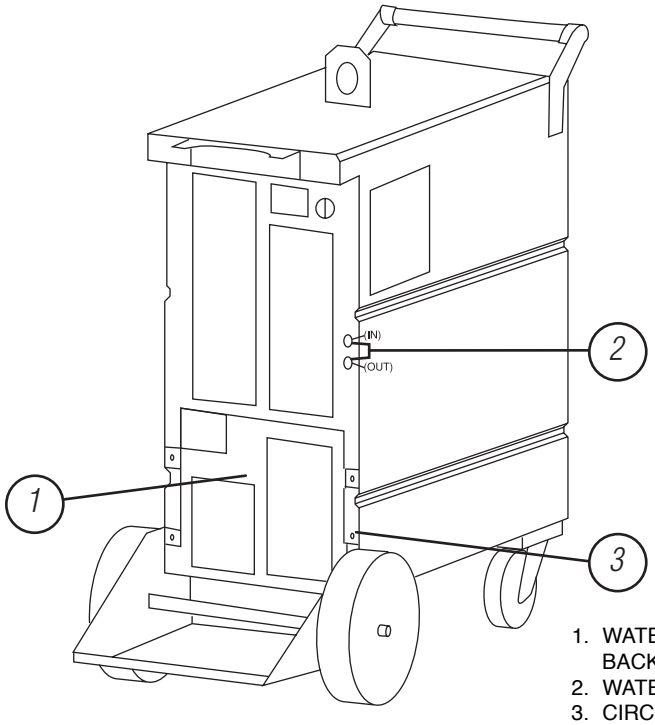
The following procedure will aid the technician in removing the machine water cooler assembly for maintenance or replacement.

MATERIALS NEEDED

5/16" Nut driver
9/16" Open end or box wrench
3/8" Nut driver or socket wrench
3/4" Open end wrench
11/16" Open end wrench
Machine Wiring Diagram in the Electrical Diagrams section of this manual

WATER COOLER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.62 - WATER COOLER LOCATION



1. WATER COOLER ACCESS DOOR (ON BACK PANEL)
2. WATER COOLING FITTINGS
3. CIRCUIT BREAKER

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the water cooler access door. See Figure F.62 for location.
8. With the 3/8" open end or socket wrench, remove the two water cooler assembly mounting screws. Slide the assembly to the left to better access the circuit breaker, which will be removed in a moment.
9. With the 5/16" nut driver, remove the two sheet metal screws holding the lower case back panel.

Return to Section TOC
Return to Master TOC

WATER COOLER REMOVAL AND REPLACEMENT *(continued)*

10. With the 9/16" open end wrench, remove the circuit breaker.
11. Locate and disconnect plug 4, behind the water cooler. Plug 4, a large molex plug, has two leads (H1A and H2A). Double-check that these are the leads feeding the plug; there is another large molex plug in the same area that is not connected to the water cooler.
12. Disconnect Plug 3, a small molex plug with four leads. This plug is also located behind the water cooler.
13. Slide out the water cooler assembly. Take care not to damage the reservoir tank and cooling coils.
14. If complete removal is required, with the 3/4" and 11/16" open end wrenches, disconnect the water cooler lines from the machine back panel. Disconnect the plastic strain relievers that hold the water lines to the subframe.

If disassembly of the water cooler is required, refer to the ***Water Cooler Disassembly procedure*** in this section of the manual.

15. To install the water cooler, slide the assembly into the machine base. Make sure the cooler fits under the retaining clips. Connect the water lines to the back panel and connect the plastic strain relievers where they hold the water lines to the subframe.
16. Connect plugs 3 and 4, behind the water cooler assembly.
17. Attach the circuit breaker. Use the 9/16" open end wrench.
18. Install the two 5/16" sheet metal screws that hold the lower case back panel.
19. Install the two 3/8" water cooler assembly mounting screws.
20. Connect the water cooler lines to the back panel using the 3/4" and 11/16" wrenches.
21. Set the tabs of the water cooler access door in place and secure the door with the two 5/16" screws.
22. Install the machine case sides and top.
23. Install the handle and the lift bail rubber gasket.

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

WATER COOLER DISASSEMBLY

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

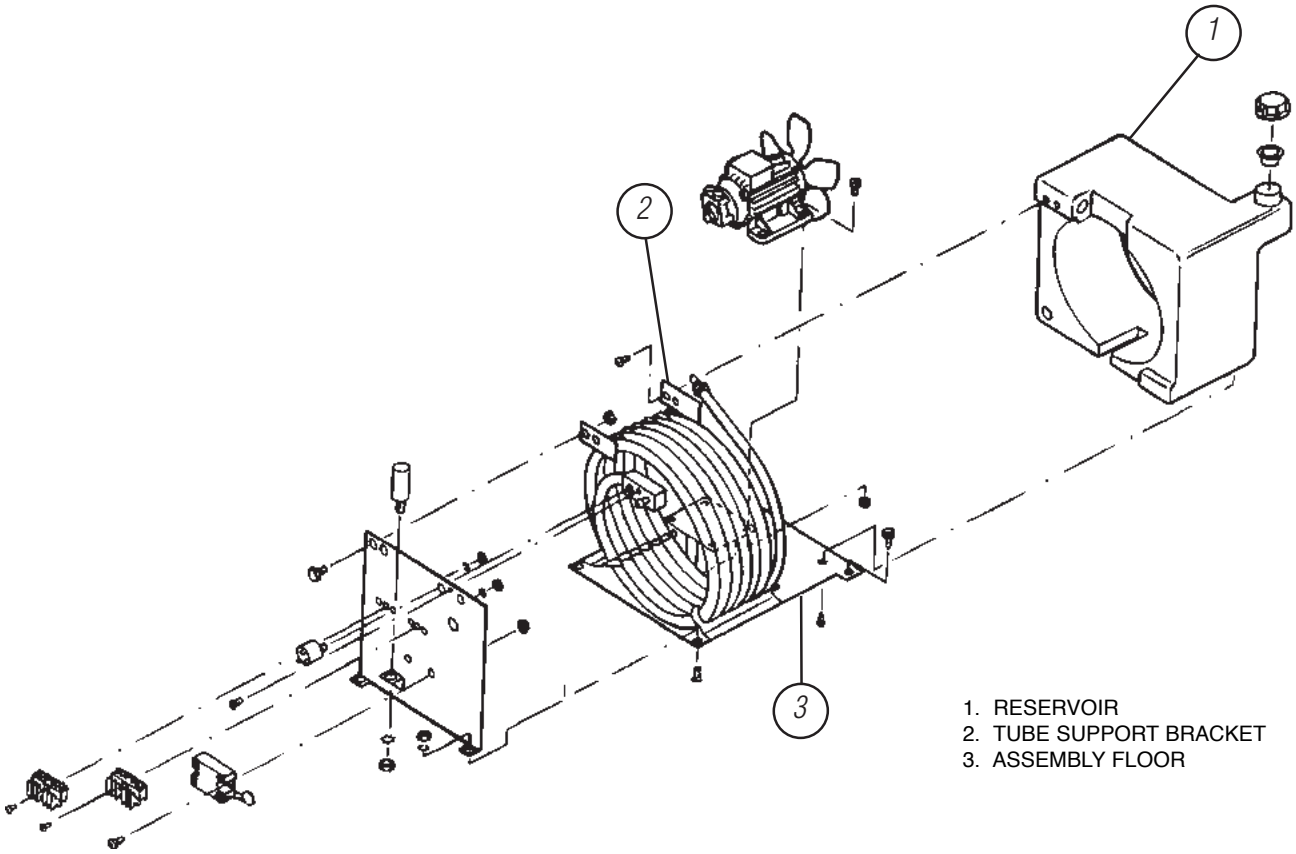
The following procedure will aid the technician in disassembly of the machine water cooler assembly for maintenance or part replacement.

MATERIALS NEEDED

Phillips head screw driver
Pliers
3/4" Open end wrench
5/16" Box wrench

WATER COOLER DISASSEMBLY *(continued)*

FIGURE F.63 - WATER COOLER DISASSEMBLY



1. RESERVOIR
2. TUBE SUPPORT BRACKET
3. ASSEMBLY FLOOR

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

WATER COOLER DISASSEMBLY *(continued)*

Reservoir Removal

A. After you have completed the capacitor discharge procedure for all four switch boards, remove the water cooler assembly. Refer to the Water Cooler Removal and Replacement procedure in this section of the manual.

B. Empty the coolant from the reservoir. Dispose of the coolant in a proper and approved manner.

C. With the Phillips head screw driver, remove the two screws holding the reservoir to the cooling tube support bracket.

D. With the Phillips head screw driver, remove the four screws holding the reservoir to the floor of the assembly.

E. With the pliers, carefully remove the two coolant hoses from the reservoir.

F. Carefully slide out and lift the reservoir free from the motor and fan blade.

G. After repair, install the reservoir by carefully setting it in place around the motor and fan blade. With the pliers, install the two coolant hoses to the reservoir. With the Phillips head screw driver, install the four screws holding the reservoir to the floor of the assembly and the two screws that hold it to the cooling tube support bracket. Replace the old coolant with fresh coolant and install the water cooler assembly into the machine according to the ***Water Cooler Removal and Replacement procedure*** in this section of the manual.

Motor/Pump/Fan Assembly Removal

A. Perform the ***Reservoir Removal procedure***.

B. With the 3/4" open end wrench, remove the two coolant hoses attached to the motor/pump assembly.

C. Remove the four wires leading from the motor to the terminal block. Note the lead numbers and locations for reassembly.

D. With the Phillips head screw driver and the 5/16" box wrench, remove the four screws and nuts mounting the motor/pump/fan assembly to the mounting platform.

E. Carefully lift out the motor/pump/fan assembly.

F. Install the motor/pump/fan assembly by carefully setting in onto the mounting platform and attaching it with the four screws and nuts. Connect the four wire leads from the motor to the terminal block. Attach the two coolant hoses to the motor/pump assembly using the 3/4" open end wrench.

7. Install the reservoir according to the directions in the Reservoir Removal procedure. Install the water cooler assembly according to the Water Cooler Removal and Replacement procedure in this section of the manual.

8. Install the machine case sides and top.

9. Install the handle and the lift bail rubber gasket.

T2 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

The following procedure will aid the technician in removing the T2 auxiliary transformer for maintenance or replacement.

MATERIALS NEEDED

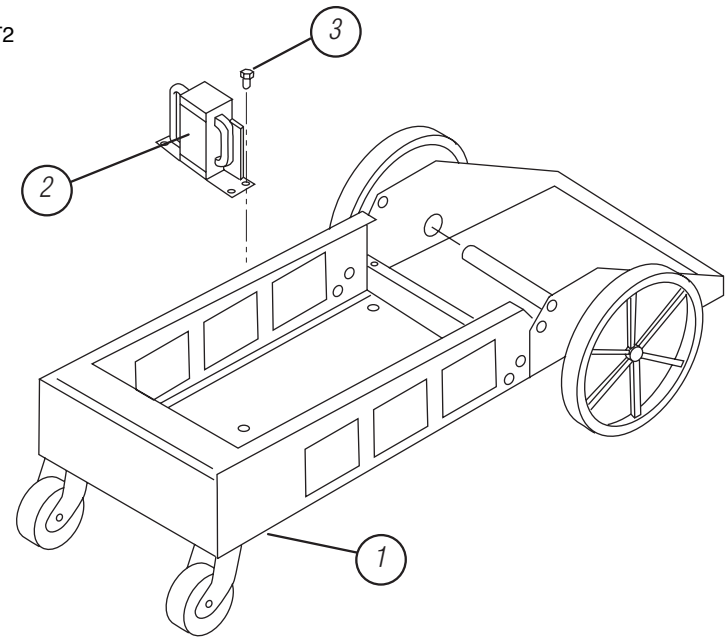
5/16" Nut driver
3/8" Nut driver or socket wrench
Machine Wiring Diagram in the Electrical Diagrams section of this manual

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

T2 AUXILIARY TRANSFORMER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.64 - T2 AUXILIARY TRANSFORMER LOCATION

1. BASE
2. AUXILIARY TRANSFORMER T2
3. MOUNTING SCREW (2)



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, proceed to remove the T2 auxiliary transformer. First you will have to remove the water cooler; follow the ***Water Cooler Removal and Replacement Procedure*** in this section of the manual.
8. Disconnect the single molex plug attached to the transformer. See Figure F.64 for location.
9. the 3/8" nut driver or socket wrench, remove the two screws that mount the transformer to the machine base. Remove the T2 auxiliary transformer.
10. To install the T2 auxiliary transformer, carefully position it onto the machine base and tighten the two mounting screws. Connect the molex plug to its receptacle on the transformer.
11. Install the water cooler. Refer to the ***Water Cooler Removal and Replacement procedure*** in this section of the manual.
12. Install the machine case sides and top.
13. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

FAN MOTOR REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

The following procedure will aid the technician in removing the machine fan motor for maintenance or replacement.

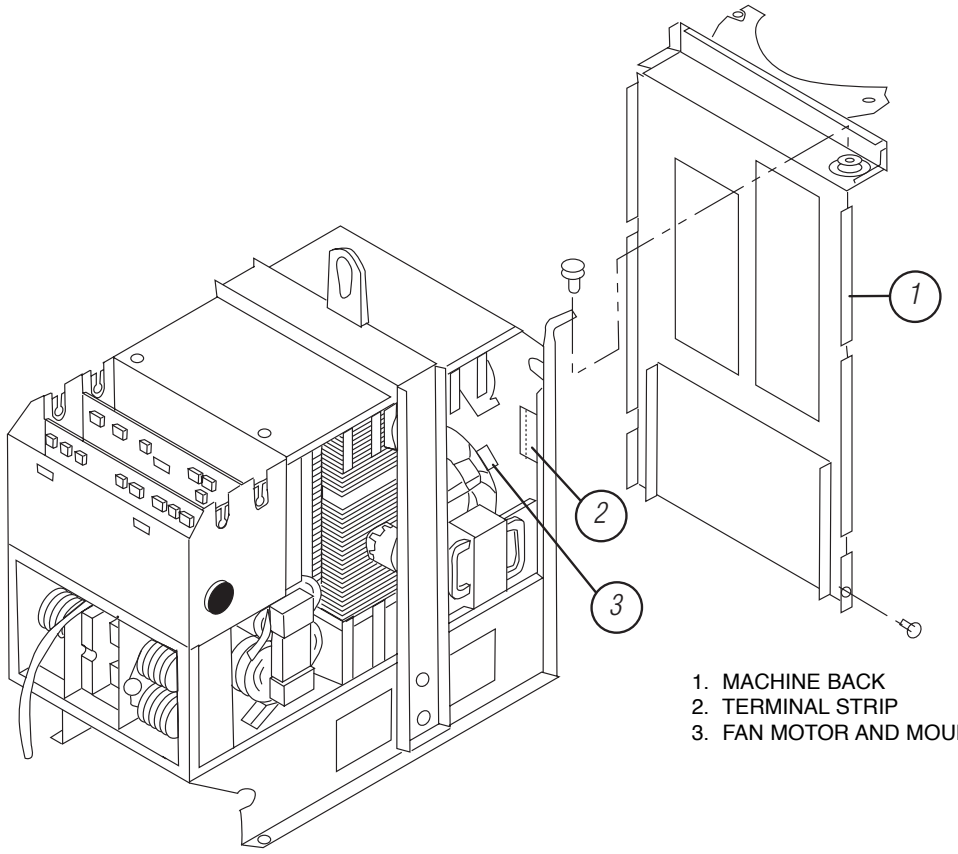
MATERIALS NEEDED

5/16" Nut driver
3/8" Nut driver
3/4" Open or box end wrench
Wire cutters
Slot head screw driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

Return to Section TOC
Return to Master TOC

FAN MOTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.65 - FAN MOTOR LOCATION



1. MACHINE BACK
2. TERMINAL STRIP
3. FAN MOTOR AND MOUNTING BRACKET

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

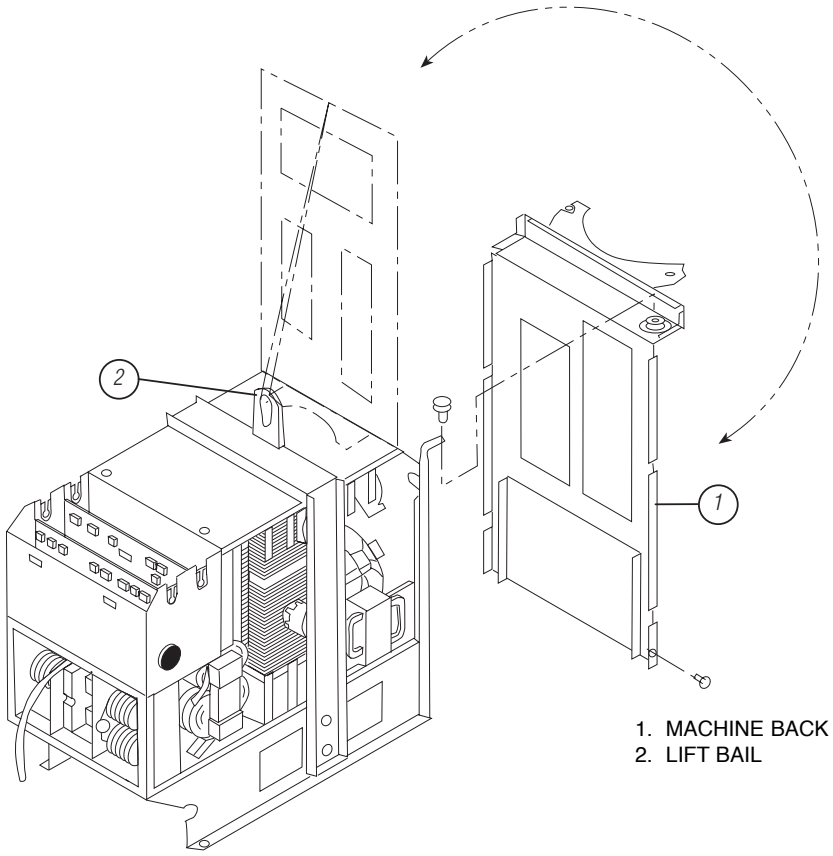
⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the wirecutters to cut any necessary cable ties (necessary for removal of the fan motor) holding the fan motor leads together. Note the location of these cable ties for reassembly.
8. Remove the fan motor leads from the terminal strip.
9. With the 5/16" nut driver, remove the water cooler access door. Then remove the four screws from the lower rear panel.
10. With the 5/16" nut driver, remove the two screws from the case back lower sides.

FAN MOTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.66 - MACHINE BACK SECURED TO LIFT BAIL.



1. MACHINE BACK
2. LIFT BAIL

11. With the 3/4" wrench, remove the lead connected to the rear positive (+) output terminal.
12. Swing the back panel up and secure it to the lift bail. See Figure F.66. Use heavy string or wire. BE CAREFUL NOT TO DAMAGE THE RS232 CONNECTOR OR THE WIREFEEDER RECEPTACLES.
13. With the slot head screw driver, remove the clip holding the fan blade onto the motor shaft.
14. Remove the fan blade by carefully sliding it off the motor shaft.
15. With the 11/32" nut driver or socket wrench, remove the two fan motor mounting nuts. Remove the split-ring lock washers and flat washers.
16. Remove the fan motor by sliding it out of the mounting bracket and free of the machine.

NOTE: Repeat this procedure to remove the second fan motor if necessary.

17. To install the fan motor, do the following: Carefully position the fan motor into place on the mounting bracket with the leads toward the terminal strip. Install the flat washers, split-ring lock washers, and nuts to the motor mounting bolts. Carefully slide the fan blade all the way onto the motor shaft. The side of the hub with the metal clip goes toward the motor. Install the clip so that it grips the rounded side of the D-shaped shaft, not the flat. Swing the back panel back down, being careful not to damage the RS232 connector or the wire feeder receptacles. Install the lead to the rear positive (+) output terminal. Install the case back lower sides and the lower rear panel with the 5/16" screws. Attach the fan motor leads to the terminal strip and replace the tie wraps cut during removal so that the motor leads are held away from the fan blades.
18. Install the machine case sides and top.
19. Install the handle and the lift bail rubber gasket.

Return to Section TOC
Return to Master TOC

INPUT RECTIFIER REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

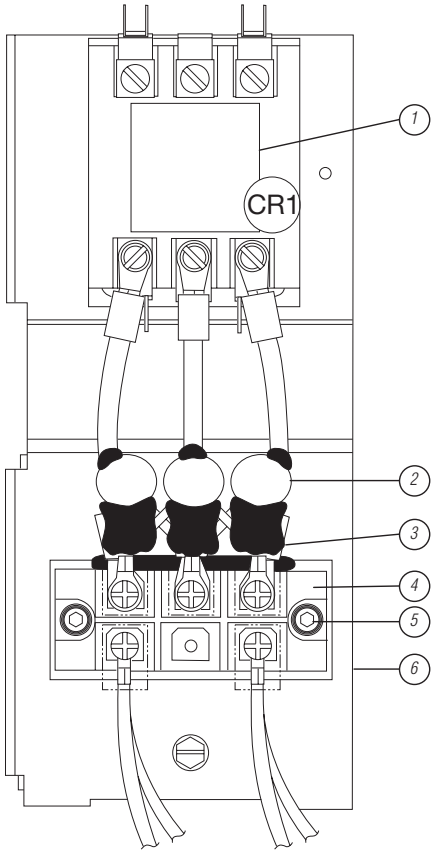
The following procedure will aid the technician in removing the input rectifier for maintenance or replacement.

