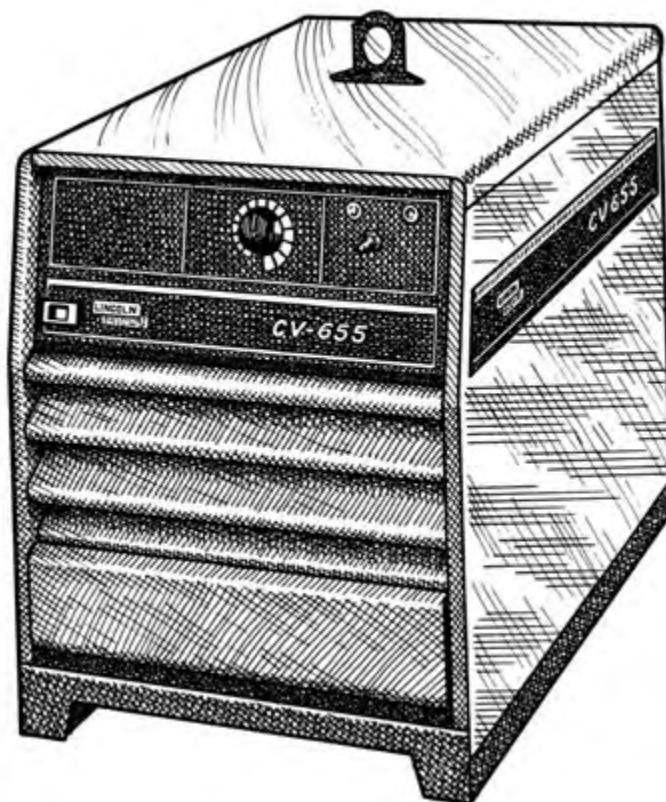


# CV-655

For use with machine code number 10120 thru 10129

## 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



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Cleveland, Ohio 44117-1199 U.S.A. TEL: 216.481.8100 FAX: 216.486.1751 WEB SITE: www.lincolnelectric.com

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**⚠ WARNING**

**⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠**

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

The Above For Diesel Engines

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

The Above For Gasoline Engines

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

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

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



**FOR ENGINE powered equipment.**

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.



1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.



1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

1.d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.



1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.



1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



**ELECTRIC AND MAGNETIC FIELDS may be dangerous**

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

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

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

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

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

Mar '95



### 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.**

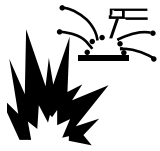
5.b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

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.

Mar '95



### 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.

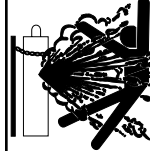
6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe 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.

Mar '95

## 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 chassis 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.

RETURN TO MAIN INDEX

	Page
<b>Safety</b> .....	i-iv
<hr/>	
<b>Installation</b> .....	<b>Section A</b>
Technical Specifications .....	A-2
Safety Precautions .....	A-4
Select Suitable Location (Stacking, Tilting, Lifting) .....	A-4
Electrical Input Connections .....	A-4
Reconnect Procedure .....	A-5
Output Connections .....	A-6
<hr/>	
<b>Operation</b> .....	<b>Section B</b>
Safety Precautions .....	B-2
General Description .....	B-3
Controls and Settings .....	B-4
Case Back Connections .....	B-6
Auxiliary Power .....	B-6
Machine Protection .....	B-6
<hr/>	
<b>Accessories</b> .....	<b>Section C</b>
<hr/>	
<b>Maintenance</b> .....	<b>Section D</b>
Safety Precautions .....	D-2
General Maintenance .....	D-2
General Component Locations .....	D-3
<hr/>	
<b>Theory of Operation</b> .....	<b>Section E</b>
<hr/>	
<b>Troubleshooting and Repair</b> .....	<b>Section F</b>
How to Use Troubleshooting Guide .....	F-2
PC Board Troubleshooting Procedures .....	F-3
Troubleshooting Guide .....	F-4
Test Procedures .....	F-13
Oscilloscope Waveforms .....	F-43
Replacement Procedures .....	F-49
Retest After Repair .....	F-57
<hr/>	
<b>Electrical Diagrams</b> .....	<b>Section G</b>
<hr/>	
<b>Parts Manual</b> .....	<b>P284</b>

**Installation .....Section A**

- Technical Specifications - CV-655 .....A-2
- Graphic Symbols that Appear on Rating Plate .....A-3
- Safety Precautions.....A-4
- Select Suitable Location.....A-4
  - Stacking.....A-4
  - Tilting .....A-4
- Electrical Input Connections.....A-4
  - Fuse and Wire Sizes.....A-4
  - Ground Connection .....A-4
  - Input Power Supply Connections .....A-5
- Reconnect Procedure.....A-5
- Output Connections .....A-6
  - Electrode and Work Cables.....A-6
  - Auxiliary Power and Control Connections .....A-7
    - Auxiliary Power Table.....A-7
    - 115VAC Duplex Receptacle.....A-7
    - 230V Receptacle.....A-7
    - 14 Pin MS Type Receptacle.....A-7
    - Terminal Strips .....A-8

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

TECHNICAL SPECIFICATIONS – CV-655

**INPUT - THREE PHASE ONLY**

<u>Standard Volatge</u>	<u>Input Current at Rated Output</u>		<u>Code Number</u>
	<u>100% Duty Cycle</u>	<u>60% Duty Cycle</u>	
230/460/60	94/47	116/58	10120
230/460/575/60	94/47/38	116/58/47	10121
208/416/60	104/52	128/64	10122
460/60	47	58	10123
575/60	38	47	10124
230/400/50/60*	94/54	116/67	10125
380/500/50/60*	56/43	69/53	10126
440/50/60	49	60	10127
200/400/50/60	107/54	132/67	10128
415/50/60	52	64	10129

**RATED OUTPUT**

<u>Duty Cycle</u>	<u>Amps</u>	<u>Volts at Rated Amperes</u>
100% Duty Cycle NEMA Class I (100)*	650	44
60% Duty Cycle	815	44

**OUTPUT**

<u>Current Range</u>	<u>Maximum Open Circuit Voltage</u>	<u>Auxiliary Power</u>
70-815	48	See the OPERATION section for Auxiliary Power information by model

**RECOMMENDED INPUT WIRE AND FUSE SIZES**

<u>INPUT VOLTAGE / FREQUENCY</u>	<u>HERTZ</u>	<u>INPUT AMPERE RATING ON NAMEPLATE</u>	<u>TYPE 75°C COPPER WIRE IN CONDUIT</u>	<u>TYPE 75°C GROUND WIRE IN CONDUIT</u>	<u>TYPE 75°C (SUPER LAG) OR BREAKER SIZE (AMPS)<sup>1</sup></u>
			<u>AWG(IEC-MM<sup>2</sup>) SIZES</u>	<u>AWG(IEC-MM<sup>2</sup>) SIZES</u>	
208	60	104	1 (43)	6 (14)	200 Amp
230	60	94	2 (34)	6 (14)	175 Amp
416	60	52	6 (14)	8 (8.4)	90 Amp
460	60	47	6 (14)	8 (8.4)	90 Amp
575	60	38	8 (8.4)	8 (8.4)	70 Amp
200	50/60	107	1 (43)	6 (14)	200 Amp
230	50/60	94	2 (34)	6 (14)	175 Amp
380	50/60	56	6 (14)	8 (8.4)	100 Amp
400	50/60	54	6 (14)	8 (8.4)	100 Amp
415	50/60	52	6 (14)	8 (8.4)	90 Amp
440	50/60	49	6 (14)	8 (8.4)	90 Amp
500	50/60	43	8 (8.4)	8 (8.4)	80 Amp

**PHYSICAL DIMENSIONS**

<u>HEIGHT</u>	<u>WIDTH</u>	<u>DEPTH</u>	<u>WEIGHT</u>
27.5 in 699 mm	22.2 in 564 mm	38.0 in 965 mm	652 lbs. 283 kg.

\* European models meet IEC974-1 standards.

<sup>1</sup>Also called "inverse time" or "thermal/magnetic" circuit breakers; circuit breakers which have a delay in tripping action that decreases as the magnitude of the current increases.

CV-655



Return to Section TOC

Return to Master TOC

Return to Section TOC

Return to Master TOC

Return to Section TOC

Return to Master TOC

Return to Section TOC

Return to Master TOC



## GRAPHIC SYMBOLS THAT APPEAR ON RATING PLATE (LOCATED ON CASE BACK)



3 Phase transformer with rectified DC output



**INPUT POWER**



**THREE PHASE**

**NEMA EW 1 (100%)**

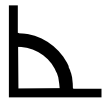
Designates welder complies with National Electrical Manufacturers Association requirements EW 1 Class I with 100% duty cycle at 650Amps output. (Domestic, Canadian, and Export models)

**IEC 974-1**

Designates welder complies with International Electrotechnical Commission requirements 974-1. (European Models)

**IP-23**

Designates the degree of environmental protection provided by the power sources enclosure.



Constant Current Output Characteristics



**SMAW**



**SAW**



Constant Voltage Output Characteristics



**GMAW**



**FCAW**



Designates welder can be used in environments with increased hazard of electric shock. (European models)

**CE**

Designates welder complies with low voltage directive and with EMC directive. (European models)



**NRTL/C**

Designates welder complies with both Underwriters Laboratories (UL) standards and Canadian Standards Association (CSA) standards. (Canadian Model)



**NRTL**

Designates welder complies with Underwriters Laboratories (UL) standards. (Domestic Models)

**U<sub>o</sub>**

Open Circuit Output Voltage

**U<sub>1</sub>**

Input Voltage Rating(s)

**I<sub>1</sub>**

Input Current Rating(s)

**X**

Output Duty Cycle Rating(s)

**U<sub>2</sub>**

Output Voltage Rating(s)

**I<sub>2</sub>**

Output Current Rating(s)

CV-655

**LINCOLN**  
ELECTRIC

Read this entire installation section before you start installation.

## SAFETY PRECAUTIONS



### WARNING



#### ELECTRIC SHOCK can kill.

- Only qualified personnel should perform this installation.
  - Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- 
- Turn the Power Switch on the CV-655 "OFF" before connecting or disconnecting output cables, wire feeder or remote connections, or other equipment.
  - Do not touch electrically hot parts.
  - Always connect the CV-655 grounding terminal (located on the welder near the reconnect panel) to a good electrical earth ground.

## SELECT SUITABLE LOCATION

Place the welder where clean cooling air can freely circulate in through the front louvers and out through the rear louvers. Dirt, dust or any foreign material that can be drawn into the welder should be kept at a minimum. Failure to observe these precautions can result in excessive operating temperatures and nuisance shut-downs.

## STACKING

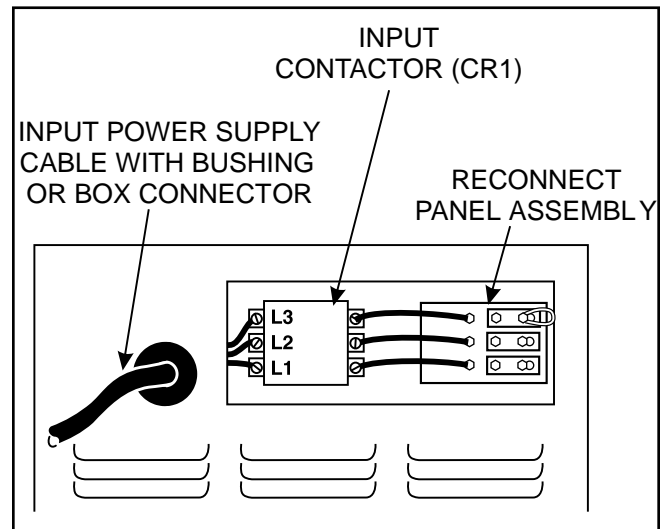
The CV-655 may be stacked three-high provided the bottom machine is on a stable, hard, level surface. Be sure that the two pins in the roof fit into the slots in the base of the CV-655 above it.

## TILTING

Do not place the machine on a surface that is inclined enough to create a risk of the machine falling over.

## ELECTRICAL INPUT CONNECTIONS

Before installing the machine check that the input supply voltage, phase, and frequency are the same as the voltage, phase, and frequency as specified on the welder nameplate.



**FIGURE A.1 - ELECTRICAL INPUT CONNECTIONS**

Use input wire sizes that meet local electrical codes or see the *Technical Specifications* page in this manual.

Input power supply entry is through the hole in the Case Back Assembly. See Figure A.1 for the location of the machine's input cable entry opening, Input Contactor (CR1), and reconnect panel.

## FUSE AND WIRE SIZES

Protect the input circuit with the super lag fuses or delay type circuit breakers listed on the *Technical Specifications* page of this manual for the machine being used. They are also called inverse time or thermal/magnetic circuit breakers.

DO NOT use fuses or circuit breakers with a lower amp rating than recommended. This can result in "nuisance" tripping caused by inrush current even when machine is not being used for welding at high output currents.

## GROUND CONNECTION

Ground the frame of the machine. A ground terminal marked with the symbol  $\oplus$  is located inside the case back of the machine near the input contactor. Access to the input box assembly is at the upper rear of the machine. See your local and national electrical codes for proper grounding methods. Use grounding wire sizes that meet local electrical codes or see the *Technical Specifications* page in this manual.

CV-655



**INPUT POWER SUPPLY CONNECTIONS**

A qualified electrician should connect the input power supply leads.

1. Follow all national and local electrical codes.
2. Use a three-phase line.
3. Remove the input access door at upper rear of the machine.
4. Follow input supply connection diagram located on the inside the door.
5. Connect the three-phase AC power supply leads L1, L2, and L3 to the input contactor terminals in the input box assembly. See Figure A.1.

**RECONNECT PROCEDURE**

**⚠ WARNING**



**Electric Shock Can Kill**

- Disconnect input power before performing this procedure.

Multiple voltage machines are shipped connected to the highest input voltage listed on the machine's rating plate. Before installing the machine, check that the reconnect panel in the input box assembly is connected for the proper voltage.

**⚠ CAUTION**

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

To reconnect a multiple voltage machine to a different voltage, remove input power and follow the input connection diagram located on the inside of case back input access door.

1. For dual voltage sample machine reconnect instructions, see Figure A.2.

<p><b>⚠ WARNING HIGH VOLTAGE CAN KILL</b></p> <ul style="list-style-type: none"> <li>• Do not operate with covers removed</li> <li>• Do not touch electrically live parts</li> <li>• Disconnect input power before servicing</li> <li>• Only qualified persons should install, use or service this equipment</li> </ul>		<p><b>DUAL VOLTAGE MACHINE INPUT SUPPLY CONNECTION DIAGRAM</b></p> <p>IMPORTANT: CHANGE LINK POSITIONS AND CONTROL TRANSFORMER CONNECTIONS.</p> <p>NOTE: MACHINES ARE SHIPPED FROM FACTORY CONNECTED FOR OVER 300 VOLTS</p>	
<p><b>CONNECTION FOR HIGHEST RATING PLATE VOLTAGE</b></p>		<ol style="list-style-type: none"> <li>1. TURN OFF THE INPUT POWER USING THE DISCONNECT SWITCH AT THE FUSE BOX.</li> <li>2. DISCONNECT AND INSULATE THE H2 LEAD TERMINAL WITH TAPE TO PROVIDE AT LEAST 600 VOLT INSULATION.</li> <li>3. CONNECT L1, L2 &amp; L3 INPUT SUPPLY LINES AND H1 &amp; H3 CONTROL TRANSFORMER LEADS TO THE INPUT SIDE OF CR1 CONTACTOR AS SHOWN.</li> <li>4. CONNECT TERMINAL MARKED Ⓛ TO GROUND PER LOCAL AND NATIONAL ELECTRIC CODES.</li> <li>5. MOUNT THE LINKS IN THE POSITIONS SHOWN: DOUBLE OR TRIPLE STACK THE LINKS IN THREE POSITIONS. LOOP THE FLEX LEAD IN THE POSITION SHOWN; POSITIONING THE LUGS TO MAINTAIN MAXIMUM CLEARANCE TO THE LINKS. INSTALL AND TIGHTEN ALL OF THE HEX NUTS.</li> </ol>	
<p><b>CONNECTION FOR LOWEST RATING PLATE VOLTAGE</b></p>		<ol style="list-style-type: none"> <li>1. TURN OFF THE INPUT POWER USING THE DISCONNECT SWITCH AT THE FUSE BOX.</li> <li>2. DISCONNECT AND INSULATE THE H3 LEAD TERMINAL WITH TAPE TO PROVIDE AT LEAST 600 VOLT INSULATION.</li> <li>3. CONNECT L1, L2 &amp; L3 INPUT SUPPLY LINES AND H1 &amp; H2 CONTROL TRANSFORMER LEADS TO THE INPUT SIDE OF CR1 CONTACTOR AS SHOWN.</li> <li>4. CONNECT TERMINAL MARKED Ⓛ TO GROUND PER LOCAL AND NATIONAL ELECTRIC CODES.</li> <li>5. MOUNT THE LINKS IN THE POSITIONS SHOWN. CONNECT THE FLEX LEAD AS SHOWN; POSITIONING THE LUGS TO MAINTAIN MAXIMUM CLEARANCE TO THE LINKS. INSTALL AND TIGHTEN ALL OF THE HEX NUTS.</li> </ol>	
<p>THE LINCOLN ELECTRIC CO., CLEVELAND OHIO U.S.A.</p>		<p>XD-UF M18225</p>	

**FIGURE A.2 - DUAL VOLTAGE MACHINE RECONNECTION PROCEDURE**

CV-655



Return to Section TOC

Return to Master TOC

## OUTPUT CONNECTIONS

### ELECTRODE AND WORK CABLES



Use the shortest possible cable lengths. See Table A.1 for recommended cable sizes based on length.

**TABLE A.1**  
**Cable Sizes for Combined Lengths of Copper Electrode and Work Cable**

Cable Length ft. (m)	Parallel Cables	Cable Size
0 (0) to 100 (30.4)	2	2/0 ( 70mm <sup>2</sup> )
100 (30.4) to 200 (60.8)	2	3/0 ( 95mm <sup>2</sup> )
200 (60.8) to 250 (76.2)	2	4/0 (120mm <sup>2</sup> )



The output terminals are located at the lower front of the welder behind a hinged door. Refer to figure A.3. Route the welding cables through the slotted strain reliefs of the base to the welding terminals.

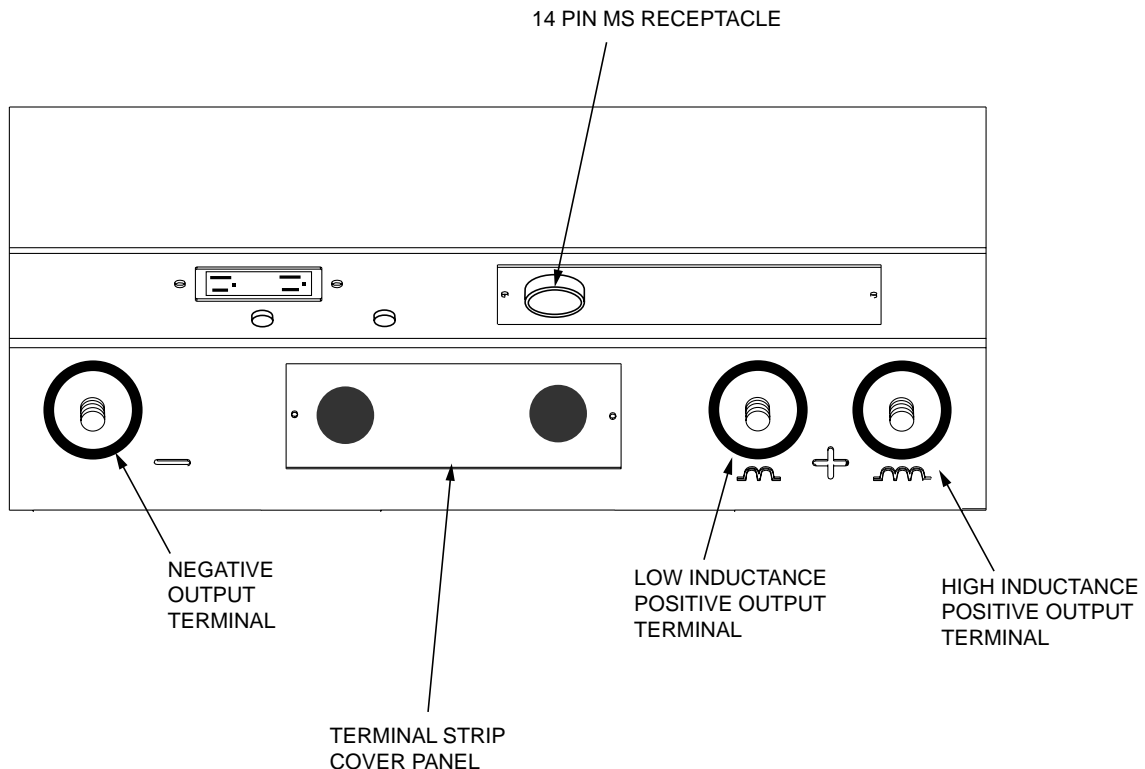
#### For Positive Polarity:

1. Connect the electrode cable to either the low inductance terminal (marked "  ") or the high inductance terminal (marked "  "). See OPERATION section "**Positive Output Terminals**" for an explanation of the use of high or low inductance terminals.

2. Connect the work cable to the negative terminal marked "-".
3. Remove the terminal strip access cover panel on the lower case front. Refer to figure A.3 for the location.
4. Work Sense lead #21 from the 14 Pin MS-receptacle must be connected to "-21" on the terminal strip.  
**Note: This is how the CV-655 is shipped from the factory.**
5. Replace the terminal strip access cover panel.

#### For Negative Polarity:

1. Connect the work cable to either the low inductance terminal (marked "  ") or the high inductance terminal (marked "  "). See OPERATION section "**Positive Output Terminals**" for an explanation of the use of high or low inductance terminals.
2. Connect the electrode cable to the negative terminal marked "-".
3. Remove the terminal strip access cover panel on the lower case front. Refer to figure A.3 for the location.
4. Work Sense lead #21 from the 14 Pin MS-receptacle must be connected to "+21" on the terminal strip.
5. Replace the terminal strip access cover panel.



**FIGURE A.3 Output Connections**

CV-655

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### AUXILIARY POWER AND CONTROL CONNECTIONS

Located at the lower front of the welder behind a hinged door is a 115 VAC duplex receptacle for auxiliary power (Domestic and Canadian Models only) and a 14-pin MS type receptacle for connection of auxiliary equipment such as wire feeders. Also, terminal strips with 115 VAC and connections for auxiliary equipment are located behind the access panel on the lower case of the welder. A 220 VAC receptacle for a water cooler (European and Export Models only) is located on the case back.

#### AUXILIARY POWER TABLE

Voltage and Circuit Breaker Ratings at Auxiliary Power Connections for Various Models

Auxiliary Power Connections	Domestic Models (60Hz)	Canadian Model (230/460/575V/60 Hz)	European Models (50/60 Hz)	Export Models (50/60 Hz)
At Duplex Receptacle	115V 20A	115V 15A	No Duplex	No Duplex
Terminal strip terminals 31 & 32	115V 20A	115V 15A	115V 15A	115V 15A
MS-Receptacle pins A & J	115V 20A	115V 15A	Open Circuit	115V 15A
MS-Receptacle pins I & K	42V 10A	42V 10A	42V 10A	42V 10A
At 220V Receptacle	No Receptacle	No Receptacle	220V 2A	220V 2A

#### 115 VAC DUPLEX RECEPTACLE (DOMESTIC AND CANADIAN MODELS ONLY)

The 115 VAC duplex receptacle is protected by a circuit breaker located below the receptacle (see Auxiliary Power Table). Receptacle is a NEMA 5-20R (protected by a 20 amp breaker) on Domestic Models and a NEMA 5-15R (protected by a 15 amp breaker) on Canadian Models.

#### 230 VAC RECEPTACLE (EUROPEAN AND EXPORT MODELS ONLY)

A Continental European receptacle is located on the rear panel for supplying 220 VAC to a water cooler. The receptacle has a protective cover to prevent accidental contact and is a Schuko type. The circuit is protected by a 2 amp circuit breaker also located on the rear panel. This circuit is electrically isolated from all other circuits, but on the European Models one line is connected to chassis ground.

#### 14-PIN MS TYPE RECEPTACLE

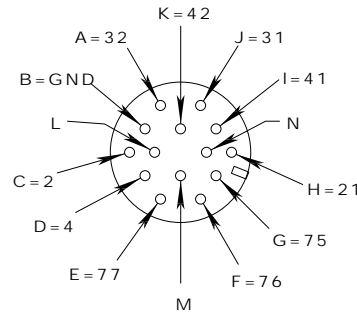
(For MS3106A-20-27PX Plug. L.E.C. Part #S12020-32)

Refer to the Figure A.4 for the available circuits in the 14-pin receptacle.

42 VAC is available at receptacle pins I and K. A 10 amp circuit breaker protects this circuit.

115 VAC is available at receptacle pins A and J (Domestic, Canadian and Export Models). This circuit is protected by a circuit breaker (see Auxiliary Power Table). Note that the 42 VAC and 115 VAC circuits are electrically isolated from each other. However, on the European model one line of the 115 VAC is connected to chassis ground.

FIGURE A.4 - 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 Sense Connection <sup>2</sup>
I	41	42 VAC
J	31	115 VAC <sup>1</sup>
K	42	42 VAC
L	---	---
M	---	---
N	---	---

<sup>1</sup> 115VAC circuit is not present in the 14-pin connector on IEC 974-1 European models.

<sup>2</sup> As shipped from the factory Lead #21 from the 14-pin connector is connected to "-21" on the terminal strip. This is the configuration for positive welding. If welding negative polarity, connect lead #21 to the "+21" connection point on the terminal strip.

Return to Section TOC | Return to Master TOC

## TERMINAL STRIPS

Terminal strips are available behind the cover panel on the lower case front to connect wire feeder control cables that do not have a 14-Pin MS-type connector. Refer to **Figure A.3** for the location of this cover panel. These terminals supply the connections as shown in the following Terminal Strip charts. See **Auxiliary Power Table** for rating of circuit breaker in 115 VAC circuit. Remove a plug button from the terminal strip cover and install an appropriate strain relief clamp for the cable being used. NOTE: There are two work sense lead connection points on the terminal strip. Connect both the work sense lead #21 from the 14 - Pin connector and #21 lead of the control cable to "-21" when welding positive polarity or to "+21" when welding negative polarity.

### TERMINAL STRIP 1 (T.S.1)

Lead No.	Function
75	Output Control
76	Output Control
77	Output Control

### TERMINAL STRIP 2 (T.S.2)

Lead No.	Function
+21	Work Connection
-21	Work Connection <sup>2</sup>
41	42 VAC
4	Trigger Circuit
2 (42 VAC)	Trigger Circuit (42 VAC)
31	115 VAC <sup>1</sup>
32	115 VAC <sup>1</sup>

<sup>1</sup> 115 VAC circuit is also present on IEC 974-1 European models.

<sup>2</sup> If connecting a feeder cable directly to the terminal strip, Lead #21 from the cable is connected to "-21" on the terminal strip for positive welding. If welding negative polarity, connect lead #21 to the "+21" connection point on the terminal strip.

# TABLE OF CONTENTS - OPERATION SECTION -

---

Operation.....Section B

- Safety Precautions.....B-2
- General Description .....B-3
  - Recommended Processes and Equipment .....B-3
  - Design Features and Advantages .....B-3
  - Welding Capability.....B-3
- Controls and Settings .....B-4
- Lower case front control connections.....B-5
- Case Back Connections .....B-6
  - 220 VAC Auxiliary Receptacle.....B-6
  - 220 VAC 2 Amp Circuit Breaker .....B-6
- Auxiliary Power .....B-6
- Thermal Fan Control .....B-6
- Overload Protection .....B-6
- Fan Motor Fuse .....B-6

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

## OPERATING INSTRUCTIONS

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

## SAFETY PRECAUTIONS



### WARNING



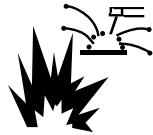
#### ELECTRIC SHOCK can kill.

- 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 cut 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.

CV-655

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## GENERAL DESCRIPTION

The CV-655 is an energy efficient constant voltage DC power source that produces outstanding arc characteristics.

Four models are available:

Domestic - all 60 Hertz models except 230/460/575v.  
NEMA Class 1 rated

Canadian - 230/460/575v 60 Hertz  
NEMA Class 1 rated

European - 50/60 Hertz models rated for IEC 974-1  
Export - 50/60 Hertz models NEMA Class 1 rated

## RECOMMENDED PROCESSES AND EQUIPMENT

The CV-655 is designed for GMAW (MIG), FCAW, and CV submerged arc welding processes (SAW), plus the capability of air carbon arc cutting (AAC) up to 3/8" (10mm) diameter.

The CV-655 is recommended for use with Lincoln's DH-10 or LN-10 as well as the LN-7\*, LN-7 GMA\*, LN-742, LN-8\*, LN-9\*, LN-9 GMA\*, LN-23P and LN-25 semiautomatic wire feeders. It is also recommended for use with the NA-3, NA-5 and NA-5R automatic feeders, but "cold starting" for sub-arc cannot be used (it must be jumpered out).

