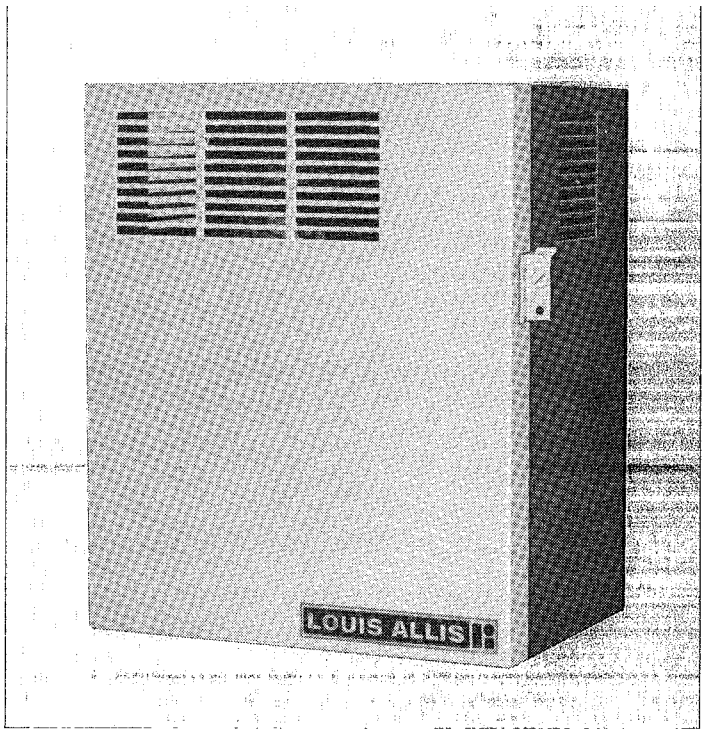
INSTRUCTION MANUAL

3J-100000

Louis Allis



SABER™ 3300 3-PHASE NON-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.

WARNING

THE ABOVE-GROUND ELECTRICAL POTENTIALS OF LOUIS ALLIS EQUIPMENT CAN BE HAZARDOUS. THEREFORE, **IT IS STRONGLY RECOMMENDED THAT ALL ELECTRICAL WORK CONFORMS TO NATIONAL ELECTRICAL CODES AND LOCAL REGULATIONS.** INSTALLATION, ALIGNMENT AND MAINTENANCE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. . . . . PREFERABLY FACTORY TRAINED.

ONLY FACTORY RECOMMENDED TEST PROCEDURES INCLUDED IN THIS INSTRUCTION MANUAL SHOULD BE FOLLOWED. ELECTRICAL POWER SHOULD ALWAYS BE DISCONNECTED BEFORE WORKING ON THE CONTROLLER. **WHEN TESTING OR TROUBLESHOOTING USE ONLY GROUNDED CHASSIS, FLOATING COMMON TYPE TEST EQUIPMENT.**

RECOMMENDED TEST EQUIPMENT:

A. Battery Operated VOM

B. Digital Multimeter

C. Oscilloscope With Differential Type Pre-Amp (To Allow Grounding Per National Electrical And Local Codes)

MagneTek Drives & Systems

TABLE OF CONTENTS

DESCRIPTION

1. GENERAL

The Saber 3300 drive system consists of a dc motor, a power conversion unit, and operator's controls.

The power conversion unit is designed to control a dc motor over a wide and infinitely adjustable speed range. It operates from three phase power lines and is non-regenerative.

The motor, operator's controls, meters, etc. may or may not be furnished as determined by customer request.

2. DC MOTOR

DC motor information including mounting and maintenance instructions is located at the end of the manual.

3. POWER CONVERSION UNIT (PCU)

The standard PCU consists of a power bridge section, a regulator/modification section, and a control section. See Figure 1 for the general location of each section.

3.1 Power Bridge Section

The power bridge section consists of 3 SCR's, and 4 diodes, mounted on the power heat sinks. Transient protection circuitry is located behind the heat sinks. This section converts three phase ac power to dc power and delivers it to the dc motor as directed by the regulator/modification section. It may be rated at 240 or 480 volts.

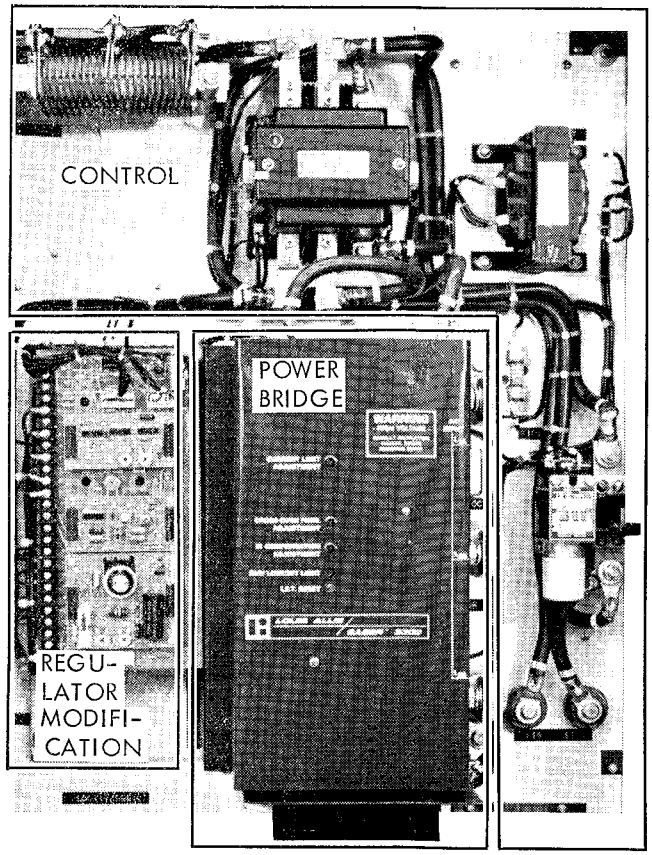


Figure 1. Power Conversion Unit

3.2 Regulator/Modification Section

This section regulates the dc voltage applied to the motor armature and, consequently, the motor speed.

Modifications to the basic regulator are made by plugging in one or more of the standard optional modules. These options include the following:

a) 1% Reference
b) 0.1% Reference
c) 1% Linear Acceleration/Deceleration

d) 0.1% Linear Acceleration/Deceleration
e) 1% Tachometer Feedback
f) 0.1% Tachometer Feedback

Standard relay modifications can be made by plugging in one of the following modification modules:

a) Jog
b) Thread
c) Follower

Refer to section on Modifications for more information.

3.3 Control Section

The control section includes miscellaneous components such as the dc loop contactor, overload relay, control transformer, terminal blocks, etc.

3.4 Protective Circuitry

All three sections contain protective circuitry and components which assure more than adequate protection to the drive system, the power lines, and personnel. Protective circuitry includes:

a) Power Line Fuses
b) Motor Overload Relay (inverse time)
c) Instantaneous Static Trip (IST)
d) Isolation of Control Circuitry
e) Phase Sequence
f) Single Phase
g) Undervoltage
h) Transient Suppression
i) Current Limit

4. PERFORMANCE AND AMBIENT SPECIFICATIONS

The following are the general specifications for the basic power conversion unit. The range of performance can be extended by adding custom engineered modifications.

Input Voltage:

Low Voltage	230 vac -5% to +10% 50/60 HZ $\pm$2%, 3ϕ, 3 wire.
High Voltage	460 vac -5% to +10% 50/60 HZ $\pm$2%, 3ϕ, 3 wire.

Speed Range: 20:1

Adjustable Current Limit: 80 - 150%

Overload for One Minute: 150%

Speed Regulation: As specified for application.

Service Factor: 1.0

Ambient Temperature: 10^{o} C to 40^{o}C

Operating Altitude (max): 3300 ft. above sea level.

INSTALLATION OF PCU

1. VENTILATION

The PCU is air-cooled. The larger units are equipped with a fan to insure an adequate flow of cooling air. Select a location for installing the PCU which is clean and well ventilated; maintenance will be minimized if the PCU is located in a clean atmosphere.

2. MOUNTING

The standard PCU is designed for wall mounting. It is mounted on a sub-panel and covered by a detachable enclosure. Remove the enclosure and hoist the PCU into position by means of the sub-panel.

CAUTION

DO NOT HOIST THE PCU BY MEANS OF THE ENCLOSURE; IT WILL NOT SUPPORT THE WEIGHT OF THE PCU. REMOVE THE ENCLOSURE BEFORE LIFTING THE PCU.

Attach the sub-panel to the wall using the mounting holes in the sub-panel. Check that the PCU is level. Replace the enclosure on the PCU.

3. WIRING

Wire size and disconnect devices should conform to the installation contractors' drawings and all applicable codes. Refer to the Interconnection Diagram to interconnect the Saber 3300 drive system and associated equipment. When making connections to the relay and power supply board assembly, 3PC, remove the regulator board assembly, 2PC.

To remove this board, remove two screws (Figure 1) on the right side and "snap" the board out of the pivot pin holders.

NOTE

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

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

Connect all shields on shielded wire to system common (not ground) on one end only. Shielded wires, particularly those in long runs, should be twisted pairs.

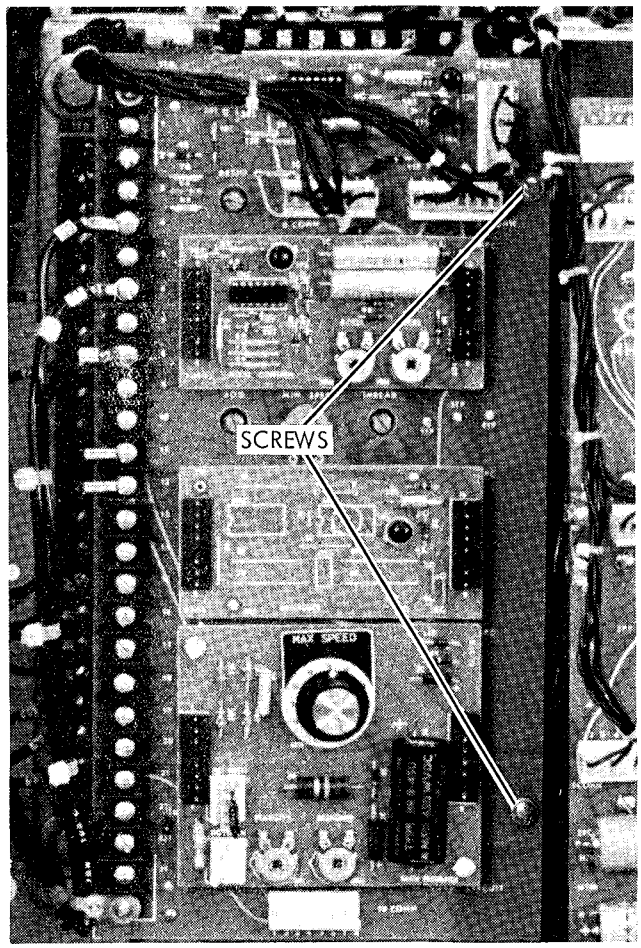


Figure 1. Removing Regulator Board Assembly

PRINCIPLES OF OPERATION

1. POWER BRIDGE SECTION

1.1 Armature Supply

A simplified schematic of the power bridge section is shown in Figure 1.

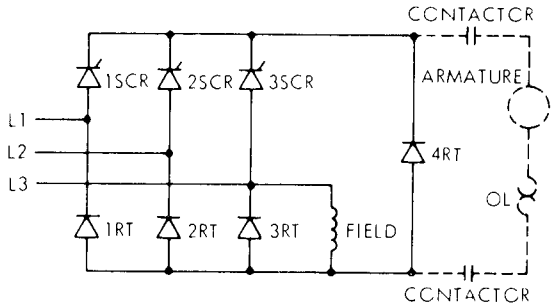


Figure 1. Power Bridge Section Schematic

The power bridge is operated from three phase ac line voltage (L1, L2, and L3). This voltage is converted to dc by full wave bridge rectifiers 1 SCR, 2 SCR, 3 SCR, 1 RT, 2 RT and 3 RT. When L1 is positive with respect to L2, current flow is through 1 SCR, through the contactor, through the motor armature and overload, and back through 2 RT to L2. Table 1 below shows all combinations of conduction paths through the armature.

No current can flow through an SCR unless that SCR has been "fired". The voltage L1 with respect to L2 is shown in Figure 2.

If 1 SCR is fired at point (a) in Figure 2, then the armature voltage resulting from L1 being positive with respect to L2 is as shown in Figure 3.