MATERIALS NEEDED

5 mm Allen wrench
Phillips head screw driver
10 mm Open end wrench
RTV Silicone sealant (Lincoln E2861)
Dow Corning 340 Joint Compound (Lincoln E1868)
S18491 M.O.V. Assembly (if necessary)
Machine Wiring Diagram in the Electrical Diagrams section of this manual

INPUT RECTIFIER REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.67 - INPUT RECTIFIER LOCATION



1. MAIN CONTACTOR
2. M.O.V. ASSEMBLY
3. SILICONE SEALANT
4. INPUT RECTIFIER
5. 5MM ALLEN SCREW
6. HEAT SINK PANEL

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, peel the silicone sealant away from the M.O.V. assembly in order to expose the heads of the screws that attach the three heavy leads from the main input contactor to the input rectifier. See Figure F.67.
8. With the Phillips head screw driver, remove the three heavy leads from the input rectifier.
9. With the Phillips head screw driver, remove the positive (+) and negative (-) leads from the input rectifier.

INPUT RECTIFIER REMOVAL AND REPLACEMENT *(continued)*

10. With the 5 mm Allen wrench and the 10 mm open end wrench, remove the two screws mounting the input rectifier to the heat sink panel.
11. When replacing the input rectifier, apply a thin, even coating of Dow Corning 340 Joint Compound (Lincoln E1868) to the mating surfaces between the input rectifier and the heat sink panel. Avoid applying the compound to either the mounting holes or the mounting hardware.
12. Mount the input rectifier to the heat sink panel and tighten the two mounting screws with the 5 mm Allen wrench and the 10 mm open end wrench. Be sure to tighten the screws evenly.
13. With the Phillips head screw driver, attach the positive (+) and negative (-) leads to the input rectifier. Attach the three heavy leads and the M.O.V. assembly to the input rectifier. Replace the M.O.V. assembly if it appears damaged.
14. Apply silicone sealant to the M.O.V. assembly connections.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT (CONTROL BOARD, POWER BOARD, AND PROTECTION BOARD)

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

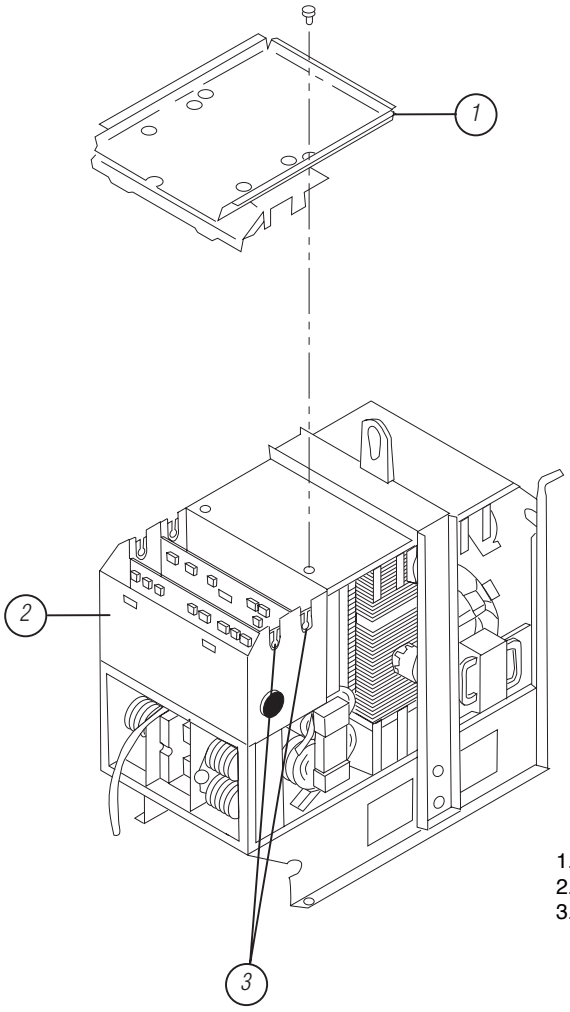
The following procedure will aid the technician in removing the control, power, or protection printed circuit boards for maintenance or replacement.

MATERIALS NEEDED

5/16" Nut driver
3/8" Nut driver
Machine Wiring Diagram in the Electrical Diagrams section of this manual

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT (CONTROL BOARD, POWER BOARD, AND PROTECTION BOARD) *(continued)*

FIGURE F.68 - PC BOARD REMOVAL



1. PC BOARD COVER
2. PC BOARD ASSEMBLY
3. RETAINER CLIPS

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws holding the printed circuit board cover in place. Slide the cover forward and lift up to remove it.

Return to Section TOC
Return to Master TOC

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT (CONTROL BOARD, POWER BOARD, AND PROTECTION BOARD) *(continued)*

⚠ CAUTION

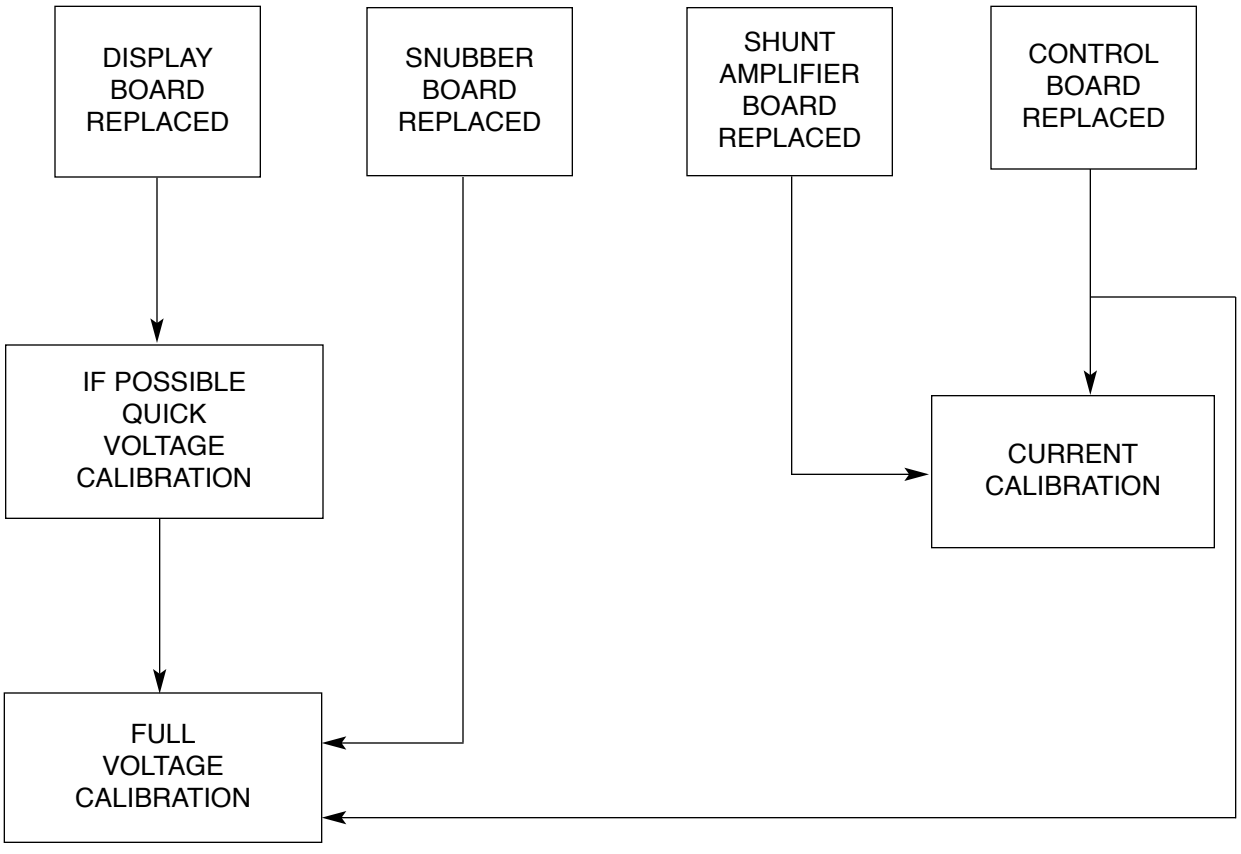
Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

8. Remove the molex plugs from the PC board you are removing.

NOTE: The plugs are numbered in order from left to right.

9. Depress the two PC board retainer clips located on the left and right sides of the board. Lift the board by the clips to remove it.
10. When reinstalling the PC board, make certain the tabs at the bottom of the board fit into the slots on the compartment floor. When the board is properly seated, the retainer clips will snap into the locked position.
11. Install the molex plugs removed earlier. Be sure to fit the each plug into its respective receptacle on the board.
12. Perform appropriate calibration procedure per flowchart in Figure F.69.
13. Install the PC board cover and tighten the two screws with the 5/16" nut driver.
14. Install the machine case sides and top.
15. Install the handle and the lift bail rubber gasket.

FIGURE F.69 – PC BOARD REPLACEMENT CALIBRATION REQUIREMENTS



DISPLAY BOARD REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

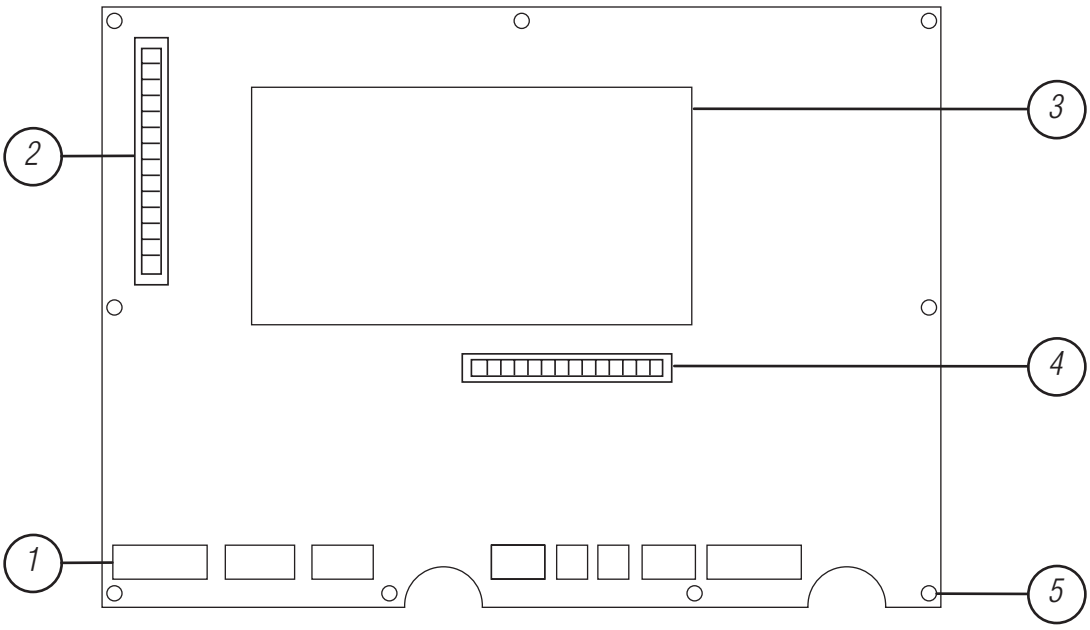
The following procedure will aid the technician in removing the display board for maintenance or replacement.

MATERIALS NEEDED

5/16" Nut driver
3/8" Nut driver

DISPLAY BOARD REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.70 - DISPLAY BOARD REMOVAL



1. MOLEX PLUG HEADERS (8)
2. KEY PAD RIBBON CONNECTOR
3. LCD DISPLAY WINDOW
4. LCD CONNECTOR
5. MOUNTING PIN HOLE

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

⚠ CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

7. After you have completed the capacitor discharge procedure for all four switch boards, carefully remove the eight molex plugs from the lower portion of the display board.

DISPLAY BOARD REMOVAL AND REPLACEMENT *(continued)*

8. Carefully remove the key pad ribbon connector from the right side of the display board.
9. Carefully remove the connector to the LCD display.

⚠ CAUTION

Do not touch the sensors located on the left side of the display board when you handle it for removal or replacement. Failure to do so can result in permanent damage to the sensors.

10. Carefully remove the display board from the its mounting pins. Remove the display board by lifting up and out.
11. Reinstall the display board by carefully pressing it onto its mounting pins. Install the LCD display connector, the key pad connector, and the eight molex plugs that fit along the bottom portion of the display board.
12. After you have installed the display board (a new one or the old one), you must perform the ***Display Board Sensor Calibration Test*** and necessary voltage calibration. Refer to this test in the test portion of this section of the manual.
13. After performing the ***Display Board Sensor Calibration Test***, install the machine case sides and top.
14. Install the handle and the lift bail rubber gasket.

MAIN INPUT CONTACTOR (CR1) REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

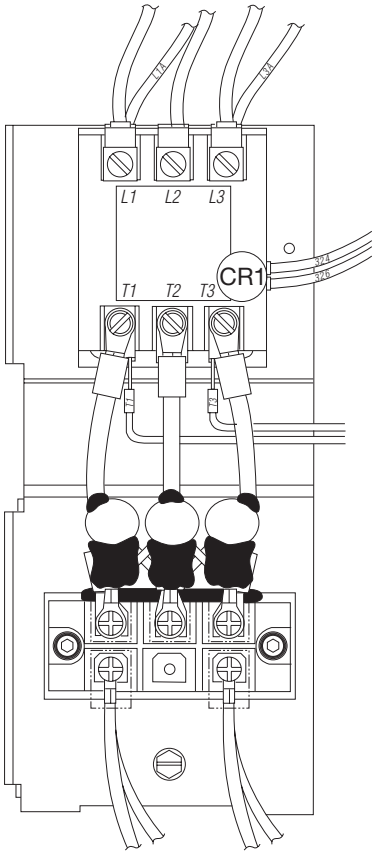
The following procedure will aid the technician in removing the main input contactor for maintenance or replacement.

MATERIALS NEEDED

Slot head screw driver
5/16" Nut driver
3/8" Open end wrench
Machine Wiring Diagram in the Electrical Diagrams section of this manual

MAIN INPUT CONTACTOR (CR1) REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.71 - MAIN CONTACTOR



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, with the slot head screw driver, remove the three heavy leads from the output side of the contactor.
8. With the slot head screw driver, remove the two small leads (L1A and L3A) from the input side of the contactor.

MAIN INPUT CONTACTOR (CR1) REMOVAL AND REPLACEMENT *(continued)*

9. With the slot head screw driver, remove the two small leads (T1 and T3) from the output side of the contactor.
10. With the slot head screw driver, remove the two contactor coil leads (#324 and #326) from the contactor.
11. With the slot head screw driver and 3/8" wrench, loosen the two mounting screws and nuts holding the contactor to the vertical mounting panel.
12. Remove the contactor by lifting up and out.
13. For replacement, mount the contactor to the vertical mounting panel with the two 3/8" mounting screws and nuts.
14. Attach all the contactor leads: coil leads #324 and #326; small leads T1 and T3 to the output side; three heavy leads to the output side; small leads L1A and L3A and three input leads to the input side. Tighten all evenly with the slot head screw driver.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

The following procedure will aid the technician in removing the output rectifier bridge for maintenance or replacement.

MATERIALS NEEDED

Slot head screw driver
5/16" Nut driver
3/8" Nut driver
7/16" Open end wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

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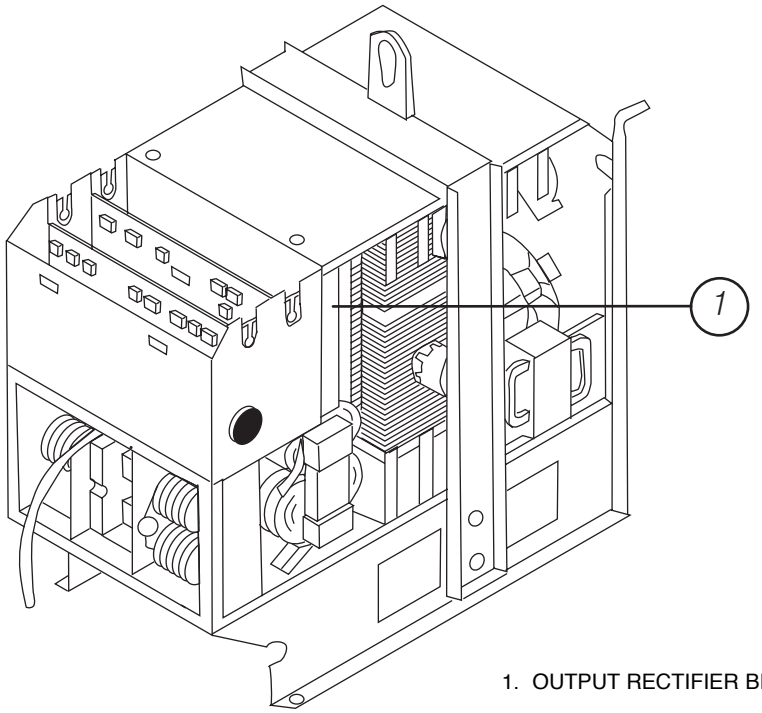
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.72 - OUTPUT RECTIFIER BRIDGE LOCATION



1. OUTPUT RECTIFIER BRIDGE

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

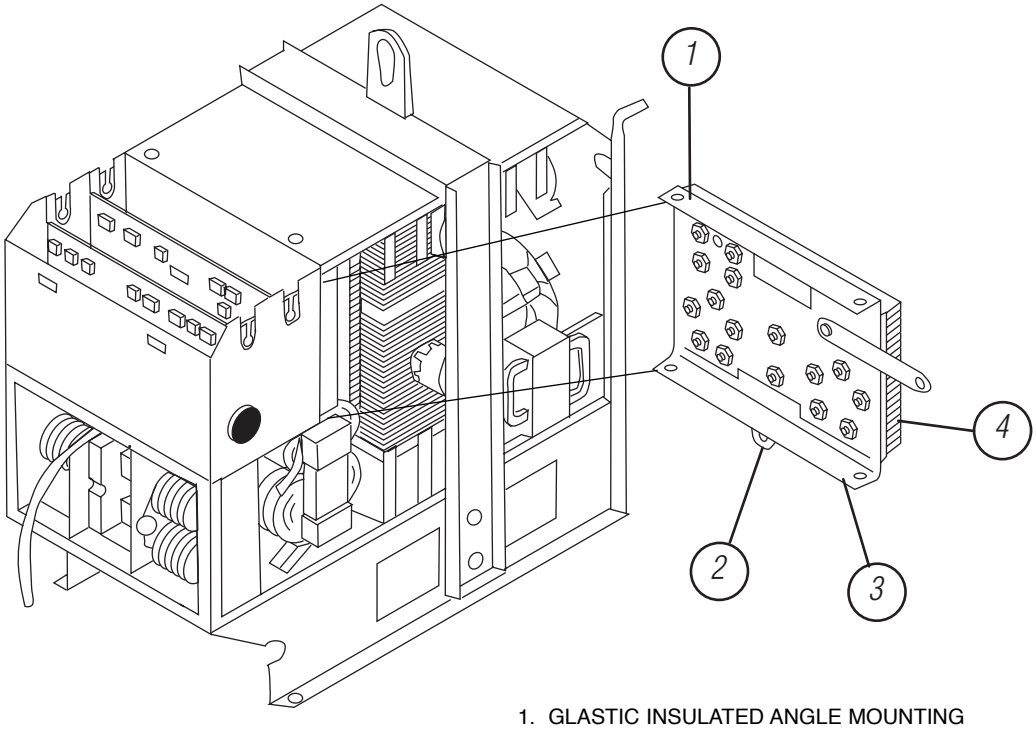
7. After you have completed the capacitor discharge procedure for all four switch boards, cut all necessary cable ties (necessary for removal of the output rectifier bridge) on the left side of the machine.
8. Disconnect all necessary leads from the left side of the output rectifier bridge (two heavy and two small leads). Place the fastener hardware back together to avoid loss.

Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

9. Cut all necessary cable ties on the right side of the machine and disconnect all necessary leads (two heavy and two small leads) from the right side of the output rectifier bridge. Place the fastener hardware back together onto the lead ends to avoid loss.
10. On the right side of the machine, use the 7/16" open end wrench to remove the bolt that connects the heat sink at the top to the glastic insulated angle mounting piece. Then remove the carriage bolt that holds the glastic insulated angle mounting piece at the bottom to the subframe. Repeat the same procedure on the left side of the machine. Save the shake-proof washers and nuts for reassembly.
11. With the 7/16" wrench, remove the bolts, top and bottom, that connect the heat sink and glastic insulated angle mounting piece at the middle. With the side bolts already removed, it is easier to access the middle bolts.
12. With the 7/16" wrench, remove the bolt, nut, and split-ring lock washer from the tab connection at the bottom of the heat sink. The input rectifier bridge can now be removed. You may have to bend the bottom tab slightly in order to get it past the main transformer.

