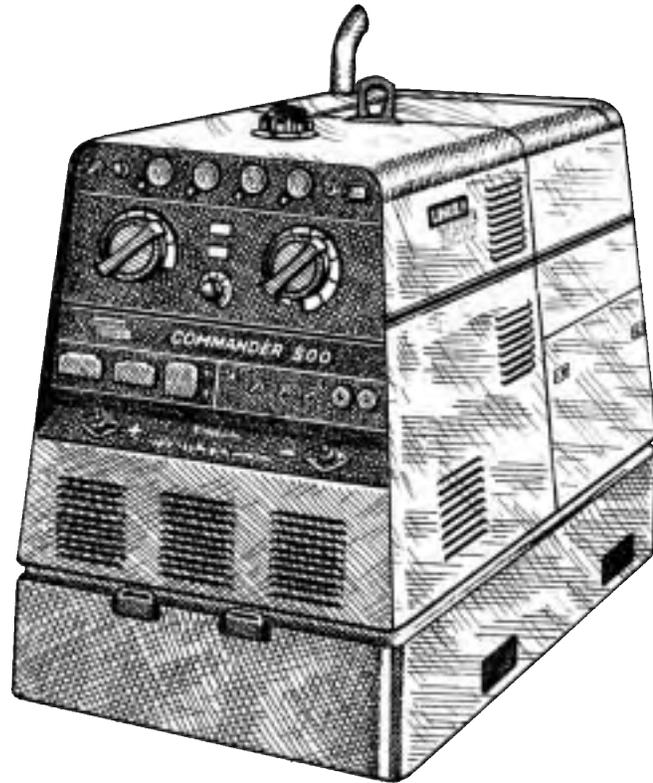


Commander™ 500

For use with machines having Code Numbers: **10837 (Standard),**
10838 (Deluxe)

Safety Depends on You

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



SERVICE MANUAL



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• World's Leader in Welding and Cutting Products •

• Sales and Service through Subsidiaries and Distributors Worldwide •

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

⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

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

The Above For Diesel Engines

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

The Above For Gasoline Engines

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

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

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



FOR ENGINE powered equipment.

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



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



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



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

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

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

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



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



ELECTRIC AND MAGNETIC FIELDS may be dangerous

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

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

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

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

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

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

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

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

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

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ELECTRIC SHOCK can kill.

3.a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- Semiautomatic DC Constant Voltage (Wire) Welder.
- DC Manual (Stick) Welder.
- AC Welder with Reduced Voltage Control.

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.



ARC RAYS can burn.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87.1 standards.

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

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



FUMES AND GASES can be dangerous.

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

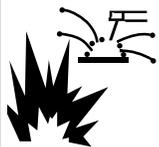
5.b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

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

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

5.e. Also see item 1.b.

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WELDING SPARKS can cause fire or explosion.

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

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

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

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

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

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

7.c. Cylinders should be located:

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

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

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

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

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

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



FOR ELECTRICALLY powered equipment.

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

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

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

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PRÉCAUTIONS DE SÛRETÉ

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

Sûreté Pour Soudage A L'Arc

1. Protégez-vous contre la secousse électrique:
 - a. Les circuits à l'électrode et à la pièce sont sous tension quand la machine à souder est en marche. Éviter toujours tout contact entre les parties sous tension et la peau nue ou les vêtements mouillés. Porter des gants secs et sans trous pour isoler les mains.
 - b. Faire très attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher métallique ou des grilles métalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
 - c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état de fonctionnement.
 - d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
 - e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
 - f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces précautions pour le porte-électrode s'appliquent aussi au pistolet de soudage.
2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas où on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.
3. Un coup d'arc peut être plus sévère qu'un coup de soleil, donc:
 - a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
 - b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
 - c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.
4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

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

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

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

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INSTALLATION

TECHNICAL SPECIFICATIONS - COMMANDER 500 (K1639-1 & -2)

INPUT - DIESEL ENGINE					
Make/Model	Description	Speed (RPM)	Displacement	Starting System	Capacities
Deutz 3 cylinder F3L 912 Diesel Engine	44 HP(33 kw) @ 1800 RPM	High Idle 1900 Low Idle 1475 Full Load 1800	173 cu. in (2.83 L)	12VDC battery & Starter	Fuel: 25 gal. 94.6 L Oil: 9.5 Qts. 9.0 L
			Bore x Stroke 3.94" x 4.72" (100mm x 120mm)		
RATED OUTPUT - WELDER					
Duty Cycle		Welding Output		Volts at Rated Amps	
100%		500 Amps (DC multi-purpose)		40 Volts	
60%		550 Amps (DC multi-purpose)		36 Volts	
50%		575 Amps (DC multi-purpose)		35 Volts	
OUTPUT - WELDER AND GENERATOR					
Welding Range		Open Circuit Voltage		Auxiliary Power ¹	
30 - 575 Amps CC/CV		80 Max OCV @ 1900 RPM		120/240 VAC 12,000 Watts, 60 Hz. 100% Duty Cycle	
20 - 250 Amps TIG					
PHYSICAL DIMENSIONS					
Height ²		Width	Depth	Weight	
42.0 in.		31.5 in.	63.1 in.	1638 labs. (743 kg)	
1966.8 mm		800.1 mm	1602.7 mm	(Approx.)	

¹Output rating in watts is equivalent to volt-amperes at unity power factor.

Output voltage is within +/- 10% at all loads up to rated capacity. When welding, available auxiliary power will be reduced.

²Top of enclosure. Add 8.9" (226.1mm) for exhaust.

COMMANDER 500



INSTALLATION

Read this entire installation section before you start installation.

SAFETY PRECAUTIONS



WARNING

Do not attempt to use this equipment until you have thoroughly read all operating and maintenance manuals supplied with your machine. They include important safety precautions, \detailed engine starting, operating and maintenance instructions and parts lists.



ELECTRIC SHOCK can kill.

- Do not touch electrically live parts such as output terminals or internal wiring.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.



ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust outside
- Do not stack anything near the engine.



MOVING PARTS can injure.

- Do not operate with doors open or guards off.
- Stop engine before servicing.
- Keep away from moving parts

Only qualified personnel should install, use or service this equipment

LOCATION / VENTILATION

The welder should be located to provide an unrestricted flow of clean, cool air to the cooling air inlets and to avoid restricting the cooling air outlets. Also, locate the welder so that the engine exhaust fumes are properly vented to an outside area.

STORING

1. Store the machine in a cool, dry place when it is not in use. Protect it from dust and dirt. Keep it where it can't be accidentally damaged from construction activities, moving vehicles, and other hazards.
2. Drain the engine oil and refill with fresh 10W30 oil. Run the engine for about five minutes to circulate oil to all the parts. See the **MAINTENANCE** section of this manual for details on changing oil.
3. Remove the battery, recharge it, and adjust the electrolyte level. Store the battery in a dry, dark place.

STACKING

Commander 500 machines cannot be stacked.

ANGLE OF OPERATION

To achieve optimum engine performance the Commander 500 should be run in a level position. The maximum angle of operation for the Deutz engine is 30 degrees fore and aft, 40 degrees right and 45 degrees left. If the engine is to be operated at an angle, provisions must be made for checking and maintaining the oil level at the normal (FULL) oil capacity in the crankcase. When operating the welder at an angle, the effective fuel capacity will be slightly less than the specified 25 gallons (94.6 liters).

COMMANDER 500



INSTALLATION

LIFTING

The Commander lift bale should be used to lift the machine. The Commander is shipped with the lift bale retracted. Before attempting to lift the Commander, secure the lift bale in a raised position. Secure the lift bale as follows:

- Open the engine compartment door.
- Locate the two access holes on the upper middle region of the compartment wall just below the lift bale.
- Use the lifting strap to raise the lift bale to the full upright position. This will align the mounting holes on the lift bale with the access holes.
- Secure the lift bale with 2 thread forming screws. The screws are provided in the loose parts bag shipped with the machine.

WARNING



FALLING EQUIPMENT can cause injury.

- Do not lift this machine using lift bale if it is equipped with a heavy accessory such as a trailer or gas cylinder.
- Lift only with equipment of adequate lifting capacity.
- Be sure machine is stable when lifting.

HIGH ALTITUDE OPERATION

At higher altitudes, output derating may be necessary. For maximum rating, derate the welder output 5% for every 300 meters (984 ft.) above 1500 meters (4920 ft.). For output of 500A and below, derate the welder output 5% for every 300 meters (984 ft.) above 2100 meters (6888 ft.)

Contact a Deutz Service Representative for any engine adjustments that may be required.

HIGH TEMPERATURE OPERATION

At temperatures above 30°C (86°F), output voltage derating is necessary. For maximum output current ratings, derate the welder voltage rating two volts for every 10°C (21°F) above 30°C (86°F).

TOWING

The recommended trailer for use with this equipment for road, in-plant and yard towing by a vehicle¹ is Lincoln's K953-1. If the user adapts a non-Lincoln trailer, he must assume responsibility that the method of attachment and usage does not result in a safety hazard nor damage the welding equipment. Some of the factors to be considered are as follows:

- Design capacity of the trailer vs. weight of the Lincoln equipment and likely additional attachments.
- Proper support of, and attachment to, the base of the welding equipment so that there will be no undue stress to the trailer's framework.
- Proper placement of the equipment on the trailer to insure stability side to side and front to back when being moved and when standing by itself.
- Typical conditions of use, such as travel speed, roughness of surface on which the trailer will be operated, and environmental conditions.
- Proper preventative maintenance of the trailer.
- Conformance with federal, state and local laws.¹

¹Consult applicable federal, state and local laws regarding specific requirements for use on public highways.

COMMANDER 500



INSTALLATION

PRE-OPERATION ENGINE SERVICE

READ the engine operating and maintenance instructions supplied with this machine.

WARNING



- Keep hands away from the engine muffler or HOT engine parts.
- Stop engine and allow to cool before fueling.

- Do not smoke when fueling.
- Fill fuel tank at a moderate rate and do not overfill.
- Wipe up spilled fuel and allow fumes to clear before starting engine.
- Keep sparks and flame away from tank.

OIL

The Commander is shipped with the engine crankcase filled with high quality SAE 10W-30 oil (API class CD or better). Check the oil level before starting the engine. If it is not up to the full mark on the dip stick, add oil as required. Check the oil level every four hours of running time during the first 35 running hours. Refer to the engine Operator's Manual for specific oil recommendations and break-in information. The oil change interval is dependent on the quality of the oil and the operating environment. Refer to the engine Operator's Manual for the proper service and maintenance intervals.

FUEL

NOTE: USE DIESEL FUEL ONLY.

Fill the fuel tank with clean, fresh diesel fuel. The capacity of the fuel tank is 25 gallons (94.6 liters). See the engine Operator's Manual for specific fuel recommendations. The Commander 500 Deluxe is protected by a low fuel shutdown to prevent the engine from running out of fuel. The machine will indicate a low fuel condition by turning on the low fuel light. A time of 30 minutes will elapse once the low fuel light illuminates before the machine will shutdown. A restart of the machine will restart the timer to allow the operator to override this feature. The amount of reserve fuel remaining in the tank after the first shutdown will vary from machine to machine. The operator must determine the amount of fuel remaining before restarting the machine. Running out of fuel may require bleeding the fuel injection pump.

NOTE: Before starting the engine, open the fuel shut-off valve (pointer to be in line with hose).

FUEL CAP

Remove the plastic cap covering from the fuel tank filler neck and install the fuel cap.

ENGINE COOLING SYSTEM

The Deutz engine is air cooled by a belt-driven axial blower. The oil cooler and engine cooling fins should be blown out with compressed air or steam to maintain proper cooling. (See the engine Operator's Manual for procedures and frequency.)

BATTERY CONNECTION

WARNING



GASES FROM BATTERY can explode.

- Keep sparks, flame and cigarettes away from battery.

To prevent EXPLOSION when:

- **INSTALLING A NEW BATTERY** — disconnect negative cable from old battery first and connect to new battery last.
- **CONNECTING A BATTERY CHARGER** — remove battery from welder by disconnecting negative cable first, then positive cable and battery clamp. When reinstalling, connect negative cable last. Keep well ventilated.

- **USING A BOOSTER** — connect positive lead to battery first then connect negative lead to negative battery lead at engine foot.



BATTERY ACID can burn eyes and skin.

- Wear gloves and eye protection and be careful when working near battery.
- Follow instructions printed on battery.

COMMANDER 500



INSTALLATION

IMPORTANT: To prevent ELECTRICAL DAMAGE WHEN:

- a) Installing new batteries
- b) Using a booster

Use correct polarity — **Negative Ground.**

The Commander is shipped with the negative battery cable disconnected. Before you operate the machine, make sure the Engine Switch is in the OFF position and attach the disconnected cable securely to the negative (-) battery terminal.

Remove the insulating cap from the negative battery terminal. Replace and tighten the negative battery cable terminal.

NOTE: This machine is furnished with a wet charged battery; if unused for several months, the battery may require a booster charge. Be sure to use the correct polarity when charging the battery.

MUFFLER OUTLET PIPE

Remove the plastic plug covering the muffler outlet tube. Using the clamp provided, secure the outlet pipe to the outlet tube with the pipe positioned to direct the exhaust in the desired direction.

SPARK ARRESTER

Some federal, state or local laws may require that gasoline or diesel engines be equipped with exhaust spark arresters when they are operated in certain locations where unarrested sparks may present a fire hazard. The standard muffler included with this welder does not qualify as a spark arrester. When required by local regulations, a suitable spark arrester must be installed and properly maintained.

CAUTION

An incorrect arrester may lead to damage to the engine or adversely affect performance.

HIGH FREQUENCY GENERATORS FOR TIG APPLICATIONS

The K799 Hi-Freq Unit and the K930-1 or-2 TIG Module are suitable for use with the Commander 500. The Commander 500 is equipped with the required R.F. bypass circuitry for the connection of high frequency generating equipment. The high frequency bypass network supplied with the K799 Hi-Freq Unit does NOT need to be installed into the Commander 500.

The Commander 500 and any high frequency generating equipment must be properly grounded. See the K799 Hi-Freq Unit and the K930-1 or-2 TIG Module operating manuals for complete instructions on installation, operation, and maintenance.

ELECTRICAL CONNECTIONS

REMOTE CONTROL

The Commander 500 is equipped with a 6-pin and a 14-pin connector. The 6-pin connector is for connecting the K857 or K857-1 Remote Control (optional) or, in the case of TIG welding applications, with the foot or hand Amptrol (K870 or K963-1 respectively).

The 14-pin connector is used to directly connect a wire feeder or TIG Module (K930-1 or-2) control cable.

NOTE: When using the 14-pin connector, if the wire feeder has a built-in power source output control, do not connect anything to the 6-pin connector.

WELDING TERMINALS

The Commander is equipped with a toggle switch for selecting "hot" welding terminals when in the "WELD TERMINALS ON" position or "cold" welding terminals when in the "WELDING TERMINALS REMOTELY CONTROLLED" position.

COMMANDER 500



INSTALLATION

WELDING OUTPUT CABLES

With the engine off, route the electrode and work cables through the strain relief bracket provided on the front of the base and connect to the terminals provided. These connections should be checked periodically and tightened if necessary.

Listed in Table A.1 are copper cable sizes recommended for the rated current and duty cycle. Lengths stipulated are the distance from the welder to work and back to the welder again. Cable sizes are increased for greater lengths primarily for the purpose of minimizing cable voltage drop.

TABLE A.1 – COMBINED LENGTH OF ELECTRODE AND WORK CABLES

Amps @ 100% Duty Cycle	Total Combined Length of Electrode and Work Cables		
	Up to 150 ft.	150-200 ft.	200-250 ft.
500	3/0 AWG	3/0 AWG	4/0 AWG

MACHINE GROUNDING

Because this portable engine driven welder creates its own power, it is not necessary to connect its frame to an earth ground, unless the machine is connected to premises wiring (home, shop, etc.).

To prevent dangerous electric shock, other equipment powered by this engine driven welder must:

- a) be grounded to the frame of the welder using a grounded type plug,
- or
- b) be double insulated.

When this welder is mounted on a truck or trailer, its frame must be securely connected to the metal frame of the vehicle. When this engine driven welder is connected to premises wiring such as that in a home or shop, its frame must be connected to the system earth ground. See further connection instructions in the section entitled **Standby Power Connections** as well as the article on grounding in the latest U.S. National Electrical Code and the local code.

In general, if the machine is to be grounded, it should be connected with a #8 or larger copper wire to a solid earth ground such as a metal water pipe going into the ground for at least ten feet and having no insulated joints, or to the metal framework of a building which has been effectively grounded. The U.S. National Electrical Code lists a number of alternate means of grounding electrical equipment. A machine grounding stud marked with the \oplus symbol is provided on the front of the welder.

AUXILIARY POWER RECEPTACLES

The auxiliary power capacity of the Commander 500 is 12,000 watts of 60 Hz, single-phase power. The auxiliary power capacity rating in watts is equivalent to volt-amperes at unity power factor. The maximum permissible current of the 240 VAC output is 50 A. The 240 VAC output can be split to provide two separate 120 VAC outputs with a maximum permissible current of 50 A per output to two separate 120 VAC branch circuits. The output voltage is within $\pm 10\%$ at all loads up to rated capacity.

NOTE: The 120/240V receptacle has two 120V outlets of different phases and cannot be paralleled.

The Commander has two 20A-120VAC (5-20R) duplex receptacles and one 50A-120/240 VAC (14-50R) receptacle. The 120/240 VAC receptacle can be split for single-phase 120 VAC operation. The auxiliary power receptacles should only be used with three-wire grounded type plugs or approved double insulated tools with two-wire plugs. The current rating of any plug used with the system must be at least equal to the current capacity of the associated receptacle.

STANDBY POWER CONNECTIONS

The Commander 500 is suitable for temporary, standby or emergency power using the engine manufacturer's recommended maintenance schedule.

The Commander 500 can be permanently installed as a standby power unit for 240 volt, three-wire, 50 amp service. Connections must be made by a licensed electrician who can determine how the 120/240 VAC power can be adapted to the particular installation and comply with all applicable electrical codes. The following information can be used as a guide by the electrician for most applications. Refer to the connection diagram shown in **Figure A.2**.

COMMANDER 500



INSTALLATION

1. Install the double-pole, double-throw switch between the power company meter and the premises disconnect.

Switch rating must be the same or greater than the customer's premises disconnect and service over current protection.

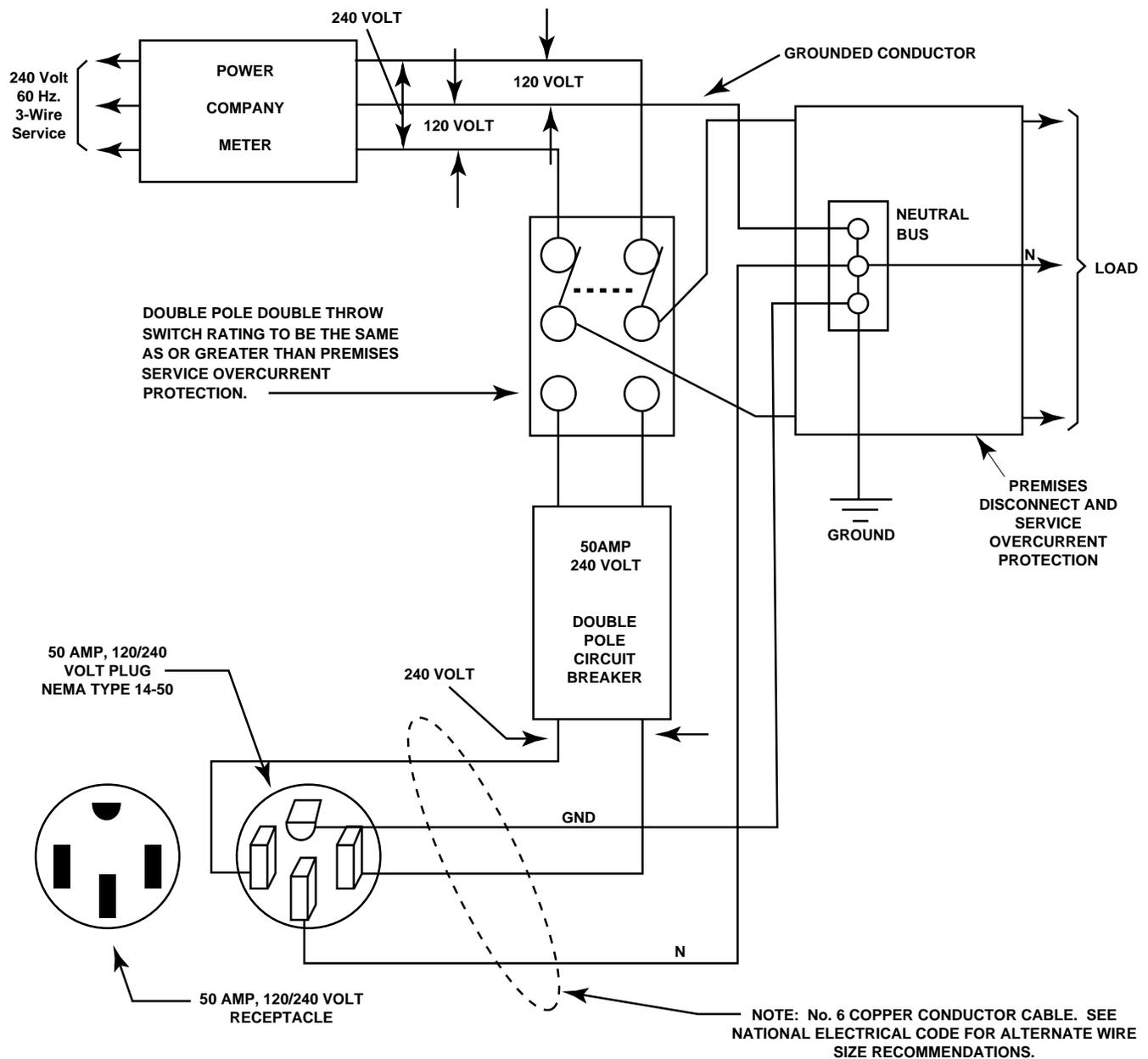
2. Take necessary steps to assure load is limited to the capacity of the Commander by installing a 50 amp, 240 VAC double-pole circuit breaker. Maximum rated load for each leg of the 240 VAC auxiliary is 50 amperes. Loading above the rated output will reduce output voltage below the allow-

able -10% of rated voltage, which may damage appliances or other motor-driven equipment and may result in overheating of the Commander 500 engine.

3. Install a 50 amp 120/240 VAC plug (NEMA Type 14-50) to the double-pole circuit breaker using No. 6, four-conductor cable of the desired length. (The 50 amp, 120/240 VAC plug is available in the optional K802R plug kit.)

4. Plug this cable into the 50 amp 120/240 volt receptacle on the Commander 500 case front.

FIGURE A.2 – CONNECTION OF THE COMMANDER 500 TO PREMISES WIRING



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OPERATION

OPERATING INSTRUCTIONS

Read and understand this entire section before operating your Commander 500.

SAFETY INSTRUCTIONS



WARNING

Do not attempt to use this equipment until you have thoroughly read all operating and maintenance manuals supplied with your machine. They include important safety precautions: detailed engine starting, operating, and maintenance instructions and parts lists.

ELECTRIC SHOCK can kill.



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

FUMES AND GASES CAN BE DANGEROUS.



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

WELDING SPARKS CAN CAUSE FIRE OR EXPLOSION.



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

ARC RAYS CAN BURN.



- Wear eye, ear, and body protection.



ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust outside
- Do not stack anything near the engine.



MOVING PARTS can injure.

- Do not operate with doors open or guards off.
- Stop engine before servicing.
- Keep away from moving parts

Only qualified personnel should operate this equipment.

ADDITIONAL SAFETY PRECAUTIONS

Always operate the welder with the hinged door closed and the side panels in place, as these provide maximum protection from moving parts and insure proper cooling air flow.

GENERAL DESCRIPTION

The Commander 500 is a diesel engine-driven welding power source. The machine uses a brush type alternating current generator for DC multi-purpose welding and for 120/240 VAC auxiliary standby power. The welding control system uses state of the art **Chopper Technology**.

The generator has a single sealed bearing for maintenance free service. The rotor is a copper wound design with two slip rings and brushes. The stator is wound entirely with heavy gauge copper wire and insulated with NEMA class F insulation material. The stator is then impregnated with three layers of high quality varnish. After the stator is assembled using tie bars, the entire assembly is covered with an environmentally protective coating. These measures insure trouble-free operation in the harshest environments.

The fuel tank is made from high density polyethylene and holds 25 gallons (94.6 liters) of diesel fuel. This will provide enough fuel to run for more than 12 hours at full load.

The Deutz F3L-912 engine is equipped with a standard, heavy duty, combination fuel filter/water separator element.

COMMANDER 500



OPERATION

RECOMMENDED APPLICATIONS

WELDER

The Commander 500 provides excellent constant current DC welding output for stick (SMAW) and TIG welding. The Commander 500 also provides excellent constant voltage DC welding output for MIG (GMAW) and Innershield (FCAW) welding.

GENERATOR

The Commander 500 provides smooth 120/240 VAC output for auxiliary power and emergency standby power.

DESIGN FEATURES AND ADVANTAGES

K1639-2 COMMANDER 500 DELUXE MODEL FEATURES

FOR WELDING

- Excellent DC multi-purpose welding for stick, MIG, TIG, cored wire and arc gouging applications.
- 30 to 500 amps output in five slope-controlled ranges for out-of position and pipe electrodes, one constant current output range for general purpose welding, one constant voltage range for MIG wire and cored wire welding and one 20-250 amp range for "Touch Start" TIG welding.
- 100% duty cycle at 500 amps output and 50% duty cycle at 575 amps output.
- Dual 3-digit output meters are provided (optional on K1639-1) for presetting the weld amperage or voltage and displaying the actual amperage and voltage during welding. The meters use superbrite L.E.D.'s for improved readability in full sunlight.

LOOK-BACK FEATURE: After welding has stopped, both displays will remain on for 7 seconds with the last current and voltage value displayed. During this time, the left-most decimal point in each display will be FLASHING.

- Standard remote control capability with 14-pin and 6-pin connectors for easy connection of Lincoln remote control accessories.
- An internal "Solid State" contactor allows for the selection of "hot" or "cold" output terminals with a toggle switch on the control panel.
- "Arc Control" potentiometer in Wire and Stick modes for precise adjustment of arc characteristics.
- Advanced circuitry to prevent pop-outs in the five slope modes.

FOR AUXILIARY POWER

- 12,000 watts of 120/240 VAC, 60Hz auxiliary power.
- Power for tools, 120/240 VAC lights, electric pumps and for standby emergency power.
- Drive a 5 HP motor (provided it is started under no load).
- Two 20 amp 120 VAC duplex receptacles for up to 40 amps of 120 VAC power.
- One 50 amp, 120/240 VAC dual voltage receptacle for up to 50 amps of 240 VAC, and up to 50 amps per side to separate branch circuits (not in parallel) of 120 VAC single-phase auxiliary power. Allows easy connection to premises wiring.
- Weld and AC auxiliary power at the same time (within machine total capacity).

OTHER FEATURES

- Deutz 3-cylinder, air/oil cooled diesel engine. Designed for long life, easy maintenance, and excellent fuel economy.
- Engine protection system shuts the engine down for low oil pressure, high oil temperature, or a broken fan/engine alternator belt.
- Gauges for oil pressure, oil temperature, engine alternator output, and fuel level.
- Indicator lights for low oil pressure, high oil temperature, engine alternator low output/broken belt, and low fuel level (on K1639-2 only).
- Automatic low fuel shutdown before running out of fuel (K1639-2 only).
- Engine hour meter standard on all models.
- Extended range 25 gallon (94.6 l) fuel tank.
- Automatic idler reduces engine speed when not welding or drawing auxiliary power. This feature reduces fuel consumption and extends engine life.
- Compact size fits crosswise in full size pickup truck.
- Single-side engine service.
- Copper alternator windings and high temperature insulation for dependability and long life.
- New paint system on case and base for outstanding corrosion protection.

COMMANDER 500



OPERATION

K1639-1 COMMANDER 500 STANDARD MODEL

- The K1639-1 is the standard version of the Commander 500 and has all the features of the K1639-2 Deluxe version except that there are no gauges, low fuel light, nor dual output meters. This version does have fully functional engine protection for low oil pressure, high oil temperature, and alternator output with associated lights.
- A field-installed Dual Output Meter and Gauge Kit (K-1768-1) is available for the K1639-1 Commander 500. The kit includes dual output meters, oil pressure gauge, oil temperature gauge, and alternator ammeter.

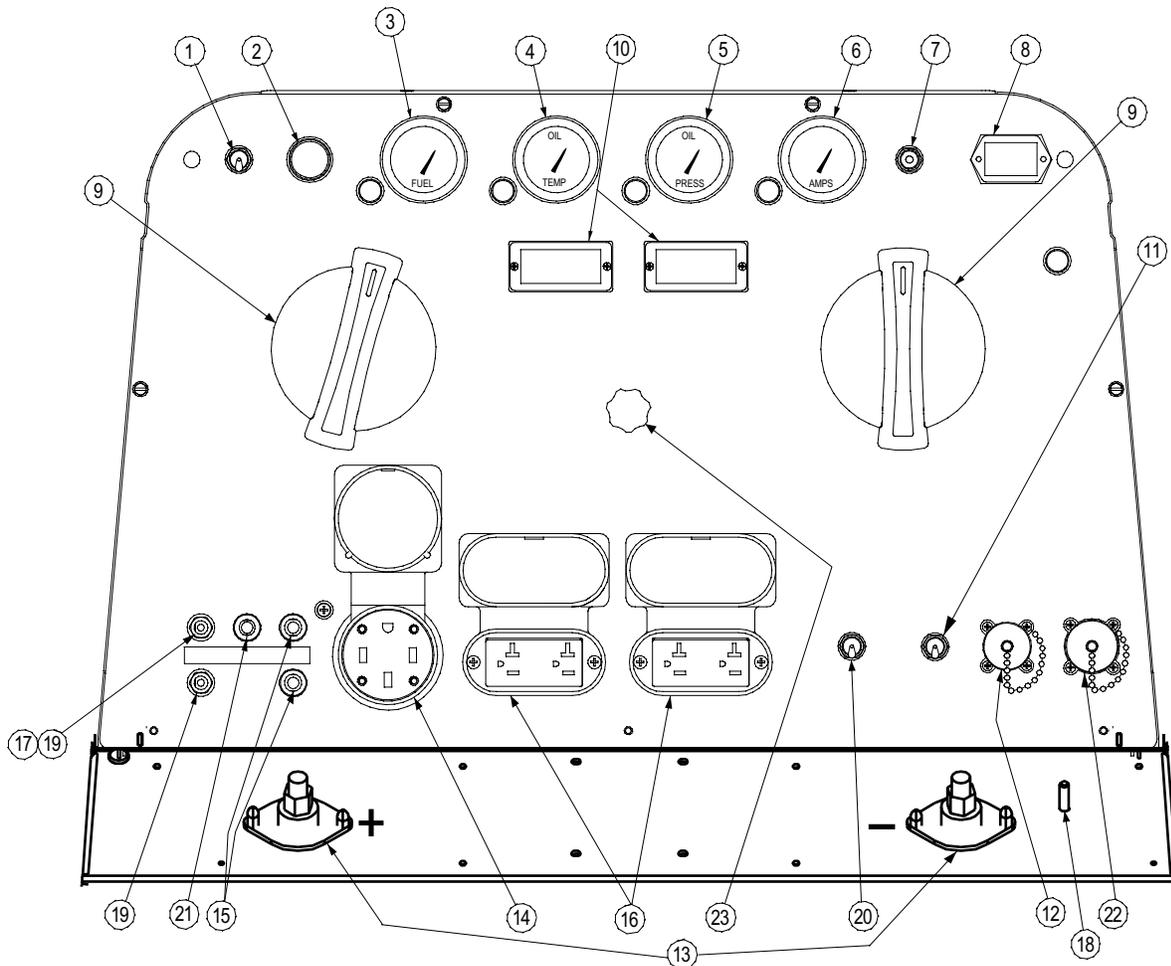
WELDING CAPABILITY

The Commander 500 is rated at 500 amps, 40 VDC at 100% duty cycle and 575 amps, 36 VDC at 50% duty cycle. The maximum open circuit voltage at 1900 RPM is 80 volts. The weld current is variable from 30 to 575 amps.

CONTROLS AND SETTINGS

All welder and engine controls are located on the case front panel. Refer to Figure B.1 and the explanations that follow.

FIGURE B.1 – CASE FRONT PANEL CONTROLS



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OPERATION

ENGINE CONTROLS (Items 1 through 8)

1. RUN/STOP SWITCH

When placed in the RUN position, this switch energizes the fuel solenoid and other electric accessories. When placed in the STOP position, the flow of fuel to the injection pump is stopped to shut down the engine.

NOTE: If the switch is left in the RUN position and the engine is not running, the fuel solenoid will be engaged for 15 seconds and then shut down. This is to protect the battery from discharge. After 15 seconds, the RUN/STOP switch must be toggled off then on before starting.

2. START PUSHBUTTON

Energizes the starter motor to crank the engine. With the engine RUN/STOP switch in the RUN position, push and hold the Start button to crank the engine; release as the engine starts. The Start button must be depressed for a minimum of two seconds. Do not press it while the engine is running, since this can cause damage to the ring gear and/or starter motor.

3. FUEL LEVEL GAUGE AND LIGHT

(K1639-2 only) - Displays the level of diesel fuel in the 25-gallon (94.6 liter) fuel tank. The yellow light turns on when the fuel gage reaches the reserve level. Once the reserve level is reached, the engine protection system will shut down the engine after 30 minutes of operation. The machine can be restarted and operated for an additional 30 minutes before the protection system will shut down the engine. This ability to override the engine protection allows the operator to "finish up" if necessary. The operator must watch the fuel level closely to prevent running out of fuel and having to bleed the system.

4. ENGINE TEMPERATURE GAUGE (K1639-2 Std., K1639-1 Opt.) AND LIGHT

The gauge displays the engine oil temperature. The yellow temperature light remains off under normal operating temperatures. If the light turns on, the engine protection system will shut down the engine. Check for restrictions at the engine cooling air inlets and outlets. (Consult the engine Operator's Manual.) Check for loose or disconnected leads at the temperature sender located on the engine. Check the engine cooling blower belt. Also, check to be sure that the welder loads are within the rating of the welder. The light will remain on when the engine has been shut down due to an over-temperature condition.

5. OIL PRESSURE GAUGE (K1639-2 Std., K1639-1 Opt.) AND LIGHT

The gauge displays the engine oil pressure when the engine is running. The yellow oil pressure light remains off with proper oil pressure. If the light turns on, the engine protection system will stop the engine. Check for proper oil level and add oil if necessary. Check for loose or disconnected leads at the oil pressure sender located on the engine. The light will go on and stay on when the RUN/STOP switch is switched to the RUN position with the engine not running.

6. ENGINE ALTERNATOR AMMETER (K1639-2 Std., K1639-1 Opt.) AND LIGHT

The yellow engine alternator light is off when the battery charging system is functioning normally. If the light turns on, the engine protection system will shut down the engine. Check the engine cooling blower belt. Also, the alternator or the voltage regulator may not be operating correctly. The light may also come on due to a faulty flashing circuit. The light will remain on when the engine has been shut down due to a fault in the alternator, regulator, or the cooling blower belt.

7. IDLER SWITCH

Has two positions as follows:

- A) In the HIGH position , the engine runs at the high idle speed controlled by the governor.
- B) In the AUTO  /  position, the idler operates as follows:
 - a. When switched from HIGH to AUTO or after starting the engine, the engine will operate at full speed for approximately 12 seconds and then go to low idle speed.
 - b. When the electrode touches the work or power is drawn for lights or tools (approximately 100 Watts minimum) the engine accelerates and operates at full speed.
 - c. When welding ceases or the AC power load is turned off, a fixed time delay of approximately 12 seconds starts.
 - d. If the welding or AC power load is not restarted before the end of the time delay, the idler reduces the engine speed to low idle speed.
 - e. The engine will automatically return to high idle speed when the welding load or AC power load is reapplied.

COMMANDER 500



OPERATION

Idler Operational Exceptions

When the WELDING TERMINALS switch is in the “Welding Terminals Remotely Controlled” position, the idler will operate as follows:

- a. When the triggering device (Amptrol, Arc Start Switch, etc.) is pressed, the engine will accelerate and operate at full speed provided a welding load is applied within approximately 15 seconds.
 - If the triggering device remains pressed but no welding load is applied within approximately 15 seconds, the engine will return to low idle speed.
 - If the triggering device is released or welding ceases, the engine will return to low idle speed after approximately 15 seconds.

8. HOUR METER

The hour meter displays the total time that the engine has been running. This meter is a useful indicator for scheduling preventive maintenance.

WELDER CONTROLS (Items 9 through 13)

9. WELD MODE & OUTPUT CONTROL

These two controls allow you to select between various welding output slopes and adjust the desired welding output. Refer to Table B.1 for a description of how these two controls work.

10. DIGITAL OUTPUT METERS

The digital output meters are located in the center of the control panel between the two large control knobs. The meters allow the output current level to be set prior to welding in stick mode, and voltage level to be set prior to welding in the wire modes. During the welding process the meters display the actual output current and voltage, within ±5% accuracy.

The digital meters allow the output voltage (CV-WIRE mode) or current (CC-STICK, PIPE and TIG modes) to be set prior to welding using the OUTPUT control dial. During welding, the meters display the actual output voltage (VOLTS) and current (AMPS). A memory feature holds the display of both meters on for seven seconds after the welding is stopped. This allows the operator to read the actual current and voltage just prior to when welding was ceased. While the display is being held the left-most decimal point in each display will be flashing. The accuracy of the meters is +/- 3%.

11. WELDING TERMINALS SWITCH

The toggle switch on the control panel labeled WELD TERMINALS ON and REMOTELY CONTROLLED is used to control the operation of the “solid state contactor.” The switch allows for the selection of “Hot” or “Cold” welding terminals.

With the switch in the WELD TERMINALS ON position, the contactor is closed and the welding terminals are always “Hot.”

With the switch in the REMOTELY CONTROLLED position, the contactor operation is controlled by an Amptrol, Arc Start Switch or some other type of triggering device through the use of a control cable connected to the 14-pin amphenol.

When the triggering device is pressed, the contactor is closed and the welding terminals are “Hot.”

When the triggering device is released, the contactor is opened and the welding terminals are “Cold.”

NOTE: The new Chopper Technology control circuitry automatically senses when a remote output control pot is plugged into either amphenol. Therefore, there is no need for a local / remote switch.

TABLE B.1 – WELD MODE AND OUTPUT CONTROL FUNCTIONS

Application	 Weld Mode ¹	 Output ²
Sloped Output for Pipe Welding	5 Range Settings 90, 150, 200, 350, 500 (max. current on each setting)	Provides a Fine Adjustment of Welding Current from Min (1) to Max (10) within each range
Touch Start TIG Welding	1 Range Setting 15-200 Amps	
Constant Current Output for Fabrication and General Purpose Welding	1 Range Setting 20-250 Amps	
Constant Voltage Output for MIG WIRE or CORED WIRE Welding	1 Range Setting 14 to 40 Volts	Provides Fine Voltage Adjustment

¹ If the WELD MODE switch is positioned between settings, the previous setting is maintained until the switch is properly positioned on a setting.

² OUTPUT also controls O.C.V. while in the 5 sloped output ranges.

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OPERATION

12. 6 - PIN CONNECTOR (AMPHENOL)

The 6-pin amphenol located on the control panel allows for connection of interfacing equipment.

13. WELD OUTPUT TERMINALS + AND -

These 1/2 - 13 studs with flange nuts provide welding connection points for the electrode and work cables. For positive polarity welding, the electrode cable connects to the "+" terminal and the work cable connects to this "-" terminal. For negative polarity welding, the work cable connects to the "+" terminal and the electrode cable connects to this "-" terminal.

AUXILIARY POWER CONTROLS

(Items 14 through 18)

14. 120/240VAC RECEPTACLE

This is a 120/240VAC (14-50R) receptacle that provides 240VAC. Or, it can be split for 120VAC single-phase auxiliary power. This receptacle has a 50 amp rating. Refer to **AUXILIARY POWER RECEPTACLES** section in the Installation section for further information about this receptacle. Also refer to the **AUXILIARY POWER OPERATION** later in this section.

15. 50 AMP CIRCUIT BREAKERS

These circuit breakers provide separate overload current protection for each 120V circuit at the 240V receptacle.

16. 120VAC RECEPTACLES

These two 120VAC (5-20R) receptacles provide 120VAC for auxiliary power. Each receptacle has a 20 amp total rating. Refer to **AUXILIARY POWER RECEPTACLES** in the Installation section for further information about these receptacles. Also refer to the **AUXILIARY POWER OPERATION** later in this section.

17. 20 AMP CIRCUIT BREAKERS

These circuit breakers provide separate overload current protection for each 120V receptacle.

18. GROUND STUD

Provides a connection point for connecting the machine case to earth ground for the safest grounding procedure. Refer to **MACHINE GROUNDING** in the Installation section for proper machine grounding information.

19. 20 AMP CIRCUIT BREAKER

This circuit breaker provides overload protection for the 120 VAC circuit in the 14-pin amphenol.

20. VOLTMETER +/- SWITCH

Changes the polarity display on the wire feeder.

21. 10 AMP CIRCUIT BREAKER

This circuit breaker provides overload protection for the 42 VAC circuit in the 14-pin amphenol.

22. 14 - PIN CONNECTOR (AMPHENOL)

For quick connection of interfacing equipment.

23. ARC CONTROL

The ARC CONTROL potentiometer is active in two modes: CC - STICK and CV - WIRE with different purposes in each mode.

CC - STICK mode: In this mode, the ARC CONTROL knob sets the short circuit current during stick welding. Increasing the number from 1 to 10 increases the short circuit current. This prevents sticking of the electrode to the plate at low welding current settings. This also increases spatter. It is recommended that the control be set to the minimum number without electrode sticking.

CV - WIRE mode: In this mode increasing the number from 1 to 10 changes the arc from soft and washed in to crisp and narrow. It acts as an inductance control. The proper setting depends on the application and operator preference.

In general, MIG welding performs best in the "SOFT" range and Innershield in the "CRISP" range.

OPERATION

ENGINE OPERATION

STARTING THE ENGINE

1. Open the engine compartment door and check that the fuel shutoff valve located to the left of the fuel filter housing is in the open position (lever to be in line with the hose).
2. Check for proper oil level on the oil dipstick. Close engine compartment door.
3. Remove all plugs connected to the AC power receptacles.
4. Set IDLER switch to "AUTO".
5. Set the RUN/STOP switch to RUN. Observe that all engine protection lights momentarily turn on. Some lights may turn off before starting. Check the fuel gauge (K1639-2 only) to make sure that there is an adequate fuel level.
6. Press and hold the engine START button for a minimum of two seconds.
7. Release the engine START button when the engine starts.
8. Check that the indicator lights are off. If the LOW FUEL light is on (K1639-2 only), the engine will shut down 30 minutes after starting. If any other indicator light is on after starting, the engine will shut down in a few seconds. Investigate any indicated problem.
9. Allow the engine to warm up at low idle speed for several minutes before applying a load and/or switching to high idle. Allow a longer warm-up time in cold weather.

COLD WEATHER STARTING

With a fully charged battery and the proper weight oil, the engine should start satisfactorily even down to about 0°F. If the engine must be frequently started below 10°F, it may be desirable to install the optional ether starter kit (K825-1). Installation and operating instructions are included in the kit.

STOPPING THE ENGINE

1. Switch the RUN/STOP switch to STOP. This turns off the voltage supplied to the shutdown solenoid. A backup shutdown can be accomplished by shutting off the fuel valve located on the fuel line.

BREAK-IN PERIOD

The engine used to supply power for your welder is a heavy duty, industrial engine. It is designed and built for rugged use. It is very normal for any engine to use small quantities of oil until the break-in is accomplished. Check the oil level twice a day during the break-in period (about 200 running hours).



CAUTION

During break-in, subject the Commander 500 to heavy loads. Avoid long periods running at idle. Before stopping the engine, remove all loads and allow the engine to cool several minutes.

The heavy loading of the engine during break-in, within the rating of the machine, is recommended to properly seat the piston rings and prevent wetstacking. Wetstacking is an accumulation of unburned fuel and/or lubricant in the form of a set, black, tar-like substance in the exhaust pipe. The rings are seated and the break-in period is complete when there are no longer any signs of wetstacking, which should occur within the first 50 to 100 hours of operation.



CAUTION

Using your welder at low amperages with long idle running periods during the break-in period may result in a glaze forming on the engine cylinder walls and the rings not seating properly. No amount of loading will properly seat the pistons rings after they are glazed over.

TYPICAL FUEL CONSUMPTION

Refer to **Table B.2** for typical fuel consumption of the Commander 500 engine for various operating scenarios.

COMMANDER 500



OPERATION

Table B.2 – DEUTZ F3L 912
ENGINE FUEL CONSUMPTION

	Deutz F3L 912 44.2 Hp @ 1800 RPM	Running Time for 25 gallons (Hours)
Low Idle - No Load 1475 RPM	.47 gallons/hour (1.77 liters/hour)	53.2
High Idle - No Load 1900 RPM	.66 gallons/hour (2.50 liters/hour)	37.9
DC CC Weld Output 500 Amps @ 40 Volts	1.94 gallons/hour (7.34 liters/hour)	12.9
Auxiliary Power 12,000 VA	1.31 gallons/hour (4.96 liters/hour)	19.1

WELDER OPERATION

STICK WELDING

The Commander 500 can be used with a broad range of DC stick electrodes.

The "WELD MODE" switch provides five overlapping slope controlled current ranges. The OUTPUT adjusts the current from minimum to maximum within each range. Voltage is also controlled by the OUTPUT in the slope controlled setting. These slope controlled settings are intended for "out-of-position" welding, including pipe welding, where the operator would like to control the current level by changing the arc length.

PIPE WELDING

The Commander 500 is equipped with special circuitry to minimize pop-outs in the five slope modes at any open circuit voltage.

For a soft arc characteristic, set the WELD MODE switch to the lowest setting that still provides the current you need and set the OUTPUT near maximum. For example: to obtain 140 amps and a soft arc, set the WELD MODE switch to the 150 MAX position and then adjust the OUTPUT for 140 amps.

When a forceful, "digging" arc is required, use a higher setting and lower the open circuit voltage. For example: to obtain 140 amps and a forceful arc, set the WELD MODE to the 250 MAX position and then adjust the OUTPUT to get 140 amps.

CONSTANT CURRENT (CC) WELDING

In the CC - STICK position of 30 to 575, the WELD MODE switch is designed for horizontal welds with all types of electrodes, especially low hydrogen. The OUTPUT adjusts the full range of 30 to 575 amps. This setting provides a soft, constant current arc. If a more forceful arc is desired, select the proper range from the slope controlled current ranges.

In the CC mode, sticking can be prevented by adjusting the ARC CONTROL. Turning this control clockwise increases the short circuit current, thus preventing sticking. This is another way of increasing arc force.

TIG WELDING

The furthest position clockwise of the WELD MODE switch is for TIG welding in the range of 20 amps to 250 amps, with a "Touch Start" feature. To initiate a weld, the OUTPUT is first set to the desired current, and the tungsten is touched to the work. During the time the tungsten is touching the work, there is very little voltage or current and, in general, no tungsten contamination. Then, the tungsten is gently lifted off the work in a rocking motion, which establishes the arc.

The Commander 500 can be used in a wide variety of DC Tungsten Inert Gas (TIG) welding applications. In general the "Touch Start" feature allows contamination-free starting without the use of a Hi-Freq unit. But the K930-1 or -2 TIG module or K799 Hi-Freq unit can be used with the Commander 500. The settings for these follow the tungsten current range table, **Table B.3**.

COMMANDER 500



OPERATION

TABLE B.3 – TYPICAL CURRENT RANGES¹ FOR TUNGSTEN ELECTRODES²

Tungsten Electrode Diameter in. (mm)	DCEN (-)	DCEP (+)	Approximate Argon Gas Flow Rate C.F.H. (l/min.)		TIG TORCH Nozzle Size ^{4,5}
	1%, 2% Thoriated Tungsten	1%, 2% Thoriated Tungsten	Aluminum	Stainless Steel	
0.010 (.25)	2-15	³	3-8 (2-4)	3-8 (2-4)	#4, #5, #6
0.020 (.50)	5-20	³	5-10 (3-5)	5-10 (3-5)	
0.40 (1.0)	15-80	³	5-10 (3-5)	5-10 (3-5)	
1/16 (1.6)	70-150	10-20	5-10 (3-5)	9-13 (4-6)	#5, #6
3/32 (2.4)	150-250	15-30	13-17 (6-8)	11-15 (5-7)	#6, #7, #8
1/8 (3.2)	250-400	25-40	15-23 (7-11)	11-15 (5-7)	
5/32 (4.0)	400-500	40-55	21-25 (10-12)	13-17 (6-8)	#8, #10
3/16 (4.8)	500-750	55-80	23-27 (11-13)	18-22 (8-10)	
1/4 (6.4)	750-1000	80-125	28-32 (13-15)	23-27 (11-13)	

¹When used with argon gas. The current ranges shown must be reduced when using argon/helium or pure helium shielding gases.

²Tungsten electrodes are classified as follows by the American Welding Society (AWS):

Pure	EWP
1% Thoriated	EWTh-1
2% Thoriated	EWTh-2

Though not yet recognized by the AWS, Ceriated Tungsten is now widely accepted as a substitute for 2% Thoriated Tungsten in AC and DC applications.

³DCEP is not commonly used in these sizes.

⁴TIG torch nozzle "sizes" are in multiples of 1/16ths of an inch:

# 4 = 1/4 in. (6 mm)	# 7 = 7/16 in. (11 mm)
# 5 = 5/16 in. (8 mm)	# 8 = 1/2 in. (12.5 mm)
# 6 = 3/8 in. (10 mm)	#10 = 5/8 in. (16 mm)

⁵TIG torch nozzles are typically made from alumina ceramic. Special applications may require lava nozzles, which are less prone to breakage, but cannot withstand high temperatures and high duty cycles.

