

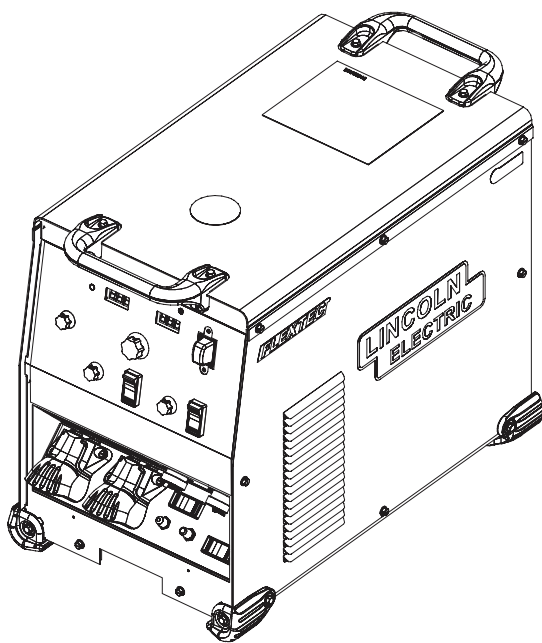


NOTE: This manual will cover most of the troubleshooting and repair procedures for the code numbers listed. Some variances may exist when troubleshooting/repairing later code numbers.

FLEXTEC™ 650

For use with machines having Code Numbers:
11814, 12391

SERVICE MANUAL



⚠ 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.



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 within applicable OSHA PEL and ACGIH TLV limits using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

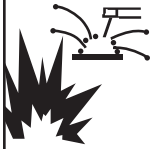
5.b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.

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

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

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

5.f. Also see item 1.b.



WELDING and CUTTING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

- 6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.
- 6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
- 6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).
- 6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
- 6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.
- 6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.
- 6.h. Also see item 1.c.
- 6.i. Read and follow NFPA 51B "Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from NFPA, 1 Batterymarch Park, PO box 9101, Quincy, Ma 022690-9101.
- 6.j. Do not use a welding power source for pipe thawing.



CYLINDER may explode if damaged.

- 7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.
- 7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.
- 7.c. Cylinders should be located:
 - Away from areas where they may be struck or subjected to physical damage.
 - A safe distance from arc welding or cutting operations and any other source of heat, sparks or flame.
- 7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.
- 7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- 7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.
- 7.g. Read and follow the instructions on compressed gas cylinders, associated equipment and CGA publication P-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.

Refer to <http://www.lincolnelectric.com/safety> for additional safety information.

PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté 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 reçoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.
3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:
 - a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
 - b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
 - c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.
4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.
5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans latéraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.
7. Quand on ne soude pas, poser la pince à un endroit isolé de la masse. Un court-circuit accidentel peut provoquer un échauffement et un risque d'incendie.
8. S'assurer que la masse est connectée le plus près possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaînes de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'échauffement des chaînes et des câbles jusqu'à ce qu'ils se rompent.
9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particulièrement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumées toxiques.
10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgène (gas fortement toxique) ou autres produits irritants.
11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

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

1. Relier à la terre le châssis du poste conformément au code de l'électricité et aux recommandations du fabricant. Le dispositif de montage ou la pièce à souder doit être branché à une bonne mise à la terre.
2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.
3. Avant de faire des travaux à l'intérieur de poste, la débrancher à l'interrupteur à la boîte de fusibles.
4. Garder tous les couvercles et dispositifs de sûreté à leur place.

Electromagnetic Compatibility (EMC)

Conformance

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

Introduction

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

Installation and Use

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

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

Assessment of Area

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

- a) other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the welding equipment;
- b) radio and television transmitters and receivers;
- c) computer and other control equipment;
- d) safety critical equipment, e.g., guarding of industrial equipment;
- e) the health of the people around, e.g., the use of pacemakers and hearing aids;
- f) equipment used for calibration or measurement
- g) the immunity of other equipment in the environment. The user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures;
- h) the time of day that welding or other activities are to be carried out.

Electromagnetic Compatibility (EMC)

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

Methods of Reducing Emissions

Mains Supply

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

Maintenance of the Welding Equipment

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

Welding Cables

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

Equipotential Bonding

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

Earthing of the Workpiece

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

Screening and Shielding

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

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

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TECHNICAL SPECIFICATIONS - FLEXTEC™ 650

POWER SOURCE-INPUT VOLTAGE AND CURRENT

MODEL	DUTY CYCLE	INPUT VOLTAGE $\pm 10\%$	INPUT AMPERES	IDLE POWER (W)	POWER FACTOR @ RATED OUTPUT
K3060-1	60% Rating	380 / 460 / 575 / 3 / 50 / 60	61 / 50 / 40	230 MAX. (Fan ON)	88%
	100% Rating		57 / 47 / 38	100 MAX. (Fan OFF)	

RATED OUTPUT*

PROCESS	DUTY CYCLE	AMPERES	VOLTS AT RATED AMPERES
GMAW (CV)	60%	750*	44V
	100%	650*	
GTAW (CC)	60%	750	34V
	100%	650	
SMAW (CC)	60%	750*	44V
	100%	650*	
FCAW-GS (VC)	60%	750*	44V
	100%	650*	
FCAW-SS (CV)	60%	750*	44V
	100%	650*	
SAW (CV)	60%	750*	44V
	100%	650*	

* Output is limited to 600A / 100% and 700A / 60% when used with K3091-1 Multi-Process Switch.

RECOMMENDED INPUT WIRE AND FUZE SIZES ⁽¹⁾

VOLTAGE 50/60 Hz	MAXIMUM INPUT AMPERES	CORD SIZE ⁽³⁾ AWG SIZES (mm)	TYPE 75°C COPPER WIRE IN CONDUIT AWG (mm ²)	COPPER GROUNDING CONDUCTOR AWG (mm ²)	FUSE (SUPER LAG) OR BREAKER SIZE ⁽²⁾
380/3/50	70 A	4 (25)	4 (25)	8 (10)	90
460/3/60	58 A	4 (25)	6 (16)	8 (10)	80
575/3/60	46 A	6 (16)	8 (10)	10 (6)	60

⁽¹⁾ Cord and Fuse Sizes based upon the U.S. National Electric Code and maximum output for 40°C (104°) ambient.

⁽²⁾ Also called "inverse time" or "thermal/magnetic" circuit breakers; circuit breakers that have a delay in tripping action that decreases as the magnitude of current increases.

⁽³⁾ Type SJ cord or similar in 30°C ambient.

WELDING PROCESS

PROCESS	OUTPUT RANGE (AMPERES)	OCV (U _o)	OCV (U _r)
GMAW (CV)	40-815	60	---
GTAW (CC)	10-815	24	15
SMAW (CC)	15-815	60	15
FCAW-GS	40-815	60	---
FCAW-S (CV)	40-815	60	---
SAW (CV)	40-815	60	---

PHYSICAL DIMENSIONS

MODEL	HEIGHT	WIDTH	DEPTH	WEIGHT
K3060-1	21.8 IN. (554 mm)	16.14 IN. (410 mm)	29.33 IN. (745 mm)	165 LBS. (74.8 kg)*

TEMPERATURE RANGES

OPERATING TEMPERATURE RANGE	STORAGE TEMPERATURE RANGE
Environmentally Hardened: 14°F to 131°F (-10°C to 55°C**)	Environmentally Hardened: -40°F to 185°F (-40°C to 85°C)

IP23 180°(H) Insulation Class

* Weight does not include input cord.

** Power Source is de-rated at temperatures above 40C.

SAFETY PRECAUTIONS

⚠ WARNING



ELECTRIC SHOCK can kill.

- Only qualified personnel should perform this installation.
- Turn off input power to the power source at the disconnect switch or fuse box before working on this equipment.
- Turn off the input power to any other equipment connected to the welding system at the disconnect switch or fuse box before working on equipment.
- Do not touch electrically hot parts.
- Always connect the FLEXTEC™ 650 grounding lug (located inside the reconnect input access door) to a proper safety (earth) ground.

VRD™ (VOLTAGE REDUCTION DEVICE)

The VRD™ feature provides additional safety in the CC-Stick mode. The VRD™ reduces the OCV (Open Circuit Voltage) at the welding output terminals while not welding to less than 35VDC peak.

The VRD™ requires that the welding cable connections be kept in good electrical condition because poor connections will contribute to poor starting. Having good electrical connections also limits the possibility of other safety issues such as heat-generated damage, burns and fires.

The machine is shipped with VRD™ “Disabled”. The VRD™ function can be disabled or enabled via dip switches on the control P.C. board. Dip switch setting will differ depending on input voltage.

The control board and dip switches can be accessed by removing the case top and side as shown in the *Operation* section **Figure B.3**.

SELECT SUITABLE LOCATION

LOCATION AND VENTILATION FOR COOLING

Place the welder where clean cooling air can freely circulate in through the rear louvers and out through the case sides. 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.

LIFTING

The FLEXTEC™ 650 has 2 lifting eyelets and 2 handles that can be used to lift the machine. Both handles or both eyelets should be used when lifting the FLEXTEC™ 650.

When using a crane or overhead device to lift using the handles, a lifting strap should be connected to both handles. Do not attempt to lift the FLEXTEC™ 650 with accessories attached to it.

STACKING

Multiple FLEXTEC™ 650s cannot be stacked.

ENVIRONMENTAL LIMITATIONS

The FLEXTEC™ 650 is IP23 rated for use in an outdoor environment. The FLEXTEC™ 650 should not be subjected to falling water during use nor should any parts of it be submerged in water. Doing so may cause improper operation as well as pose a safety hazard. The best practice is to keep the machine in a dry, sheltered area.

⚠ CAUTION

Do not mount the FLEXTEC™ 650 over combustible surfaces. Where there is a combustible surface directly under stationary or fixed electrical equipment, that surface shall be covered with a steel plate at least .060” (1.6 mm) thick, which shall extend not less than 5.90” (150 mm) beyond the equipment on all sides.

INPUT AND GROUNDING CONNECTIONS

MACHINE GROUNDING



The frame of the welder must be grounded. A ground terminal marked with the symbol shown is located inside the reconnect/input connection area for this purpose. See your local and national electrical codes for proper grounding methods.

HIGH FREQUENCY PROTECTION

Locate the FLEXTEC™ 650 away from radio controlled machinery. The normal operation of the FLEXTEC™ 650 may adversely affect the operation of RF controlled equipment, which may result in bodily injury or damage to the equipment.

HIGH TEMPERATURE OPERATION

WELDER OUTPUT RATINGS AT 55°C ELEVATED TEMPERATURES			
AMPS	DUTY CYCLE	VOLTS	TEMPERATURES
600	100%	44V	55°C
650	50%		
750	30%		

⚠ WARNING



ELECTRIC SHOCK can kill.

- Only a qualified electrician should connect the input leads to the FLEXTEC™ 650.
- Connections should be made in accordance with all local and national electrical codes and the connection diagram located on the inside of the reconnect/input access door of the machine. Failure to do so may result in bodily injury or death.

INPUT CONNECTION

(See Figure A.1)

Use a three-phase supply line. A 1.75 inch (45 mm) diameter access hole for the input supply is located on the case back. Remove the reconnect access panel located on the case back and connect W, V, U and ground according to the Input Supply Connection Diagram decal.

INPUT FUSE AND SUPPLY WIRE CONSIDERATIONS

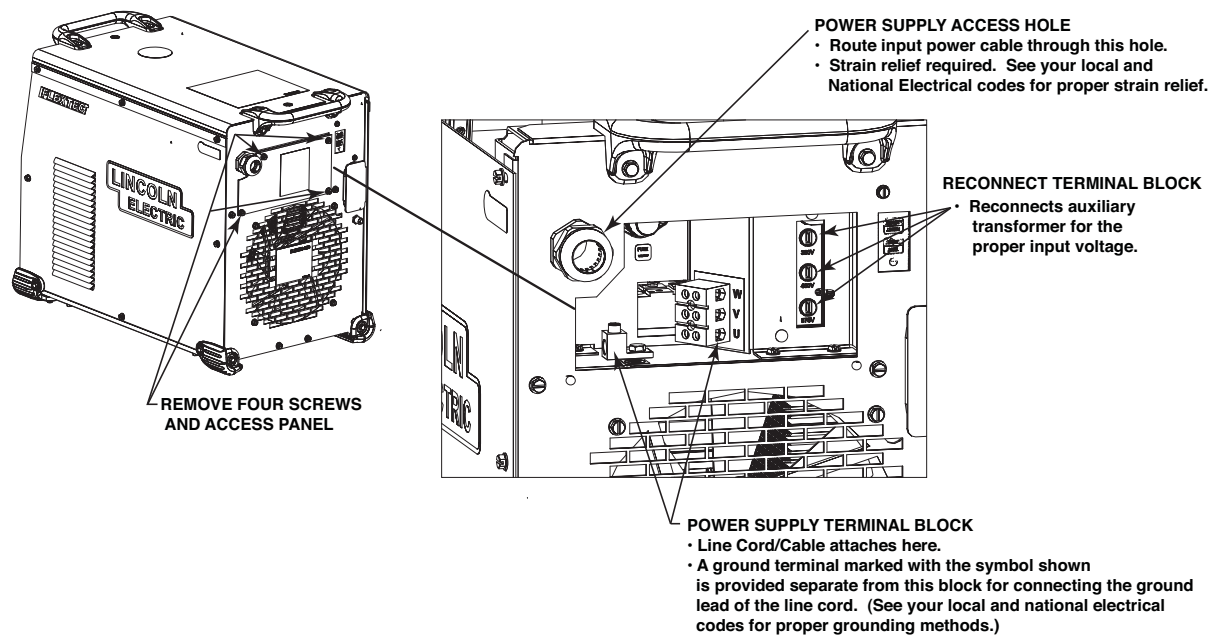
Refer to Specification in this Installation Section for recommended fuse, wire sizes and type of the copper wires. Fuse the input circuit with the recommended super lag fuse or delay type breakers (also called "inverse time" or "thermal/magnetic" circuit breakers). Choose input and grounding wire size according to local or national electrical codes. Using input wire sizes, fuses or circuit breakers smaller than recommended may result in "nuisance" shut-offs from welder inrush currents, even if the machine is not being used at high currents.

INPUT VOLTAGE SELECTION

Welders are shipped connected for 460 Volt input voltage. To move this connection to a different input voltage, see Figure A.1 which is illustrated below. If the Auxiliary lead (indicated as 'A') is placed in the wrong position and power is applied to the machine, the machine will protect itself and display an error message:

- "Err" "713 or 714" will be shown on the display.
- The control board and switch boards will blink out error 713 or 714 on their status leds.
- The weld output will be turned off and the control board will force itself into an idle state.
- The machine will need to have the misconnect condition removed before it will recover. Power must be removed prior to changing reconnect position.

FIGURE A.1

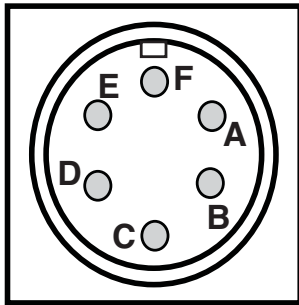


FLEXTEC™ 650

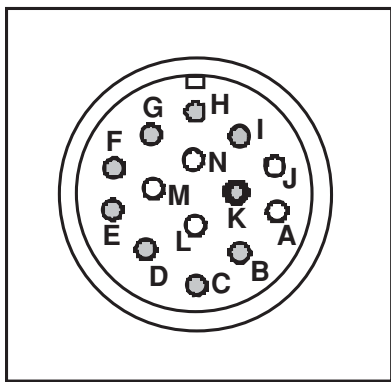


CABLE CONNECTIONS

See figure A.2 for locating **6-pin** and **14-pin** connectors on the front of the FLEXTEC™ 650.

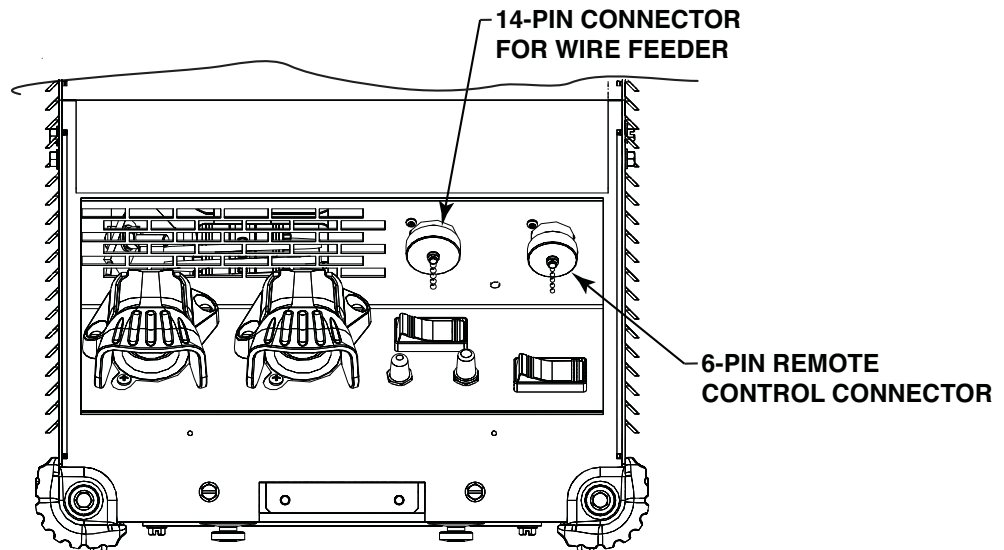


6-PIN REMOTE CONTROL CONNECTOR		
FUNCTION	PIN	WIRING
6-pin remote control connector for remote or hand/foot amp-trol.	A	77 Remote potentiometer, 10K
	B	76 Remote potentiometer, wiper
	C	75 Remote potentiometer, common
	D	Trigger, common
	E	Trigger, input
	F	Ground



14-PIN REMOTE CONTROL CONNECTOR		
FUNCTION	PIN	WIRING
14-pin connector for wire feeder connectivity.	A	115 VAC
	B	Ground
	C	Trigger, common
	D	Trigger, input
	E	77 Remote potentiometer, 10K
	F	76 Remote potentiometer, wiper
	G	75 Remote potentiometer, common
	H	Voltage sense (21)
	I	Motor (42 VAC)
	J	115 VAC
	K	Motor (42 VAC)
	L	
	M	
	N	

FIGURE A.2



FLEXTEC™ 650



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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

RECOMMENDED ELECTRODE AND WORK CABLE SIZES FOR ARC WELDING

GENERAL GUIDELINES

Connect the electrode and work cables between the appropriate output studs of the FLEXTEC™ 650 per the following guidelines:

- Most welding applications run with the electrode being positive (+). For those applications, connect the electrode cable between the wire drive feed plate and the positive (+) output stud on the power source. Connect a work lead from the negative (-) power source output stud to the work piece.
- When negative electrode polarity is required, such as in some Innershield applications, reverse the output connections at the power source (electrode cable to the negative (-) stud and work cable to the positive (+) stud).

The following recommendations apply to all output polarities and weld modes:

- **Select the appropriate size cables per the “Output Cable Guidelines”** (See Table A.1). Excessive voltage drops caused by undersized welding cables and poor connections often result in unsatisfactory welding performance. Always use the largest welding cables (electrode and work) that are practical and be sure all connections are clean and tight.

NOTE: Excessive heat in the weld circuit indicates undersized cables and/or bad connections.

- **Route all cables directly to the work and wire feeder, avoid excessive lengths and do not coil excess cable.** Route the electrode and work cables in close proximity to one another to minimize the loop area and therefore the inductance of the weld circuit.
- **Always weld in a direction away from the work (ground) connection.**

TABLE A.1

OUTPUT CABLE GUIDELINES

AMPERES	PERCENT DUTY CYCLE	CABLE SIZES FOR COMBINED LENGTHS OF ELECTRODE AND WORK CABLES (RUBBER COVERED COPPER - RATED 167°F or 75°C)**				
		0 to 50Ft. (0 to 15m)	50 to 100Ft. (15 to 30m)	100 to 150 Ft. (30 to 46m)	150 to 200 Ft. (46 to 61m)	200 to 250 Ft. (61 to 76m)
200	60	2	2	2	1	1/0
200	100	2	2	2	1	1/0
250	30	3	3	2	1	1/0
250	40	2	2	1	1	1/0
250	60	1	1	1	1	1/0
250	100	1	1	1	1	1/0
300	60	1	1	1	1/0	2/0
300	100	2/0	2/0	2/0	2/0	3/0
350	40	1/0	1/0	2/0	2/0	3/0
400	60	2/0	2/0	2/0	3/0	4/0
400	100	3/0	3/0	3/0	3/0	4/0
500	60	2/0	2/0	3/0	3/0	4/0
600	60	3/0	3/0	3/0	4/0	2-3/0
600	80	2-1/0	2-1/0	2-1/0	2-2/0	2-3/0
600	100	2-1/0	2-1/0	2-1/0	2-2/0	2-3/0
650	60	3/0	3/0	4/0	2-2/0	2-3/0
650	80	2-1/0	2-1/0	2-1/0	2-2/0	2-3/0
700	100	2-2/0	2-2/0	2-3/0	2-3/0	2-4/0
800	80	3-1/0	3-1/0	3-1/0	2-3/0	2-4/0
800	100	2-3/0	2-3/0	2-3/0	2-3/0	2-4/0

** Tabled values are for operation at ambient temperatures of 104°F(40°C) and below. Applications above 104°F(40°C) may require cables larger than recommended or cables rated higher than 167°F(75°C).

CONTROL CABLE CONNECTIONS

GENERAL GUIDELINES

Genuine Lincoln control cables should be used at all times (except where noted otherwise). Lincoln cables are specifically designed for the communication and power needs of the FLEXTEC™ 650. Most are designed to be connected end to end for ease of extension. Generally, it is recommended that the total length not exceed 100 feet (30.5 m). The use of non-standard cables, especially in lengths greater than 25 feet, can lead to communication problems (system shutdowns), poor motor acceleration (poor arc starting) and low wire driving force (wire feeding problems). Always use the shortest length of control cable possible and DO NOT coil excess cable.

Regarding cable placement, best results will be obtained when control cables are routed separate from the weld cables. This minimizes the possibility of interference between the high currents flowing through the weld cables and the low level signals in the control cables.

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Return to Master TOC

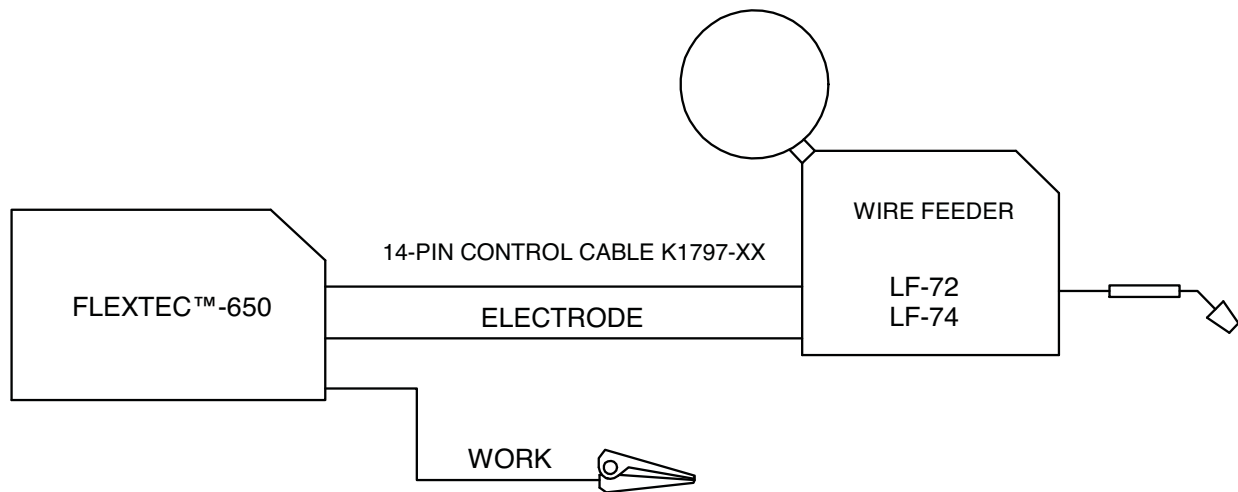
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FLEXTEC™ 650



CONNECTING LF-72 AND LF-74 TO THE FLEXTEC™ 650

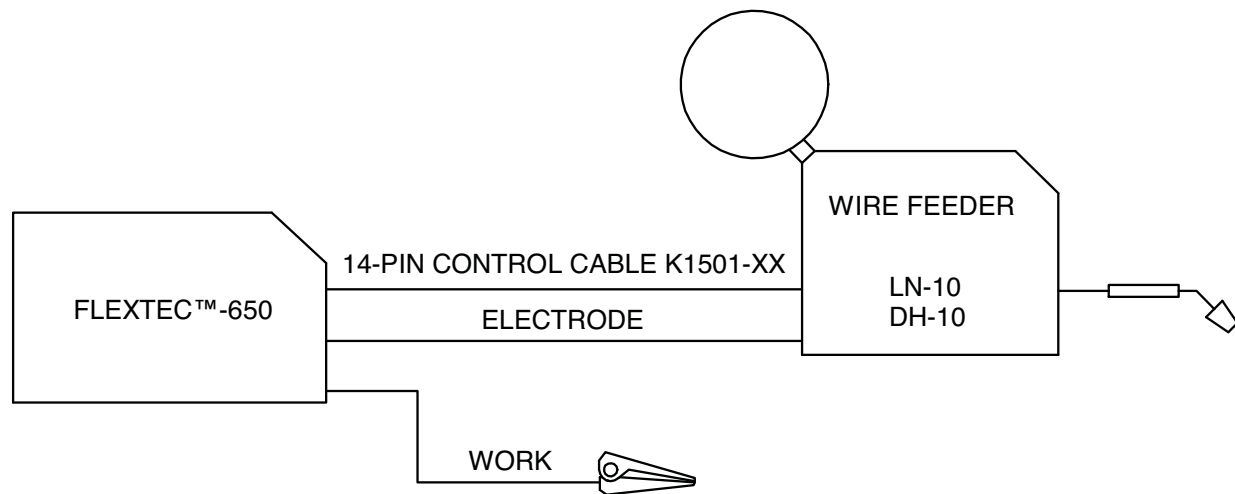


CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	OFF
REMOTE/LOCAL	LOCAL
	(REMOTE IF K2329-1 INSTALLED)
VOLTMETER POLARITY	PROCESS DEPENDENT

FLEXTEC™ 650



CONNECTING LN-10 AND DH-10 TO THE FLEXTEC™ 650



CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	OFF
REMOTE/LOCAL	REMOTE
VOLTMETER POLARITY	PROCESS DEPENDENT

LN-10, DH-10 CONTROL SWITCH SETUP

Initial set up of the LN-10, DH-10 control for the system components being used and for general operator preferences is done using a pair of 8-pole DIP switches located inside the LN-10, DH-10 control box.

SETUP DIP SWITCH ACCESS

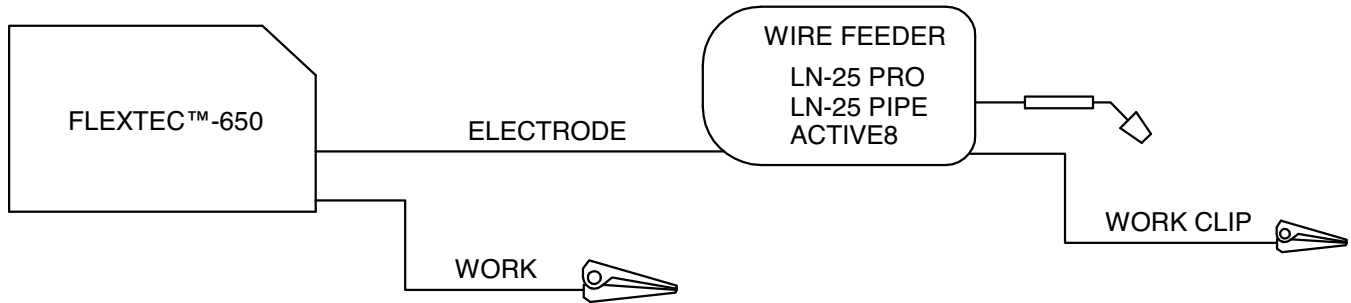
1. Shut off the input power to the LN-10, DH-10 control by turning off the power at the welding power source it is connected to.
2. Remove the two screws on the top of the LN-10, DH-10 control box door and swing the door down to open.
3. Locate the two 8-pole DIP switches, near the top left corner of the LN-10, DH-10 Control P.C. board, labeled S1 and S2.
4. Switch settings are only programmed during input power-up restoration.

SETTING THE DIP SWITCHES

The DIP switches are each labeled with an “ON” arrow showing the on direction for each of the 8 individual switches in each DIP switch (S1 and S2). The functions of these switches are also labeled and set as described below:

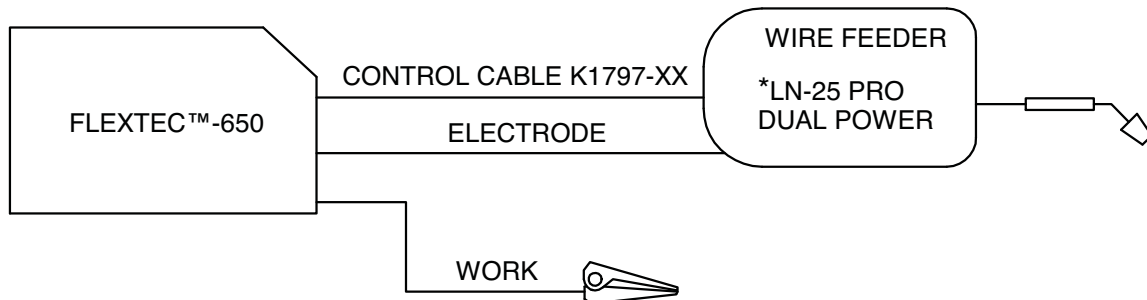


CONNECTING LN-25 PRO, LN-25 PIPE, ACTIVE8 TO THE FLEXTEC™ 650



CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	ON
REMOTE/LOCAL	LOCAL
VOLTMETER POLARITY	PROCESS DEPENDENT

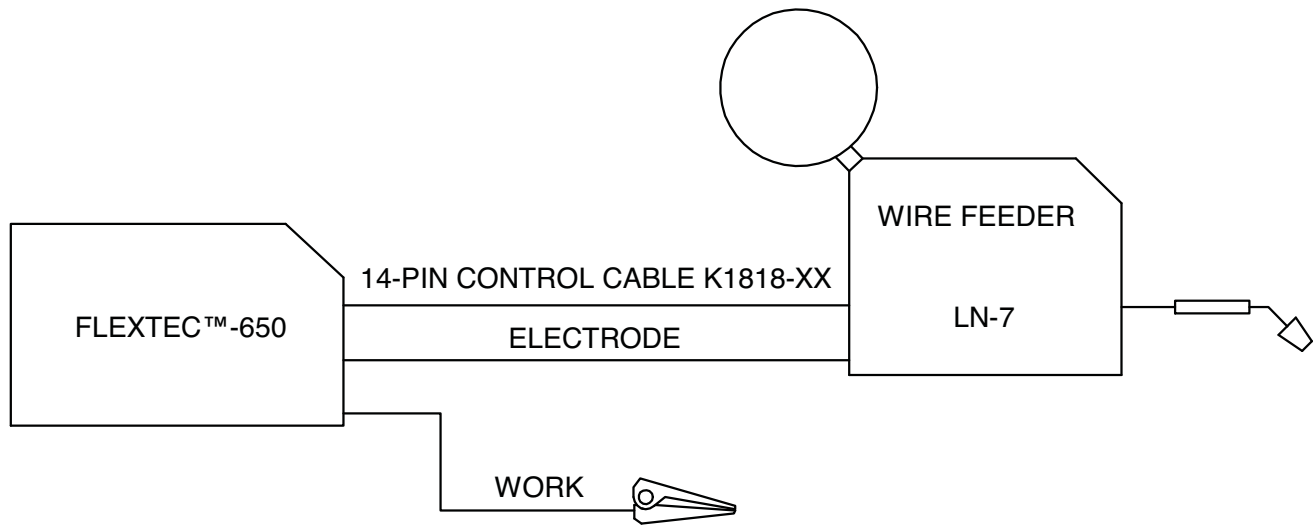
CONNECTING LN-25 PRO DUAL POWER TO THE FLEXTEC™ 650



CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	OFF
REMOTE/LOCAL	REMOTE
VOLTMETER POLARITY	PROCESS DEPENDENT

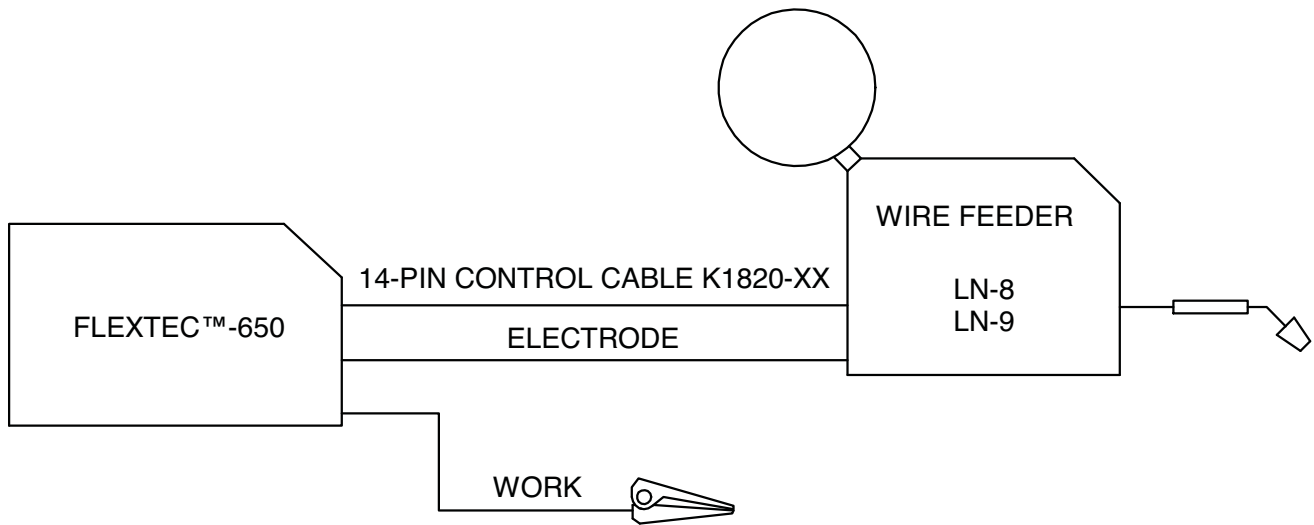
*CONTROL CABLE SETUP SHOWN. REFER TO LN-25 PRO CONNECTION DIAGRAM IF SETTING UP "ACROSS-THE-ARC" FEEDER.

CONNECTING LN-7 TO THE FLEXTEC™ 650



CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	OFF
REMOTE/LOCAL	LOCAL
VOLTMETER POLARITY	PROCESS DEPENDENT

CONNECTING LN-8 AND LN-9 TO THE FLEXTEC™ 650



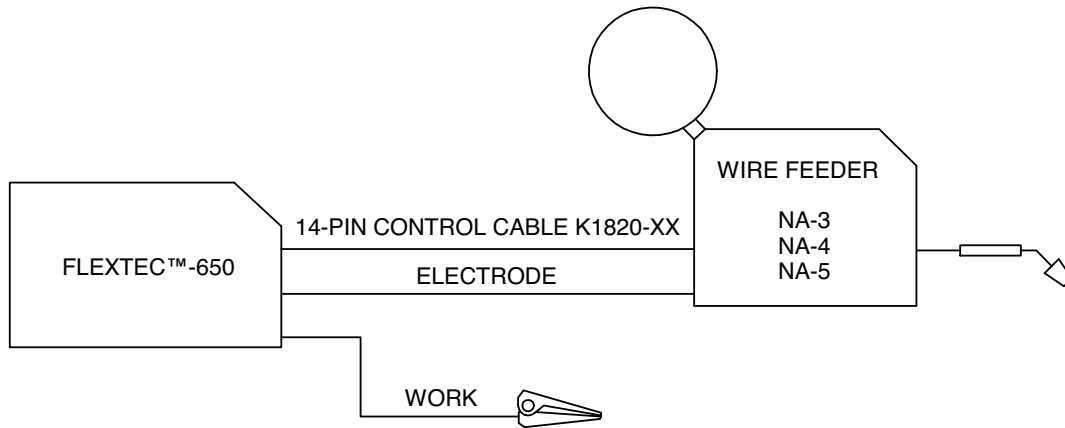
CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	OFF
REMOTE/LOCAL	REMOTE
VOLTMETER POLARITY	PROCESS DEPENDENT

FLEXTEC™ 650



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CONNECTING NA-3, NA-4, NA-5 TO THE FLEXTEC™ 650

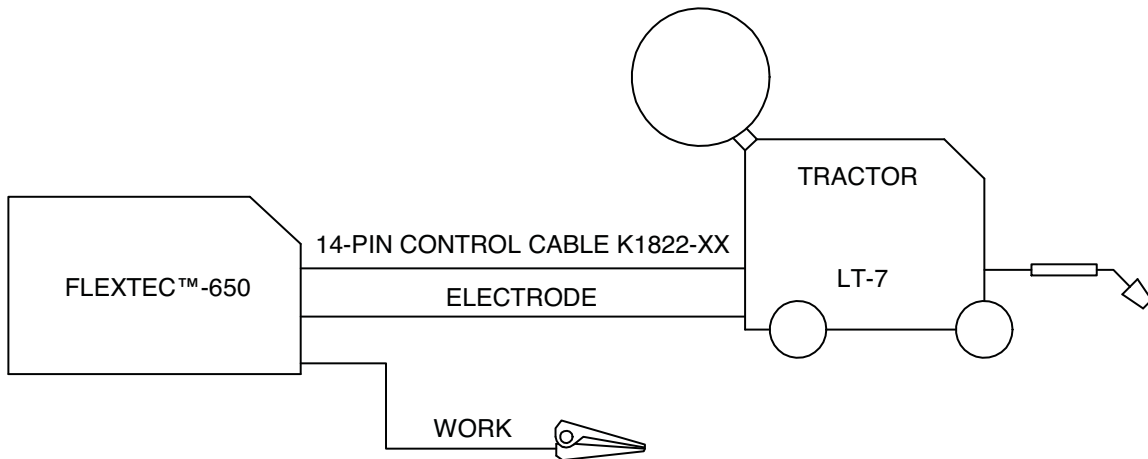


FOR NA-3, NA-4 WIRE FEEDERS ONLY:
 - MOVE JUMPER LEAD ON VARIABLE VOLTAGE BOARD TO "L" PIN.

