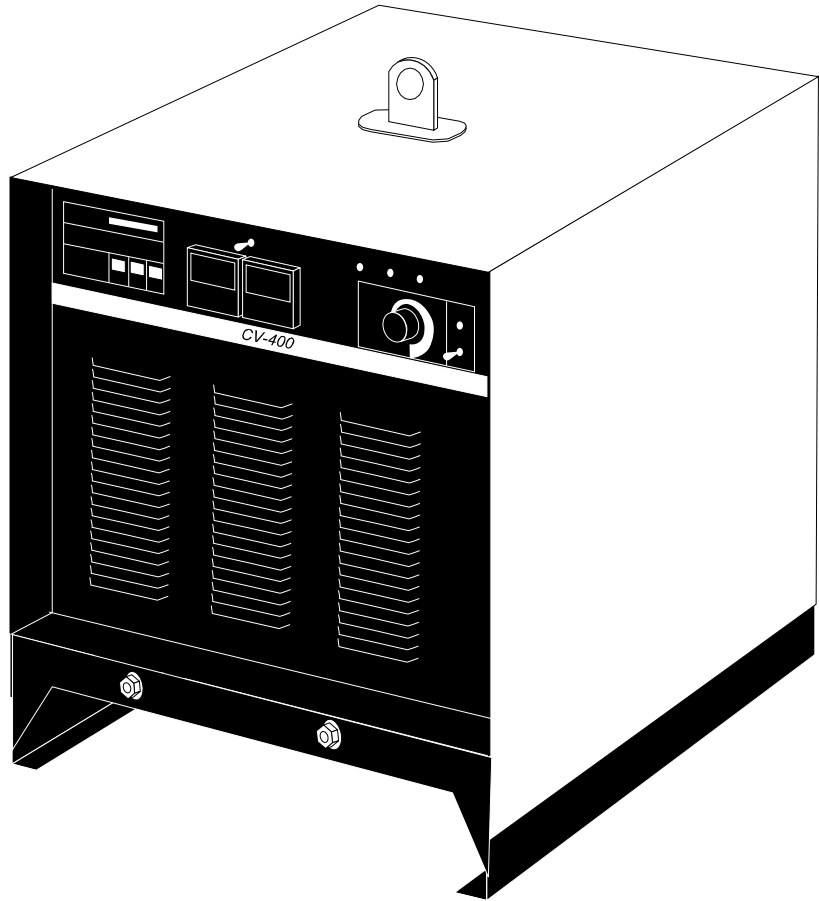


IDEALARC® CV-400

For Machines with Code Numbers 10084 thru 10087

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



World's Leader in Welding and Cutting Products

Premier Manufacturer of Industrial Motors

Sales and Service through subsidiaries and Distributors Worldwide
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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 Z87.1 standards.

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

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.



FUMES AND GASES can be dangerous.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values (TLV) using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

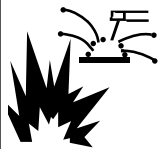
5.b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.d. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices. MSDS forms are available from your welding distributor or from the manufacturer.

5.e. Also see item 1.b.

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WELDING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area.

If this is not possible, cover them to prevent the welding sparks from starting a fire.

Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. 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.



CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.

- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



FOR ELECTRICALLY powered equipment.

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

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

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PRÉCAUTIONS DE SÛRETÉ

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

Sûreté Pour Soudage A L'Arc

1. Protégez-vous contre la secousse électrique:
 - a. Les circuits à l'électrode et à la pièce 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 vêtements mouillés. Porter des gants secs et sans trous pour isoler les mains.
 - b. Faire très attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher métallique ou des grilles métalliques, 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 de fonctionnement.
 - 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 précautions pour le porte-électrode s'appliquent 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 où 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 soleil, 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 latéraux 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 un endroit isolé de la masse. Un court-circuit accidentel peut provoquer un échauffement et un risque d'incendie.
8. S'assurer que la masse est connectée le plus près 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 chaînes de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'échauffement des chaînes et des câbles jusqu'à ce qu'ils se rompent.
9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particulièrement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumées 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 phosgène (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 châssis du poste conformément au code de l'électricité et aux recommandations du fabricant. Le dispositif de montage ou la pièce 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 faire des travaux à l'intérieur de poste, la débrancher à l'interrupteur à la boîte de fusibles.
4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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INSTALLATION

TECHNICAL SPECIFICATIONS - IDEALARC CV-400

INPUT - THREE PHASE ONLY				
<u>Standard Voltage</u> 230/460		<u>Input Current at Rated Output</u> 77A/39A @ 400A 36V		
RATED OUTPUT				
<u>Duty Cycle</u> 100% 60% 50%	<u>Welding Output</u> 400 450 500		<u>Volts at Rated Amps</u> 36* 38 40	
OUTPUT				
<u>Current Range</u> 60 - 500 Amps	<u>Voltage Range</u> 12 - 42 Volts	<u>Maximum Open Circuit Voltage</u> 46 VDC	<u>Auxiliary Power</u> 115 VAC, 10 Amps 42 VAC, 10 Amps	
RECOMMENDED INPUT WIRE AND FUSE SIZES				
<u>Input Voltage/ Frequency Volts/Hz</u> 230 460	<u>Input Amps Rating on Nameplate</u> 77 39	<u>Fuse (Super Lag) or Breaker Size</u> 125 60	<u>Type 75° C Copper Wire in Conduit AWG (IEC) Sizes</u> 3 (27 mm ²) 8 (8.4 mm ²)	<u>Type 75° C Copper Ground Wire in Conduit AWG (IEC) Sizes</u> 6 (13 mm ²) 10 (5.3 mm ²)
PHYSICAL DIMENSIONS				
<u>Height²</u> 27.5 in. (699 mm)	<u>Width</u> 22.2 in. (565 mm)	<u>Depth</u> 32.0 in. (813 mm)	<u>Weight</u> 357 lbs. (162 kg)	

* No added capacity over NEMA rated 36V at 400 amps.

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INSTALLATION

Read this entire installation section before you start installation.

SAFETY PRECAUTIONS



WARNING



ELECTRIC SHOCK can kill.

- Do not touch electrically live parts such as output terminals or internal wiring.
- Insulate yourself from the work and ground.
- Turn power switch off before connecting or disconnecting cables or connections.
- Always connect grounding terminal to a proper electrical earth ground.

Only qualified personnel should install, use, or service this equipment.

LOCATION AND VENTILATION

Place the IDEALARC CV-400 where clean, cooling air can flow freely in through the front louvers and out through the rear louvers. Keep dust, dirt, and other foreign materials that can be drawn into the machine to a minimum. Failure to observe these precautions can lead to excessive operating temperatures and nuisance shut-downs.

THE CV-400 carries an IP-21 environmental rating. Locate indoors or shelter from falling water such as rain.

LIFTING



WARNING

FALLING EQUIPMENT can cause injury.



- Do not lift this machine using the lift hook if it is equipped with a heavy accessory such as a trailer or a gas cylinder.
- Lift only with equipment of adequate lifting capacity.
- Be sure the machine is stable when lifting.
- Do not stack more than three high.
- Do not stack the CV-400 on top of any other machine.

The IDEALARC CV-400 weighs 357 pounds (162 kilograms). A permanent lift hook is located at the top of the machine, positioned at the center of gravity for stable lifting.

STACKING

IDEALARC CV-400s may be stacked three high. The bottom machine must be on a stable, hard, level surface capable of supporting the weight of up to three machines (1071 pounds/486 kilograms). Be sure that the two holes in the top front corners of the bottom machine line up with the holes in the base rails of the machine above. Fasten the machines together with 5/16" bolts, lockwashers, and nuts through these holes. The lift hook is positioned so that it fits without interference under the base of the second machine.

TILTING

Place the machine on a secure, level surface. Any surfaces you place it on other than the ground must be firm, non-skid, and structurally sound.

ELECTRICAL INPUT CONNECTIONS

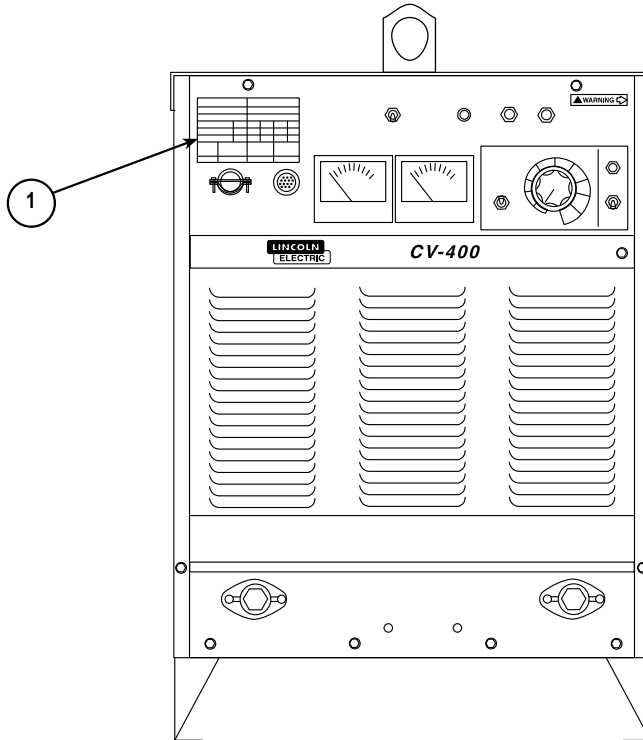
Be sure the voltage, phase, and frequency of the input power is as specified on the rating plate, located on the case front control panel. See *Figure A.1*.

Input supply line entry is through a hole in the case rear top panel. A removable door covers the input connection box, which contains the input contactor (CR1) and reconnect panel assembly for multiple voltage connection. Input power is connected to the three line terminals on the input contactor. See *Figure A.2*.

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FIGURE A.1
RATING PLATE LOCATION



1. RATING PLATE

GROUND CONNECTION

The frame of the welder must be grounded. An earth grounding lead must be connected to the grounding terminal, marked on the input box floor with the symbol r (See *Figure A.2*). Refer to *Technical Specifications* page for proper ground wire size.

INPUT SUPPLY CONNECTIONS

Be sure the voltage, phase, and frequency of the input power is the same as specified on the rating plate.



WARNING

ELECTRIC SHOCK can kill.



- Have a qualified electrician install and service this equipment.
- Turn the input power off at the fuse box before working on this equipment.

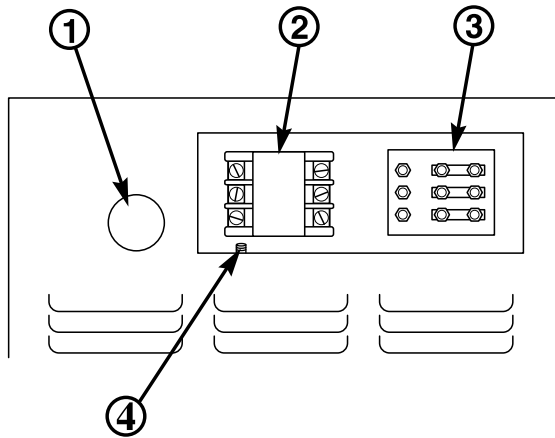
- Do not touch electrically hot parts.

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INSTALLATION

**FIGURE A.2
REAR PANEL**



1. INPUT SUPPLY LINE ENTRY HOLE
2. INPUT CONTACTOR CR1
3. RECONNECT PANEL/JUMPER LINKS
4. GROUND TERMINAL

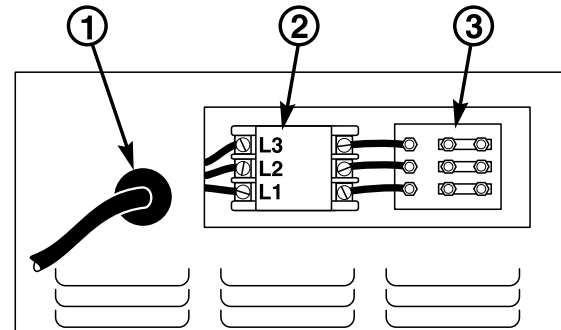
Have a qualified electrician connect the input power leads to the L1, L2, and L3 terminals of the input contactor. Follow all national and local electrical codes. Use a three-phase line. Install the reconnect panel jumper links (see Figure A.3) for the proper input voltage. See the connection diagram located on the inside cover of the access panel cover. Also refer to **Reconnect Procedure** later in this section.

INPUT WIRE AND FUSE SIZE

Fuse the input circuit with the super lag fuse recommended in the **Technical Specifications** at the beginning of this section or use delay type¹ circuit breakers. Choose an input and grounding wire size according to local or national codes; also see the **Technical Specifications**. Using fuses or circuit breakers smaller than recommended may result in "nuisance" shut-offs from welder inrush currents, even if you are not welding at high output currents.

¹ Also called "inverse time" or "thermal/magnetic" circuit breakers. These circuit breakers trip faster as the magnitude of the fault current increases.

**FIGURE A.3
INPUT POWER SUPPLY CONNECTIONS**



1. INPUT SUPPLY LINE
2. INPUT CONTACTOR
3. RECONNECT PANEL/JUMPER LINKS

INSTALLATION

RECONNECT PROCEDURE

Multiple input voltage welders are shipped from the factory connected for the highest voltage listed on the machine's rating plate. Before installing the welder, be sure the reconnect panel is connected for the proper voltage.

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

To reconnect a multiple voltage machine to a different voltage, remove input power and change the position of the jumper links on the reconnect panel. Follow the input connection diagram, located on the inside access panel cover, appropriate for your machine's input voltage. This same connection diagram is shown in Figure A.4 below.

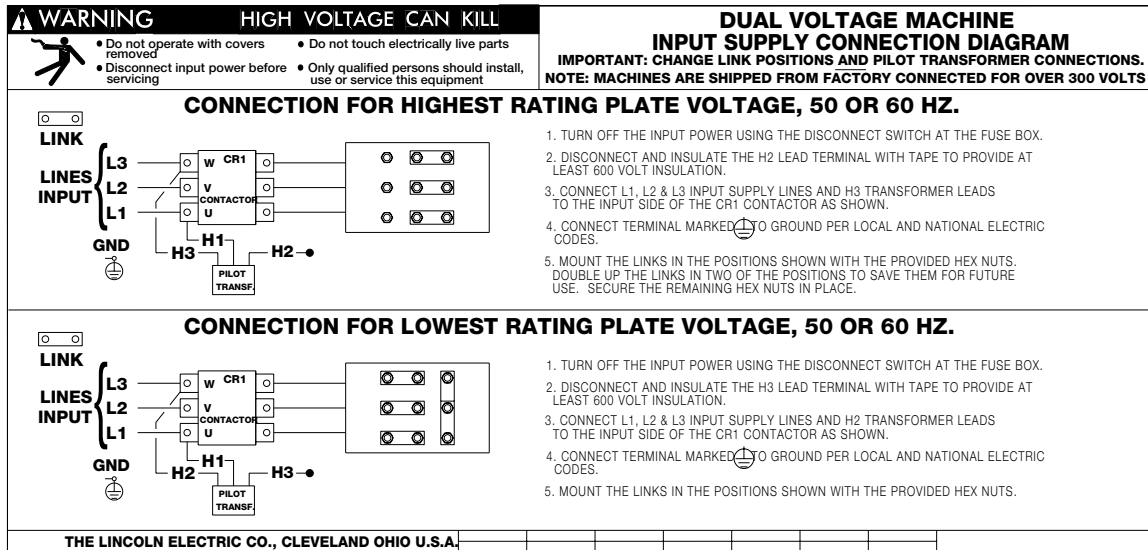
OUTPUT CONNECTIONS

CONNECT ELECTRODE AND WORK LEADS TO OUTPUT TERMINALS

The output (welding) cables are connected to the output terminals marked "+" and "-". These 1/2" terminals are located at the lower right and lower left corners of the front panel. See **Figure A.5**.

See **Table A.1** for recommended cable sizes for combined lengths of electrode and work cables.

FIGURE A.4
INPUT CONNECTION DIAGRAM FOR 230/460 VOLTS AC, 50/60 HZ



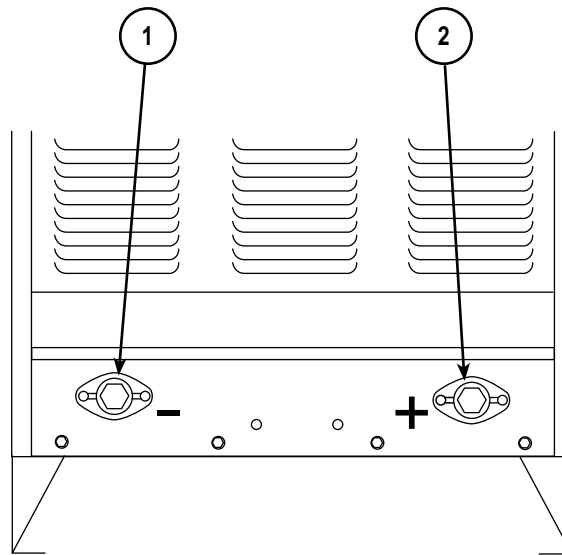
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INSTALLATION

**FIGURE A.5
OUTPUT TERMINAL CONNECTIONS**



1. NEGATIVE (-) WELDING CABLE CONNECTION
2. POSITIVE (+) WELDING CABLE CONNECTION

**TABLE A.1 - CABLE SIZES FOR COMBINED LENGTH
OF ELECTRODE AND WORK CABLE**

CABLE LENGTHS	MACHINE LOAD	
	400A (100% DUTY CYCLE)	500A (50% DUTY CYCLE)
UP TO 50 ft (15 m)	3/0 85 mm ²	2/0 67 mm ²
50 to 100 ft (15 to 30 m)	3/0 85 mm ²	2/0 67 mm ²
100 to 150 ft (30 to 46 m)	3/0 85 mm ²	3/0 85 mm ²
150 to 200 ft (46 to 61 m)	3/0 85 mm ²	3/0 85 mm ²
200 to 250 ft (67 to 76 m)	4/0 107 mm ²	4/0 107 mm ²

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INSTALLATION

CONNECT WIRE FEEDERS

The wire feeder control cable can connect to the CV-400 at the 14-pin amphenol on the front of the machine (with the appropriate adapter cable) or the terminal strips behind the hinged control panel cover. A strain relief box connector is provided for cable access to the terminal strips. The wire feeder grounding wire connects to a chassis ground screw provided near the terminal strips and marked with the ground symbol ⏏ . See the **Accessories** section of this manual for specific instructions for connecting the following automatic and semiautomatic wire feeders to the CV-400:

Automatic Wire Feeders: NA-3, NA-5, NA-5R.

Semiautomatic Wire Feeders: LN-7, LN-7 GMA, LN-8, LN-9, LN-9 GMA, LN-22, LN-23P, LN-25, LN-742.

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IDEALARC CV-400



OPERATION

OPERATING INSTRUCTIONS

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

SAFETY INSTRUCTIONS

WARNING



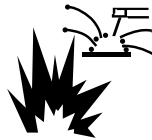
ELECTRIC SHOCK can kill.

- 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.

IDEALARC CV-400



OPERATION

GENERAL DESCRIPTION

The IDEALARC CV-400 is an SCR controlled three-phase input, DC output power source for welding. It uses a single range potentiometer control. The welder's unique combination of transformer, three phase hybrid rectifier, capacitor bank, output choke, and solid state control system deliver outstanding performance.

RECOMMENDED PROCESSES

The IDEALARC CV-400 is a constant voltage power source only. It is recommended for all open arc processes including Innershield and all solid wire and gas procedures within its capacity of 60 to 500 amps.

The CV-400 can be connected to wire feeding equipment, including:

- Automatic wire feeders NA-3, NA-5, and NA-5R. (Requires the CV-400 Diode Kit option to use the cold start and cold electrode sensing features of these feeders.)
- Semiautomatic wire feeders LN-7, LN-7 GMA, LN8, LN-9, LN-9 GMA, LN-22, LN23P, LN-25, and LN-742.

OPERATIONAL FEATURES AND CONTROLS

The following operational controls are standard on the IDEALARC CV-400:

- Power Source Pilot Light
- ON/OFF Power Toggle Switch
- Output Control Potentiometer
- Output Control Switch (with Local or Remote positions)
- Auxiliary Power Connections for Wire Feeder and Other Equipment (115V and 42V)
- Thermal Protection Indicator Light
- Voltmeter "+" Electrode or "-" Electrode Switch

DESIGN FEATURES

- Input line voltage compensation keeps output constant for fluctuations of $\pm 10\%$.
- SCR control.
- Hinged front control panel provides easy access to printed circuit boards and other control circuitry.
- Fully enclosed fan motor with permanently lubricated, sealed ball bearings needs no maintenance.
- Fully recessed control panel protects controls and minimizes accidental contact.
- Recessed output terminals reduce chance of accidental contact.
- Low profile case permits installation under a workbench.
- Removable rear access panel provides easy access to input contactor and input lead connections.
- Removable case sides provide easy access for service or inspection, even when machines are stacked.
- Double-dipped transformer, SCR bridge, and choke resist corrosion.

IDEALARC CV-400



OPERATION

WELDING CAPABILITY

The CV-400 has the following duty cycle ratings. If the duty cycle is exceeded, a thermal protector will shut off the machine output until it cools to normal operating temperature. The amber thermal protection indicator light will turn on until the machine cools.

Duty Cycle*	Amps	Volts
100%	400	36
60%	450	38
50%	500	40

*Based on a 10 minute time period. For example, a 60% duty cycle means 6 minutes on and 4 minutes off.

LIMITATIONS

The IDEALARC CV-400 has no provisions for paralleling. It should not be used outdoors without rain sheltering.

IDEALARC CV-400

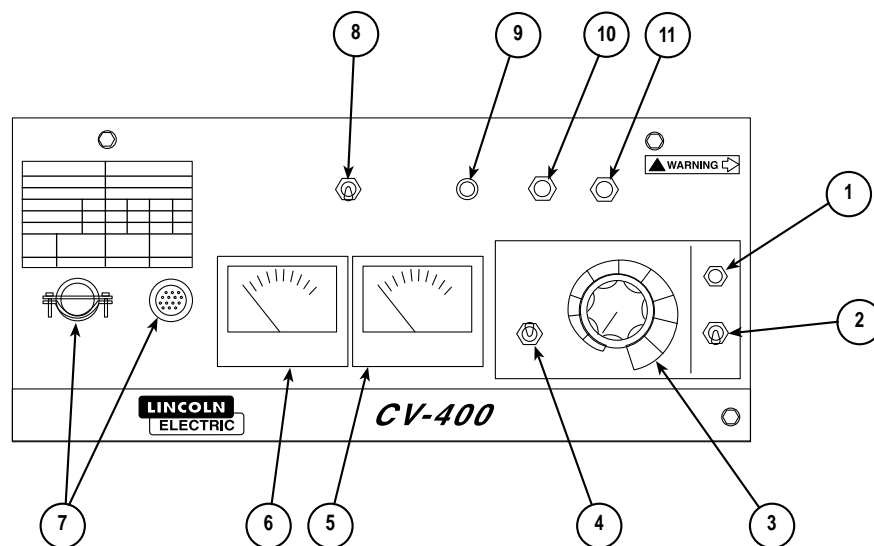


OPERATION

CONTROLS AND SETTINGS

All operator controls and settings are located on the case front assembly. See Figure B.1 for their locations.

FIGURE B.1 – CASE FRONT CONTROLS



1. POWER SOURCE PILOT LIGHT
2. ON/OFF POWER TOGGLE SWITCH
3. OUTPUT CONTROL POTENTIOMETER
4. OUTPUT CONTROL SWITCH (WITH LOCAL OR REMOTE POSITIONS)
5. DC VOLTMETER
6. DC AMMETER
7. AUXILIARY POWER CONNECTIONS FOR WIRE FEEDER AND OTHER EQUIPMENT (115V AND 42V)
8. VOLTMETER "+" ELECTRODE OR "-" ELECTRODE SWITCH
9. THERMAL PROTECTION INDICATOR LIGHT

1. **POWER SOURCE PILOT LIGHT:** This light indicates that the power source input contactor is energized (closed). This also means that the main power transformer and all auxiliary control transformers are energized.
2. **ON/OFF POWER TOGGLE SWITCH:** Energizes or deenergizes the input contactor. The switch turns the machine ON or OFF. Position "I" is ON; position "O" is OFF.
3. **OUTPUT CONTROL POTENTIOMETER:** Controls output voltage.
4. **OUTPUT CONTROL SWITCH (WITH LOCAL OR REMOTE POSITIONS):** Selects the mode of control. In the "Local" position, control is by the machine control panel. In the "Remote" position, control is by either a wire feeder unit or through an optional remote control device.
5. **DC VOLTMETER (OPTIONAL):** Displays actual output voltage.
6. **DC AMMETER (OPTIONAL):** Displays actual output current.
7. **AUXILIARY POWER AND REMOTE CONTROL CONNECTIONS FOR WIRE FEEDER AND OTHER EQUIPMENT (115V AND 42V):** The 14-pin amphenol receptacle provides either 115 or 42 VAC as well as remote control connections. Terminal strips with screw connections are located behind the hinged control panel for hard wired control. A strain relief connector is provided for cable entry. The 42 VAC auxiliary is not available at the terminal strip.
8. **VOLTMETER "+" ELECTRODE OR "-" ELECTRODE SWITCH:** Selects the electrode polarity for the remote work sensing lead (#21) when using automatic or semiautomatic wire feeders. It must agree with the actual electrode polarity chosen and with the wire feeder polarity switch on the feeder.
9. **THERMAL PROTECTON INDICATOR LIGHT:** This light indicates that either of the two protective thermostats has opened. Welding output is disabled but input power is still applied.
10. **42 VAC AUXILIARY CIRCUIT BREAKER:** This 10 amp breaker protects the 42 VAC auxiliary circuit.
11. **115 VAC AUXILIARY CIRCUIT BREAKER:** This 10 amp breaker protects the 115 VAC auxiliary circuit.

IDEALARC CV-400



OPERATION

WELDING OPERATION

LOCAL CONTROL

The following procedures are for using the CV-400 in the local control mode of operation. For remote control of the machine, see the Remote Control section.