COMMANDER 500 SETTINGS WHEN USING THE K799 HI-FREQ UNIT

- Set the WELD MODE switch to the 20-250 setting (TIG).
- Set the IDLER switch to the HIGH position.
- Set the WELDING TERMINALS switch to the WELD TERMINALS ON position. This will close the solid state contactor and provide an always "hot" electrode.

NOTE: This is necessary because the K799 circuitry with respect to the #2 and #4 leads does not provide the proper signal to open and close the solid state contactor in the Commander 500.

COMMANDER 500 SETTINGS WHEN USING THE K930-1 TIG MODULE

- Set the WELD MODE switch to the 20-250 setting (TIG).
- Set the IDLER switch to the AUTO position.
- Set the WELDING TERMINALS switch to the REMOTELY CONTROLLED position. This will keep the solid state contactor open and provide a "cold" electrode until the triggering device (Amptrol or Arc Start Switch) is pressed.

COMMANDER 500



OPERATION

WIRE FEED (CONSTANT VOLTAGE) WELDING

Connect a wire feeder to the Commander 500 and set welder controls according to the instructions listed earlier in this section.

The Commander 500 in the CV-WIRE position can be used with a broad range of flux cored wire (Innershield and Outershield) electrodes and solid wires for MIG welding (gas metal arc welding). Welding can be finely tuned using the ARC CONTROL.

Some recommended Innershield electrodes are: NR-311, NS-3M, NR-207, NR-203 Ni 1%, NR-204-H.

Recommended Outershield electrodes are: 0S-70, 0S-71M.

Some recommended solid wires for MIG welding are: .035 (0.9 mm), .045 (1.1 mm) and .052 (1.3 mm), L-50 and L-56, .035 (0.9 mm) and .045 (1.1 mm) Blue Max MIG 308 LS.

For any electrodes, including the above recommendations, the procedures should be kept within the rating of the machine. For additional electrode information, see Lincoln publications N-675, GS-100 and GS-210.

AUXILIARY POWER OPERATION

Start the engine and set the IDLER control switch to the desired operating mode. Full power is available regardless of the welding control settings, if no welding current is being drawn.

The auxiliary power of the Commander consists of two 20 Amp-120VAC (5-20R) duplex receptacles and one 50 Amp-120/240 VAC (14-50R) receptacle. The 120/240VAC receptacle can be split for single phase 120 VAC operation.

The auxiliary power capacity is 12,000 watts of 60 Hz, single phase power. The auxiliary power capacity rating in watts is equivalent to volt-amperes at unity power factor. The maximum permissible current of the 240 VAC output is 50 A. The 240 VAC output can be split to provide two separate 120 VAC outputs with a maximum permissible current of 50 A per output to two separate 120 VAC branch circuits. Output voltage is within $\pm 10\%$ at all loads up to rated capacity.

NOTE: The 120/240V receptacle has two 120V outputs of different phases and cannot be paralleled.

The auxiliary power receptacles should only be used with three-wire grounded type plugs or approved double insulated tools with two wire plugs.

The current rating of any plug used with the system must be at least equal to the current capacity of the associated receptacle.

SIMULTANEOUS WELDING AND AUXILIARY POWER LOADS

It must be noted that the above auxiliary power ratings are with no welding load. Simultaneous welding and power loads are specified in **Table B.4**. The permissible currents shown assume that current is being drawn from either the 120 VAC or 240 VAC supply (not both at the same time).

ARC GOUGING

For optimal performance when arc gouging, set the Commander 500 WELD MODE switch to the CC - STICK position, and the ARC CONTROL to 10.

Set the OUTPUT knob to adjust output current to the desired level for the gouging electrode being used according to the ratings in the following table:

Electrode Diameter	Current Range (DC, electrode positive)
1/8"	30-60 Amps
5/32"	90-150 Amps
3/16"	150-200 Amps
1/4"	200-400 Amps
5/16"	250-400 Amps
3/8"	350-575 Amps*

* Maximum current setting is limited to the Commander 500 maximum of 575 Amps.

PARALLELING

When paralleling machines in order to combine their outputs, all units must be operated in the CC - STICK mode only. To achieve this, turn the WELD MODE switch to the CC - STICK position. Operation in other modes may produce erratic outputs and large output imbalances between the units.

COMMANDER 500



OPERATION

TABLE B.4 – COMMANDER 500 SIMULTANEOUS WELDING AND POWER LOADS

Welding Output Range Setting	Welding Output	Permissible Power - Watts (Unity Power Factor)	Permissible Auxiliary Current in Amperes	
			@ 120 V ± 10%*	@ 240 V ± 10%*
30-575	500A/40V	0	0	0
500	500A/40V	0	0	0
350	350A/30V	9500	80*	40
250	250A/29V	12000	100**	50
150	150A/27V	12000	100**	50
90	90A/25V	12000	100**	50

* Each duplex receptacle is limited to 20 amps.

** Not to exceed 50 A per 120 VAC branch circuit when splitting the 240 VAC output.

EXTENSION CORD RECOMMENDATIONS

An extension cord can be used with the auxiliary power outputs as long as it is of ample size. Table B.5 lists permissible extension cord lengths based on conductor size and auxiliary power output.

TABLE B.5 – COMMANDER 500 EXTENSION CORD LENGTH RECOMMENDATIONS

Current (Amps)	Voltage (Volts)	Load (Watts)	Maximum Allowable Cord Length in ft. (m) for Conductor Size											
			14 AWG		12 AWG		10 AWG		8 AWG		6 AWG		4 AWG	
15	120	1800	30	(9)	40	(12)	75	(23)	125	(38)	175	(53)	300	(91)
15	240	3600	60	(18)	75	(23)	150	(46)	225	(69)	350	(107)	600	(183)
20	120	2400			30	(9)	50	(15)	88	(27)	138	(42)	225	(69)
20	240	48010			60	(18)	100	(30)	175	(53)	275	(84)	450	(137)
25	240	6000					90	(27)	150	(46)	225	(69)	250	(76)
30	240	7200					75	(23)	120	(37)	175	(53)	300	(91)
38	240	9000							100	(30)	150	(46)	250	(76)
50	240	12000									125	(38)	200	(61)

Conductor size is based on maximum 2.0% voltage drop.

COMMANDER 500



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Return to Master TOC

Return to Master TOC

Return to Master TOC

COMMANDER 500



ACCESSORIES

OPTIONS/ACCESSORIES

The following options/accessories are available for your Commander 500 from your local Lincoln Distributor.

FIELD INSTALLED OPTIONS

K802N POWER PLUG KIT - Provides a plug for each receptacle.

K857 25 ft. (8.5 m) or K857-1 100 ft. (30.4 m) REMOTE CONTROL - Portable control provides same dial range as the output control on the welder from a location up to the specified length from the welder. Has convenient plug for easy connection to the welder. The Commander 500 is equipped with a 6-pin connector for connecting the remote control.

K704 ACCESSORY SET - Includes 35 feet (10 m) of electrode cable and 30 feet (9 m) of work cable, headshield, work clamp and electrode holder. Cable is rated at 500 amps, 60% duty cycle.

K953-1 TWO-WHEEL TRAILER - For road, in-plant and yard towing. Road towing with optional fender and light kit. (For highway use, consult applicable federal, state and local laws regarding possible additional requirements.)

- K953-1 Trailer
- K958-1 Ball Hitch
- K958-2 Lunette Eye Hitch
- K959-1 Fender and Light Kit
- K965-1 Cable Storage Rack

K825-1 ETHER START KIT - Provides maximum cold weather starting assistance for frequent starting below 10° F (-12.2° C). Required Ether tank is not provided with kit.

K949-1 OIL DRAIN KIT - Includes ball valve, hose and clamp.

K1690-1 (1 DUPLEX) GFCI Kit - Includes a UL approved 115 volt ground fault circuit interrupter receptacle (duplex type) with cover and installation instructions. Each half of the receptacle is rated 15 amps, but the maximum total current from the GFCI duplex is limited to 20 amps. The GFCI receptacle replaces the factory installed 115 volt duplex receptacle. Two kits are required.

K899-1 SPARK ARRESTER KIT - Easily mounts to standard muffler.

K1816-1 FULL KVA ADAPTER KIT - Plugs into the 120/240V NEMA 14-50R receptacle on the case front (which accepts 4-prong plugs) and converts it to a NEMA 6-50R receptacle (which accepts 3-prong plugs).

K1768-1 DUAL OUTPUT METERS AND GAUGES - Dual output meters provide preset ability of voltage for wire welding and current for stick welding. Measures both current and voltage when welding. Gauges include battery ammeter, engine temperature, and engine oil pressure. Fuel gauge is not available in kit form.

STICK WELDING ACCESSORIES

K704 Accessory Kit, which includes:

- Electrode holder and cable.
- Ground clamp and cable.
- Headshield.

K857 Remote Control Kit is optional for remote current control.

TIG WELDING ACCESSORIES

- Magnum TIG Torch
- Magnum Parts Kit and Argon gas
- K930-ALL TIG Module (not required for scratch-start DC TIG welding)
- K936-1 Control Cable
- K870 Foot Amptrol

Also available:

- K963-1/-2 Hand Amptrol
- K814 Arc Start Switch
- K937-22 Control Cable Extension
- K937-45 Control Cable Extension
- K844-1 Water Valve

COMMANDER 500



ACCESSORIES

SEMI-AUTOMATIC WELDING ACCESSORIES

LN-7 OR LN-8 WIRE FEEDERS - Semiautomatic, constant speed wire feeders. For CV operation only.

LN-23P WIRE FEEDER - This portable wire feeder is capable of CV operation. K350-1 Adapter Kit is required.

LN-25 WIRE FEEDER - The LN-25 with or without an external contactor may be used with the Commander 300.

NOTE: Gas-shielded welding requires a Magnum Gun. Gasless welding requires an Innershield Gun.

OTHER WIRE FEEDERS FOR THE COMMANDER 300

- NA-3 Automatic Wire Feeder
- LN-742 Semiautomatic Wire Feeder
- Spool gun and K488 Module

HIGH FREQUENCY GENERATORS FOR TIG APPLICATIONS

The K799 Hi-Freq Unit and the K930-ALL TIG Modules are suitable for use with the Commander 500. The Commander 500 is equipped with the required RF bypass circuitry for the connection of high frequency generating equipment. The high frequency bypass network supplied with the K799 Hi-Freq Unit does NOT need to be installed into the Commander 500.

The Commander 500 and any high frequency-generating equipment must be properly grounded. See the K799 Hi-Freq Unit and the K930-All TIG Module operating manuals for complete instructions on installation, operation, and maintenance.

CONNECTION OF LINCOLN ELECTRIC WIRE FEEDERS



WARNING

ELECTRIC SHOCK can kill.



- Do not operate with panels open.
- Disconnect **NEGATIVE (-) BATTERY LEAD** before servicing.
- Do not touch electrically live parts.

MOVING PARTS can injure.



- Keep guards in place.
- Keep away from moving parts.
- Only qualified personnel should install, use or service this equipment.

COMMANDER 500



ACCESSORIES

CONNECTION OF THE LN-7 TO THE COMMANDER 500 USING K867 UNIVERSAL ADAPTER (SEE FIGURE C.1.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-7 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

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

NOTE: Figure C.1 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Commander 500 output terminals.

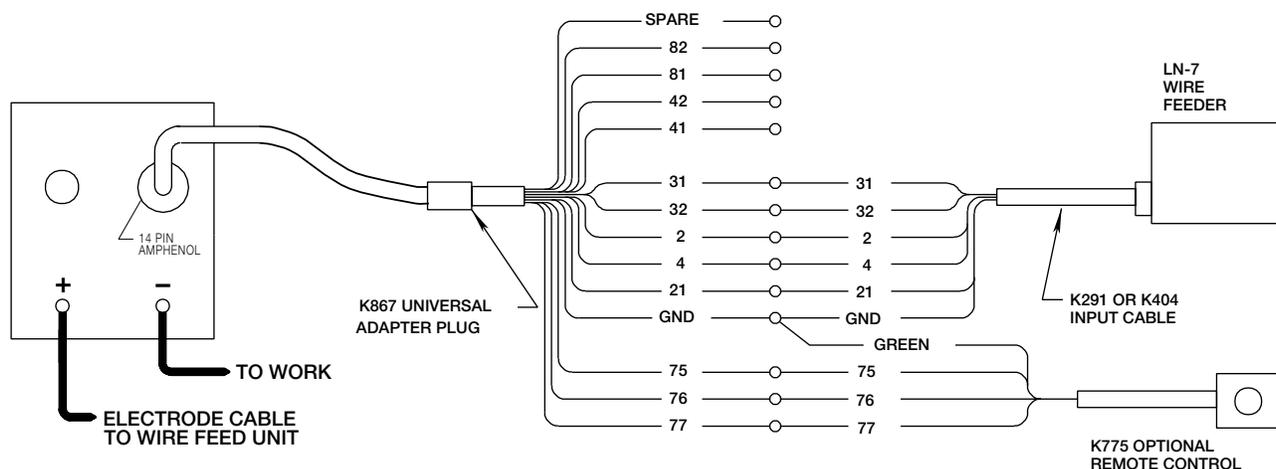
3. Connect the K867 Universal Adapter to the K291 or K404 input cable and the 14-pin amphenol of the Commander 500 as indicated in Figure C.1. Make the proper connections for local or remote control according to Figure C.1.
4. Connect the K291 or K404 input cable to the LN-7.
5. Place the IDLER switch in the HIGH position.

CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory—do not adjust above RPM specifications listed in this manual.

6. Set the VOLTMETER switch to "+" or "-" depending on the polarity chosen.
7. Set the OUTPUT RANGE switch to WIRE WELDING CV.
8. Set the WELDING TERMINALS switch to WELDING TERMINAL REMOTELY CONTROLLED.
9. Adjust wire feed speed at the LN-7.
10. Adjust the ARC CONTROL to the desired level ("soft" or "crisp").

**FIGURE C.1
COMMANDER 500/LN-7 WITH K867 ADAPTER CONNECTION DIAGRAM**



COMMANDER 500



CONNECTION OF THE LN-7 TO THE COMMANDER 500 USING K584 OR K594 INPUT CABLE ASSEMBLY (SEE FIGURE C.2.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-7 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

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

NOTE: Figure C.2 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Commander 500 output terminals.

3. Connect the K584-XX or K594-XX Input Cable Assembly to the LN-7.
4. Connect the K584-XX or 594-XX input cable assembly to the 14-pin amphenol on the Commander 500.
5. Place the IDLER switch in the HIGH position.

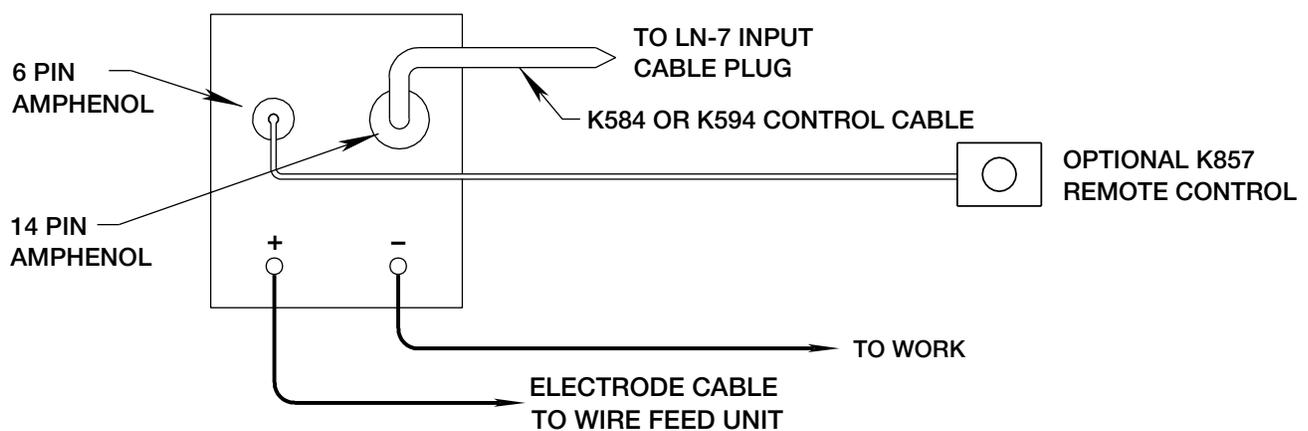
CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory—do not adjust above RPM specifications listed in this manual.

6. Set the VOLTMETER switch to "+" or "-" depending on the polarity chosen.
7. Set the OUTPUT RANGE switch to WIRE WELDING CV.
7. Set the WELDING TERMINALS switch to WELDING TERMINALS REMOTELY CONTROLLED.
9. Adjust wire feed speed at the LN-7.
10. Adjust the ARC CONTROL to the desired level ("soft" or "crisp").

NOTE: For remote control, a K857 or K857-1 remote control is required. Connect it to the 6-pin amphenol.

FIGURE C.2
COMMANDER 500/LN-7 WITH K584 OR K594 INPUT CABLE ASSEMBLY CONNECTION DIAGRAM



COMMANDER 500



CONNECTION OF THE LN-8 TO THE COMMANDER 500 USING K867 UNIVERSAL ADAPTER (SEE FIGURE C.3.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-8 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

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

NOTE: Figure C.3 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Commander 500 output terminals.

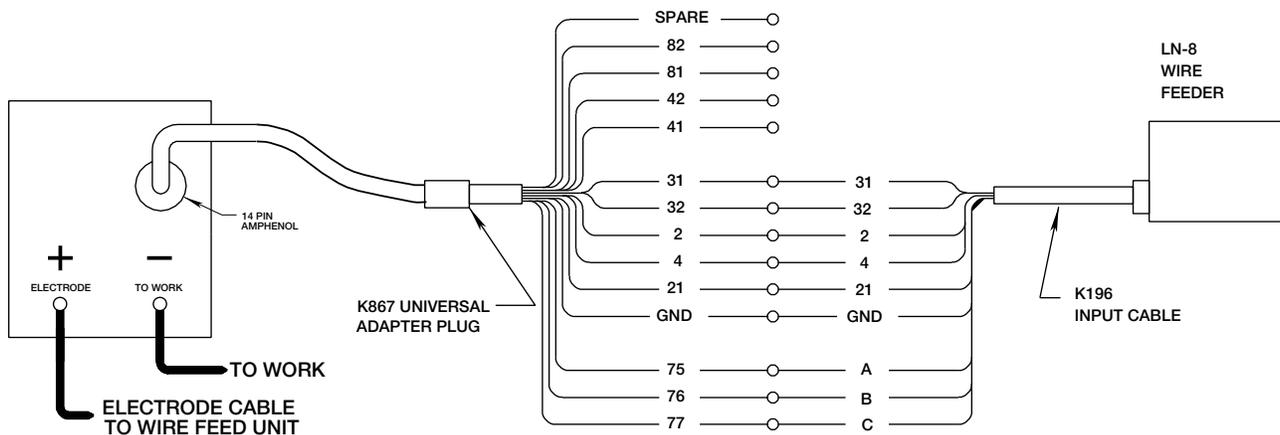
3. Connect the K867 Universal Adapter to the K196 input cable and the 14-pin amphenol of the Commander 300 as indicated in Figure C.3. Make the proper connections for local or remote control according to Figure C.3.
4. Connect the K196 input cable to the LN-8.
5. Place the IDLER switch in the HIGH position.

CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory—do not adjust above RPM specifications listed in this manual.

6. Set the VOLTMETER switch to "+" or "-" depending on the polarity chosen.
7. Set the OUTPUT RANGE switch to WIRE WELDING CV.
8. Set the WELDING TERMINALS switch to WELDING TERMINALS REMOTELY CONTROLLED.
9. Adjust wire feed speed and voltage at the LN-8.
10. Adjust the ARC CONTROL to the desired level ("soft" or "crisp").

**FIGURE C.3
COMMANDER 500/LN-8 WITH K867 ADAPTER CONNECTION DIAGRAM**



COMMANDER 500



ACCESSORIES

CONNECTION OF THE LN-8 TO THE COMMANDER 500 USING K595 INPUT CABLE ASSEMBLY (SEE FIGURE C.4.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-8 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

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

NOTE: Figure C.4 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Commander 500 output terminals.

3. Connect the K595-XX Input Cable Assembly to the LN-8.
4. Connect the K595-XX to the 14-pin amphenol on the Commander 500.
5. Place the IDLER switch in the HIGH position.

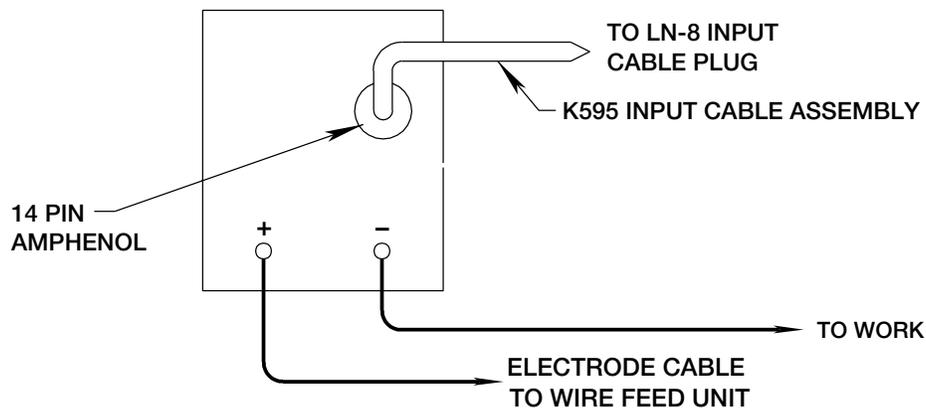


CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory—do not adjust above RPM specifications listed in this manual.

6. Set the VOLTMETER switch to "+" or "-" depending on the polarity chosen.
7. Set the OUTPUT RANGE switch to WIRE WELDING CV.
8. Set the WELDING TERMINALS switch to WELDING TERMINALS REMOTELY CONTROLLED.
9. Adjust wire feed speed and voltage at the LN-8.
10. Adjust the ARC CONTROL to the desired level ("soft" or "crisp").

FIGURE C.4
COMMANDER 500/LN-8 WITH K595 INPUT CABLE ASSEMBLY CONNECTION DIAGRAM



COMMANDER 500



ACCESSORIES

CONNECTION OF THE LN-23P TO THE COMMANDER 500 USING K350-1 ADAPTER (SEE FIGURE C.5.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-23P to the "-" terminal of the welder. Connect the work cable to the "+" terminal of the welder.

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

NOTE: Figure C.5 shows the electrode connected for negative polarity.

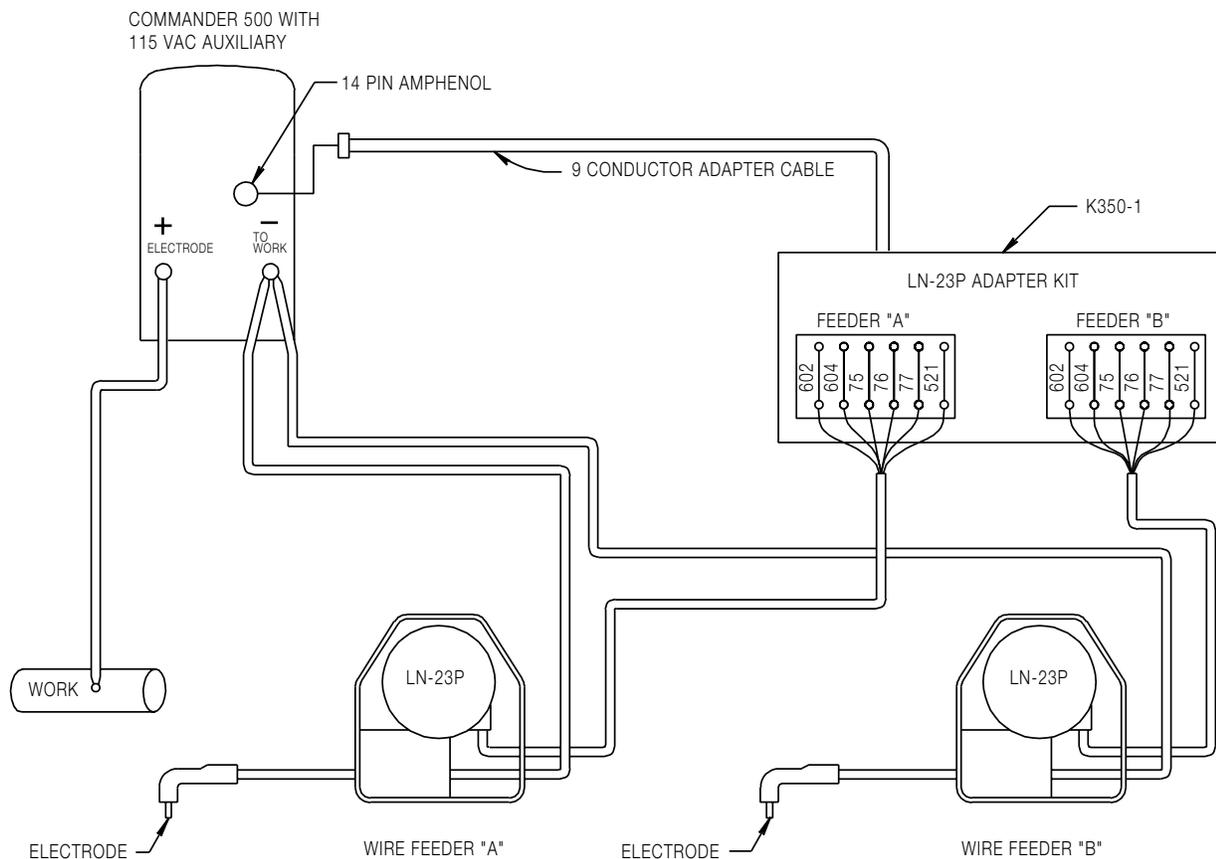
3. Connect the K350-1 adapter to the amphenol on the LN-23P and the 14-pin amphenol of the Commander 500 as indicated in Figure C.5.
4. Place the IDLER switch in the HIGH position.

CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory—do not adjust above RPM specifications listed in this manual.

5. Set the VOLTMETER switch to negative.
6. Set the OUTPUT RANGE switch to WIRE WELDING CV.
7. Set the WELDING TERMINALS switch to WELDING TERMINALS REMOTELY CONTROLLED.
8. Adjust wire feed speed and voltage at the LN-23P.

**FIGURE C.5
COMMANDER 500/LN-23P CONNECTION DIAGRAM**



COMMANDER 500



ACCESSORIES

CONNECTION OF THE LN-25 TO THE COMMANDER 500 "ACROSS THE ARC" (SEE FIGURE C.6.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-25 to the "-" terminal of the welder. Connect the work cable to the "+" terminal of the welder.

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

NOTE: Figure C.6 shows the electrode connected for negative polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Commander 500 output terminals. Reverse the LN-25 polarity switch.

3. Attach the single lead from the LN-25 to the work using the spring clip on the end of the lead. This is only a sense lead – it carries no welding current.
4. Place the IDLER switch in the AUTO position.

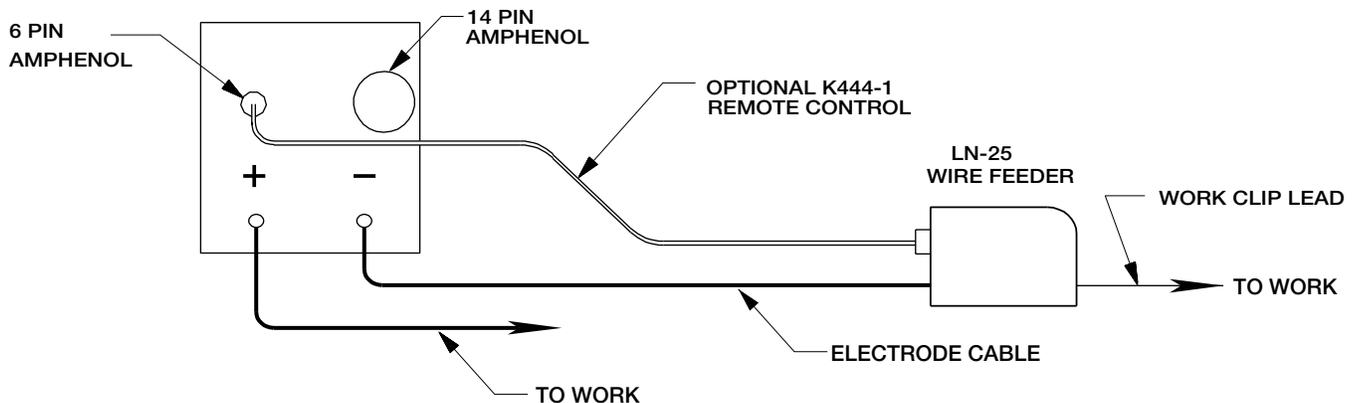


CAUTION

If you are using an LN-25 without an internal contactor, the electrode will be HOT when the Commander 300 is started.

5. Set the OUTPUT RANGE switch to WIRE WELDING CV.
6. Set the WELDING TERMINALS switch to WELDING TERMINALS ALWAYS ON.
7. Set the VOLTMETER switch to "+" or "-" depending on the polarity chosen.
8. Adjust wire feed speed at the LN-25.
9. Adjust the ARC CONTROL to the desired level ("soft" or "crisp").

**FIGURE C.6
COMMANDER 500/LN-25 ACROSS THE ARC CONNECTION DIAGRAM**



COMMANDER 500



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MAINTENANCE

SAFETY PRECAUTIONS

WARNING

- Have qualified personnel do all maintenance and troubleshooting work.
- Turn the engine off before working inside the machine.
- Remove covers or guards only when necessary to perform maintenance and replace them when the maintenance requiring their removal is complete.
- If covers or guards are missing from the machine, get replacements from a Lincoln Distributor.

Read the Safety Precautions in the front of this manual and in the instruction manual for the diesel engine used with your machine before working on the Commander 500.

Keep all equipment safety guards, covers, and devices in position and in good repair. Keep your hands, hair, clothing, and tools away from the fans, and all other moving parts when starting, operating, or repairing this machine.

ROUTINE AND PERIODIC MAINTENANCE

ENGINE MAINTENANCE

DAILY

- a. Check the crankcase oil level.
- b. Refill the fuel tank to minimize moisture condensation in the tank.
- c. Open the water drain valve located on the bottom of the water separator element one or two turns and allow to drain into a container suitable for diesel fuel for two to three seconds. Repeat the above drainage procedure until diesel fuel is detected in the container.

WEEKLY

Blow out the machine with low pressure air periodically. In particularly dirty locations, this may be required once a week.



CAUTION

To prevent the engine from accidentally starting, disconnect the negative battery cable before servicing the engine.

See **Table D.1** for a summary of maintenance intervals for the items listed below. Follow either the hourly or the calendar intervals, whichever come first. More frequent service may be required, depending on your specific application and operating conditions.

OIL: Check the oil level after every 8 hours of operation or daily. **BE SURE TO MAINTAIN THE OIL LEVEL.**

Change the oil the first time between 25 and 50 hours of operation. Then, under normal operating conditions, change the oil as specified in **Table D.1**. If the engine is operated under heavy load or in high ambient temperatures, change the oil more frequently.

CHANGE THE OIL: Change the oil, while the engine is still warm, as follows:

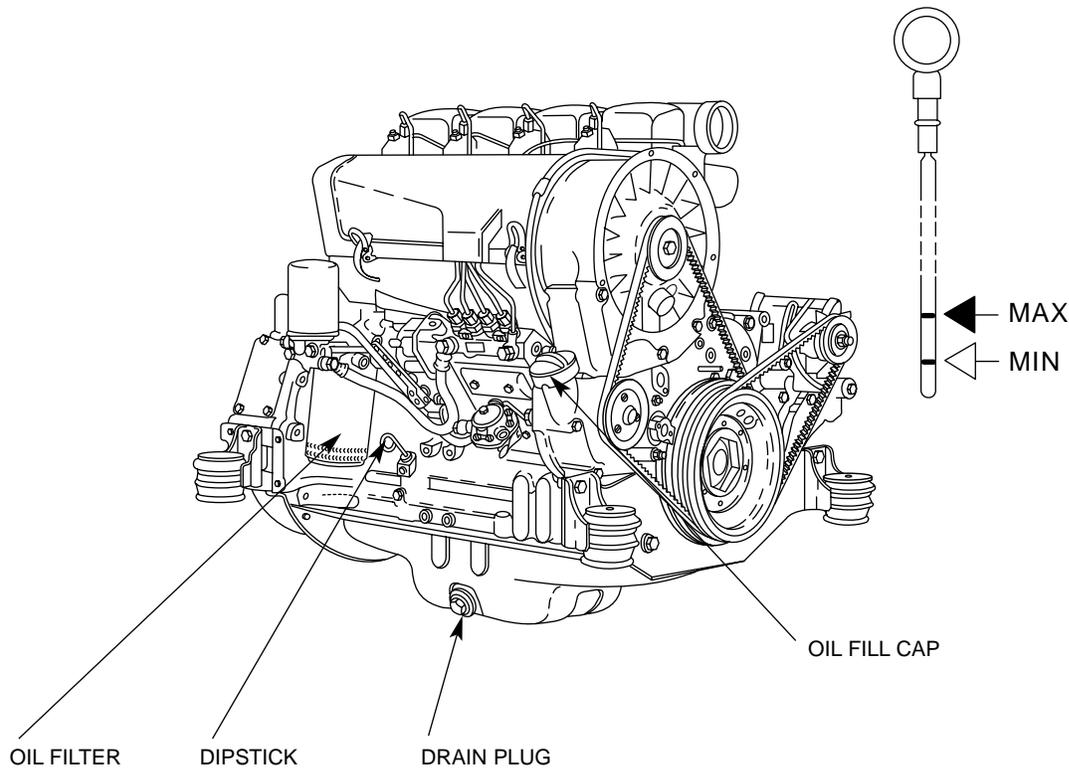
1. Drain the oil from the drain plug located on the engine bottom, as shown in **Figure D.1**. Examine the washer and replace it if it appears damaged.
2. Replace the plug and washer and tighten firmly.
3. Remove the oil fill cap and add oil until the level reaches the "MAX" mark on the dipstick. See **Figure D.1**. Use high quality oil viscosity grade 10W40. Consult the engine manual for oil specifications for various ambient temperatures. Always check the level with the dipstick before adding more oil.
4. Reinstall the oil fill cap and the dipstick.

COMMANDER 500



MAINTENANCE

FIGURE D.1 – OIL DRAIN AND REFILL



CHANGE THE OIL FILTER: Change the oil filter the first time between 25 and 50 hours of operation. Then, under normal operating conditions, change the oil filter after every 250 hours of operation. If the engine is operated under heavy load or in high ambient temperatures, change the oil filter more frequently. See **Table D.1** for recommended maintenance intervals. See **Table D.2** for replacement oil filters.

Change the oil filter as follows:

1. Remove the oil drain plug. Drain the oil from the engine and allow the oil filter to drain. See Figure D.1.
2. Remove the old filter (spin it off) and discard it. Wipe off the filter mounting surface and adapter. See Figure D.1.
3. Fill the new filter with fresh engine oil. Apply a thin coat of new oil to the rubber gasket on the new oil filter.
4. Spin the new filter onto the mounting adapter finger tight until the gasket is evenly seated. Then turn it down another 1/2 turn. Do not overtighten the new filter.

5. Refill the engine with the proper amount and type of oil as described in the **Change the Oil** section, above. Start the engine and check for leaks around the filter element. Correct any leaks (usually by retightening the filter, but only enough to stop leaks) before placing the Commander 500 back in service.
6. If there are no leaks, stop the engine and recheck the oil level. If necessary, add oil to bring the level up to the "MAX" mark, but do not overfill. See Figure D.1.

FUEL: At the end of each day's use, refill the fuel tank to minimize moisture condensation and dirt contamination in the fuel line. Do not overfill; leave room for the fuel to expand.

Refer to your engine operation manual for recommended grade of fuel.

COMMANDER 500



FUEL FILTERS:


WARNING


When working on the fuel system:

- Keep naked lights away, do not smoke !
- Do not spill fuel !

The Commander 500 is equipped with a **Fuel Pre-Filter/Water Separator Assembly** located before the lift pump and a **Secondary Fuel Filter** located after the lift pump and before the fuel injectors. The Fuel Pre-Filter/Water Separator is mounted to the engine block just below the lift pump (Figure D.2). The Secondary Fuel Filter is mounted directly to the engine just above the oil filter (**Figure D.3**).

Fuel Pre-Filter/Water Separator Assembly: The pre-filter is a 150 micron screen designed to protect against gross fuel contamination of the water separator element and the Secondary Fuel Filter. If the pre-filter becomes plugged, it may be removed, inspected, cleaned and reinstalled. In general this only needs to be done with each water separator element change (about every 1,000 hrs). However, if at any time excessive fuel contamination is suspected or a sudden fall-off in engine performance is detected the pre-filter screen should be inspected and cleaned. See Figure D.2 and follow this procedure:

1. Close the fuel shutoff valve located on the side of the Fuel Pre-Filter/Water Separator Assembly. The lever should be perpendicular to the hose
2. Unscrew the cap ring located on the top of the filter header and remove the plastic center cap and O-ring.
3. Remove the large white volume plug located directly under the center cap in the upper cavity of the filter header. Use a small screwdriver (or similar device) to lift the plug part way out of the cavity to assist with its removal.

NOTE: Be careful not to damage the pre-filter screen with the tool used to remove the plug.

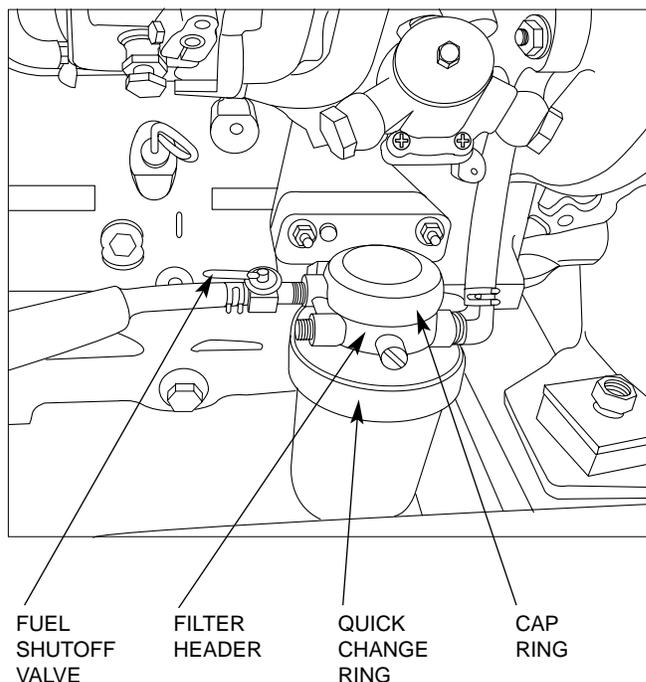
4. Using a pair of pliers, gently tug on the pull tabs of the pre-filter screen in an alternating pattern to gradually remove the pre-filter screen.
5. Brush off any debris and rinse in diesel fuel.
6. Re-install the pre-filter screen into the upper cavity of the filter header making sure the four pull tabs are pointing up. Putting your fingers on the pull tabs, push down evenly until the lower body of the pre-filter screen contacts the floor of the upper cavity.

7. Re-insert the large white volume plug into the upper cavity.
8. Place the O-ring onto the angled seal surface of the filter header and re-install the plastic cap. Make sure its flange rests on the O-ring.
9. Screw on the cap ring and tighten hand tight.
10. Remember to open the fuel shutoff valve (Lever in line with the hose) before starting the engine.

Water Separator Element: The water separator element is a two-stage filter with a special filtration/water separating media. An expanded water reservoir provides maximum protection against water in the fuel. The recommended change interval for the water separator element is 1,000 hours. See Figure D.2 and follow this procedure.

1. Close the fuel shutoff valve located on the side of the Fuel Pre-Filter/Water Separator Assembly. The lever should be perpendicular to the hose.
2. Rotate the quick change ring (located just below filter header) clockwise approximately 1/2 turn and slide it down and off the element.
3. Grasp the element and pull down with a slight rocking motion to remove the element from the grommet post on the bottom of the filter header.

FIGURE D.2 – FUEL PRE-FILTER/WATER SEPARATOR ASSEMBLY



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4. Slide the new element onto the grommet post on the bottom of the filter header until the element no longer easily moves up into the filter header. Now rotate the element (it may take almost 1 full turn) with a slight upward pressure until the element begins to further engage the header. With the proper orientation now established, apply additional pressure to seat the element in the filter header. You should feel the element “pop” into place when properly seated.

NOTE: The element will only go on one way. Never use excessive force when mounting the element to the header.

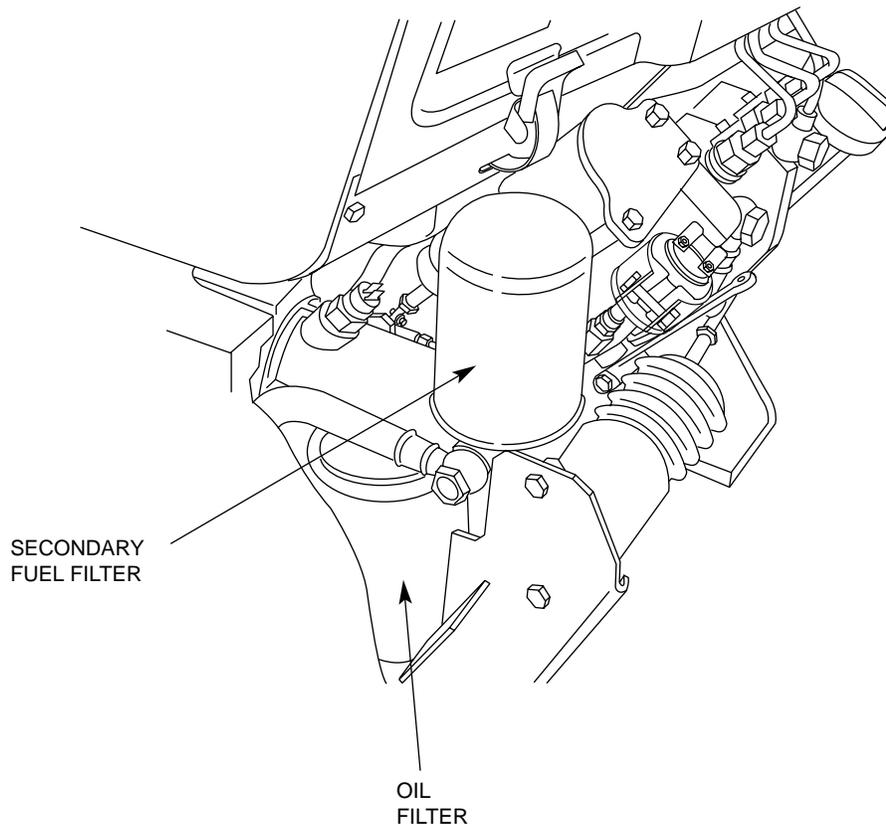
5. Slide the quick change ring up over the element and rotate counter clockwise until an audible click or pop is heard. If you do not hear the click, you have not rotated the ring far enough and the element is not in the locked position. Another indication that the ring is in the locked position is that one set (it doesn't matter which one) of arrows located on the outside of the ring should be located directly under the air vent valve.

6. Open the fuel shutoff valve (lever in line with the hose).

7. Open the air vent valve on the front of the filter header until fuel emerges free of air bubbles. Then close the air vent valve.

Secondary Fuel Filter: The Secondary Fuel Filter is a spin-on cartridge type mounted directly to the engine. Consult your engine Operator's Manual for complete information on service intervals and element changing procedures.

FIGURE D.3 – SECONDARY FUEL FILTER



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BLEEDING THE FUEL SYSTEM: In the event the engine is operated until it runs out of fuel, you will need to bleed the fuel system in order to start the engine. Refer to the engine operation manual.

AIR FILTER:



CAUTION

Excessive air filter restriction will result in reduced engine life.

The air filter element is a dry cartridge type. It can be cleaned and reused. However, damaged elements should not be reused. Stop engine after 100 hours of running time and clean filter element. Replace the filter if necessary. Service the air cleaner regularly according to your engine operation manual.

1. Locate the air filter canister located behind the engine door on the top of the engine.
2. Remove the air filter element.

3. Remove loose dirt from the element with compressed air or a water hose directed from inside out.

Compressed Air: 100 psi maximum with nozzles at least one inch away from the element.

Water Hose: 40 psi maximum without nozzle.

4. Soak the element in a mild detergent solution for 15 minutes. Do not soak more than 24 hours. Swish the element around in the solution to help remove dirt.
5. Rinse elements from inside out with a gentle stream of water (less than 40 psi) to remove all suds and dirt.
6. Dry the element before reuse with warm air at less than 160°F (71°C). Do not use a light bulb to dry the element.
7. Inspect for holes and tears by looking through the element toward a bright light. Check for damaged gaskets or dented metal parts. Do not reuse damaged elements. Protect the element from dust and damage during drying and storage.
8. Reinstall the air filter element.

After six cleanings, replace the air filter. A cleaned filter will have approximately 70% of the life of a new filter element. A restricted filter element may not appear excessively dirty.

COMMANDER 500



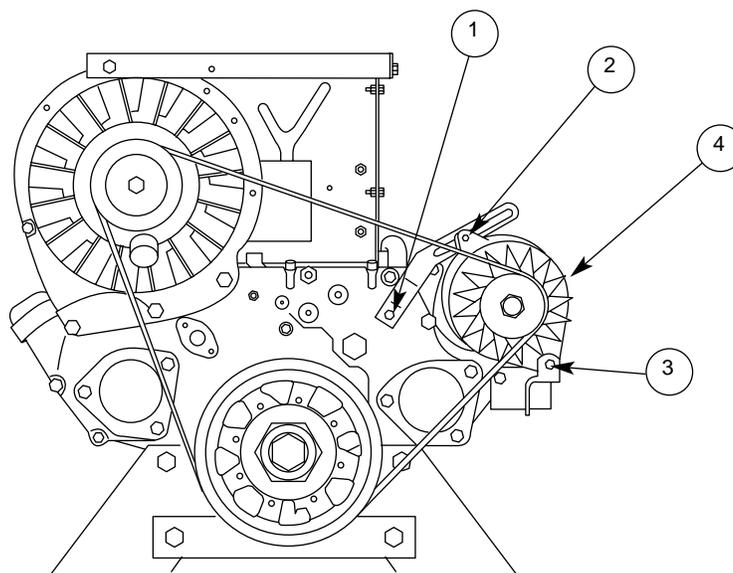
MAINTENANCE

COOLING SYSTEM: The cooling system of the Deutz engine needs to be checked and cleaned periodically. Consult the engine Operation Manual for the proper frequency and procedure.

COOLING BLOWER BELT: The following procedure should be followed to replace the cooling blower belt:

1. Allow the machine to cool.
2. Unfasten and slide the battery holder out from the welder.
3. Disconnect the negative battery cable.
4. Remove the engine case side.
5. Loosen the air cleaner hose clamp and detach the hose.
6. Remove the engine end panel with air box and air cleaner attached for access to the engine.
7. See Figure D.4. Loosen the alternator mounting bolts (1, 2, 3) and rotate the alternator toward the engine.
8. Remove the old cooling blower belt and install a new one.
9. Push outward on the alternator (4) and adjust the cold belt tension to 63-73 lbs. (10-15 mm maximum deflection) midway between any two pulleys. Tighten bolts (1), (2), (3).
10. Reinstall the air cleaner hose, engine case side, and engine end panel. Reattach the negative battery cable. Slide in and refasten the battery holder.
11. Check the cooling blower belt tension after 100 hours of operation. (Follow seps 1-6; 9 and 10.)

FIGURE D.4 – COOLING BLOWER BELT REPLACEMENT AND ADJUSTING



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**TABLE D.1
DEUTZ ENGINE MAINTENANCE SCHEDULE**

FREQUENCY	MAINTENANCE REQUIRED
Daily or Before Starting Engine	<ul style="list-style-type: none"> • Fill fuel tank. • Check oil level. • Check air cleaner for dirty, loose, or damaged parts. Replace if necessary. • Check air intake and cooling areas, clean as necessary.
¹First 50 Hours and Every 250 Hours Thereafter	<ul style="list-style-type: none"> • Change engine oil. • Change oil filter. • Change fuel filter. • Check fan belt.
Every 50 Hours	<ul style="list-style-type: none"> • Check fuel lines and clamps.
Every 100 Hours	<ul style="list-style-type: none"> • Check battery electrolyte level and connections. • Clean air filter.

Refer to your Deutz engine operation manual for periodic maintenance at 100 hours and beyond.

¹125 Hours for severe conditions.

**TABLE D.2
ENGINE MAINTENANCE PARTS**

ITEM	MANUFACTURER	PART NUMBER
Air Cleaner Element	Donaldson AC	P181052 A302C
Cooling Blower Belt	Lincoln Gates	T13536-3 7585
Oil Filter Element	Deutz Purolator Napa Fram	1174418 PER2168 1820 PH3776
Fuel Filter Element	Deutz Purolator Napa Fram	1174423 PC42 3358 P4102
Water Separator Element	Lincoln Stanadyne	M16890-C 31572
Fuel Pre-Filter Screen	Lincoln Stanadyne	M16890-B 29575
Battery		BCI Group 34

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BATTERY MAINTENANCE



WARNING



GASES FROM BATTERY can explode.

- Keep sparks, flame, and cigarettes away from battery.



BATTERY ACID can burn eyes and skin.

- Wear gloves and eye protection and be careful when working near a battery. Follow the instructions printed on the battery.

To prevent EXPLOSION when:

- **INSTALLING A NEW BATTERY** - Disconnect the negative cable from the old battery first and connect to the new battery last.
- **THE CORRECT POLARITY IS NEGATIVE GROUND** - Damage to the engine alternator and the printed circuit board can result from incorrect connection.



- **CONNECTING A BATTERY CHARGER** - Remove the battery from the welder by disconnecting the negative cable first, then the positive cable and battery clamp. When reinstalling, connect the negative cable last. Keep the area well ventilated.

- **USING A BOOSTER** - Connect the positive lead to the battery first, then connect the negative lead to the engine foot.
- To prevent BATTERY BUCKLING, tighten the nuts on the battery clamp until snug.

CLEANING THE BATTERY: Keep the battery clean by wiping it with a damp cloth when dirty. If the terminals appear corroded, disconnect the battery cables and wash the terminals with an ammonia solution or a solution of 1/4 pound (0.113 kg) of baking soda and 1 quart (0.946 l) of water. Be sure the battery vent plugs (if equipped) are tight so that none of the solution enters the cells.