FIGURE F.73 – HEAT SINK REMOVAL



1. GLASTIC INSULATED ANGLE MOUNTING PIECE (TOP)
2. BOTTOM TAB CONNECTION
3. GLASTIC INSULATED ANGLE MOUNTING PIECE (BOTTOM)
4. HEAT SINK

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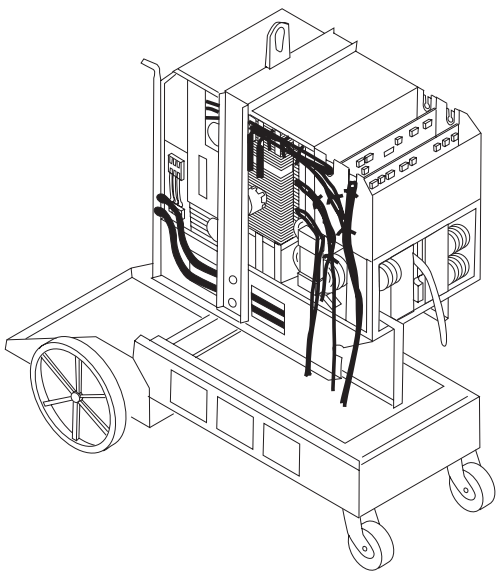
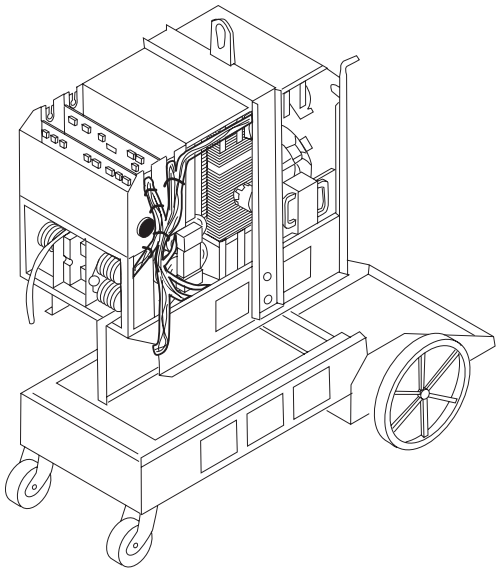
OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.74 – CABLE TIE LOCATIONS



PRIMARY HARNESS ASSEMBLY (BLACK)



SECONDARY HARNESS ASSEMBLY (WHITE)

13. For reassembly, attach the glastic insulated angle mounting pieces to the heat sink first. Slide the bridge into position and then fasten the bottom tab to the subframe with the bolt, split-ring lock washer and nut. Then attach and tighten down the top and bottom bolts that hold the heat sink on both sides of the machine.
14. Reconnect the leads on both sides of the bridge. Install new cable ties according to Figure F.74.
15. Install the machine case sides and top.
16. Install the handle and the lift bail rubber gasket.

FET MODULE REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

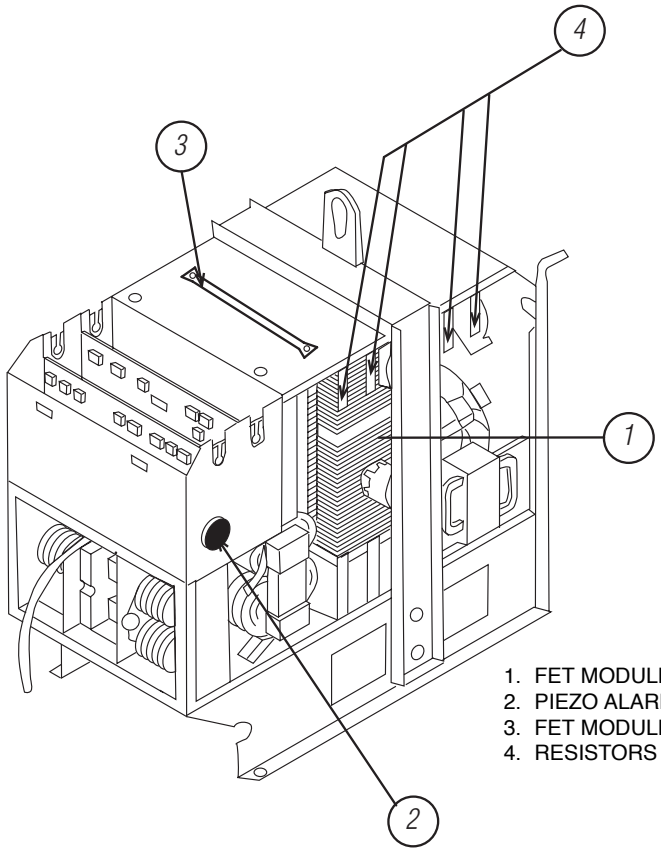
The following procedure will aid the technician in removing the FET modules and main transformer for maintenance or replacement.

MATERIALS NEEDED

Slot head screw driver
Phillips head screw driver
5/16" Nut driver
3/8" Nut driver
5/16" Open end or box wrench
7/16" Open end or box wrench
3/8" Socket wrench
1/2" Socket wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.75 - FET MODULE LOCATION



1. FET MODULE
2. PIEZO ALARM BUZZER
3. FET MODULE LOCKING BAR
4. RESISTORS

TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, use the 5/16" nut driver to remove the two screws holding the printed circuit board cover in place. Slide the cover forward and lift up to remove it.

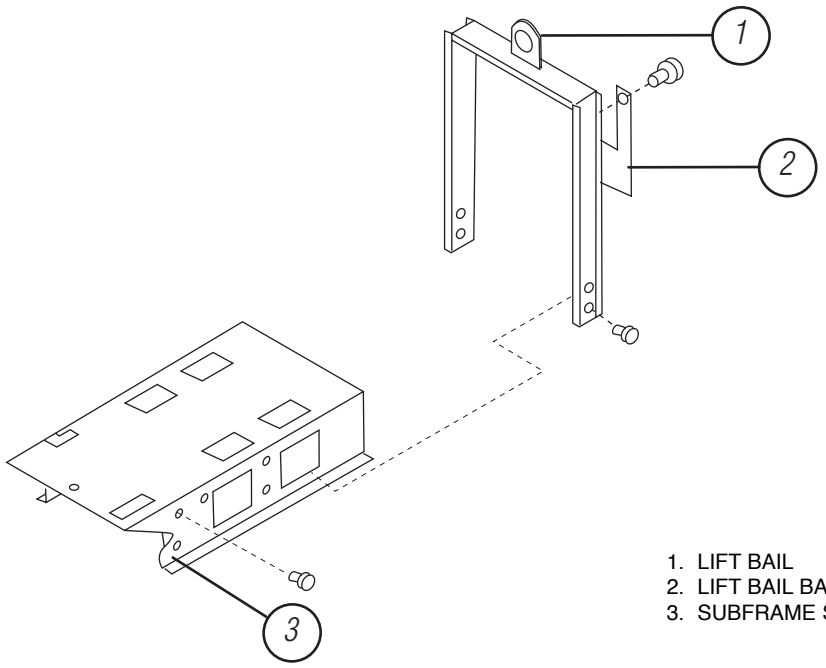
⚠ CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

8. Remove the molex plugs from the PC boards except the display board.

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.76 - LIFT BAFFLE/BAIL REMOVAL



1. LIFT BAIL
2. LIFT BAIL BAFFLE
3. SUBFRAME STAND

9. With the wire cutters, cut all necessary cable ties.
10. Disconnect the leads to the output rectifier bridge. Cut all necessary cable ties.
11. Disconnect two plugs from the snubber board.
12. Disconnect the output cable strap and pull it through and free from the lift bail baffle eyelet hole. Cut any necessary cable ties.
13. With the 3/8" nut driver, remove the two screws that hold the lift bail baffle. See Figure F.76. Remove the baffle.
14. With the 1/2" socket wrench, remove the four bolts (two on each side of the machine) from the lift bail. See Figure F.76. Slide the lift bail up and free of the machine.
15. On the right side of the machine, cut any necessary cable ties to free the wiring harness from the subframe.
16. With the Phillips head screw driver, remove the screw that holds the piezoelectric alarm buzzer in place. Cut the cable tie that holds the wire.
17. With the 3/8" wrench, remove the six resistors that are attached to the top of the subframe (four on the top right, two on the top left). Note the physical placement and wiring for reassembly; labeling is recommended. Also loosen the bottom resistors closest to the FET module assembly. This will allow the capacitors to clear the resistors when the FET module assembly slides forward for removal.
18. With the 5/16" nut driver, remove the sheet metal screw holding the ground leads to the right rear of the subframe. On the left side, unclip the cable tie holding the leads. Let the back of the subframe swing out carefully; the harness will support it.
19. With the 5/16" wrench, remove the two sheet metal screws holding the subframe bottom support section. Note the green ground lead on the left side; be sure to reconnect it during reassembly.
20. With the 7/16" wrench, disconnect the heavy current-carrying flat copper strap running from the shunt amplifier to the output rectifier bridge.

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

21. Remove the water cooler assembly in order to access the retainer clips that hold the bottom of the FET module assembly in place. (Complete removal of the unit should not be necessary.) Refer to the ***Water Cooler Removal and Replacement procedure*** in this section of the module.
22. Remove the locking bar from the top of the subframe where it secures the FET module assembly. Depress the top and bottom retainer clips with the slot head screw driver so that the FET module assembly can slide forward.
23. Slowly lift and remove the subframe, making sure no clips, cable ties, or lead connections are still holding it.
24. With the wire cutters, cut all necessary cable ties holding the FET module assembly to the wiring harness. Using needle nose pliers, disconnect the leads attached to the FET module assembly (all red and white leads should remain connected). Refer to the Wiring Diagram to determine which leads should be disconnected. The main transformer and the reconnect module must be free of the FET module assembly. Also disconnect the thermostat lead.
25. Carefully lift the FET module assembly and remove it from the machine.
26. With the FET module assembly removed, the main transformer, background choke, and output choke are now easily accessible. Refer to the ***Main Transformer Removal and Replacement procedure*** in this section of the module.

Replacement of the FET Module Assembly:

27. Carefully set the assembly into the bottom of the machine. The terminal label should face the front (toward the main transformer).
28. Connect all leads to their appropriate terminals on the assembly. Use the Wiring Diagram for reference.
29. Carefully position the subframe on top of the FET module assembly. Slide the assembly into place so that the retainer clips snap into their slots, top and bottom. Fit the locking bar into place on top of the subframe to secure the FET module assembly.

FET MODULE REMOVAL AND REPLACEMENT *(continued)*

30. Install the water cooler assembly. Refer to the ***Water Cooler Removal and Replacement procedure*** in this section of the module.
31. With the 7/16" wrench, connect the heavy current-carrying flat copper strap running from the shunt amplifier to the output rectifier bridge. With a 5/16" wrench, install the two sheet metal screws holding the subframe bottom support section. Connect the green ground lead on the left side.
32. Swing the back of the subframe into place. With the 5/16" nut driver, install the sheet metal screw holding the ground leads to the right rear of the subframe. On the left side, clip the cable tie to hold the leads.
33. With the 3/8" wrench, install the six resistors that are attached to the top of the subframe (four on the top right, two on the top left) according to the markings you made during disassembly. Also tighten the bottom resistors closest to the FET module assembly.
34. With the Phillips head screw driver, install the screw that holds the piezo-electric alarm buzzer in place. Replace the cable tie that holds the wire.
35. Slide the lift bail into place. With the 1/2" socket wrench, install the four bolts (two on each side of the machine) to secure the lift bail. With the 3/8" nut driver, install the two screws to secure the lift bail baffle. Feed the output cable strap through the lift bail baffle eyelet hole. Replace any necessary cable ties.
36. Connect the two plugs to the snubber board.
37. Connect the leads to the output rectifier bridge. Replace all necessary cable ties.
38. Install the molex plugs to the PC boards. Refer to ***Figure F.1***, PC Board Connector Locations in this section of the manual.
39. Install the printed circuit board cover with two 5/16" screws.
40. Replace any necessary cable ties for the wiring harness and other leads that were cut during disassembly.
41. Install the machine case sides and top.
42. Install the handle and the lift bail rubber gasket.

MAIN TRANSFORMER REMOVAL AND REPLACEMENT

⚠ 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 1-888-935-3877 .

TEST DESCRIPTION

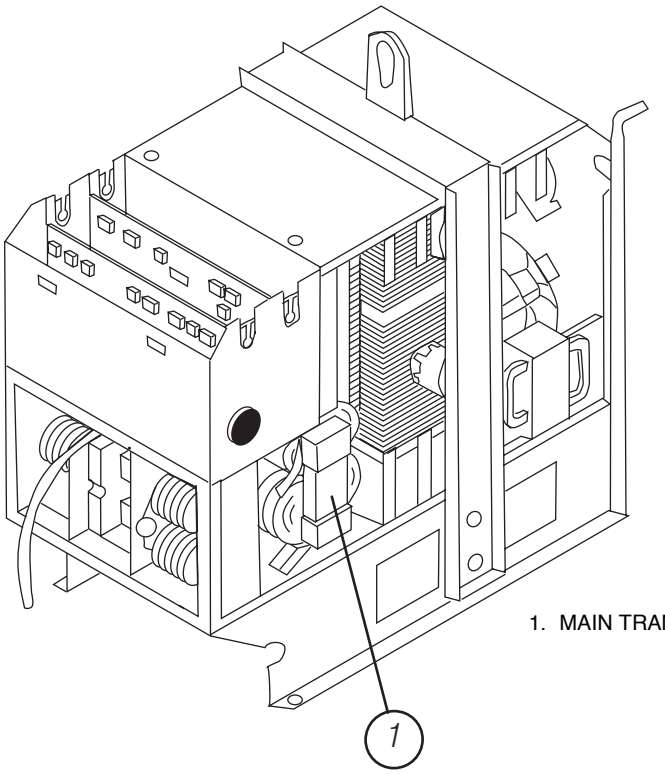
The following procedure will aid the technician in removing the main transformer for maintenance or replacement.

MATERIALS NEEDED

Slot head screw driver
Phillips head screw driver
5/16" Nut driver
3/8" Nut driver
5/16" Open end or box wrench
7/16" Open end or box wrench
3/8" Socket wrench
1/2" Socket wrench
Wire cutters
Machine Wiring Diagram in the Electrical Diagrams section of this manual

MAIN TRANSFORMER/CHOKE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.77 - MAIN TRANSFORMER LOCATION



TEST PROCEDURE

1. Remove main input supply power to the machine.
2. With the 3/8" nut driver, remove the 4 screws that hold the handle to the machine.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. With the 5/16" nut driver, remove the sheet metal screws from the case top.
5. With the 5/16" nut driver, remove the screws holding the right and left case sides. Remove the case sides by lifting up and out.
6. Perform the ***Capacitor Discharge Procedure*** described earlier in this section of the manual.

⚠ WARNING

Before continuing with the test procedure, perform the ***Capacitor Discharge Procedure*** to avoid electric shock.

7. After you have completed the capacitor discharge procedure for all four switch boards, perform the ***FET Module Assembly Removal Procedure***. Refer to the procedure in this section of the manual. After the FET module assembly has been removed, the main transformer and chokes are easily accessible.
8. With the 3/8" socket wrench, remove the four main transformer mounting bolts.
9. Disconnect the heavy leads between the main transformer and the choke assembly. You will need to cut the cable ties on the insulating sleeve and slide the sleeve forward to access the connection.
10. Lift the main transformer out. Remove the background or output chokes if necessary by removing any mounting bolts holding the chokes to the machine frame bottom.

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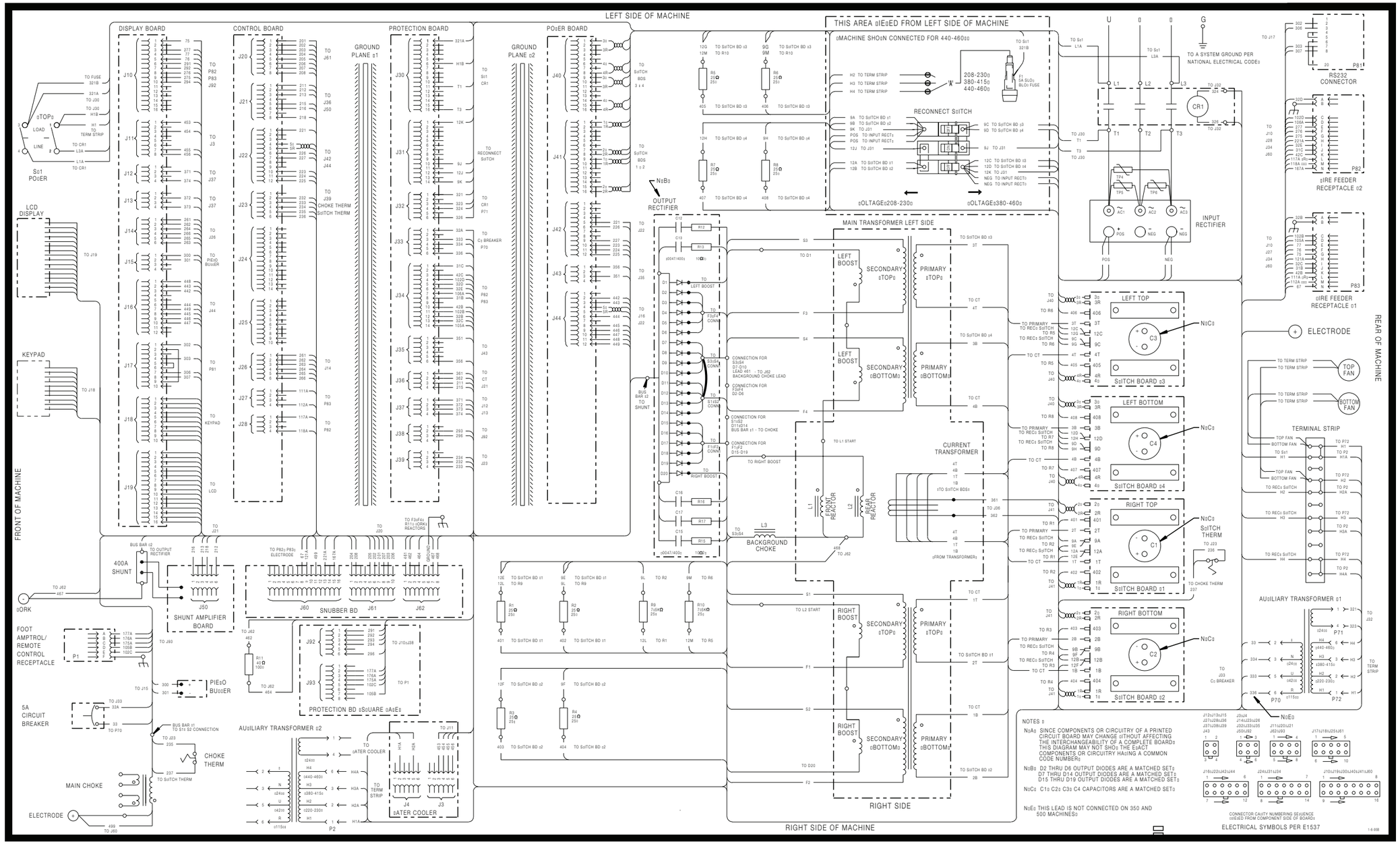
WIRING DIAGRAM