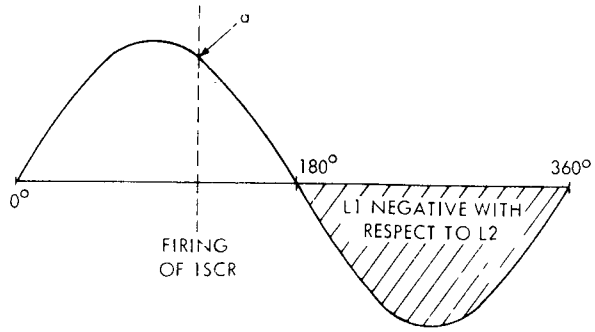


Figure 2. Voltage L1 with Respect to L2

Table 1. Armature Conduction Path Combinations

3 ∅ Line Combination	Current Path
L1 Pos. with Respect to L2	L1 - 1 SCR - Arm. - 2 RT - L2
L1 Pos. with Respect to L3	L1 - 1 SCR - Arm. - 3 RT - L3
L2 Pos. with Respect to L3	L2 - 2 SCR - Arm. - 3 RT - L3
L2 Pos. with Respect to L1	L2 - 2 SCR - Arm. - 1 RT - L1
L3 Pos. with Respect to L1	L3 - 3 SCR - Arm. - 1 RT - L1
L3 Pos. with Respect to L2	L3 - 3 SCR - Arm. - 2 RT - L2

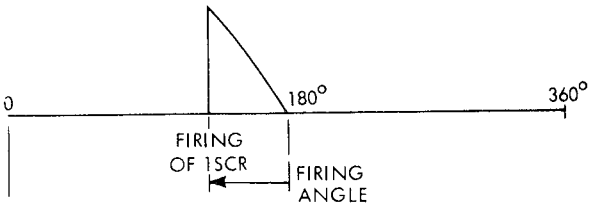


Figure 3. Resultant Armature Voltage, L1 Positive with Respect to L2

Similar curves could be drawn for the other two phases of line voltage and for the other two SCR's.

The average dc voltage at the armature and, consequently, the motor speed are determined by the firing points (firing angle) of the SCR's: the greater the angle, the higher the average dc voltage.

NOTE

Under certain conditions (small firing angle and continuous armature current) the SCR's will not turn off (commutate) unless a path is provided to divert the current from the SCR's. Diode 4 RT provides this path.

1.2 Field Supply

Motor field current is supplied from the AC lines by utilizing two of the diodes which are common to the armature supply.

2. REGULATOR SECTION

A block diagram of the entire system is shown in Figure 4. For convenience, the discussion of the functions of the various blocks is broken down as follows.

1. Power Supply
2. Reference Supply
3. Acceleration/Deceleration Control
4. Isolation Circuit and Universal Amplifier
5. Regulating Amplifiers
6. SCR Firing
7. Relay Circuitry
8. Protective Circuitry

2.1 Power Supply

A control transformer supplies single phase 115 vac to power supplies PS1 and PS2 and provides isolation from the power circuit. PS1 contains zener regulated supplies, to supply dc power to the control circuits shown to the left of the isolation circuit in Figure 4.

PS2 contains zener supplies, which provide dc power to the control circuits on the right hand side of the isolation circuit.

2.2 Reference Supply

The reference supply is a stable dc voltage source. It is used with the SPEED potentiometer (and with the JOG and THREAD potentiometers when these two options are included) to supply a reference level to the PCU.

2.3 Acceleration/Deceleration Control

This circuit provides for gradual (but not necessarily linear) acceleration or deceleration. It insures that motor speed will change at a nearly constant pre-set rate when the SPEED potentiometer is changed.

2.4 Isolation Circuit

The isolation circuit isolates all references and feedback signals from line power potentials and minimizes the possibility of the operator contacting high voltages while making adjustments.

2.5 Regulating Amplifiers

In the basic system motor speed is regulated by controlling armature voltage. Armature voltage and the desired speed reference voltage are applied to the input terminals of the armature voltage error amplifier.

An adjustable IR compensation signal is also provided at the input of the voltage error amplifier. This signal compensates the armature voltage signal for load changes (current changes) and provides for maintaining nearly constant motor speed regardless of load.

The resultant signal is amplified by the armature voltage error amplifier and the output signal is supplied to the current error amplifier as a current reference.

The current error amplifier is the control element of a closed loop current regulator. This current control loop provides the basis for system stability and current limiting. The current reference signal from the armature voltage error amplifier and an armature current feedback signal (received from an armature current sensing resistor) are applied to the input of the current error amplifier. Stability of the motor control system is maintained by compensating for system time constants through use of the crossover frequency adjustment.

Current limiting is accomplished by adjusting the maximum level of the current reference signal. The maximum level is the point at which the armature voltage error amplifier goes into saturation. This adjustment in conjunction with the armature current feedback sets the maximum level of armature current that can be called for by the motor.

The output signal of the current error amplifier is applied to a comparator located in the SCR firing circuit. The magnitude of this signal will adjust the firing angle of the SCR's in the power bridge so as to reduce the voltage error.

2.6 SCR Firing

The SCR firing circuitry consists of the ac reference, the firing pulse inhibitor, a firing pulse amplifier, and a comparator.

There are three of each in the control, one for each of the SCR's in the power section. The ac reference is an ac signal, phase shifted 90^{o} from the line to line ac voltage. This phase shift provides a constant gain in the SCR firing circuitry and also makes the firing circuitry insensitive to voltage spikes on the ac lines. The ac reference is fed to the comparator which sums the ac reference and the output of the current regulating amplifier. When this summation is positive, and when the firing pulse inhibitor allows the comparator to operate, the firing pulse amplifier generates a pulse train to the gate of the SCR.

Once the SCR is fired, the firing pulse inhibitor shuts off the comparator. The firing pulse inhibitor monitors the SCR voltage directly and enables the comparator to refire the SCR if the SCR turns off prematurely. This may result from a notch in the ac line voltage or insufficient current flow in the SCR.

2.7 Protective Circuitry

2.7.1 Run Lockout Relay

In addition to fuses and a motor overload, the drive is equipped with a run lockout relay operated by phase sequence, single phase and over-current (IST) circuitry. The run lockout controls the 115 volt, ac power, to the relay circuitry and the motor contactor. The relay is normally energized and allows normal drive functions to proceed. When an abnormal condition develops, the relay is de-energized and interrupts the 115 volt, ac power to the motor contactor and logic. A warning light, (IST reset) which is normally out, goes on when the relay is tripped. The fault condition must be corrected and the IST reset must be depressed before the drive is again operative.

2.7.2 Phase Sequence Protection

The SCR firing circuits depend on properly phased ac connections. The phase sequence circuit sums two preselected ac reference signals, one of which is phase shifted. With proper phase sequence, an enable signal is generated and supplied to the run lockout relay to permit operation of the drive. If, during installation of the drive, the ac power connections do not have the proper phase relationship, the run lockout relay will not be energized and the drive will not operate.

2.7.3 Single Phase Protection

This protection is accomplished by using the phase sequence circuit to determine that two of the three phases are available. The third phase is protected in that it supplies power to the control transformer which, in turn, supplies power to the relay logic and to the motor contactor. Loss of power in this phase would de-energize the relays and the contactor and prevent operation of the drive.

2.7.4 Instantaneous Static Trip (IST)

This protects the drive against nuisance fuse blowing or semi-conductor damage by monitoring armature current. The circuit operates within 1/3 of a cycle to inhibit SCR firing when a predetermined armature current level is reached (approx. 300% of rated). It also de-energizes the run lockout relay to prevent drive operation.

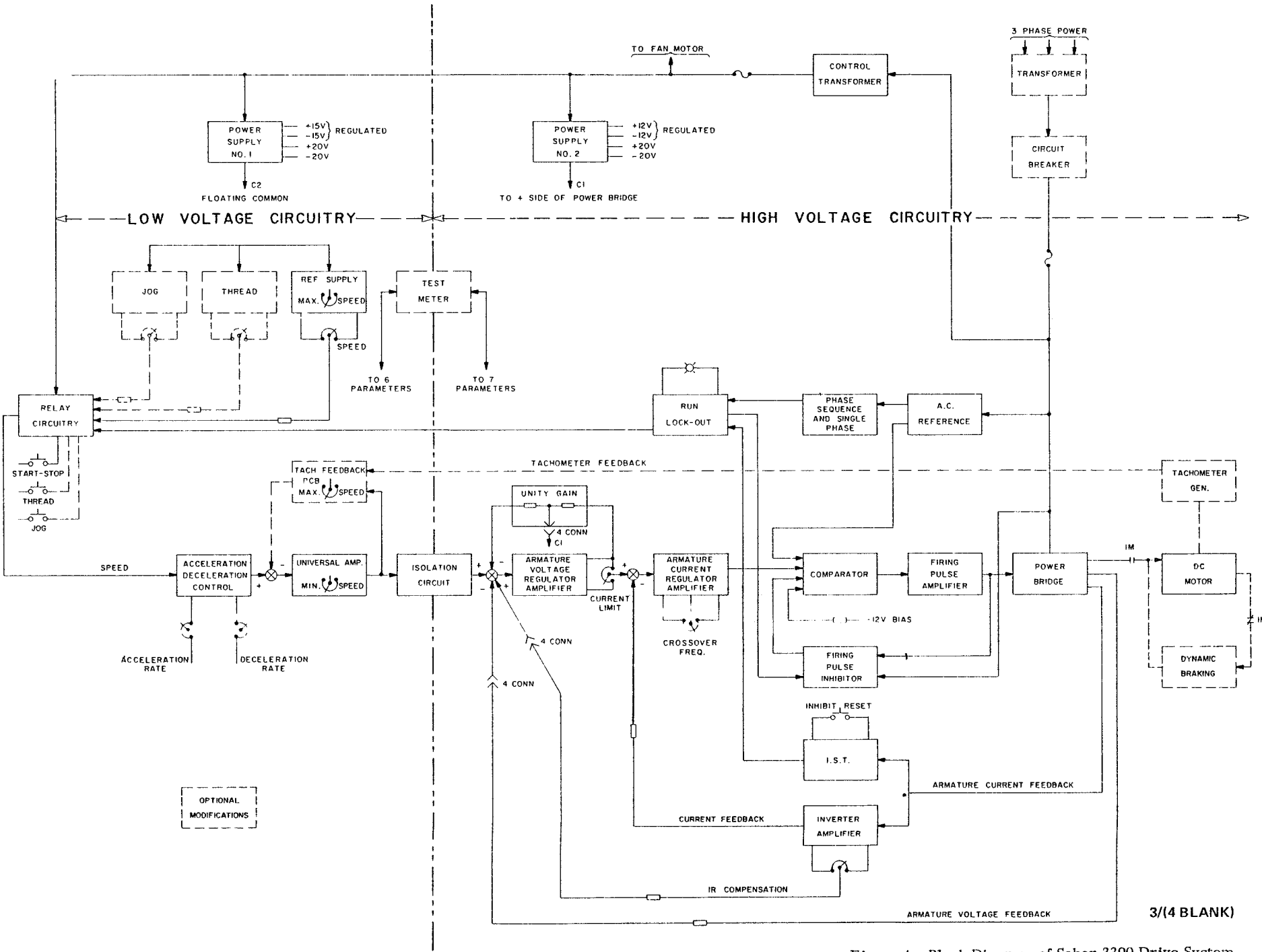


Figure 4. Block Diagram of Saber 3300 Drive System

MODIFICATIONS

1. THREADING MODIFICATION

The threading modification (Figure 1) provides for drive operation at adjustable, pre-set low speeds. The thread speed potentiometer is located in the body of the thread modification module. The set speed can be adjusted from 0 to 25% of rated motor speed.

When the operator depresses the THREAD pushbutton, the motor will approach the set speed under acceleration control. It will run at the set speed until the RUN or STOP pushbutton is depressed. If the RUN button is depressed, the motor speed will increase to the normal running speed. If the STOP button is depressed, the motor will stop.

2. JOG MODIFICATION

The jog modification (Figure 1) provides for momentary drive operation at adjustable, pre-set low speeds. The JOG SPEED potentiometer is located in the body of the jog speed modification module. The set speed can be adjusted from 0 to 25% of rated motor speed. The set speed will be maintained as long as the operator depresses the JOG pushbutton.

Figure 1. Modification Module

3. FOLLOWER MODIFICATION

The tachometer follower modification (Figure 1) permits the Saber 3300 Drive to follow the speed of another drive or machine. This is accomplished by applying a signal proportional to the speed of the master drive as a reference to the follower drive. The modification includes a ratio adjustment potentiometer and may be used with ac and dc tachometer generators. Input parameters of the tachometer follower module are as follows:

a. Input voltage range for full output: 20 - 130V.

b. Input Impedance: 4K - 29K depending on ratio pot setting.

The transducer follower modification (Figure 1) permits the Saber 3300 drive to follow a signal from a transducer such as a pressure regulator. Input parameters of the transducer follower module are as follows:

a. Input signal for full output: 10 - 50 ma

b. Input impedance: 60 OHMS Max. Dependant on ratio pot setting

c. Zero bias range: 0 - $\pm$ 10 ma.