Before operating the machine, make sure you have all materials needed to complete the job. Be sure you are familiar with and have taken all possible safety precautions before starting work. It is important that you follow these operating steps each time you use the machine.

1. Turn on the main AC input power to the machine.
 2. Set the VOLTMETER "+" or "-" switch to the appropriate position.
- Set toggle to "Electrode Negative" position if the electrode is connected to the negative (-) output terminal.
 - Set toggle to "Electrode Positive" position if the electrode is connected to the positive (+) output terminal.

3. Set the OUTPUT CONTROL switch to "Local." (Exception: when using an LN-9, LN-9 GMA, or NA-5 wire feeder, set the switch to "Remote." Otherwise, the wire feeder may automatically shut down.)
4. Set the ON/OFF switch to the ON position (I). The power source pilot light glows and the fan starts.
5. Set the OUTPUT CONTROL Potentiometer to the desired voltage.
6. Make the weld.

REMOTE CONTROL

The toggle switch on the control panel labeled "Output Control Remote" gives you the option of controlling the machine output from a remote location. In the "Remote" position a wire feeder with remote control capabilities or a remote control device such as a K775 must be connected to the CV-400. See the **Accessories** section for wire feeder installation information.

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OPERATION

OVERLOAD PROTECTION

The power source is thermostatically protected with proximity thermostats against overload or insufficient cooling. One thermostat is located on the nose of the center bottom primary coil and a second thermostat is attached to the lead connecting the secondaries. Both thermostats are connected in series with 2-4 circuit. If the machine is overloaded, the primary thermostat will open, the output will be zero, the amber thermal protection light will be on and the fan will continue to run. The secondary thermostat will open either with an excessive overload or insufficient cooling. The output will be zero, the amber protection light will be on and the fan will continue to run. When the thermostats reset, the protection light will be off.

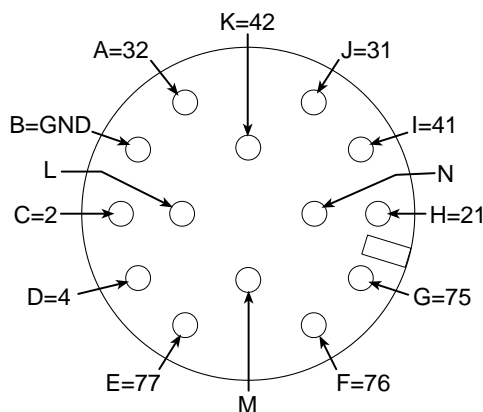
The power source is also protected against overloads on the SCR bridge assembly through the solid state fault protection circuit. This circuit senses an overload on the power source and limits the output to approximately 550 amps by phasing back the SCR's.

Protection is provided to protect the circuitry from accidental grounds. If leads 75, 76, or 77 are accidentally "grounded" to the positive output lead, the output will be reduced to a low value, thus preventing any damage to the machine. If the ground occurs between 75, 76, 77 and the negative output lead, one of the PC board electronic "self-restoring" fuses will blow, preventing any machine damage. After the ground is cleared, the fuses automatically reset within a few seconds.

AUXILIARY POWER

On machines above code 9400, the IDEALARC CV-400 can provide nominally 115 volts AC and 42 volts AC auxiliary power for operating wire feeding equipment and other accessories. This power is available at the 14-pin amphenol on the control panel and/or at the terminal strip behind the hinged control panel on the case front. On the amphenol, 115 volts AC is available at pins A and J (Domestic and Export models only); 42 volts AC is available at pins I and K. On the terminal strip, 115 volts AC is available at terminals 31 and 32; 42 volts AC is not available at the terminal strip. The two circuits, 115 volts AC and 42 volts AC, are isolated; and each is protected by a 10 amp circuit breaker.

FRONT VIEW OF 14-PIN CONNECTOR RECEPTACLE



PIN	LEAD NO.	FUNCTION
A	32	115 VAC
B	GND	Chassis Connection
C	2	Trigger Circuit
D	4	Trigger Circuit
E	77	Output Control
F	76	Output Control
G	75	Output Control
H	21	Work Connection
I	41	42 VAC
J	31	115 VAC
K	42	42 VAC
L	---	---
M	---	---
N	---	---

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IDEALARC CV-400



ACCESSORIES

OPTIONS/ACCESSORIES

The following options/accessories are available for your CV-400 from your local Lincoln Electric Distributor.

FACTORY INSTALLED OPTIONS

Diode Option - This internally installed option allows use of the cold start and cold electrode sensing features of the NA-3, NA-5, or NA-5R automatic wire feeders. See the topic **Connecting the NA-3 [NA-5] to the CV-400**.

Ammeter and Voltmeter - Display output current and voltage when welding.

FIELD INSTALLED OPTIONS

The following options/accessories are available from your local Lincoln Distributor.

Undercarriage (K817P) - Includes a platform and polyolefin wheels for easily moving the welder.

Undercarriage (K841) - Includes a platform, wheels, and brackets for supporting the welder and two gas cylinders.

Remote Output Control (K775 or K857 with K864 Adapter Plug) - The K857 has a 6-pin MS-style connector. The K857 requires a K864 adapter cable which connects to the 14-pin connector on the CV-400.

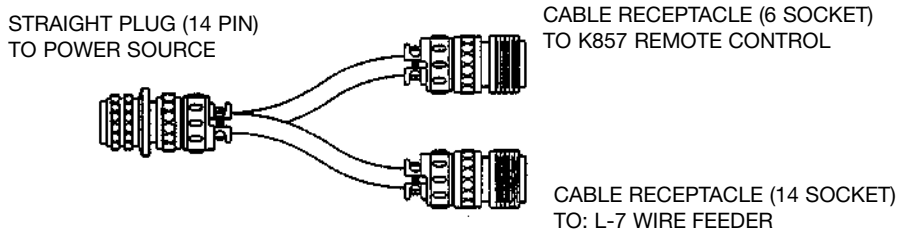
The K775 consists of a control box with 28 ft (8.5m) of four conductor cable. This connects to terminals 75, 76, and 77 on the terminal strip and the case grounding screw marked with the symbol \overline{TT} on the machine. These terminals are located behind the control panel on the front. These devices will give the same control as the output control on the machine.

Remote Control Adapter Cable (K864) - A "V" cable 12 inches (.30 m) long to connect a K857 Remote Control with a wire-feeder control cable (14-pin connector) and the machine (14-pin connector). If a remote control is used alone, the wire-feeder connection is not used. See Figure C.1.

Capacitor Discharge Circuit (K828-1) - Mounts inside the CV-400. Recommended when:

- CV-400 is used in conjunction with any LN-23P or older LN-8 or LN-9 semiautomatic wire-feeder. Eliminates possible arc flash re-start of weld when trigger interlock is used. Not required with current LN-8 (above Code 8700), or LN-9s with serial numbers above 115187 (manufactured after 12/83), or any LN-9 having an L6043-1 Power PC Board.
- CV-400 is used with an LN-22 equipped with an older K279 Contactor-Voltage Control Option. Eliminates electrode overrun when gun trigger is released. Not required when later K279 (above Code 8800) is used.
- A small spark is objectionable if electrode touches work just after the trigger is released.

FIGURE C.1
REMOTE CONTROL ADAPTER CABLE (K864)



IDEALARC CV-400



ACCESSORIES

CONNECTION OF LINCOLN ELECTRIC AUTOMATIC OR SEMIAUTOMATIC WIRE FEEDERS

⚠ 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.
 - Insulate yourself from work and ground.
 - Always wear dry insulating gloves.

Auxiliary power for wire feeder operation is available at both a 14-pin amphenol and at terminal strips with screw-type connections located behind the hinged control panel on the front of the machine. The 14-pin amphenol can provide both 115 VAC (pins A and J) and 42 VAC (pins I and K). The terminal strip provides only 115 VAC (terminals 31 and 32). The two circuits are isolated, and each is protected by a 10A circuit breaker.

NOTE: When using a CV-400 with wire feeders, there may be a small spark if the electrode contacts the work or ground within a few seconds after releasing the trigger. With some wire feeders, when the electrical interlock is in the ON position the arc can restart if the electrode touches the work or ground during these few seconds. Refer to K828-1 capacitor discharge circuit earlier in this section.

The following descriptions show how to connect the wire feeders using the terminal strip.

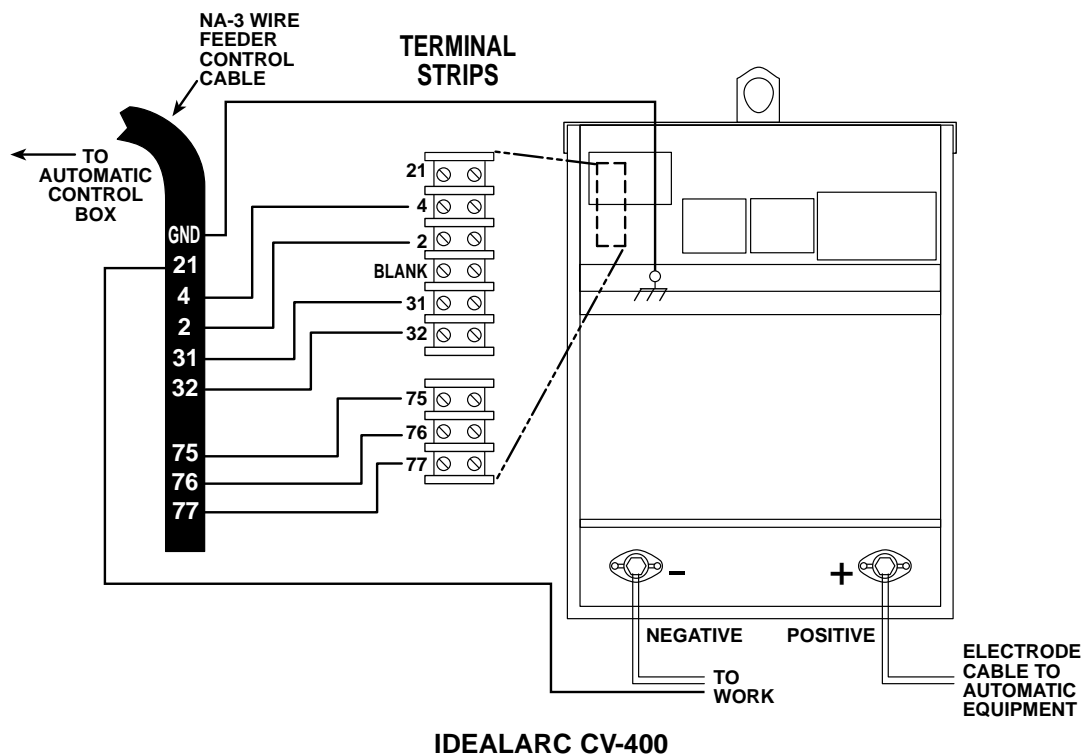
AUTOMATIC WIRE FEEDERS

CONNECTING THE NA-3 TO THE IDEALARC CV-400

1. Set the CV-400 POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-400.
3. Connect the wire feeder control cable leads to the CV-400 terminal strip as shown in Figure C.2.
4. Connect the wire feeder control cable ground lead to the frame terminal marked **TT**.

NOTE: The CV-400 must be properly grounded.

FIGURE C.2
NA-3 WIRE FEEDER CONNECTION TO THE IDEALARC CV-400



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ACCESSORIES

5. Extend wire feeder control cable lead #21 so it can be connected directly to the work piece.
 - a. Make a bolted connection using AWG #14 or larger insulated wire. Tape the bolted connection with insulating tape.
 - b. An S-16586- X remote voltage sensing work lead is available for this purpose.
 - c. Keep the #21 lead electrically separate from the work cable circuit and connection.
 - d. Tape the #21 lead to the work cable for ease of use.

NOTE: The connection diagram shown in **Figure C.2** shows the electrode connected for positive polarity. To change polarity:

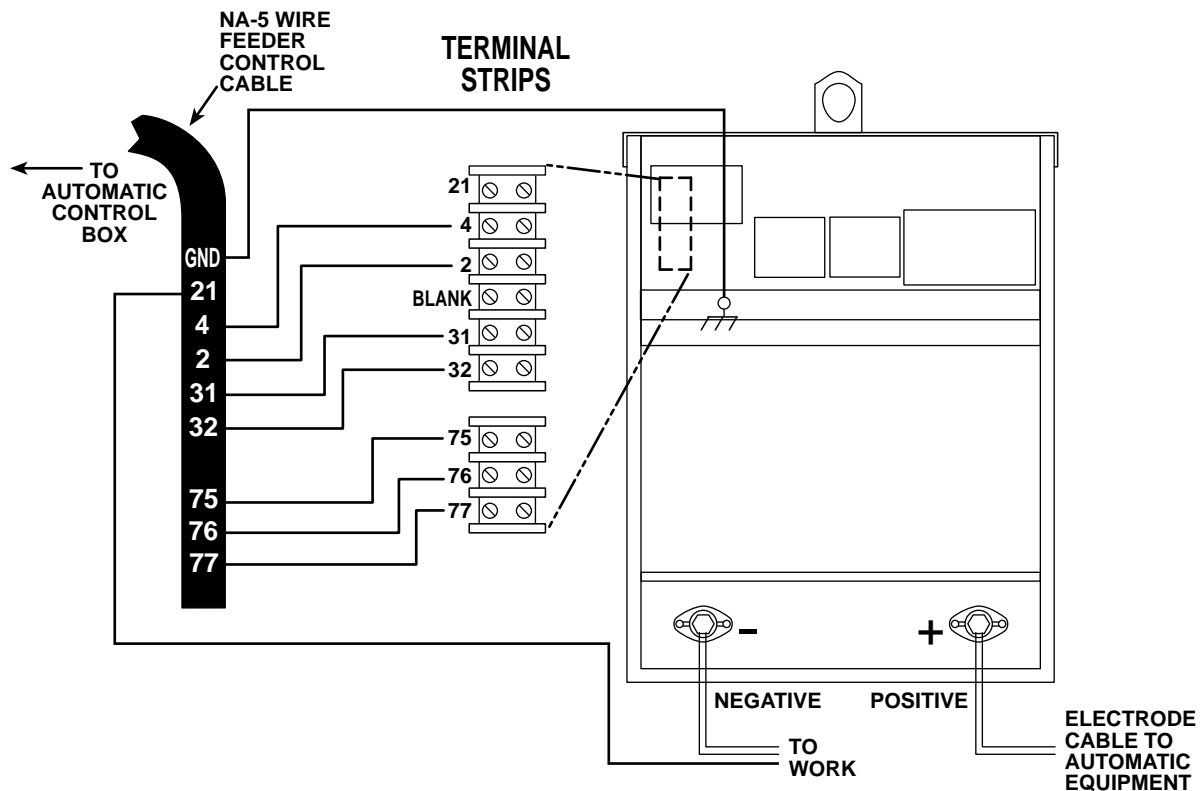
- a. Set the CV-400 POWER toggle switch to the OFF (0) position.
- b. Move the electrode cable to the negative (-) output terminal.
- c. Move the work cable to the positive (+) output terminal.
- d. Set the VOLTMETER toggle switch to negative.

CONNECTING THE NA-5 TO THE IDEALARC CV-400

1. Set the CV-400 POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-400.
3. Connect the wire feeder control cable leads to the CV-400 terminal strip as shown in Figure C.3.
4. Connect the wire feeder control cable ground lead to the frame terminal marked **77**.

NOTE: The CV-400 must be properly grounded.

FIGURE C.3
NA-5 WIRE FEEDER CONNECTION TO THE CV-400



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LINCOLN
ELECTRIC

ACCESSORIES

5. Extend wire feeder control cable lead #21 so it can be connected directly to the work piece.
 - a. Make a bolted connection using AWG #14 or larger insulated wire. Tape the bolted connection with insulating tape.
 - b. An S-16586- X remote voltage sensing work lead is available for this purpose.
 - c. Keep the #21 lead electrically separate from the work cable circuit and connection.
 - d. Tape the #21 lead to the work cable for ease of use.
6. Connect NA-5 wire feeder control jumpers on Voltage Control Board. See the NA-5 operator's manual.

NOTE: For proper NA-5 operation, the electrode cables must be secured under the clamp bar on the left side of the NA-5 Control Box.

NOTE: The connection diagram shown in **Figure C.3** shows the electrode connected for positive polarity. To change polarity:

- a. Set the CV-400 POWER toggle switch to the OFF (0) position.
- b. Move the electrode cable to the negative (-) output terminal.
- c. Move the work cable to the positive (+) output terminal.
- d. Set the VOLTMETER toggle switch to negative (-).
- e. See **NA-5** manual for changing welding polarity.

ACCESSORIES

SEMI-AUTOMATIC WIRE FEEDERS

CONNECTING THE LN-7 TO THE IDEALARC CV-400 (TERMINAL STRIP)

1. Set the CV-400 POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-400.
3. Connect the wire feeder control cable leads to the CV-400 terminal strip as shown in Figure C.4.
4. Connect the wire feeder control cable ground lead to the frame terminal marked /// .

NOTE: The CV-400 must be properly grounded.

5. PERFORM THIS STEP ONLY IF THE LN-7 IS EQUIPPED WITH A METER KIT.

NOTE: If the work cable length is less than 25 feet and the connections to the work piece are secure, then wire feeder control cable lead #21 can be connected directly to the CV-400 terminal strip.

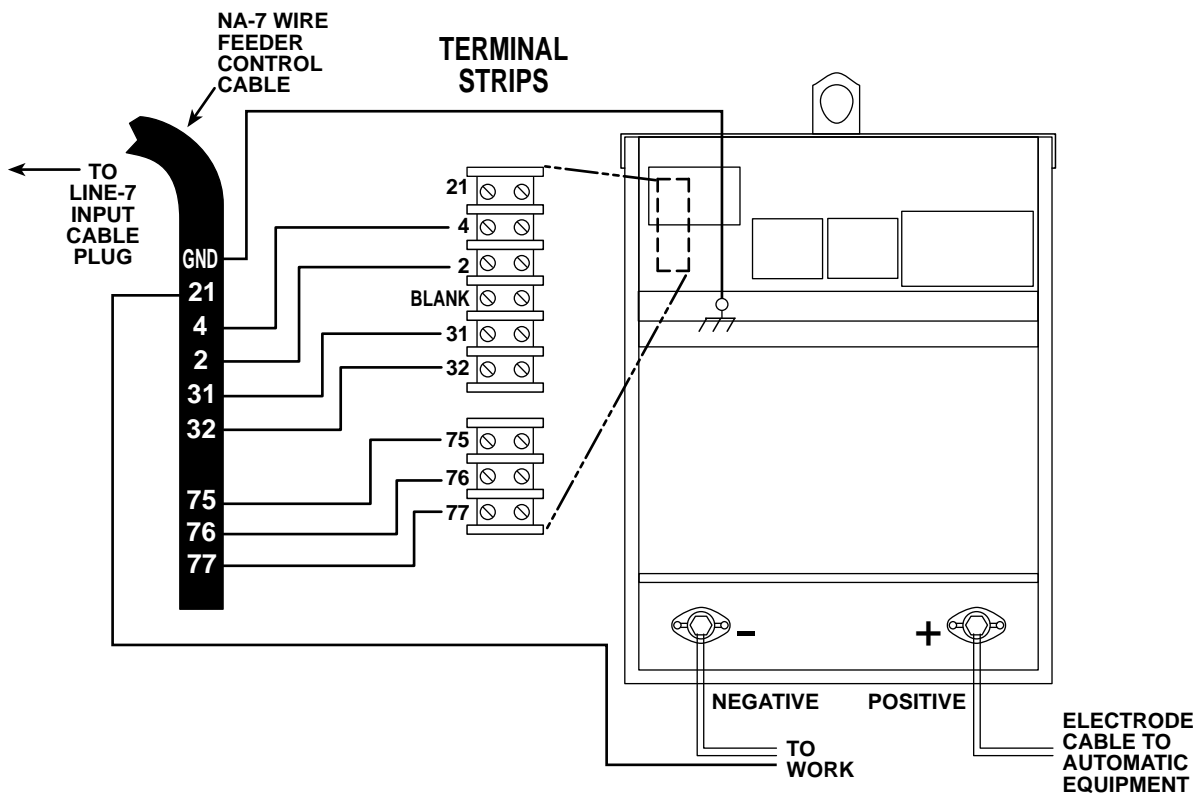
Extend wire feeder control cable lead #21 so it can be connected directly to the work piece.

- a. Make a bolted connection using AWG #14 or larger insulated wire. Tape the bolted connection with insulating tape.
 - b. An S-16586- X remote voltage sensing work lead is available for this purpose.
 - c. Keep the #21 lead electrically separate from the work cable circuit and connection.
 - d. Tape the #21 lead to the work cable for ease of use.
6. Set voltmeter toggle switch to match electrode polarity.

NOTE: The connection diagram shown in Figure C-4 shows the electrode connected for positive polarity. To change polarity:

- a. Set the CV-400 POWER toggle switch to the OFF (0) position
- b. Move the electrode cable to the negative (-) output terminal.
- c. Move the work cable to the positive (+) output terminal.
- d. Set the VOLTMETER toggle switch to negative (-).

FIGURE C.4
LN-7 WIRE FEEDER CONNECTION TO THE IDEALARC CV-400



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ACCESSORIES

CONNECTING THE LN-8 OR LN-9 TO THE IDEALARC CV-400

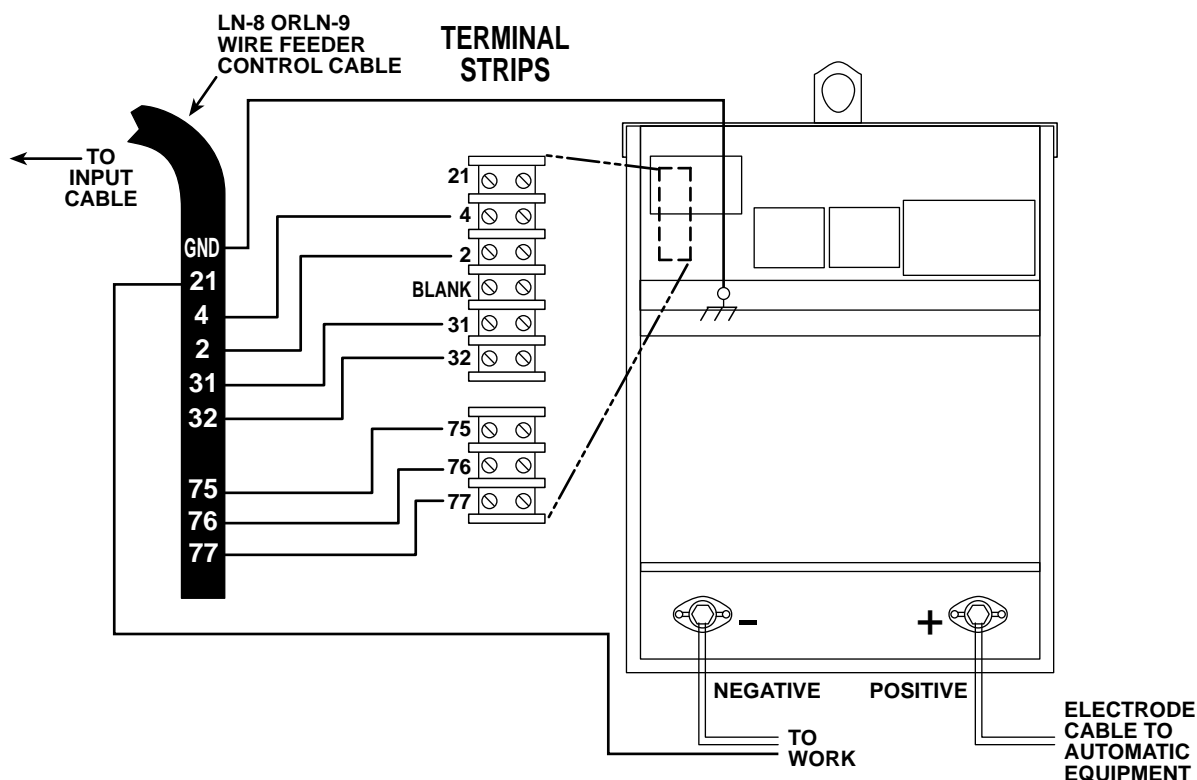
1. Set the CV-400 POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-400.
3. Connect the wire feeder control cable leads to the CV-400 terminal strip as shown in Figure C.5.
4. Connect the wire feeder control cable ground lead to the frame terminal marked **TT**.
5. Extend wire feeder control cable lead #21 so it can be connected directly to the work piece.
 - a. Make a bolted connection using AWG #14 or larger insulated wire. Tape the bolted connection with insulating tape.
 - b. An S-16586- X remote voltage sensing work lead is available for this purpose.
 - c. Keep the #21 lead electrically separate from the work cable circuit and connection.
 - d. Tape the #21 lead to the work cable for ease of use.
6. Connect the LN-9 wire feeder control jumpers on the Voltage Control board. See LN-9 operator's manual.

NOTE: Using the extended #21 lead eliminates the need to use the LN-9's remote work lead accessory, which has a direct work lead jack.

NOTE: The connection diagram shown in Figure C.5 shows the electrode connected for positive polarity. To change polarity:

- a. Set the CV-400 POWER toggle switch to the OFF (0) position.
- b. Move the electrode cable to the negative (-) output terminal.
- c. Move the work cable to the positive (+) output terminal.
- d. Set the VOLTMETER toggle switch on power source to negative (-).
- e. Set the voltmeter toggle switch on feeder (if equipped) to match electrode polarity.

FIGURE C.5
LN-8 OR LN-9 WIRE FEEDER CONNECTION TO THE IDEALARC CV-400



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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

WARNING

To avoid receiving an electric shock, keep electrode holders and cable insulation in good condition.