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

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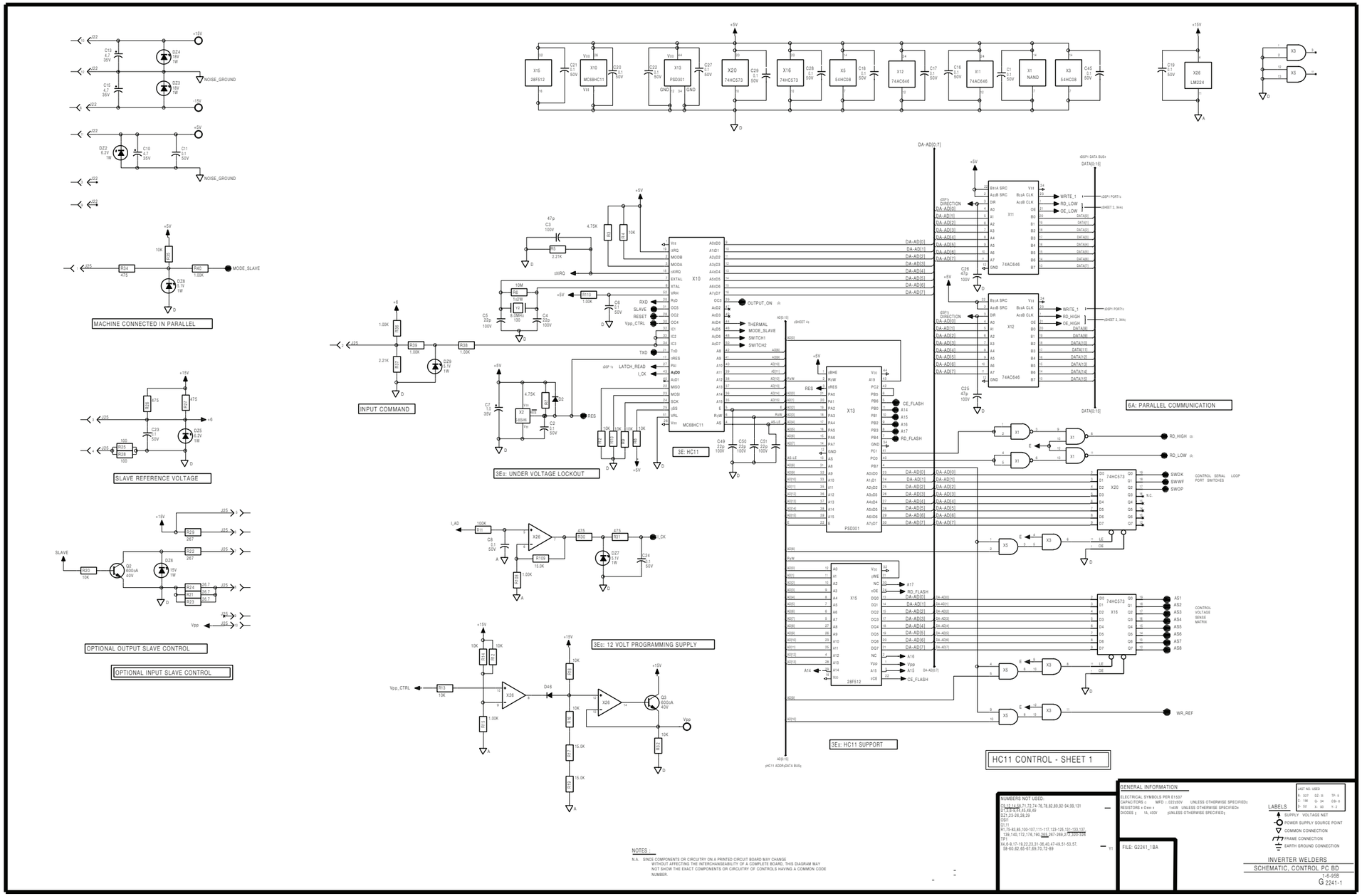
G2404 CONTROL PC BOARD SCHEMATIC (1 OF 4)



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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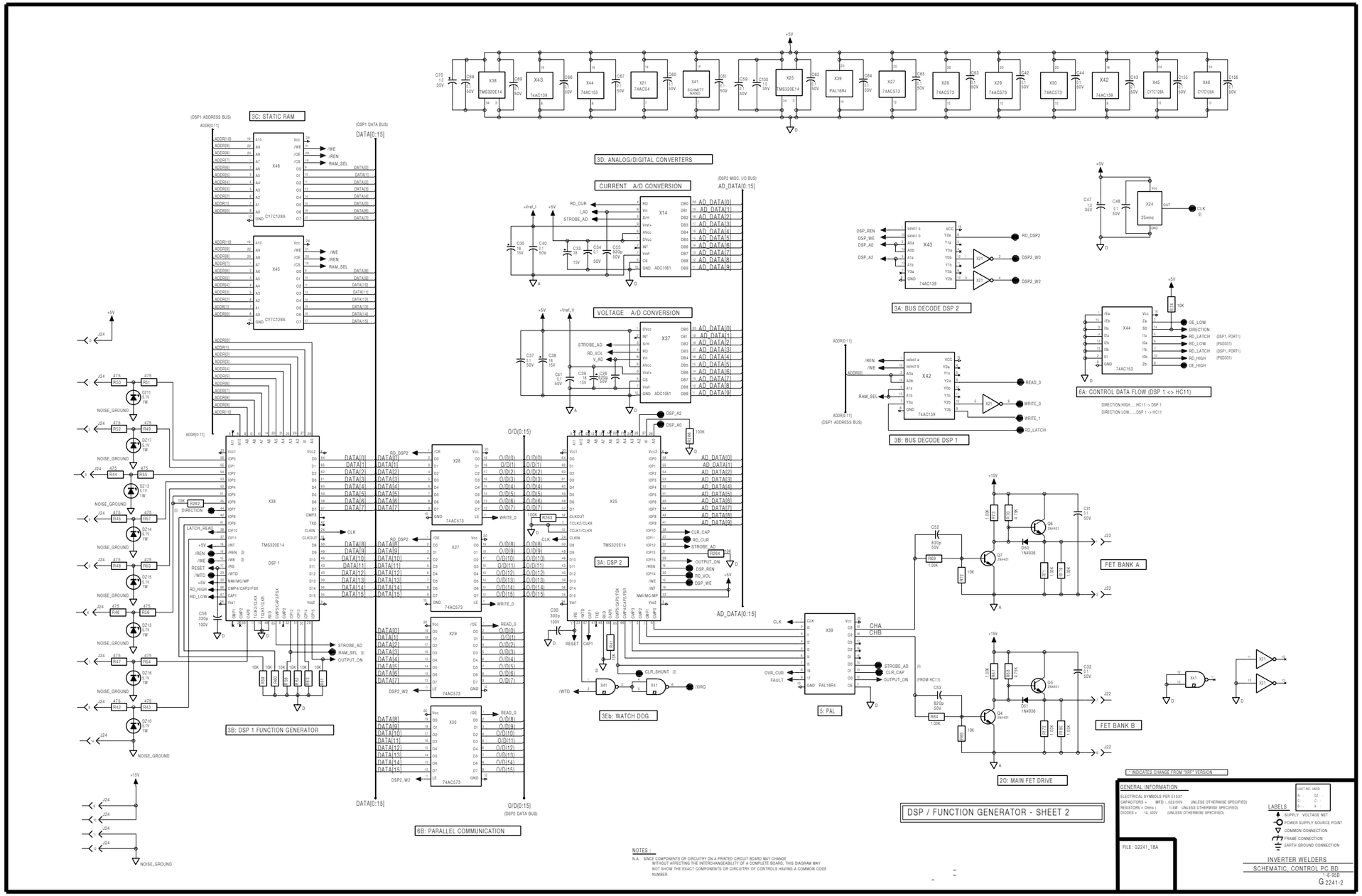
G2404 CONTROL PC BOARD SCHEMATIC (2 OF 4)



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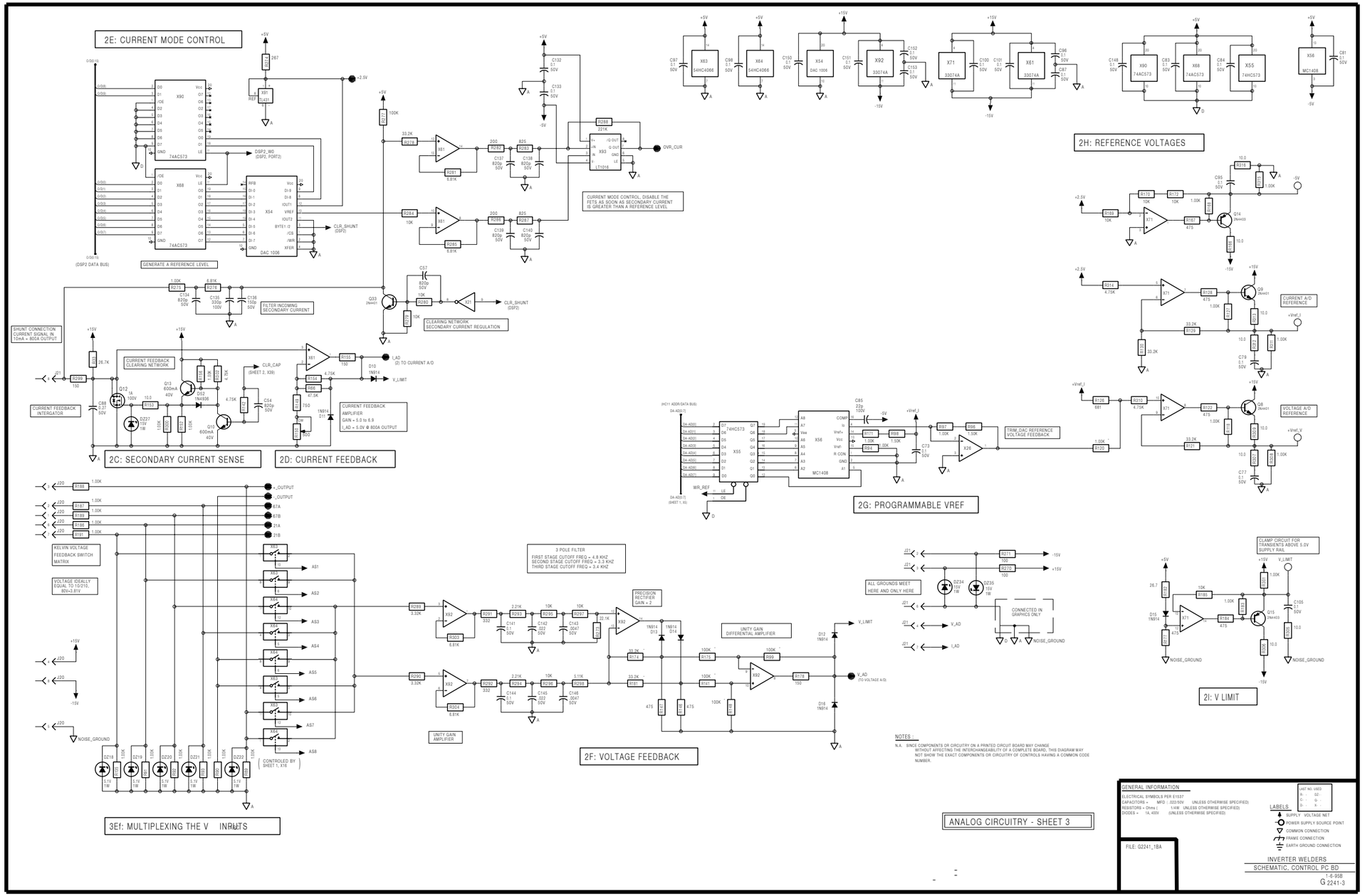
G2404 CONTROL PC BOARD SCHEMATIC (3 OF 4)



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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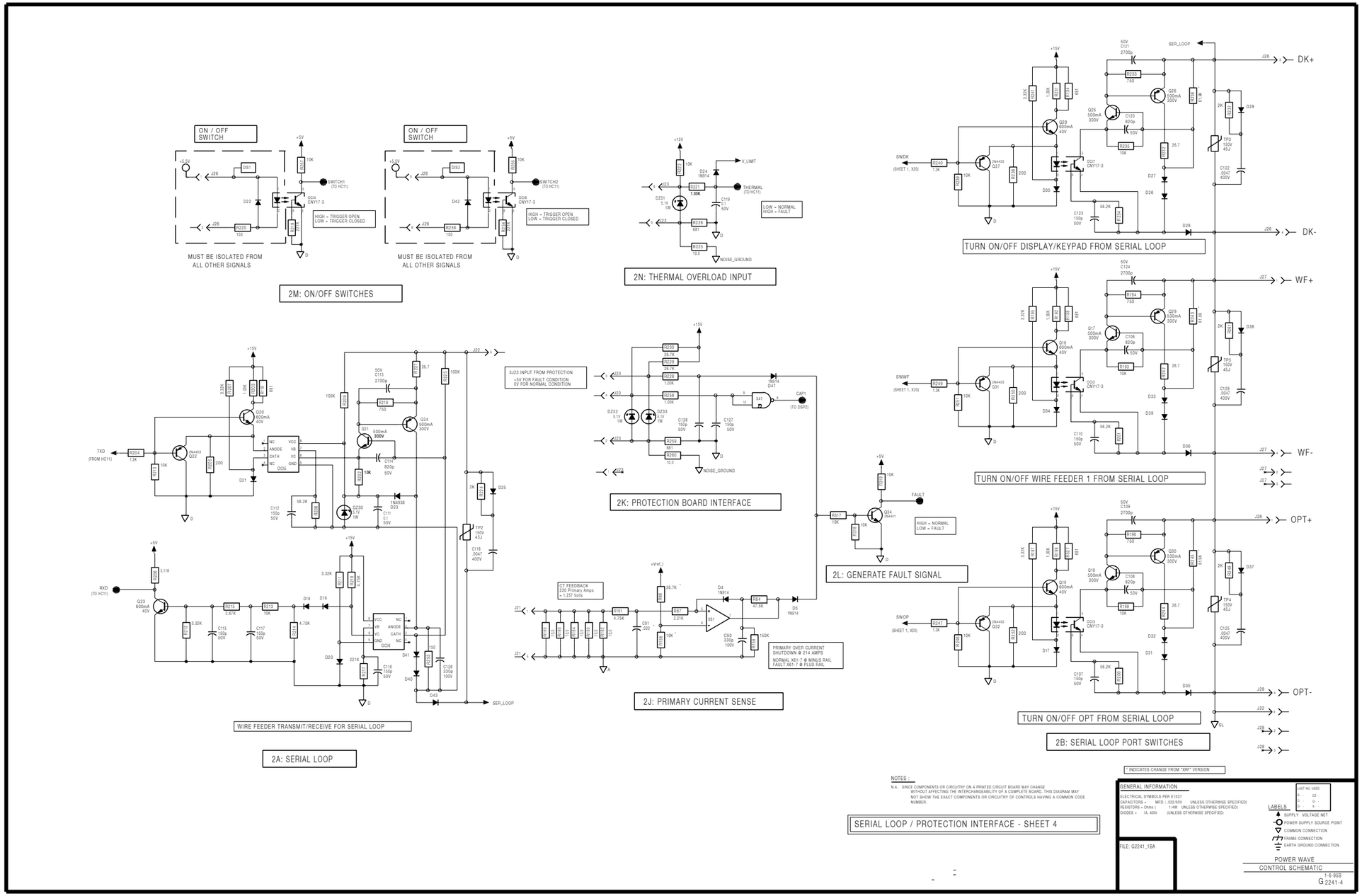
G2404 CONTROL PC BOARD SCHEMATIC (4 OF 4)



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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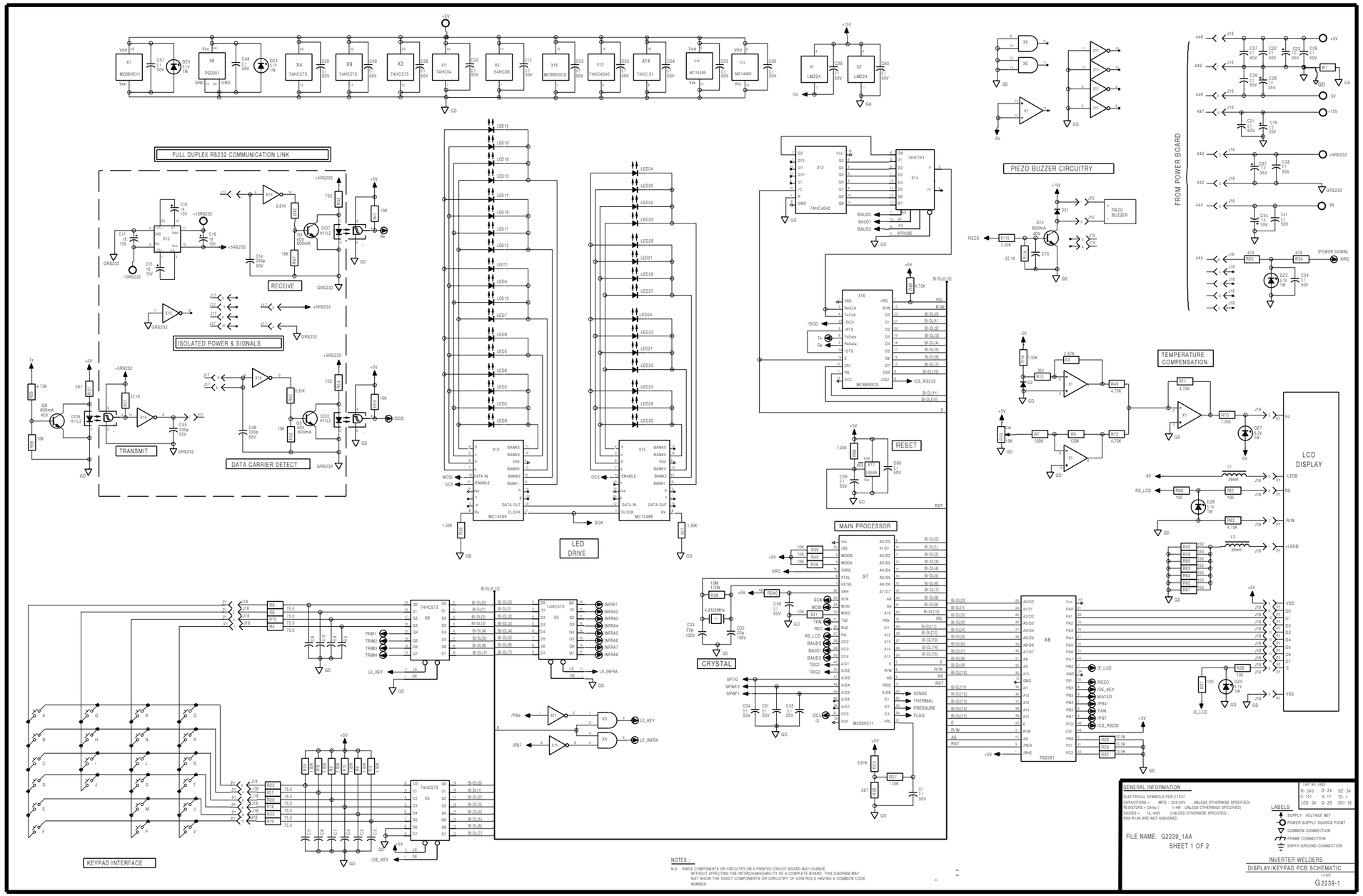
G2407 DISPLAY PC BOARD SCHEMATIC (1 OF 2)



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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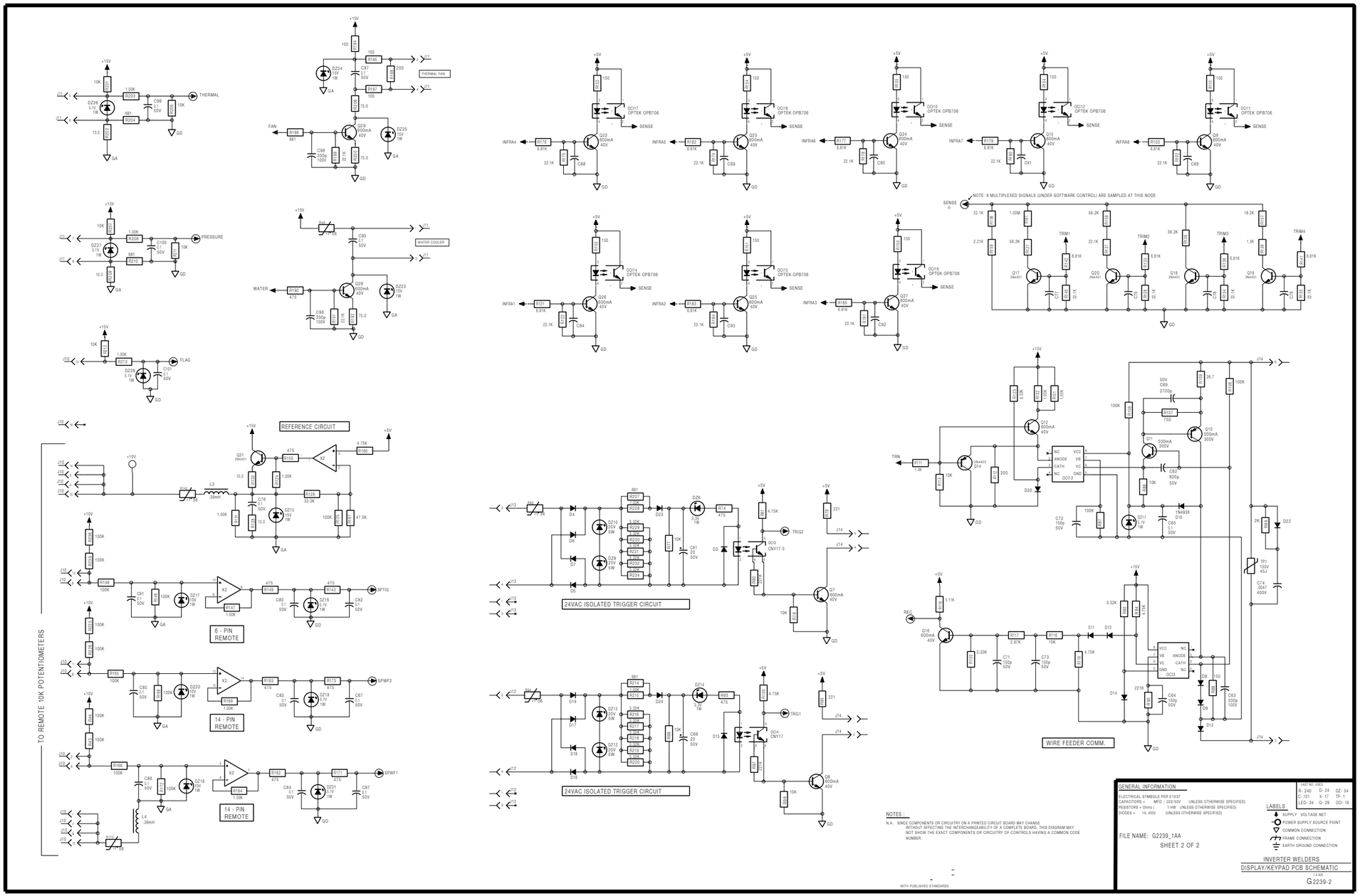
G2407 DISPLAY PC BOARD SCHEMATIC (2 OF 2)