4. LINEAR ACCELERATION CONTROL MODIFICATION

The linear acceleration control (Figure 2) assures that motor speed changes occur at a constant, pre-adjusted rate. Acceleration and deceleration of the motor speed take place at a constant rate. The range of adjustment permits acceleration to normal running speed in 1 to 20 seconds. Because the Saber 3300 is a non-regenerative drive, deceleration time must be set longer than the coast-to-stop time, if control of deceleration is required. The range of adjustments permits deceleration to be controlled between the coast-to-stop time and 20 seconds.

5. TACHOMETER FEEDBACK

The tachometer feedback modification (Figure 3) provides improved regulation and drift characteristics. A voltage proportional to motor speed is generated by a tachometer generator mounted on the motor and applied to the modification printed circuit board. The board will accept either a d-c or a-c voltage.

The board contains a maximum speed potentiometer which adjusts the speed at which the motor will run with a maximum reference signal. The board also increases the gain of the universal amplifier to provide sufficient amplification of the error between the reference and feedback currents, to process through the isolation circuit.

6. TEST METER

The test meter modification module (Figure 4) is wired to monitor 13 different internal voltages. These voltages are significant in the proper operation of the controller. Selection of the voltage to be indicated on the meter is by means of a selector switch. See Table 2 in Troubleshooting section.

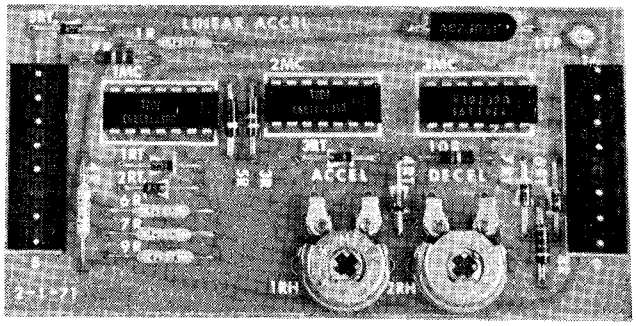


Figure 2. Linear Acceleration Control Modification

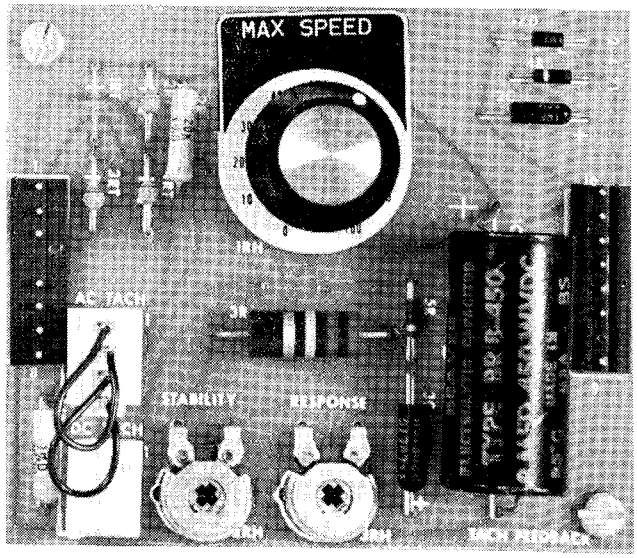


Figure 3. Tachometer Feedback Modification

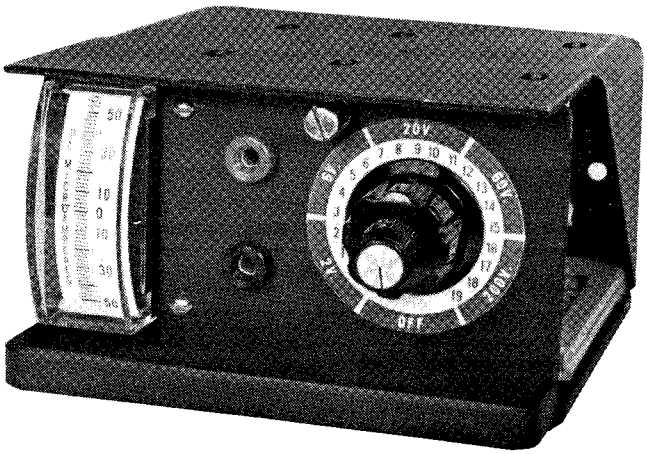


Figure 4. Test Meter

7. DYNAMIC BRAKING

The dynamic braking modification provides rapid stopping whenever the STOP pushbutton is depressed by dissipating the rotating energy in a resistor. Braking torque is directly proportional to speed; as speed decreases, braking torque decreases.

8. CIRCUIT BREAKER

The circuit breaker modification provides a means of manually disconnecting the power unit from the a-c power source. A molded case circuit breaker with an externally operated handle which is mechanically interlocked with the enclosure door is mounted on the PCU subpanel.

9. BLOWER MOTOR CONTROL MODIFICATION

This modification provides an ac power source and control for blower cooling the dc drive motor.

START-UP INSTRUCTIONS AND ADJUSTMENTS

1. PREPOWER CHECK

Make the following checks before applying ac input power to prevent damage to the control.

1. Visually inspect all equipment for any signs of damage during shipment, loose connections, or other defects.

2. Make sure the power supply voltage, frequency, and phase is correct for the particular drive being used. Check the drive schematic or nameplate to determine the proper power supply.

3. Remove all shipping devices and relay wedges. Manually operate all contactors and relays to make sure they move freely.

4. Check that all electrical connections are tight. The connections may have vibrated loose during shipment.

5. Make sure that all transformers are connected for the proper voltage according to the drive schematic.

2. INITIAL START-UP ADJUSTMENTS

Prior to shipment, each drive was tested at the factory and adjusted to give proper performance for the specified application.

Before making any adjustments study the contents of this manual carefully. Make sure that all items listed under PREPOWER CHECK have been checked before applying power to the control.

Following is a list of adjustments and description of their functions. They should be set to approximate position shown before applying power. See Figure 1 for location of the adjustments on the PCU.

2.1 CURRENT LIMIT (5 RH)

This adjustment is located on the Firing Logic PCB, 1 PC and limits the maximum current obtainable from the PCU during motor overloads. This adjustment is set at the factory and no further adjusting should be necessary. If, due to a PCB change or because a lower current limit setting is required, current limit must be adjusted, follow the procedure outlined in paragraph 4.6.

2.2 CROSSOVER FREQUENCY (4 RH)

This adjustment is located on the Firing Logic PCB, 1 PC and determines the stability of the closed loop current regulator. This adjustment is normally made at the factory. Follow paragraph 4.5 if readjustment is necessary.

2.3 BALANCE POTS (1 RH and 2 RH)

These adjustments are located on the Firing Logic PCB, 1 PC; they are set at the factory and should not be readjusted unless absolutely necessary. The function of 1 RH and 2 RH is to adjust 2 and 3 SCR firing angle bias with respect to 1 SCR so that the three phase currents are balanced. Follow paragraph 4.7 for method of readjusting.

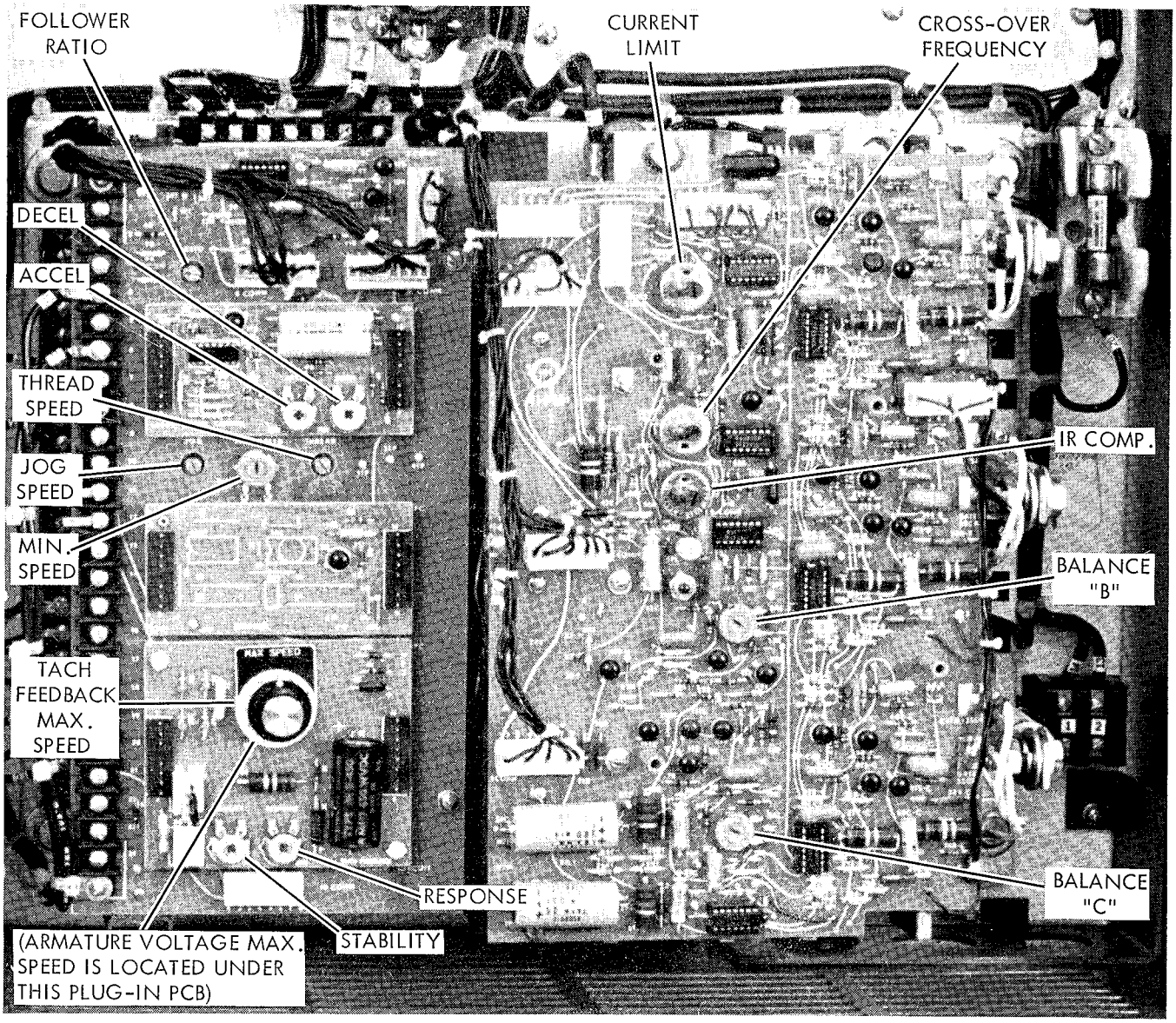


Figure 1. PCU Adjustments

2.4 IR COMP (3 RH)

This adjustment is located on the Firing Logic PCB, 1 PC and is used for armature voltage feedback control. When tachometer-generator feedback is employed, this adjustment is not necessary and should be set to 0%. The IR COMP adjustment provides regenerative feedback from the load (or armature) current so as to maintain constant motor speed independent of load demand from the motor. As initial adjustment, before start-up, set to 0%. Follow paragraph 7 of START-UP PROCEDURE for final adjustment.

2.5 STABILITY (2 RH)

This adjustment is located on the Tach Feedback PCB, 6 PC and determines the open loop gain of the tachometer-generator speed feedback control. As initial adjustment, before start-up, set to 100%.

2.6 RESPONSE (3 RH)

This adjustment is located on the Tach Feedback PCB, 6 PC and controls the speed response of the drive due to reference signal changes. As initial adjustment, before start-up, set to 15%.

2.7 MAX SPEED (1 RH)

This adjustment is located on the Tach Feedback PCB, 6 PC. It determines the motor speed when the SPEED pot is set at 100%. As initial adjustment, before start-up, set to 25%. Follow paragraph 5 of START-UP PROCEDURE for final settings.

2.8 MAX SPEED (1 RH)

This adjustment is located on the Regulator PCB, 2 PC and is used for armature voltage feedback control only. It determines the motor speed when the SPEED pot is set at 100%. As initial adjustment, before start-up, set to 25%. Follow paragraph 5 of START-UP PROCEDURE for final adjustment.

2.9 MIN SPEED (2 RH)

This adjustment is located on Regulator PCB, 2 PC and is used for both tachometer-generator feedback and armature voltage feedback control. This adjustment determines the motor speed when the SPEED pot is set at zero. As initial adjustment, before start-up, set to 50%. Follow paragraph 6 of START-UP PROCEDURE for final adjustment.

2.10 THREAD SPEED (Thread Modification Module)

Turn THREAD SPEED adjustment to an initial setting of zero. This adjustment screw protrudes through a hole provided in 2PC (see figure 1). See paragraph 5.1 of MODIFICATION ADJUSTMENTS, for final setting.