\* The 14-pin MS receptacle on the European models does not provide 115 VAC for these feeders; 115 VAC must be obtained from terminal strip.

There are no provisions on the CV-655 for paralleling.

## DESIGN FEATURES AND ADVANTAGES

- Two inductance positions: operator can choose the optimum arc characteristics.
- Power on/off switch with pilot light and thermostat tripped indicator light.
- Full range output voltage control for easy operation.
- Panel switches for remote or local output control, and output on or remote selection.
- Hinged cover to protect output terminals and auxiliary connections.
- 42 VAC, 10 amp auxiliary power available for the wire feeder; circuit breaker protected.

## DESIGN FEATURES AND ADVANTAGES (CONT'D)

- 115 VAC, auxiliary power available for the wire feeder; circuit breaker protected. 20 amp breaker on Domestic model and 15 amp breaker on Canadian, European, and Export Models.
- 115VAC duplex plug receptacle available on Domestic and Canadian Models. 20 amp breaker on Domestic Models and 15 amp breaker on Canadian Model.
- Single MS-type (14-pin) connection for wire feeder.
- Thermal Fan Control with electronic and thermostatic protection for current overload and excessive temperatures.
- Optional Field Installed Digital or Analog Voltmeter/Ammeter kits are available.
- 220 VAC receptacle on European and Export models for connecting to a water cooler. Protected by 2 amp breaker.

## WELDING CAPABILITY

The CV-655 has the following Output and Duty Cycle based on operation for a 10 minute period:

650 Amps, 44 Volts at 100%  
815 Amps, 44 Volts at 60%

CV-655



## CONTROLS AND SETTINGS

All operator controls and adjustments are located on the case front of the CV-655. Refer to Figures B.1, and B.2 and corresponding explanations.

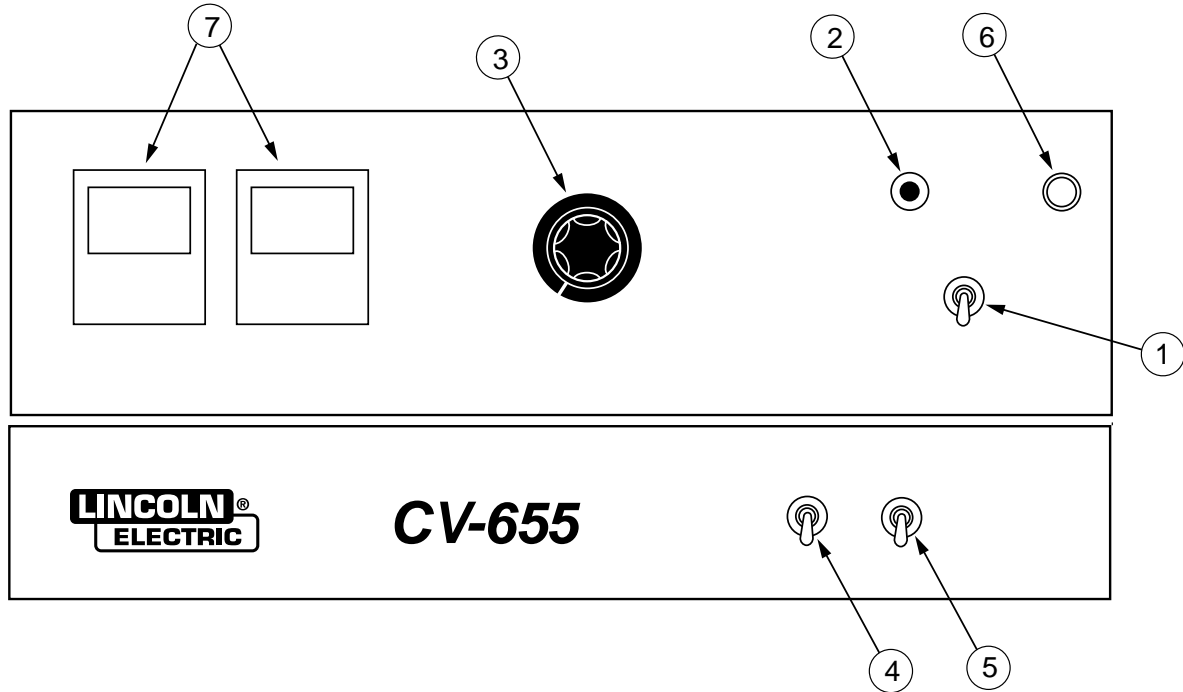
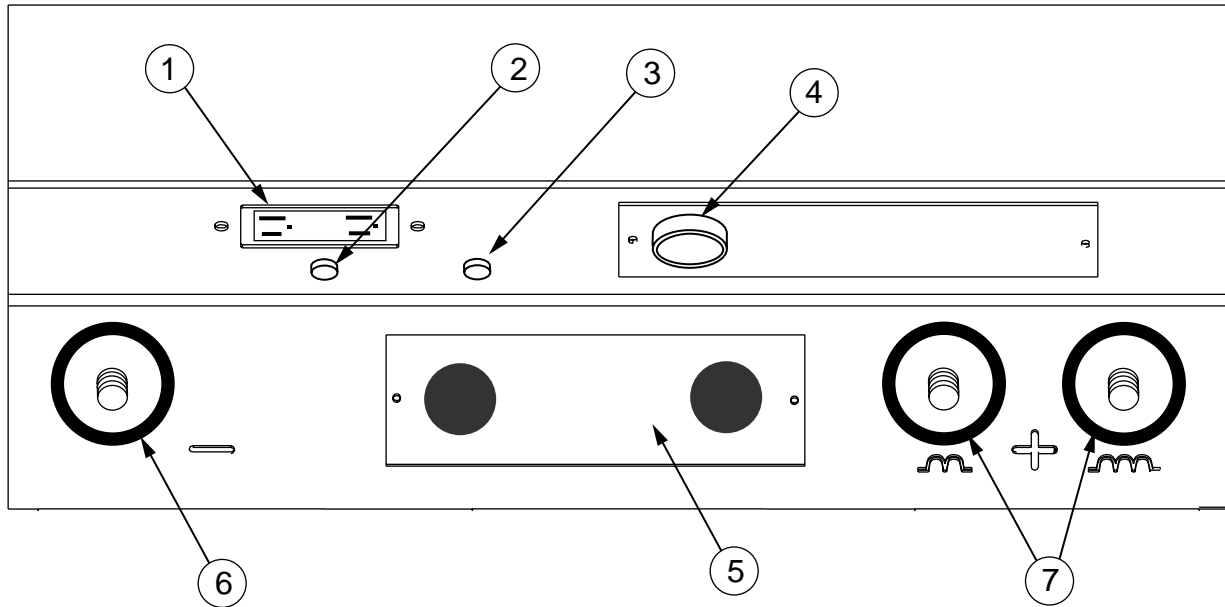


FIGURE B.1 CONTROL PANEL CONTROLS

- 1. INPUT POWER ON/OFF SWITCH** - This toggle switch turns the machine on or off. Putting the switch in the ON position energizes the machine's input contactor applying input power to the machine. Switching the switch to the OFF position de-energizes the input contactor.
- 2. PILOT LIGHT** - When the power switch is in the ON position the machine's white pilot light will illuminate. If the input contactor de-energizes the machine in an overload situation the pilot will still illuminate. In this situation it will be necessary to reset the machine by switching the power switch to the OFF then ON position. (See **Overload Protection** Section)
- 3. OUTPUT VOLTAGE CONTROL** - This control provides continuous control of the machine's output voltage from minimum to maximum (typical full pot range between 15 to 44 volts) as it is rotated clockwise.
- 4. OUTPUT TERMINALS ON/REMOTE** - When this switch is in the REMOTE position, the CV-655's output terminals will be electrically "cold" until a remote device such as a wire feeder closes the #2 and #4 circuit in the MS-receptacle or terminal strip. When this switch is in the ON position the machine's output terminals will be electrically energized all the
- 5. LOCAL/REMOTE CONTROL SWITCH** - When this switch is set to the LOCAL position, control of the output voltage is via the output voltage control on the CV-655's control panel. When this switch is set to the REMOTE position, control is through a remote source such as a wire feeder via the #75, #76, and #77 leads in the MS-receptacle or terminal strip.
- 6. THERMAL PROTECTION LIGHT** - If the machine overheats due to lack of proper air flow through the machine or due to exceeding the machine's duty cycle, thermostats will disable the welding output and this light will illuminate. Input power is still applied to the machine and the cooling fan will continue to run. When the machine cools the welding output will resume.
- 7. OPTIONAL VOLTMETER & AMMETER** - Digital or analog meter kits are available as field installed options. Refer to the **Accessories Section** of this manual.


CV-655


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**FIGURE B.2 LOWER CASE FRONT CONTROLS & CONNECTIONS**

**1. 115VAC DUPLEX RECEPTACLE (Domestic and Canadian Models)** This receptacle provides up to 20 amps of 115 VAC auxiliary power on the Domestic Models and up to 15 amps on the Canadian Model.

**2. 115VAC CIRCUIT BREAKER**  - This breaker protects the 115 VAC auxiliary circuits located in the duplex receptacle, terminal strip and MS- receptacle. Breaker is rated 20 amps on Domestic Models and 15 amps on all other models.



**3. 42VAC 10 AMP CIRCUIT BREAKER**  - This breaker protects the 42VAC auxiliary circuits located in the terminal strip and MS-receptacle.

**4. 14 PIN MS-RECEPTACLE** - This connector provides easy connection for a wire feeder control cable. It provides connections for auxiliary power, output switching, remote output control, wire feeder voltmeter sense lead and ground. Refer to **14 Pin MS Type Receptacle** in the Installation Section of this manual for information about the circuits made available at this receptacle.

**5. TERMINAL STRIP COVER PANEL** - Remove this panel to gain access to the circuits made available at the terminal strip. This terminal strip contains the same circuits as the 14 pin MS-receptacle. The cover also provides for installation of cable strain relief clamps.

**6. NEGATIVE OUTPUT TERMINAL** - This output terminal is for connecting a welding cable. To change

welding polarity and for proper welding cable size refer to **Electrode and Work Cables** in the Installation Section of this manual.

**7. POSITIVE OUTPUT TERMINALS** - These output terminals are for connecting a welding cable to either the High Inductance  or Low Inductance  Terminal for desired arc characteristics. High Inductance is recommended for Stainless Steel welding. Low Inductance is recommended for Short Arc GMAW. For Spray Arc and other processes either may be used to provide the preferred starting and welding arc characteristics: High Inductance will provide a "softer" arc, but will not provide as "crisp" of an arc start as the Low Inductance. To change welding polarity and for proper welding cable size refer to **Electrode and Work Cables** in the Installation Section of this manual.

## CASE BACK CONNECTIONS

### 220VAC AUXILIARY RECEPTACLE (European and Export Models)

This receptacle provides up to 2 amps of 220VAC auxiliary power for a water cooler.

### 220VAC 2 AMP CIRCUIT BREAKER (European and Export Models)

This breaker protects the 220VAC auxiliary circuit located in the 220VAC receptacle.

### CAUTION

When using a CV-655 with wire feeders, there will be a small spark if the electrode contacts the work or ground with several seconds after releasing the trigger.

When used with some wire feeders with the electrical trigger interlock in the ON position, the arc might restart if the electrode touches the work or ground during these several seconds.

## AUXILIARY POWER

42 volt AC auxiliary power, as required for some wire feeders, is available through the wire feeder receptacle. A 10 amp circuit breaker protects the 42 volt circuit from overloads.

CV-655 machines can also supply 115 volt AC auxiliary power through the wire feeder receptacle. A 20 amp circuit breaker on the Domestic model, and a 15 amp on the Canadian and Export models protects the 115 volt circuit from overloads. 115VAC is not available in the MS-receptacle on the European models.

### CAUTION

Note that some types of equipment, especially pumps and large motors, have starting currents which are significantly higher than their running current. These higher starting currents may cause the circuit breaker to open. If this situation occurs, the user should refrain from using the CV-655 auxiliary power for that equipment.

## THERMAL FAN CONTROL

The machine's cooling fan remains off when the temperature of the rectifiers and windings inside the machine are below that requiring air flow cooling, as determined by electronic monitoring of several thermal sensors and the welding current of the machine. The fan may remain off until welding begins, but once the fan is activated, it will remain on for at least 5 minutes to assure proper cooling. This feature saves energy and also minimizes the amount of dirt and other air borne particles being drawn into the machine.

## OVERLOAD PROTECTION

This welder has thermostatic protection from excessive duty cycles, overloads, loss of cooling, and high ambient temperatures. When the welder is subjected to an overload or loss of cooling, a thermostat will open. This condition will be indicated by the illumination of the yellow Thermostatic Protection Light on the case front (see **Figure B.1**). The fan will continue to run to cool the power source. No welding is possible until the machine is allowed to cool and the Thermostatic Protection Light goes out.

The CV-655 also has over-current protection. When the load exceeds a threshold current (about 900 amps), overcurrent shut down will occur after a period of time that shortens as the current increases beyond this threshold. If the current reaches about 1000 amps the output will be "clamped" at about 1000 amps and shut down will occur in about 5 seconds. When this overload shut down occurs the short circuit output of the machine drops to only about 20 amps, but the input contactor and input pilot light will remain on until reset by turning the power switch off, then back on with overload removed.

## FAN MOTOR FUSE (EUROPEAN MODEL)

A 10 amp slow blow fuse protects the fan motor circuit. This fuse is located inside the CV-655 mounted on the fan motor bracket.

CV-655

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# TABLE OF CONTENTS - ACCESSORIES -

---

<b>Accessories.....</b>	<b>Section C</b>
Wire Feeders.....	C-2
Field Installed Options.....	C-2
Connection of Lincoln Electric Automatic or Semiautomatic Wire Feeders.....	C-3
Automatic Wire Feeders.....	C-3
NA-3 or LT-7 (Terminal Strip) .....	C-3
NA-5 or NA-5R (Terminal Strip) .....	C-4
Semiautomatic Wire Feeders.....	C-6
LN-7 (14-Pin MS Receptacle).....	C-6
LN-7 (Terminal Strip).....	C-7
LN-8 or LN-9 (Terminal Strip) .....	C-8
LN-8 or LN-9 (14-Pin MS Receptacle) .....	C-9
DH-10 (14-Pin MS Receptacle) .....	C-9

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

The CV-655 can be used to power any of the following Lincoln Wire feeders:

### SEMI-AUTOMATIC WIRE FEEDERS

- DH-10
- LN-10
- LN-7 GMA\*
- LN-742
- LN-7
- LN-9\*
- LN-9 GMA\*
- LN-23P
- LN-25
- LN-8\*

### AUTOMATIC WIRE FEEDERS\*\*

- NA-3
- NA-5
- NA-5R

\* European CV-655 models only provide 115VAC for these feeders at the terminal strip (TS2)

\*\* Cold starting for sub-arc cannot be used. (It must be jumpered out. See Auto Feeder manual)

### FIELD INSTALLED OPTIONS

**K1482-1 Digital Ammeter/Voltmeter Kit** - Installs easily to the front control panel and provides digital display of actual welding voltage and amperage while welding. (Installation instructions are included with the kit).

**K1483-1 Analog Ammeter/Voltmeter Kit** - Installs easily to the front control panel and provides analog display of actual welding voltage and amperage while welding. (Installation instructions are included with the kit).

**K1484-1 Dual Feeder Kit** - This kit replaces the 14 Pin MS-receptacle panel on the lower case front of the CV-655. It provides two 14 Pin MS-receptacles and a built in transfer circuit for connecting and operating two like-polarity wire feeders. European CV-655 models can only use 42V feeders with this kit. (Installation instructions are included with the kit).

**K1485-1 Cable Hanger Bracket** - Mounts over standard lift bale of the CV-655 and provides a cable hanger on both sides of the power source, each side capable of holding up to 100 ft. of weld cable. (Installation instructions are included with the kit).

**K1486-1 Air Filter Kit** - Removable metal filter easily slides in and out of a bracket which mounts to the front of the CV-655. Filter is designed to trap 80% of entering particles which are 5 microns, or larger, in size. (Installation instructions are included with the kit).

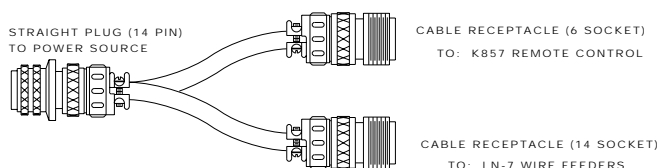
**NOTE:** A dirty air filter may cause the thermal protection of the CV-655 to prematurely activate. Remove and blow out, or wash and dry, the filter every two months, or less if in extremely dirty conditions. Replace if necessary.

**Undercarriage (K817P, K842)** - The CV-655 is designed for use with the Lincoln K817P or K842 Undercarriage. Complete installation instructions are included with each undercarriage. When any of the undercarriages are installed, the CV-655 lift bail is no longer functional. Do not attempt to lift the machine with the undercarriage attached. The undercarriage is designed for moving the machine by hand only. Mechanized towing can lead to injury and /or damage to the CV-655.

### REMOTE OUTPUT CONTROL (K775 or K857 WITH K864 ADAPTER)

An optional "remote output control" is available. This is the same remote control that is used on other Lincoln power sources (K775). 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 so marked with the symbol  $\overline{\text{TT}}$  on the machine. These terminals are located behind the cover panel on the lower connection panel of the CV-655. This control will give the same control as the output control on the machine.

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-655.



### REMOTE CONTROL ADAPTER CABLE (K864)

A "V" cable 12" (.30m) long to connect a K857 Remote Control (6 pin connector) with a wire-feeder (14-pin connector) and the machine (14-pin connector). If a remote control is used alone the wire-feeder connection is then not used.

CV-655

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## CONNECTION OF LINCOLN ELECTRIC AUTOMATIC OR SEMIAUTOMATIC WIRE FEEDERS

### ⚠ WARNING



#### ELECTRIC SHOCK can kill.


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

Auxiliary power for wire feeder operation is available at both a 14-pin MS receptacle and at terminal strips with screw-type connections located on the front of the machine. Refer to the **Installation** section for pinouts and lead designations. The two circuits are isolated, and each is protected by a circuit breaker.

The following descriptions show how to connect the wire feeders using either the 14-pin MS receptacle or the terminal strip.

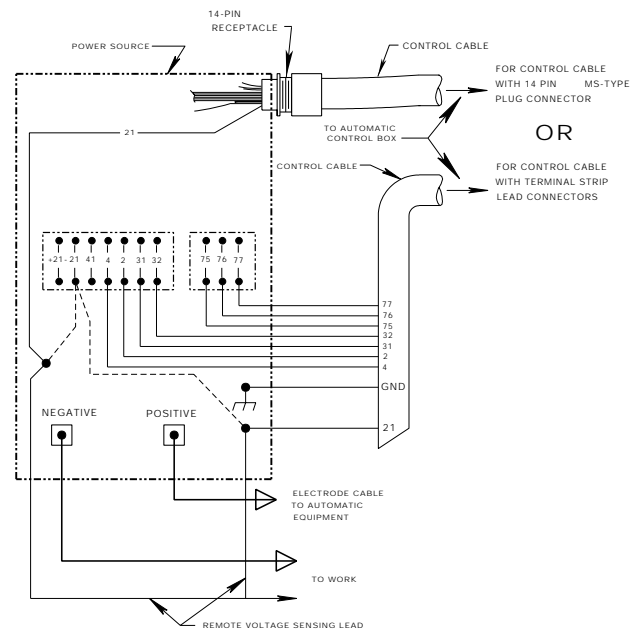
## AUTOMATIC WIRE FEEDERS

### CONNECTING THE NA-3 OR LT-7 TO THE CV-655 (TERMINAL STRIP)

1. Set CV-655 POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-655.
3. Connect the wire feeder control cable leads to the CV-655 terminal strip as shown in Figure C.1.
4. Connect the wire feeder control cable ground lead to the frame terminal marked .

**NOTE:** The CV-655 must be properly grounded.

**FIGURE C.1 – NA-3 OR LT-7 WIRE FEEDER CONNECTION TO THE CV-655**



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 work cable for ease of use.

CV-655



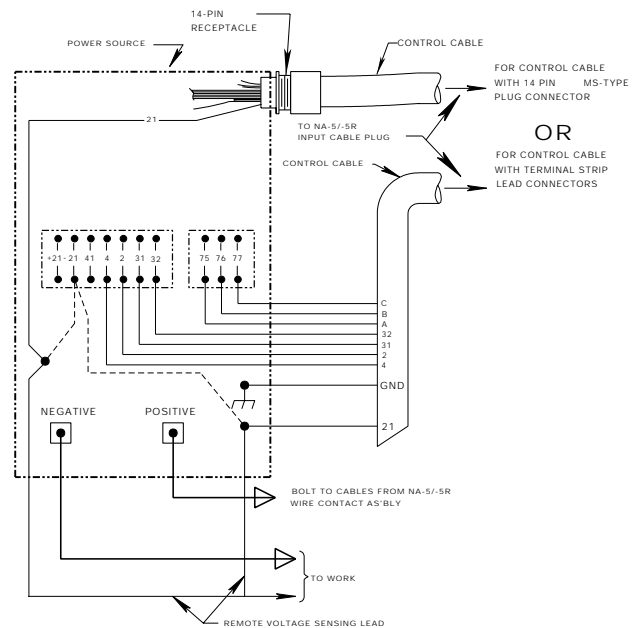
**NOTE:** The connection diagram shown in Figure C.1 shows the electrode connected for positive polarity. To change polarity:

- Set the CV-655 POWER toggle switch to the OFF (0) position.
  - Move the electrode cable to the negative (-) output terminal.
  - Move the work cable to the positive (+) output terminal. (High inductance or low inductance as needed).
  - If connecting lead #21 to the terminal strip, connect it to the +21 terminal (to match **work** polarity). If work polarity changes back to negative, lead #21 must be connected to the -21 terminal.
  - Reverse the leads on the back of the ammeter and voltmeter in the automatic control box.
  - If the automatic controls include a variable voltage board, connect its jumper lead to pin "L". This will permit the inch down button to operate. However, the jumper also disables the cold starting/autostop feature of the automatic controls. Only hot starting will be available.
6. Set the CV-655 OUTPUT CONTROL switch to the "Remote" position and the OUTPUT TERMINALS switch in the "Remote" position.

#### CONNECTING THE NA-5/-5R TO THE CV-655 (TERMINAL STRIP)

- Set the CV-655 POWER toggle switch to the OFF (0) position.
- Disconnect main AC input power to the CV-655.
- Connect the wire feeder control cable leads to the CV-655 terminal strip as shown in Figure C.2.

**FIGURE C.2 – NA-5/-5R WIRE FEEDER CONNECTION TO THE CV-655**



- Connect the wire feeder control cable ground lead to the frame terminal marked **⏚**.

**NOTE:** The CV-655 must be properly grounded.

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

CV-655

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6. Connect NA-5/-5R wire feeder control jumpers on Voltage Control Board. See NA-5/-5R Operator's Manual.

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

- a. Set the CV-655 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. (High inductance or low inductance as needed).
- d. If connecting lead #21 to the terminal strip, connect it to the +21 terminal (to match work polarity). If work polarity changes back to negative, lead #21 must be connected to the -21 terminal.

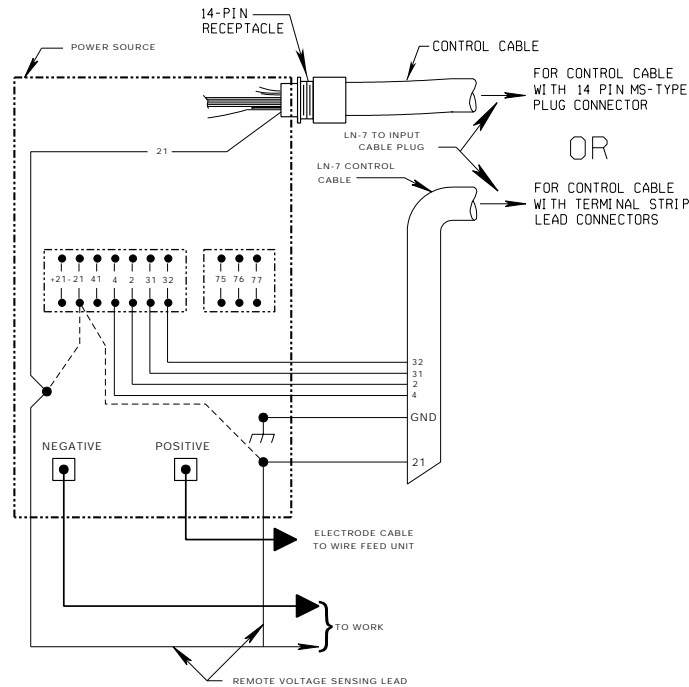
**NOTE:** For proper NA-5 operation, the electrode cables must be secured under the clamp bar on the left side of the NA-5 Control Box.

7. Set the CV-655 OUTPUT CONTROL switch to the "Remote" position and the OUTPUT TERMINALS switch to the "Remote" position.

CV-655



FIGURE C.3  
CV-655/LN-7 WITH K584 INPUT CABLE ASSEMBLY CONNECTION DIAGRAM



## SEMI-AUTOMATIC WIRE FEEDERS

### CONNECTING THE LN-7 TO THE CV-655 (14-PIN MS RECEPTACLE)

1. Set the POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-655.
3. Connect the electrode cable from the control cable to the "+" terminal of the welder and to the LN-7 wire feeder (High inductance or low inductance as needed). Connect the work cable to the "-" terminal of the welder. Reverse this hookup for negative polarity.
4. Connect control cable between the CV-655 and the LN-7. See Figure C.3.
5. Place the output terminals switch in the "Remote" position.
6. Adjust wire feed speed at the LN-7 and set the welding voltage with the output CONTROL.

**NOTE:** If optional remote control is used, place the OUTPUT CONTROL switch and the OUTPUT TERMINALS switch in the "Remote" position.

**NOTE:** Welding cable must be sized for the current and duty cycle of the application.

CV-655

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**CONNECTING THE LN-7 TO THE CV-655 (TERMINAL STRIP)**

1. Set the CV-655 POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV 655.
3. Connect the wire feeder control cable leads to the CV-655 terminal strip as shown in *Figure C.3*.
4. Connect the wire feeder control cable ground lead to the frame terminal marked *rn*.

**NOTE:** The CV-655 must be properly grounded.

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

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.

**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-655 terminal strip.

- 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 work cable for ease of use.

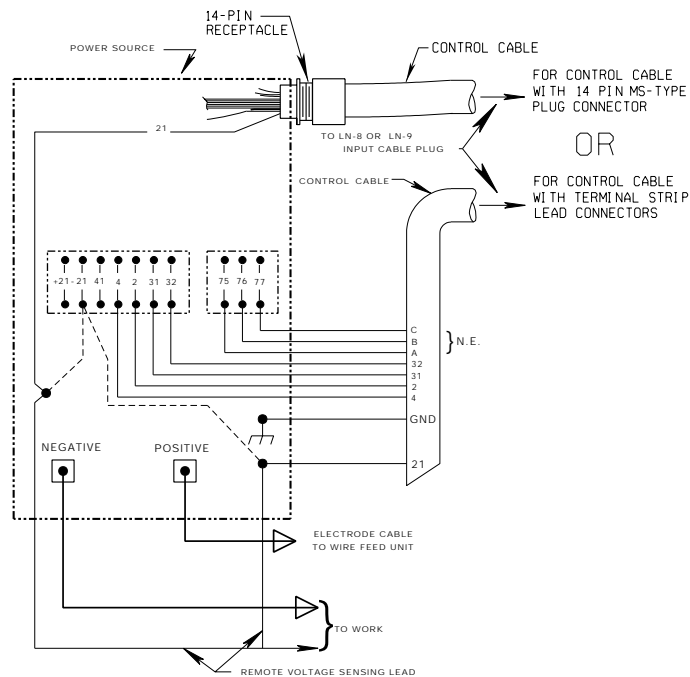
**NOTE:** The connection diagram shown in Figure C.3 shows the electrode connected for positive polarity. To change polarity:

- a. Set the CV-655 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 (High inductance or low inductance as needed).
- d. Connect control cable lead #21 to "+21" on the terminal strip.


CV-655



FIGURE C.4 - LN-8 OR LN-9 WIRE FEEDER CONNECTION TO THE CV-655



### CONNECTING THE LN-8 OR LN-9 TO THE CV-655 (TERMINAL STRIP)

1. Set the CV-655 POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-655.
3. Connect the wire feeder control cable leads to the CV-655 terminal strip as shown in Figure C.4.
4. Connect the wire feeder control cable ground lead to the frame terminal marked .
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 work cable for ease of use.

6. Connect LN-9 wire feeder control jumpers on Voltage Control board. See LN-9 Operator's Manual.

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

- a. Set the CV-655 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 (High inductance or low inductance as needed).
  - d. Connect control cable lead #21 to "+21" on the terminal strip.
7. Set the OUTPUT CONTROL switch to the "Remote" position and the OUTPUT TERMINALS switch to the "Remote" position.

