INSTRUCTION MANUAL

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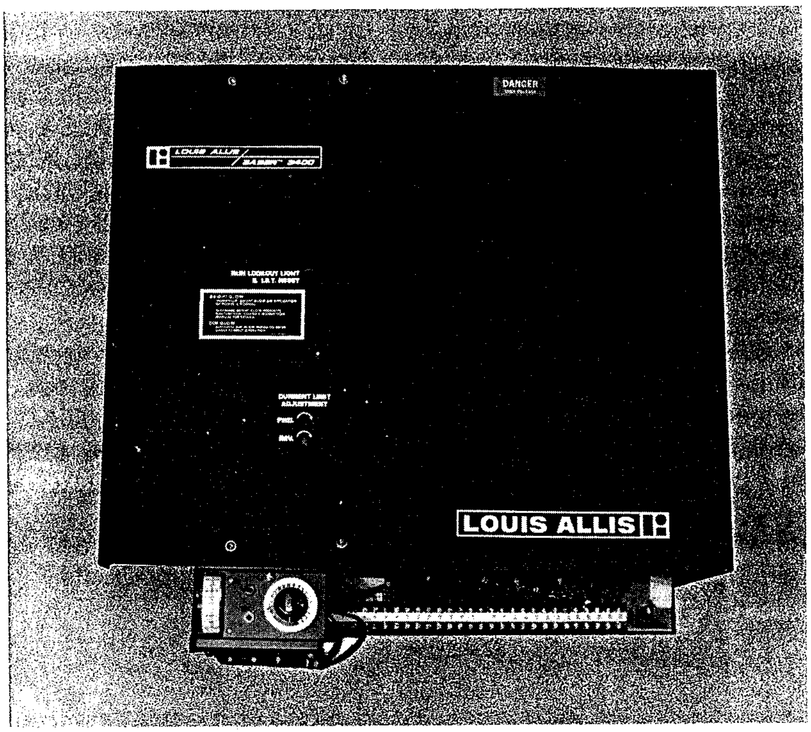
LOUIS ALLIS



SABER[TM] 3400 MOD III 3-PHASE ARMATURE-REGENERATIVE DC STATIC DRIVE

MagneTek
Drives & Systems

This instruction manual covers installation, operation, adjustments, and maintenance of the equipment, but does not provide for every possible circumstance that may occur, nor does it define all modifications, variations, or details of the equipment. Should further information be desired or should particular problems develop which are not covered sufficiently herein, please contact your nearest Louis Allis representative.

WARRANTY

Standard products manufactured by the Company are warranted to be free from defects in workmanship and material for a period of one year from the date of shipment, and any products which are defective in workmanship or material will be repaired or replaced, at the option of the Company, at no charge to the Buyer. Final determination as to whether a product is actually defective rests with the Company. The obligation of the Company hereunder shall be limited solely to repair and replacement of products that fall within the foregoing limitations, and shall be conditioned upon receipt by the Company of written notice of any alleged defects or deficiency promptly after discovery within the warranty period, and in the case of components or units purchased by the Company, the obligation of the Company shall not exceed the settlement that the Company is able to obtain from the supplier thereof. No products shall be returned to the Company without its prior consent. Products which the Company consents to have returned shall be shipped f.o.b. the Company's factory. The Company cannot assume responsibility or accept invoices for unauthorized repairs to its components, even though defective. The life of the products of the Company depends, to a large extent, upon type of usage thereof, and THE COMPANY MAKES NO WARRANTY AS TO FITNESS OF ITS PRODUCTS FOR SPECIFIC APPLICATIONS BY THE BUYER NOR AS TO PERIOD OF SERVICE UNLESS THE COMPANY SPECIFICALLY AGREES OTHERWISE IN WRITING AFTER THE PROPOSED USAGE HAS BEEN MADE KNOWN TO IT.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE

This warranty does not apply to experimental or developmental products.

RECEIPT OF SHIPMENT

All equipment is tested against defect at Louis Allis and is shipped in good condition. Any damages or shortages evident when equipment is received must be reported immediately to the commercial carrier who transported the equipment. Assistance is available from the nearest Louis Allis district office, if required. Always refer to Louis Allis order number, equipment description and serial number when contacting Louis Allis.

EQUIPMENT STORAGE

For long periods of storage, equipment should be covered to prevent corrosion. Equipment should be stored in a clean, dry location After storage, insure that equipment is dry and no condensation has accumulated before applying power. All rotating equipment stored longer than three months requires regreasing

SAFETY FIRST

This equipment has been designed to provide maximum safety for operating personnel However, hazardous voltages exist within the confines of the enclosure. Installation and servicing should therefore be accomplished by qualified personnel only and in accordance with OSHA regulations

CAUTION

NEVER CONNECT CAPACITORS ACROSS THE INVERTER OUTPUT AND MOTOR. UPON APPLICATION OF POWER, THE INVERTER INITIALLY SEES THE CAPACITORS AS A SHORT CIRCUIT, HIGH CURRENTS RESULT AND EQUIPMENT WILL BE DAMAGED.

IF REQUIRED, POWER FACTOR CORRECTION CAPACITOR NETWORKS MAY BE CONNECTED ACROSS THE INPUT POWER SOURCE ONLY AFTER CONSULTING LOUIS ALLIS.

IMPROPER USE OF POWER FACTOR CORRECTION CAPACITOR NETWORKS WILL DAMAGE EQUIPMENT.

This equipment has not been tested to show compliance with new FCC Rules (47CFR, Part 15) designed to limit interference to radio and TV reception. Operation of this equipment in a residential area is likely to cause unacceptable interference to radio communication requiring the operator to take whatever steps are necessary to correct the interference.

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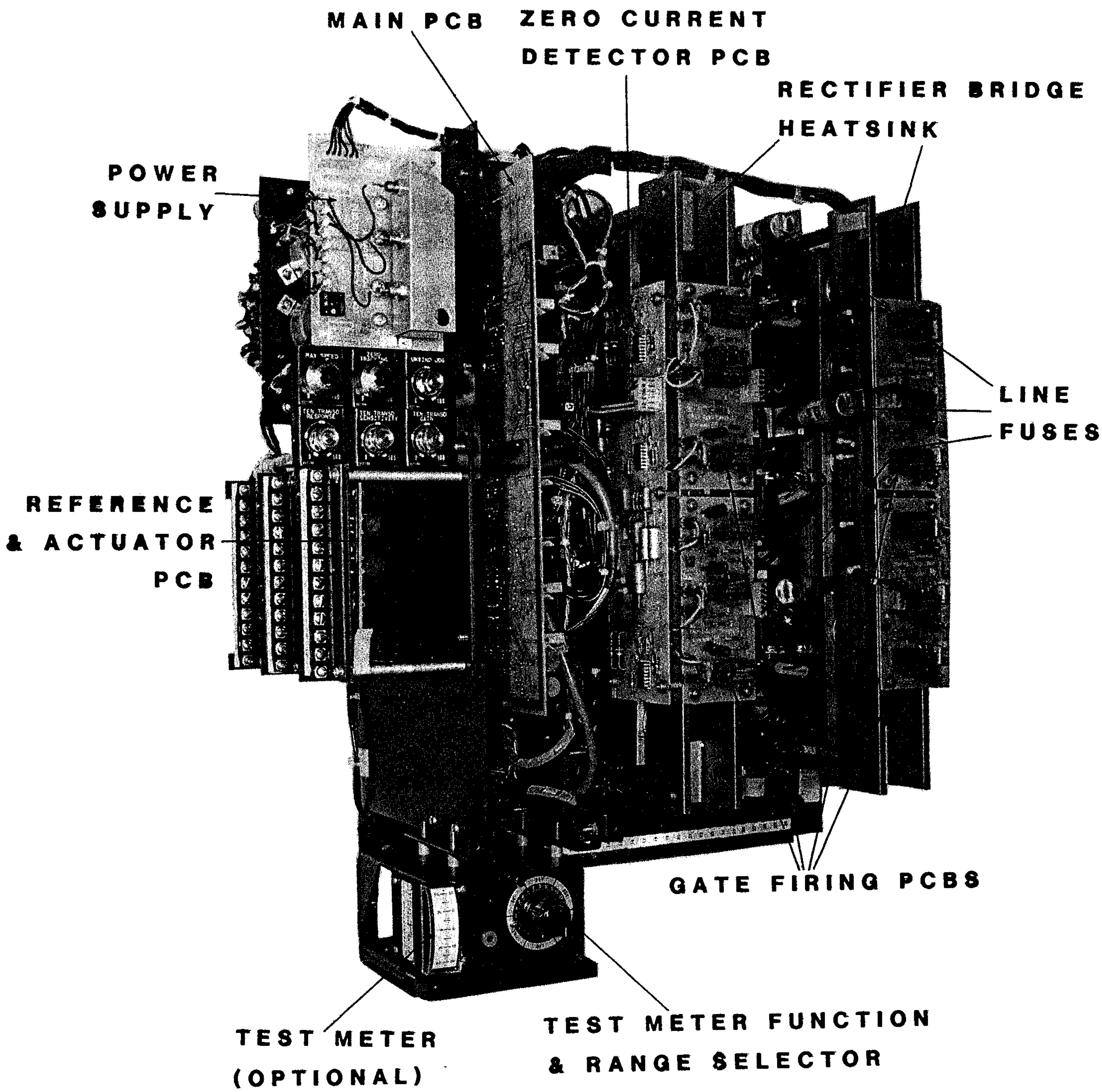


Figure 1-1. Saber 3400, 12SCR Power Conversion Unit

SECTION 1. INTRODUCTION

1.1 PURPOSE AND FUNCTION OF EQUIPMENT

The Saber 3400, 12SCR drive system consists of a power conversion unit (PCU), a DC motor and operator's controls. The purpose of the system is to provide controlled rotational energy to drive the customer's machinery.

1.2 DESCRIPTION OF PCU AND COMPONENT LOCATION

The PCU (Figure 1-1) is designed to control a DC motor over a wide and infinitely adjustable speed range from zero to rated RPM. It is fully regenerative and is capable of four quadrant operation. That is, it can transfer power from the AC lines to the motor load and cause rotation in both the forward and reverse directions. It can also transfer power from the motor to the AC line to impede rotation.

The PCU consists of a Rectifier Bridge section, four Gate Firing Printed Circuit Boards (PCBs), a Main PCB, a Reference and Actuator PCB, two Zero Current Detector PCBs, a Power Supply, and adjustment potentiometers. A cooling fan is provided on the larger units. A Test Meter Module and a Linear Acceleration PCB are available as options for the basic unit.

1.2.1 Rectifier Bridge

The Rectifier Bridge section consists of two 3-phase full wave bridges. Each bridge is made up of six silicon controlled rectifiers (SCRs) mounted on power heatsinks. The two bridges are connected in an inverse parallel configuration. Transient voltage and current protection circuitry is located behind the heatsink assemblies on the subpanel. The Rectifier Bridge section may be designed for either a 230 or a 460 volt 3-phase AC line.

1.2.2 Gate Firing PCBs

The Gate Firing PCBs, mounted on the bridge heatsink, deliver the gating signals which fire the SCRs. Two Gate Firing PCBs are required for each Rectifier Bridge.

1.2.3 Main PCB

The Main PCB consists of three separate sections as follows:

A. Firing Logic and Pulse Amplifier Circuits. There are two Firing Logic and Pulse Amplifier circuits - one for forward and one for reverse bridge conduction. These circuits generate gating signals which fire the SCRs. Each circuit contains all the logic circuitry necessary to insure that only one of the bridges is activated and that the proper SCRs in that bridge are fired in phase with the AC line voltage.

B. Current Regulator and Safety Circuit. This circuit compares a reference voltage with a feedback signal which is proportional to the actual motor current. It amplifies the difference between these two voltages and applies this amplified difference as a phase control signal to the Firing Logic and Pulse Amplifier circuits. This circuit includes: a) an adjustable current limiting circuit to clamp the maximum motor current, b) loss of phase protection, and c) overcurrent shutdown.

1.2.4 Reference and Actuator PCB

This circuit provides an accurate +10VDC signal for setting motor speed. It also generates a signal proportional to the motor current required to balance speed reference (desired speed) and speed feedback (actual speed).

1.2.5 Zero Current Detector PCB

One Zero Current Detector PCB is mounted on each Rectifier Bridge heatsink and is used to detect non-conduction of the SCRs.

1.2.6 Power Supply

The Power Supply converts 115VAC power to ±15VDC, +5VDC and ±40VDC control voltages for the Main PCB.

1.2.7 Protective Circuitry

The PCU contains the following circuits which protect the drive system, power lines and personnel:

A. Power line fuses.

B. Motor armature loop contactor capable of breaking full load current.

C. Motor overload relay.

D. Instantaneous Statis Trip (IST).

E. Isolation and control circuitry.

F. Phase loss shutdown.

G. Undervoltage shutdown.

H. Transient suppression.

I. Current Limit.

1.3 PERFORMANCE AND AMBIENT SPECIFICATION:

The following general specifications apply to the basic PCU. Performance range can be extended by adding custom engineered modifications.

A. Input Voltage:

Low Voltage Unit	230VAC -5%, +10%; 60Hz ±2%, 3Ø
High Voltage Unit	460VAC -5%, +10%; 60Hz ±2%, 3Ø

B.	Speed Range:	As specified for application
C.	Adjustable Current Limit:	80 to 150%
D.	Overload for one Minute:	150% rated full load
E.	Speed Regulation:	As specified for application
F.	Service Factor:	1.0
G.	Ambient Temperature Range:	10^{o} to 40^{o}C
H.	Operating Altitude:	3300 feet above sea level maximum

1.4 PRE-INSTALLATION CONSIDERATIONS:

1.4.1 Receipt of Shipment

All equipment is tested against defect at Louis Allis Drives & Systems. Any damages or shortages evident when the equipment is received must be reported immediately to the commercial carrier who transported the equipment. Assistance, if required, is availabe from the nearest Louis Allis District Office. Always refer to the Louis Allis order number, equipment description, and serial number when contacting Louis Allis Drives & Systems.

1.4.2 Unpacking Instructions

Remove the protective shipping material from around the equipment. Remove all packing material. Unbolt the equipment from its crate. Inspect for loose wiring. Make sure that all contact wedges and other shipping devices have been removed.

1.5 TOOLS AND TEST EQUIPMENT

Tools and test equipment required for servicing the PCU are as follows:

A. Oscilloscope, Dual Trace, Differential Pre-amp (Tektronix 545A or equivalent).

B. Probes, X10 (all voltages except armature), and X100 (armature voltage checks).

C. Multimeter (Simpson 260 or equivalent).

D. Tachometer, Hand Held (Mod. 455, James G. Biddle Co. or equivalent).

E. Card Extender (Louis Allis Part Number 05P00001-0112).

F. Soldering Iron, 42 Watt (maximum).

G. Socket Wrench Set 1/4" to 1".

H. Box Wrench Set 3/8" to 1".

I. Allen Wrench 3/8".

J. Screw Driver Set, Standard Blade and Phillips.

1.6 PACKING INSTRUCTIONS FOR RESHIPMENT OR STORAGE

For long periods of storage, equipment should be covered to prevent corrosion and should be placed in a clean, dry location. If possible, equipment should be stored in its original crating. Periodic inspection should be made to insure that the equipment is dry and that no condensation has accumulated. The equipment warranty does not cover damage due to improper storage.

When packing a PCU for reshipment, remove all plug-in components such as sealed relays and printed circuit boards which would be susceptible to shaking loose during transportation. These items should be packed in a small corrugated carton individually protected with soft wrapping material and the carton secured in the shipping crate.

The PCU should be bolted in a crate which provides at least 2 inches clearance. The PCU should then be wrapped in polyethylene and covered with wax impregnated double walled #350 corrugation or crated. Assistance, if required, is available from the nearest Louis Allis District Office.

END OF SECTION 1 TEXT

SECTION 2. INSTALLATION AND STARTUP

2.1 PHYSICAL INSTALLATION

The power conversion unit is air cooled. Smaller units are cooled by convection, but larger units are equipped with a fan to insure adequate air flow. Select a site for installing the PCU which is clean and well ventilated; maintenance will be minimized if the PCU is located in a clean atmosphere.

The standard PCU is designed for wall mounting. Attach the PCU to a wall or other vertical structure using the bolting holes provided in the base panel. Insure that the unit is level.

2.2 ELECTRICAL HOOKUP

Refer to the Interconnection Diagram in the drawing section for information on wiring the PCU to other drive system equipment. Insure that wire size and disconnect devices conform to the installation contractor's drawings and to all applicable codes. Observe the following:

A. In long cable runs, take care to prevent excessive voltage drop.

B. Separate the leads used for speed reference, feedback, and other low level signals from those used for the motor armature, field and AC power.

C. Maintain proper phase rotation.

D. Connect all shields on shielded wire to system common (not ground) on one end only. Twisted shielded pair wire should be used for long runs.

2.3 STARTUP PROCEDURE

This procedure contains instructions for starting up and checking out the PCU following installation.

2.3.1 Prepower Check

Perform the following checks before applying AC input power to prevent damage to the PCU.