2.11 JOG SPEED (Jog Modification Module)

Turn JOG SPEED adjustment to an initial setting of zero. This adjustment screw protrudes through a hole provided in 2PC (see figure 1). See paragraph 5.2 of MODIFICATION ADJUSTMENTS, for final setting.

2.12 ACCEL/DECEL (Linear Accel Modification PCB)

These two adjustments are located on the Linear Accel PCB, 4PC (see figure 1). They control the rates of drive acceleration and deceleration. As initial adjustments before start-up, turn ACCEL to zero setting and DECEL to 100% setting. See paragraph 5.3 of MODIFICATION ADJUSTMENTS, for final settings.

2.13 RATIO (Tachometer Follower Modification Module)

This adjustment screw protrudes through a hole provided in 2PC (see figure 1). Before applying ac input power to the controller, place the MAN/AUTO selector switch in MAN position, and turn RATIO adjustment to zero setting. See paragraph 5.4 of MODIFICATION ADJUSTMENTS, for final setting.

2.14 AUTO ZERO SPEED TRACKING and RATIO (Transducer Follower Modification Module)

These two adjustments are located on the Transducer Follower module, 3EA. The RATIO adjustment screw protrudes through a hole provided in 2PC (see figure 1). The ZERO SPEED TRACKING adjustment is located on the top side of the module. To gain access to this adjustment, 2PC must be swung open (see 3J-600001, paragraph 3).

Before applying ac input power to the controller, place the MAN/AUTO selector switch in MAN position, and turn RATIO adjustment screw to zero setting and AUTO SPEED TRACKING adjustment to 100% setting. See paragraph 5.5 of MODIFICATION ADJUSTMENTS, for final setting.

3. START-UP PROCEDURE

1. Close main circuit breaker to apply power to PCU.

2. Press the RUN pushbutton.

3. Slowly rotate the SPEED potentiometer to 100%.

4. If serious instability or hunting is noted in the speed of the motor, proceed as follows:

a) Armature voltage feedback control.

Follow paragraph 4.5 for readjustment of CROSSOVER FREQUENCY adjustment.

b) Tachometer Feedback Control.

Trim STABILITY and RESPONSE adjustments as required. If these adjustments do not stabilize the motor speed, perform the following in sequence:

1) Remove 4 CONN on Firing Logic PCB, 1 PC. This eliminates the voltage feedback on the armature voltage error amplifier. Readjust STABILITY and RESPONSE adjustments. This change is most effective with low inertia loads. If stability is achieved, tag the PCB in the area of 4 CONN to note that 4 CONN has been removed. If stability is not achieved, proceed to step b) 2) below.

2) Trim CROSSOVER FREQUENCY adjustment in accordance with paragraph 4.5.

5. Adjust MAX SPEED potentiometer for rated armature voltage or rated motor speed. The SPEED potentiometer must be at 100% for this adjustment. The rated motor armature voltage will normally be either 240 or 480 V. D.C. Armature voltage may be measured at output terminals of PCU. If an accurate method of measuring motor speed is available, set MAX SPEED for rated speed of motor.

NOTE

Rated voltage and rated speed appear on motor nameplate.

6. Turn the SPEED potentiometer to 0%. Increase the MIN SPEED potentiometer to point where the motor shaft just begins to rotate, then turn it back just slightly. The motor should stop. If it is desirable to have the motor shaft turning at some minimum speed, set the MIN SPEED potentiometer to the speed level desired. It may be necessary to trim up the MAX SPEED adjustment after completion of the MIN SPEED adjustment.

7. IR COMP adjustment for armature voltage feedback drives.

If drive is an armature voltage feedback unit adjust the IR COMP potentiometer to provide good motor speed regulation with load changes. It is necessary to apply an appreciable load change to the motor to make this adjustment. The following procedure is a suggested approach of doing this.

Uncouple the motor from the load. Energize PCU and set SPEED potentiometer to 100%. Measure and record the exact motor speed in RPM. Stop the drive and recouple the motor to the load. Energize the PCU and, with the SPEED potentiometer still at 100%, check the motor RPM. The motor speed will normally be several percent lower, loaded, than unloaded. Adjust the IR COMP potentiometer to bring the motor speed to 1/2% lower than the unloaded speed previously recorded.

NOTE

IR COMP should be set to 0% for tachometer feedback drives.

8. If the controller is equipped with any of the modifications listed in paragraphs 2.10 through 2.14, proceed to paragraph 5, MODIFICATION ADJUSTMENTS, to complete drive set up and adjustments.

4 INFREQUENT ADJUSTMENTS

The following adjustments are normally set during test, at the factory. It will usually not be necessary to readjust them. If the need for adjustment arises due to a PCB replacement or a change to operation occurs, the following procedure may be used.

4.1 If the drive has tachometer feedback remove the PCB. Remove 4 CONN on Firing Logic PCB, 1 PC. This will temporarily make the unit a current regulating control and facilitate the adjustments. Replace after adjustment is made.

4.2 Disconnect the motor field leads at the PCU.

4.3 Lock the motor shaft. The motor shaft may be considered locked if it is connected to a high friction load. If the motor is uncoupled or if the friction is negligible, place a suitable locking device on the shaft.

CAUTION

DO NOT ALLOW POWER TO BE APPLIED OVER AN EXTENDED PERIOD OF TIME WITH THE MOTOR SHAFT LOCKED. HIGH CONCENTRATION OF CURRENTS IN THE COMMUTATOR MAY CAUSE BURNING OF THE COMMUTATOR AND DETERIORATION OF THE BRUSHES. THIRTY (30) SECONDS SHOULD BE ADEQUATE TIME TO MAKE EACH ADJUSTMENT. A COOLING OFF TIME OF APPROXIMATELY TEN (10) MINUTES SHOULD BE ALLOWED AFTER EACH 30 SECONDS OF ON TIME.

4.4 Connect a D.C. Voltmeter to the PCU output terminals for the motor armature. If the Test Meter modification is available select position 7 for armature voltage.

4.5 CROSSOVER FREQUENCY

Connect a voltmeter to the output of the armature current amplifier, test point 3 TP to common 10 TP on 1PC. Set the voltmeter to D.C. Volts, with the position lead on 3 TP and the range selector at 10 Volts.

Apply power and energize the armature loop contactor. Slowly advance the speed potentiometer until the armature voltage meter reads 5% of rated armature voltage. If the voltage appears to limit at a value below 5% rated armature voltage, advance the current limit potentiometer setting to reach 5% rated voltage. Advance CROSSOVER FREQUENCY adjustment until voltmeter on output of armature current amplifier indicates a fluctuating output. Turn potentiometer back 10% from this point and voltage indication should stabilize.

If an oscilloscope is available connect to 5 TP and 10 TP on 1 PC. With armature voltage meter reading 5% of rated voltage,

adjust CROSSOVER FREQUENCY potentiometer for 0.69 V peak to peak ripple indication.

4.6 CURRENT LIMIT

Method #1. - If a test meter modification is available, set current limit as follows. Disconnect one of the output wires from the PCU to the motor armature. Remove 4 CONN on Firing Logic PCB, 1 PC. This eliminates the voltage feedback on the armature voltage error amplified. Replace after adjustment is completed.

Apply power to the PCU and turn the SPEED potentiometer up to approximately 25%. Set the test meter selector to position #5 and adjust the CURRENT LIMIT potentiometer for 7.5 V. D. C. indication on test meter. This will approximate the proper setting for 150% current limit. This adjustment is linear, therefore for 100% current limit the voltage indication is 5 V.D.C.

Method #2 - To adjust CURRENT LIMIT potentiometer perform steps 4.1 - 4.3. Connect a voltmeter to output of voltage error amplifier, 6 TP to 10 TP and select meter scale to read 10 V.D.C. The Negative lead of voltmeter should be connected to 6 TP. Connect an ammeter capable of reading 150% rated motor current, in series with the armature.

Advance the speed potentiometer until meter indicates 8.0 V. D. C. and adjust CURRENT LIMIT potentiometer until 120% of rated armature current is observed.

4.7 BALANCE

This adjustment requires the use of an oscilloscope to view the output current pulses, or a clamp-on AC ammeter to compare phase currents in the AC lines.

Use phase A as reference level and adjust amplitude of phase B and C current pulses on the oscilloscope to match phase A pulse by trimming the BALANCE potentiometers.

Use line L1A current as reference level and adjust the current in lines L2B and L3C to the same level by trimming the BALANCE potentiometers. There will be some interaction between adjustments using this method, therefore recheck line L1A current and retrim BALANCE potentiometers if necessary.

5. MODIFICATION ADJUSTMENTS

5.1 THREAD MODIFICATION

1. Press STOP pushbutton.

2. Press THREAD pushbutton. Increase THREAD SPEED adjustment setting until drive is running at desired thread speed. Thread speed is adjustable from 0 to approximately 25% rated motor speed.

3. Press RUN pushbutton or STOP pushbutton. If RUN pushbutton is pressed, motor speed will increase to speed determined by SPEED control setting.

5.2 JOG MODIFICATION

1. Press STOP pushbutton.

2. Press JOG pushbutton and hold depressed. Increase JOG SPEED adjustment setting until drive is running at desired jog speed. Jog speed is adjustable from 0 to approximately 25% rated motor speed.

3. Release JOG pushbutton; drive will stop.

4. Press RUN pushbutton if it is desired to have drive return to normal running speed.

5.3 LINEAR ACCELERATION MODIFICATION

1. Press STOP pushbutton.

2. Press RUN pushbutton. Note length of time it takes drive to reach run speed as determened by the SPEED control.

3. Press STOP pushbutton. Increase ACCEL adjustment setting to achieve desired acceleration rate. The rate of acceleration is adjustable from 2 to 20 seconds. Zero setting corresponds to approximately a 20 second acceleration time; 100% setting corresponds to approximately a 2 second acceleration time. Repeat procedure as necessary to obtain desired acceleration rate.

4. Turn SPEED control rapidly to zero setting. Note time it takes drive to coast to rest. Deceleration time must be longer than normal coast-to-stop time. Fastest deceleration rate is limited to the coast down time of the machine. If longer deceleration time is desired, decrease DECEL setting. Repeat procedure as necessary to obtain dedired deceleration rate.

5.4 TACHOMETER FOLLOWER MODIFICATION

1. Press STOP pushbutton.

2. Place MAN/AUTO selector switch in AUTO position.

3. Press RUN pushbutton.

4. Set external voltage signal, from ac or dc tachometer-generator or variable dc supply, to maximum output and adjust RATIO potentiometer for desired drive speed.

a. The output of the tach-gen. must be 25 to 70 volts ac, rms, or dc at 5 milliamps loading, for drive to run at rated speed. Operating frequency from an ac tach, at lowest operating speed, must be more than 20 Hz.

b. The dc supply output must be between 25 and 75 vdc at 5 milliamps loading, for drive to run at rated speed.

5.5 TRANSDUCER FOLLOWER MODIFICATION

1. Press STOP pushbutton.

2. Place MAN/AUTO selector switch in AUTO position.

3. Determine minimum and maximum process instrument transducer current signal inputs to the transducer follower module. Outputs of the process instrument must be . . . . .

a. capable of working properly into 10 to 100 ohms impedence, and

b. have an output current of 5 to 50 milliamps at top drive speed.

4. Press RUN pushbutton.

5. With the transducer signal at minimum level, increase AUTO ZERO SPEED TRACKING adjustment for desired minimum drive speed.

6. Increase transducer signal to maximum level and decrease RATIO adjustment for desired top drive speed.

MAINTENANCE

WARNING HIGH VOLTAGE

REMOVE AC INPUT POWER BEFORE ATTEMPTING TO PERFORM ANY MAINTENANCE FUNCTION ON THE POWER SECTION BECAUSE PERSONNEL WILL BE EXPOSED TO HIGH VOLTAGE WHEN THE ENCLOSURE DOOR IS OPENED. ELECTRICAL SHOCK CAN CAUSE SERIOUS OR FATAL INJURY.

1. FUSES

To replace a fuse, remove the bolt on the a-c input lead and the bolt on the other end of the fuse and lift it out. Install a new fuse in the same position as the one removed - approximately parallel to the other fuses - to insure adequate separation between the fuses.

2. POWER BRIDGE SECTION

Very little maintenance is required for the power bridge section. Periodic inspection should be made to see that the section is kept clean and free from dirt and moisture; connections should be checked and tightened where necessary. Fuse contacts should also be inspected. Only qualified maintenance personnel trained to work with high voltage power circuitry and low voltage semiconductor circuitry should be allowed access to the power section. When a printed circuit board (PCB) must be repaired or replaced, it may be necessary to reset some of the adjustments (see ADJUSTMENTS). PCB repair requires special techniques. Do not attempt to repair a PCB before contacting the Louis Allis Company.