FOR NA-5 WIRE FEEDER ONLY:
 - MOVE "BLUE" JUMPER LEAD ON VOLTAGE BOARD TO "AUTO" TERMINAL.

CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	ON
REMOTE/LOCAL	LOCAL
VOLTMETER POLARITY	PROCESS DEPENDENT

CONNECTING LT-7 TO THE FLEXTEC™ 650



CONTROL SETTING	
WELD MODE	CV, CV-INNERSHIELD
WELD TERMINALS	OFF
REMOTE/LOCAL	REMOTE
VOLTMETER POLARITY	PROCESS DEPENDENT

FLEXTEC™ 650



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FLEXTEC™ 650



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Return to Master TOC

SAFETY PRECAUTIONS

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

WARNING



ELECTRIC SHOCK can kill.

- Unless using cold feed feature, when feeding with gun trigger, the electrode and drive mechanism are always electrically energized and could remain energized several seconds after the welding ceases.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.



FUMES AND GASES can be dangerous.

- Keep your head out of fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.



WELDING SPARKS can cause fire or explosion.

- Keep flammable material away.
- Do not weld on containers that have held combustibles.



ARC RAYS can burn.

- Wear eye, ear and body protection.

Observe additional guidelines detailed in the beginning of this manual.

GRAPHIC SYMBOLS THAT APPEAR ON THIS MACHINE OR IN THIS MANUAL



INPUT POWER



ON



OFF



HIGH TEMPERATURE



CIRCUIT BREAKER



WIRE FEEDER



POSITIVE OUTPUT



NEGATIVE OUTPUT



3 PHASE INVERTER



INPUT POWER



THREE PHASE



DIRECT CURRENT

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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

GRAPHIC SYMBOLS THAT APPEAR ON THIS MACHINE OR IN THIS MANUAL

U_r **REDUCED OPEN
CIRCUIT VOLTAGE**

U_0 **OPEN CIRCUIT
VOLTAGE**

U_1 **INPUT VOLTAGE**

U_2 **OUTPUT VOLTAGE**

I_1 **INPUT CURRENT**

I_2 **OUTPUT CURRENT**



**PROTECTIVE
GROUND**



WARNING or CAUTION



Explosion



Dangerous Voltage



Shock Hazard

PRODUCT DESCRIPTION

The FLEXTEC™ 650 is a multi-process CC/CV DC inverter and is rated for 650 amps, 44 volts at a 100% duty cycle. The FLEXTEC™ 650 is intended for both factory and field operation. It comes in a compact, rugged case that is designed for portability and outdoor use with an IP23 environmental rating. The user interface of the FLEXTEC™ 650 is simple and intuitive. Weld modes are selected via a 5 position selector switch. Volts and Amps are displayed on an easy to view LED display and the amps and volts are set via a large output control knob. A hot start and an arc control knob allow for finer tuning of the welding arc for the application.

The FLEXTEC™ 650 is designed for the North America and export markets and operates on 3 phase 380V, 460V or 575V 50hz or 60hz power.

DUTY CYCLE

The FLEXTEC™ 650 is capable of welding at a 100% duty cycle (continuous welding) at 650 amps rated output. The 60% duty cycle rating is 750 amps (based off of a ten minute cycle – 6 minutes on time and 4 minutes off time). The maximum output of the machine is 815 amps.

The FLEXTEC™ 650 is also rated for Desert Duty, elevated temperature operation, in a 55°C ambient. The machine is de-rated for this application. (See Table in the Installation Section.

DESIGN FEATURES

- Severe Duty Design for outdoor use (IP23 rating)
- Passive Power Factor Correction – reliably gives 88% power factor for lower installation costs.
- 91% Efficiency rating – reduces electrical utility costs.
- Simple user interface - user interface is designed with the operator in mind. Getting setup for the weld is several clicks away and even the most novice welder can be confident he is setup properly.
- F.A.N. (fan as needed). Cooling fan runs when the output is energized and for a 5 minute cool down period after output is disabled
- Thermal protection by thermostats with Thermal Indicator LED.
- Reversible handles for ease of lifting and transporting
- Multiple options for lifting / transporting: Reversible handles; eyelet lifting bolts; and single forklift fork access
- Error Codes display on LED screen for ease of trouble shooting
- Electronic over current protection.
- Input voltage mis-connection protection.
- Utilizes digital signal processing and microprocessor control.
- VRD™ (Voltage Reduction Device)- Enable this function for reduced OCV in CC modes for added safety.

RECOMMENDED PROCESSES AND EQUIPMENT

RECOMMENDED PROCESSES

The FLEXTEC™ 650 is designed for CC-SMAW, CC-GTAW (lift tig), CV-GMAW, CV-FCAW-SS, CV-FCAW-GS and CV-SAW welding processes. CAG (arc gouging) is also supported.

PROCESS LIMITATIONS

The FLEXTEC™ 650 is suitable only for the processes listed.

NOTE: When used with K3091-1 Multi-Process Switch, the output is limited to 600A / 100% and 700A / 60%.

EQUIPMENT LIMITATIONS

Operating Temperature Range is -10° C to + 55° C.

Output De-rated at Temperatures above 40°C.

COMMON EQUIPMENT PACKAGES

Basic Package	
K3060-1	FLEXTEC™ 650
K2327-5	LF-72 Bench Model
K2149-1	Work Cable
3100211	Harris Regulator and gas hose

Common Optional Kits	
K857	Remote Output Control (25 feet)
K857-1	Remote Output Control (100 feet)
K870	Foot Amptrol
K963-3	Hand Amptrol
K3091-1	Multi-Process Switch

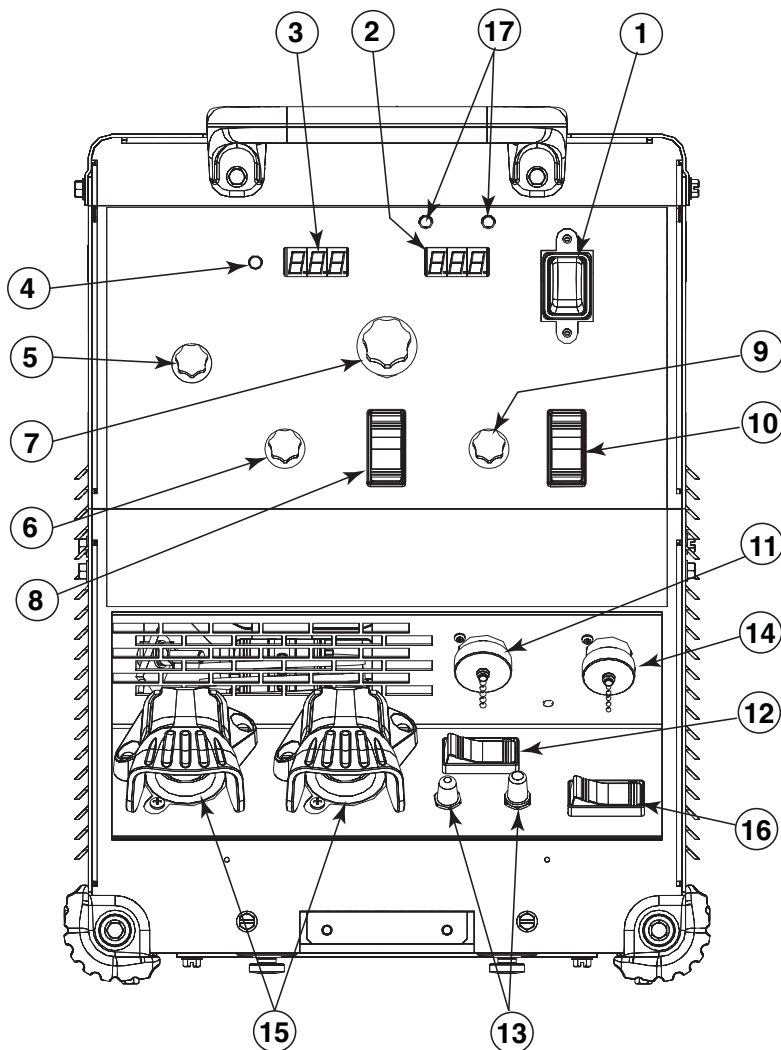
Compatible Wire Feeders	
All Models	LF-72
	LF-74
	LN-10
	DH-10
	LN-25 Pro
	LT-7 Tractor
	LN-8
	LN-9
	NA SERIES

CASE FRONT CONTROL DESCRIPTIONS

(See Figure B.1)

1. **Power Switch:** Controls input power to the FLEXTEC™ 650.
2. **Voltage Display Meter**
3. **Amperage Display Meter**
4. **Thermal LED:** A yellow light that comes on when an over temperature situation occurs. Output is disabled until the machine cools down. When cool, the light goes out and output is enabled.
5. **Weld Process Selector Switch:** A rotary switch that toggles through the five available weld modes for the FLEXTEC™ 650 – CC-SMAW; CC-GTAW; CV; CV-Innershield; CV-SAW.
6. **Hot Start Control Dial**
7. **Output Control Dial:** Sets the output current or voltage for the selected weld process.
8. **Local/Remote Selector Toggle Switch:** Sets the control of the output to local (output control knob) or remote (K857 hand amptrol or K870 foot amptrol).
9. **Arc Force Control Dial**
10. **Weld Terminals On/Remote Selector Switch.**
11. **14 Pin Wire Feeder Circular Connector.**
12. **115V or 42V Wire Feeder Selector Switch.**
13. **Circuit Breaker Reset Buttons** for the 14 pin wire feeder connector.
14. **6 Pin Remote Circular Connector.**
15. **Positive and Negative Welding Output Studs.**
16. **Wire Feeder Voltmeter Polarity Selection Switch.**
17. **VRD™ (Voltage Reduction Device) Indicator Lights.**

FIGURE B.1



FLEXTEC™ 650

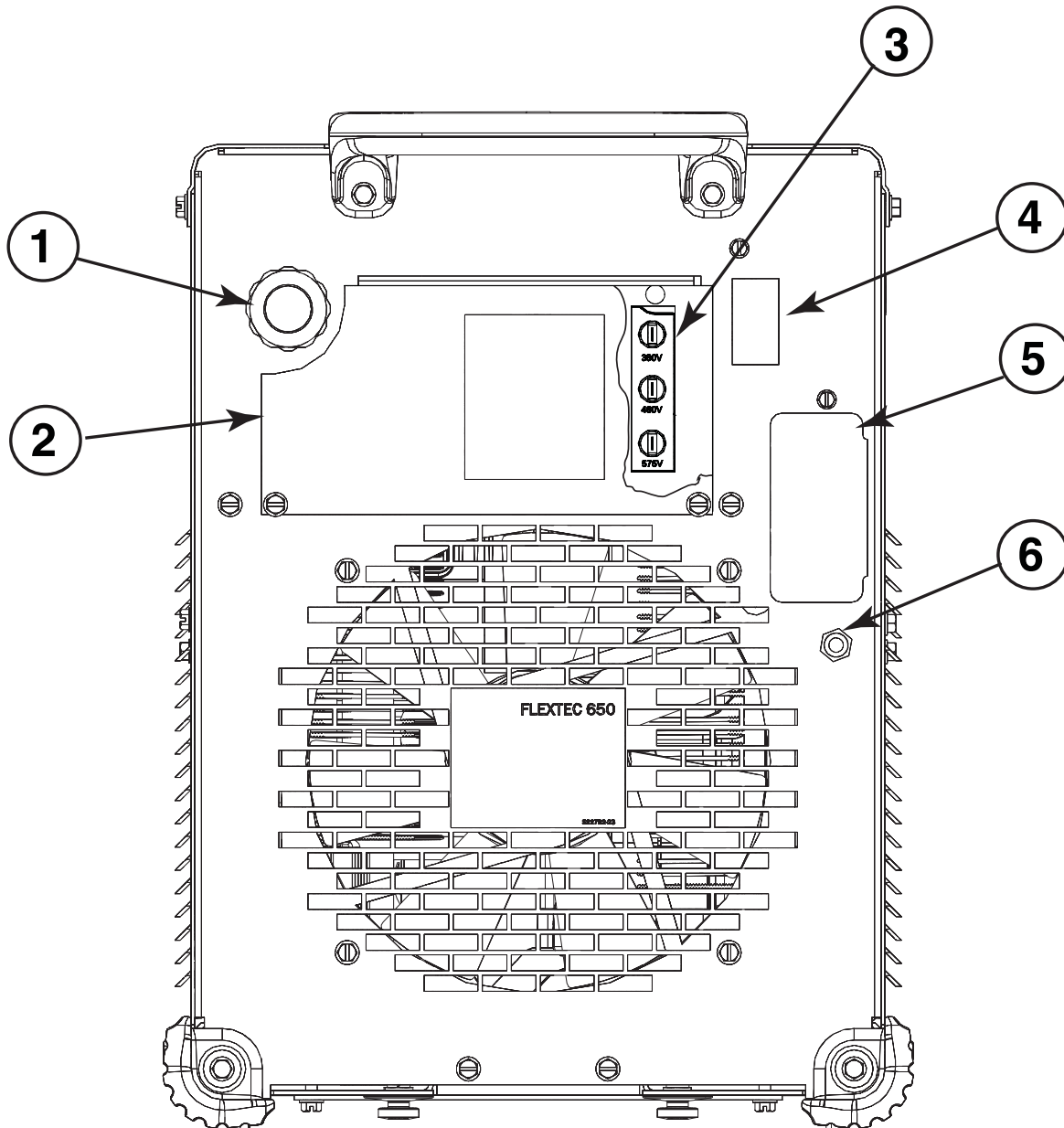
LINCOLN
ELECTRIC

CASE BACK CONTROLS

(See Figure B.2)

1. **Input Power Cord Access Hole.**
2. **Access Panel** – Allows access for connecting input power and configuring the machine.
3. **Input Power Reconnect** – Configures the machine for the input supply voltage.
4. **OPTION** – GFCI protection for the 115V auxiliary output.
5. **115 Volt, 15 Amp Auxiliary Output Duplex With Protective Environmental Cover.**
6. **15 Amp Circuit Breaker** for the 115V auxiliary power.

FIGURE B.2



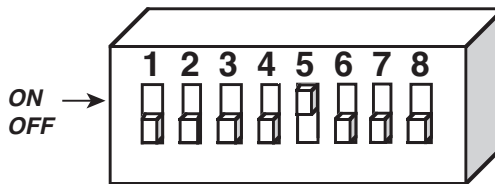
FLEXTEC™ 650

LINCOLN®
ELECTRIC

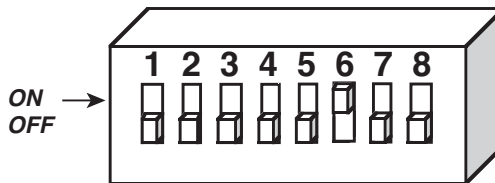
INTERNAL CONTROLS - ENABLING VRD™

To Enter VRD™ Mode (VRD™ Enabled)

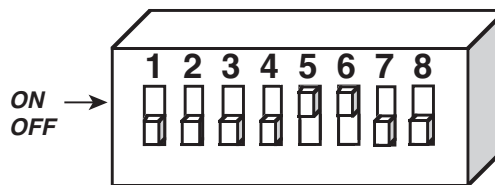
- a. For 380V input: Switch #5 in the "ON" Position.



- b. For 460V input: Switch #6 in the "ON" Position.



- c. For 575V input: Switch #5 and #6 in the "ON" Position



INTERNAL CONTROLS DESCRIPTION

The Control PC Board has one bank of Dip Switches. As shipped from the factory VRD™ mode is disabled and the Dip Switches are all in the "off" position.

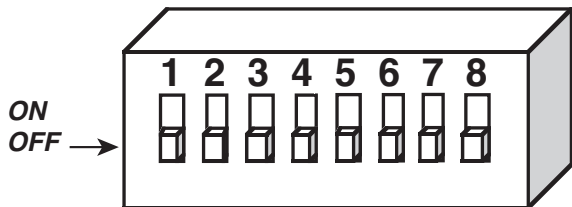
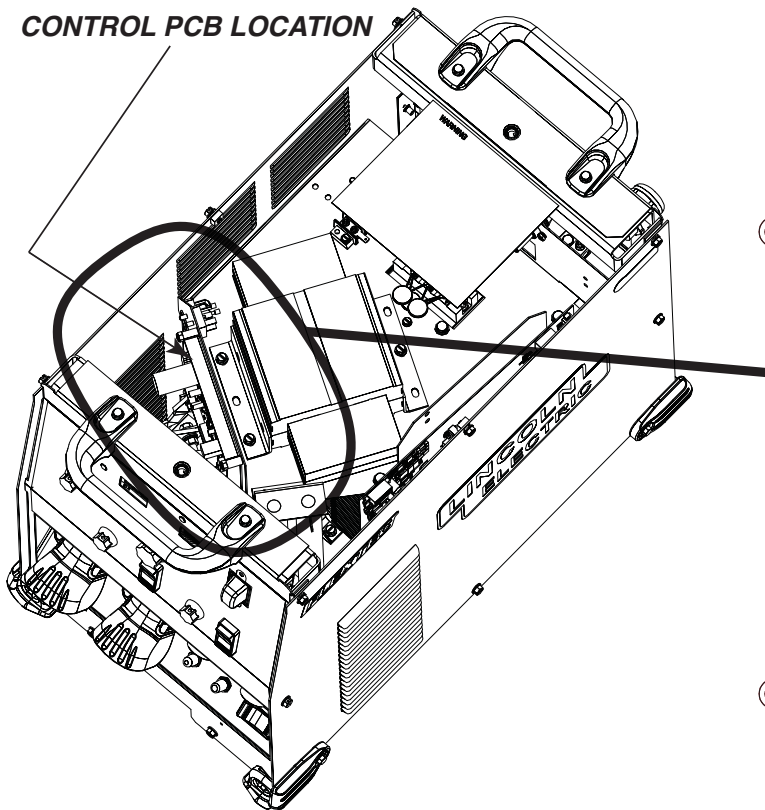
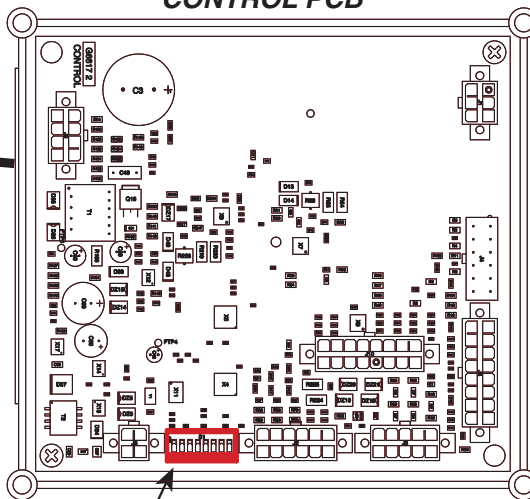


FIGURE B.3

CONTROL PCB LOCATION



CONTROL PCB



DIP SWITCH LOCATION

POWER-UP SEQUENCE

When power is applied to the FLEXTEC™ 650, the displays will illuminate and display the voltage and/or amperage settings.

COMMON WELDING PROCEDURES

MAKING A WELD

WARNING

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

The FLEXTEC™ 650 is a multi-process inverter welder. The Weld Process Selector Switch is used to set the desired weld mode. The FLEXTEC™ 650 has 5 selectable welding modes:

1. **SMAW** – This is a CC (constant current) weld mode used for the SMAW stick welding process.
2. **GTAW** – This is a CC (constant current) weld mode used for the GTAW tig welding process.
3. **CV** – This is CV (constant voltage) weld mode used for welding the GMAW mig welding process and the FCAW-GS flux cored gas shielded welding process.
4. **CV-Innershield** – This is a CV (constant voltage) weld mode used for welding the FCAW-SS, flux cored self shielded welding process.
5. **CV-SAW** – This is a CV (constant voltage) weld mode used for welding the SAW submerged arc welding process

The FLEXTEC™ 650 is also capable of gouging. Gouging can be done in either the SMAW mode or the CV and CV-Innershield modes.

In addition to the weld process selector switch, a hot start control dial, output control dial and arc control dial are provided to setup and fine tune the welding procedure.

WELD CONTROLS AND DISPLAYS

WELD PROCESS SELECTOR SWITCH

5 Position switch used to select the welding process.

HOT START CONTROL DIAL

- The Hot Start control regulates the starting current at arc initiation. Hot Start can be set to "0" and no additional current is added at arc start. Increasing from 0 to 10 will increase the additional current (relative to the preset current) that is added at arc initiation.

ARC CONTROL DIAL

- Full range selection of arc control from -10 to +10. In CV mode, this control is an inductance control. In stick mode, the control adjusts the arc force.

OUTPUT CONTROL DIAL

- Output control is conducted via a single turn potentiometer.
- Adjustment is indicated by the meters.
- When in REMOTE modes, this control sets the maximum welding current. Full depression of a foot or hand amptrol results in the preset level of current.

VOLTAGE DISPLAY METER

- Prior to CV operation (current flow), the meter displays desired preset voltage value (+/- .5V).
- Prior to STICK or TIG operation, the meter displays the Open Circuit Voltage of the Power Source or three dashes if the output has not been turned on.
- During welding, this meter displays actual average volts.
- After welding, the meter holds the actual voltage value for 5 seconds. The displays blink indicating that the machine is in the "Hold" period.
- Output adjustment while in the "Hold" period results in the "prior to operation" characteristics.

AMPERAGE DISPLAY METER

- Prior to STICK or TIG operation (current flow), the meter displays preset current value (either 2 amps or +/- 3% (e.g. 3 amps on 100), whichever is greater).
- Prior to CV operation, the meter displays three dashes indicating non-presetable AMPS.
- During welding, this meter displays actual average amps.
- After welding, the meter holds the actual current value for 5 seconds. The displays blink indicating that the machine is in the "Hold" period.
- Output adjustment while in the "Hold" period results in the "prior to operation" characteristics.

WELD TERMINALS ON/REMOTE TOGGLE SWITCH

- This switch determines the trigger location.
- When set to the “ON” position, the weld terminals are at OCV (open circuit voltage) and ready to weld.
- When set to the “remote” position, output is enabled through a remote trigger.

CONTROL - LOCAL/REMOTE TOGGLE SWITCH

- Set the switch to “local” to control output at the FLEXTEC™ 650 via the Output Control dial.
- Set the switch to “remote” to control output via a remote device (K857 hand ampctrl or K870 foot ampctrl) connected to the 6-pin remote connector or a wire feeder connected to the 14-pin connector.

WIRE FEEDER SELECTOR SWITCH

- This switch configures wire feeder supply voltage in the 14 pin connector to either 42 volt or 115 volt.
- If the switch is in the incorrect position for the attached wire feeder, there will be no power supplied to the wire feeder.

WIRE FEEDER VOLTMETER POLARITY SWITCH

- The switch provides a work connection for wire feeder voltmeters. Place the switch in the position of the electrode polarity indicated by the decal. The switch does not change the welding polarity.

THERMAL LIGHT

- This status light indicates when the power source has been driven into thermal overload. If the output terminals were "ON", the output will be turned back on once the unit cools down to an acceptable temperature level. If the unit was operating in the "REMOTE" mode, the trigger will need to be opened before or after the thermal has cleared and closed after the machine has cooled down to an acceptable temperature to establish output.

VRD™ (VOLTAGE REDUCTION DEVICE) INDICATOR LIGHT

There are 2 indicator lights on the case front of the FLEXTEC™ 650 above the Voltage LED Display to indicate the status of VRD™ operation. As shipped, the VRD™ function is disabled. VRD™ is enabled by setting dip switches on the Control P.C. board (See Internal Controls **Figure B.3** in this Operation Section). When VRD™ is active:

- A green light indicates the OCV (open circuit voltage) is less than 35V peak.
- A red light indicates the OCV is at or above 35V peak.
- Both lights will illuminate for 5 seconds at power up.

For each weld mode, the VRD™ lights function as shown in Table B.1:

TABLE B.1 – VRD™ INDICATOR LIGHTS

MODE		VRD™ “ON”	VRD™ “OFF”
CC-SMAW CC-GTAW	OCV	Green (OCV reduced)	No lights are active
	While Welding	Green or Red (depends on wold voltage)*	
CV-GAS CV-INNERSHIELD CV-SAW	OCV	Red (OCV Not Reduced) Weld Terminals “ON”	
		Red (OCV Not Reduced) Weld Terminals Remotely Controlled Gun Trigger Closed	
		Green (No OCV) Weld Terminals Remotely Controlled Gun Trigger Open	
While Welding	Green or Red (depends on wold voltage)*		

* It is normal for the lights to alternate between colors while welding.

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BASIC MODES OF OPERATION

SMAW

This weld mode is a constant current (CC) mode featuring continuous control from 15 – 815 amps. It is intended for the SMAW stick welding processes and arc gouging.

Hot Start - The Hot Start control regulates the starting current at arc initiation. Hot Start can be set to “0” and no additional current is added at arc start. Increasing from 0 to 10 will increase the additional current (relative to the preset current) that is added at arc initiation.

Arc Control - The Arc Control regulates the Arc Force to adjust the short circuit current. The minimum setting (-10) will produce a "soft" arc and will produce minimal spatter. The maximum setting (+10) will produce a "crisp" arc and will minimize electrode sticking.

Weld Terminals On/Remote – Set to “On” and the machine is in the ready to weld state.

Voltage Display Meter – This display will display three dashed lines when the machine is in the idle state. This indicates that voltage is not settable in this weld mode. While output is enabled, the actual welding voltage will be displayed. After welding, the meter holds the actual voltage value for 5 seconds. Output adjustment while in the "hold" period results in the "prior to operation" characteristics stated above. The displays blink indicating that the machine is in the "hold" period.

GTAW

This weld mode is a constant current (CC) mode featuring continuous control from 10 – 815 amps. It is intended for the GTAW tig welding processes.

Hot Start - Hot start regulates the arc initiation current. A setting of +10 results in the most positive arc initiation.

Arc Control – This control is not used in the GTAW mode.

Weld Terminals On/Remote

- When set to the “ON” position, the weld terminals are at OCV (open circuit voltage) and ready to weld.
- When set to the “remote” position, output is enabled through a remote trigger.

Voltage Display Meter – This display will display three dashed lines when the machine is in the idle state.

This indicates that voltage is not settable in this weld mode. While output is enabled, the actual welding voltage will be displayed. After welding, the meter holds the actual voltage value for 5 seconds. Output adjustment while in the "hold" period results in the "prior to operation" characteristics stated above. The displays blink indicating that the machine is in the "hold" period.

Amperage Display Meter – This display will display the pre-set welding current when the machine is in the idle state. After welding, the meter holds the actual amperage value for 5 seconds. Output adjustment while in the "hold" period results in the "prior to operation" characteristics stated above. The displays blink indicating that the machine is in the "hold" period.

Output Control Local/Remote – When the control is set to “local” (no remote potentiometer/control plugged into the 6 pin or 14 pin connectors), the output is controlled through the Output Control Dial on the front of the FLEXTEC™ 650. Set this switch to “Remote” when an external potentiometer/control is connected.

- When a remote potentiometer is connected, the output control on the FLEXTEC™ 650 and the remote act as a master/slave configuration. Use the control dial on the FLEXTEC™ 650 to set the maximum welding current. The remote will control output from minimum to the pre-set maximum.

Output Control Dial

- When the Local/Remote is set to “Local”, this dial sets the welding amperage.
- When the Local/Remote is set to “Remote”, this dial sets the maximum welding amperage. The remote potentiometer controls the amperage from minimum to this pre-set maximum.

CV-GAS

This weld mode is a constant voltage (CV) mode featuring continuous control from 10 to 45 volts. It is intended for the GMAW, FCAW-GS, MCAW welding processes and arc gouging.

Hot Start – Rotate from the “0” position to the “10” position to provide more energy during the start of a weld.

Arc Control – The Arc Control regulates pinch effect. At the minimum setting (-10), minimizes pinch and results in a soft arc. Low pinch settings are preferable for welding with gas mixes containing mostly inert gases. At the maximum setting (+10), maximizes pinch effect and results in a crisp arc. High pinch settings are preferable for welding FCAW and GMAW with CO².

Weld Terminals On/Remote

- When set to the “ON” position, the weld terminals are at OCV (open circuit voltage) and ready to weld. This selection is used for across the arc wire feeders.
- When set to the “remote” position, output is enabled through a remote trigger.

Amperage Display Meter – This display will display three dashed lines when the machine is in the idle state. This indicates that amperage is not settable in this weld mode. While output is enabled, the actual welding amperage will be displayed. After welding, the meter holds the actual amperage value for 5 seconds. Output adjustment while in the “hold” period results in the “prior to operation” characteristics stated above.

The displays blink indicating that the machine is in the “hold” period.

Voltage Display Meter – This display will display the pre-set welding voltage when the machine is in the idle state. After welding, the meter holds the actual voltage value for 5 seconds. Output adjustment while in the “hold” period results in the “prior to operation” characteristics stated above. The displays blink indicating that the machine is in the “hold” period.

Output Control Local/Remote – When the control is set to “local” (no remote potentiometer/control plugged into the 6 pin or 14 pin connectors), the output is controlled through the Output Control Dial on the front of the FLEXTEC™ 650. Set this switch to “Remote” when an external potentiometer/control is connected.

Output Control Dial

- When the Local/Remote is set to “Local”, this dial sets the welding voltage.
- When the Local/Remote is set to “Remote”, this dial is disabled.

CV-INNERSHIELD

This weld mode is a constant voltage (CV) mode featuring continuous control from 10 to 45 volts. It is intended for the FCAW-SS welding process and arc gouging.

Hot Start – Toggle from the “0” position to the “10” position to provide more energy during the start of a weld.

Arc Control – The Arc Control regulates pinch effect. At the minimum setting (-10), minimizes pinch and results in a soft arc. At the maximum setting (+10), maximizes pinch effect and results in a crisp arc.

Weld Terminals On/Remote

- When set to the “ON” position, the weld terminals are at OCV (open circuit voltage) and ready to weld. This selection is used for across the arc wire feeders.
- When set to the “remote” position, output is enabled through a remote trigger.

Amperage Display Meter – This display will display three dashed lines when the machine is in the idle state. This indicates that amperage is not settable in this weld mode. While output is enabled, the actual welding amperage will be displayed. After welding, the meter holds the actual amperage value for 5 seconds. Output adjustment while in the “hold” period results in the “prior to operation” characteristics stated above. The displays blink indicating that the machine is in the “hold” period.

Voltage Display Meter – This display will display the pre-set welding voltage when the machine is in the idle state. After welding, the meter holds the actual voltage value for 5 seconds. Output adjustment while in the “hold” period results in the “prior to operation” characteristics stated above. The displays blink indicating that the machine is in the “hold” period.

Output Control Local/Remote – When the control is set to “local” (no remote potentiometer/control plugged into the 6 pin or 14 pin connectors), the output is controlled through the Output Control Dial on the front of the FLEXTEC™ 650. Set this switch to “Remote” when an external potentiometer/control is connected.

Output Control Dial

- When the Local/Remote is set to “local”, this dial sets the welding voltage.
- When the Local/Remote is set to “Remote”, this dial is disabled.

CV-SAW

This weld mode is a constant voltage (CV) mode featuring continuous control from 10 to 45 volts. It is intended for the CV-SAW submerged arc welding process.

Hot Start – Not used for this welding process.

Arc Control – Not used for this welding process.

Weld Terminals On/Remote

- When set to the “ON” position, the weld terminals are at OCV (open circuit voltage) and ready to weld. This selection is used for across the arc wire feeders.
- When set to the “Remote” position, output is enabled through a remote trigger.

Amperage Display Meter – This display will display three dashed lines when the machine is in the idle state. This indicates that amperage is not settable in this weld mode. While output is enabled, the actual welding amperage will be displayed. After welding, the meter holds the actual amperage value for 5 seconds. Output adjustment while in the "hold" period results in the "prior to operation" characteristics stated above. The displays blink indicating that the machine is in the "hold" period.

Voltage Display Meter – This display will display the pre-set welding voltage when the machine is in the idle state. After welding, the meter holds the actual voltage value for 5 seconds. Output adjustment while in the "hold" period results in the "prior to operation" characteristics stated above. The displays blink indicating that the machine is in the "hold" period.

Output Control Local/Remote – When the control is set to “local” (no remote potentiometer/control plugged into the 6 pin or 14 pin connectors), the output is controlled through the Output Control Dial on the front of the FLEXTEC™ 650. Set this switch to “Remote” when an external potentiometer/control is connected.

Output Control Dial

- When the Local/Remote is set to “local”, this dial sets the welding voltage.
- When the Local/Remote is set to “Remote”, this dial is disabled.

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Options And AccessoriesC-2

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OPTIONS / ACCESSORIES

General Options

K2149-1 Work Lead Package.



K1842-10 10ft. Weld Power Cable (Lug to Lug).



K3091-1 Multi-Process Switch

Inverter and Wire Feeder Cart

Rear-wheeled cart with front casters and gas bottle platform. Convenient handles allow for easy cable storage. Small footprint fits through 30 in. (762 mm) door. Not intended for use with double head wire feeders.



Order K3059-1

Fume Extracting Systems



Accessory Kit For stick welding. Includes 35 ft. (10.7 m) 2/0 electrode cable with lug, 30 ft. (9.1 m) 2/0 work cable with lugs, headshield, filter plate, cover plate, work clamp and electrode holder. 400 amp capacity. **Order K704**



Remote Output Control

Consists of a control box with choice of two cable lengths. Permits remote adjustment of output.

Order K857 for 25 ft. (7.6 m)

Order K857-1 for 100 ft. (30 m)



TIG Options

Pro-Torch™ TIG Torches – PTA-9, PTA-17, PTA-26 – 2 piece power cord.



Foot Amptrol®

Provides 25 ft. (7.6 m) of remote current control for TIG welding. (6-pin plug connection).

Order K870



Hand Amptrol® - Provides 25 ft. (7.6 m) of remote current control for TIG welding. (6-pin plug connection).

Order K963-3



Arc Start Switch - May be used in place of the Foot or Hand Amptrol®. Comes with a 25 ft. (7.6m) cable. Attaches to the TIG torch for convenient finger control to start and stop the weld cycle at the current set on the machine.

Order K814



GFCI KIT - Order K3157-1

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SAFETY PRECAUTIONS

⚠ WARNING



ELECTRIC SHOCK can kill.

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

See additional warning information throughout this manual.

VISUAL INSPECTION

Clean interior of machine with a low pressure air stream. Make a thorough inspection of all components. Look for signs of overheating, broken leads or other obvious problems. Many problems can be uncovered with a good visual inspection.

ROUTINE MAINTENANCE

VRD™ Functionality should be checked once per day or once per shift. VRD™ functionality can be verified by the indicator lights on the front of the power source. One of the lights will be illuminated at all times when VRD™ is enabled. No lights will be illuminated when VRD™ is disabled. VRD™ can be verified by cycling power as well. When VRD™ is enabled, the VRD™ indicator lights will illuminate for 5 seconds at power up and one light will remain illuminated.

1. Every 6 months or so the machine should be cleaned with a low pressure airstream. Keeping the machine clean will result in cooler operation and higher reliability. Be sure to clean these areas:
 - All printed circuit boards
 - Power switch
 - Main transformer
 - Heatsink fins
 - Input rectifier
 - Auxiliary transformer
 - Reconnect switch area
 - Fan (blow air through the rear louvers)

2. Examine the sheet metal case for dents or breakage. Repair the case as required. Keep the case in good condition to insure that high voltage parts are protected and correct spacings are maintained. All external sheet metal screws must be in place to insure case strength and electrical ground continuity.