A. Inspect all equipment for signs of damage, loose connections or other defects.

B. Insure the power supply voltage, frequency and phase are correct for the drive system. Power supply specifications are contained on the PCU nameplate or drive system schematic diagram.

C. Remove all shipping devices and relay wedges. Manually operate all contactors and relays to insure they move freely.

D. Insure that all electrical connections are secure.

E. Insure that all transformers are connected for proper voltage according to the drive system schematic.

2.3.2 Initial Startup

The drive system is started by applying AC input power to the PCU. Observe red lamp 1PBL on Main PCB when power is initially applied. The lamp should light brightly for 0.5 to 2 seconds and then go dim.

On PCUs with AC blower motor, check that blower rotates in the correct direction when power is applied.

Since each PCU is thoroughly tested and adjusted for proper performance before it is shipped from the factory, additional adjustments are normally not required after installation. However, in some cases damage during shipment or inadvertent tampering with the potentiometers may necessitate installation adjustments. Adjustment procedures are contained in Section 4 of this manual. Before making any adjustments, carefully study the contents of this manual.

END OF SECTION 2 TEXT

SECTION 3. FUNCTIONAL DESCRIPTION

3.1 PCU BLOCK DIAGRAM DESCRIPTION

Refer to Figure 3-3 for a block diagram of the PCU.

Input power is applied through input fuses 1F, 2F and 3F and current transformers 1CT, 2CT and 3CT to phase transformer 1PT. Outputs of the phasing transformer are three-phase voltages to the AC Line Sensing and Synchronizing circuits. The AC Line Sensing and Synchronizing circuits provide a synchronization signal to each Firing Logic and Pulse Amplifier circuit. The Current Regulator and Safety circuits provide current regulation and protection against interruption of the input and excessive currents of the output circuit. The Firing Logic and Pulse Amplifier circuits generate the firing pulses which are transmitted by the Gate Firing PCBS to fire the SCRs in the Rectifier Bridge. Output of the PCU is a controlled DC voltage to the motor armature and a DC shunt field voltage.

3.2 12SCR RECTIFIER BRIDGE DESCRIPTION

3.2.1 Armature Supply

The rectifier bridge performs two major functions: it converts AC voltage to DC voltage by rectification of the three-phase AC waveform, and it varies the amplitude of DC voltage by controlling the portion of three-phase AC waveform which is passed. Because an SCR will conduct current in one direction only and will not conduct at all until it is turned on (fired) by a gating pulse, it is possible to obtain amplitude - controlled DC voltage from an AC line.

To simplify the concepts of rectification and amplitude control, a representation of the voltage from phase A to phase C is shown in Figure 3-1. Because an SCR will conduct current in only one direction, only the portion of the sinewave above the line can supply power to the load. Because an SCR will not conduct at all until it is turned on, the amplitude of the resulting DC voltage can be varied. A larger average voltage will result if the SCR is fired at point (a) rather than point (b) as shown in Figure 3-2.

The three-phase full wave bridge is made up of six SCRs which are fired two at a time. In this way, each phase of the AC line is connected, one at a time, to the DC motor armature. With AC input phases designated A, B, and C and SCRs designated 1 through 6, the sequence of firing is as shown in Table 3-1.

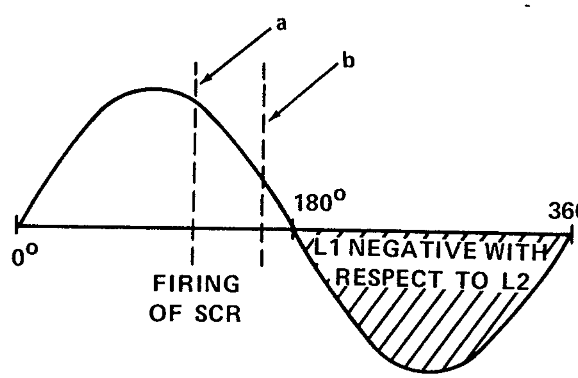


Figure 3-1.
Voltage Phase A with Respect to Phase C

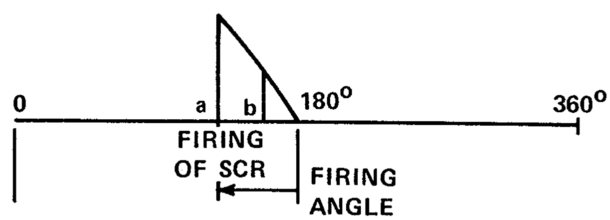


Figure 3-2.
Resultant Armature Voltage, Phase A Positive with Respect to Phase C

Table 3-1. SCR Firing Sequence

Phase	SCR's Firing
A to B	1 and 6
A to C	1 and 2
B to C	3 and 2
B to A	3 and 4
C to A	5 and 4
C to B	5 and 6

For current to flow in the armature, the AC voltage must be at a higher potential than the motor CEMF when the SCR is fired. It is inherent to the operation of an SCR, as previously mentioned, that a forward voltage bias (anode to cathode) is necessary before conduction can occur. The motor CEMF represents a reverse bias to the SCR. When the SCR begins to conduct, armature current flow is sustained through the point where AC applied voltage equals CEMF and continues to flow until forced to zero by the reverse voltage applied to the inductive armature circuit or until commutated by firing of the next set of SCRs.

The conduction interval, as shown in Figure 3-4, is 60 (electrical) degrees for each pair of SCRs. A different SCR pair is therefore fired at equal intervals six times every 360 degrees.

The three-phase AC line voltage and three-phase full wave bridge are shown in Figure 3-4. The timing of gating pulses to achieve maximum output voltage is also shown.

The 12SCR power bridge actually consists of two 6SCR full wave bridges connected to an inverse parallel configuration as shown in Figure 3-5.

For a direction of motor rotation so that the CEMF is positive at motor terminal A1 (Figure 3-5), the bridge with SCRs suffixed F will conduct current from the AC lines to the motor armature. This current flow causes continued rotation in the same direction. The bridge with SCRs suffixed R will conduct current from the motor to the AC lines, retarding rotation in this direction. The direction of current flow is determined by the relative magnitude of CEMF and bridge output voltage. For example, if the bridge output voltage is higher than CEMF, current will flow to the motor. If bridge output voltage is less than CEMF, current will flow from the motor to the AC line. In the example shown in Figure 3-5, the bridge with R suffix will transfer power from the motor to the AC line when output voltage is less than CEMF. The functions of the two bridges are reversed for motor rotation in the opposite direction.

The SCRs in both bridges cannot be permitted to fire at the same time. If 1SCRF and 2SCRR or 6SCRR were fired at the same time, a line-to-line short circuit would occur, causing dangerously high currents which would destroy the semiconductors. Logic circuits prevent SCRs in one rectifier bridge from being fired while current is still flowing in the other rectifier bridge.

3.2.2 Field Supply

A fixed voltage motor field supply is obtained by half-wave rectification of the three-phase line voltage. A 230VAC line provides a 150VDC motor shunt field supply; a 460VAC line provides a 300VDC supply.

3.3 CIRCUIT DESCRIPTIONS

Following are detailed circuit level descriptions for each printed circuit board. Refer to the Drawing Section for schematic diagrams of the PCBs.

3.3.1 Gate Firing PCB

The four Gate Firing PCBs are mounted directly to the Rectifier Bridge heatsinks. Each Gate Firing PCB contains three gate firing circuits. Each gate firing circuit delivers firing pulses (from the appropriate Firing Logic Pulse Amplifier) to the proper SCR. Pulse transformers on the Gate Firing PCBs isolate the firing circuitry from the AC line.

3.3.2 Zero Current Detector PCB

Two Zero Current Detector PCBs are mounted to the Rectifier Bridge heatsinks to sense non-conduction of the SCRs. One PCB is mounted on the left heatsink and monitors the six SCRs on that unit. The other PCB is mounted on the right heatsink and monitors the other six SCRs. If there is a small voltage across any set (pair) of SCRs, the SCRs are assumed to be conducting. If there is a large voltage across all three sets, zero current is assumed, and a light-emitting diode (LED) is energized.

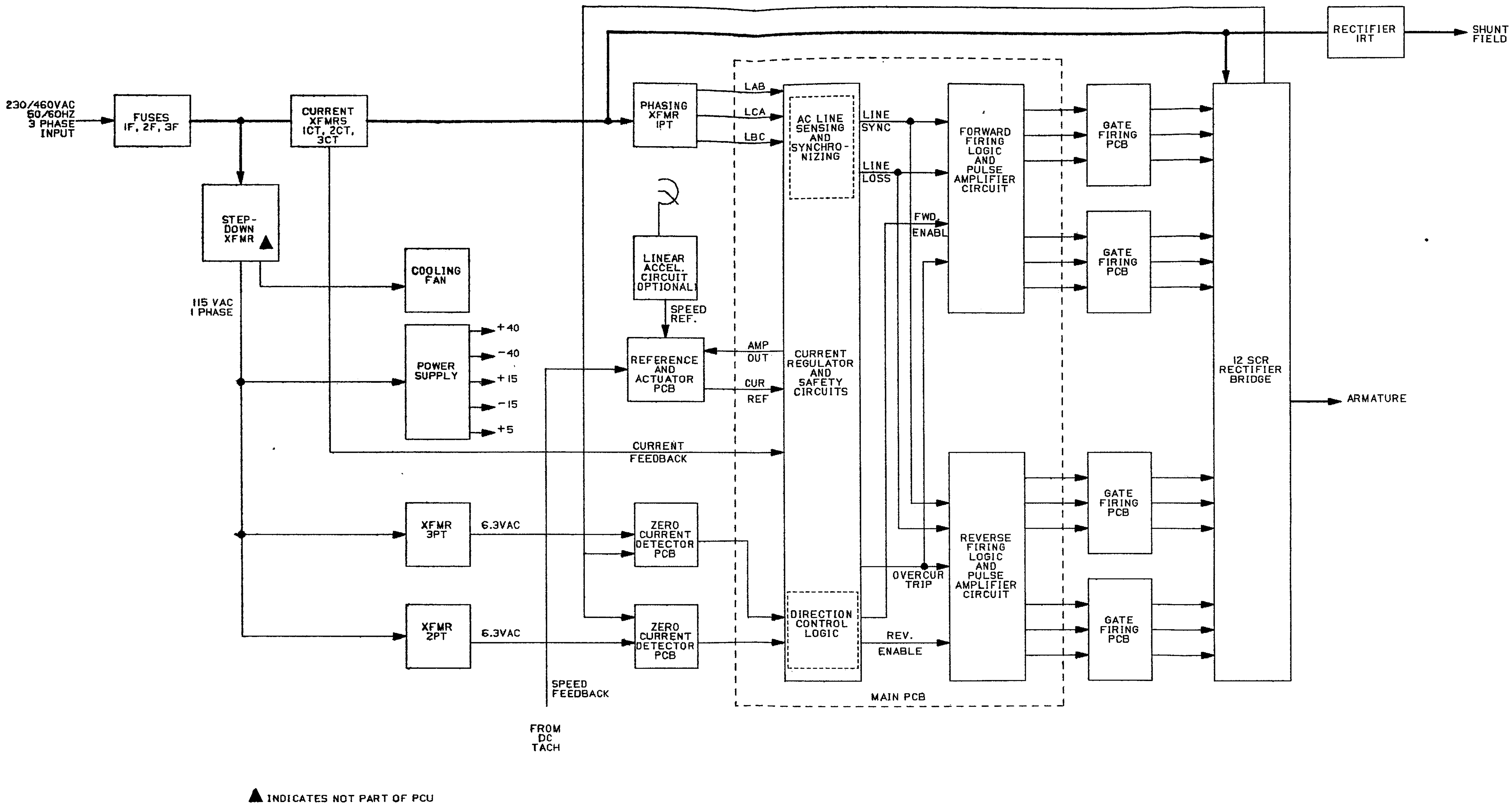


FIGURE 3-1. PCU BLOCK DIAGRAM

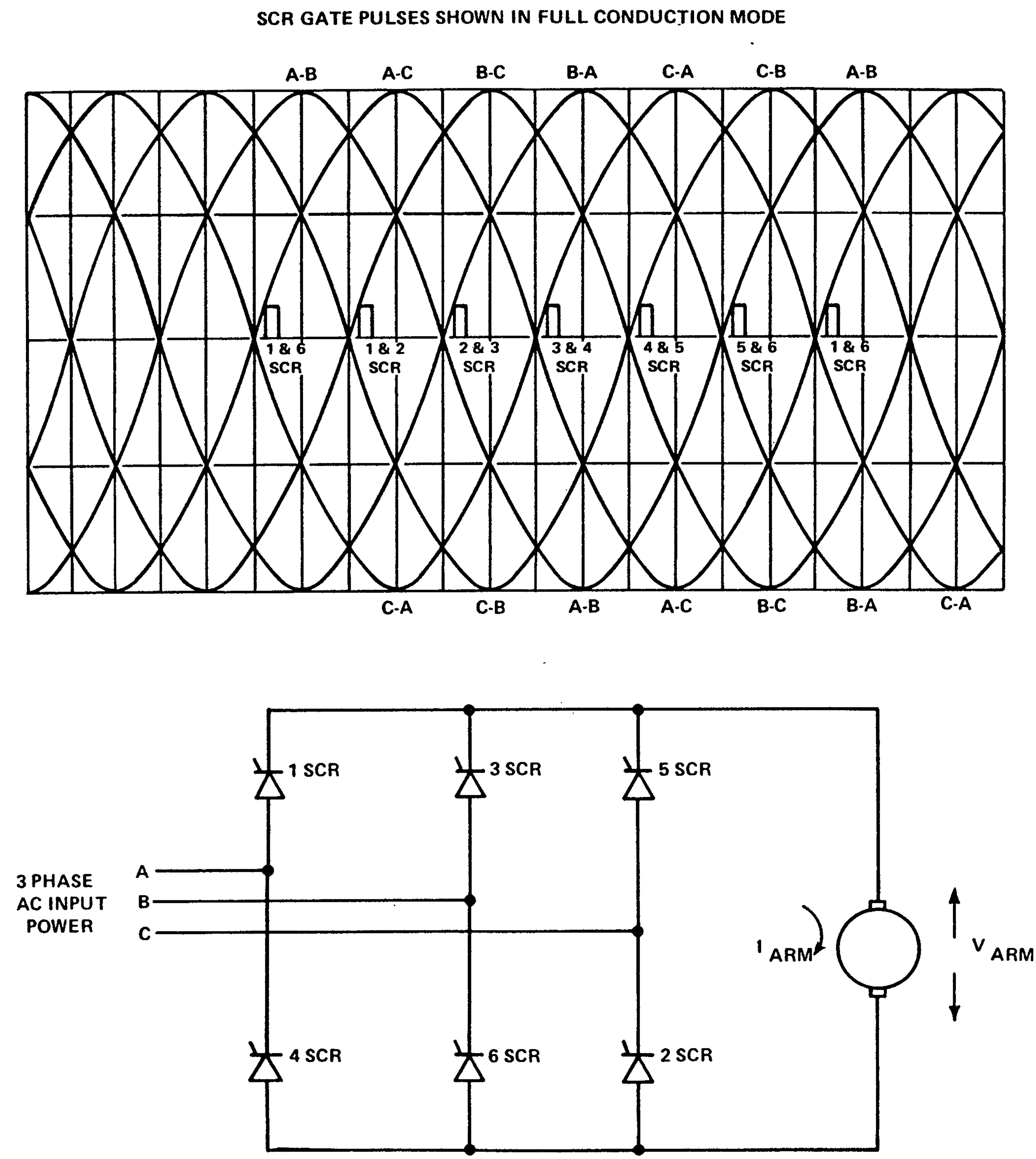


Figure 3-4. SCR Gate Pulses, AC Line Waveforms and 6SCR Power Bridge

The LED is optically coupled to a photo-sensitive transistor which provides the output of the Zero Current Detector PCB. This output is present when the six SCRs are non-conducting. Optical coupling of the signal from the rectifier bridge to the firing logic circuitry provides electrical isolation from the AC line.

3.3.3 Main PCB (Refer to Figure 6-2)

AC line sensing and synchronizing circuits use the three-phase voltages from the phasing transformer to generate a sync signal, free from power line noise interference, for the SCR Timing Generator circuits. A second signal is also generated to sense the connected phase rotation and allow correct operation with either rotation. The line loss detector senses an excessively low line level or missing power line (possibly due to a blown fuse) and causes shutdown of the equipment.

The current reference input is clamped to a maximum positive or negative level to achieve current limiting. A FET switch disconnects the current reference during a drive shutdown condition.

The current feedback signal from AC line current transformers is rectified and scaled by the burden resistor located on the 6CONN assembly. An electronically driven switch changes the feedback signal to agree in polarity with the selected direction. An overcurrent trip circuit detects excessive current peaks which may occur under fault conditions and causes a safe shutdown.

The current reference and feedback signals are summed at the current error amplifier. The output of this amplifier is applied to the forward SCR Timing Generator as a phase firing angle command. It is also inverted and applied to the reverse SCR Timing Generator.