NOTE

Your warranty may be voided if PCB repair is unauthorized.

2.1 Component Location

Location of all major assemblies and components is shown in Figure 1.

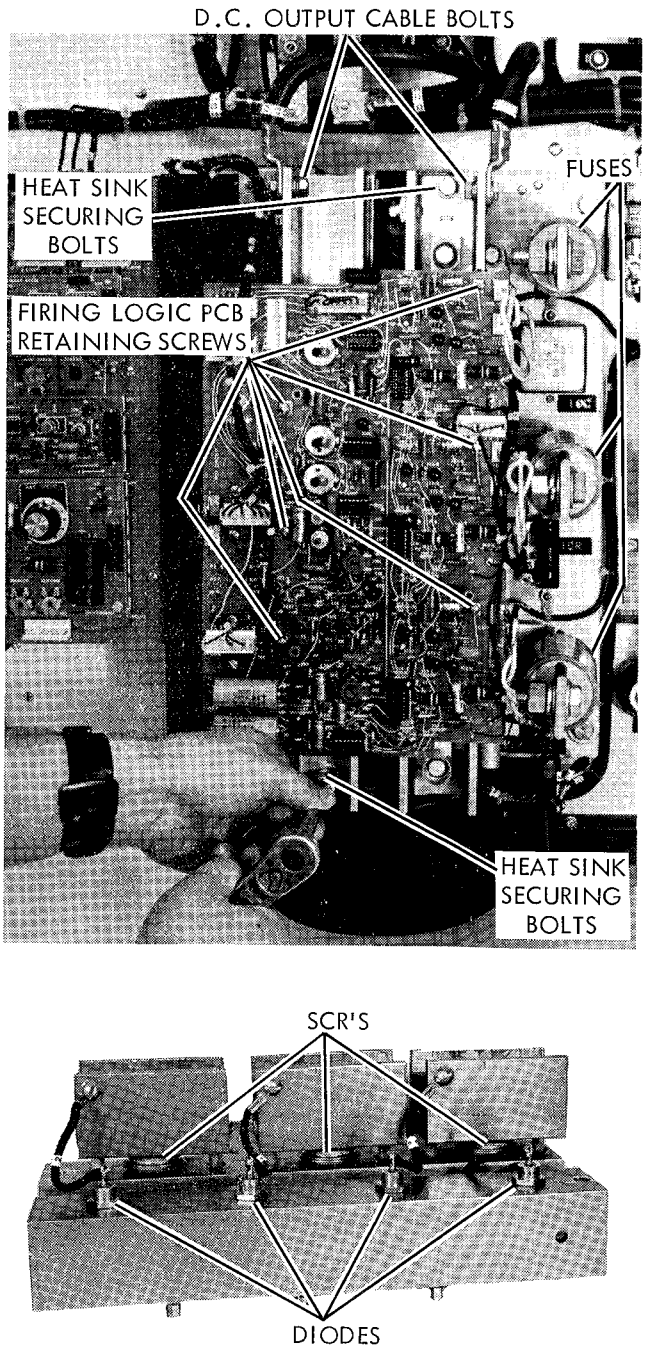


Figure 1. Power Bridge Assembly

2.2 Removal and Disassembly

1. Disconnect the two d-c output cables from the heat sinks by removing the bolt on each. See Figure 1.

2. Remove the harness connectors from the printed circuit board.

3. Remove the two bolts securing the heat sink assembly and remove the assembly from the spring clip retainers. See Figure 1.

2.3 Testing Diodes and SCR's

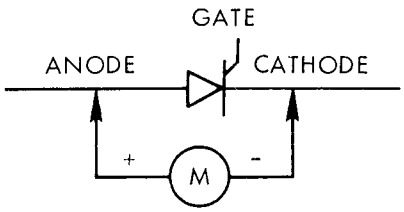
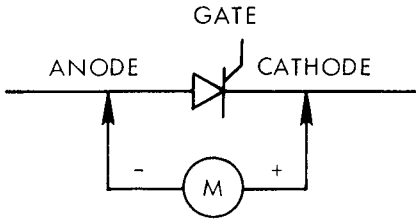
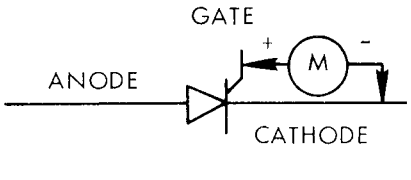
Diodes and SCR's may be tested by using the outlined procedure in Table 1 to check for shorts or open circuits. When readings fall into the questionable or faulty areas, do not replace the device until a comparison test is made with a known good device in the same circuit. Always use the same ohm meter when performing comparison tests.

1. Remove the six retaining screws and lift off the firing logic printed circuit board, 1PC. See Figure 1.

2. To remove a diode, remove the nut on the diode stud and the screw at the end of the diode lead.

3. To remove SCR's, loosen but do not remove the two bolts securing the rear heat sink and slide the SCR out.

Table 1. SCR and Diode Test Procedure

TEST CONNECTION	OHM METER READING	DIODE OR SCR CONDITION
 R x 10K SCALE	SCR greater than 20K 2K - 20K less than 2K DIODE less than 1K	 O.K. questionable faulty O.K.
 R x 10K SCALE	SCR greater than 20K 2K - 20K less than 2K DIODE greater than 20K	 O.K. questionable faulty O.K.
 R X 1 SCALE	SCR 5 - 100 OHMS 100 OHMS - 1K less than 5 OHMS greater than 1K	 O.K. questionable faulty faulty

2.4 Reassembly and Installation

1. When replacing diodes be sure the contact surfaces of the heat sink and diode are clean. To insure adequate heat transfer place a light coating of Penetrox A manufactured by Burndy Corp. (or equivalent) on the contact surfaces. Set the diode in place in the heat sink and place a Belleville washer on the stud. Turn the nut finger tight and then turn it an additional 1/2 turn.

2. When installing SCR's, be sure the contact surfaces of the heat sink and SCR are clean. To insure adequate heat transfer place a light coating of Penetrox A manufactured by Burndy Corp. (or equivalent) on the contact surfaces. Insert the SCR with the cathode toward the common heat sink. Rotate the SCR so the terminals extend from the heat sink assembly as shown in Figure 2. Position the SCR so the hole on each side engages a locating pin on the heat sink.

There are two methods of clamping the heat sinks. In both methods be sure the ends and sides of the heat sinks are aligned. Press the heat sinks firmly against the SCR to insure complete surface contact then proceed as follows:

For standard clamp: Tighten both bolts to finger tightness. Turn one bolt an additional 1/2 turn, turn the other bolt an additional full turn and then turn the first bolt another 1/2 turn.

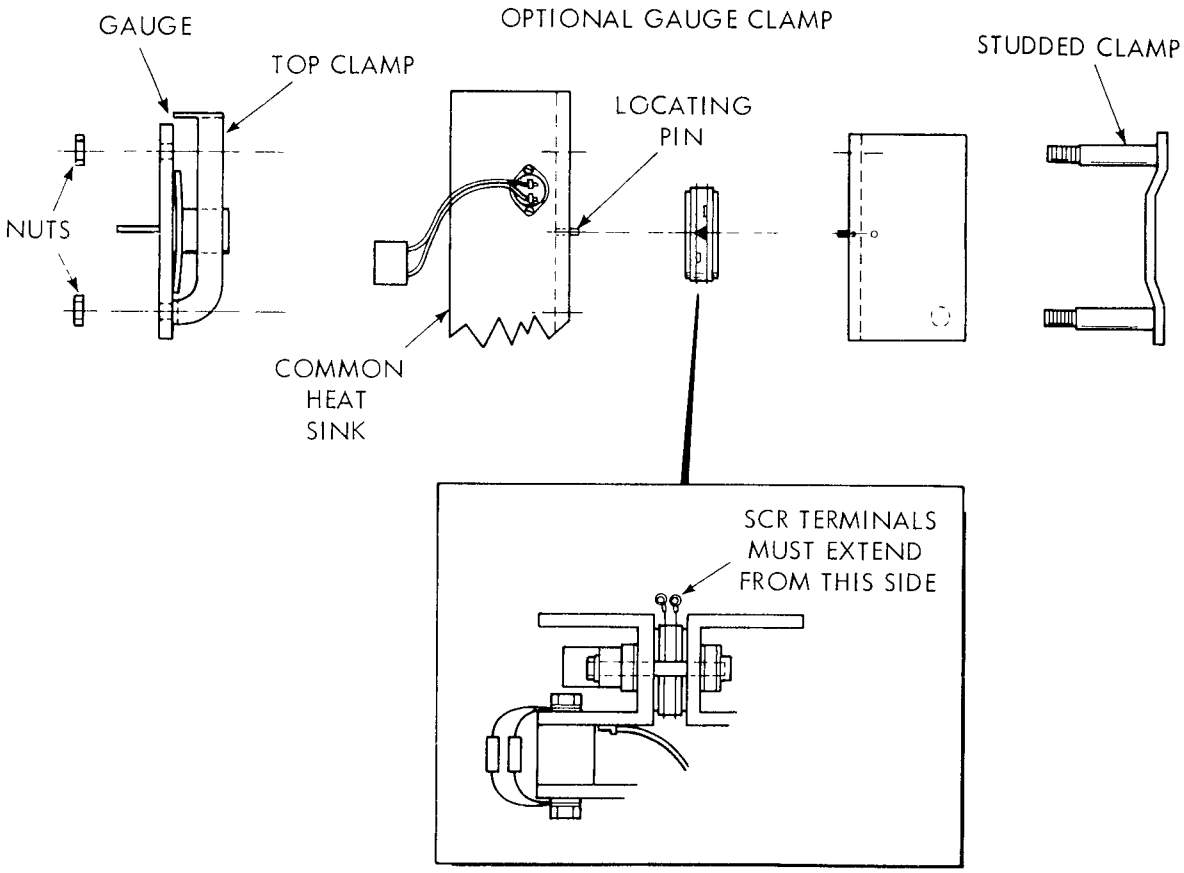


Figure 2. Positioning SCR's and Clamping Heat Sinks

For optional gauge clamp: Set gauge on top clamp to zero. (The gauge is shown at zero in Figure 2.) Insert the studs of the studded clamp through the holes in the heat sinks and assemble the top clamp over the studs. Thread nuts evenly onto the studs by hand. Tighten the nuts alternately 1/4 turn at a time until the gauge indicates a deflection of 1.0.

3. REGULATOR AND MODIFICATION SECTION

1. Adjustments can be made on the regulator board or through holes in the regulator board assembly, 2PC, as shown in Figure 1 of START-UP and ADJUSTMENTS.

2. To get at the relay and power supply board assembly, 3PC, remove two screws on the right side of the regulator board and swing the regulator board on the pivot pins. If removal of the regulator board is necessary, release the clips on the harness connectors with a small screw driver and remove the connectors. Then "snap" the board out of the pivot pin holders.

3. Individual boards and relay modification modules are plug-in units. The name of each is printed on the board assembly near the proper receptacle to aid in finding the correct location of each. The plugs of each board and module are keyed so that each can only fit into the correct receptacle and only in the correct position.

TROUBLESHOOTING

WARNING

THE ABOVE-GROUND ELECTRICAL POTENTIALS OF LOUIS ALLIS EQUIPMENT CAN BE HAZARDOUS THEREFORE, IT IS STRONGLY RECOMMENDED THAT **ALL ELECTRICAL WORK CONFORMS TO NATIONAL ELECTRICAL CODES AND LOCAL REGULATIONS.** INSTALLATION, ALIGNMENT AND MAINTENANCE SHOULD BE PERFORMED ONLY BY QUALIFIED PERSONNEL . . PREFERABLY FACTORY TRAINED.

ONLY FACTORY RECOMMENDED TEST PROCEDURES INCLUDED IN THIS INSTRUCTION MANUAL SHOULD BE FOLLOWED ELECTRICAL POWER SHOULD ALWAYS BE DISCONNECTED BEFORE WORKING ON THE CONTROLLER **WHEN TESTING OR TROUBLESHOOTING USE ONLY GROUNDED CHASSIS, FLOATING COMMON TYPE TEST EQUIPMENT**

RECOMMENDED TEST EQUIPMENT

A Battery Operated VOM
B Digital Multimeter
C Oscilloscope With Differential Type Pre-Amp (To Allow Grounding Per National Electrical And Local Codes)

WARNING

ALWAYS REMOVE AC INPUT POWER WHEN CHECKING AND REPLACING POWER SECTION COMPONENTS (SCR'S, DIODES, TRANSFORMERS, FUSES, ETC) AND WHEN REPLACING RELAYS AND PRINTED CIRCUIT BOARDS

1. GENERAL

An understanding of the drive system is of great value in maintaining and servicing the equipment. It is recommended, therefore, that the information given in the preceding parts of this manual be studied.

