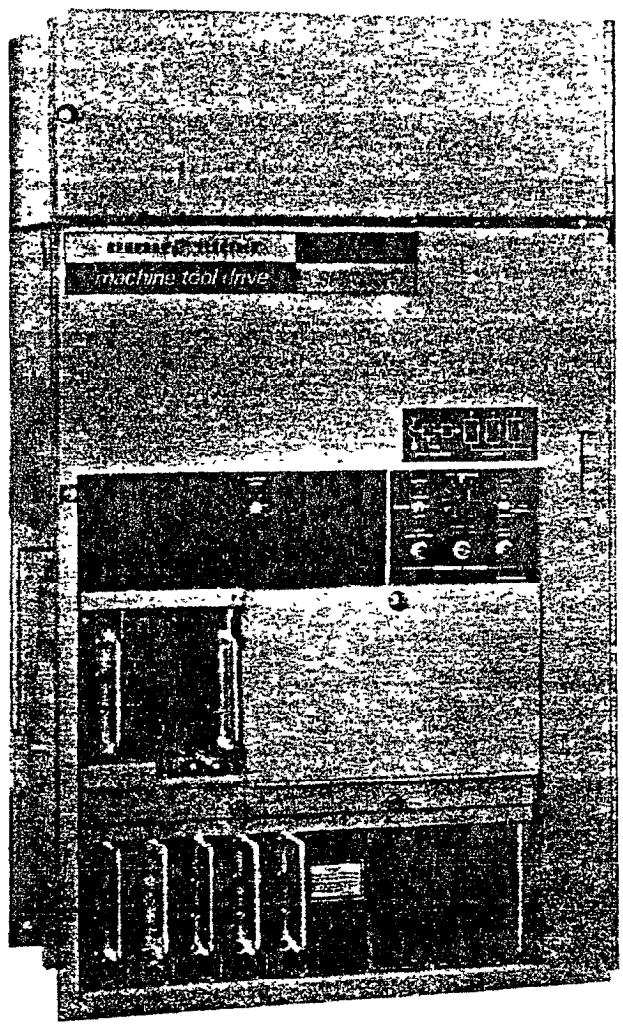
INSTRUCTIONS

GEK–11080

MACHINE TOOL DRIVE - SPINDLE

DC - 3031R

INSTALLATION - OPERATION - MAINTENANCE



These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

GENERAL ELECTRIC

SIMPLIFIED START-UP AND CHECKOUT PROCEDURE

IF ANY DIFFICULTIES ARE ENCOUNTERED DURING START-UP AND CHECKOUT, REFER TO SECTION 4 OF INSTRUCTION BOOK FOR DETAILED START-UP AND CHECKOUT PROCEDURE.

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE A.C. SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE DRIVE.

1. VERIFY THAT THE 3-PHASE A.C. POWER INPUT TO THE DRIVE IS OF THE PROPER VALUE AS LISTED ON THE EQUIPMENT DATA NAMEPLATE (−5, +10%).

2. SET TEST REFERENCE POTENTIOMETER TO ZERO, SWITCH No. 1 TO CENTER, SWITCH No. 2 TO CENTER; THIS DISCONNECTS POWER FROM SCR MODULE AND DISCONNECTS ALL REFERENCE INPUTS.

3. APPLY MAIN A.C. POWER TO THE DRIVE SYSTEM. "READY-ON/FAULT-OFF" INDICATOR ILLUMINATES (THE A.C. CIRCUIT BREAKER IN THE TOP HALF OF THE DRIVE SYSTEM MUST BE SWITCHED ON – WHEN SUPPLIED). THIS INDICATOR WHEN ILLUMINATED INDICATES THE FOLLOWING:

   A. THREE PHASE POWER IS APPLIED AND IS IN THE PROPER PHASE SEQUENCE.

   B. DRIVE FUSES ARE NOT OPEN.

   C. MOTOR FIELD IS ENERGIZED AND FIELD LOSS RELAY IS PICKED-UP.

NOTE

IF THE INDICATOR FAILS TO ILLUMINATE, INTERCHANGE ANY TWO TRANSFORMER INPUT PHASES ONCE: IF INDICATOR IS STILL OUT PROCEED TO THE TROUBLE-SHOOTING TABLE 6–1.

4. VERIFY TEST REFERENCE POTENTIOMETER IS SET TO 0, PLACE SWITCH No. 1 TO DOWN AND SWITCH No. 2 TO UP SWITCH POSITION. USE TEST REFERENCE POTENTIOMETER IN CW AND CCW DIRECTION TO VERIFY PROPER MOTOR OPERATION.

5. SET TEST REFERENCE POTENTIOMETER TO 0, SWITCH No. 1 TO UP SWITCH POSITION, SWITCH No. 2 TO CENTER; THIS PROVIDES NORMAL SYSTEM OPERATION.

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SECTION I
GENERAL

1.1 SCOPE OF MANUAL

This instruction manual is a guide for the installation check-out operation and troubleshooting of the equipment of a basic system. Instructions for special purpose equipment, as requested on the requisition, will normally be covered in the elementary drawings included with the system. If special purpose equipment is added to the Troubleshooting or Equipment Description section, it will be so noted by an asterisk. These instructions do not purport to cover all details or variations in the equipment nor to provide for every possible contingency in connection with the installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the General Electric Company.

1.2 SAFETY, PERSONNEL AND EQUIPMENT

The following paragraphs list some general safety reminders and safety recommendations to be followed when operating this equipment.

Only trained electrical and electronics personnel should install and maintain this equipment. It is dangerous to the untrained or unskilled.