CV-655



### CONNECTING THE LN-8 OR LN-9 TO THE CV-655 (14-PIN MS RECEPTACLE)

1. Set the POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-655.
3. Connect the electrode cable from the LN-8 or LN-9 to the "+" terminal of the welder (High inductance or low inductance as needed). Connect the work cable to the "-" terminal of the welder. Reverse this hookup for negative polarity. See *Figure C.4*.

**NOTE:** Welding cable must be sized for the current and duty cycle of the application.

4. Connect the control cable between the 14-pin MS receptacle on the CV-655 and the input cable plug on the LN-8 or LN-9. See *Figure C.4*.
5. Place the OUTPUT CONTROL switch in the "Remote" position and the OUTPUT TERMINALS switch in the "Remote" position.
6. Adjust wire feed speed at the LN-8 or LN-9 and set the welding voltage with the WIRE FEEDER VOLTAGE CONTROL.

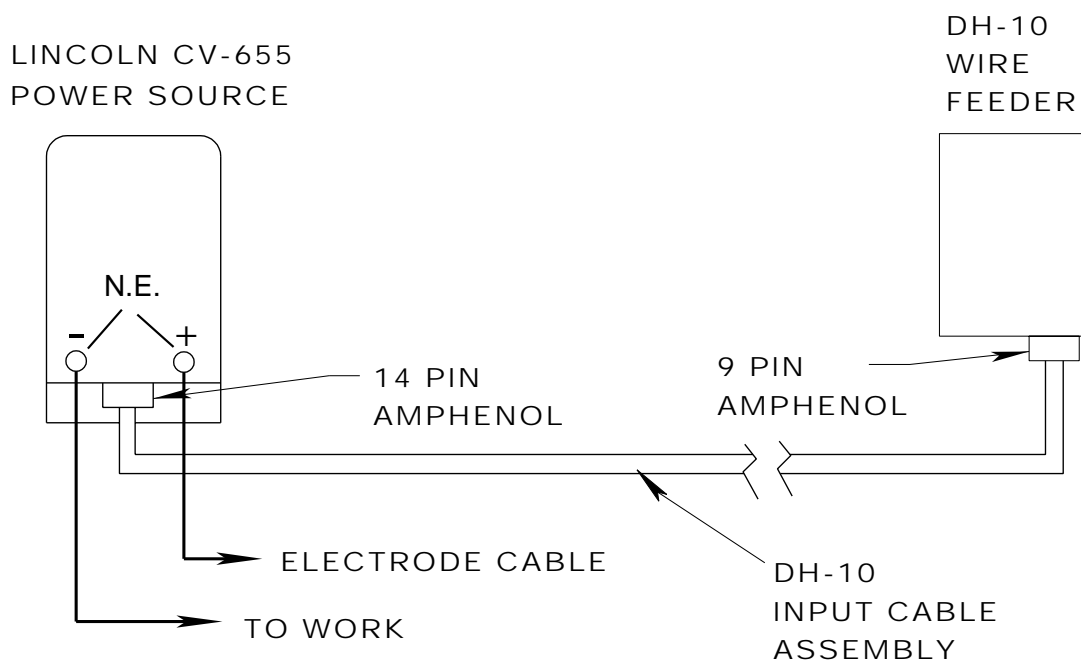
### CONNECTING THE DH-10 TO THE CV-655 (14-PIN MS RECEPTACLE)

1. Set the POWER toggle switch to the OFF (0) position.
2. Disconnect main AC input power to the CV-655.
3. Connect the electrode cable from the DH-10 to the "+" terminal of the welder (High inductance or low inductance as needed). Connect the work cable to the "-" terminal of the welder. Reverse this hookup for negative polarity.

**NOTE:** Welding cable must be sized for the current and duty cycle of the application.

4. Connect the DH-10 input cable between the 14-pin MS receptacle on the CV-655 and the input cable plug on the DH-10. See *Figure C.5*.
5. Place the OUTPUT CONTROL switch in the "Remote" position and the OUTPUT TERMINALS switch in the "Remote" position.
6. Adjust wire feed speed at the DH-10 and set the welding voltage with the WIRE FEEDER VOLTAGE CONTROL.
7. Set the DIP switches on the DH-10 for CV-655. See the DH-10 Operator's Manual.

FIGURE C.5 – CV-655 DH-10 CONNECTION



CV-655



# NOTES

---

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

CV-655



# TABLE OF CONTENTS -MAINTENANCE-

---

Maintenance .....Section D

    Safety Precautions.....D-2

    General Maintenance.....D-2

    General Component Locations.....D-3

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

CV-655



## 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.

## GENERAL MAINTENANCE

1. The fan motor has sealed bearings which require no service.
2. In extremely dusty locations, dirt may restrict the cooling air causing the welder to run hot with premature tripping of thermal protection. Blow out the welder with low pressure air at regular intervals to eliminate excessive dirt and dust build-up on internal parts.
3. Periodically check the welding cables. Inspect for any slits or punctures. Also make sure that all connections are tight.

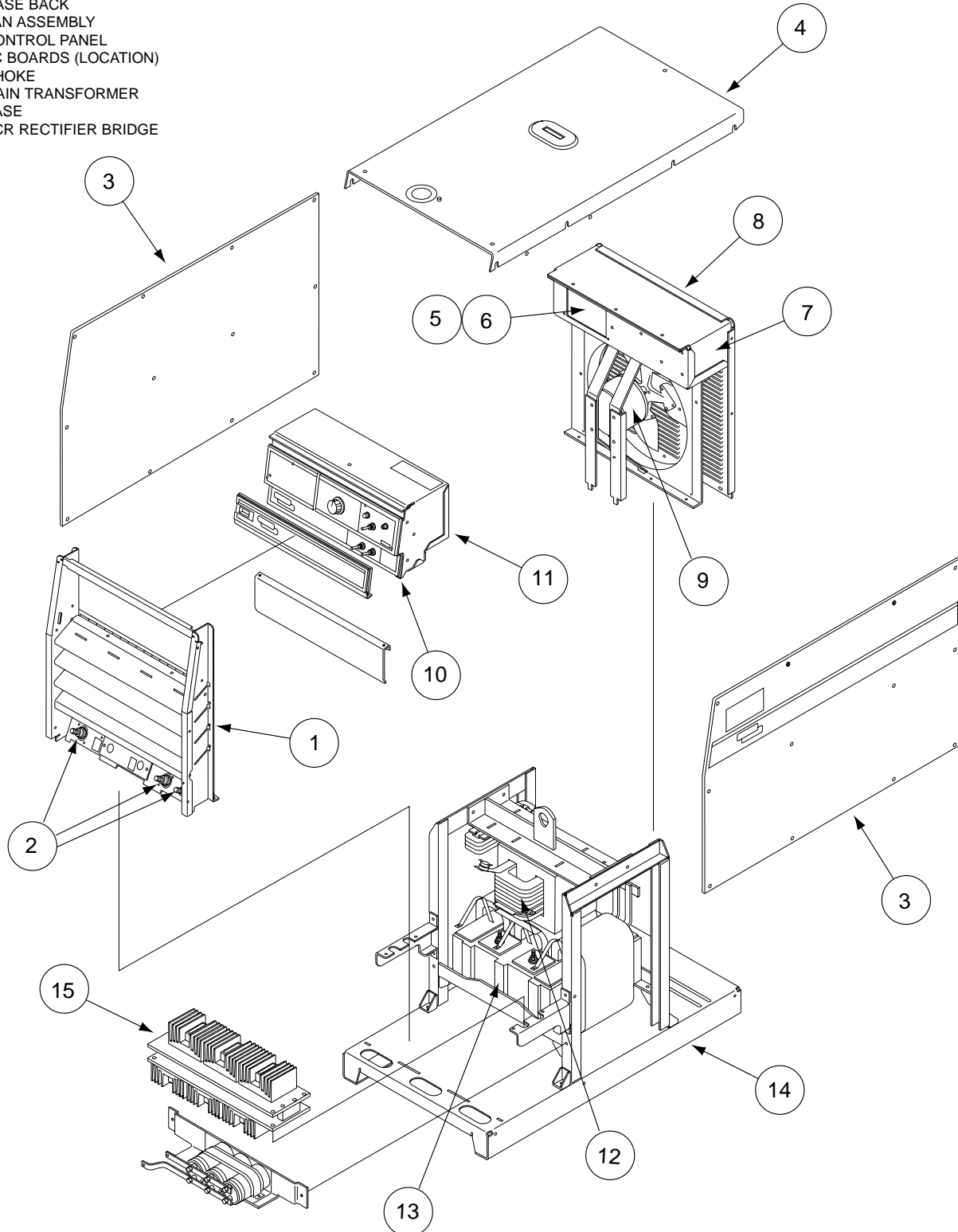
CV-655





FIGURE D.1 - GENERAL COMPONENT LOCATIONS

1. CASE FRONT
2. OUTPUT TERMINALS
3. CASE SIDES
4. CASE TOP
5. RECONNECT PANEL (LOCATION)
6. INPUT CONTACTOR (LOCATION)
7. CONTROL TRANSFORMER (LOCATION)
8. CASE BACK
9. FAN ASSEMBLY
10. CONTROL PANEL
11. PC BOARDS (LOCATION)
12. CHOKE
13. MAIN TRANSFORMER
14. BASE
15. SCR RECTIFIER BRIDGE



CV-655

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# NOTES

---

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

CV-655



# TABLE OF CONTENTS -THEORY OF OPERATION SECTION-

Theory of Operation .....Section E

  General Description .....E-2

  Input Line Voltage, Contactor, Reconnect,  
  Fault Protection and Transformers .....E-2

  Control Board, Firing Board, Snubber/Fan  
  Board and Rectification .....E-3

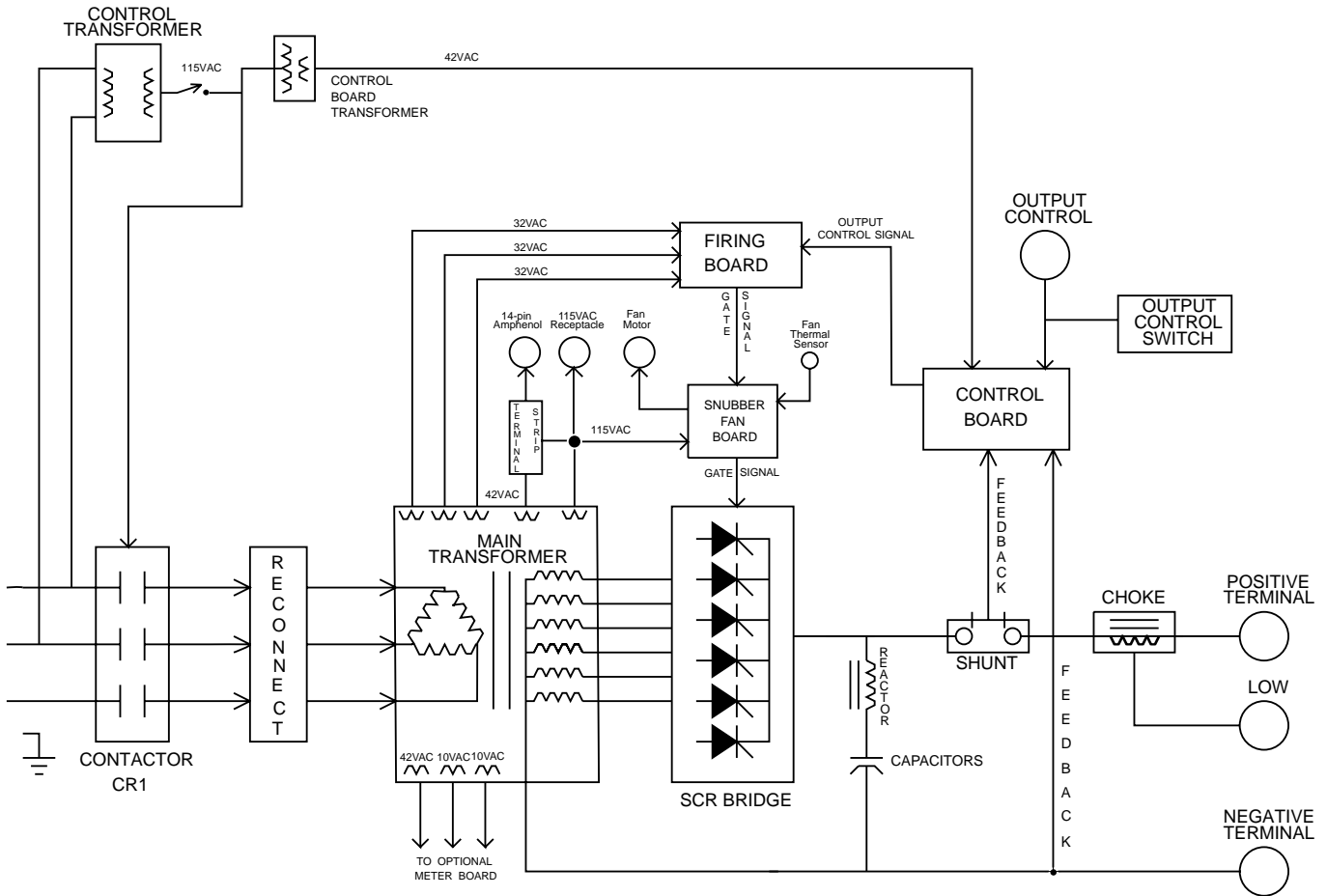
  Protective Devices and Shutdown Circuits .....E-4

    Thermal Protection .....E-4

    Over Current Protection .....E-4

  SCR Operation .....E-5

FIGURE E.1 – CV-655 BLOCK LOGIC DIAGRAM



CV-655



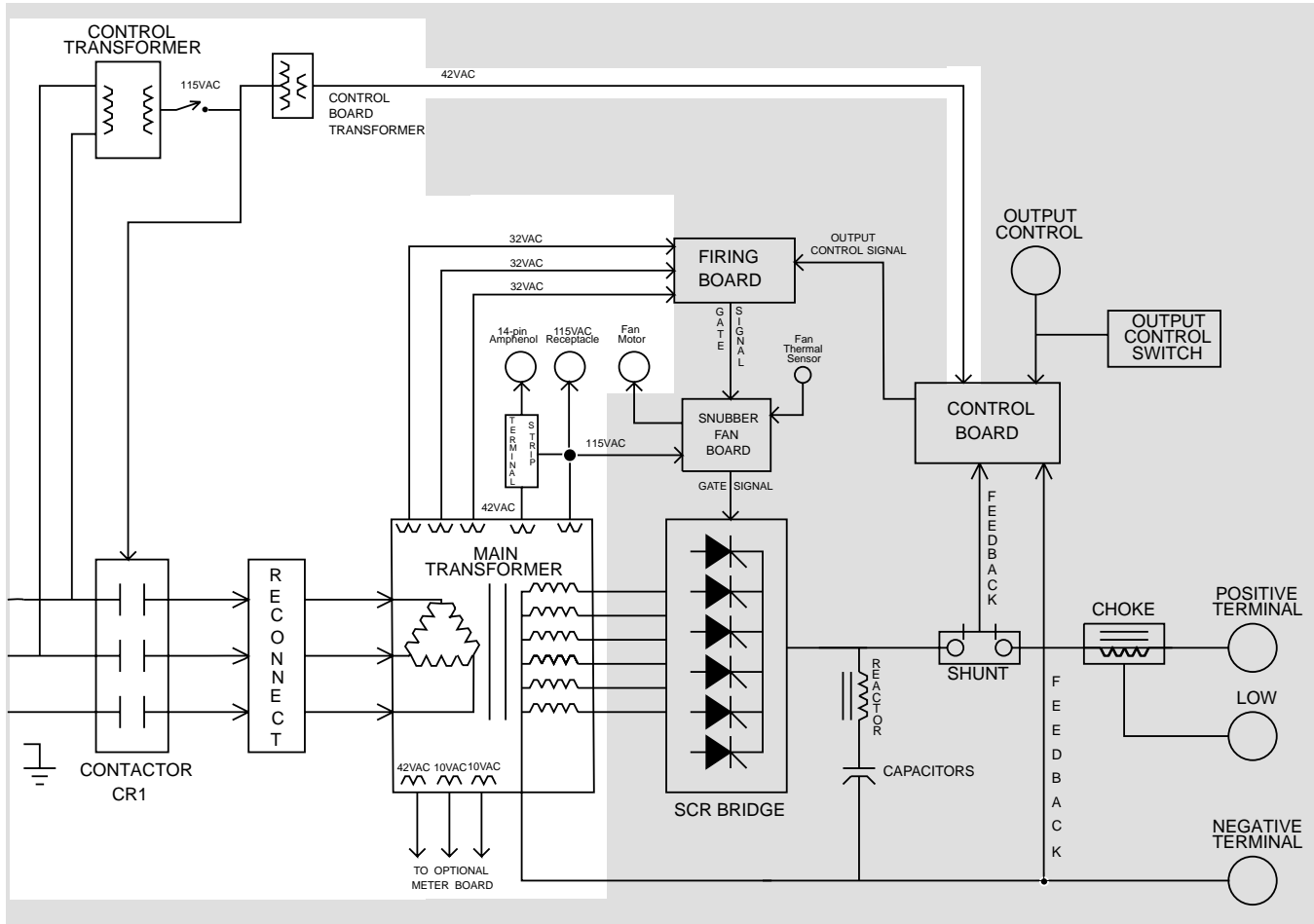
Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

FIGURE E.2 – INPUT LINE VOLTAGE, CONTACTOR, RECONNECT, MAIN AND CONTROL TRANSFORMERS



## GENERAL DESCRIPTION

The CV-655 is a three-phase, SCR controlled constant voltage DC power source. It is rated at 650 amps, 100% duty cycle with outstanding arc characteristics for multiple welding processes.

## INPUT LINE, CONTACTOR, RECONNECT, FAULT PROTECTION AND TRANSFORMERS

The desired three-phase input power is connected to the CV-655 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. The secondary of the control transformer supplies 115 VAC power to the control board transformer and to the input contactor. The control board transformer supplies 42 VAC to the control board.

A reconnect panel allows the user to configure the machine for the desired input voltage. This three-phase AC input 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 six starts of the secondary windings are connected to the rectifier assembly.

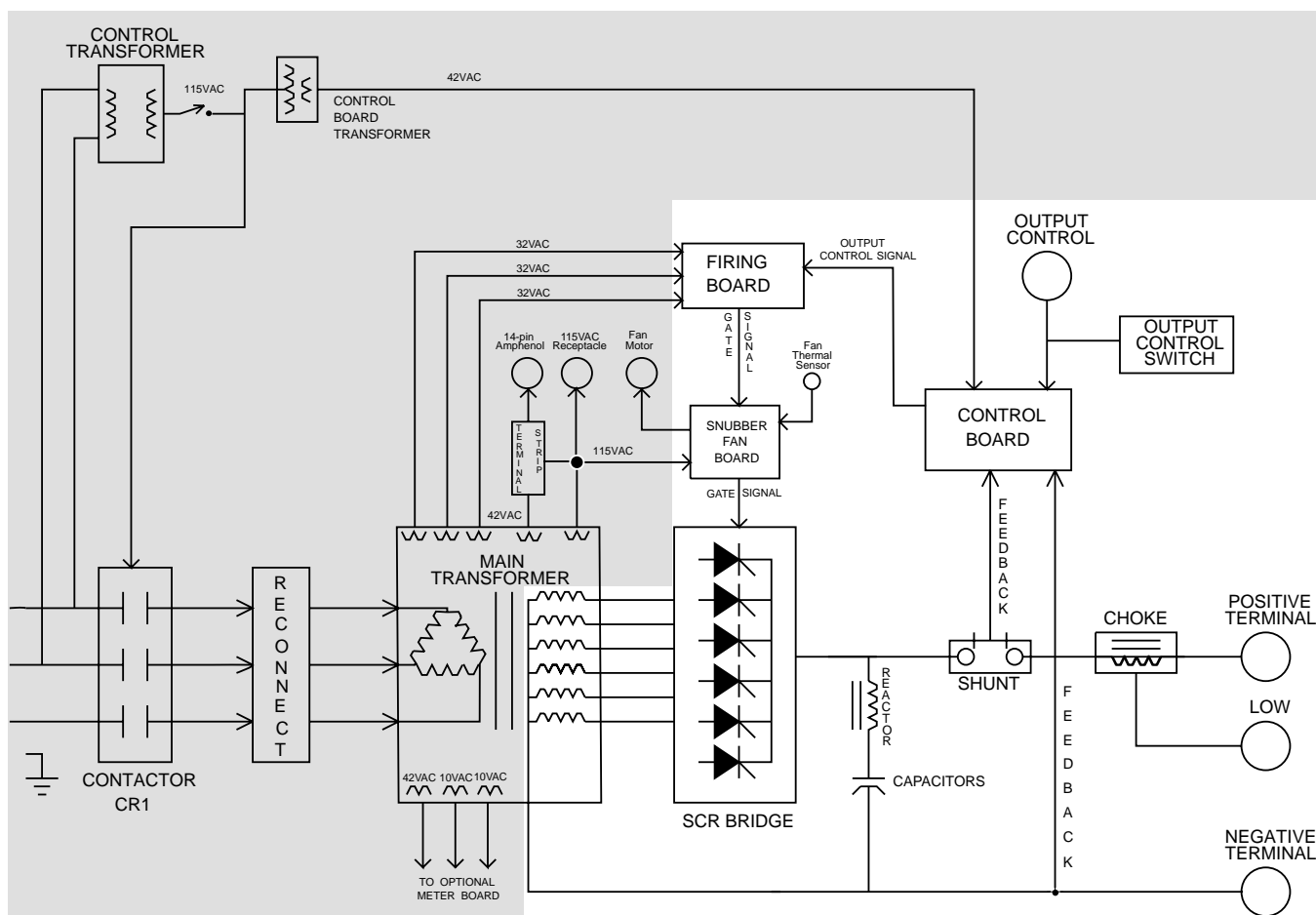
In addition, the main transformer also has eight isolated secondary windings. There are three 32 VAC windings, which provide power and "timing" to the firing board. The 115 VAC winding powers the fan motor and provides the user with up to 20 amps of 115 VAC auxiliary power at the receptacle or 14-pin MS type connector. The 42 VAC winding provides up to 10 amps at the 14-pin MS type connector. Three other isolated coils are used to power the optional digital meter PC board. One winding is rated at 42 VAC, and the other two are each rated at 10 VAC.

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

CV-655

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FIGURE E.3 – CONTROL BOARD, FIRING BOARD, SNUBBER/FAN BOARD AND RECTIFICATION



## CONTROL BOARD, FIRING BOARD, SNUBBER/FAN BOARD AND RECTIFICATION

The “neutrals” of the welding secondary windings in the main transformer are connected together, and the six starts are connected to the six Silicon Controlled Rectifier (SCR) assemblies to form a six-phase output. This six-phase AC output from the main transformer secondary is rectified and controlled through the SCR bridge.

A portion of the firing board is a three-phase circuit. Each phase provides two firing pulses, one for each of the two SCRs controlled by that phase. When a gate firing enable signal is received, the firing circuit supplies the proper amount of energy to the gates of the power SCRs. When this gate firing signal is applied at the correct time, through the snubber/fan board, the SCR will turn ON. The amount of ON time versus OFF time determines the output of the machine. See **SCR Operation**. At this time the reactor and capacitor circuit is brought into the machines output circuit. This enhances the constant voltage (CV) characteristics of the CV-655.

The control board receives current feedback information from the shunt and voltage feedback information from the welding output terminals. This feedback information is processed on the control board. The control board compares the commands of the output control potentiometer (or remote control device) with the feedback information and sends the appropriate output control signal to the firing board.

A tapped output choke is connected to the two positive output terminals. This large inductor stores energy, which provides current filtering for the welding output of the CV-655. Two positive output terminals are provided. One is connected to the tap lead in the choke, thus providing a lower inductance. The other utilizes the entire choke for higher inductance arc characteristics.

The snubber/fan board furnishes protection to the SCR bridge from the transient voltages. It also monitors the thermal sensor and activates the fan motor when cooling is necessary.

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

CV-655

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## PROTECTIVE DEVICES AND SHUTDOWN CIRCUITS

### THERMAL PROTECTION

Two thermostats protect the CV-655 from excessive operating temperatures. Excessive operating temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle and output rating. If excessive operating temperatures should occur, a thermostat will open. This condition will be indicated by the illumination of the yellow Thermostatic Protection Light located on the case front. The fan should continue to run, but the welding output will be disabled until the machine cools and the Thermostatic Protection Light is out.

### OVER CURRENT PROTECTION

The CV-655 also has over-current protection. When the load exceeds a threshold current (about 900 amps), overcurrent shutdown will occur after a period of time that shortens as the current increases beyond this threshold. If the current reaches about 1000 amps the output will be "clamped" at about 1000 amps and shut down will occur in about 5 seconds. When this overload shut down occurs the short circuit output of the machine drops to only about 20 amps, but the input contactor and input pilot light will remain on until reset. This is done by turning the power switch off, then back on with the overload removed.

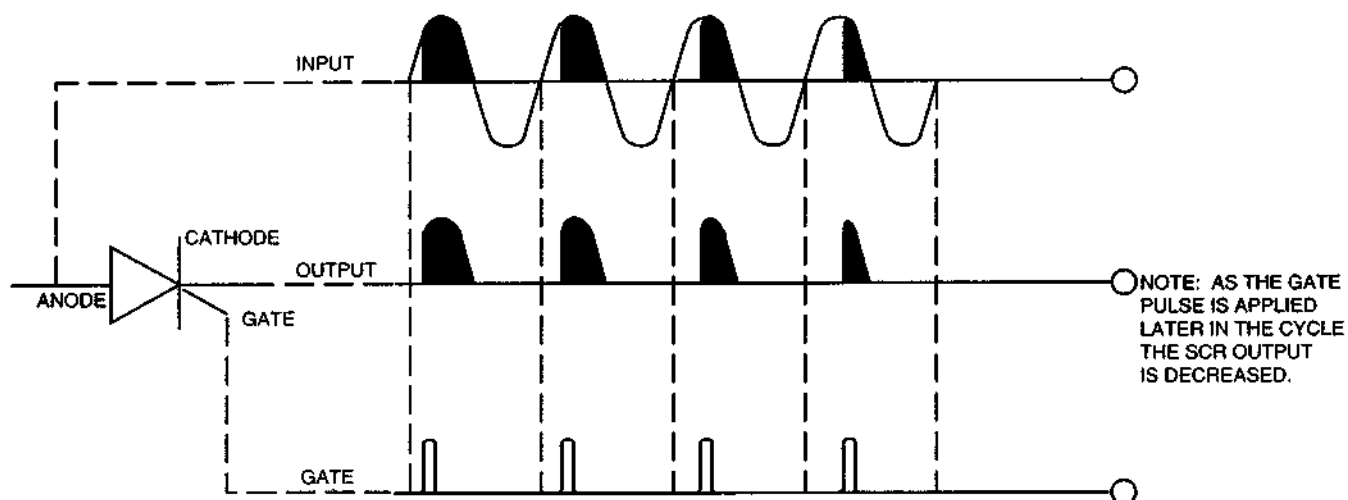
### FAN MOTOR FUSE (EUROPEAN MODEL)

A 10 amp slow blow fuse protects the fan motor circuit. This fuse is located inside the CV-655 mounted on the fan motor bracket.

CV-655



FIGURE E.4 - 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 of 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.

# NOTES

---

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

CV-655





# TABLE OF CONTENTS

## TROUBLESHOOTING & REPAIR SECTION

---

<b>Troubleshooting &amp; Repair Section .....</b>	<b>Section F</b>
How to Use Troubleshooting Guide .....	F-2
PC Board Troubleshooting Procedures .....	F-3
Troubleshooting Guide .....	F-4-F-12
Test Procedures	
Internal Trigger Circuit Test .....	F-13
Firing Board Test .....	F-17
Main Transformer (T1) Voltage Test.....	F-22
Control Transformer (T2) Voltage Test.....	F-27
Control Board Transformer (T3) Test .....	F-30
Input Contactor Test.....	F-32
Static SCR Test .....	F-35
Active SCR Test.....	F-38
Thermal Fan/Snubber Board LED Chart.....	F-41
Control Board LED Chart .....	F-42
Oscilloscope Waveforms	
Normal Open Circuit Voltage Waveform-Maximum Output Setting .....	F-43
Typical Output Voltage Waveform-Machine Loaded .....	F-44
Abnormal Open Circuit Voltage Waveform-One Output SCR Not Functioning.....	F-45
Abnormal Open Circuit Voltage Waveform-Maximum Output Setting (No Load) .....	F-46
Typical SCR Gate Voltage Waveform-Maximum Output Setting (No Load).....	F-47
Replacement Procedures	
Input Contactor (CR1) Cleaning/Replacement .....	F-49
SCR Rectifier Bridge Removal and Replacement .....	F-51
Main Transformer and Choke Removal and Replacement.....	F-54
Retest After Repair .....	F-57

## HOW TO USE TROUBLESHOOTING GUIDE



### WARNING

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

---

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

**Step 1. LOCATE PROBLEM (SYMPTOM).** Look under the column labeled “PROBLEM (SYMPTOMS)”. This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into three main categories: Output Problems, Function Problems and Welding Problems.