Before troubleshooting the PCU, be sure that the dc motor is not defective and that load conditions do not exceed drive capability. After this has been done, check that all mechanical connections are tight, that there are no loose relays and fuses, and that all contactors operate freely.

The printed circuit boards (Figure 1) are numbered as follows:

BOARD	NUMBER
Firing Logic	1 PC
Regulator	2 PC
Relay and Power Supply	3 PC
Acceleration	4 PC
Reference Supply	5 PC
Tach Feedback	6 PC

The modification module are numbered as follows:

MODULE	NUMBER
Thread Module Modification	1 EA.
Job Module Modification	2 EA.
Follower Module Modification	3 EA.

The following PCU troubleshooting procedures are arranged in a logical sequence. When any malfunction occurs, check fuses first. Do not replace fuses without first determining and correcting the cause of fuse failure. See paragraph 2.

If no fuses are blown, proceed to paragraph 3 and subsequent paragraphs.

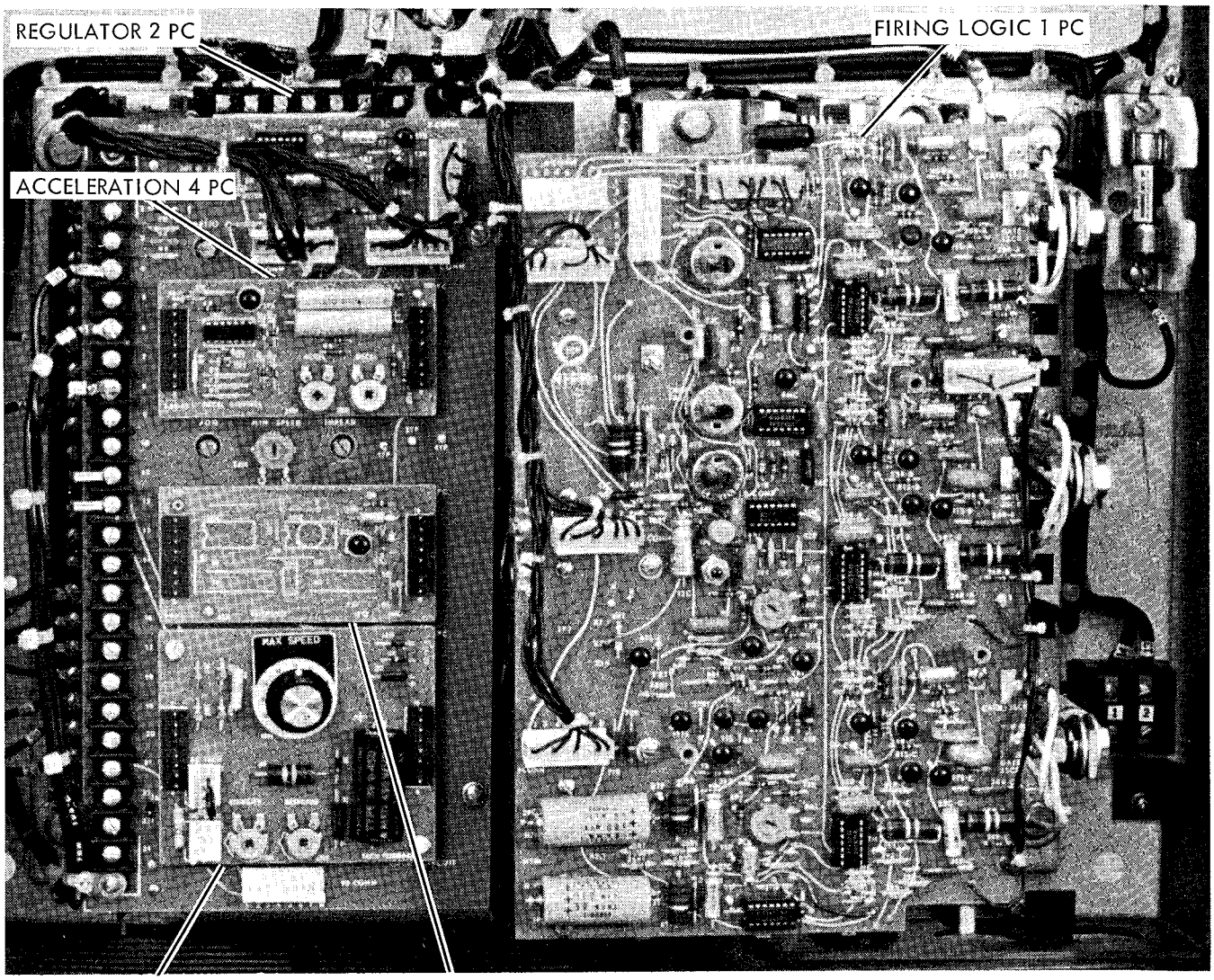


Figure 1. Printed Circuit Boards

2. FUSE FAILURE CHECK

2.1 Fuse Number 1F, 2F, or 3F.

1. Check motor for shorted armature or shorted field.

2. Check power bridge for shorted diodes or SCR's. (See Maintenance Section.)

3. Check for short circuit in control transformer, 1 PT.

4. Check for shorts to chassis in power circuits.

2.2 Fuse Number 4F.

1. Remove all modification modules provided. If thread modification 1 EA, is removed, jumper terminals 1 and 2 on connector 15 (located near the module plug). If follower module 3 EA, is removed, jumper terminals 1 and 2 on connector 14 (located

near the module plug). If the trouble disappears, one or more of the modules are faulty. Remove the jumper and correct or replace the faulty module and replace the fuse.

2. Check for short circuits, including short to chassis, in the following components or their associated wiring:

a) 115 vac lines to power supply board, 3PC, terminals 18 to 19.
b) Run relay 1 CR on power supply board, 3PC.
c) Drive-on relay 2 CR on power supply board, 3PC.
d) Power supply board, 3PC.
e) Firing logic board, 1PC.
f) Contractor 1M
g) Cooling fan motor 1MTR, if provided.
h) Contactor 2M, if provided.

3. CONTACTOR 1M DOES NOT ENERGIZE AND RUN LOCKOUT LIGHT IS OFF

1. Check that ac input power is applied to the unit.

2. Reset the motor overload.

3. Reset the blower motor overload, if provided.

4. Check for open thermoguard control in motor. Control will close automatically when motor temperature drops.

5. Check for loose or broken connections

6. Check for failure of run relay 1 CR or drive-on relay 2 CR on power supply board 3PC.

7. Check for failure of contactor 1M. Correct faulty wiring or replace faulty contactor.

8. If motor operates only in thread or jog mode, check for malfunction of run relay 1 CR on firing logic board, 3PC. Correct faulty wiring or replace faulty relay.

4. RUN LOCKOUT LIGHT ON - IST RESET HAS NO EFFECT

1. Check that all three input phases are present.

2. Check for malfunction of run lockout relay 1 CR on firing logic board 1PC as follows:

a) Check for open circuit in isolation circuit interlock (1-2-(1) to 1-2-(8). (See page 5 for explanation of these numbers).

b) Check for open circuit in current feedback interlock (1-3-(1) to 1-3-(2)).

c) Check for open contact in heat sink thermoguard (1-13-(4) to 1-13-(1)). Contact will close automatically when heat sink temperature drops.

d) Check for failure of run lockout relay 1 CR. Correct faulty wiring or replace faulty relay.

NOTE

From this point on a test meter is used in the troubleshooting procedure. If a test meter is not furnished with the drive, a Simpson Model 260 Multimeter, or equivalent, can be used.

3. Check the firing logic board, 1PC, power supply voltage (see Table 1). If voltage is zero, suspect the 1PC board. If voltage is low, the firing logic board is probably normal but a faulty circuit on the 1PC board may be imposing an overload. Check test point 11 on 1PC for +20VDC. If reading is -20VDC, the trouble is in the IST circuit on 1PC. If the reading is +20VDC, follow the troubleshooting procedure outlined in Table 2; use an oscilloscope to check waveforms.

Table 1. TEST METER SWITCH POSITIONS AND EQUIVALENT TEST POINTS

(Equivalent test points shown are for use with a multimeter. The equivalent test points are 3-part numbers which identify the printed circuit board number, the connector number and the pin number of the test point. For example test point 1-5-(7) is pin number 7 on connector number 5 on printed circuit board number 1).

Position No.	Equivalent Test Points	Function	Normal Indication
1	1-5-(7)	+12VDC, firing logic board, 1PC	+12VDC
2	1-5-(6)	-12VDC, firing logic board, 1PC	-12VDC
3	1-5-(2)	Speed input, firing logic board, 1PC	0-10VDC
4	1-5-(1) to 1-5-(4)	Current Regulator Output	Variable. Rated voltage 8VDC at full load.
5	1-5-(3)	Current Limit Reference	Variable. 5VDC at full load.
6	1-5-(5)	Armature Current	Variable. 1V at full load.
7	1-5-(8)	1/4 Armature Voltage (armature voltage equals reading x 4)	230VAC Line: 0-60VDC 460VAC Line: 0-120VDC
8-10	OPEN		
11	2-10-(6)	Power Supply, 3PC	+15VDC
12	2-10-(8)	Power Supply, 3PC	-15VDC
13	2-10-(1) to 2-10-(5)	DC Tach Input	Variable.* Normally 85-90VDC at 1750 RPM
14	2-10-(7)	AC Tach Input	Variable.* Normally 55-65 VDC at 1750 RPM
15	2-10-(4)	Accel/Decel Cont. Output	0-10VDC
16	2-10-(2)	Universal Amp. Output	0-10VDC
17-19	OPEN		

5. CONTACTOR 1M ENERGIZES - MOTOR DOES NOT TURN WITH SPEED POT TURNED UP

1. Check motor field windings for continuity and check motor field voltage, current and field connections. Check for open circuit in armature.

2. Remove all modification modules provided. If thread modification, 1EA, is removed, jumper terminals 1 and 2 on connector 15 (located near the module plug). If follower module, 3EA, is removed, jumper terminals 1 and 2 on connector 14 (located near the module plug). If the trouble disappears, one or more of the modules is faulty. Remove the jumpers and correct or replace the faulty module.

3. Remove tach feedback board, 6PC, if provided. If the trouble disappears, the trouble is in 6PC or the tachometer.

4. Set the test meter (see Table 1) to positions 1 and 2 for +12VDC and -12VDC respectively. If reading is zero, suspect power supply for 1PC; if reading is low, suspect a failed circuit on 1PC which is imposing an overload.

5. Set the test meter to positions 11 and 12 for +15VDC and -15VDC respectively. If reading is zero, suspect the power supply for 3PC. If reading is low, suspect a circuit on the regulator board, 2PC, which is imposing an overload.

6. Set the test meter to position 3 and check that voltage varies from 0 to 10VDC. If reading is normal, replace firing logic board, 1PC.

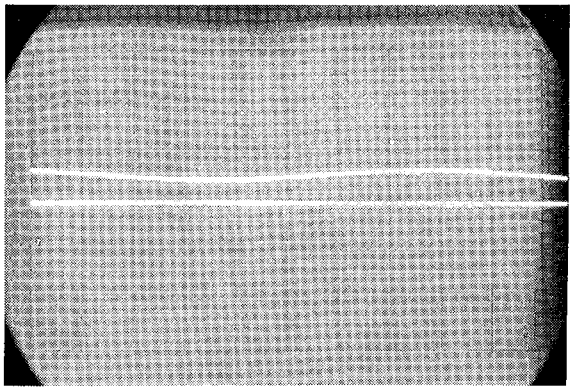
7. Check speed pot as follows: check that voltage between terminals 7 and 19 on the regulator board, 2PC, varies from 0 to +10VDC with various settings of the pot. If reading is abnormal, replace pot and check wiring.

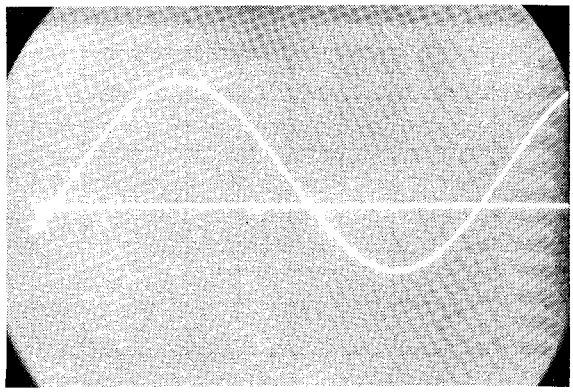
8. Set test meter to position 15 and check that voltage indication is between 0 and -10VDC. (There is a delay between the setting of the SPEED pot and the appearance of the reading). An abnormal reading indicates a faulty acceleration board, 4PC.

9. Set test meter to position 16. Normal voltage reading is 0 to +10VDC. An abnormal reading indicates a faulty universal amplifier. A normal reading indicates a faulty isolation circuit. Check connector 2 to insure proper connection or replace regulator board, 2PC, or firing logic board, 1PC.