Definition of terms and colors of signs on the equipment:

WARNING: Denotes operating procedures and practices that may result in personal injury or loss of life if not correctly followed.

Color: Black or white lettering on red field.

CAUTION: Denotes operating procedures and practices that, if not strictly observed, will result in damage to, or destruction of, the equipment.

Color: Black lettering on amber field.

NOTE: Denotes an operating procedure or condition that should be highlighted.

Color: Black lettering on white field.

WARNING: HIGH VOLTAGE

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC VOLTAGE SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS WITHIN THE SCR DRIVE. EXTREME CARE MUST BE EXERCISED IN THE SELECTION AND USE OF TEST INSTRUMENTS. OPERATOR SHOULD NOT STAND ON GROUNDED SURFACES OR BE IN CONTACT WITH GROUND WHEN APPLYING TEST INSTRUMENTS TO TEST POINTS. CONVENTIONAL TEST INSTRUMENTS SHOULD NOT HAVE CHASSIS GROUNDED WHILE TESTS ARE BEING MADE THUS THE CHASSIS CAN BE AT A HIGH VOLTAGE WITH RESPECT TO GROUND DURING TESTING. EXTREME CARE SHOULD BE TAKEN WHILE ATTEMPTING TO ADJUST, TROUBLESHOOT OR MAINTAIN ANY DRIVE SYSTEM DESCRIBED HEREIN.

When working on or near the equipment with power/voltage applied, it is recommended that all metal objects such as rings, watches and tie clasps be removed.

It is highly recommended that all personnel working on this equipment wear rubber soled shoes (insulated).

WARNING

WHEN WORKING AROUND ROTATING EQUIPMENT, DO NOT WEAR ANY LOOSE CLOTHING THAT COULD BECOME CAUGHT IN THE EQUIPMENT.

CAUTION

DO NOT INSERT OR REMOVE PRINTED CIRCUIT CARDS FROM THE EQUIPMENT WHILE POWER IS APPLIED OR OPERATING; THIS CAN DAMAGE THE EQUIPMENT.

NOTE

ALWAYS READ THE COMPLETE SUBSECTION (EXAMPLE 3-2) PRIOR TO ANY TURN-ON OR TROUBLESHOOTING OF THE EQUIPMENT, FOLLOW THE PROCEDURE STEP BY STEP.

READ AND HEED ALL WARNING, CAUTION AND NOTE SIGNS POSTED ON THE EQUIPMENT.

1.3 WARRANTY AND SHIPPING

1.3.1 Warranty Statement

The Company warrants to the Purchaser that the equipment to be delivered hereunder will be free from defects in material or workmanship and will be of the kind and quality designated or specified in the contract.

This warranty shall apply only to defects appearing within one year from the date of shipment by the Company. (For full "Conditions of Sale" and a complete statement of warranty, refer to your contract papers.)

1.3.2 Receipt of Shipment

All equipment is factory inspected before shipment and is shipped in good condition. Any damages or shortages evident when the equipment is received must be immediately reported to the commercial carrier who transported the equipment. If required, assistance may be received from the General Electric Company. but when seeking assistance, please provide the purchase order number, requisition number and model number to help us in assisting you.

1.4 RECEIVING, HANDLING AND STORAGE

1.4.1 Receiving

The equipment should be placed under adequate cover immediately upon receipt as packing cases are not suitable for out-of-doors or unprotected storage.

1.4.2 Handling

Smaller power units, wall mounted, can be transported by lift trucks with forks completely under the base. All smaller power units have two detachable screw-in eyelets at the top, for lifting by crane. The larger floor mounted power unit bases have two lifting holes on each side, so that a pipe may be slipped through each pair and crane hooks be used to pick up the unit by means of the pipes. The holes in the power unit may also be used for receiving crane hooks. Spreader bars should be used to spread the cables above the cabinet and bumpers should be used wherever hooks or cables may come into contact with the cabinet, to prevent damage to the cabinet metal and painted surfaces.

1.4.3 Storage

If the equipment is not to be installed immediately, it should be stored in a clean, dry location that is not subject to extreme temperatures. Precautions should be taken to prevent moisture from accumulating in the equipment. The entrance of moisture, dust or dirt during storage or installation is detrimental to the equipment insulation.

1.4.3 Storage (con'd)

In addition, when a control that has been in operation and will be shut down for either a short or extended period of time, it is recommended the environmental conditions be maintained the same as when in operation. Space heaters or equivalent devices should be used to maintain the equipment in its normal operating state (temperature). Refer to instruction book GEK-24902 for further information.

SECTION II
SYSTEMS EQUIPMENT DESCRIPTION

2.1 EQUIPMENT PURPOSE

The Speed Variator drive is a closed loop, adjustable speed, bi-directional, adjustable acceleration, constant horsepower or torque range system designed for coordinated lines, machine tool control and special purpose systems. The system consists of three basic blocks:

1. DC Motor
2. Power and Control Unit
3. Transformer

2.2 EQUIPMENT FURNISHED - GENERAL

For the exact description of equipment received, refer to your order information.

2.2.1 DC Motor-Up to 75 horsepower, shunt wound, separately excited field, 240VDC armature, maximum ambient 40C, thermostat protection with an a-c tachometer normally supplied.

2.2.2 Power and Control Unit - 460VAC, three phase, 60Hz *power input; transformer neutral, SCR three phase, half wave conversion with full regeneration, with output voltage from zero to 240VDC; open panel, wall or floor mounted enclosures.

2.2.3 Transformer "isolation" type for three phase, three wire input of 230/460VAC*, 60 HZ* power and four wire output of 460VAC line to line and 260VAC line to neutral.