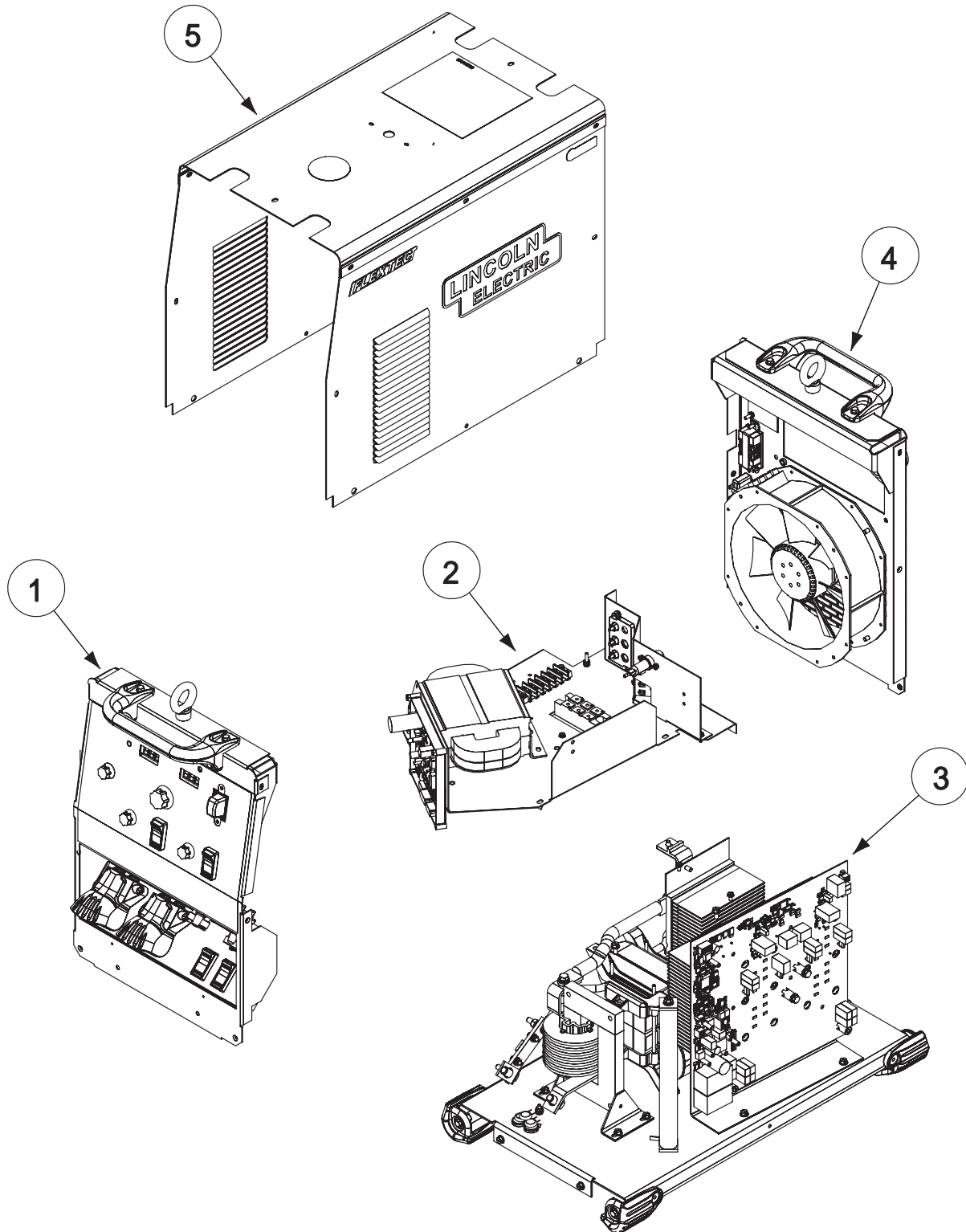
PERIODIC MAINTENANCE

THERMAL PROTECTION

Thermostats protect the machine from excessive operating temperatures. Excessive temperatures may be caused by a lack of cooling air or operating the machine beyond the duty cycle and output rating. If excessive operating temperature should occur, the thermostat will prevent output voltage or current. The meter will remain energized during this time. Thermostats are self-resetting once the machine cools sufficiently. If the thermostat shutdown was caused by excessive output or duty cycle and the fan is operating normally, the Power Switch may be left on and the reset should occur within a 15 minute period.

FIGURE D.1 – MAJOR COMPONENT LOCATIONS

1. Case Front Assembly
2. Divider Panel Assembly
3. Base Assembly
4. Case Back Assembly
5. Covers Assembly



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FLEXTEC™ 650



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Switch Board And Main Transformer E-4

Output Section E-5

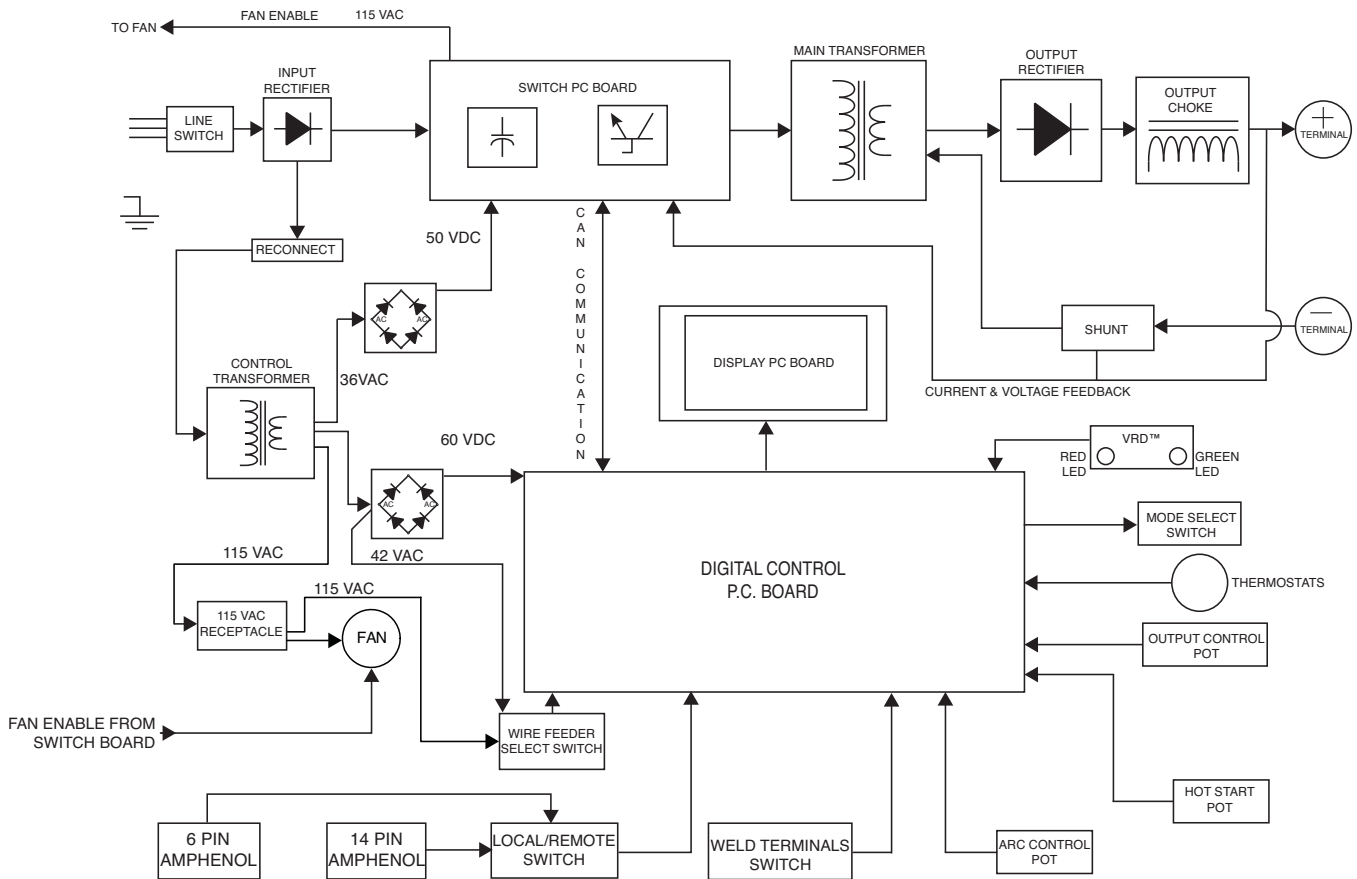
Control Board, User Interface Controls, Display Board And VRD™(Voltage Reduction Device) E-6

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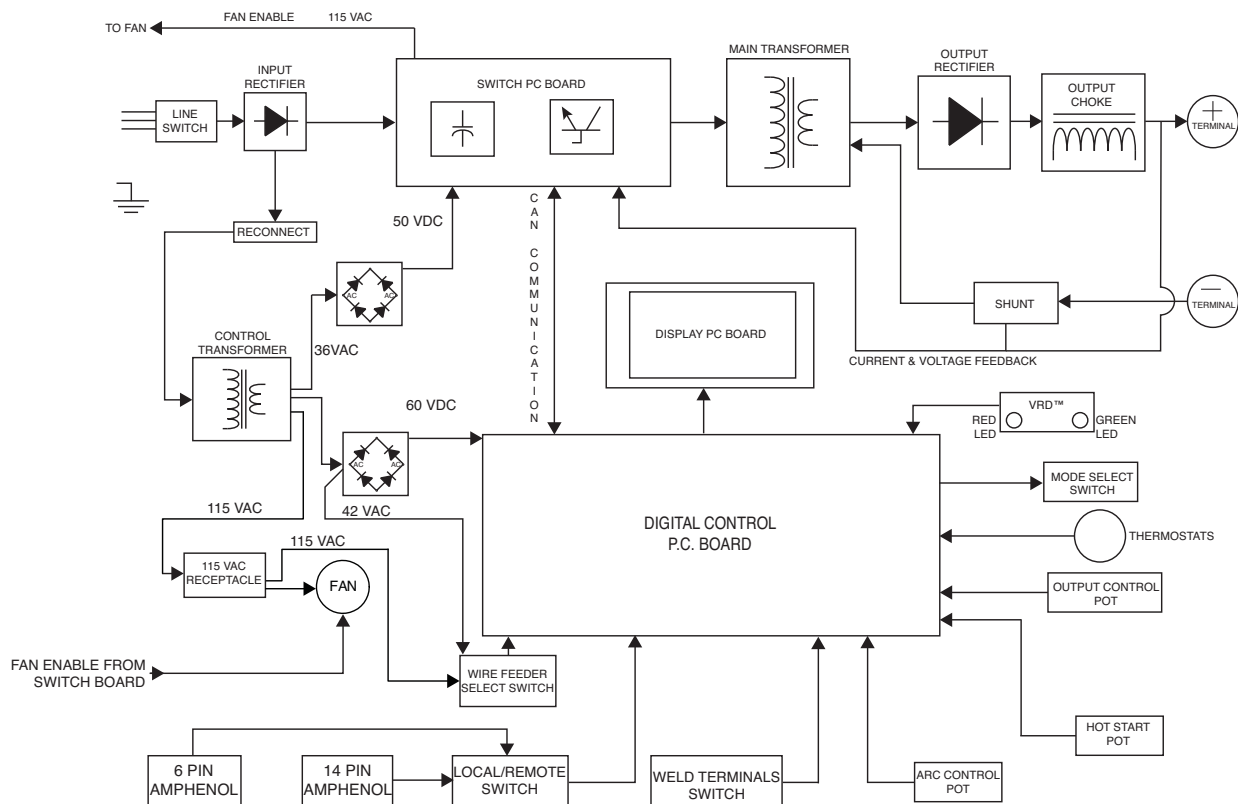
FIGURE E.1 BLOCK LOGIC DIAGRAM



FLEXTEC™ 650



FIGURE E.2 - GENERAL DESCRIPTION



GENERAL DESCRIPTION

The FLEXTEC™ 650 is a multi-process CC / CV DC inverter and is rated for 650 Amps, 44 Volts at a 100% duty cycle. The FLEXTEC™ 650 is intended for both factory and field operation. It carries an IP 23 environmental rating. The user interface of the FLEXTEC™ 650 is simple and intuitive. Weld modes are selected by a four position selector switch. Volts and amps are displayed on an easy to view LED display and the amps or volts are set by a large output control knob. A hot start toggle selector switch and an arc control knob allow for finer tuning of the welding arc for the application. The FLEXTEC™ 650 operates on 380, 460 or 575 volts, 50/60 Hz. Three phase only.

The FLEXTEC™ 650 has an output rating of 600 amps at 100% and is also rated for desert duty in elevated temperatures of 131°F (55°C) ambient, with a slight derating. The FLEXTEC™ 650 utilizes a passive Power Factor Correction which reliably gives 95% power factor and 86% efficiency.

There is also a simple user interface which makes setup quick and easy.

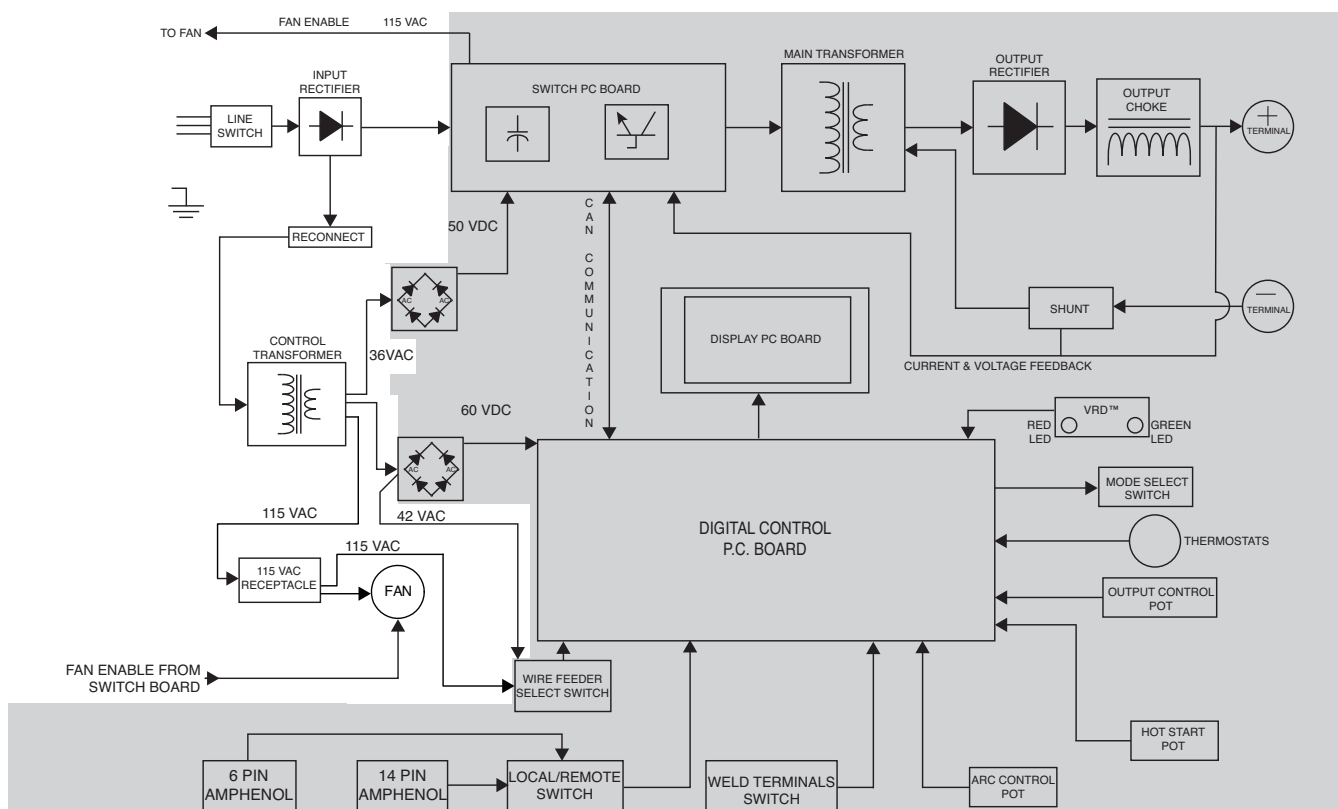
The FLEXTEC™ 650 has a 115VAC 15 amp receptacle for powering tool, fans, fume extraction equipment, etc. It also has VRD™ functionality reduced OCV for added safety.

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

FLEXTEC™ 650



FIGURE E.3 - INPUT SECTION



INPUT SECTION

When the correct three-phase input voltage is applied to the FLEXTEC™ 650, via the input line switch, this AC voltage is applied to the input rectifier and the auxiliary transformers.

The voltages generated from the auxiliary transformer supply the following:

- 36 VAC - Power supply for the switch P.C. board
- 42 VAC - Wire feeder power supply and control P.C. board
- 115 VAC - Wire feeder power supply, fan power supply, 115 VAC receptacle power supply.

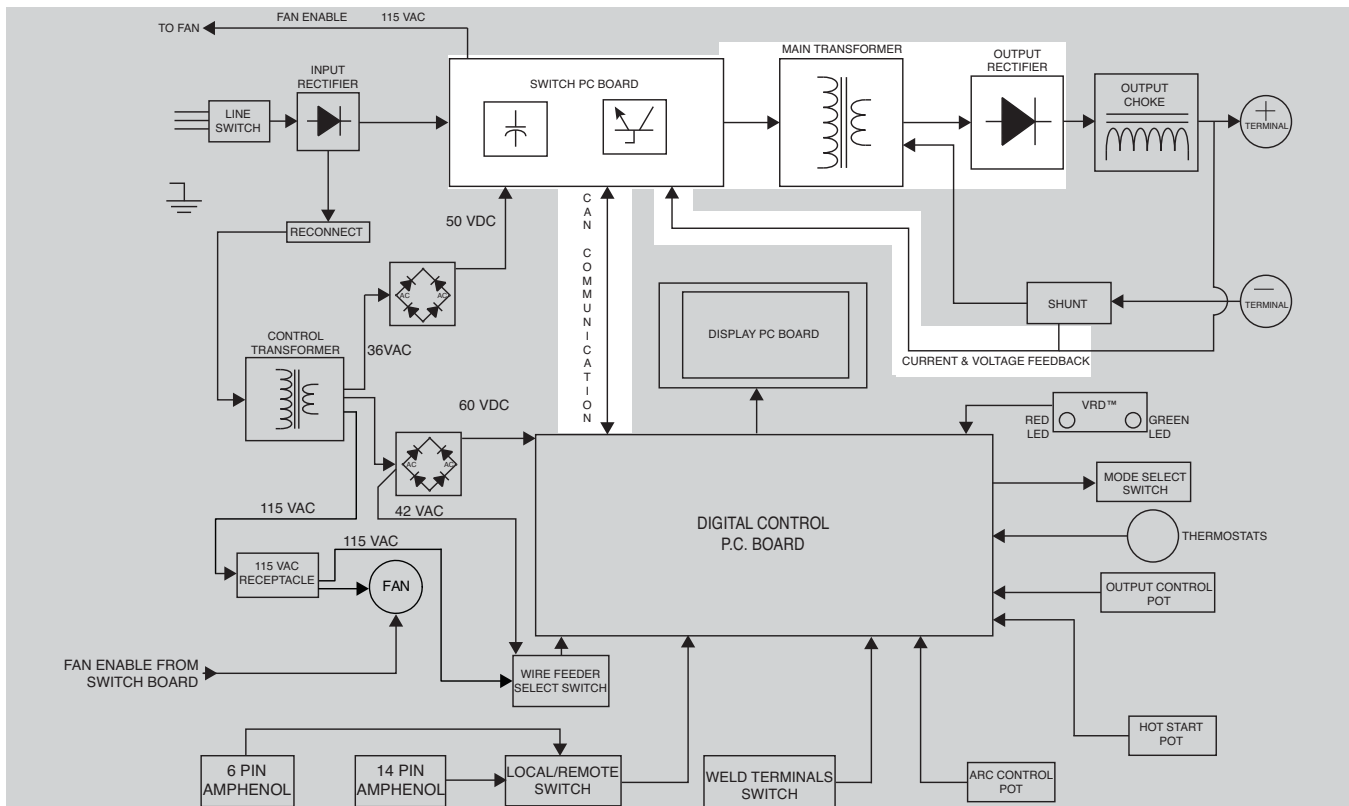
The input voltage is also applied to a three phase input rectifier and the rectified DC voltage is then passed to the switch board.

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

FLEXTEC™ 650



FIGURE E.4 - SWITCH BOARD AND MAIN TRANSFORMER



SWITCH BOARD AND MAIN TRANSFORMER

The main function of the switch board is to receive (from the input rectifier) and process rectified primary power conversion. The operating frequency is 20kHz. The circuitry is designed to function from a three-phase input voltage range from 380 VAC to 575 VAC. The switch board provides pulse width modulated power to the primary windings of the main welding transformer.

The switch board also creates power supplies for the CAN communications (Controller Area Network) and the circuitry on the switch board.

LED 1 indicates the 5VDC supply is functioning. LED 2 indicates CAN power is present. LED 3 indicates communication status information (normally green). LED 4 indicates that the internal DC supplies for the switch board circuitry are functional.

In addition the switch board monitors the voltage and current feedback and compares these to the CAN digital signals received from the control board.

The switch board then sends the appropriate pulse width modulated power to the main transformer.

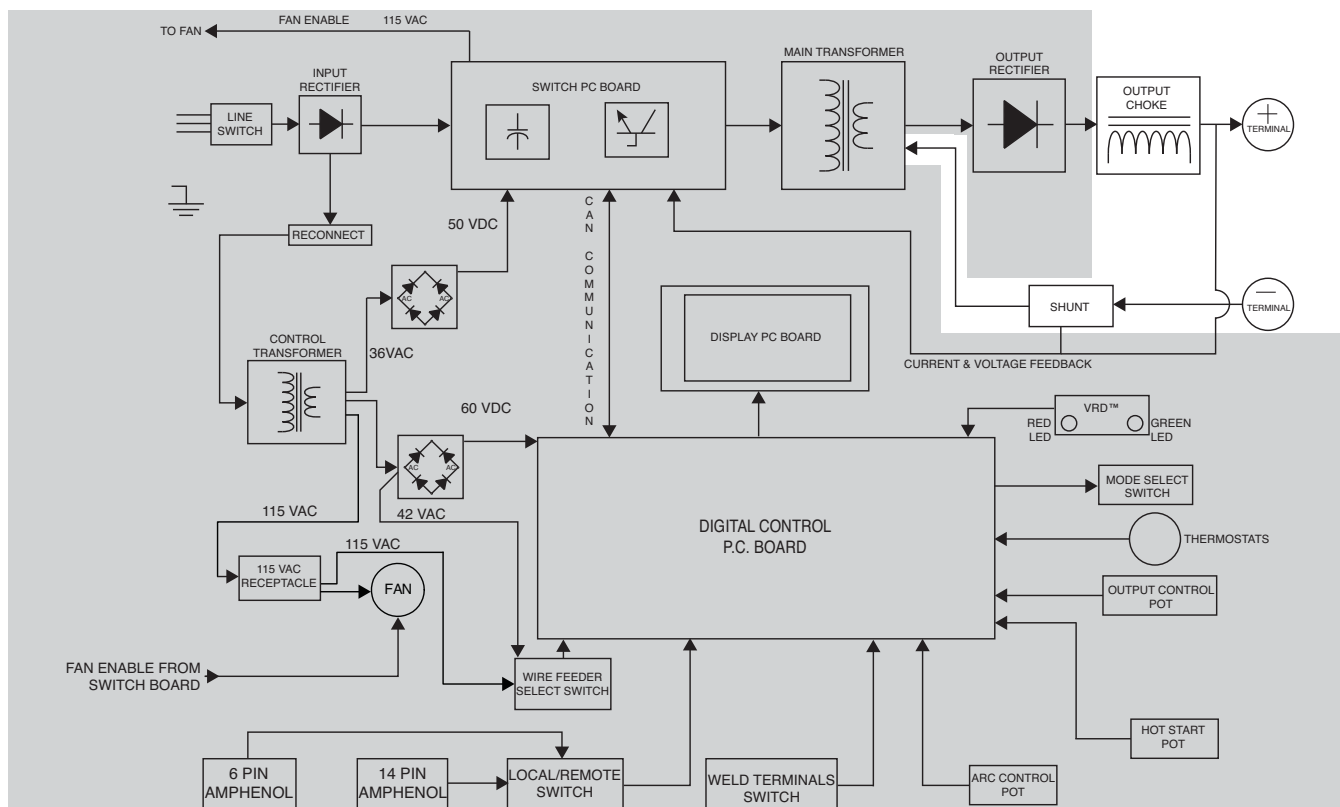
The main welding transformer's primary windings receive the pulse width modulated power from the switch board. The 20kHz AC output that is created on the secondary windings is applied to the output rectifier.

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

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FIGURE E.5 - OUTPUT SECTION



OUTPUT SECTION

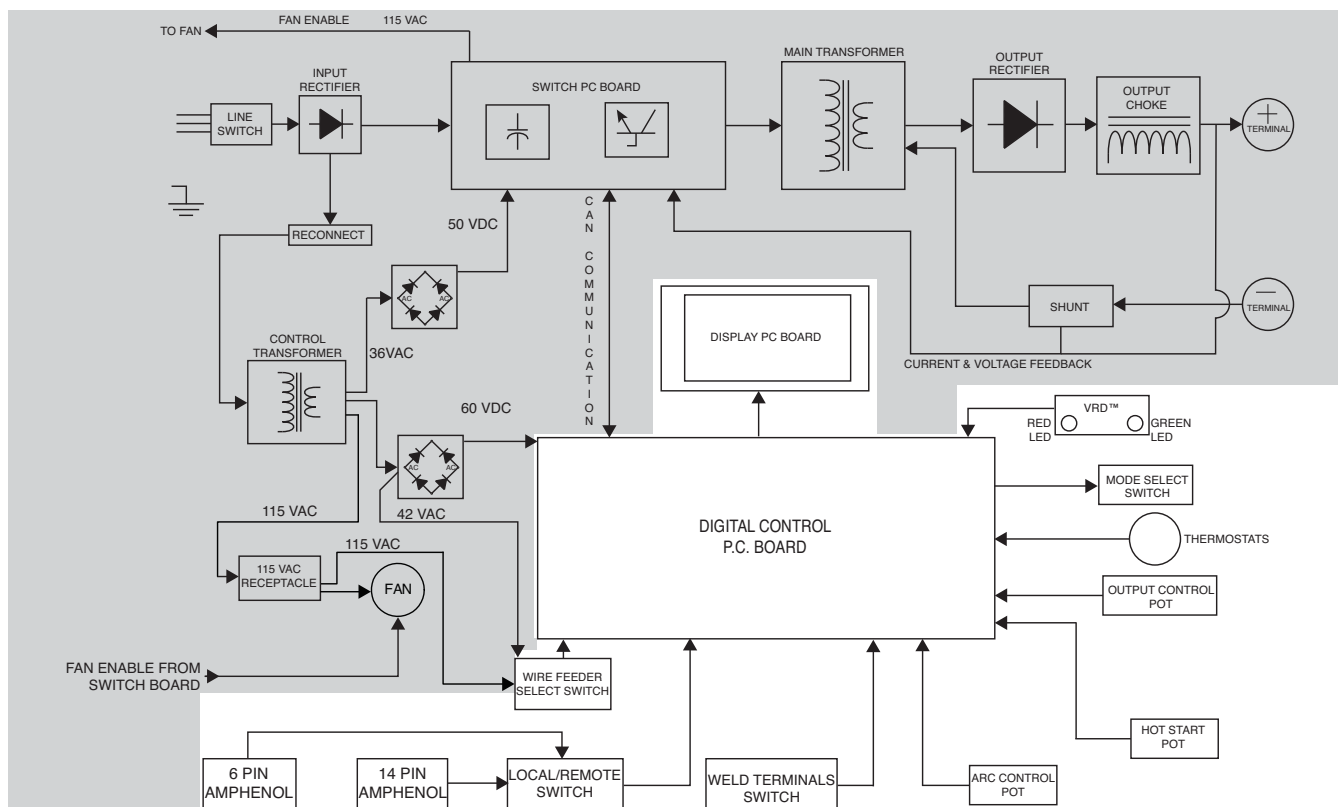
The 20kHz AC output from the main welding transformer is applied to the output rectifier bridge. The resultant DC+ power is coupled, through an output choke, to the positive output terminal. The edge wound output choke is an inductor that provides filtering to enhance the arc performance and accurate waveform response. The R1 and R5 load resistor help to stabilize the open circuit voltage and the winding arc. There is a shunt in series with the negative output terminal. The voltage that is dropped across this shunt (600A @ 50mv) is an accurate indication of output current and is sent to the switch board for processing.

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

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FIGURE E.6 - CONTROL BOARD, USER INTERFACE CONTROLS, DISPLAY BOARD AND VRD™



CONTROL BOARD, USER INTERFACE CONTROLS, DISPLAY BOARD AND VRD™ (VOLTAGE REDUCTION DEVICE)

The user interface controls and switches allow the operator to communicate to the control board the desired processes and welding requirement.

The control board receives power from the D2 rectifier. This 60 VDC is utilized by the control board circuitry to create several DC supplies. These supplies are applied to the display board and the user interface controls and switches. The control board also processes the information received from the user interface controls and switches and sends the appropriated digital information to the switch board.

The display board receives power and digital data from the control board. It displays to the user the preset settings and voltage. During welding it displays the actual voltage and output current.

There are two VRD™ indicator lights on the front of the machine. When shipped the VRD™ function is disabled. VRD™ is enabled by setting dip switches on the Control PC board. See **Operation** section in this manual.

- A green light indicates the OCV is less than 35VDC peak. A red light indicates the OCV is at or above 35VDC peak.

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

FLEXTEC™ 650

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THERMAL PROTECTION

Three normally closed (NC) thermostats protect the FLEXTEC™ 650.

Two thermostats provide secondary thermal protection, are wired in series and are connected to the control board. One of these thermostats is located on the output rectifier heatsink and the other is located on the main inverter transformer. These protect the machine against reduced airflow or overload. If excessive operating temperatures should occur, the thermostats will prevent output from the machine. The fan will remain ON, a thermal fault will be logged and the thermal LED will be lit.

One thermostat provides auxiliary thermal protection. It is located on the auxiliary transformer and is connected to the switch board. It protects the machine against receptacle overload and misconnect overheating. If the thermostat opens, the fan and the output will remain ON. There is no thermal fault logged.

The thermostats are self-resetting once the machine cools sufficiently or any overload is cleared. If the thermostat shutdown was caused by excessive output or duty cycle and the fan is operating normally, the power switch may be left ON and the reset should occur within a 15 minute period. If the fan is not turning or the air intake louvers are obstructed, then the power must be removed from the machine and the fan problem or air obstruction corrected.

PROTECTIVE CIRCUITS

Protective circuits are designed into the FLEXTEC™ 650 to sense trouble and shut down the machine before damage occurs to the machine's internal components.

UNDER/OVER VOLTAGE PROTECTION

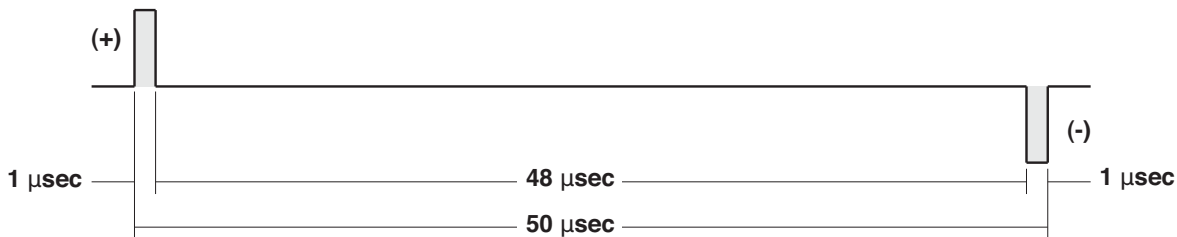
The machine is protected from both over and under-voltage conditions. If the DC voltage being applied to the switch board is lower than 180VDC or higher than 1050VDC the machine's output will be disabled. If the condition persists for more than one second error code 714 will be displayed when supply voltage is too low. 713 will be displayed when supply voltage is too high.

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

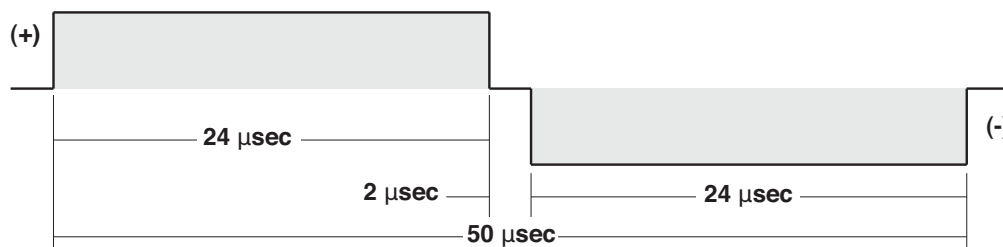
FLEXTEC™ 650



FIGURE E.7 - TYPICAL IGBT OUTPUTS



MINIMUM OUTPUT



MAXIMUM OUTPUT

PULSE WIDTH MODULATION

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

MINIMUM OUTPUT

By controlling the duration of the gate signal, the IGBT is turned on and off for different durations during the cycle. The top drawing in Figure E.7 shows the minimum output signal possible over a 50-microsecond time period.

The positive portion of the signal represents one IGBT group¹ conducting for one microsecond. The negative portion is the other IGBT group¹. The dwell time (off time) is 48 microseconds (both IGBT groups off). Since only two microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

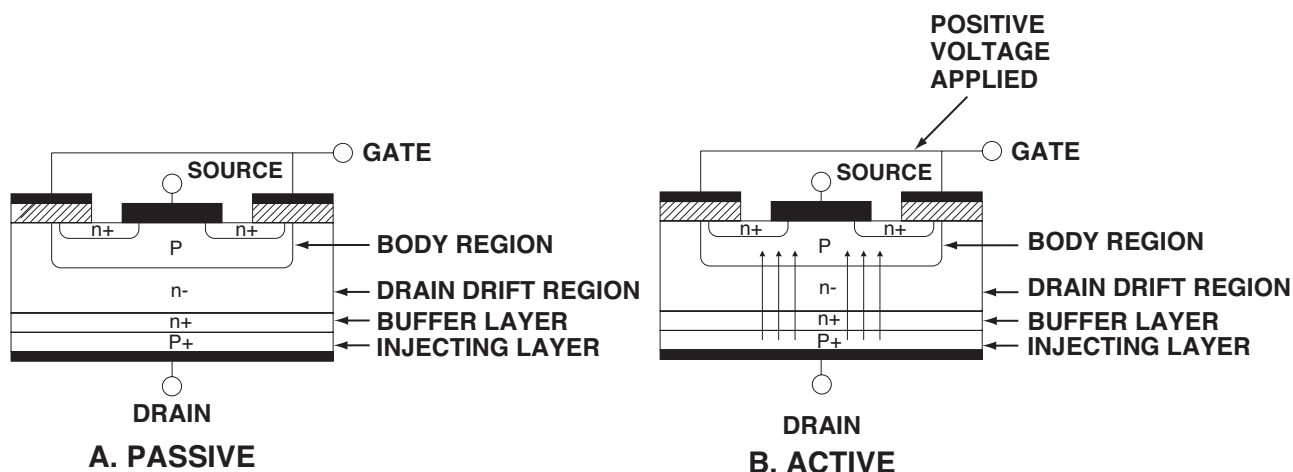
MAXIMUM OUTPUT

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

¹ An IGBT group consists of two IGBT modules feeding one transformer primary winding.

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

FIGURE E.8 - IGBT



INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

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

Example A in Figure E.8 shows an IGBT in passive mode. There is no gate signal, zero volts relative to the source and therefore, no current flow. The drain terminal of the IGBT may be connected to a voltage supply; but since there is no conduction, the circuit will not supply current to components connected to the source. The circuit is turned OFF like a light switch.

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

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

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FLEXTEC™ 650



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HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and Repair should only be performed by 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 the following categories: output problems and weld and arc 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. RECOMMENDED COURSE OF ACTION

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 specified 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 tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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.

- 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.

Observe all Safety Guidelines detailed throughout this manual

USING THE STATUS LED TO TROUBLESHOOT SYSTEM PROBLEMS

Errors are displayed on the user interface. In addition, there are status lights on the control pc board and the switch pc board that contain error sequences.

Included in this section is information about the Status Lights and some basic troubleshooting charts for both machine and weld performance.

The status lights on the main control board and the switch pc board are dual-color LED's. Normal operation for each is steady green.

Error Codes for the FLEXTEC™ 650		
Error Code#	Description	Possible Solution
31	Primary Overcurrent - Peak current through the transformer primary has exceeded threshold (140 amps).	<ol style="list-style-type: none"> 1. Verify connections to the switch board, transformer and output rectifier assemblies are made correctly and there are no damaged components in the machine. 2. Replace defective main transformer. 3. Replace defective switch board assembly (G7123).
36	Thermal Fault - Thermostat on output rectifier heat sink or embedded in transformer has tripped.	<ol style="list-style-type: none"> 1. Do not exceed allowable ambient temperature or duty cycle limits. 2. Verify that fan is operating and airflow is not being blocked. 3. Measure thermostats at control board and replace if defective.
711	Capacitor Fault (Over-Voltage or Under-Voltage) - Input voltage is less than 160 VDC or more than 1050 VDC.	<ol style="list-style-type: none"> 1. Verify input voltage level, frequency and quality. Verify that line is not too soft. 2. If problem occurs on a generator, verify proper operation when connected to municipal power lines. 3. Replace defective switch board assembly (G7123).
712	CAN Communication Timeout - CAN communication between switch board and control board has timed out.	<ol style="list-style-type: none"> 1. Check the physical wiring and connections between control board and switch board. 2. Verify power supply to control board and switch board. 3. Replace defective switch board assembly (G7123) or control board (S28868-4).
713	Misconnection - Switch board Supply Voltage too High - Switch board auxiliary supply voltage is higher than 42 DC at machine power-up.	<ol style="list-style-type: none"> 1. Improper input voltage configuration. Verify primary reconnect position, measure input voltage level and check three phase operation. 2. Damaged auxiliary transformer or intermittent "A" lead connection. Verify 42 VAC output at 14 pin connector to determine the source of the problem. 3. Replace defective switch board assembly (G7123).
714	Misconnection - Switch Board Supply Voltage too Low - Switch board auxiliary supply voltage is lower than 42 DC at machine power-up.	<ol style="list-style-type: none"> 1. Improper input voltage configuration. Verify primary reconnect position, measure input voltage level and check three phase operation. 2. Damaged auxiliary transformer or intermittent "A" lead connection. Verify 42 VAC output at 14 pin connector to determine the source of the problem. 3. Replace defective switch board assembly (G7123).