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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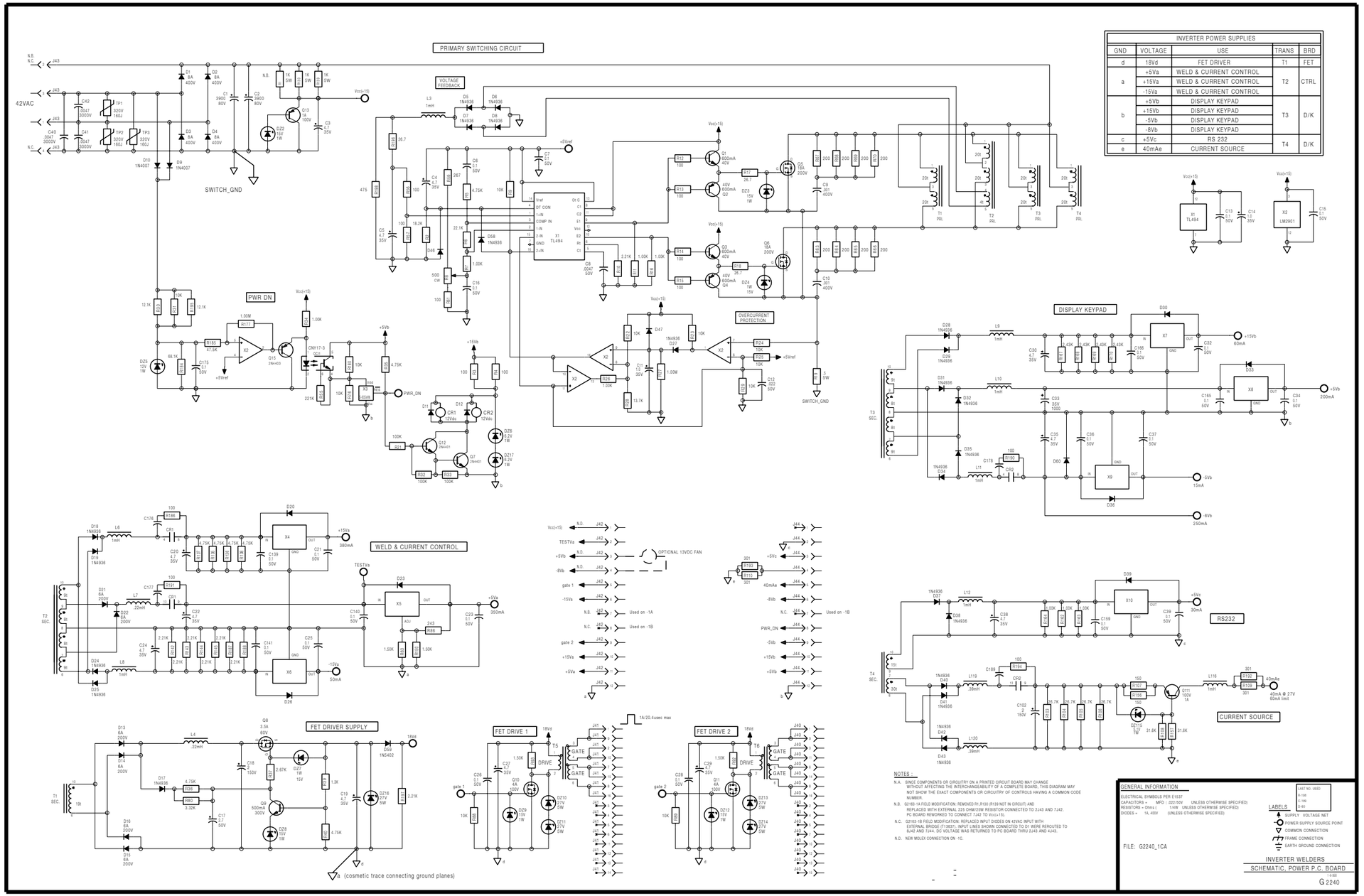
G2163 POWER PC BOARD SCHEMATIC



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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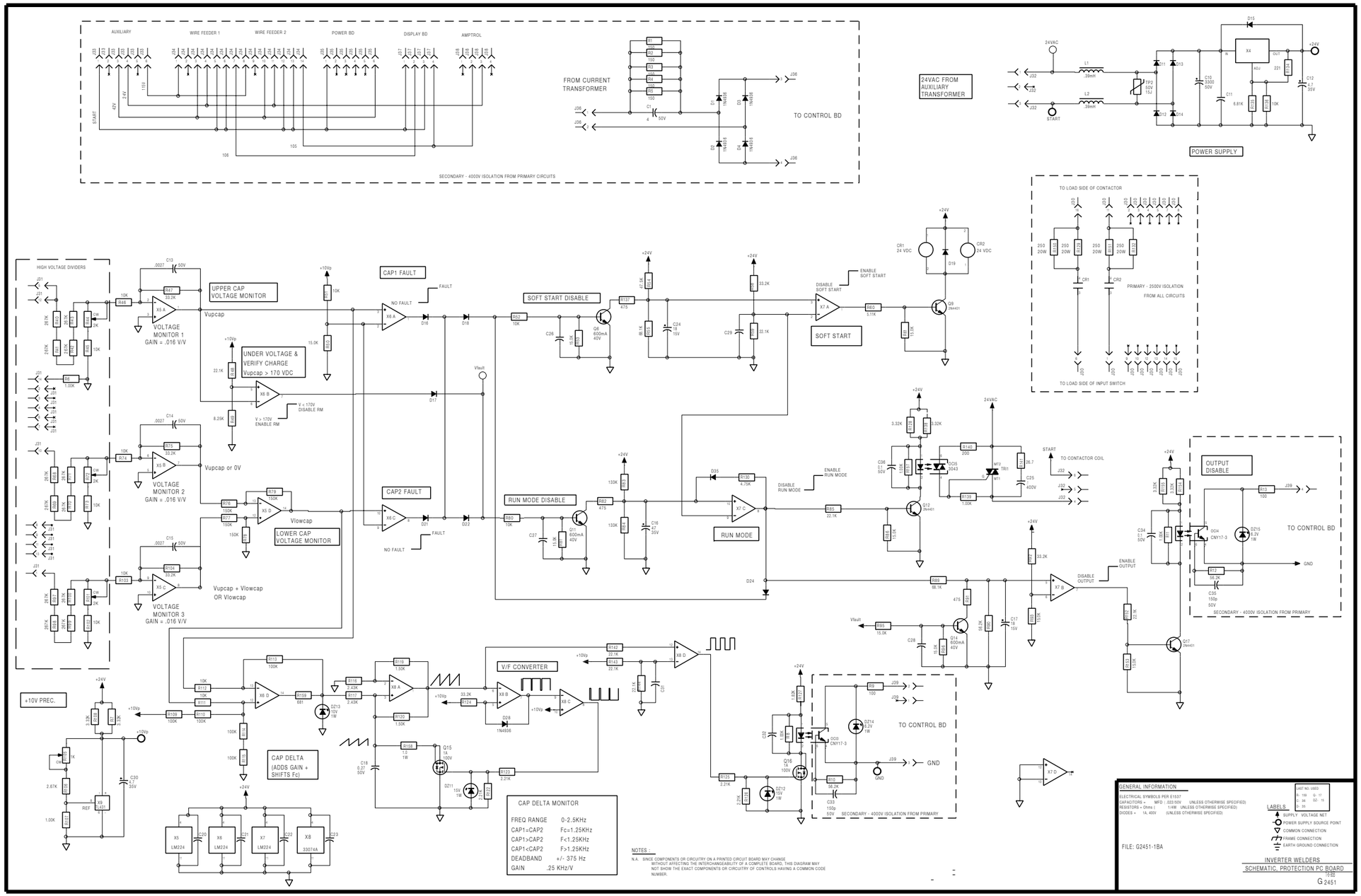
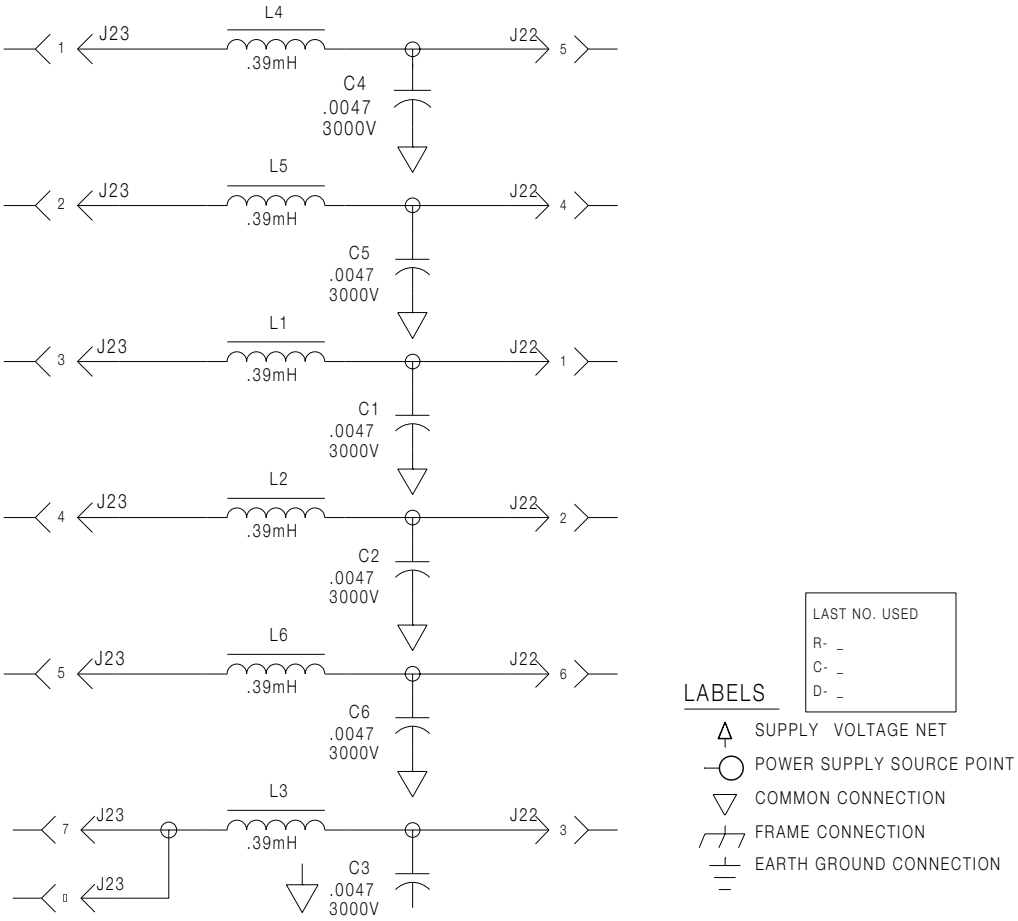
G2453 PROTECTION PC BOARD SCHEMATIC



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

ELECTRICAL DIAGRAMS

M16062 SQUARE WAVE PROTECTION PC BOARD SCHEMATIC



NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
DIODES = 1A, 400V (UNLESS OTHERWISE SPECIFIED)

SQUARE WAVE TIG 350
PROTECTION P.C. BOARD SCHEMATIC
M16115
5-29-90SPA

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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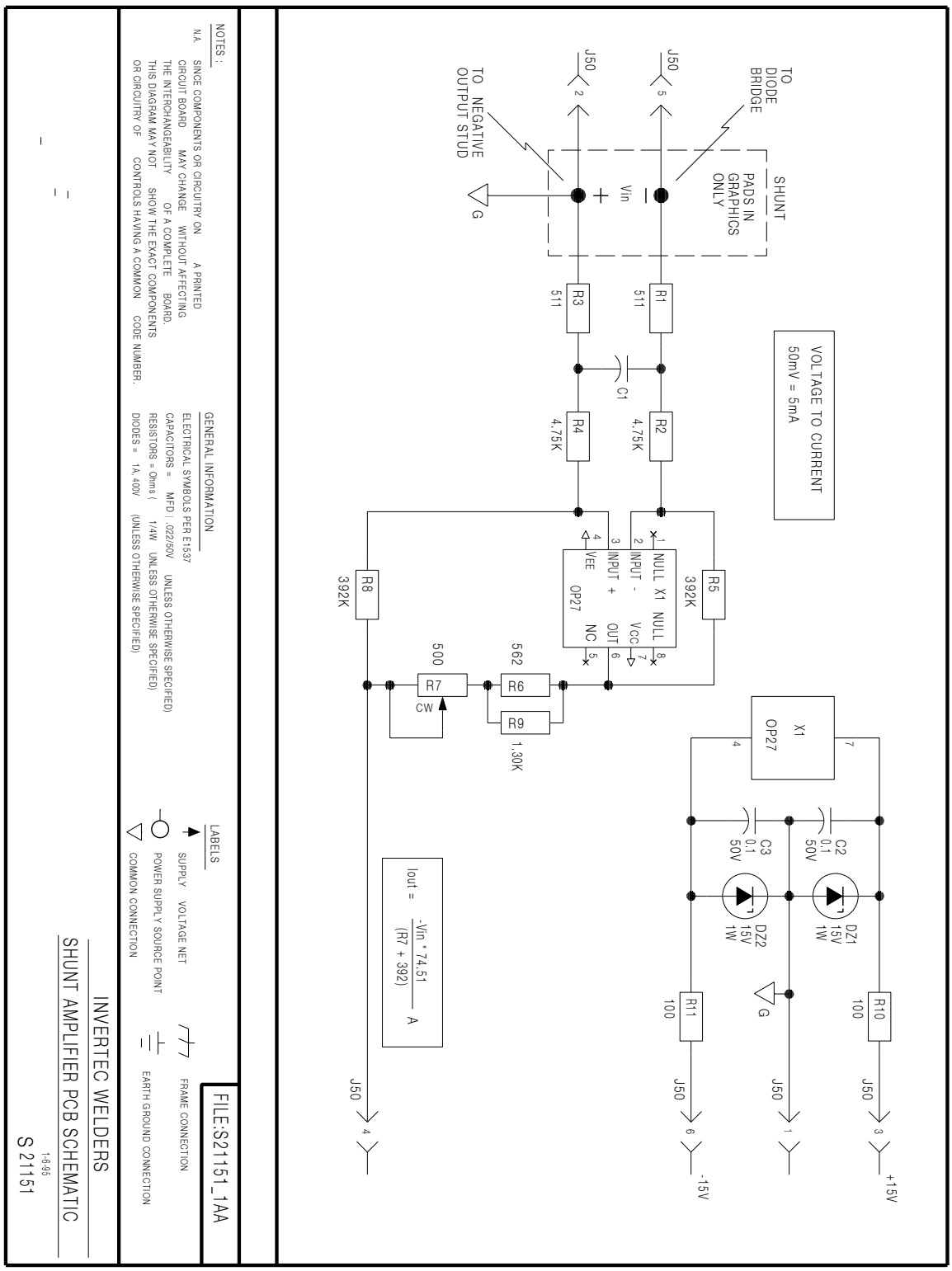
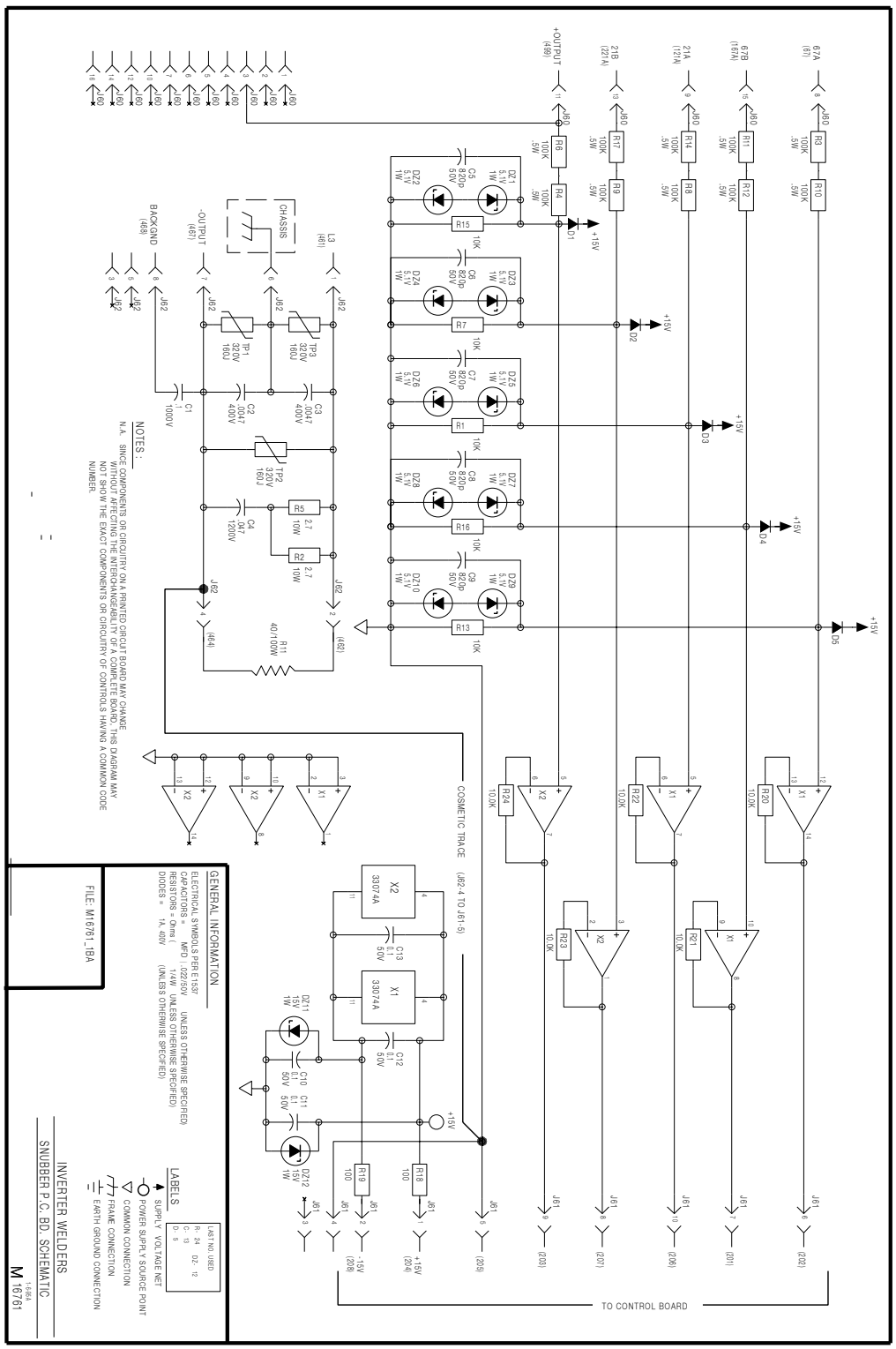
M17150 SHUNT PC BOARD SCHEMATIC