2.2.4 Special Purpose Equipment - see Elementary Diagrams

2.2.5 Control and Indicator Functions

Table 2-1 will give a listing of the controls and indicators and their function. For a more detailed understanding, refer to the functional flow diagram in Section IX .

* Optional equipment is available for 50 HZ power and other voltages.

TABLE 2-1 FUNCTION OF CONTROLS/INDICATORS

EQUIP/ ITEM	CONTROL/INDICATORS	FUNCTIONS
POWER UNIT	"READY-ON/FAULT-OFF" indicator light.	Illuminates when incoming 3 phase power is on and in correct phase sequence and no other "faults" are in the system.
	"FAULT RESET" pushbutton.	Resets the fault circuit coil if problem was of a transient nature or problem has been corrected.
ADJUSTABLE VOLTAGE EXCITER(AVE)	"MIN FIELD" adjust potentiometer.	(Protective circuit to inhibit excessive field weakening) Adjust to the minimum weak field of the motor nameplate.
	"CROSSOVER" adjust potentiometer.	Sets armature voltage point at which field weakening begins
REGULATOR Test Function Card		Provides test function output for monitoring of driver/regulator operations
	Meter Range Selector (if supplied)	Selects meter scale multiplier for different voltage ranges ± 3 volts full scale. (X1, X10, X100)
	"ON/OFF" Switch (if supplied)	Enables function desired to be displayed on meter.
	Function monitor select thumbwheel switch.	Selects positions 1 thru 19 for display on monitor.
	Banana Jacks.	Output test function selected for external test equipment connection.
± 20 Power Supply	No Adjustments	Supplies ±20VDC for regulator power. Fused inputs FUA 1 and FUA 2.
Pre-amplifier Card	TIMING ADJ. potentiometer.	Provides an adjustable range in time for acceleration/deceleration of the system to the speed requested (RPM) by the reference signal.
	RESPONSE potentiometer.	Provides an adjustment of system sensitivity for stability and response.
	SPEED BALANCE potentiometer (G01 only)	Provides the capability to match top speeds between the forward and reverse directions.

TABLE 2-1 FUNCTION OF CONTROLS/INDICATORS (cont'd)

EQUIPMENT ITEM	CONTROL/INDICATOR	FUNCTION
Pre-amplifier Card (cont'd)	ZERO ADJ potentiometer (G02 only)	Adjusts the output to zero when input is zero.
DRIVER Driver Coordination Card	ZERO ADJUST potentiometer	FACTORY SET - Do not adjust. If suspected, notify factory.
	DEADBAND Potentiometer	FACTORY SET - Do not adjust. If suspected, notify factory.
Auxiliary Function Card	VOLTAGE LIMIT potentiometer.	Provides a means of adjusting the armature voltage for a maximum of 260VDC.
	IOC Adjust potentiometer.	Provides an adjustment range for automatic system shutdown due to instantaneous overcurrent peaks.
	CURRENT LIMIT potentiometer.	Provides an adjustment range for overcurrent protection normally set for 150% of full load current.
Phase Control Adder Card	No Adjustments	To provide pulse trains at the SCR gates for firing SCR's at the proper time.
Phase Control Card	No Adjustments	Provides trigger and ramp signals.
POWER UNIT	"MAXIMUM SPEED" potemtiometer.	Provides a means of adjusting the speed reference input to obtain top speed.
"DIAGNOSTIC" Function (See page 4-13)	"SWITCH #1" "SWITCH #2"	Two switches are used to select various test conditions or normal running.
	"TEST REFERENCE" potentiometer	Provides a voltage or current source for the test functions.
	"FIELD LOSS BYPASS' pushbutton	Button that shorts out field loss interlock. Use only for special tests or troubleshooting.

TABLE 2-1 FUNCTION OF CONTROLS/INDICATORS (cont'd)

EQUIPMENT/ITEM	CONTROL/INDICATOR	FUNCTION
REGULATOR AUXILIARY CARDS (when supplied)		
Signal Level Detector (SL) Card		Drops out in the 30 to 50 RPM range. Indicates low speed. Used to hold MA Contactor in above set speed during regnerative stopping.
	"SL GAIN" potentiometer	Used to set RPM at which relay (ISL) drops out.
	"SL" indicator light	Light illuminates when relay energizes.
Tachometer Monitor (TM)Card		Shuts drive down in the event of an overspeed or loss of tach signal.
	"TRIP SPEED" POTENTIOMETER	Used to set desired overspeed trip point.
	"ZERO ALIGN" potentiometer	Used to set trip point if tach signal is lost.
	"FAULT" indicator light	Illuminates when trip occurs.

2.3 BASIC SYSTEM THEORY OF OPERATION

The drive system must be able to provide the following:

Convert a-c power to d-c power
Start and stop motor
Control motor speed through its designed speed range
Sense and correct motor needs due to system disturbances.
Protect equipment
Provide accurate and smooth operation of motor
Monitor and control itself
Provide special acts or needs

The basic system block diagram is shown in Figure 2-1. Figures 2-2 and 2-3 provide identification of equipment in the system.

The system will be divided into five functional areas; Power, Command and Logic, Driver Regulator, Power Conversion Module and Motor. For more details of operation, see Section IX.

2.3.1 Power

Three phase (three wire) a-c power is brought into the transformer (T) primary. The secondary of the transformer must develop a fourth leg, neutral (XO), for a return current path. The transformer supplies power to the power conversion module for conversion to d-c power. It also supplies power to the synchronizing transformer assembly (STA) and the adjustable voltage exciter (AVE). The STA provides synchronization voltage to the driver regulator and AVE.