Each SCR Timing Generator circuit operates independently except for sharing the sources of line synchronizing and Run-Stop information. The analog firing angle command is first converted to a digital word using components external to the SCR Timing Generator. Internally, the SCR Timing Generator produces the proper timing delays and gating pulse wave-shape for firing all six SCR devices in the forward or reverse power circuit. An internal phase locked loop synchronizes the circuit to the power line via the line sync signals. Startup and shutdown logic is also contained internally.

Field Effect Transistors are used to amplify the SCR gating pulses prior to their connection to the Gate Firing PCB transformers. An electronic switch is used to turn power on and off to the pulse amplifiers as part of the normal startup and shutdown control.

The direction control logic enables either the forward or reverse SCR Timing Generator in response to the direction of current flow called for by the current reference command signal. The Zero Current Detector PCB signals are used as conditional input signals for this logic. A zero current condition must exist before the direction control can change states.

3.3.4 Reference and Actuator PCB

This printed circuit board performs two basic functions. One function is to reduce the ±15VDC from the Power Supply to an accurate ±10VDC. The ±10VDC is used in conjunction with the SPEED potentiometer and Linear Acceleration Circuit (if provided) to set the speed reference or desired speed of the system. The second function is to generate a signal proportional to the amount of motor current (either motoring or regenerative) required to maintain a balance between the speed reference (desired speed) and the speed feedback (actual speed). Note that for a given direction of rotation, the polarity of the speed reference and speed feedback signals is always opposite. By convention, a negative speed reference signal into the Reference and Actuator PCB corresponds to forward rotation, thus requiring the speed feedback signal to be positive. Conversely, a positive speed reference signal and negative speed feedback signal correspond to reverse rotation.

END OF SECTION 3 TEXT

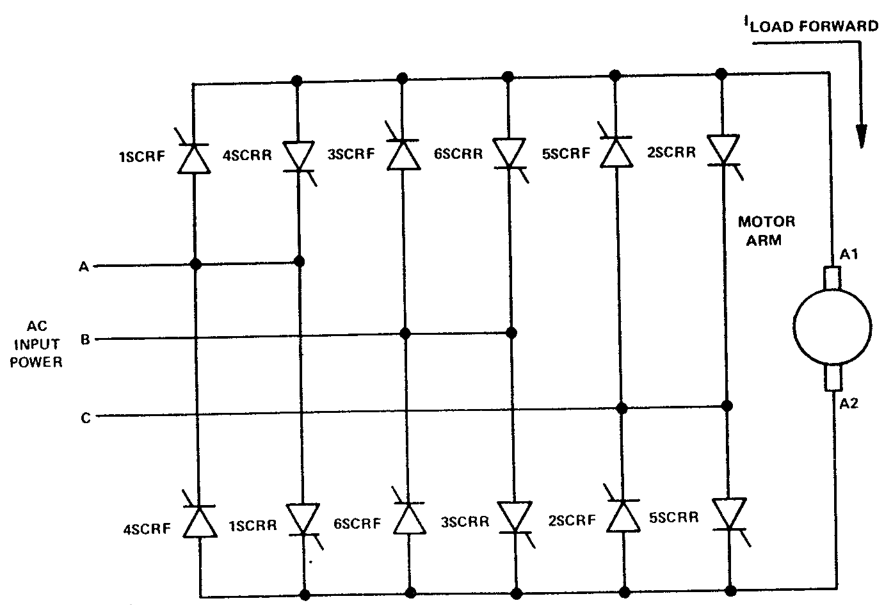


Figure 3-5. Simplified 12SCR Power Circuit

SECTION 4. ADJUSTMENTS

4.1 GENERAL

This section describes the adjustments associated with the PCU. These adjustments should be performed as required after parts have been replaced. These adjustments are to be performed by competent electrical maintenance personnel familiar with solid state circuitry. It is imperative that personnel familiarize themselves with the theory sections of this manual before attempting any adjustments.

4.2 CAUTIONS AND WARNINGS

WARNING

Be extremely careful when adjusting the PCU while input power is applied. The rectifier heatsinks conduct armature voltage which could be as high as 630VDC. Don't take chances.

WARNING

When using an oscilloscope, observe recommended oscilloscope procedure, paragraph 4.2.2.

CAUTION

Do not apply power to the armature for longer than one minute when the motor armature is locked. To do so could cause the armature winding to burn out.

4.2.1 Test Equipment

Equipment required for performing adjustment procedures is as specified in paragraph 1.5.

4.2.2 Recommended Oscilloscope Procedure

When using an oscilloscope to observe the high voltage waveforms in the PCU, the two oscilloscope channels should be used in a differential mode with two X100 probes and with the oscilloscope chassis connected to earth ground.

WARNING

If the differential mode is not used, the oscilloscope chassis must NOT be grounded nor connected with any other circuit. In this mode, the oscilloscope chassis and any object touching that chassis may be at a LETHAL ELECTRICAL POTENTIAL. Operation of an oscilloscope in this manner is EXTREMELY HAZARDOUS AND IS SPECIFICALLY NOT RECOMMENDED.

4.3 ADJUSTMENTS

Following are adjustment procedures for the potentiometers of the PCU printed circuit boards. Location of potentiometers is shown in Figure 4-1. Each potentiometer is first adjusted with the PCU deenergized and finally adjusted with the drive system energized and operating.

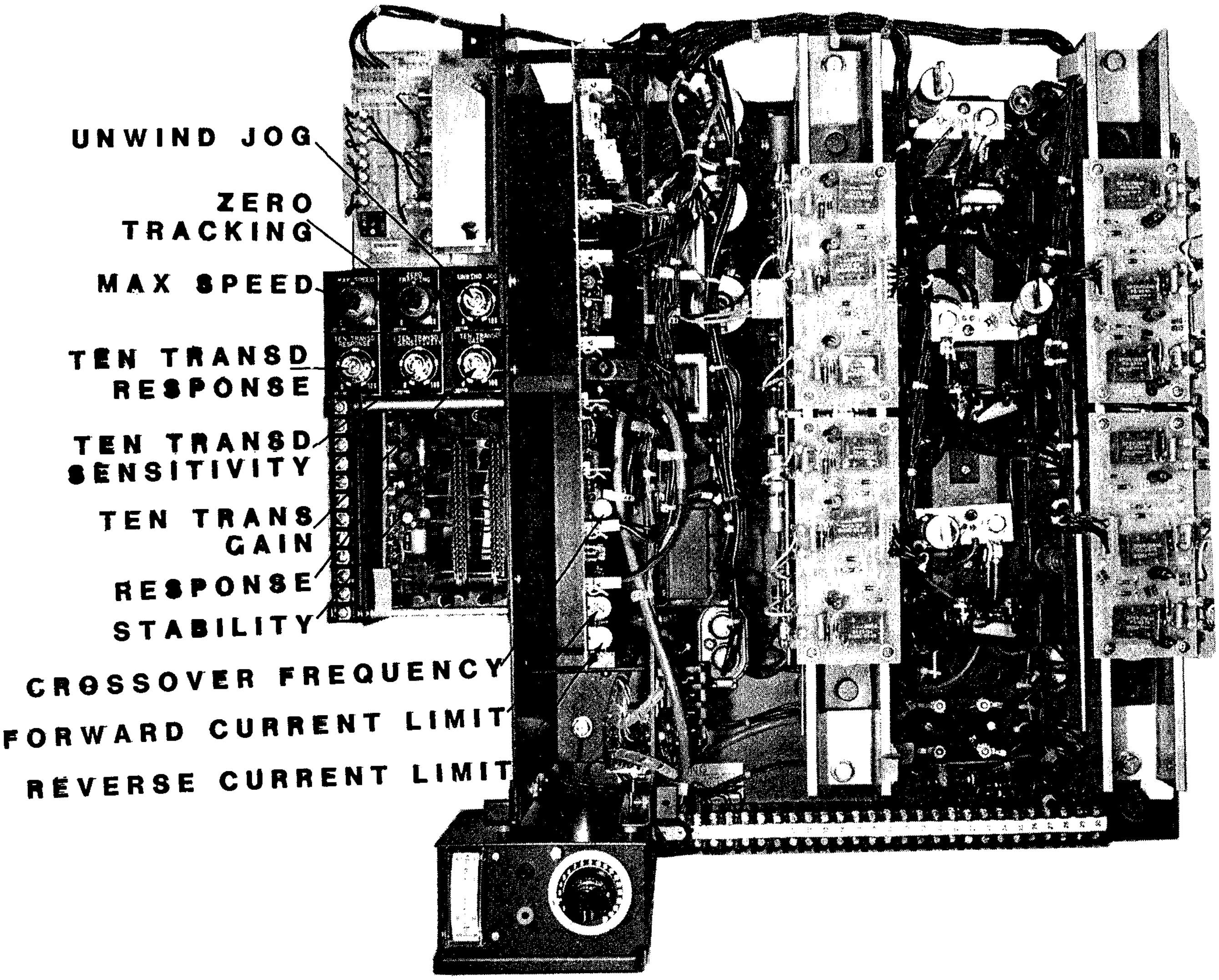


Figure 4-1. Potentiometers Location

SECTION 5. MAINTENANCE

5.1 PREVENTIVE MAINTENANCE

> **WARNING**
>
> Do not attempt preventive maintenance without first insuring all input power has been removed.

Preventive maintenance is primarily a matter of routine inspection and cleaning. The rectifier brdige heatsinks should be kept clean by brushing while using a vacuum cleaner. Excess dust and dirt accumulation on the heatsinks can cause overheating of the diodes and SCRs.

Periodically clean the cooling fan to prevent dirt buildup. At the same time, check that the impellers are free and not binding in the housing. The blower is permanently lubricated and should be replaced if the shaft does not spin freely.

5.2 REPAIR AND REPLACEMENT PROCEDURES

> **WARNING**
>
> Do not attempt repair or part replacement without first insuring all input power has been removed.

5.2.1 Printed Circuit Boards

Repair of printed circuit boards requires special techniques and test facilities. For this reason, field repair is not authorized and replacement of a suspect board is recommended.

Defective or questionable printed circuit boards should be returned to Louis Allis Drives and Systems, Service Department, 16555 West Ryerson Road, New Berlin, Wisconsin 53151, for repair and test. The printed circuit board should be individually protected with one inch thickness of soft wrapping material before it is packed in a suitable carton. Louis Allis Drives and Systems Division assumes no responsibility for printed circuit boards returned without proper return tags and forms. Contact the nearest Louis Allis District Office for proper return tags and forms.

Repaired or replacement printed circuit boards are tested and adjusted using factory facilities. Settings normally will not require readjustment.

5.2.2 Testing and Replacing SCRs

A. Testing. The SCRs in the rectifier bridge are the "Hockey Puk" configuration. The "Hockey Puk" type must be properly secured in their heatsinks in order to be effectively tested with an ohmmeter. The proper pressure must be applied to the poles of these SCRs to provide continuity. Check SCRs as follows without removing from the heatsink assembly.

1. To remove the heatsink assembly from the PCU, first remove cable plug 12CONNA or 12CONNB from the Zero Current Detector PCB and cable plugs 8CONN and 14CONN, or 9CONN and 13CONN, from the Gate Firing PCBs. If right heatsink assembly is being removed, open cable clamp to separate wire bundle from upper end of heatsink assembly. Disconnect the armature output lead from the top of the heatsink, then remove the mounting screws at the top and bottom of the assembly and pull heatsink assembly out of fuse clips on PCU panel. Disconnect gate and cathode leads from the Gate Firing PCBs.

2. Using a multimeter on the X100 range, press the positive probe of the ohmmeter on the common heatsink and the negative probe on each of the separate heatsinks. The reading in each case should be infinity.

3. Next, connect the negative probe of the ohmmeter on the common heatsink and the positive probe on each of the separate heatsinks. The reading in each case should be infinity. Since most SCRs fail by shorting and since the SCRs of the PCU are paired together by the heatsink assembly, a low resistance reading could indicate one or both SCRs are defective.

On a center bolt heatsink assembly, the suspected SCRs must be removed from the heatsink to be checked separately. On a "U" clamp heatsink assembly, the suspected SCRS can be tested separately by disconnecting the jumper wire from one of the separate heatsinks for the pair of SCRs.

4. Check the gate resistance of the SCRs by setting the ohmmeter range to X1 and connecting the ohmmeter positive lead to the gate of the SCR and the negative lead to the cathode. Indication should be 20 ohms.

5. If none of the SCRs are defective, reinstall the heatsink assembly as in C below. Defective SCRs must be replaced as in B below.

B. Replacement.

1. Remove or loosen mounting screws as required and remove Gate Firing PCBs and Zero Current Detector PCB from heatsinks. On "U" clamp heatsink assembly, disconnect jumper wire from separate heatsink of SCR to be replaced.

2. Mark anode and cathode bases of heatsink so they can be properly reassembled. Remove the clamp and separate the heatsink halves. Remove the SCR.

3. Check each mating surface for nicks, scratches, flatness, and surface finish. Surfaces are designed for .0004 inch total flatness runout and 32 microinch finish.

CAUTION
THE HEATSINK SURFACES ARE ELECTROPLATED. DO NOT SAND OR GRIND AS THE ELECTROPLATING WILL BE DESTROYED.

4. Apply a light coat (2 or 3 drops) of silicone oil (GE SF1154) on the mounting surfaces.

5. Position the new SCR with anode and cathode bases on the proper heatsink half as marked. Align the guide pins on the heatsinks with the guide holes in the SCR pole face indentures.

CAUTION

When assembling the SCR, observe the following conditions:

a. Gate and auxiliary cathode leads do not contact the heatsinks or one another.

b. Gate and auxiliary cathode leads are properly connected and secured. (Soldering is advised for proper connections).

c. Gate and auxiliary cathode lead protective sleeving is in good condition and pushed on properly.

6. Secure the SCR unit together using one of the following procedures. Note that torque requirements are the maximum allowable for the device. It is better to undertighten slightly than to exceed the given value.

a. METHOD 1 (Center bolt type, without optional force indicator). See Figure 5-1.

(1) Assembly clamps and bolt finger-tight.

(2) Insure that heatsink surfaces are parallel and square to one another.

(3) Tighten clamp bolt to 180 ±5 inch-pounds torque.

b. METHOD 2 (U-clamp type, without optional force indicator). See Figure 5-2.

(1) Assembly clamps and tighten bolts finger-tight with an even exposure of threads through the nut plate.

(2) Insure heatsink surfaces are parallel and square to one another.

(3) Tighten first bolt a half turn. Tighten second bolt a full turn. Tighten first bolt a full turn. Tighten second bolt a half turn.

c. METHOD 3 (U-clamp type, with optional force indicator). See Figure 5-3.

(1) Insure that the force indicator is set to zero.

(2) Install clamp and tighten nuts finger-tight.

(3) Quarter-turn nuts alternately until deflection on the gauge is 1.0.

7. Remove excess Silicone Oil.

8. Reinstall Zero Current Detector PCB and Gate Firing PCBs on heatsinks.

C. Installing Heatsink Assembly.

1. Connect all gate and cathode leads to the Gate Firing PCBs. Check that all jumper wires (on "U" clamp heatsink assembly) are securely connected to heatsinks.

2. Appply a light coating of Penetrox A to the fuse clips which the heatsink assembly will connect. Press heatsink assembly into fuse clips and secure in place with mounting screws at top and bottom. Reconnect armature output lead at top of heatsink.

3. Reconnect cable plugs to Zero Current Detector PCB and Gate Firing PCBs. On the right heatsink assembly, replace wire bundle in cable clamp and secure.