1. Disconnect power supply lines to the machine before performing periodic maintenance.
2. In extremely dusty locations, dirt may clog the air channels, causing the welder to run hot. Periodically blow out dust and dirt from the inside of the machine with a low pressure air system. Be sure to clean the following components thoroughly. See **Figure D.1** for their location.
 - Main transformer
 - Output studs
 - Polarity switch
 - Rectifier assembly
 - Control box assembly
3. Dirt and dust may also accumulate on the remote control terminal strips. Wipe or blow off the terminal strips regularly, especially in damp locations.
4. Inspect the welder output terminals and control cables for fraying, cuts, and bare spots.
5. The fan motor has sealed ball bearings and requires no maintenance.

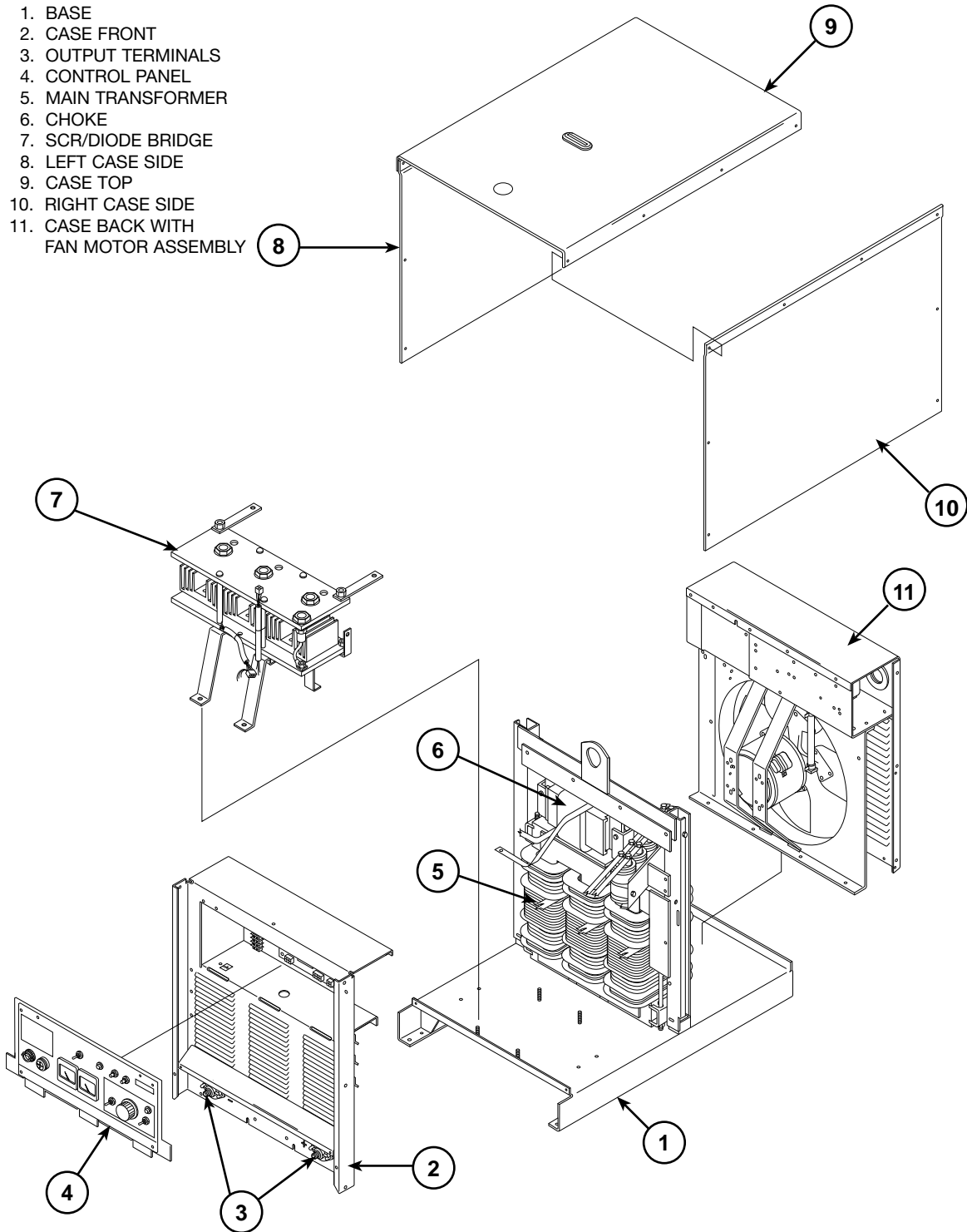
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MAINTENANCE

FIGURE D.1 Major Component Locations

- 1. BASE
- 2. CASE FRONT
- 3. OUTPUT TERMINALS
- 4. CONTROL PANEL
- 5. MAIN TRANSFORMER
- 6. CHOKE
- 7. SCR/DIODE BRIDGE
- 8. LEFT CASE SIDE
- 9. CASE TOP
- 10. RIGHT CASE SIDE
- 11. CASE BACK WITH FAN MOTOR ASSEMBLY



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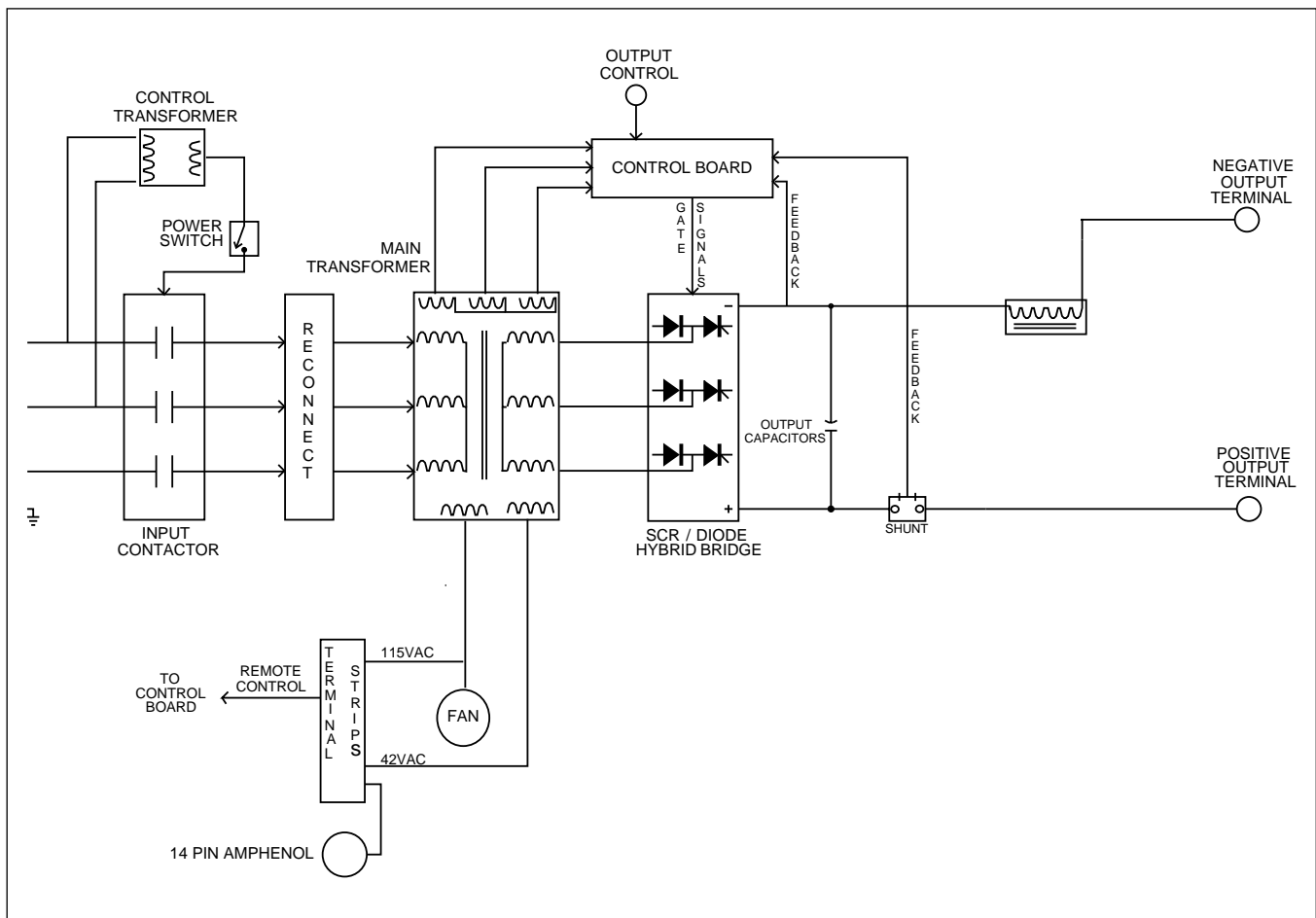
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FIGURE E.1 – BLOCK LOGIC DIAGRAM



GENERAL DESCRIPTION

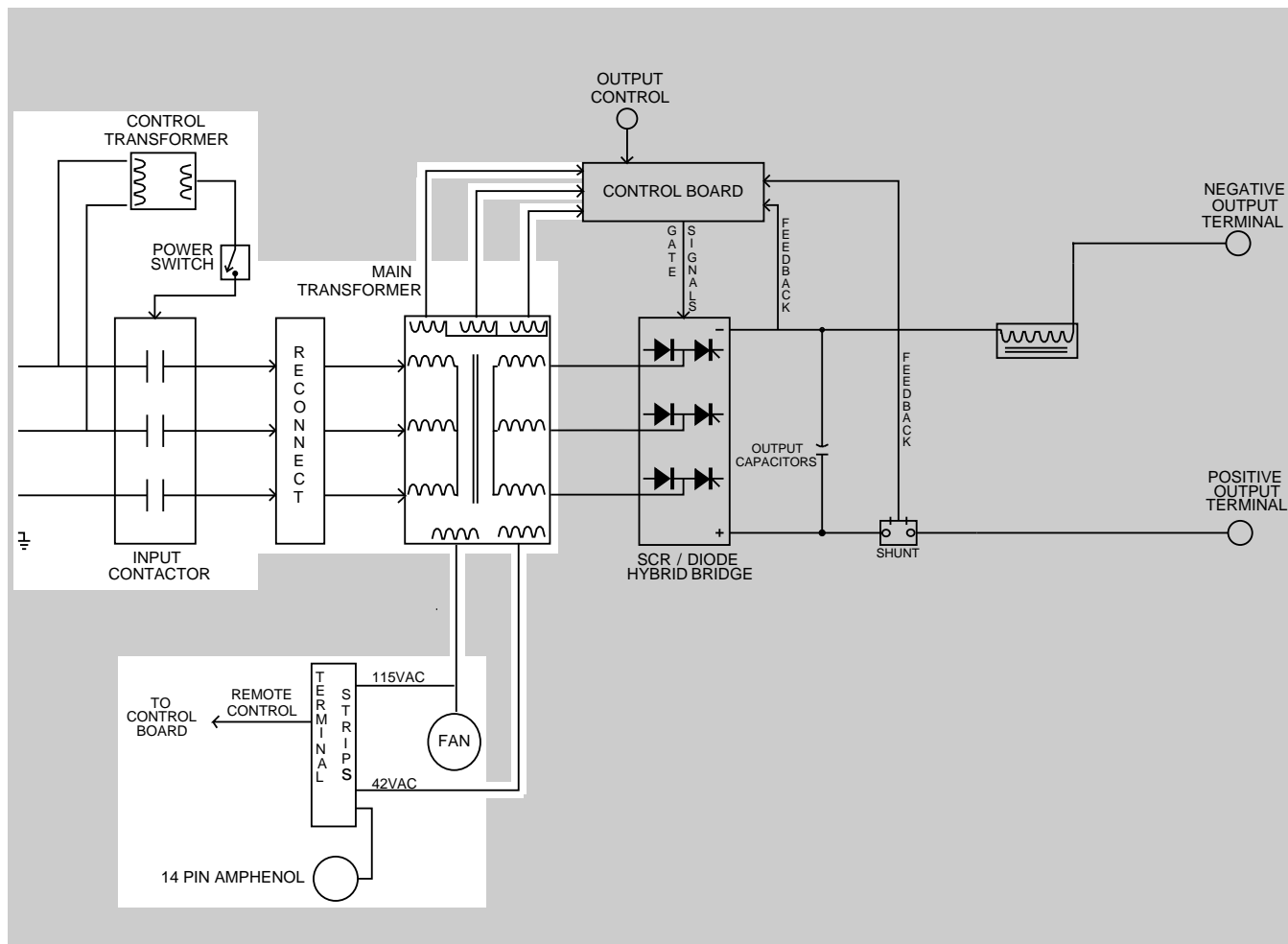
The CV-400 is an SCR controlled three-phase DC power source. It is designed for all open arc constant voltage (CV) processes within the capacity of the machine. The output characteristics have been optimized for CV processes without the use of a variable arc control. Minimum to maximum output is obtained with a single potentiometer control.

IDEALARC CV-400



THEORY OF OPERATION

FIGURE E.2 – INPUT LINE VOLTAGE, CONTACTOR AND MAIN TRANSFORMER



INPUT LINE VOLTAGE, CONTACTOR AND MAIN TRANSFORMER

The desired three-phase input power is connected to the CV-400 through an input contactor, located in the input box at the rear of the machine. Two phases of the input line are also connected to the control transformer, which, through the power switch, supplies power to activate the input contactor.

A reconnect panel allows the user to configure the machine for the desired input voltage. This AC voltage is applied to the primary of the main transformer.

The transformer changes the high voltage, low current input power to a lower voltage, higher current output.

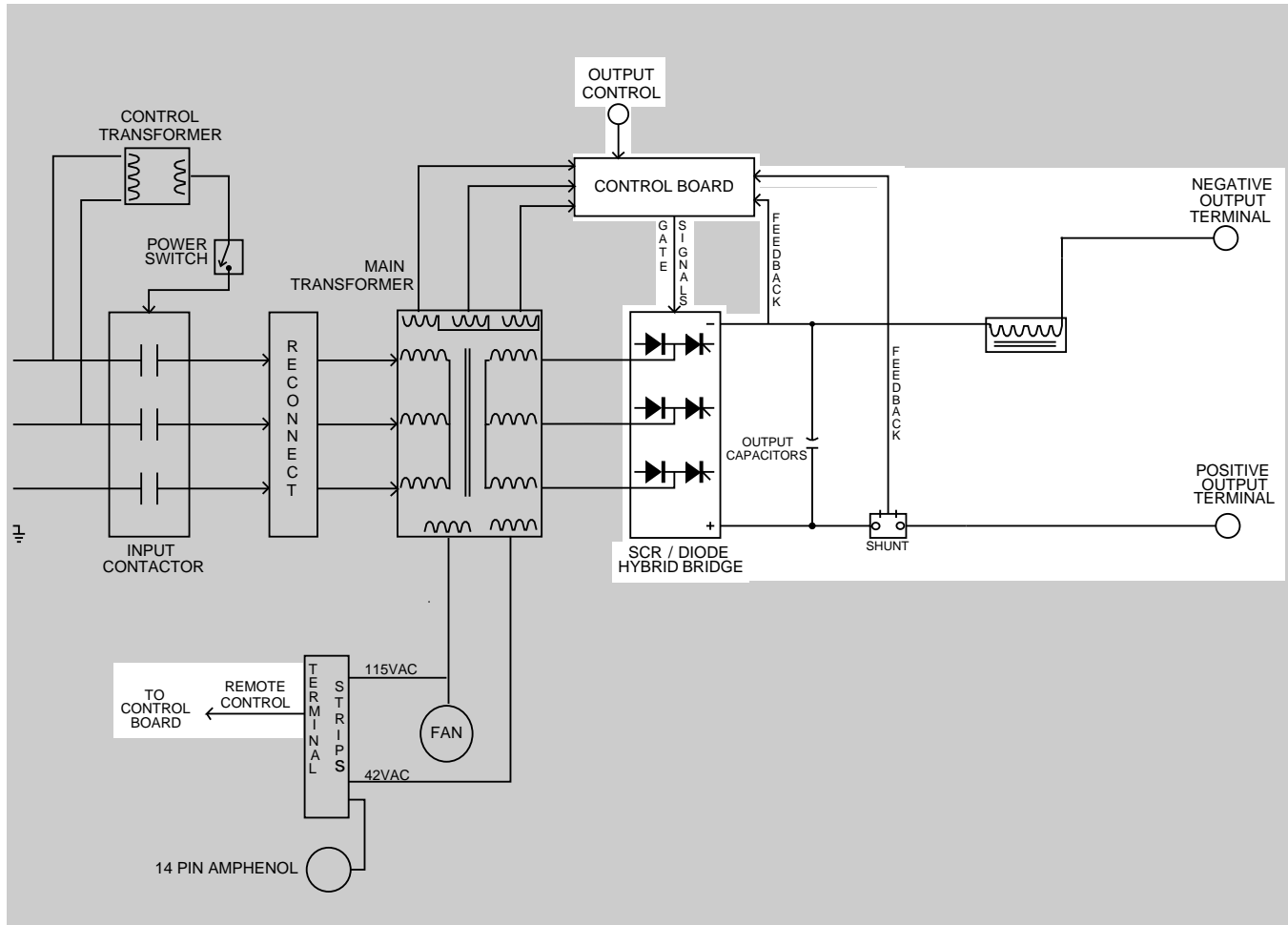
The finishes or "neutrals" of the main secondary coils are connected together, and the three starts of the secondary windings are connected to the rectifier bridge assembly. In addition, the main transformer has separate and isolated 115VAC and 42VAC auxiliary windings. The 115VAC is available at the terminal strip and the 14 pin amphenol and is protected by a 10 amp circuit breaker. The 42VAC is available at the 14 pin amphenol only and is also protected by a 10 amp circuit breaker. The three 21VAC phase angle windings are also housed in the main transformer assembly. These windings provide power and "timing" for the control board.

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

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FIGURE E.3 – OUTPUT CONTROL, RECTIFICATION AND FEEDBACK



OUTPUT CONTROL, RECTIFICATION AND FEEDBACK

The three-phase AC output from the main transformer secondary is rectified and controlled through the SCR/diode bridge. Output current and voltage is sensed at the shunt and output capacitors, respectively. This feedback information is processed in the control board. The control board compares the commands of the output control (or remote control) with the feedback information and sends the appropriate gate firing signals to the SCR/diode bridge. **See SCR Operation** in this section.

A "dry closure" of leads #2 and #4, either at the terminal strip or the 14 pin amphenol, signals the control board to apply gate firing signals to the SCR/diode bridge, which creates a DC voltage at the output of the bridge assembly. This output is filtered by the capacitors to reduce the ripple content of the waveform. Thus, a smoother DC output is created. The choke, which is in series with the negative output terminal, stores energy and provides current filtering.

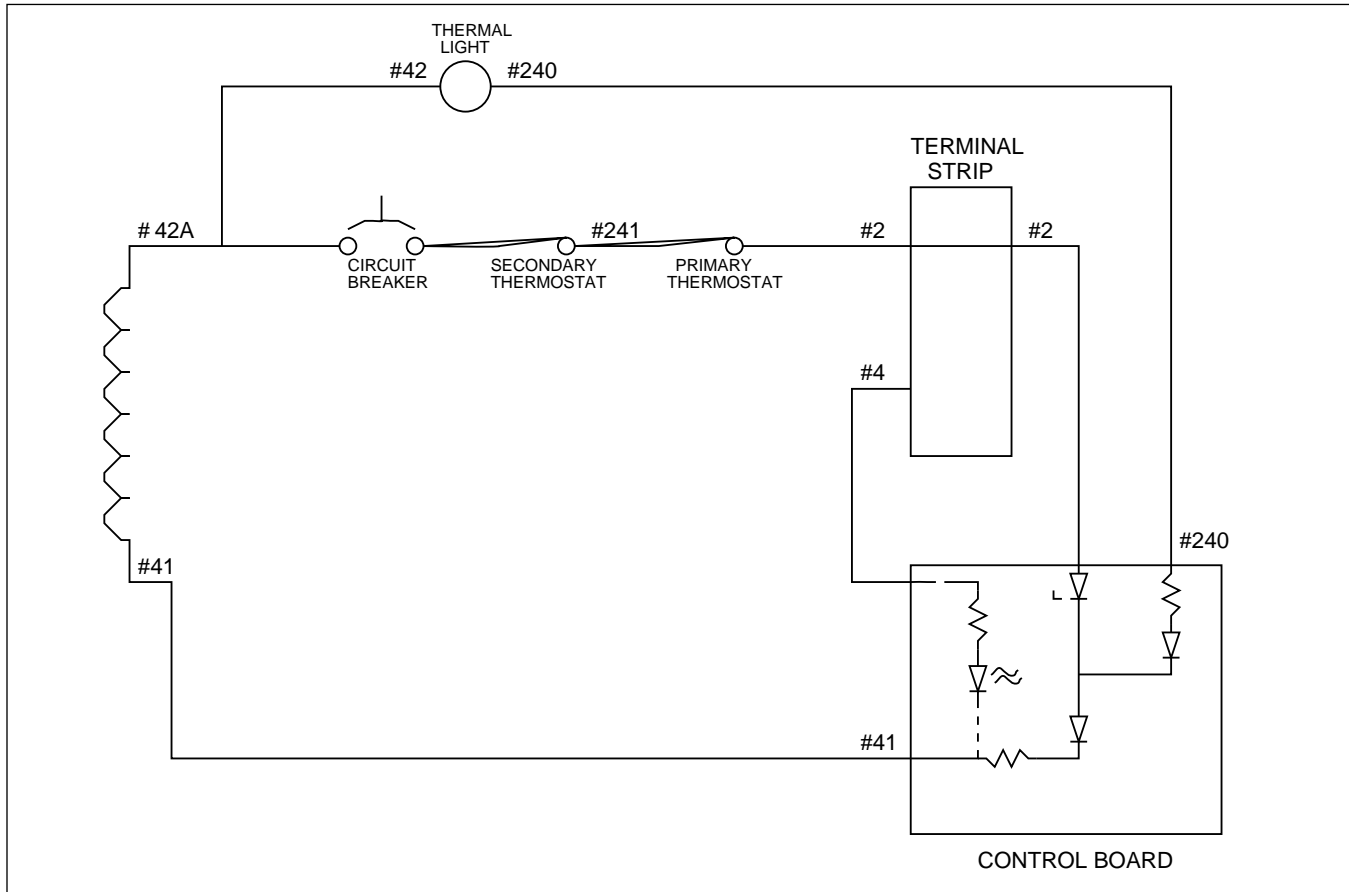
NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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THEORY OF OPERATION

FIGURE E.4 – CV-400 TRIGGER AND THERMAL LIGHT CIRCUIT



PROTECTIVE DEVICES AND CIRCUITS

Two thermostats protect the CV-400 from excessive operating temperatures and overload conditions. Excess operating temperatures may be caused by insufficient cooling air or by operating the machine beyond the duty cycle and output rating. The primary thermostat is located on the nose of the center bottom primary coil. The secondary thermostat is attached to the lead connecting the secondaries. Both thermostats are connected in series with the trigger circuits. If the machine is over-heated, the thermostats will open and output will be zero. The thermal protection light will glow and the fan will continue to run. See Figure E.4, CV-400 Trigger And Thermal Light Circuit. Under normal conditions the Thermal Light is "shorted out" by the circuit breaker and thermostat circuit. If the thermostats or the circuit breaker opens, more current will flow through the Thermal Light circuit, and the light will glow.

The power source is also protected against overloads on the SCR bridge assembly through the solid state fault protection circuit. This circuit senses an overload on the power source and limits the output to approximately 550 amps by phasing back the SCRs.

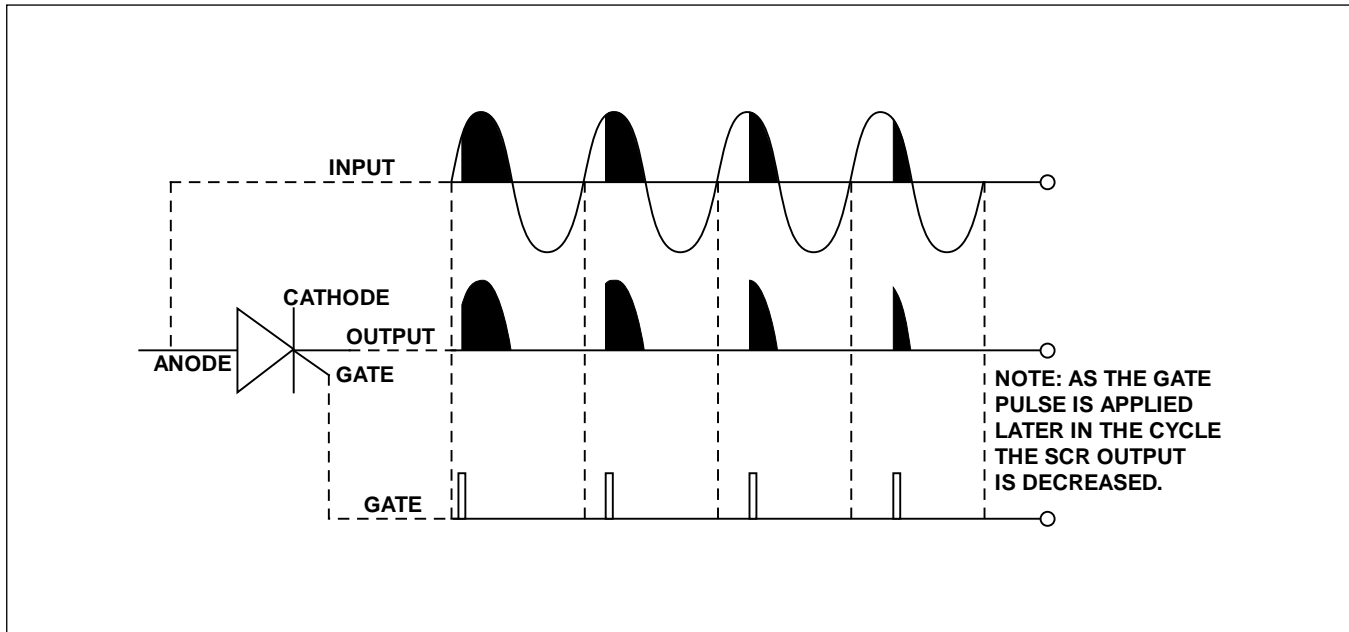
Protection is also provided to protect the circuitry from accidental grounds. If the customer accidentally "grounds" 75, 76, or 77 to the positive output lead, the CV-400 output will be reduced to a very low value, thus preventing any damage to the machine. If the ground occurs between 75, 76, and 77 and the negative output lead, one of the PC board electronic "self-restoring" fuses will blow, preventing any machine damage. After the ground is cleared, the fuses automatically reset within a few seconds.