2.3.2 Command and Logic

The command and logic circuitry (relays, switches and protective devices) is responsible for the starting, stopping, direction, protection and speed reference (REF) input to the system.

2.3.3 Driver Regulator

The driver regulator is composed of six printed circuit cards. Its task is to receive the reference input and coordinate and deliver firing signals to the power conversion module. The driver regulator, after reacting to the reference command, monitors the power conversion module and motor performance, by way of feedback signals (fdbk) and maintains appropriate output. When the input reference changes, the driver regulator must provide the power conversion module with the new command signal. It also provides system protection such as current limit and overcurrent trip (IOC).

2.3 BASIC SYSTEM THEORY OF OPERATION (con'd)

2.3.4 Power Conversion Module

The Power conversion module consists of three identical submodules, each consisting of one dual pulse amplifier card and two SCRs on a heatsink assembly and transient suppression circuits. The three phase a-c power from the transformer is converted to d-c power by the SCRs and adjusts the voltage applied to the motor. This is accomplished by the driver regulator firing signals acting on the SCR gates at the proper instant in time to allow the motor to meet the request.

2.3.5 DC Motor

The motor armature will react to the amount of voltage and current from the power conversion module across its speed range. The motor field voltage is determined by the adjustable voltage exciter (AVE) assembly (if supplied) which allows the motor to run above its base speed, as much as four to one, or is determined by a static, non-adjustable, exciter (CVE) on base speed drives.

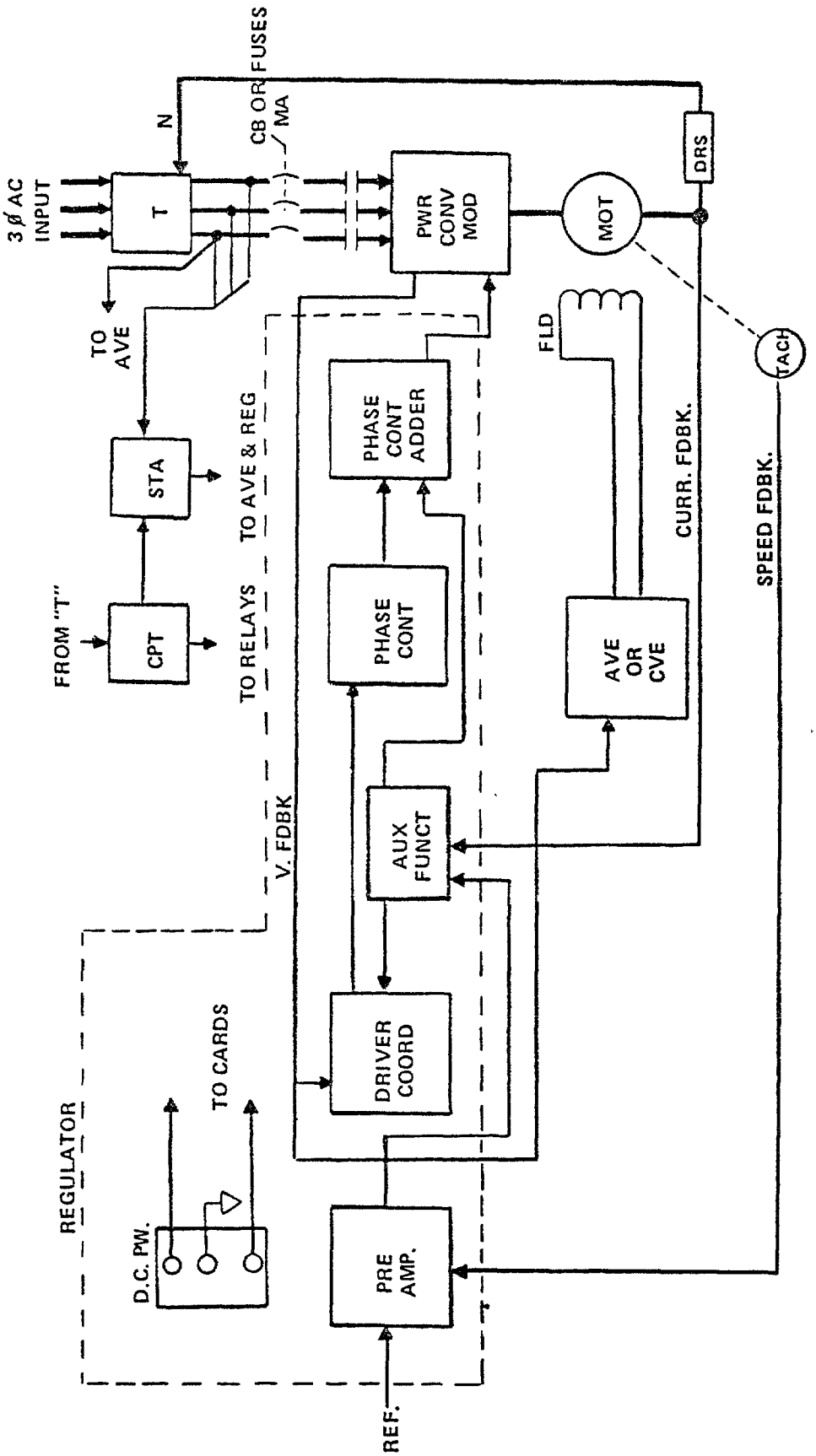
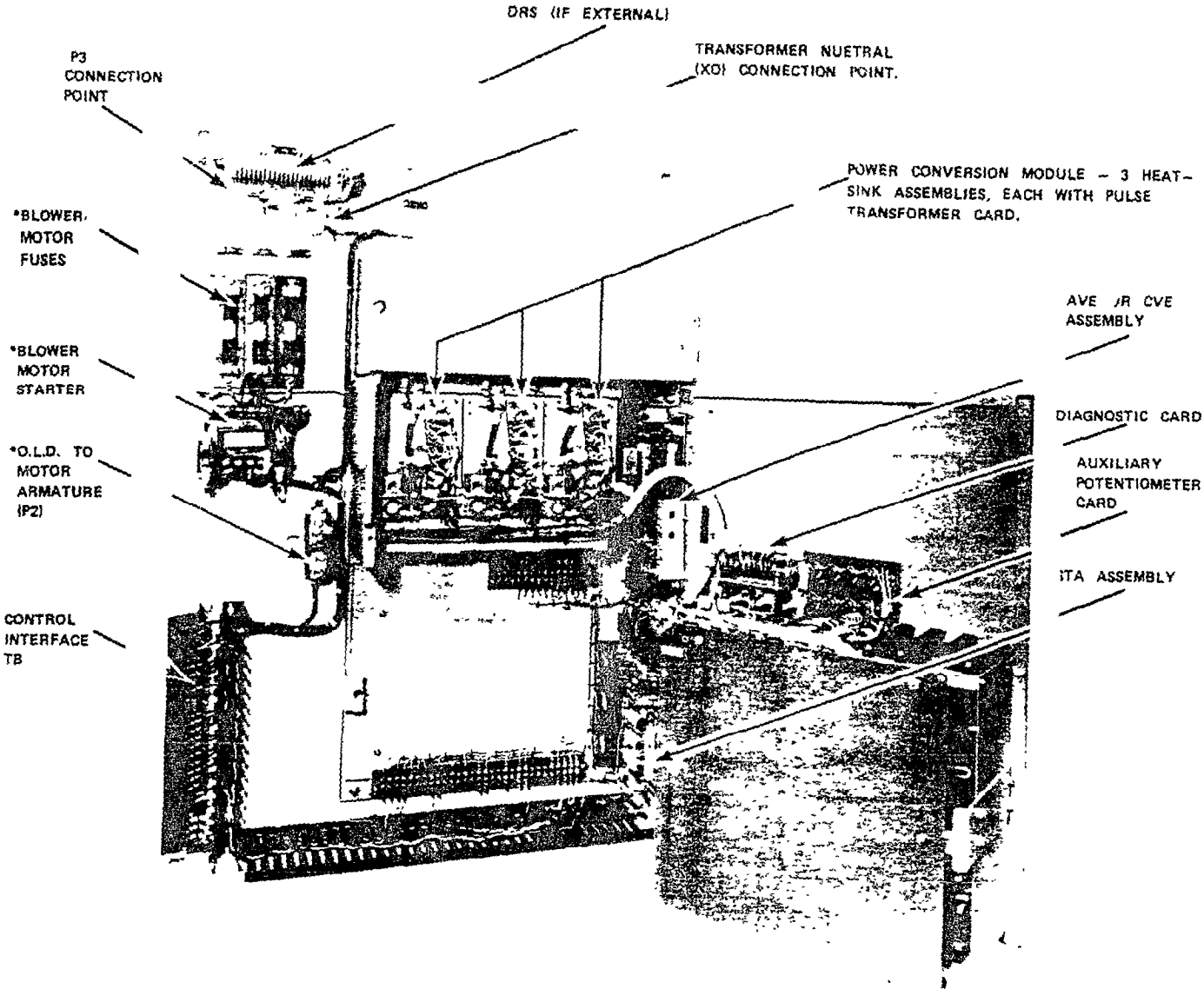