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

ELECTRICAL DIAGRAMS

L9579 SNUBBER PC BOARD SCHEMATIC



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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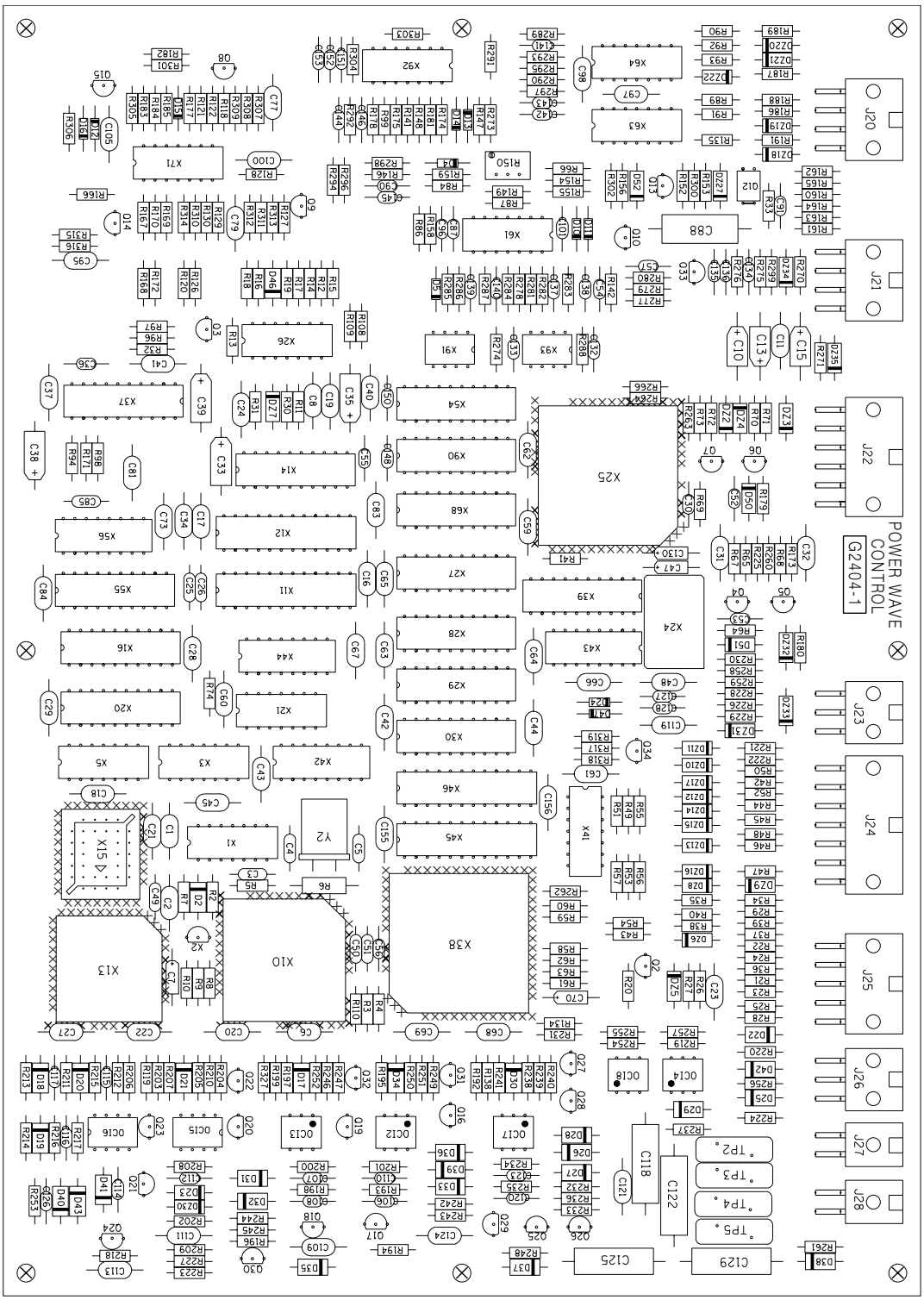
ELECTRICAL DIAGRAMS

G2404 CONTROL PC BOARD SCHEMATIC



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

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G2404 CONTROL PC BOARD BILL OF MATERIALS

X10	IC-CMOS,MCU,NOROM,PLCC,68HC11A1FN
X2	IC-CMOS,UNDERVOLT-SENSING,RESET,MCU
X15	IC-CMOS,EPROM,FLASH,8-BIT,64K
C118,C122, C125,C129	CAPACITOR-PEF,.0047,400V,10%
X26	IC-OP-AMP,QUAD,GEN-PURPOSE,224N
R150	TRIMMER-MT,1/2W,500,10%,LINEAR
Y2	CRYSTAL-QUARTZ,8.000MHZ
C4,C5,C49, C50,C51,C85	CAPACITOR-CEMO,22P,100V,5%
C3,C25,C26	CAPACITOR-CEMO,47P,100V,5%
C109,C113, C121,C124	CAPACITOR-CEMO,2700P,50V,5%
C87,C91,C96, C101,C132,C133 C141,C142, C144,C145,C148 C150,C151, C152,C153	CAPACITOR-CEMO,.022,50V,20%
C36,C52,C53, C54,C55,C57 C106,C108,C114, C120,C134 C137,C138, C139,C140	CAPACITOR-CEMO,820P,50V,5%
C30,C56,C90, C126,C135	CAPACITOR-CEMO,330P,100V,5%
C107,C110, C112,C115,C116 C117,C123, C127,C128,C136	CAPACITOR-CEMO,150P,100V,5%
X21	IC-CMOS,INVERTER,HEX,AC04
X42,X43	IC-CMOS,DECODER,1-OF-4,DUAL,AC139
J27,J28	CONNECTOR,MOLEX,MINI,RT-L,PG,4 PIN
J23,J26	CONNECTOR,MOLEX,MINI,RT-L,PG,6 PIN
J20,J21	CONNECTOR,MOLEX,MINI,RT-L,PG,8-PIN
D2,D17,D18, D19,D20,D21, D22 D25,D26,D27, D28,D29,D30 D31,D32,D33, D34,D35,D36 D37,D38,D39, D40,D41,D42 D43,D46	DIODE-AXLDS,1A,400V
R6	RESISTOR-CC,1/2W,10M,5%
C10,C13,C15	CAPACITOR-TAEL,4.7,35V,10%
C33,C35, C38,C39	CAPACITOR-TAEL,18,15V,10%
C7,C47, C70,C130	CAPACITOR-TAEL,1.0,35V,10%
C88	CAPACITOR-PCF,0.27,50V,20%
OCI2,OCI3,OCI4, OCI7,OCI8	OPTOCOUPLER-PHOTO-Q,70V,CNY17-3
X91	IC-VOLT REF,ADJ,PRECISION,431I
C1,C2,C6, C8,C11, C16,C17 C18,C19,C20,C21,C22,C23 C24,C27,C28,C29,C31,C32 C34,C37,C40,C41,C42,C43 C44,C45,C48,C59,C60,C61 C62,C63,C64,C65,C66,C67 C68,C69,C73,C77,C79,C81 C83,C84,C95,C97,C98,C100 C105,C111,C119,C155,C156	CAPACITOR-CEMO,0.1,50V,10%
X41	IC-CMOS,GATE,NAND,2-INPUT,QUAD,SCHM
J25	CONNECTOR,MOLEX,MINI,RT-L,PG,10-PIN
J22	CONNECTOR,MOLEX,MINI,RT-L,PG,12-PIN
J24	CONNECTOR,MOLEX,MINI,RT-L,PG,14-PIN
DZ6,DZ27, DZ34,DZ35	ZENER DIODE-1W,15V,5%,1N4744A
DZ2,DZ5	ZENER DIODE-1W,6.2V,5%,1N4735A
DZ3,DZ4	ZENER DIODE-1W,18V,5%,1N4746A
DZ7,DZ8,DZ9, DZ10,DZ11,DZ12 DZ13,DZ14,DZ15, DZ16,DZ17 DZ18,DZ19,DZ20, DZ21,DZ22 DZ30,DZ31,DZ32,DZ33	ZENER DIODE-1W,5.1V,5%,1N4733A
Q17,Q18, Q21,Q25	TRANSISTOR-N,T226,0.5A,300V,MPS-A42
Q24,Q26, Q29,Q30	TRANSISTOR-P,T226,0.5A,300V,MPS-A92
Q2,Q3,Q4,Q5, Q6,Q7,Q8,Q9 Q10,Q13,Q16, Q19,Q20,Q23 Q28,Q33,Q34	TRANSISTOR-N,T226,0.5A,40V,2N4401
Q14,Q15,Q22, Q27,Q31,Q32	TRANSISTOR-P,T226,0.5A,40V,2N4403
Q12	TRANSISTOR-NMF,4PDIP,1A,100V,RFD110
D4,D5,D10,D11, D12,D13,D14 D15,D16,D24,D47	DIODE-AXLDS,0.15A,75V,1N914
D23,D50,D51,D52	DIODE-AXLDS,1A,400V,FR,1N4936
TP2,TP3,TP4,TP5	MOV150VRMS,45J,14MM,CRIMPED
R25,R28,R270, R271	RESISTOR-MF,1/4W,100,1%
R15,R36,R38, R39,R40,R64 R67,R69,R71,R73,R89,R90 R91,R92,R93,R94,R97,R108 R110,R118,R120,R127,R135 R152,R156,R168,R171,R173 R179,R180,R183,R186,R187 R188,R189,R191,R192,R199 R203,R221,R228,R231,R258 R275,R300,R301,R308,R311 R315*	RESISTOR-MF,1/4W,1.00K,1%
R2,R4,R8,R9, R10,R12,R13 R14,R16,R18,R20,R32,R35 R41,R58,R59,R60,R61,R62 R63,R65,R72,R74,R158,R169 R170,R172,R185,R193,R198 R202,R210,R213,R222,R235 R239,R246,R251,R255,R257 R262,R264,R279,R280,R284 R295,R296,R297,R317,R318 R319*	RESISTOR-MF,1/4W,10.0K,1%
R11,R99,R141, R148,R175 R209,R223,R263,R266,R277	RESISTOR-MF,1/4W,100K,1%
R153,R160,R162, R163,R164 R165,R166,R225,R260,R305 R306,R307,R309,R312,R313 R316*	RESISTOR-MF,1/4W,10.0,1%
R204,R240, R247,R249 R155,R178, R220,R253,R256 R299*	RESISTOR-MF,1/4W,1.30K,1%
	RESISTOR-MF,1/4W,150,1%

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ELECTRICAL DIAGRAMS

G2404 CONTROL PC BOARD BILL OF MATERIALS (Continued)

R96,R98	RESISTOR-MF,1/4W,1.50K,1%
R17,R19,R109	RESISTOR-MF,1/4W,15.0K,1%
R159	RESISTOR-MF,1/4W,150K,1%
R205,R238,R250, R252,R282 R286*	RESISTOR-MF,1/4W,200,1%
R224,R237, R248,R261	RESISTOR-MF,1/4W,2.00K,1%
R5,R37,R87, R293,R294	RESISTOR-MF,1/4W,2.21K,1%
R217,R219, R254,R288	RESISTOR-MF,1/4W,221K,1%
R22,R29,R274	RESISTOR-MF,1/4W,267,1%
R215	RESISTOR-MF,1/4W,2.67K,1%
R33,R86, R229,R230	RESISTOR-MF,1/4W,26.7K,1%
R21,R23,R24, R182,R227,R232 R242,R244	RESISTOR-MF,1/4W,26.7,1%
R291,R292	RESISTOR-MF,1/4W,332,1%
R195,R197, R207,R211,R212 R241,R289,R290	RESISTOR-MF,1/4W,3.32K,1%
R121,R129, R130,R174,R181 R278*	RESISTOR-MF,1/4W,33.2K,1%
R26,R27,R30, R31,R34,R42 R43,R44,R45,R46,R47,R48 R49,R50,R51,R52,R53,R54 R55,R56,R57,R122,R128,R146 R147,R167,R177,R184	RESISTOR-MF,1/4W,475,1%
R3,R7,R68,R70, R142,R154 R161,R214,R216,R302,R310 R314*	RESISTOR-MF,1/4W,4.75K,1%
R206,R298	RESISTOR-MF,1/4W,5.11K,1%
R200,R201, R208,R234	RESISTOR-MF,1/4W,56.2K,1%
R119,R126, R134,R138,R226 R259,R327	RESISTOR-MF,1/4W,681,1%
R276,R281, R285,R303,R304	RESISTOR-MF,1/4W,6.81K,1%
R149,R194, R196,R218,R233	RESISTOR-MF,1/4W,750,1%
C143,C146	CAPACITORCEMO,4700P,50V,10%
OCI5,OCI6	OPTOCOUPLERPHOTOD/Q,HISPD,6N136
X61,X71,X92	IC-OP-AMP,QUAD,HIGH-PERF,33074A
X3,X5	IC-CMOS,GATE,AND,2-INPUT,QUAD,HC08A
X16,X20,X55	IC-CMOS,LATCH,3-STATE,OCTAL,HC573A
R283,R287	RESISTOR-MF,1/4W,825,1%
X24	CRYSTAL-(OSCILLATOR MODULE),25MHZ
X56	IC-CONVERTER,D/A,8-BIT,1408
X25,X38	IC,CMOS,MCU,DSP (SS)
X45,X46	IC-CMOS,RAM,STATIC,8-BIT,2K
X14,X37	IC-CMOS,CONVERTER,A/D,MPU,10-BIT,F
X54	IC-CMOS,CONVERTER,D/A,MPU,10BIT
X1	IC-CMOS,GATE,NAND,2-INPUT,QUAD,HC00
X27,X28,X29, X30,X68,X90	IC-CMOS,LATCH,3-STATE,OCTAL,AC573
X44	IC-CMOS,MUX,4-INPUT,DUAL,AC153
X11,X12	IC-CMOS,TRNSCVR,BUS,3-STATE,OCTAL
X39	IC,CMOS,PLD,GENERIC (SS)
X93	IC-OP-COMPARATOR,HI-SPD,5-V,1016
R273	RESISTOR-MF,1/4W,22.1K,1%
R66,R84	RESISTOR-MF,1/4W,47.5K,1%
R236,R243,R245	RESISTOR-MF,1/4W,61.9K,1%
X63,X64	QUAD ANALOG SWITCH (SS)

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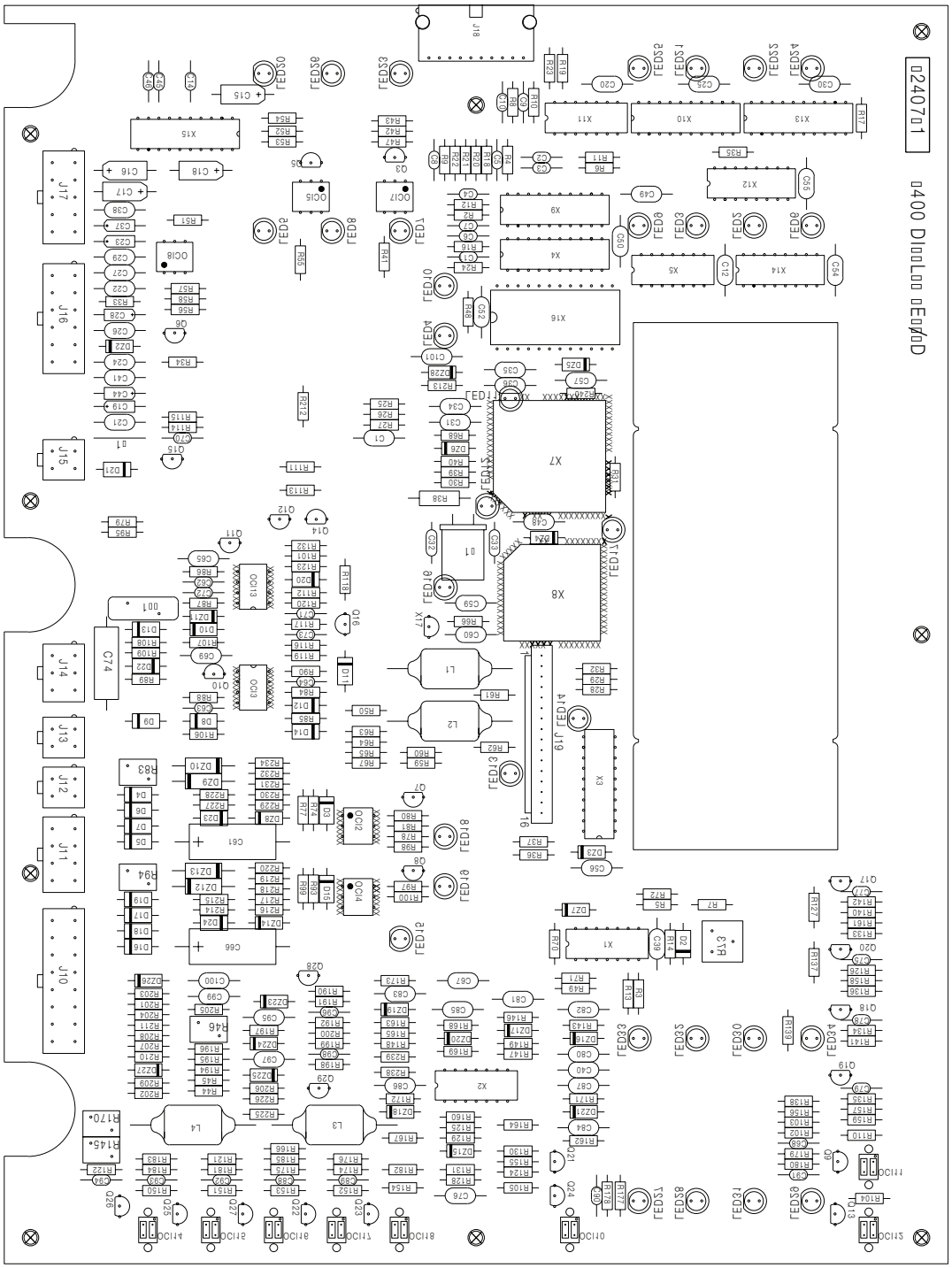
ELECTRICAL DIAGRAMS

G2407 DISPLAY PC BOARD SCHEMATIC



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G2407 DISPLAY PC BOARD BILL OF MATERIALS

W1	20 AWG UNINSULATED JUMPER
X7	IC-CMOS,MCU,NOROM,PLCC,68HC11A1FN
X17	IC-CMOS,UNDERVOLT SENSING,RESET,MCU
C74	CAPACITOR-PEF,.0047,400V,10%
X1,X2	IC-OP-AMP,QUAD,GEN-PURPOSE,224N
C32,C33	CAPACITOR-CEMO,22P,100V,5%
C69	CAPACITOR-CEMO,2700P,50V,5%
C2,C3,C4, C5,C6,C7, C8,C9 C10,C11,C68, C70,C75,C77 C78,C79,C88, C89,C90,C91 C92,C93,C94	CAPACITOR-CEMO,.022,50V,20%
C62	CAPACITOR-CEMO,820P,50V,5%
C14,C45,C46, C63,C96,C98	CAPACITOR-CEMO,330P,100V,5%
C64,C71,C72,C73	CAPACITOR-CEMO,150P,100V,5%
X11	IC-CMOS,INVERTER,HEX,HC04A
X12	IC-CMOS,COUNTER,BINARY,12STAGE
J12,J13,J15	CONNECTOR,MOLEX,MINI,PCB,4-PIN
J14	CONNECTOR,MOLEX,MINI,PCB,6-PIN
J11	CONNECTOR,MOLEX,MINI,PCB,8-PIN
R46,R83,R94, R145,R170	THERMISTOR-PTC,56 OHMS,90MA
X10,X13	IC-CMOS,DRIVER,DISPLAY,LED,CC,MCU
D2,D3,D4,D5, D6,D7,D8,D9 D11,D12,D13, D14,D15,D16 D17,D18,D19, D20,D21,D22 D23,D24	DIODE-AXLDS,1A,400V
LED2,LED3, LED4,LED5, LED6 LED7,LED8,LED9,LED10,LED11 LED12,LED13,LED14,LED15 LED16,LED17,LED18,LED19 LED20,LED21,LED22,LED23 LED25,LED26,LED27,LED28 LED29,LED30,LED31,LED32 LED33,LED34	LED-T-1 3/4,GREEN,HLMP-3502
R38	RESISTOR-CC,1/2W,10M,5%
C15,C16, C17,C18 C19,C23,C28,	CAPACITOR-TAEL,18,15V,10%
C37,C44	CAPACITOR-TAEL,1.0,35V,10%
C61,C66	CAPACITOR-ALEL,20,50V,+75/-10%
OCI2,OCI4	OPTOCOUPLER-PHOTO-Q,70V,CNY173
OCI3,OCI13	OPTOCOUPLER-PHOTOD/Q,HI-SPD,6N136
C1,C12,C20, C21,C22, C24,C25 C26,C27,C29,C30,C31,C34 C35,C36,C38,C39,C40,C41 C48,C49,C50,C52,C54,C55 C56,C57,C59,C60,C65,C67 C76,C80,C81,C82,C83,C84 C85,C86,C87,C95,C97,C99 C100,C101	CAPACITOR-CEMO,0.1,50V,10%
J17	CONNECTOR,MOLEX,MINI,PCB,10-PIN
J16	CONNECTOR,MOLEX,MINI,PCB,12-PIN
J10	CONNECTOR,MOLEX,MINI,PCB,16-PIN
J19	CONNECTOR,PCB,WW,VERTICAL,16-PIN
J18	CONNECTOR,PCB,WW,MALE,RTL,10-PIN
R73	TRIMMER-ST,1/2W,10K,10%,LINEAR

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ELECTRICAL DIAGRAMS

G2407 DISPLAY PC BOARD BILL OF MATERIALS (Continued)