ASSEMBLY NO. 46S1603-	RESISTOR NO. 5P225-	RESISTANCE OHMS (1%)	FOR HP @ 230V	FOR HP @ 460V	AMPS DC
-0001	-0271	750		7.5	13.9
-0002	-0221	475		10	19.7
-0003	-0181	274	7.5	15	27
-0004	-0151	182	10	20	36.5
-0005	-0131	150		25	43
-0006	-0121	121	15	30	56
-0007	-0921	90.9	20	40	73
-0008	-0101	68.1	25	50	92
-0009	-0931	56.2	30	60	110
-0010	-0941	42.2	40	75	137
-0011	-0081	33.2	50	100	177
-0012	-0071	28.0	60	125	220
-0013	-0051	22.1	75	150	270

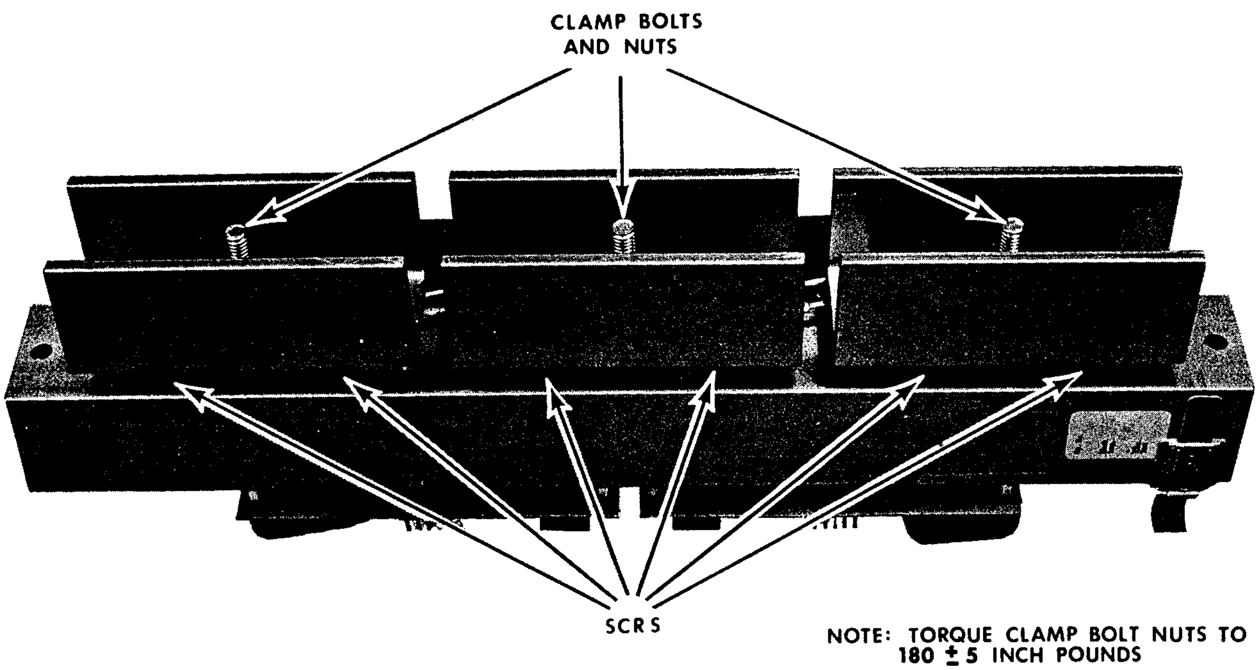


Figure 5-1. SCR Heat Sink Configuration, Center Bolt Type Without Force Indicator

5.2.3 Selecting Burden Resistors.

When replacing the burden resistor assembly (connected to 6CONN on the Main PCB), the resistor value must agree with the motor rating. Select burden resistor utilizing Table 5-1.

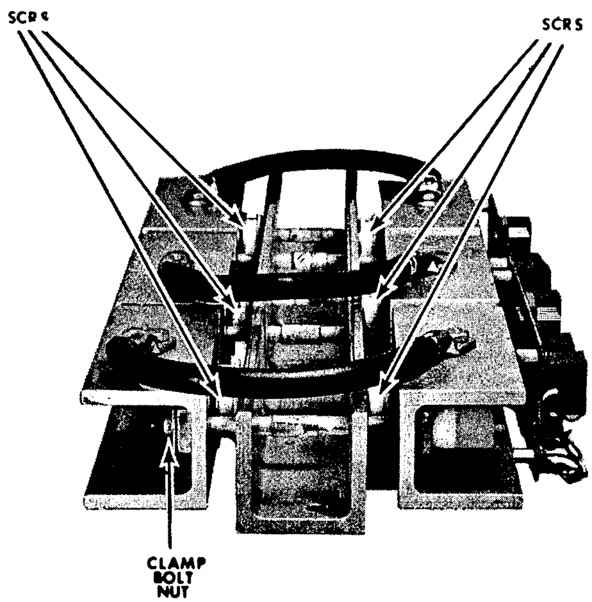


FIGURE 5-2. SCR Heatsink Configuration, "U" Clamp Type Without Force Indicator

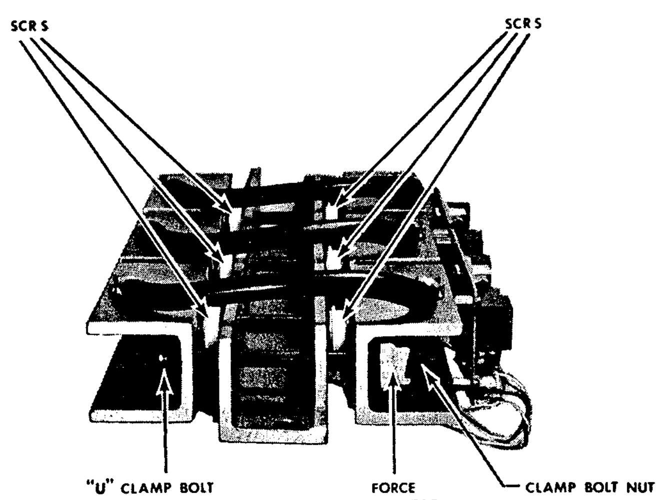


FIGURE 5-3. SCR Heatsink Configuration, "U" Clamp Type with Force Indicator

END OF SECTION 5 TEXT

SECTION 6. TROUBLESHOOTING

6.1 TROUBLESHOOTING PROCEDURES

Troubleshooting consists of a logical series of operational checks and observations designed to localize a fault to a printed circuit board or major circuit area. This section contains information for three separate troubleshooting techniques. The technique selected depends on the ability and experience of the maintenance technician and the test equipment available for troubleshooting activities. The three techniques are as follows:

A. PCB Substitution. This technique consists of observing the symptoms, determining which PCB is defective, and replacing the defective PCB with a good PCB. No test equipment is required for this method.

B. Troubleshooting Table. Table 6-1 contains information for identifying the probable cause and performing the corrective action for each of the six system faults (see paragraph 6.2). Test equipment required for this method is a multimeter or a built-in Test Meter Module. If the Test Meter Module is used, values given in Table 6-2 apply.

C. Troubleshooting Logic Blocks. Tables 6-3 through 6-8 are troubleshooting logic flow charts for each of the six system faults. The tables utilize a progressive series of checks and observations to isolate the fault. Test equipment for this method is a multimeter and an oscilloscope.

6.2 EQUIPMENT FAULTS

Faults of the drive system are manifested in terms of six different symptoms as follows:

1. Motor does not run at all.

2. Motor runs at reduced speed only.

3. Motor runs at full speed only.

4. PCU IST's (instantaneous static trips) or blows fuses on startup.

5. Motor runs in one direction only or does not regenerate.

6. PCU IST's or blows fuses when regenerating or reversing operation (operates well in one direction).

Choose the troubleshooting symptom or troubleshooting logic block diagram corresponding to the primary system fault which is observed.

6.3 TROUBLESHOOTING INFORMATION

In addition to the troubleshooting table and logic blocks, the following information is also provided to assist in troubleshooting:

A. Figure 6-1 is an internal connection diagram for the PCU and may be used for tracing signals.

B. Figure 6-2 is a schematic diagram of the Main PCB.

C. Figures 6-3 and 6-5 locate test points on the Main PCB and Reference and Actuator PCB, respectively.

D. Figures 6-6 through 6-16 are waveforms referenced in Tables 6-3 through 6-8.

E. A schematic diagram for each assembly of the PCU is contained in the Drawing Section of this manual.

6.4 WARNINGS AND CAUTIONS

The following warnings and cautions must be observed at all times during troubleshooting procedures.

WARNING

Be extremely careful when working on the PCU when input power is applied. The rectifier heatsinks conduct armature voltage which could be as high as 630VDC. Don't take chances.

WARNING

When using an oscilloscope, follow the recommended oscilloscope procedure of paragraph 6.5.

CAUTION

When checking voltages with an oscilloscope or multimeter at test points P1F-P6F and P1R-P6R of the Main PCB and gates of the SCRs, do not connect or disconnect any test leads without removing input power. Connecting or disconnecting leads while power is applied will cause the wrong SCRs to fire and may blow the primary power fuses.

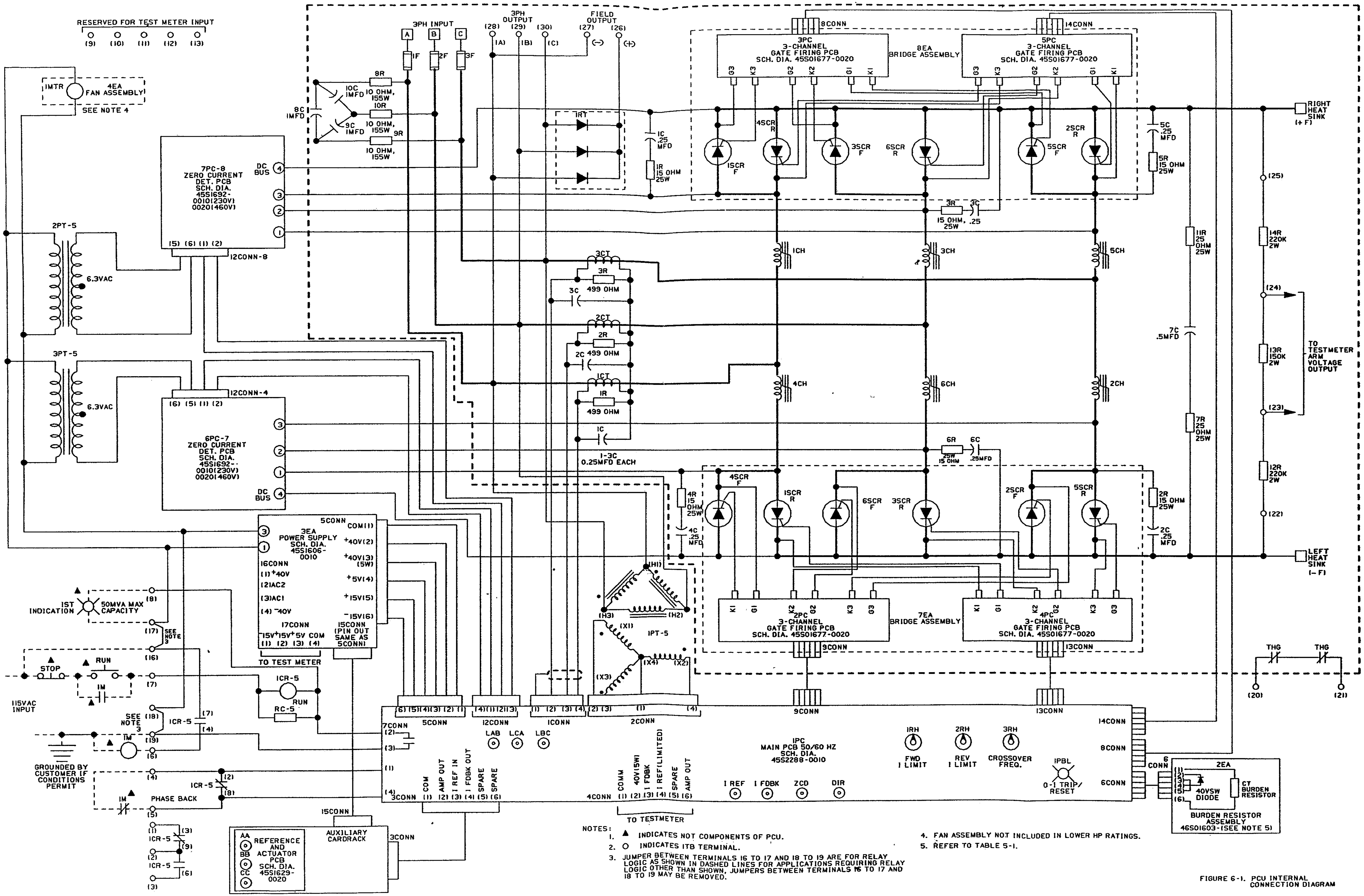
6.5 RECOMMENDED OSCILLOSCOPE PROCEDURE

When using an oscilloscope to observe the high voltage waveforms in the PCU, the two oscilloscope channels should be used in a differential mode with two X100 probes and with the oscilloscope chassis connected to earth ground.

WARNING

If the differential mode is not used, the oscilloscope chassis must NOT be grounded nor connected with any other circuit. In this mode, the oscilloscope chassis and any object touching that chassis may be at a LETHAL ELECTRICAL POTENTIAL. Operation of an oscilloscope in this manner is EXTREMELY HAZARDOUS AND IS SPECIFICALLY NOT RECOMMENDED.

END OF SECTION 6 TEXT



NOTES:

1. ▲ INDICATES NOT COMPONENTS OF PCU.
2. ○ INDICATES ITB TERMINAL.
3. JUMPER BETWEEN TERMINALS 16 TO 17 AND 18 TO 19 ARE FOR RELAY LOGIC AS SHOWN IN DASHED LINES FOR APPLICATIONS REQUIRING RELAY LOGIC OTHER THAN SHOWN, JUMPERS BETWEEN TERMINALS 16 TO 17 AND 18 TO 19 MAY BE REMOVED.
4. FAN ASSEMBLY NOT INCLUDED IN LOWER HP RATINGS.
5. REFER TO TABLE 5-1.