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THEORY OF OPERATION

FIGURE E.5 – SCR OPERATION



SCR OPERATION

A silicon controlled rectifier (SCR) is a three-terminal device used to control rather large currents to a load. An SCR acts very much like a switch. When a gate signal is applied to the SCR, it is turned ON, and there is current flow from anode to cathode. In the ON state the SCR acts like a closed switch. When the SCR is turned OFF, there is no current flow from anode to cathode; thus the device acts like an open switch. As the name suggests, the SCR is a rectifier, so it passes current only during positive half cycles of the AC supply. The positive half cycle is the portion of the sine wave in which the anode of the SCR is more positive than the cathode.

When an AC supply voltage is applied to the SCR, the device spends a certain portion of the AC cycle time in the ON state and the remainder of the time in the OFF state. The amount of time spent in the ON state is controlled by the gate.

An SCR is fired by a short burst current into the gate. This gate pulse must be more positive than the cathode voltage. Since there is a standard PN junction between gate and cathode, the voltage between these terminals must be slightly greater than 0.6V. Once the SCR has fired, it is not necessary to continue the flow of gate current. As long as current continues to flow from anode to cathode the SCR will remain on. When the anode to cathode current drops below a minimum value called holding current, the SCR will shut off. This normally occurs as the AC supply voltage passes through zero into the negative portion of the sine wave. If the SCR is turned on early in the positive half cycle, the conduction time is longer, resulting in greater SCR output. If the gate firing occurs later in the cycle, the conduction time is less, resulting in lower SCR output.

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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 two main categories: Output 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 cover.

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

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



CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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TROUBLESHOOTING & REPAIR

PC BOARD TROUBLESHOOTING PROCEDURES

WARNING

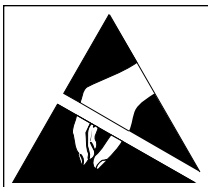


ELECTRIC SHOCK can kill.

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. 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.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.

- a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.

- b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.

6. Always indicate that this procedure was followed when warranty reports are to be submitted.

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

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the sheet metal cover(s) are removed.	1. Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.	1. Contact the Lincoln Electric Service Department, (216) 383-2531 or 1-800-833-9353 (WELD).
Machine is dead - no output - no fan - no pilot light.	<ol style="list-style-type: none"> 1. Make sure the input power switch is ON. 2. Check the three-phase input voltage at the machine. Input voltage must match the rating plate and the reconnect panel. 3. Check for blown or missing fuses in the input lines. 	<ol style="list-style-type: none"> 1. Check the input power switch (S1) for proper operation. See the Wiring Diagram. 2. Check the leads associated with the power switch (S1) and the control transformer (T2) for loose or faulty connections. See the Wiring Diagram. 3. Perform the Control Transformer Test.
The machine is dead - no output - no fan - the pilot light is on.	<ol style="list-style-type: none"> 1. Check the three-phase input voltage at the machine. Input voltage must match the rating plate and the reconnect panel. 2. Check for blown or missing fuses in the input lines. 	<ol style="list-style-type: none"> 1. Perform the Input Contactor Test. 2. Check the associated leads for loose or faulty connections between the input contactor (CR1), the reconnect panel and the main transformer. See the Wiring Diagram. 3. Perform the Main Transformer 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 216-383-2531 or 1-800-833-9353.

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TROUBLESHOOTING & REPAIR

TROUBLESHOOTING GUIDE

Observe Safety Guidelines
detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The input contactor operates - the fan runs - the pilot light is on - but the machine has no welding output.	<ol style="list-style-type: none"> 1. If the amber thermal protection light is on, the primary or secondary thermostat is open. Allow machine to cool. 2. Make certain the output trigger circuit (#2 and #4) is being activated by a "closure." 3. Check the 10 amp circuit breaker in the 42VAC circuit. Reset if necessary. 4. If remote control is not being used, make certain the Output Control switch (S2) is in the "Machine or Local" position. 5. Check for loose or faulty welding cable connections. 	<ol style="list-style-type: none"> 1. Perform the <i>Main Transformer Test</i>. 2. Perform the <i>SCR/Diode Rectifier Bridge Test</i>. 3. The control board may be faulty. Replace.
The input contactor (CR1) chatters.	<ol style="list-style-type: none"> 1. Make certain the three-phase input voltage matches the machine rating plate and the reconnect panel. 	<ol style="list-style-type: none"> 1. Perform the <i>Input Contactor Test</i>.

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 216-383-2531 or 1-800-833-9353.

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The machine has high welding output and no control.	<ol style="list-style-type: none"> 1. If remote control is being used, set the Output Control Switch (S2) to the "Machine or Local" position and control the weld output with the machine Output Control (R4). If the problem is solved, check the remote control unit or wire feeder and associated control cable. 2. Check the remote control leads for "grounds" to the negative welding output. If leads #75, #76 or #77 are "grounded" to the negative welding output, the machine output may go very high without control. 	<ol style="list-style-type: none"> 1. Check the Output Control switch (S2) and associated wiring. See the Wiring Diagram. 2. Check feedback leads #220, #204, #205 and #206 for loose or faulty connections. 3. Perform the SCR/Diode Rectifier Bridge Test. 4. The control board may be faulty. Replace.
The machine has minimum (or very low) welding output and no control.	<ol style="list-style-type: none"> 1. If remote control is being used, set the Output Control Switch (S2) to the "Machine or Local" position and control the weld output with the machine Output Control (R4). If the problem is solved, check the remote control unit or wire feeder and associated control cable. 2. Make certain the remote control leads (#75, #76, #77) are not grounded to the positive welding output. 3. Make certain the three-phase input voltage is correct and matches the machine rating and the reconnect panel. 	<ol style="list-style-type: none"> 1. Check the Output Control (R4) and associated wiring. See the Wiring Diagram. 2. Check the Output Control switch (S2) and associated wiring. See the Wiring Diagram. 3. Perform the Main Transformer Test. 4. Perform the SCR/Diode Rectifier Bridge Test. 5. The control board may be faulty.



CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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TROUBLESHOOTING & REPAIR

TROUBLESHOOTING GUIDE

Observe Safety Guidelines
detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The machine does not have maximum output.	<ol style="list-style-type: none"> 1. Make sure the correct three-phase input voltage is being applied to the machine. 2. If remote control is being used, set the Output Control switch (S2) to the "Machine or Local" position and control the weld output with the machine Output Control (R4). If the problem is solved, check the remote control unit or wire feeder and associated control cable. 	<ol style="list-style-type: none"> 1. Check the Output Control (R4). Normal resistance is 10,000 ohms. Also check associated wiring for loose or faulty connections. See the Wiring Diagram. 2. Check the Output Control switch (S2) and associated wiring. See the Wiring Diagram. 3. Perform the Main Transformer Test. 4. Perform the SCR/Diode Bridge Rectifier Test. 5. The control board may be faulty. Replace.
The machine will not shut off when the power switch is put in the OFF position.	<ol style="list-style-type: none"> 1. Make sure the three-phase input lines are connected correctly to the CV-400. 	<ol style="list-style-type: none"> 1. Check the input power switch (S1) and associated leads. See the Wiring Diagram. 2. Perform the Input Contactor 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 216-383-2531 or 1-800-833-9353.

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
<p>The output terminals are always electrically "hot."</p>	<ol style="list-style-type: none"> 1. Remove any external leads that may be connected to the 14 pin amphenol or the terminal strip. If the problem disappears, the fault is in the control cable or wire feeder. 	<ol style="list-style-type: none"> 1. Check for an internal short between leads #2 and #4. See the Wiring Diagram. 2. Remove plug J3 (SCR gate leads) from the control board. If the problem disappears, the control board may be faulty. Replace. If the output terminals are still electrically "hot," perform the SCR/Diode Rectifier Bridge Test. 3. The snubber board may be faulty. Check or 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 216-383-2531 or 1-800-833-9353.

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TROUBLESHOOTING & REPAIR

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
Poor arc characteristics.	<ol style="list-style-type: none"> 1. Make sure the correct weld procedures are being used. (Electrode, Gas, etc.) 2. Check the welding cables for loose or faulty connections. 	<ol style="list-style-type: none"> 1. Check the output capacitors and connections. A capacitor failure is indicated if the small vent plug on top of a capacitor is raised or blown out. WARNING: The liquid electrolyte in these capacitors is toxic. Avoid contact with any portion of your body. Clean up vented electrolyte using rubber gloves and a water dampened cloth. Any electrolyte which gets on skin, clean with soap and water. 2. The control board may be faulty.
Poor arc striking with semiautomatic or automatic wire feeders.	<ol style="list-style-type: none"> 1. Make sure the correct weld procedures are being used. (Electrode, Gas, etc.) 2. Check the welding cables for loose or faulty connections. 	<ol style="list-style-type: none"> 1. The control board may be faulty.
The welding arc is variable and sluggish.	<ol style="list-style-type: none"> 1. Check the input voltage at the CV-400, making sure the correct voltage and all three phases are being applied to the machine. 2. Make sure the welding process is correct for the machine settings. 3. Check the welding cables for loose or faulty connections. Also make sure cables are sized correctly for the welding current. 	<ol style="list-style-type: none"> 1. Perform the SCR/Diode Rectifier Bridge Test. 2. Perform the Main Transformer Test. 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 216-383-2531 or 1-800-833-9353.

IDEALARC CV-400



TROUBLESHOOTING & REPAIR

CONTROL TRANSFORMER (T2) 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This procedure will determine if the correct voltage is being applied to the primary of the control transformer and induced on the secondary winding of the control transformer.

MATERIALS NEEDED

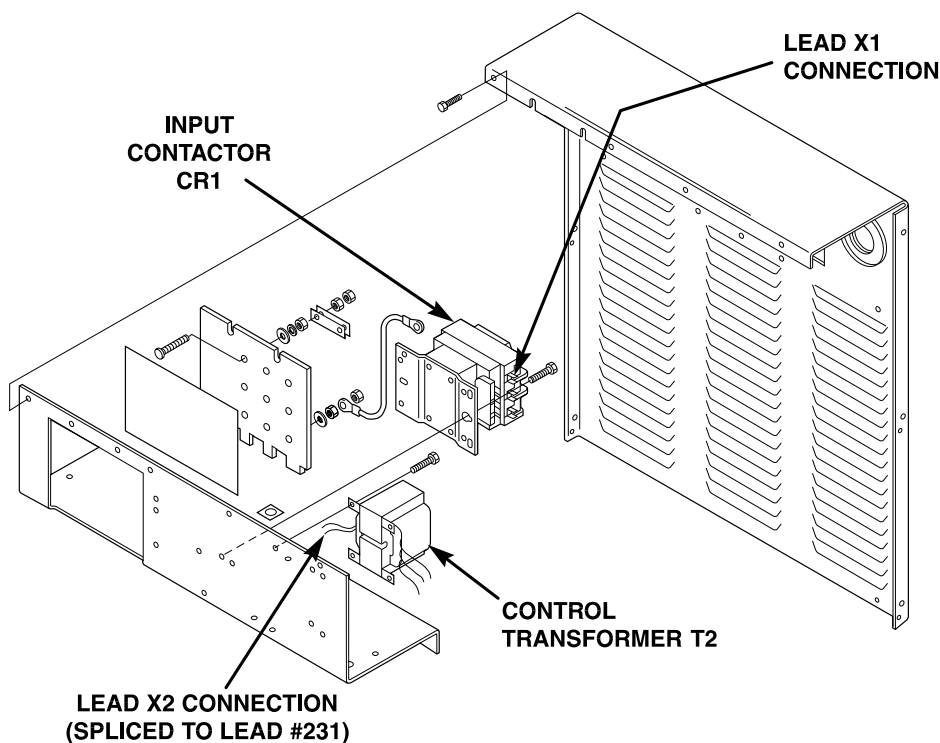
Volt/ohmmeter (Multimeter)
5/16" Nut driver
IDEALARC CV-400 wiring diagrams (See the Electrical Diagrams section of this manual.)

IDEALARC CV-400



CONTROL TRANSFORMER (T2) VOLTAGE TEST *(continued)*

FIGURE F.1 – CONTROL TRANSFORMER AND LEAD LOCATIONS



TEST PROCEDURE

1. Disconnect the main input supply power to the machine.
2. With the 5/16" nut driver, remove the top, case sides, and rear input panel.
3. Locate the control transformer (T2) on the left side of the input box (facing the back of the machine). See Figure F.1.
4. Locate the control transformer primary leads (H1, H2, H3, etc.). See the Wiring Diagram.
5. Locate control transformer leads X1 (top) and X2.
 - a. Lead X1 is connected to the input contactor (CR1) coil located on the input side of the contactor. See Figure F.1.
 - b. Lead X2 is spliced into lead #231. See the Wiring Diagram. Lead #231 is connected to the power switch (S1). See **Figure F.2**.

NOTE: Unused leads should be taped.

- a. Inspect for broken or incorrect connections.

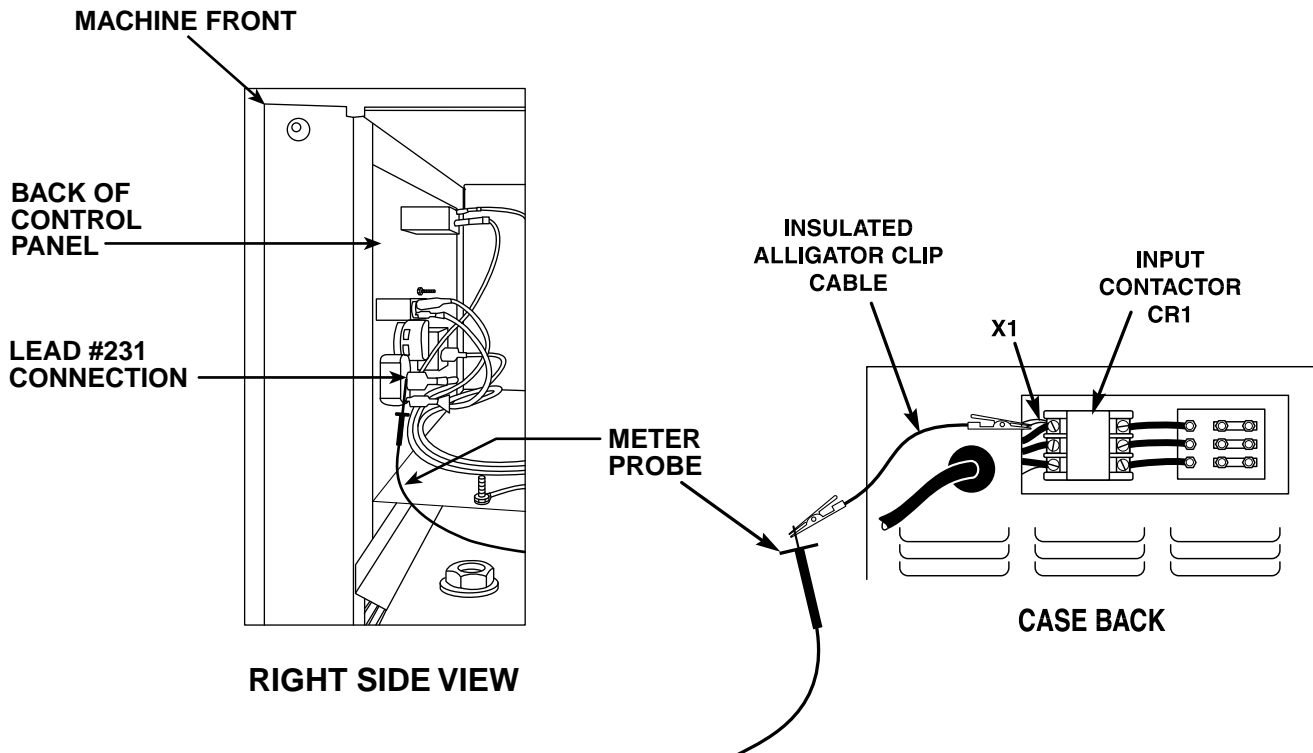
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TROUBLESHOOTING & REPAIR

CONTROL TRANSFORMER (T2) VOLTAGE TEST *(continued)*

FIGURE F.2 – CONTROL TRANSFORMER X1 AND X2 TEST CONNECTIONS



6. Test for 115VAC between leads X1 and #231.

NOTE: If the main AC input supply voltage varies, the control transformer voltage will vary by the same percentage.

- Connect one end of an insulated alligator clip to the X1 connection at the input contactor (CR1) coil. See Figure F.2.
- Connect the other end of the alligator clip to one of the meter probes. Be sure that neither the alligator clip nor the meter probe touches any metal surfaces.
- Connect the other meter probe to the #231 connection (top lead) at the power switch. See Figure F.2.
- Apply input power to the CV-400.

7. Read the meter for 115VAC.

- If 115VAC is present, the control transformer is functioning properly.
- If 115VAC is NOT present, go to Step 8.

8. If 115VAC is not present between leads X1 and #231, check the spliced connection between #231 and X2. Test for correct main input supply power to the control transformer primary windings (H1, H2, H3, etc.). Check the main input supply power hookup to the machine. See the Wiring Diagram.

- If the correct main input supply power to the control transformer primary windings is present AND the secondary voltage is not correct, the control transformer may be faulty. Replace.

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TROUBLESHOOTING & REPAIR

INPUT 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This test will determine if the input contactor is receiving the correct coil voltage and if the contacts are functioning correctly.

MATERIALS NEEDED

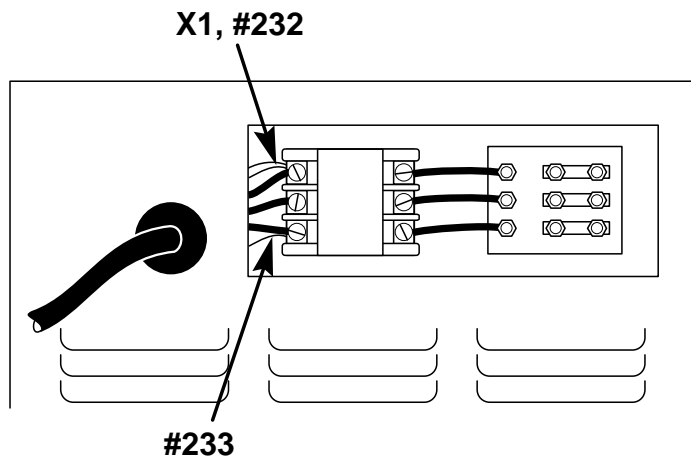
Volt/ohmmeter (Multimeter)
5/16" Nut driver
IDEALARC CV-400 wiring diagrams (See the Electrical Diagrams section of this manual.)
External 120VAC supply

IDEALARC CV-400



INPUT CONTACTOR TEST *(continued)*

FIGURE F.3 – INPUT CONTACTOR CONNECTIONS



TEST PROCEDURE

1. Disconnect the main input supply power to the machine.
2. With the 5/16" nut driver, remove the case top and the reconnect panel cover.
3. Locate the two leads connected to the input contactor coil, #233 and X1 #232 (top). See Figure F.3 for location.
4. Connect an AC voltmeter to the leads.

5. Apply the correct voltage to the machine and turn the power switch (S1) ON.
6. Check for 120VAC at the contactor coil leads.

If the 120VAC is NOT present, with the power switch (S1) on, check the power switch (S1) and associated circuitry. See the Wiring Diagram. Also perform the **Control Transformer (T2) Voltage Test**.

If the 120VAC is present and the contactor does NOT activate, then the input contactor is faulty. Replace the input contactor.

WARNING

Electric Shock can kill.



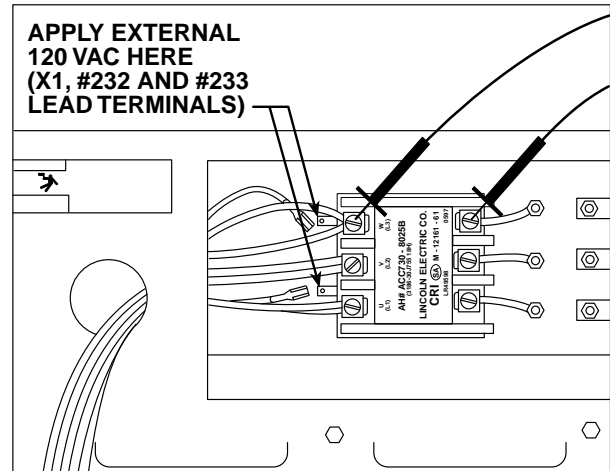
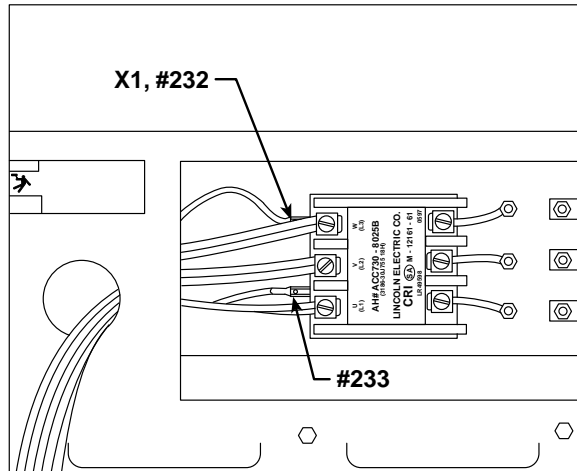
- With the input power on, there are high voltages inside the machine. Do not reach into the machine or touch any internal part of the machine while the power is on.

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INPUT CONTACTOR TEST (continued)

FIGURE F.4 – INPUT CONTACTOR TEST CONNECTIONS



TEST FOR CONTACT CONTINUITY

1. Disconnect the main input supply power to the machine.
2. Remove the two leads connected to the input contactor coil, #233 and X1/#232. See Figure F.4 for location.
3. Using the external 120VAC supply, apply 120VAC to the terminals of the input contactor coil. If the contactor does NOT activate, the input contactor is faulty. Replace the input contactor.
4. With the contactor activated, check the continuity across the contacts. (Zero ohms or very low resistance is normal.) See Figure F.4. If the resistance is high, the input contactor is faulty. Replace the input contactor.
5. When the contactor is NOT activated, the resistance should be infinite or very high across the contacts. If the resistance is low, the input contactor is faulty. Replace the input contactor.

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TROUBLESHOOTING & REPAIR

MAIN TRANSFORMER (T1) 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This test will determine if the correct voltages are being applied to the primary windings of the Main Transformer (T1) and induced on the secondary winding, auxiliary windings, and phase angle windings.

MATERIALS NEEDED

- Volt/ohmmeter (Multimeter)
- 5/16" Nut driver
- IDEALARC CV-400 wiring diagram (See the Electrical Diagrams section of manual.)

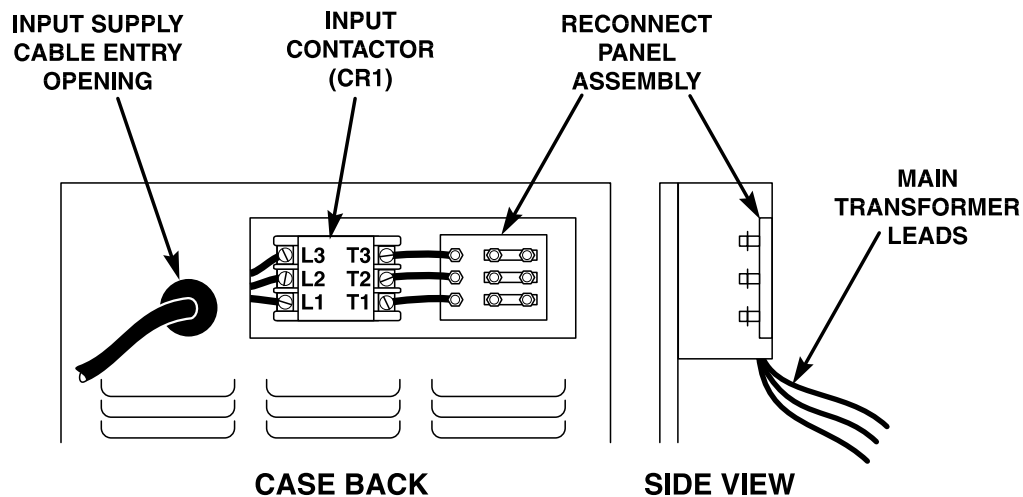
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TROUBLESHOOTING & REPAIR

MAIN TRANSFORMER (T1) VOLTAGE TEST *(continued)*

FIGURE F.5 – INPUT CONTACTOR, RECONNECT PANEL, AND PRIMARY LEADS TO MAIN TRANSFORMER LOCATIONS



TEST PROCEDURE

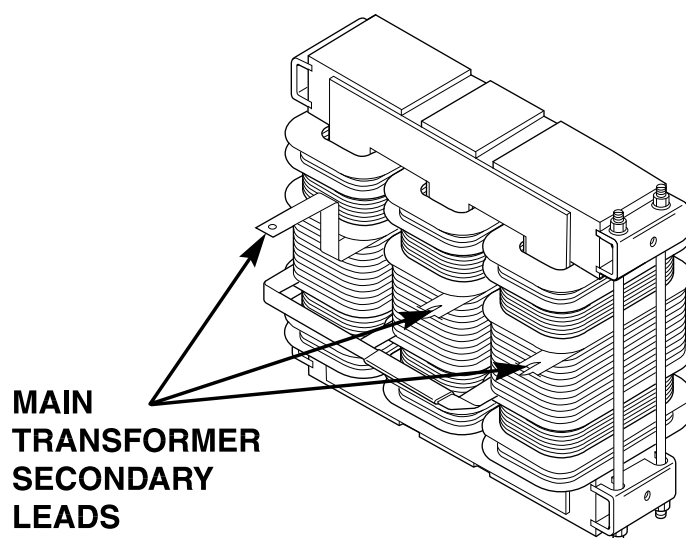
1. Set the ON/OFF power switch to OFF.
2. Disconnect main input supply power from the machine.
3. With the 5/16" nut driver, remove the case top and sides and the reconnect panel cover.
4. Inspect the input contactor, reconnect panel, and primary leads to the main transformer for loose or faulty connections. See Figure F.5.
 - a. Confirm that the reconnect panel is connected properly for the three-phase main input power supplied to the machine. See the reconnect panel connection diagram located on the inside of the input box assembly access door.
5. Connect main input supply power to the machine.
6. Set the ON/OFF power switch to ON.
 - a. Make sure the input contactor (CR1) energizes and the fan runs.
7. Test with an AC voltmeter for proper main input supply voltage to the line side of the input contactor (CR1). See the Wiring Diagram.
 - a. L1 to L2.
 - b. L2 to L3.
 - c. L1 to L3.