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

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

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



### CAUTION

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

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CV-655



## PC BOARD TROUBLESHOOTING PROCEDURES

### WARNING



#### ELECTRIC SHOCK can kill.

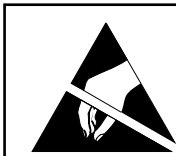
- Have an electrician install and service this equipment. Turn the input power OFF at the fuse box before working on equipment. Do not touch electrically hot parts.

### CAUTION

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

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

#### PC board can be damaged by static electricity.



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

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.

- If you don't have a wrist strap, touch an un-painted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.

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

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

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

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

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

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

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

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

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

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

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

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

CV-655

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Observe Safety Guidelines detailed in the beginning of this manual.

## TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>OUTPUT PROBLEMS</b>		
Major physical or electrical damage is evident.	1. Contact the Lincoln Electric Service Dept. 1-800-833-9353.	
The machine is dead - the input contactor does not operate. The pilot light is not lit.	<ol style="list-style-type: none"> <li>1. The power switch (S1) is in the ON position.</li> <li>2. Check for blown or missing fuses in the input lines.</li> <li>3. Check the three-phase input line voltage at the machine. The input voltage must match the rating plate and reconnect panel.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the power switch (S1) and associated leads and connections. See the Wiring Diagram.</li> <li>2. Perform the <b>Control Transformer Test</b>.</li> </ol>
The input contactor operates, but no welding output. The 115 VAC auxiliary supply is present at the receptacle.	<ol style="list-style-type: none"> <li>1. Check the electrode and work cables for loose or faulty connections.</li> <li>2. If the Thermal Protection Light is ON, the machine is overheated. Wait for the machine to cool and remedy the cause of the overheating problem. See the <b>Fan/Snubber Board LED Chart</b>.</li> <li>3. Make certain either the output terminals switch is in the ON position or the external gun trigger circuit is functioning properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b>Internal Trigger Circuit Test</b>.</li> <li>2. Perform the <b>Firing Board Test</b>.</li> <li>3. Perform the <b>Main Transformer Test</b>.</li> <li>4. Perform the <b>SCR Output Bridge Test</b>.</li> <li>5. The control board may be faulty. See <b>Control Board LED Chart</b>.</li> </ol>

**CAUTION**

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

CV-655



Return to Section TOC

Return to Master TOC

Return to Section TOC

Return to Master TOC

Return to Section TOC

Return to Master TOC

Return to Section TOC

Return to Master TOC

Observe Safety Guidelines detailed in the beginning of this manual.

**TROUBLESHOOTING GUIDE**

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>OUTPUT PROBLEMS</b>		
The input contactor chatters.	1. Check the three-phase input line voltage at the machine. The input voltage must match the rating plate and reconnect panel configuration.	1. Check for loose or faulty wiring between the input power switch (SW1), and the input contactor. See the Wiring Diagram.  2. The control board may be defective. See the <b>Control Board LED Chart</b> .  3. The input contactor may be faulty.
The machine is dead - the input contactor does not operate. The pilot light is lit.	1. Check the three-phase input line voltage at the machine. The input voltage must match the rating plate and reconnect panel configuration.	1. Check the wiring between the power switch and the input contactor (CR1).  2. The input contactor may be faulty.

 **CAUTION**

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CV-655



Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

**TROUBLESHOOTING GUIDE**

Observe Safety Guidelines detailed in the beginning of this manual.

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

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>OUTPUT PROBLEMS</b>		
<p>The machine has welding output but no control.</p>	<ol style="list-style-type: none"> <li>1. Check the output control switch (SW3) for proper setting.</li> <li>2. If a remote control cable is used, make certain the cable and connections are good.</li> </ol>	<ol style="list-style-type: none"> <li>1. The output control potentiometer, output control switch (SW3) or associated wiring may be defective. See the Wiring Diagram.</li> <li>2. Perform the <b>Firing Board Test</b>.</li> <li>3. Perform the <b>SCR Output Bridge Test</b>.</li> <li>4. Perform the <b>Control Transformer Test</b>.</li> <li>5. The control board may be faulty. See the <b>Control Board LED Chart</b>.</li> </ol>
<p>The machine does not have maximum output.</p>	<ol style="list-style-type: none"> <li>1. Check the three-phase input lines at the CV-655. Make certain the input voltages match the machine's rating and reconnect panel configuration.</li> <li>2. Put the output control switch (SW3) in the "Local" control position. If the problem is resolved, the remote unit or wire feeder may be defective.</li> </ol>	<ol style="list-style-type: none"> <li>1. The output control potentiometer, output control switch (SW3) or associated wiring may be defective. See the Wiring Diagram.</li> <li>2. Perform the <b>Main Transformer Test</b>.</li> <li>3. Perform the <b>Firing Board Test</b>.</li> <li>4. Perform the <b>SCR Bridge Test</b>.</li> <li>5. The control board may be faulty. See the <b>Control Board LED Chart</b>.</li> </ol>

 **CAUTION**

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

CV-655



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

Observe Safety Guidelines detailed in the beginning of this manual.

**TROUBLESHOOTING GUIDE**

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>OUTPUT PROBLEMS</b>		
<p>The 115 VAC receptacle is not working. The machine's welding output is normal.</p>	<ol style="list-style-type: none"> <li>1. The circuit breaker may be tripped. Reset if necessary.</li> <li>2. Make sure the 115 VAC plug and "load" is in good working condition.</li> </ol>	<ol style="list-style-type: none"> <li>1. The circuit breaker may be defective. Check associated wiring. See the Wiring Diagram.</li> <li>2. Check for 115 VAC at terminals #31 and #32 on the terminal strip. If 115 VAC is present at the terminal strip, check the wiring between the terminal strip, the circuit breaker and the 115 VAC receptacle. If 115 VAC is NOT present at the terminal strip, perform the <b>Main Transformer Test</b>.</li> <li>3. The 115 VAC receptacle may be defective.</li> </ol>

**CAUTION**

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

Observe Safety Guidelines detailed in the beginning of this manual.

**TROUBLESHOOTING GUIDE**

<b>PROBLEMS (SYMPTOMS)</b>	<b>POSSIBLE AREAS OF MISADJUSTMENT(S)</b>	<b>RECOMMENDED COURSE OF ACTION</b>
<b>FUNCTION PROBLEMS</b>		
<p>The output control potentiometer does not function when the output control switch (SW3) is in the "Local" position. The CV-655 operates normally when controlled remotely.</p>	<p>1. The output control switch (SW3) may be defective.</p>	<p>1. The output control potentiometer or associated wiring may be faulty. See the Wiring Diagram.</p>
<p>The remote output control unit does not function properly when the output control switch (SW3) is in the "Remote" position. The CV-655 operates normally when controlled locally from the machine's output control potentiometer.</p>	<p>1. The remote control unit or connecting cable may be defective. Check or replace.</p>	<p>1. The output control switch (SW3) may be defective. Check or replace. See the Wiring Diagram.</p> <p>2. Check the remote control leads #75, #76 and #77 at plug P15, the terminal strip and the 14-pin MS type connector. Check for loose or faulty connections. See the Wiring Diagram.</p>



**CAUTION**

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

CV-655



Return to Section TOC  
Return to Master TOC



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**TROUBLESHOOTING GUIDE**

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
<b>FUNCTION PROBLEMS</b>		
The Thermal Protection Light is on but the fan does not run.	<ol style="list-style-type: none"> <li>1. Check for obstructions that could prevent the fan from turning.</li> <li>2. Fan fuse may be faulty. (European models only)</li> </ol>	<ol style="list-style-type: none"> <li>1. The fan motor could be faulty. Check or replace.</li> <li>2. The Thermal Fan/Snubber PC Board may be defective. See the <b><i>Thermal Fan/Snubber PC Board LED Chart</i></b>.</li> </ol>
The fan runs continuously.	<ol style="list-style-type: none"> <li>1. Note: The fan is thermal controlled. Under normal conditions, it does not continuously run.</li> </ol>	<ol style="list-style-type: none"> <li>1. The Thermal Fan Thermistor may be faulty. See the Wiring Diagram.</li> <li>2. The Thermal Fan/Snubber PC Board may be defective. See the <b><i>Thermal Fan/Snubber PC Board LED Chart</i></b>.</li> </ol>
One or both of the optional digital meters are not lit.	<ol style="list-style-type: none"> <li>1. Check for loose plugs P13 and P12 at the digital meter PC board.</li> </ol>	<ol style="list-style-type: none"> <li>1. The digital meter board may not be receiving voltages from the T1 transformer windings. Perform the <b><i>Main Transformer Test</i></b>.</li> <li>2. Check the wiring between Plug J13 and the associated leads at the main transformer. See the Wiring Diagram.</li> <li>3. The digital meter PC board may be faulty.</li> </ol>



**CAUTION**

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

CV-655



Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

Observe Safety Guidelines detailed in the beginning of this manual.

**TROUBLESHOOTING GUIDE**

<b>PROBLEMS (SYMPTOMS)</b>	<b>POSSIBLE AREAS OF MISADJUSTMENT(S)</b>	<b>RECOMMENDED COURSE OF ACTION</b>
<b>FUNCTION PROBLEMS</b>		
The optional digital meter is not working properly and/or the display is erratic.	<ol style="list-style-type: none"> <li>1. Make certain plugs P12 and P13 are securely plugged into the digital meter PC board. Also make sure plug P3 is securely plugged into the control board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check feedback leads #222, #210, #201 and #202 for loose or faulty connections. See the Wiring Diagram.</li> <li>2. The optional digital meter PC board may be faulty.</li> </ol>
The analog meters are not reading correctly.	<ol style="list-style-type: none"> <li>1. Make sure plug P3 is securely plugged into the control board and plug J14 is securely seated in the plug assembly from the control board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check feedback leads #222, #210, #201 and #202 for loose or faulty connections. See the Wiring Diagram.</li> <li>2. The meter(s) may be defective.</li> </ol>

** CAUTION**

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

Return to Section TOC | Return to Section TOC | Return to Section TOC | Return to Section TOC | Return to Section TOC

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**TROUBLESHOOTING GUIDE**

<b>PROBLEMS (SYMPTOMS)</b>	<b>POSSIBLE AREAS OF MISADJUSTMENT(S)</b>	<b>RECOMMENDED COURSE OF ACTION</b>
<b>WELDING PROBLEMS</b>		
<p>Poor arc characteristics.</p>	<ol style="list-style-type: none"> <li>1. Check the three-phase input line voltage at the machine. The input voltage must match the rating plate and reconnect panel.</li> <li>2. Check the welding cables for loose or faulty connections.</li> <li>3. Make sure the proper welding procedures are being used. (Wire feed speed, arc voltage and wire size)</li> <li>4. Make sure the positive welding cable is connected to the correct positive output terminal. (Low or High inductance)</li> </ol>	<ol style="list-style-type: none"> <li>1. The capacitor bank may be faulty. Check or Replace. <b>WARNING: The liquid electrolyte in these capacitors is toxic. Avoid contact with any portion of your body.</b></li> <li>2. Perform the <i>Firing Board Test</i>.</li> <li>3. Perform the <i>SCR Bridge Test</i>.</li> <li>4. Perform the <i>Main Transformer Test</i>.</li> <li>5. The control board may be faulty. See the <i>Control Board LED Chart</i>.</li> <li>6. Check the reactor for "shorts" or "opens".</li> </ol>
<p>Poor arc striking with semiautomatic or automatic wire feeders.</p>	<ol style="list-style-type: none"> <li>1. Make sure the proper welding procedures are being used. (Wire feed speed, arc voltage and wire size)</li> <li>2. Check the welding cables for loose or faulty connections.</li> </ol>	<ol style="list-style-type: none"> <li>1. The capacitor discharge resistor may be faulty. Check. See Wiring Diagram.</li> <li>2. Perform the <i>Firing Board Test</i>.</li> <li>3. Perform the <i>SCR Bridge Test</i>.</li> <li>4. The control board may be faulty. See the <i>Control Board LED Chart</i>.</li> </ol>



**CAUTION**

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

CV-655



Return to Section TOC  
Return to Master TOC

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**TROUBLESHOOTING GUIDE**

<b>PROBLEMS (SYMPTOMS)</b>	<b>POSSIBLE AREAS OF MISADJUSTMENT(S)</b>	<b>RECOMMENDED COURSE OF ACTION</b>
<b>WELDING PROBLEMS</b>		
<p>The arc is variable or sluggish.</p>	<ol style="list-style-type: none"> <li>1. Check the three-phase input line voltage at the machine. The input voltage must match the rating plate and reconnect panel configuration.</li> <li>2. Make sure the machine's settings are correct for the welding process.</li> <li>3. Check the welding cables for loose or faulty connections. Also make sure cables are sized correctly for the welding current.</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform the <b><i>Firing Board Test.</i></b></li> <li>2. Perform the <b><i>SCR Bridge Test.</i></b></li> <li>3. Perform the <b><i>Main Transformer Test.</i></b></li> <li>4. The control board may be faulty. See the <b><i>Control Board LED Chart.</i></b></li> </ol>



**CAUTION**

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

CV-655



Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

## INTERNAL TRIGGER CIRCUIT TEST



### WARNING

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

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

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### TEST DESCRIPTION

This test will help determine if the wiring and connections are good from the 14-pin receptacle and terminal strip through the P15 and P16 connectors and thermostats to the firing board. The technician will also be able to determine if the 42 VAC trigger supply voltage is present.

### MATERIALS NEEDED

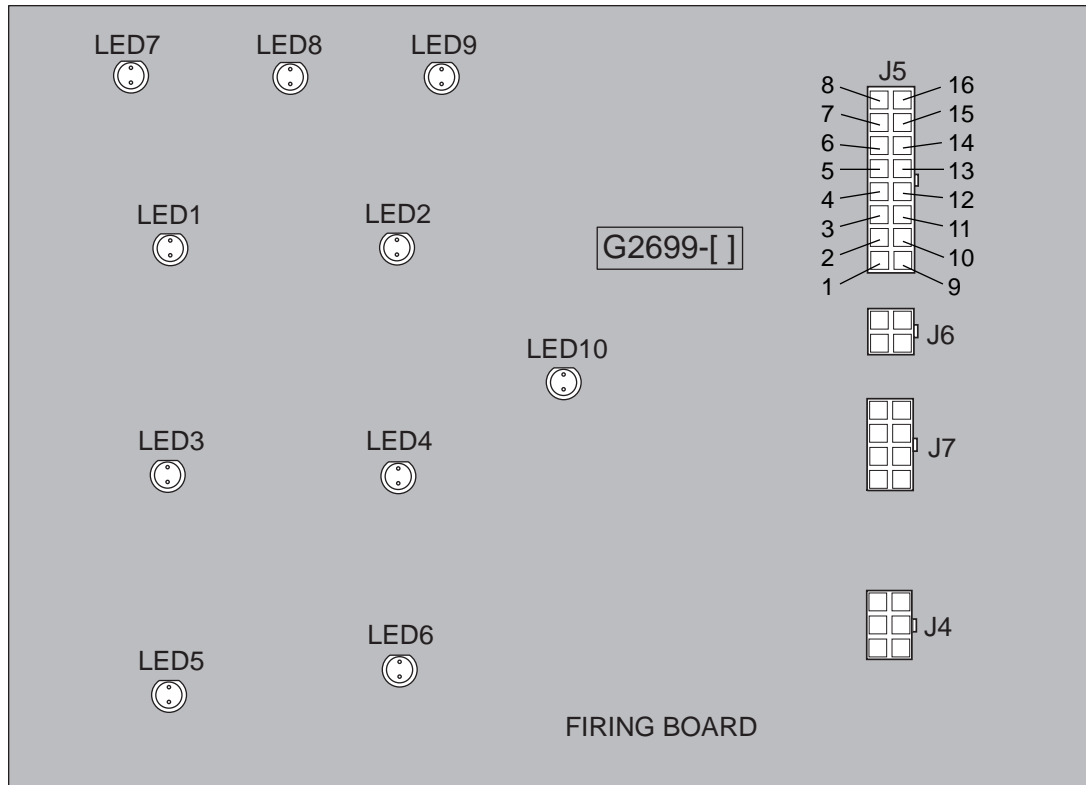
- Ohmmeter (Multimeter)
- CV-655 Wiring Diagram
- Simplified Trigger Diagram

CV-655



## INTERNAL TRIGGER CIRCUIT TEST (continued)

FIGURE F.1 – FIRING BOARD TRIGGER CIRCUIT TEST POINTS AND LEDS

**WARNING**

**ELECTRIC SHOCK** can kill.



- Do not touch electrically hot parts.

2. If LED 10 does not light when the trigger circuit is activated, proceed with the following voltage and continuity checks.
3. Check the 10 Amp circuit breaker. It is the one closest to the 115V duplex receptacle. Reset if tripped.

**TEST PROCEDURE**

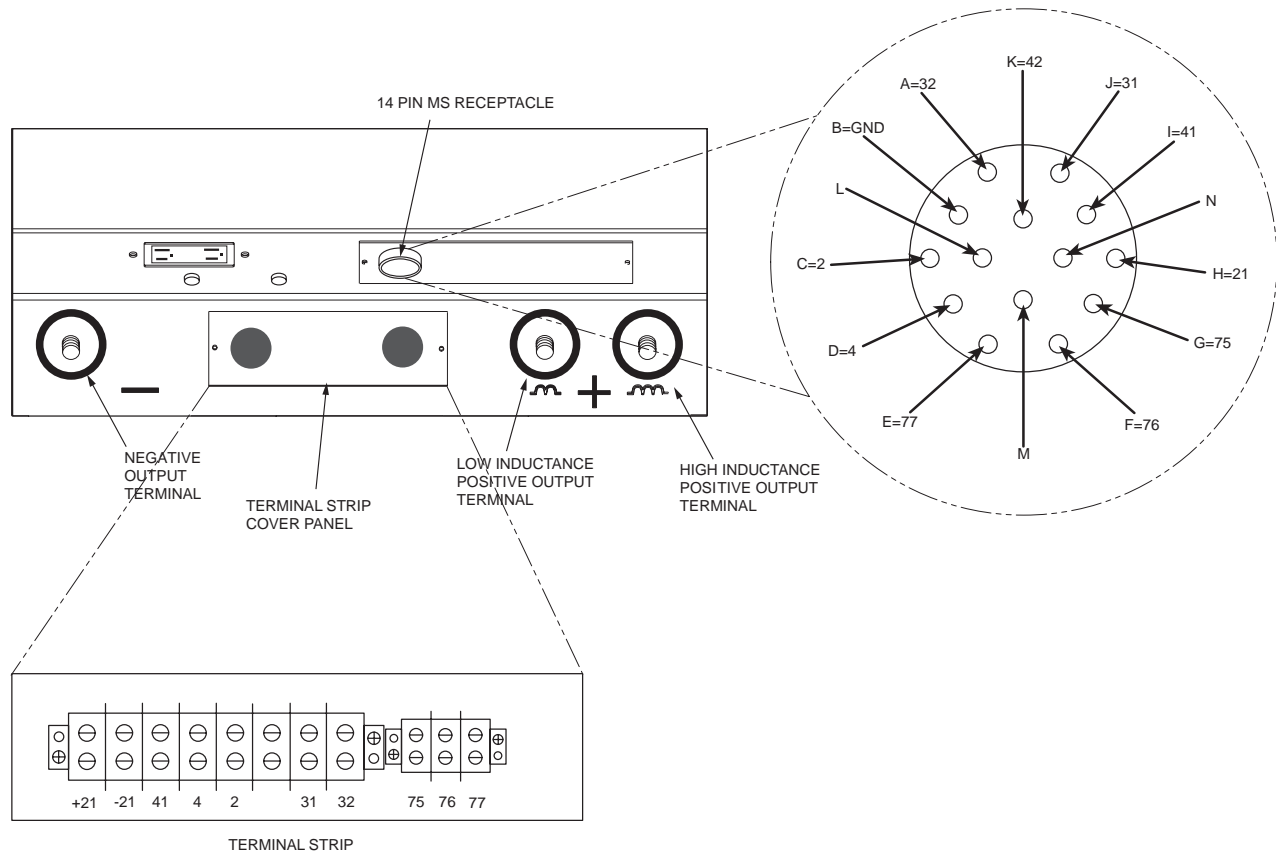
1. With the correct input power applied to the CV-655 and the trigger circuit activated, LED 10 on the firing board should be lit. See Figure F.1. If LED 10 lights when the trigger is activated, the wiring and circuitry to the firing board is good. Perform the **Firing Board Test** and see the **Control Board LED Chart**. See the **Simplified Trigger Diagram**.

**NOTE:** LED 10 should not be lit if the trigger circuit is not activated.

CV-655



FIGURE F.2 – TERMINAL STRIP AND 14-PIN RECEPTACLE

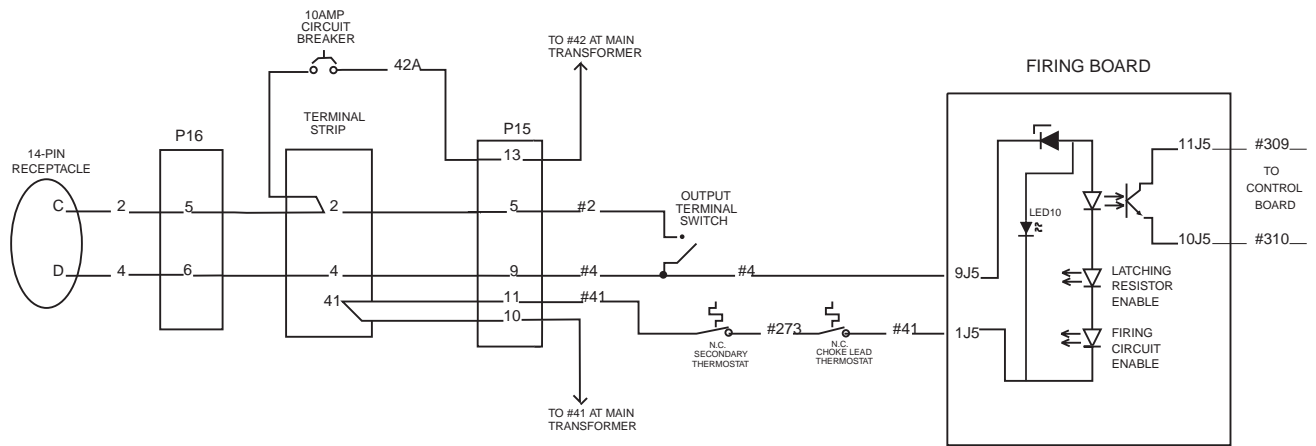


4. Check for the presence of 42 VAC at the terminal strip ( #2 to #41). See the **Simplified Trigger Diagram**.
5. If 42 VAC is not present at the terminal strip, check the circuit breaker and leads #42A and #41 at the P15 connector. See the **Simplified Trigger Diagram**. Also perform the **Main Transformer Test**.
6. Remove the main input supply power to the CV-655 machine.
7. Check continuity (zero ohms) from lead #42A (plug P15 pin-13) to lead #2 at the 14-pin receptacle pin "C". Also check continuity to the output terminal switch. See the **Simplified Trigger Diagram**. If a resistance of any value is indicated, check the associated wires and plugs.
8. Check continuity (zero ohms) from pin "D" (lead #4) at the 14-pin receptacle to the output terminal switch and also to plug J5-pin 9 at the firing board. See the **Simplified Trigger Diagram** and Figures **F.1** and **F.2**. If a resistance of any value is indicated, check the associated wires and plugs.

CV-655

9. Check continuity (zero ohms) from lead #41 (plug P15 pin-10) to plug J5-pin 1 at the firing board. See the Simplified Trigger Diagram and **Figure F.1**. If a resistance of any value is indicated, check the associated wires, plugs and thermostats.

FIGURE F.3 – SIMPLIFIED TRIGGER DIAGRAM



CV-655

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## FIRING BOARD TEST



### WARNING

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

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

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### TEST DESCRIPTION

This test will help determine whether or not the firing board is receiving the correct voltages and signals. The LEDs (Light Emitting Diodes) will help determine if the firing board is generating gate signals for the main SCRs.

### MATERIALS NEEDED

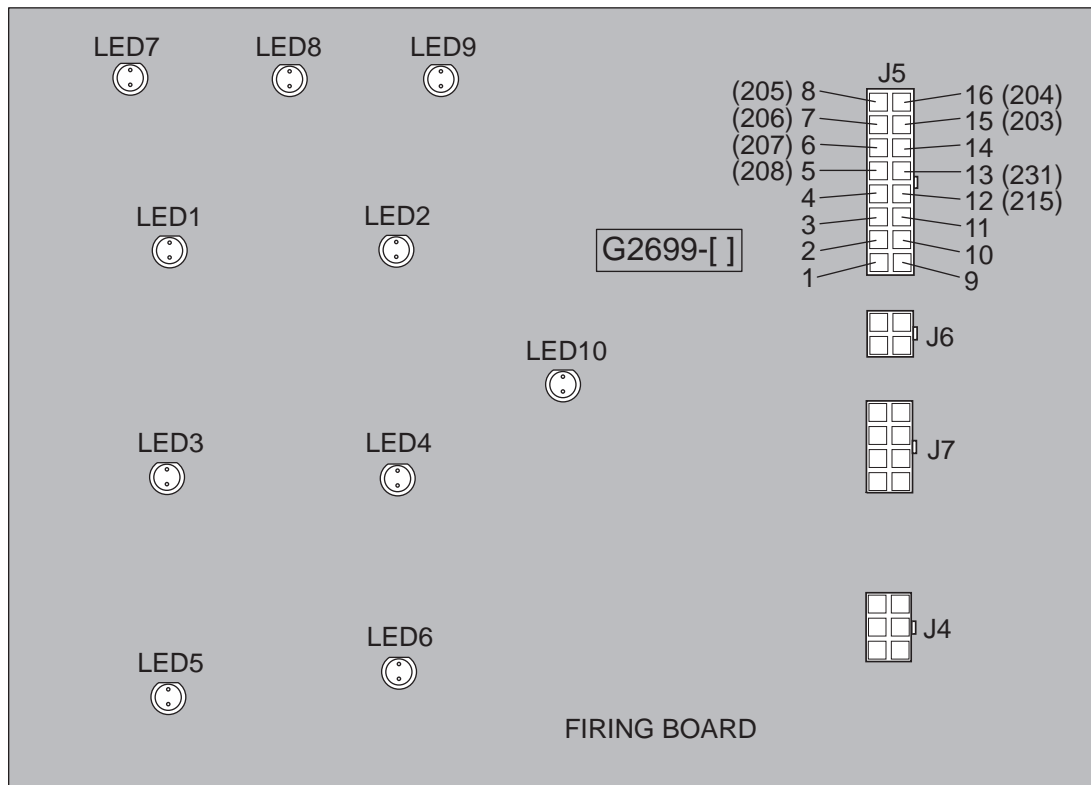
Volt/ohmmeter (Multimeter)  
CV-655 wiring diagram and firing board schematic drawing

CV-655



## FIRING BOARD TEST *(continued)*

FIGURE F.4 – FIRING BOARD TRIGGER CIRCUIT TEST POINTS AND LEDs



### TEST PROCEDURE

1. Disconnect the AC input power to the CV-655 machine.
2. Locate the firing board on the left side of the control box.
3. Perform a visual inspection on the firing board to see if there are any loose or faulty connections or physical damage.
4. Connect the correct AC input power to the CV-655.



### WARNING

**ELECTRIC SHOCK** can kill.



- Do not touch electrically hot parts.

5. Turn the power switch (SW1) to the ON position.
6. LEDs 7, 8 and 9 should be lit and equally bright. See Figure F.4 to locate the LEDs. Use Table F.1 to check operation of LEDs 7, 8, and 9. The three LEDs should be of equal intensity.