FIGURE 6-1. PCU INTERNAL CONNECTION DIAGRAM

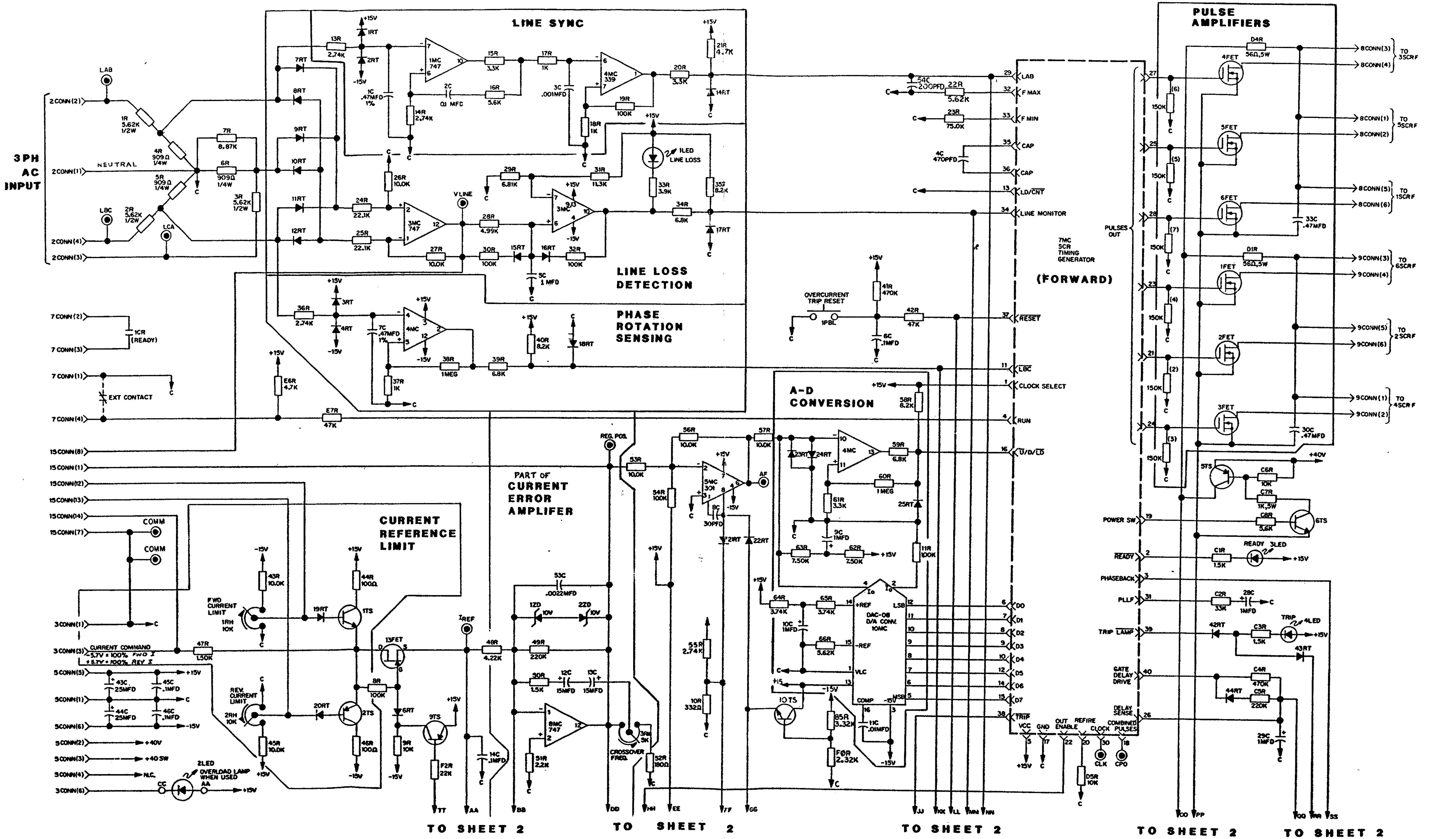


Figure 6-2. Main PCB Schematic Diagram
Sheet 1

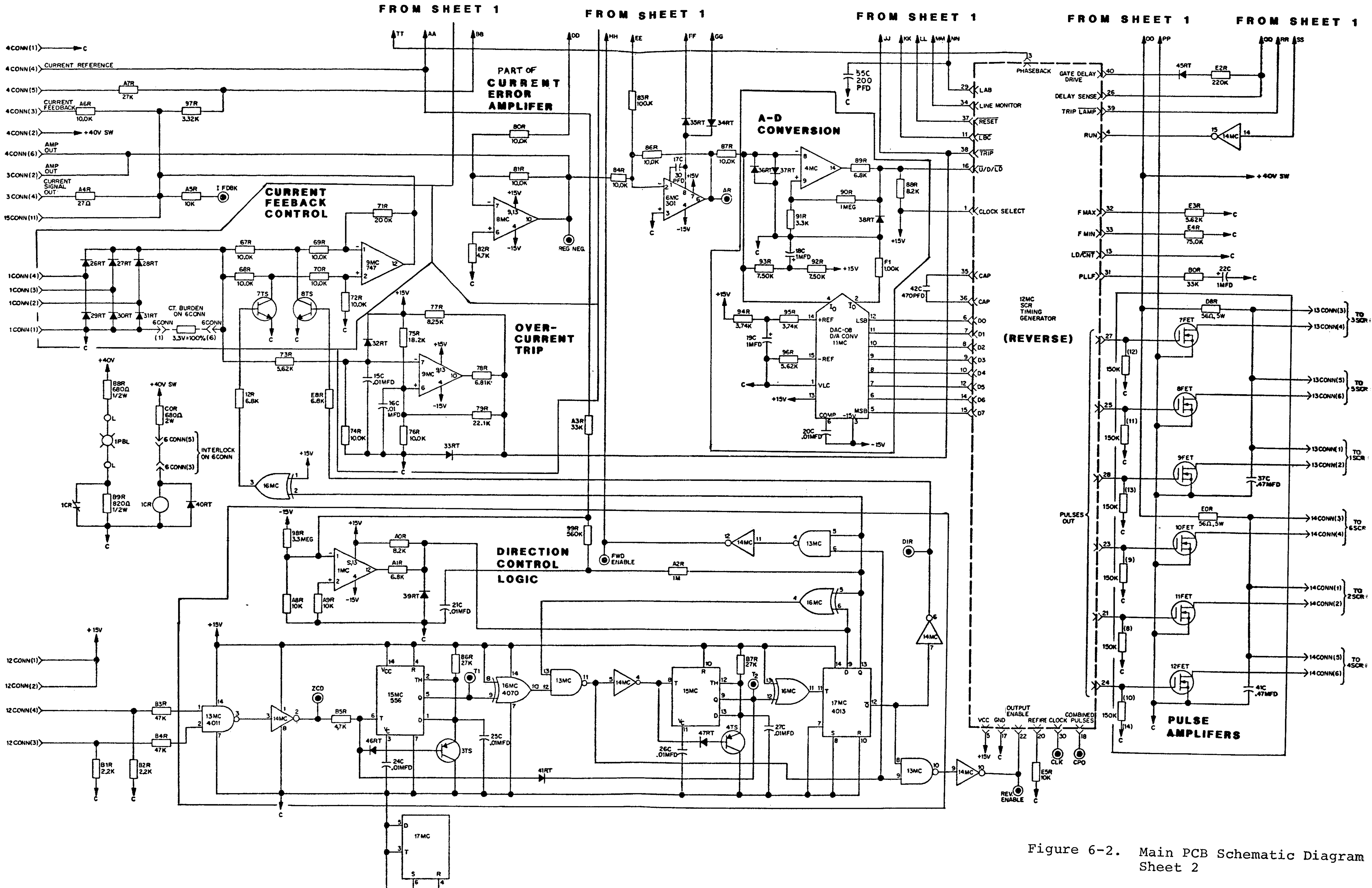


Figure 6-2. Main PCB Schematic Diagram Sheet 2

TABLE 6-1. Drive System Troubleshooting
Using Multimeter or Test Meter Module

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Motor Does Not Run at All	a. No AC input power.	a. Using multimeter, insure that proper input power is present.
	b. Defective interlock or thermoguard switches.	b. Repair or replace switches as required.
	c. Blown fuse(s).	c. Check for blown fuse(s). Replace as required. Try starting drive system. If PCU ISTs or blows fuses on startup, go to symptom 4 procedures, below.
	d. Improper 1-phase control power.	d. Check for 115VAC input at 1TB 16 and 19. If voltage is missing or incorrect, check external wiring and stepdown transformer.
	e. Defective phasing transformer 1PT.	e. Check secondary voltage of transformer 1PT (line to neutral) at TPs LAB, LBC, and LCA. Voltage should be 50 $\pm$5VAC. If voltage is incorrect, replace 1PT.
	f. Defective power supply.	f. Check for the following DC voltages: +15, -15, +5, and +20. If Test Meter Module is available, use Table 6-2. If any voltages are incorrect or missing, replace power supply.
	g. Defective field supply rectifier 1RT (3-phase half-wave).	g. Check for field supply voltage. If voltage is incorrect, replace rectifier module.
	h. Improper I_{FBK} voltage.	h. Check voltage at TP I_{FBK}. Voltage should be between -5.0 and +5.0VDC. Nominal -3.0 to +3.0VDC. If Test Meter Module is available, use Table 6-2. If voltage is improper, replace Main PCB.

TABLE 6-1. Drive System Troubleshooting Using Multimeter or Test Meter Module (CONTINUED)

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Motor Does Not Run at All (Continued)	i. Improper I_{REF} voltage.	i. Check voltage at TP I_{REF}. Voltage should be -5.0 to +5.0VDC (but not zero volts). Nominal -4.0 or +4.0VDC. If Test Meter Module is available, use Table 6-2. If voltage is improper, proceed as follows: 1. Check voltage at TP BB (on Reference and Actuator PCB). Voltage should be -15.0 to +15.0VDC (but not zero volts). 2. If voltage at TP BB is proper, replace Main PCB. If voltage at TP BB is improper, replace Reference and Actuator PCB.
	j. No armature voltage.	j. Check armature voltage. If Test Meter Module is available, use Table 6-2. If no armature voltage is present, replace Main PCB.

NOTE

If drive system cannot be successfully repaired, consult the Louis Allis Drives and Systems Division, Litton Industrial Products.

SYMPTOM	PROBABLE CAUSE	REMEDY
2. Motor Runs at Reduced Speed Only	a. Defective power supply.	a. Check for following DC voltages on the power supply: +40, +15, -15 and +5. If Test Meter Module is available, use Table 6-2. If any voltages are incorrect or missing, replace power supply.

TABLE 6-1. Drive System Troubleshooting
Using Multimeter or Test Meter Module
(Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
2. Motor Runs at Reduced Speed Only (Continued)	b. Defective +10 and/or -10 volt power supply on Reference and Actuator PCB.	b. Check for +10 and -10VDC on Reference and Actuator PCB as follows: 1. Remove power. 2. Remove Reference and Actuator PCB from Cardrack. 3. Insert Reference and Actuator PCB into Card Extender. 4. Insert Card Extender into Cardrack and apply power. 5. Check for +10 and -10VDC at pins 11 and M on Card Extender. 6. If eigher +10 or -10 VDC is incorrect, replace Reference and Actuator PCB.
	c. Defective speed pot or Linear Accel PCB (if supplied with drive system).	c. Check voltage on wiper of speed pot. Voltage should be 10VDC at 100% setting. Check that all interlocks are good. If speed pot and interlocks are good, check output of Linear Accel PCB. If output is not 10V ±2, replace PCB.
	d. Improper I_{REF} voltage.	d. Check voltage at TP I_{REF}. Voltage should be between -5.0 and +5.0VDC. Nominal -4.0 to +4.0VDC. If Test Meter Module is available, use Table 6-2. If voltage is improper, proceed as follows:

NOTE

For any given direction of rotation, the speed reference and tach feedback signals are always opposite in polarity. By convention a negative speed reference signal corresponds to forward rotation, thus making the tach feedback signal positive.

TABLE 6-1. Drive System Troubleshooting
Using Multimeter or Test Meter Module
(Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
2. Motor Runs at Reduced Speed Only (Continued)	d. Improper I_{REF} voltage. (Continued)	1. Check voltage at TP BB (on Reference and Actuator PCB). Voltage should be similar to TP I_{REF}. 2. If voltage at TP BB is proper, replace Main PCB. If voltage at TP BB is improper, replace Reference and Actuator PCB.
	e. Improper I_{FBK} voltage.	e. Check voltage at TP I_{FBK}. Voltage should be between -5.0 and +5.0VDC. Nominal -3.0 to +5.0VDC. If Test Meter Module is available, use Table 6-2. If voltage is improper, replace Main PCB.
	f. Defective field supply rectifier 1RT (3-phase half-wave).	f. Check for field supply voltage. If voltage is incorrect, replace 1RT.
	g. Defective phasing transformer 1PT.	g. Check secondary voltage of transformer 1PT (line to neutral) at TP's LAB, LBC, and LCA. Voltage should be 50VAC. If voltage is incorrect, replace 1PT.
3. Motor Runs at Full Speed Only	a. Defective power supply.	a. Check for following DC voltages at the power supply: +40, +15, -15, and +5. If Test Meter Module is available, use Table 6-2. If any voltages are incorrect or missing, replace power supply.

TABLE 6-1. Drive System Troubleshooting Using Multimeter or Test Meter Module

(Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
3. Motor Runs at Full Speed Only (Continued)	b. Defective tachometer.	b. To check for defective tachometer, proceed as follows: 1. Remove power. 2. Remove Reference and Actuator PCB from Cardrack. 3. Insert Reference and Actuator PCB into Card Extender. 4. Insert Card Extender into Cardrack and apply power. 5. Check tach voltage on Reference and Actuator PCB, pin 12 and TP CC. Check that polarity of tach feedback signal is opposite polarity of speed reference signal. For tach voltage at maximum speed, refer to tach nameplate. 6. If any discrepancies exist in tach voltage, replace tachometer.
NOTE For any given direction of rotation, the speed reference and tach feedback signals are always opposite in polarity. By convention a negative speed reference signal corresponds to forward rotation, thus making the tach feedback signal positive.		
	c. Defective speed pot or Linear Accel PCB (if supplied).	c. Perform following checks: 1. Check voltage on wiper of speed pot. Voltage should be zero with pot at zero. Note that on some reversing drives, zero position is at 50% rotation. 2. Check output of Linear Accel PCB. If input is zero but output is high, replace PCB.

TABLE 6-1. Drive System Troubleshooting Using Multimeter or Test Meter Module (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
3. Motor Runs at Full Speed Only (Continued)	d. Defective Reference and Actuator PCB.	d. Perform following checks on Reference and Actuator PCB: 1. Check voltage at TP AA. Voltage should be at least 10VDC and opposite in polarity to tach voltage. If voltage is incorrect, replace Reference and Actuator PCB. 2. Check voltage at TP BB. Voltage should be similar to TP I_{REF}. If voltage is incorrect, replace Reference and Actuator PCB.
	e. Defective Main PCB.	e. Check voltage at TP I_{REF}. Voltage should be between -5.0 and +5.0VDC. If Test Meter Module is available, use Table 6-2. If voltage is incorrect, replace Main PCB.
4. PCU IST's or Blows Fuses on Start-Up	a. Shorted motor.	a. Insure that motor is not shorted. If in doubt, disconnect motor armature.
	b. Shorted SCR(s).	b. Check for shorted SCR(s) per paragraph 5.2.2.
	c. Short across DC bus.	c. Remove short across DC bus.
	d. Defective power supply.	d. Check for following DC voltages at the power supply: +15, -15, +5 and +40. If Test Meter Module is available, use Table 6-2. If any voltages are incorrect, replace power supply.
	e. Defective phasing transformer 1PT.	e. Check secondary voltage of transformer 1PT (line to neutral) at TP's LAB, LBC, AND LCA. Voltage should be 50VAC. If voltage is incorrect, replace 1PT.

TABLE 6-1. Drive System Troubleshooting
Using Multimeter or Test Meter Module
(Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
4. PCU IST's or Blows Fuses on Start-up (Continued)	f. Defective field supply rectifier 1RT (3-phase half-wave).	f. Check for field supply voltage. If voltage is incorrect, replace 1RT.
	g. Improper 1-phase control power.	g. Check for 115VAC input at 1TB 16 and 19. If voltage is missing or incorrect, check external wiring and stepdown transformer.
	h. Defective Main PCB.	h. Remove then reapply power. 1PBL lamp should light brightly and go dim 0.5 to 2 seconds after power is applied. If not, manually reset overcurrent trip circuit by pressing 1PBL lamp. If lamp does not dim, replace Main PCB.
5. Motor Runs in One Direction Only or Will Not Regenerate	a. Defective Zero Current Detector PCB.	a. Replace both Zero Current Detector PCBs.
	b. Defective Main PCB.	b. Replace Main PCB.
6. PCU IST's or Blows Fuses When Regenerating or Reversing Direction (Operates Well In One Direction)	a. Defective Zero Current Detector PCB.	a. Replace both Zero Current Detector PCB's.
	b. Defective Main PCB.	b. Replace Main PCB.

TABLE 6-2. TEST METER MODULE VOLTAGE MEASUREMENT PROCEDURES

STEP SELECTOR (INNER KNOB)	RANGE SELECTOR (OUTER KNOB)	NORMAL READING AND SOURCE OF VOLTAGE	TEST POINT EQUIVALENT
1	20V	+15VDC, on Power Supply	
2	20V	-15VDC, on Power Supply	
3	6V	+5VDC, on Power Supply	
4	6V	Variable, depending on load and speed. -5.0 to +5.0VDC, on Main PCB.	TP I_{REF}
5	6V	Variable, depending on load and speed. 0 to -4.2VDC, on Main PCB.	TP REG NEG
6	6V	Variable, depending on load and speed. -5.0 to +5.0VDC, on Main PCB.	TP I_{FBK}
7	60V	+40VDC, on Power Supply	
8 thru 15			
16	200V	Variable, depending on load and speed. Max 550VDC output (for 460VAC input). Output ÷ 4 = 137.5 VDC (actual reading on Test Meter).	Armature Voltage
17 thru 19			