After cleaning, flush the outside of the battery, the battery compartment, and surrounding areas with clear water. Coat the battery terminals lightly with petroleum jelly or a non-conductive grease to retard corrosion.

Keep the battery clean and dry. Moisture accumulation on the battery can lead to more rapid discharge and early battery failure.

CHECKING SPECIFIC GRAVITY: Check each battery cell with a hydrometer. A fully charged battery will have a specific gravity of 1.260. Charge the battery if the reading is below 1.215.

NOTE: Correct the specific gravity reading by adding four gravity points (0.004) for every five degrees the electrolyte temperature is above 80 degrees F (27 degrees C). Subtract four gravity points (.004) for every five degrees the electrolyte temperature is below 80 degrees F (27 degrees C).

CHECKING ELECTROLYTE LEVEL: If battery cells are low, fill them to the neck of the filler hole with distilled water and recharge. If one cell is low, check for leaks.

CHARGING THE BATTERY: The Commander 500 is equipped with a wet charged battery. The charging current is automatically regulated when the battery is low (after starting the engine) to a trickle current when the battery is fully charged.

When you charge, jump, replace, or otherwise connect battery cables to the battery, be sure the polarity is correct. Improper polarity can damage the charging circuit. **The Commander 500 charging system is NEGATIVE GROUND.** The positive (+) battery terminal has a red terminal cover.

If you need to charge the battery with an external charger, disconnect the negative cable first, then the positive cable before you attach the charger leads. After the battery is charged, reconnect the positive battery cable first and the negative cable last. Failure to do so can result in damage to the internal charger components.

Follow the instructions of the battery charger manufacturer for proper charger settings and charging time.

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WELDER/GENERATOR MAINTENANCE

STORAGE: Store the Commander 500 in clean, dry, protected areas.

CLEANING: Blow out the generator and controls periodically with low pressure air. Do this at least once a week in particularly dirty areas.

NAMEPLATES: Whenever routine maintenance is performed on this machine - or at least yearly - inspect all nameplates and labels for legibility. Replace those which are no longer clear. Refer to the parts list for the replacement item number.

BRUSH REMOVAL AND REPLACEMENT: It is normal for the brushes and slip rings to wear and darken slightly. Inspect the brushes when a generator overhaul is necessary.

WARNING

Do not attempt to polish slip rings while the engine is running.

BEARINGS: The Commander 500 is equipped with double-shielded ball bearings having sufficient grease to last indefinitely under normal service. Where the welder is used constantly or in excessively dirty locations, it may be necessary to add one half ounce of grease per year. A pad of grease one inch wide, one inch long, and one inch high weighs approximately one half ounce. Over-greasing is far worse than insufficient greasing.

When greasing the bearings, keep all dirt out of the area. Wipe the fittings completely clean and use clean equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

RECEPTACLES: Keep the electrical receptacles in good condition. Remove any dirt, oil, or other debris from their surfaces and holes.

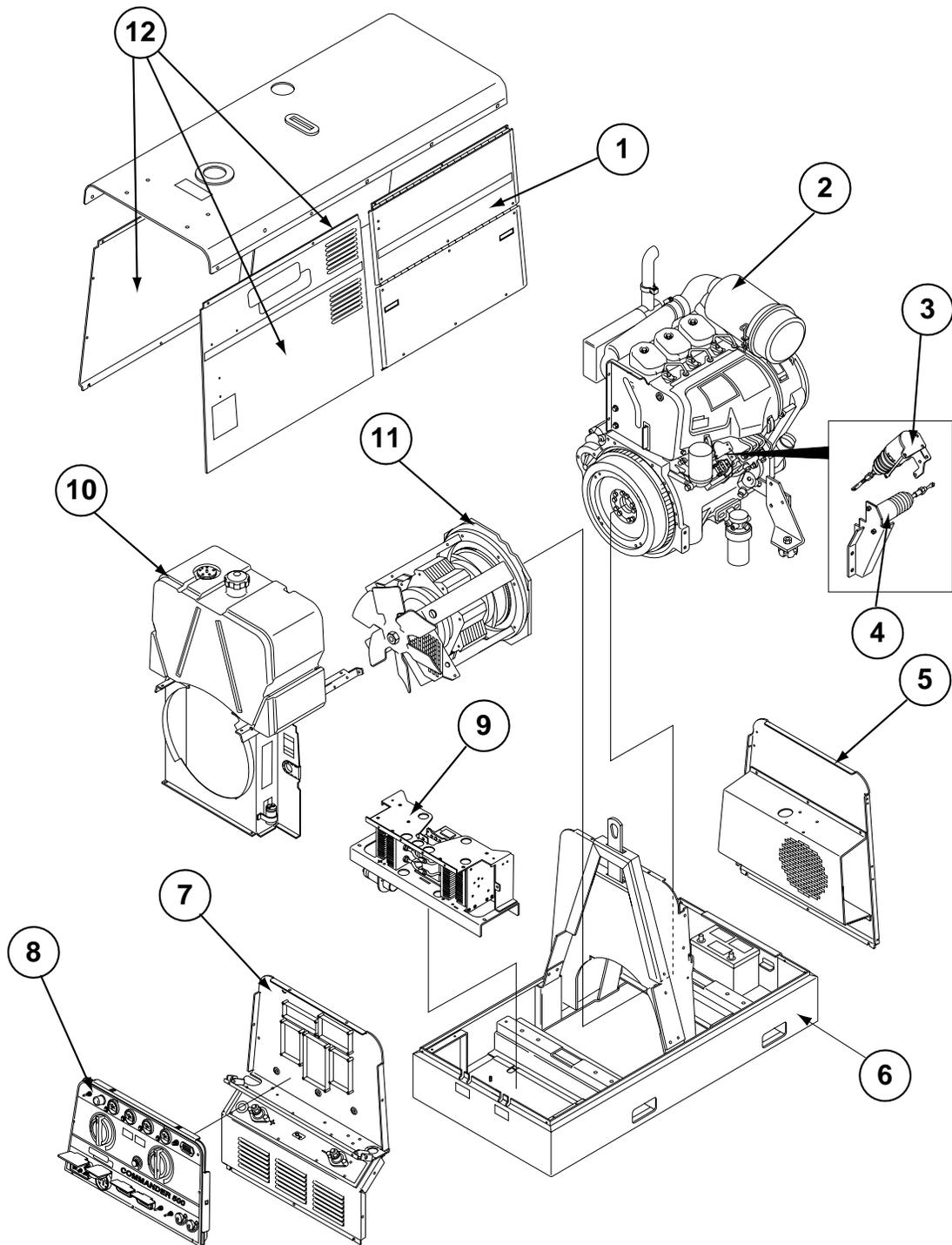
CABLE CONNECTIONS: Check the welding cable connections at the weld output terminals often. Be sure that the connections are always tight.

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FIGURE D.5 – MAJOR COMPONENT LOCATIONS



- | | |
|------------------------|---|
| 1. CASE DOOR ASSEMBLY | 7. FRONT PANEL ASSEMBLY WITH OUTPUT PANEL |
| 2. ENGINE | 8. CONTROL PANEL |
| 3. SHUT DOWN SOLENOID | 9. OUTPUT RECTIFIER BRIDGE ASSEMBLY |
| 4. IDLER SOLENOID | 10. FUEL TANK |
| 5. REAR PANEL ASSEMBLY | 11. ROTOR/STATOR |
| 6. BASE | 12. CASE TOP AND SIDES |

COMMANDER 500



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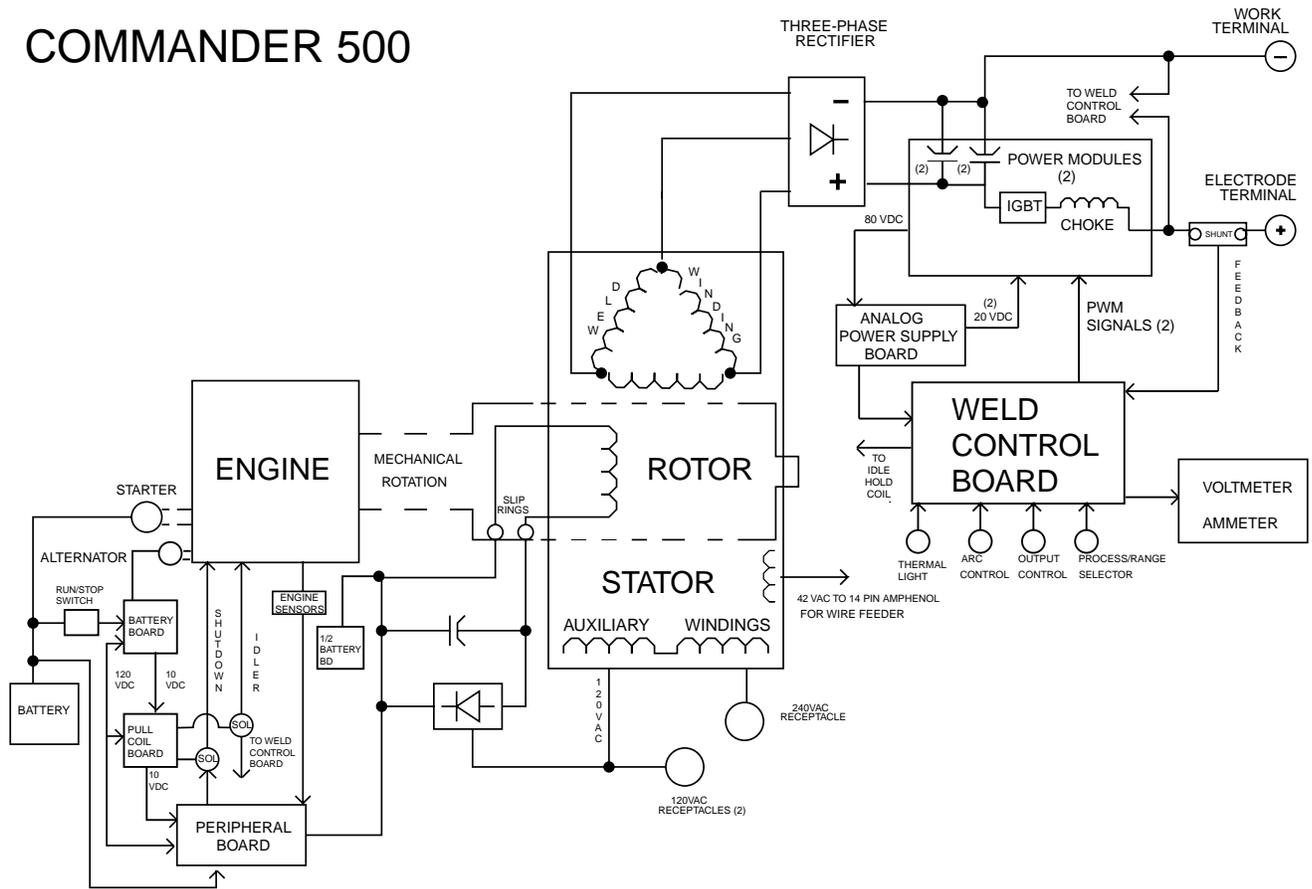
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FIGURE E.1 – MULTI-WELD 500 BLOCK LOGIC DIAGRAM

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COMMANDER 500



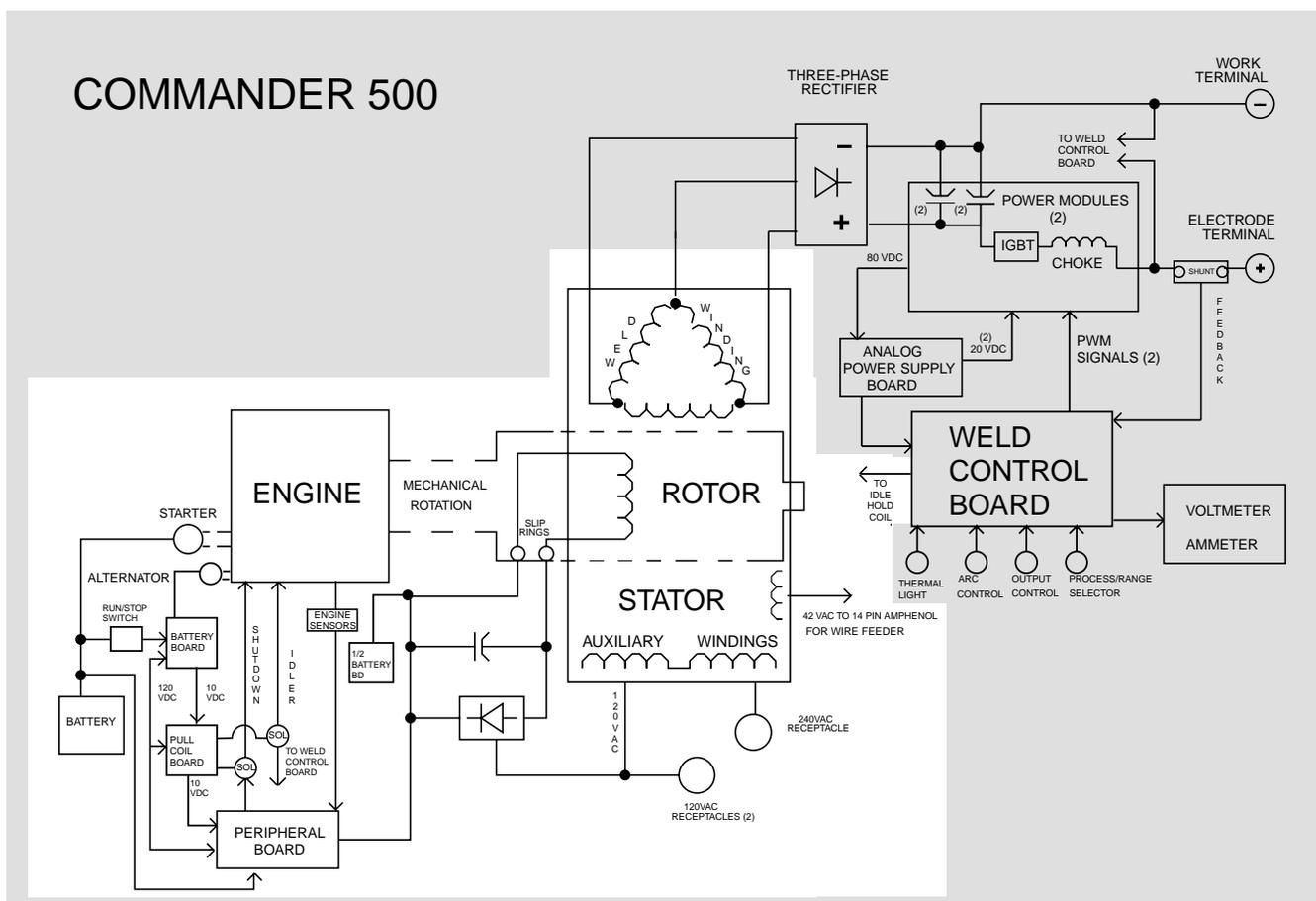
Return to Master TOC

Return to Master TOC

Return to Master TOC

Return to Master TOC

FIGURE E.2 - BATTERY, ENGINE, ROTOR, STATOR, PULL COIL BOARD AND PERIPHERAL BOARD – ENGINE PROTECTION



GENERAL DESCRIPTION

The Commander 500 is a diesel engine-driven welding power source capable of producing 500 amps at 40VDC at a 100% duty cycle. The engine is coupled to a brush-type alternating current generator. This AC output is rectified and controlled by **Chopper Technology** to produce DC current for multi-purpose welding applications. The Commander 500 is also capable of producing 12,000 watts of AC auxiliary power at 100% duty cycle.

BATTERY, ENGINE, ROTOR, STATOR, PULL COIL BOARD AND PERIPHERAL BOARD – ENGINE PROTECTION

The 12VDC battery powers the engine starter motor and also supplies power to the Battery PC board, Pull Coil PC board, Peripheral PC board and associated circuitry. When the engine, which is mechanically coupled to the rotor, is started and running, the 12 VDC

battery voltage is fed through the Battery PC board to the rotor field coil via a brush and slip ring configuration. This excitation or "flashing" voltage magnetizes the rotor lamination. This rotating magnet induces a voltage in the stationary windings of the main alternator stator. The stator houses a three-phase weld winding, a 120/240VAC single-phase auxiliary winding, and a 42VAC wire feeder power winding.

The engine alternator supplies charging current for the battery circuit. The Peripheral board monitors the engine sensors and will shut the engine off in the event of low oil pressure, engine over temperature, malfunction of the engine's alternator system or a low fuel condition. The idler solenoid is mechanically connected to the engine's throttle linkage. If no welding or auxiliary current is being drawn from the Commander 500, the Pull Coil board activates the idler solenoid, which then brings the engine to a low idle state. When output current is sensed, either weld or auxiliary, the Weld Control PC board deactivates the idler solenoid, and the engine returns to high RPM.

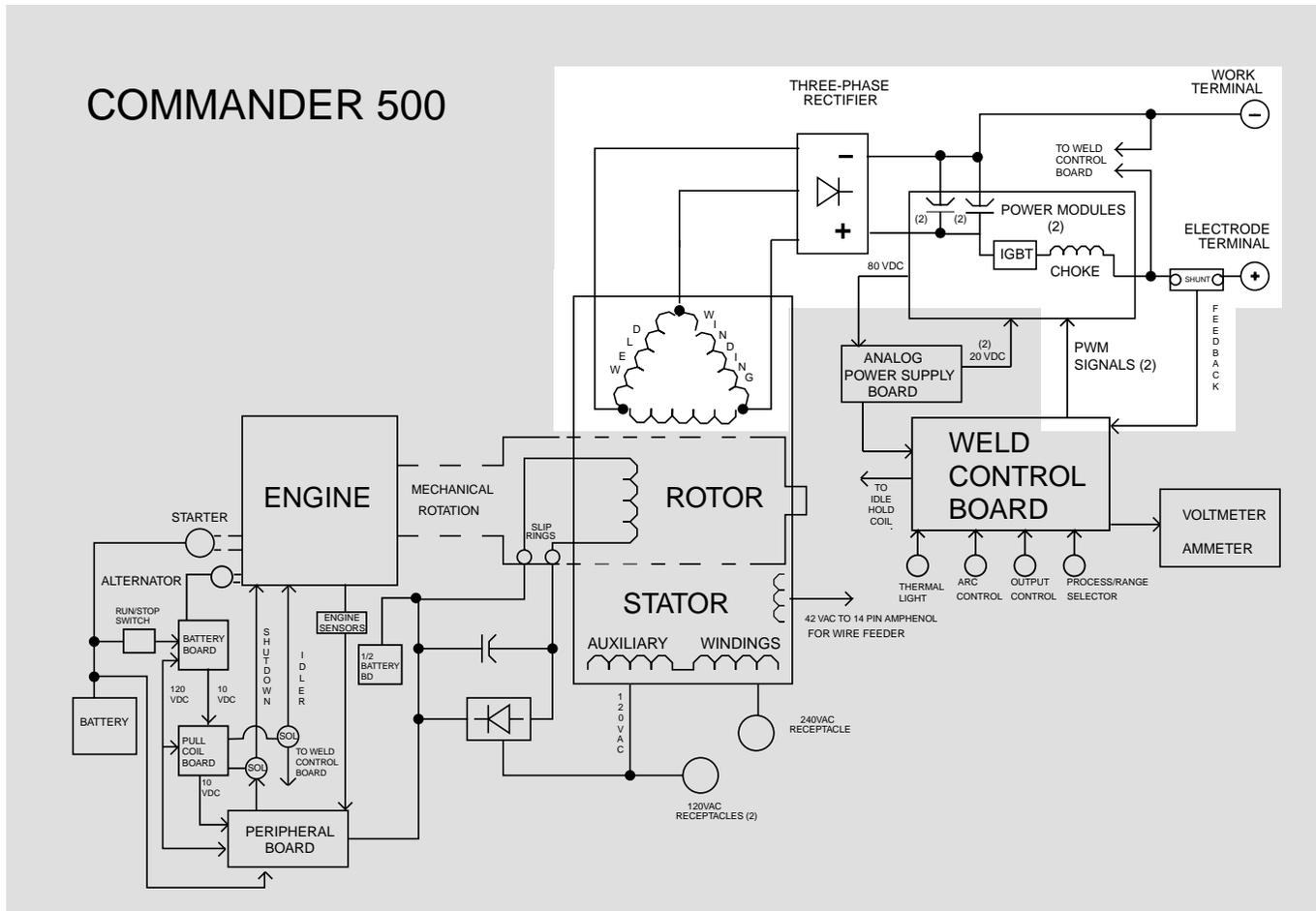
NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

COMMANDER 500



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FIGURE E.3 - WELD WINDINGS, RECTIFIER, POWER MODULES AND FEEDBACK



WELD WINDINGS, RECTIFIER, POWER MODULES AND FEEDBACK

The three-phase stator weld windings are connected to a three-phase rectifier bridge. The resultant DC voltage is applied to four paralleled capacitors incorporated within each of the two power modules. There are two capacitors in each module. These capacitors function as filters and also as power supplies for the IGBTs. See **IGBT Operation** in this section. The IGBTs act as high-speed switches operating at 20KHZ. These devices are switched on and off by the Weld Control PC board through pulse width modulation circuitry. See **Pulse Width Modulation** in this section. This

"chopped" DC output is applied through choke coils and a shunt to the welding output terminals. The choke functions as a current filter, and it helps to balance the outputs of the two power modules. Free-wheeling diodes are incorporated in the power modules to provide a current path for the stored energy in the choke when the IGBTs are turned off. See **Chopper Technology** in this section.

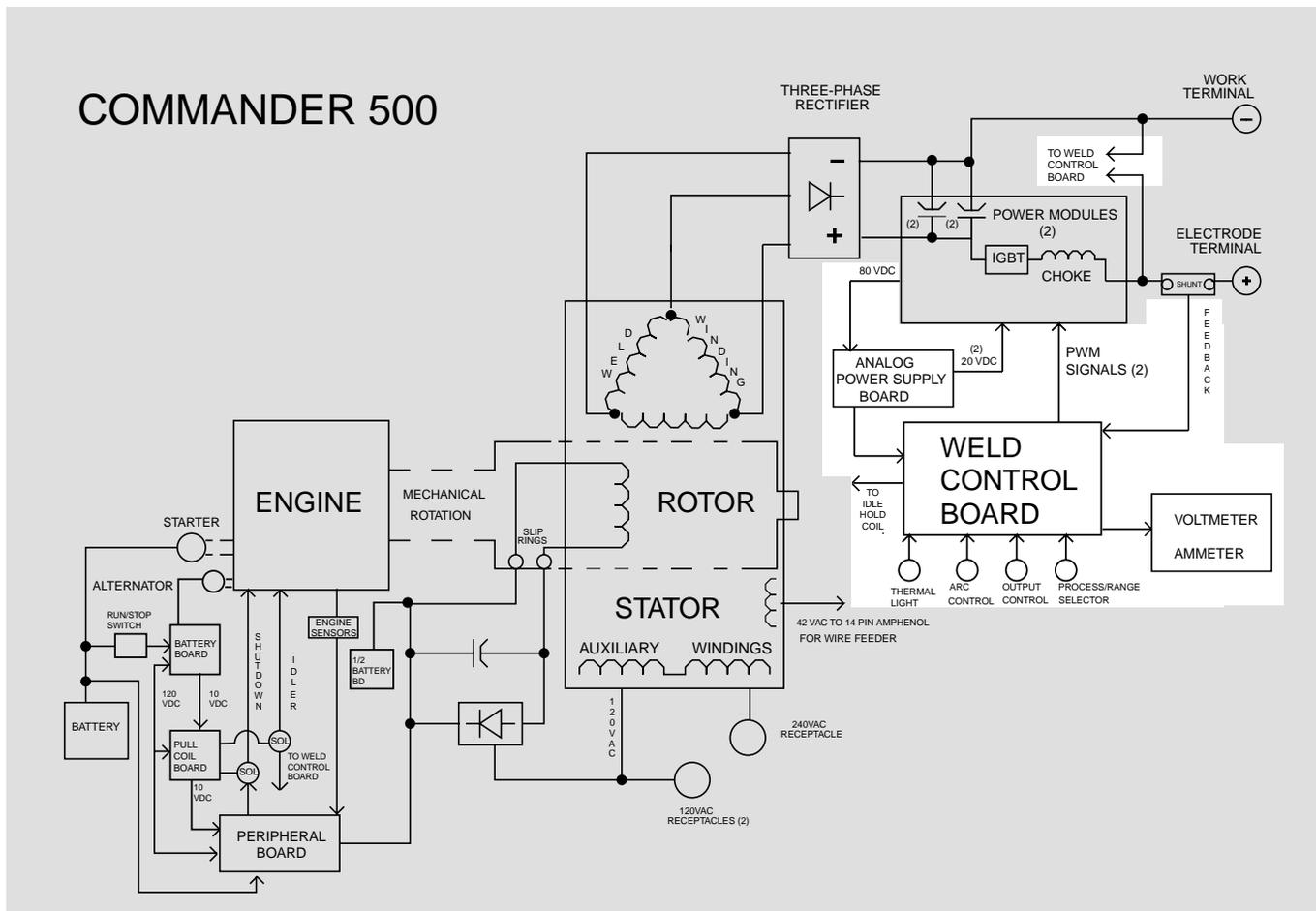
Output voltage and current feedback information is fed to the Weld Control PC board. This information is sensed from the output terminal circuits and the shunt.

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

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FIGURE E-4 – ANALOG CONTROL POWER SUPPLY BOARD AND WELD CONTROL BOARD



ANALOG CONTROL POWER SUPPLY BOARD AND WELD CONTROL BOARD

The Analog Power Supply PC board, which is powered by 80 VDC derived from the filter capacitors on the Power Modules, supplies various regulated DC voltages to operate the Weld Control PC board circuitry. It also supplies two regulated DC voltages to operate the IGBT driver circuitry on the two Power Modules.

The Weld Control PC board monitors the operator controls (arc control, output, and process/range selector). It compares these commands to the current and voltage feedback information it receives from the shunt

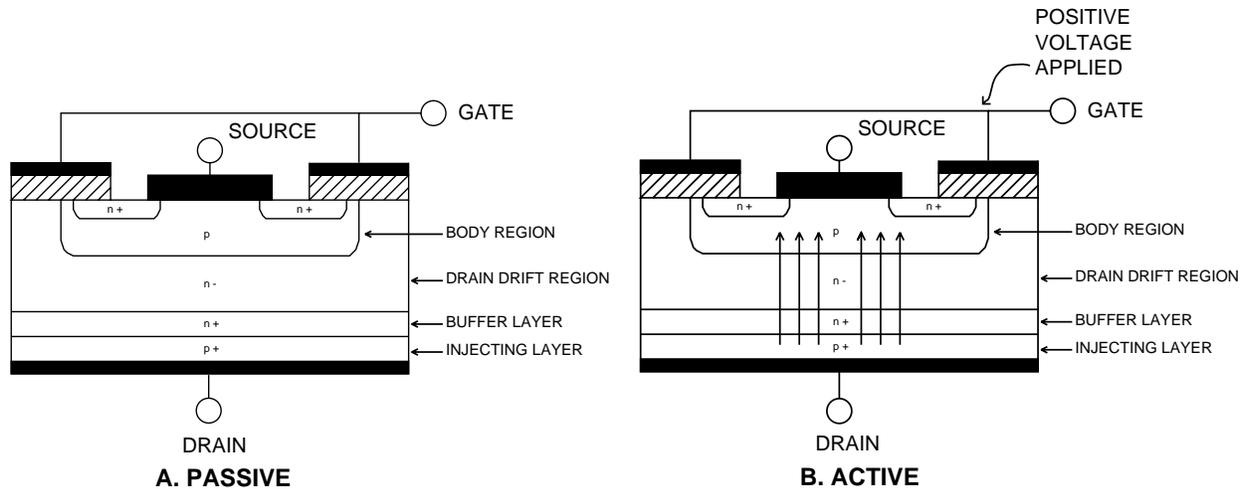
and output terminal circuits. The circuitry on the Weld Control PC board determines how the output should be controlled to optimize welding results, and it sends the correct PWM signals to the IGBT driver circuits. The Weld Control PC board also commands the thermal light and the voltmeter and ammeter (some items may be optional).

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

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FIGURE E.5 – IGBT OPERATION



INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

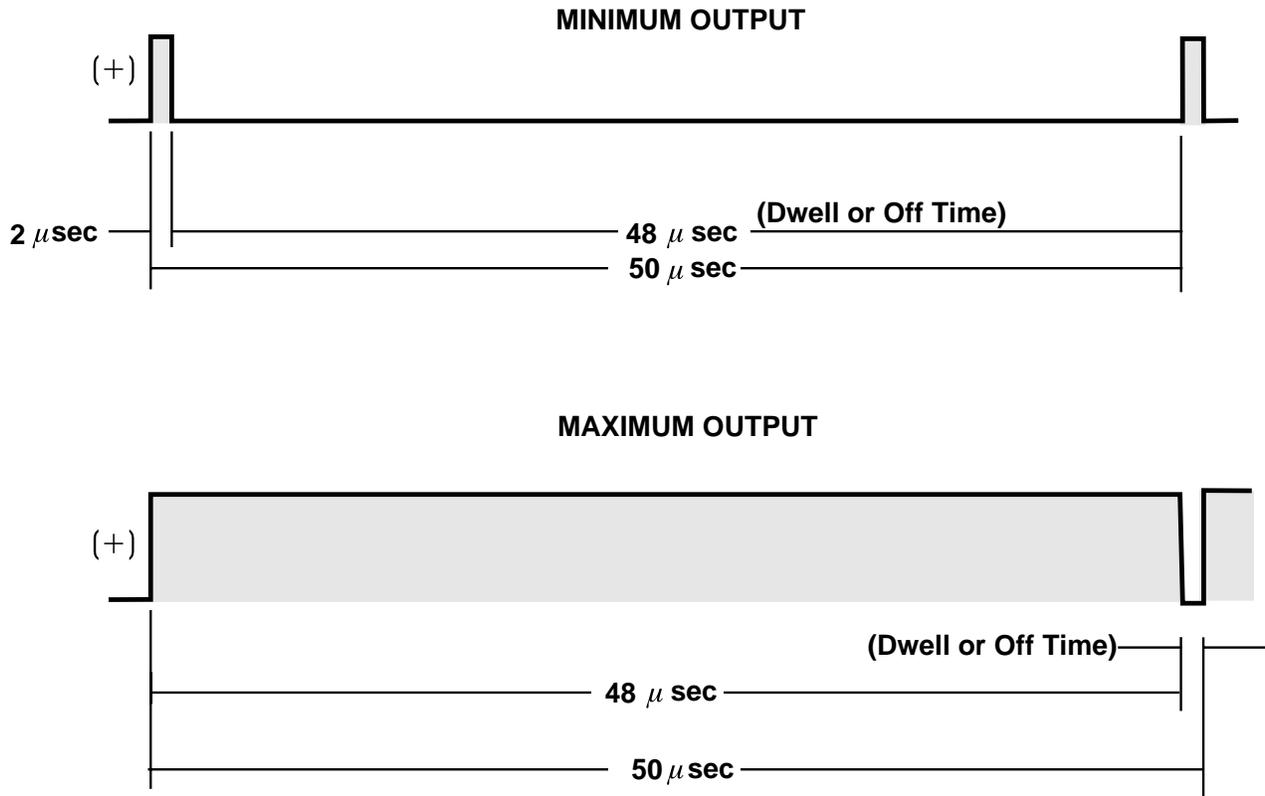
An IGBT is a type of transistor. IGBTs are semiconductors well suited for high frequency switching and high current applications.

Drawing A shows an IGBT in a 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 in the OFF position.

Drawing B shows the IGBT in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the IGBT, it is capable of conducting current. A voltage supply connected to the drain terminal will allow the IGBT to conduct and supply current to 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.

THEORY OF OPERATION

FIGURE E.6 – TYPICAL IGBT OUTPUTS



PULSE WIDTH MODULATION

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

MINIMUM OUTPUT

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

The positive portion of the signal represents one IGBT group conducting for 2 microsecond. The dwell time (off time) is 48 microseconds. Since only 2 microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT

By holding the gate signals on for 48 microseconds and allowing only 2 microseconds of dwell time (off time) during the 50-microsecond cycle, the output is maximized. The darkened area under the top curve can be compared to the area under the bottom curve. The more darkened area under the curve, the more power is present.

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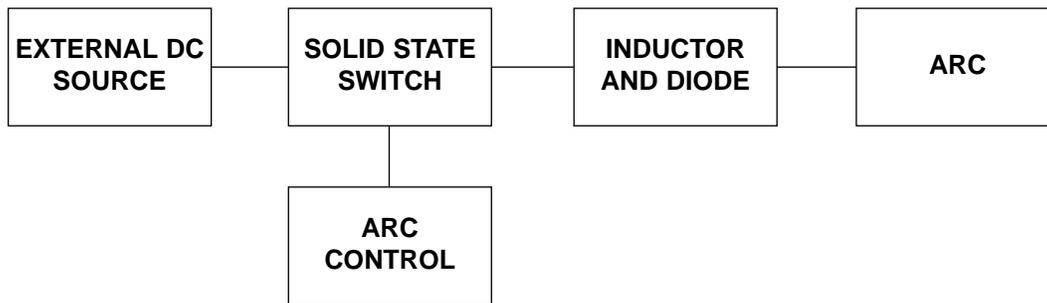


THEORY OF OPERATION

CHOPPER TECHNOLOGY FUNDAMENTALS

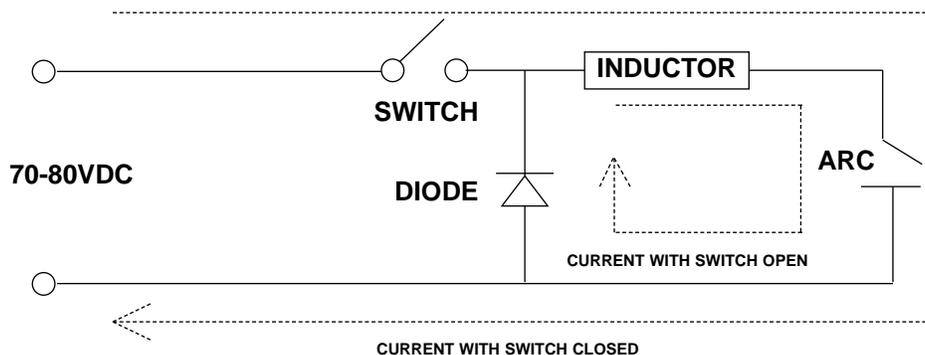
The new era of welding machines such as the Commander 500, employ a technology whereby a DC source is turned on and off (chopped up) at high speed, then smoothed through an inductor to control an arc.

Hence the name "Chopper." The biggest advantage of chopper technology is the high-speed control of the arc, similar to the inverter machines. A block diagram for this is as follows:



In this system, the engine drives a three-phase alternator, which generates power that is rectified and filtered to produce about 85VDC[?]. The current is applied through a solid state switch to an inductor. By

turning the switch on and off, current in the inductor and the arc can be controlled. The following diagram depicts the current flow in the system when the switch is open and closed.



When the switch is closed, current is applied through the inductor to the arc. When the switch opens, current stored in the inductor sustains flow in the arc and through the diode. The repetition rate of switch closure is 20Khz, which allows ultra-fast control of the arc. By

varying the ratio of on time versus off time of the switch (Duty Cycle), the current applied to the arc is controlled. This is the basis for Chopper Technology: Controlling the switch in such a way as to produce superior welding.

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TROUBLESHOOTING & REPAIR

HOW TO USE TROUBLESHOOTING GUIDE



WARNING

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

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

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

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

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

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



CAUTION

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

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PC BOARD TROUBLESHOOTING PROCEDURES

WARNING**ELECTRIC SHOCK can kill.**

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

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

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

**PC Board can be damaged by static electricity.**

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
 - If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.

- Remove the PC Board from the static-shielding bag and place it directly into the equipment. Don't set the PC Board on or near paper, plastic or cloth which could have a static charge. If the PC Board can't be installed immediately, put it back in the static-shielding bag.
 - If the PC Board uses protective shorting jumpers, don't remove them until installation is complete.
 - If you return a PC Board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.
4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

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

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
 - a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
 - b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was followed when warranty reports are to be submitted.

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

TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident.	1. Contact your local Lincoln Authorized Field Service Facility.	1. Contact the Lincoln Electric Service Department at 1-800-833-9353 (WELD)
No welding output in neither Stick or CV modes. The engine operates normally. The auxiliary output is normal.	<ol style="list-style-type: none"> 1. Place the Welding Terminals Switch in the "ALWAYS ON" position. If the problem is solved, the fault may be in the external control cable (if used), leads #2 and #4. See the Wiring Diagram. 2. With the engine at high idle (1900RPM), the machine in the Stick mode and the OUTPUT CONTROL at maximum, check for the presence of approximately 87VDC (open circuit voltage) at the output terminals. 3. If the correct OCV is present at the welding output terminals check the welding cables, clamps and electrode holder for loose or faulty connections. 	<ol style="list-style-type: none"> 1. Check for loose or faulty connections on the heavy current carrying leads between the output bridge, the power modules, the choke and the output terminals. 2. Check the Welding Terminals Switch and associated leads. See the Wiring Diagram. 3. Check gate leads #23, #23A, #25 and #25A for loose or faulty connections. See the Wiring Diagram. 4. Perform the Stator Voltage Test. 5. Perform the Output Rectifier Bridge Test. 6. Perform the Power Module Test. 7. Perform the Analog Power Supply PC Board Test. 8. The Weld Control PC Board may be faulty. 9. See the Start-Up and OCV Diagnostic Chart.

CAUTION

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

COMMANDER 500



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TROUBLESHOOTING & REPAIR

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No welding output in neither Stick or CV modes. Also no auxiliary power. The engine operates normally.	<ol style="list-style-type: none"> 1. Check the brushes for wear and proper contact to the rotor slip rings. 2. Make sure the engine is operating at the correct high idle speed (1900RPM). 3. Check for loose or faulty connections or leads on the auxiliary power studs in the control box. See the Wiring Diagram. 	<ol style="list-style-type: none"> 1. Perform the <i>Rotor Resistance Test.</i> 2. Perform the <i>Flashing and Rotor Voltage Test.</i> If the "flashing" voltage is not present the Battery PC board or leads #201 or #200 may be faulty. See the Wiring Diagram. Also make sure that lead #5P has continuity (zero ohms) to ground. 3. Check the field diode bridge and capacitor. Replace if necessary. 4. Perform the <i>Stator Voltage Test.</i> 5. See the <i>Start-Up and OCV Diagnostic Chart.</i>
No auxiliary power at the receptacles. The welding output is normal and the engine operates normally.	<ol style="list-style-type: none"> 1. The circuit breakers may be tripped. Reset if necessary. 2. Check for loose or faulty connections at the auxiliary receptacles. 	<ol style="list-style-type: none"> 1. Check the wiring between the auxiliary receptacles, the connection studs in the control box, and the main stator. See the Wiring Diagram. 2. Perform the <i>Stator Voltage Test.</i>



CAUTION

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

COMMANDER 500



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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The machine has welding output but no control of output. The auxiliary power is normal.	<ol style="list-style-type: none"> 1. If a remote control unit is connected to the machine, check the remote control and related cable. 2. Check the welding and work cables for loose or faulty connections. 	<ol style="list-style-type: none"> 1. Check the OUTPUT control potentiometer and related leads. See the Wiring Diagram. 2. Check the shunt and associated feedback leads. See the Wiring Diagram. 3. Check the voltage feedback leads for loose or faulty connections. See the Wiring Diagram. 4. Perform the Power Module Test. 5. The Weld Control PC board may be faulty. 5. See the Start-Up and OCV Diagnostic Chart.
The machine has low welding output and low auxiliary output.	<ol style="list-style-type: none"> 1. Check the brushes for wear and proper contact to the slip rings. 2. The engine RPM may be low. 	<ol style="list-style-type: none"> 1. If the engine high idle speed is low, perform the Throttle Adjustment Test. 2. Perform the Rotor Resistance Test. 3. Perform the Flashing and Rotor Voltage Test. If the rotor voltage is low, the field capacitor or field bridge may be faulty. Test and replace if necessary. See the Wiring Diagram. 4. If the engine high idle RPM is OK, then the engine may have lost horsepower and be in need of major repair.



CAUTION

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

COMMANDER 500



TROUBLESHOOTING & REPAIR

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The machine control is still active when the remote control unit is attached.	<ol style="list-style-type: none"> 1. This is normal in TIG mode. 2. The remote control unit may be defective. 3. Check the Amphenol connections and associated wiring. 	<ol style="list-style-type: none"> 1. Check Plug J10 on the Weld Control PC board for loose or faulty connections. 2. The Weld Control PC board may be faulty.
The machine seems locked into the CC mode of operation (Stick mode).	<ol style="list-style-type: none"> 1. Check the position of the MODE SELECTOR switch. It must be in the correct position for the process being used. 2. Check that the jumper plug J3 is properly installed in the Weld Control PC board. (J3 has a jumper wire from pin 1 to pin 5.) 	<ol style="list-style-type: none"> 1. Check the MODE SELECTOR switch and associated leads. See the Wiring Diagram. 2. The Weld Control PC board may be faulty.



CAUTION

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

COMMANDER 500



TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The wire feeder does not work when connected to the welder amphenol.	<ol style="list-style-type: none"> 1. Check the appropriate circuit breaker (CB1 or CB6). Reset if tripped. 2. The wire feeder control cable may be faulty. 3. The wire feeder may be faulty. 	<ol style="list-style-type: none"> 1. Check for the presence of appropriate source voltage at the 14-pin amphenol. 2. If the appropriate voltage (42 VAC or 115 VAC) is NOT present at the 14-pin amphenol, check for loose or faulty connections. See the Wiring Diagram. 3. Perform the Stator Voltage Test.
The battery does not stay charged.	<ol style="list-style-type: none"> 1. Check for loose or faulty connections at the battery and engine charging system. 2. The battery may be faulty. Check or replace. 	<ol style="list-style-type: none"> 1. The battery charging circuit may be faulty. Perform the Charging Circuit Test.



CAUTION

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

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TROUBLESHOOTING & REPAIR

TROUBLESHOOTING GUIDE

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine will not crank when the start button is pushed.	<ol style="list-style-type: none"> 1. Check for loose or faulty battery cable connections. 2. The battery may be low or faulty. 3. The START button may be faulty. 	<ol style="list-style-type: none"> 1. The starter motor or starter solenoid may be faulty. 2. The engine may be hard to crank due to a mechanical failure in the engine. 3. See the Engine Starting Diagnostic Chart.
The engine cranks but will not start.	<ol style="list-style-type: none"> 1. Check for adequate fuel supply. 2. Make sure the fuel shut off valve is in the open position. 3. The engine oil temperature may be too high. Check cooling system. 4. The battery voltage may be too low. 	<ol style="list-style-type: none"> 1. The shutdown solenoid may be faulty. Perform the Shutdown Solenoid Test. 2. The Peripheral PC board may be faulty. With the RUN/STOP switch in the "RUN" position, the Peripheral PC board should normally supply 10VDC to the shutdown solenoid via leads #224 and #262. See the Wiring Diagram. 3. The Pull Coil PC board may be faulty. 4. The engine may be in need of mechanical repair. 5. See the Engine Starting Diagnostic Chart.



CAUTION

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

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine shuts down shortly after starting.	<ol style="list-style-type: none"> 1. Check for adequate fuel supply. 2. If any indicator light is lit when the engine shuts down, that particular system has faulted. Check system. 3. Check the battery cables for loose or faulty connections. 	<ol style="list-style-type: none"> 1. Check the RUN/STOP switch and associated leads for loose or faulty connections. 2. Perform the Shutdown Solenoid Test. 3. The Peripheral PC board may be faulty. With the RUN/STOP switch in the "RUN" position, the Peripheral PC board should normally supply 10VDC to the shutdown solenoid via leads #224 and #262. See the Wiring Diagram. 4. See the Engine Starting Diagnostic Chart.
The engine will not idle down to low speed. The machine has normal weld output and auxiliary power.	<ol style="list-style-type: none"> 1. Make sure the IDLER switch is in the "AUTO" position. 2. Make sure there is NOT an external load on the weld terminals nor the auxiliary power receptacles. 3. Check for mechanical restrictions in the solenoid linkage. 	<ol style="list-style-type: none"> 1. Perform the Idler Solenoid Test. 2. Check leads #227, #232L, #232M and #226A for loose or faulty connections. See the Wiring Diagram. 3. The Pull Coil PC board may be faulty.

CAUTION

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

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TROUBLESHOOTING GUIDE

Observe Safety Guidelines
detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine will not go to high idle when using the auxiliary power. Auxiliary power is normal when the IDLER switch is in the "HIGH" position. Automatic idle function works properly when the welding terminals are loaded.	<ol style="list-style-type: none"> 1. Make sure the auxiliary power leads are tight. 2. The automatic idler may not function if the auxiliary power is loaded to less than 150 watts. 	<ol style="list-style-type: none"> 1. Check the current sensing toroid for loose or faulty connections. See the Wiring Diagram. 2. Make sure leads #3 and #6A pass through the toroid twice in opposite directions. 3. The current sensing toroid may be faulty. 4. The Weld Control PC board may be faulty.
The engine will not go to high idle when attempting to weld or when the auxiliary power is loaded. Welding output and auxiliary power outputs are normal when IDLER switch is in the "HIGH" position.	<ol style="list-style-type: none"> 1. Make sure the welding cables and auxiliary power lead connections are tight. 	<ol style="list-style-type: none"> 1. The Weld Control PC board may be faulty. 2. The current sensing toroid may be faulty.
The machine goes to low idle but does not stay at low idle.	<ol style="list-style-type: none"> 1. Make sure there is NOT an external load (auxiliary or weld) connected to the Commander 500. 	<ol style="list-style-type: none"> 1. The idler solenoid linkage may be misadjusted or damaged. 2. The idler solenoid lead connections may be loose or damaged. See the Wiring Diagram. 3. Perform the Idler Solenoid Test. 4. The Weld Control PC board may be faulty.

**CAUTION**

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

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
<p>The welding arc is "cold." The engine runs normally. The auxiliary power is normal.</p>	<ol style="list-style-type: none"> 1. Check for loose or faulty connections at the weld output terminals and welding cable connections. 2. The welding cables may be too long or coiled, causing an excessive voltage drop. 3. Make sure the electrode (wire, gas, voltage, current etc.) is correct for the process being used. 	<ol style="list-style-type: none"> 1. Check for the correct OCV at the welding output terminals. If the correct voltage is present at the output terminals, check for loose connection on the heavy current carrying leads inside the Commander 500. See the Wiring Diagram. 2. If the OCV is low at the welder output terminals, perform the <i>Engine Throttle Adjustment Test.</i> 3. Perform the <i>Output Rectifier Bridge Test.</i> 4. Perform the <i>Stator Voltage Test.</i> 5. Perform the <i>Power Module Test.</i> 6. The Weld Control PC board may be faulty.