CV-655



## FIRING BOARD TEST *(continued)*

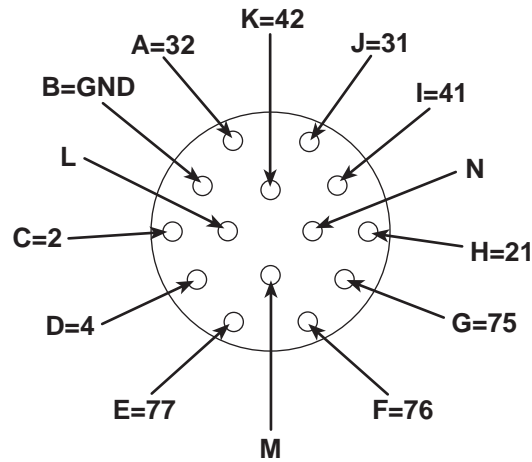
TABLE F.1 - LED 7, 8, 9 AND 10

IF	THEN
<p>LED 7 is ON</p> <p>LED 7 is not lit or is dimmer than the other LEDs</p>	<p>32 VAC power is being supplied to the firing board from leads #203 and #204 connected to the phase angle winding in the Main Transformer. Normal is 32 VAC.</p> <p>The proper AC voltage may not be reaching the firing board. Check for loose or faulty connections. Perform the <b>Main Transformer Test</b>.</p>
<p>LED 8 is ON</p> <p>LED 8 is not lit or is dimmer than the other LEDs</p>	<p>32 VAC power is being supplied to the firing board from leads #205 and #206 connected to the phase angle winding in the Main Transformer.</p> <p>The proper AC power may not be reaching the firing board. Check for loose or faulty connections. Perform the <b>Main Transformer Test</b>.</p>
<p>LED 9 is ON</p> <p>LED 9 is not lit or is dimmer than the other LEDs</p>	<p>32 VAC power is being supplied to the firing board from leads #207 and #208 connected to the phase angle winding in the <b>Main Transformer</b>.</p> <p>The proper AC power may not be reaching the firing board. Check for loose or faulty connections. Perform the <b>Main Transformer Test</b>.</p>
<p>LED 10 is ON</p>	<p>This indicates the trigger circuit is activated at the 14-pin receptacle or the terminal strip or that the Output Terminal Switch (SW5) is closed.</p>

CV-655



FIGURE F.5 – 14-PIN RECEPTACLE



7. Connect a jumper wire from pin C (lead #2) to pin D (lead #4) at the 14-pin receptacle. See Figure F.5. (Or put the Output Terminal Switch in the ON position.) This should initiate machine output at the welding terminals. LED 10 on the firing board should now be on. See **Table F.1**. If LED 10 does not glow when leads #2 and #4 are connected together, perform the **Internal Trigger Test**. The firing board may be faulty.
8. Locate LEDs 1 to 6 on the firing board. See **Figure F.4**. Each LED should glow with equal brightness.  
**NOTE:** LEDs 1 through 6 indicate that the SCR gate firing signals are being generated by the firing board.
9. Set the Output Control Switch (SW3) in the "Output Control at CV-655" (local) position.
10. Rotate the Output Control Potentiometer (R1). As the pot is turned clockwise, LEDs 1 through 6 should get brighter. As the pot is turned counter-clockwise, the LEDs should get dimmer.  
  
If the LEDs glow and change in brightness equally as the pot is turned, and the problem continues, the SCR bridge may be faulty. Perform the **SCR Output Bridge Test**.  
  
If one or two lights stay bright or dim and the others change, this could indicate an open or shorted gate lead or faulty snubber board. Perform the **SCR Output Bridge Test**. If the Output Bridge and associated gate leads are OK, the firing board may be faulty.  
  
If all of LEDs 1 through 6 do not glow or do not change in brightness equally as the output control is rotated, go to step 11.

CV-655

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11. Test for 9.5 VDC to 11.0 VDC between leads #231 and #215 on the firing board.

Locate plug J5 on the firing board. Locate leads #231 (pin-13) and #215 (pin-12). See **Figure F.4**.

Connect a jumper wire from pin C (lead #2) to pin D (lead #4) at the 14-pin receptacle. (Or put the Output Terminal Switch in the ON position.) This should initiate machine output at the welding terminals.

Rotate the Output Control (R1) clockwise and counter-clockwise. The DC voltage between leads #231 and #215 should vary from 9.5 VDC to 11.0 VDC as the control is turned from minimum to maximum. If the voltage varies and LEDs 1 through 6 do NOT vary in brightness, the firing board may be faulty.

If the voltage does NOT vary, the control board, control potentiometer or associated leads may be faulty. See the Wiring Diagram.

**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 1-800-833-9353 (WELD).

**TEST DESCRIPTION**

This test will determine if the correct voltages are being applied to the primary windings of the main transformer. The secondary windings, the auxiliary windings and the phase angle windings will also be checked.

**MATERIALS NEEDED**

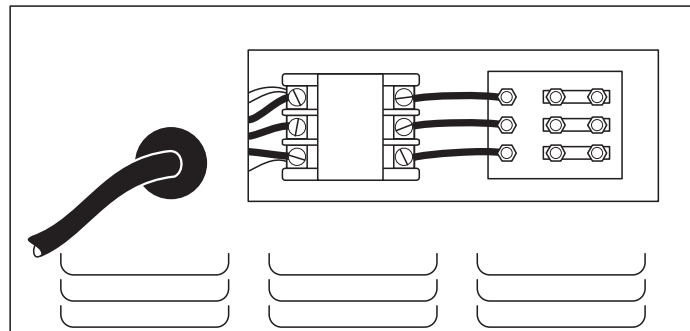
Volt/ohmmeter (Multimeter)  
CV-655 Wiring Diagram

CV-655



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

FIGURE F.6 – INPUT CONTACTOR AND PRIMARY LEADS



### TEST PROCEDURE

1. Disconnect the main input power from the CV-655.
2. Inspect the input contactor, reconnect panel and primary leads to the main transformer for loose or faulty connections. See Figure F.6. Remove the case sides.
3. Confirm that the reconnect panel is configured correctly for the three-phase AC input power supplied to the CV-655. See the connection diagram located on the inside of the input box assembly.
4. Connect the correct AC three-phase input power to the CV-655 machine.
5. Turn the power switch (SW1) to the ON position.
6. Make sure the input contactor (CR1) energizes.
7. Test with an AC voltmeter for the proper main AC input voltages applied to the line side of the input contactor (CR1). See the Wiring Diagram. If the correct voltages are not present at the line side of the input contactor, check the input fuses and leads.
  - a. L1 to L2
  - b. L2 to L3
  - c. L1 to L3
8. Test with an AC voltmeter for the proper AC input voltages at the output side of the input contactor (CR1). See the Wiring Diagram. If the correct voltages are not present, perform the ***Input Contactor Test***.
  - a. T1 to T2
  - b. T2 to T3
  - c. T1 to T3



### WARNING

**ELECTRIC SHOCK** can kill.



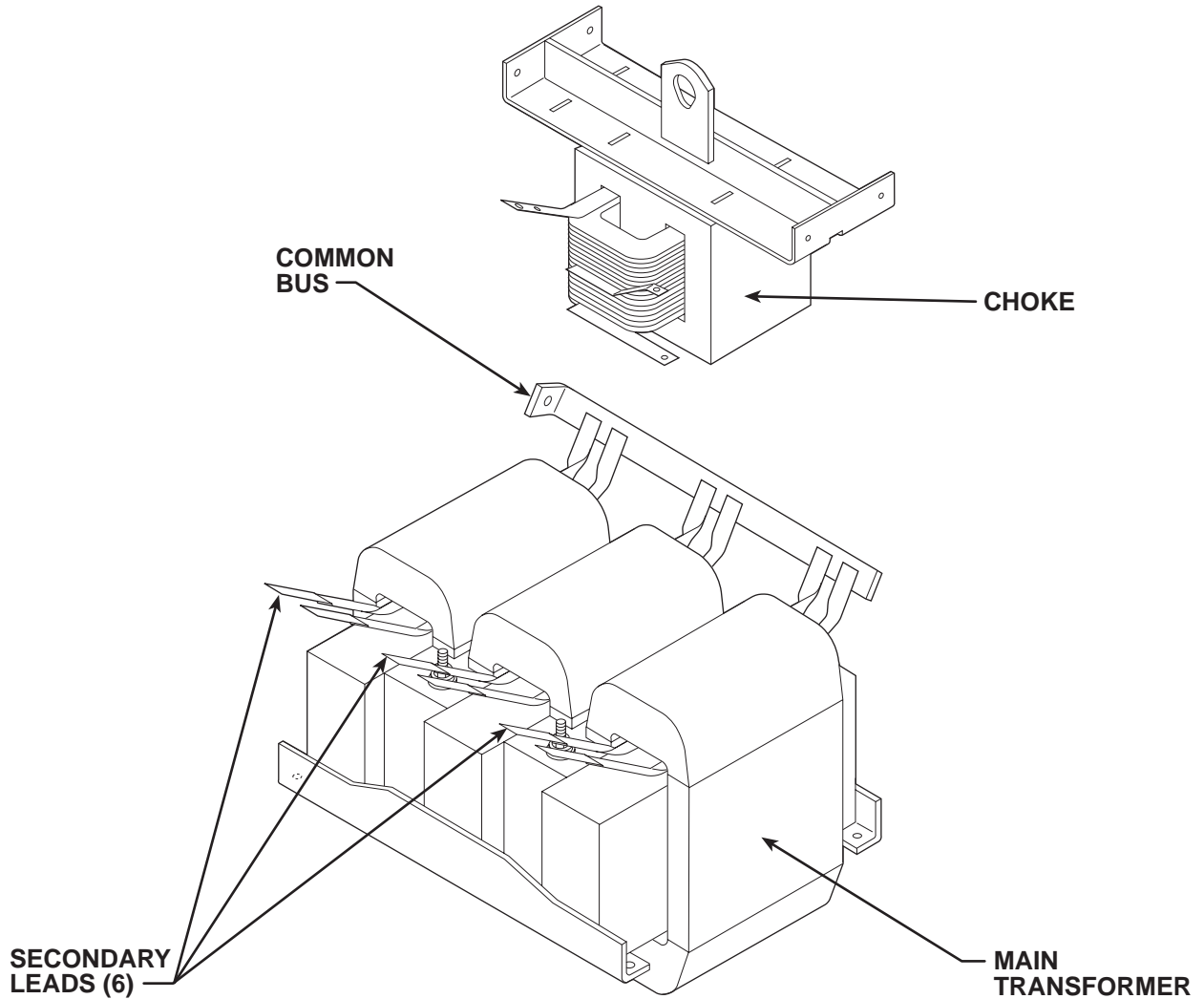
- Do not touch electrically hot parts.

CV-655



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

FIGURE F.7 - MAIN TRANSFORMER SECONDARY LEADS TO COMMON BUS VOLTAGE CHECK



9. Test with an AC voltmeter for approximately 55 VAC from each of the six main transformer secondary leads to the common bus connected to the output choke. See Figure F.7.

**NOTE:** The secondary voltages will vary if the input line voltages vary. If any one or more of the voltage checks are incorrect, check for loose or faulty connections. See the Wiring Diagram. If the leads and connections are OK, the main transformer may be faulty.

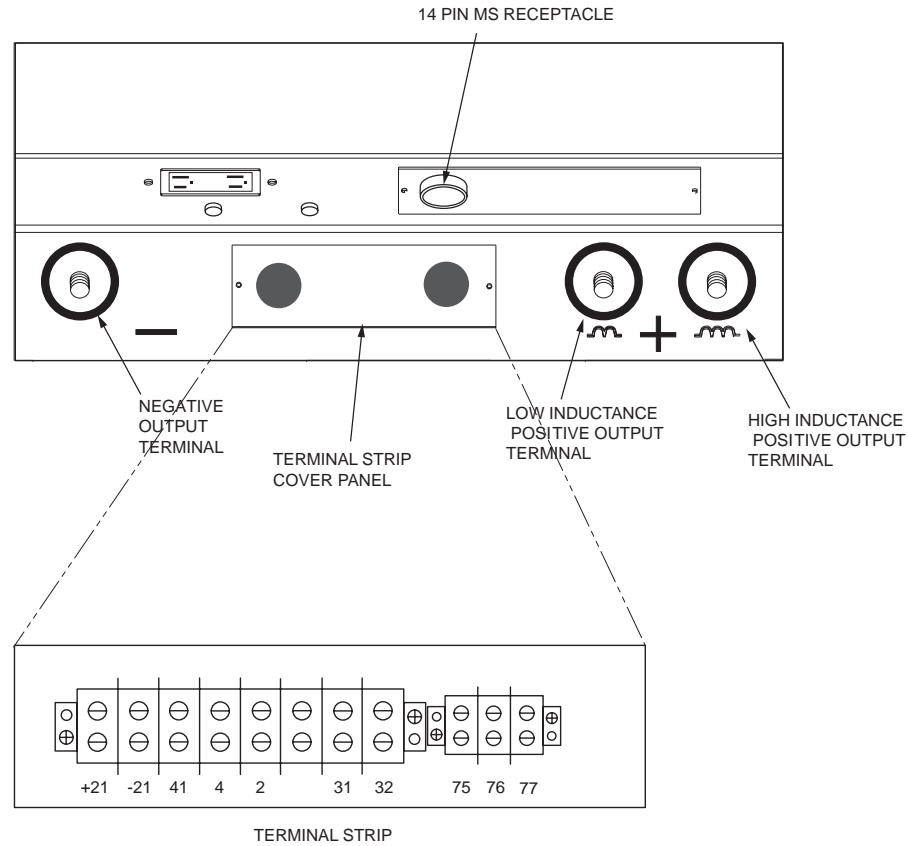
CV-655

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

### FIGURE F.8 - TERMINAL STRIP



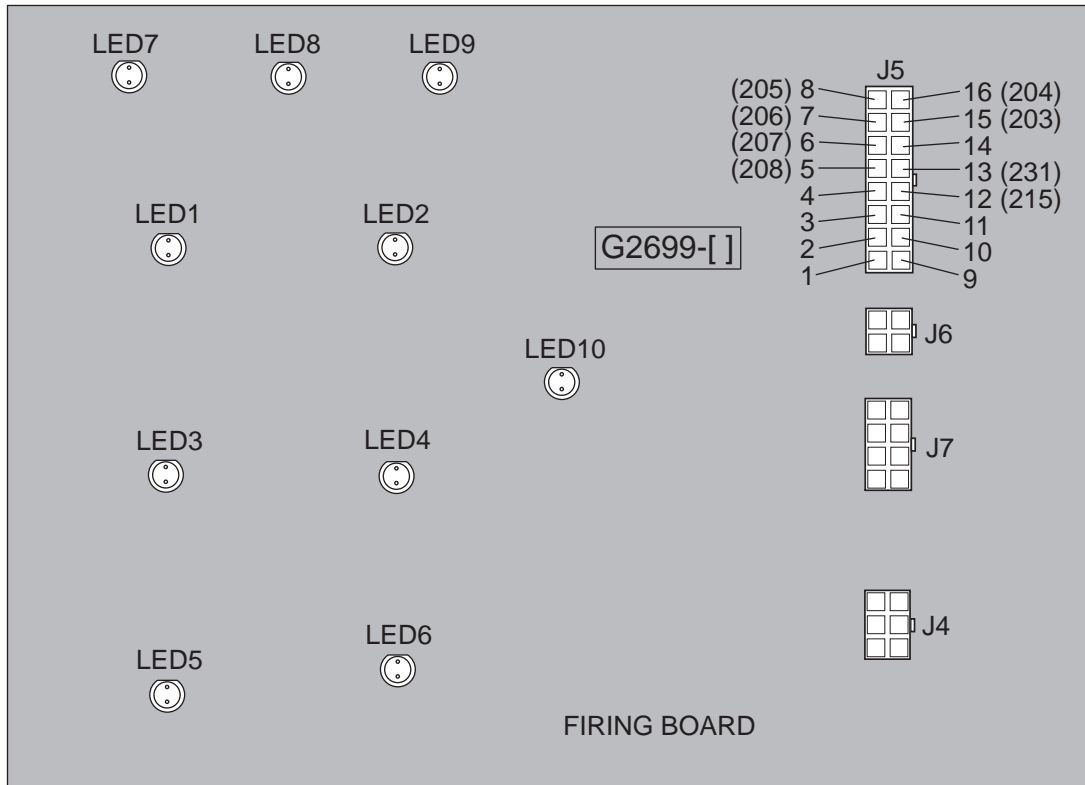
10. Test for 115 VAC between leads #31 and #32 on the terminal strip. The terminal strip can be accessed by removing the small panel at the lower portion of the case front. See Figure F.8. 115 VAC AC should also be present at the 115 VAC receptacle. If the correct voltage is not present, make sure the 20 amp circuit breaker is not tripped or faulty. Also check the wiring between the main transformer, the terminal strip, the circuit breaker and the receptacle. See the Wiring Diagram.
11. If 115 VAC is NOT present and the wiring and circuit breaker are good, the main transformer may be defective.
12. Test for 42 VAC between leads #41 and #2 on the terminal strip. The terminal strip can be accessed by removing the small panel at the lower portion of the case front. See Figure F.8. If the correct voltage is not present, make sure the 10 amp circuit breaker is not tripped or faulty. Also check the wiring between the main transformer, the terminal strip, and the circuit breaker. See the Wiring Diagram.
13. Remove the AC input power to the CV-655. Remove the screws from the control box cover and carefully lower the cover.
14. Locate the firing board on the left side of the control box.

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

FIGURE F.9 - FIRING BOARD PLUG J5 PINS



15. Locate plug J5 on the firing board. See Figure F.9.



### WARNING

**ELECTRIC SHOCK** can kill.



- Do not touch electrically hot parts.

16. Turn on the CV-655 and check for approximately 32 VAC at the following leads and pins at plug J5. These are the phase angle winding voltages. See Fig. F.9.

Plug J5 pin-15 (lead #203) to pin-16 (lead #204)

Plug J5 pin-8 (lead #205) to pin-7 (lead #206)

Plug J5 pin-6 (lead #207) to pin-5 (lead #208)

17. Locate plug J13 on the optional digital meter board. If a digital meter board is not in place, plug J13 will not be used but will be present in the harness. Check the following voltages at the appropriate leads and pin locations.

10 VAC Plug J13 pin-1 (lead #331) to pin-2 (lead #332)

10 VAC Plug J13 pin-4 (lead #333) to pin-5 (lead #334)

42 VAC Plug J13 pin-3 (lead #335) to pin-6 (lead #336)

18. If the correct primary voltages are applied to the main transformer and any of the secondary voltages are missing or not correct, the transformer may be faulty.

**NOTE:** Always check the wiring between the transformer windings and the test points before replacing the transformer.

CV-655



## CONTROL TRANSFORMER (T2) TEST



### WARNING

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

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

---

### TEST DESCRIPTION

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

### MATERIALS NEEDED

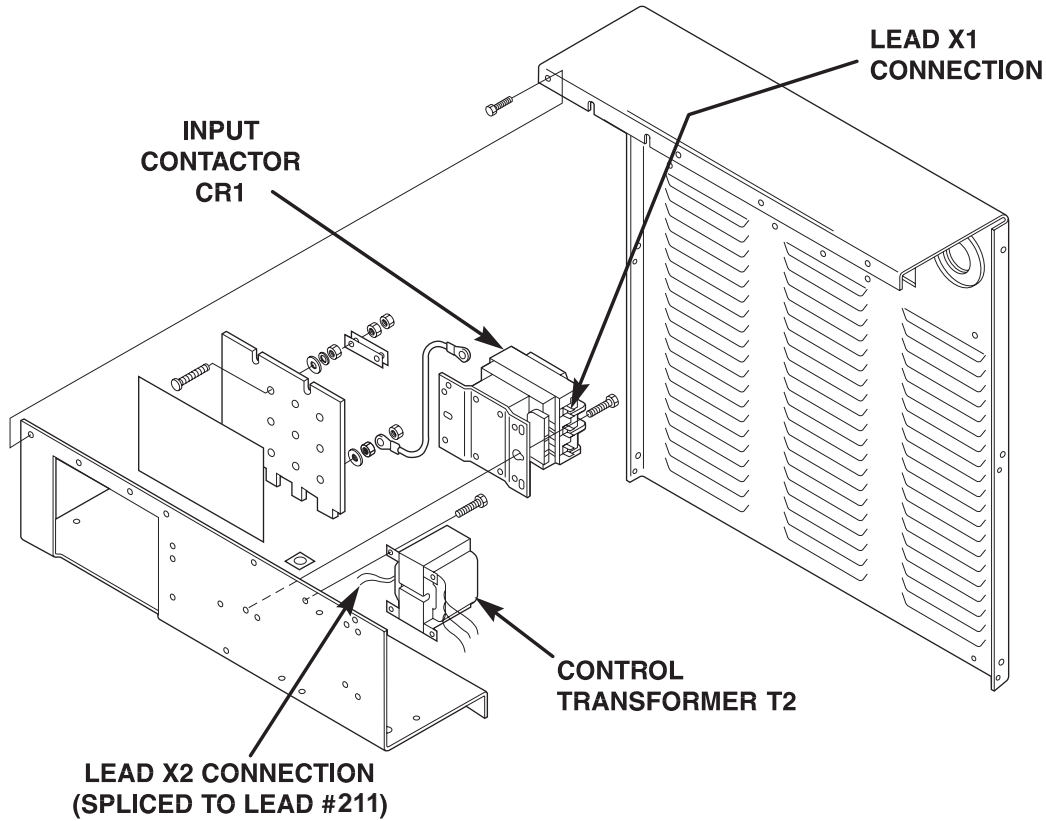
Volt/ohmmeter (Multimeter)  
CV-655 Wiring Diagram

CV-655



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

FIGURE F.10 – CONTROL TRANSFORMER



### TEST PROCEDURE

1. Disconnect the main AC input voltage to the CV-655.
2. Remove the case top and sides.
3. Locate the control transformer (T2) on the left side of the input box (facing the back of the machine). See Figure F.10.
4. Locate the control transformer primary leads (H1, H2, H3, etc.). See the Wiring Diagram.

**NOTE:** Unused leads should be insulated and taped. Inspect for broken or incorrect connections.

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

5. Locate the control transformer secondary leads. See **Figure F.10**. Lead X1 is connected to the coil terminal on the CR1 input contactor. Lead X2 is spliced into lead #211, which is then connected to the input power switch (SW1).
7. If approximately 115 VAC is present at leads X1 to X2, the control transformer is functioning properly.

### **WARNING**



**HIGH VOLTAGE** is present at the input leads.

6. Apply the correct three-phase input power to the CV-655 and check for 115 VAC at leads X1 to X2.

**NOTE:** The CV-655 does not have to be ON to perform this test. If the main AC input supply voltage varies, the control transformer secondary voltage will vary by the same percentage.

8. If approximately 115 VAC is NOT present at leads X1 to X2, make certain the correct input voltage is being applied to the primary winding of the control transformer and that the correct primary leads (H1, H2, H3, etc.) are being used. See the connection information diagram on the input access door.
9. If the correct voltage is being applied to the primary of the control transformer and the secondary voltage is incorrect or not present, the control transformer may be defective.

CV-655

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## CONTROL BOARD TRANSFORMER (T3) TEST

### WARNING

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

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

---

### TEST DESCRIPTION

This test will determine if the correct voltage is being applied to the primary winding of the control board transformer (T3) and also if the correct voltage is being induced upon the secondary winding.

### MATERIALS NEEDED

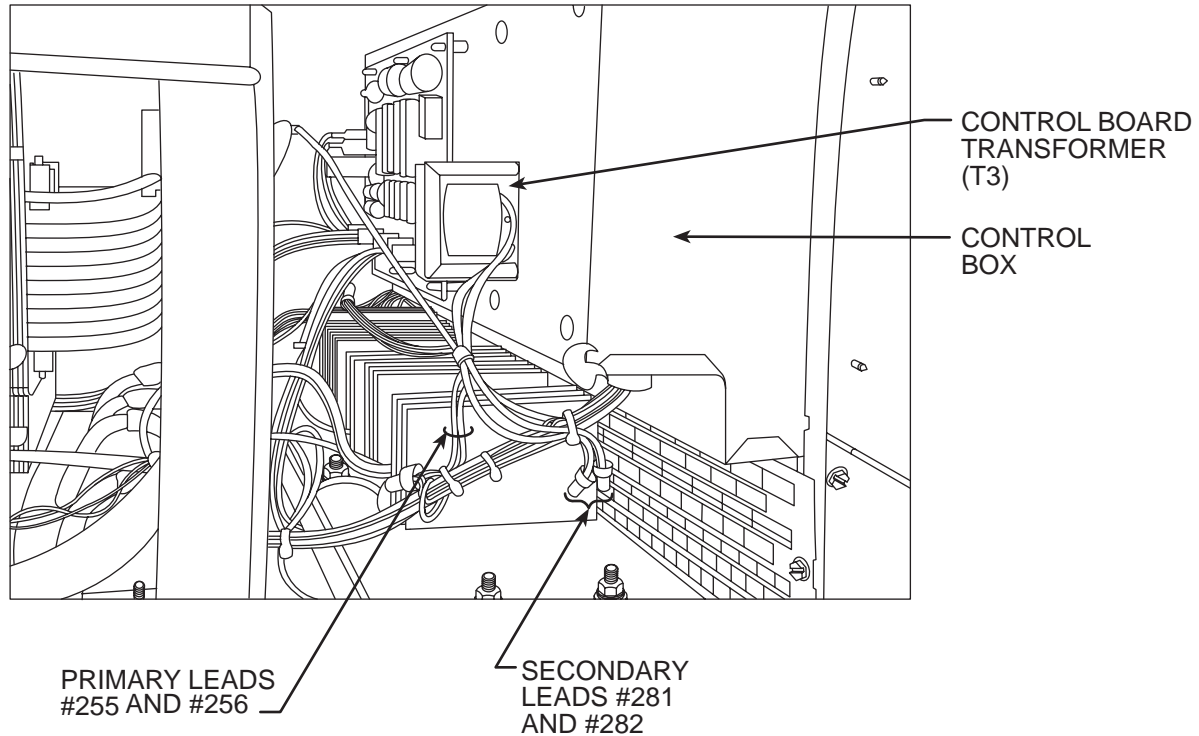
Volt/ohmmeter (Multimeter)  
CV-655 Wiring Diagram

CV-655



## CONTROL BOARD TRANSFORMER (T3) TEST *(continued)*

FIGURE F.11 – CONTROL BOARD TRANSFORMER (T3) LEADS



### TEST PROCEDURE

1. Disconnect the main AC input power to the CV-655 machine.
2. Remove the case top and sides.
3. Locate the control board transformer (T3) mounted on the rear of the control box. See Figure F.11.
4. Locate the transformer (T3) primary leads (#255 and #256). See Figure F.11 and the Wiring Diagram. Also locate the secondary leads (#281 and #282).
5. Apply the correct three-phase input power to the CV-655 and turn the power switch (SW1) to the ON position.
6. Carefully check for 42 VAC at the secondary leads (#281 to #282). If 42 VAC is present, the control board transformer (T3) is good. If 42 VAC is missing or low, proceed to the next step.
7. Carefully check for 115 VAC at the primary leads (#255 and #256). If the 115 VAC is present but the secondary voltage (42 VAC) is missing or low, the T3 transformer may be faulty. Replace.
8. If the 115 VAC is NOT present at the primary leads, check the associated switch (SW1) and wiring. See the Wiring Diagram.
9. Perform the **Control Transformer (T2) Test**.



### WARNING



**ELECTRIC SHOCK** can kill.

- Do not touch electrically hot parts.

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## 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 1-800-833-9353 (WELD).

---

### TEST DESCRIPTION

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

### MATERIALS NEEDED

- Volt/ohmmeter (Multimeter)
- 3/8" Nut driver
- CV-655 Wiring Diagram
- External 120 VAC supply

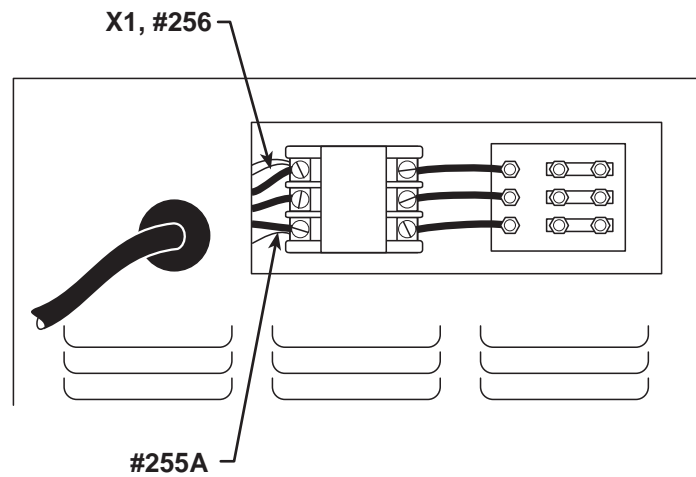
CV-655





## INPUT CONTACTOR TEST (continued)

FIGURE F.12 – INPUT CONTACTOR CONNECTIONS



## TEST PROCEDURE

1. Disconnect the main input supply power to the machine.
2. With the 3/8" nut driver, remove the case top and input access cover.
3. Locate the three leads connected to the input contactor coil (X1/#256 and #255A). See Figure F.12.
4. Connect an AC voltmeter to the leads.
5. Apply the correct three-phase input power to the CV-655 and turn the power switch (SW1) to the ON position.
6. Check for 120 VAC at the contactor coil leads.
7. If the 120 VAC is NOT present, with the input power switch (SW1) on, check the switch and associated circuitry. See the Wiring Diagram. Perform the **Control Transformer (T2) Test**.
8. If the 120 VAC IS present and the contactor does NOT activate, the input contactor is faulty. Replace the input contactor.