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MAIN TRANSFORMER (T1) VOLTAGE TEST *(continued)*

FIGURE F.6 – MAIN SECONDARY LEAD TEST POINTS



8. Read the meter.
 - a. If proper voltage is present for all three phases, proper main input supply voltage is being supplied.
 - b. If proper voltage is not present in any or all of the three phases, check input fuses and leads.
9. Test with an AC voltmeter for proper main input supply voltage from the output side of the input contactor (CR1). See the Wiring Diagram and **Figure F.5**.
 - a. T1 to T2.
 - b. T2 to T3.
 - c. T1 to T3.
10. Read the meter.
 - a. If proper voltage is present for all three phases, the input contactor is working properly.
 - b. If the proper voltage is not present for any or all of the three phases, the input contactor may be faulty. Replace the input contactor.
11. Test with an AC voltmeter for approximately 42VAC across each of the three main secondary start leads located at the SCR/Diode Rectifier Bridge. Remove the red insulating paint to achieve good contact if necessary. See Figure F.6. See the Wiring Diagram.
 - a. If one or more of the above voltage tests are incorrect, check for loose or faulty connections.
 - b. If the connections are good, then the main transformer may be faulty. Replace the main transformer.

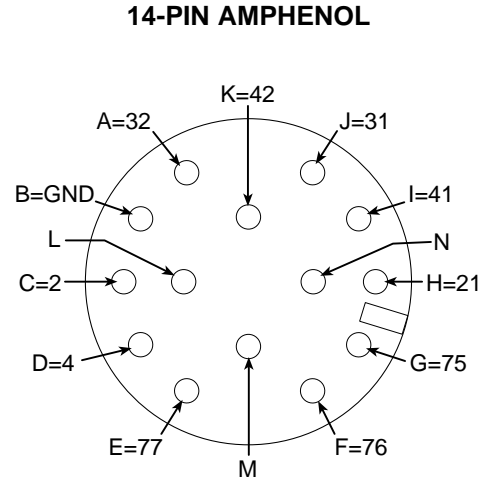
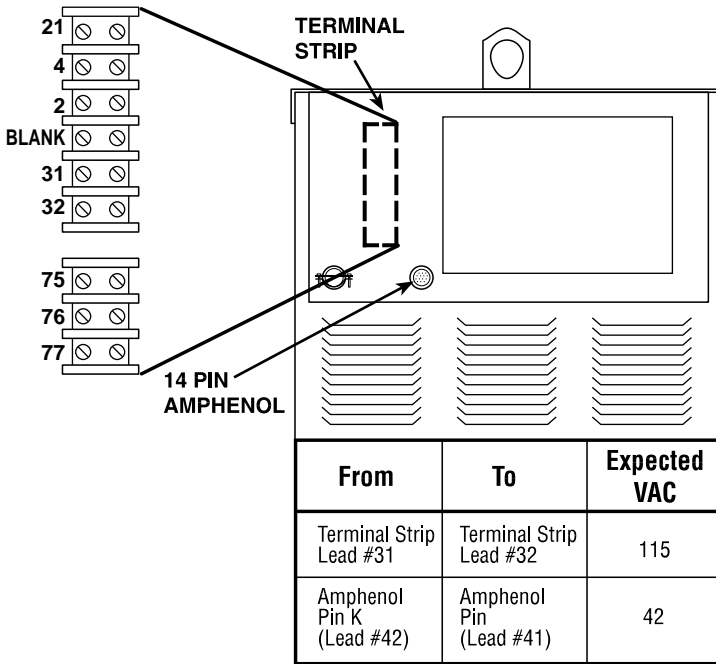
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TROUBLESHOOTING & REPAIR

MAIN TRANSFORMER (T1) VOLTAGE TEST (continued)

FIGURE F.7 – PHASE ANGLE WINDINGS TEST POINTS AND TERMINAL STRIP LOCATION



12. Test for 115VAC between leads #31 and #32 on the terminal strip. Also test for 42VAC between pin K (lead #42) and pin I (lead 41) in the 14-pin amphenol. See Figure F.7.
 - a. Remove the sheet metal screws from the control box cover with the 5/16" nut driver and flip the cover down. It does not have to be completely removed to perform the tests.
 - b. If the above voltage checks are incorrect, check for loose or faulty wiring. Check continuity.
 - c. If the wiring is good, then the main transformer may be faulty. Replace the main transformer.

13. Test with an AC voltmeter for 21VAC for each phase angle winding at plug P1 on the control board as shown in **Figure F.8** and the accompanying table.

NOTE: If the main input supply voltage varies, the main transformer voltages will vary proportionately.

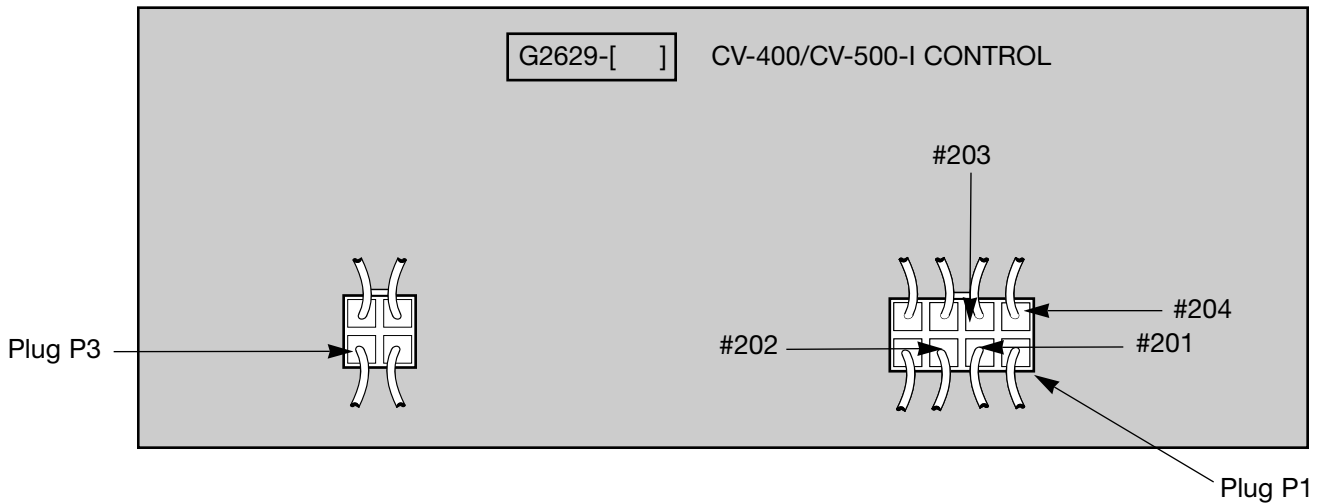
- a. If the voltage is low, remove plug P1 and recheck the voltage for 21VAC. If the reading is normal, the control board may be faulty. Replace the control board.
- b. If one or more of the voltage tests are incorrect, check for loose or faulty wiring.
- c. If the wiring is good, then the main transformer may be faulty. Replace the main transformer.

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TROUBLESHOOTING & REPAIR

MAIN TRANSFORMER (T1) VOLTAGE TEST *(continued)*

FIGURE F.8 – CONTROL BOARD PLUG P1 LOCATION



Plug P1 PHASE ANGLE WINDING VOLTAGES

From Lead #	To Lead #	Expected VAC
201	204	21 VAC
202	204	21 VAC
203	204	21 VAC

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TROUBLESHOOTING & REPAIR

STATIC SCR/DIODE RECTIFIER BRIDGE 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This test will help determine if an SCR or diode is shorted or “leaky.” See the Machine Waveform Section in this manual for normal and abnormal output waveforms.

MATERIALS NEEDED

- Analog Volt/ohmmeter (Multimeter)
- 5/16” Nut driver
- 9/16” Wrench
- IDEALARC CV-400 wiring diagrams (See the Electrical Diagrams section of this manual.)

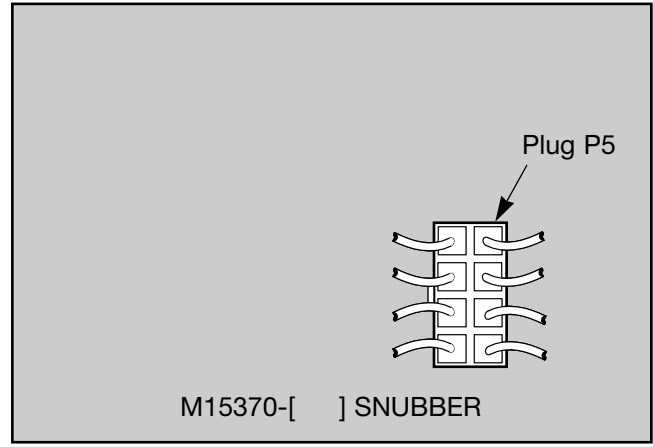
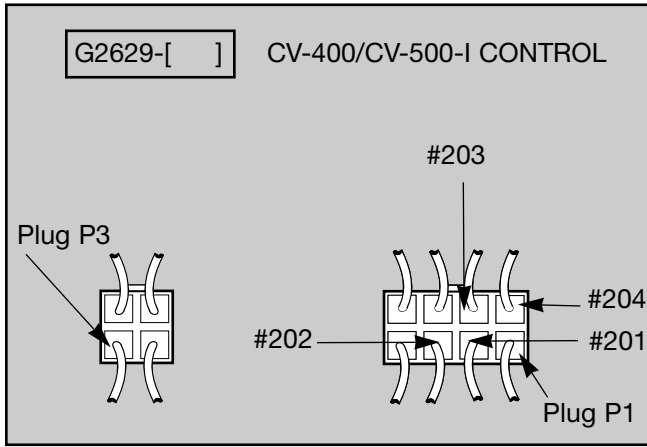
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TROUBLESHOOTING & REPAIR

STATIC SCR/DIODE RECTIFIER BRIDGE TEST (continued)

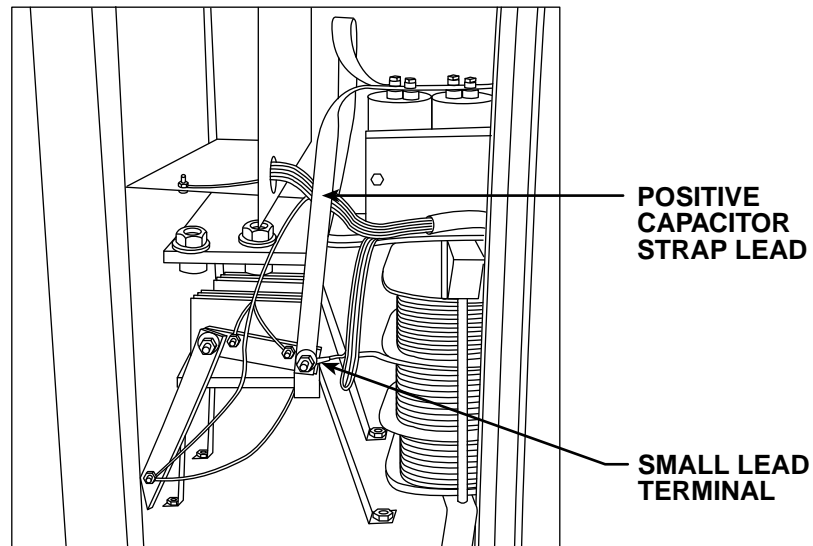
FIGURE F.9 – CONTROL BOARD AND SNUBBER BOARD PLUG LOCATIONS



TEST PROCEDURE

1. Disconnect the main input supply power to the machine.
2. With the 5/16" nut driver, remove the case top and sides.
3. Disconnect the welding cables from the welding output terminals.
4. Locate and remove moxex plug P3 from the control board. See Figure F.9.
5. Locate and remove moxex plug P5 from the snubber board. See Figure F.9.
6. Locate and remove lead #204 from resistor R2 (7.5 ohms, 100 watts). See Figure F.14.
7. Using the 9/16" wrench, remove the positive capacitor strap lead and small lead terminal from the rectifier plate and output shunt junction. See Figure F.10.

FIGURE F.10 – CAPACITOR STRAP LEAD CONNECTIONS



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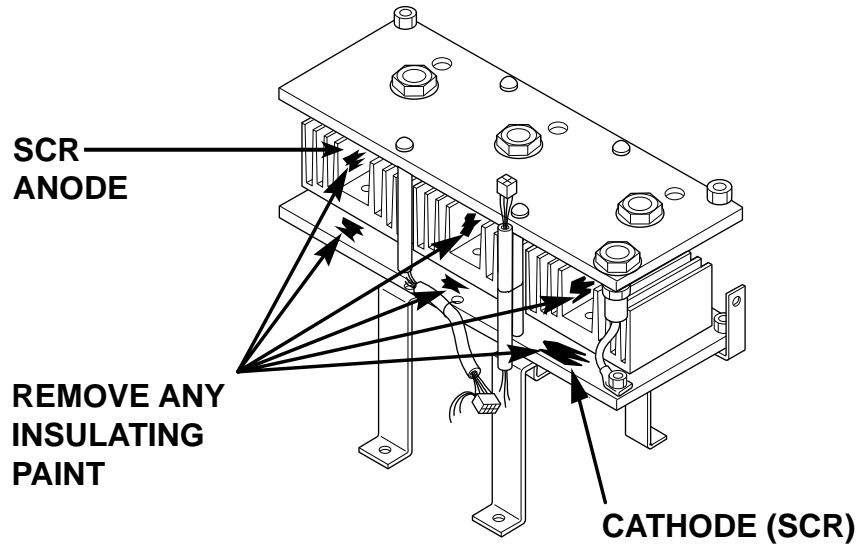
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TROUBLESHOOTING & REPAIR

STATIC SCR/DIODE RECTIFIER BRIDGE TEST (continued)

FIGURE F.11 – HEAT SINK AND SCR TEST POINTS



8. Remove any red insulating paint from the heat sink test points. See Figure F.11.

NOTE: Do not disassemble the heat sink.
9. Measure the resistance from the anode to the cathode of SCR 1 using an analog volt/ohmmeter (multimeter) set at R x 1000 scale. See Figure F.11.
 - a. Reverse the meter leads and measure the resistance from the cathode to the anode of SCR 1. See Figure F.11.
 - b. If a low resistance is measured in either meter polarity, SCR 1 is faulty. Replace SCR 1.
10. Test the resistance of SCR 2 and SCR 3 using the same procedure described in Step 9.
11. Measure the resistance of diode D1 from anode (+probe) to cathode (-probe) using an analog ohmmeter set at R x 1000 scale. The resistance should be low. See Figure F.11.
 - a. Reverse the meter leads and measure the resistance from cathode (+probe) to anode (-probe) of diode D1. The resistance should be high. See Figure F.11.
 - b. If a low resistance is measured in both meter polarities, diode D1 is shorted. Replace diode D1.
 - c. If a high resistance is measured in both meter polarities, diode D1 is open. Replace diode D1.
12. Test diodes D2, D3 and D4 for proper operation using the same procedure described in Step 11.
13. Reconnect all leads and molex plugs.
14. If this test did not identify the problem or to further test the SCRs, go to the **Active SCR Test**.

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TROUBLESHOOTING & REPAIR

ACTIVE SCR 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This test will help determine if the device can be gated ON and conduct current from anode to cathode.

MATERIALS NEEDED

- An SCR tester as specified in this procedure.
- 5/16" Nut driver
- 9/16" Wrench
- IDEALARC CV-400 wiring diagrams (See the Electrical Diagrams section of this manual.)

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TROUBLESHOOTING & REPAIR

ACTIVE SCR TEST (continued)

FIGURE F.12 – CONTROL BOARD PLUG P1 AND P3 LOCATIONS

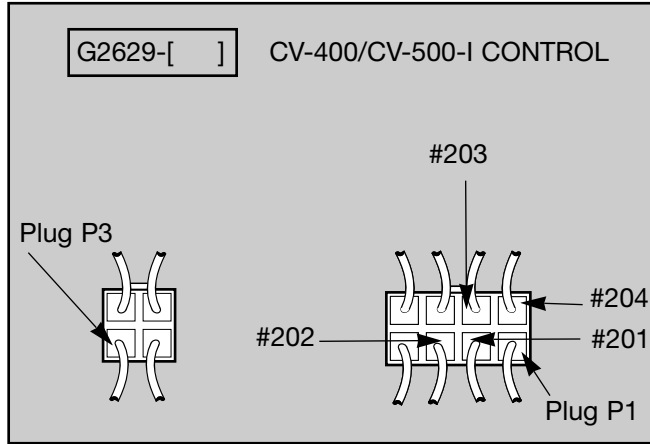


FIGURE F.13 – SNUBBER BOARD PLUG P5 LOCATION

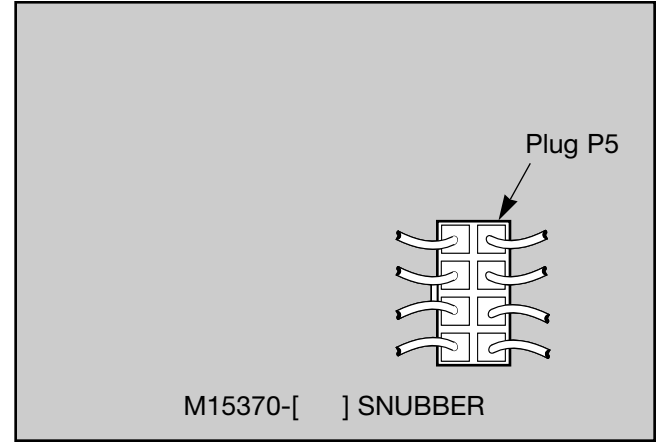
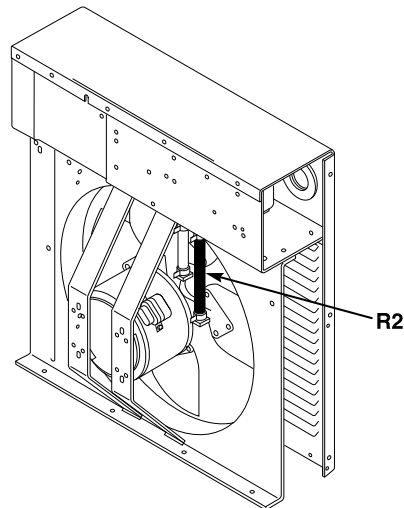


FIGURE F.14 – RESISTOR R2 LOCATION



TEST PROCEDURE

1. Disconnect the main input supply power to the machine.
2. With the 5/16" nut driver, remove the case top and sides. Remove the screws holding the front panel and lower the panel.
3. Disconnect the welding cables from the welding output terminals.
4. Locate and remove molex plug P3 from the control board. See Figure F.12.
5. Locate and remove molex plug P5 from the snubber board. See Figure F.13.
6. Locate and remove lead #204 from resistor R2 (7.5 ohms, 100 Watts). See Figure F.14.
7. Using 9/16" wrench, remove the positive capacitor strap lead and small lead terminal from the positive rectifier plate and output shunt junction. See Figure F.10.

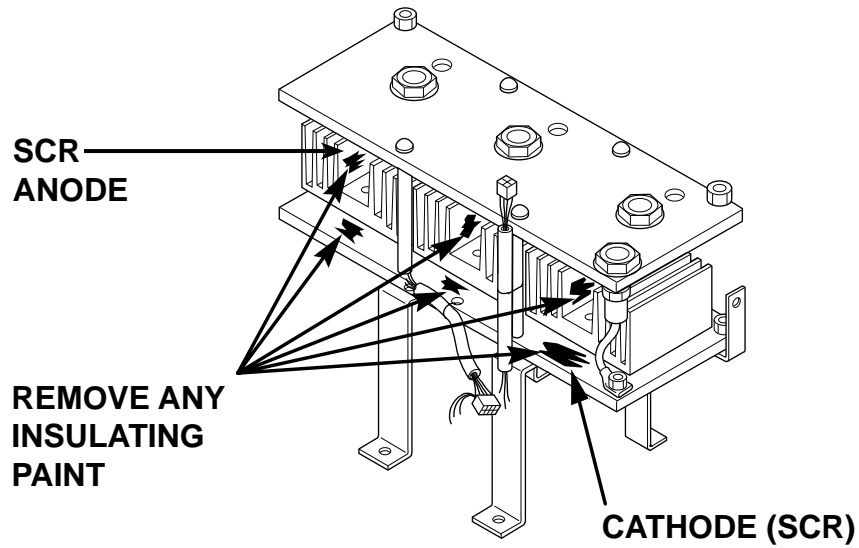
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TROUBLESHOOTING & REPAIR

ACTIVE SCR TEST (continued)

FIGURE F.15 – HEAT SINK TEST POINTS



8. Remove any red insulating paint from the heat sink test points. See Figure F.15.

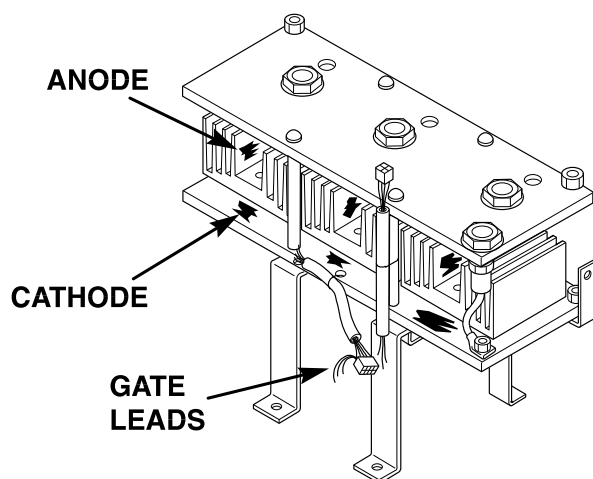
NOTE: Do not disassemble the heat sinks.

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ACTIVE SCR TEST (continued)

FIGURE F.16 – SCR TESTER CIRCUIT AND SCR CONNECTIONS



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

9. Construct the circuit shown in Figure F.16. One 6-volt lantern battery can be used., Set voltmeter scale low, at approximately 0-5 volts or 0-10 volts.
10. Test the voltage level of the battery. Short leads (A) and (C). Close switch SW-1. Battery voltage should be 4.5 volts or higher. If lower, replace the battery.
11. Connect the tester to the SCR 1 as shown in Figure F.16.
 - a. Connect tester lead (A) to the anode.
 - b. Connect tester lead (C) to the cathode.
 - c. Connect tester lead (G) to the gate.
12. Close switch SW-1.

NOTE: Switch SW-2 should be open.
13. Read meter for zero voltage.
 - a. If the voltage reading is higher than zero, the SCR is shorted.
14. Close or keep closed switch SW-1.
15. Close switch SW-2 for 2 seconds. Release and read meter.
 - a. If the voltage is 3-6 volts while the switch is closed and after the switch is open, the SCR is functioning.
 - b. If the voltage is 3-6 volts only when the switch is closed or if there is no voltage when the switch is closed, the SCR is defective.
16. Open switch SW-1.
17. Reconnect the tester leads. See Figure F.16.
 - a. Connect tester lead (A) to the cathode.
 - b. Connect tester lead (C) to the anode.
 - c. Disconnect test lead (G) from the gate.
18. Close switch SW-1.
19. Read meter for zero voltage.
 - a. If the voltage is zero, the SCR is functioning.
 - b. If the voltage is higher than zero, the SCR is shorted.
20. Perform the Active Test Procedure outlined in Steps 11-19 for SCRs 2 and 3.
21. Replace all SCR assemblies that do not pass the above tests.
22. Replace all moxex plugs onto the control board and snubber board. Reconnect positive capacitor lead and small lead terminal.
23. Reconnect lead #204 to resistor R2.

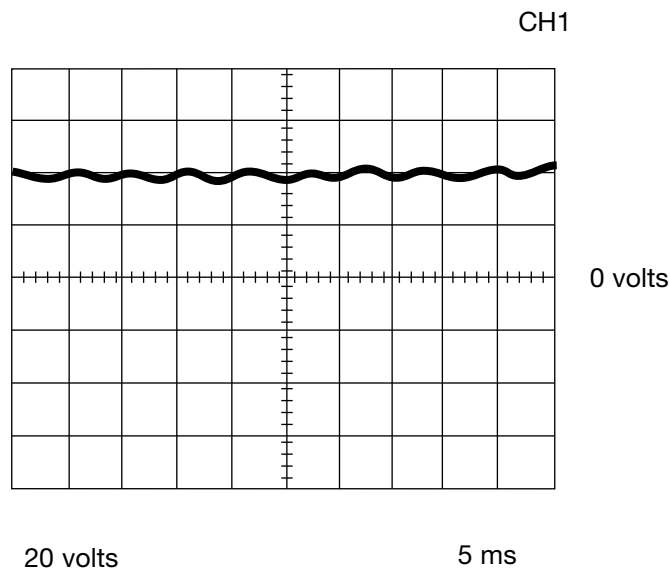
NOTE: Be sure the battery is functioning properly. A low battery can affect the results of the test. Repeat Battery Test Procedure in Step 10 if needed.