CAUTION

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

COMMANDER 500



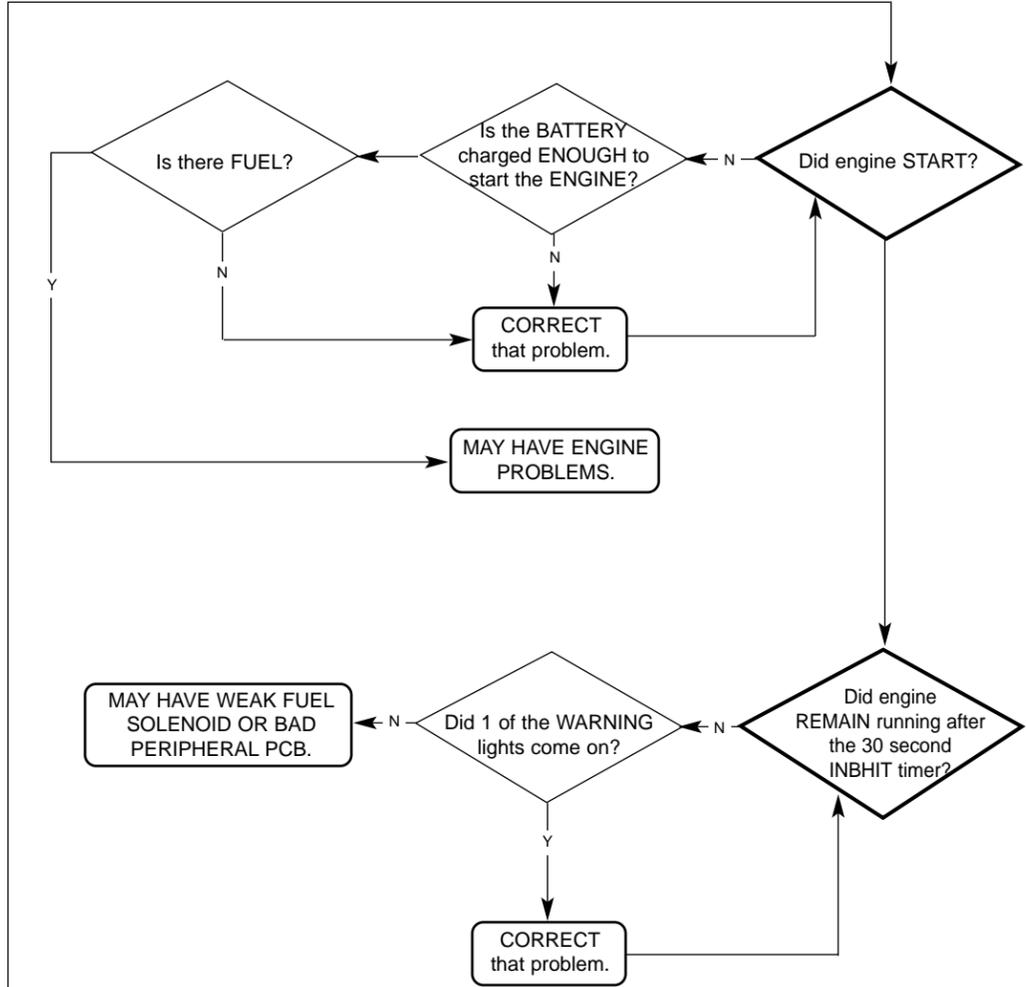
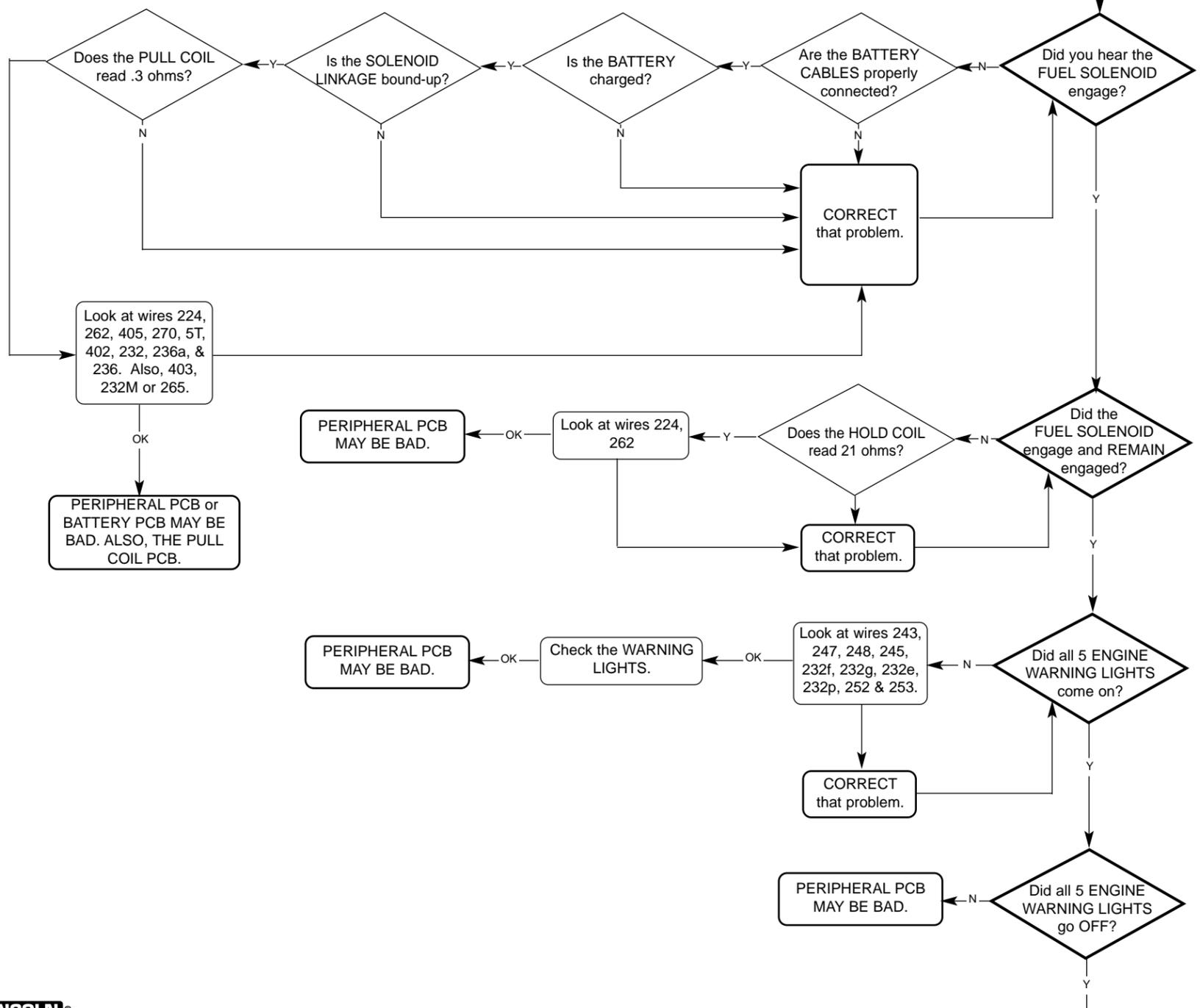
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ENGINE STARTING DIAGNOSTIC CHART

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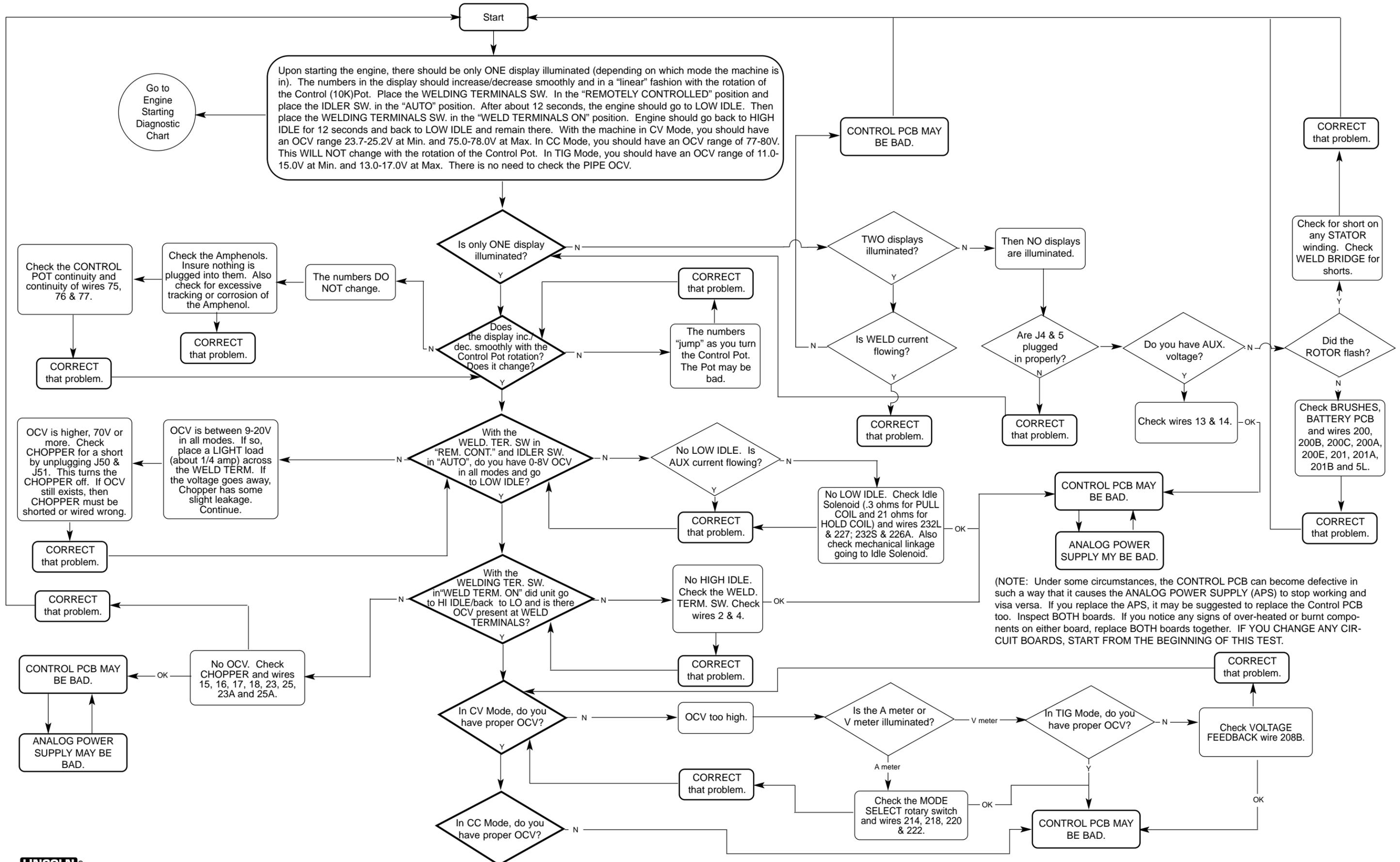
Starting ENGINE

Upon placing the RUN/STOP switch in the "RUN" position, you should hear a "click" near the engine. This is the FUEL SOLENOID engaging. It should stay engaged. You should also see all 5 ENGINE WARNING LIGHTS come on for about 5 seconds and then go off. Then, operate the START button. ENGINE WARNING LIGHTS WILL COME BACK on then off again. All gauges should be in the NORMAL operating ranges. About 30 seconds after starting the engine, the "inhibit" circuit which prevents ENGINE SHUTDOWN will turn-off. Engine should remain running.



START-UP AND OCV DIAGNOSTIC CHART

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CASE COVER REMOVAL AND REPLACEMENT PROCEDURE



WARNING

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

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

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the case sheet metal covers.

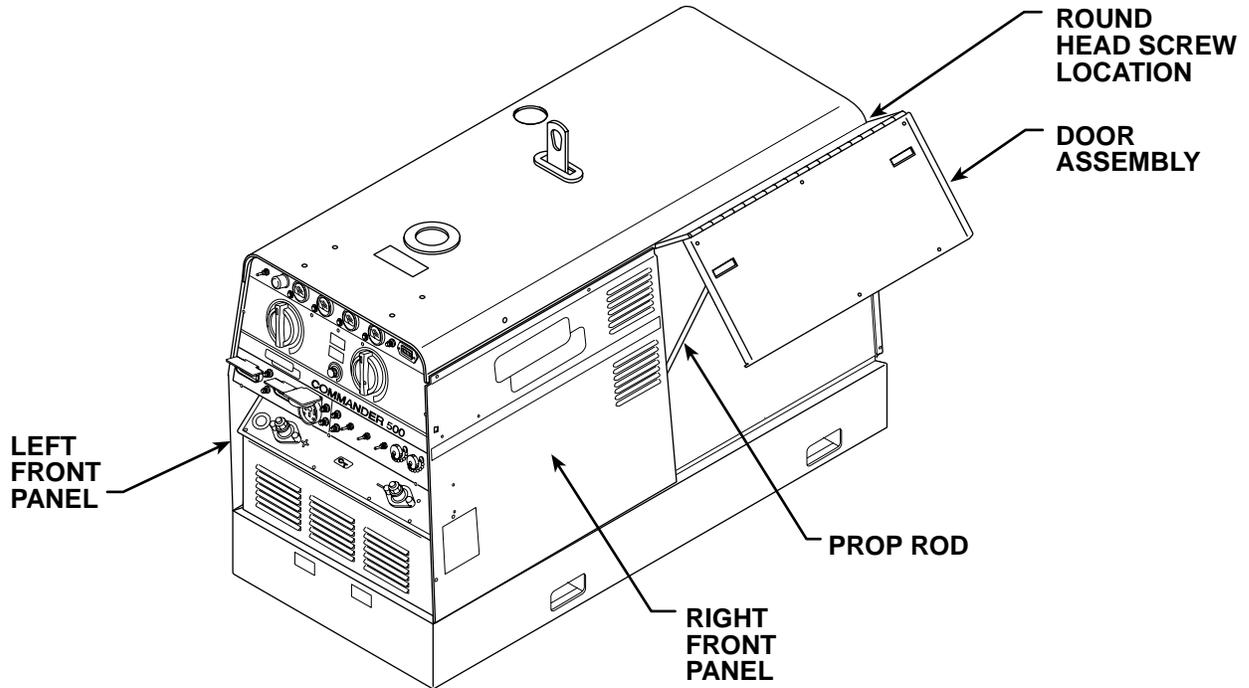
MATERIALS NEEDED

- 3/8" wrench
- 7/16" wrench
- 1/2" wrench
- 3/4" wrench

This procedure should take approximately 30 minutes to perform.

CASE COVER REMOVAL AND REPLACEMENT PROCEDURE (CONTINUED)

FIGURE F.1 – COVER REMOVAL



PROCEDURE

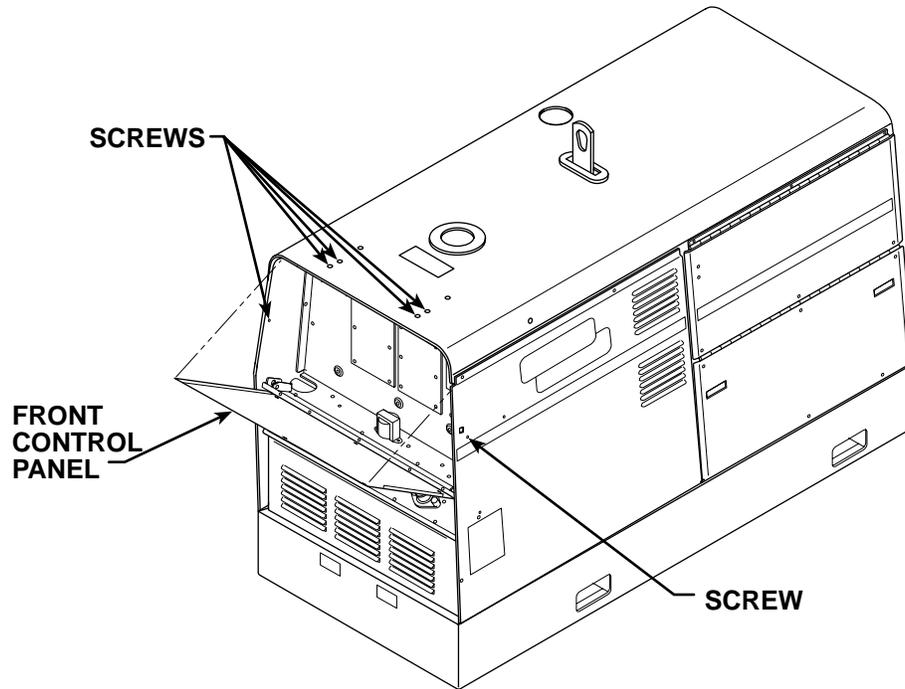
1. Turn the engine off.
2. Using the 3/8" wrench, remove the battery cover. Slide the battery out and disconnect the negative battery cable.
3. Unlatch and open the engine service access door. See Figure F.1.
4. Support the door assembly. Using the 3/8" wrench, remove the #10-24 round head screw, lock washer, flat washer, and nut from the top corner of the door hinge assembly where it attaches to the roof. Remove the support rod.

COMMANDER 500



CASE COVER REMOVAL AND REPLACEMENT PROCEDURE (CONTINUED)

FIGURE F.2 – FRONT PANEL/ROOF DETAILS



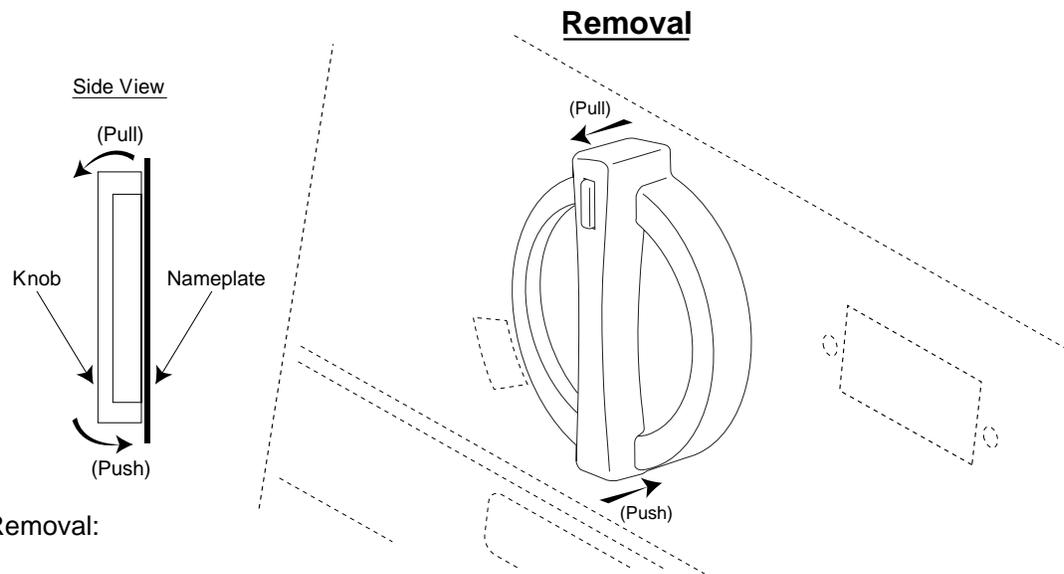
5. Using the 3/8" wrench, remove the four screws from the top front of the roof assembly and the two screws from the sides of the control box. Carefully lower the front control panel. See Figure F.2.
6. sWith the 9/16" wrench, remove the exhaust pipe rain cap.
7. Remove the fuel tank cap, gasket, and the lift bail cover seal.
8. With the help of an assistant, carefully remove the roof. The door assembly remains attached to the roof. Replace the fuel cap.
9. With 3/8" wrench, remove the left rear panel and the right and left front panels. See **Figure F.1**.

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TROUBLESHOOTING & REPAIR

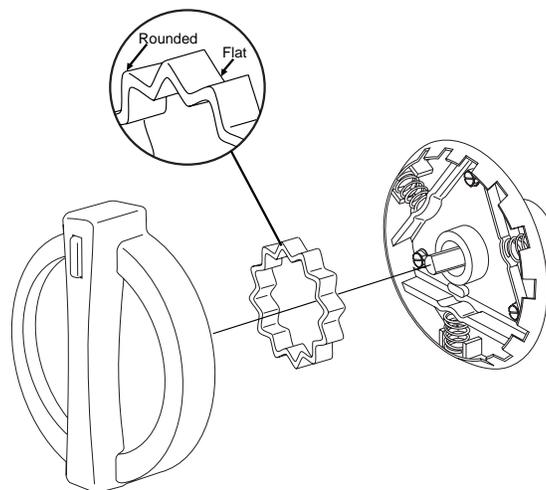
CASE FRONT KNOBS - REMOVAL AND REPLACEMENT PROCEDURE



Removal:

1. Rotate the handle portion of the knob to an approximate vertical orientation (switch detent may position handle a few degrees off vertical). This orientation should be noted and repeated at replacement for proper "D" shaft orientation.
2. With one hand, grasp the very bottom of vertical handle and push towards the machine nameplate and pull down. At the same time and with the other hand, grasp the very top of the handle and pull the top edge of the knob away from the machine nameplate. The knob should "peel" away from the nameplate and the white nylon holding fingers of the knob base, from top to bottom.

Replacement



Replacement:

1. If the white nylon cam of the detent mechanism is removed from its spring loaded base by the above procedure or intentionally, it should be returned before the knob replacement is attempted. Press the cam into its spring loaded holder so it sets flat and flush (Selector Switch Only).
2. Orientate the knob handle to the vertical as noted above and position the knob over the base, centered and parallel.
3. Press the knob onto the "D" shaft and white nylon holding fingers, maintaining the parallel position. The knob should "click" into place and should not pull off with normal operation.

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POWER MODULE CAPACITOR DISCHARGE PROCEDURE



WARNING

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

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

DESCRIPTION

This procedure will insure that the large capacitors in the power modules have been discharged. This procedure should be performed whenever work is to be attempted on or near the power modules.

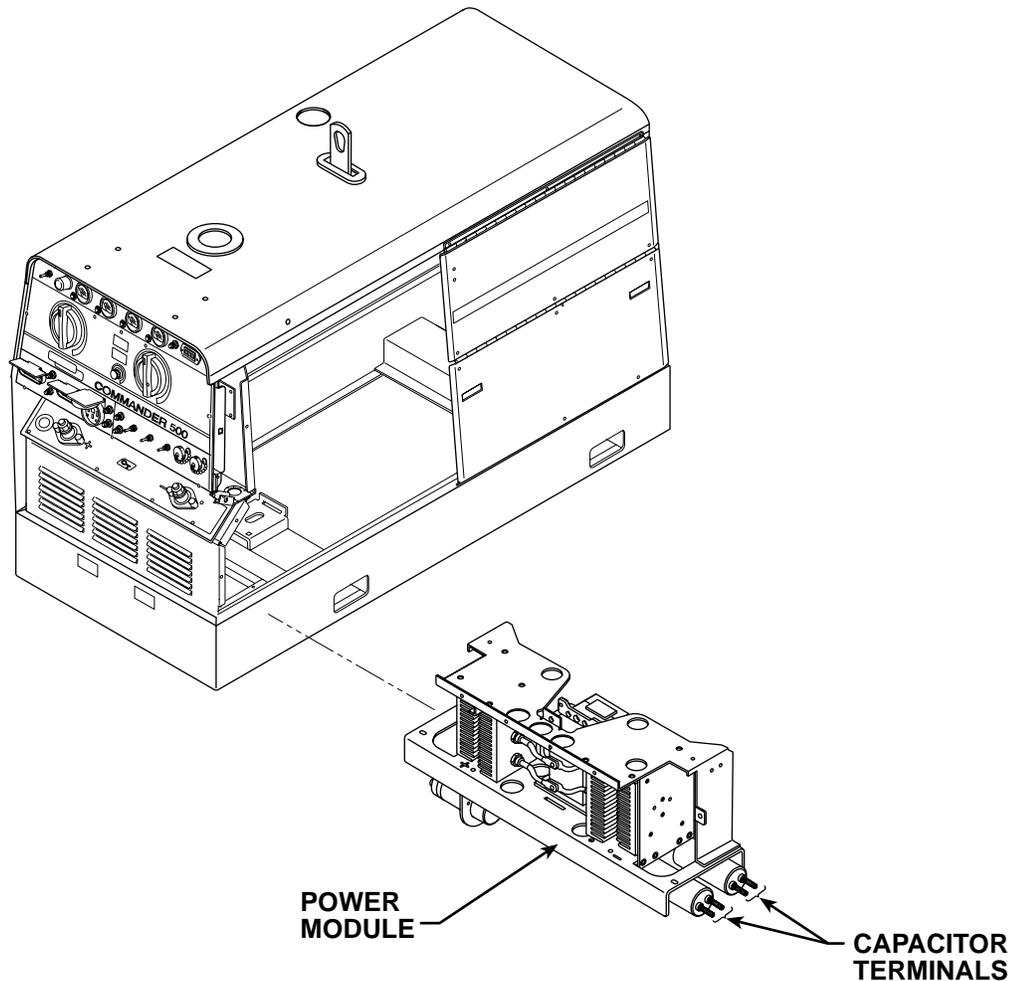
MATERIALS NEEDED

- 3/8" Wrench
- Volt/Ohmmeter
- Resistor (25-1000 ohms and 25 watts minimum)
- Jumper leads

This procedure should take approximately 15 minutes to perform.

POWER MODULE CAPACITOR DISCHARGE PROCEDURE (CONTINUED)

FIGURE F.4 – POWER MODULE CAPACITOR TERMINAL DISCHARGE



PROCEDURE

1. This procedure must be performed with the engine off.
2. Using the 3/8" wrench, remove the front left and right side panels.
3. Locate the four capacitors (two on each side). See Figure F.4.
4. Using the resistor and jumper leads, CAREFULLY discharge the capacitor terminals. **NEVER USE A SHORTING STRAP FOR THIS PURPOSE. DO NOT TOUCH THE TERMINALS WITH YOUR BARE HANDS.** Repeat procedure on the other side.
5. Check the voltage across the capacitor terminals. It should be zero volts.

COMMANDER 500



IDLER SOLENOID TEST



WARNING

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

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

TEST DESCRIPTION

This test will determine if the idler solenoid is capable of functioning when it is energized with 12VDC.

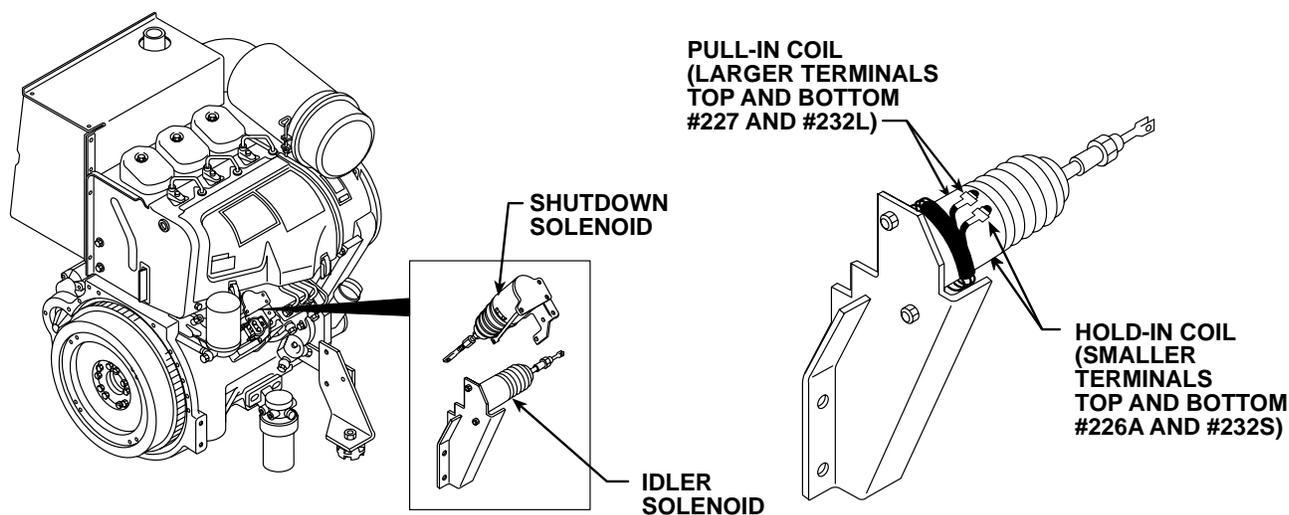
MATERIALS NEEDED

External 12VDC supply (30 amps required)
Wiring Diagram
Volt/Ohmmeter

This procedure should take approximately 30 minutes to perform.

IDLER SOLENOID TEST (CONTINUED)

FIGURE F.5 – IDLER SOLENOID LEADS



TEST PROCEDURE

1. Turn the engine off.
2. Unlatch, lift, and secure the right side engine service access door.
3. Locate and remove the four spade connectors that attach the idler solenoid leads to the wiring harness leads (#226A, #232S, #227 and #232L). See Figure F.5 and the Wiring Diagram. Remove and necessary wire wraps.

4. Check the pull-in coil resistance (larger terminals #227 to #232L). The normal resistance is approximately 0.4 ohms.

Check the hold-in coil resistance (smaller terminals #226A to #232S). Normal coil resistance is approximately 20 ohms.

If either coil resistance is not correct, the solenoid may be faulty. Replace.

5. Using the external 12VDC supply, apply 12VDC to the larger idler solenoid terminals (#227 to #232L +). The solenoid should activate.

⚠ CAUTION

When the solenoid activates, remove the voltage supply immediately. Do not leave the external supply connected to terminals #227 and #232L for longer than three seconds. Component damage could result.

The solenoid should deactivate when the 12VDC is removed.

6. If the solenoid does not operate properly, check for a mechanical restriction in the linkage.
7. Using the external 12VDC supply, apply 12VDC to the smaller idler solenoid terminals for the hold-in coil (#226A to #232S +). Push in the solenoid plunger. With 12 VDC applied to the hold-in coil, the plunger should stay in until the 12 VDC is removed.
8. If the linkage is intact and the solenoid does not operate correctly when the 12VDC is applied, the solenoid may be faulty. Replace.
9. Replace harness leads to the correct terminals. See Figure F.5 and the Wiring Diagram. Replace any previously removed wire wraps.
10. Close and secure the right side engine service access door.

COMMANDER 500

LINCOLN
ELECTRIC

SHUTDOWN SOLENOID TEST



WARNING

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

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

TEST DESCRIPTION

This test will determine if the shutdown solenoid is capable of functioning when it is energized with 12VDC.

MATERIALS NEEDED

External 12VDC supply (30 amps required)
Wiring Diagram
Volt/Ohmmeter

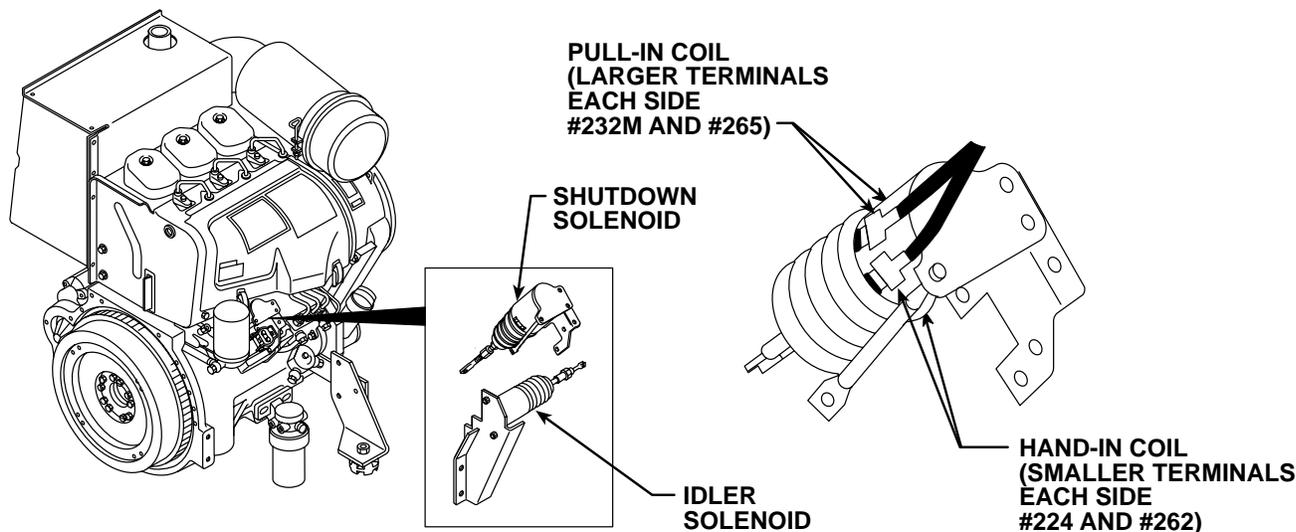
This procedure should take approximately 30 minutes to perform.

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SHUTDOWN SOLENOID TEST (CONTINUED)

FIGURE F.6 – SHUTDOWN SOLENOID LEAD TERMINALS



TEST PROCEDURE

1. Turn the engine off.
2. Unlatch, lift, and secure the right side engine service access door.
3. Locate and remove the four spade connectors that attach the shutdown solenoid leads to the wiring harness leads (#224, #262, #232M and #265). See Figure F.6 and the Wiring Diagram. Remove any necessary wire wraps.

4. Check the pull-in coil resistance (larger terminals #232M to #265). The normal resistance is approximately 0.4 ohms.

Check the hold-in coil resistance (smaller terminals #224 to #262). Normal coil resistance is approximately 20 ohms.

If either coil resistance is not correct, the solenoid may be faulty. Replace.

5. Using the external 12VDC supply, apply 12VDC to the larger shutdown solenoid terminals (#232M+ to #265-). The solenoid should activate.

CAUTION

When the solenoid activates, remove the voltage supply immediately. Do not leave the external supply connected to terminals #232M and #265 for longer than three seconds. Component damage could result.

The solenoid should deactivate when the 12VDC is removed.

6. If the solenoid does not operate properly, check for a mechanical restriction in the linkage.
7. Using the external 12VDC supply, apply 12VDC to the smaller idler solenoid terminals for the hold-in coil (#262- to #224+). Push in the solenoid plunger. With 12 VDC applied to the hold-in coil, the plunger should stay in until the 12 VDC is removed.
8. If the linkage is intact and the solenoid does not operate correctly when the 12VDC is applied, the solenoid may be faulty. Replace.
9. Replace harness leads to the correct terminals. See Figure F.6 and the Wiring Diagram. Replace any previously removed wire wraps.
10. Close and secure the right side engine service access door.

COMMANDER 500



ENGINE THROTTLE ADJUSTMENT TEST



WARNING

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

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

TEST DESCRIPTION

If the machine output is low or high, this test will determine whether the engine is operating at the correct speed (RPM) during both HIGH and LOW idle conditions. Directions for adjusting the throttle to the correct RPM are given.

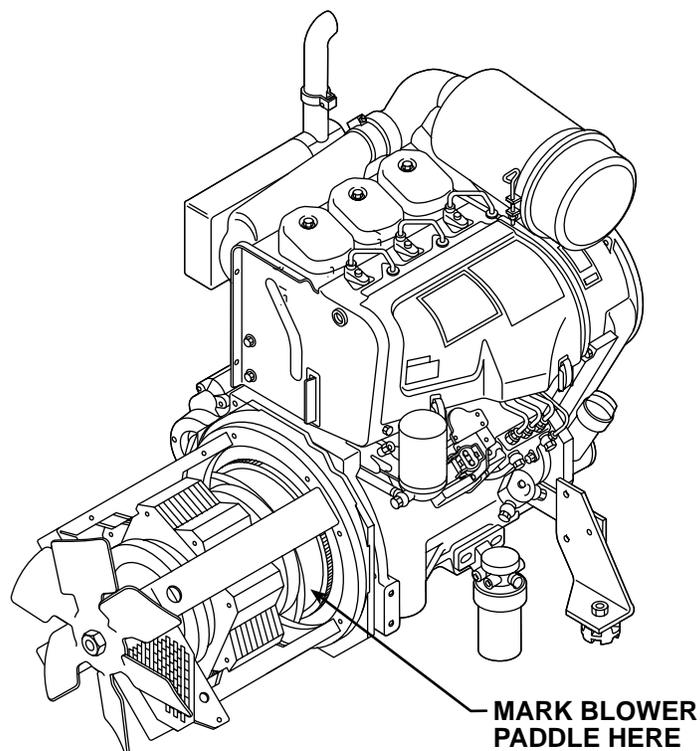
MATERIALS NEEDED

- Slot head screw driver
- 10mm Wrench
- White or red marking pencil
- Strobe-tach, frequency counter, or oscilloscope

This procedure should take approximately 35 minutes to perform.

ENGINE THROTTLE ADJUSTMENT TEST (CONTINUED)

FIGURE F.7 – STROBE MARK LOCATION



TEST PROCEDURE

Strobe-tach Method

1. Conduct this procedure with the engine OFF.
2. Unlatch, lift and secure the right side engine service access door. Perform the **Case Cover Removal and Replacement Procedure** through Step 9. (For Strobe-Tach method only.)
3. With a white or red marking pencil, place a mark on one of the blower paddles. See Figure F.7 for location.
4. Connect the strobe-tach according to the manufacturer's instructions.
5. Start the engine and direct the strobe-tach light on the bolt head. Synchronize it to the rotating mark.

With the machine at HIGH IDLE the tach should read between 1890 and 1910 RPM.

With the machine at LOW IDLE the tach should read between 1450 and 1500 RPM.

COMMANDER 500



ENGINE THROTTLE ADJUSTMENT TEST (CONTINUED)

FIGURE F.8 - HIGH IDLE ADJUSTMENT

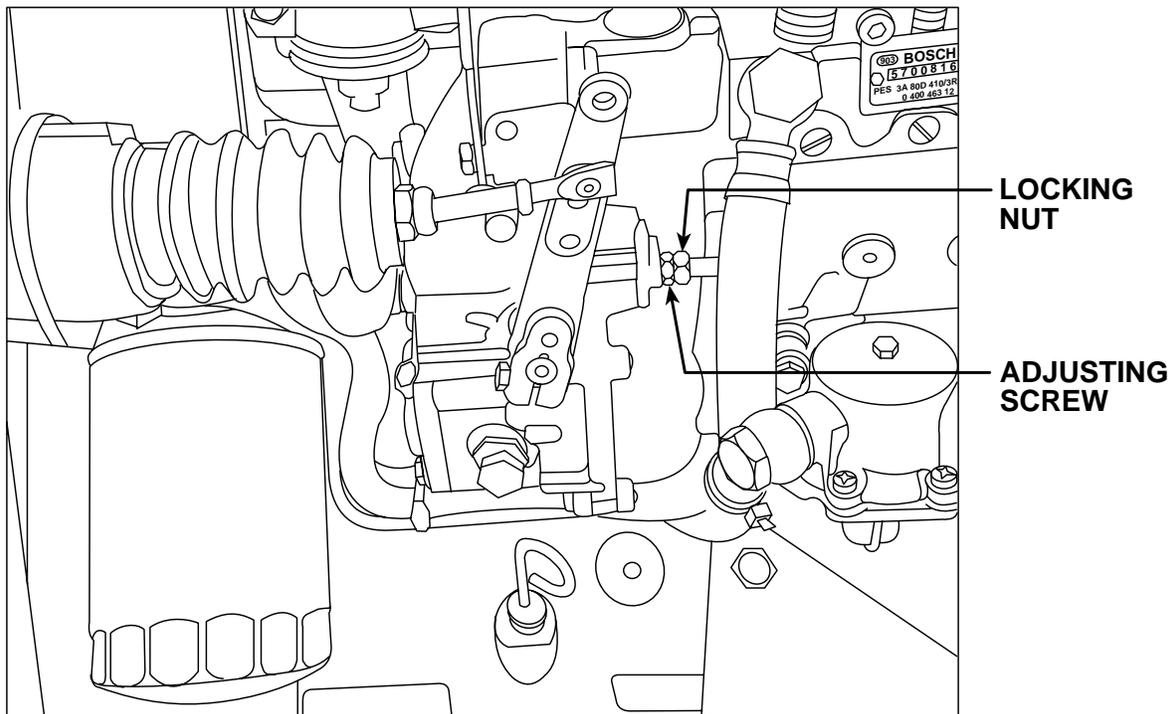
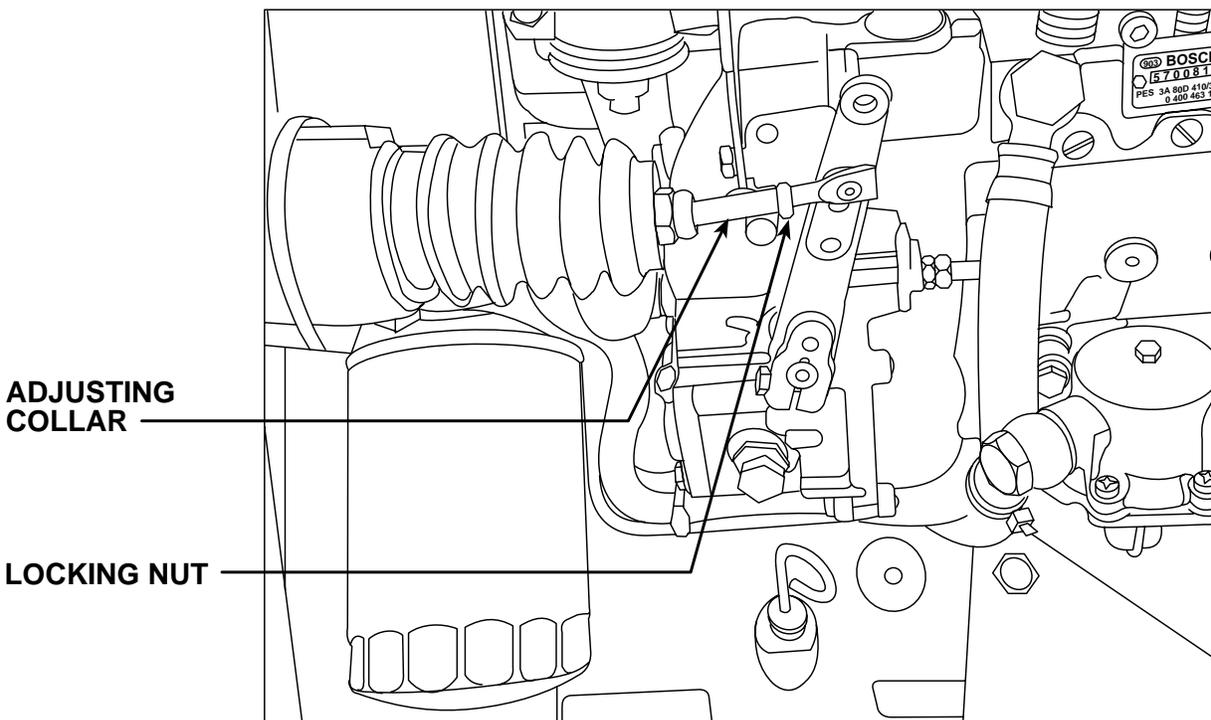


FIGURE F.9 - LOW IDLE ADJUSTMENT



COMMANDER 500



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

ENGINE THROTTLE ADJUSTMENT TEST (CONTINUED)

6. If either of the readings is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 10mm wrench to loosen the locking nut. See **Figure F.8** for location of the adjusting screw and locking nut. Turn the threaded screw counter-clockwise to increase the HIGH IDLE speed. Adjust the speed until the tach reads between 1890 and 1910 RPM. Retighten the locking nut.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLE switch to AUTO and wait for the engine to change to low idle speed. Use the 10mm wrench to loosen the solenoid lever arm locking nut. See **Figure F.9**. Adjust the collar, to change the amount of throw in the lever arm, until the tach reads between 1450 and 1500 RPM. Retighten the locking nut.

Frequency Counter Method

1. Plug the frequency counter into one of the 115 VAC auxiliary receptacles.
2. Start the engine and check the frequency counter. At HIGH IDLE (1900 RPM), the counter should read 63 Hz. At LOW IDLE (1475 RPM), the counter should read 49 Hz. Note that these are median measurements; hertz readings may vary slightly above or below.
3. If either of the readings is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 10mm wrench to loosen the locking nut. See **Figure F.8** for location of the adjusting screw and locking nut. Turn the threaded screw counter-clockwise to increase the HIGH IDLE speed. Adjust the speed until the frequency reads 63 Hz. Retighten the locking nut.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLE switch to AUTO and wait for the engine to change to low idle speed. Use the 10mm wrench to loosen the solenoid lever arm locking nut. See **Figure F.9**. Adjust the collar, to change the amount of throw in the lever arm, until the frequency reads 49 Hz. Retighten the locking nut.

Oscilloscope Method

1. Connect the oscilloscope to the 115 VAC receptacle, according to the manufacturer's instructions. At HIGH IDLE (1900 RPM), the waveform should exhibit a period of 15.8 milliseconds. At LOW IDLE (1475 RPM), the waveform should exhibit a period of 20.3 milliseconds. Refer to the NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115 VAC SUPPLY) HIGH IDLE - NO LOAD in this section of the manual.
2. If either of these waveform periods is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 10mm wrench to loosen the locking nut. See **Figure F.8** for location of the adjusting screw and locking nut. Turn the threaded screw counter-clockwise to increase the HIGH IDLE speed. Adjust the speed until the period is 15.8 milliseconds. Retighten the locking nut.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLE switch to AUTO and wait for the engine to change to low idle speed. Use the 10mm wrench to loosen the solenoid lever arm locking nut. See **Figure F.9**. Adjust the collar, to change the amount of throw in the lever arm, until the period is 20.3 milliseconds. Retighten the locking nut.

ROTOR RESISTANCE TEST



WARNING

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

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

TEST DESCRIPTION

This test will determine if there is a shorted winding in the rotor or if the rotor is grounded.

MATERIALS NEEDED

Ohmmeter
3/8" Wrench or socket wrench

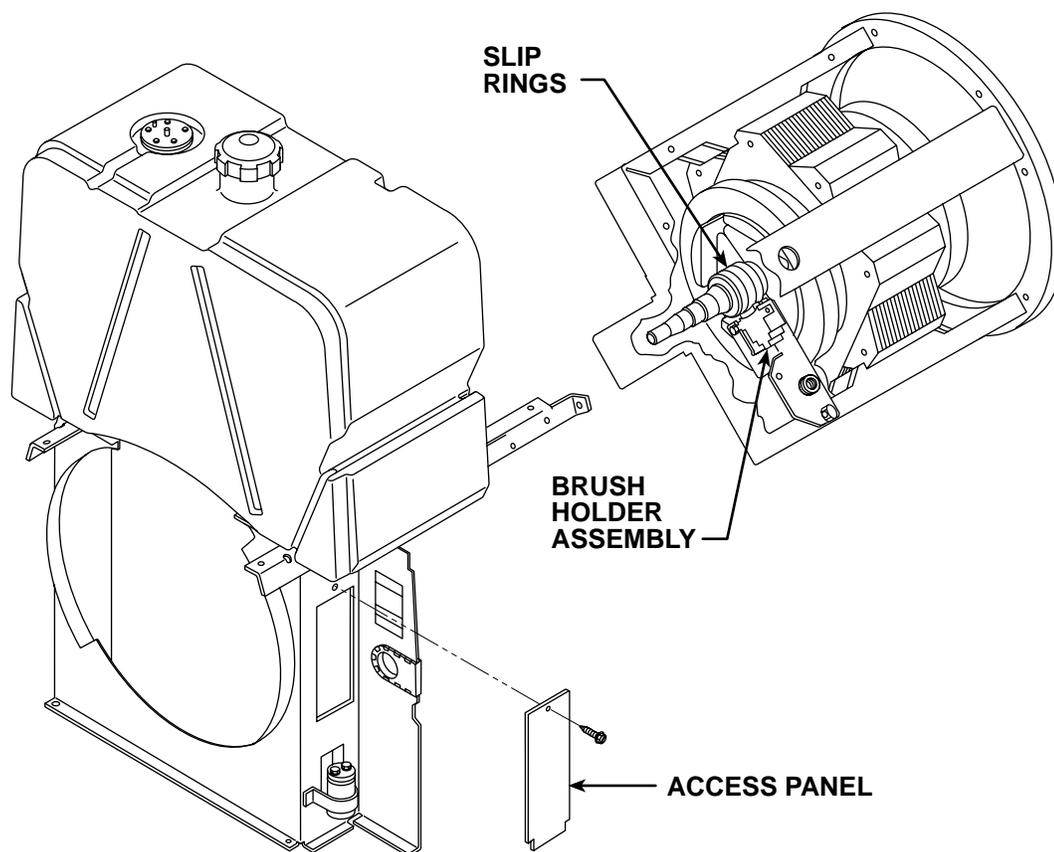
This procedure should take approximately 15 minutes to perform.

COMMANDER 500



ROTOR RESISTANCE TEST (CONTINUED)

FIGURE F.10 – ROTOR BRUSH LEADS



TEST PROCEDURE

1. Conduct this test with the engine off.
2. Using the 3/8" wrench, remove the right front case side.
3. Using the 3/8" wrench, remove the brush holder access panel. See Figure F.10.
4. Using the 3/8" wrench, remove the brush holder assembly. See Figure F.10.
5. Using the ohmmeter, check the rotor winding resistance across the slip rings. Normal resistance is approximately 27.0 ohms.
6. Measure the resistance to ground. Place one meter probe on either of the slip rings. Place the other probe on any good unpainted ground. The resistance should be very high, at least 500,000 ohms.
7. If the test does not meet the resistance specifications, then the rotor may be faulty. Replace.
8. Position the brush holder assembly and attach it with two screws previously removed. Make certain the brushes are centered and seated properly on the slip rings. Adjust if necessary.
9. Replace the brush holder access panel.
10. Replace the right front case cover.

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FLASHING AND ROTOR VOLTAGE TEST



WARNING

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

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

TEST DESCRIPTION

This test will determine if the correct DC voltage is being applied to the rotor at the maximum engine speed (1900 RPM). This information will aid the technician in determining if the generator field is operating properly.

MATERIALS NEEDED

Volt/Ohmmeter
3/8" Wrench
Wiring Diagram

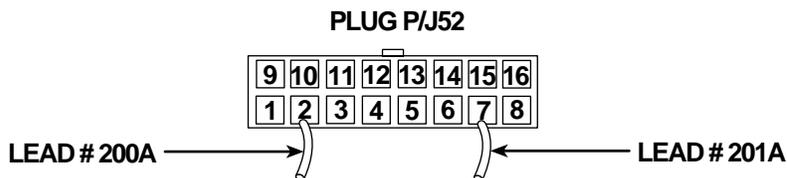
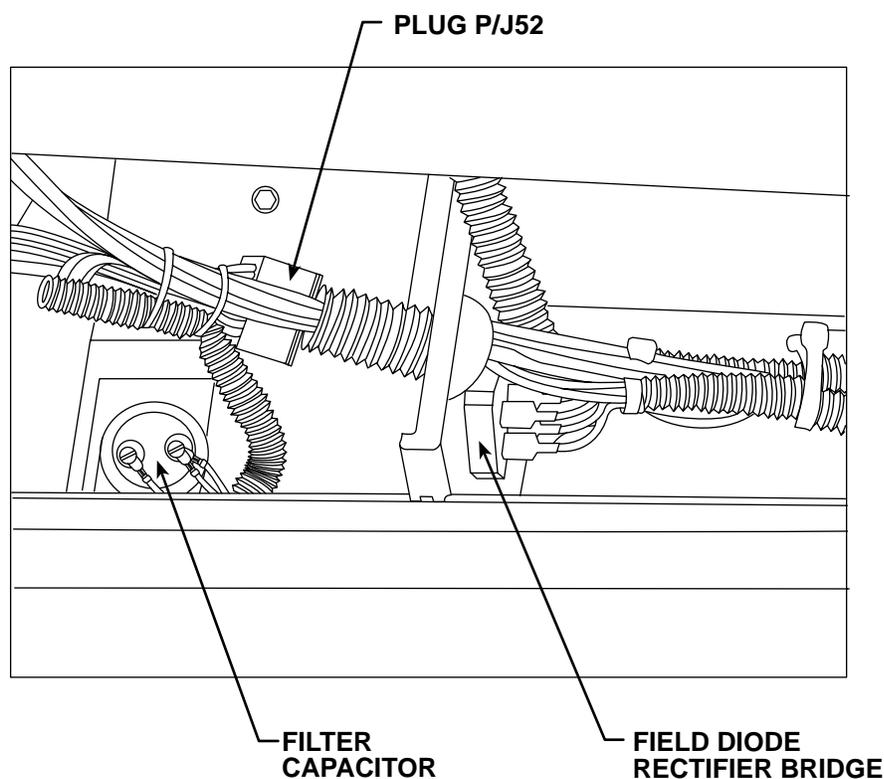
This procedure should take approximately 35 minutes to perform.

COMMANDER 500



FLASHING AND ROTOR VOLTAGE TEST (CONTINUED)

FIGURE F.11 – PLUG P/J52 LOCATION

**TEST PROCEDURE**

1. Using the 3/8" wrench, remove the sheet metal screws from the right front case side.
2. Carefully remove the right case side.
3. Set the volt/ohmmeter to the DC volts position.
4. Locate Plug P/J52 and leads #200A and #201A. See Figure F.11.
5. Connect the positive meter probe to lead #200A and the negative meter probe to lead #201A.
6. Start the engine and run it at high idle speed (1900 RPM). Check the voltage reading on the meter. It should read approximately 16 VDC.