**WARNING**

**ELECTRIC SHOCK** can kill.

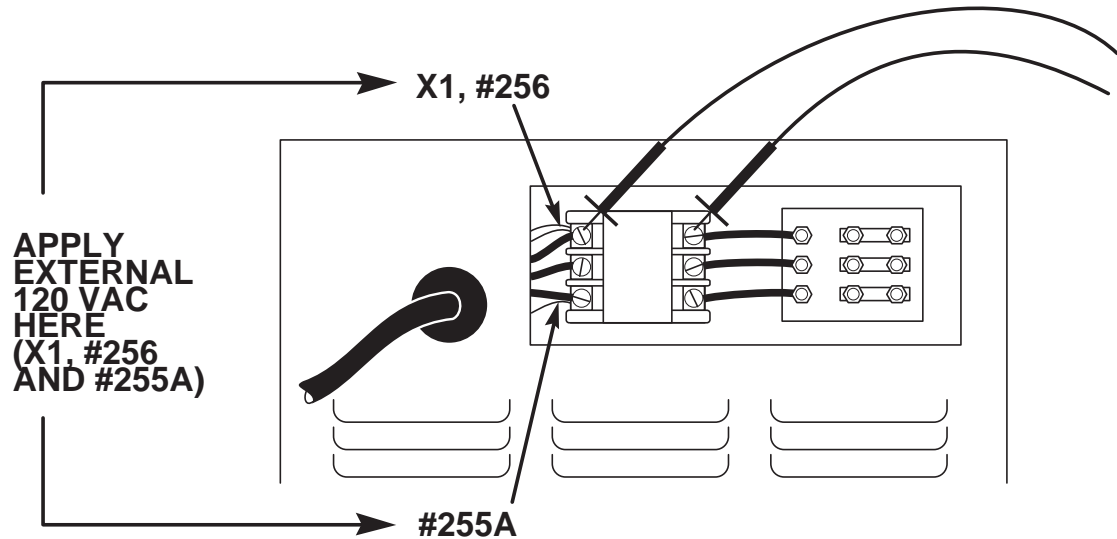


- Do not touch electrically hot parts.

CV-655

## INPUT CONTACTOR TEST (continued)

FIGURE F.13 – INPUT CONTACTOR TEST CONNECTIONS



### TEST FOR CONTACT CONTINUITY

1. Disconnect the main input supply power to the CV-655 machine.
2. Locate, label and remove the three leads connected to the input contactor coil (X1/#256 and #255A). See Figure F.13.
3. Using the external 120 VAC supply, apply 120 VAC to the terminals of the input contactor coil. If the contactor does NOT activate, the input contactor is faulty.
4. With the contactor activated, check the continuity across the contacts. (Zero ohms or very low resistance is normal.) See Figure F.13. 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.



### WARNING



**ELECTRIC SHOCK** can kill.

- Do not touch electrically hot parts.

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## STATIC 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 1-800-833-9353 (WELD).

---

**TEST DESCRIPTION**

The test is used to quickly determine if an SCR is shorted or “leaky.” See the **Oscilloscope Waveform** Section in this manual for normal and abnormal SCR waveforms.

**MATERIALS NEEDED**

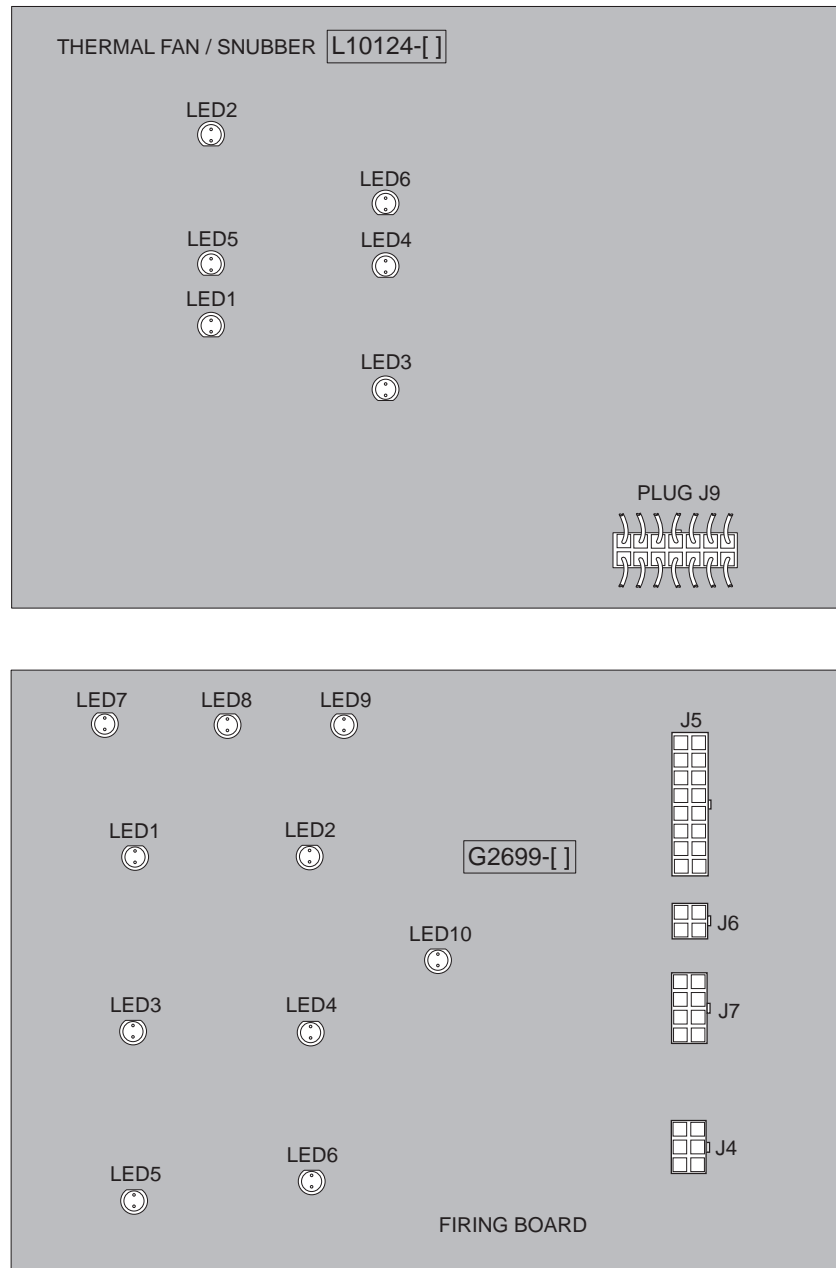
Analog ohmmeter (Multimeter)  
CV-655 Wiring Diagram

CV-655



## STATIC SCR TEST *(continued)*

FIGURE F.14 – THERMAL FAN/SNUBBER BOARD AND FIRING BOARD PLUG LOCATIONS



### TEST PROCEDURE

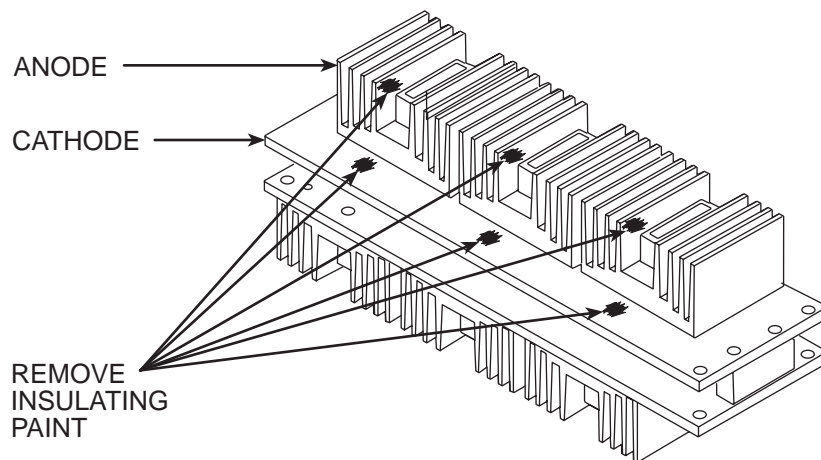
1. Disconnect the main AC input power to the CV-655 machine.
2. Locate and disconnect plug J9 from the thermal fan/snubber board and plug J5 from the firing board. See Figure F.14.
3. Remove the red insulating paint from the heat sink test points. See Figure F.15. DO NOT DISASSEMBLE THE HEAT SINKS.
4. Test for high or infinite resistance from the anode to the cathode of SCR1. See **Figure F.15**. Use an analog ohmmeter (multimeter).
5. Test for high or infinite resistance from the cathode to the anode of SCR1 by reversing the meter leads. See **Figure F.15**.

CV-655



## STATIC SCR TEST *(continued)*

FIGURE F.15 – HEAT SINK TEST POINTS



6. If a high or infinite resistance is indicated for both steps #4 and #5, SCR1 is not shorted.
7. If a low resistance is indicated in either steps #4 or #5, there is a shorted SCR in the output rectifier bridge. Repeat steps #4 and #5 for each of the six SCRs. It may be necessary to disconnect the transformer secondary leads from the rectifier assembly to isolate the defective SCR(s). See the Wiring Diagram.
8. Replace plug J9 into the thermal fan/snubber board and plug J5 into the firing board.

**NOTE:** To further check the SCRs' functions use an SCR tester and proceed to the **Active SCR Test**.

## 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 1-800-833-9353 (WELD).

---

### TEST DESCRIPTION

The Active SCR Test will determine if the device is able to be gated ON and conduct current from anode to cathode.

### MATERIALS NEEDED

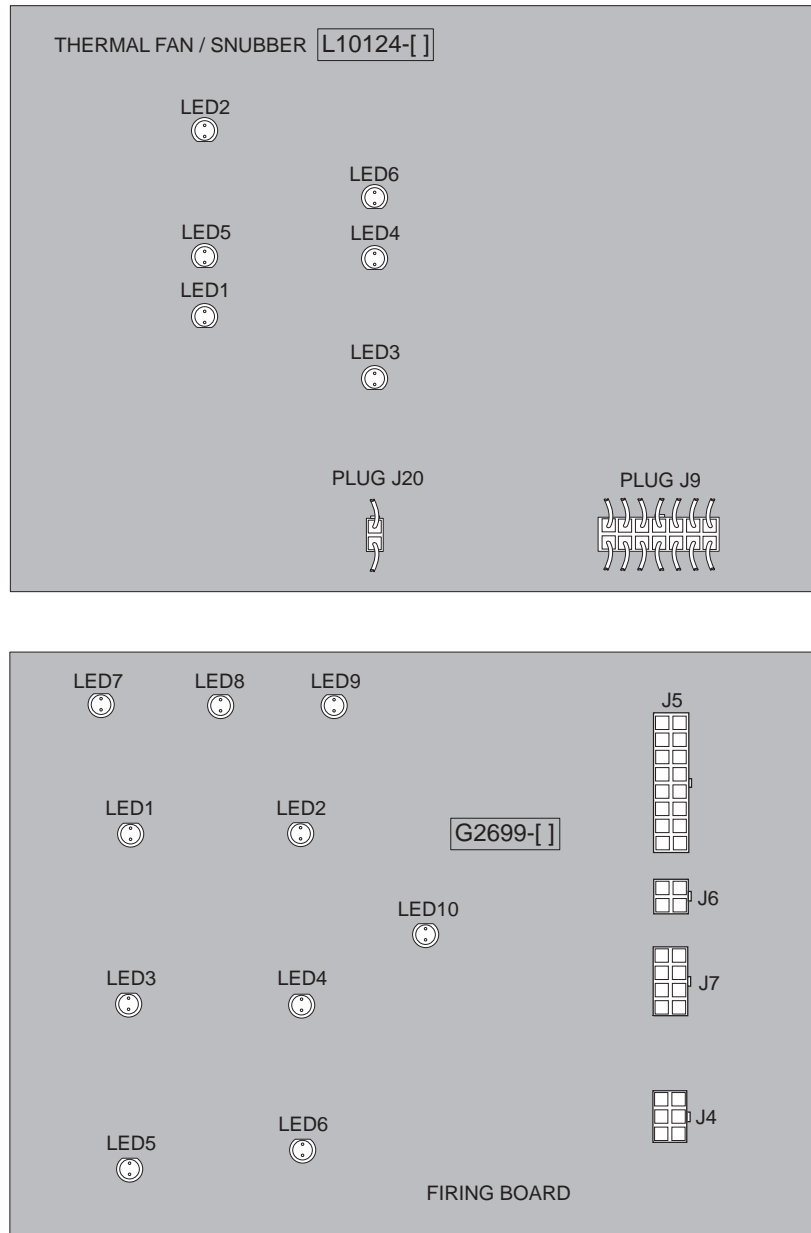
An SCR Tester as specified in this procedure  
CV-655 Wiring Diagram

CV-655



## ACTIVE SCR TEST *(continued)*

FIGURE F.16 – THERMAL FAN/SNUBBER BOARD AND FIRING BOARD PLUG LOCATIONS

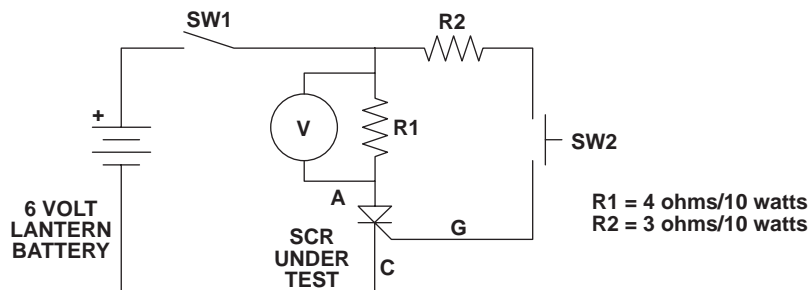
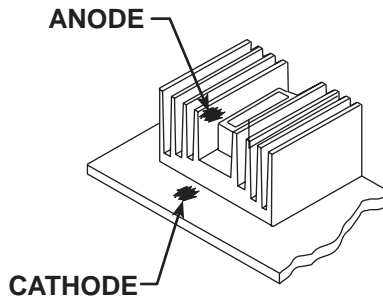


### TEST PROCEDURE

1. Disconnect the main AC input power to the machine.
2. Locate and disconnect plug J9 from the thermal fan/snubber board and plug J5 from the firing board. See Figure F.16.
3. Remove the red insulating paint from the heat sink test points. See **Figure F.17**. DO NOT DISASSEMBLE THE HEAT SINKS.

CV-655

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**ACTIVE SCR TEST** (continued)**FIGURE F.17 – HEAT SINK TEST POINTS**

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.

4. Construct the circuit shown in Figure F.17. One 6-volt lantern battery can be used. Set the voltmeter scale low, at approximately 0-5 volts or 0-10 volts.
  - a. 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.
  - b. If the voltage is 3-6 volts only when the switch is closed or there is no voltage when the switch is closed, the SCR is defective.
 

**NOTE:** Be sure the battery is functioning properly. A low battery can affect the results of the test. Repeat the battery test procedure in Step 4 if needed.
5. Connect the Tester to SCR 1 as shown in Figure F.17.
  - a. Connect Tester lead (A) to the anode.
  - b. Connect Tester lead (C) to the cathode.
  - c. Connect Tester lead (G) to the gate.
6. Close switch SW-1.  
NOTE: Switch SW-2 should be open.
7. Read the meter for zero voltage.
  - a. If the voltage reading is higher than zero, the SCR is shorted.
8. Close or keep closed switch SW-1.
9. Close switch SW-2 for 2 seconds and release and read the meter.
  - a. If the voltage is 3-6 volts while the switch is closed and after the switch is open, the SCR is functioning.
10. Open switch SW-1.
11. Reconnect the Tester leads. See Figure F.17.
  - a. Connect Tester lead (A) to the cathode.
  - b. Connect Tester lead (C) to the anode.
  - c. Disconnect Test lead (G) from the gate.
12. Close switch SW-1.
13. Read the 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.
14. Perform the Active Test Procedure outlined in Steps 5-13 for SCRs 2-6.
15. Replace all SCR assemblies that do not pass the above tests.
16. Plug J9 onto the thermal fan/snubber board and plug J5 into the firing board.



### THERMAL FAN/SNUBBER BOARD LED CHART

LED #	LED FUNCTIONS AND INDICATIONS (Machine is ON)
1	Indicates fan should be running.
2	Indicates welding current is greater than 50 amps.
3	Indicates fan should be running due to heating of main SCRs.
4	Indicates an open thermal fan thermistor or an open connection between the thermistor and the thermal fan/snubber board. See the Wiring Diagram (leads #319 and #316).
5	Indicates a thermostat (choke or secondary) has opened. The thermal protection light should also be illuminated.
6	Indicates the fan motor should be running. LED 6 should be illuminated and the fan running when any of the following LEDs are lit: LED 2, LED 3, LED 4, or LED 5.

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

CV-655



## CONTROL BOARD LED CHART

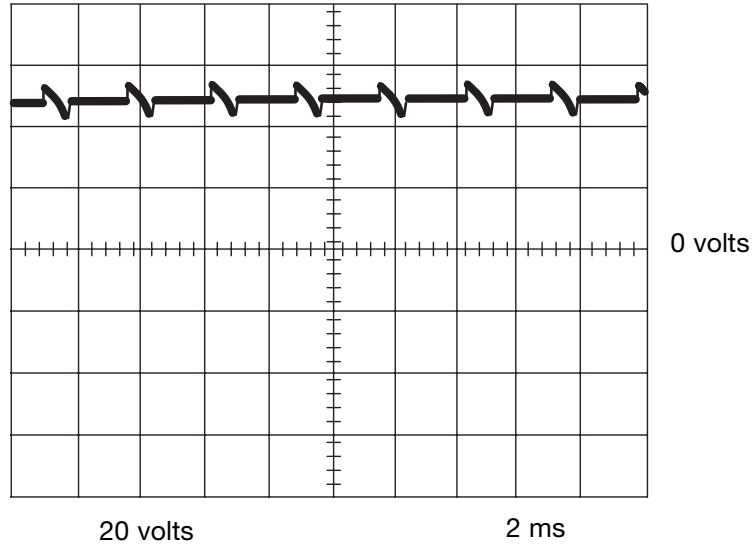
LED #	LED FUNCTIONS AND INDICATIONS (Machine is ON)
1*	LED 1 Indicates AC input voltage is present. This is necessary to generate the DC supply voltages. These voltages power the control board circuitry.
2*	LED 2 Indicates the -10V supply is present.
3*	LED 3 Indicates the +16V supply is present.
4	LED 4 Should not be on. If this LED comes on while welding, the machine will phase back to about 10 amps. This is do to either a short across the out put, or a current draw of about 1000A. If no short or 1000 amp load exists, replace the control PCB.
5	LED 5 Indicates control voltage is present. With trigger circuit OPEN and CONTROL POT set to minimum, LED 5 should be very bright. Closing the trigger circuit and turning the CONTROL POT towards maximum, LED 5 should dim and then go out. Replace the control P.C. board if LED 5 does not go ON.
6	LED 6 Indicates trigger condition. LED 6 ON indicates trigger is CLOSED. LED 6 OFF indicates trigger is OPEN. If LED 6 does not come ON, look for open connections in the 2 & 4 circuit.
7	LED 7 Indicates welder output voltage is being sensed on the control board. When turning on the CONTROL POT towards maximum, LED 7 should glow brighter. If LED 7 does not light , make sure lead 222 from the negative output lead is connected to J1 PIN 14.
8	LED 8 Indicates a fault condition. When LED 8 is ON the machine is phased back to 10 amps and will stay there until the POWER SWITCH is turned OFF and then back ON. This fault is do to a short across the welders' output, or 1000 amp current draw. If no short or 1000 amp draw exists, replace control PCB.
9 + 11	LED's 9 & 11 should be OFF on CV-655 machines.
10	LED 10 Should be ON when machine power is ON. If not, replace the Control PCB.

**\*FOOTNOTE:** If LED's 1, 2, or 3 are not ON when the machines POWER IS ON, replace PCB.

CV-655



### NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM MAXIMUM OUTPUT SETTING – NO LOAD



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 2 milliseconds in time.

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

SCOPE SETTINGS	
Volts/Div .....	20V/Div.
Horizontal Sweep.....	2 ms/Div.
Coupling .....	DC
Trigger .....	Internal

CV-655



Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

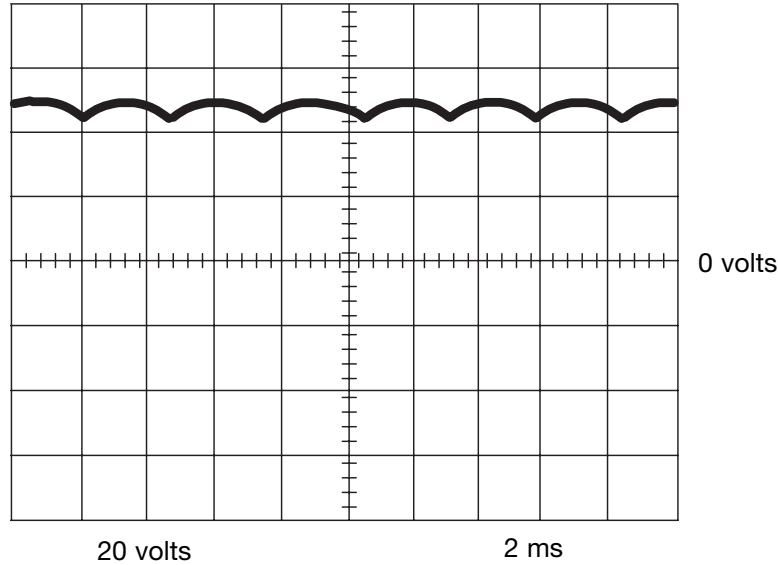
Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

# 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 2 milliseconds in time. The machine was loaded with a resistance grid bank. The grid bank meters read 650 amps at 44 VDC.

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

**SCOPE SETTINGS**

Volts/Div.....20V/Div.  
 Horizontal Sweep.....2 ms/Div.  
 Coupling .....DC  
 Trigger .....Internal

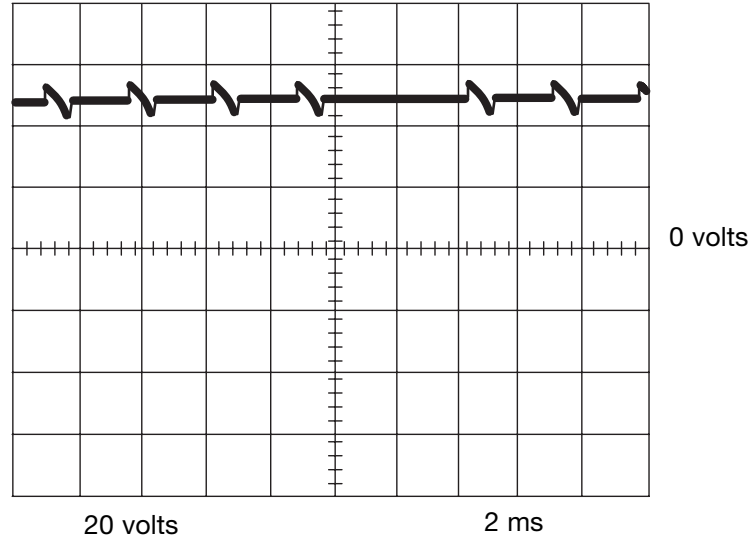
CV-655



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

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

### ABNORMAL OPEN CIRCUIT VOLTAGE WAVEFORM ONE OUTPUT SCR NOT FUNCTIONING



This is NOT the typical DC open circuit voltage wave form. One output SCR is NOT Functioning. Note the “GAP” in the wave form. Note that each vertical division represents 20 volts and that each horizontal division represents 2 milliseconds in time.

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

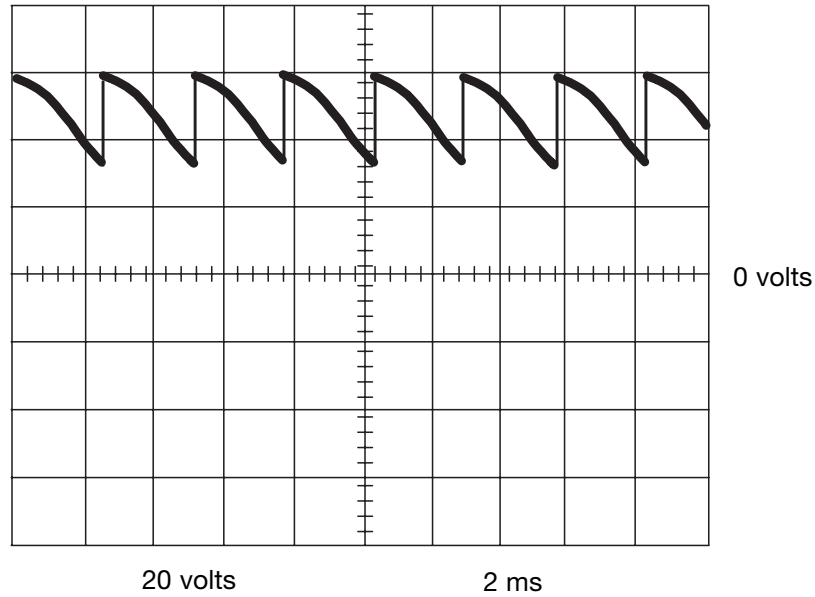
**SCOPE SETTINGS**

Volts/Div .....20V/Div.  
 Horizontal Sweep.....2 ms/Div.  
 Coupling .....DC  
 Trigger .....Internal

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

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

**ABNORMAL OPEN CIRCUIT VOLTAGE WAVEFORM  
MAXIMUM OUTPUT SETTING - NO LOAD  
OUTPUT CAPACITORS DISCONNECTED**



This is NOT the typical DC open circuit voltage waveform generated from a properly operating machine. The output capacitors have been disconnected. Note that each vertical division represents 20 volts and that each horizontal division represents 2 milliseconds in time.

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

**SCOPE SETTINGS**

Volts/Div.....	20V/Div.
Horizontal Sweep.....	2 ms/Div.
Coupling .....	DC
Trigger .....	Internal

CV-655



Return to Section TOC  
Return to Master TOC

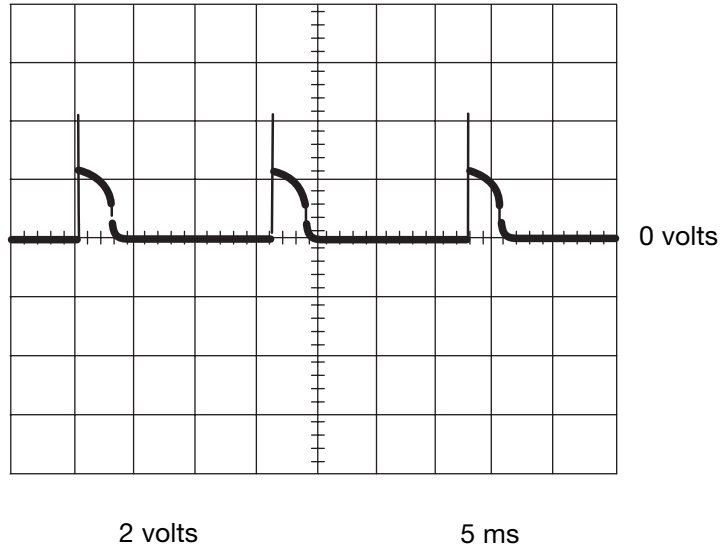
Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

### TYPICAL SCR GATE VOLTAGE WAVEFORM

#### MAXIMUM OUTPUT SETTING – NO LOAD



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

CV-655



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

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

CV-655





## 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 1-800-833-9353 (WELD).

---

### DESCRIPTION

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

### MATERIALS NEEDED

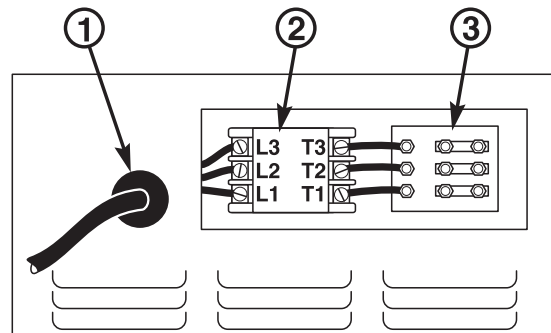
- Phillips head screw driver
- 5/16" Socket wrench
- Flat head screw driver
- Low pressure air source
- Allen head type wrench

CV-655



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

FIGURE F.18 - 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.
2. Locate and get access to the input contactor (CR1) in the input box. See Figure F.18.
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.18.
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 the L1 and L3 terminals on the input side of the contactor.

4. Disconnect the output leads T1, T2, and T3 from the input contactor.
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, #256 and #255A). See the Wiring Diagram.
7. Remove the three self-tapping mounting screws using a 5/16" socket wrench.
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.

CV-655

**LINCOLN**  
ELECTRIC

## SCR RECTIFIER BRIDGE REMOVAL AND REPLACEMENT PROCEDURE



### WARNING

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

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

---

### DESCRIPTION

The following procedure will aid the technician in removing the SCR/Rectifier Bridge for maintenance or replacement.