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TROUBLESHOOTING & REPAIR

TYPICAL OUTPUT VOLTAGE WAVEFORM – MACHINE LOADED



This is the typical DC open circuit voltage waveform generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time. The machine was loaded with a resistance grid bank. The CV-400 meters read 400 amps at 36 VDC.

Note: Scope probes connected at machine output terminals: (+) probe to positive terminal, (-) probe to negative terminal.

SCOPE SETTINGS

Volts/Div.....	20V/Div.
Horizontal Sweep.....	5 ms/Div.
Coupling	DC
Trigger	Internal

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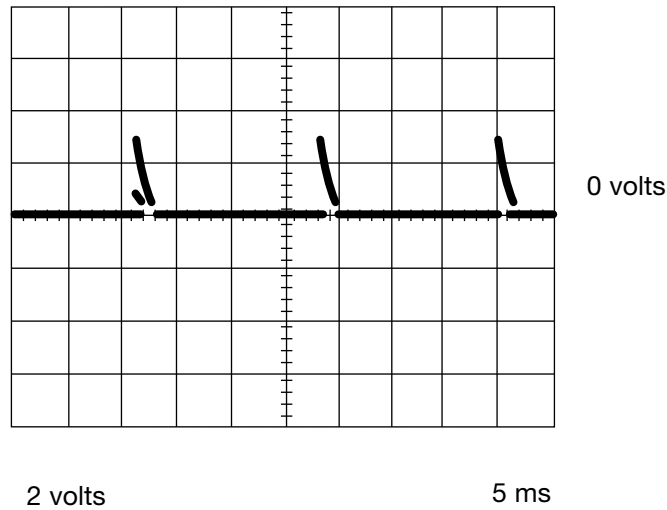
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TROUBLESHOOTING & REPAIR

TYPICAL SCR GATE VOLTAGE WAVEFORM

MAXIMUM OUTPUT SETTING – NO LOAD

CH1



This is the typical SCR gate pulse voltage waveform. The machine was in an open circuit condition (no load) and operating properly. Note that each vertical division represents 2 volts and that each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at SCR gate and cathode: (+) probe to gate, (-) probe to cathode.

SCOPE SETTINGS

Volts/Div.....	2V/Div.
Horizontal Sweep.....	5 ms/Div.
Coupling	DC
Trigger	Internal

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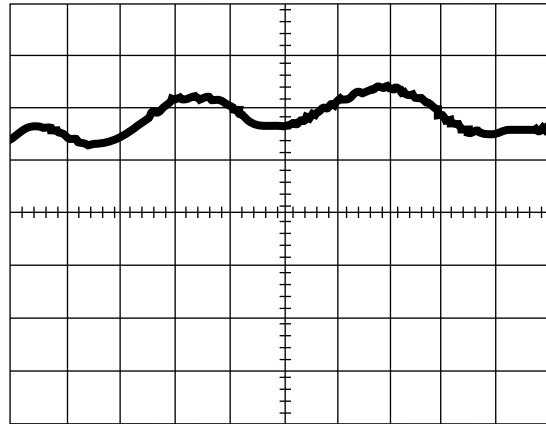
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TROUBLESHOOTING & REPAIR

ABNORMAL OUTPUT VOLTAGE WAVEFORM - MACHINE LOADED

ONE OUTPUT SCR NOT FUNCTIONING

CH1



20 volts

5 ms

This is NOT the typical DC output voltage waveform. One output SCR is not functioning. Note the “ripple” in the waveform. One SCR gate is disconnected to simulate an open or non-functioning output SCR. Each vertical division represents 20 volts and each horizontal division represents 5 milliseconds in time. The machine was loaded with a resistance grid bank. The CV-400 meters read 400 amps at 36 VDC.

Note: Scope probes connected at machine output terminals: (+) probe to positive terminal, (-) probe to negative terminal.

SCOPE SETTINGS

Volts/Div.....	20V/Div.
Horizontal Sweep.....	5 ms/Div.
Coupling	DC
Trigger	Internal

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TROUBLESHOOTING & REPAIR

INPUT CONTACTOR (CR1) CLEANING/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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in inspecting, cleaning, and replacing the input contactor.

MATERIALS NEEDED

- Phillips head screwdriver
- 5/16" Socket wrench
- Flat head screw driver
- 7/16" Socket wrench
- Low pressure air source

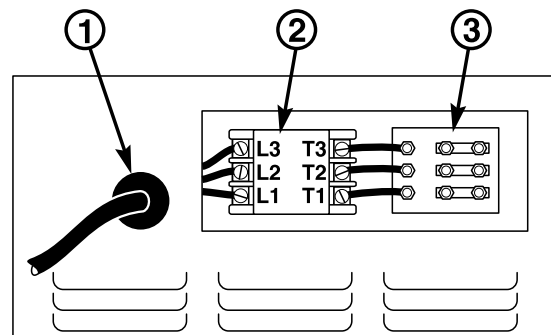
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TROUBLESHOOTING & REPAIR

INPUT CONTACTOR (CR1) CLEANING/REPLACEMENT *(continued)*

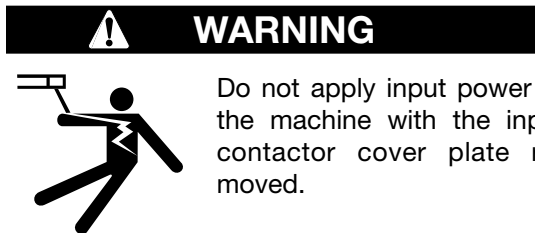
FIGURE F.17 – INPUT CONTACTOR CLEANING AND REMOVAL



1. INPUT SUPPLY LINE
2. INPUT CONTACTOR CR1
3. RECONNECT PANEL

CLEANING PROCEDURE

1. Remove the main input supply power to the machine and remove the input access panel.
2. Locate and get access to the input contactor (CR1) in the input box. See Figure F.17.
3. Remove the input contactor cover plate using a phillips head screwdriver.



WARNING

Do not apply input power to the machine with the input contactor cover plate removed.

4. Blow out any dirt or dust in or around the contacts with a low pressure air stream.
5. Inspect the contacts for signs of excessive wear, pitting, or contacts fused (stuck) together.
 - a. If any of these conditions are present, replace the input contactor assembly.
6. Replace the input contactor cover plate.

CONTACTOR REPLACEMENT PROCEDURE

1. Disconnect main input supply power to the machine.
2. Locate and get access to the input contactor (CR1) in the input box. See Figure F.17.
3. Disconnect the main input supply power leads L1, L2, and L3 to the input contactor.

Remove the control transformer primary leads H1, H2 or H3 (dependent on input voltage) from L1 and L3 terminals on the input side of the contactor.

4. Using the 7/16" socket wrench, disconnect the output leads T1, T2, and T3 from the input contactor. (Label the leads.)
5. Identify and label the leads connected to the input contactor coil. See the Wiring Diagram.
6. Disconnect the leads from the input contactor coil (leads X1, #232 and #233). See the Wiring Diagram.
7. Remove the three self-tapping mounting screws using a 5/16" socket wrench. See Figure F.17.
8. Remove the input contactor.
9. Insert the replacement input contactor and install it following the procedures in reverse order.

NOTE: Be sure to reconnect all leads correctly.

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TROUBLESHOOTING & REPAIR

FAN MOTOR AND BLADE 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in gaining access to the fan blade and fan motor for maintenance or replacement.

MATERIALS NEEDED

- 5/16" Nut driver
- 3/8" Wrench
- Allen head type wrench

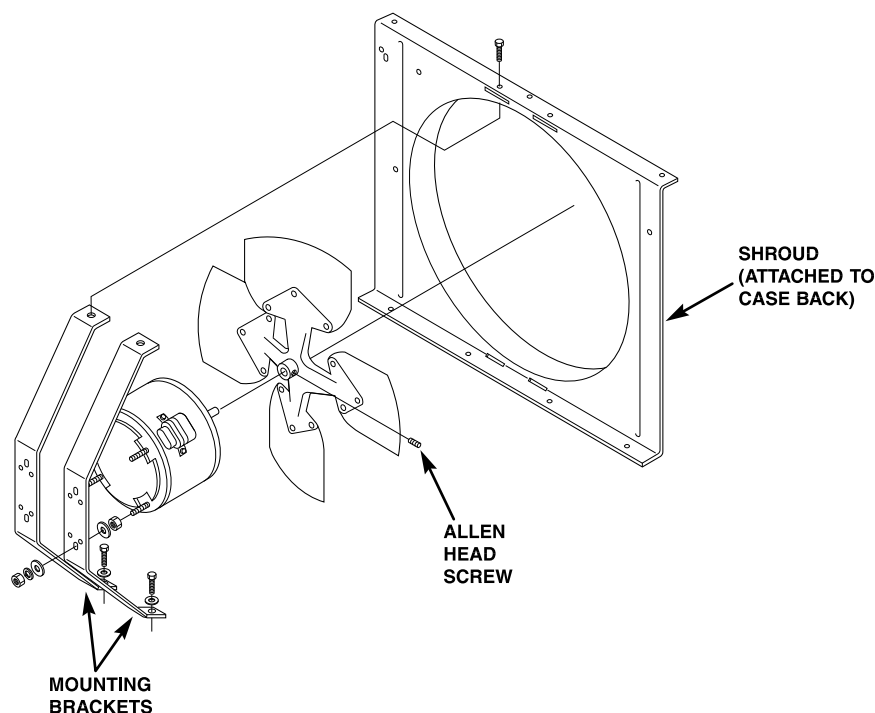
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TROUBLESHOOTING & REPAIR

FAN MOTOR AND BLADE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.18 – FAN MOTOR MOUNTING DETAILS



PROCEDURE

1. Remove the main input supply power to the machine.
2. Using the 5/16" nut driver, remove the case top and sides.
3. The fan blade can be removed using the Allen head wrench.

NOTE: You may need to loosen the machine case back to gain clearance to remove the fan. See Figure F.18.
4. If the fan motor is to be removed, the leads to the motor must be disconnected. This will require cutting the wires or "breaking the splice."
5. Remove the four mounting nuts and associated flat and lock washers that hold the motor to the mounting bracket. See Figure F.18.
6. Carefully remove the fan motor.
7. To replace the fan motor, mount the motor to its mounting bracket using the four nut and associated flat and lock washers.
8. Resplice any motor leads cut for removal. Soldering the wires is recommended.
9. Reattach the fan blade, if it was removed earlier, using the Allen head wrench to tighten it to the motor shaft.
10. Install the case top and sides.

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TROUBLESHOOTING & REPAIR

SCR/DIODE RECTIFIER ASSEMBLY 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in the removal and replacement of the SCR/diode assembly.

MATERIALS NEEDED

- 5/16" Nut driver
- 7/16" Wrench
- 1/2" Wrench
- 9/16" Wrench
- 3/8" Wrench
- Slot head screw driver
- 1/2" Socket and extension

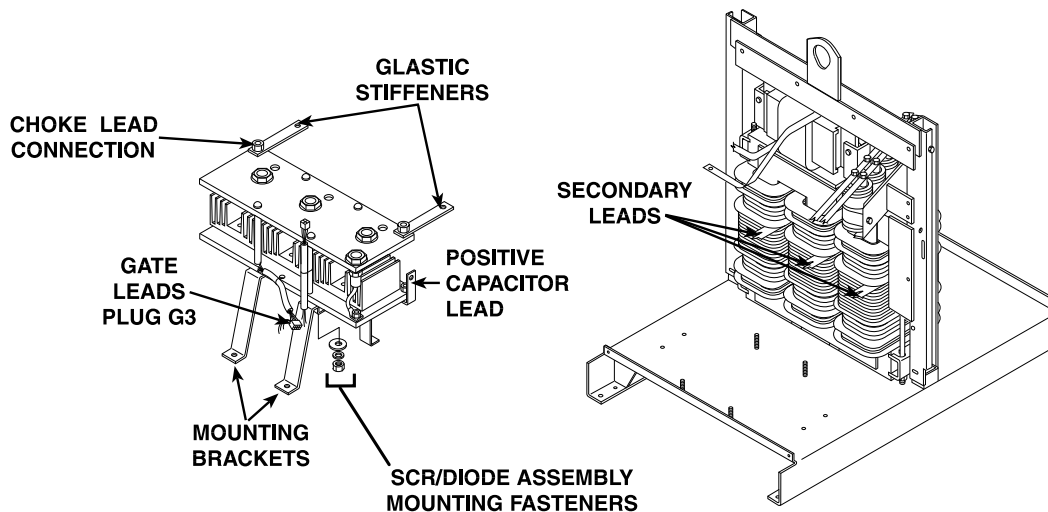
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TROUBLESHOOTING & REPAIR

SCR/DIODE RECTIFIER ASSEMBLY REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.19 – SCR/DIODE ASSEMBLY DETAILS



PROCEDURE

1. Remove the main input supply power to the machine.
2. With the 5/16" nut driver, remove the case top and sides.
3. Remove the glastic stiffeners (one on right side-two on left side). See Figure F.19.
4. Remove lead #220 from the right side of the negative heat sink plate.
5. Remove the positive capacitor lead and shunt from the positive heat sink plate. See Figure F.19.
6. Remove the choke and negative capacitor leads from the left side of the negative heat sink plate. See Figure F.19.
7. Remove the gate leads from the control board (plug P3).
8. Remove plug P5 from the snubber board. Also remove lead #224 from the positive output lead. Remove lead #225 from the negative output lead. Remove the green ground lead from the front panel.
9. Remove the three heavy aluminum secondary leads from the SCR finned heat sinks.
10. Remove the four nuts and associated washers that hold the SCR/diode assembly to the mounting brackets.
11. Carefully lift and remove the SCR/diode heat sink assembly from the machine. Note: It may be necessary to loosen the four sheet metal screws that hold the front panel to the base. Carefully lift and pull out the front panel to allow clearance for SCR/diode assembly removal. Clear any necessary leads that might hinder removal.
12. For reassembly, carefully place the SCR/diode assembly into position on the mounting bracket and reinstall the washers and nuts. Tighten the front panel to base if it was loosened earlier.
13. Replace and tighten the four nuts and lock-washers that hold the SCR/diode assembly to the mounting brackets.
14. Reattach the three heavy aluminum secondary leads to the SCR finned heat sinks. Apply a thin coating of Dow Corning 340 heat sink compound (Lincoln E1868) to connection points.
15. Connect the green ground lead to the front panel, lead #225 to the negative output lead, and lead #224 to the positive output lead.
16. Connect plug P5 to the snubber board and plug P3 to the control board.
17. Connect the choke and negative capacitor lead to the left side of the negative heat sink plate. See Figure F.19. Apply a thin coating of Dow Corning 340 heat sink compound (Lincoln E1868) to connection points.
18. Connect the positive capacitor lead and shunt to the positive heat sink plate. See Figure F.19.
19. Install the glastic stiffeners to the left and right sides. See Figure F.19. Apply a thin coating of Dow Corning 340 heat sink compound (Lincoln E1868) to connection points.
20. Install the case top and sides.

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TROUBLESHOOTING & REPAIR

SCR 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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the SCRs from the output rectifier heat sink for maintenance or replacement.

MATERIALS NEEDED

- NO.000 Fine Steel Wool
- Penetrox A-13 (Lincoln E2529) or Penetrox A
- 7/16" Open end wrench
- Allen head type wrenches

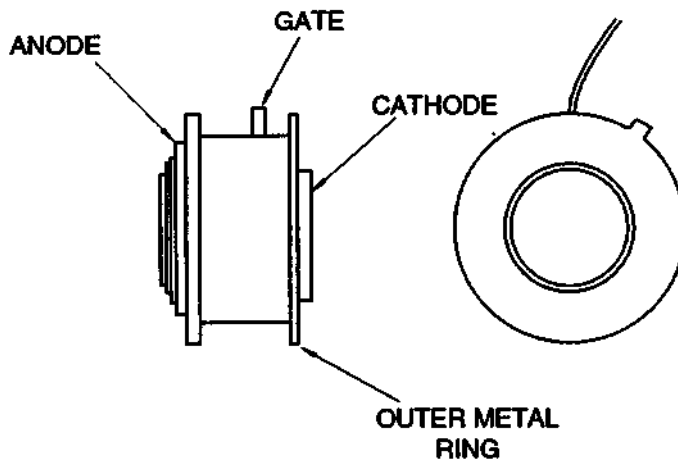
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TROUBLESHOOTING & REPAIR

SCR REMOVAL AND REPLACEMENT (continued)

FIGURE F.20 - SCR DETAILS



SPECIAL INSTRUCTIONS

NOTE: Before disassembling the existing rectifier, note toward which heat sink the outer metal ring of the power SCR is mounted. Also, note the positioning of the gate lead of the SCR. Failure to reinstall the new SCR in the same orientation as the original may result in subsequent damage to the new SCR and other components of the welder. See Figure F.20.

CAUTION

The unclamping and clamping procedure outlined below is critical for the prevention of internal SCR damage. Failure to follow this procedure may result in subsequent damage of the SCR. Handle all SCRs with care.

PROCEDURE

1. Remove the main input supply power to the machine.
2. Perform the **SCR/Diode Rectifier Assembly Removal and Replacement** procedure.
3. Alternately loosen nuts 1/2 turn each until heat sinks are loose. Remove nuts and leaf spring. IT IS RECOMMENDED THAT NEW HARDWARE, LEAF SPRING AND HOUSING BE USED FOR REASSEMBLY.
4. Remove the old SCR.

5. Clean the area on the heat sink around the SCR mounting surface, using a putty knife or similar tool. DO NOT SCRATCH THE SCR MOUNTING SURFACE.
6. Polish each heat sink's mounting surface using NO. 000 fine steel wool. Wipe surface clean with a lint-free cloth or paper towel.
7. Inspect the mounting surfaces of each new SCR.
 - a. Remove all burrs and wipe clean. Do not use steel wool or any abrasive cleanser on the SCR mounting surfaces.
8. Apply a thin (0.001" to 0.003") layer of PENETROX A-13 (Lincoln Electric #E2529) or PENETROX A, heat sink compound, to each heat sink's SCR mounting surface.
 - a. Care must be used to prevent foreign material contamination of the SCR to heat sink junction.
9. Place the new SCR between the heat sinks. Be sure that the outer metal ring of the SCR is facing toward the same heat sink as the old SCR's metal ring. Be sure that the roll pin of the heat sink engages the "hole" in the SCR. The SCR contact surfaces must sit flat against both heat sink surfaces.

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SCR REMOVAL AND REPLACEMENT (continued)

FIGURE F.21 – 1/2" WIDE LEAF SPRING

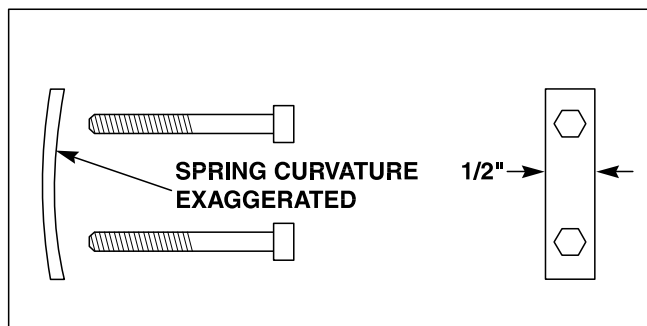
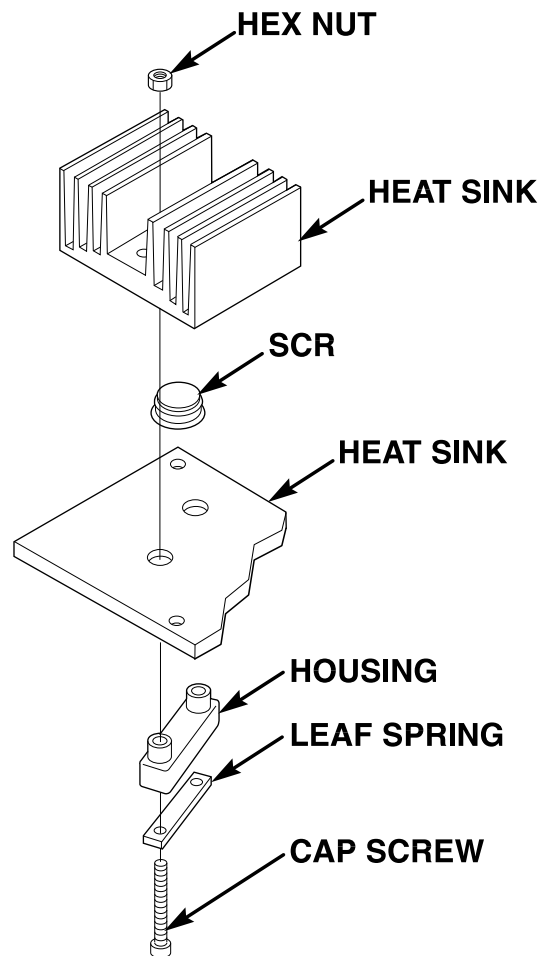


FIGURE F.22 – CLAMP ASSEMBLY



- Go to the procedure below that matches your machine's cap screws. NOTE WHICH THREAD IS ON YOUR CAP SCREWS BEFORE PROCEEDING TO THE ASSEMBLY PROCEDURE. Two different designs of leaf springs and housings have been used to clamp the SCR to the rectifier. The two different designs can be identified by the size of the leaf spring. One design uses a 1/2 inch wide leaf spring, and the other uses a 5/8 inch wide spring. The different designs require different assembly and clamping procedures. The assembly procedure will be different depending upon the thread on the cap screws. A 1/4-28 thread requires a different tightening procedure than a 1/4-20 thread.

PROCEDURE FOR THE 1/2 INCH WIDE SPRING

- Place a piece of sleeving around each cap screw.
- Insert cap screws through the leaf spring. Orient the leaf spring so that its ends are curved upward toward the cap screw heads. See Figure F.21. Pressing on the cap screw heads should produce a "rocking" motion of the spring in its housing. If the spring does NOT rock, it is installed upside down. Remove the spring and turn it over. Check for "rocking" motion. See Figure F.21.
- Insert cap screws and leaf spring into the plastic housing.
- Insert clamp assembly through heat sinks. Install nuts. Tighten clamp nuts equally on cap screws until finger tight. (See Figure F.22. Heat sinks may not be exactly as pictured.)
- Reinspect the SCR for proper seating.

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TROUBLESHOOTING & REPAIR

SCR REMOVAL AND REPLACEMENT (*continued*)

CLAMPING PROCEDURE FOR 1/4-28 CAP SCREWS

NOTE: This procedure can only be used with 1/4-28 cap screws.

Do not use cap screws with any other type thread or new SCR will be damaged.

Do not over tighten cap screws. The leaf spring will apply the required clamping force to the SCR.

1. Do not turn the nuts. While holding the nuts stationary, turn the cap screws only with the following procedure.
2. Tighten first cap screw 1/4 turn.
3. Tighten second cap screw 1/2 turn.
4. Tighten first cap screw 1/2 turn.
5. Tighten second cap screw 1/2 turn.
6. Tighten first cap screw 1/4 turn. Stop.
7. Assembly now has the proper clamping force.
8. Perform the **Active SCR Test**.

CLAMPING PROCEDURE FOR 1/4-20 CAP SCREWS

NOTE: This procedure can only be used with 1/4-20 cap screws.

Do not use cap screws with any other type thread or new SCR will be damaged.

Do not over tighten cap screws. The leaf spring will apply the required clamping force to the SCR.

1. Do not turn the nuts. While holding the nuts stationary, turn the cap screws only with the following procedure.
2. Tighten first cap screw 1/4 turn.
3. Tighten second cap screw 1/2 turn.
4. Tighten first cap screw 1/2 turn.
5. Tighten second cap screw 1/4 turn. STOP.
6. Assembly now has the proper clamping force.
7. Perform the **Active SCR Test**.

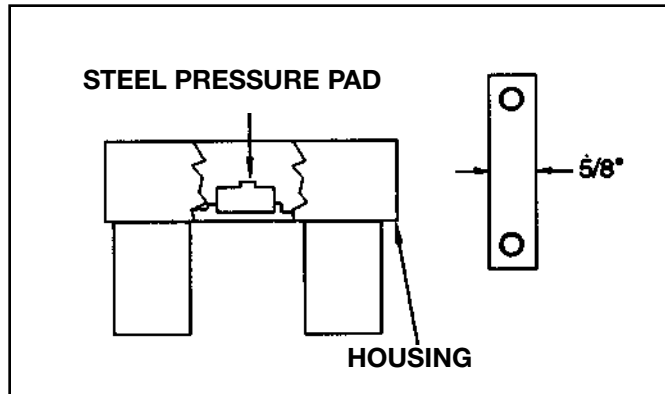
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TROUBLESHOOTING & REPAIR

SCR REMOVAL AND REPLACEMENT (continued)

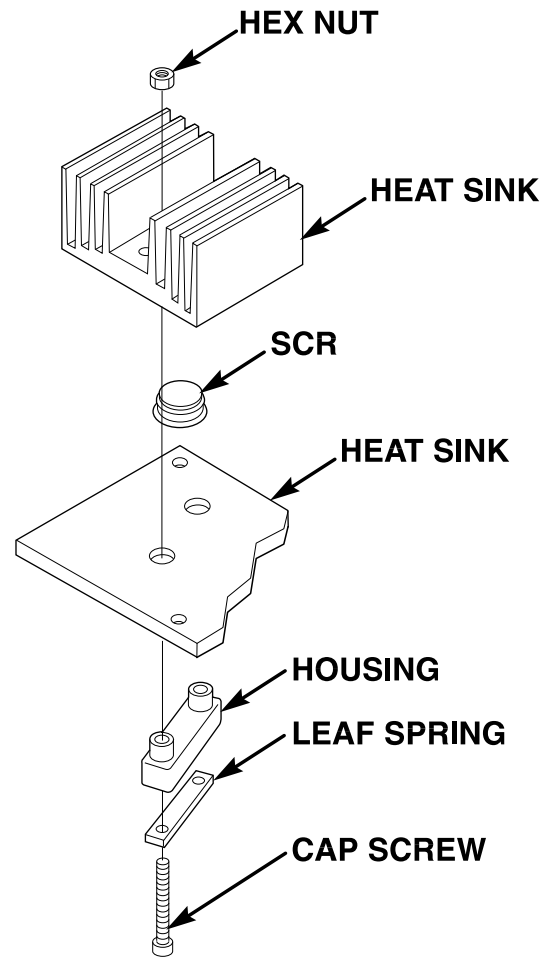
FIGURE F.23 – HOUSING AND PRESSURE PAD FOR 5/8" WIDE LEAF SPRING



PROCEDURE FOR THE 5/8 INCH WIDE SPRING

1. Place a piece of sleeving around each cap screw.
2. Insert cap screws through the leaf spring. The leaf spring is flat so the orientation of the leaf spring does not matter.
3. Place the steel pressure pad in the housing with the 1/8 inch wide standoff facing up. See Figure F.23.
4. Insert cap screws and leaf spring into plastic housing being sure that the steel pressure pad remains in position. Pressing on the cap screw heads should produce a rocking action of the spring in its housing.
5. Insert the clamp assembly through the heat sinks. Install nuts. Tighten the clamp nuts equally on the cap screws until finger tight. Be sure that the leaf spring is not cocked in the housing. See Figure F.24. Heat sinks may not be exactly as pictured.
6. Reinspect the SCR for proper seating.