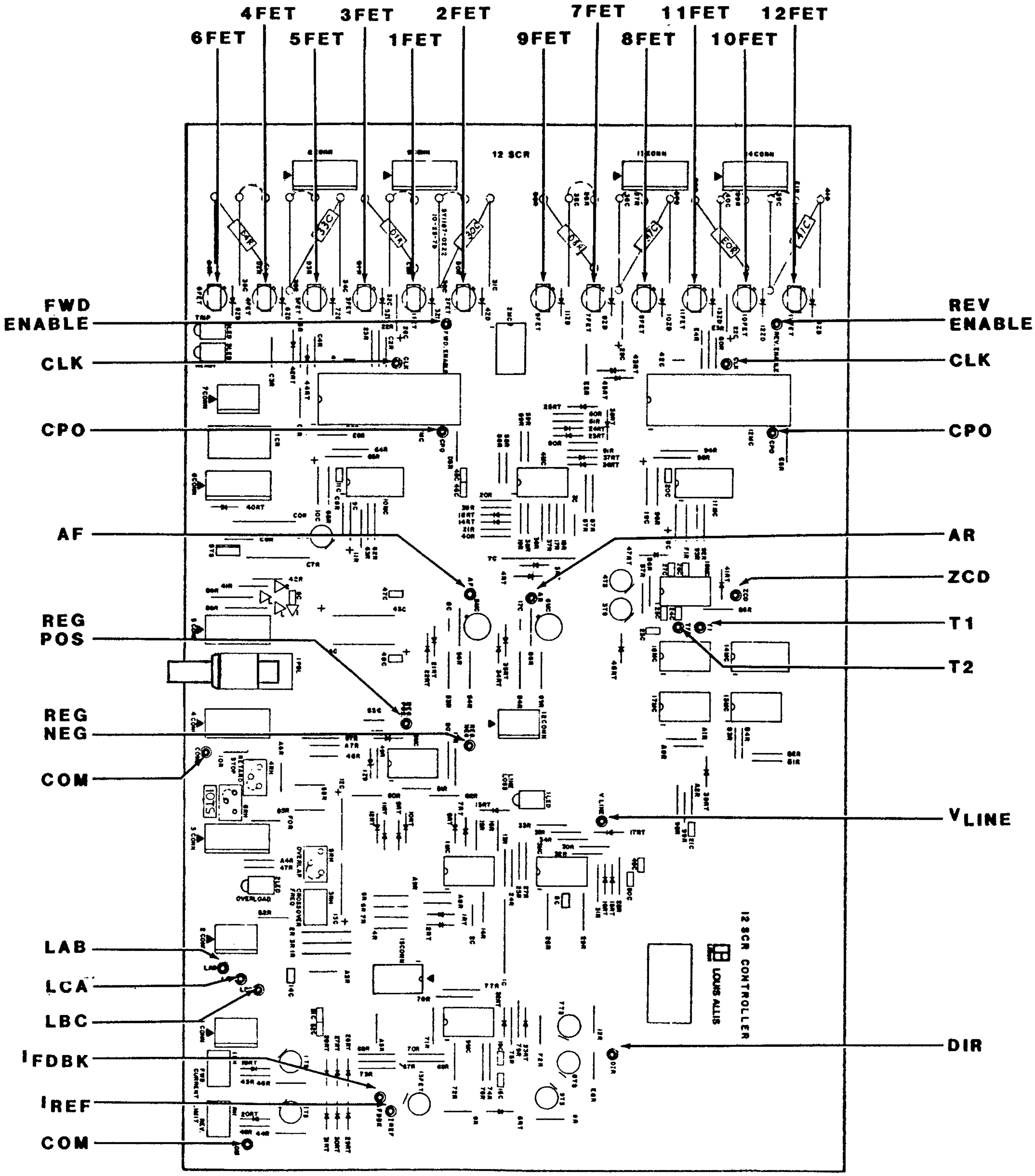


Figure 6-3. Main PCB Test Point Location

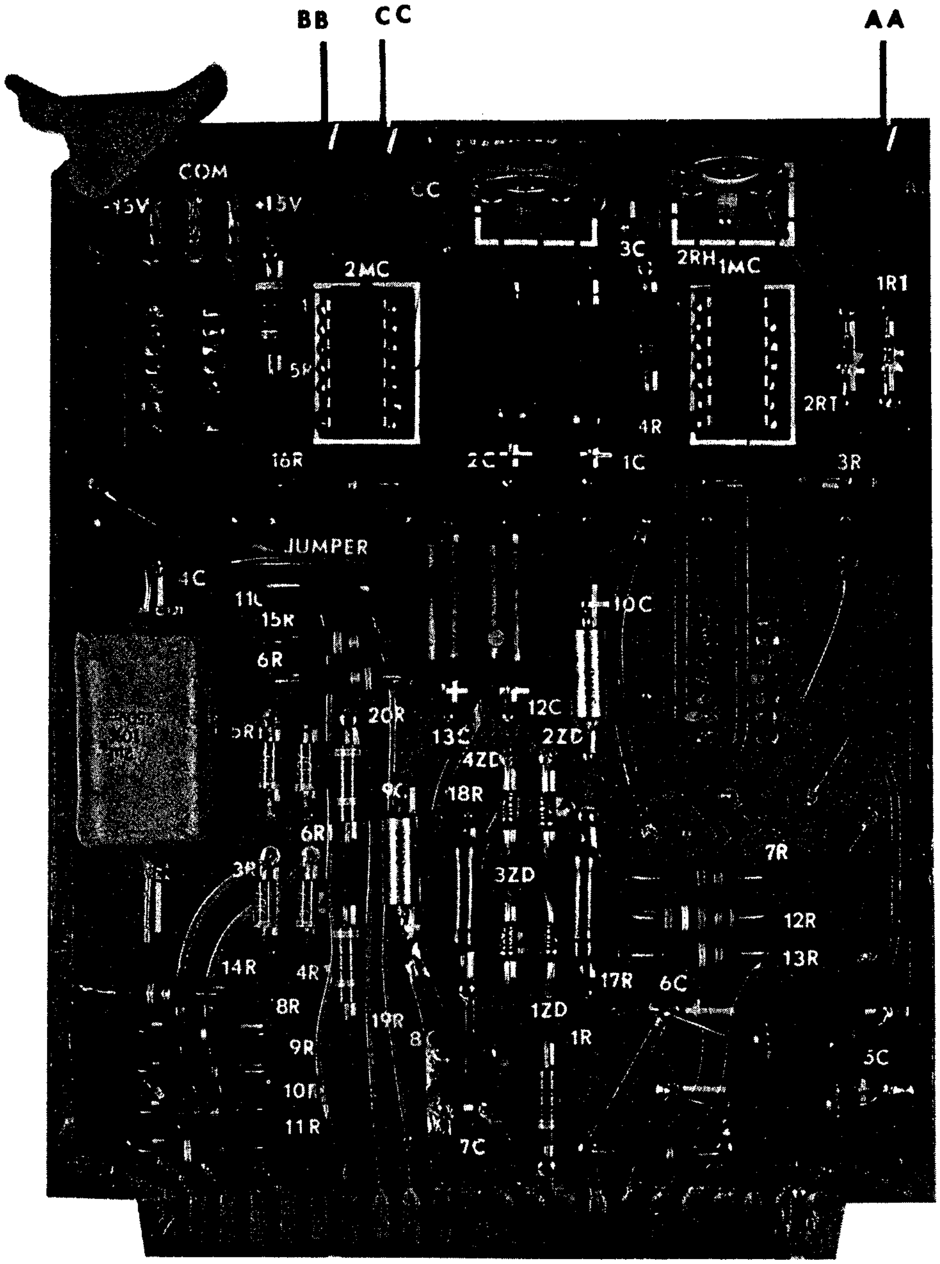
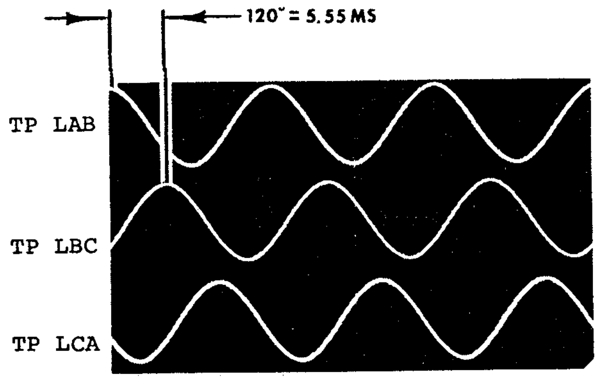


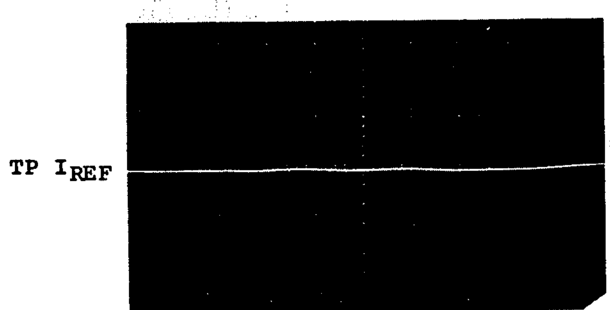
Figure 6-5. Reference and Actuator PCB Test Point Location



SCALE: VERT. 100V/CM
HORIZ. 5MS/CM

NOTE: WAVEFORMS REMAIN CONSTANT REGARDLESS OF MOTOR SPEED, LOAD OR DIRECTION OF ROTATION

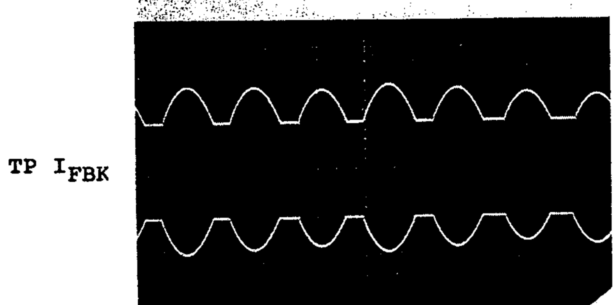
Figure 6-6. Secondary Voltage for Phasing Transformer 1PT



SCALE: VERT. 5V/CM
HORIZ. 2MS/CM

NOTE: WAVEFORM IS SOMEWHAT IRREGULAR AT LOW SPEED AND NO LOAD. WHEN SPEED AND LOAD ARE INCREASED, WAVEFORM TENDS TO FLATTEN AS SHOWN.

Figure 6-7. Current Reference Signal

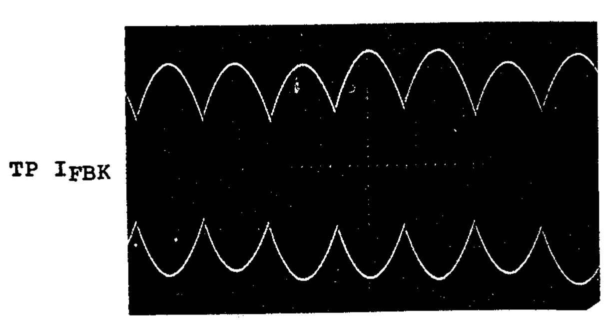


SCALE: VERT. 2V/CM
HORIZ. 2MS/CM

FORWARD ROTATION

REVERSE ROTATION

NOTE: WAVEFORM INDICATES MOTOR ROTATING AT LOW RPM AND LIGHT LOAD (DISCONTINUOUS CONDUCTION)



SCALE: VERT. 2V/CM
HORIZ. 2MS/CM

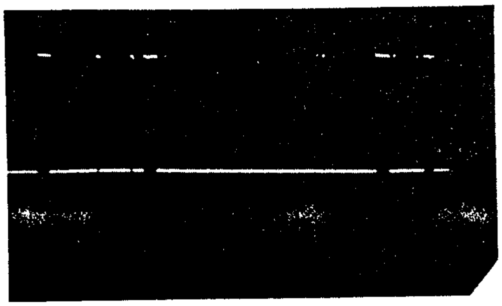
FORWARD ROTATION

REVERSE ROTATION

NOTE: WAVEFORM INDICATES MOTOR ROTATING AT FULL SPEED AND FULL LOAD (CONTINUOUS CONDUCTION)

Figure 6-8. Current Feedback Signal (Light Load and Full Load Signals)

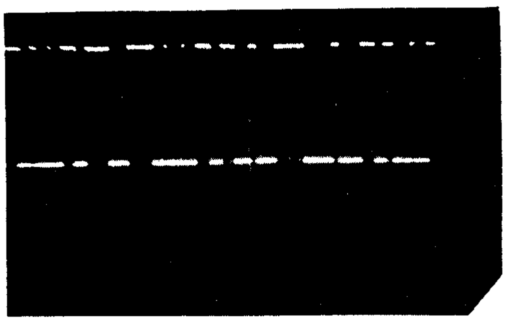
TP ZCD



SCALE: VERT. 2V/CM
HORIZ. 2MS/CM

NOTE: MOTOR DISCONNECTED OR CONNECTED AND SET FOR ZERO SPEED

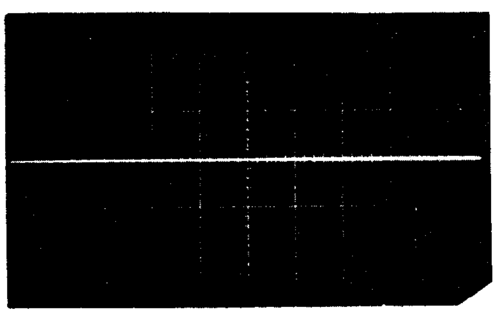
TP ZCD



SCALE: VERT. 2V/CM
HORIZ. 2MS/CM

NOTE: MOTOR ROTATING AT LOW SPEED AND PARTIAL LOAD OR FULL SPEED AND NO LOAD

TP ZCD

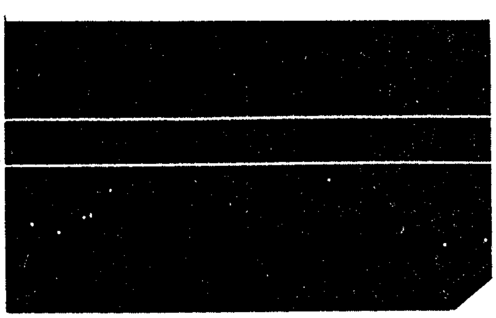


SCALE: VERT. 2V/CM
HORIZ. 2MS/CM

NOTE: MOTOR ROTATING AT FULL SPEED AND FULL LOAD

Figure 6-9. Zero Current Detector Signal (Zero Speed, Low Speed/Low Load, or Full Speed Signals)

TP DIR

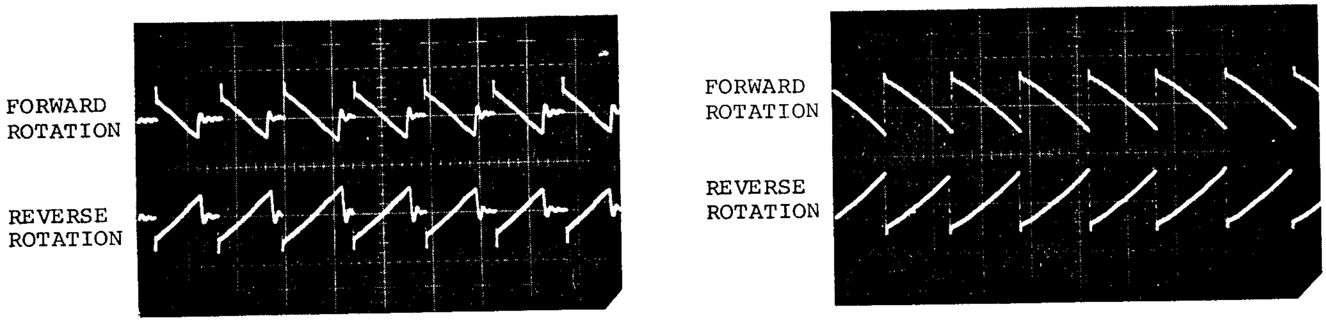


SCALE: VERT. 5V/CM
HORIZ. 2MS/CM

+5V FORWARD ROTATION

0 REVERSE ROTATION

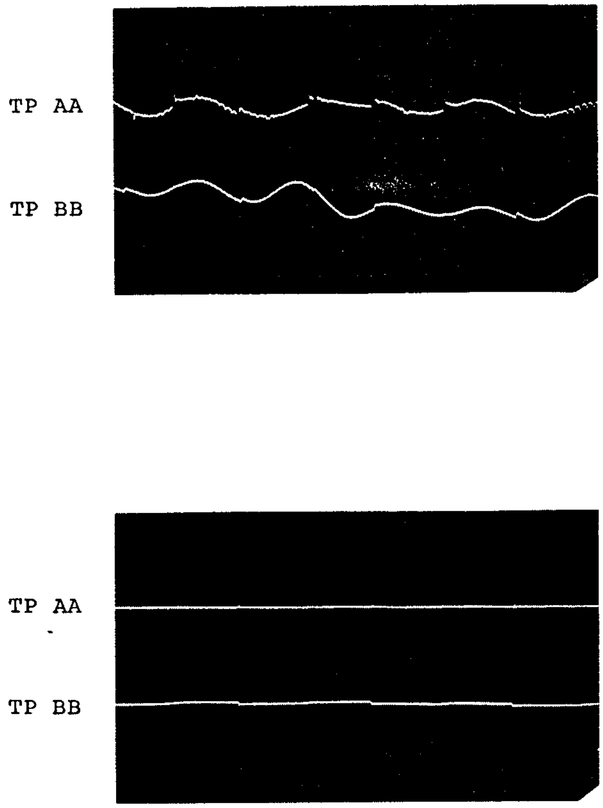
Figure 6-10. Direction Control Signal



SCALE: VERT. 500V/CM
HORIZ. 2MS/CM

NOTE: LEFT WAVEFORMS INDICATE DISCONTINUOUS CONDUCTION (MOTOR AT LOW SPEED LIGHT LOAD OR HIGH SPEED AND NO LOAD). RIGHT WAVEFORMS INDICATE CONTINUOUS CONDUCTION (MOTOR AT FULL SPEED AND FULL LOAD).

Figure 6-14. Armature Voltage (Discontinuous and Continuous Conduction)



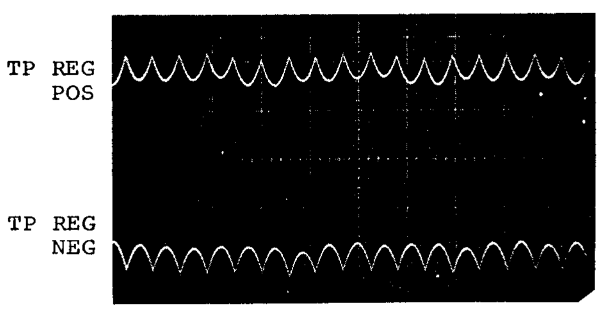
SCALE: VERT. 2V/CM
HORIZ. 2MS/CM

NOTE: MOTOR ROTATING FULL SPEED (NO LOAD). WAVEFORMS INDICATE DRIVES SYSTEM IN AN UNSTABLE STATE LACKING STABILITY AND RESPONSE.

SCALE: VERT. 2V/CM
HORIZ. 2MS/CM

NOTE: MOTOR ROTATING FULL SPEED NO LOAD. WAVEFORMS INDICATE DRIVE SYSTEM IN A STABLE STATE.