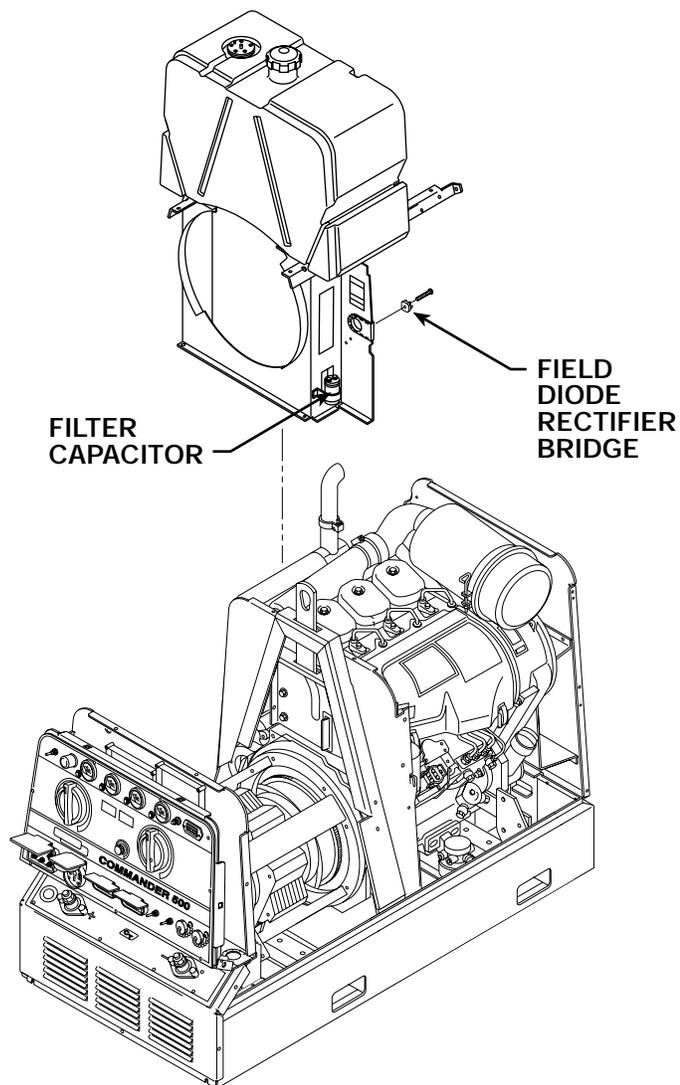
NOTE: Cut any cable ties necessary to perform the test. DO NOT UNPLUG PLUG P/J52.

COMMANDER 500



FLASHING AND ROTOR VOLTAGE TEST (CONTINUED)

FIGURE F.12 - FIELD DIODE RECTIFIER BRIDGE AND FILTER CAPACITOR



7. If the voltage reading is low or not present, the generator field is not functioning properly. Perform the ***Rotor Resistance Test***. Also check the field diode rectifier bridge, filter capacitor, and associated leads and connections. See Figure F.12 for location. See the Wiring Diagram.
8. If the rotor voltage readings are normal, the field circuit is functioning properly. Replace any cable ties cut during the test. Install the right case side.

NOTE: The normal flashing voltage is approximately 9VDC. This is battery voltage, which is processed through the Battery board. This voltage must be present during start-up to "flash" the rotor field.

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STATOR VOLTAGE TEST

WARNING

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

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

TEST DESCRIPTION

This test will determine if the correct AC voltages are being generated from the stator windings.

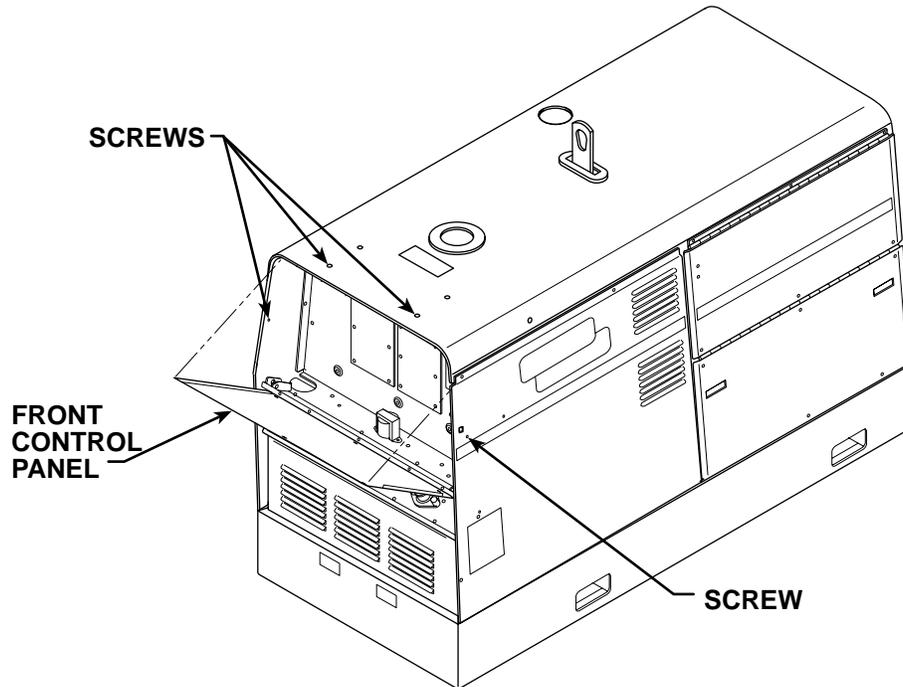
MATERIALS NEEDED

- Volt/Ohmmeter
- 3/8" wrench
- 3/4" Wrench

This procedure should take approximately 40 minutes to perform.

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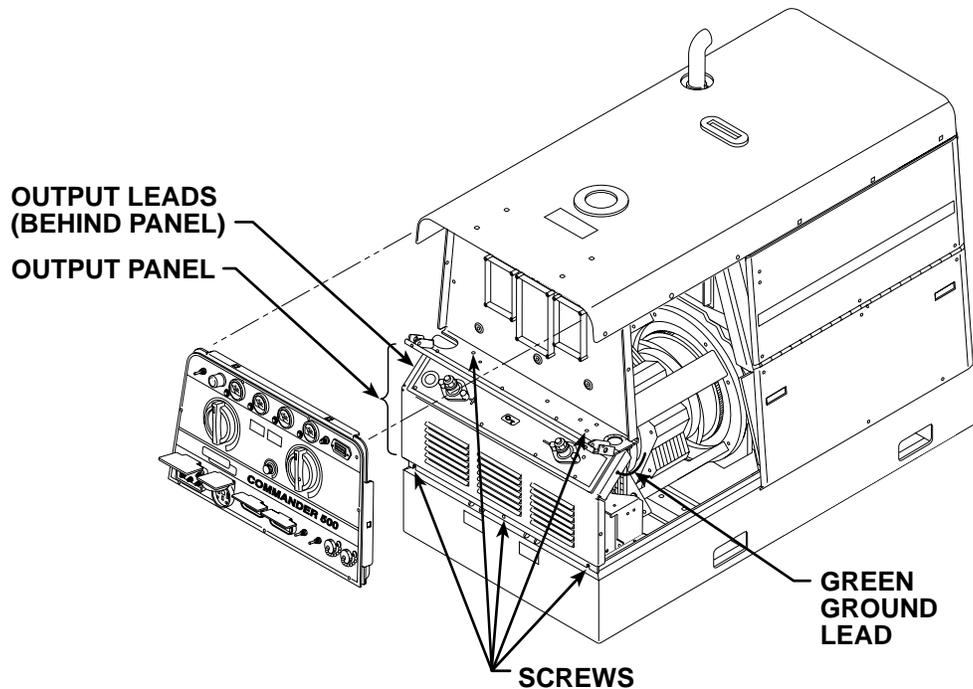
STATOR VOLTAGE TEST (CONTINUED)**FIGURE F.13 – FRONT CONTROL PANEL REMOVAL****TEST PROCEDURE**

1. Turn the engine off.
2. Using the 3/8" wrench, remove the four screws holding the front control panel to the case top and sides. See Figure F.13. (There are two screws on the top and one screw on each side.)
3. Carefully lower the front control panel.
4. Using the 3/8" wrench, remove the front left and right side panels.
5. Using the 3/4" wrench, remove the internal leads from the output terminals. Insulate the leads.

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STATOR VOLTAGE TEST (CONTINUED)

FIGURE F.14 – OUTPUT PANEL REMOVAL

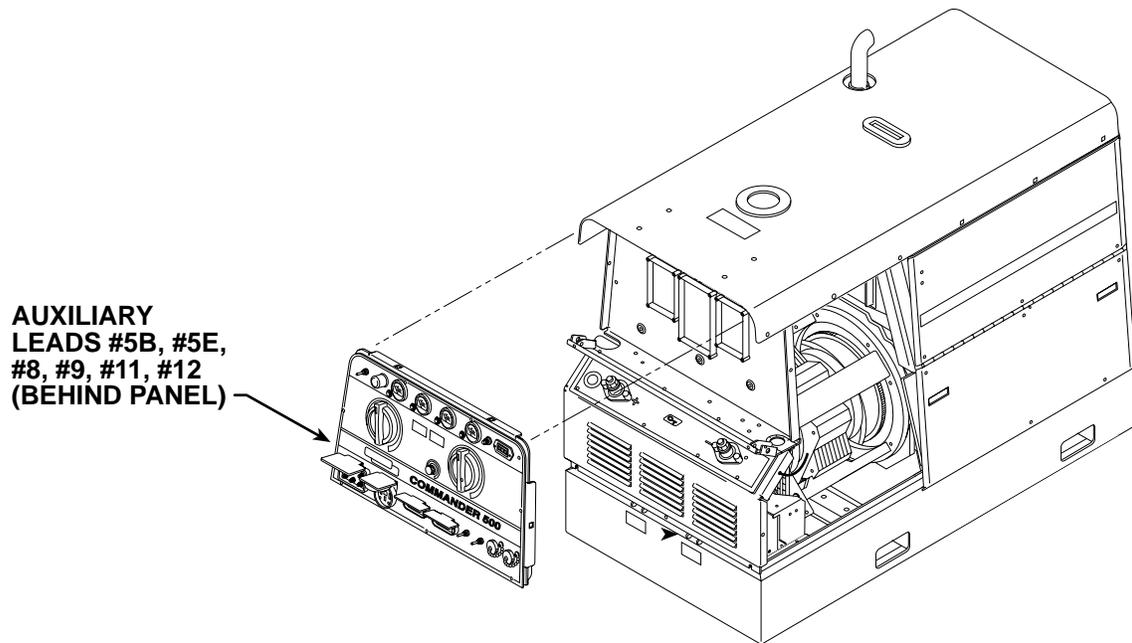


6. Using the 3/8" wrench, remove the three screws holding the lower front panel (output panel) to the case front assembly. Then remove the front two screws holding the top of the panel. These are accessed in the

control box, on the bottom at each side of the box. See Figure F.14. Carefully move the lower front panel to the right side. Note the green ground lead will still be attached.

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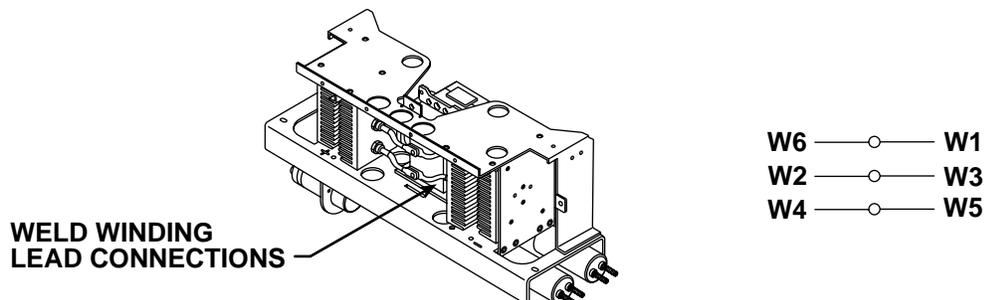
STATOR VOLTAGE TEST (CONTINUED)**FIGURE F.15 – AUXILIARY LEAD TEST LOCATION****AUXILIARY POWER AND WELD WINDINGS TEST**

1. Start the engine and run at high idle (1900 RPM). Do not load welding or auxiliary power.
2. Check for 115-132VAC at leads #9 to #5B. Also check for 115-132VAC from leads #8 to #5E. See Figure F.15 and the Wiring Diagram.
3. Check for 230 to 264VAC at leads #11 to #12. See Figure F.15 and the Wiring Diagram.

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STATOR VOLTAGE TEST (CONTINUED)

FIGURE F.16 – OUTPUT RECTIFIER DIODE BRIDGE



4. Locate the weld winding leads connected to the three-phase output rectifier diode bridge. See Figure F.16.
5. Check for approximately 68VAC from W1 to W2. Also check from W3 to W4 and from W5 to W6.
6. If any of these voltages are low or missing perform the **Flashing and Rotor Voltage Test** and also the **Rotor Resistance Test**.
7. Also check leads #6F and #5P for loose or faulty connections to the field bridge. See the Wiring Diagram.
8. If the tests in Steps 6 and 7 are OK and the stator voltages are low or missing, the stator may be faulty.
9. Replace the lower front panel and output leads.
10. Replace the upper control panel and secure.
11. Replace the front left and right case sides.

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ANALOG POWER SUPPLY PC BOARD VOLTAGE TEST



WARNING

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

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

TEST DESCRIPTION

This test will determine if the Analog Power Supply PC board is receiving and passing the proper signal voltages.

MATERIALS NEEDED

Analog Volt/Ohmmeter
Wiring Diagram

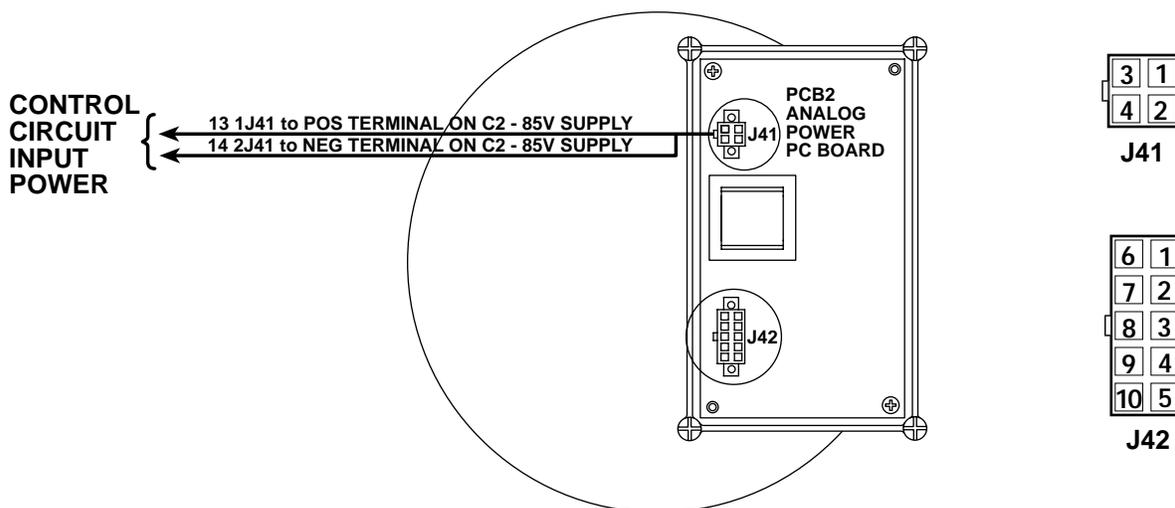
This procedure should take approximately 30 minutes to perform.

COMMANDER 500



ANALOG POWER SUPPLY PC BOARD VOLTAGE TEST (CONTINUED)

FIGURE F.17 – ANALOG POWER SUPPLY PC BOARD



TEST PROCEDURE

1. Turn the engine off.
2. Perform the **Case Cover Removal** procedure.
3. Locate plugs J41 and J42 from the Analog Power Supply PC board. See Figure F.17.
4. Start the engine and run it at high idle (1900 RPM) with no load.
5. Check for the correct input voltage:
 - a. Set the volt/ohmmeter to the Volts DC position.
 - b. Place the negative probe on J41 pin 2 and the positive probe on J41 pin 1.
 - c. The reading should be between 75 and 85 VDC.

6. Check for the correct output voltage readings per **Table F.1**. If any of the readings are not correct, the Analog Power Supply PC board may be faulty.
 7. When finished testing, perform the **Case Cover Replacement** procedure.
- If the reading is not correct, the stator output may be incorrect, the rectifier output may be incorrect, the power capacitors may be faulty, or the Power Module PC board may be faulty. Perform the **Stator Voltage Test**, the **Output Rectifier Bridge Test**, and the **Power Module PC Board Test**. The capacitors C1, C2, C3 or C4 may be faulty. Test and replace if necessary.

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ANALOG CONTROL POWER SUPPLY PC BOARD TEST (CONTINUED)

TABLE F.1
ANALOG CONTROL POWER SUPPLY PC BOARD VOLTAGE TABLE

Test Points	Component Tested	Voltage Reading
1J42 to 6J42	Chopper Power Supply	+20 VDC
3J42 to 8J42	Chopper Power Supply	+20 VDC
2J42 to 7J42	Weld Control PC Board Power Supply	+5 VDC
5J42 to 7J42	Weld Control PC Board Power Supply	+15 VDC
9J42 to 7J42	Weld Control PC Board Power Supply	-15 VDC
10J42 to 4J42	Weld Control PC Board Power Supply	+15 VDC

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

OUTPUT RECTIFIER BRIDGE TEST



WARNING

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

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

TEST DESCRIPTION

This test will determine if there are faulty diodes in the output rectifier bridge.

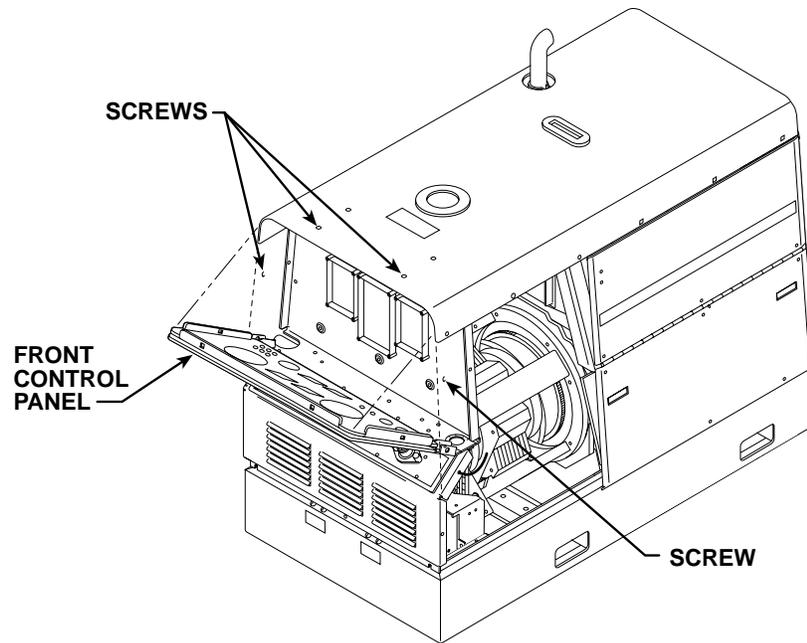
MATERIALS NEEDED

- Volt/Ohmmeter (Diode Tester)
- 3/8" Wrench
- 7/16" Wrench
- 3/4" Wrench
- Wiring Diagram

This procedure should take approximately 40 minutes to perform.

OUTPUT RECTIFIER BRIDGE TEST (CONTINUED)

FIGURE F.18 – FRONT CONTROL PANEL REMOVAL



TEST PROCEDURE

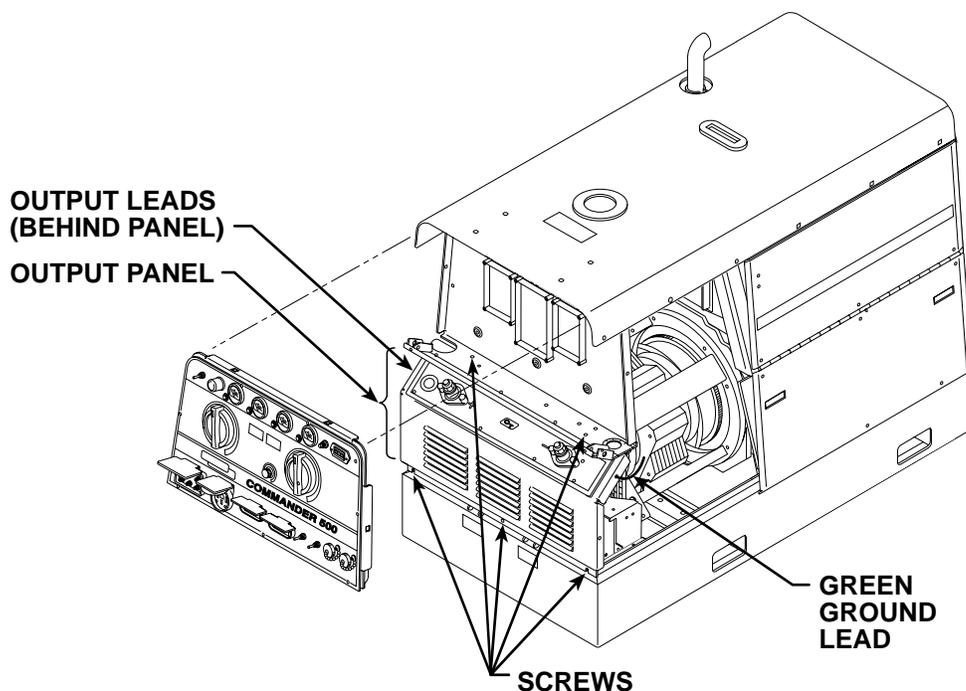
1. Turn the engine off.
2. Using the 3/8" wrench remove the screws holding the front control panel to the case top and sides. See Figure F.18. (There are two screws on the top and one screw on each side.)
3. Carefully lower the front control panel.
4. Using the 3/8" wrench, remove the front left and right side panels.
5. Perform the **Power Module Capacitor Discharge Procedure**.
6. Using the 3/4" wrench, remove the internal leads from the output terminals. Insulate the leads.

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OUTPUT RECTIFIER BRIDGE TEST (CONTINUED)

FIGURE F.19 – OUTPUT PANEL REMOVAL



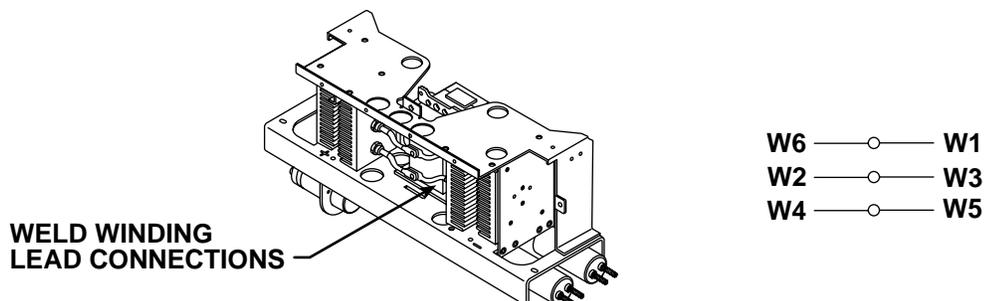
7. Using the 3/8" wrench, remove the three screws holding the lower front panel (output panel) to the case front assembly. Then remove the front two screws holding the top of the panel. These are accessed in the control box, on the bottom at each side of the box. Using the 7/16" wrench, disconnect the green ground lead. See Figure F.19. Carefully move the lower front panel to the right side.
8. Disconnect Bypass PC board leads #206B and #208 from their in-line connectors.

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OUTPUT RECTIFIER BRIDGE TEST (CONTINUED)

FIGURE F.20 – DIODE LEAD REMOVAL



9. Using the 7/16" wrench, remove the stator leads and diode pigtail leads from the three studs. Label the leads for reassembly. Note leads and pigtail placement for reassembly. See Figure F.20.
10. Electrically isolate the six diode pigtail leads by carefully bending them out into "free air."
11. With an ohmmeter or diode tester, check each of the six diodes from their pigtails to their respective heat sinks.
12. Reverse the tester leads and check the diodes again. Diodes should have a low resistance in one polarity and a very high resistance in the opposite polarity.
13. Replace any "shorted" or "open" diode as the tests indicate. See the ***Diode Removal and Replacement Procedure***.
14. Replace the pigtails and stator leads onto the correct studs. Assemble the washers and nuts.
15. Replace the lower front panel and output leads.
16. Replace the upper control panel and secure.
17. Replace the front left and right case sides.

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POWER MODULE TEST



WARNING

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

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

TEST DESCRIPTION

This test will help determine if the power modules are shorted. This is a resistance test, not a voltage test. This test will only help diagnose a problem in the "power" section of the module. **Other PC board components could be faulty.**

MATERIALS NEEDED

- Volt/Ohmmeter (Analog)
- 3/8" Wrench
- 7/16" Wrench
- 3/4" Wrench

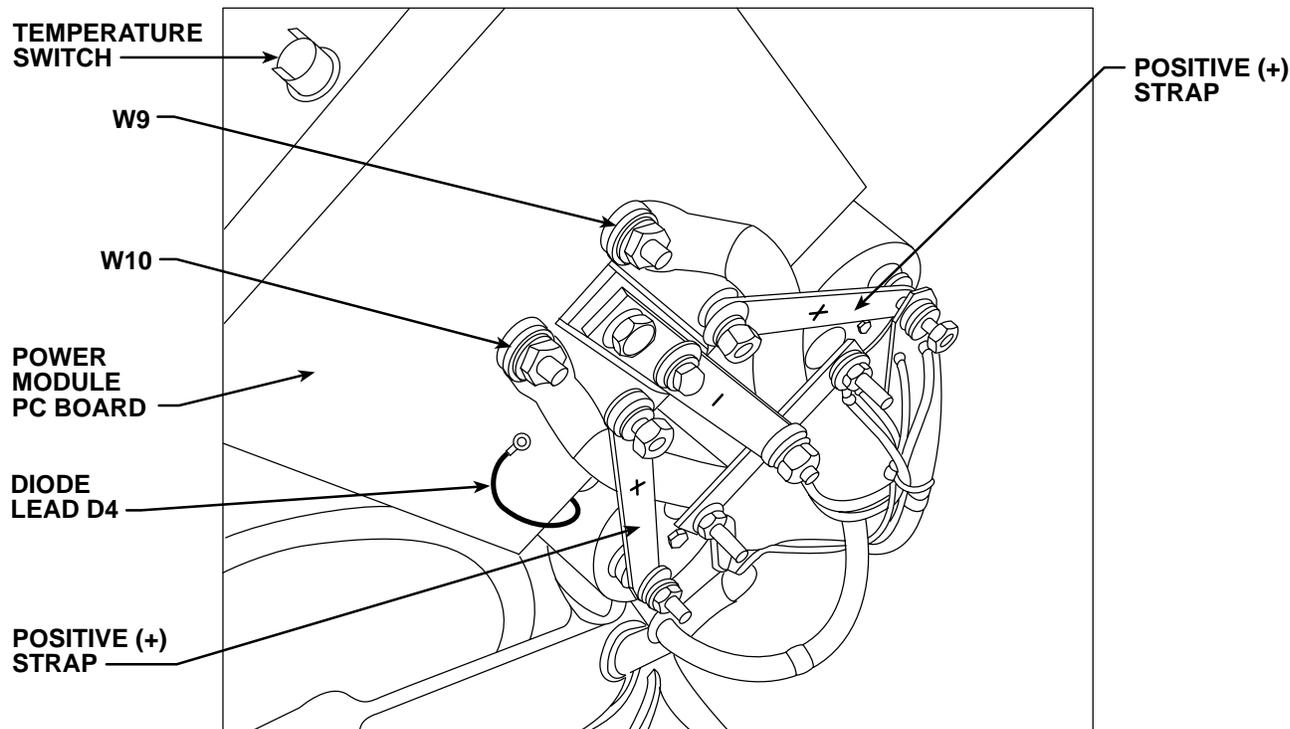
This procedure should take approximately 45 minutes to perform.

COMMANDER 500



POWER MODULE TEST (CONTINUED)

FIGURE F.21 – POWER MODULE CAPACITOR LEADS (LEFT SIDE)



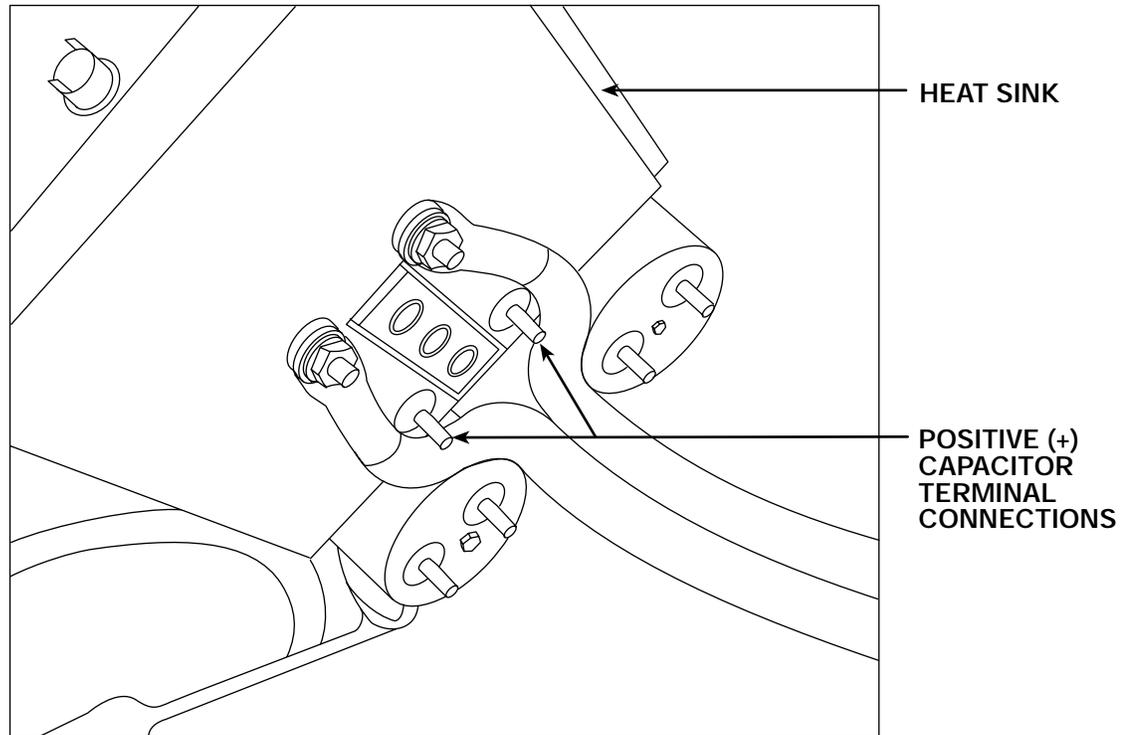
TEST PROCEDURE

1. Turn the engine off.
2. Perform the **Case Cover Removal** procedure.
3. Perform the **Power Module Capacitor Discharge** procedure.
4. Using the 7/16" wrench, loosen the nuts on the positive terminals of the power capacitors. Then remove the nuts, lock washers, and flat washers from the terminals where the positive straps connect to the power module PC board. Flip the straps out of the way. Also remove diode lead D3 (if working on right side power module) or D4 (if working on left side power module). See Figure F.21.
5. Using the 7/16" wrench, remove the flex leads W9 and W10 (left side) or W7 and W8 (right side) from the Power Module PC board terminals.
6. Using the 7/16" wrench, remove the negative jumper strap attaching the power capacitors to the Power Module PC board.

NOTE: Make sure the bolts do not fall back against the heat sink.

POWER MODULE TEST (CONTINUED)

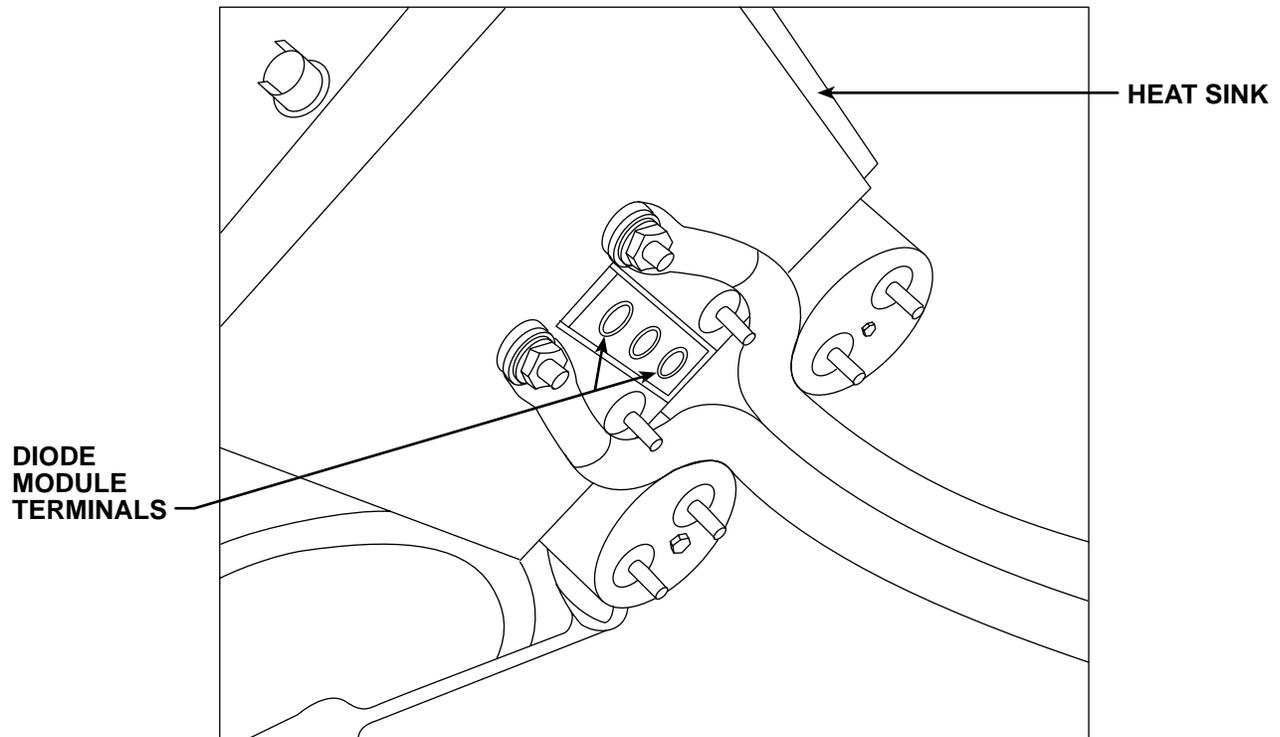
FIGURE F.22 – IGBT TEST

**Check IGBT For "Shorts"**

7. Using the analog ohmmeter, connect the positive meter probe to the heat sink and the negative meter probe to the positive capacitor terminal on the Power Module PC board. See Figure F.22. The resistance reading should be high (over 20,000 ohms).
8. Reverse the meter probe leads. The resistance should be very high (over 50,000 ohms). If the resistance is low in either Step 7 or 8, the IGBT may be shorted or leaky.

POWER MODULE TEST (CONTINUED)

FIGURE F.23 – DIODE MODULE TEST

**Check Diode Module**

9. Using the analog ohmmeter, connect the negative meter probe to the terminal on the diode module. See Figure F.23. Connect the positive meter probe to the heat sink. The resistance should be very high (over 50,000 ohms).
10. Using the analog ohmmeter, connect the positive meter probe to the terminal on the diode module. Connect the negative meter probe to the heat sink. The resistance should be low (approximately 300 ohms). Also check diode D3 (right side) or D4 (left side) for an open or shorted condition. See the Wiring Diagram.

When all tests are complete:

11. Reconnect all leads previously removed.
12. Torque the capacitor nuts to 50-60 inch-pounds.
13. If finished testing, perform the **Case Cover Replacement** procedure.

CHARGING CIRCUIT TEST



WARNING

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

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

TEST DESCRIPTION

This test will determine if the engine alternator and associated circuitry are functioning properly.

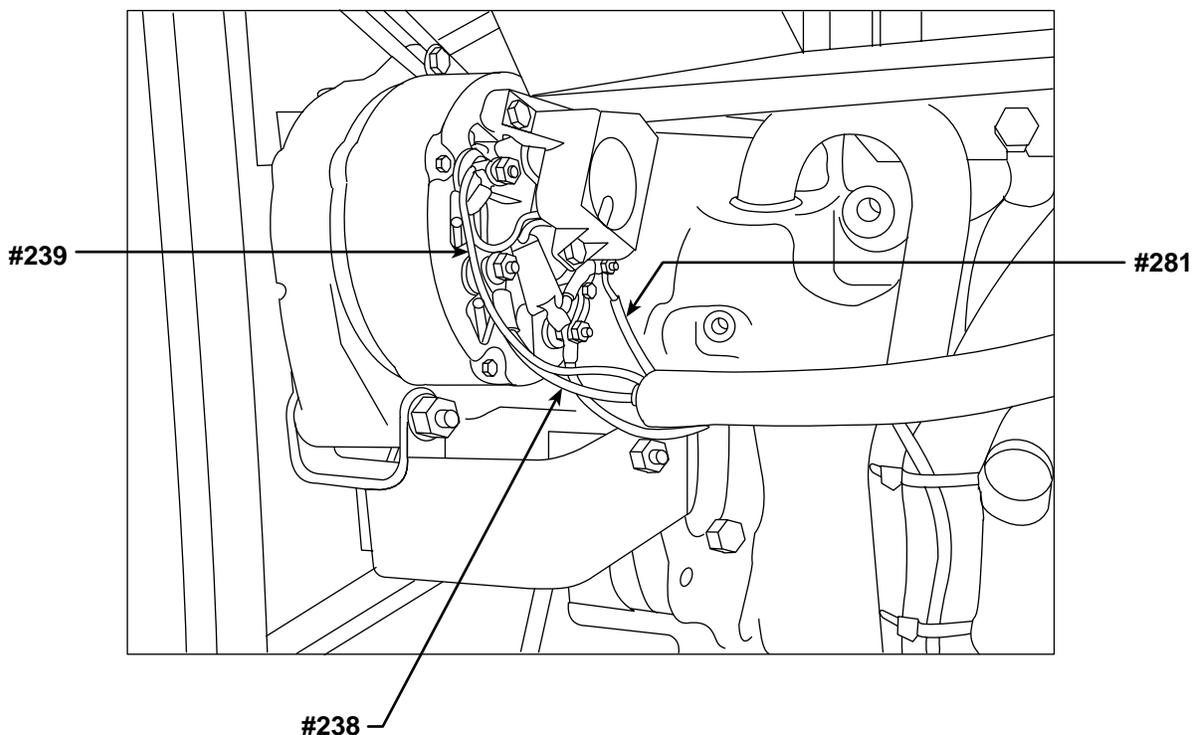
MATERIALS NEEDED

- 3/8" Wrench
- Volt/Ohmmeter
- Wiring Diagram

This procedure should take approximately 30 minutes to perform.

CHARGING CIRCUIT TEST (CONTINUED)

FIGURE F.24 – ENGINE ALTERNATOR LOCATION



TEST PROCEDURE

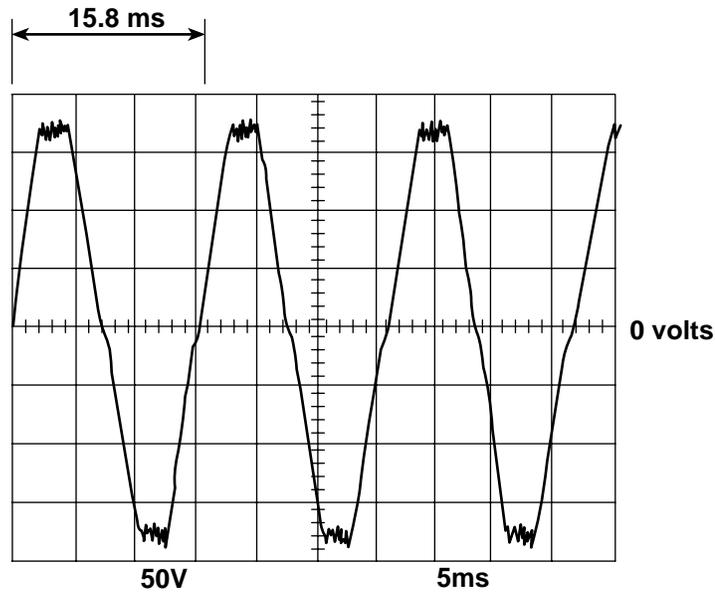
1. Turn engine off.
2. Using the 3/8" wrench, remove the left rear case cover.
3. Locate the engine alternator. See Figure F.24.
4. Start the engine and run it at high idle (1900 RPM).
5. Set the voltmeter for DC volts and measure the DC volts at lead #239 to engine ground. See the Wiring Diagram. Normal is 13.2 to 14.5VDC.
6. Set the voltmeter for DC volts and measure the DC volts at lead #238 to engine ground. See the Wiring Diagram. Normal is 13.2 to 14.5VDC.
7. Set the voltmeter for DC volts and measure the DC volts at lead #281 to engine ground. See the Wiring Diagram. Normal is 13.2 to 14.5 VDC.
8. If the correct flashing voltage is present and the charging output voltage is low or missing, the engine alternator may be faulty.
9. Stop the engine and check the alternator V-belt for proper tension. See the engine operation manual.
10. Replace the left rear case cover.

NOTE: Lead #281 carries the flashing voltage for the engine alternator. Battery voltage should be present whenever the engine is running. See the Wiring Diagram.

TROUBLESHOOTING & REPAIR

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115VAC SUPPLY)

HIGH IDLE – NO LOAD



This is the typical auxiliary output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at machine 115VAC receptacle.

SCOPE SETTINGS

Volts/Div.....	50V/Div.
Horizontal Sweep.....	5 ms/Div.
Coupling.....	DC
Trigger.....	Internal

COMMANDER 500



Return to Section TOC

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Return to Master TOC

Return to Master TOC

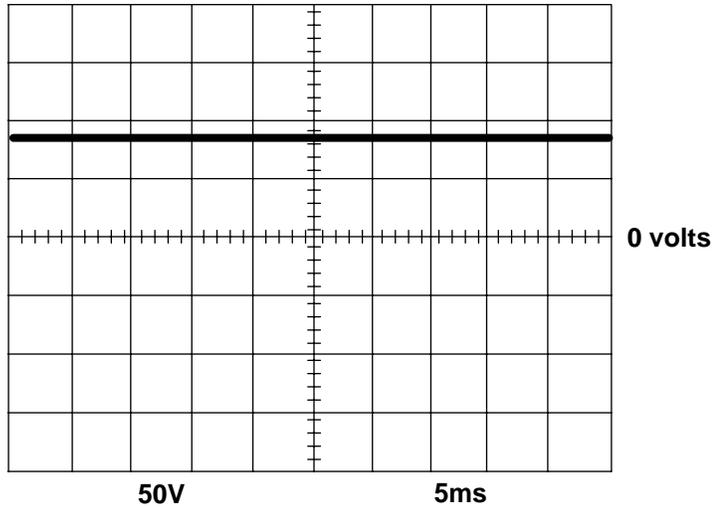
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TROUBLESHOOTING & REPAIR

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (STICK)

MAX TAP – MAX CONTROL POT – HIGH IDLE – NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

SCOPE SETTINGS

Volts/Div.....	50V/Div.
Horizontal Sweep.....	5 ms/Div.
Coupling.....	DC
Trigger.....	Internal

COMMANDER 500



Return to Section TOC

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Return to Section TOC

Return to Master TOC

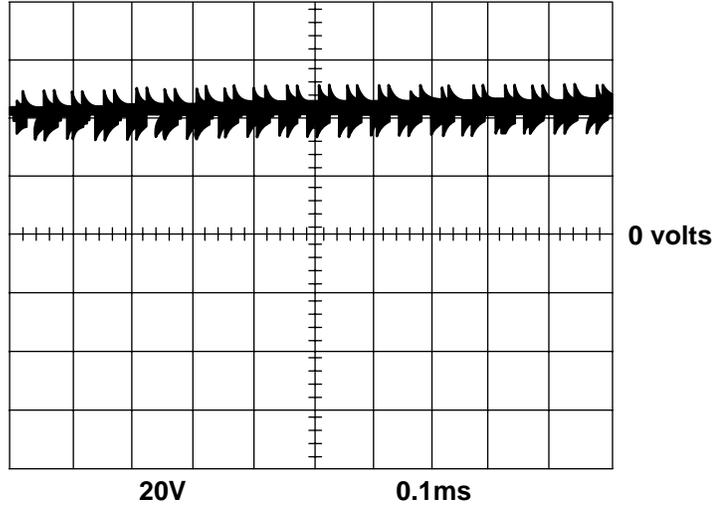
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TROUBLESHOOTING & REPAIR

NORMAL WELD VOLTAGE WAVEFORM (STICK CC) MACHINE LOADED TO 500 AMPS AT 40 VOLTS



This is the typical DC output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 0.1 milliseconds in time.

The machine was loaded with a resistance grid bank to 500 amps at 40 volts.

SCOPE SETTINGS

Volts/Div.....	20V/Div.
Horizontal Sweep..	0.1 ms/Div.
Coupling.....	DC
Trigger.....	Internal

COMMANDER 500



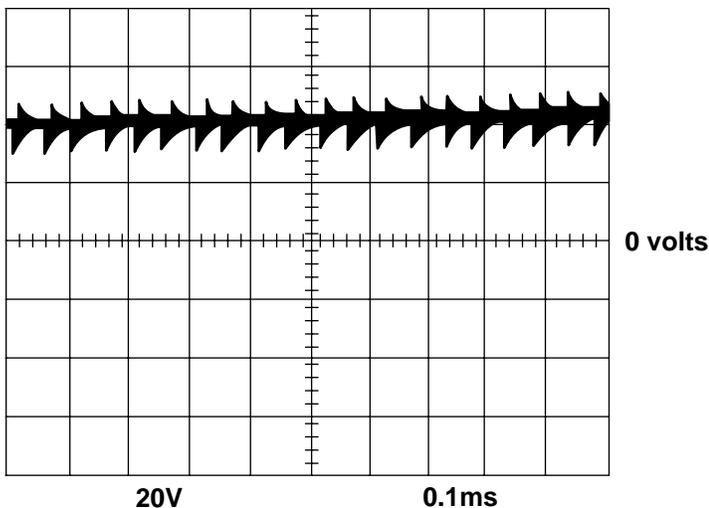
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TROUBLESHOOTING & REPAIR

NORMAL WELD VOLTAGE WAVEFORM (WIRE CV)

MACHINE LOADED TO 500 AMPS AT 40 VOLTS



This is the typical DC output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time.

The machine was loaded with a resistance grid bank to 500 amps at 40 volts.

SCOPE SETTINGS

Volts/Div.....	20V/Div.
Horizontal Sweep ..	0.1 ms/Div.
Coupling.....	DC
Trigger.....	Internal

COMMANDER 500



Return to Section TOC

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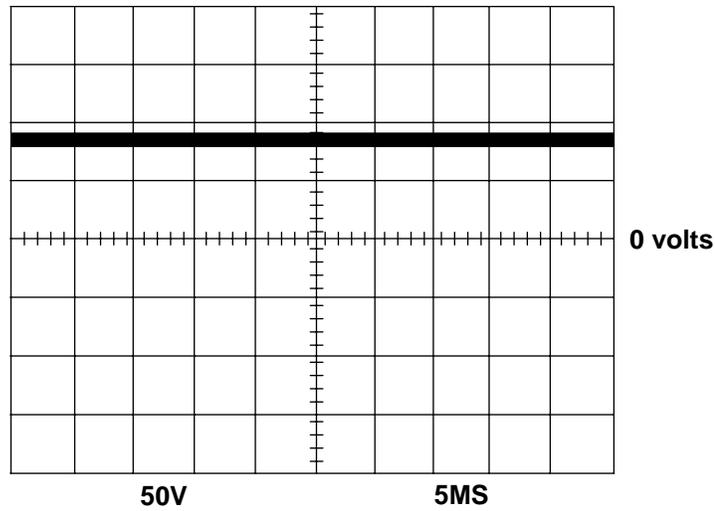
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TROUBLESHOOTING & REPAIR

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (WIRE CV TAP)

MAX CONTROL POT – HIGH IDLE – NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

SCOPE SETTINGS

Volts/Div.....	50V/Div.
Horizontal Sweep.....	5 ms/Div.
Coupling.....	DC
Trigger.....	Internal

COMMANDER 500



Return to Section TOC
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SHUTDOWN SOLENOID REMOVAL AND REPLACEMENT

WARNING

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

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

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the shutdown solenoid.

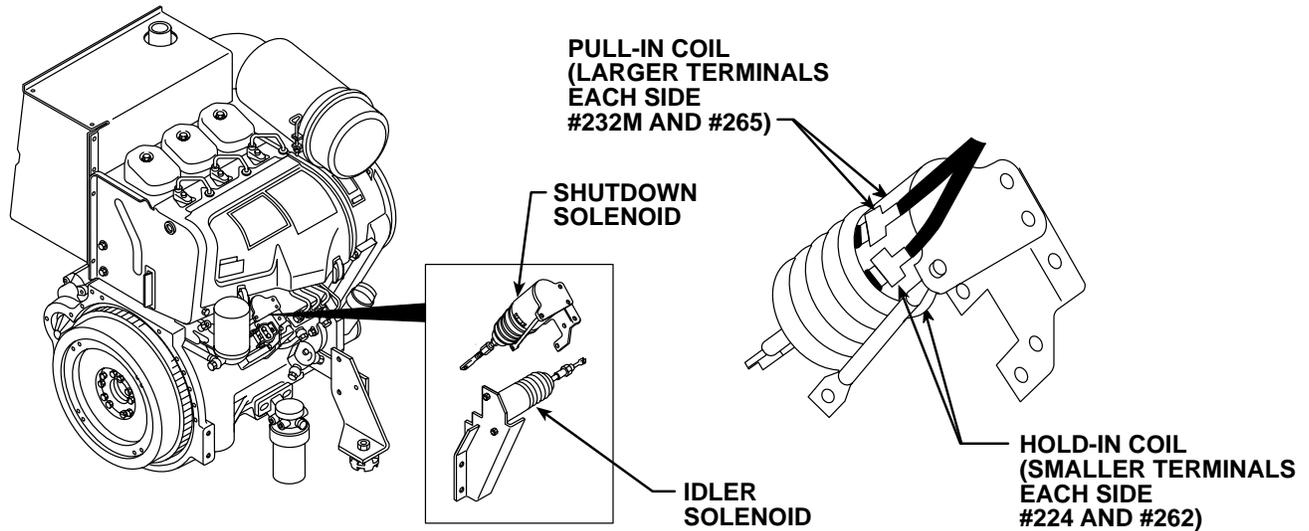
MATERIALS NEEDED

- 7/16" Wrench
- Long slot head screwdriver
- Needle nose pliers

This procedure should take approximately 30 minutes to perform.