FIGURE F.24 – CLAMP ASSEMBLY



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TROUBLESHOOTING & REPAIR

SCR REMOVAL AND REPLACEMENT (*continued*)

CLAMPING PROCEDURE FOR 1/4-28 CAP SCREWS

NOTE: This procedure can only be used with 1/4-28 cap screws.

Do not use cap screws with any other type thread or new SCR will be damaged.

Do not over tighten cap screws. The leaf spring will apply the required clamping force to the SCR.

1. Do not turn the nuts. While holding the nuts stationary, turn the cap screws only with the following procedure.
2. Tighten first cap screw 1/4 turn.
3. Tighten second cap screw 1/2 turn.
4. Tighten first cap screw 1/2 turn.
5. Tighten second cap screw 1/2 turn.
6. Tighten first cap screw 1/2 turn.
7. Tighten second cap screw 1/4 turn. STOP.
8. Assembly now has the proper clamping force.
9. Perform the **Active SCR Test**.

AFTER REPLACING THE SCRs

Follow the steps in the **SCR/Diode Rectifier Removal and Replacement** procedure to reassemble the machine.

CLAMPING PROCEDURE FOR 1/4-20 CAP SCREWS

NOTE: This procedure can only be used with 1/4-20 cap screws.

Do not use cap screws with any other type thread or new SCR will be damaged.

Do not over tighten cap screws. The leaf spring will apply the required clamping force to the SCR.

1. Do not turn the nuts. While holding the nuts stationary, turn the cap screws only with the following procedure.
2. Tighten first cap screw 1/4 turn.
3. Tighten second cap screw 1/2 turn.
4. Tighten first cap screw 1/2 turn.
5. Tighten second cap screw 1/4 turn.
6. Tighten first cap screw 1/8 turn.
7. Tighten second cap screw 1/8 turn. STOP.
8. Assembly now has the proper clamping force.
9. Perform the **Active SCR Test**.

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TROUBLESHOOTING & REPAIR

MOUNTING OF STUD TYPE DIODES TO ALUMINUM HEAT SINKS



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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in mounting stud type diodes to the aluminum heat sinks on the DC-400.

MATERIALS NEEDED

- 5/16" Nut driver
- 1/2" Open end wrench
- Lincoln E1868 (Dow Corning 340) Heat Sink Compound
- "Slip" type torque wrench
- No. 000 fine steel wool

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TROUBLESHOOTING & REPAIR

MOUNTING OF STUD TYPE DIODES TO ALUMINUM HEAT SINKS *(continued)*

PROCEDURE

1. Remove the main input supply power to the machine.
2. With the 5/16" nut driver, remove the case top and sides.
3. Loosen the appropriate diode nut and remove the diode that is to be replaced.
4. Clean the area on the heat sink around the diode mounting surface using a putty knife or similar tool. DO NOT SCRATCH THE DIODE MOUNTING SURFACE.
5. Polish each heat sink's mounting surface using No. 000 fine steel wool. Wipe the surface clean with a lint-free cloth or paper towel.
6. Inspect the mounting surfaces of each new diode. Remove all burrs and wipe clean. Do not use steel wool or any abrasive cleanser on the diode mounting surface.
7. Apply a thin (0.003" to 0.007") uniform layer of E1868 (Dow Corning 340) heat sink compound to the heat sink mounting surface.
 - a. Do not apply compound to the diode stud or mounting threads.
 - b. The diode threads must be clean and free of defects so that the nut can be finger tightened before applying torque. A "slip" type torque wrench must be used to tighten the diode nut.
8. Tighten the diode nuts to the specifications in the following table.
 - a. Start the nuts for diodes with steel studs by hand and then torque them according to the following table.
 - b. Run the nuts for diodes with copper studs on all the way by hand then torque them according to the following table.
 - c. Turn the nuts a minimum of 1/2 turn more while torquing.
9. Install the case top and sides.

DIODE STUD SIZE	FOOT-POUNDS	INCH-POUNDS
3/4-16	25-27	300-324
3/8-24	10±.5	125+0/-5
1/4-28		22-25

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TROUBLESHOOTING & REPAIR

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 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the main transformer for maintenance or replacement.

MATERIALS NEEDED

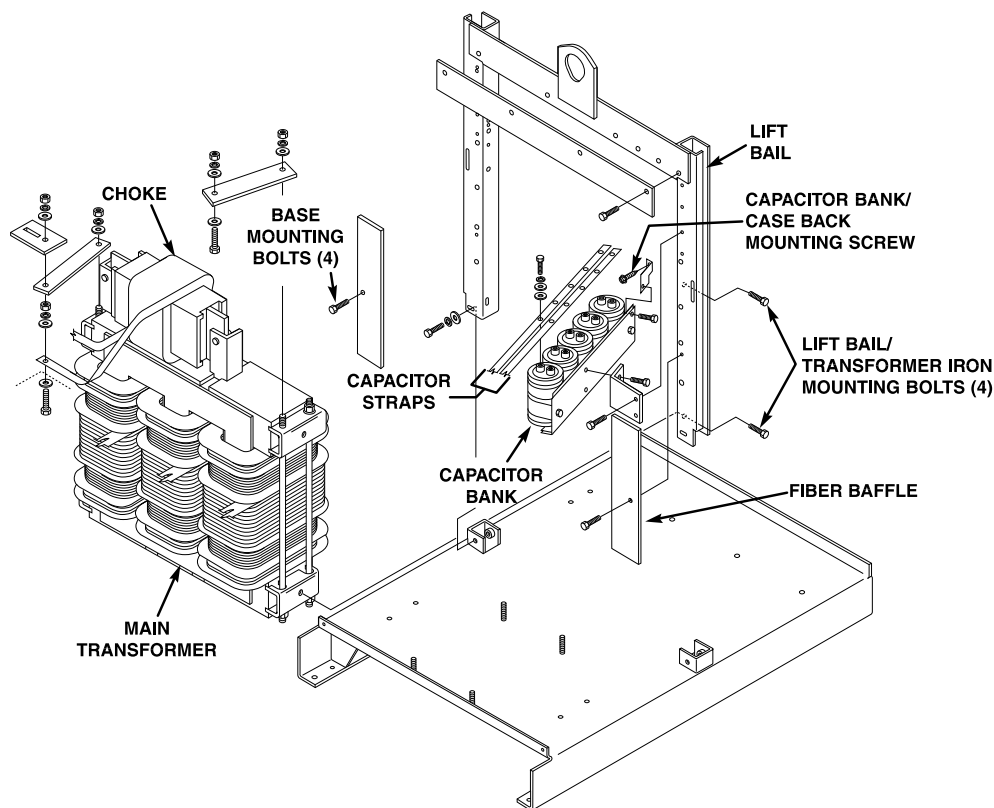
- 5/16" Nut driver
- 9/16" Socket wrench
- 9/16" Box end wrench
- 1/2" Socket wrench
- 1/2" Box end wrench
- 3/8" Nut driver or socket wrench
- 9/16" Deep well socket wrench

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MAIN TRANSFORMER REMOVAL & REPLACEMENT (continued)

FIGURE F.25 – LIFT BAIL REMOVAL



REMOVAL OF LIFT BAIL

1. Remove the main input supply power to the machine.
2. With the 5/16" nut driver, remove the case top and sides.
3. Remove the two fiber baffles from the left and right sides of the lift bail adjacent to the main transformer. See Figure F.25.
4. Remove the two leads (#220 and #204) from resistor R2 (7.5 ohms, 100 watts).
5. Remove the positive capacitor strap from the output shunt.
6. Remove the negative capacitor strap from the negative rectifier plate.
7. Remove the sheet metal screw that holds the capacitor bank assembly to the case back. (This should enable the capacitor bank to be removed with the lift bail assembly.)

8. Using the 9/16" socket wrench, remove the four bolts (left and right) mounting the lift bail to the transformer top and bottom irons.
9. Using the 9/16" socket wrench, remove the four bolts, flat washers, and lock washers mounting the lift bail assembly to the base of the machine.

WARNING

The transformer and choke assembly is now loose and free to slide or "tip" on the base of the machine.

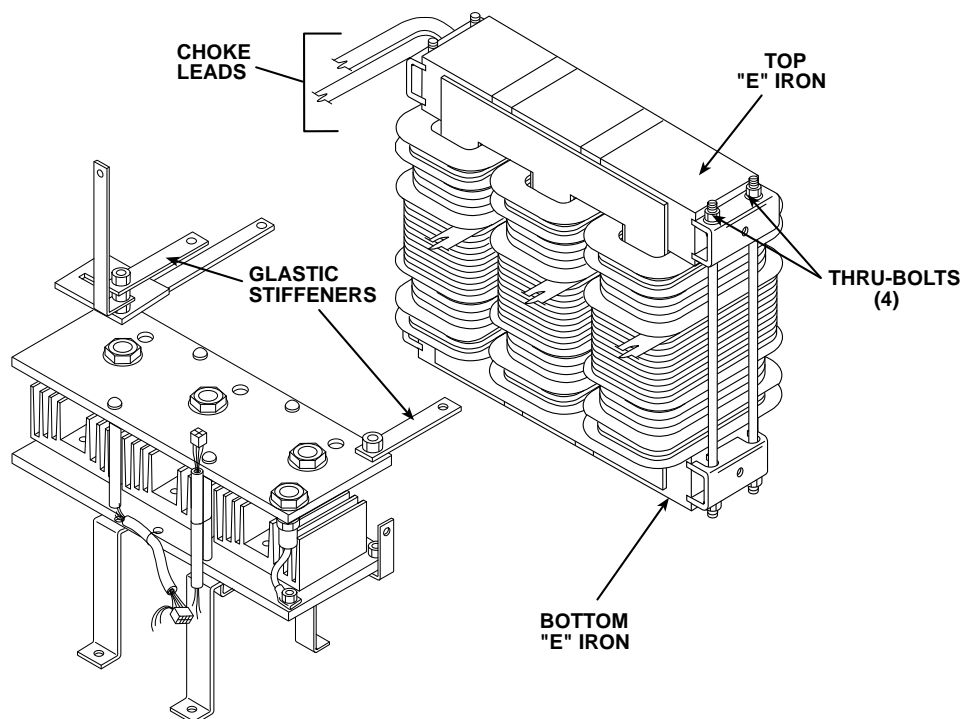
10. Remove the lift bail by lifting straight up and clear from the machine.

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MAIN TRANSFORMER REMOVAL & REPLACEMENT *(continued)*

FIGURE F.26 – CHOKE REMOVAL



REMOVAL OF CHOKE AND TOP IRON ASSEMBLY

1. Remove the three (two left and one right) glastic stiffeners connecting the negative rectifier plate and choke assembly to the main transformer thru-bolts. See Figure F.26.
2. Remove the top choke lead from the negative rectifier plate.
3. Remove the bottom choke lead from the negative output terminal.
4. Using the 9/16" deep well socket wrench, remove the four thru-bolts that clamp the top "E" iron and choke assembly to the bottom "E" iron. NOTE: for easier reassembly, clean the threads.
5. Using a hoist, carefully lift the choke and top iron assembly out and clear of the transformer coils.

NOTE: The coils may be "stuck" to the top iron and may require some careful prying to dislodge them. Depending upon which coil(s) are to be replaced, it may be advantageous to remove some of the "stuck" coils with the top iron.

6. The leads from the coils that are to be removed and/or replaced must be disconnected. See the Wiring Diagram.

When aluminum leads are re-connected, apply a thin layer of Dow Corning 340 Heat Sink Compound (Lincoln E1868) to mating surfaces.

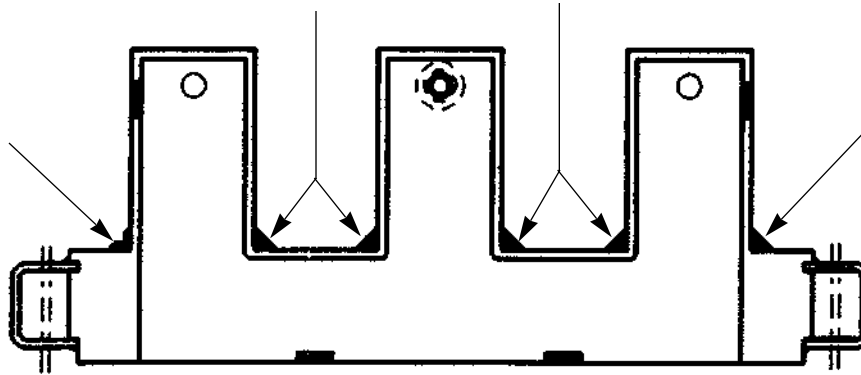
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TROUBLESHOOTING & REPAIR

MAIN TRANSFORMER REMOVAL & REPLACEMENT *(continued)*

FIGURE F.27 – EPOXY MIX APPLICATION AREAS



REASSEMBLY OF TRANSFORMER COILS

NOTE: The following procedure describes a complete replacement of all primary and secondary transformer coils. Adapt the procedure for the specific coils you may be replacing.

1. Apply a coating of Lincoln Electric E2547 Epoxy Mix along both sides of the bottom iron (lamination) assembly in the areas where the coil sides will be mounted. Coat the areas no closer than .38 inches from the top edge of the iron. See Figure F.27, arrows. Be sure that none of the epoxy drips onto the top of the iron assembly where it will meet the top assembly.

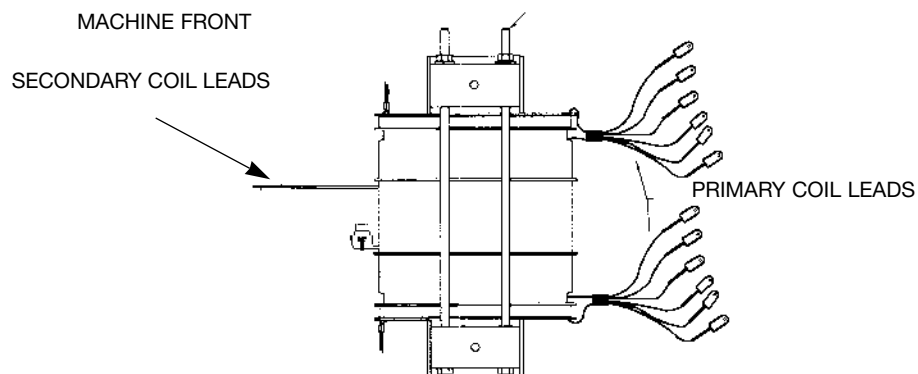
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TROUBLESHOOTING & REPAIR

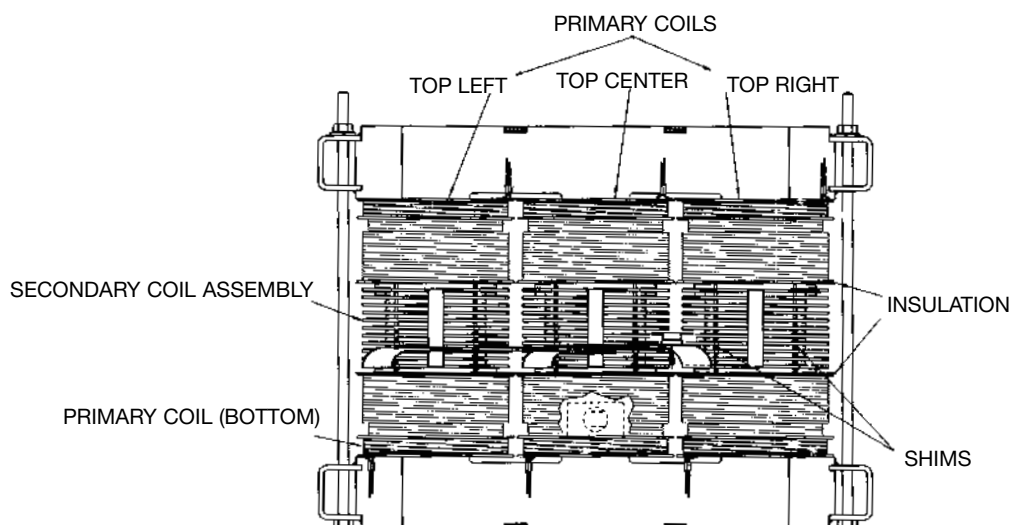
MAIN TRANSFORMER REMOVAL & REPLACEMENT (continued)

FIGURE F.28 – COIL LEAD PLACEMENT



3. Install the bottom primary coils, one on each of the three legs of the bottom iron assembly. The coils must be in correct position (left, center, right). Place the coils so that the leads come out at the back of the machine. See Figure F.28 for proper positioning.
4. Place insulation (Lincoln Electric part number S20728) on top of each of the three primary coils. The longer side of the insulation should be placed toward the front of the machine. See Figure F.29 for the location of this insulation
5. Place the three secondary coils on top of the insulation installed in Step 4. The leads should come out at the front of the machine with the short leads on top. See F.28 for proper positioning.
6. Insert shims (Lincoln Electric part number CI001250 or CI000317) between the secondary coil sides and the iron assembly on either side of the legs. See Figure F.29.
7. Place insulation (Lincoln Electric part number S20728) on top of each of the three secondary coils. The longer side of the insulation should be placed toward the front of the machine, where the secondary start and finish leads come out. See Figure F.29.
8. Install the three top primary coils, noting which is right, left, and center. Leads should come out at the back of the machine. See Figure F.28 for proper positioning. The coils must be in correct position (left, center, right).
9. Install the top iron (lamination) and choke assembly. With the 9/16" deep well socket wrench, reassemble the four thru-bolts that clamp the top "E" iron to the bottom "E" iron. Lightly tap on the top of the iron with a hammer before tightening. Tighten the nuts and thru bolts to 19-25 lb-ft.

FIGURE F.29 – COIL INSULATION



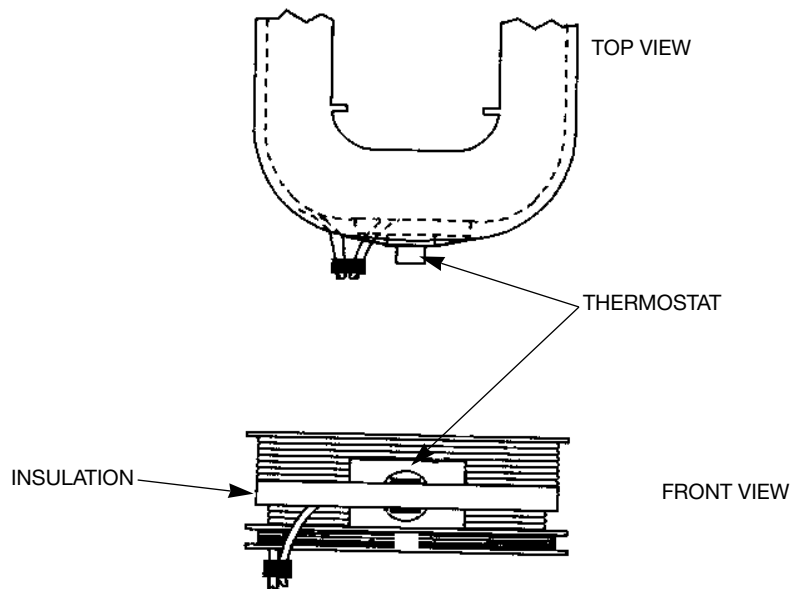
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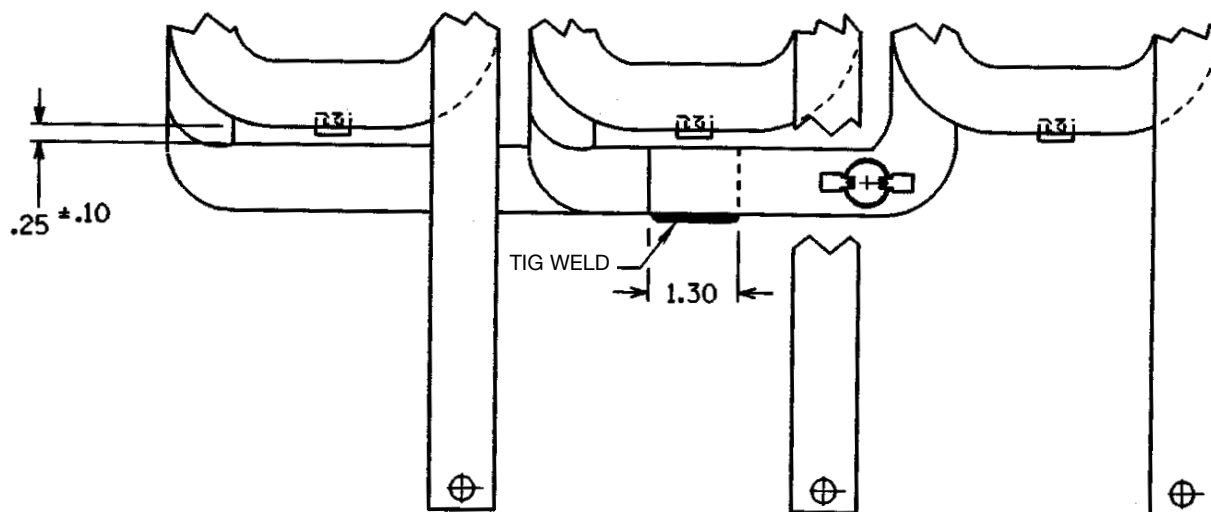
MAIN TRANSFORMER REMOVAL & REPLACEMENT *(continued)*

FIGURE F.30 – PRIMARY THERMOSTAT LOCATION



- 10. Mount the primary thermostat to the lead end coil nose. See Figure F.30. Place a small amount of Lincoln Electric E1603 Epoxy between the coil nose and the coil insulation and between the insulation and the thermostat. Hold the thermostat in place with E2381 (.375" wide) tape. If necessary, after assembly protect the thermostat terminals with E2547 terminal boots.
- 11. If necessary, trim off excess secondary lead stickout and TIG weld the leads together. See Figure F.31.

FIGURE F.31 – SECONDARY LEAD TRIM AND WELD DETAIL



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TROUBLESHOOTING & REPAIR

MAIN TRANSFORMER REMOVAL & REPLACEMENT *(continued)*

REASSEMBLING THE MAIN TRANSFORMER INTO THE MACHINE

NOTE: The following procedure assumes you have completely reassembled the transformer coils as described in the procedure above. The lower iron has remained in place in the machine. See Figures F.25 and F.26.

1. Attach the bottom choke lead to the negative output terminal.
2. Attach the top choke lead to the negative rectifier plate.

REASSEMBLE THE LIFT BAIL

1. Carefully position the lift bail onto the machine base. Using the 9/16" socket wrench, attach the lift bail to the base of the machine with four bolts, flat washers, and lock washers.
2. Using the 9/16" socket wrench, attach the lift bail to the transformer top and bottom irons with four bolts.
3. Attach the sheet metal screw that holds the capacitor bank assembly to the case back.
4. Connect leads #220 and #204 to resistor R2.
5. Connect the negative capacitor strap to the negative rectifier plate.
6. Connect the positive capacitor strap to the output shunt and positive rectifier plate.
7. Attach the fiber baffle on the bottom choke lead.
8. Attach the two fiber baffles to the left and right sides of the lift bail, adjacent to the main transformer.
9. Install the machine case top and sides.

NOTE: When aluminum leads are reconnected, apply a thin layer of Dow Corning 340 Heat Sink Compound (Lincoln E1868) to the mating surfaces.

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TROUBLESHOOTING & REPAIR

RETEST AFTER REPAIR

Retest a machine:

- If it is rejected under test for any reason that requires you to remove any mechanical part which could affect the machine's electrical characteristics. OR
- If you repair or replace any electrical components.