FIGURE 2–1 SYSTEM BLOCK DIAGRAM



* IDENTIFIES MODIFICATION OPTIONS

FIGURE 2-2 TYPICAL OPEN PANEL POWER UNIT – DOOR OPEN

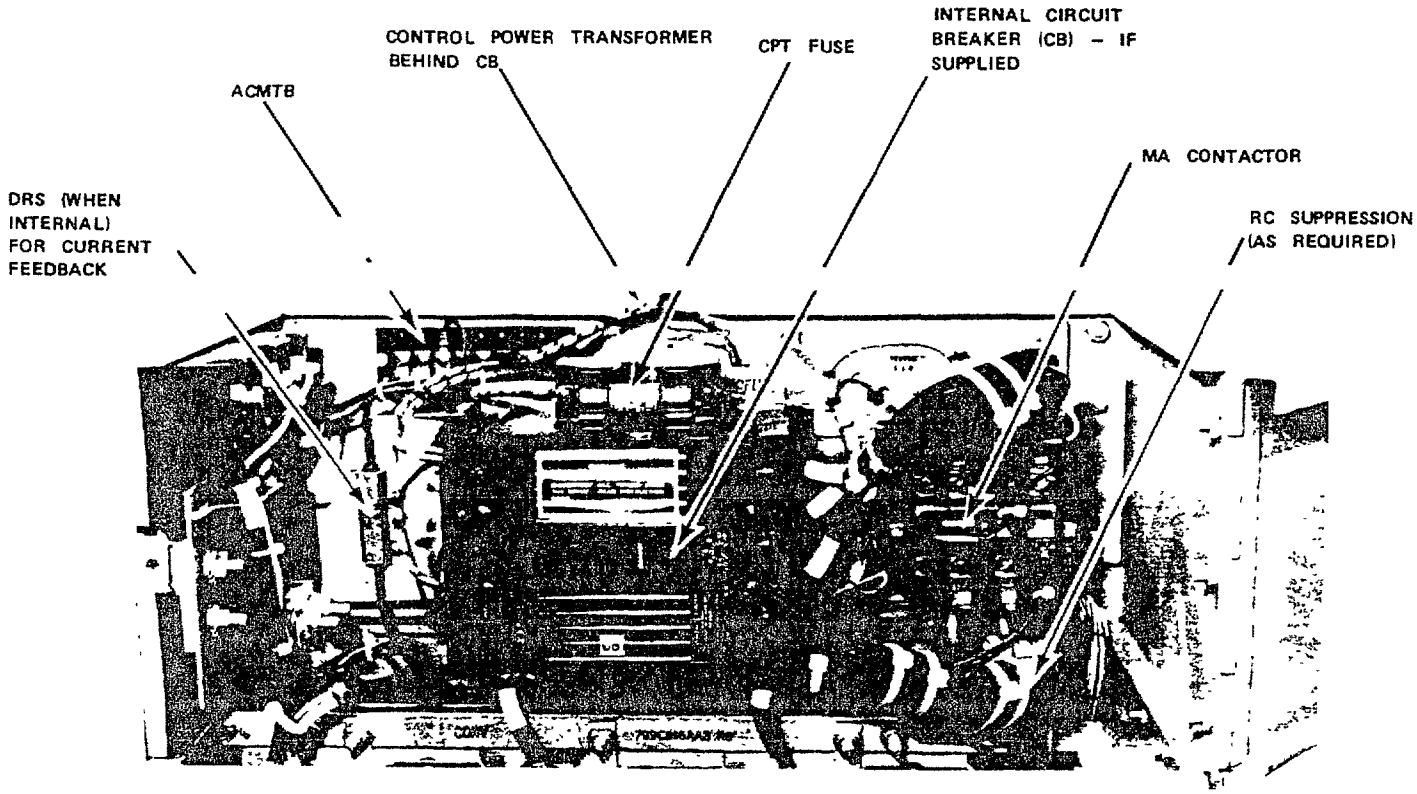


FIGURE 2-3A AUXILIARY CONTROL MODULE (ACM) – DOOR OPEN

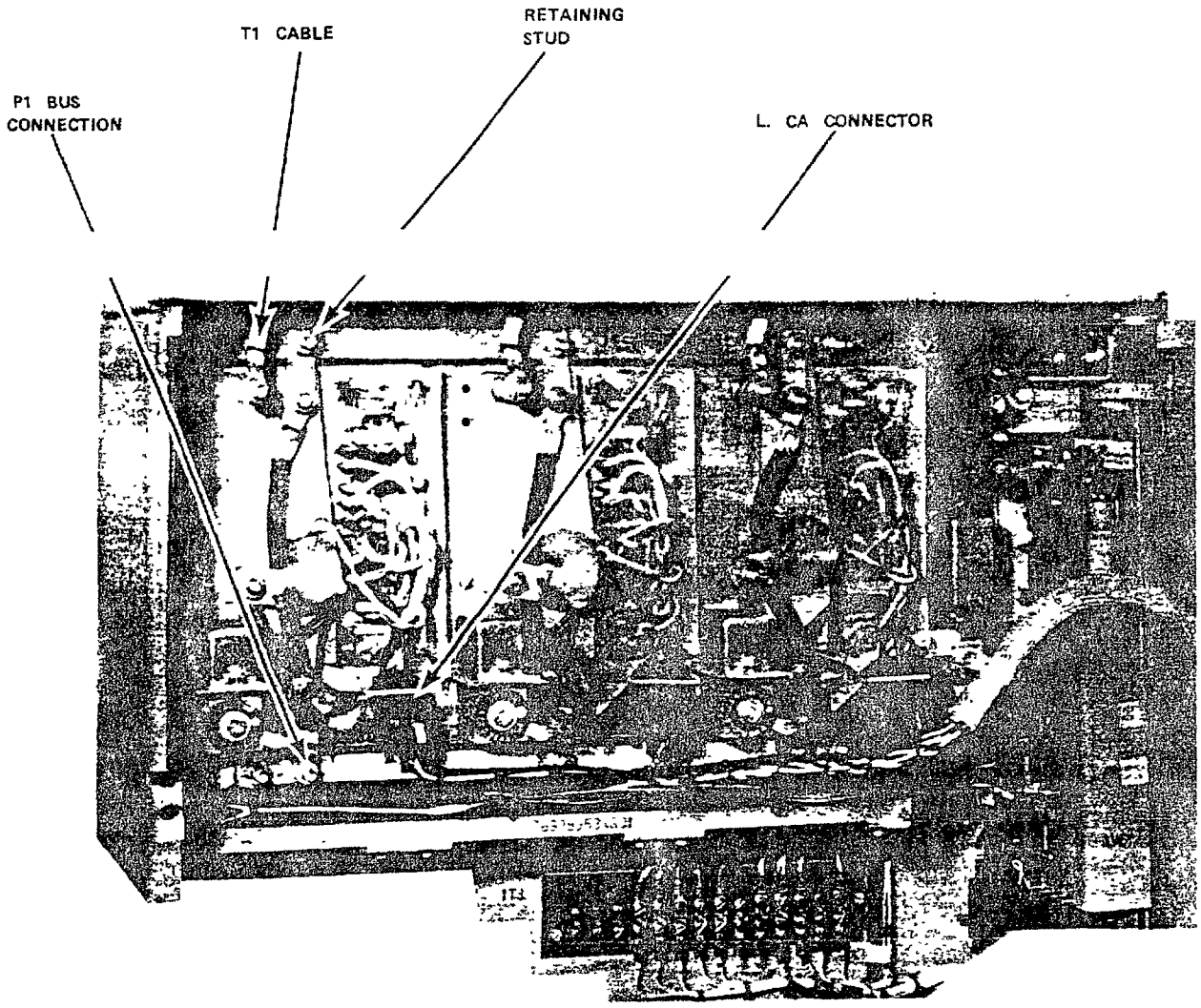


FIGURE 2–3B POWER MODULE, HEATSINK ASSEMBLY (3 ASSEMBLIES) DIS–CONNECT POINTS

SECTION III
INSTALLATION

3.1 EQUIPMENT LOCATION

Speed Variator power units equipped with filters are suitable for most factory areas where other industrial equipment is installed. Locations subject to steam vapors or excess moisture, oil vapor or chemical fumes should be avoided. If the unit has a filter and blower system, the filters should be changed or cleaned before they become clogged. Power units should be installed in a well-ventilated area not subject to excessive heat.

WARNING

EQUIPMENT SHOULD NEVER BE INSTALLED WHERE HAZARDOUS, INFLAMMABLE OR COMBUSTIBLE VAPORS OR DUSTS ARE PRESENT. SUFFICIENT CLEARANCE IN FRONT OF THE UNITS SHOULD BE ALLOWED FOR THE ACCESS OF MAINTENANCE OR REPAIR.

3.2 TOOLS REQUIRED

The normal electrical and mechanical tool boxes maintained in most factories are all that is required for the installation of this equipment.

3.3 MECHANICAL INSTALLATION

The mechanical installation will depend upon the type of mechanical enclosure supplied. If the equipment is supplied in an open panel for installation, this has been designed to be installed in a customer supplied enclosure. If the equipment supplied is mounted in a wall enclosure, install it as per outline drawings for wall enclosures. Floor mounted equipment enclosure should be mounted as per the outline for the floor mounted enclosure.

3.4 ELECTRICAL WIRING AND INTERCONNECTION

All wiring shall be in accordance with the National Electrical Code and be consistent with all local codes. All internal electrical connections between components and the Speed Variator power units were made at the General Electric factory. When installing Speed Variators, all connections should be checked for tightness. Connections may become loose in

shipping or storage. A diagram showing the connections between the power unit and the related components is furnished with each equipment. All terminals to which the external connections are to be made are numbered on the equipment as indicated on the interconnection diagram. The equipment should be wired as per the interconnection diagram and verified by continuity tests. It is recommended as each connection or wire is connected to the equipment that it be checked off on the interconnection diagram. When motor tachometer leads are connected it is recommended that the tachometer wiring be a twisted pair with at least six turns per foot of length. Also the speed reference input and current feedback (DRS) leads should be twisted pairs. If twisted pair, shielded wire is used, do not ground the shield