Figure 6-15. Reference and Actuator PCB Output Signals (Stable and Unstable States)



SCALE: VERT. 2V/CM
HORIZ. 5MS/CM

NOTE: WAVEFORM INDICATES MOTOR ROTATING AT FULL SPEED AND FULL LOAD (CONTINUOUS CONDUCTION)

Figure 6-16. Current Regulator Positive and Negative Signals

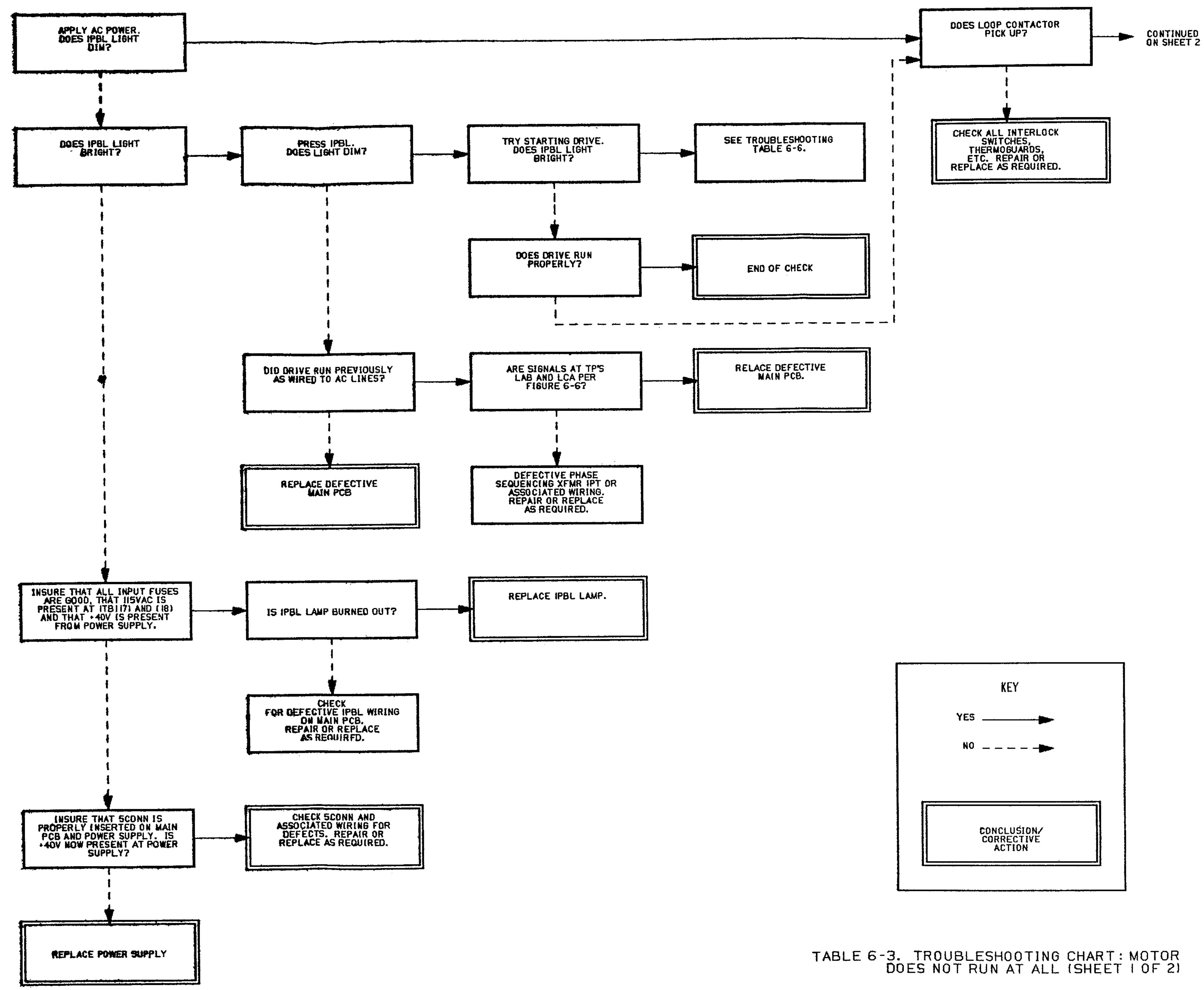


TABLE 6-3. TROUBLESHOOTING CHART: MOTOR DOES NOT RUN AT ALL (SHEET 1 OF 2)

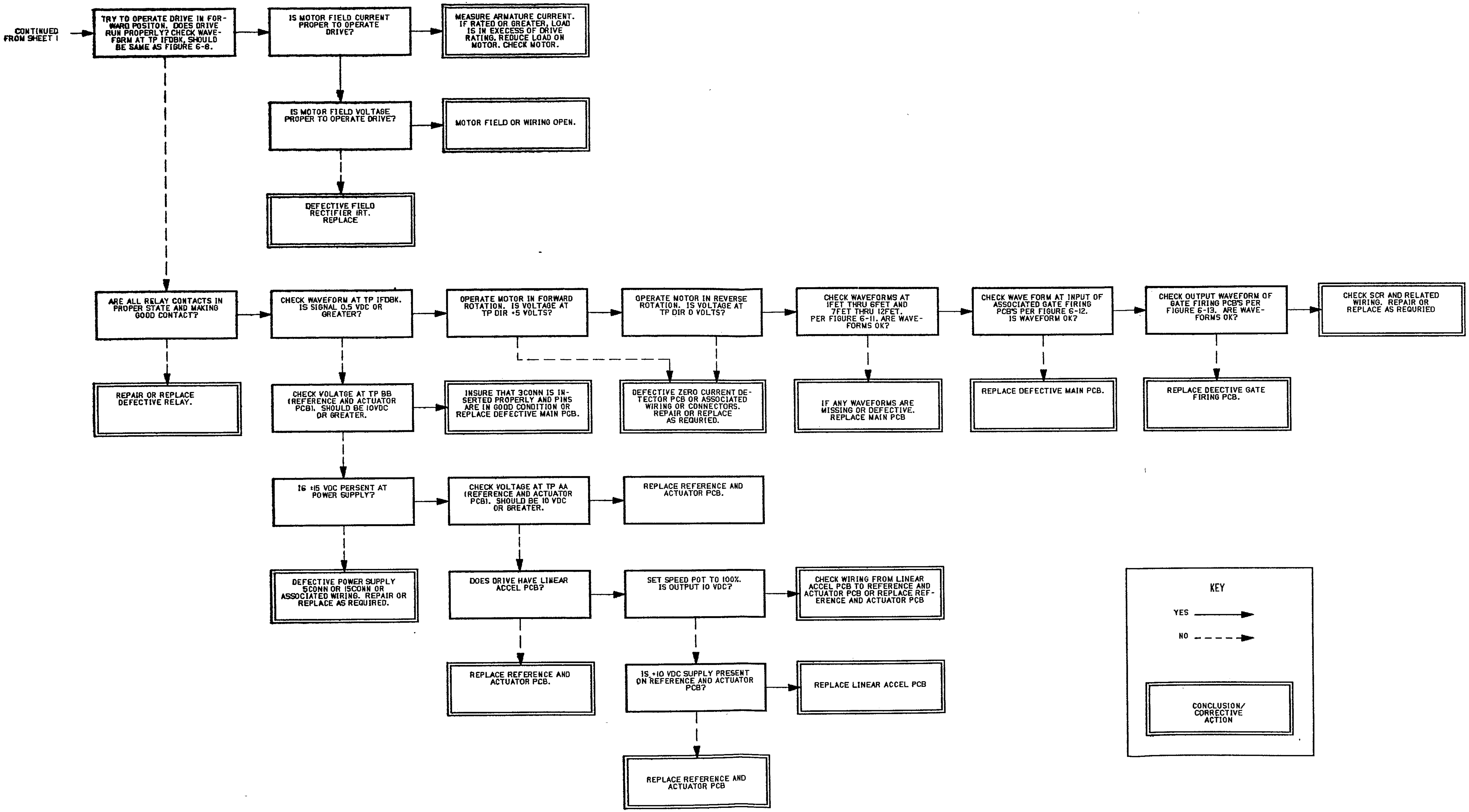


TABLE 6-3. TROUBLESHOOTING CHART: MOTOR DOES NOT RUN AT ALL (SHEET 2 OF 2)

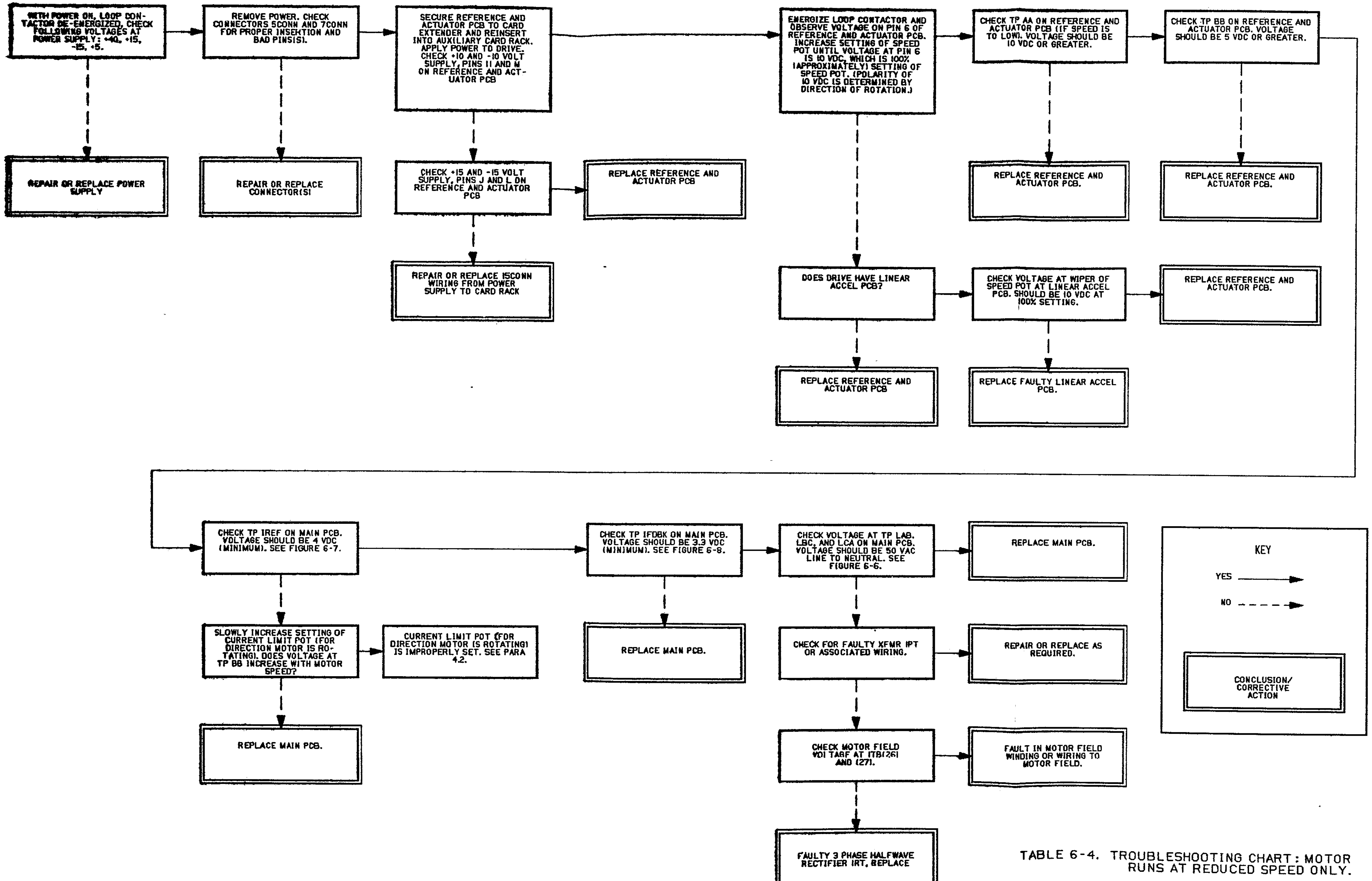


TABLE 6-4. TROUBLESHOOTING CHART: MOTOR RUNS AT REDUCED SPEED ONLY.

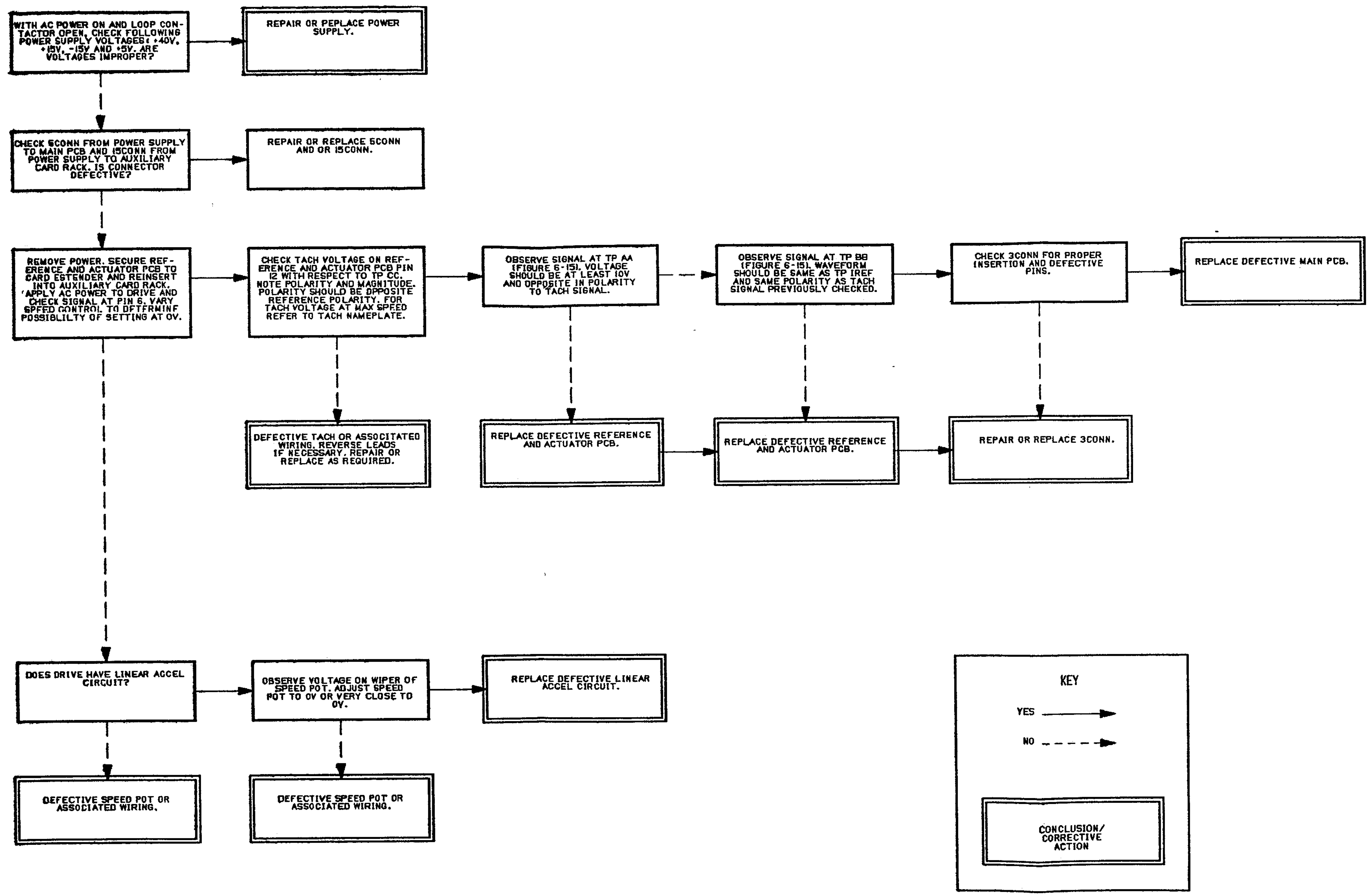


TABLE 6-5. TROUBLESHOOTING CHART: MOTOR RUNS AT FULL SPEED ONLY.