### MATERIALS NEEDED

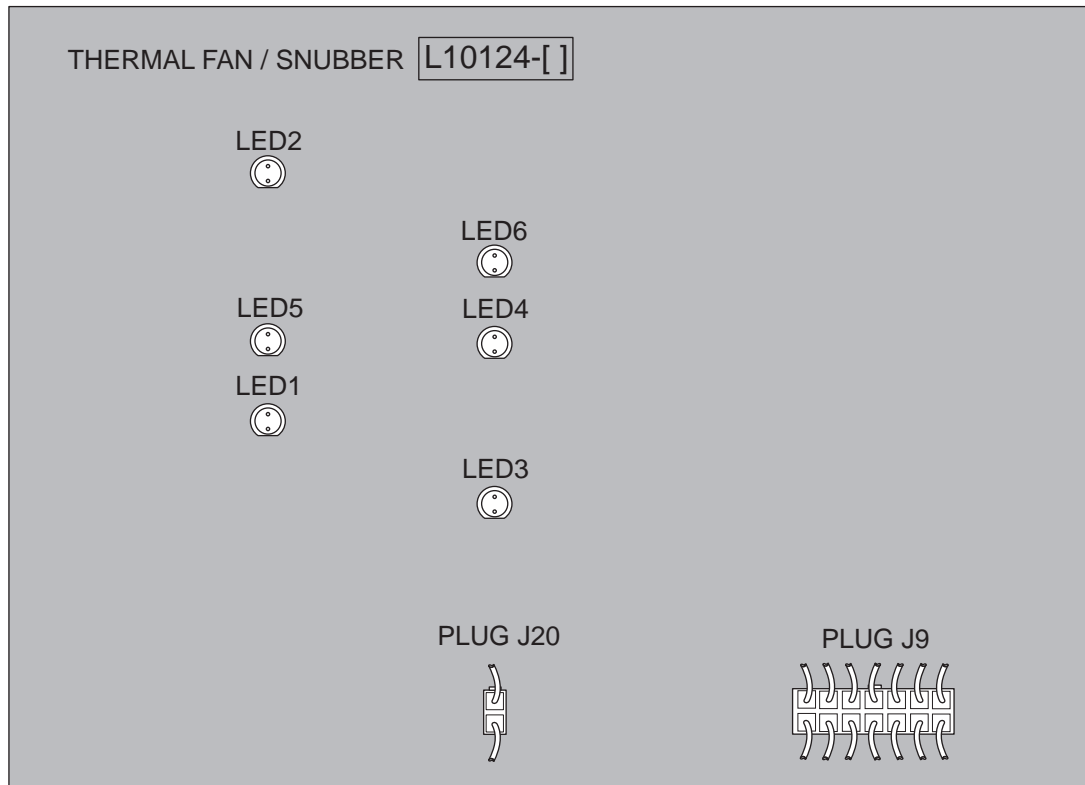
- 1/2" Socket wrench
- 3/8" Wrench
- 1/2" Wrench
- 9/16" Wrench

CV-655



## SCR RECTIFIER BRIDGE REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

FIGURE F.19 - THERMAL FAN/SNUBBER BOARD PLUG LOCATIONS



### PROCEDURE

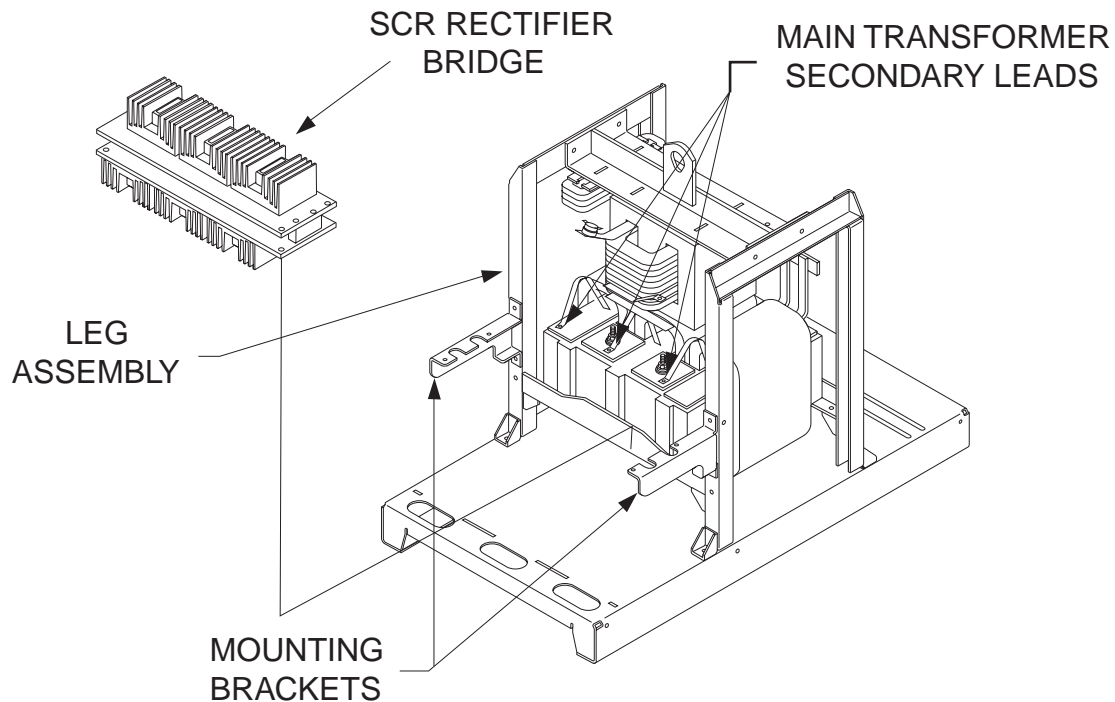
1. Remove the input power to the CV-655 machine.
2. Using the 3/8" wrench, remove the case top and sides.
3. Locate and remove plugs J9 and J20 from the Thermal Fan/Snubber Board. See Figure F.19.
4. Disconnect lead #222 from the negative output terminal. This lead runs from plug J9 to the negative output terminal. Cut any necessary cable ties. See the Wiring Diagram.

CV-655



## SCR RECTIFIER BRIDGE REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

FIGURE F.20 – SCR RECTIFIER BRIDGE ASSEMBLY DETAILS



5. Using the 1/2" socket wrench, remove the six transformer secondary leads from the heat sink assembly. The small "A" leads do not have to be removed. Note lead placement for reassembly. See the Wiring Diagram and Figure F.20.
6. With the 9/16" wrench, remove the shunt from the left side of the heat sink assembly.
7. With the 3/8" wrench, remove the four mounting bolts that hold the heat sink assembly to the horizontal mounting brackets. Be sure to remove the insulators and take note of placement for reassembly.
8. While supporting the heat sink assembly, remove the left side horizontal mounting bracket from the left side leg assembly. See Figure F.20.
9. Carefully slide the rectifier heat sink assembly from the machine. Clear all leads.

### REASSEMBLY

1. Upon reassembly, apply a thin coating of Dow Corning 340 Heat Sink Compound to all bolted connections.
2. With the left side horizontal mounting bracket removed, slide the heat sink assembly into the machine.
3. Support the heat sink assembly and install the left side mounting bracket. Then mount the heat sink assembly to the bracket with four bolts. Note insulator placement.
4. Attach the shunt to the left side of the heat sink assembly.
5. Install the six transformer secondary leads to the heat sink assembly. See the Wiring Diagram.
6. Connect lead #222 to the high inductance output terminal.
7. Install plugs J9 and J20 onto the thermal fan/snubber board.
8. Replace any cable ties cut at disassembly.
9. Install the case top and sides.

CV-655

**LINCOLN**  
ELECTRIC

## MAIN TRANSFORMER AND CHOKE REMOVAL AND REPLACEMENT PROCEDURE



### WARNING

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

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

---

### DESCRIPTION

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

### MATERIALS NEEDED

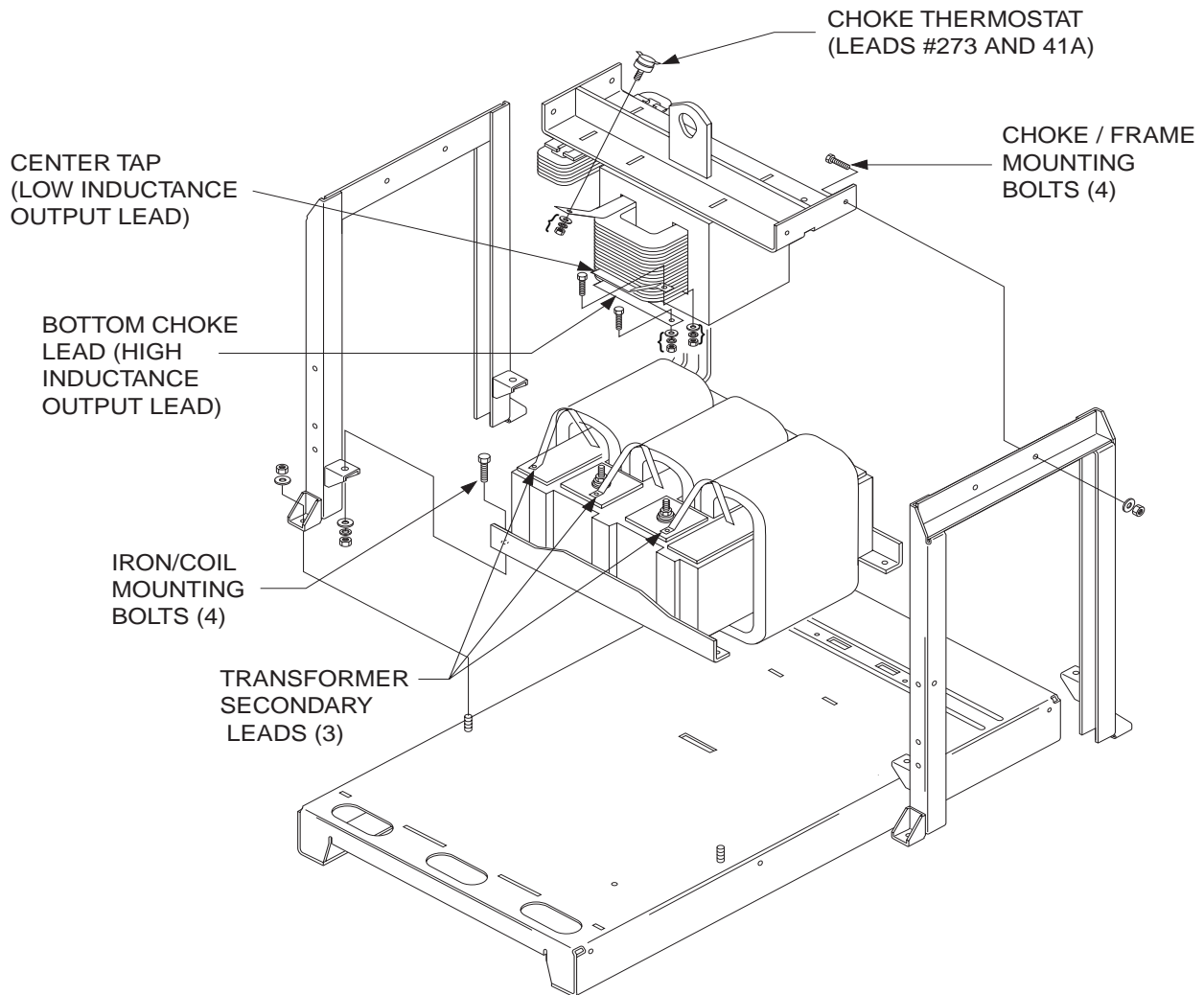
- 3/8" Wrench
- 7/16" Wrench
- 9/16" Wrench
- Wire cutters
- Soldering iron and solder
- 1/2" Socket wrench
- 9/16" Socket wrench

CV-655



## MAIN TRANSFORMER AND CHOKE REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

FIGURE F.21 – OUTPUT CHOKE/MAIN TRANSFORMER ASSEMBLY DETAILS



### PROCEDURE

1. Remove the input power to the CV-655 machine.
2. Remove the case top and sides.

### OUTPUT CHOKE REMOVAL

3. Label and remove leads #273 and 41A from the choke thermostat.
4. Using the 9/16" wrench, remove the flexible lead from the top lead of the output choke. See Figure F.21.
5. Using the 9/16" wrench, remove the low inductance output lead from the center tap of the choke. See Figure F.21.
6. Using the 9/16" wrench, remove the high inductance output lead from the bottom choke lead. See Figure F.21.
7. Using the 1/2" wrench, Remove the reactor leads from the SCR heat sink assembly.
8. Using the 1/2" wrench, Remove the other reactor lead from the capacitor bank assembly.
9. Support the choke with a crane or hoist.
10. Using the 9/16" wrench, remove the four bolts, washers and nuts mounting the choke assembly to the transformer frame assembly.
11. Carefully lift the choke and reactor assembly from the CV-655 machine.

CV-655



## MAIN TRANSFORMER AND CHOKE REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

### MAIN TRANSFORMER REMOVAL

12. With the 1/2" wrench, remove the six transformer secondary leads from the SCR heat sink assembly.
13. Remove the transformer primary leads from the reconnect panel. Label for reassembly.
14. Carefully label and unsolder the following leads from the transformer windings. Cut any necessary cable ties. See the Wiring Diagram.
 

<input type="checkbox"/> 335	<input type="checkbox"/> 203	<input type="checkbox"/> 31
<input type="checkbox"/> 336	<input type="checkbox"/> 204	<input type="checkbox"/> 32A
<input type="checkbox"/> 331	<input type="checkbox"/> 205	<input type="checkbox"/> 41
<input type="checkbox"/> 332	<input type="checkbox"/> 206	<input type="checkbox"/> 42A
<input type="checkbox"/> 333	<input type="checkbox"/> 207	<input type="checkbox"/> 41 thermostat
<input type="checkbox"/> 334	<input type="checkbox"/> 208	
15. Using a rope sling and hoist, support the iron/coil assembly.
16. With the 9/16" wrench, remove the four bolts, washers and nuts holding the iron/coil assembly to the frame assembly.
17. Cut or remove any necessary cable ties.
18. Using the hoist, carefully remove the iron/coil assembly from the CV-655 machine. Clear all leads.

### REASSEMBLY

1. Using the rope sling, carefully position the iron/coil assembly onto the CV-655. Mount it to the frame assembly with four bolts, washers and nuts.
2. Attach the transformer primary leads to the reconnect panel.
3. Attach the six transformer secondary leads to the SCR heat sink assembly.
4. Solder the following leads to the transformer windings. See The Wiring Diagram.
 

<input type="checkbox"/> 335	<input type="checkbox"/> 203	<input type="checkbox"/> 31
<input type="checkbox"/> 336	<input type="checkbox"/> 204	<input type="checkbox"/> 32A
<input type="checkbox"/> 331	<input type="checkbox"/> 205	<input type="checkbox"/> 41
<input type="checkbox"/> 332	<input type="checkbox"/> 206	<input type="checkbox"/> 42A
<input type="checkbox"/> 333	<input type="checkbox"/> 207	<input type="checkbox"/> 41 thermostat
<input type="checkbox"/> 334	<input type="checkbox"/> 208	
5. Using a crane or hoist, carefully place the choke and reactor assembly onto the main transformer. Attach with the four bolts, washers and nuts previously removed.
6. Attach the high inductance output lead to the bottom choke lead.
7. Attach the low inductance output lead to the choke center tap.
8. Attach flexible lead to the top choke lead.
9. Attach leads #273 and 41A to the choke thermostat.
10. Connect the reactor leads to the SCR heat sink assembly and the capacitor bank.
11. Replace any cable ties cut at disassembly.
12. Install the case top and sides.

CV-655





## RETEST AFTER REPAIR

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

### INPUT IDLE AMPS AND WATTS

Input volts/Phase/Hertz	Maximum Idle Amps	Maximum Idle KW
208/3/60	8.8	1.2
230/3/60	8.0	1.2
380/3/60	4.8	1.2
416/3/60	4.4	1.2
460/3/60	4.0	1.2
550/3/60	3.3	1.2
575/3/60	3.2	1.2
200/3/50	14.1	1.5
220/3/50	12.8	1.5
230/3/50	12.2	1.5
380/3/50	7.4	1.5
400/3/50	7.0	1.5
415/3/50	6.8	1.5
440/3/50	6.4	1.5
500/3/50	5.6	1.5
550/3/50	5.1	1.5

### MAXIMUM OPEN CIRCUIT VOLTAGES

Mode	Input Hertz	Open Circuit Volts
WELD (CV)	60	48V DC
Auxiliary Output (#31-#32)	60	122/128 VAC
Auxiliary Output (#41-#42)	60	45/49 VAC

### MINIMUM ACCEPTABLE OUTPUT VOLTAGE - AT MAXIMUM OUTPUT SETTINGS

Mode	Control Settings	Load
WELD (CV)	Output Control at Maximum	815 Amps @ 44.0 Volts (Min)
Auxiliary Output (#31-#32)	N/A	5 Amps @ 121/127 VAC (Min)
Auxiliary Output (#41-#42)	N/A	5 Amps @ 43/47 VAC (Min)

CV-655



Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

Return to Section TOC  
Return to Master TOC

CV-655



**TABLE OF CONTENTS  
-ELECTRICAL DIAGRAMS SECTION-**

ELECTRICAL DIAGRAMS .....	SECTION G
WIRING DIAGRAM - CODE 10120, 10122, 10123, 10124 .....	G-2
WIRING DIAGRAM - CODE 10121 .....	G-3
WIRING DIAGRAM - CODE 10125, 10126, 10127, 10128, 10129 .....	G-4
CONTROL PC BOARD SCHEMATIC .....	G-5
CONTROL PC BOARD ASSEMBLY .....	G-6
FAN / SNUBBER PC BOARD SCHEMATIC .....	G-7
FAN / SNUBBER PC BOARD ASSEMBLY .....	G-8
FIRING PC BOARD SCHEMATIC .....	G-9
FIRING PC BOARD ASSEMBLY .....	G-10

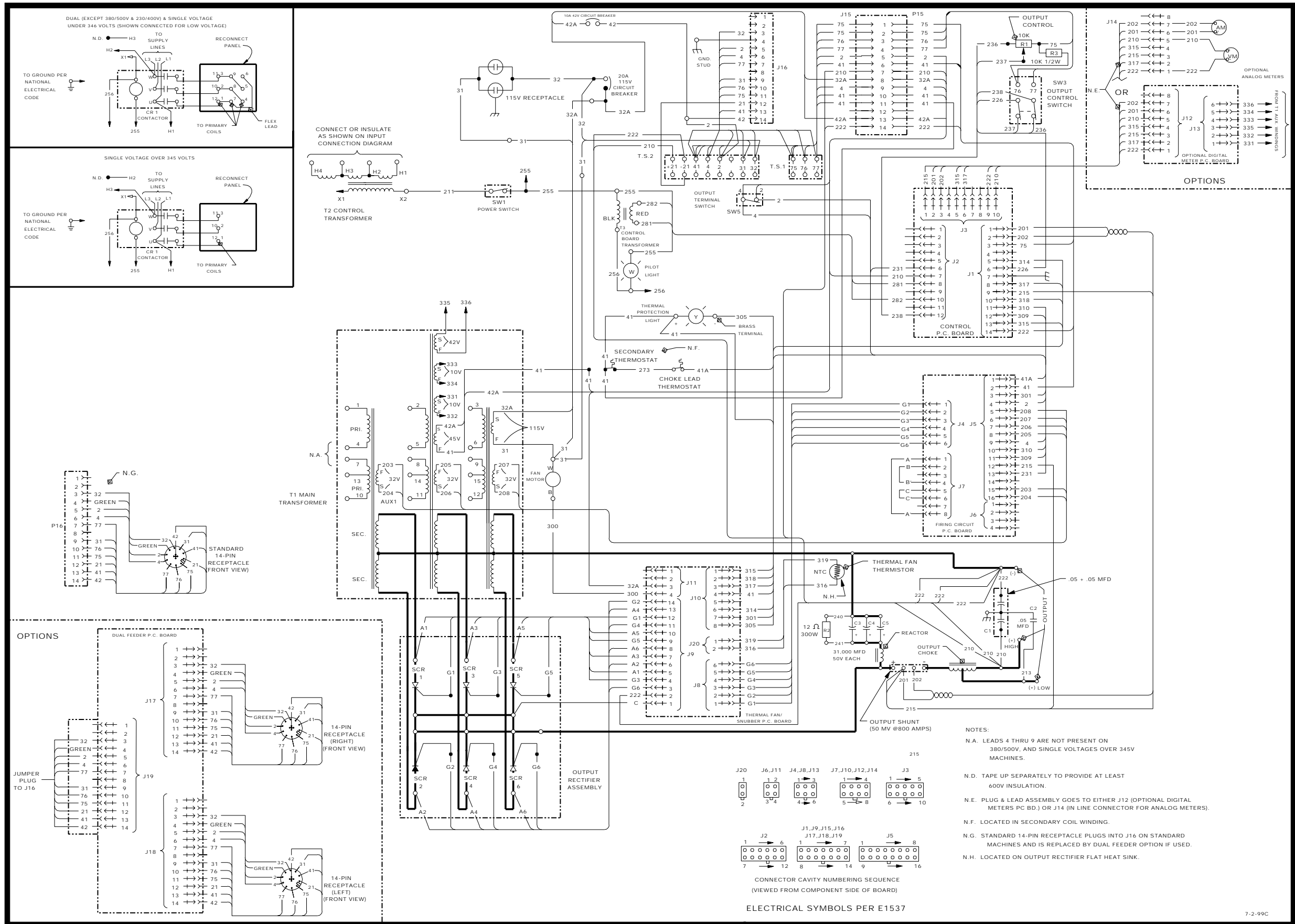
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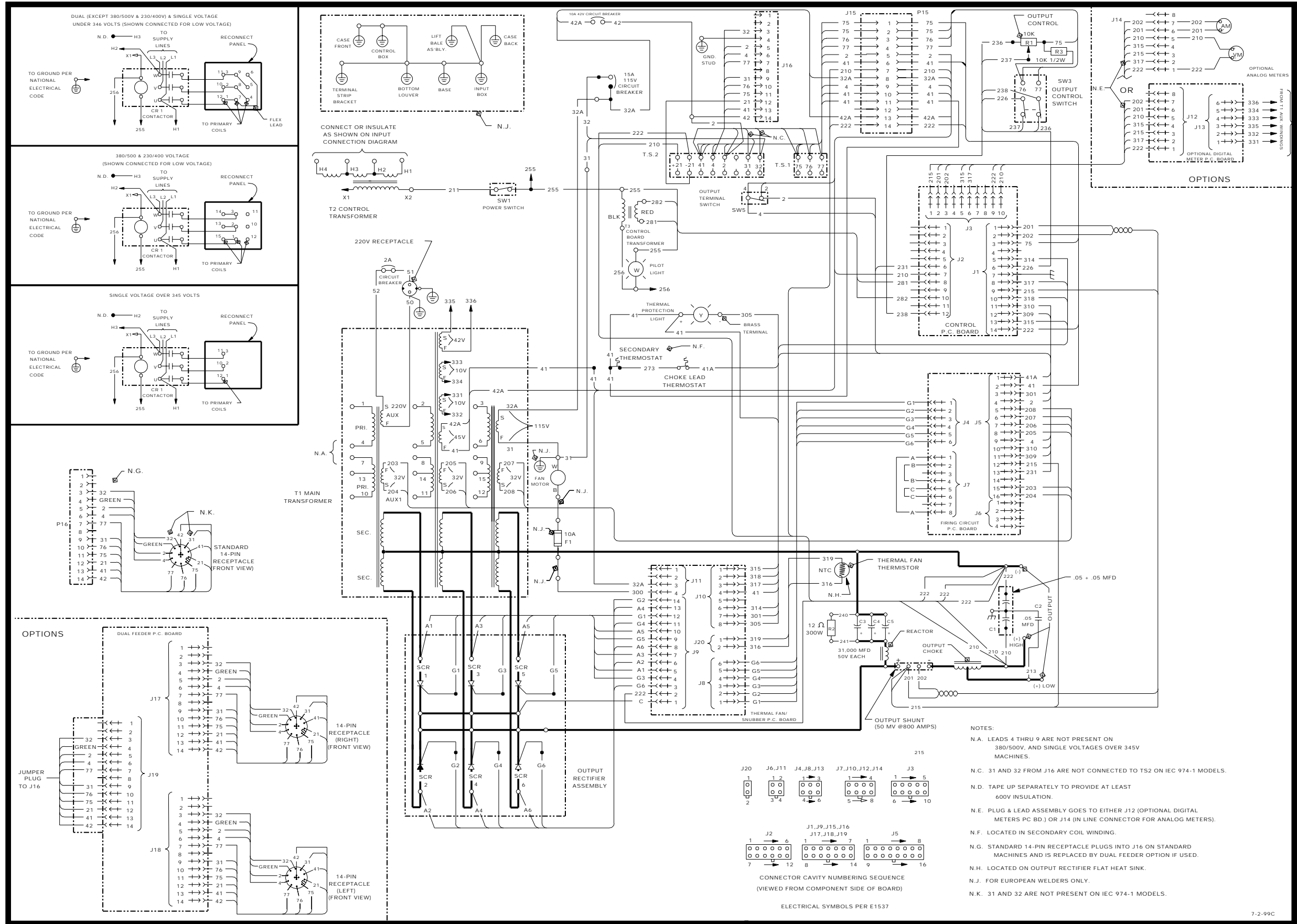
WIRING DIAGRAM - CV655 - CODE 10120, 10122, 10123, 10124



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.



WIRING DIAGRAM - CV655 - CODE 10125, 10126, 10127, 10128, 10129



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.