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your **Local Lincoln Authorized Field Service Facility** for technical troubleshooting assistance before you proceed.

FLEXTEC™ 650



Observe all Safety Guidelines detailed throughout this manual

Error Codes for the FLEXTEC™ 650

Error Code#	Description	Possible Solution
715	Switch Board Undervoltage Lock Out - Switch board auxiliary supply voltage momentarily drops below 20 VDC.	<ol style="list-style-type: none"> 1. Damaged auxiliary transformer or intermittent “A” lead connection. Verify 42 VAC output at 14 pin connector to determine the source of the problem. 2. Verify input voltage level, frequency and quality. Verify that line is not too soft. 3. Replace defective switch board assembly (G7123).
717	Control Board Misconfiguration - A jumper on the control board has been placed in the incorrect position.	<ol style="list-style-type: none"> 1. Verify that the wiring to connector J5 on the control board matches the machine wiring diagram. 2. Replace defective control board assembly (S28868-4).
21, 24, 716, 718	Internal Control Board Error - The microprocessor on the control board has experienced a critical internal error and cannot continue.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Replace defective control board assembly (S28868-4).
719	Internal Switch Board Error - The microprocessor on the switch board has experienced a critical internal error and cannot continue.	<ol style="list-style-type: none"> 1. Cycle power to the machine. 2. Replace defective switch board assembly (G7123).
45-VRD	Voltage Limit Exceeded - When configured for VRD™ operation, during OCV, the voltage exceeded allowable VRD™ levels.	<ol style="list-style-type: none"> 1. Verify S28868-4 Control P.C. Board DIP switch settings are configured for correct input voltage.

VRD™ OPERATION

VRD™ INDICATOR LIGHTS			
MODE		VRD™ “ON”	VRD™ “OFF”
CC-SMAW CC-GTAW	OCV	Green (OCV reduced)	No lights are active
	While Welding	Green or Red (depends on wold voltage)*	
CV-GAS CV-INNERSHIELD CV-SAW	OCV	Red (OCV Not Reduced) Weld Terminals “ON”	
		Red (OCV Not Reduced) Weld Terminals Remotely Controlled Gun Trigger Closed	
		Green (No OCV) Weld Terminals Remotely Controlled Gun Trigger Open	
	While Welding	Green or Red (depends on wold voltage)*	

* It is normal for the lights to alternate between colors while welding.

CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your **Local Lincoln Authorized Field Service Facility** for technical troubleshooting assistance before you proceed.

FLEXTEC™ 650



Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident when the sheet metal cover(s) are removed.	1. Contact your local authorized Lincoln Electric Field Service Facility for technical assistance.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.
The input fuses repeatedly fail or the input circuit breakers keep tripping.	1. Make sure the input fuses or circuit breakers are properly sized.	1. Perform the Input Rectifier Test . 2. Perform the Switch Board Test .
The machine is 'dead'. No lights, no output, the machine appears to have no input power.	1. Make sure the input power switch is in the ON position. 2. Check the main input fuses or breakers to make sure all three phases of the correct input power is present at the machine. 3. Check the lead "A" located at the reconnect block. Make certain it is connected to the proper input voltage position.	1. Check the input switch SW1 for proper operation. Also check the associated leads for loose or faulty connections. See the Wiring Diagram. 2. Perform the Auxiliary T1 Transformer Test . 3. Check Diode D1 for opens or shorts. See the Wiring Diagram. 4. Perform the Control Board Test .
There is no welding output from the FLEXTEC™ 650 machine. NOTE: This problem may be accompanied by an error code.	1. Make sure the S3 weld terminals switch is in the "ON" position. 2. Make certain the correct three phase input power is being applied to the machine. The input may be too high or too low. If this is the case error 711 will be displayed. 3. There may be a thermal shutdown. Check the thermal LED.	1. Perform the Auxiliary T1 Transformer Test . 2. Perform the Input Rectifier Test . 3. Perform the Switch Board Test . 4. Perform the Control Board Test . 5. Perform the Output Rectifier Test . 6. Check diode D2 for opens or shorts. See the Wiring Diagram.

⚠ CAUTION

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

FLEXTEC™ 650



Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The thermal LED is "ON". The machine regularly overheats.	<ol style="list-style-type: none"> 1. The welding application may be exceeding the recommended duty cycle and/or limits of the machine. 2. Dirt or dust may have clogged the cooling channels inside the machine. See the Maintenance section. 3. Air intake and exhaust louvers may be blocked due to inadequate clearance around the machine. 4. Make sure the fan is functioning correctly. The FLEXTEC™ 650 is equipped with F.A.N. (fan as needed) circuitry. The fan runs whenever the output current is established and will continue running for approximately five minutes after the output current is disabled. 	1. Perform the Thermostat Test - Thermal Protection .
The machine turns on but the display is not visible, flickers or has missing digits.	<ol style="list-style-type: none"> 1. Turn the machine off and then back on to re-boot. 2. Check for loose or faulty connections between the control board and the display board. See the Wiring Diagram. 	1. Perform the Display Board Test .
The fan is running at all times.	<ol style="list-style-type: none"> 1. Check for 115 volt receptacle overload and/or misconnect overheating. 	1. Perform the Thermostat Test - T1 Transformer .

⚠ CAUTION

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

FLEXTEC™ 650



Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELD AND ARC QUALITY PROBLEMS		
There is a general degradation of the welding performance.	<ol style="list-style-type: none"> 1. Make sure the correct three phase input is being applied to the machine. 2. Make sure the machine's controls are set correctly for the welding process being used. 3. Check for poor connections or "loops" in the welding cables. 4. If using a wirefeeder check for the correct and consistent wire feed speed at the wirefeeder. 	<ol style="list-style-type: none"> 1. Perform the <i>Choke Test</i>. 2. Perform the <i>Control Board Test</i>.
The machine loses output during a weld.	<ol style="list-style-type: none"> 1. A secondary over-current may have occurred. The welding application may have exceeded the current limitations of the machine. 2. Make sure the correct three phase input power is being applied to the machine. 	<ol style="list-style-type: none"> 1. Perform the <i>Input Rectifier Test</i>.

⚠ CAUTION

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

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Return to Section TOC

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Return to Section TOC

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TROUBLESHOOTING AND REPAIR

INPUT PANEL TERMINAL BLOCK TEST

WARNING

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

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

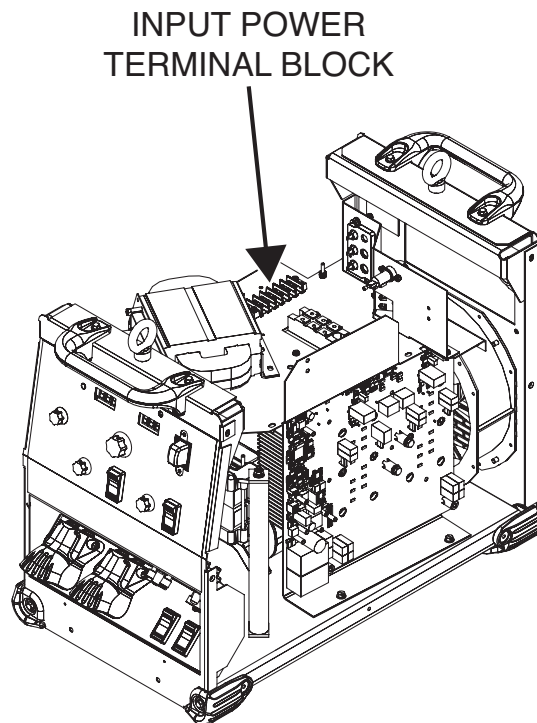
TEST DESCRIPTION

This test will check to make sure the primaries of the Auxiliary Transformers are configured correctly for the three phase input voltage.

MATERIALS NEEDED

- 3/8" Wrench
- Straight Blade Screwdriver
- Wiring Diagram

FIGURE F.1 – INPUT POWER TERMINAL BLOCK LOCATION



PROCEDURE

⚠ WARNING



ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

4. Locate the Input Power Terminal Block. See Figure F.1.
5. Insure the lead "A" in the reconnect terminal is connected to the correct position for the three phase input voltage. See Wiring Diagram.
6. If the reconnection of lead "A" is incorrect, the FLEXTEC™ 650 will present an error 58 on the display of the machine.
7. This machine can only run on three phase input power.
8. Replace previously removed input panel.
9. Perform **Retest After Repair**.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Remove input panel.
3. Perform the **DC Link Capacitor Discharge Procedure**.

FLEXTEC™ 650



DC LINK CAPACITOR DISCHARGE PROCEDURE**⚠ WARNING**

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

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

TEST DESCRIPTION

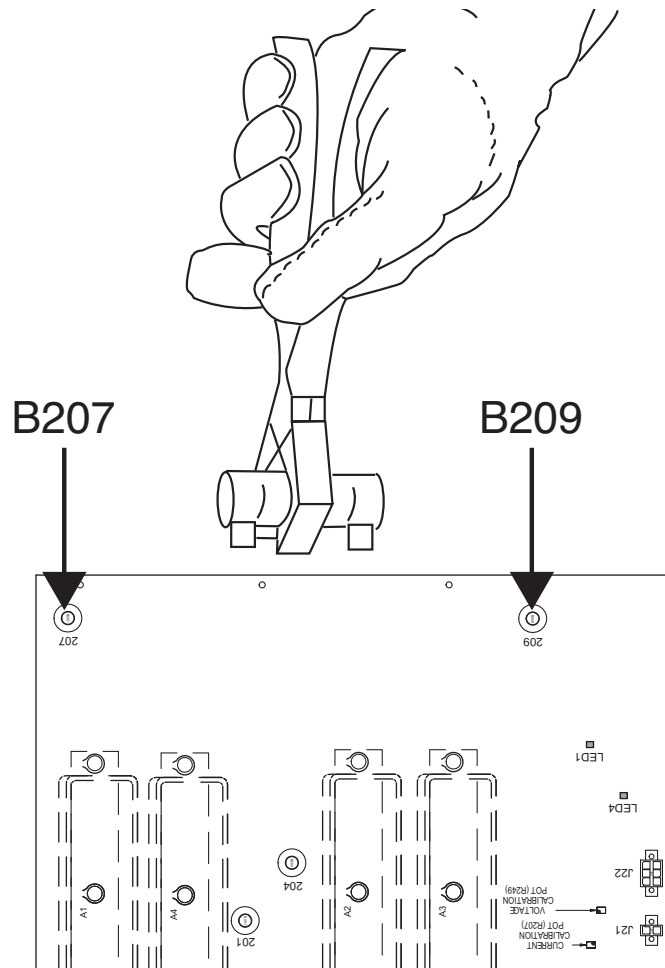
This procedure will help determine if the DC Link Capacitors are discharged.

MATERIALS NEEDED

- 3/8" Wrench
- 25-1000 Ohm Resistor
- Electrical Insulating Gloves
- Analog Voltmeter or Digital Multimeter With A Diode Check Position

DC LINK CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.2 – SWITCH BOARD LEADS 207 & 209



PROCEDURE

 **WARNING**


ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

3. Locate the two large bolted connections labeled “207” and “209” on the top edge of the FLEX-TEC™ 650 switch board. See Wiring Diagram. See Figure F.2.
4. Carefully discharge the link capacitors using a 25 watt or more, 25 to 1000 ohm resistor connected to two test leads.
5. After discharging, use a DC voltmeter to ensure the link capacitors are discharged by connecting the probes of the meter to “209” positive and “207” negative. The voltage should be zero - if not repeat procedure.
6. Perform the **Case Cover Replacement Procedure**.

Perform Link Capacitor discharge procedure as follows.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform **Case Cover Removal Procedure**.

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INPUT RECTIFIER TEST**⚠ WARNING**

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

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

TEST DESCRIPTION

This test will help determine if the Input Rectifier has failed.

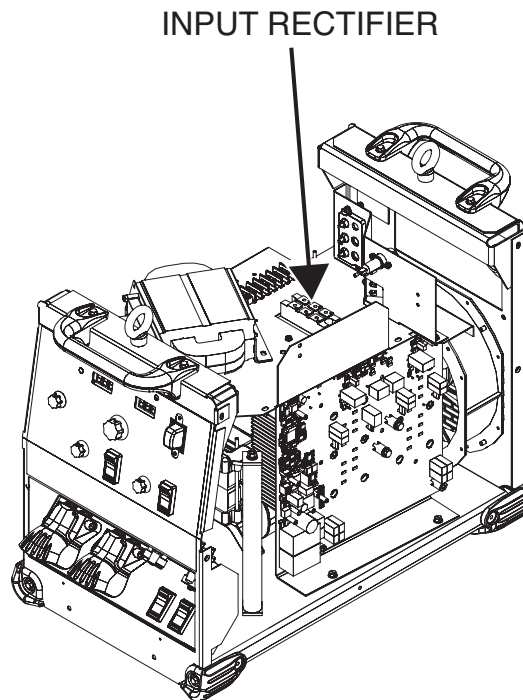
MATERIALS NEEDED

3/8" Wrench

Analog Voltmeter or Digital Multimeter With A Diode Check Position

INPUT RECTIFIER TEST (continued)

FIGURE F.3 – INPUT RECTIFIER LOCATION



PROCEDURE


WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

4. Locate the input rectifier assembly. See Figure F.3.
5. Perform the tests detailed in *Table F.1*. Also See *Figure F.4*.
6. If the tests results are questionable remove all of the leads from the input rectifier and re-test. See the Wiring Diagram.
7. If any portion of the test fails, the input rectifier may be faulty.
8. Perform the *Case Cover Replacement Procedure*.
9. Perform *Retest After Repair*.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform the *Case Cover Removal Procedure*.
3. Perform the *DC Link Capacitor Discharge Procedure*.

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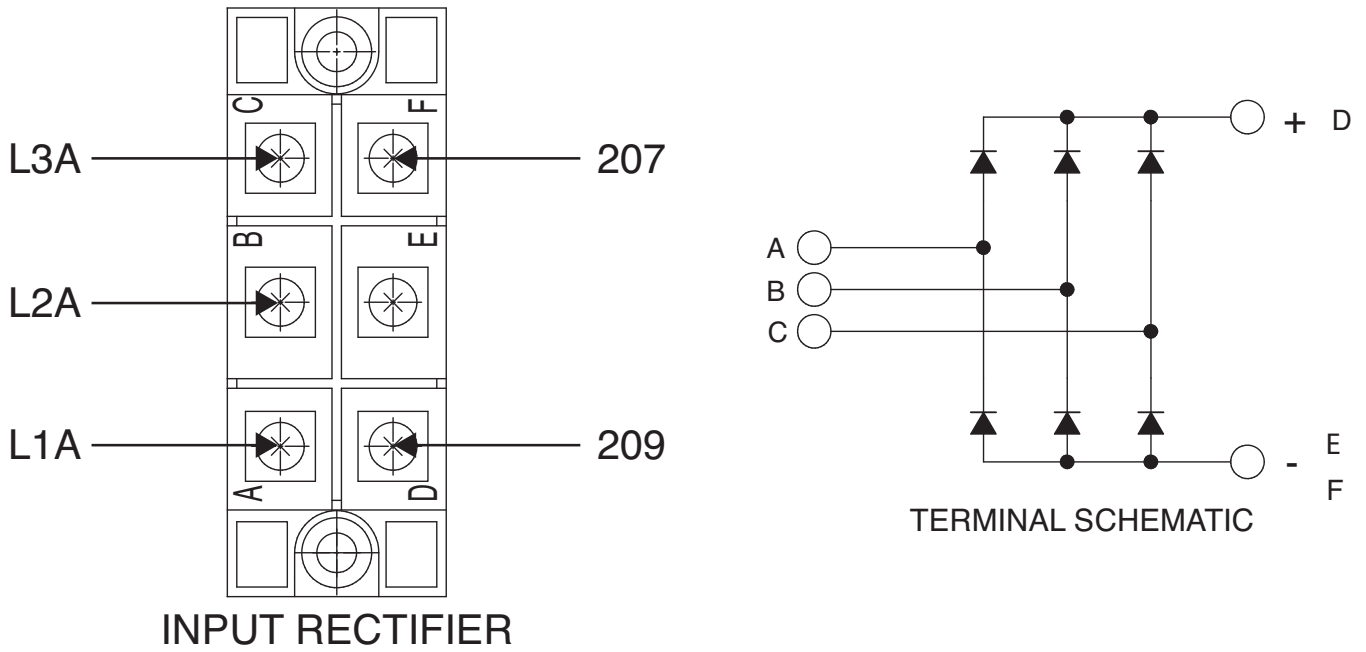


INPUT RECTIFIER TEST (continued)

TABLE F.1 – INPUT RECTIFIER TEST POINTS

+ PROBE (RED)	- PROBE (BLACK)	RESULT
Terminal L3A Rectifier Terminal (C)	Rectifier Terminal (D) - Lead 209	0.3V - 1.0V
Terminal L2A Rectifier Terminal (B)	Rectifier Terminal (D) - Lead 209	0.3V - 1.0V
Terminal L1A Rectifier Terminal (A)	Rectifier Terminal (D) - Lead 209	0.3V - 1.0V
Rectifier Terminal (F) - Lead 207	Terminal L3A Rectifier Terminal (C)	0.3V - 1.0V
Rectifier Terminal (F) - Lead 207	Terminal L2A Rectifier Terminal (B)	0.3V - 1.0V
Rectifier Terminal (F) - Lead 207	Terminal L1A Rectifier Terminal (A)	0.3V - 1.0V

FIGURE F.4 – INPUT RECTIFIER DETAIL



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FAN AND F.A.N. CIRCUIT TEST**⚠ WARNING**

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

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

TEST DESCRIPTION

This procedure will aid the technician in making sure the Fan and Fan Circuitry is functioning properly.

MATERIALS NEEDED

Jumper
Volt/Ohmmeter

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Return to Master TOC

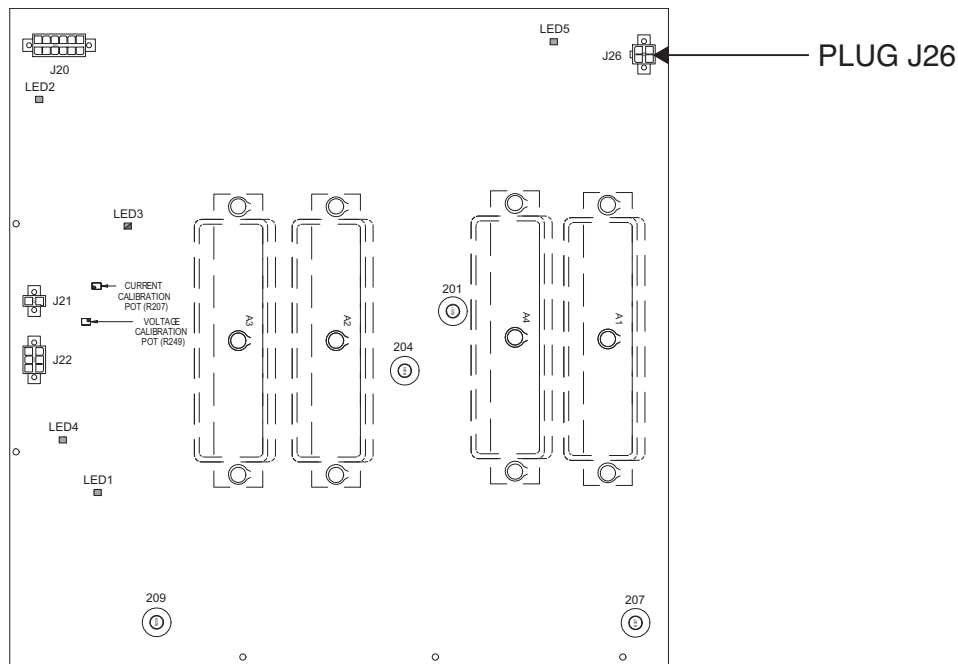
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Return to Master TOC

FIGURE F.5 – PLUG J26 LOCATION



PROCEDURE

⚠ WARNING



ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
 - Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
 - Do not touch electrically hot parts.
-
1. Remove the input power to the FLEXTEC™ 650 machine.
 2. Perform **Case Cover Removal Procedure**.
 3. Perform the **DC Link Capacitor Discharge Procedure**.

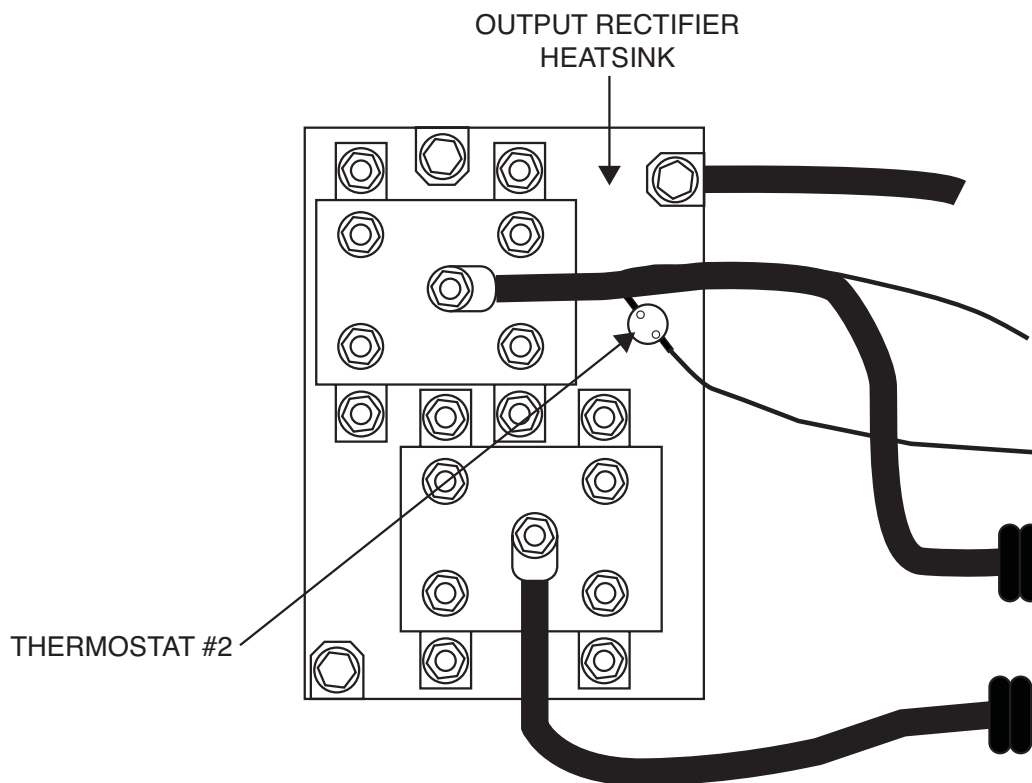
4. Unplug J26 on the switch board and insert a jumper wire carefully into the wire end of the connector to short leads #32A and #32C together. See Figure F.5. See Wiring Diagram.
5. Carefully apply the correct input power (three-phase).
6. When the FLEXTEC™ 650 is turned on, the fan should start and run as long as power is on. If this test results in the fan running properly, all components of the fan circuit are OK with the possible exception of the switch board and/or control board.
7. If the above test failed to start the fan, check the 120 volts secondary of the T1 transformer and the fan itself. Perform **Transformer T1 Test**. If the transformer produces the required 120 volts and the J26 leads are jumped, the fan is suspect and/or fan capacitor are suspect. See Wiring Diagram.

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FAN AND F.A.N. CIRCUIT TEST (continued)

FIGURE F.6 – THERMOSTAT #2 (OUTPUT RECTIFIER HEATSINK)



8. If the above test results in a running fan, remove the jumper wire between leads 32A and 32C and plug J26 back into the switch board. See Wiring Diagram. Remove one of the two quick connect leads on thermostat #2. See Figure F.6.
9. If removing the lead causes the control board to flash error 36 and the thermo LED turns on but the fan still does not start, the switch board is suspect.
10. If no error 36 flashes and the thermo LED does not turn on, the control board is suspect.
11. Replace the suspect component, re-connect the quick connection removed from the #2 thermostat and retest by loading the machine on a grid.
12. A properly operating F.A.N. circuit will start the fan as soon as an arc is detected and for five minutes after the load has been removed.
13. Perform the **Case Cover Replacement Procedure**.
14. Perform **Retest After Repair**.

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T1 TRANSFORMER TEST

WARNING

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

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

TEST DESCRIPTION

This test will help determine if the T1 Transformer is receiving the correct primary voltage and if it is producing the correct secondary voltages.

MATERIALS NEEDED

Digital Multimeter

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Return to Section TOC

Return to Section TOC

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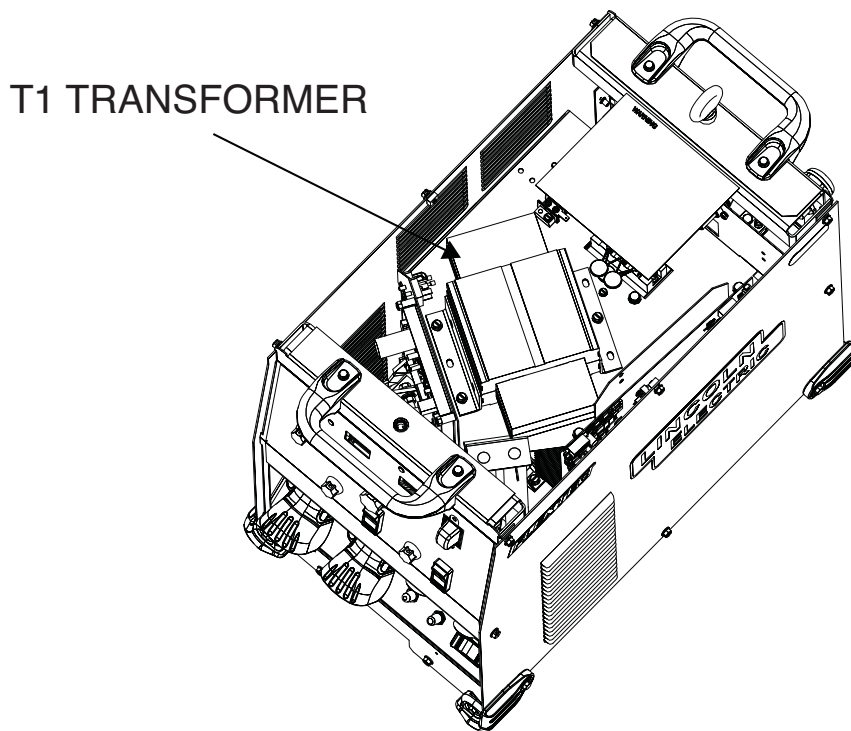
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Return to Master TOC

T1 TRANSFORMER TEST (continued)

FIGURE F.7 – T1 TRANSFORMER LOCATIONS



PROCEDURE


WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **DC Link Capacitor Discharge Procedure**.
4. Locate the T1 Transformer. See Figure F.7.
5. Carefully apply the correct three-phase input power to the FLEXTEC™ 650.
6. At the Reconnect Terminal Block carefully check for the correct primary voltages on the T1 Transformer. See **Table F.2, Figure F.8** and the Wiring Diagram.
7. If the correct primary voltages are present check for the presence of the correct secondary voltages. See **Table F.2** and the Wiring Diagram.
8. If the primary voltages are correct and the secondary voltages are low or not present the T1 Transformer may be faulty.
9. When testing is complete replace all leads previously removed.
10. Perform the **Case Cover Replacement Procedure**.
11. Perform **Retest After Repair**.

FLEXTEC™ 650



T1 TRANSFORMER TEST (continued)

FIGURE F.8 – RECONNECT TERMINAL BLOCK LOCATION

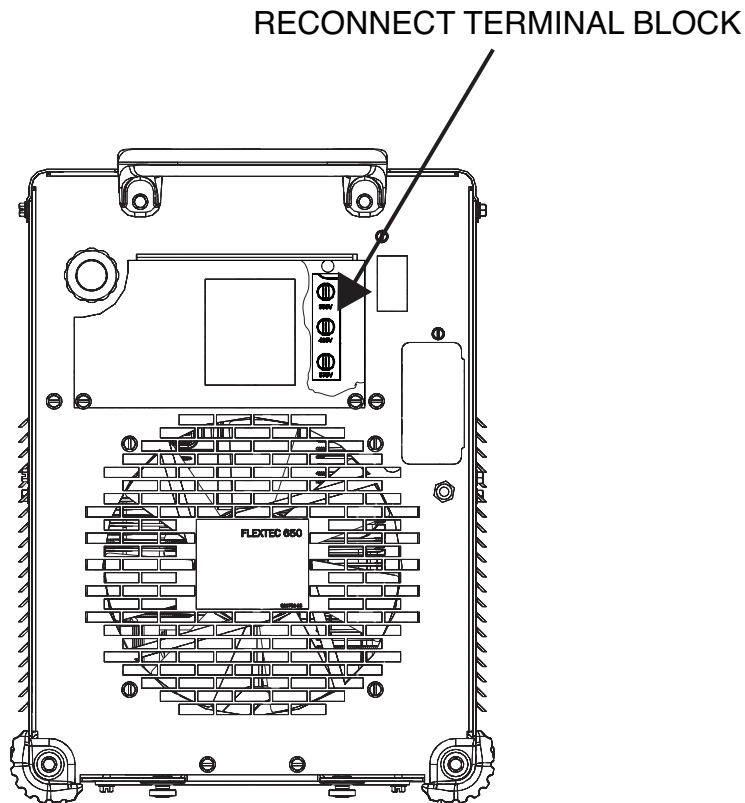


TABLE F.2 – TRANSFORMER T1 TEST POINTS

DESCRIPTION	TEST POINTS	EXPECTED READINGS	CONDITIONS / COMMENTS
Primary Voltage	H1 to H2	380VAC	Correct Input Power Applied
Primary Voltage	H1 to H3	460VAC	Correct Input Power Applied
Primary Voltage	H1 to H4	575VAC	Correct Input Power Applied
Secondary Voltage	X15 to X16	36VAC	Correct Input Power Applied
Secondary Voltage	X13 to X14	42VAC	Correct Input Power Applied
Secondary Voltage	X11 to X12	115VAC	Correct Input Power Applied

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

FLEXTEC™ 650



TROUBLESHOOTING AND REPAIR

THERMOSTAT TEST - T1 TRANSFORMER

WARNING

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

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

TEST DESCRIPTION

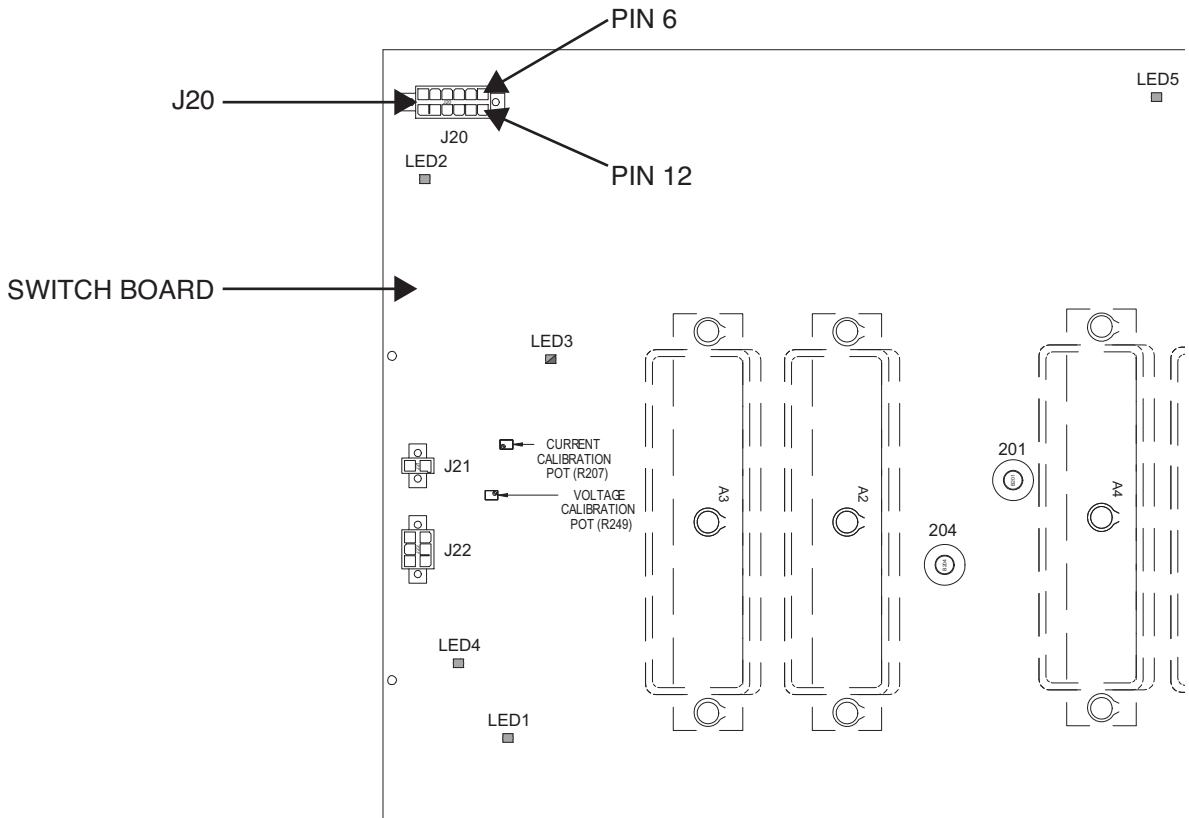
This test will determine if a Thermostat is intermittently opening or is fully open.

MATERIALS NEEDED

Volt/Ohmmeter

THERMOSTAT TEST - T1 TRANSFORMER (continued)

FIGURE F.9 – PLUG J20 LOCATION



PROCEDURE

WARNING



ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

4. Locate plug J20 on the switch board. See Figure F.9.
5. Remove the plug from the switch board and check the continuity between Pin 6 (Lead #226) and Pin 12 (Lead #227). See Figure F.9. The resistance should be very low (less than one ohm).
6. If the resistance is greater than one ohm check the leads, connections and the thermostat. See Wiring Diagram.
7. Perform the **Case Cover Replacement Procedure**.
8. Perform **Retest After Repair**.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform **Case Cover Removal Procedure**.
3. Perform the **DC Link Capacitor Discharge Procedure**.

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

SWITCH BOARD TEST**⚠ WARNING**

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

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

TEST DESCRIPTION

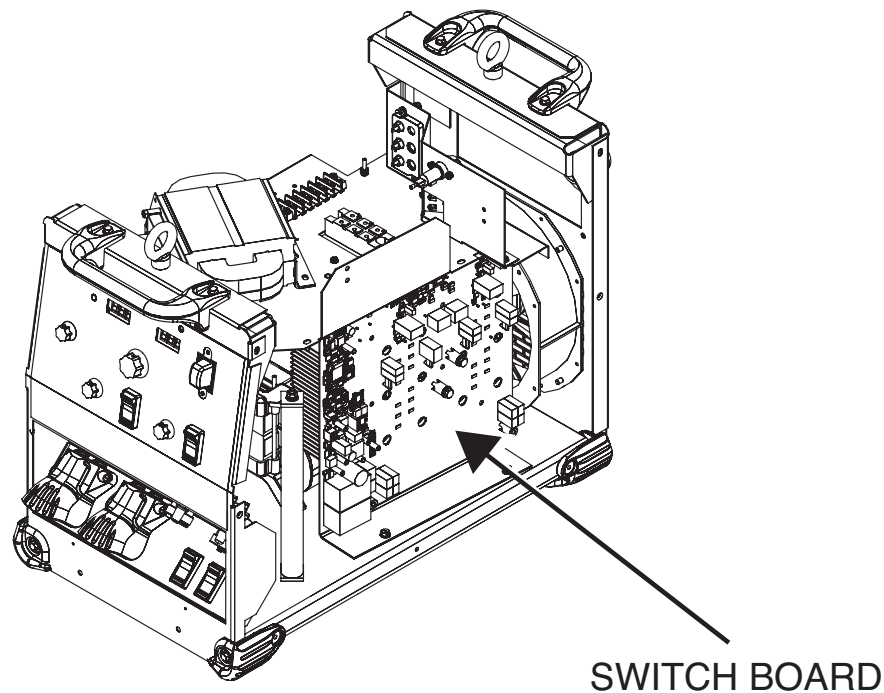
The Switch Board has many functions and components. This test will help determine if the Switch Board is receiving the correct voltages and also if the Switch Board is functioning properly.

MATERIALS NEEDED

Volt / Ohmmeter (Multimeter)
7/16" Wrench

SWITCH BOARD TEST (continued)

FIGURE F.10 – SWITCH BOARD LOCATION



PROCEDURE

 **WARNING**


ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
 - Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
 - Do not touch electrically hot parts.
 - High voltages are present on and around the switch board. Take the appropriated safety precautions when performing the following procedures.
-
1. Remove the input power to the FLEXTEC™ 650 machine.
 2. Perform the **Case Cover Removal Procedure**.
 3. Perform the **DC Link Capacitor Discharge Procedure**.