WARNING

ALL MOTOR BASES AND EQUIPMENT ENCLOSURE HOUSINGS SHOULD BE CONNECTED TO THE FACTORY OR FACILITY EARTH GROUNDING SYSTEM

NOTE

ON SOME SYSTEMS, THE TRANSFORMER, CHOKE AND DRS RESISTOR ARE SHIPPED SEPARATELY, AND MUST BE MOUNTED AND CONNECTED TO THE SYSTEM.

CAUTION

DO NOT USE POWER FACTOR CORRECTION CAPACITORS WITH THIS EQUIPMENT SINCE DAMAGE CAN RESULT FROM HIGH VOLTAGES GENERATED WHEN CAPACITORS ARE SWITCHED.

CAUTION

ANY REMOTE CONTROL EQUIPMENT THAT INTERFACES WITH THIS DRIVE, THROUGH A GROUNDED CONDUCTOR, MUST PROVIDE PROTECTION BETWEEN THE GROUNDED CONDUCTOR AND THE DRIVE SIGNAL COMMON AGAINST GROUND CURRENTS BY EITHER:

1. Equipment has an isolator card.
2. Fusing (½ A Instrument type) in the grounded return line to the drive common.

THIS PROVIDES GROUND FAULT PROTECTION BETWEEN DRIVE COMMON AND REMOTE GROUNDED CONDUCTOR.

3.5 50 HZ OPERATION

To convert a 60 HZ base input frequency power unit to operate on a 50 HZ base input frequency, the following must be done:

a. A 50 HZ isolation transformer must be supplied. (If a dual 50/60 HZ, dual connection has been supplied, check transformer connection information for proper connection requirements).

b. Move the three wire jumpers to the 50 HZ stab-on posts on both Phase Control cards in the driver regulator.

c. Readjust the "MIN FLD" potentiometer on the AVE back to the recorded value on the Test Data Sheet (for drives that have an Adjustable Voltage Exciter - AVE supplied).

SECTION IV
CHECKOUT

4.1 GENERAL

This section provides a step-by-step approach, and must be followed in sequence, to start up a DC-3031R drive system. If during the course of start up and checkout, a step/indication cannot be performed, refer to Section VI, TROUBLESHOOTING, Table 6-1, 6-2, or 6-3. These Troubleshooting tables are written to follow each startup step in sequence. Startup and checkout steps are cross-referenced to paragraph/step numbers and indications in the Troubleshooting tables. This section does not include instructions on special regulators or auxiliary functions which may be included in some systems. These instructions would be detailed elsewhere. All checks may be made from the front of the regulator by use of the diagnostic function (IDT). External reference signals are not necessary until final system tests are made. Systems with remote auxiliary protective devices must be connected and operating when they have normally closed contacts to permit system operation. The following abbreviations will be used in this section for checkout with the diagnostic function.