Return to Section TOC

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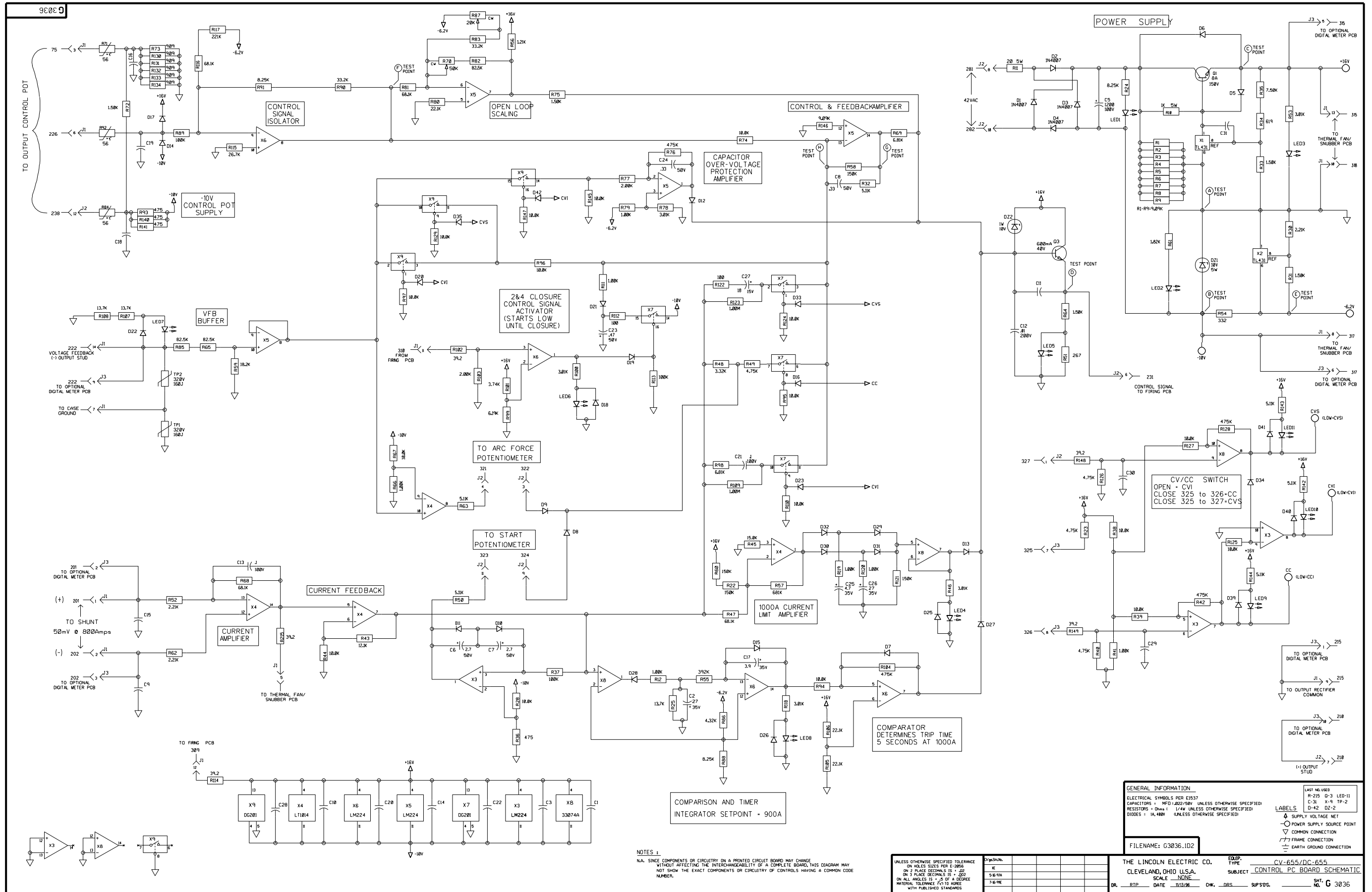
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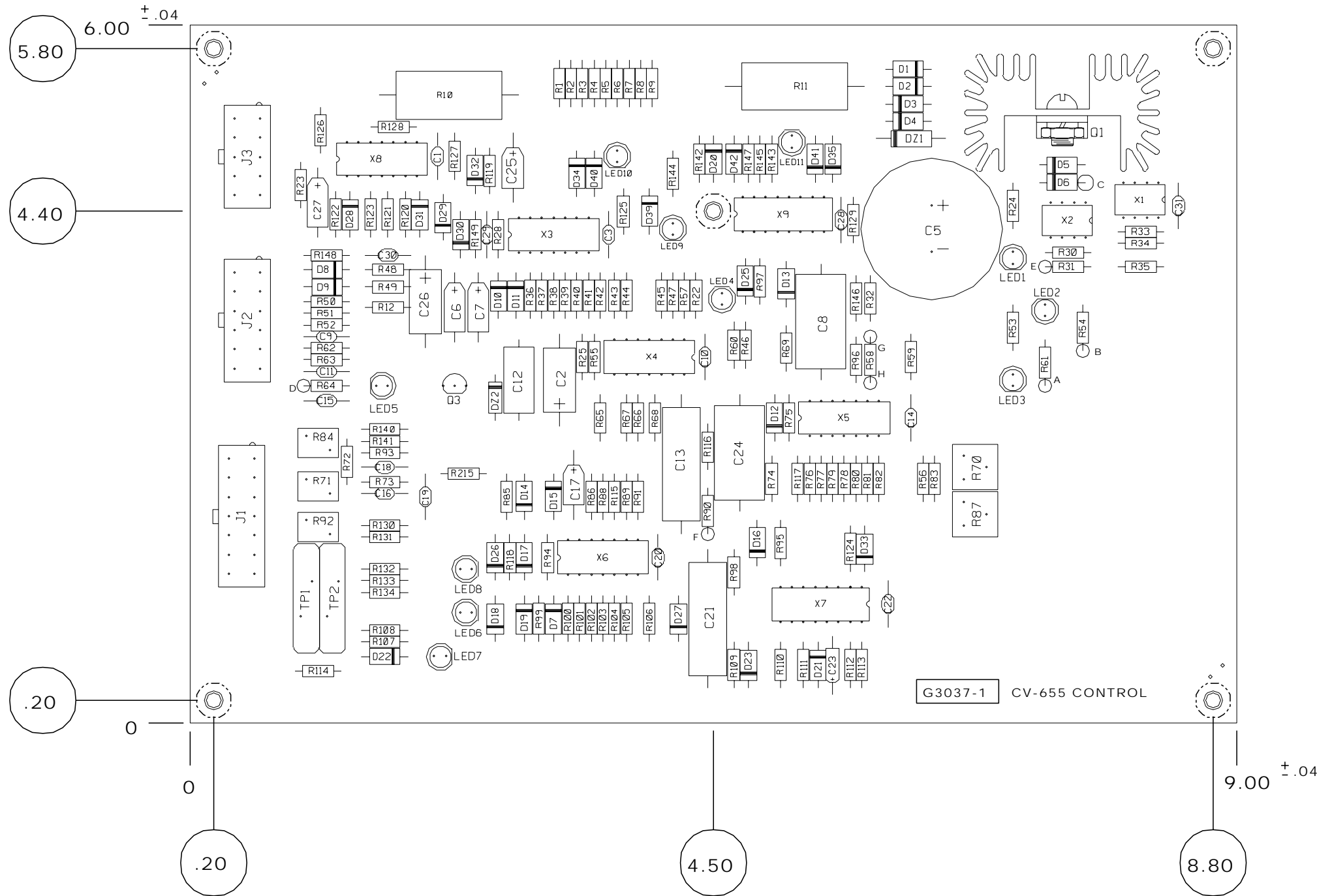
SCHEMATIC - CONTROL PC BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC (vertical text on the left margin)

PC BOARD ASSEMBLY - CONTROL BOARD



ITEM	REQ'D.	PART NO.	IDENTIFICATION
C1,C3,C9,C10,C11,C14,C15	16	S16668-5	.022/50
C16,C18,C19,C20,C22,C28,C29			
C30,C31	2	S13490-93	27 /35
C2,C26	1	S13490-138	1200 /100
C5	2	S13490-40	2.7/50
C6,C7	2	S13490-98	.33/50
C8,C24	1	T11577-32	.01/200
C12	2	T11577-26	.1/100
C13,C21	1	S13490-69	3.9/35
C17	1	S13490-63	.47/50
C23	1	S13490-25	4.7/35
C25	1	S13490-39	18 /15
C27	4	T12199-2	1N4007
D1,D2,D3,D4	34	T12199-1	1N4004
D5,D6,D7,D8,D9,D10,D11,D12			
D13,D14,D15,D16,D17,D18,D19			
D20,D21,D22,D23,D25,D26,D27			
D28,D29,D30,D31,D32,D33,D34			
D35,D39,D40,D41,D42			
DZ1	1	T12702-33	1N5347B
DZ2	1	T12702-27	1N4740A ZENER DIODE
J1	1	S18248-14	HEADER
J2	1	S18248-12	HEADER
J3	1	S18248-10	HEADER
LED1,LED2,LED3,LED4,LED5	11	T13657-2	RED LED
LED6,LED7,LED8,LED9,LED10			
LED11			
D1	1	S18105-4	HEAT SINK ASBLY
Q3	1	T12704-68	2N4401
R1,R2,R3,R4,R5,R6,R7,R8,R9	10	S19400-9091	9.09K 1/4W
R146	1	T14648-19	1K 5W
R10	1	T14648-23	20 OHM 5 WATT
R11	7	S19400-1001	1K 1/4W
R12,R41,R66,R79,R111,R119			
R120	4	S19400-1503	150K 1/4W
R22,R58,R60,R121	4	S19400-4751	4.75K
R23,R40,R49,R126	3	S19400-8251	8.25K 1/4W
R24,R88,R91	3	S19400-1372	13.7K 1/4W
R25,R107,R108	17	S19400-1002	10K 1/4W
R28,R38,R39,R44,R67,R74,R94			
R95,R96,R97,R110,R124,R125			
R127,R129,R145,R147			
R30,R52,R62	3	S19400-2211	2.21K 1/4W
R31,R33,R64,R72,R75	5	S19400-1501	1.5K 1/4W
R32,R50,R63,R142,R143,R144	6	S19400-5111	5.11K 1/4W
R34	1	S19400-6190	619 1/4W
R35	1	S19400-7501	7.5K 1/4W
R36,R93,R140,R141	4	S19400-4750	475 1/4W
R37,R89,R113	3	S19400-1003	100K 1/4W
R42,R76,R104,R128	4	S19400-4753	475K 1/4W
R43	1	S19400-1212	12.1K 1/4W
R45	1	S19400-1502	15K 1/4W
R46,R53,R78,R100,R118	5	S19400-3011	3.01K 1/4W
R47,R68,R81,R82,R116	5	S19400-6812	68.1K 1/4W
R48	1	S19400-3321	3.32K 1/4W
R51	1	S19400-2670	267 1/4W
R54	1	S19400-3320	332 1/4W
R55	1	S19400-3923	392K 1/4W
R56	1	S19400-1211	1.21K 1/4W
R57	1	S19400-6813	681K 1/4W
R59	1	S19400-1822	18.2K 1/4W
R61	1	S19400-1821	1.82K 1/4W
R65,R85	2	S19400-8252	82.5K 1/4W
R69,R98	2	S19400-6811	6.81K 1/4W
R70	1	T10812-39	50K 1/2W TRIMMER
R71,R84,R92	3	S18380-1	PTC THERMISTOR
R73,R130,R131,R132,R133,R134	6	S19400-9090	909 1/4W
R77,R103	2	S19400-2001	2.0K 1/4W
R80,R105,R106	3	S19400-2212	22.1K 1/4W
R83,R90	2	S19400-3322	33.2K 1/4W
R86	1	S19400-4321	4.32K 1/4W
R87	1	T10812-77	20K 1/2W TRIMMER
R99	1	S19400-6191	6.19K 1/4W
R101	1	S19400-3741	3.74K 1/4W
R102,R114,R148,R149,R215	5	S19400-39R2	39.2 1/4W
R109,R123	2	S19400-1004	1M 1/4W
R112,R122	2	S19400-1000	100 1/4W
R115	1	S19400-2672	26.7K 1/4W
R117	1	S19400-2213	221K 1/4W
TP1,TP2	2	T13640-18	160J
X1,X2	2	S15128-10	VOLTAGE REF.
X3,X5,X6	3	S15128-4	LM224 OP-AMP
X4	1	S15128-16	LINEAR INTEGRATED CIRCUIT
X7,X9	2	S15018-11	CMOS ANALOG SWITCH I.C. (SS)
X8	1	S15128-18	33074A OP-AMP

CAPACITORS - MFD/VOLTS  
 RESISTORS - OHMS/1/4 WATT UNLESS OTHERWISE SPECIFIED

CV-655  
 CONTROL P.C. BOARD AS'BLY.

G 3037-1D1

**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.

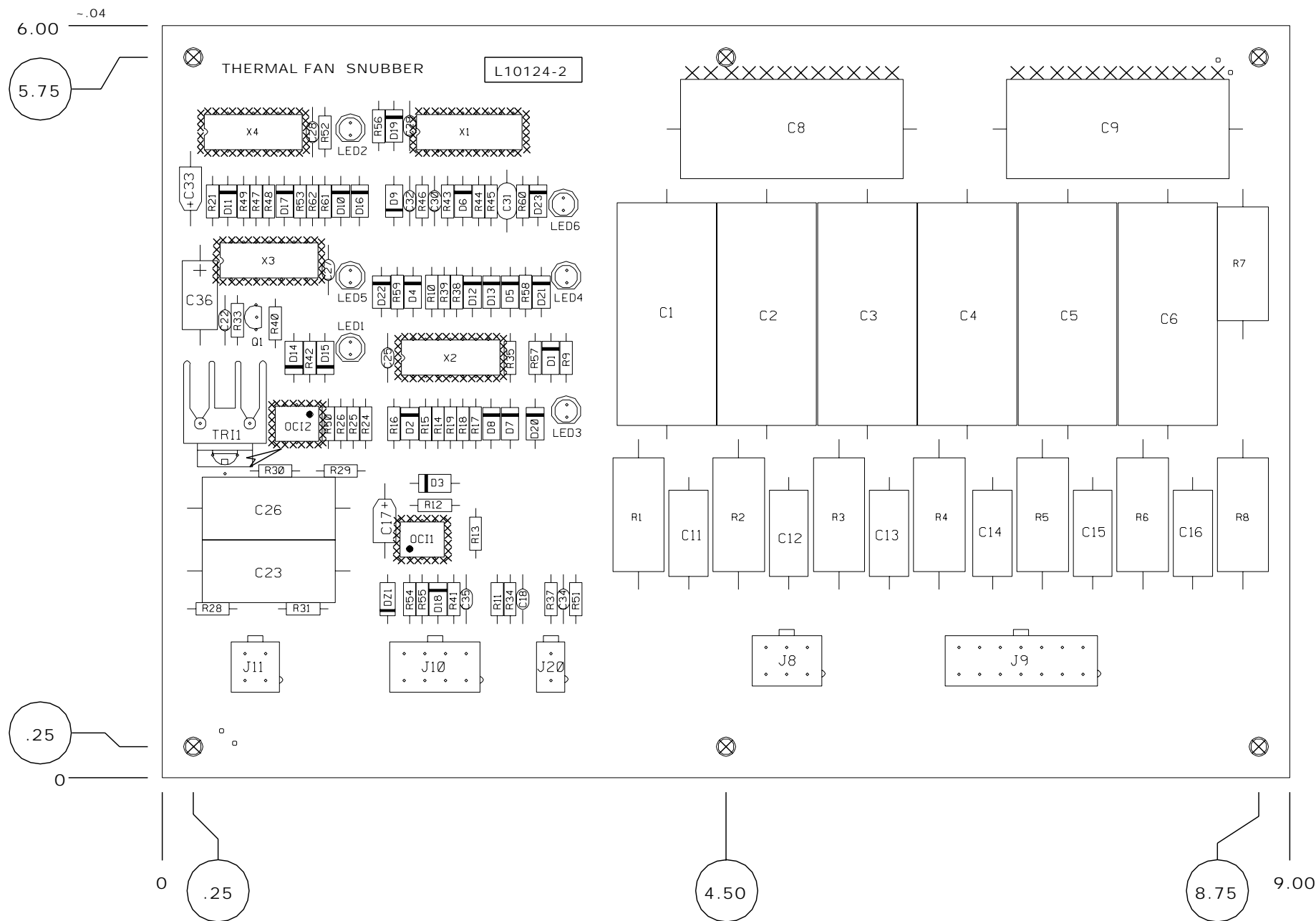


Return to Section TOC





PC BOARD ASSEMBLY - FAN / SNUBBER BOARD



ITEM	REQ'D	PART NO.	IDENTIFICATION
C1,C2,C3,C4,C5,C6,C8,C9	8	T11577-68	0.68 MFD /400 WVDC CAPACITOR
C11,C12,C13,C14,C15,C16	6	S13490-96	.15/200
C17,C33	2	S13490-25	4.7/35
C18,C22,C25,C27,C28,C29	10	S16668-5	.022/50
C23,C26	2	T11577-57	0.1/400
C31	1	S16668-11	.1/50
C36	1	S13490-104	39UF/20V
D1,D2,D3,D4,D5,D6,D7,D8,D9	23	T12199-1	1N4004
D10,D11,D12,D13,D14,D15			
D16,D17,D18,D19,D20,D21			
D22,D23			
DZ1	1	T12702-53	1N4728A
J8	1	S18248-6	HEADER
J9	1	S18248-14	HEADER
J10	1	S18248-8	HEADER
J11	1	S18248-4	HEADER
J20	1	S18248-2	HEADER
LED1,LED2,LED3,LED4,LED5	6	T13657-2	RED LED
LED6			
OC11	1	S15000-10	OPTO ISOLATOR
OC12	1	S15000-12	OPTOCOUPLER TRIAC DRIVER
Q1	1	T12704-68	2N4401
R1,R2,R3,R4,R5,R6	6	T14648-22	50 5W
R7	1	T14648-2	25 5W
R8	1	T14648-9	2.5K 5W
R9,R10,R16,R19,R21,R43,R46	9	S19400-1002	10K 1/4W
R48,R52			
R11,R37	2	S19400-4752	47.5K 1/4W
R12,R14,R33,R44,R49,R53	6	S19400-1003	100K 1/4W
R13	1	S19400-1821	1.82K 1/4W
R15,R40,R41,R61	4	S19400-1502	15K 1/4W
R17,R18	2	S19400-2802	28.0K 1/4W
R24,R25,R26,R50	4	S19400-1501	1.5K 1/4W
R28	1	S19400-1500	150 1/4W
R29	1	S19400-3570	357 1/4W
R30	1	S19400-4750	475 1/4W
R31,R54,R55	3	S19400-39R2	39.2 1/4W
R34,R51	2	S19400-1001	1K 1/4W
R35	1	S19400-2673	267K 1/4W
R38	1	S19400-8251	8.25K 1/4W
R39	1	S19400-1000	100 1/4W
R42	1	S19400-3923	392K 1/4W
R45	1	S19400-1623	162K/.25W
R47	1	S19400-5111	5.11K 1/4W
R56,R57,R58,R59,R60,R62	6	S19400-2001	2.0K 1/4W
TR11	1	S18395-27	TRIAC/HEAT SINK ASSEMBLY
X1	1	S15018-13	16 PIN I.C. (SS)
X2,X3	2	S15128-4	IC,LM224,OP-AMP
X4	1	S15018-15	14 PIN I.C. (SS)

CAPACITORS = MFD/VOLTS  
RESISTORS = OHMS

CV-655/DC-655  
THERMAL FAN/SNUBBER P.C. BD. AS'BLY

2-12-99A

L 10124-2

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Return to Section TOC

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Return to Section TOC

Return to Master TOC

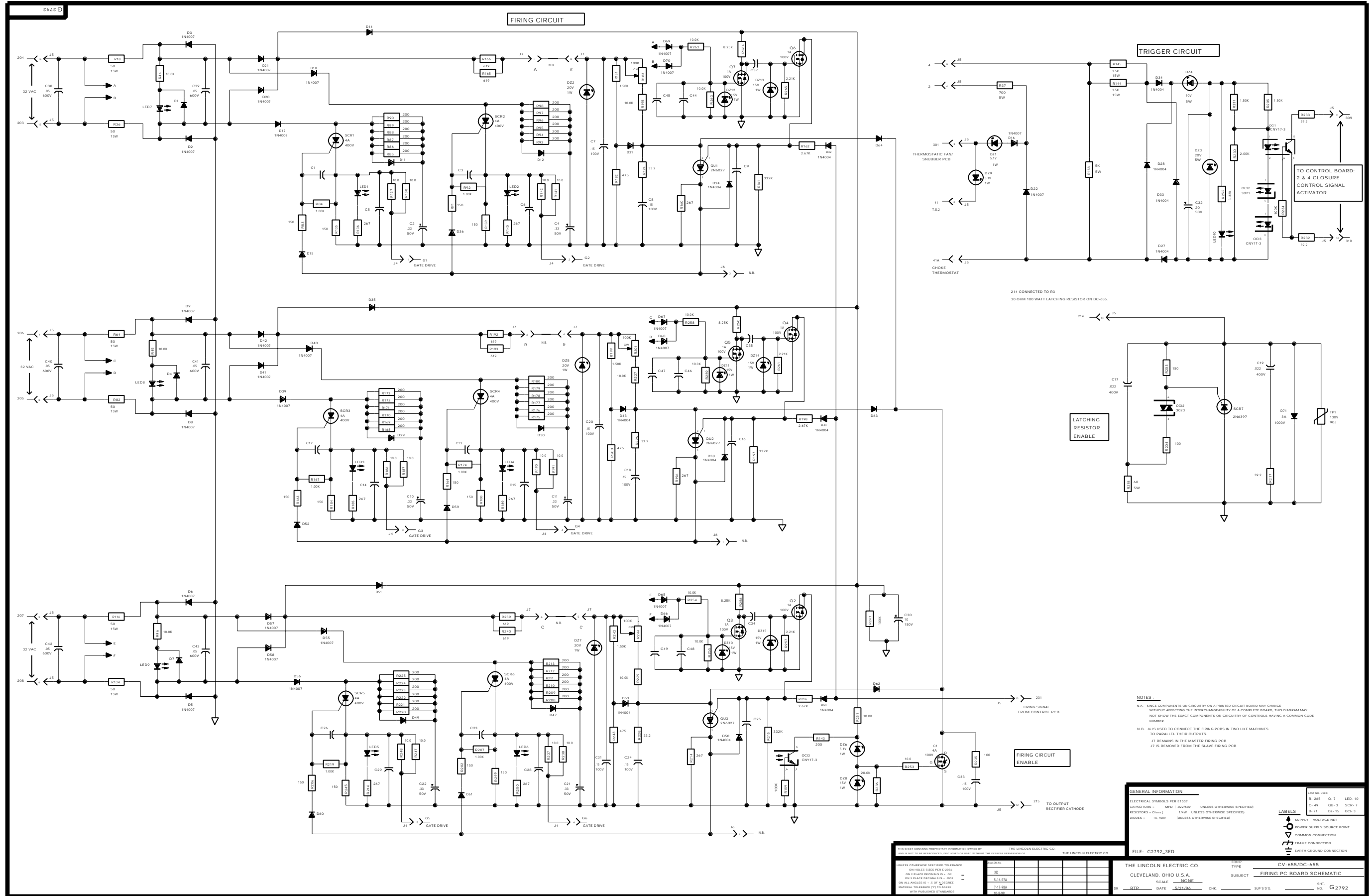
Return to Master TOC

Return to Master TOC

Return to Master TOC

SCHEMATIC - FIRING PC BOARD

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



NOTES:
N/A: SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGIBILITY OF A COMPLETE BOARD...
N.B. J4 IS USED TO CONNECT THE FIRING PCB'S IN TWO LIKE MACHINES TO PARALLEL THEIR OUTPUTS...
J7 REMAINS IN THE MASTER FIRING PCB
J7 IS REMOVED FROM THE SLAVE FIRING PCB

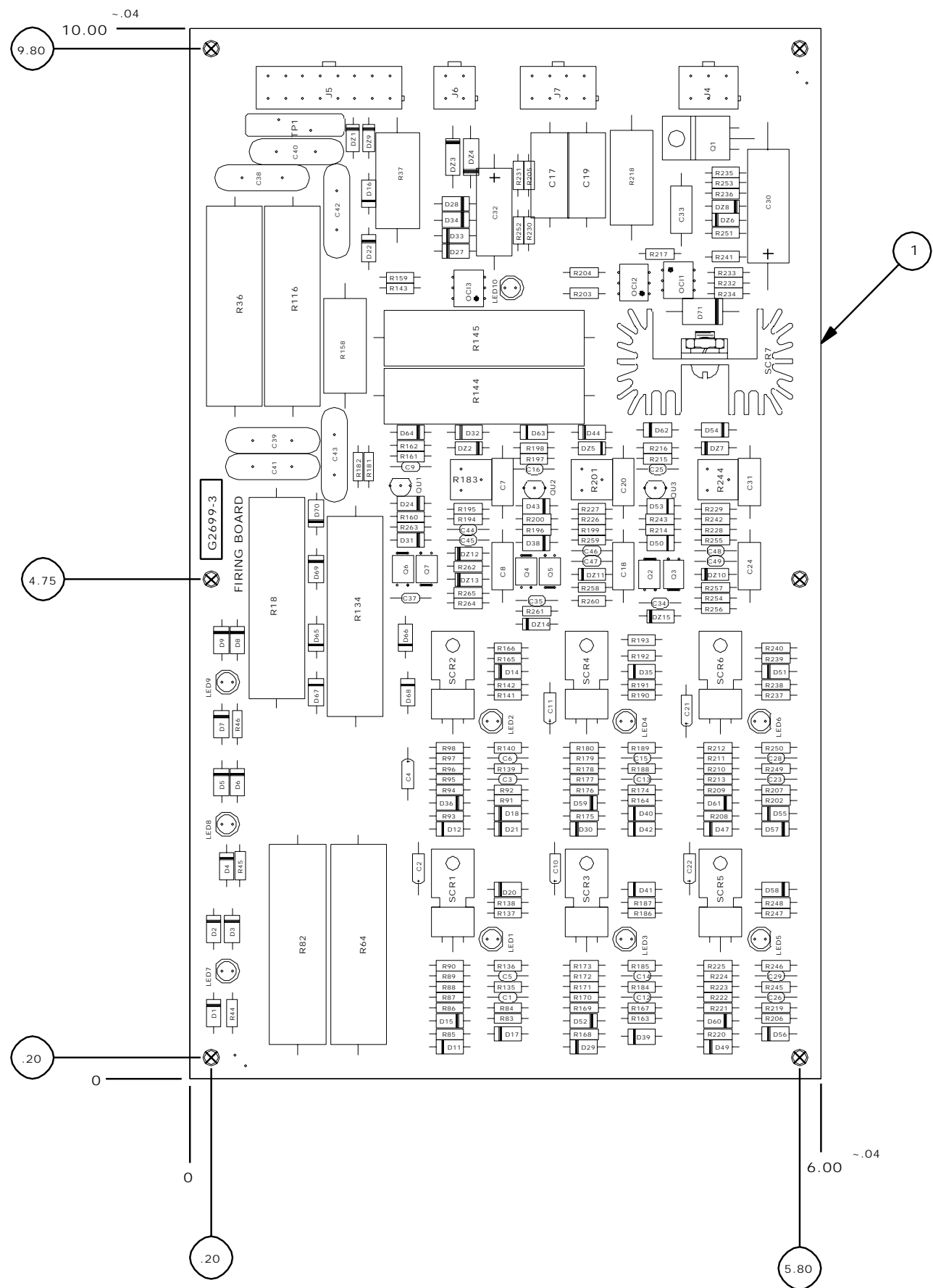
Table with columns for Component, Value, and Quantity. Includes components like R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100.

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.
SCALE: NONE
RTP: DATE: 5/21/86
CHK: SUP'D/G:
SHT NO: G2792

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.



PC BOARD ASSEMBLY - FIRING BOARD



ITEM	REQ'D	PART NO.	DESCRIPTION
C1,C3,C5,C6,C9,C12,C13,C14	24	S16668-5	.022/50
C15,C16,C23,C25,C26,C28 C29,C34,C35,C37,C44,C45 C46,C47,C48,C49	6	S13490-95	33/50
C2,C4,C10,C11,C21,C22	7	S13490-108	15/100
C7,C8,C18,C20,C24,C31,C33	2	T11577-41	.022/400
C17,C19	1	S13490-74	10/100
C30	1	S13490-73	20/50
C32	6	T11577-46	.05/600V
C38,C39,C40,C41,C42,C43	34	T12199-1	1N4004
D1,D4,D7,D11,D12,D14,D15	26	T12199-2	1N4007
D24,D27,D28,D29,D30,D31 D32,D33,D34,D35,D36,D38 D43,D44,D47,D49,D50,D51 D53,D53,D54,D59,D60,D61 D62,D63,D64	1	T12705-48	100V/3AMP DIODE
D2,D3,D5,D6,D8,D9,D16,D17	3	T12702-52	1N4733A
D18,D20,D21,D22,D39,D40 D41,D42,D55,D56,D57,D58 D65,D66,D67,D68,D69,D70	3	T12702-4	1N4747
D71	1	T12702-25	1N5357B
D21,D26,D29	1	T12702-33	1N5347B
D22,D25,D27	7	T12702-29	1N4744A
D23	1	S18248-6	HEADER
D24	1	S18248-16	HEADER
D28,D210,D211,D212,D213	1	S18248-4	HEADER
D28,D210,D211,D212,D213	1	S18248-8	HEADER
DZ14,DZ15	10	T13657-2	RED LED
DZ1	2	S15000-18	OPTO ISOLATOR
OC1,OC3	1	S15000-12	OPTOCOUPLER TRIAC DRIVER
OC2	1	T12704-80	HEXFET TRANS. (SS)
O2,O3,O4,O5,O6,O7	6	T12704-73	IC PKG MOSFET (SS)
OU1,OU2,OU3	3	T12707-4	2N6027
R18,R36,R44,R82,R116,R134	6	T14650-6	RESISTOR WW, 15W, 50.5% SQ
R37	1	T14648-15	700 5W
R44,R45,R48,R195,R227,R229	13	S19400-1002	10K 1/4W
R251,R254,R255,R258,R259 R262,R263	13	S19400-1500	150 1/4W
R83,R91,R135,R139,R163	6	S19400-1001	1K 1/4W
R164,R184,R188,R202,R203 R256,R245,R249	8	S19400-2000	200 1/4W
R84,R92,R167,R174,R207	37	S19400-2000	200 1/4W
R219	9	S19400-2670	267 1/4W
R93,R94,R95,R96,R97,R98 R143,R168,R169,R170,R171 R172,R173,R175,R176,R177 R178,R179,R180,R208,R209 R210,R211,R212,R213,R220 R221,R222,R223,R224,R225	9	S19400-2670	267 1/4W
R136,R140,R160,R185,R189	13	S19400-10R0	10 1/4W
R196,R214,R246,R250	2	T14650-1	1500 OHMS, 15 W, RESISTOR
R137,R138,R141,R142,R186	1	T14648-1	5K 5W
R187,R190,R191,R237,R238 R247,R248,R253	3	S19400-1003	100K 1/4W
R144,R145	3	S19400-3323	332K 1/4W
R158	3	S19400-2671	267K 1/4W
R159,R234,R241	6	S19400-6190	619 1/4W
R161,R197,R215	5	S19400-1501	1.5K 1/4W
R165,R166,R192,R193,R239	3	S19400-4750	475 1/4W
R240	3	T10812-67	100K 1/2W TRIMMER
R191,R199,R205,R231,R242 R182,R200,R243	3	S19400-33R2	33 1/4W
R183,R201,R244	2	S19400-1000	100 1/4W
R192,R226,R228	3	S19400-39R2	39.2 1/4W
R234,R235	1	T14648-18	68 5W
R217,R232,R233	1	S19400-2001	2.0K 1/4W
R218	1	S19400-2002	20K 1/4W
R230	1	S19400-3321	3.32K 1/4W
R236	3	S19400-8251	8.25K 1/4W
R252	3	S19400-2211	2.21K 1/4W
R256,R260,R264	6	S15161-19	4A, 400V, SCR
R257,R261,R265	1	S18395-21	SCR HS ASBLY
SCR1,SCR2,SCR3,SCR4,SCR5	1	T13640-25	MOV,90J
SCR6			
SCR7			
TP1			

CAPACITORS - MFD/VOLTS  
RESISTORS - OHMS

CV-655/DC-655  
FIRING P.C. BOARD ASSEMBLY

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G 2699-3

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# SVM ERROR REPORTING FORM

We need to know if there are errors in our manuals. We also value any suggestions as to additional tests or procedures that would make this SVM a better tool for you.

If you discover new or different "Problems or Symptoms" that are not covered in the three column troubleshooting chart, please share this information with us. Please include the machine's code number and how the problem was resolved.

Thank You,  
Technical Services Group  
Lincoln Electric Co.  
22801 ST. Clair Ave.  
Cleveland, Ohio 44117-1199

FAX 216-481-2309

SVM Number \_\_\_\_\_

Page Number if necessary \_\_\_\_\_

Your Company \_\_\_\_\_

Your Name \_\_\_\_\_

Please give detailed description below:

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