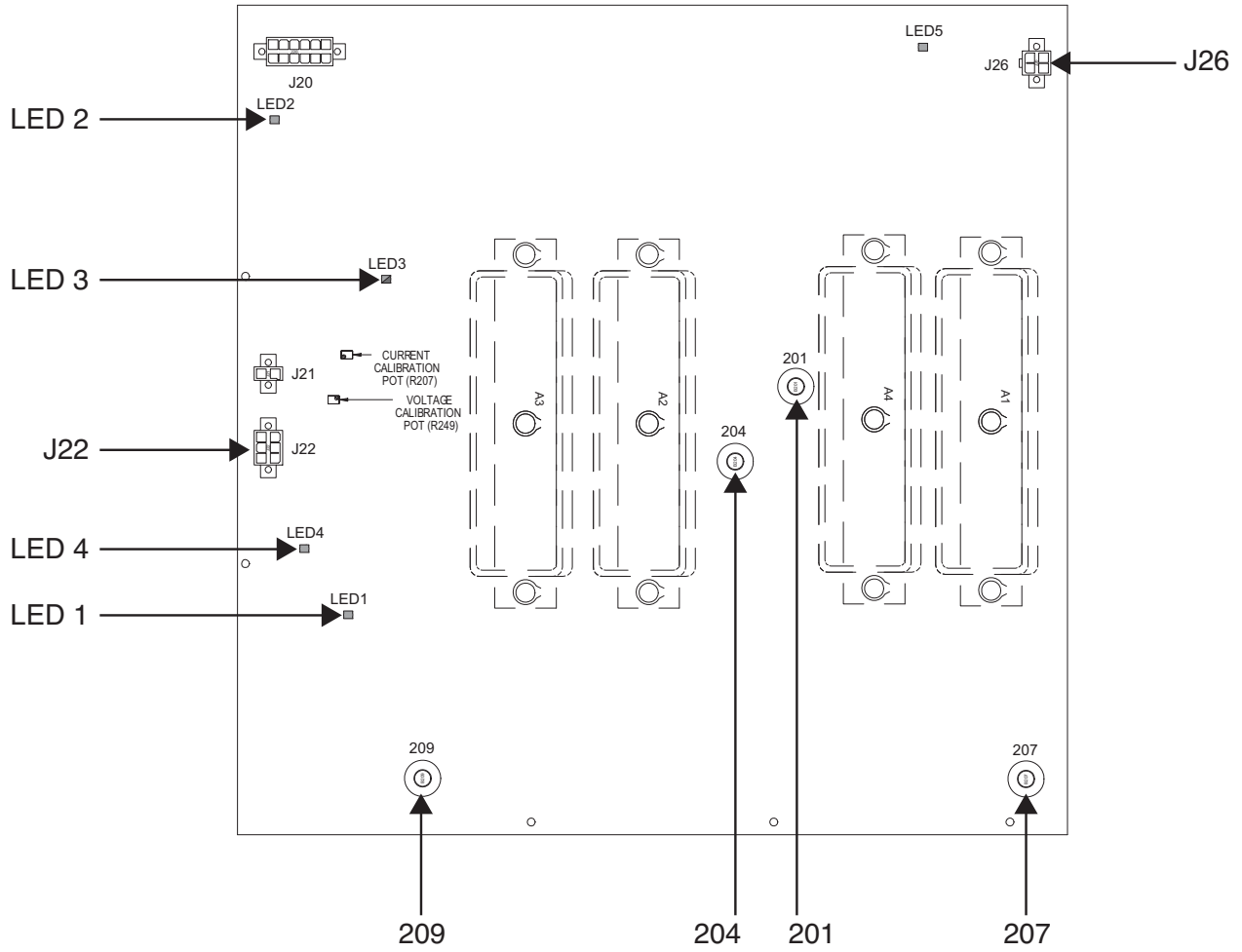
4. Locate the switch board on the right side of the machine. See Figure F.10.
5. Carefully apply the correct input power to the FLEXTEC™ 650 machine. Check the LEDs per **Table F.3**. See **Figure F.11** for LED locations.
6. If the LEDs are not indicating a properly functioning switch board (per **Table F.3**.) proceed with the following steps.
7. Check the switch board voltages per **Table F.5**. See **Figure F.11** for test point locations.
8. Remove the input power and check the switch board resistances per **Table F.4**. See **Figure F.11** for test point locations.
9. If any of the above tests are not correct the switch board may be faulty.
10. If faulty, perform the **Switch Board Removal and Replacement Procedure**.
11. Replace all plugs and leads that may have been disconnected.
12. Perform the **Case Cover Replacement Procedure**.
13. Perform **Retest After Repair**.

FLEXTEC™ 650



SWITCH BOARD TEST (continued)

FIGURE F.11 – SWITCH BOARD PRIMARY SIDE



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

SWITCH BOARD TEST (continued)

TABLE F.3 – SWITCH BOARD LEDS

DESCRIPTION	INDICATES	LIGHT	CONDITIONS
LED 1	+5.0VDC Supply (Green)	ON	Power applied to FLEXTEC™ 650
LED 2	CAN Communications is Powered (Green)	ON	Power applied to FLEXTEC™ 650
LED 3	Status LED Indicator (Red or Green)	ON*	Power applied to FLEXTEC™ 650 *May be blinking
LED 4	+5.0VDC Supply functional for Switch Board Control Circuitry (Green)	ON	Power applied to FLEXTEC™ 650

LIGHT CONDITION	MEANING
Steady Green	System OK. Switch board is communicating correctly with control board.
Blinking Green	Occurs during startup or reset and indicates that the switch board is waiting for communication from the control board. Normal for the first 1-10 seconds after power is turned ON.
Alternating Green and Red	<p>A system fault has occurred. If the switch board status LED is flashing and combination of Red and Green, errors are present. Read the error code before the machine is powered OFF.</p> <p>Error code interpretation through the status LED is detailed in the Service Manual. Individual code digits are flashed in RED with a long pause between digits. If more than one code is present, the codes will be separated by a Green light.</p> <p>To clear the error, turn the power source OFF and back ON to reset.</p>

ERROR CODE #	INDICATION
31 Primary Overcurrent Error	Excessive primary current present. May be related to switch board hardware or output rectifier failure.
32 Capacitor Voltage Error	Excessively low or high voltage on the capacitor. May be caused by improper input configuration or an open/short circuit in the primary side of the machine.
47 Communications Watchdog Timeout	Communication with the control board was lost. May be caused by excessive noise or damage to the CAN connection to the control board.
58 Bad Supply Voltage	The supply voltage to the switch board was found to be outside of the allowable range. May be caused by an improper input voltage configuration.
Other	Error codes that are not listed are defined as fatal errors. These codes generally indicate internal errors on the switch board. If cycling power does not clear the error, replace the switch board.

SWITCH BOARD TEST (continued)

TABLE F.4 – SWITCH BOARD RESISTANCE MEASUREMENTS

DESCRIPTION	METER TEST POINTS AND POLARITY	EXPECTED READINGS	CONDITIONS
Checking for short circuit on the “High Side” IGBTs	B209(+) to B201(-)	Greater Than 100,000 Ohms	Machine “OFF” no input power applied
Checking for short circuit on the “Low Side” IGBTs	B204(+) to B207(-)	Greater Than 100,000 Ohms	Machine “OFF” no input power applied
Checking for short circuit on “Primary Side”	B209(+) to B207(-)	Between 18,000 to 29,000 Ohms	Machine “OFF” no input power applied
Main Transformer Primary connections and winding	B201 to B204	Very Low Resistance Approximately 0.5 Ohms	Machine “OFF” no input power applied

TABLE F.5 – SWITCH BOARD VOLTAGE MEASUREMENTS

DESCRIPTION	TEST POINTS	EXPECTED READINGS	CONDITIONS
Rectified and filtered input voltage	B209(+) to B207(-)	535 VDC to 815 VDC depending upon the input voltage 380 VAC to 575 VAC	Correct input power applied to machine and pre-charge completed. If not correct, perform the <i>Input Rectifier Test</i> .
Input supply voltage from Auxiliary Transformer T1 and Rectifier D1	Plug J22 Pin 1 (+) To Plug J22 Pin 2 (-)	50 VDC	Correct input power applied to machine and pre-charge completed. If not correct, perform the <i>Auxiliary T1 Transformer Test</i> . Also check rectifier D1 for proper operation.
Fan supply voltage from Auxiliary Transformer T1	Plug J26 Pin 1 To Plug J26 Pin 2	115 VAC when fan is not energized	Correct input power applied to machine and pre-charge completed. The fan should be energized when welding current is detected by the output shunt. See the Wiring Diagram.

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

FLEXTEC™ 650



OUTPUT RECTIFIER TEST**⚠ WARNING**

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

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

TEST DESCRIPTION

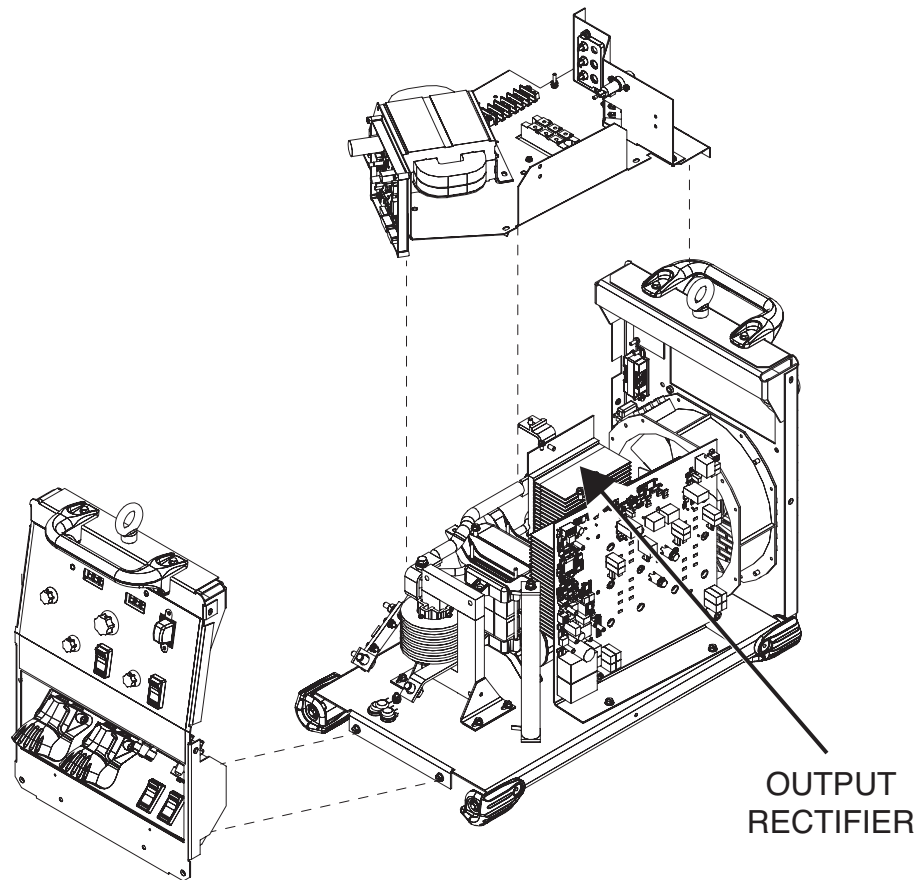
This test will determine if the Output Rectifier Modules are functioning properly.

MATERIALS NEEDED

Digital Multimeter
1/2" Wrench
7/16" Wrench

OUTPUT RECTIFIER TEST (continued)

FIGURE F.12 – OUTPUT RECTIFIER LOCATION



PROCEDURE

 **WARNING**


ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

3. Perform the *DC Link Capacitor Discharge Procedure*.
4. Locate output rectifier. See Figure F.12.
5. Disconnect the transformer leads (X1 and X2) from the output rectifier assembly terminals and disconnect the lead connecting the heatsink to the output choke. See Wiring Diagram. See *Figure F.13*.

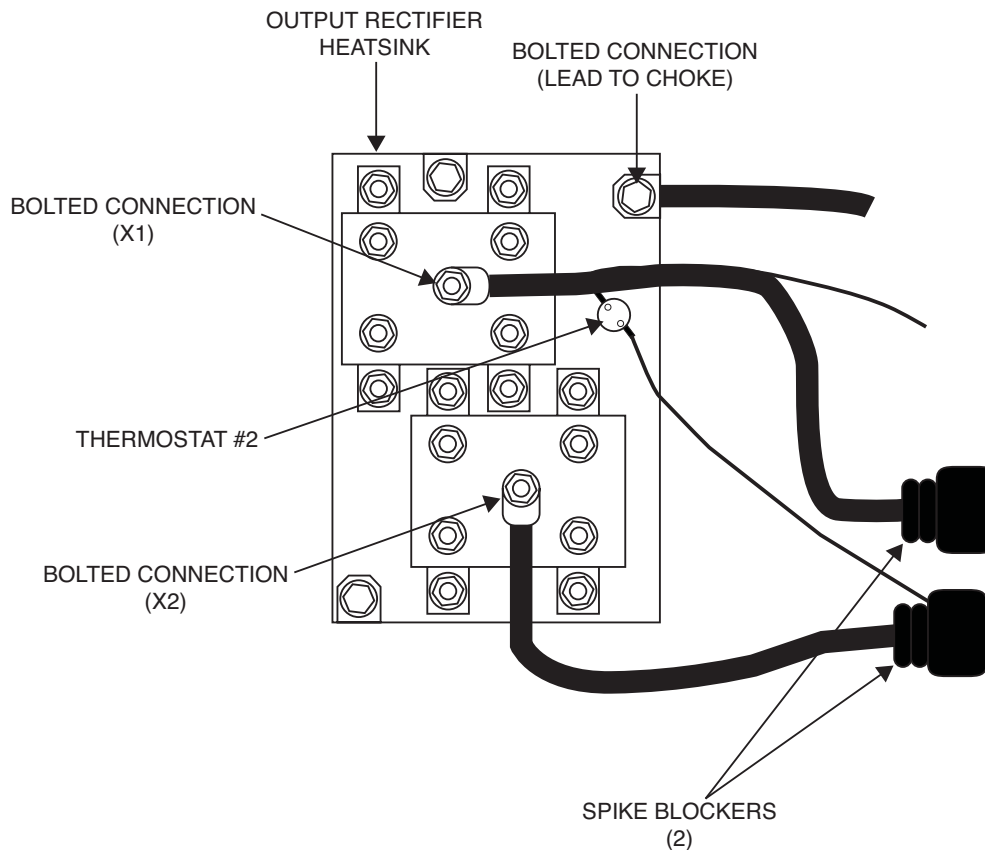
1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform the *Case Cover Removal Procedure*.

FLEXTEC™ 650



OUTPUT RECTIFIER TEST (continued)

FIGURE F.13 – OUTPUT RECTIFIER CONNECTIONS



6. Measure the rectifiers per chart below with your meter set for diode checking.

+ PROBE (RED)	- PROBE (BLACK)	RESULT
Rectifier PCB Terminal B1 (X1)	Output Rectifier Heatsink	0.2V - 0.7V
Rectifier PCB Terminal B1 (X2)	Output Rectifier Heatsink	0.2V - 0.7V

7. If the tests determine that the diodes are shorted or open, the output rectifier may be faulty.
8. If faulty, perform the **Output Rectifier Removal and Replacement Procedure**.
9. When test is complete replace all leads previously removed.
10. Perform the **Case Cover Replacement Procedure**.
11. Perform **Retest After Repair**.

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

FLEXTEC™ 650



CHOKE TEST

WARNING

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

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

TEST DESCRIPTION

This procedure will determine if the Choke is open, shorted (turn to turn) or grounded.

MATERIALS NEEDED

Volt / Ohmmeter

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Section TOC

Return to Master TOC

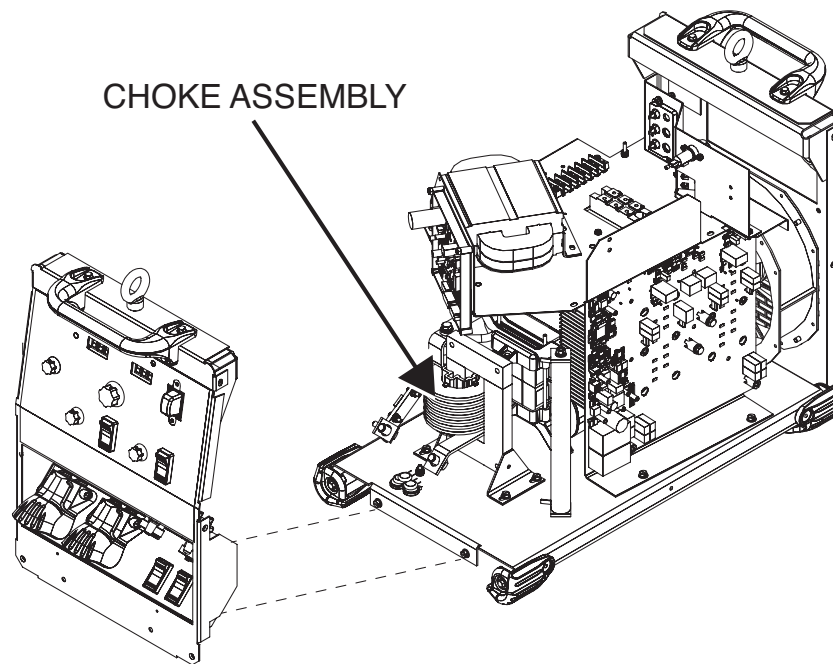
Return to Master TOC

Return to Master TOC

Return to Master TOC

CHOKE TEST (continued)

FIGURE F.14 – CHOKE LOCATION



PROCEDURE

 **WARNING**


ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

4. Locate choke assembly. See Figure F.14.
5. **OPEN:** No weld output. Check the resistance from the choke lead connected to heat sink of the output rectifier to the positive output terminal. The resistance should be very low (less than one Ohm). See Wiring Diagram. See *Figure F.15*.
6. **Turn to Turn Short:** Reduced inductance. Arc instability, excessive heating of the choke. Check for physical signs of arcing within the choke assembly. See *Figure F.15*.

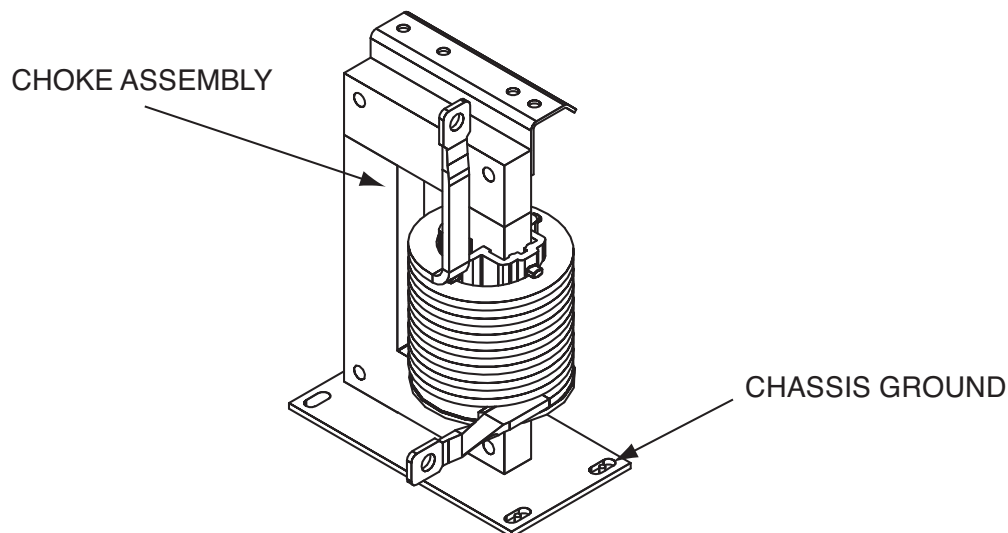
1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform the *Case Cover Removal Procedure*.
3. Perform the *DC Link Capacitor Discharge Procedure*.

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CHOKE TEST (continued)

FIGURE F.15 – CHOKE



7. **Choke Coil Grounded:** Reduced inductance. Alternate weld current path. Electrically isolate the choke coil by disconnecting both choke leads. (one at the output rectifier and one at the positive output terminal). Check the resistance from the choke coil to chassis ground. It should be at least 500,000 ohms. See the Wiring Diagram. See Figure F.15.
8. Perform the **Case Cover Replacement Procedure**.
9. Perform **Retest After Repair**.

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

FLEXTEC™ 650



CONTROL BOARD TEST**⚠ WARNING**

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

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

TEST DESCRIPTION

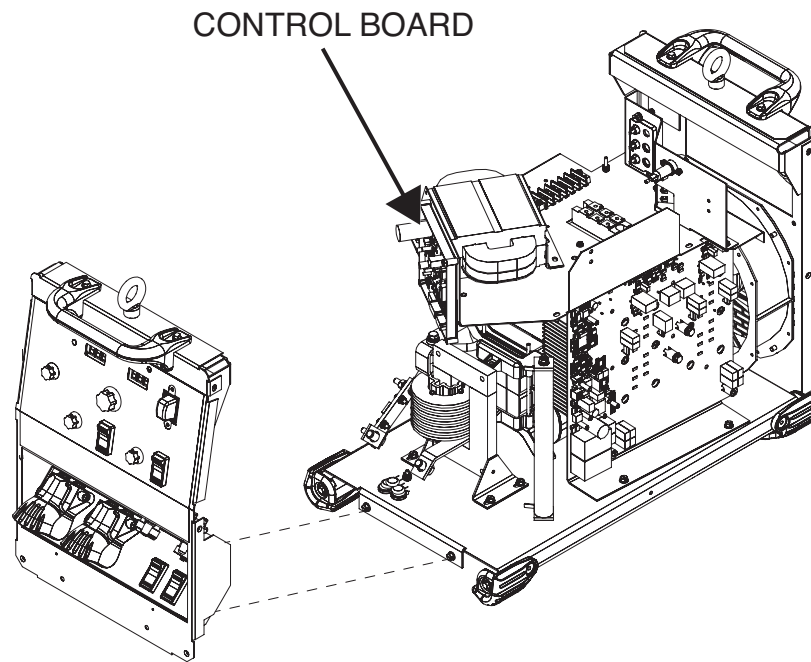
This procedure will determine if the Control Board is receiving the correct input voltage from the D2 Rectifier and if the correct voltages are being created on the Control Board.

MATERIALS NEEDED

Volt / Ohmmeter

CONTROL BOARD TEST (continued)

FIGURE F.16 – CONTROL P.C. BOARD



PROCEDURE

 **WARNING**


ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
 - Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
 - Do not touch electrically hot parts.
-
1. Remove the input power to the FLEXTEC™ 650 machine.
 2. Perform the *Case Cover Removal Procedure*.
 3. Perform the *DC Link Capacitor Discharge Procedure*.

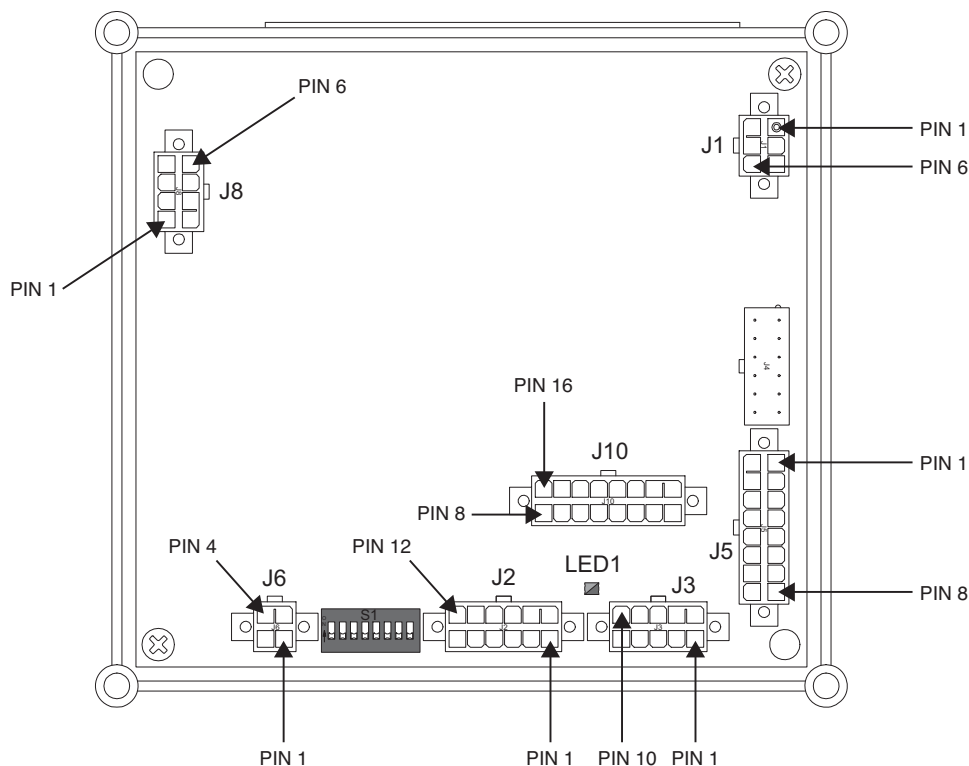
4. Locate the control P.C. board. See Figure F.16.
5. Apply the correct three phase input voltage to the machine and carefully check the control board voltages per *Table F.6*. See *Figure F.17*.
6. If the correct input voltage is being applied to the control board and any of the output voltages are not correct per *Table F.6* the control board may be faulty.
7. See *Table F.7*, for error code information.
8. If faulty, perform the *Control Board Removal and Replacement Procedure*.
9. Perform the *Case Cover Replacement Procedure*.
10. Perform *Retest After Repair*.

FLEXTEC™ 650



CONTROL BOARD TEST (continued)

FIGURE F.17 – CONTROL P.C. BOARD LEAD LOCATIONS



FUNCTIONS

Receives input voltage from 36 Volt auxiliary transformer, T1.

Reads the user selected weld settings from the front panel knobs and switches.

Used to put machine into test modes.

Communicates the user settings to the switch board.

Reads the thermostat inputs.

Communicates output settings to the display board.

Test modes can be accessed via switch and knob positions upon start up. Details are provided in the **Troubleshooting** section.

ERROR LOGS

The left display reads “E00” to “E14” and the right display reads a number that represents the error that has been logged into memory.

These logged errors are stored in flash memory during power down and will be retained in memory until over written or cleared.

There are 15 memory slots for logging errors. E00 represents the most recent error and E14 would be the oldest.

To clear the error log, toggle the Local/Remote switch to the remote position. The left display reads “Err” and the right display reads “---”. When the switch is toggled back to the local position, the error logs will have been cleared and the display will go back to normal error log display operation.

Multiple consecutive errors of the same type will not be recorded.

CONTROL BOARD TEST (continued)

TABLE F.6 – CONTROL BOARD VOLTAGE TESTS

DESCRIPTION	TEST POINTS	EXPECTED READINGS	CONDITIONS / COMMENT
Input Power from D2 Rectifier	J8 Pin 5 (#84)+ To J8 Pin 2 (#85)-	50 VDC	Correct three-phase input power applied to machine
15 VDC to Thermostat Circuit	J8 Pin 1 (#225)+ To J8 Pin 2 (#85)-	15 VDC	Correct input power from D1 Rectifier applied to Control Board
Thermostat Input	J8 Pin 4 (#224)+ To J8 Pin 2 (#85)-	15 VDC	Correct three phase input power applied to machine Thermostats Closed
Power to Display Board	J5 Pin 4 (#359)+ To J5 Pin 8 (379)-	15 VDC	Correct three-phase input power applied to machine
Power for Thermal LED	J3 Pin 2 (#B)+ To J8 Pin 2 (#85)-	15 VDC	Correct three-phase input power applied to machine
Mode Switch Power	J10 Pin 8 (#308)+ To J8 Pin (#85)-	10 VDC	Correct three-phase input power applied to machine
Power to Output Control	J3 Pin 5 (#251)+ To J3 Pin 1 (#253)-	10 VDC	Correct three-phase input power applied to machine. Machine in "Local" control.
Power to Arc Control	J5 Pin 15 (#280)+ To J5 Pin 9 (#282)-	10 VDC	Correct three-phase input power applied to machine.
Power to Weld Terminals Switch	J2 Pin 10 (#210)+ To J2 Pin 12 (#212)-	15 VDC	Correct three-phase input power applied to machine. Weld Terminals Switch in remote "OPEN".
Power to Local / Remote Switch	J2 Pin 7 (#290)+ To J2 Pin 5 (#289)-	15 VDC	Correct three-phase input power applied to machine. Local / Remote switch in remote "OPEN".
Power to Hot Start Switch	J10 Pin 16 (#316)+ To J5 Pin 6 (#317)-	15 VDC	Correct three-phase input power applied to machine. Hot Start OFF "OPEN".
Remote Control Power to the 14 Pin Connector	J2 Pin 2 (#77)+ To J2 Pin 1 (#75)-	10 VDC	Correct three-phase input power applied to machine
Remote Control Power to the 6 Pin Connector	J2 Pin 9 (#277)+ To J2 Pin 4 (#275)-	10 VDC	Correct three-phase input power applied to machine
Remote Trigger Power	J1 Pin 4 (#4)+ To J1 Pin 6 (#2)-	15 VDC	Correct three-phase input power applied to machine

CONTROL BOARD TEST (continued)

TABLE F.7 – CONTROL PC BOARD FUNCTIONS & ERROR CODES

G6617 CONTROL P.C. BOARD		
LED#	COLOR	FUNCTION
1	GREEN	Status "OK"
1	RED	Status "ERROR" (Check code for specific error)

ERROR CODE #	INDICATION
31 Primary Overcurrent Error	Excessive primary current present. May be related to switch board hardware or output rectifier failure.
32 Capacitor Voltage Error	Excessively low or high voltage on the capacitor. May be caused by improper input configuration or an open / short circuit in the primary side of the machine.
36 Thermal Error	Indicates over temperature. Usually accompanied by Thermal LED. Check fan operation. Be sure process does not exceed duty cycle limit of the machine.
54 Secondary Overcurrent Error	A high level of output current has caused an overload. When this fault occurs, the machine output will be turned OFF.
58 Improper Supply Voltage	The supply voltage to the switch board was found to be outside of the allowable range. May be caused by and improper input voltage configuration.
213 CAN Communication Error	Loss of CAN communication between the switch board and control board or corrupt data between control board and switch board.
Other	Error codes that are not listed are defined as fatal errors. These codes generally indicate internal errors on the switch board. If cycling power does not clear the error, replace the switch board.

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

FLEXTEC™ 650



DISPLAY BOARD TEST**⚠ WARNING**

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

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

TEST DESCRIPTION

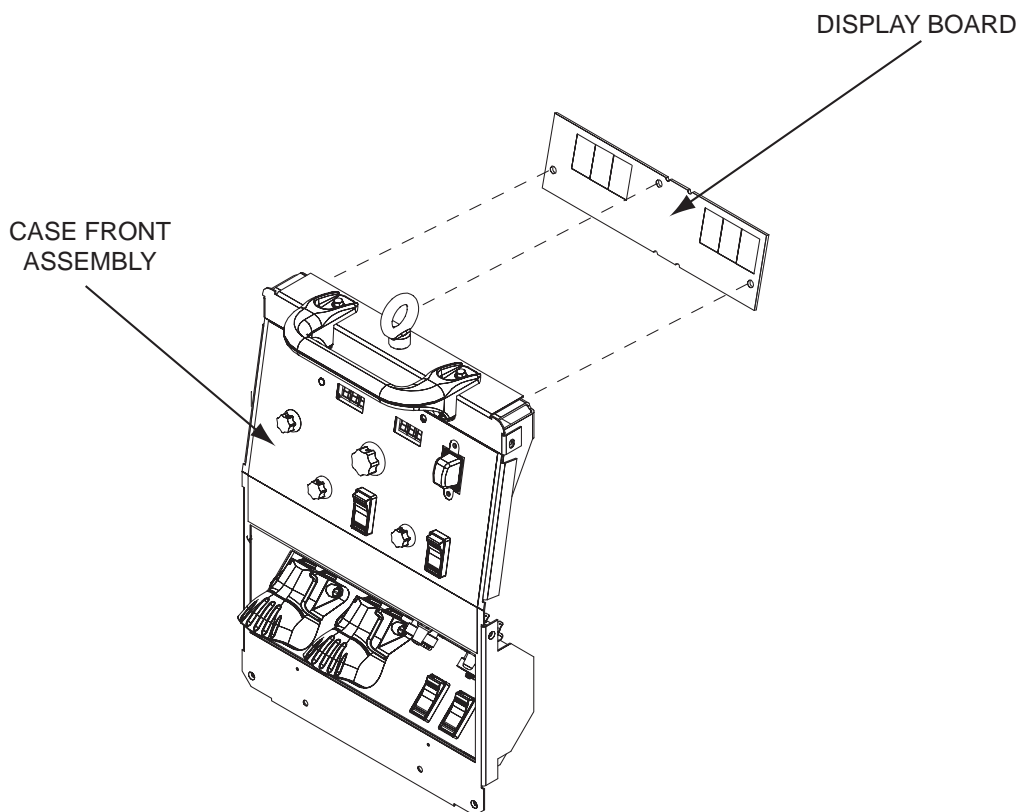
This procedure will determine if the Display Board is receiving the correct input power from the Control Board.

MATERIALS NEEDED

Volt/Ohmmeter

DISPLAY BOARD TEST (continued)

FIGURE F.18 – DISPLAY BOARD LOCATION



PROCEDURE


WARNING


ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

4. Locate the display board. See Figure F.18.
5. Apply the correct three-phase input power and carefully check for 15VDC at J10 pin 7 (Lead #359+) to J10 Pin 8 (Lead #379-). See **Figure F.19**. See Wiring Diagram.
6. If the 15VDC is present at the display board and the display board will not power-up, the display board may be faulty.
7. If the 15VDC is not present at the display board, check for 15VDC at the control board plug J5 Pin 4 (Lead #359+) to J5 Pin 8 (Lead #379-). See Wiring Diagram.

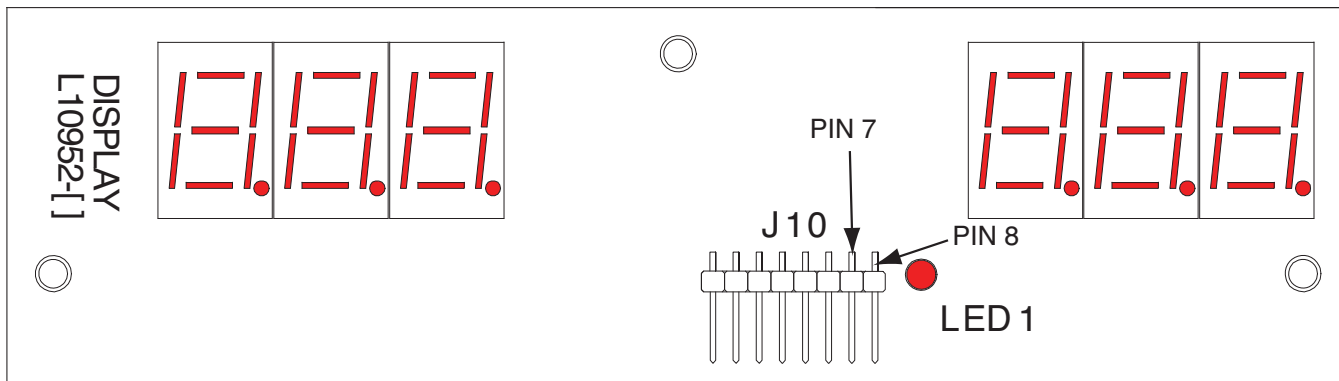
1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **DC Link Capacitor Discharge Procedure**.

FLEXTEC™ 650



DISPLAY BOARD TEST (continued)

FIGURE F.19 – DISPLAY BOARD



8. If the 15VDC is present at the control board but not at the display board check the continuity of leads #359 and #379. See Wiring Diagram.
9. If the 15VDC is not present at the control board (Plug J5) the control board may be faulty.
10. Also check the continuity of the signal leads between the control board plug J5 and J10 at the display board.
11. If faulty, perform the ***Display Board Removal and Replacement Procedure***.
12. Perform the ***Case Cover Replacement Procedure***.
13. Perform ***Retest After Repair***.

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

FLEXTEC™ 650



TROUBLESHOOTING AND REPAIR

THERMOSTAT TEST - THERMAL PROTECTION

WARNING

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

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

TEST DESCRIPTION

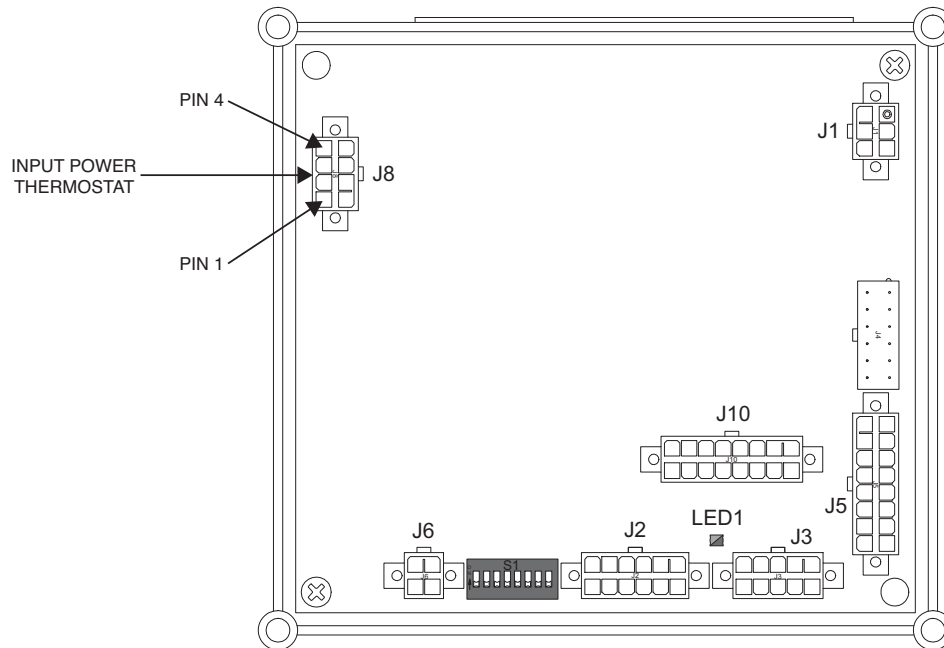
This test will determine if a Thermostat is intermittently opening or is fully open.