Table 2. Checking Circuits on 1PC

PHASE SEQUENCE WAVE FORM
9TP-1PC to 10TP-1PC





Abnormal

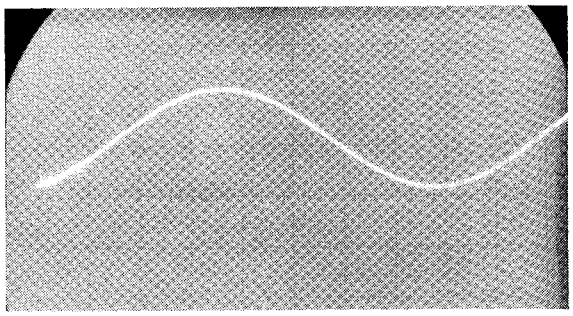
Normal

Check for Proper Connections and Amplitude of 3 ϕ INPUT

Run Lockout Circuit Malfunction 1PC

AC REFERENCE WAVE FORM
(4 VOLT PEAK TO PEAK, 60 HZ)
2TP-B AND 2TP-C 1PC TO 10TP-1PC

Any Wave Form Different from that Shown at Right is Considered Abnormal



Abnormal

Normal

AC Reference Circuit Malfunction (1PC)

Phase Sequence and Single Phase Circuit Malfunction (1PC)

RECOMMENDED OSCILLOSCOPE PROCEDURE

WHEN TESTING OR TROUBLESHOOTING A CONTROLLER USE ONLY GROUNDED CHASSIS, FLOATING COMMON TYPE TEST EQUIPMENT AND ALWAYS REMOVE AC POWER BEFORE MAKING TEST CONNECTIONS.

FOR CONTROL SIGNAL OBSERVATIONS USE AN OSCILLOSCOPE WITH A DIFFERENTIAL TYPE PRE-AMP. THE OSCILLOSCOPE CHASSIS MUST BE GROUNDED AND A SET OF MATCHED PROBES (x1 OR x10) MUST BE USED, DEPENDENT UPON THE SIGNAL AMPLITUDE. CONNECT ONE PROBE TO THE CONTROL CIRCUIT COMMON AND THE NEGATIVE PRE-AMP INPUT. CONNECT THE OTHER PROBE TO THE SIGNAL UNDER OBSERVATION AND THE POSITIVE PRE-AMP INPUT.

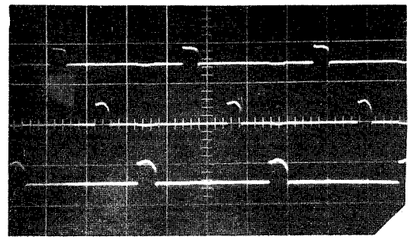
USE OF UNGROUNDED CHASSIS OR OF GROUNDED CHASSIS WITHOUT DIFFERENTIAL PRE-AMPS IS SPECIFICALLY NOT RECOMMENDED.

RECOMMENDED OSCILLOSCOPE PROCEDURE

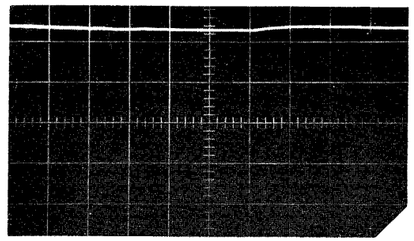
WHEN TESTING OR TROUBLESHOOTING A CONTROLLER USE ONLY GROUNDED CHASSIS, FLOATING COMMON TYPE TEST EQUIPMENT AND ALWAYS REMOVE AC POWER BEFORE MAKING TEST CONNECTIONS.

FOR POWER SIGNAL OBSERVATIONS USE AN OSCILLOSCOPE WITH A DIFFERENTIAL TYPE PRE-AMP THE OSCILLOSCOPE CHASSIS MUST BE GROUNDED AND A SET OF MATCHED PROBES (x10 OR x100) MUST BE USED, DEPENDENT UPON THE SIGNAL AMPLITUDE CONNECT ONE PROBE TO THE POWER CIRCUIT COMMON AND THE NEGATIVE PRE-AMP INPUT. CONNECT THE OTHER PROBE TO THE SIGNAL UNDER OBSERVATION AND THE POSITIVE PRE-AMP INPUT.

USE OF UNGROUNDED CHASSIS OR OF GROUNDED CHASSIS WITHOUT DIFFERENTIAL PRE-AMPS IS SPECIFICALLY NOT RECOMMENDED.



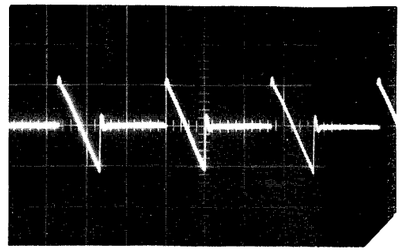
1TP-A, 1TP-B, 1TP-C,
FIRING AMPLIFIERS OUTPUTS
VERT. 2V/CM
HORIZ. 5MS / CM
NOTE: ALL NORMAL CONDITIONS



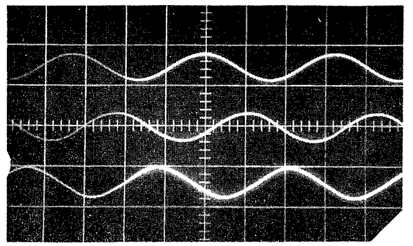
4TP, ISOLATION CIRCUIT OUTPUT
VERT. 2V / CM
HORIZ. 2MS / CM
NOTE: ALL NORMAL CONDITIONS

7TP, POWER SUPPLY # 2
−12 VDC OUTPUT

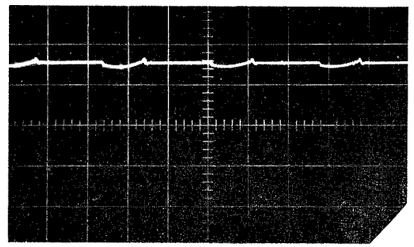
10TP, POSITIVE STAND OFF
COMMON



ARMATURE VOLTAGE
VERT. 200V / CM
HORIZ. 2MS / CM
NOTE: MOTOR AT HALF SPEED T(
FULL SPEED NO LOAD

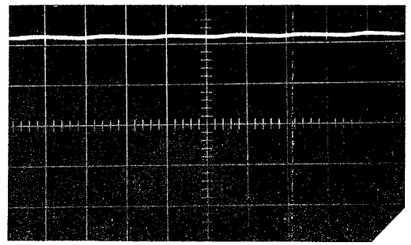


2TP-A, 2TP-B, 2TP-C,
AC REFERENCE GENERATORS OUTPUTS
VERT. 5V / CM
HORIZ. 5MS / CM
NOTE: ALL NORMAL CONDITIONS

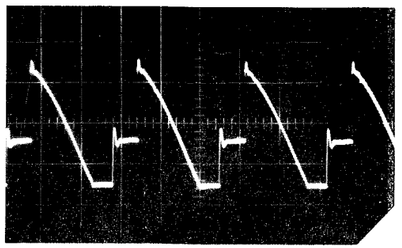


5TP, ARMATURE CURRENT
REGULATOR AMPLIFIER OUTPUT
VERT. 2V / CM
HORIZ. 2MS / CM
NOTE: ALL NORMAL CONDITONS

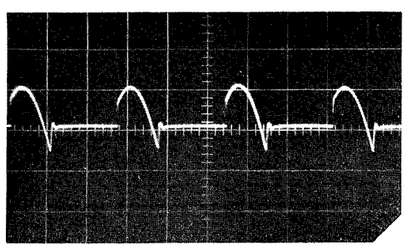
8TP, POWER SUPPLY # 2
+12 VDC OUTPUT



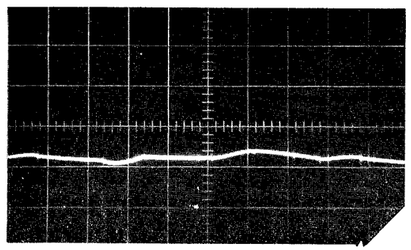
11TP, 1ST CIRCUIT OUTPUT
VERT. 10V / CM
HORIZ. 5MS / CM
NOTE: ALL NORMAL CONDITIONS



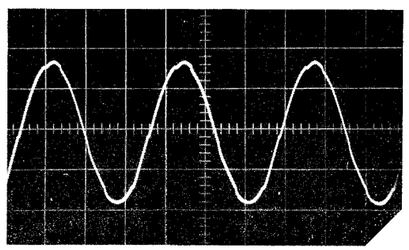
ARMATURE VOLTAGE
VERT. 200V / CM
HORIZ. 2MS / CM
NOTE: MOTOR AT HALF SPEED
HALF LOAD



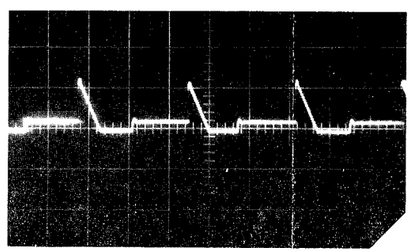
3TP, ARMATURE CURRENT
INVERTER AMPLIFIER OUTPUT
VERT. 0.5V / CM
HORIZ. 2MS / CM
NOTE: ALL NORMAL CONDITIONS



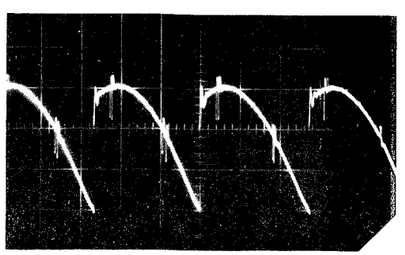
6TP, ARMATURE VOLTAGE
REGULATOR AMPLIFIER OUTPUT
VERT. 0.5V / CM
HORIZ 2MS / CM
NOTE: ALL NORMAL CONDITIONS



9TP, PHASE SEQUENCE AND
SINGLE PHASE CIRCUITRY OUTPUT
VERT. 5V / CM
HORIZ. 5MS / CM
NOTE: ALL NORMAL CONDITIONS



ARMATURE VOLTAGE
VERT. 200V / CM
HORIZ. 2MS / CM
NOTE: MOTOR AT LOW SPEED
NO LOAD



ARMATURE VOLTAGE
VERT. 200V / CM
HORIZ. 2MS / CM
NOTE: MOTOR AT FULL SPEED
FULL LOAD

RECOMMENDED SPARE PARTS

PARTS LIST A
SABER 3300/3SCR CONTROLLERS

DESCRIPTION	SYMBOL	L.A. PART NO.	QTY/DRIVE
Regulator PCB	2 PC	46S1660-0010	1
(The following available modification PCB's plug into the Regulator PCB)			
Standard Accel	4 PC	46S1669-0010	1
1% Linear Accel	4 PC	46S1670-0010	1
.1% Linear Accel	4 PC	46S1670-0020	1
1% Reference	5 PC	46S1671-0010	1
.1% Reference	5 PC	46S1671-0020	1
1% Tach Feedback	6 PC	46S1672-0010	1
.1% Tach Feedback	6 PC	46S1672-0020	1
Relay & Power Supply PCB	3 PC	46S1662-0010	1
(The following available Relay and Test Meter modifications plug into Relay & Power Supply PCB)			
Thread	1 EA	46S1667-0010	1
Jog	2 EA	46S1667-0020	1
Tachometer Follower	3 EA	46S1668-0010	1
Transducer Follower	3 EA	46S1678-0010	1
Test Meter	TM	46S1631-0010	1

PARTS LIST B

SABER 3300/3SCR 230 VOLT CONTROLLERS

Description	Symbol	L. A. Part Number						Qty/Drive
		7.5 HP	10 & 15 HP	20 & 25 HP	30 HP	40 & 50 HP	60 & 75 HP	
Fuse	1-3F	40 amp 5P17-0128	70 amp 5P17-0150	125 amp 5P17-0146	150 amp 5P17-0124	200 amp 5P17-0125	400 amp 5P17-0130	3
Power Bridge		46S1626-2307	46S1626-2310	46S1627-2325	46S1627-2330	46S1627-2350	46S1627-2375	1
. Diode	1-3RT	5P50-0176		5P50-0174		5P50-0173	5P50-0173	3
. Diode	1-4RT		5P50-0174		5P50-0173			4
. Diode	4RT	5P50-0174		5P50-0173		5P50-0171	5P50-0171	1
. Thyristor	1-3SCR	5P50-0162	5P50-0162	5P50-0164	5P50-0164	5P50-0164	5P50-0165	3
Firing Logic PCB	1PC	← 46S1661-0010 →						1
Fuse 250V, 15 amp	4F	← 5P17-0073 →						1
Fuse * 600V, 2-1/4 amp 600V, 2-1/2 amp 500V, 5 amp	5-7F	5P17-0183	5P17-0183 (10 H.P.) 5P17-0184 (15 H.P.)	5P17-0184	← 5P17-0185 →			3
Control Assembly +		46S1665-0010	46S1665-0010	46S1664-0010	46S1664-0010	46S1664-0010	46S1664-0010	1

* For units with blower starter modification only.