DZ15,DZ23, DZ24,DZ25	ZENER DIODE-1W,15V,5%,1N4744A
DZ2,DZ3,DZ4, DZ5,DZ6,DZ11 DZ16,DZ19, DZ21,DZ26,DZ27 DZ28*	ZENER DIODE-1W,5.1V,5%,1N4733A
DZ7	ZENER DIODE-1W,8.2V,5%,1N4738A
Q11	TRANSISTOR-N,T226,0.5A,300V,MPS-A42
Q10	TRANSISTOR-P,T226,0.5A,300V,MPS-A92
Q3,Q5,Q6, Q7,Q8,Q9, Q12,Q13 Q15,Q16,Q17, Q18,Q19,Q20 Q21,Q22,Q23, Q24,Q25,Q26 Q27,Q28,Q29	TRANSISTOR-N,T226,0.5A,40V,2N4401
Q14	TRANSISTOR-P,T226,0.5A,40V,2N4403
D10	DIODE-AXLDS,1A,400V,FR,1N4936
TP1	MOV-150VRMS,45J,14MM
R36,R37,R61, R68,R194,R195 R197*	RESISTOR-MF,1/4W,100,1%
R2,R6,R11,R12, R14,R16,R24 R27,R66,R70,R101,R124,R131 R132,R147,R164,R169,R203 R208,R213,R215,R228,R240	RESISTOR-MF,1/4W,1.00K,1%
R28,R29,R30, R31,R32,R39 R40,R41,R47,R52,R55,R58 R77,R78,R86,R98,R99,R113 R116,R201,R205,R207,R211 R212*	RESISTOR-MF,1/4W,10.0K,1%
R7,R44,R45, R87,R106,R108 R125,R146,R148,R165,R166 R168,R172,R225,R226,R238 R239*	RESISTOR-MF,1/4W,100K,1%
R161	RESISTOR-MF,1/4W,1.00M,%
R128,R130, R202,R209	RESISTOR-MF,1/4W,10.0,1%
R111,R138	RESISTOR-MF,1/4W,1.30K,1%
R50,R59,R60, R63,R64,R65 R67,R88,R104,R105,R110 R150,R151,R152,R153,R154	RESISTOR-MF,1/4W,150,1%
R17,R35	RESISTOR-MF,1/4W,1.50K,1%
R157	RESISTOR-MF,1/4W,18.2K,1%
R112,R196	RESISTOR-MF,1/4W,200,1%
R89	RESISTOR-MF,1/4W,2.00K,1%
R79,R95	RESISTOR-MF,1/4W,221,1%
R159	RESISTOR-MF,1/4W,2.21K,1%
R51,R102,R114, R122,R126 R134,R135,R137,R140,R156	RESISTOR-MF,1/4W,22.1K,1%
R174,R175,R178,R180,R181 R184,R191,R199	
R80,R90,R97	RESISTOR-MF,1/4W,221K,1%
R26,R57	RESISTOR-MF,1/4W,267,1%
R3,R117	RESISTOR-MF,1/4W,2.67K,1%
R109	RESISTOR-MF,1/4W,26.7,1%
R85,R115,R120, R123,R216 R217,R218,R219,R220,R229 R230,R231,R232,R234	RESISTOR-MF,1/4W,3.32K,1%
R129	RESISTOR-MF,1/4W,33.2K,1%
R139	RESISTOR-MF,1/4W,39.2K,1%
R33,R34,R74, R93,R143,R149 R155,R162,R163,R171,R173 R190*	RESISTOR-MF,1/4W,475,1%
R48,R49,R56, R62,R71,R72 R81,R84,R100,R119,R160	RESISTOR-MF,1/4W,4.75K,1%
R118	RESISTOR-MF,1/4W,5.11K,1%
R127,R158	RESISTOR-MF,1/4W,56.2K,1%
R198,R204, R210,R214,R227	RESISTOR-MF,1/4W,681,1%
R25,R42,R53, R103,R121,R133 R136,R141,R142,R176,R177 R179,R182,R183,R185	RESISTOR-MF,1/4W,6.81K,1%
R43,R54,R107	RESISTOR-MF,1/4W,750,1%
LED24	LED-T-1 3/4,YELLOW,HLMP-3400
L1,L2,L3,L4	CHOKE-390UH,5%,225MA,CONFORMAL
X5	IC-CMOS,GATE,AND,2-INPUT,QUAD,HC08A
X3,X4,X9	IC-CMOS,LATCH,3-STATE,OCTAL,HC573A
X14	IC-CMOS,MUX,DATA,8-INPUT,HC151
Y1	CRYSTAL-QUARTZ,4.9152MHZ
X15	IC-CMOS,DRVR/RCVR,EIA232,145407
X16	IC-CMOS,ACIA,2.0MHZ,68B50P
OCI5,OCI7,OCI8	OPTOCOUPLER-LOGIC-OUT,H11L2
OCI10,OCI11, OCI12,OCI14 OCI15,OCI16, OCI17,OCI18	OPTOSENSOR-REFLECTIVE,PHOTO-Q
DZ9,DZ10, DZ12,DZ13	ZENER DIODE-5W,20V,5%,1N5357B
DZ17,DZ18,DZ20	ZENER DIODE-1W,10V,5%,1N4740A
DZ8,DZ14	ZENER DIODE-1W,3.3V,5%,1N4728A
R5	RESISTOR-MF,1/4W,133K,1%
R13	RESISTOR-MF,1/4W,301,1%
R167	RESISTOR-MF,1/4W,47.5K,1%
R4,R8,R9,R10, R18,R19,R20 R21,R22,R23, R192,R200,R206	RESISTOR-MF,1/4W,75.0,1%

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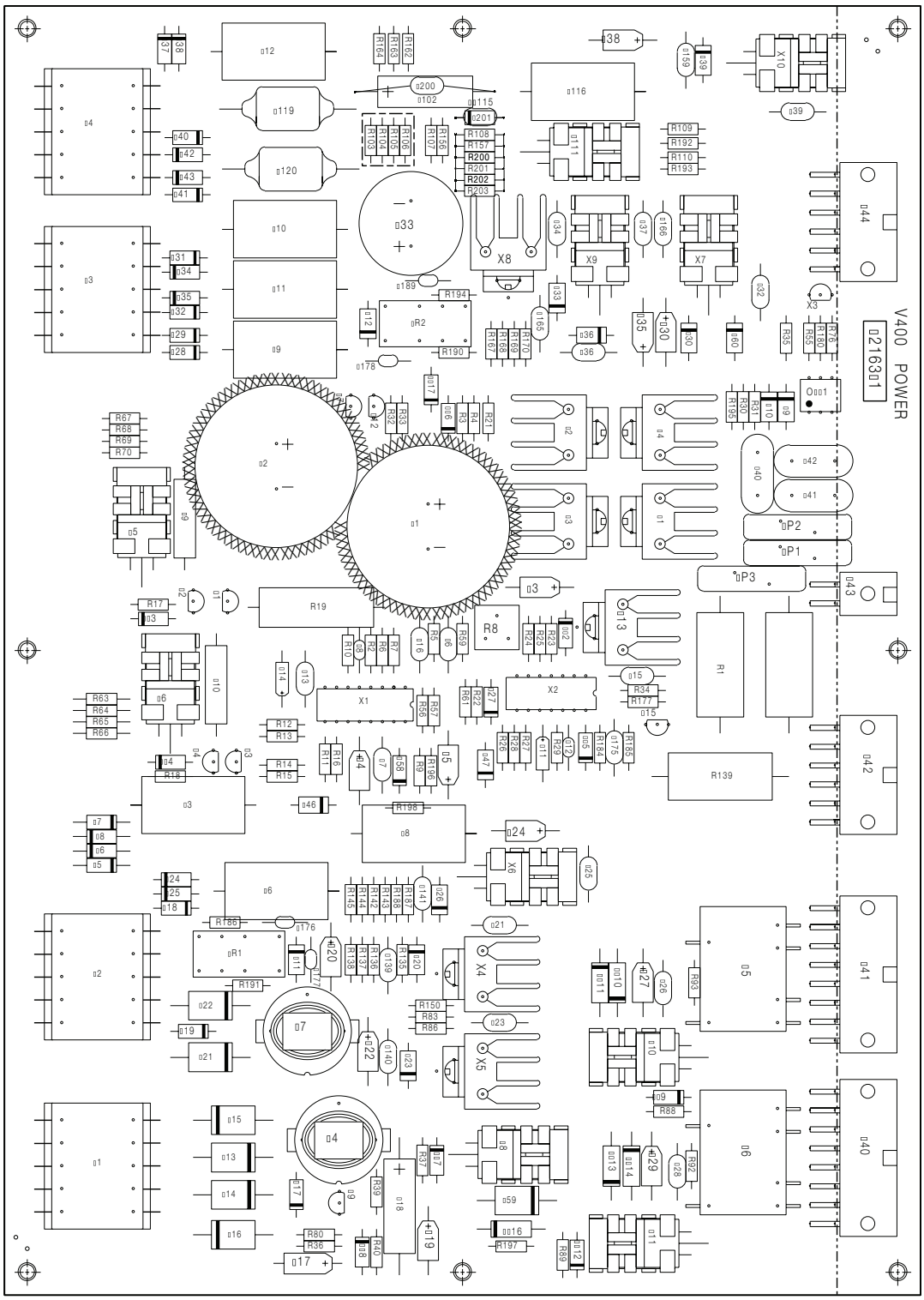
ELECTRICAL DIAGRAMS

G2163 POWER PC BOARD SCHEMATIC



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G2163 POWER PC BOARD BILL OF MATERIALS

C33	CAPACITOR-ALEL,1000,35V,+30/20
C3,C4,C5, C19,C20, C22,C24 C27,C29,C30, C35,C38	CAPACITOR-TAEL,4.7,35V,10%
C11,C14 C6,C7,C13, C15,C16,C21, C23 C25,C26,C28, C32,C34,C36 C37,C39,C139,C140,C141 C159,C165,C166,C175,C191	CAPACITOR-CEMO,0.1,50V,10%
R3,R4,R12, R13,R14, R15,R56 R57,R61,R186,R190,R191 R194*	RESISTOR-MF,1/4W,100,1%
R7,R11,R16, R26,R34,R162 R163,R164	RESISTOR-MF,1/4W,1.00K,1%
R9,R22,R23, R24,R25, R29,R31 R76,R88,R89,R180	RESISTOR-MF,1/4W,10.0K,1%
R27,R177	RESISTOR-MF,1/4W,1.00M,%
R5,R35,R36, R40,R135,R136 R137,R138	RESISTOR-MF,1/4W,4.75K,1%
D11,D12,D20, D23,D26,D30 D33,D36,D39, D46,D47,D60	DIODE-AXLDS,1A,400V
L119,L120	CHOKE-390UH,5%,225MA,CONFORMAL
DZ2,DZ3,DZ4, DZ7,DZ8,DZ9 DZ12*	ZENER DIODE-1W,15V,5%,1N4744A
D59	DIODE-AXLDS,3A,200V,1N5402
D5,D6,D7,D8, D17,D18,D19 D24,D25,D27,D28,D29,D31 D32,D34,D35,D37,D38,D40 D41,D42,D43,D58	DIODE-AXLDS,1A,400V,FR,1N4936
J43	CONNECTOR,MOLEX,MINI,RT-L,PG,4
C17 C9,C10	CAPACITOR-TAEL,2.7,50V,10% CAPACITOR-PEF,.001,400V,10%
J42,J44	CONNECTOR,MOLEX,MINI,RT-L,PG,12
Q1,Q3,Q7,Q12 Q2,Q4,Q15	TRANSISTOR-N,T226,0.5A,40V,2N44 TRANSISTOR-P,T226,0.5A,40V,2N44
R86 R17,R18,R196	RESISTOR-MF,1/4W,243,1% RESISTOR-MF,1/4W,26.7,1%
X3	IC-CMOS,UNDERVOLT-SENSING,RESET
OCI1	OPTOCOUPLER-PHOTO-Q,70V,CNY173
DZ115	ZENER DIODE-1W,5.1V,5%,1N4733A
R2,R103,R104, R105,R106 R108,R157	RESISTOR-MF,1/4W,18.2K,1%
R37	RESISTOR-MF,1/4W,2.67K,1%
C12,C176, C177,C178,C189 C8	CAPACITOR-CEMO,.022,50V,20% CAPACITOR-CEMO,4700P,50V,10%
X2	IC-COMPARATOR,QUAD,2901N
J40,J41	CONNECTOR,MOLEX,MINI,RT-L,PG,16
DZ10,DZ11, DZ13,DZ14,DZ16	ZENER DIODE-5W,27V,5%,1N5361B
C1,C2	CAPACITOR-ALEL,3900,80V,20%
R28	RESISTOR-MF,1/4W,13.7K,1%
L4,L7	CHOKE-220UH,?%,2.35A
T1	TRANSFORMER-PCB,PWM,3-WDG
T4	TRANSFORMER-PCB,PWM,4-WDG
T3	TRANSFORMER-PCB,PWM,6-WDG
T2	TRANSFORMER-PCB,PWM,7-WDG
C18,C102	CAPACITORALEL,2,150V,+75/-10%
R8	TRIMMER-ST,1/2W,500,10%,LINEAR
R19	RESISTOR-WW,5W,0.5,5%
R39	RESISTOR-MF,1/4W,1.30K,1%
R107,R156	RESISTOR-MF,1/4W,150,1%
R83,R92, R93,R150	RESISTOR-MF,1/4W,1.50K,1%
R63,R64,R65, R66,R67,R68 R69,R70	RESISTOR-MF,1/4W,200,1%
R10,R142,R143, R144,R145 R187,R188,R197	RESISTOR-MF,1/4W,2.21K,1%
R6	RESISTOR-MF,1/4W,22.1K,1%
R59	RESISTOR-MF,1/4W,267,1%
R80	RESISTOR-MF,1/4W,3.32K,1%
X5	POSITIVE VOLTAGE REG & HEATSINK
DZ5	ZENER DIODE-1W,12V,5%,1N4742A
R167,R168, R169,R170	RESISTOR-MF,1/4W,2.43K,1%
R185	RESISTOR-MF,1/4W,47.5K,1%
R184	RESISTOR-MF,1/4W,68.1K,1%
CR1,CR2	RELAY-DPDT,12VDC,360 OHMS,AUAG
R30,R195	RESISTOR-MF,1/4W,12.1K,1%
R109,R110, R192,R193	RESISTOR-MF,1/4W,301,1%
X1	IC-PWM-CONTROLLER,I-MODE,494
D9,D10	DIODE-AXLDS,1A,1000V
T5,T6	TRANSFORMER-PULSE,3-WINDING,1:1
C40,C41,C42	CAPACITOR-CD,.0047,3000V,20%
L3,L6,L8,L9, L10,L11,L12 L116*	CHOKE-1.0MH,15%,0.8A,SLEEVED
Q9	TRANSISTORN,T226,0.5A,300V,MPS
D13,D14,D15, D16,D21,D22	DIODE-AXLDS,3.0A,200V,FR
R21,R32,R33	RESISTOR-MF,1/4W,100K,1%
X4	POSITIVE VOLTAGE REG & HEATSINK
X8	POSITIVE VOLTAGE REG & HEATSINK
Q13	TRANSISTOR & HEATSINK
DZ6,DZ17	ZENER DIODE-1W,6.2V,5%,1N4735A
R198	RESISTORMF,1/4W,475,1%
X7	IC-VOLT REG,3-TERMINAL,(+),15V,
X9	IC-VOLT REG,FIXED,3-T,(-),1A,5V
X6	IC-VOLT REG,FIXED,3-T,(-),1A,15
Q111	TRANSISTOR-P,T220,3A,100V,TIP32
Q5,Q6	TRANSISTOR-NMF,T220,18A,200V,IR
Q8	TRANSISTOR-NMF,T220,3.5A,60V,IR
Q10,Q11	TRANSISTOR-NMF,T220,4A,100V,IRF
D1,D2,D3,D4	XM5384 DIODE & HEAT SINK ASBLY
TP1,TP2,TP3	MOV-320VRMS,160J,20MM
R1,R130,R139	RESISTOR-WW,5W,1K,5%,SQ
R55	RESISTOR-MF,1/4W,221K,1%
C190	CAPACITOR-PEF,0.1,100V, 10%

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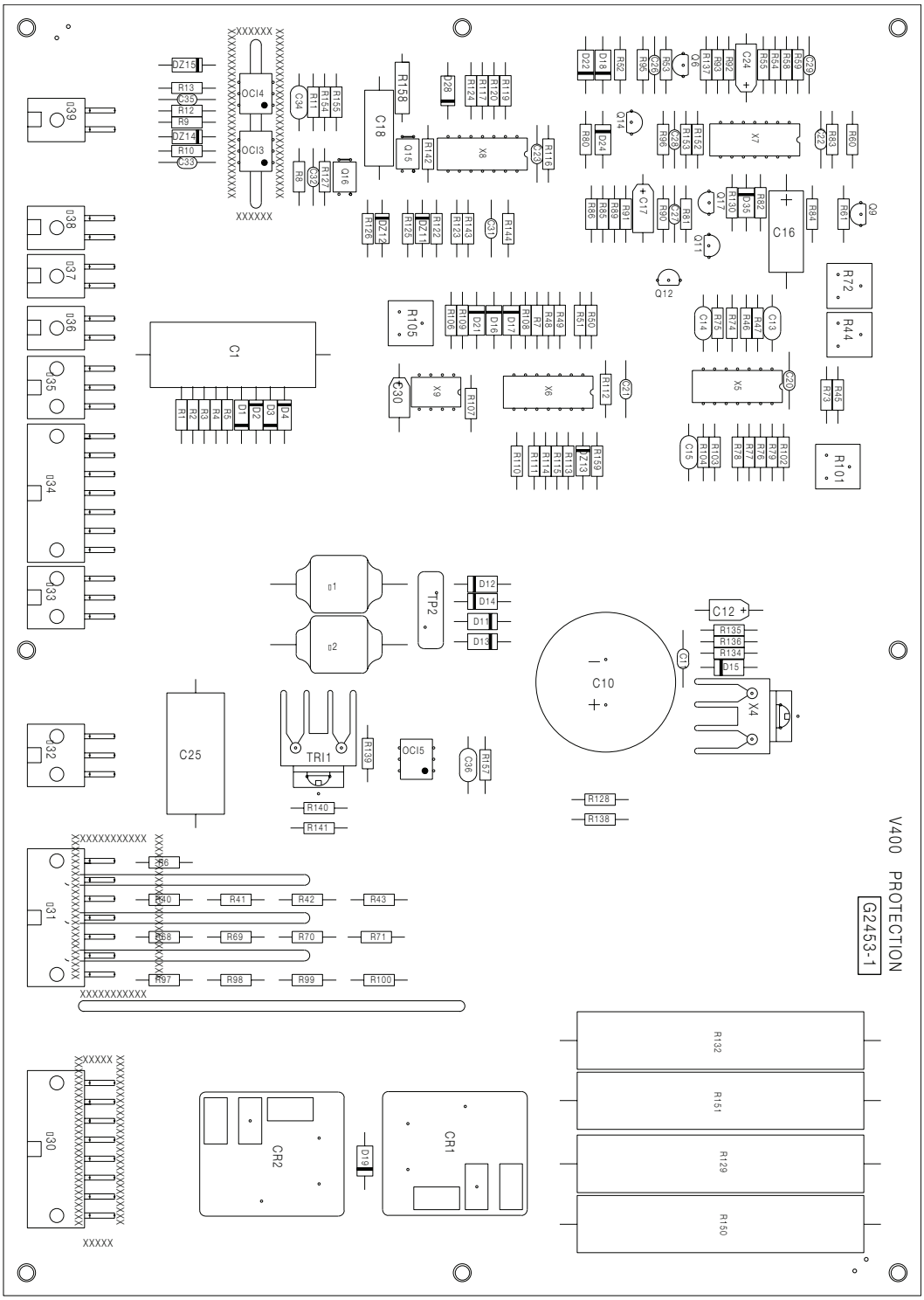
ELECTRICAL DIAGRAMS

G2453 PROTECTION PC BOARD SCHEMATIC



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G2453 PROTECTION PC BOARD BILL OF MATERIALS