SHUTDOWN SOLENOID REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F. 25 – SHUTDOWN SOLENOID LEAD CONNECTIONS



PROCEDURE

1. Turn engine off.
2. Unlatch, lift and secure the engine access door.
3. Locate and remove the four spade connectors that attach the shutdown solenoid terminals to the wiring harness leads (#224, #232M, #265 and #262). See Figure F.25. Cut the cable tie.

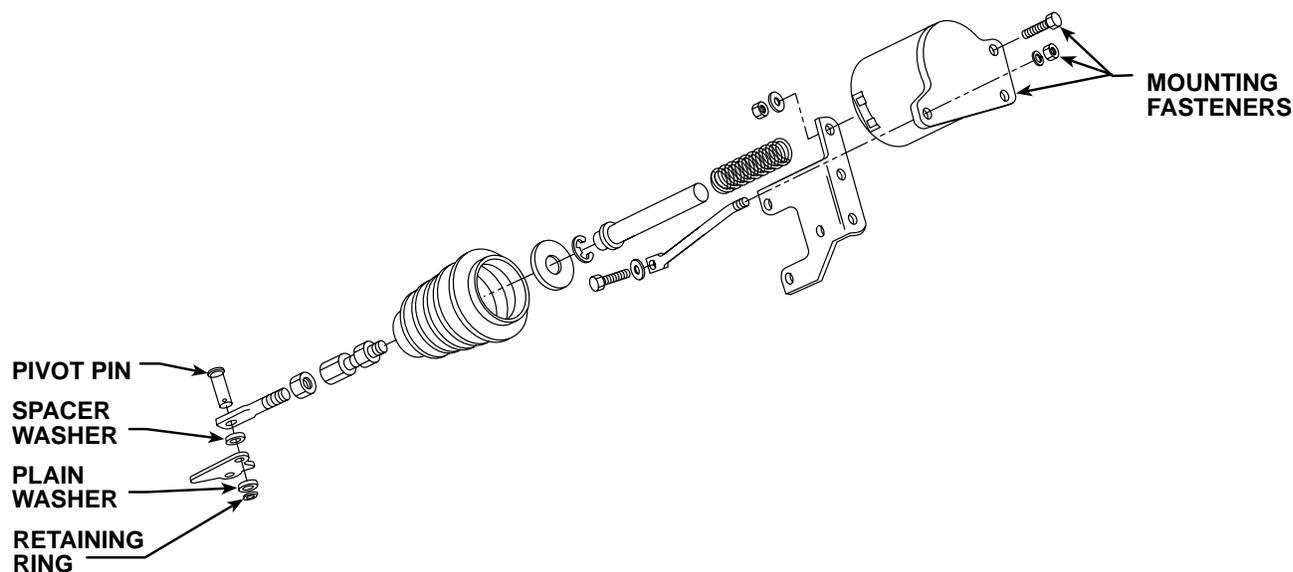
COMMANDER 500



Return to Section TOC
Return to Master TOC

SHUTDOWN SOLENOID REMOVAL AND REPLACEMENT (*CONTINUED*)

FIGURE F. 26 – SHUTDOWN SOLENOID LINKAGE ARM ASSEMBLY



4. Using the 7/16" wrench, remove the three nuts, two bolts and three lock washers mounting the shutdown solenoid assembly to the engine. See Figure F.26.
5. Using the long screwdriver and needle nose pliers carefully remove the retaining ring, plain washer, spacer washer and pivot pin from the linkage arm assembly. See Figure F.26.
6. Carefully remove the solenoid assembly.
7. Replace any faulty parts and reassemble the solenoid assembly.

REASSEMBLY

1. Using the long screw driver and needle nose pliers, carefully assemble the retaining ring, plain washer, spacer washer, and pivot pin to the linkage arm assembly. See Figure F. 26.
2. Using the 7/16" wrench, mount the shutdown solenoid assembly to the engine with three nuts, two bolts, and three lock washers.
3. Attach the four spade connectors from the wiring harness leads (#224, #232M, #265, and #262) to the shutdown solenoid terminals. **See Figure F.25.** Replace the cable tie.
4. Close the engine access door.

COMMANDER 500



POWER MODULE/OUTPUT RECTIFIER BRIDGE ASSEMBLY REMOVAL AND REPLACEMENT



WARNING

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

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

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the power module/output rectifier bridge assembly. Once the assembly is removed, the power module PC boards and output rectifier bridge diodes can be accessed for removal and replacement.

MATERIALS NEEDED

- 3/8" Wrench
- 7/16" Wrench or socket wrench
- 1/2" Wrench
- Phillips head screw driver

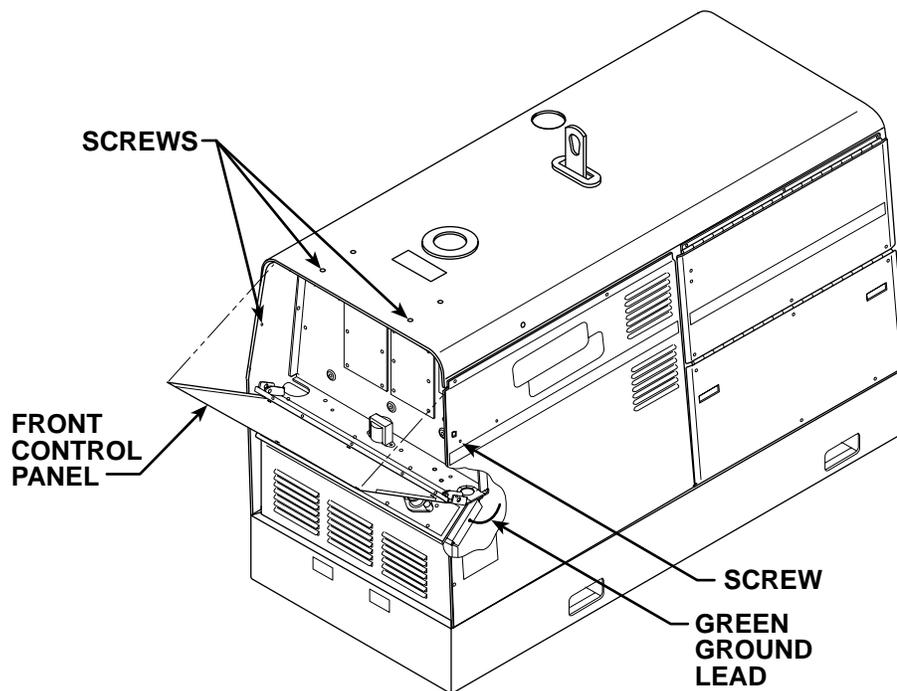
This procedure should take approximately 80 minutes to perform.

COMMANDER 500



POWER MODULE/OUTPUT RECTIFIER BRIDGE ASSEMBLY REMOVAL AND REPLACEMENT (CONTINUED)

F.27 – CONTROL PANEL REMOVAL



PROCEDURE

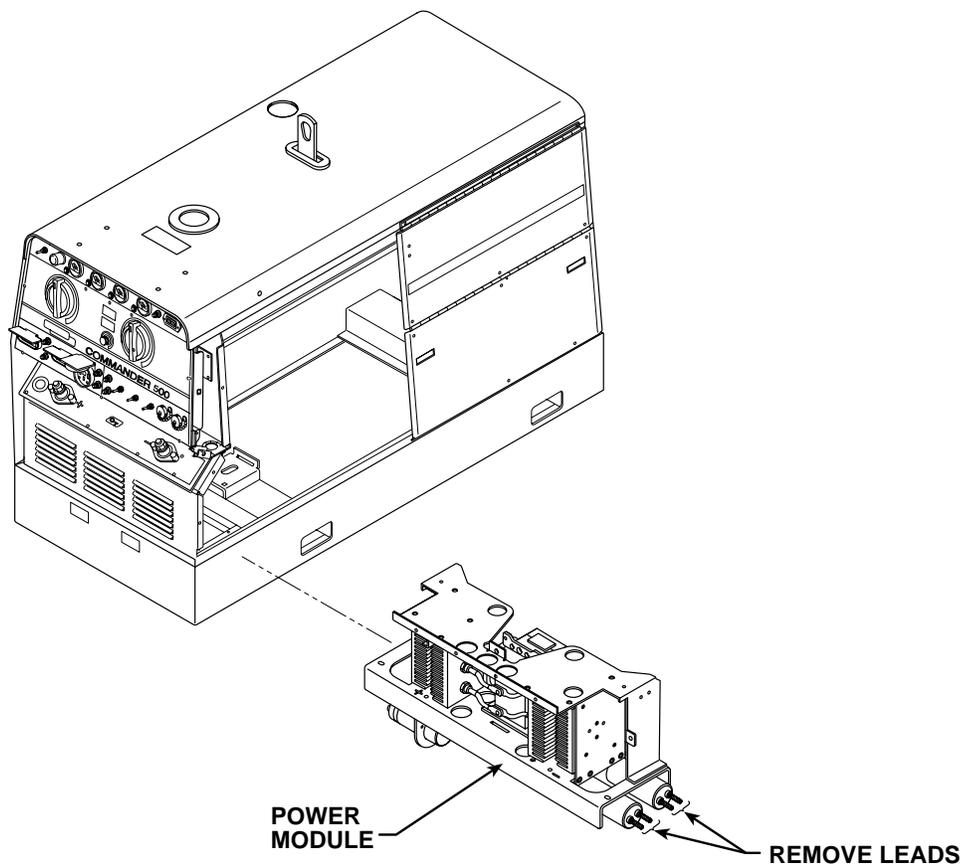
1. Turn the engine off.
2. Using the 3/8" wrench, remove the screws holding the front control panel to the case top and sides. See Figure F.27. (There are two screws on the top and one screw on each side.)
3. Carefully lower the front control panel.
4. Using the 3/8" wrench, remove the front left and right side panels.
5. Perform the **Output Panel Removal** section of the **Case Cover Removal** procedure.
6. Perform the **Power Module Capacitor Discharge Procedure**.
7. Optional: With the 7/16" wrench, remove the ground wire from the output panel assembly. If the ground wire is not in the way, it can remain attached.

COMMANDER 500



POWER MODULE/OUTPUT RECTIFIER BRIDGE ASSEMBLY REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F. 28 – POWER MODULE CAPACITOR LEAD REMOVAL



Refer to Figure F.28 for Steps 8-12.

8. Using the 7/16" wrench, loosen the nuts on the positive terminals of the power capacitors. Then remove the nuts, lock washers, and flat washers from the terminals where the positive straps connect to the power module PC board. Flip the straps out of the way. Also disconnect diode lead D3 (right side power module) and D4 (left side power module).
9. With the phillips screw driver, remove plug and lead assembly for P/J 50 (right side) or P/J51 (left side). Cut any necessary cable ties.
10. Disconnect the thermostat leads. Separate lead #249 on the right side. Cut any necessary cable ties.
11. Disconnect leads #14A and 13A at their in-line connectors (left side only).
12. With the 1/2" wrench, disconnect the bolt, lock washer and flat washer from the shunt at choke lead W11. Cut the cable tie and pull lead W11 through the toroid.

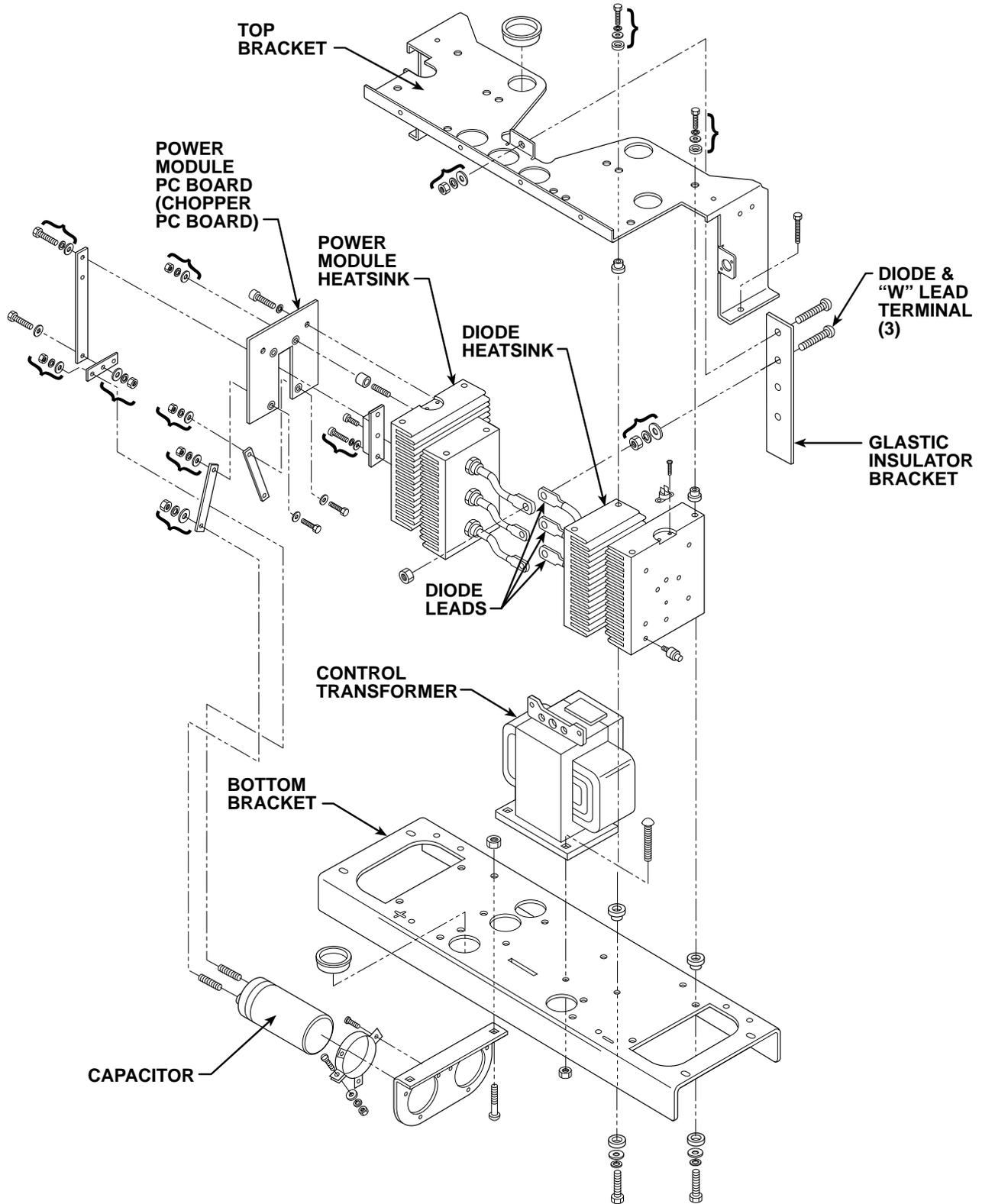
COMMANDER 500



TROUBLESHOOTING & REPAIR

POWER MODULE/OUTPUT RECTIFIER BRIDGE ASSEMBLY REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.29 – POWER MODULE/OUTPUT RECTIFIER BRIDGE ASSEMBLY DETAILS



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Return to Master TOC

POWER MODULE/OUTPUT RECTIFIER BRIDGE ASSEMBLY REMOVAL AND REPLACEMENT (CONTINUED)

Refer to **Figure F.29** for Steps 13-15.

13. Using the 7/16" wrench, remove the stator "W" leads from the three terminals on the plastic insulator bracket of the rectifier bridge. Label the leads for reassembly. Pull the leads out through the power module top bracket.
14. Using the 1/2" wrench, remove the flat strap to the negative output terminal. Pull the strap through the power module top bracket.
15. With the 7/16" socket wrench, remove the four nuts, lock washers, flat washers, and carriage bolts that hold the power module bottom bracket to the machine base.

The power module/output rectifier bridge assembly can now be removed and set to the side.

REPLACEMENT PROCEDURE

1. Place the assembly back into the machine.
2. Install the four carriage bolts, flat washers, lock washers, and nuts that hold the bottom bracket to the machine base.
3. Pull the flat negative output strap through the top bracket and attach it.

4. Feed the stator "W" leads through the top bracket and attach them to the terminals on the glastic insulator bracket.
5. Pass choke lead W11 through the toroid and connect it to the shunt.
6. Connect plug assemblies P/J50 and P/J51 to the power module PC board (both sides).
7. Connect the power module capacitor leads. Torque the capacitor nuts to 50-60 inch-pounds.
8. Replace any cable ties cut during removal.
9. Install the output panel.
10. Connect the ground wire to the output panel assembly, if removed.
11. Attach the front left and right side panels and the front control panel.

POWER MODULE (CHOPPER) PC BOARD/DIODE MODULE REMOVAL AND REPLACEMENT



WARNING

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

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

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Power Module (chopper) PC board and the board diode module.

MATERIALS NEEDED

- 7/16" Wrench
- 3/8" Allen head wrench
- 9/64" Allen head socket
- Phillips head screw driver
- Penetrox A13 thermal joint compound (T12837-1) -2 gm tube

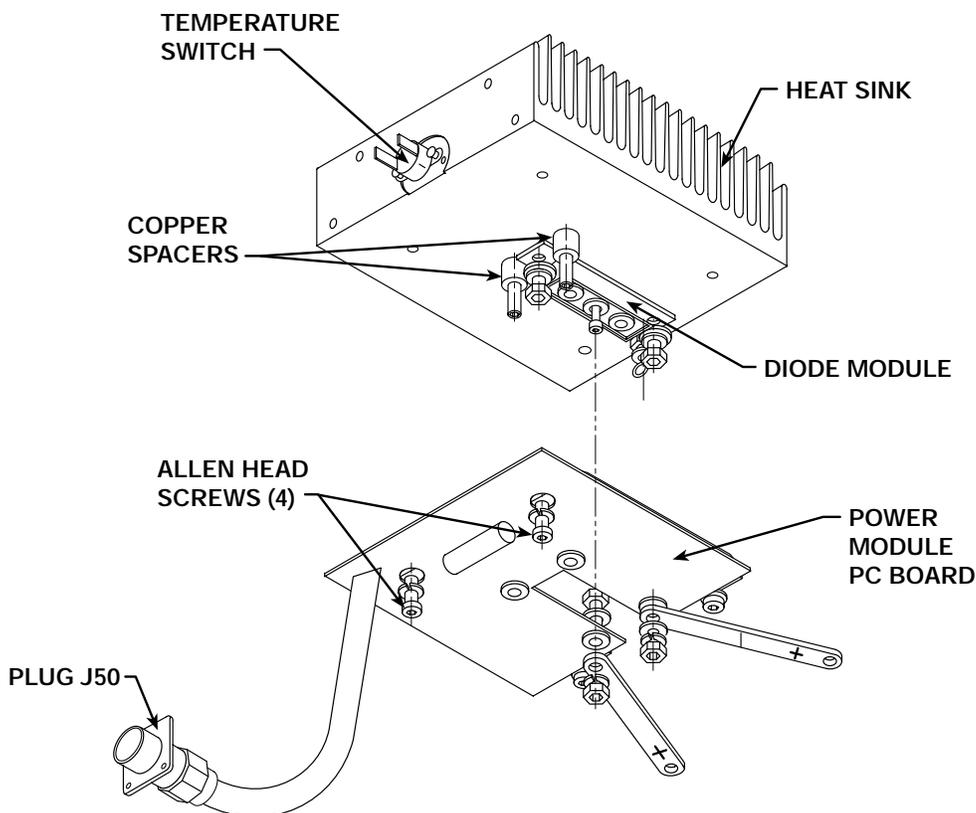
This procedure should take approximately 60 minutes to perform.

COMMANDER 500



POWER MODULE (CHOPPER) PC BOARD/DIODE MODULE REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.30 – POWER MODULE PC BOARD



POWER MODULE PC BOARD REMOVAL

Refer to Figure F.30.

1. Turn the engine off.
2. Remove the front right or left case side, depending on which Power Module PC board you are removing.
3. Perform the **Output Panel Removal** procedure section of the **Case Cover Removal** procedure.
4. Perform the **Power Module Capacitor Discharge** procedure.
5. With the phillips screw driver, remove plug and lead assembly for P/J 50 (right side) or P/J51 (left side). Cut any necessary cable ties.
6. With the 7/16" wrench, remove the nuts, lock washers, and flat washers holding the two heavy leads and the small diode leads to the Power Module PC board. (Right side: W7, W8, and D3. Left side: W9, W10 and D4.) See the Wiring Diagram.
7. With the 7/16" wrench, remove the nuts, lock washers, and flat washers holding the positive capacitor straps to the Power Module PC board. Loosen the nuts at the capacitor terminals and swing the straps out of the way.
8. With the 3/8" allen wrench, remove the top and bottom cap screws from the Power Module PC board.

NOTE: Each top cap screw has a copper standoff on the opposite side of the board. Be sure to place this standoff between the heat sink and the PC board at reassembly.

9. Remove the power module board.

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POWER MODULE (CHOPPER) PC BOARD/DIODE MODULE REMOVAL AND REPLACEMENT (*CONTINUED*)

POWER MODULE PC BOARD REPLACEMENT

1. Apply Penetrox A-13 joint compound (T12837-1) to the surface of the heat sink where the Power Module PC board mounts.
2. Install the top and bottom allen head cap screws. Insert the bolts into the board before mounting it. Torque the screws to 50-60 inch-pounds.
4. Install the small diode leads and the heavy leads, flat washers, lock washers, and nuts to the Power Module PC board. Torque the nuts to 50-60 inch-pounds.
5. Install plug and lead assembly P/J50 (right side) or P/J51 (left side).

IMPORTANT: Each top cap screw has a copper standoff on the opposite side of the board. Be sure to place this standoff between the heat sink and the PC board.

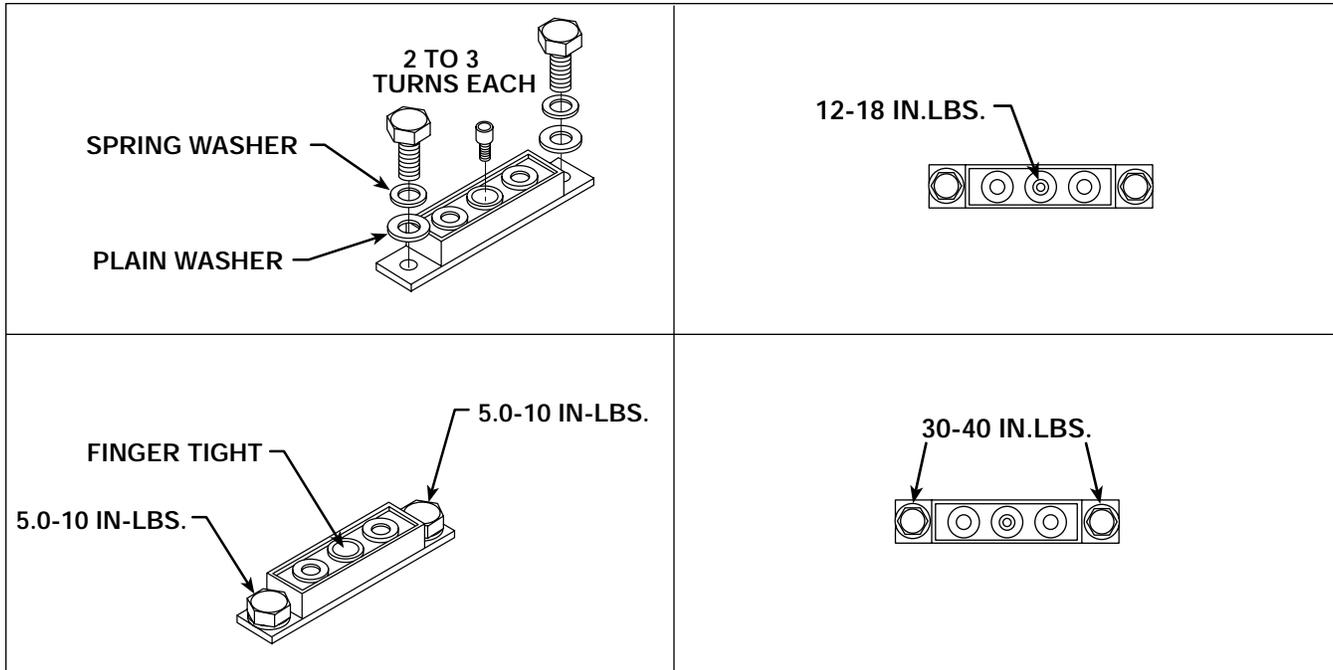
3. Install the positive capacitor straps, flat washers, lock washers, and nuts. Torque the nuts to 50-60 inch-pounds at the Power Module PC board and at the capacitor terminals.

6. Replace any cable ties cut at disassembly.

See the procedures below for removal and replacement of the Power Module PC board diode module. When procedures are complete, perform the **Output Panel Replacement** and the **Case Cover Replacement Procedures**.

POWER MODULE (CHOPPER) PC BOARD/DIODE MODULE REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.31 – DIODE MODULE MOUNTING DETAILS AND TIGHTENING SEQUENCE



DIODE MODULE REMOVAL

Refer to Figure F.31.

1. Remove the Power Module PC board as described above.
2. Using the 7/16" wrench, remove the two outer screws, spring washers, and large flat washers from the diode module.
3. Using the 9/64" allen wrench, remove the set screw from the center of the diode module.
4. Remove the diode module from the heat sink.

DIODE MODULE REPLACEMENT

Refer to Figure F.31.



CAUTION

The proper tightening sequence is required to mount the diode module to the heat sink in order to avoid warping the base plate. Apply the proper torque to all fasteners.

1. Be sure the heat sink mounting surface is clean, dry, and free of grease.
2. Apply a thin, even coat (.1 to .25mm or .004 to .010 in) of Penetrox A13 thermal joint compound (T12837-1) to the diode module base plate only, under the plastic body of the module. Do not apply compound to the area under the mounting holes.
3. Press the module firmly against the heat sink, aligning the mounting holes.
4. Place a spring washer then a flat washer over each outer mounting screw and insert them into the holes. Insert the allen head screw into the center hole. Tighten all three screws 2 – 3 turns each, finger-tight only (1).
5. Using the torque wrench and 7/16" socket, tighten each outer screw between 5.0 and 10 in-lbs (2).
6. Using the torque wrench and 9/64" allen head socket, tighten the center screw between 12 and 18 in-lbs (3).
7. Now tighten the two outer screws between 30 and 40 in-lbs (4).
8. Replace the Power Module PC board as described above.

COMMANDER 500

OUTPUT RECTIFIER BRIDGE DIODE REMOVAL AND REPLACEMENT



WARNING

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

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

DESCRIPTION

The following procedure will aid the technician in removing and replacing stud type diodes to the aluminum heat sinks on the Commander 500.

MATERIALS NEEDED

- 7/16" Wrench
- 1/2" Wrench
- 1" Open end wrench
- Penetrox A13 joint compound (T12837-1) -2 gm. tube
- Loctite 271
- "Slip" type torque wrench
- E2827-2 abrasive disc or fine steel wool

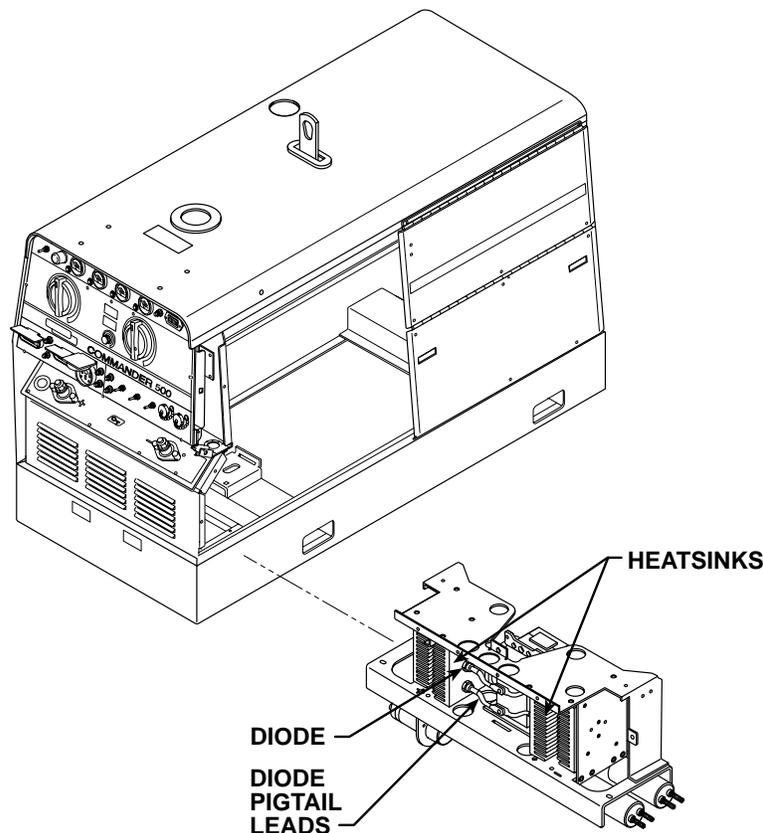
This procedure should take approximately 25 minutes to perform.

COMMANDER 500



OUTPUT RECTIFIER BRIDGE DIODE REMOVAL AND REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.32 – POWER MODULE/OUTPUT RECTIFIER BRIDGE ASSEMBLY DETAILS



PROCEDURE

Refer to Figure F.32.

1. Turn the engine off.
2. Perform the **Output Panel Removal** as described in the **Case Cover Removal** procedure.
3. Perform the **Power Module Capacitor Discharge** procedure.
4. Using the 7/16" wrench, remove the appropriate stator leads and diode pigtail lead from the stud on the output rectifier bridge glastic insulator bracket. The bottom diodes require a 1/2" wrench to remove the double heavy leads.
5. Label the leads for reassembly if more than one is removed.
6. Using the 1" wrench, loosen the appropriate diode and remove the diode that is to be replaced.
7. Clean the area on the heat sink around the diode mounting surface using a putty knife or similar tool. **DO NOT SCRATCH THE DIODE MOUNTING SURFACE.**
8. Polish the heat sink's mounting surface using an abrasive disc, E2827-2 or fine steel wool to provide a bright, clean surface where the diode seats on the heat sink. Wipe the surface clean with a lint-free cloth or paper towel.

COMMANDER 500



OUTPUT RECTIFIER BRIDGE DIODE REMOVAL AND REMOVAL AND REPLACEMENT (CONTINUED)

8. Inspect the mounting surfaces of each new diode. Remove all burrs and wipe clean. Do not use steel wool or any abrasive cleanser on the diode mounting surface.
9. Apply a thin (0.003" to 0.007") uniform layer of Penetrox A13 joint compound (T12837-1) to the heat sink mounting surface.
 - a. Do not apply compound to the diode stud or mounting threads.
 - b. Apply two drops of Loctite 271 to the diode stud threads before tightening.
10. Tighten the diode to the specifications in the following table.
11. Connect the stator leads and diode pigtail leads as labeled at disassembly.
12. Replace the output panel.

NOTE: The diode threads must be clean and free of defects so that it can be finger tightened before applying torque. A "slip" type torque wrench must be used to tighten the diode.

DIODE STUD SIZE	FOOT POUNDS	INCH POUNDS
3/4 - 16	25-27	300-324
3/8 - 24	10 ± 0.5	125 +0/-5

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STATOR/ROTOR REMOVAL AND REPLACEMENT

WARNING

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

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

DESCRIPTION

The following procedure will aid the technician in removing and replacing the Commander 500 stator and rotor.

MATERIALS NEEDED

5/16" Wrench	Slot head screw driver
3/8" Wrench	Phillips head screw driver
7/16" Wrench	Gear puller (small)
1/2" Wrench	Hoist
3/4" Wrench	Feeler gauge (for air gap check)
1" Open end wrench	
1 1/8" Wrench	
9/16" Deep socket wrench	
17mm Wrench	

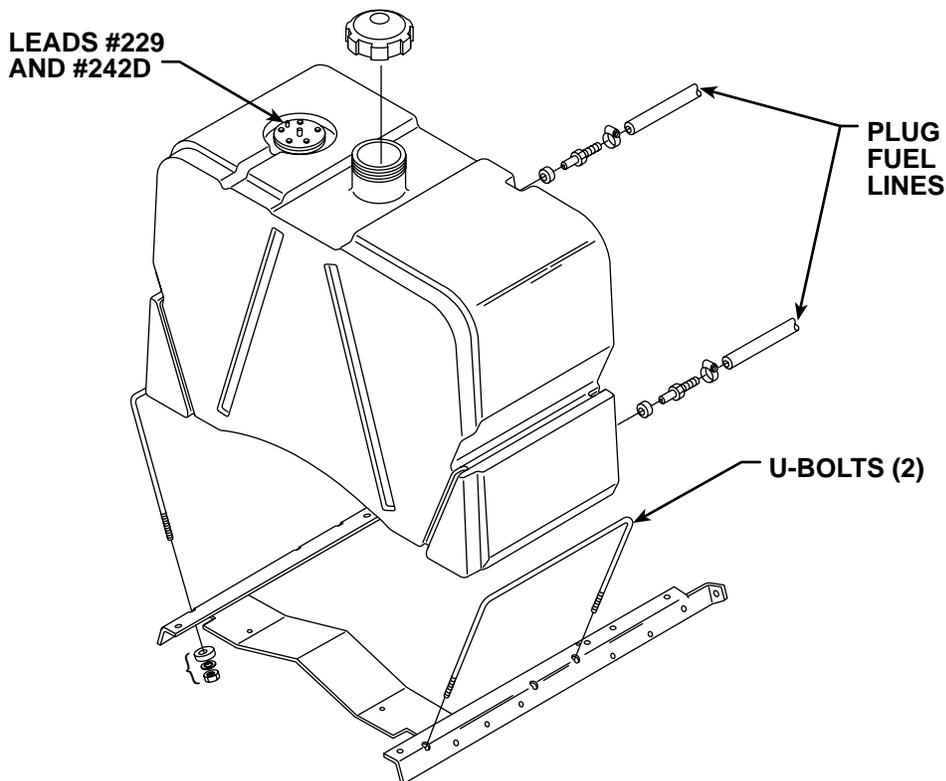
This procedure should take approximately 5-1/2 hours to perform.

COMMANDER 500



STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.33 – FUEL TANK REMOVAL DETAILS



PREPARATION AND LEAD REMOVAL PROCEDURE

Refer to Figure F.33.

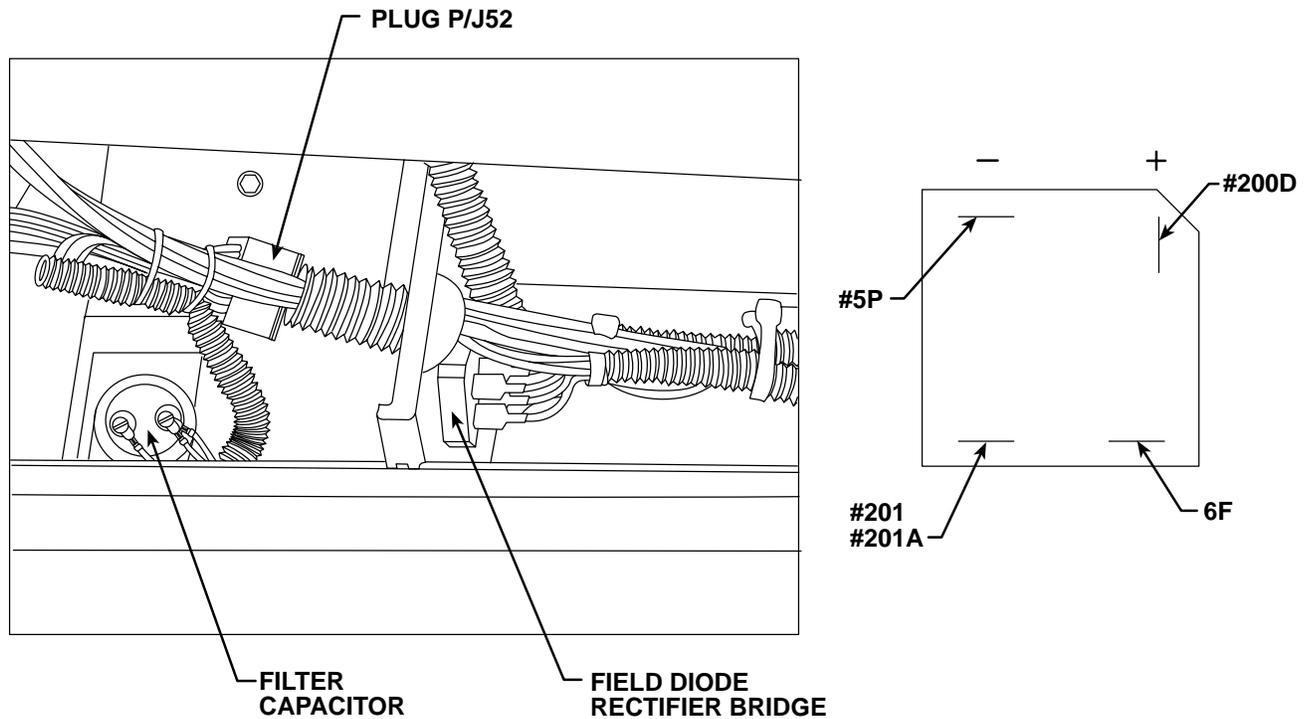
1. Turn the engine off.
2. Perform the **Case Cover Removal** procedure, including removing the output panel.
3. Perform the **Power Module/Output Rectifier Bridge Assembly Removal Procedure**.
4. Perform the **Power Module Capacitor Discharge Procedure**.
5. Using the 3/8" wrench, remove leads #229 (white) and #242D from the fuel level sensor. Label the leads for reassembly.
6. Turn the fuel off at the shutoff valve. Remove and plug the fuel return line.
7. Remove and plug the lower fuel line. Pull it through the firewall.
8. Using the 9/16" deep socket wrench, remove the four lock nuts, washers, and rubber washers from the fuel tank mounting U-bolts.
9. Carefully remove the U-bolts and lift the fuel tank from the machine.

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STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.34 – PLUG J52/FILTER CAPACITOR/FIELD RECTIFIER BRIDGE DISCONNECTION



Refer to Figure F.34 for Steps 10-12.

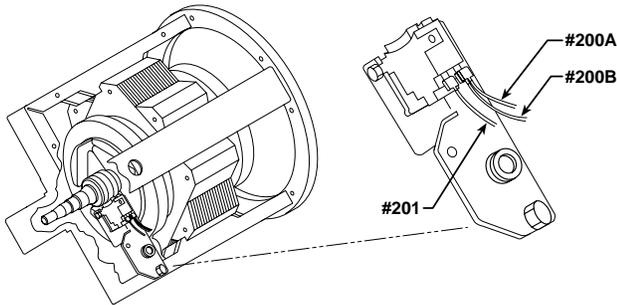
10. Disconnect plug J52 at the right front side. See Figure F.34.
11. Using the slot head screw driver, disconnect leads #200C, #200E(+) and #201D(-) from the filter capacitor.
12. Label and remove leads #5P, #201 and #201A, #200D, and #6F from the field diode rectifier bridge.

COMMANDER 500



STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)

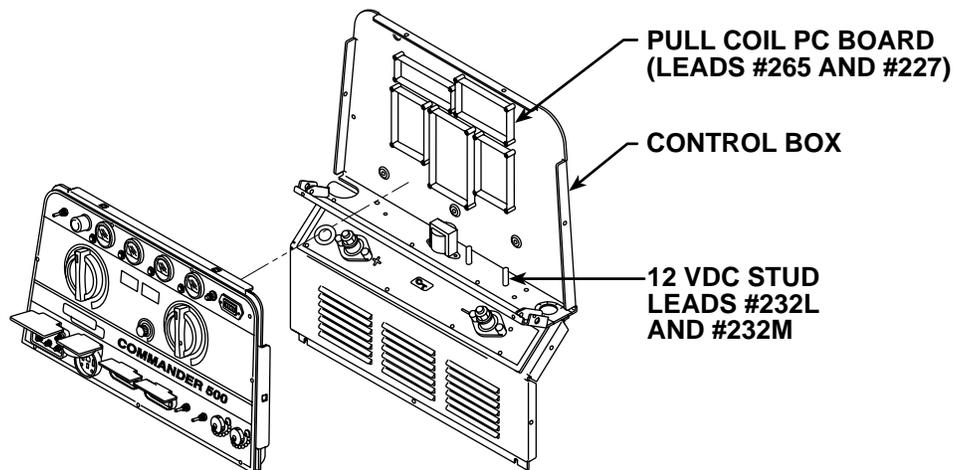
FIGURE F.35 – BRUSH HOLDER AND LEAD REMOVAL



Refer to Figure F.35 for Steps 13-15.

13. Using the 3/8" wrench, remove the brush holder access panel.
14. Using the 3/8" wrench, remove the brush holder assembly.
15. Cut the cable tie and then label and remove brush leads #201(-) and piggy-backed leads #200A(+) and #200B(+) from the brush holder assembly. (The piggy-backed leads connect closest to the stator laminations.)

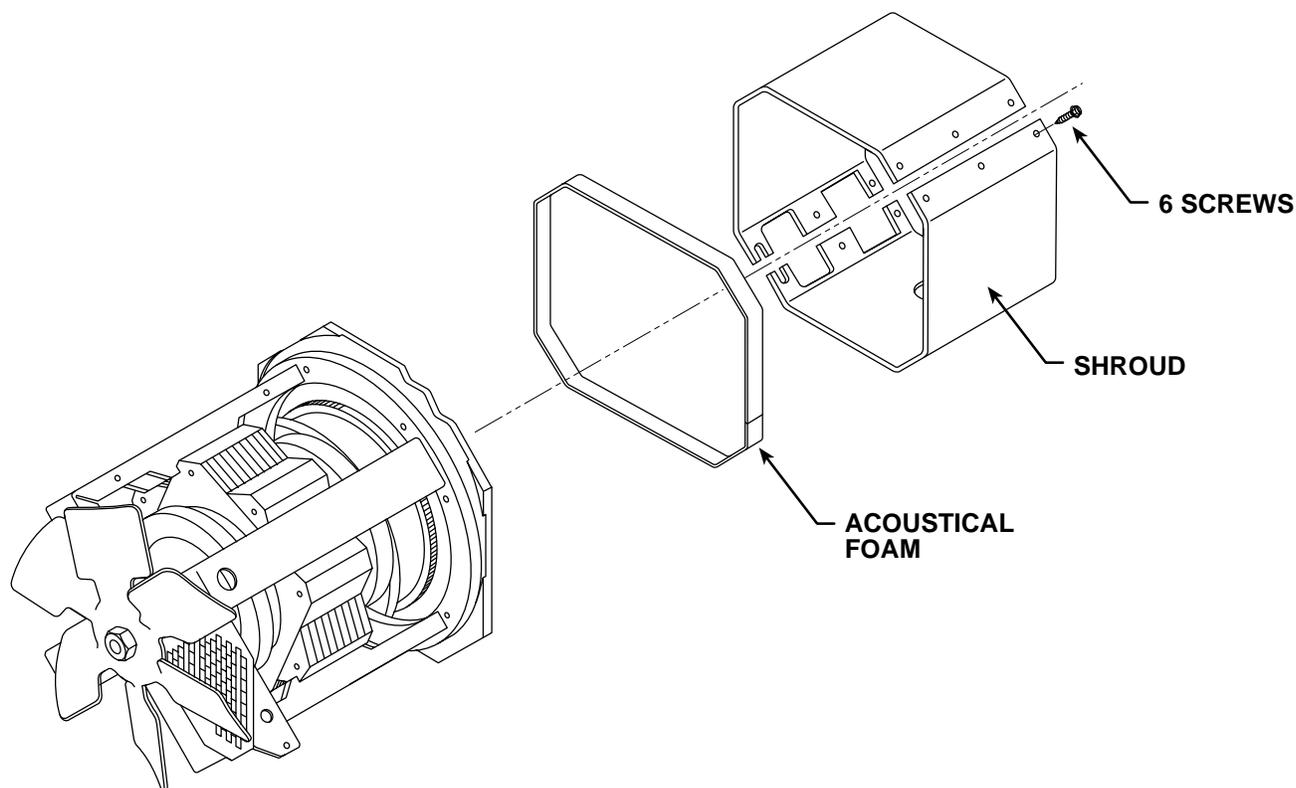
FIGURE F.36 – CONTROL BOX CONNECTIONS



16. See Figure F.36. Disconnect leads #265 and #227 from the Pull Coil PC board. With the 7/16" wrench, remove the nut, lock washer, and flat washer from the 12 VDC insulated stud. Remove leads 232L and #232M from the stud. Cut any necessary cable ties. Pull all leads freed in this step through the control box panel.
17. With the 3/8" wrench, remove the two screws from the bottom of the control box. Swing the control box aside and lay it down.

COMMANDER 500



STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)**FIGURE F.37 – ALTERNATOR SHROUD REMOVAL**

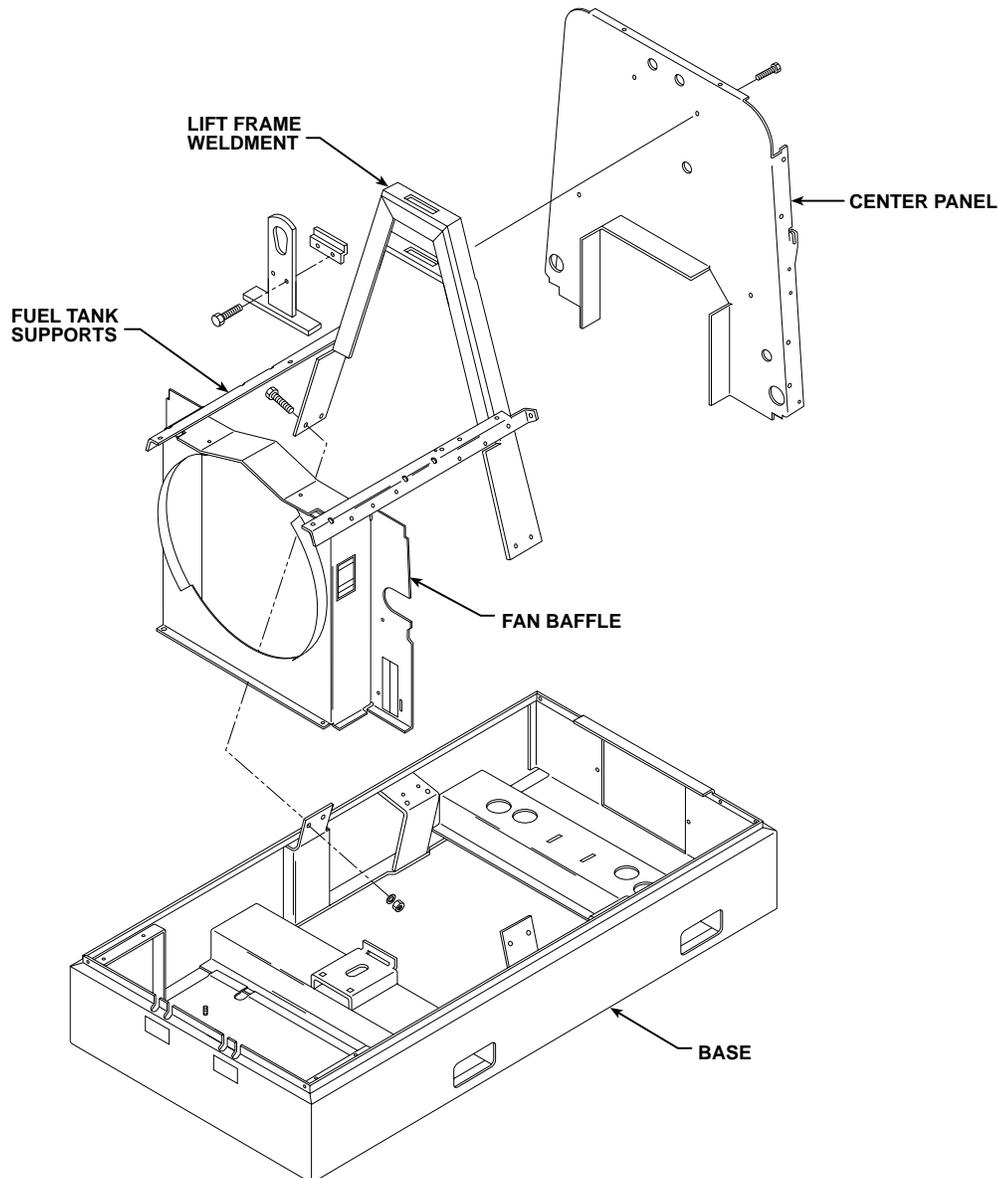
18. With the 5/16" wrench, remove the six screws that hold the top and bottom of the alternator shroud together.

19. With the 7/16" wrench, remove the two nuts, lock washers and flat washers that hold the bottom of the shroud to the machine base. Remove the shroud.

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ELECTRIC

STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.38 – LIFT FRAME AND ASSOCIATED COMPONENT REMOVAL



In steps 20 – 24, the lift frame weldment, fuel tank supports, and fan baffle are removed as a unit. See Figure F.38.

20. Using the 3/8" wrench, remove the two bolts (at top) that hold the center panel to the lift frame weldment.
21. Using the 1/2" wrench, remove the two bolts (at bottom) that hold the center panel to the lift frame weldment.