+ See Parts List A

PARTS LIST C
SABER 3300/3SCR, 460 VOLT CONTROLLERS

Description	Symbol	L A. Part Number						Qty/Drive
		7.5, 10, & 15 HP	20HP	25, 30, 40, & 50 HP	60 HP	75 & 100 HP	125 & 150 HP	
Fuse	1-3F	40 amp 5P17-0128	60 amp 5P17-0141	125 amp 5P17-0146	150 amp 5P17-0124	200 amp 5P17-0125	400 amp 5P17-0130	3
Power Bridge		46S1626-4620	46S1626-4620	46S1627-4650	46S1627-4660	46S1627-4700	46S1627-4750	1
. Diode	1-3RT			5P50-0175		5P50-0169	5P50-0169	3
. Diode	4RT			5P50-0169		5P50-0170	5P50-0170	1
. Diode	1-4RT	5P50-0175	5P50-0175		5P50-0169			4
. Thyristor	1-3SCR	5P50-0160	5P50-0160	5P50-0161	5P50-0161	5P50-0161	5P50-0163	3
Firing Logic PCB	1PC	← 46S1661-0020 →						1
Fuse, 250V, 15 amp	4F	← 5P17-0073 →						1
Fuse * 500V, 1 amp	5-7F	5P17-0186						3
500V, 1-1/8 amp			5P17-0187	5P17-0187 (25 H.P.)				
600V, 2-1/4 amp				5P17-0183	5P17-0183	5P17-0183		
500V, 3 amp							5P17-0188	
Control Assembly +		46S1665-0010	46S1665-0010	46S1664-0010	46S1664-0010	46S1664-0010	46S1664-0010	1

* For units with blower starter modification only

\+ See Parts List A.

MOTOR

1. INSTALLATION

1.1 Mounting

Mount the motor on a level bed plate, base, or platform which is rigid enough to prevent transfer of external vibration to the motor.

1.2 Connection to Load

Correct alignment of drive motor and load is essential for long, maintenance-free motor life. Always use flexible couplings for direct coupling of motor to load. Check alignment with a dial indicator as shown in Figure 1. Total run-out should not exceed .002 inches (see Figure 2).

When the motor is driving the load through a belt, the motor and load sheaves must be in line (Figure 3). Belt tension must be sufficient to prevent slipping but not so great as to cause unnecessary strain on the

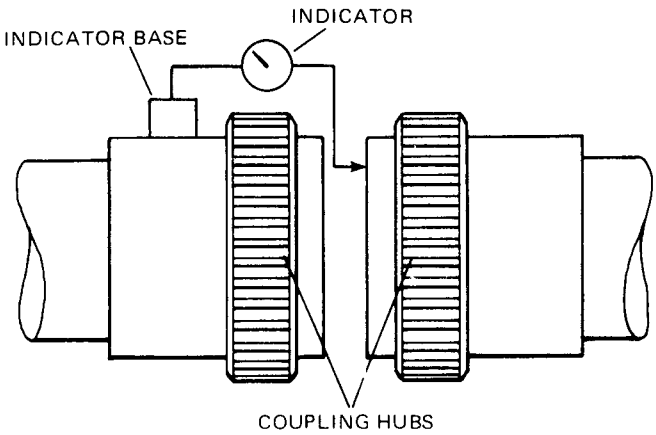


Figure 1. Angular Alignment Check

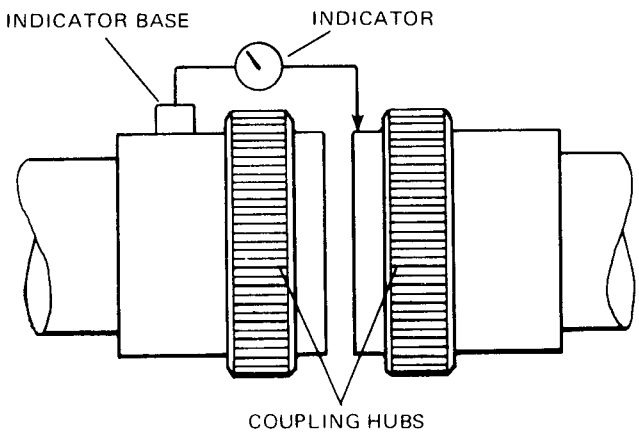


Figure 2. Run-out Check

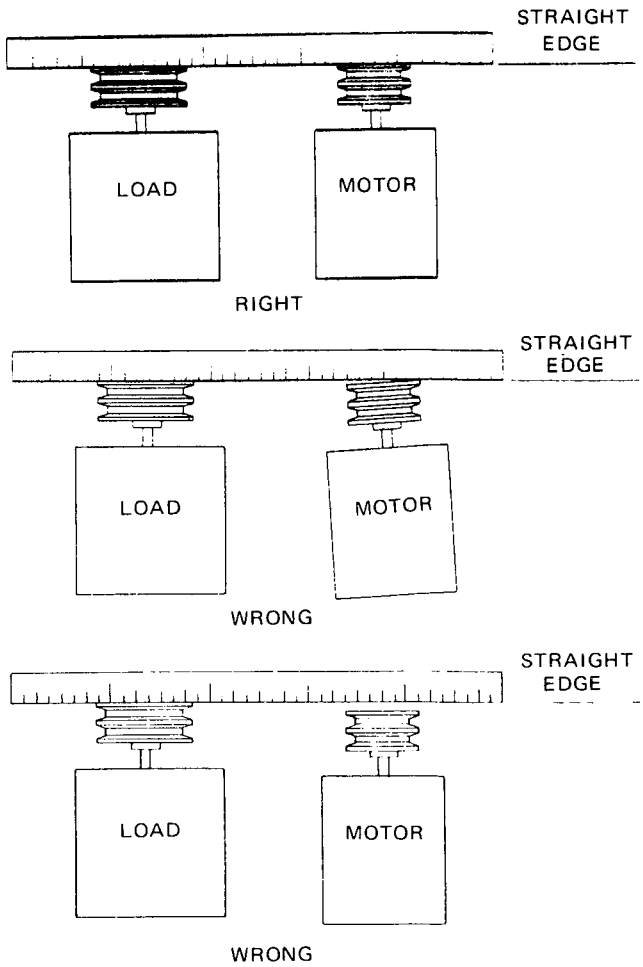


Figure 3. Sheave Alignment

motor bearings. In general, belt tension is proper when the belt can be depressed an amount equal to one-half its own thickness for each 24 inches of unsupported length. (See Figure 4). If special belts are used, refer to belt manufacturer's recommendations.

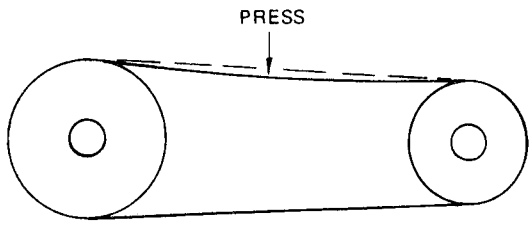


Figure 4. Checking Belt Tension

1.3 Temperature and Ventilation

Ambient temperature surrounding the motor should not exceed 40° C. Locate the motor in a well ventilated environment.

2. MAINTENANCE

2.1 Brushes

2.1.1 General

Proper care of brushes and brush holder assembly is essential to good DC motor operation. Preventive maintenance of the brush assembly will add years of service to the DC motors.

Brushes installed in Louis Allis motors have been carefully selected for optimum performance. Replacements should be identical wherever possible. If brushes are not available locally, contact the nearest Louis Allis sales office.

2.1.2 Installation

When installing brushes be sure the brush holder is properly aligned with the commutator.

New brushes must be seated to the commutator. When installing new brushes, place sandpaper between brushes and commutator with brush resting on the abrasive side of the paper. Work the sandpaper back and forth until the curvature of the brush fits the commutator. Rough sandpaper may be used to cut the brush to shape, but the operation should be finished with No. 0000 sandpaper. At each inspection, check the brushes for proper seating. Where the brush does not contact the commutator over the entire brush surface, reseat the brush as described above.

Brush pressure is important. Make certain that the brushes are free to move in the brush holder, that they rest firmly on the commutator, and that all the brushes carry approximately the same pressure. Normal brush pressure on commutator is about four pounds per square inch.

2.2 Commutator

Check that the commutator is smooth, highly polished and free of dirt, oil, grease and moisture. Clean out the spaces between commutator bars with a suitable tool. Check that the mica between the commutator bars is lower than the surface of the bars. If dirt or other foreign matter is found on the commutator determine the source of these materials and take whatever steps are necessary to keep the materials out of the motor.

If excessive sparking occurs, the surface of the commutator will be dull and black. Clean the commutator with a fine commutator stone or No. 0000 sandpaper (do not use emery cloth). Correct the overload or improper brush seating which is causing the excessive sparking.

If the commutator is so rough and grooved that it cannot be dressed with a stone or sandpaper or if the commutator has worn

to the point where the mica is flush with the commutator, remove the armature, turn down the commutator in a lathe and undercut the mica. Undercutting is normally required very infrequently. Hard usage, abuse and improper maintenance are the main conditions which lead to the need for undercutting.

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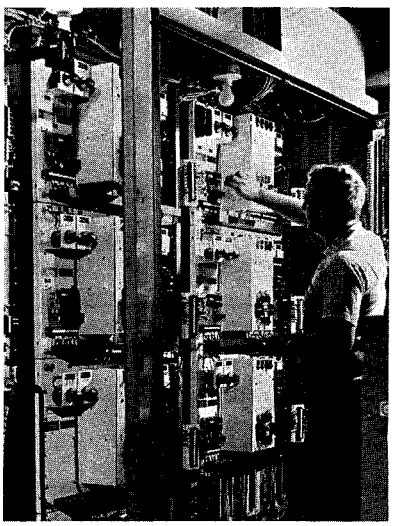

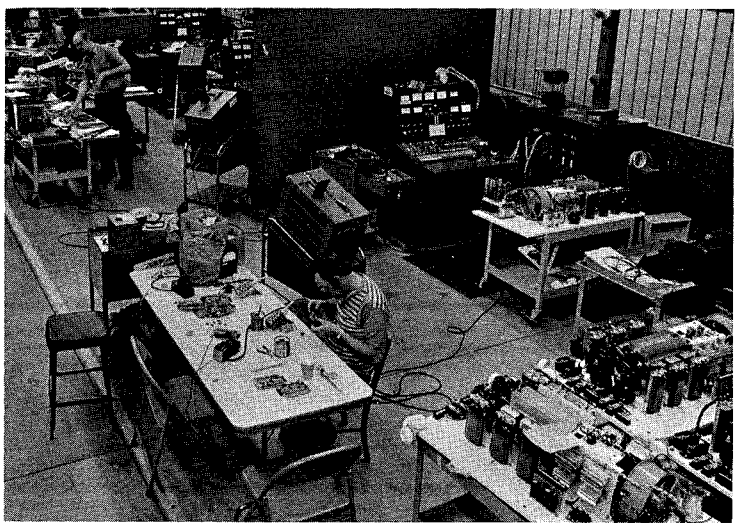

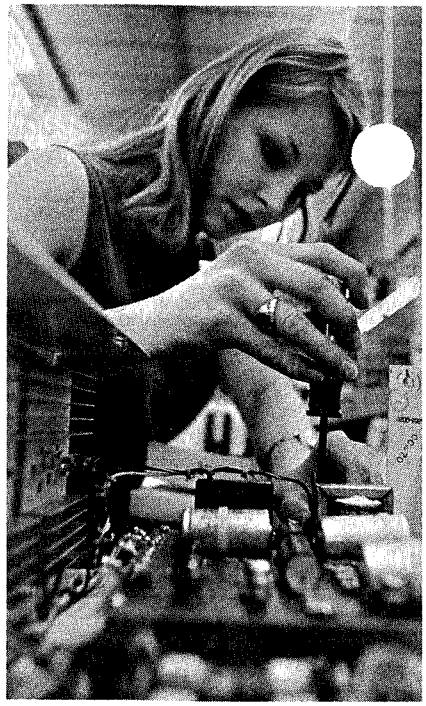

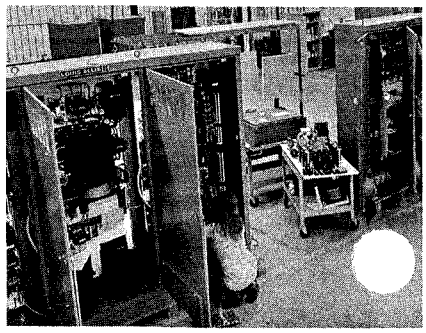

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