CR1,CR2	RELAY-SPNO,24VDC,600OHMS,AG-CDO
X5,X6,X7	IC-OP-AMP,QUAD,GEN-PURPOSE,224N
C13,C14,C15	CAPACITOR-CEMO,2700P,50V,5%
C11,C20,C21, C22,C23,C26 C27,C28,C29, C31,C32	CAPACITOR-CEMO,.022,50V,20%
D11,D12,D13, D14,D15,D16 D17,D18,D19, D21,D22,D24 D35 *	DIODE-AXLDS,1A,400V
C12,C30	CAPACITOR-TAEL,4.7,35V,10%
C17,C24	CAPACITOR-TAEL,18,15V,10%
C10	CAPACITOR-ALEL,3300,50V,+30/10%
X9	IC-VOLT REF,ADJ,PRECISION,431I
X8	IC-OPAMP,QUAD,HIGH-PERF,33074A
R105	TRIMMER-ST,1/2W,1K,10%,LINEAR
DZ11,DZ12	ZENER DIODE-1W,15V,5%,1N4744A
Q6,Q9,Q11, Q12,Q14,Q17	TRANSISTOR-N,T226,0.5A,40V,2N4401
Q15,Q16	TRANSISTOR-NMF,4PDIP,1A,100V,RFD110
D1,D2,D3,D4,D28	DIODE-AXLDS,1A,400V,FR,1N4936
TP2	MOV-50VRMS,15J,14MM
R9,R13	RESISTOR-MF,1/4W,100,1%
R6,R8,R11, R107,R139,R157	RESISTOR-MF,1/4W,1.00K,1%
R45,R46,R51, R52,R73,R74	RESISTOR-MF,1/4W,10.0K,1%
R80,R102,R103, R111,R112 R136*	
R109,R110,R113, R114,R115	RESISTOR-MF,1/4W,100K,1%
R50,R53,R61, R81,R86,R93 R95,R96,R153	RESISTOR-MF,1/4W,15.0K,1%
R76,R77,R78,R79	RESISTOR-MF,1/4W,150K,1%
R134	RESISTOR-MF,1/4W,221,1%
R122,R123, R125,R126	RESISTOR-MF,1/4W,2.21K,1%
R48,R59,R85, R142,R143,R144 R152*	RESISTOR-MF,1/4W,22.1K,1%
R40,R41,R42, R43,R68,R69 R70,R71,R97, R98,R99,R100	RESISTOR-MF,1/4W,267K,1%
R47,R58,R75,R92, R104,R124	RESISTOR-MF,1/4W,33.2K,1%
R135	RESISTOR-MF,1/4W,6.81K,1%
R49	RESISTOR-MF,1/4W,8.25K,1%
J36,J37,J38,J39	CONNECTOR,MOLEX,MINI,RT-L,PG,4 PIN
J32,J33,J35	CONNECTOR,MOLEX,MINI,RT-L,PG,6 PIN
L1,L2	CHOKE-390UH,5%,225MA,CONFORMAL
OCI5	OPTOCOUPLER-TRIAC DRIVER,ZVC,3043
J31,J34	CONNECTOR,MOLEX,MINI,RT-L,PG,14PIN
C25	CAPACITOR-PEF,0.1,400V,10%
R129,R132, R150,R151	RESISTOR-WW,20W,250,5%,SQ
R140	RESISTOR-MF,1/4W,200,1%
R106	RESISTOR-MF,1/4W,2.67K,1%
R141	RESISTOR-MF,1/4W,26.7,1%
R7,R108,R128, R138,R154 R155*	RESISTOR-MF,1/4W,3.32K,1%
R54	RESISTOR-MF,1/4W,47.5K,1%
R10,R12,R90	RESISTOR-MF,1/4W,56.2K,1%
R55,R89	RESISTOR-MF,1/4W,68.1K,1%
C33,C35	CAPACITOR-CEMO,150P,100V,5%
OCI3,OCI4	OPTOCOUPLER-PHOTO-Q,70V,CNY17-3
C34,C36	CAPACITOR-CEMO,0.1,50V,10%
J30	CONNECTOR,MOLEX,MINI,RT-L,PG,16-PIN
C1	CAPACITOR-PEMF,4.0,50V,10%
DZ13	ZENER DIODE-1W,10V,5%,1N4740A
DZ14,DZ15	ZENER DIODE-1W,6.2V,5%,1N4735A
R1,R2,R3,R4,R5	RESISTOR-MF,1/4W,150,1%
R119,R120	RESISTOR-MF,1/4W,1.50K,1%
X4	POSITIVE VOLTAGE REG & HEATSINK
TRI1	TRIAC & HEATSINK ASBLY
C16	CAPACITOR-TAEL,47,35V,10%
R44,R72,R101	TRIMMER-ST,1/2W,2K,10%,LINEAR
C18	CAPACITOR-PCF,0.27,50V,5%
R83,R84	RESISTOR-MF,1/4W,133K,1%
R127	RESISTOR-MF,1/4W,1.82K,1%
R116,R117	RESISTOR-MF,1/4W,2.43K,1%
R82,R91,R137	RESISTOR-MF,1/4W,475,1%
R130	RESISTOR-MF,1/4W,4.75K,1%
R60	RESISTOR-MF,1/4W,5.11K,1%
R158	RESISTOR-WW,1W,1.0,1%
R159	RESISTOR-MF,1/4W,681,1%

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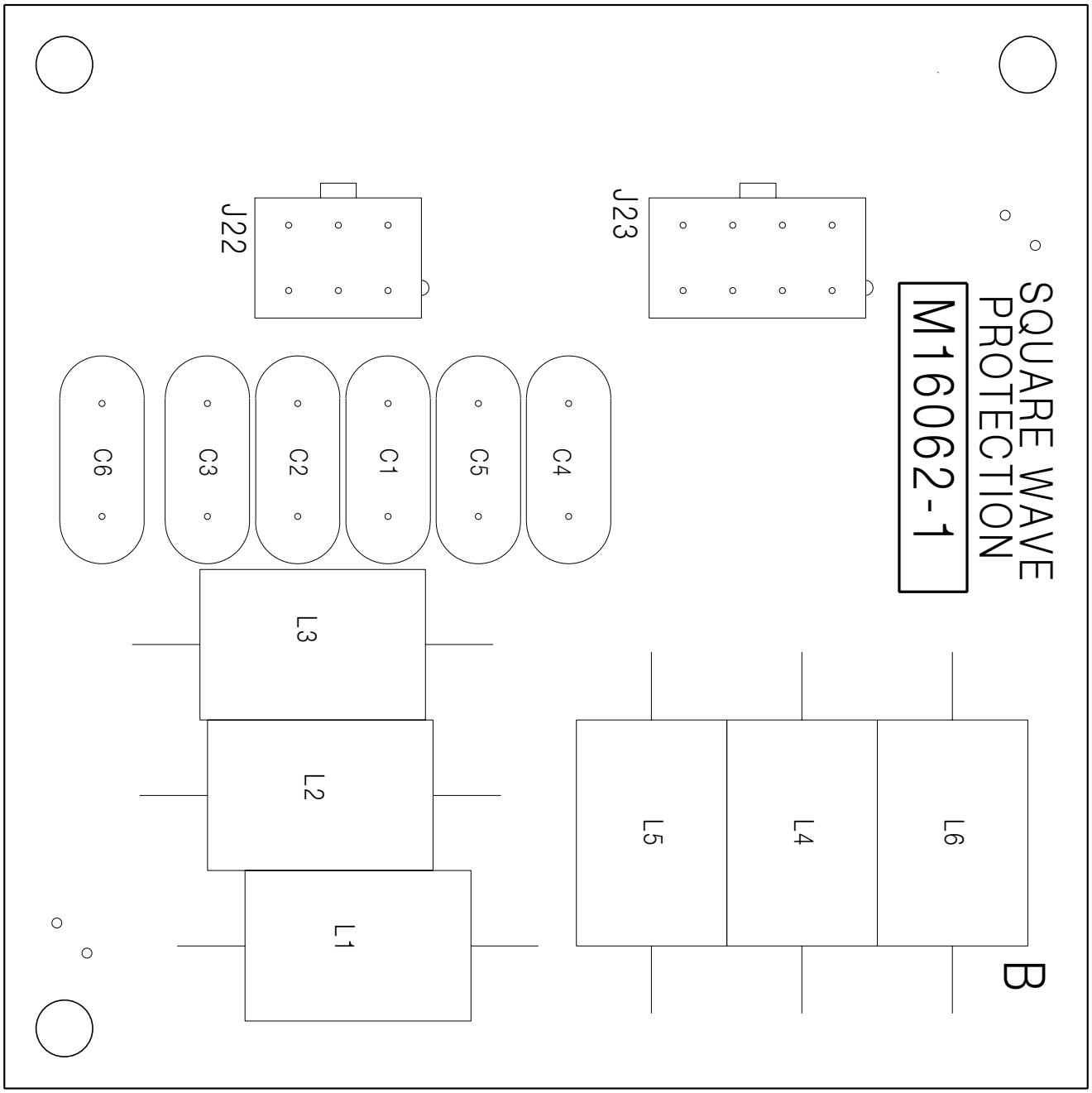
ELECTRICAL DIAGRAMS

M16062 SQUARE WAVE PROTECTION PC BOARD SCHEMATIC



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ELECTRICAL DIAGRAMS

M16062 SQUARE WAVE PROTECTION PC BOARD BILL OF MATERIALS

J22	CONNECTOR,MOLEX,MINI,PCB,6-PIN
J23	CONNECTOR,MOLEX,MINI,PCB,8-PIN
L1,L2,L3, L4,L5,L6	CHOKE-390UH,5%,225MA
C1,C2,C3, C4,C5,C6	CAPACITORCD,.0047,3000V,20%

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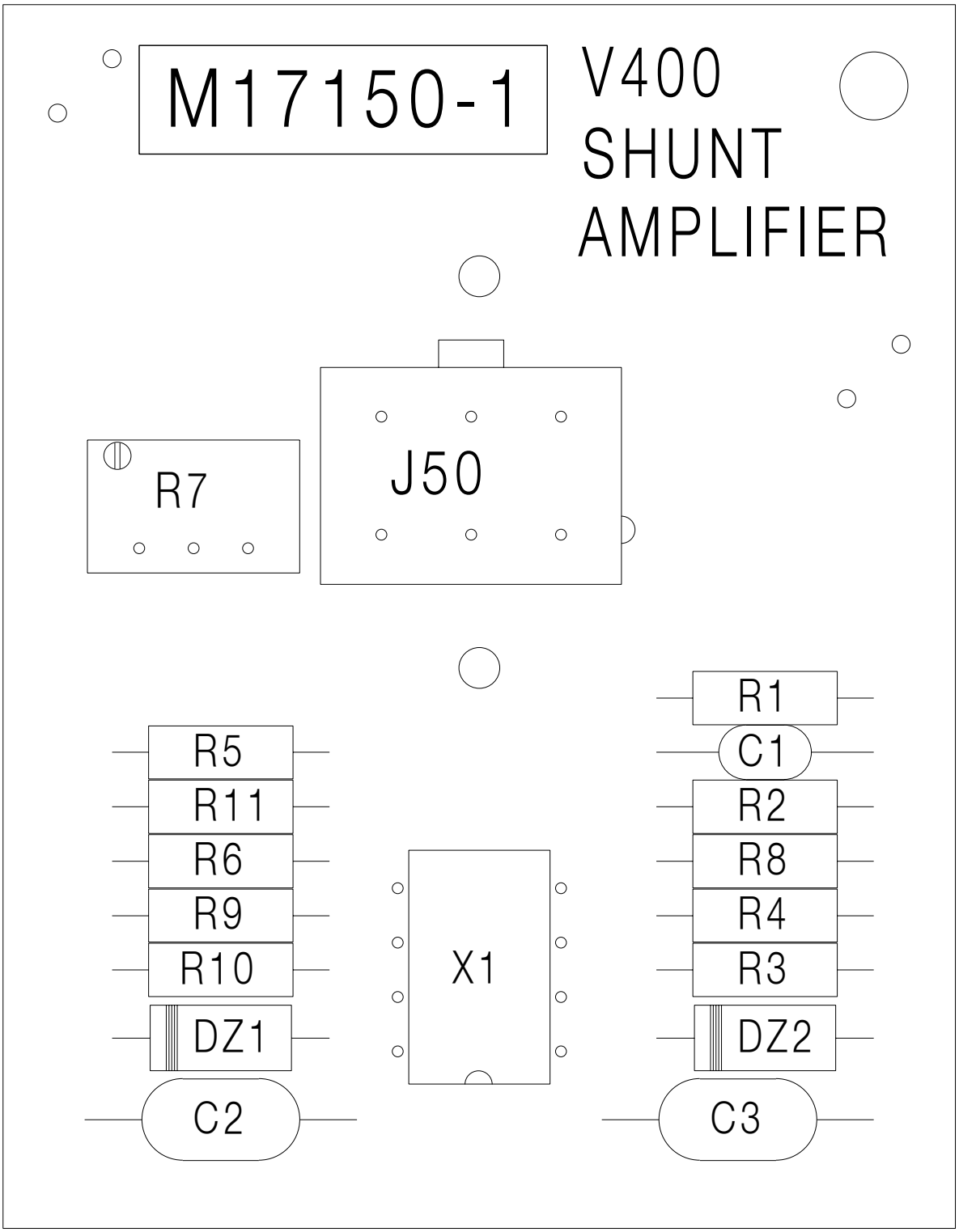
M17150 SHUNT PC BOARD SCHEMATIC



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ELECTRICAL DIAGRAMS

M17150 SHUNT PC BOARD BILL OF MATERIALS

R7	TRIMMER-MT,1/2W,500,10%,LINEAR
J50	CONNECTOR,MOLEX,MINI,PCB,6-PIN
X1	IC-OP-AMP,SINGLE,PRECISION,OP-27GZ
C2,C3	CAPACITOR-CEMO,0.1,50V,10%
DZ1,DZ2	ZENER DIODE-1W,15V,5%,1N4744A
R10,R11	RESISTOR-MF,1/4W,100,1%
R5,R8	RESISTOR-MF,1/4W,392K,1%
R2,R4	RESISTOR-MF,1/4W,4.75K,1%
C1	CAPACITOR-CEMO,.022,50V,20%
R9	RESISTOR-MF,1/4W,1.30K,1%
R1,R3	RESISTOR-MF,1/4W,511,1%
R6	RESISTOR-MF,1/4W,562,1%

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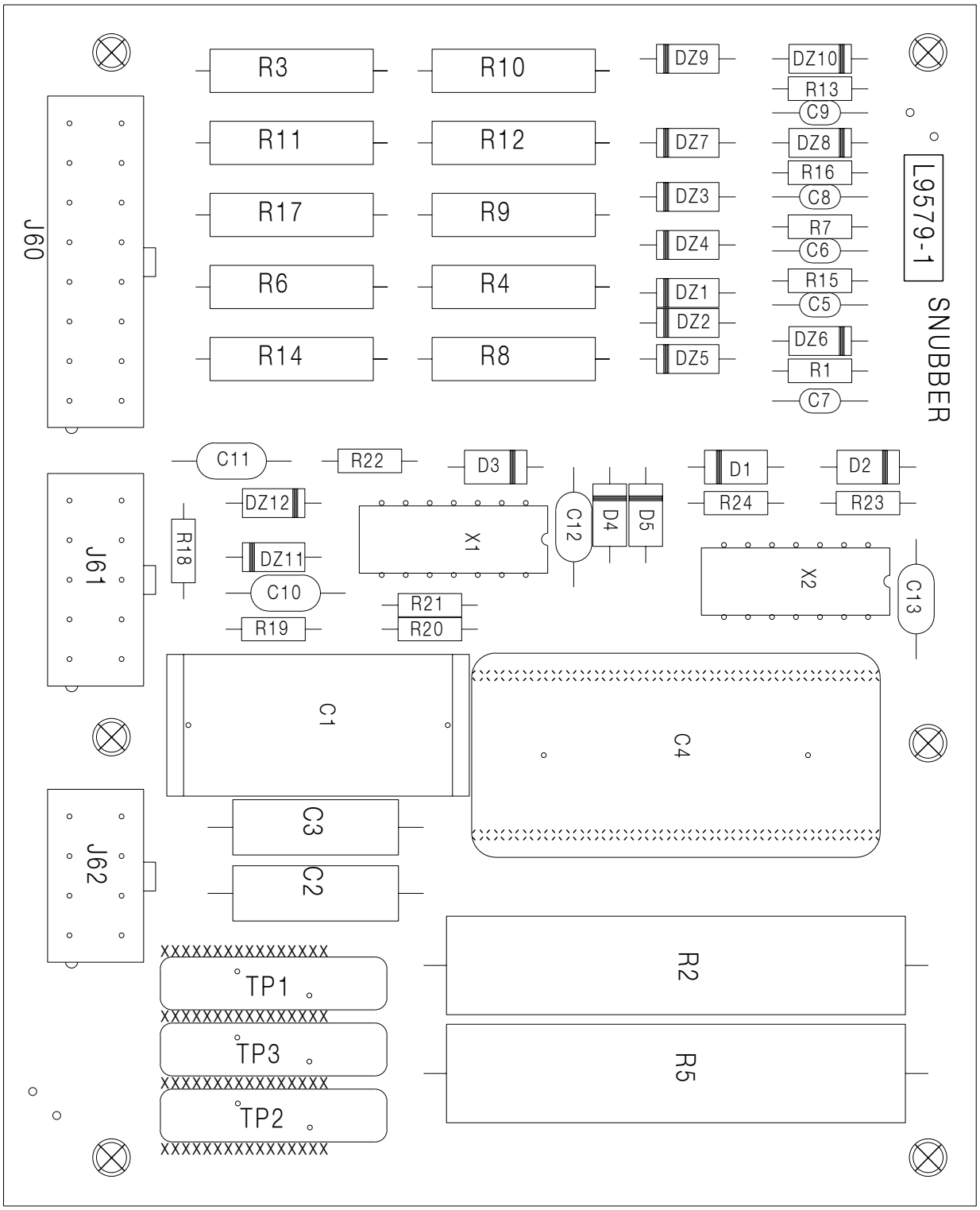
L9579 SNUBBER PC BOARD SCHEMATIC



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ELECTRICAL DIAGRAMS

L9579 SNUBBER PC BOARD BILL OF MATERIALS

C2,C3	CAPACITOR-PEF,.0047,400V,10%
J62	CONNECTOR,MOLEX,MINI,PCB,8-PIN
TP1,TP2,TP3	MOV-320VRMS,160J,20MM
R1,R7,R13, R15,R16, R20,R21 R22,R23,R24	RESISTOR-MF,1/4W,10.0K,1%
R3,R4,R6,R8, R9,R10,R11,R12 R14,R17	RESISTOR-MF,HV,0.5W,100K,5%
C5,C6,C7, C8,C9	CAPACITOR-CEMO,820P,50V,5%
C10,C11,C12,C13	CAPACITOR-CEMO,0.1,50V,10%
J61	CONNECTOR,MOLEX,MINI,PCB,10-PIN
J60	CONNECTOR,MOLEX,MINI,PCB,16-PIN
DZ11,DZ12	ZENER DIODE-1W,15V,5%,1N4744A
DZ1,DZ2,DZ3, DZ4,DZ5,DZ6 DZ7,DZ8,DZ9,DZ10	ZENER DIODE-1W,5.1V,5%,1N4733A
R18,R19	RESISTOR-MF,1/4W,100,1%
C1	CAPACITORPPMF,0.1,1000V,10%,BOX
X1,X2	IC-OP-AMP,QUAD,HIGH-PERF,33074A
D1,D2,D3,D4,D5	DIODE-AXLDS,1A,400V
R2,R5	RESISTOR-WW,10W,2.7,5%
C4	CAPACITOR-PPF,.047,1200V,5%

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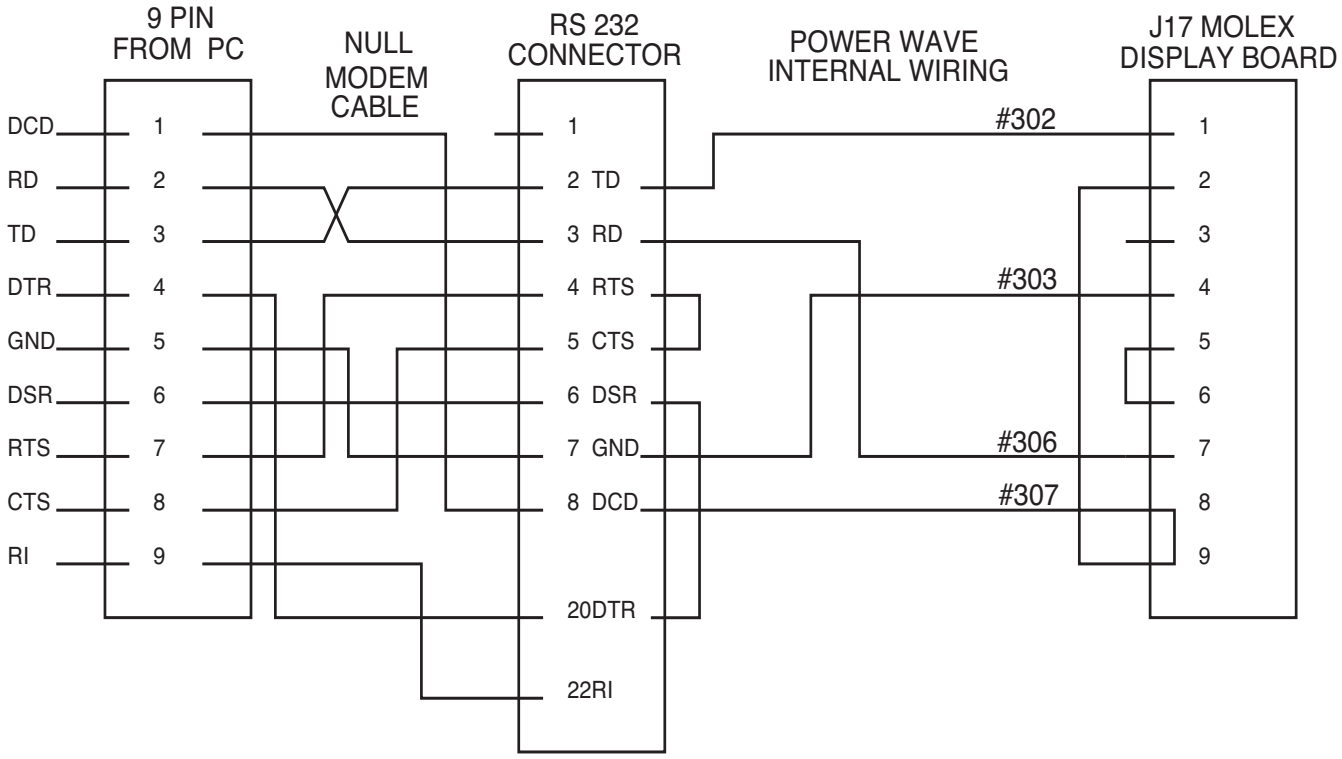
ELECTRICAL DIAGRAMS

POWER WAVE® RS 232 CONNECTIONS



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