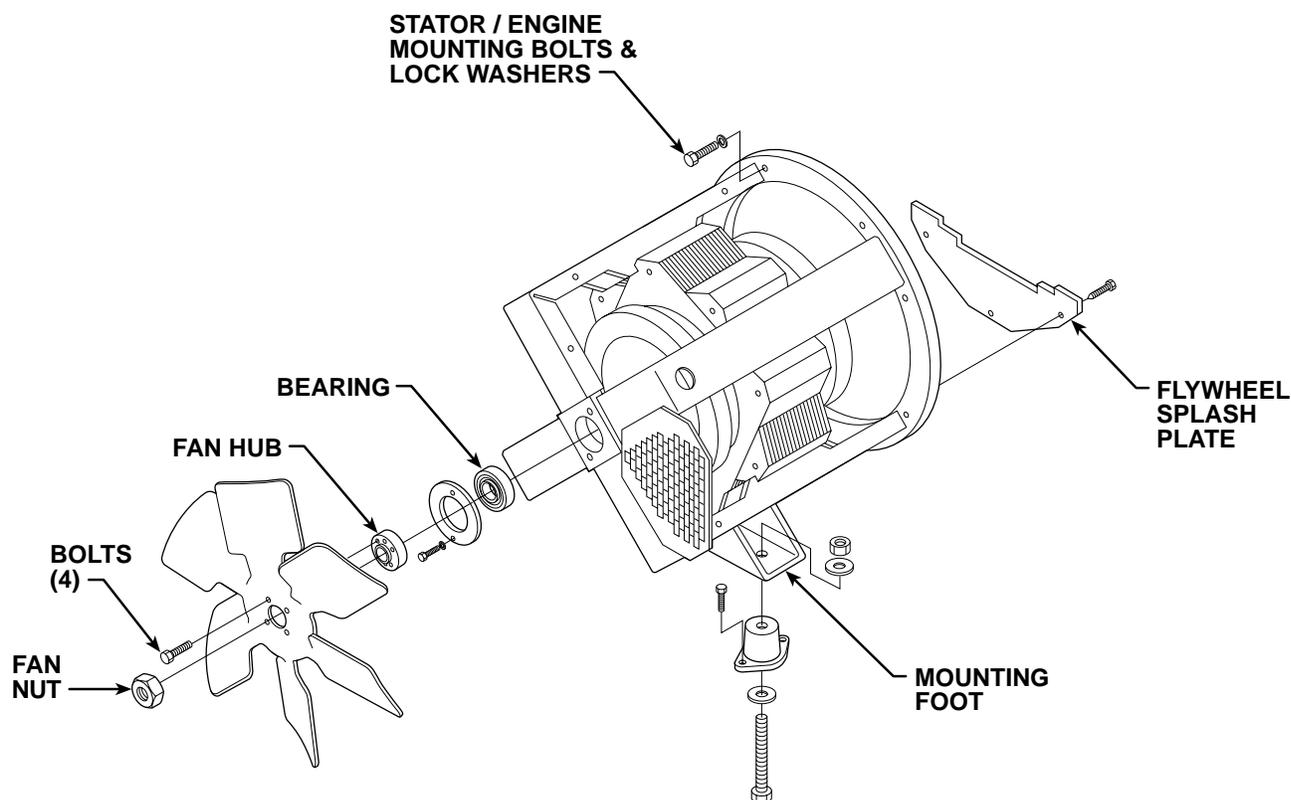
22. With the 3/8" wrench, remove the nuts, lock washers, and flat washers from the two studs that hold the fan baffle to the machine base.
23. Using the 3/4" wrench, remove the four bolts, lock washers, and nuts from the bottom of the lift frame weldment.
24. Carefully remove the lift frame weldment, fuel tank supports, and attached fan baffle. You will need to lift the fan baffle off the two studs on the machine base, then cock it slightly to remove it.

COMMANDER 500



STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.39 – STATOR REMOVAL



STATOR REMOVAL PROCEDURE

First, cut any necessary cable ties in order to free the stator leads from the bundle of leads running to the control box. Refer to Figure F.39 for stator removal.

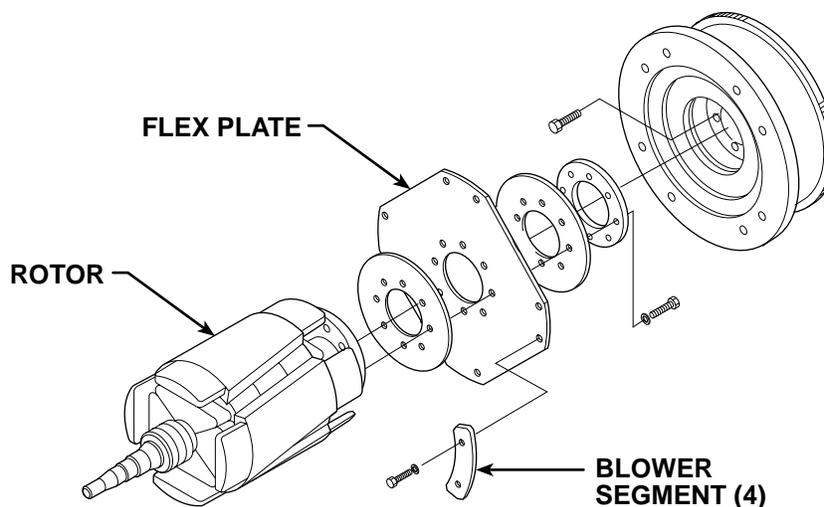
- Using the 1/2" wrench, remove the four fan blade mounting bolts and lock washers.
- Using the 1 1/8" wrench, remove the fan nut. Remove the fan, noting its direction for reassembly.
- Using the gear puller, remove the fan hub.
- Using the 3/8" wrench, remove the two bolts and flat washers holding the bearing in place.
- Using two 3/4" wrenches, remove the nut, lock washer, and carriage bolt holding the alternator mounting foot to the machine base. Do this on each side.
- Using the 3/8" wrench, remove the three bolts from the flywheel splash plate. Remove the plate.
- Support the stator with the hoist. Place wooden blocks under the engine to support it when the stator is removed.
- Using the 17mm" wrench, remove the bolts and lock washers holding the stator to the engine.
- Remove the stator from the engine. It may be necessary to pry and slide it free.

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STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)

FIGURE F.40 – ROTOR REMOVAL



ROTOR REMOVAL PROCEDURE

Refer to Figure F.40 for rotor removal.

1. Support the rotor with the hoist.
2. Using the 5/8" wrench, remove the flex plate bolts, lock washers, and four blower segments.

⚠ WARNING

The rotor will be free to fall when the bolts are removed.

3. Using the hoist, carefully remove the rotor and flex plate assembly.

REASSEMBLY NOTES

Reassemble the rotor and stator to the Commander 500 by carefully retracing the disassembly procedure steps in reverse order. Keep the following special points in mind as you proceed. Lead Reconnection Checklists are provided here as an aid to reassembly.

INSTALL ROTOR: Support the rotor with the hoist. Install the blower segments and flex plate to the engine flywheel.

INSTALL STATOR: Be sure the engine is blocked securely and the stator is supported with the hoist. Install the stator to the engine with the bolts and lock washers. Install the fan blade, making sure that it faces the proper direction, with the fan nut and four cap screws.

Check the air gap for .010" minimum.

Install the brush holder assembly. Be sure the brushes are centered and properly seated on the slip rings.

Install the flywheel splash plate.

COMMANDER 500



STATOR/ROTOR REMOVAL AND REPLACEMENT (CONTINUED)**LEAD RECONNECTION CHECKLIST****ENGINE**

- Leads #242D and #229 to fuel level sensor
- Plug J52
- Brush leads #201(-) and #200A(+) and #200B(+)
- Leads #5P, #201 and #201A, #200D, and #6F to the field bridge rectifier

OUTPUT PANEL AND CONTROL BOX

- Leads #265 and #227 to Pull Coil PC board
- Leads #232L and #232M to 12 VDC insulated stud
- Leads #200C, #200E(+), and #200B(-) to the field capacitor

COMMANDER 500



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TROUBLESHOOTING & REPAIR

RETEST AFTER REPAIR

Retest a machine:

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

ENGINE RPM

Mode	No Load RPM	Load RPM
Low Idle	1400 - 1450	NA
High Idle	1890 - 1910	1750 - 1890

WELDER DC (STICK) OUTPUT

Mode Selector Switch	Fine Control	Open Circuit Voltage	Load Volts	Load Amps
30-575 Setting	Maximum	75 - 80	39.5 - 42.0	575 - 585

PIPE MODES SHORT CIRCUIT CURRENT (FINE CONTROL AT MAXIMUM)

Selector Position	Short Circuit Current (Amps)
90	127 - 140
150	215 - 230
200	310 - 330
350	545 - 575
500	640 - 660

WELDER CV (WIRE) OUTPUT

Mode Selector Switch	Fine Control	Open Circuit Voltage	Load Volts	Load Amps
CV - Wire	Maximum	75 - 78	39 - 42	520 - 535
CV - Wire	Maximum	NA	48 - 49	20
CV - Wire	Minimum	23 - 25	13 - 14	20

COMMANDER 500



TROUBLESHOOTING & REPAIR

RETEST AFTER REPAIR (CONTINUED)

TOUCH START TIG MODE OUTPUT

Mode Selector Switch	Fine Control	Open Circuit Voltage	Short Circuit Current
TIG 20 - 250 A	Maximum	14.0 - 15.8	25 - 27
TIG 20 - 250 A	Minimum	12.0 - 13.8	21 - 24

AUXILIARY POWER OUTPUT

230 Volt Receptacle			115 Volt Receptacles		
Open Circuit Voltage	Load Volts	Load Amps	Open Circuit Voltage	Load Volts	Load Amps
245 - 254	225 - 240	50	118 - 132	112 - 128	15

COMMANDER 500



Return to Section TOC
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Return to Master TOC

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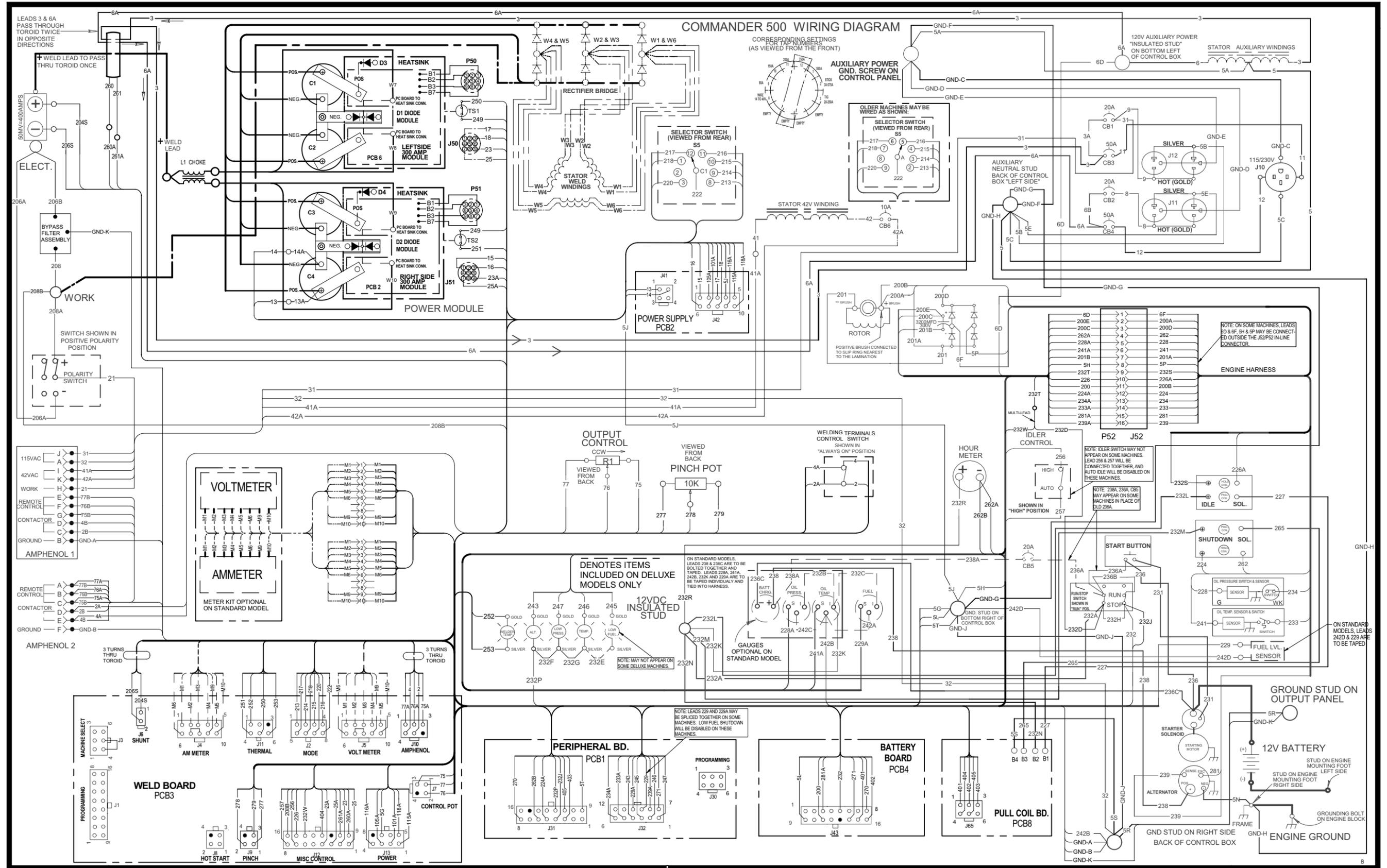
Return to Master TOC

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COMMANDER 500

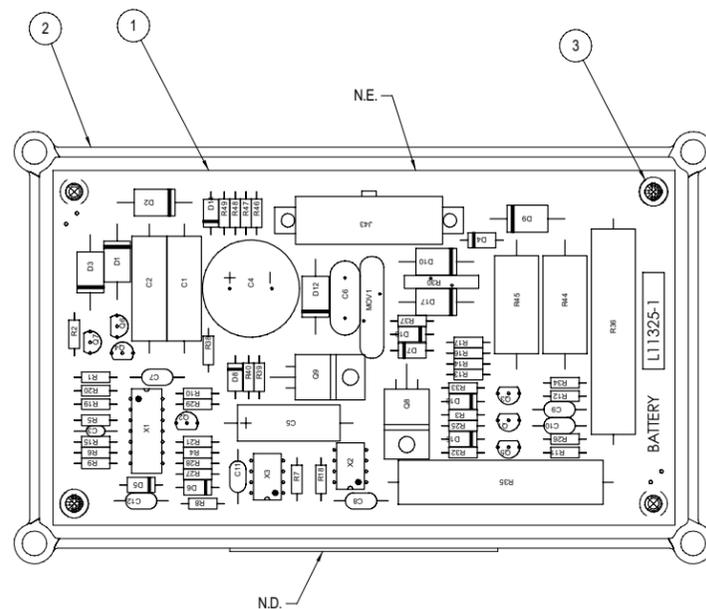


WIRING DIAGRAM - COMMANDER 500



PC BOARD ASSEMBLY - BATTERY PC BOARD

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ITEM	PART NO.	QTY	PC BOARD REFERENCE DESIGNATORS	DESCRIPTION
1	L11325-C	1		BATTERY PC BOARD BLANK
2	M19436-3	1		POTTING TRAY
3	S8025-80	2		SELF TAPPING SCREW
4	E2527	112 g		EPOXY ENCAPSULATION RESIN
5	E3539	AS REQ'D		ELECTRICAL INSULATING COMPOUND

FOR ITEMS LISTED BELOW REFER TO ELECTRONIC COMPONENT DATABASE FOR COMPONENT SPECIFICATIONS

ITEM	PART NO.	QTY	PC BOARD REFERENCE DESIGNATORS	DESCRIPTION
6	T11577-26	2	C1, C2	CAPACITOR; PEF; 0.1/100V; 10%
7	S16668-8	1	C3	CAPACITOR; CEMO; 330pf / 100V; 5%
8	S13490-121	1	C4	CAPACITOR; ALEL; 1000/35V +30% / -20%
9	S13490-15	1	C5	CAPACITOR; ALEL; 100/16V +75% / -10%
10	T11577-58	1	C6	CAPACITOR; CD; 0.0047/3000V; 20%
11	S16668-11	6	C7 THRU C12	CAPACITOR; CEMO; 1 / 50V; 10%
12	T12705-37	3	D1, D2, D3	DIODE; AXLDS; 3A; 40V; SCHOTTKY
13	T12199-1	9	D4, D5, D6, D7, D8, D13, D14, D15, D16	DIODE; AXLDS; 1A; 400V; 1N4004
14	T12705-29	4	D9, D10, D12, D17	DIODE; AXLDS; 3A; 600V; 1N5406
15	S24020-16	1	J43	CONNECTOR; MOLEX; MINI; PCB; 16 PIN; TIN
16	T13640-26	1	MOV1	MOV; 14VRMS; 100J; 20MM
17	T12704-68	6	Q1 THRU Q6	TRANSISTOR; NPN; TO226; 0.5A; 40V; 2N4401
18	T12704-69	1	Q7	TRANSISTOR; PNP; TO226; 0.5A; 40V; 2N4403
19	T12704-49	1	Q8	TRANSISTOR; P; T220; 8A; 150V; MJE15031
20	T12704-41	1	Q9	TRANSISTOR; N; T220; 8A; 150V; MJE15030
21	S19400-4750	1	R1	RESISTOR; MF; 1/4W; 475 OHM; 1%
22	S19400-1001	2	R2, R4	RESISTOR; MF; 1/4W; 1K OHM; 1%
23	S19400-2211	2	R3, R25	RESISTOR; MF; 1/4W; 2.21K OHM; 1%
24	S19400-4751	1	R6	RESISTOR; MF; 1/4W; 4.75K OHM; 1%
25	S19400-1002	4	R7, R8, R9, R10	RESISTOR; MF; 1/4W; 10K OHM; 1%
26	S19400-1211	6	R11, R12, R13, R14 & R16, R17	RESISTOR; MF; 1/4W; 1.21K OHM; 1%
27	S19400-6812	1	R15	RESISTOR; MF; 1/4W; 68.1K OHM; 1%
28	S19400-3321	2	R18, R19	RESISTOR; MF; 1/4W; 3.32K OHM; 1%
29	S19400-8251	2	R20, R21	RESISTOR; MF; 1/4W; 8.25K OHM; 1%
30	S19400-9091	1	R26	RESISTOR; MF; 1/4W; 9.09K OHM; 1%
31	S19400-3322	2	R5, R27	RESISTOR; MF; 1/4W; 33.2K OHM; 1%
32	S19400-5110	1	R28	RESISTOR; MF; 1/4W; 511 OHM; 1%
33	S19400-1003	1	R29	RESISTOR; MF; 1/4W; 100K OHM; 1%
34	S18380-3	1	R30	THERMISTOR; PTC; .08-0.19 OHMS; 1.85A
35	S19400-3921	3	R32, R33, R34	RESISTOR; MF; 1/4W; 3.92K OHM; 1%
36	T14649-1	2	R35, R36	RESISTOR; WW; 10W; 4.7 OHM; 5% SQ.
37	S19400-47R5	1	R37	RESISTOR; MF; 1/4W; 47.5 OHM; 1%
38	S19400-24R9	1	R38	RESISTOR; MF; 1/4W; 24.9 OHM; 1%
39	S19400-1000	6	R39, R40, & R46, R47, R48, R49	RESISTOR; MF; 1/4W; 100 OHM; 1%
40	T14648-22	2	R44, R45	RESISTOR; WW; 5W; 50 OHM; 5% SQ.
41	S15128-11	1	X1	IC; COMPARATOR; QUAD; 2901N

UNLESS OTHERWISE SPECIFIED:
CAPACITORS = MFD/VOLTS
RESISTORS = 1/4W/OHMS
INDUCTANCE = HENRYS
SCHEMATIC REFERENCE - L11309

BUY PER E3867
TEST PER E3868-1



IDENTIFICATION CODE

NOTES:

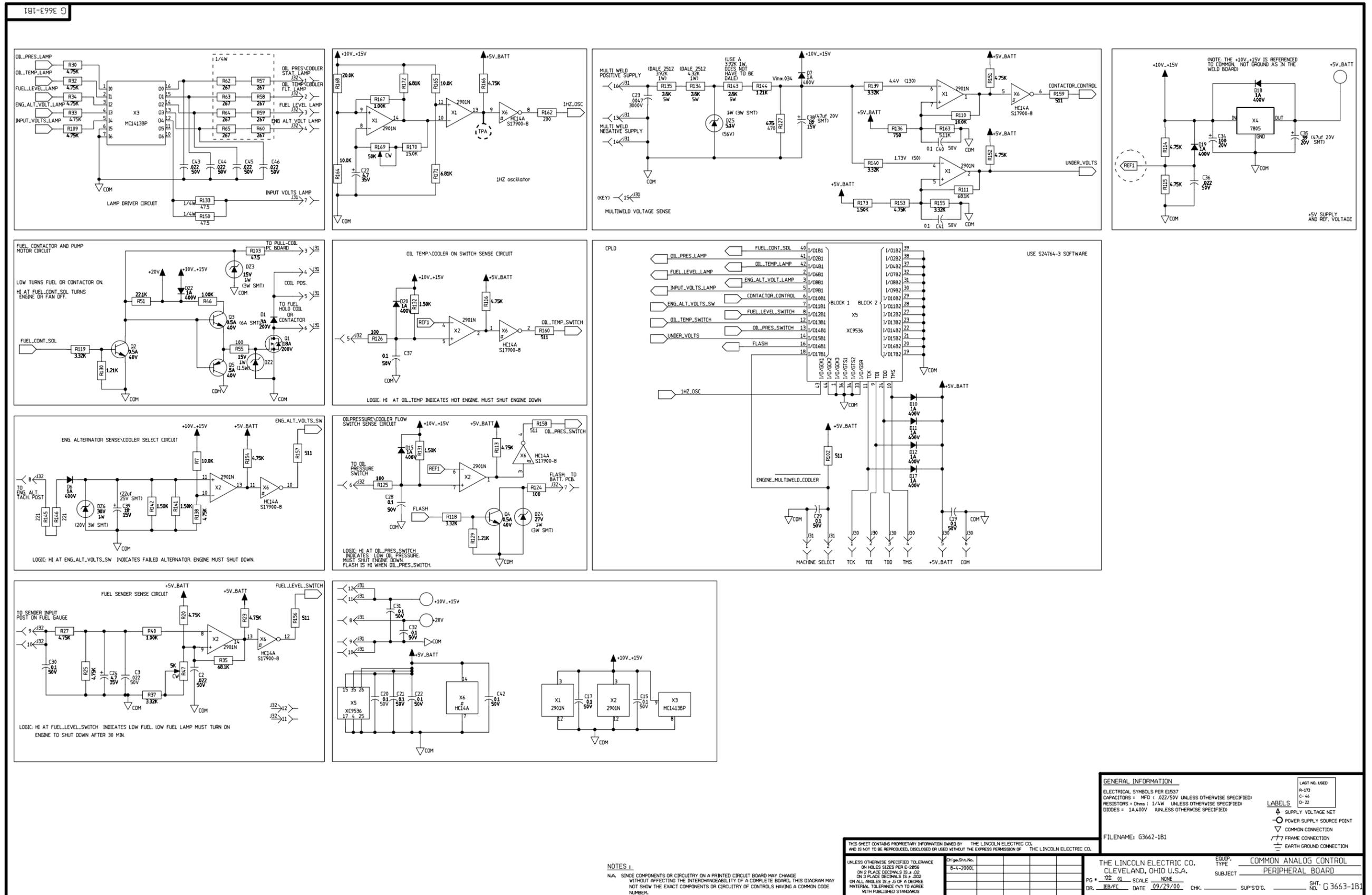
- N.A. **CAUTION:** THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. LINCOLN ELECTRIC TO SEE E2454 BEFORE HANDLING.
- N.C. SECURE PC BOARD ASSEMBLY IN PLACE WITH ITEM (3). (2 PLACES)
- N.D. IDENTIFY COMPLETE ASSEMBLY WITH A PRINTED LABEL OR OTHER PERMANENT MARKING IN AREA SHOWN.
- N.E. NO COMPONENTS ON BOTTOM SIDE OF PC BOARD.

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UNLESS OTHERWISE SPECIFIED TOLERANCE: MANUFACTURING TOLERANCE PER E2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE (1") TO AGREE WITH PUBLISHED STANDARDS DO NOT SCALE THIS DRAWING	Orig. Sheet No. 3-31-2000	'X' INFO. 5000736 XF-UF	DESIGN INFORMATION DRAWN BY: MAP ENGINEER APPROVED:
EQUIPMENT TYPE: MISC.		SUBJECT: BATTERY PC BD. ASSEMBLY	
SCALE: 1:1		DATE: 5-26-99 DRAWING No.: L 11325-1	

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



SCHEMATIC - PERIPHERAL PC BOARD



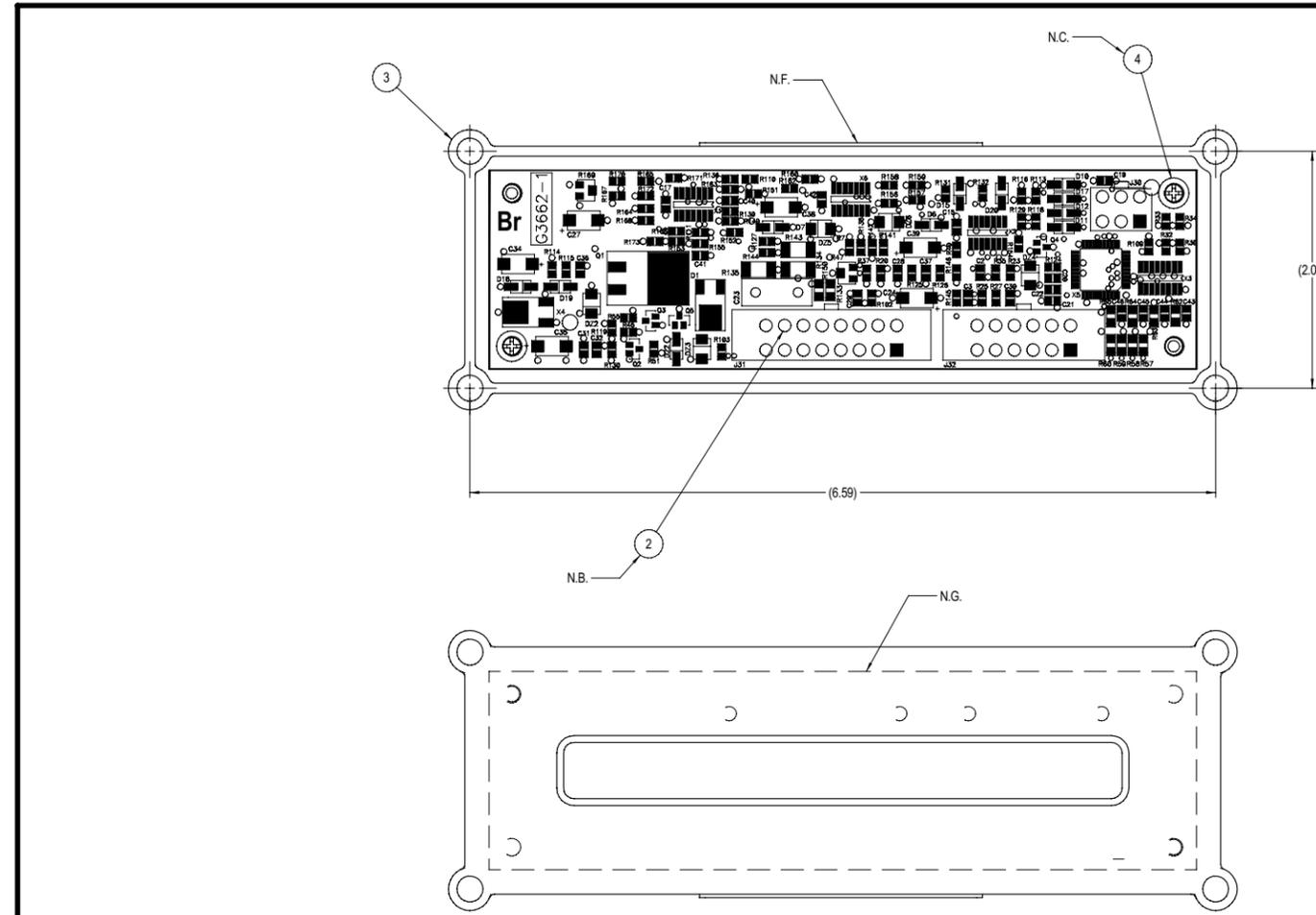
NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.



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PC BOARD ASSEMBLY - PERIPHERAL PC BOARD

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V

ITEM	PART NO.	QTY	PC BOARD REFERENCE DESIGNATORS	DESCRIPTION
1	G3662-B	1		PCB BLANK
2	S24671	1		PLUG KEYING PLUG
3	M19436-4	1		POTTING TRAY
4	S8025-80	2		SELF TAPPING SCREW
5	E2527	65g		EPOXY ENCAPSULATING RESIN
6	E3539	AS REQ.		ELECTRICAL INSULATING COMPOUND
7	S24764-3	1	X5	SOFTWARE
FOR ITEMS LISTED BELOW REFER TO ELECTRONIC COMPONENT DATABASE FOR COMPONENT SPECIFICATIONS				
8	S25020-3SMT	15	C15,C17,C19,C20,C21,C22,C28,C29,C30,C31,C32,C37,C40,C41,C42	SCAP.0.1uF,0805,50V,X7R,10%,TR,NP
9	S25020-2SMT	7	C2,C3,C36,C43,C44,C45,C46	SCAP.0.022uF,CER,0805,50V,X7R,10%,TR
10	T11577-58	1	C23	CAP.0.0047,3000V,20%,CERAMIC DISC
11	S25024-5SMT	2	C24,C27	SCAP.4.7uF,TANT,7343,35V,10%,TR,NP
12	S25024-9SMT	1	C34	SCAP.100uF,TANT,7343,20V,20%,TR,NP
13	S25024-7SMT	2	C35,C38	SCAP.47uF,TAN,7343,20V,10%
14	S25024-6SMT	1	C39	SCAP.22uF,TAN,7343,25V,10%,POLAR,TR
15	S25040-3SMT	1	D1	SDIO,MURD620CT,6A,200V,ULTRA-FAST,TR,NP
16	S25040-2SMT	11	D6,D7,D10,D11,D12,D15,D17,D18,D19,D20,D22	SDIO,1A,400V,DO-214BA,GLS,NP
17	S25044-4SMT	2	D22,D23	SDIO,1SMB5929B73,3W,15V,5%
18	S25044-6SMT	1	D24	SDIO,1SMB5935B73,3W,27V,5%,TR,NP
19	S25044-7SMT	1	D25	SDIO,1SMB5943B73,3W,56V,5%
20	S25044-8SMT	1	D26	SDIO,1SMB5932B73,3W,20V,5%
21	S18248-6	1	J30	CON.MOLEX,39-28-1063,PCB,6 PIN,TIN
22	S24020-16	1	J31	CON.MOLEX,15-97-7162,MINI,PCB,16 PIN,TIN
23	S24020-12	1	J32	CON.MOLEX,15-97-7122,MINI,PCB,12 PIN,TIN
24	S25051-2SMT	1	Q1	STRA,IRF640S,200V,D2 PAK
25	S25050-1SMT	3	Q2,Q3,Q4	STRA,2N4401,SOT-23,NPN,TR
26	S25050-2SMT	1	Q5	STRA,2N4403L,PNP,SOT-23,NP
27	S25000-5110SMT	6	R102,R156,R157,R158,R159,R160	SRES,511,TKF,0805,1%,1/10W,TR
28	S25000-47R5SMT	1	R103	SRES,47.5,0805,1%,1/10W
29	S25000-4750SMT	1	R127	SRES,475,TKF,0805,1%,1/10W,TR
30	S25000-1211SMT	3	R129,R130,R144	SRES,1.21K,0805,1%,1/10W,TR,NP
31	S25000-1501SMT	5	R131,R132,R141,R142,R173	SRES,1.5K,TKF,0805,1%,1/10W,TR
32	S25001-47R5SMT	2	R133,R150	SRES,47.5,TKF,1206,1%,1/4W
33	S25010-4SMT	1	R134	SRES,4.32K,2512,1%,1W
34	S25010-5SMT	2	R135,R143	SRES,3.32K,2512,1%,1W
35	S25000-7500SMT	1	R136	SRES,750,TKF,0805,1%,1/10W
36	S25000-2210SMT	2	R145,R146	SRES,221,TKF,0805,1%,1/10W,TR
37	S25000-2000SMT	1	R162	SRES,200,TKF,0805,1%,1/10W
38	S25000-5111SMT	1	R163	SRES,5.11K,TKF,0805,1%,1/10W
39	S25000-2002SMT	1	R168	SRES,20K,TKF,0805,1%,1/10W
40	S25056-3SMT	1	R169	SRES,50K,5 TURN POT,1/4W,10%
41	S25000-1502SMT	1	R170	SRES,15K,TKF,0805,1%,1/10W
42	S25000-6811SMT	2	R171,R172	SRES,6.81K,TKF,0805,1%,1/10W
43	S25000-4751SMT	20	R20,R21,R23,R25,R27,R30,R32,R33,R34,R109,R113,R114,R115,R116,R138,R151,R152,R153,R154,R166	SRES,4.75K,0805,1%,TR,NP
44	S25000-6812SMT	2	R35,R111	SRES,68.1K,0805,1%,1/10W,NP
45	S25000-3321SMT	6	R37,R118,R119,R139,R140,R155	SRES,3.32K,0805,1%,1/10W,NP(B80Q42M71)
46	S25000-1001SMT	3	R40,R46,R167	SRES,1K,0805,1%,1/10W,TR,NP
47	S25056-4SMT	1	R47	SRES,5K,5 TURN POT,1/4W,10%
48	S25000-2212SMT	1	R51	SRES,22.1K,TKF,0805,1%,1/10W
49	S25000-1000SMT	4	R55,R124,R125,R126	SRES,100,TKF,0805,1%,1/10W
50	S25001-2670SMT	8	R57,R58,R59,R60,R62,R63,R64,R65	SRES,267,1206,1%,1/4W,TR,NP
51	S25000-1002SMT	4	R7,R110,R164,R165	SRES,10K,0805,1%,1/10W,TR,NP
52	S15128-11SMT	2	X1,X2	SICS,290T,NP
53	M15102-4SMT	1	X3	SICS,MC1413BD,ARRAY DRIVER,SO16
54	S25068-1SMT	1	X4	SICS,5V,REG,0.5A,2%,DPAK
55	S25070-3SMT	1	X5	SICS,XC9536,44-PIN,VO44
56	S17900-8SMT	1	X6	SICS,74HC14A

- NOTES:**
- N.A. **CAUTION:** THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. LINCOLN ELECTRIC TO SEE E2454 BEFORE HANDLING.
 - N.B. PLACE CONNECTOR KEYING PLUG, OVER HEADER PIN, IN LOCATION SHOWN. PLUG SHOULD BE INSERTED BELOW CONNECTOR TOP SURFACE.
 - N.C. SECURE PC BOARD ASSEMBLY IN PLACE WITH ITEM (4). (2 PLACES)
 - N.F. IDENTIFY COMPLETE ASSEMBLY WITH A PRINTED LABEL OR OTHER PERMANENT MARKING IN AREA SHOWN.
 - N.G. NO COMPONENTS ON BOTTOM SIDE OF PC BOARD.
 - N.H. PROGRAM ITEM 55 WITH ITEM 7.

BUY AS
G3662-1B1
 PART NO. IDENTIFICATION CODE

UNLESS OTHERWISE SPECIFIED:
 RESISTANCE = OHMS
 SCHEMATIC REFERENCE - G3663

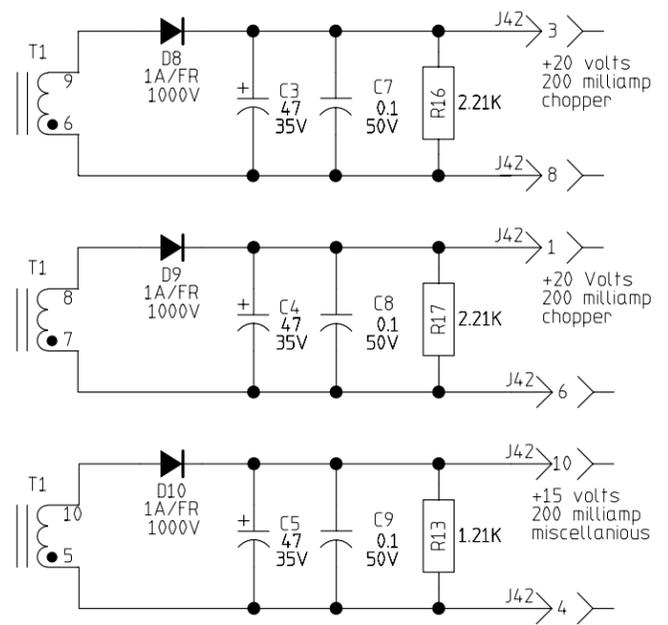
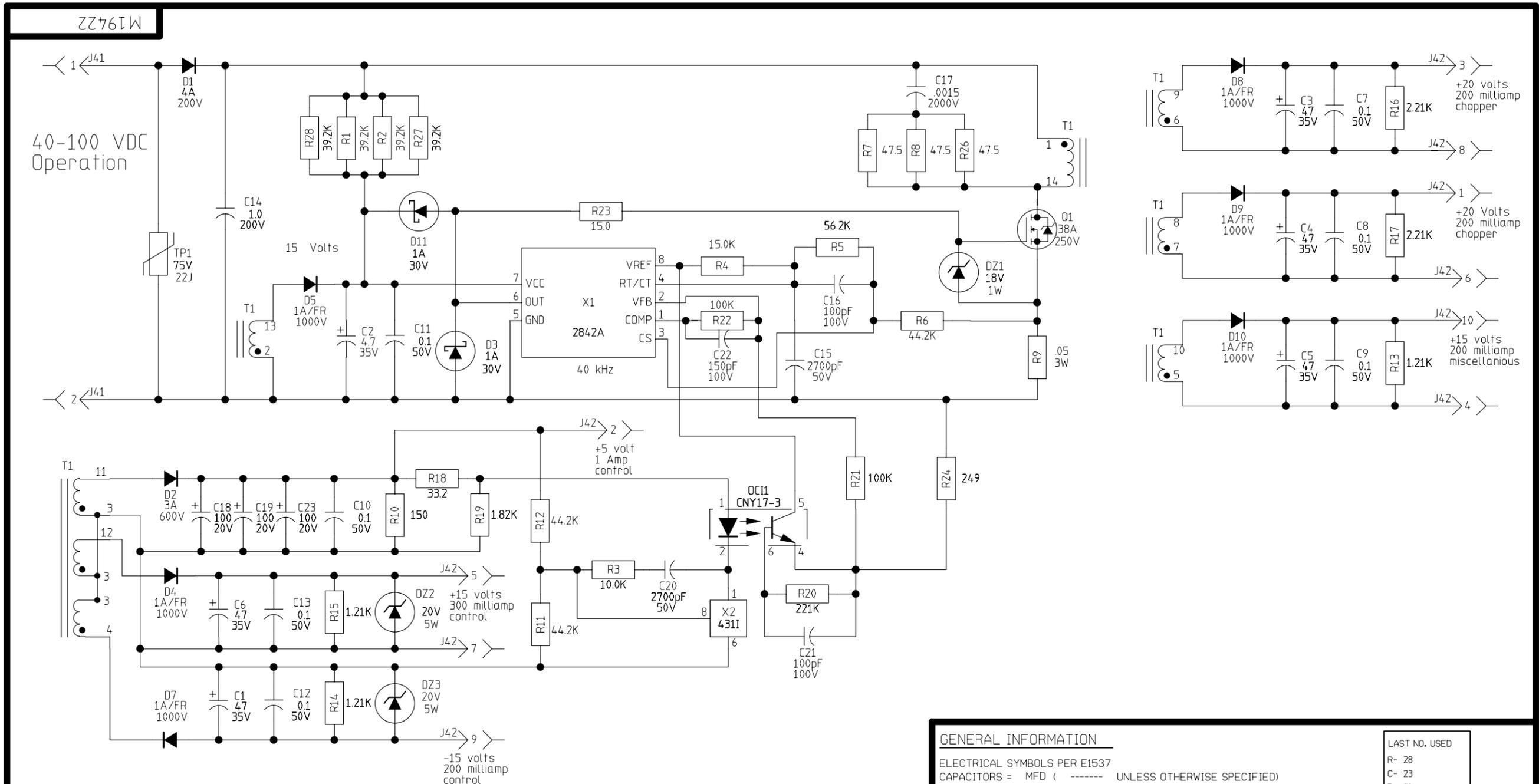
BUY PER E3867
 TEST PER E3869-P

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UNLESS OTHERWISE SPECIFIED, TOLERANCES: DIMENSIONS: FRACTIONS PER E2300 ON PLACE DECIMALS IS ± .005 ON PLACE DECIMALS IS ± .010 ON ALL ANGLES IS ± 5 DEGREE MATERIAL TOLERANCE IS TO AGREE WITH PUBLISHED STANDARDS DO NOT SCALE THIS DRAWING	Doc. Sheet No. 9-117-99A	PC INFO DRAWN BY: J.D. ENGINEER: JPM APPROVED:	DESIGN INFORMATION REFERENCE EQUIPMENT TYPE: COMMON ANALOG CONTROL SUBJECT: PERIPHERAL CONTROL PCB ASSEMBLY SCALE: 1:5X DATE: 2/10/99 DRAWING No.: G 3662-1

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



SCHEMATIC - POWER SUPPLY (ANALOG) PC BOARD



40-100 VDC Operation

NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
 CAPACITORS = MFD (----- UNLESS OTHERWISE SPECIFIED)
 RESISTORS = Ohms (----- UNLESS OTHERWISE SPECIFIED)
 DIODES = ----- (UNLESS OTHERWISE SPECIFIED)

LABELS

- ▲ SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- ▽ COMMON CONNECTION
- ▮ FRAME CONNECTION
- ⊥ EARTH GROUND CONNECTION

LAST NO. USED
R- 28
C- 23
D- 11

FILENAME: M19422_1BA

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UNLESS OTHERWISE SPECIFIED TOLERANCE
 ON HOLES SIZES PER E-2056
 ON 2 PLACE DECIMALS IS ± .02
 ON 3 PLACE DECIMALS IS ± .002
 ON ALL ANGLES IS ± .5 OF A DEGREE
 MATERIAL TOLERANCE (*) TO AGREE
 WITH PUBLISHED STANDARDS

Ch'ge.Sht.No.				
XC-UF				
9-17-99				

THE LINCOLN ELECTRIC CO.
 CLEVELAND, OHIO U.S.A.
 PG # 01 SCALE NONE
 DR. TK DATE 09/02/99 CHK. SUP'S'D'G. SHT. NO. M 19422

EQUIP. TYPE Multi-System
 SUBJECT Analog Control Power Supply

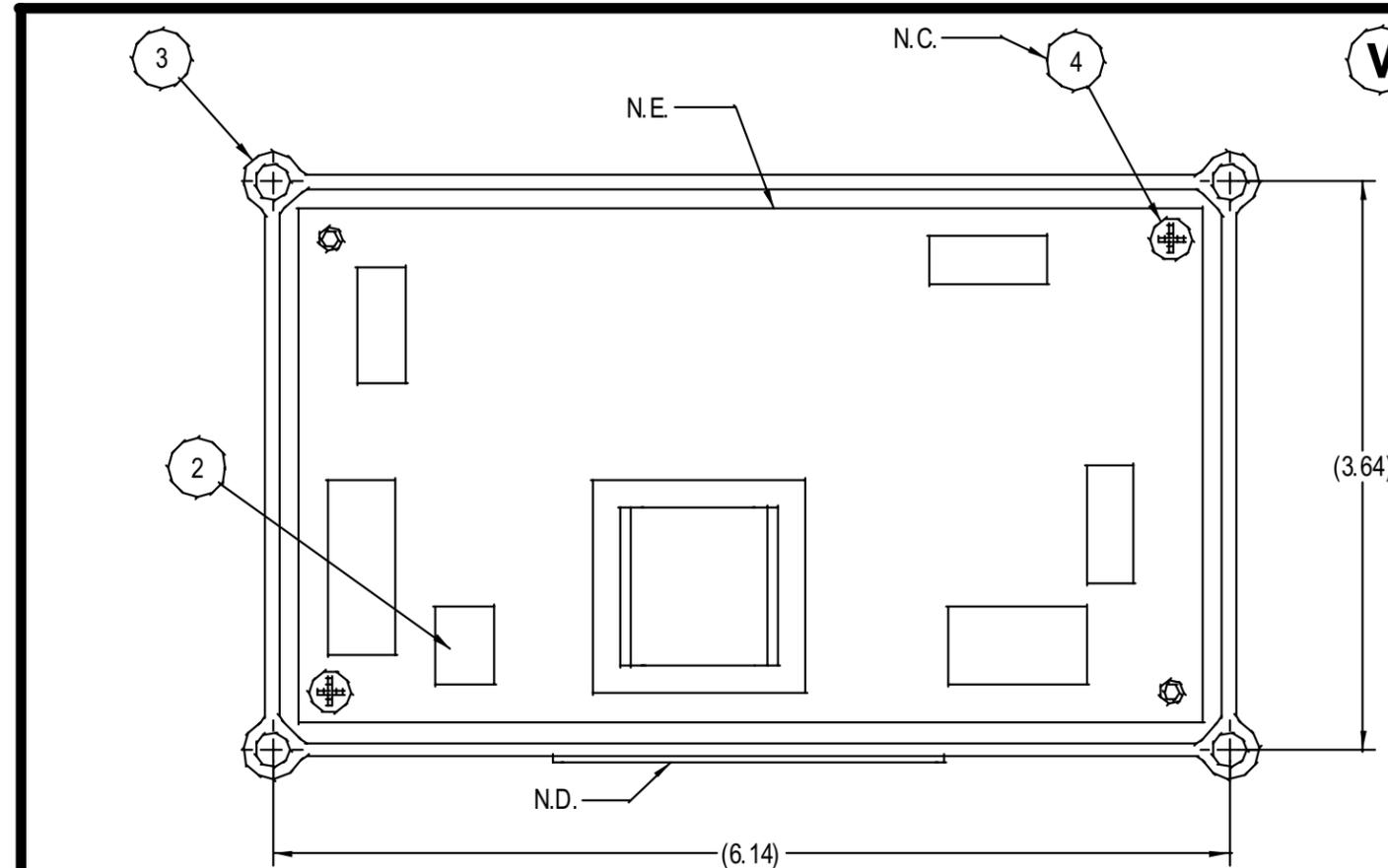
NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.



Return to Section TOC

Return to Master TOC

PC BOARD ASSEMBLY - POWER SUPPLY (ANALOG) PC BOARD



NOTES:

- N.A. **CAUTION:** THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. LINCOLN ELECTRIC TO SEE E2454 BEFORE HANDLING.
- N.B. PLACE CONNECTOR KEYING PLUG, OVER HEADER PIN, IN LOCATION SHOWN. PLUG SHOULD BE INSERTED BELOW CONNECTOR TOP SURFACE.
- N.C. SECURE PC BOARD ASSEMBLY IN PLACE WITH ITEM (4). (2 PLACES)
- N.D. IDENTIFY COMPLETE ASSEMBLY WITH A PRINTED LABEL OR OTHER PERMANENT MARKING IN AREA SHOWN.
- N.E. NO COMPONENTS ON BOTTOM SIDE OF PC BOARD.