MATERIALS NEEDED

Volt / Ohmmeter

THERMOSTAT TEST - THERMAL PROTECTION (continued)

FIGURE F.20 – PLUG J8 LOCATION



PROCEDURE


WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform **Case Cover Removal Procedure**.
3. Perform the **DC Link Capacitor Discharge Procedure**.

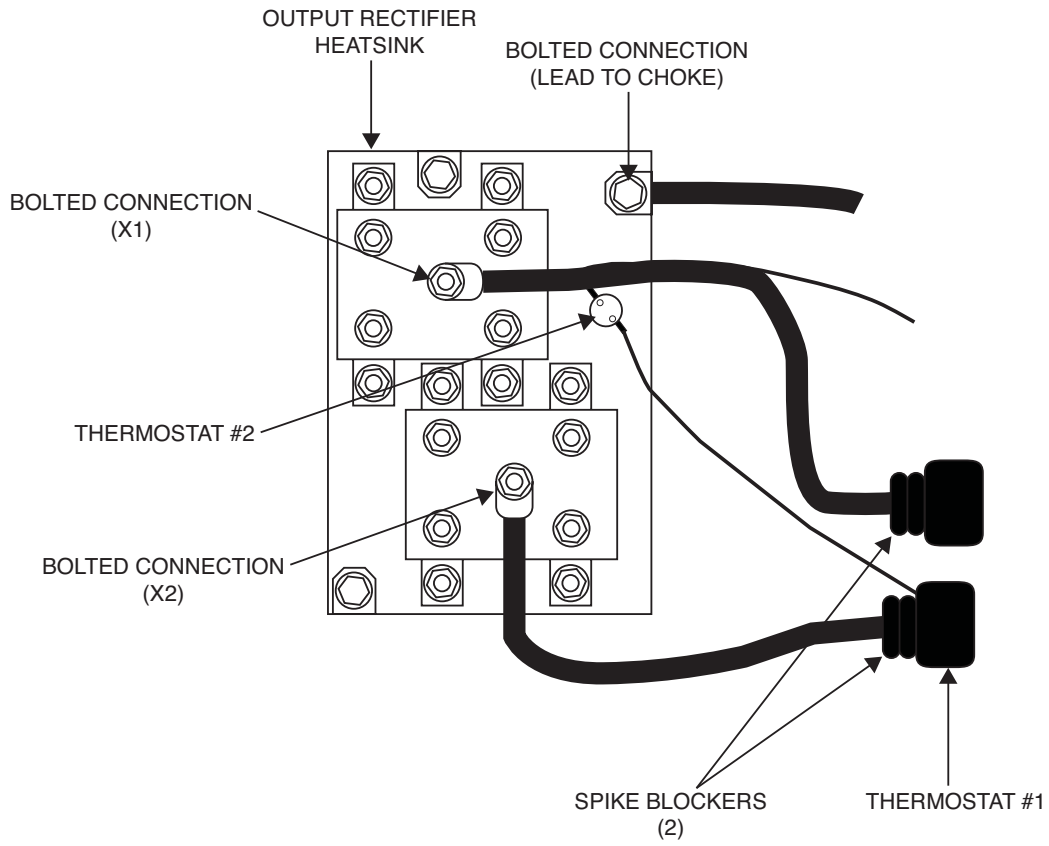
4. Locate plug J8 on the control board. See Figure F.20.
5. Remove the plug from the control board and check the continuity between Pin 1 (Lead #225) and Pin 4 (Lead #224). See Figure F.20. The resistance should be very low (less than one ohm).
6. If the resistance is greater than one ohm, check the leads, connections and the two thermostats. See **Figure F.21** for locations.
7. Perform the **Case Cover Replacement Procedure**.
8. Perform **Retest After Repair**.

FLEXTEC™ 650



THERMOSTAT TEST - THERMAL PROTECTION (continued)

FIGURE F.21 – THERMOSTAT #2



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FLEXTEC™ 650



CASE COVER REMOVAL AND REPLACEMENT PROCEDURE**⚠ WARNING**

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

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

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Case Sheet Metal Covers.

MATERIALS NEEDED

3/8" Wrench

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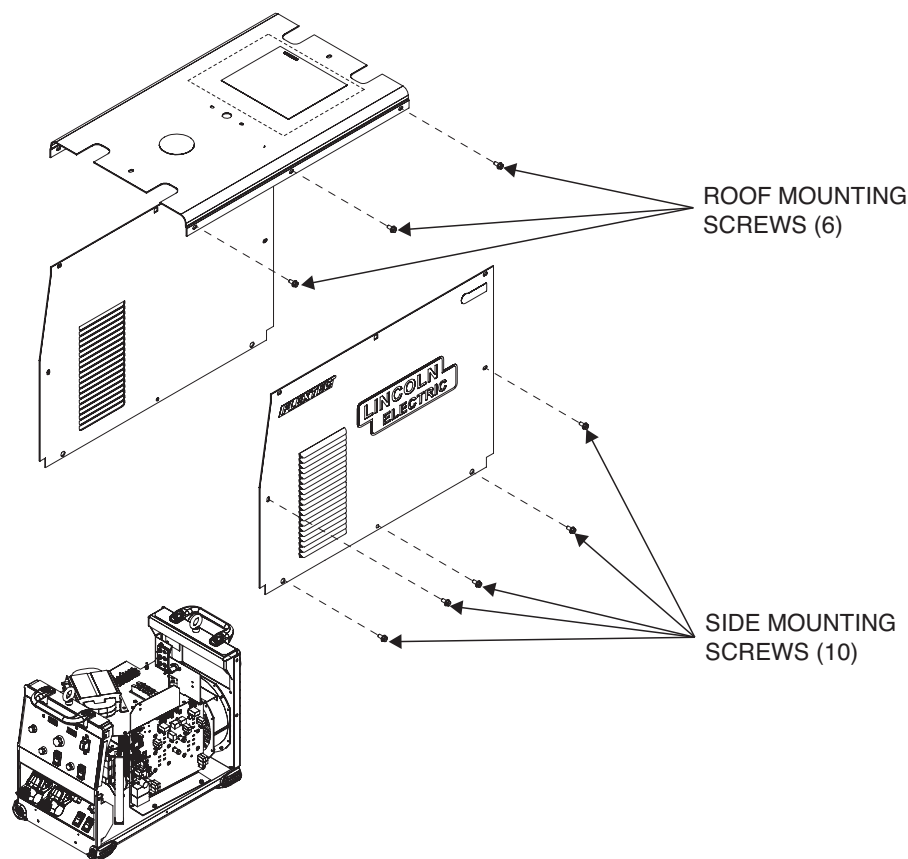
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CASE COVER REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.22 – CASE COVER SCREW LOCATIONS



REMOVAL PROCEDURE


WARNING

ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Turn on/off switch to off position (down).
3. Remove two eyebolts from top front and top back of FLEXTEC™ 650.

4. Using a 3/8" wrench, remove six mounting screws securing the roof and remove roof. See Figure F.22.
5. Using a 3/8" wrench, remove remaining mounting screws from case sides and mounting screws securing rubber corners (5 screws total). Remove case sides. See Figure F.22.
6. Access to the main switch board is made by removing the top and right side panels.
7. Access to the output rectifier assembly, transformer and choke is made by removing the top and left side panels.
8. When servicing is complete replace the case covers.

FLEXTEC™ 650



CASE COVER REMOVAL AND REPLACEMENT PROCEDURE (continued)**REPLACEMENT PROCEDURE**

1. Using a 3/8" wrench, replace previously removed side mounting screws securing the case sides and the mounting screws securing rubber corners (5 screws total). See **Figure F.22**.
2. Using a 3/8" wrench, replace the six previously removed mounting screws securing the roof. See **Figure F.22**.
3. Secure the two previously removed eyebolts to the top front and top back of FLEXTEC™ 650 machine.

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FLEXTEC™ 650



CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE

WARNING

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

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

TEST DESCRIPTION

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

MATERIALS NEEDED

5/16" Nutdriver

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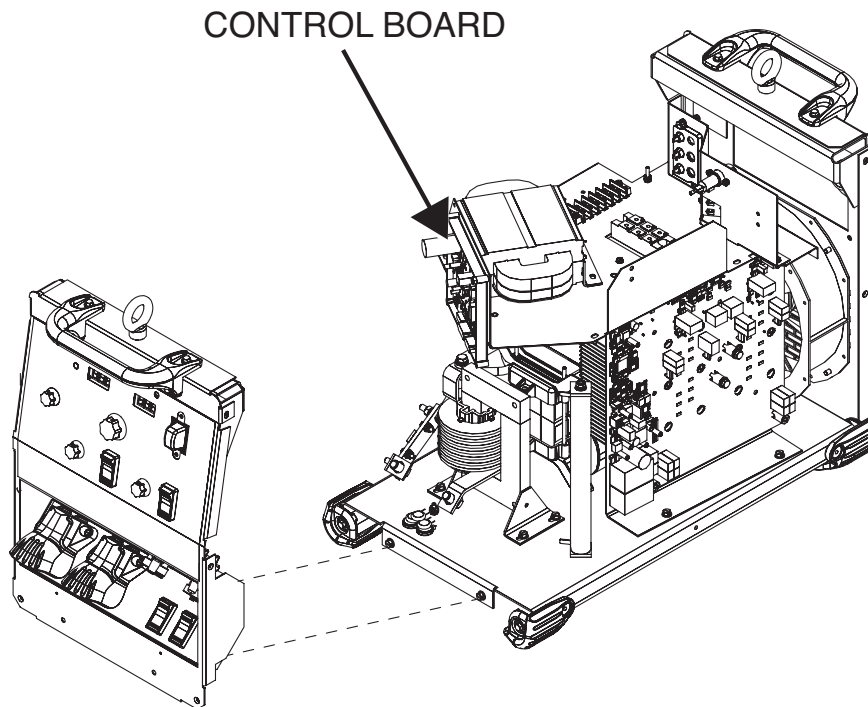
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CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.23 – CONTROL BOARD LOCATION



REMOVAL PROCEDURE

⚠ WARNING



ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

4. Locate the control board. See Figure F.23.
5. Label and disconnect the eight molex type plugs (J1, J4, J5, J3, J10, J2, J6 and J8) from the control board. See **Figure F.24**.
6. Using the 5/16" nutdriver, remove the two screws mounting the control board to the baffle assembly.
7. Clear all leads and remove the control board.

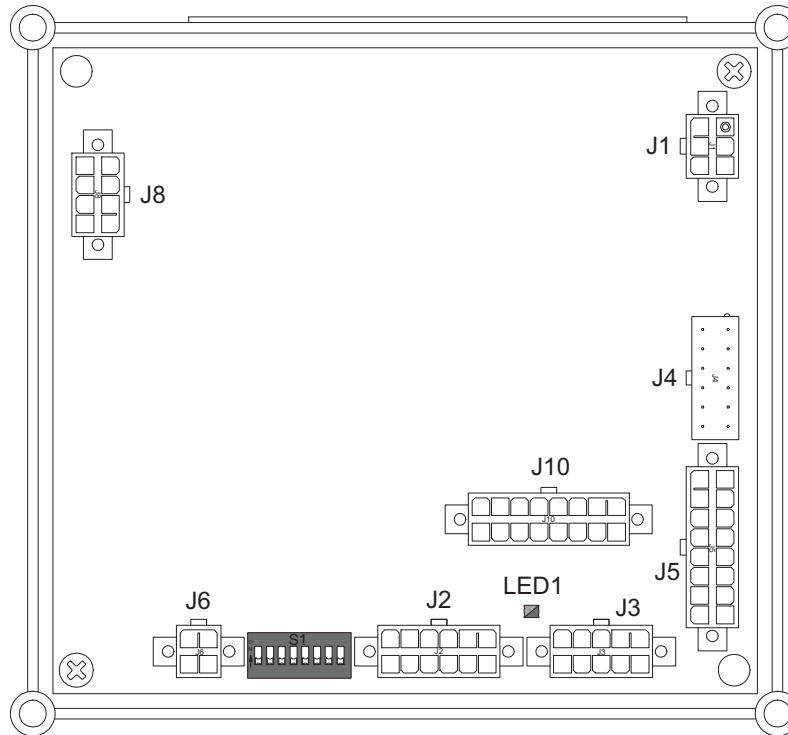
1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **DC Link Capacitor Discharge Procedure**.

FLEXTEC™ 650



CONTROL BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.24 – CONTROL BOARD PLUG LOCATION



REPLACEMENT PROCEDURE

1. Using a 5/16" nutdriver, secure the two previously removed screws, mounting the new control board to the baffle assembly.
2. Connect the eight molex type plugs (J1, J4, J5, J3, J10, J2, J6 and J8) previously removed. See Figure F.24. and the Wiring Diagram.
3. Make sure the dip switch settings are all in the OFF position (Down) or set per input voltage for VRD™.
4. Perform the **Case Cover Replacement Procedure**.
5. Perform **Retest After Repair**.

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FLEXTEC™ 650



DISPLAY BOARD REMOVAL AND REPLACEMENT PROCEDURE

WARNING

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

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

TEST DESCRIPTION

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

MATERIALS NEEDED

Screwdriver

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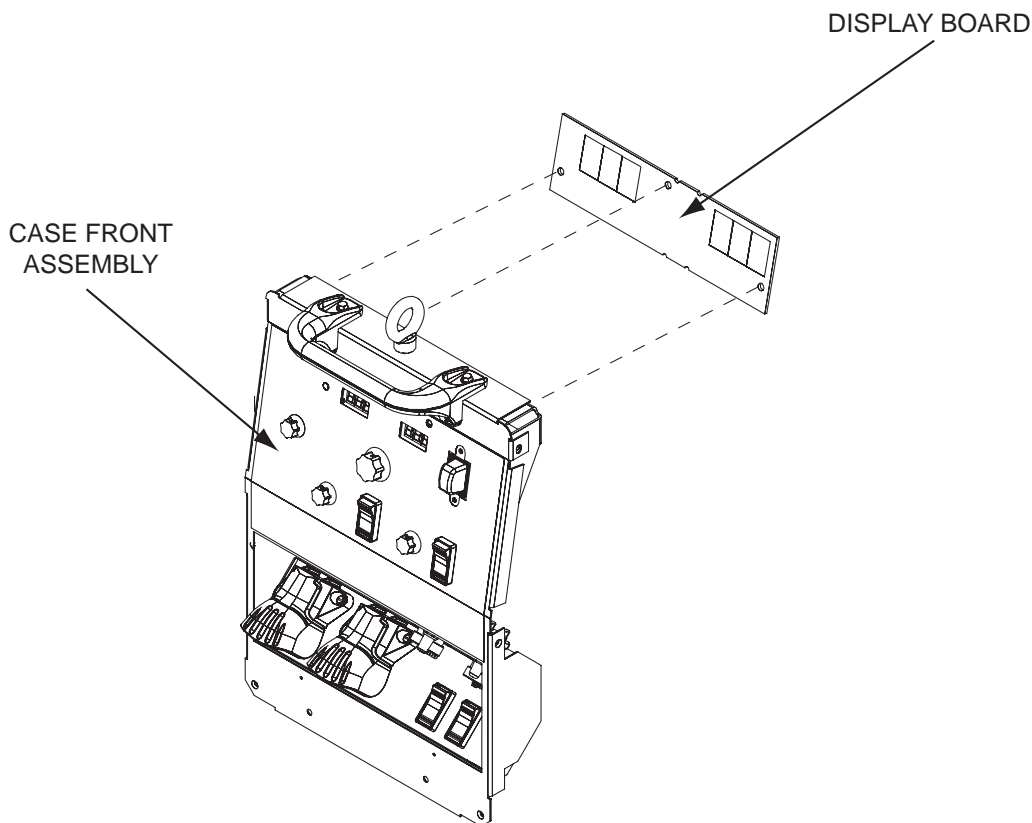
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DISPLAY BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.25 – DISPLAY BOARD LOCATION



REMOVAL PROCEDURE

⚠ WARNING



ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

3. Perform the *DC Link Capacitor Discharge Procedure*.
4. Locate the display board. See Figure F.25.
5. Gently remove the display board from the three mounting pins.
6. Remove the J10 plug from the display board. See *Figure F.26*.

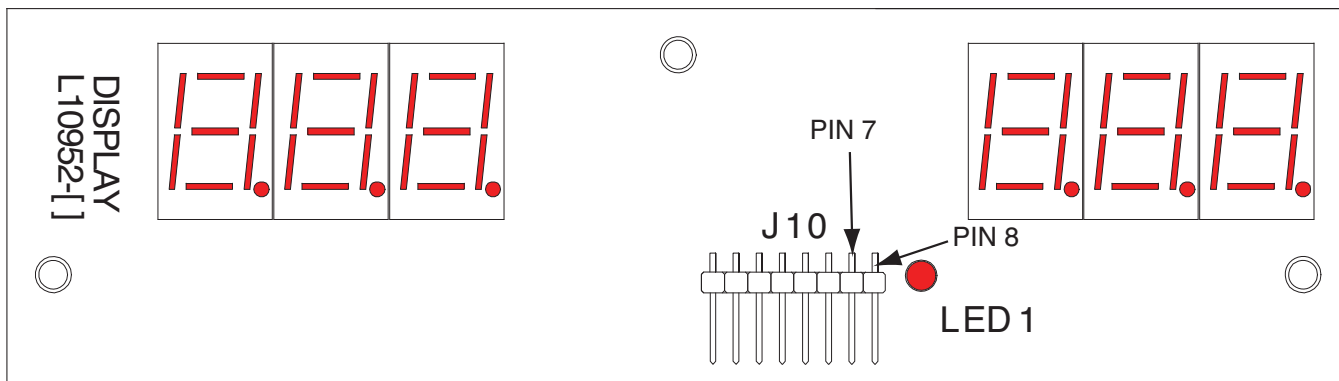
1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform the *Case Cover Removal Procedure*.

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DISPLAY BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.26 – DISPLAY BOARD



REPLACEMENT PROCEDURE

1. Carefully connect J10 plug into the new display board.
2. Align the display board with the three mounting pins and slide the display board into place.
3. Perform the **Case Cover Replacement Procedure**.
4. Perform **Retest After Repair**.

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FLEXTEC™ 650



SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE

WARNING

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

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

TEST DESCRIPTION

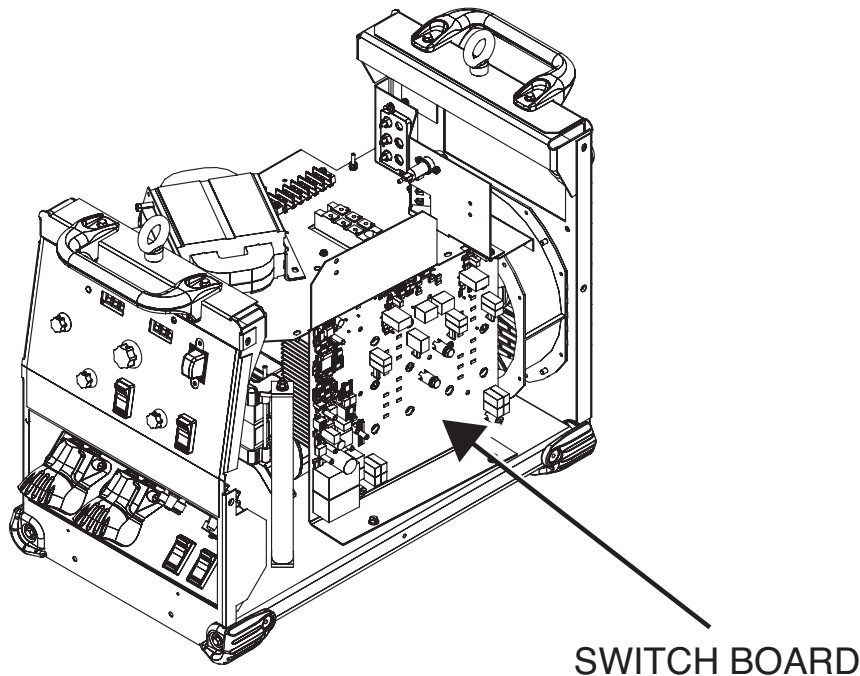
This procedure will aid the technician in the removal and replacement of the Switch Board.

MATERIALS NEEDED

- 7/16" Wrench
- #25 Torx Bit or Wrench
- Cardstock or Paper Towels
- Rag and Alcohol
- Dow Thermal Compound
- Torque Wrench (40-48 in-lb)

SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.27 – SWITCH BOARD LOCATION



REMOVAL PROCEDURE

⚠ WARNING



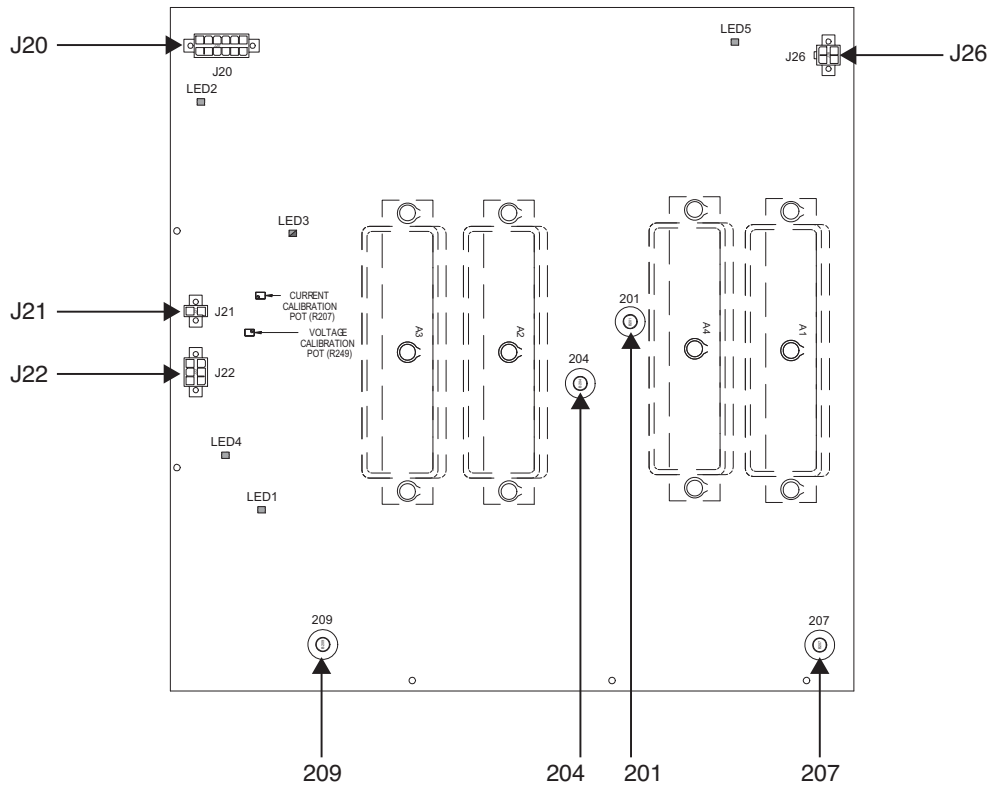
ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform **Case Cover Removal Procedure**.
3. Perform the **DC Link Capacitor Discharge Procedure**.
4. Locate the switch board. See Figure F.27.

SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.28 – SWITCH BOARD PLUG AND LEAD LOCATIONS



5. Label and disconnect the four plugs (J20, J21, J22 and J26) from the switch board. See Figure F.28.
6. Using the 7/16" wrench, remove the bolts, lock washers and flat washers securing leads #207, #209, #201 and #204 to the switch board. See Figure F.28. **Note lead placement for re-assembly.**
7. Using the #25 torx wrench, remove the 12 screws and lock washers mounting the switch board to the heat sink. See **Figure F.29**.
8. Carefully and gently remove the switch board from the heat sink.
9. Remove heavy amounts of thermal compound off of heatsink. **DO NOT** use a metal scraper or anything that can damage the surface of the heatsink. We suggest using cardstock or paper towels. See **Figure F.30**.
10. Remove remaining amounts of compound with a rag and alcohol.
11. Replace the switch board.

SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.29 – TORX MOUNTING SCREW LOCATIONS

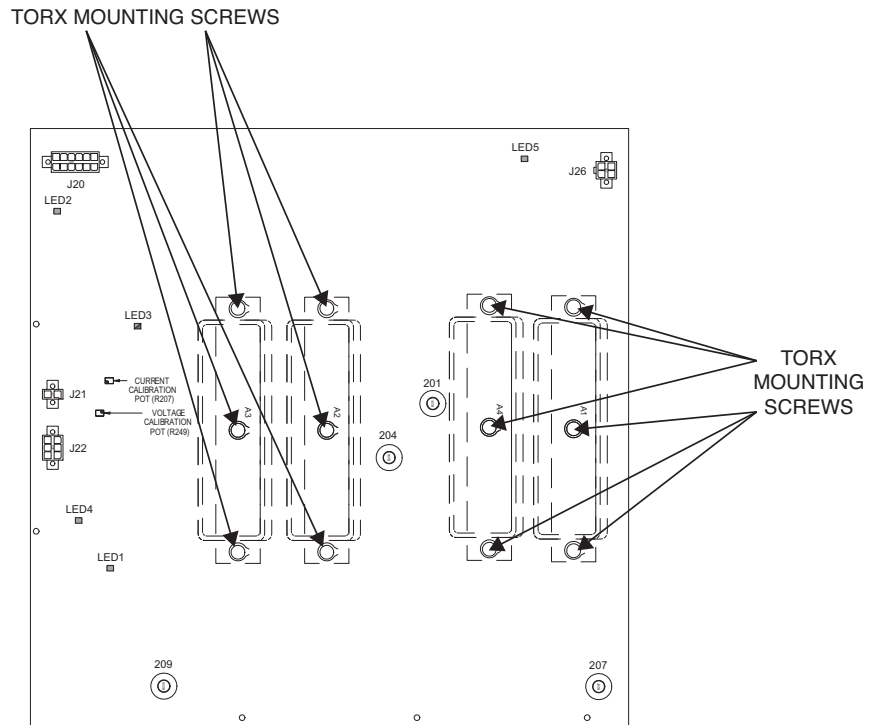
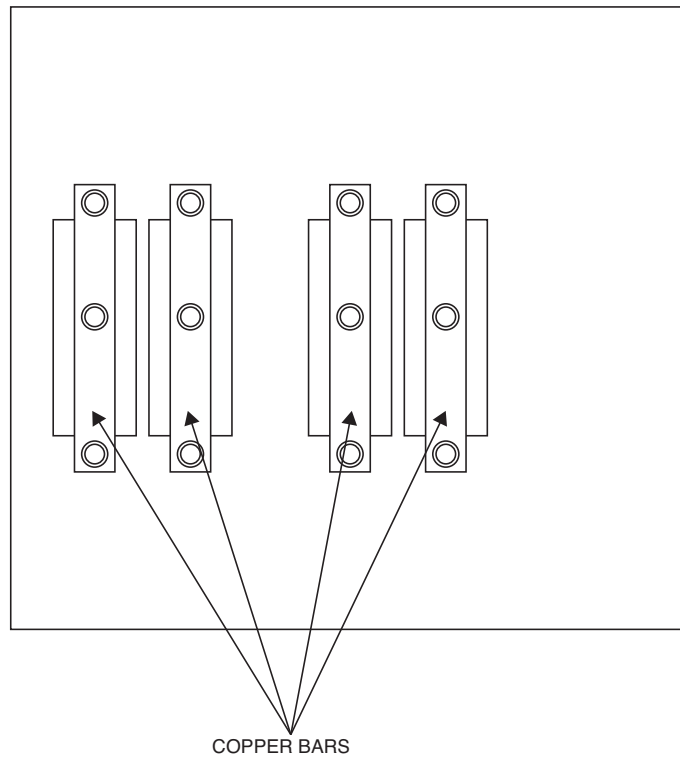


FIGURE F.30 – MODULE BAR GREASE REMOVAL AND APPLICATION POINTS



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SWITCH BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Lay the FLEXTEC™ 650 on its side so that the heatsink is in a horizontal position. This simplifies the mounting of the replacement switch board.
 2. Clean the copper bars on the back side of the switch board with a rag and alcohol. These mating surfaces to the heatsink must be clean and free of debris to ensure good contact and proper thermal transfer. See **Figure F.30**.
 3. Apply a thin layer of thermal compound (Dow Corning 340), (approximately .010" thick), to the copper bars. Cover the bars completely. ONLY use the compound supplied with the replacement board. Substitute compounds may not have the proper thermal transfer properties and can cause the components to fail due to excessive operating temperatures.
NOTE: Keep the compound away from the mounting holes. Compound is not permitted on the screw threads.
 4. Position the switch board onto the heatsink. Align the mounting holes in the copper bars with the mounting holes on the heatsink prior to making contact between the heatsink and the copper bars. This will minimize the amount of movement of the switch board after contact and help ensure the thermal compound interface. See **Figure F.30**.
 5. Hand tighten the 12 mounting screws. Then, torque each screw to 40-48 in-lbs. This torque is important for a good thermal interface between the switch board and the heatsink. See **Figure F.29**.
 6. Attach power leads #207 and #209 to the switch board. Torque the connection to 40-48 in-lbs.
 7. Attach power leads #201 and #204 to the switch board. Torque the connection to 40-48 in-lbs.
- NOTE:** It is very important that leads are attached to their corresponding power terminal. The power terminals on the switch board are identified with the lead numbers. Misconnection will cause switch board failure.
8. Plug in the four molex connectors (J20, J21, J22 and J26) from the wiring harness to their corresponding molex header on the switch board.
 9. Perform the **Case Cover Replacement Procedure**.
 10. Perform **Retest After Repair**.

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OUTPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE

WARNING

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

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

TEST DESCRIPTION

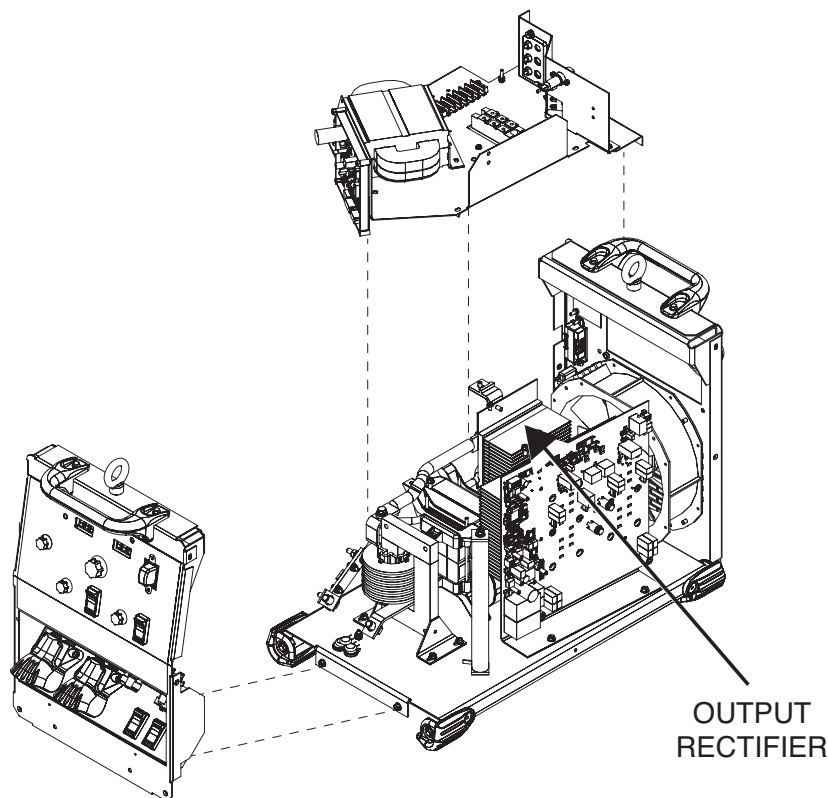
This procedure will aid the technician in the removal and replacement of the Output Rectifier.

MATERIALS NEEDED

- 1/2" Wrench
- 3/8" Wrench
- 7/16" Wrench
- Dow 340 Thermal Compound
- Torque Wrench

OUTPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.31 – OUTPUT RECTIFIER LOCATION



REMOVAL PROCEDURE

WARNING



ELECTRIC SHOCK can kill.

- Have a qualified individual install and service this equipment.
- Turn the input supply power OFF at the disconnect switch or fuse box before working on this equipment.
- Do not touch electrically hot parts.

1. Remove the input power to the FLEXTEC™ 650 machine.
2. Perform *Case Cover Removal Procedure*.
3. Perform the *DC Link Capacitor Discharge Procedure*.

4. Locate the output rectifier assembly. See Figure F.31.
5. Using the 1/2" wrench, remove the bolt, lock washer and flat washers securing the choke lead to the output rectifier heat sink. See *Figure F.32*. See the Wiring Diagram.
6. Using the 7/16" wrench, remove the bolts, lock washers and flat washers securing the two transformer leads (X1 and X2) to the output rectifier modules. See *Figure F.32*.
7. Remove the two leads from the output heat sink thermostat. See *Figure F.32*.
8. Using the 7/16" wrench, remove the three bolts, lock washers and flat washers mounting the output rectifier assembly to the three plastic mounting brackets. See *Figure F.33*.
9. Using the 3/8" wrench, remove the bottom two plastic mounting brackets from the machine base.
10. Carefully remove the output rectifier assembly from the machine.

FLEXTEC™ 650



OUTPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.32 – OUTPUT RECTIFIER BOLT LOCATIONS

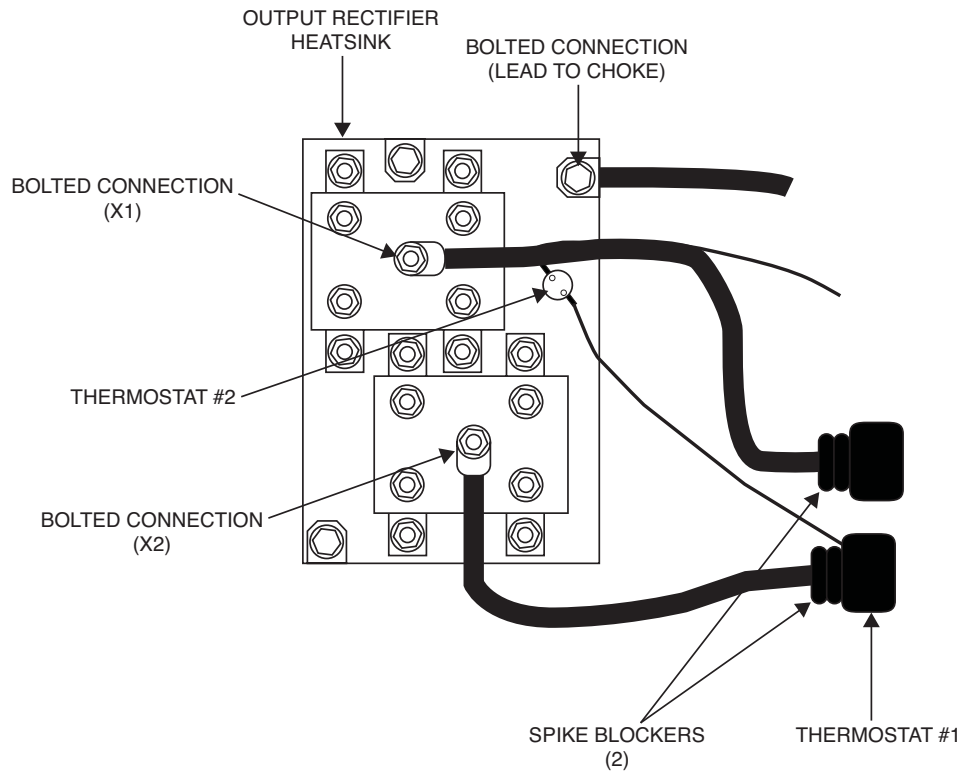
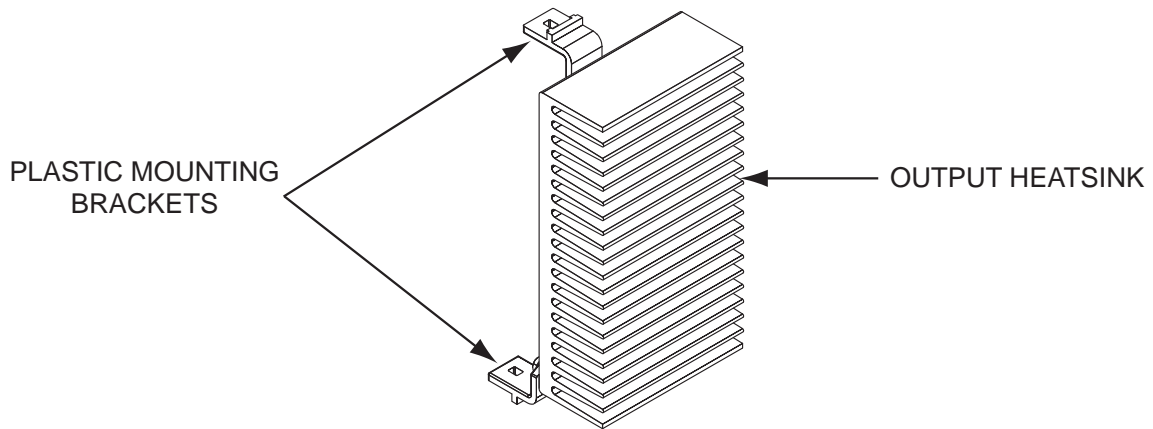


FIGURE F.33 – OUTPUT RECTIFIER PLASTIC MOUNTING BRACKETS



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OUTPUT RECTIFIER REMOVAL AND REPLACEMENT PROCEDURE (continued)

REPLACEMENT PROCEDURE

1. Carefully position the new output rectifier assembly into place.
2. Using the two bolts and washers previously removed, connect the bottom two plastic mounting brackets onto the machine base.
3. Using the three bolts and washers previously removed, attach the output rectifier assembly to the three plastic mounting brackets. Tighten all bolts.
4. Connect the two previously removed thermostat leads.
5. Apply a thin coating (0.010) of Dow Corning 340 compound to the mating surfaces of the transformer leads (X1 and X2) and the choke lead.
6. Using the bolts and washers previously removed, connect the three leads to the correct connection points. See **Figure F.32**.
7. Hand tighten the bolts. Then torque each bolt to 40-48 inch pounds. The torque is important for good thermal and electrical contact between the output rectifier, the choke and the transformer.
8. Perform the **Case Cover Replacement Procedure**.
9. Perform **Retest After Repair**.