INPUT IDLE AMPS AND WATTS

Input Volts/Phase/Hertz	Maximum Idle Amps	Maximum Idle KW
200/3/60	10.9	1.2
208/3/60	10.5	1.2
220/3/60	9.9	1.2
230/3/60	9.5	1.2
380/3/60	5.8	1.2
400/3/60	5.5	1.2
415/3/60	5.3	1.2
440/3/60	5.0	1.2
460/3/60	4.8	1.2
500/3/60	4.4	1.2
575/3/60	3.8	1.2
200/3/50	19.8	1.2
220/3/50	18.0	1.2
230/3/50	17.2	1.2
380/3/50	10.4	1.2
400/3/50	9.9	1.2
415/3/50	9.5	1.2
440/3/50	9.0	1.2
500/3/50	7.9	1.2

OPEN CIRCUIT VOLTAGES

Test Points	Input Hertz	Open Circuit Volts
Welding Output Terminals	60	43/47VDC
Welding Output Terminals	50	43/47VDC
Auxiliary Output (#31 - #32)	60	114/124VAC
Auxiliary Output (#31 - #32)	50	109/119VAC
Auxiliary Output (#41 - #42)	60	43.8/47.5VAC
Auxiliary Output (#41 - #42)	50	42.0/45.6VAC
Auxiliary Output (#51 - #52)	50	220/231VAC

WELDING OUTPUT LOAD TEST

Output Control Setting	Amps	Volts
Minimum	75 to 150	6 to 11
Maximum	525	more than 41.2

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ELECTRICAL DIAGRAMS

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Electrical Diagrams SectionSection G

Wiring Diagram (Codes 10084, 10085, 10086)G-2

Wiring Diagram (Code 10087)G-3

Control PC Board (G2629-1) Layout.....G-4

Control PC Board (G2629-1) SchematicG-5

Snubber PC Board (M15370-3) LayoutG-6

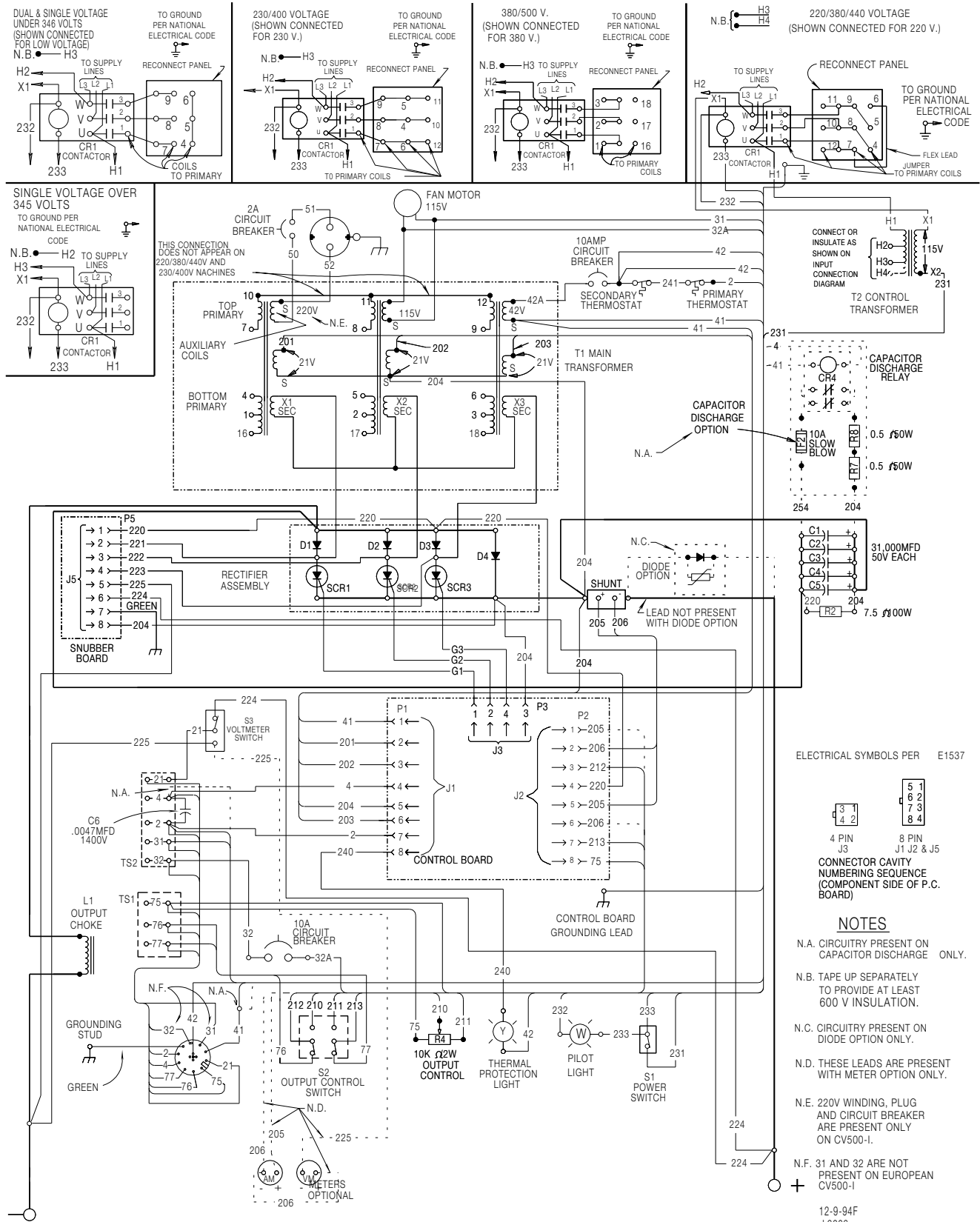
Snubber PC Board (M15370-3) SchematicG-7

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ELECTRICAL DIAGRAMS

Wiring Diagram (Codes 10084, 10085, 10086)



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

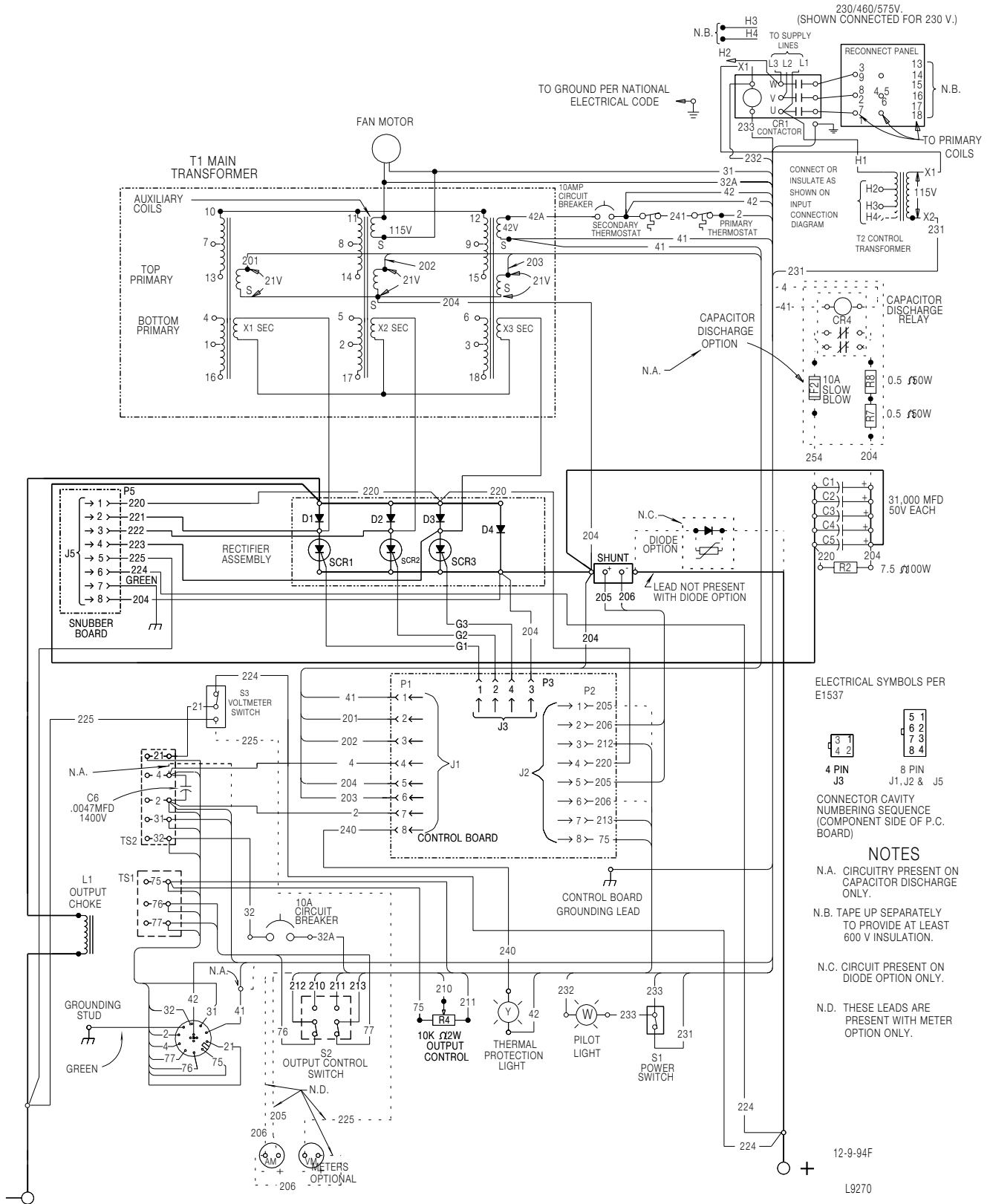
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ELECTRICAL DIAGRAMS

Wiring Diagram (Code 10087)



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

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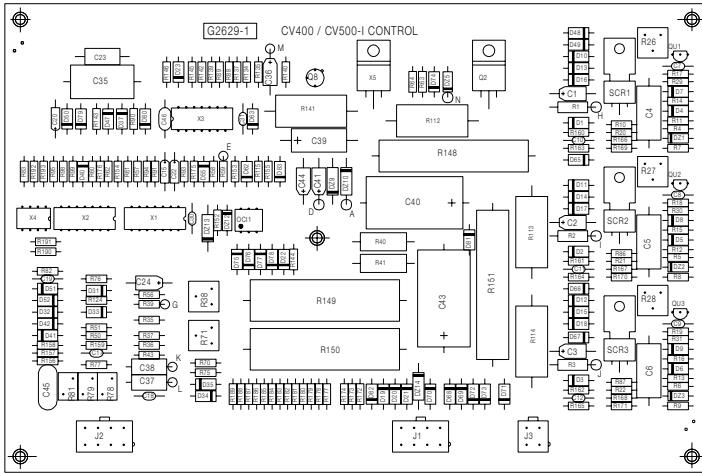
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ELECTRICAL DIAGRAMS

Control PC Board (G2629-1) Layout



ITEM	REQ'D.	PART No.	IDENTIFICATION
C1, C2, C3, C24, C36, C41, C44	7	S13490-25	4.7/35
C4, C5, C6	3	S13490-96	.15/200
C7, C8, C9, C10, C11, C12, C17 C18, C19, C30, C31	11	S16668-5	.022/50
C15, C20, C22	3	S13490-19	1.8/20
C23	1	S13490-108	.15/100
C35	1	S13490-98	.33/50
C37, C38	2	S13490-102	.047/100
C39	1	S13490-66	47/35
C40, C43	2	T11577-2	150/50
C45	1	T11577-52	.0047 or .005/1400
C46	1	S16668-11	1/50
D1, D2, D3, D4, D5, D6, D7, D8, D9 D10, D11, D12, D13, D14, D15 D16, D17, D18, D22, D23, D31 D32, D33, D34, D35, D37, D40 D41, D42, D47, D48, D49, D50 D51, D52, D55, D62, D63, D65 D66, D67, D74, D75, D76, D77 D78, D79, D80, D81, D82, D83	51	T12199-1	IN4004
D19, D20, D21, D68, D69, D70 D71, D72, D73	9	T12199-4	1N4005 DIODE
D21, D22, D23, D25	4	T12702-29	1N4744A
D29	1	T12702-50	1N5354B
D210	1	T12702-33	1N5347B
D212	1	T12702-40	1N4735
D213	1	T12702-23	1N5352B
D214	1	T12702-41	1N5359B ZENER DIODE
J1, J2	2	S18248-8	HEADER
J3	1	S18248-4	HEADER
IC1	1	S15000-10	OPTO ISOLATOR
Q2	1	T12704-54	N-CHANNEL FET (SS)
Q8	1	T12704-36	2N4857
OU1, OU2, OU3	3	T12707-4	2N6027
R1, R2, R3	3	T14231-14	27 1/2W
R4, R5, R6, R7, R8, R9, R146 R154	8	S19400-2671	2.67K 1/4W
R10, R35, R86, R87	4	S19400-4750	475 1/4W
R11, R12, R13, R29, R30, R31 R51, R56, R57, R59, R137, R153 R175	13	S19400-1003	100K 1/4W
R14, R15, R16, R76, R166, R167 R168	7	S19400-2670	267 1/4W
R17, R18, R19, R82, R93	5	S19400-4751	4.75K
R20, R21, R22, R60, R63, R190	6	S19400-1001	1K 1/4W
R26, R27, R28, R38	4	T10812-39	50K 1/2W TRIMMER
R36, R43	2	S19400-1500	150 1/4W
R37, R62, R135, R155	4	S19400-2213	221K 1/4W
R39	1	S19400-4322	43.2K 1/4W
R40, R41	2	T12732-10	2.7 1W
R50, R58, R61	3	S19400-2211	2.21K 1/4W
R64, R83, R91, R98, R124, R140 R142, R143, R144, R145, R176	11	S19400-1002	10K 1/4W
R70	1	S19400-1212	12.1K 1/4W
R71	1	T10812-41	10K 1/2W TRIMMER
R75, R152	2	S19400-1000	100 1/4W
R77, R158, R159	3	S19400-1501	1.5K 1/4W
R78, R79, R81	3	S18380-1	PTC THERMISTOR
R88	1	S19400-3322	33.2K 1/4W
R89, R99	2	S19400-4753	475K 1/4W
R90, R94, R134, R139	4	S19400-1502	15K 1/4W
R95	1	S19400-2212	22.1K 1/4W
R112, R113, R114	3	T14648-18	68 5W
R115, R193	2	S19400-1821	1.82K 1/4W
R141	1	T14648-19	1K 5W
R148	1	T12300-68	250 10W
R149, R150	2	T14650-1	1500 OHMS, 15 W
R151	1	T14649-11	160/10W
R156, R157	2	S19400-1372	13.7K 1/4W
R160, R161, R162, R163, R164 R165	6	S19400-5620	562 1/4W
R169, R170, R171	3	S19400-2000	200 1/4W
R172, R173, R174	3	S19400-2430	243 1/4W
R177, R178, R179, R180, R181 R182, R183, R184, R185, R186 R187, R188, R189	13	S19400-6812	68.1K 1/4W
R191	1	S19400-4321	4.32K 1/4W
R192	1	S19400-2001	2.0K 1/4W
SCR1, SCR2, SCR3	3	S1516-19	4A, .400V, SCR
X1, X2, X3	3	S15128-4	LM224 OP-AMP
X4	1	S15128-10	VOLTAGE REF.
X5	1	S15128-6	VOLTAGE REGULATOR

CAPACITORS = MFD/VOLTS
RESISTORS = OHMS/1/4 WATT UNLESS OTHERWISE SPECIFIED.
INDUCTANCE = HENRYS

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. 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.

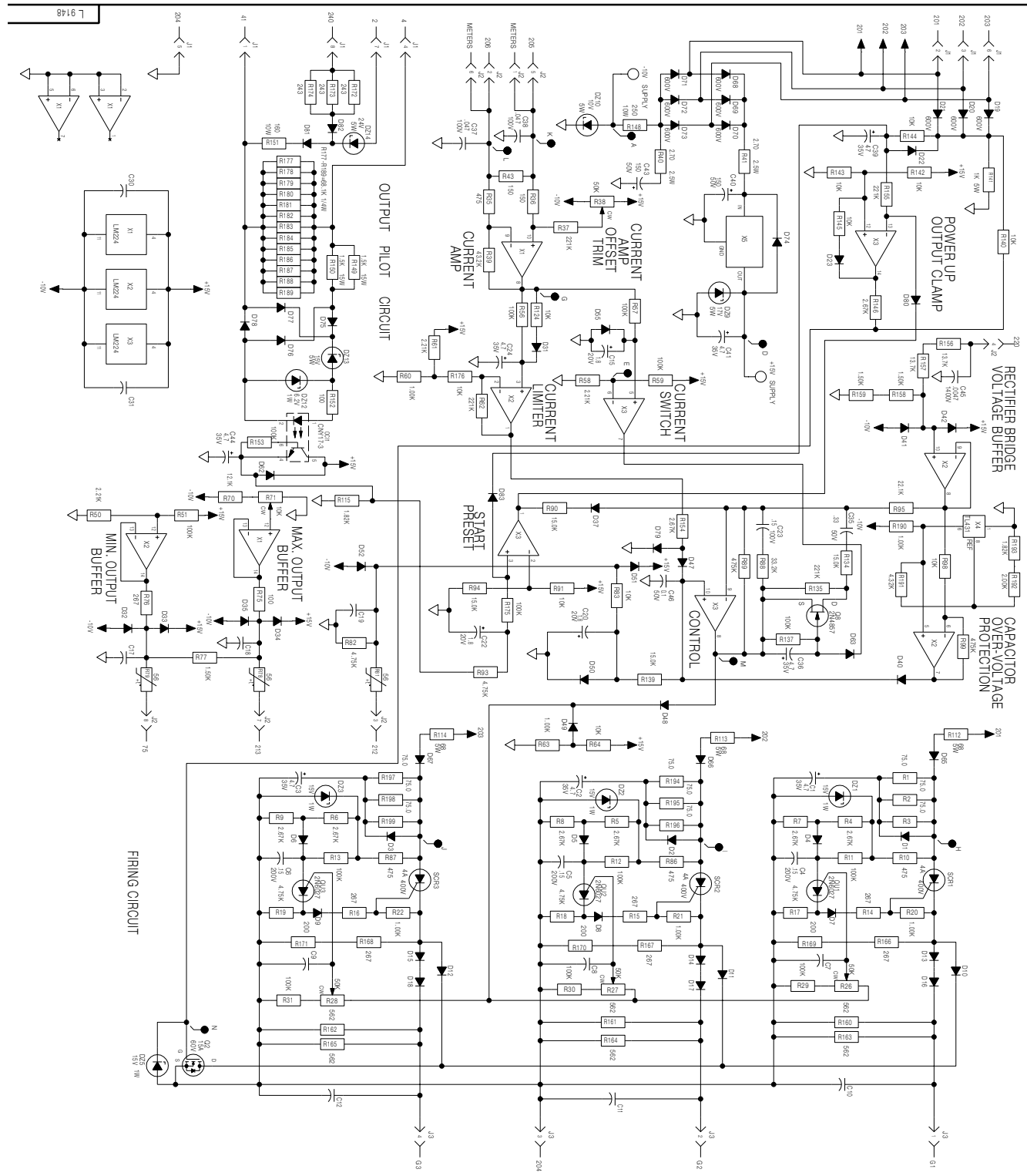
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ELECTRICAL DIAGRAMS

Control PC Board (G2629-1) Schematic



L 9148
7-18-97

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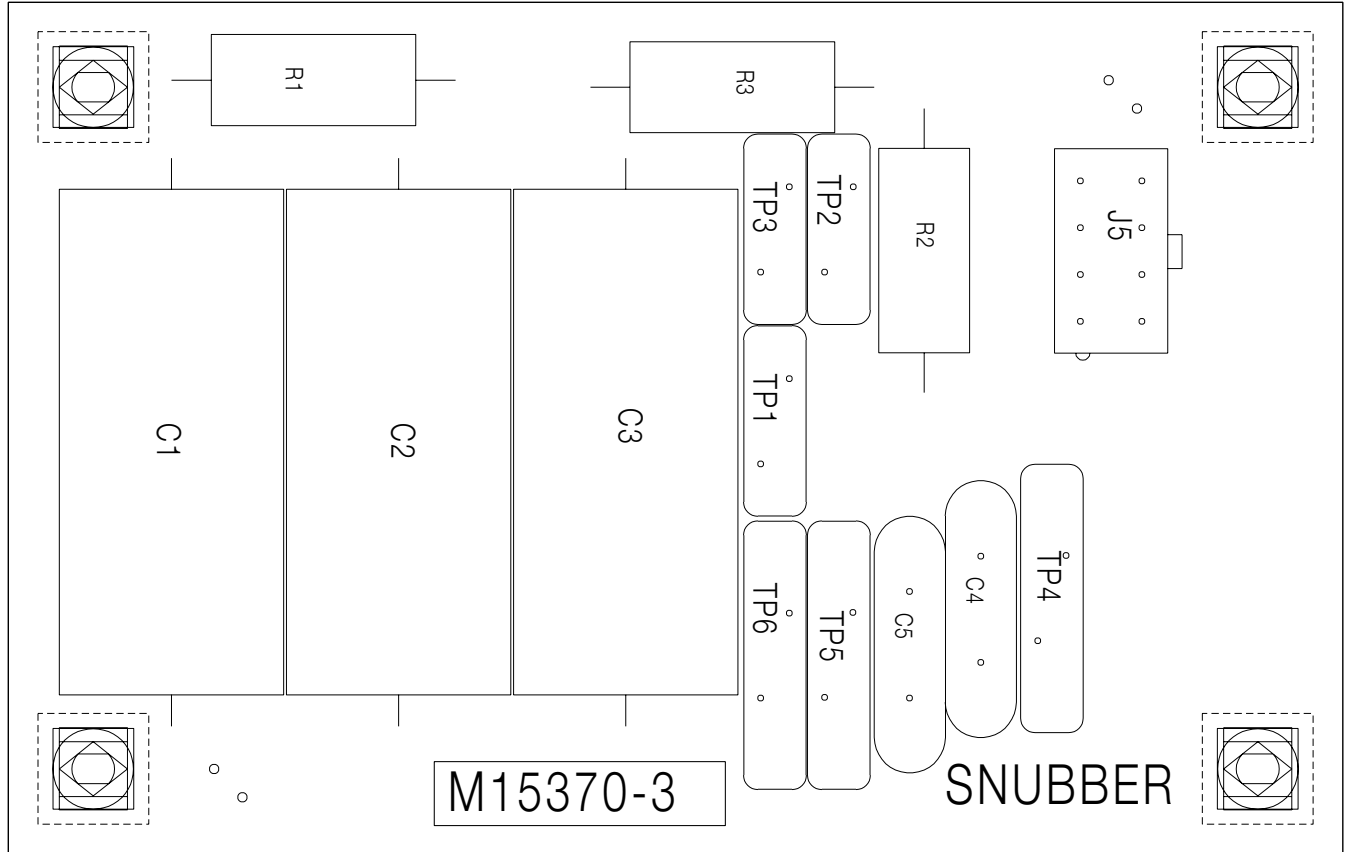
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ELECTRICAL DIAGRAMS

Snubber PC Board (M15370-3) Layout



ITEM	REQD	PART NO.	DESCRIPTION
C1,C2,C3	3	T11577-68	.68/400
C4,C5	2	T11577-46	.05/600
R1,R2,R3	3	T12733-10	10 2W
TP1,TP2,TP3	3	T13640-12	38J
TP4,TP5	2	T13640-18	160J
TP6	1	T13640-16	80J

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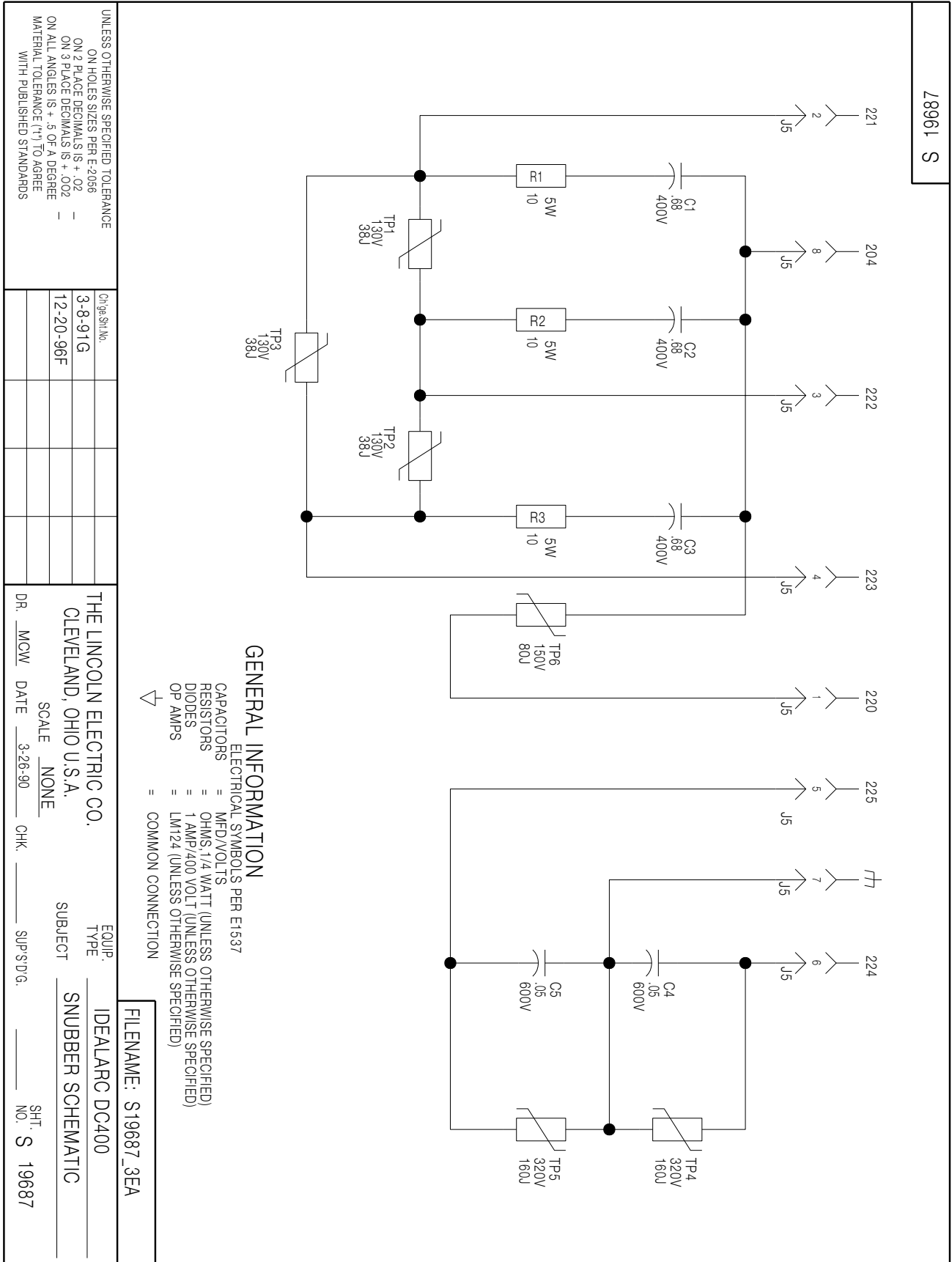
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ELECTRICAL DIAGRAMS

Snubber PC Board (M15370-3) Schematic



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