UNLESS OTHERWISE SPECIFIED:
 CAPACITORS = MFD/VOLTS
 RESISTORS = 1/4W/OHMS
 INDUCTANCE = HENRYS

BUY AS

M19423-1B0
 PART NO. IDENTIFICATION CODE

BUY PER E3867
TEST PER E3861

SCHEMATIC REFERENCE M19422

ITEM	PART NO.	QTY	PC BOARD REFERENCE DESIGNATORS	DESCRIPTION
1	G3679-B	1		PCB BLANK
2	S24671	1		PLUG,KEYING PLUG
3	M19436-3	1		POTTING TRAY
4	S8025-80	2		SELF TAPPING SCREW
5	E2527	112 g		EPOXY ENCAPSULATING RESIN
6	E3539	AS REQD		ELECTRICAL INSULATING COMPOUND
FOR ITEMS LISTED BELOW REFER TO ELECTRONIC COMPONENT DATABASE FOR COMPONENT SPECIFICATIONS				
7	S13490-66	5	C1,C3,C4,C5,C6	CAPACITOR,TAEL,47,35V 10%
8	S13490-25	1	C2	CAPACITOR,TAEL,4.7,35V 10%
9	S16668-11	7	C7,C8,C9,C10,C11,C12,C13	CAPACITOR,CEMO,0.1, 50V,10%
10	T11577-62	1	C14	CAPACITOR,PEMF,1.0,200V,10%
11	S16668-4	2	C15,C20	CAPACITOR,CEMO,2700PF,50V,5%
12	S16668-3	2	C16,C21	CAPACITOR,CEMO,100PF,100V,5%
13	S20500-5	1	C17	CAPACITOR,PPMF,.0015,2000V
14	S13490-97	3	C18,C19,C23	CAPACITOR,TAEL,100,20V 10%
15	S16668-9	1	C22	CAPACITOR,CEMO,150P,100V,5%
16	T12705-47	1	D1	DIODE,AXLDS,4A,200V,UFR
17	T12705-59	1	D2	DIODE,AXLDS,3A,600V,UFR
18	T12705-23	2	D3,D11	DIODE,AXLDS,1A,30V,SCHOTTKY
19	T12705-44	6	D4,D5,D7,D8,D9,D10	DIODE,AXLDS,1A,1000V,FR
20	T12702-45	1	DZ1	ZENER DIODE,1W,18V,5%
21	T12702-25	2	DZ2,DZ3	ZENER DIODE,5W,20V,5%
22	S24020-4	1	J41	CONNECTOR,MOLEX,MINI,PCB,4-PIN
23	S24020-10	1	J42	CONNECTOR,MOLEX,MINI,PCB,10-PIN
24	S15000-10	1	OCI 1	OPTOCOUPLER,PHOTO-Q,70V
25	T12704-89	1	Q1	TRANSISTOR,NMF,T247,38A,250V(SS)
26	S19400-3922	4	R1,R2,R27,R28	RESISTOR,MF,1/4W,39.2K,1%
27	S19400-1002	1	R3	RESISTOR,MF,1/4W,10.0K,1%
28	S19400-1502	1	R4	RESISTOR,MF,1/4W,15.0K,1%
29	S19400-5622	1	R5	RESISTOR,MF,1/4W,56.2K,1%
30	S19400-4422	3	R6,R11,R12	RESISTOR,MF,1/4W,44.2K,1%
31	S19400-47R5	3	R7,R8,R26	RESISTOR,MF,1/4W,47.5,1%
32	T12300-86	1	R9	RESISTOR,WW,3W,0.05,1%
33	S19400-1500	1	R10	RESISTOR,MF,1/4W,150,1%
34	S19400-1211	3	R13,R14,R15	RESISTOR,MF,1/4W,1.21K,1%
35	S19400-2211	2	R16,R17	RESISTOR,MF,1/4W,2.21K,1%
36	S19400-33R2	1	R18	RESISTOR,MF,1/4W,33.2,1%
37	S19400-1821	1	R19	RESISTOR,MF,1/4W,1.82K,1%
38	S19400-2213	1	R20	RESISTOR,MF,1/4W,221K,1%
39	S19400-1003	2	R21,R22	RESISTOR,MF,1/4W,100K,1%
40	S19400-15R0	1	R23	RESISTOR,MF,1/4W,15.0,1%
41	S19400-2490	1	R24	RESISTOR,MF,1/4W,249,1%
42	S20375-7	1	T1	TRANSFORMER,PCB,PWM,FLYBACK
43	T13640-9	1	TP 1	MOV,75VRMS,22J,14MM
44	M15458-4	1	X1	IC,PWM-CONTROLLER,IMODE,2842A
45	S15128-10	1	X2	VOLTAGE REF,ADJ,PRECISION,431I

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UNLESS OTHERWISE SPECIFIED TOLERANCE MANUFACTURING TOLERANCE PER E2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± 5 OF A DEGREE MATERIAL TOLERANCE ("I") TO AGREE WITH PUBLISHED STANDARDS. DO NOT SCALE THIS DRAWING	Org. Sheet No.	"X" INFO.	DESIGN INFORMATION	REFERENCE	EQUIPMENT TYPE	COMMON ANALOG CONTROL	
	9-17-99	XM5644	DRAWN BY: ILD		SUBJECT:	ANALOG POWER SUPPLY PCB ASSEMBLY	
		XM5627	ENGINEER: TK	SUPERSEDING:	SCALE: 1:1	DATE: 2/23/99	DRAWING No.: M 19423-1
		XC-UF	APPROVED:				

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

Return to Section TOC
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

EN-166

SOLID EDGE

PC BOARD ASSEMBLY - PULL-COIL PC BOARD

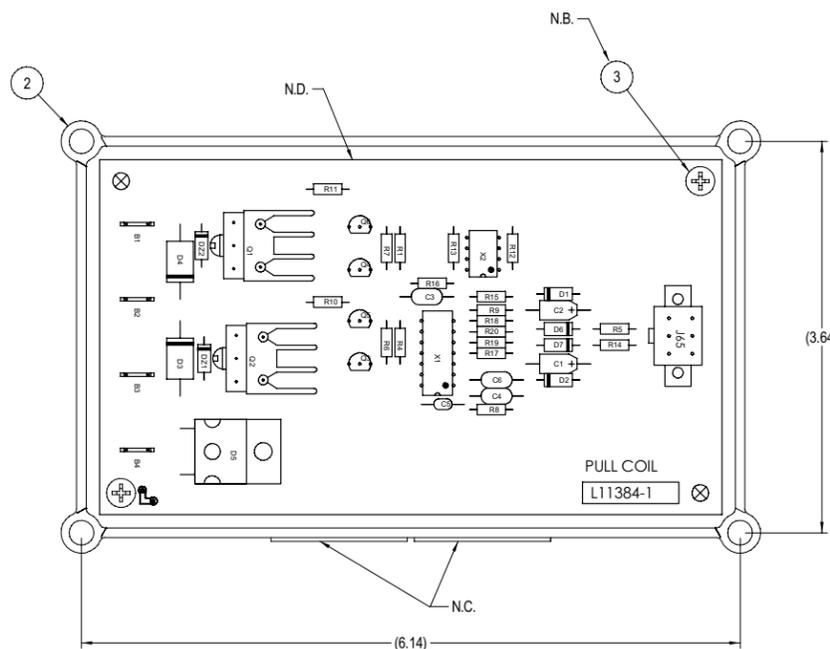
Return to Section TOC
Return to Master TOC

NOTES:

- N.A. **CAUTION:** THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. LINCOLN ELECTRIC TO SEE E2454 BEFORE HANDLING.
- N.B. SECURE P.C. BOARD ASSEMBLY IN PLACE WITH ITEM (4), 2 PLACES.
- N.C. IDENTIFY COMPLETE ASSEMBLY AND SERIAL CODE WITH PRINTED LABELS PER E3876.
- N.D. NO COMPONENTS ON BOTTOM SIDE OF P.C. BOARD.



ITEM	PART NO.	QTY	PC BOARD REFERENCE DESIGNATORS	DESCRIPTION
1	L11384-B	1		PCB BLANK
2	M19436-3	1		POTTING TRAY
3	S8025-80	2		SELF TAPPING SCREW
4	E2527	112 g		EPOXY ENCAPSULATING RESIN
5	E3539	AS REQ'D		ELECTRICAL INSULATING COMPOUND
FOR ITEMS LISTED BELOW REFER TO ELECTRONIC COMPONENT DATABASE FOR COMPONENT SPECIFICATIONS				
6	T13157-14	4	B1,B2,B3,B4	CONNECTOR,TAB,QC,VERTICAL,1/4,REEL
7	S13490-69	2	C1,C2	CAPACITOR,TAEL,3.9,35V,10%
8	S16668-11	3	C3,C4,C6	CAPACITOR,CEMO,0.1,50V,10%
9	S16668-5	1	C5	CAPACITOR,CEMO,.022,50V,20%
10	T12705-34	4	D1,D2,D6,D7	DIODE,AXLDS,1A,400V,FR,1N4936
11	T12705-14	2	D3,D4	DIODE,AXLDS,3A,200V,1N5402
12	T12705-52	1	D5	DIODE,T218,60A,400V,SR
13	T12702-29	2	DZ1,DZ2	ZENER DIODE,1W,15V,5% 1N4744A
14	S24020-6	1	J65	CONNECTOR,MOLEX,MINI,PCB,6-PIN,TIN
N.A. 15	S18395-16	2	Q1,Q2	MOSFET/HEATSINK ASBLY,T12704-82&S1810
16	T12704-68	2	Q3,Q4	TRANSISTOR,NPN,TO226,0.5A,40V,2N4401
17	T12704-69	2	Q5,Q6	TRANSISTOR,PNP,TO226,0.5A,40V,2N4403
18	S19400-2212	4	R1,R4,R17,R18	RESISTOR,MF,1/4W,22.1K,1%
19	S19400-1000	2	R10,R11	RESISTOR,MF,1/4W,100,1%
21	S19400-4751	2	R12,R15	RESISTOR,MF,1/4W,4.75K,1%
22	S19400-1212	1	R16	RESISTOR,MF,1/4W,12.1K,1%
23	S19400-1003	2	R19,R20	RESISTOR,MF,1/4W,100K,1%
24	S19400-1001	5	R5,R6,R7,R13,R14	RESISTOR,MF,1/4W,1.00K,1%
25	S19400-8252	2	R8,R9	RESISTOR,MF,1/4W,82.5K,1%
26	S15128-11	1	X1	IC,COMPARATOR,QUAD,2901N
27	S15128-10	1	X2	VOLTAGE REF,ADJ,PRECISION,431I



UNLESS OTHERWISE SPECIFIED:
CAPACITORS = MFD/VOLTS
RESISTORS = 1/4W/OHMS
INDUCTANCE = HENRYS

BUY AS
L11384-1B0
PART NO. IDENTIFICATION CODE

BUY PER E3867
TEST PER E3883

SCHEMATIC REFERENCE L11383

EXPERIMENTAL DRAWING
NOT TO BE USED FOR PRODUCTION
SEE TITLE BLOCK FOR REVISION LEVEL

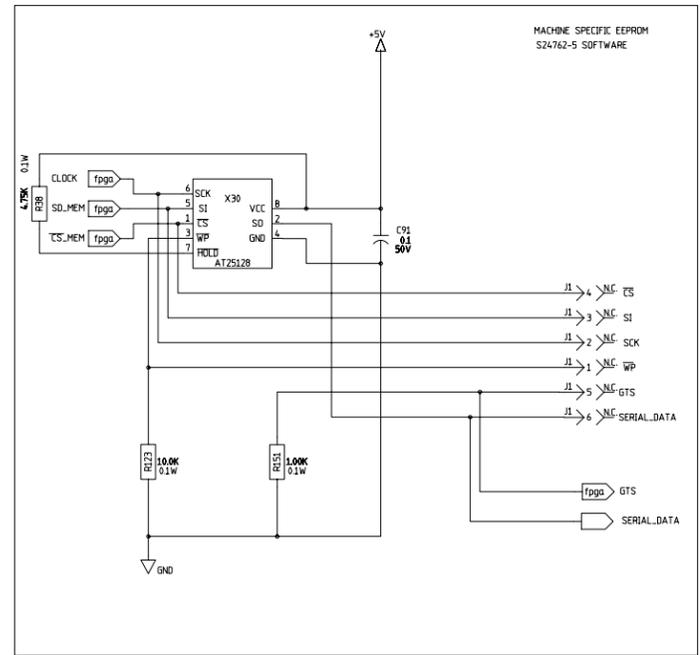
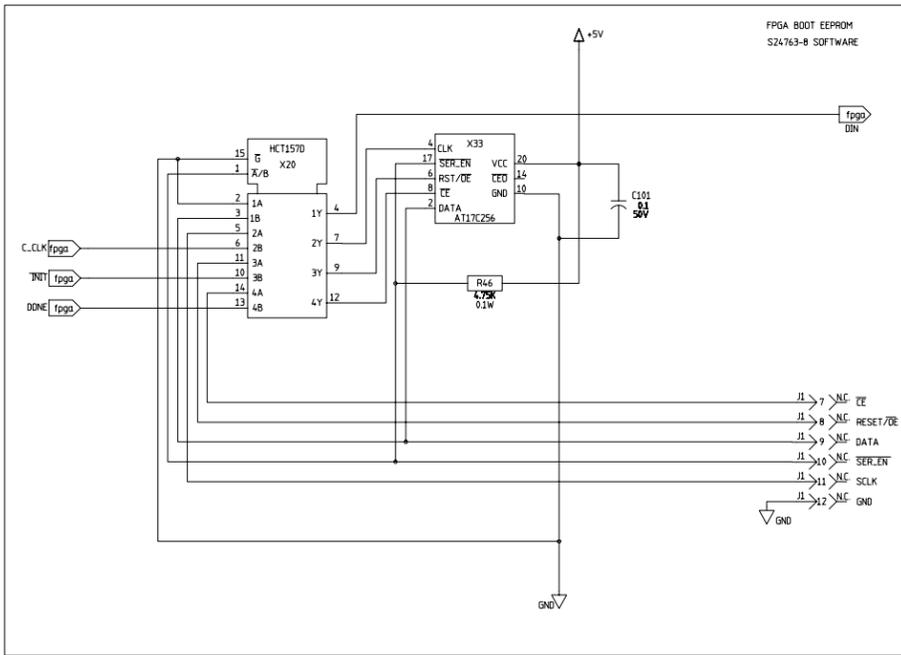
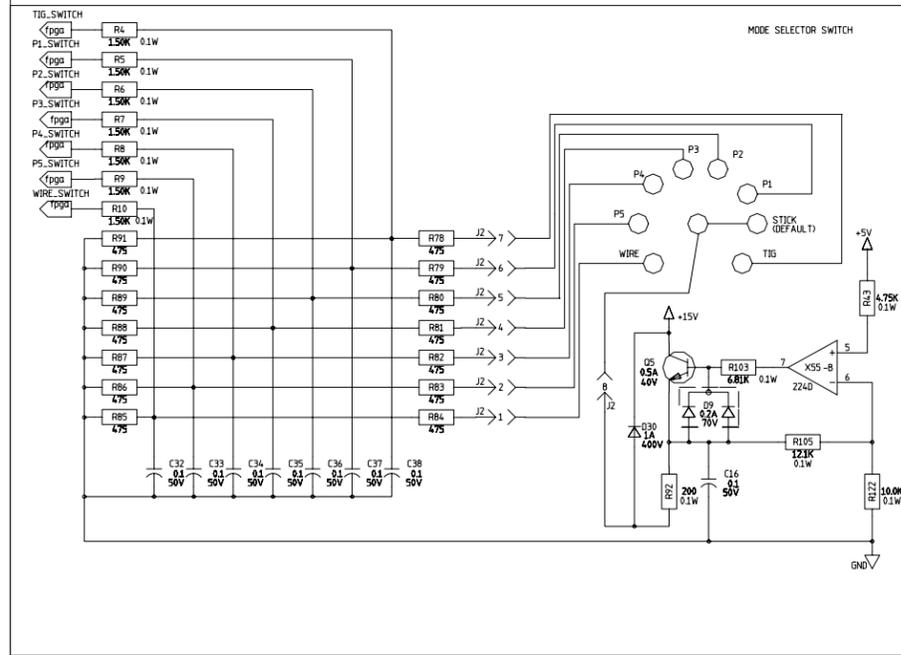
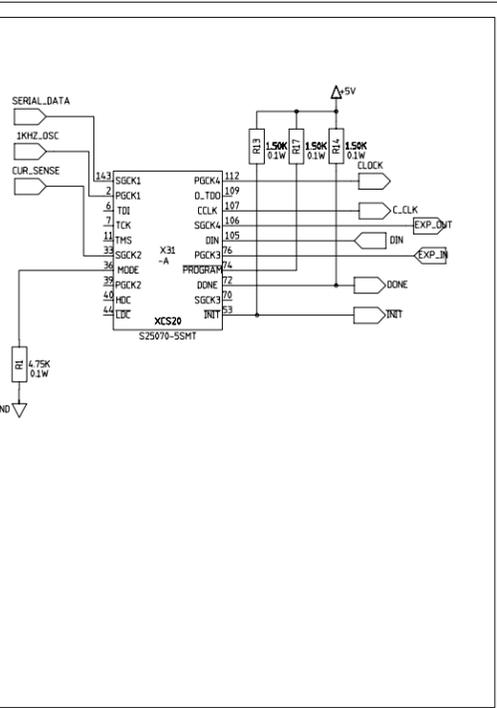
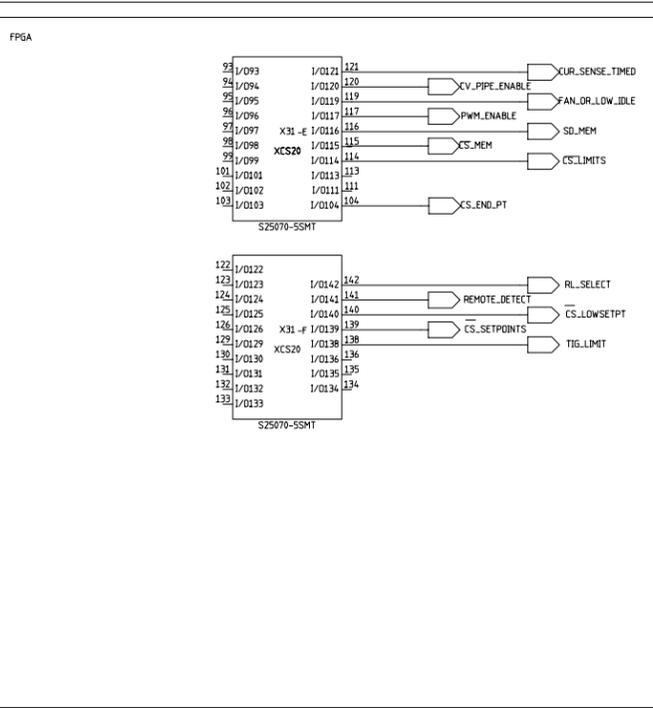
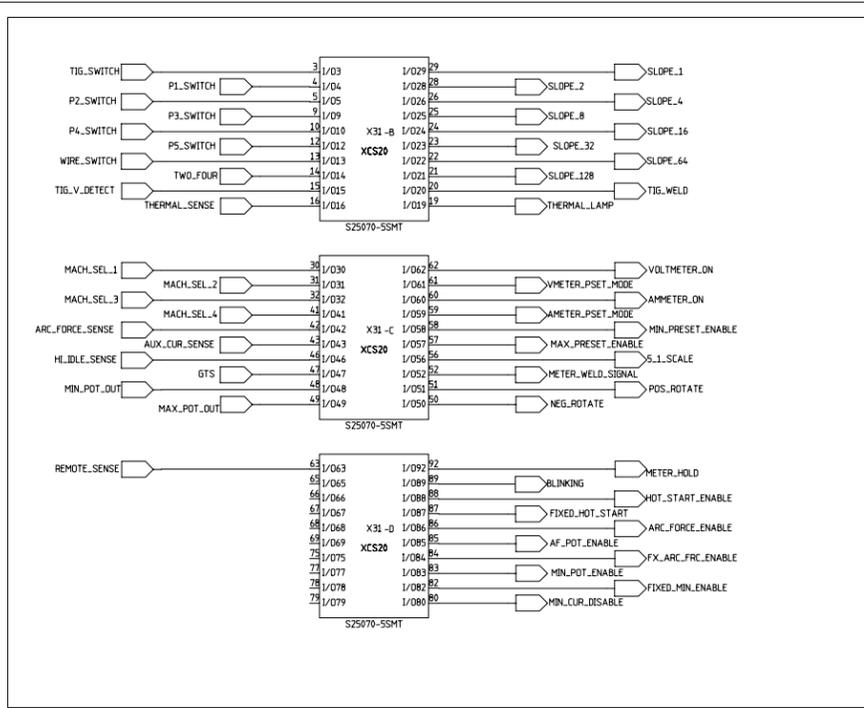
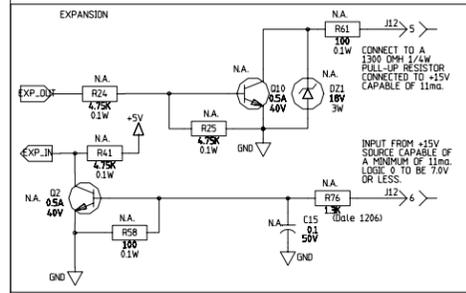
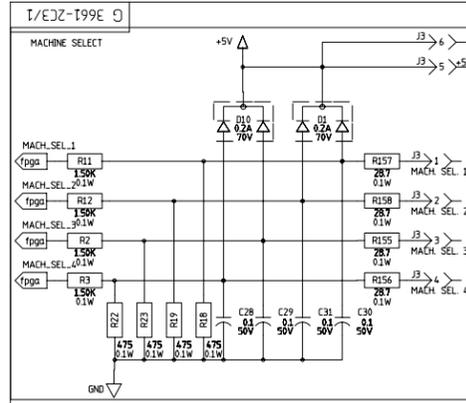
THIS SHEET CONTAINS PROPRIETARY INFORMATION OWNED BY THE LINCOLN ELECTRIC COMPANY AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS WRITTEN PERMISSION OF THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO U.S.A.					
UNLESS OTHERWISE SPECIFIED TOLERANCE: MANUFACTURING TOLERANCE PER E2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("I") TO AGREE WITH PUBLISHED STANDARDS. DO NOT SCALE THIS DRAWING	Chg. Sheet No.	"X" INFO. 5000762 5000751 XC	DESIGN INFORMATION DRAWN BY: MAPI ENGINEER: APPROVED:	REFERENCE M19423-1 SUPERSEDING	EQUIPMENT TYPE: ENGINE WELDERS
				SUBJECT: PULL COIL P.C. BOARD ASSEMBLY	
				SCALE: NONE DATE: 8-26-99 DRAWING No.: L 11384-1	

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. **Individual Printed Circuit Board Components are not available from Lincoln Electric.** This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



SCHEMATIC - WELD CONTROL PC BOARD - SHEET 1

Return to Section TOC
Return to Master TOC

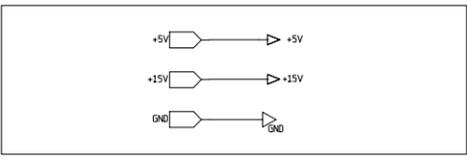


NOTES:

- COMPONENTS NOT INSERTED ON G3900-2C4 VERSIONS.
- COMPONENTS NOT INSERTED ON G3660-2 VERSIONS, AND INSERTED ON G3900-2C4 VERSIONS.
- ADDITIONAL COMPONENTS NOT INSERTED ON G3900-2C4 VERSIONS.

NOTES:

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.



PAGE 1 OF 5

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1937

CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)

RESISTORS = OHMS (.0805 UNLESS OTHERWISE SPECIFIED)

DIODES = 2A, 200V (UNLESS OTHERWISE SPECIFIED)

FILENAME: 5000749; G3660-2; G3900-2C

THIS SCHEMATIC USED IN G3660-2C AND G3900-2C BOARDS--
DESIGNED BY: B.F. SS, AMF

THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.

EQUIP. TYPE: ANALOG WELD CONTROL PCB

SUBJECT: FPGA, MEMORY & INTERFACE

PG: 01 SCALE: NONE

DR: FC DATE: 10/12/2000 CHK: AM SUP'S'DG: SHT. NO: G3661-2C4/1

LAST NO. USED: POTS - 390, 541, 617 & 766

R-393
C-142
D-64

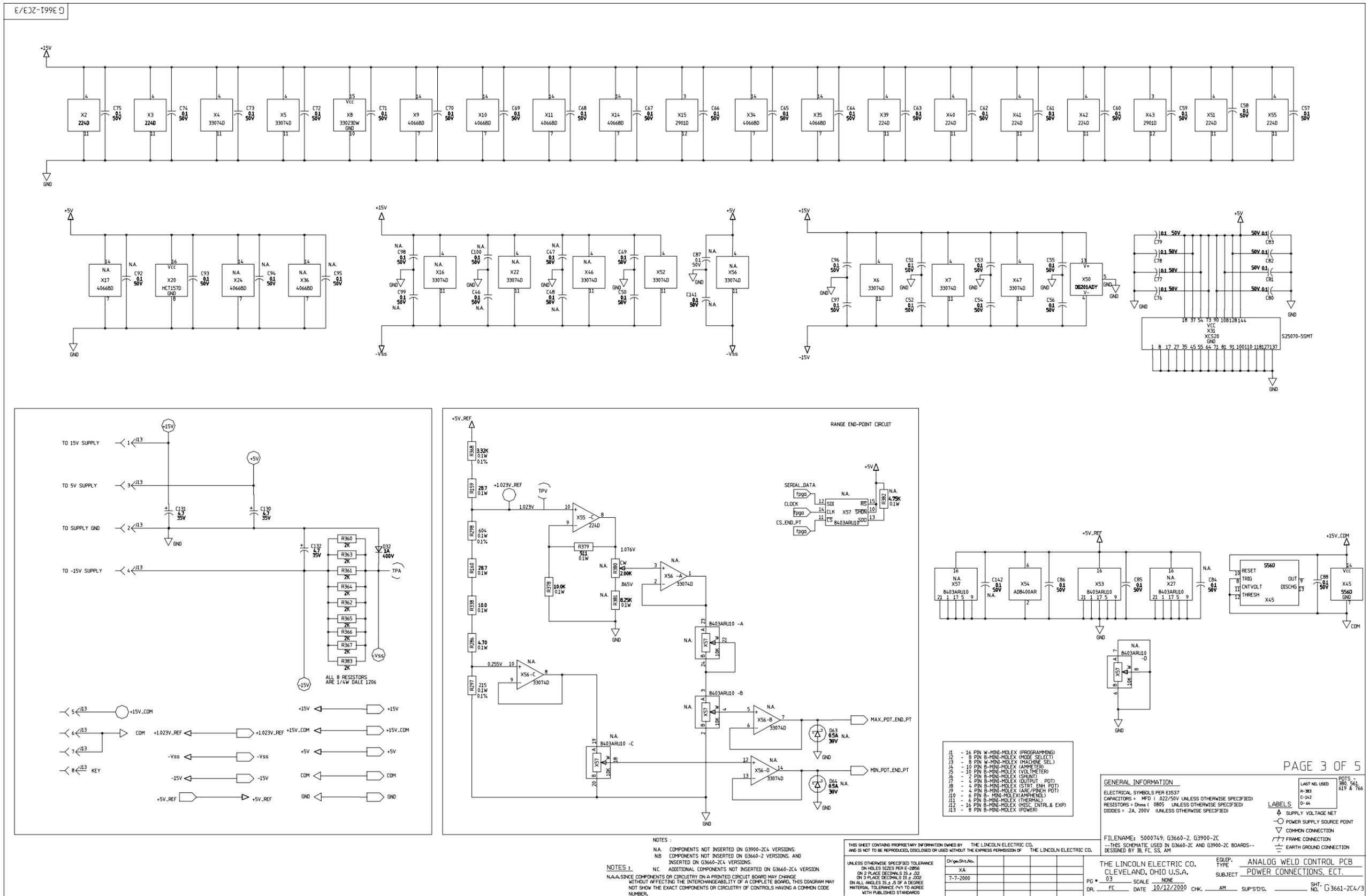
LABELS

- ▲ SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- ▽ COMMON CONNECTION
- FRAME CONNECTION
- ⊕ EARTH GROUND CONNECTION

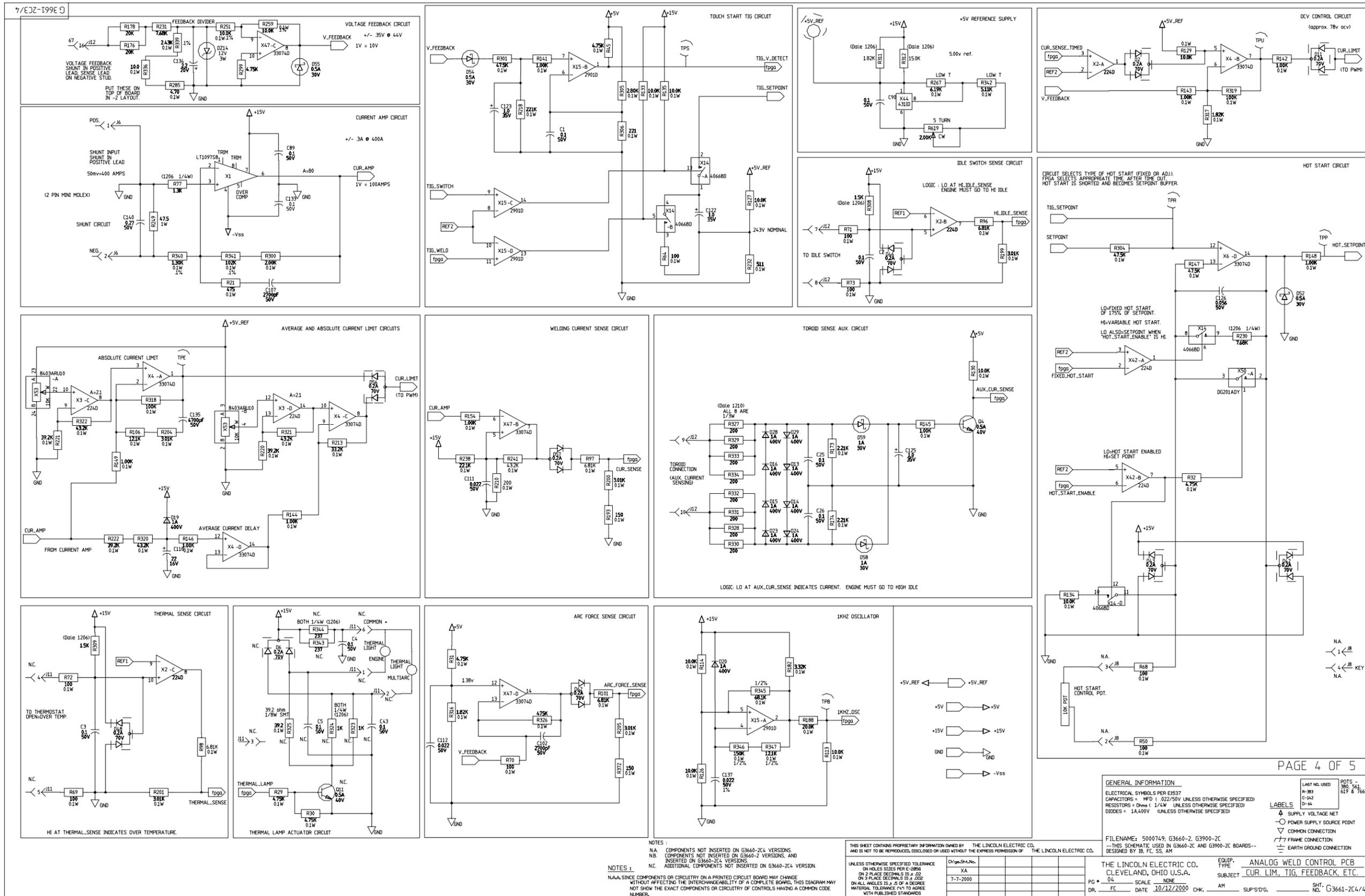
NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.



SCHEMATIC - WELD CONTROL PC BOARD - SHEET 3



SCHEMATIC - WELD CONTROL PC BOARD - SHEET 4



NOTES:
 N.A. COMPONENTS NOT INSERTED ON G3660-2C4 VERSIONS.
 N.B. COMPONENTS NOT INSERTED ON G3660-2 VERSIONS, AND INSERTED ON G3660-2C4 VERSIONS.
 N.C. ADDITIONAL COMPONENTS NOT INSERTED ON G3660-2C4 VERSION.

UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLES SIZES PER E-9896 ON 2 PLACE DECIMALS IS ±.002 ON 3 PLACE DECIMALS IS ±.000 ON ALL ANGLES IS ±.5 OF A DEGREE MATERIAL TOLERANCE 1/4 TO AGREE WITH PUBLISHED STANDARDS

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FILENAME: 5000749; G3660-2; G3900-2C
 --THIS SCHEMATIC USED IN G3660-2C AND G3900-2C BOARDS--
 DESIGNED BY: IB, FC, SS, AM

THE LINCOLN ELECTRIC CO.
 CLEVELAND, OHIO U.S.A.
 PG. 04 SCALE NONE
 DR. FC DATE 10/12/2000 CHK. AM SUP'D/G. NCL G3661-2C4/4

GENERAL INFORMATION
 ELECTRICAL SYMBOLS PER E1537
 CAPACITORS = MFD 1/ 0.22/50V UNLESS OTHERWISE SPECIFIED
 RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
 DIODES = 1A/400V UNLESS OTHERWISE SPECIFIED

LEGEND
 ▲ SUPPLY VOLTAGE NET
 ○ POWER SUPPLY SOURCE POINT
 ▽ COMMON CONNECTION
 ▮ FRAME CONNECTION
 ⊥ EARTH GROUND CONNECTION

POTS - LAST NO. USED
 R-383
 C-342
 D-44

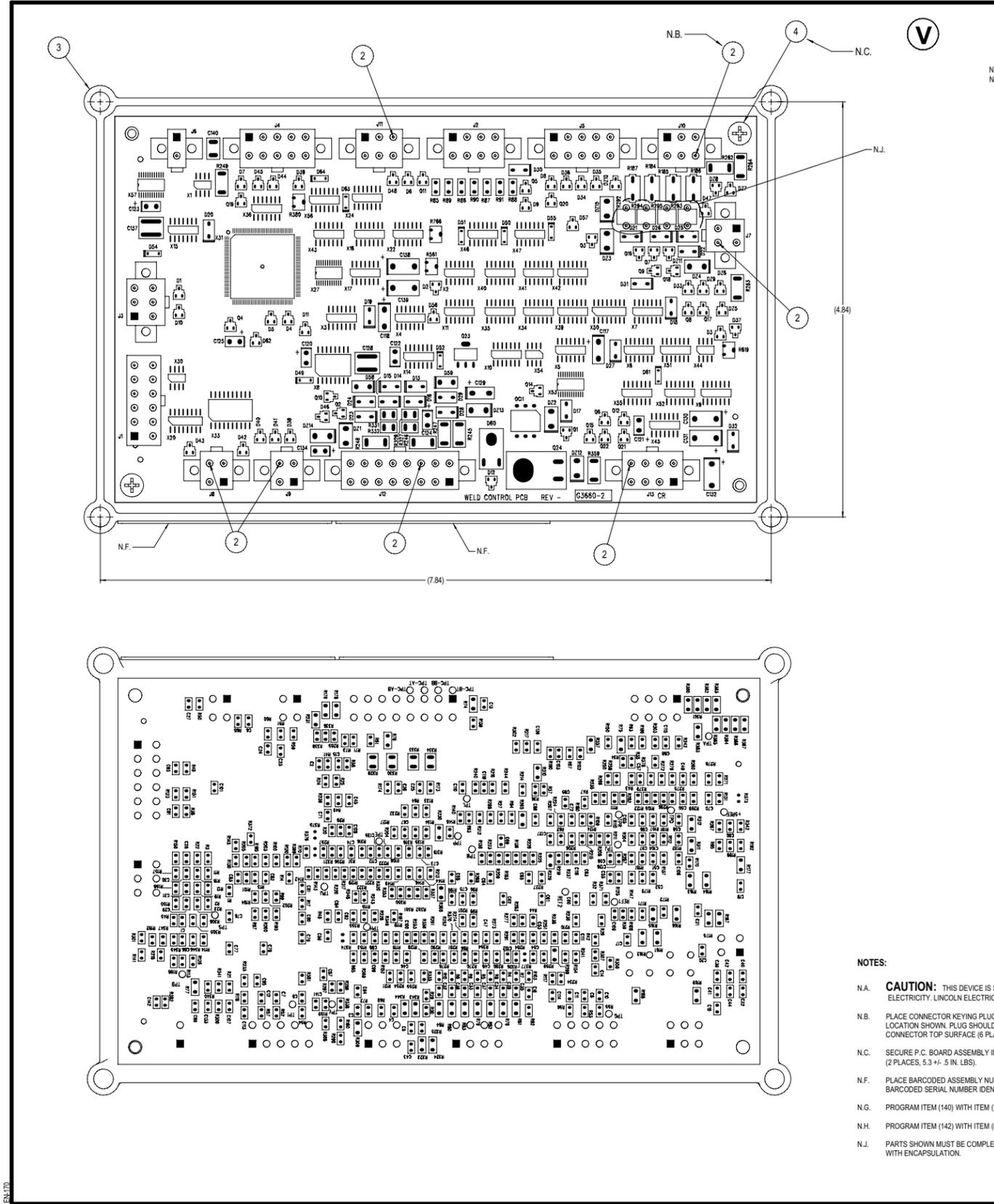
KEY
 1 N.A.
 2 N.A.
 3 N.A.
 4 N.A.

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

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



PC BOARD ASSEMBLY - WELD CONTROL PC BOARD



ITEM	PART NO.	QTY	PC BOARD REFERENCE DESIGNATORS	DESCRIPTION
1	G3660-2	1		WELD CONTROL PCB BLANK
2	S24671	7		PLUG KEYING PLUG
3	M19436-2	1		POTTING TRAY
4	S8029-80	2		SELF TAPPING SCREW
5	E2227	170.0		EPOXY ENCAPSULATING RESIN
6	E3339	AS REQ.		ELECTRICAL INSULATING COMPOUND
7	S24762-8	1	X00	SOFTWARE
8	S24763-8	1	X03	SOFTWARE
FOR ITEMS LISTED BELOW REFER TO ELECTRONIC COMPONENT DATABASE FOR COMPONENT SPECIFICATIONS				
9	S25020-3SMT	102	C1, C2, C3, C4, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C56, C56, C57, C58, C59, C60, C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91, C92, C93, C94, C95, C96, C97, C98, C99, C100, C101, C103, C104, C105, C106, C108, C109, C110, C111, C112, C113, C114, C115, C116	CAPACITOR, SMD, CERAMIC, 0.022MF, 50V, 10%, X
10	S25020-2SMT	9	C107, C103, C104, C105, C106, C107, C117, C118	CAPACITOR, SMD, CERAMIC, 0.022MF, 50V, 10%, X
11	S25020-6SMT	6	C107, C103, C104, C105, C106, C107	CAPACITOR, SMD, CERAMIC, 2700PF, 50V, 5%, X
12	S25024-6SMT	2	C117, C118	CAPACITOR, SMD, TANTALUM, 22MF, 16V, 10%, S
13	S25024-4SMT	1	C119	CAPACITOR, SMD, CERAMIC, 500PF, 50V, 5%, C0
14	S25024-2SMT	6	C120, C121, C122, C123, C124, C125	CAPACITOR, SMD, TANTALUM, 0.10MF, 35V, 10%, L
15	S25020-4SMT	2	C126, C127	CAPACITOR, SMD, CERAMIC, 0.05MF, 50V, 10%, X
16	S25020-16SMT	1	C128	CAPACITOR, SMD, CERAMIC, 0.01MF, 50V, 1%, X
17	S25024-1SMT	1	C129	CAPACITOR, SMD, TANTALUM, 0.47MF, 50V, 10%, S
18	S25024-3SMT	3	C130, C131, C132	CAPACITOR, SMD, TANTALUM, 4.7MF, 35V, 10%, S
19	S25024-3SMT	3	C133, C134	CAPACITOR, SMD, TANTALUM, 2.2MF, 20V, 10%, S
20	S25020-10SMT	2	C135, C136	CAPACITOR, SMD, CERAMIC, 4700PF, 50V, 10%, X
21	S25020-1SMT	1	C137	CAPACITOR, SMD, CERAMIC, 0.022MF, 50V, 1%, X
22	S25024-2SMT	2	C138, C139	CAPACITOR, SMD, TANTALUM, 4.7MF, 20V, 10%, S
23	S25020-17SMT	1	C140	CAPACITOR, SMD, CERAMIC, 0.27MF, 50V, 10%, X
24	S25040-6SMT	12	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12	DIODE, SMD, DUAL, 0.20A, 70V, UDR, CC, SOT-
25	S25040-2SMT	20	D13, D14, D15, D16, D17, D18, D19, D20, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31, D32	DIODE, SMD, DUAL, 0.400V, DO-214BA/AC
26	S25040-5SMT	16	D33, D34, D35, D36, D37, D38, D39, D40, D41, D42, D43, D44, D45, D46, D47, D48	DIODE, SMD, DUAL, 0.20A, 70V, UFR
27	S25040-1SMT	9	D49, D50, D51, D52, D54, D55, D56, D57, D58	DIODE, SMD, 0.5A, 30V, SOD-123, SCHOTTKY
28	S25040-4SMT	3	D59, D60, D62	DIODE, SMD, DUAL, 0.20A, 70V, LFR
29	S25040-2SMT	2	D68, D69	DIODE, SMD, 1A, 30V, SMA, SCHOTTKY
30	S25040-3SMT	1	D60	DIODE, SMD, DUAL, 6A, 200V, DPAK, CC ULTRA-
31	S25044-5SMT	1	D32, D33	ZENER DIODE, SMD, 3W, 18V, 5%, SMB
32	S25044-1SMT	3	D32, D34, D34	ZENER DIODE, SMD, 3W, 12V, 5%, SMB
33	S25045-1SMT	7	D25, D26, D27, D28, D29, D30	ZENER DIODE, SMD, 225mW, 12V, 5%, SOT-23
34	S25044-4SMT	2	D32, D33	ZENER DIODE, SMD, 3W, 15V, 5%, SMB
35	S25044-1SMT	1	D35	ZENER DIODE, SMD, 3W, 5.1V, 5%, SMB
36	S18248-12	1	J1	CONNECTOR, MOLEX, MINI, PCB, 12-PIN, TIN
37	S24020-9	2	J2, J13	CONNECTOR, MOLEX, MINI, PCB, 9-PIN, TIN
38	S24020-6	3	J3, J10, J11	CONNECTOR, MOLEX, MINI, PCB, 6-PIN, TIN
39	S24020-10	2	J4, J5	CONNECTOR, MOLEX, MINI, PCB, 10-PIN, TIN
40	S24020-35	1	J6	CONNECTOR, MOLEX, MINI, PCB, 35-PIN, GOLD
41	S24020-4	3	J7, J8, J9	CONNECTOR, MOLEX, MINI, PCB, 4-PIN, TIN
42	S24020-16	1	J12	CONNECTOR, MOLEX, MINI, PCB, 16-PIN, TIN
43	S15009-22SMT	1	Q01	OPTOCOUPLER, SMD, PHOTO-TRANSISTOR, 10V, V
44	S25050-1SMT	13	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q14	TRANSISTOR, SMD, NPN, 0.5A, 40V, SOT-23, MM
45	S25050-2SMT	8	Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22	TRANSISTOR, SMD, PNP, SOT23, 0.5A, 40V, MM
46	S25051-1SMT	1	Q23	TRANSISTOR, SMD, NPN, SOT-223, 1.5A, 100V, V
47	S25051-2SMT	1	Q24	TRANSISTOR, SMD, NPN, DPAK, 18A, 200V, I/P
48	S25000-4751SMT	26	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R212, R106, R106	RESISTOR, SMD, METAL FILM, 1/10W, 4.75K, 1
49	S25000-1501SMT	15	R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R218	RESISTOR, SMD, METAL FILM, 1/10W, 1.50K, 1
50	S25000-4750SMT	6	R18, R19, R20, R21, R22, R23	RESISTOR, SMD, METAL FILM, 1/10W, 4750HMS
51	S25000-1000SMT	22	R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R212, R106, R106	RESISTOR, SMD, METAL FILM, 1/10W, 1000HMS
52	S25000-4251SMT	5	R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73	RESISTOR, SMD, METAL FILM, 1/10W, 0.25K, 1
53	S25001-1301SMT	4	R74, R75, R76, R77	RESISTOR, SMD, 1.3K, 1/4W, 1206, 1%, TR
54	S25001-4750SMT	14	R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91	RESISTOR, SMD, 4750HMS, 1/4W, 1206, 1%, TR
55	S25000-2000SMT	4	R92, R93, R94, R210	RESISTOR, SMD, METAL FILM, 1/10W, 2000HMS
56	S25000-6811SMT	10	R95, R96, R97, R98, R99, R100, R101, R102, R103, R212, R106, R106	RESISTOR, SMD, METAL FILM, 1/10W, 0.81K, 1
57	S25000-1212SMT	2	R106, R106	RESISTOR, SMD, METAL FILM, 1/10W, 12K, 1K, 1
58	S25000-1001SMT	38	R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R218	RESISTOR, SMD, METAL FILM, 1/10W, 10.0K, 1
59	S25000-1001SMT	15	R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154	RESISTOR, SMD, METAL FILM, 1/10W, 1.00K, 1
60	S25000-4752SMT	5	R147, R301, R302, R303, R304	RESISTOR, SMD, METAL FILM, 1/10W, 47.5K, 1
61	S25000-2807SMT	6	R155, R156, R157, R158, R159, R160	RESISTOR, SMD, METAL FILM, 1/10W, 28.07OHM
62	S25001-1000SMT	6	R161, R162, R163, R164, R165, R166	RESISTOR, SMD, 1000HMS, 1/4W, 1206, 1%, TR
63	S25001-1213SMT	3	R167, R168, R169	RESISTOR, SMD, METAL FILM, 1/10W, 1.2K, 1K, 1
64	S25000-2211SMT	5	R170, R171, R172, R173, R174	RESISTOR, SMD, METAL FILM, 1/10W, 2.2K, 1K, 1
65	S25001-7500SMT	1	R175	RESISTOR, SMD, METAL FILM, 1/10W, 7500HMS, 1% TR
66	S25001-2002SMT	3	R176, R177, R178	RESISTOR, SMD, 20K, 1/4W, 1206, 1%, TR
67	S25000-3321SMT	5	R179, R180, R181, R182, R183	RESISTOR, SMD, METAL FILM, 1/10W, 3.3K, 1K, 1
68	S25000-3321SMT	5	R184, R185, R186, R187	RESISTOR, SMD, METAL FILM, 1/10W, 3.3K, 1K, 1
69	S25000-2002SMT	1	R188	RESISTOR, SMD, METAL FILM, 1/10W, 20.0K, 1
70	S25000-1500SMT	7	R190, R191, R192, R193, R194, R195, R237	RESISTOR, SMD, METAL FILM, 1/10W, 1500HMS
71	S25000-3011SMT	12	R201, R202, R203, R204, R205, R206, R207	RESISTOR, SMD, METAL FILM, 1/10W, 3.01K, 1
72	S25000-1822SMT	2	R208, R209	RESISTOR, SMD, METAL FILM, 1/10W, 18.2K, 1
73	S25000-2670SMT	1	R211	RESISTOR, SMD, METAL FILM, 1/10W, 2670HMS
74	S25000-3322SMT	2	R213, R214	RESISTOR, SMD, METAL FILM, 1/10W, 33.2K, 1
75	S25000-2213SMT	1	R215, R216, R217, R218, R309	RESISTOR, SMD, METAL FILM, 1/10W, 22.1K, 1%
76	S25000-1503SMT	1	R219	RESISTOR, SMD, METAL FILM, 1/10W, 150K, 1%
77	S25000-3022SMT	5	R220, R221, R222, R223, R231	RESISTOR, SMD, METAL FILM, 1/10W, 30.2K, 1
78	S25000-3323SMT	2	R224, R225	RESISTOR, SMD, METAL FILM, 1/10W, 33.2K, 1%
79	S25000-6813SMT	1	R226	RESISTOR, SMD, METAL FILM, 1/10W, 681K, 1%
80	S25000-6812SMT	2	R227, R228	RESISTOR, SMD, METAL FILM, 1/10W, 68.1K, 1
81	S25001-7881SMT	3	R229, R230, R231	RESISTOR, SMD, 7.88K, 1/4W, 1206, 1%, TR
82	S25000-5110SMT	7	R232, R233, R234, R235, R236, R237, R379	RESISTOR, SMD, METAL FILM, 1/10W, 5.110HMS
83	S25000-2212SMT	4	R238, R239, R240, R242	RESISTOR, SMD, METAL FILM, 1/10W, 22.1K, 1
84	S25000-4322SMT	1	R243, R244, R245, R246, R247, R248, R249, R250, R251, R252, R253, R254	RESISTOR, SMD, METAL FILM, 1/10W, 43.2K, 1
85	S25003-4755SMT	5	R245, R246, R247, R248, R249	RESISTOR, SMD, 1W, 47.5OHMS, 1%
86	S25004-2430SMT	10	R250, R251, R252, R253, R254, R255, R256, R257, R258, R259	RESISTOR, SMD, PREC. MF, 1/10W, 10.0K, 0.1%
87	S25008-4321SMT	2	R260, R261	RESISTOR, SMD, PREC. MF, 1/10W, 4.32K, 0.5%
88	S25010-35SMT	3	R262, R263, R264	RESISTOR, SMD, PREC. MF, 1/10W, 35.0K, 0.5%
89	S25001-1211SMT	1	R265	RESISTOR, SMD, METAL FILM, 1/10W, 12.1K, 1%
90	S25000-4751SMT	2	R266, R267	RESISTOR, SMD, METAL FILM, 1/10W, 47.5K, 1%
91	S25008-1002SMT	16	R269, R270, R271, R272, R273, R274, R275, R276, R277, R278, R279, R280, R281, R282, R283, R284	RESISTOR, SMD, PREC. MF, 1/10W, 10.0K, 0.5%
92	S25000-4707SMT	3	R285, R286, R287	RESISTOR, SMD, METAL FILM, 1/10W, 4.707OHM
93	S25000-2001SMT	1	R288, R289, R290, R291, R292, R293, R294, R295, R296, R297, R298, R299, R300, R301, R302, R303, R304, R305, R306, R307, R308, R309, R310, R311, R312, R313, R314, R315, R316, R317, R318, R319, R320, R321, R322, R323, R324, R325, R326, R327, R328, R329, R330, R331, R332, R333, R334, R335, R336, R337, R338, R339, R340, R341, R342, R343, R344, R345, R346, R347, R348, R349, R350, R351, R352, R353, R354, R355, R356, R357, R358, R359, R360, R361, R362, R363, R364, R365, R366, R367, R368, R369, R370, R371, R372, R373, R374, R375, R376, R377, R378, R379, R380, R381, R382, R383, R384, R385, R386, R387, R388, R389, R390, R391, R392, R393, R394, R395, R396, R397, R398, R399, R400, R401, R402, R403, R404, R405, R406, R407, R408, R409, R410, R411, R412, R413, R414, R415, R416, R417, R418, R419, R420, R421, R422, R423, R424, R425, R426, R427, R428, R429, R430, R431, R432, R433, R434, R435, R436, R437, R438, R439, R440, R441, R442, R443, R444, R445, R446, R447, R448, R449, R450, R451, R452, R453, R454, R455, R456, R457, R458, R459, R460, R461, R462, R463, R464, R465, R466, R467, R468, R469, R470, R471, R472, R473, R474, R475, R476, R477, R478, R479, R480, R481, R482, R483, R484, R485, R486, R487, R488, R489, R490, R491, R492, R493, R494, R495, R496, R497, R498, R499, R500, R501, R502, R503, R504, R505, R506, R507, R508, R509, R510, R511, R512, R513, R514, R515, R516, R517, R518, R519, R520, R521, R522, R523, R524, R525, R526, R527, R528, R529, R530, R531, R532, R533, R534, R535, R536, R537, R538, R539, R540, R541, R542, R543, R544, R545, R546, R547, R548, R549, R550, R551, R552, R553, R554, R555, R556, R557, R558, R559, R560, R561, R562, R563, R564, R565, R566, R567, R568, R569, R570, R571, R572, R573, R574, R575, R576, R577, R578, R579, R580, R581, R582, R583, R584, R585, R586, R587, R588, R589, R590, R591, R592, R593, R594, R595, R596, R597, R598, R599, R600, R601, R602, R603, R604, R605, R606, R607, R608, R609, R610, R611, R612, R613, R614, R615, R616, R617, R618, R619, R620, R621, R622, R623, R624, R625, R626, R627, R628, R629, R630, R631, R632, R633, R634, R635, R636, R637, R638, R639, R640, R641, R642, R643, R644, R645, R646, R647, R648, R649, R650, R651, R652, R653, R654, R655, R656, R657, R658, R659, R660, R661, R662, R663, R664, R665, R666, R667, R668, R669, R670, R671, R672, R673, R674, R675, R676, R6	