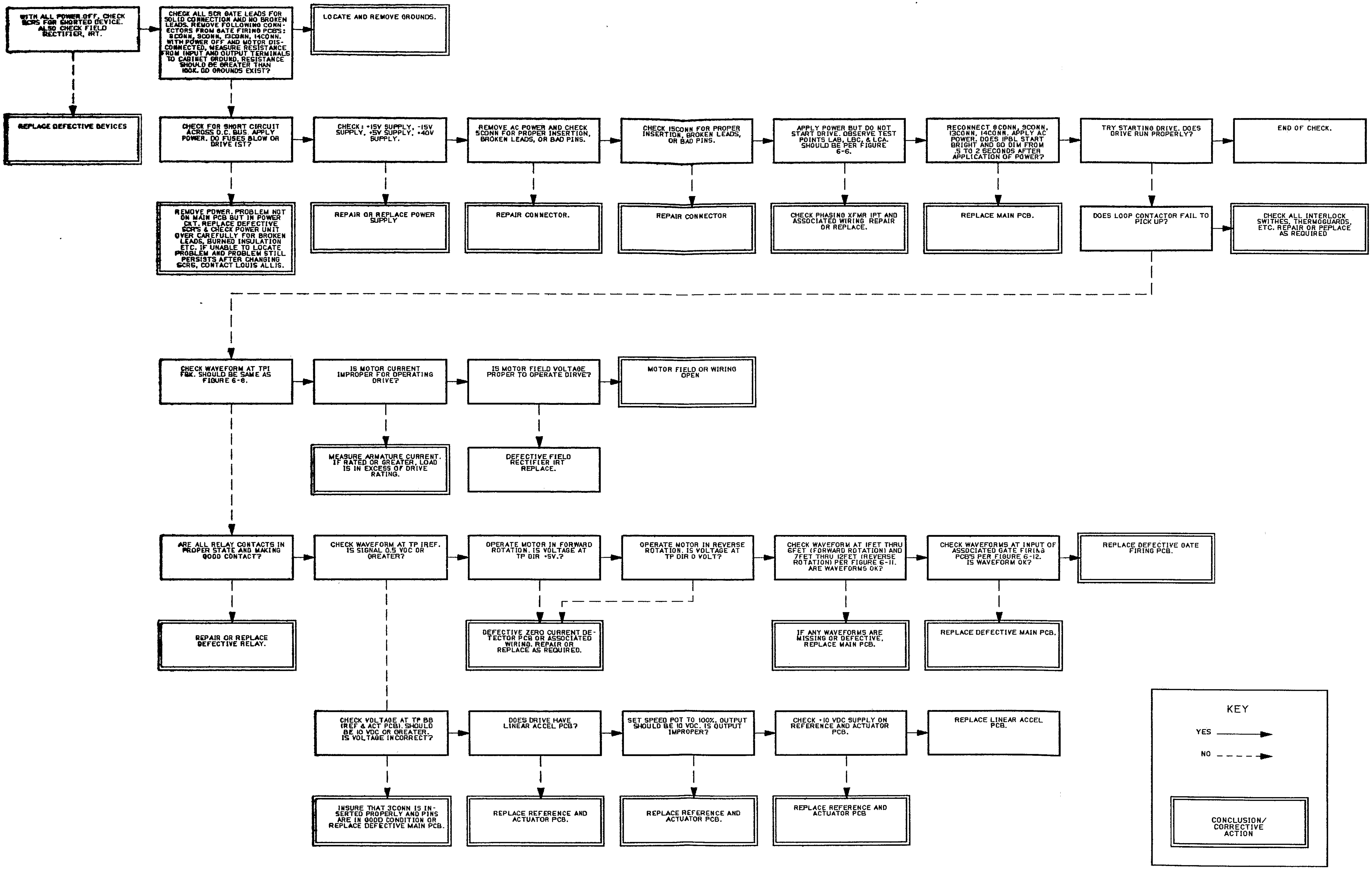
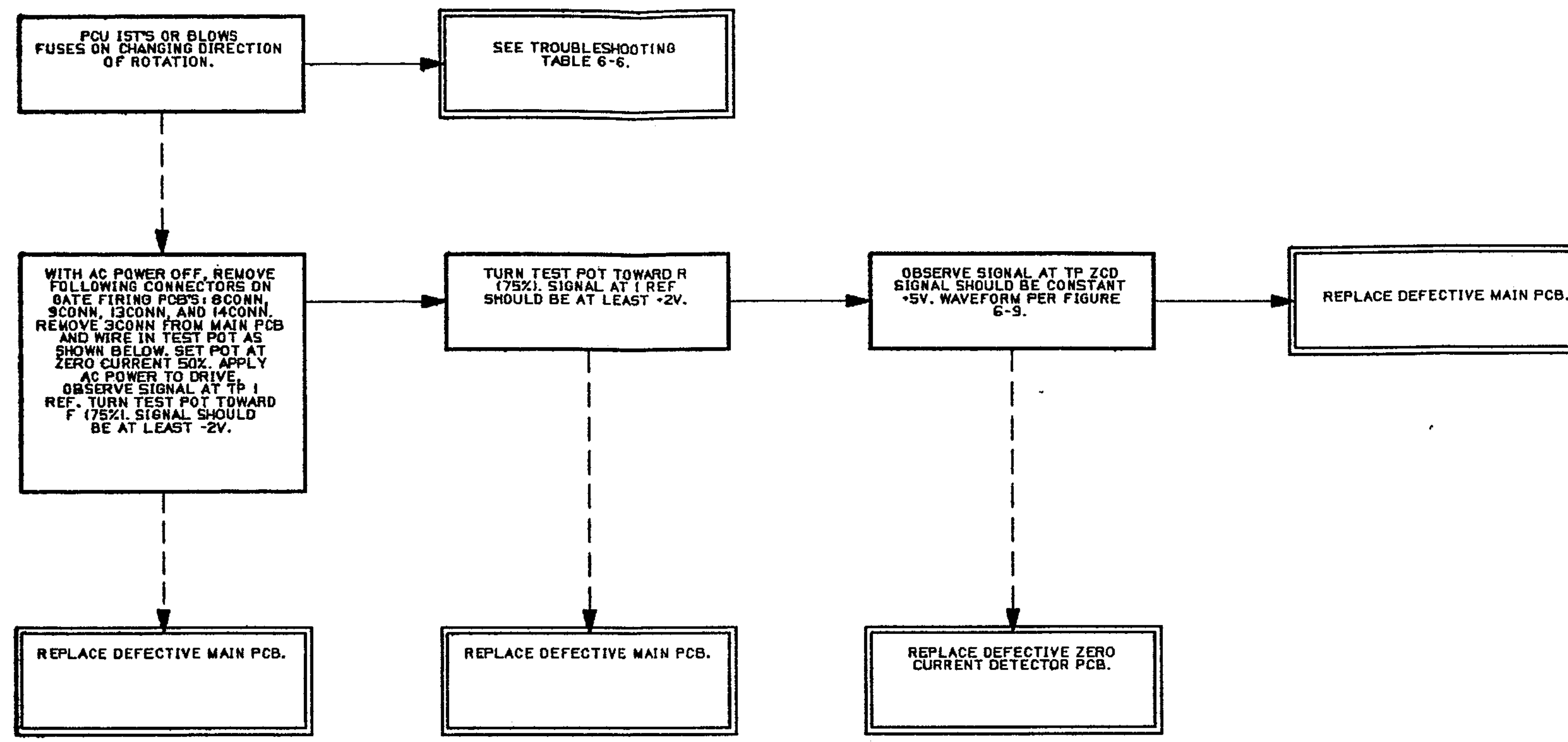
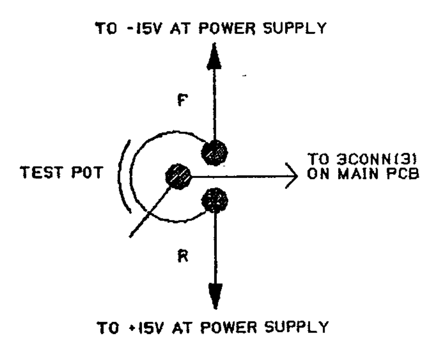


TABLE 6-6. TROUBLESHOOTING CHART: PCU IST'S OR BLOWS FUSES ON START UP



NOTE
THIS PROCEDURE WILL PERMIT MAIN PCB TO BE CHECKED WITHOUT FIRING SCR'S.



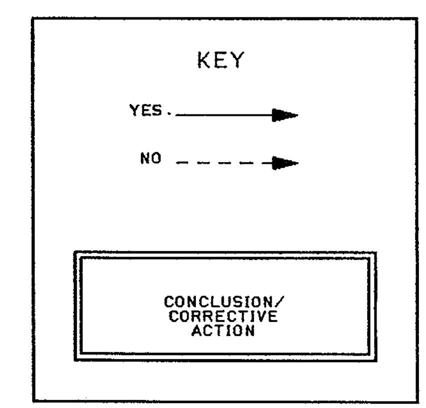


TABLE 6-7. TROUBLESHOOTING CHART: MOTOR RUNS IN ONE DIRECTION ONLY OR DOES NOT REGENERATE.

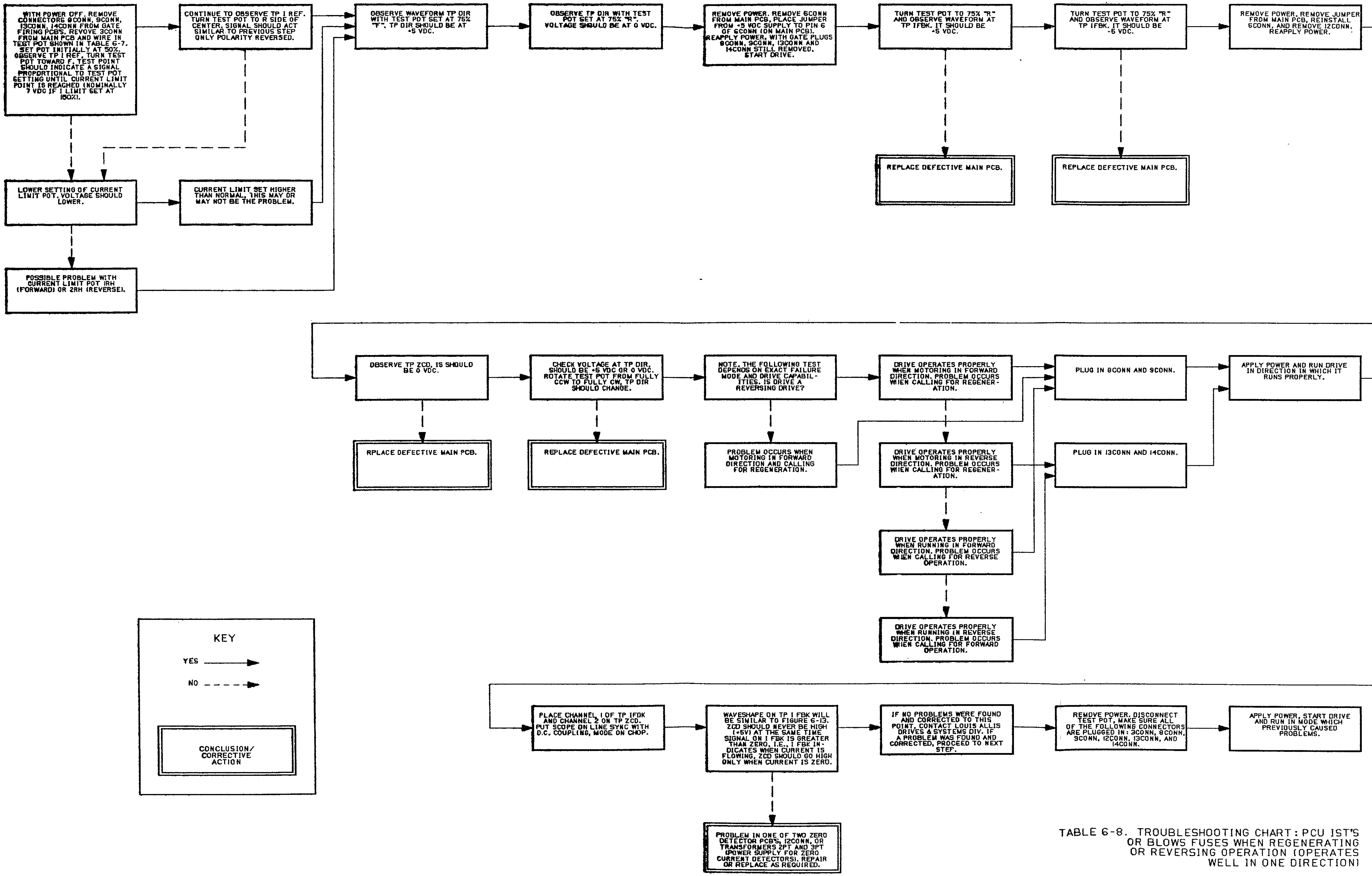


TABLE 6-8. TROUBLESHOOTING CHART: PCU IST'S OR BLOWS FUSES WHEN REGENERATING OR REVERSING OPERATION (OPERATES WELL IN ONE DIRECTION)

SECTION 7
REPLACEMENT PARTS

This section provides a listing of major controller components which may be required for repair. The quantity shown for each item represents the total number included in one drive controller. For parts which are not listed here, refer to Bills of Material received with the equipment; on engineered drive systems, check Bills of Material for possible difference of part numbers due to the particular drive design.

If a stock of repair parts is to be established, contact Customer Service at Louis Allis for recommended stocked quantities.

When ordering parts, specify the Louis Allis order number, model number and serial number stamped on the nameplate. Contact the nearest Louis Allis District Office for ordering information.

TABLE 7-1

COMMON PARTS, SABER 3400/12SCR MOD III CONTROLLERS

DESCRIPTION	SYMBOL	L.A. PART NO.	QTY/DRIVE
Main PCB, 50/60Hz	1PC	46S02283-0010	1
Power Supply PCB	3EA-1PC	46S01599-0010	1
3 Channel Gate Firing PCB	2-5PC	46S01677-0020	4
Reference and Actuator PCB		46S01629-0020	1
Linear Accel PCB *		46S01695-0110	1
Relay, 3PDT	1CR	05P00036-0284	1
Rectifier, Field	1RT	o5P0005θ-0]46	1
Test Meter Module *	TM	46S01682-0010	1

* Stock only if this option is included in the Controller.

TABLE 7-2

PARTS FOR SABER 3400/12SCR MOD III CONTROLLERS
230 VOLT

DESCRIPTION	SYMBOL	L. A. PART NUMBER						QTY/DRIVE
		7.5HP	10 & 15HP	20,25 & 30HP	40 & 50HP	60HP	75HP	
Fuse	1-3F	40 Amps 5P17-0128	70 Amp 5P17-0122	125 Amp 5P17-0146	200 Amp 5P17-0125	← 300 Amp 5P17-0143 →		1
Thyristor	1-6SCR	← 5P50-0164 →			5P50-0165	5P50-0212	5P50-0208	6
Fan	1MTR	--	--	5P16-0006	← 5P16-0008 →			1
	2MTR	--	--	5P16-0006	--	--	--	1
Burden Resistor Assembly	2EA	46S1603-0003	46S1603-0004 (10) 0006 (15)	46S1603-0007 (20) 0008 (25) 0009 (30)	46S1603-0010 (40) 0011 (50)	46S1603-0012	46S1603-0013	1
Zero Current Detector PCB		← 46S01692-0010 →						2

TABLE 7-3

PARTS FOR SABER 3400/12SCR MODIII CONTROLLERS
460 VOLT

DESCRIPTION	SYMBOL	L. A. PART NUMBER 7.5, 10 & 15HP	20,25 & 30HP	40,50 & 60HP	75 & 100HP	125HP	150HP	QTY/DRIVE
Fuse	1-3F	40 Amp 5P17-0128	70 Amp 5P17-0122	125 Amp 5P17-0146	200 Amp 5P17-0125	← 300 Amp 5P17-0143 →		3
Thyristor	1-6SCR	← 5P50-0161 →			5P50-0163	5P50-0190	5P50-0208	6
Fan	1MTR	--	--	5P16-0006	← 5P16-0008 →			1
	2MTR	--	--	5P16-0006	--	--	--	1
Burden Resistor Assembly	2EA	46S1603- 0001 (7.5) 0002 (10) 0003 (15)	46S1603- 0004 (20) 0005 (25) 0006 (30)	46S1603- 0007 (40) 0008 (50) 0009 (60)	46S1603- 0010(75) 0011(100)	46S1603- 0012	46S1603- 0013	1
Zero Current Detector PCB		← 46S01692-0020 →						2

Louis Allis complete "Spectrum of Service" puts maximum up-time into packaged drives and drive systems

A basic benefit built into every Louis Allis product is serviceability. Modular design, clean packaging, easy access to components, special terminal blocks. .these are just a few of the features which save hours if service is needed.

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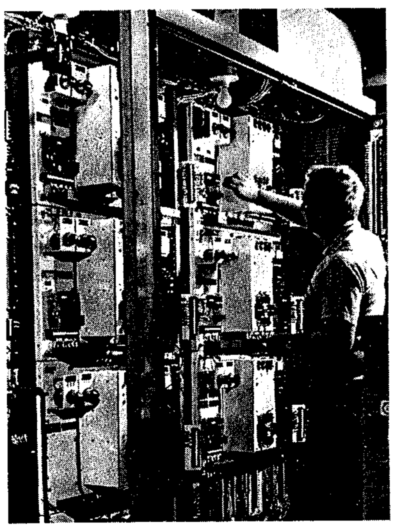
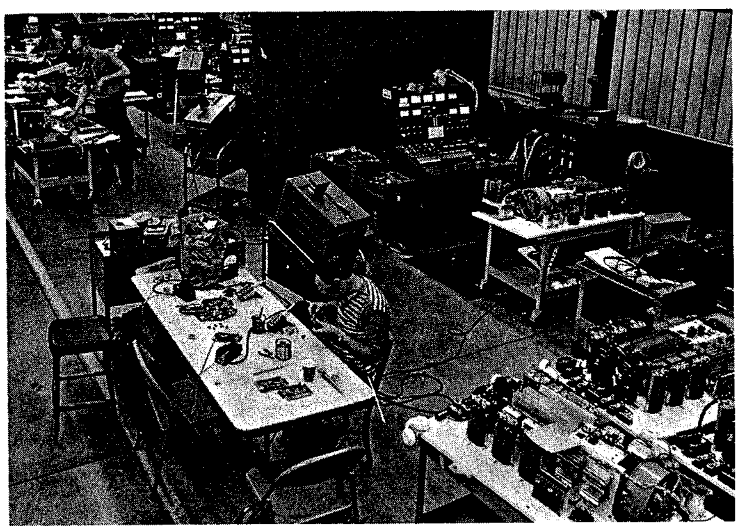
TESTING

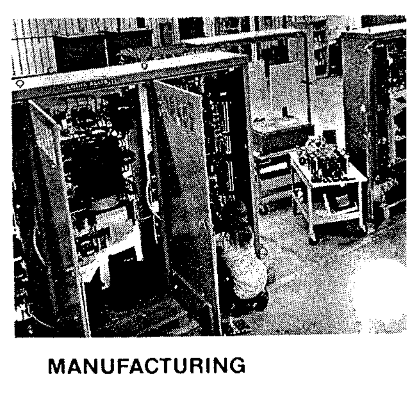


ASSEMBLY



COMPONENTS

DESIGN ENGINEERING



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