RETEST AFTER REPAIR

RETEST A MACHINE:

If it is rejected under test for any reason that requires you to remove any part which could affect the machine's electrical characteristics.

OR

If you repair or replace any electrical components.

INPUT IDLE AMPS AND WATTS

INPUT VOLTS / HERTZ	MAXIMUM IDLE AMPS				MAXIMUM IDLE WATTS			
	OCV ON FAN ON	OCV ON FAN OFF	OCV OFF FAN ON	OCV OFF FAN ON	OCV ON FAN ON	OCV ON FAN OFF	OCV OFF FAN ON	OCV OFF FAN ON
380V, 50 Hz	1.5	1.1	1.1	0.8	420W	300W	210W	90W
460V, 50 Hz	1.5	1.1	1.1	0.8	500W	370W	230W	100W
575, 50 Hz	1.3	1.1	1.0	0.7	520W	400W	230W	100W

MAXIMUM OPEN CIRCUIT VOLTAGES

INPUT VOLTS/HERTZ	OUTPUT TERMINALS - NO LOAD	
380 / 50	VRD™ Enabled	GTAW 12-32VDC Max
460 / 60		SMAW 12-35VDC Max
575 / 60	VRD™ Disabled	GTAW 20-32VDC Max
		SMAW 58-72VDC Max
		CV 58-72VDC Max
		CV-1 58-72VDC Max
		SAW 58-72VDC Max

TEST AFTER REPAIR**FLEXTEC™ 650– CONSTANT CURRENT GRID LOAD TESTING**

Dip Switch #4 in the ON position; All other Dip Switch positions OFF.

Switches and potentiometers:

Weld Terminals On/Remote Switch – REMOTE Position

Process Selection Switch – GTAW Position

Local / Remote Switch – Selects whether the local output control potentiometer or the remote 6 pin connector potentiometer will be used.

Output Control Potentiometer – Controls Current Set (20 to 500 Amps) when Local / Remote switch is in LOCAL position.

Arc Control Potentiometer - Fully Counter-Clockwise

Hot Start Switch – OFF position.

14 pin feeder connector – Not connected

6 pin remote connector – Controls Current Set (20 to 500 Amps) when Local / Remote switch is in REMOTE position.

Turn on Power. Allow at least 10 seconds after power on before running this test to allow for initialization of the switch board.

The right display will read “Cur“ and the left display will show the preset for the current set.

Adjust the output control knob to the preset current desired for testing.

Switch the Weld Terminals switch to the ON position (with the machine properly loaded by a grid load) and the machine will show the actual voltage and current on the display.

Switch the Weld Terminals Switch to the REMOTE position and the output will turn off.

FLEXTEC™ 650– CONSTANT VOLTAGE GRID LOAD TESTING

Dip Switch #4 in the ON position; All other Dip Switch positions OFF.

Switches and potentiometers:

Weld Terminals On/Remote Switch – REMOTE Position

Process Selection Switch – CV Position

Local / Remote Switch – Selects whether the local output control potentiometer or the remote 6 pin connector potentiometer will be used.

Output Control Potentiometer – Controls Voltage Set (10.0 to 45.0 Volts) when Local / Remote switch is in LOCAL position.

Arc Control Potentiometer – Fully Clockwise

Hot Start Switch – OFF position.

14 pin feeder connector – Not connected

6 pin remote connector – Controls Voltage Set (10.0 to 45.0 Volts) when Local / Remote switch is in REMOTE position.

Turn on Power. Allow at least 10 seconds after power on before running this test to allow for initialization of the switch board.

The left display will read “U“ and the right display will show the preset for the voltage set.

Adjust the Output Control knob or the 6 pin remote potentiometer to set the preset voltage desired for testing.

Switch the Weld Terminals switch to the ON position (with the machine properly loaded by a grid load) and the machine will show the actual voltage and current on the display.

When the Output Control potentiometer is changed quickly while operating, the output may “drop out” during a transition to a new set voltage. This is normal for the special voltage grid load test mode.

Switch the Weld Terminals Switch to the REMOTE position and the output will turn off.

Test results will point to area of concern or will indicate unit is fully functional.

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Electrical DiagramsG-1

 Wiring Diagram (G7148)G-2

 Schematic – Complete Machine (G7201)G-3 thru G-4

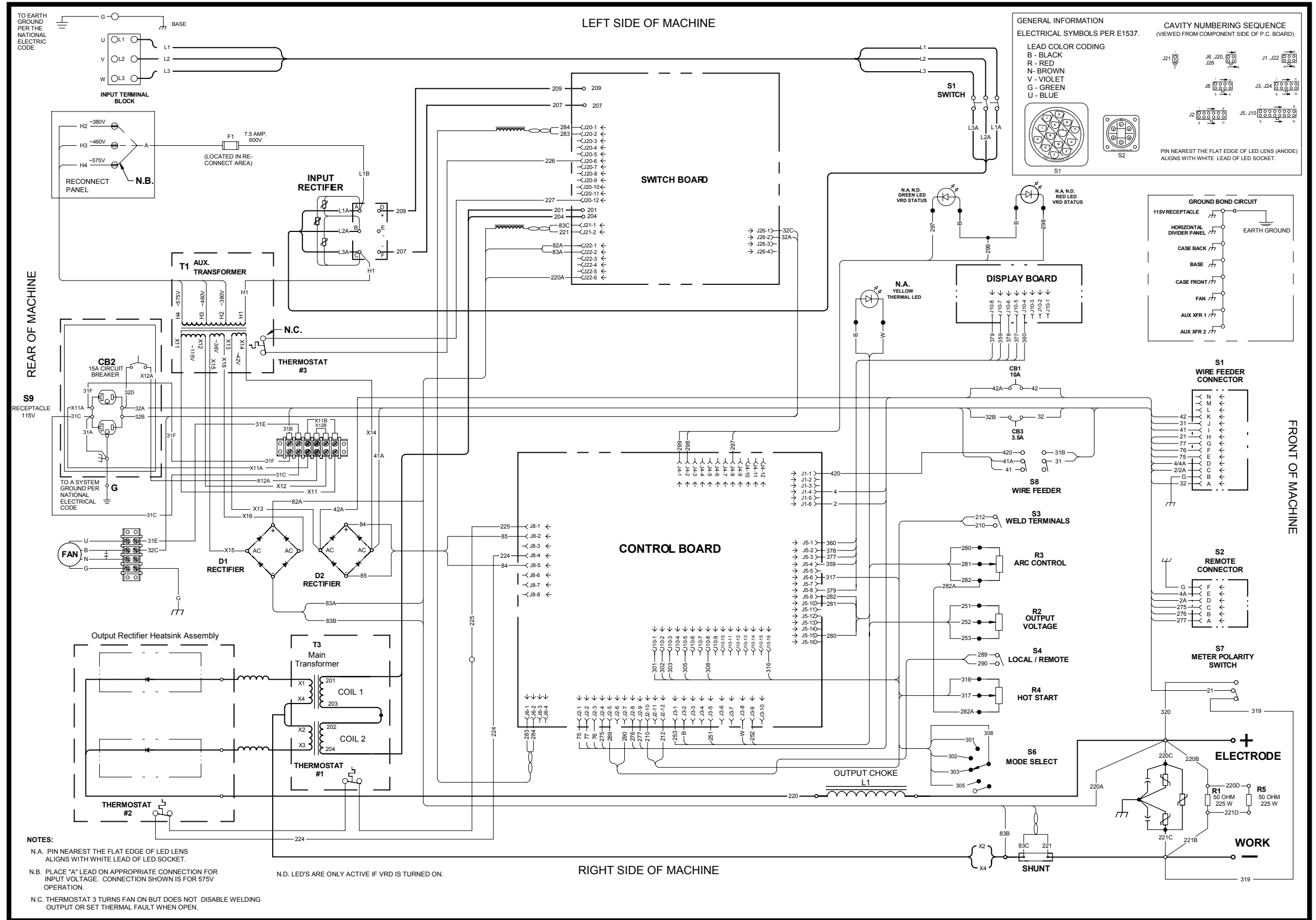
 Schematic - Control PC Board (G4767-2F3)G5 thru G-11

 Schematic - Switch PC Board (G6988-1E3)G12 thru G18

*** NOTE:** Many PC Board Assemblies are now totally encapsulated, surface mounted and or multi-layered and are therefore considered to be unserviceable. Assembly drawings of these boards are no longer provided.

WIRING DIAGRAM - COMPLETE MACHINE - (CODE 11814) (G7148)

FLEXTEC 650 WIRING DIAGRAM



G7148 A

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

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SCHEMATIC - FLEXTEC™ 650 - COMPLETE MACHINE - (CODE 11814) (G7201) PG 1

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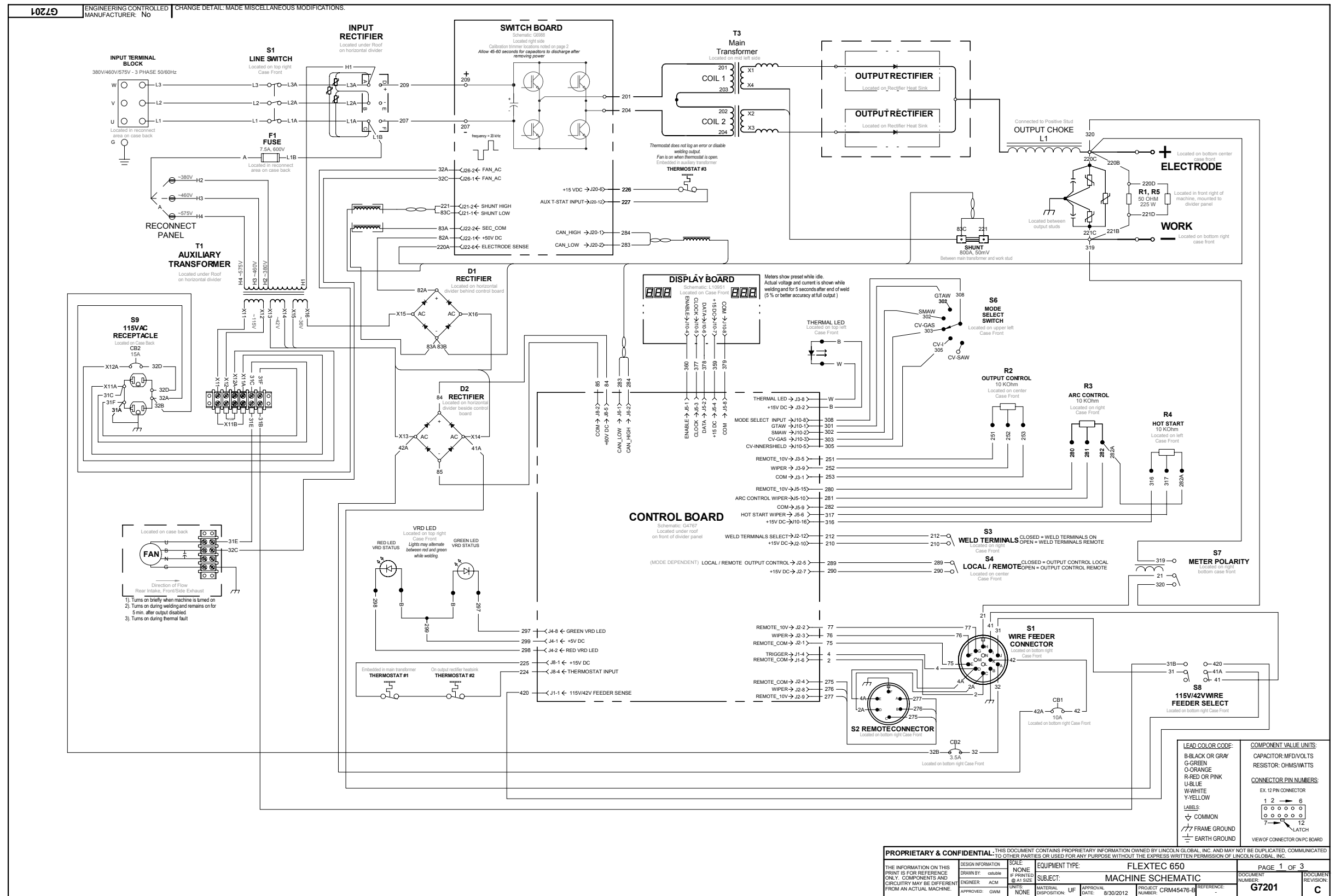
Return to Section TOC

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

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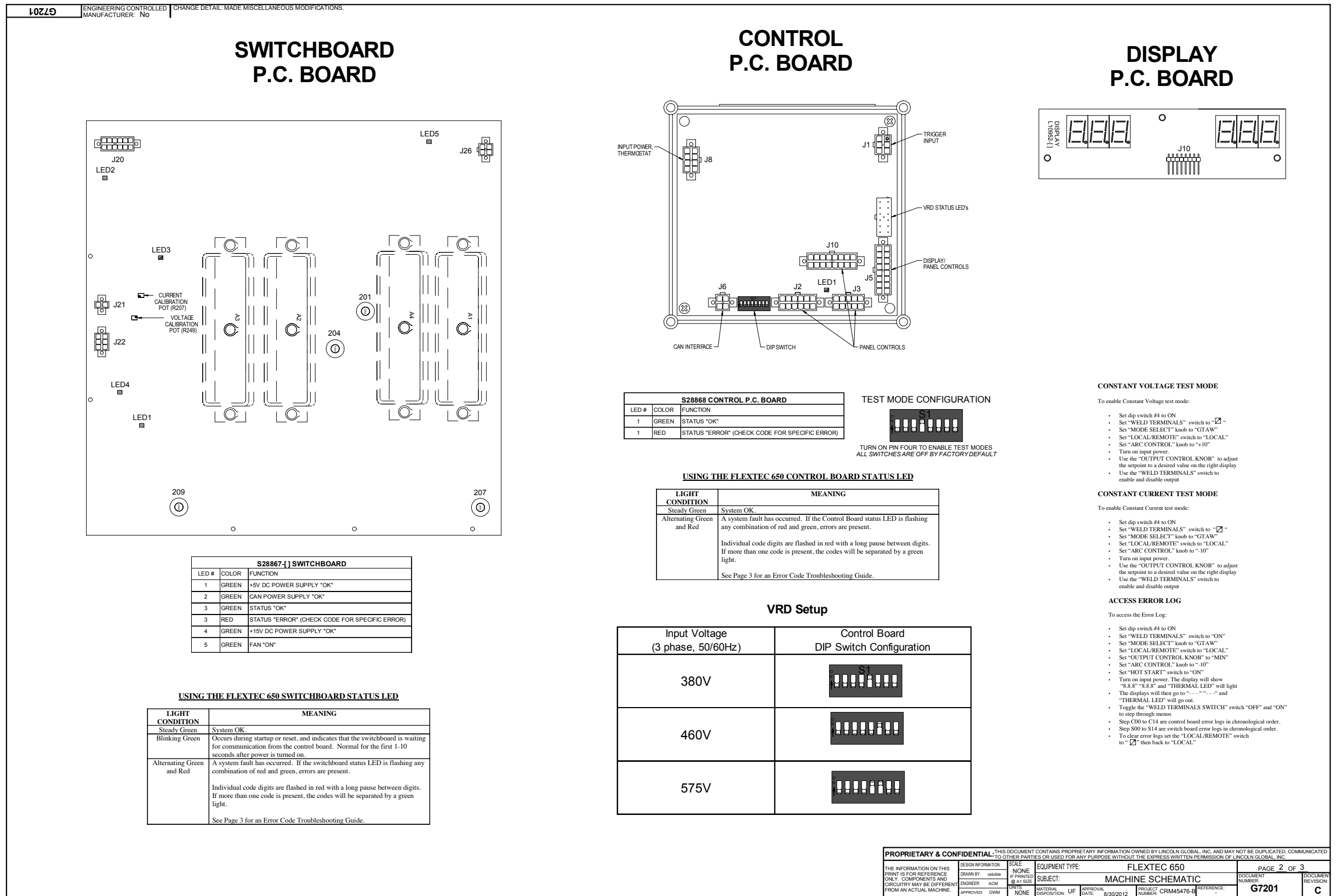
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NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

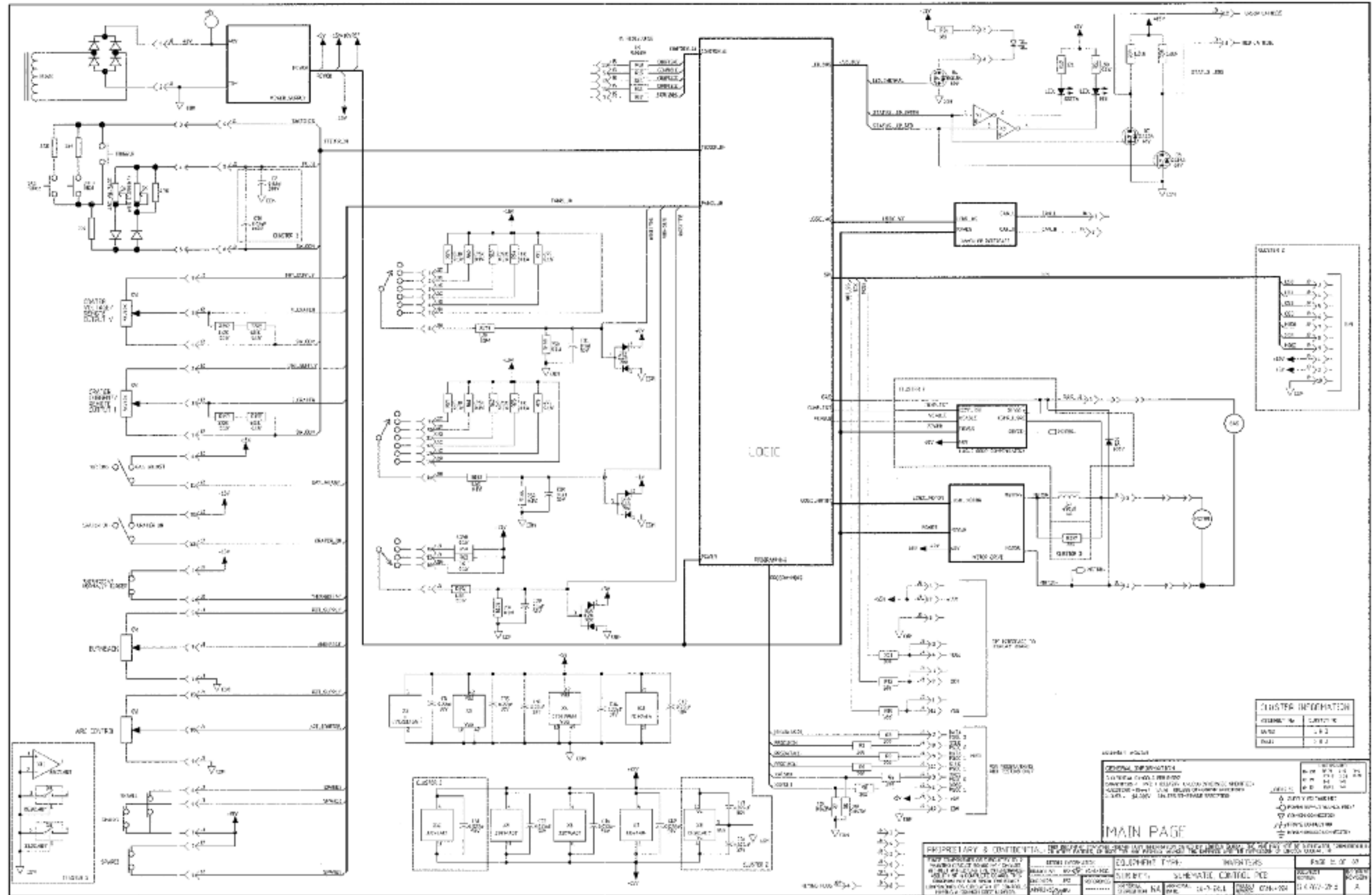
SCHEMATIC - CONTROL PC BOARD (G4767-2F3) PG 1

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

SCHEMATIC - CONTROL PC BOARD (G4767-2F3) PG 2

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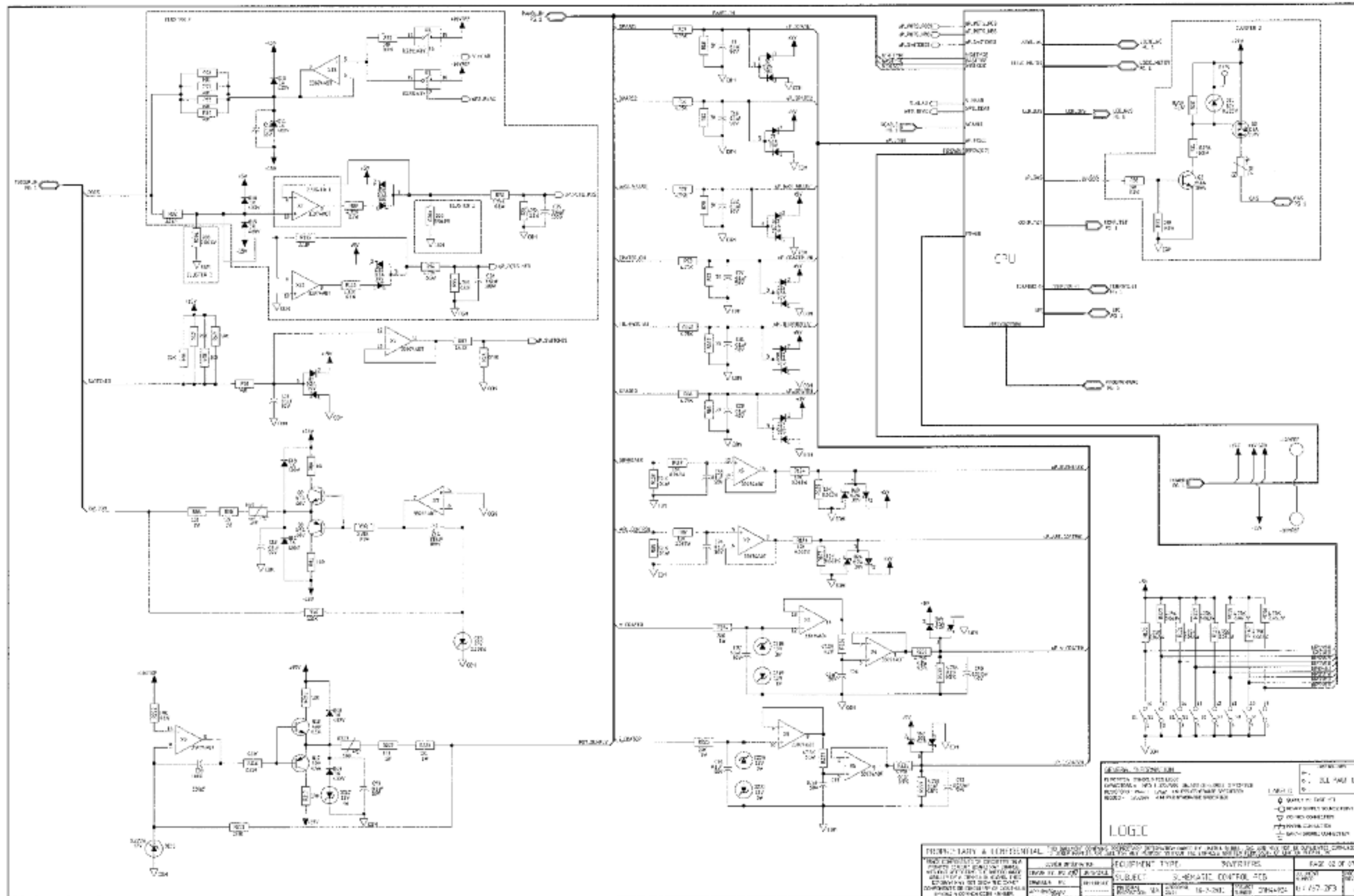
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NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

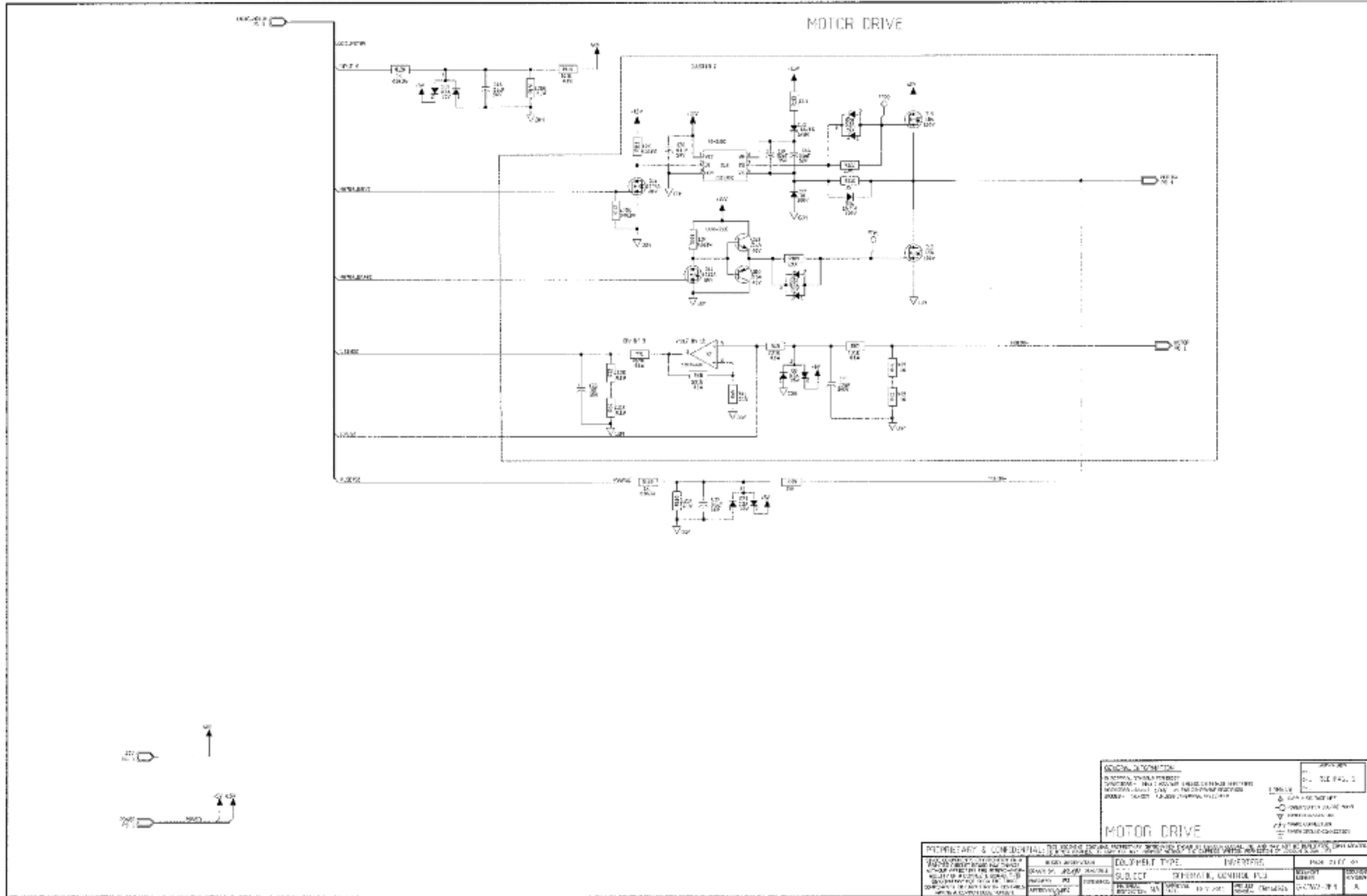
SCHEMATIC - CONTROL PC BOARD (G4767-2F3) PG 3

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Return to Section TOC
Return to Master TOC

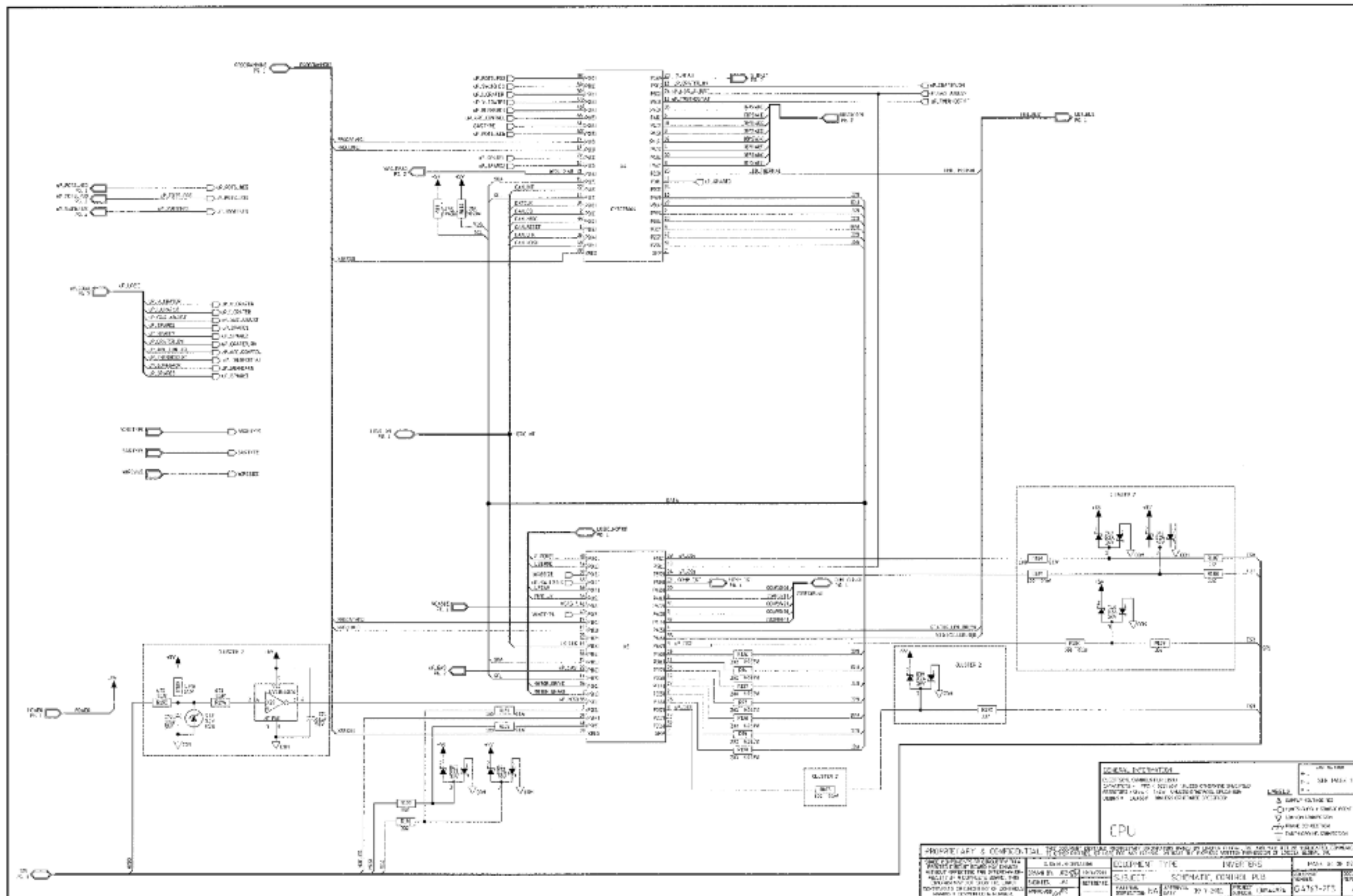
Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC



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

SCHEMATIC - CONTROL PC BOARD (G4767-2F3) PG 4



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

Return to Section TOC (left margin, repeated vertically)

SCHEMATIC - CONTROL PC BOARD (G4767-2F3) PG 5

Return to Section TOC

Return to Section TOC

Return to Section TOC

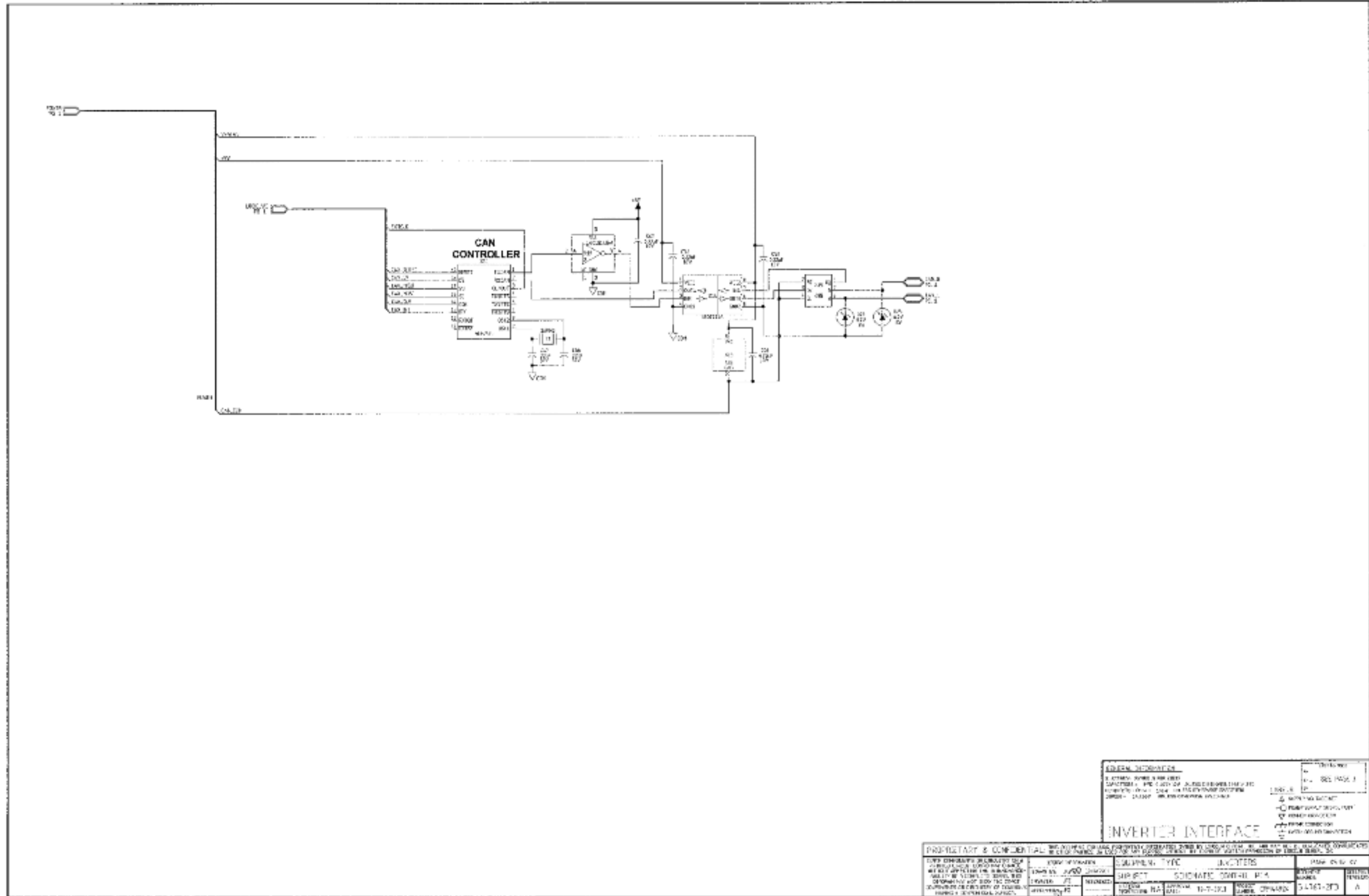
Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC



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

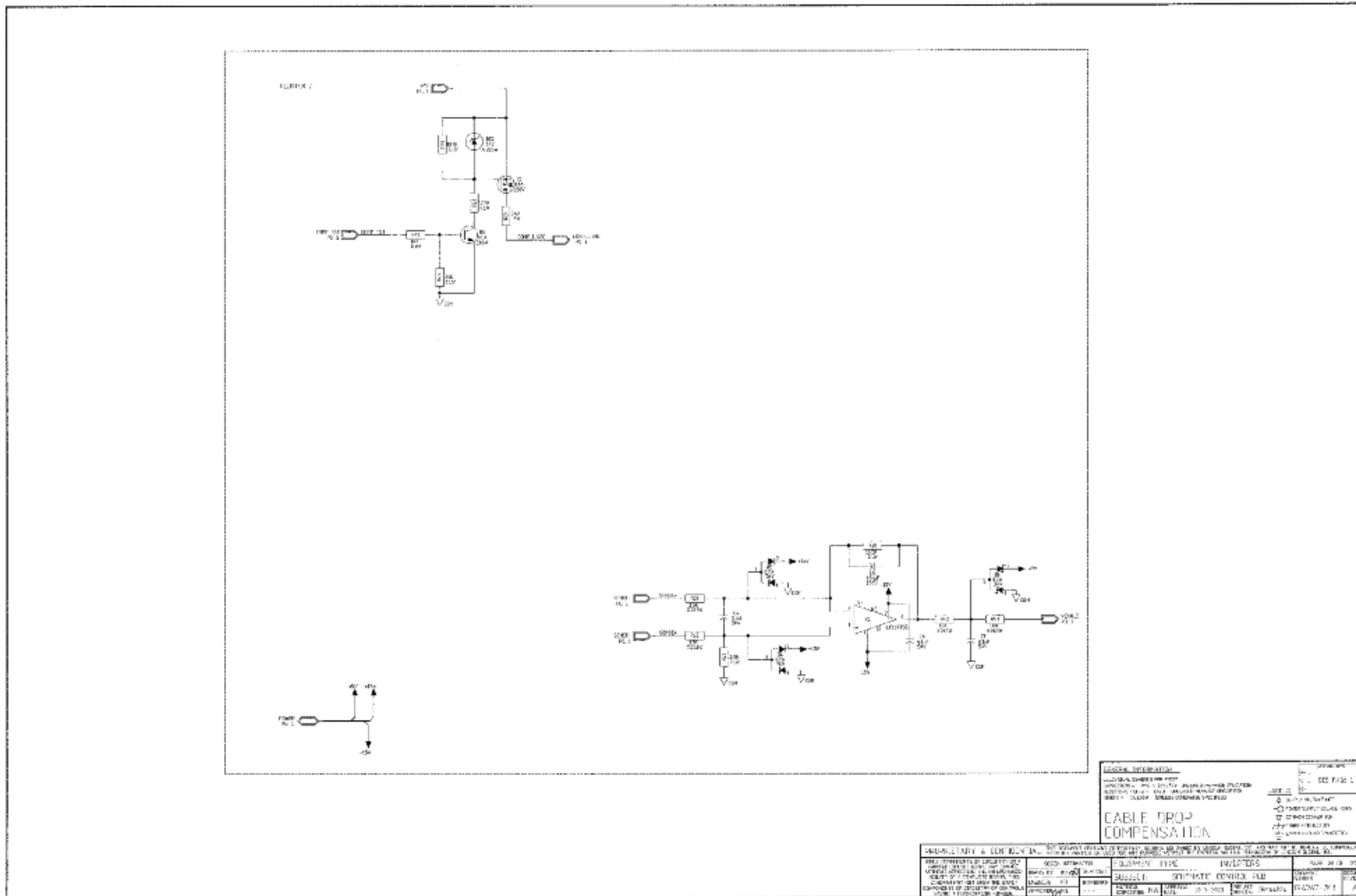
SCHEMATIC - CONTROL PC BOARD (G4767-2F3) PG 6

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



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

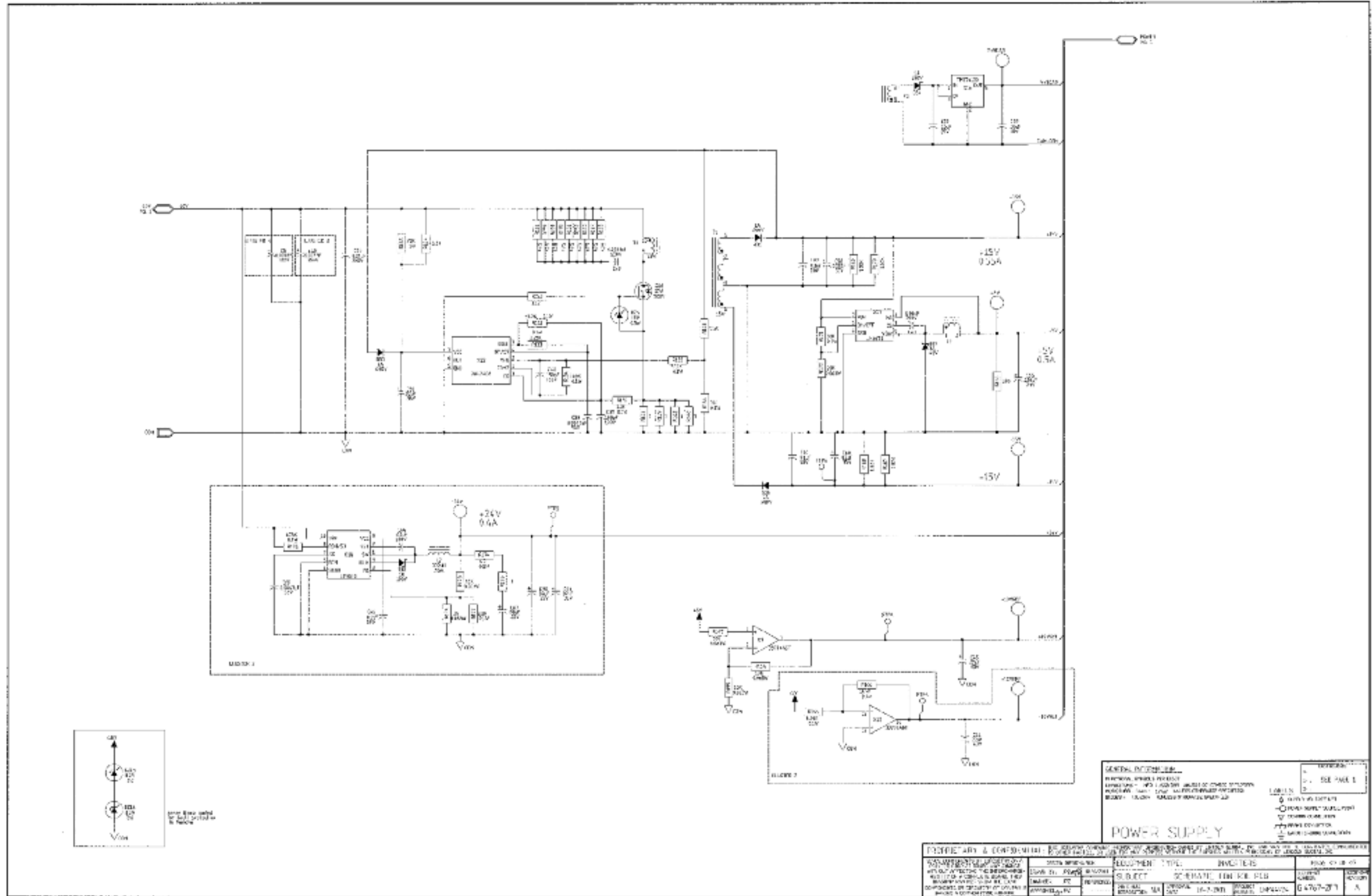
SCHEMATIC - CONTROL PC BOARD (G4767-2F3) PG 7

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



GENERAL INFORMATION:

REVISIONS: 1 - SEE PAGE 1

DATE: 10-1-80

BY: J. J. JONES

APPROVED: J. J. JONES

POWER SUPPLY

PROPRIETARY & CONFIDENTIAL: This document contains information that is the property of Lincoln Electric Company. It is not to be distributed outside the company without the written consent of Lincoln Electric Company.		REVISION TYPE: INVENTS	PAGE: 11 OF 15
DATE: 10-1-80	BY: J. J. JONES	SUBJECT: SCHEMATIC FOR PCB	DRAWN: J. J. JONES
APPROVED: J. J. JONES	CHECKED: J. J. JONES	PART: G4767-2F3	REV: A

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

SCHEMATIC - SWITCH PC BOARD (G6988-1E3) PG 1

Return to Section TOC

Return to Section TOC

Return to Section TOC

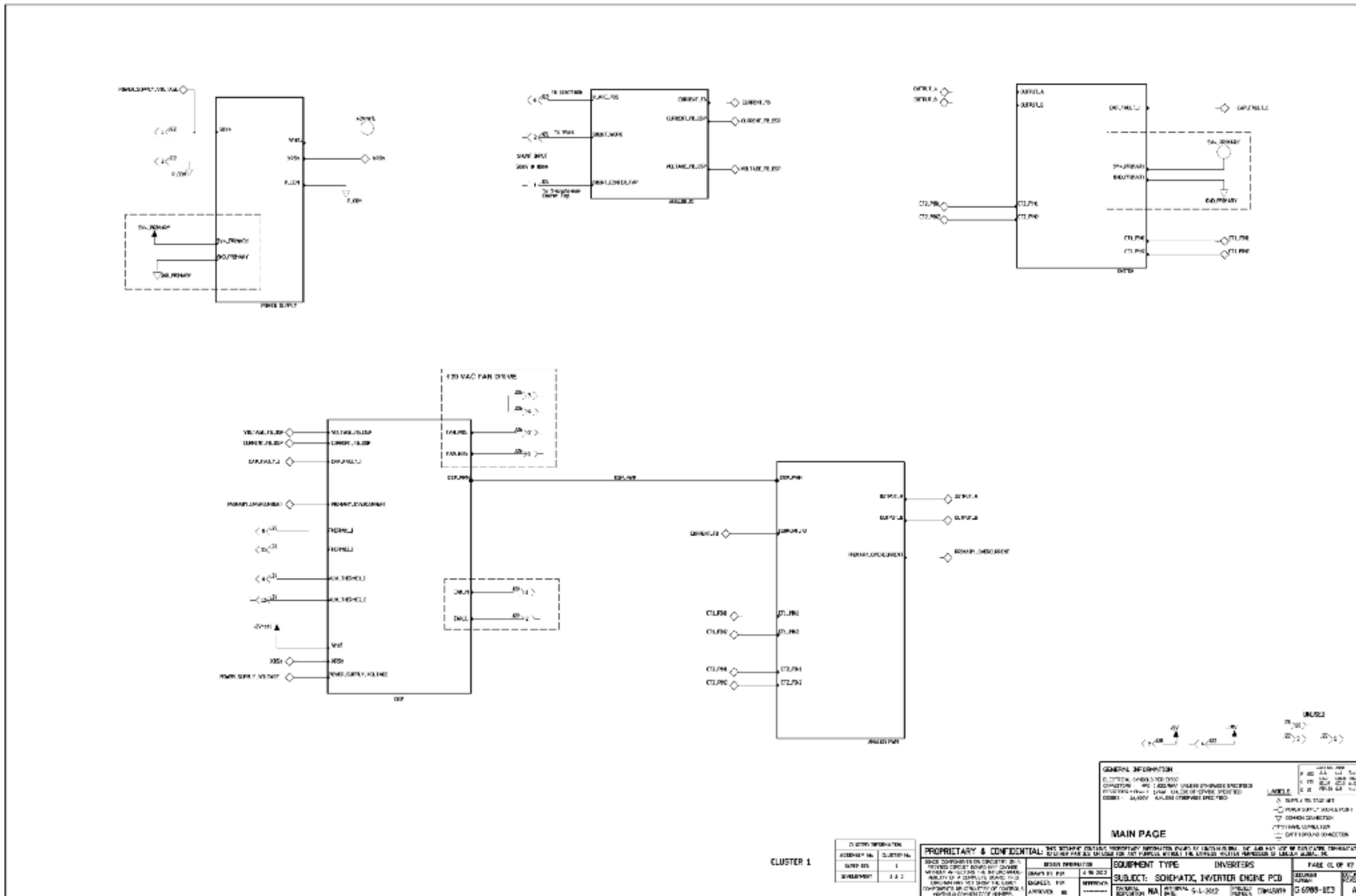
Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC



GENERAL INFORMATION		REVISIONS	
DATE: 04/03/2010	BY: J. J. J.	NO. 1	DATE: 04/03/2010
DESCRIPTION: 120 VAC FAN DRIVE	BY: J. J. J.	NO. 2	DATE: 04/03/2010
DATE: 04/03/2010	BY: J. J. J.	NO. 3	DATE: 04/03/2010

CLUSTER INFORMATION		EQUIPMENT TYPE	
CLUSTER NO. 1	CLUSTER NO. 1	INVERTERS	INVERTERS
DATE: 04/03/2010	BY: J. J. J.	SUBJECT: SCHEMATIC, INVERTER ENGINE PCB	DATE: 04/03/2010
DESCRIPTION: 120 VAC FAN DRIVE	BY: J. J. J.	DATE: 04/03/2010	BY: J. J. J.

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



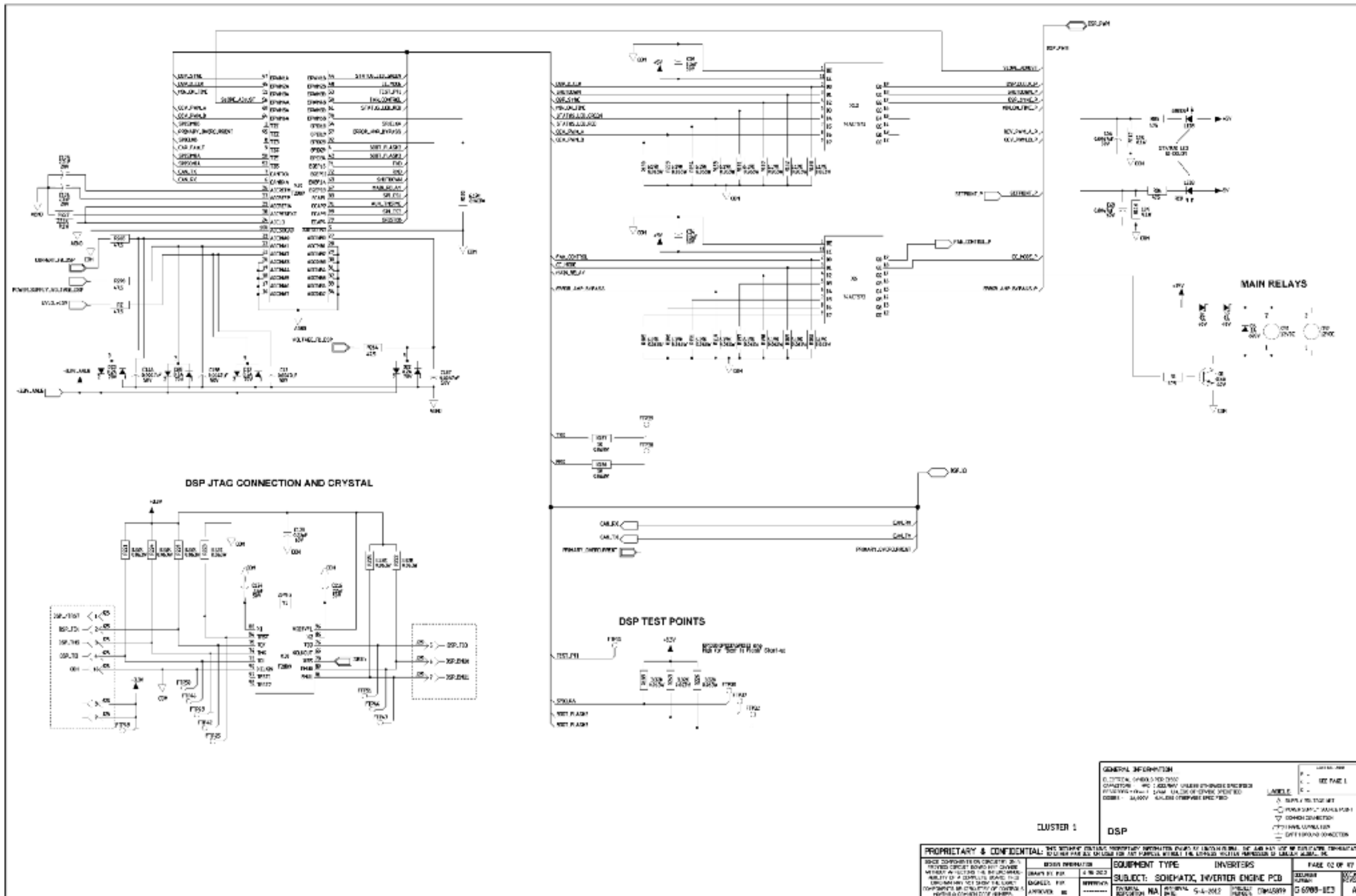
SCHEMATIC - SWITCH PC BOARD (G6988-1E3) PG 2

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



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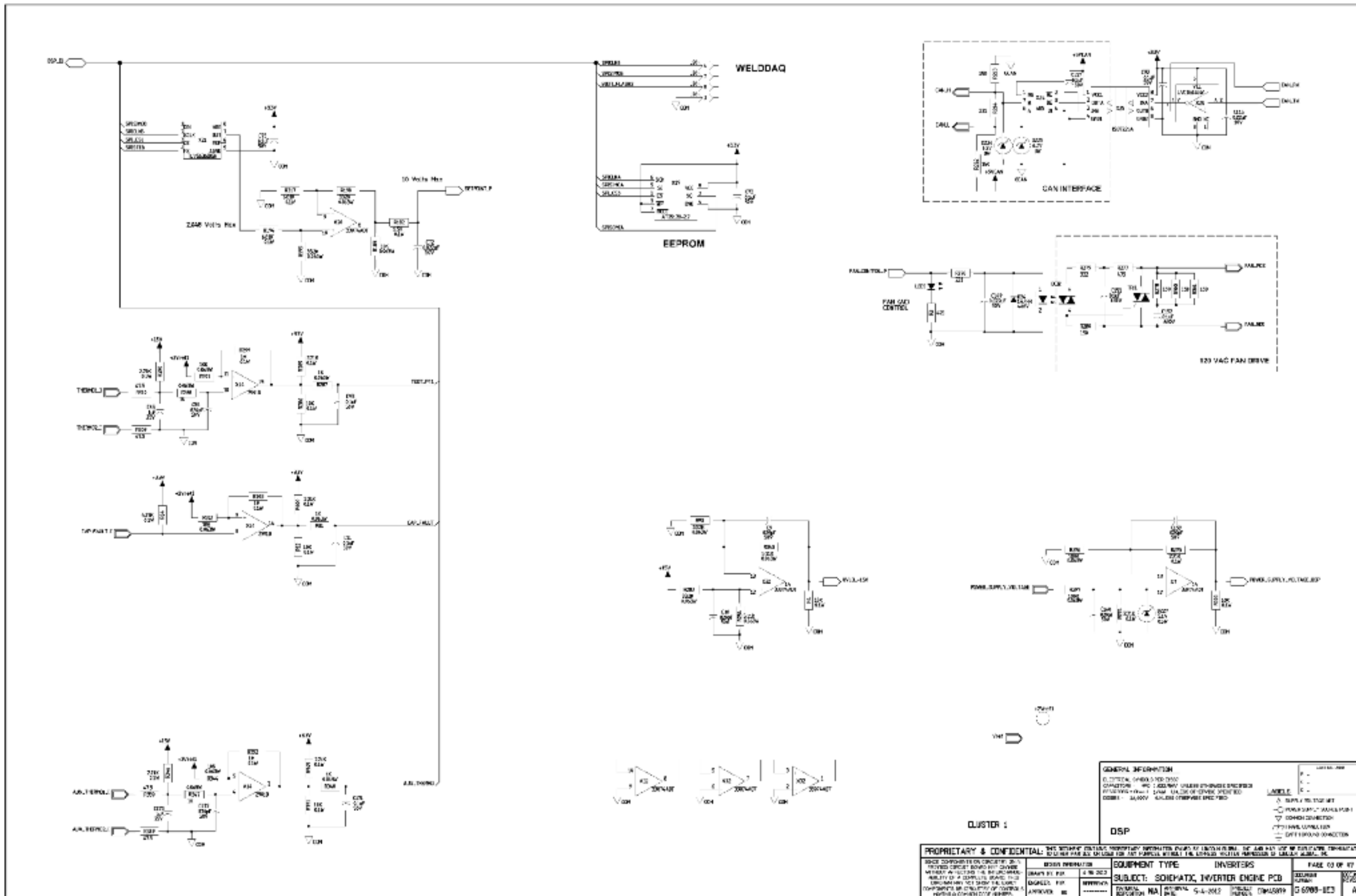
SCHEMATIC - SWITCH PC BOARD (G6988-1E3) PG 3

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



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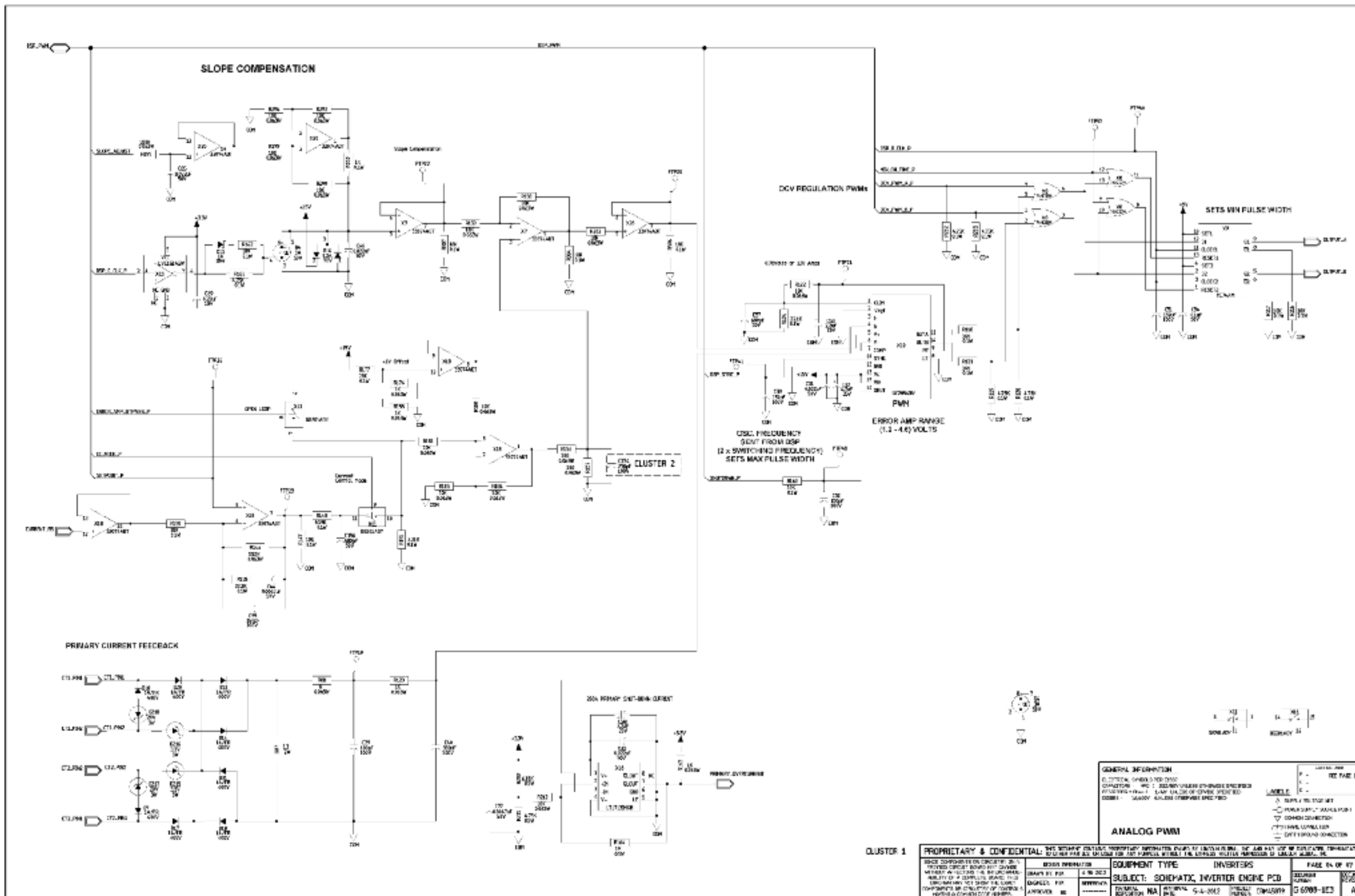
SCHEMATIC - SWITCH PC BOARD (G6988-1E3) PG 4

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



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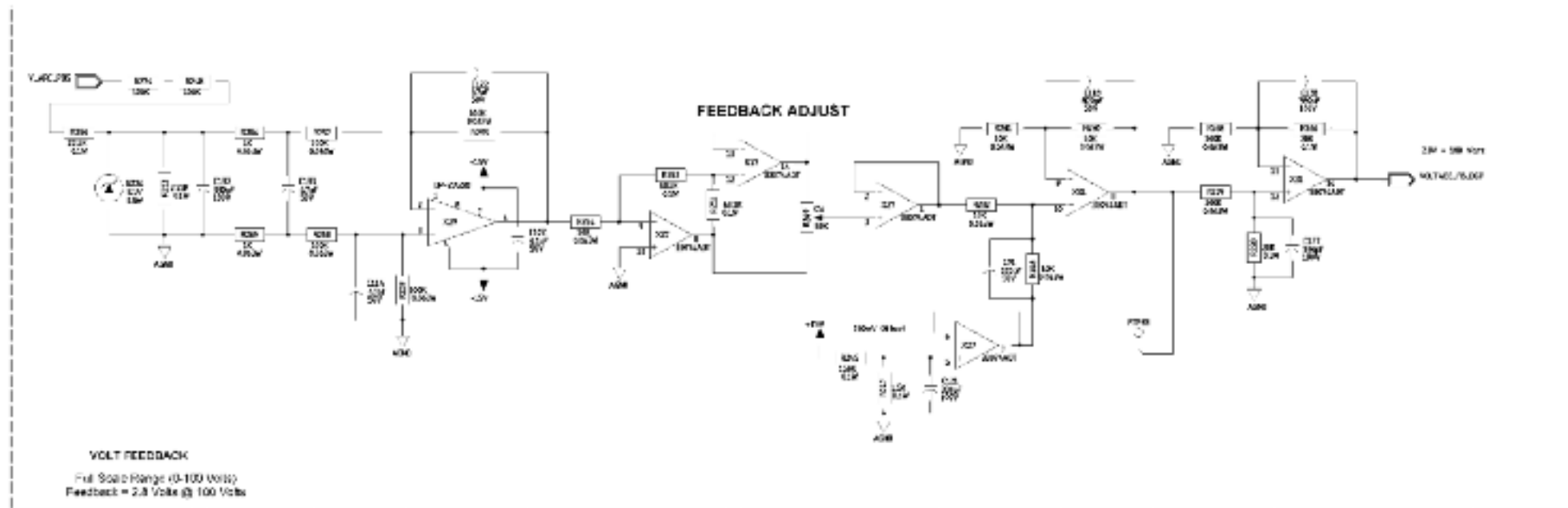
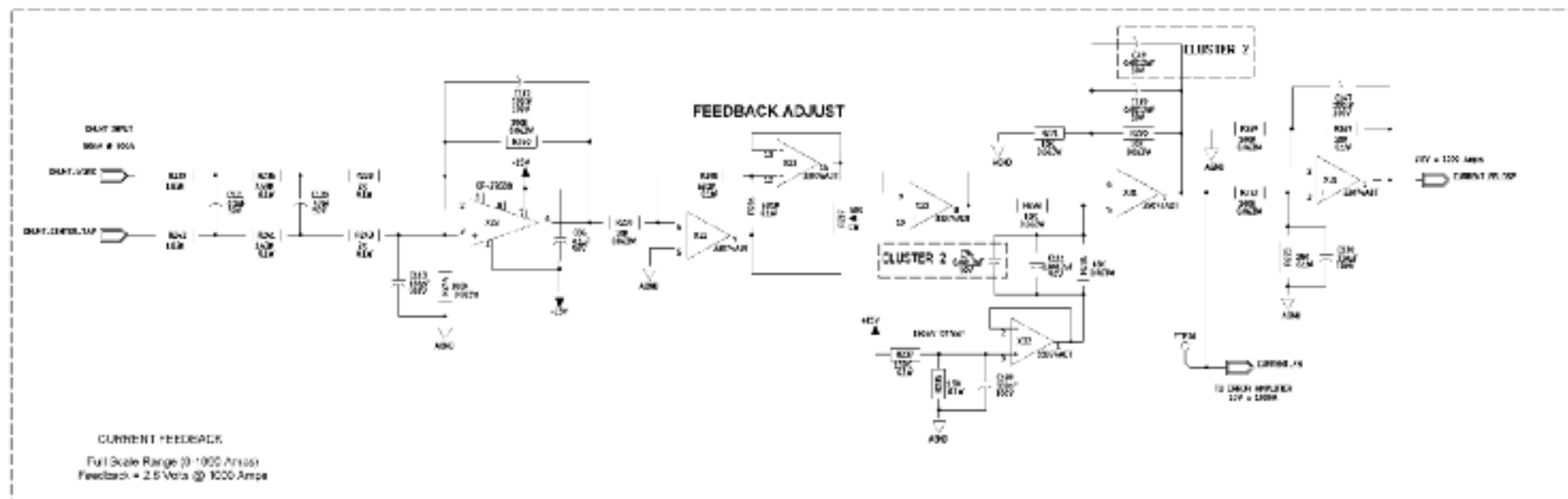
SCHEMATIC - SWITCH PC BOARD (G6988-1E3) PG 5

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC



GENERAL INFORMATION		REV. 001	
C. CONTROL: 0480-5-100-0500		P. -	SEE PAGE 1
CHARACTER: 100: 1.000000 0.000000 0.000000		C. -	
DIMENSIONS: 1.0000 1.0000 1.0000 1.0000		SYMBOLS	
DIMS: 1.0000 1.0000 1.0000 1.0000		△	WIRE TO POINT
		○	POWER SUPPLY WIRE
		□	COMMON CONNECTION
		○	WIRE TO POINT
		○	DIFFERENTIAL CONNECTION

CLUSTER 1	PROPRIETARY & CONFIDENTIAL	REVISION INFORMATION	EQUIPMENT TYPE	INVERTERS	PAGE 05 OF 07
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NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

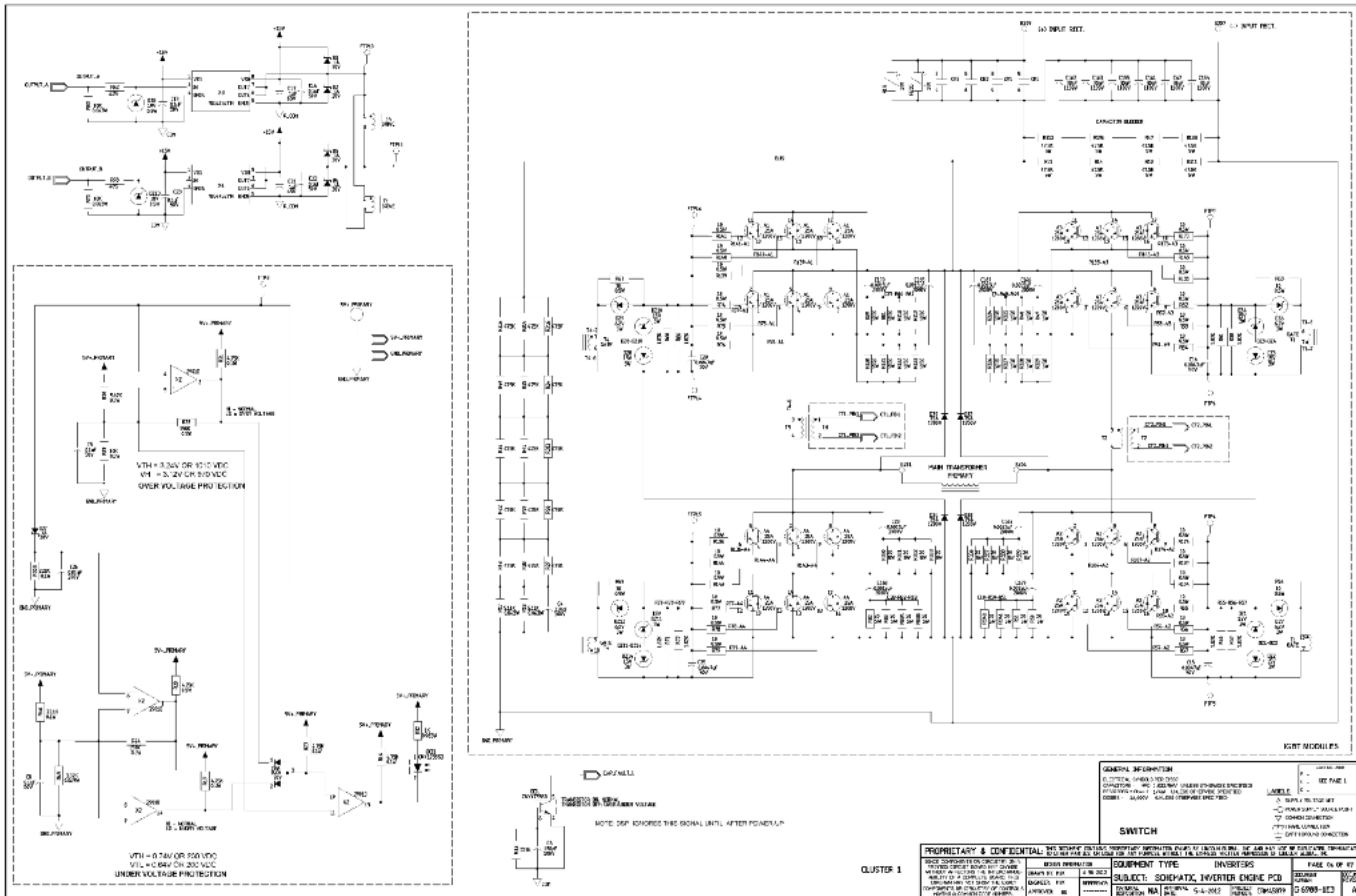
SCHEMATIC - SWITCH PC BOARD (G6988-1E3) PG 6

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



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

SCHEMATIC - SWITCH PC BOARD (G6988-1E3) PG 7

Return to Section TOC

Return to Section TOC

Return to Section TOC

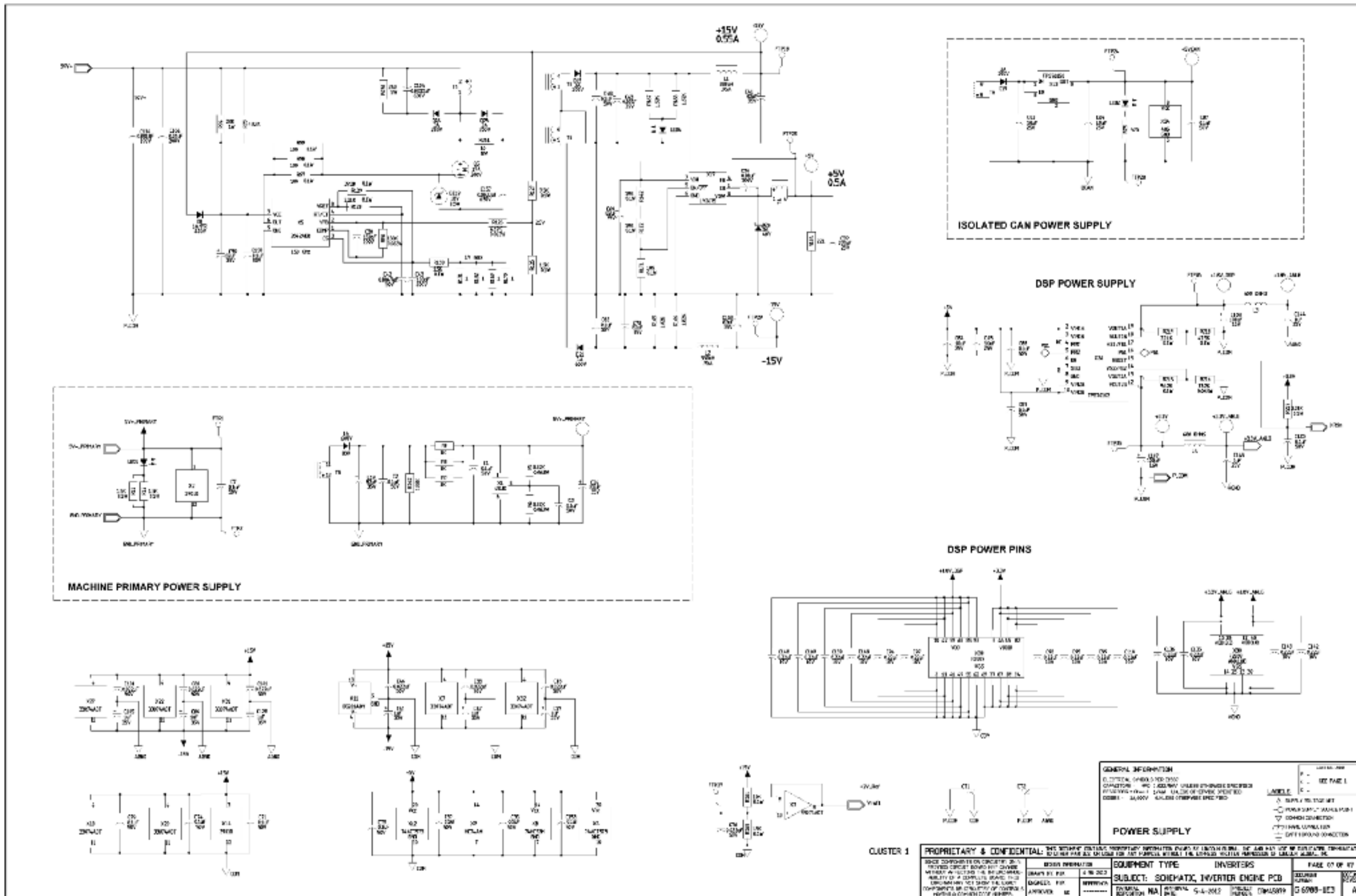
Return to Section TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC



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