Switch #1	SW1
Switch #2	SW2
Switch Positions	
Up	U
Center	C
Down	D
Test Reference Potentiometer	TRP
Field Loss Bypass Switch	FLS
Ready-on/Fault-off indicator (Fault indicator) light	FI
Fault Reset Switch	FR
TRP Direction	
Clockwise	CW
Counter-clockwise	CCW
Test Function Card Selective Test Points	TP (#)
Card(s) Test Jack Points	TJ (#)
DC Voltages Plus or Minus Signs	+ or -
Voltage Tolerance	± or +_% or -_%
AC Voltage	No ± sign except for tolerance
Volt Ohm Meter	VOM

WARNING

THE INTERNAL DRIVE CIRCUIT BREAKER (IF SUPPLIED) DOES NOT DISCONNECT ALL POWER TO THIS DRIVE. PLACE EXTERNAL CIRCUIT BREAKER/ DISCONNECT DEVICE TO OFF TO REMOVE ALL POWER TO THE DRIVE AND VERIFY POWER IS DISCONNECTED TO THE DRIVE BY MEASURING WITH A VOM AT THE INPUT TO THE INTERNAL DRIVE CIRCUIT BREAKER OR INPUT FUSES

IF DOOR INTERLOCKS (IF SUPPLIED) ARE DEACTIVATED OR BYPASSED, EXTREME CAUTION MUST BE USED - BE SURE TO REMEMBER TO RETURN INTERLOCKS TO OPERATING CONDITION AFTER MEASUREMENT OR TROUBLE-SHOOTING.

4.2 TEST EQUIPMENT REQUIRED

This equipment has been designed so that a volt ohm meter (VOM) and RPM measuring device is all that is required for the normal startup and checkout. In addition to the VOM, other test equipment that may be required for auxiliary functions and devices or detailed trouble shooting are listed below:

Volt-ohm Meter (VOM)- 3 ranges minimum
X1, X10, X100; 20,000 ohm per volt
d-c sensitivity
Oscilloscope (scope)
RPM Measuring Device- (0 to 6000 RPM)
DC Ammeter - 0 to 300 amps, adjustable range, clamp-on type

4.3 POWER-OFF CONTINUITY TEST

WARNING

VERIFY THAT THE MAIN THREE-PHASE AC POWER INPUT TO THE SYSTEM EQUIPMENT IS DISCONNECTED OR SWITCHED OFF.

Perform a point-to-point continuity test for all newly installed wiring and interconnection. Continuity is defined as 1/2 ohm or less.

4.4 NO LOAD - POWER-ON TEST

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE DRIVE.

No load testing is defined as the motor shaft disconnected from the end devices or no working load on the end device.

Examples: Drill press bit rotating but not drilling material.

NOTE

DURING CHECKOUT, RECORD MEASUREMENTS AND SETTINGS ON THE TEST DATA SHEET SUPPLIED, UNDER THE USER DATA COLUMN. "TDS" BESIDE A STEP INDICATES AN ENTRY ON THE TEST DATA SHEET

4.4.1 Turn On - Initial Checkout.

CAUTION

ALWAYS RETURN SPEED REFERENCE INPUT TO ZERO AND LET MOTOR COME TO A REST PRIOR TO CHANGING ANY DIAGNOSTIC SWITCH POSITIONS OR REMOVING AC POWER.

a. Verify that the 3-phase a-c power input to the drive is of the proper value as listed on the equipment data nameplate (-5, +10%).

b. Set TRP to zero, SW1 to C, SW2 to C; this disconnects power from SCR module and disconnects all reference inputs.

c. Apply main a-c power to the drive system (the a-c circuit breaker in the drive system must be switched on - when supplied). The fault indicator illuminates. This indicator being illuminated verifies the following:

   1. Three phase power is applied and is in the proper phase sequence.

   2. Drive fuses (or internal circuitbreaker) are not open.

3. Motor field is energized and Field Loss relay is picked-up.

NOTE

IF THE INDICATOR FAILS TO ILLUMINATE, INTERCHANGE ANY TWO TRANSFORMER INPUT PHASES ONCE: IF FI IS STILL OUT, PROCEED TO THE TROUBLE-SHOOTING TABLE 6-1.

4.4.2 Static Test

This part of the test checks the following functions with the SCR modules disconnected and using the Test Reference potentiometer for reference input with a simulated armature voltage feedback signal for the AVE (when supplied):

Test reference input
Linear timed acceleration and deceleration
Forward and Reverse amplifier circuits
Lockouts
Firing signals
Motor field voltage
Field weakening (AVE) when used
Field Loss relay protection

TDS a. Verify TRP is set to 0 and SW1 is at C. Place SW2 to D. With the VOM, verify that TP1 is +20±.6 and TP2 is -20±.6 volts. (Refer to Section IX)

b. With the VOM monitoring TP3, turn the TRP fully CW and verify a voltage of -7.5 minimum as observed, still monitoring TP3 turn the TRP fully CCW and verify that an equal but positive voltage is measured.

TDS c. Select TP4 and with the VOM verify that the voltages measured on TP3 are approximately equal but opposite in polarity (CW is +, CCW is -). Turn the TRP to 0 and then monitoring the VOM (still connected to TP4) quickly turn the TRP fully CW. The voltage should rise smoothly to the value measured previously as determined by the setting of the "timing adj" potentiometer. This adjustment can be set from .3 to 8 seconds to give the desired acceleration and deceleration time.

d. On systems with a G01 Preamp Card, use the VOM and the TRP (CW) to verify that when TP4 is positive that TP5 clamps at a minimum of -.5 and TP6 follows TP4 but is opposite polarity. (For G02 see paragraph 4.5.1.)

NOTE

WHEN A G02 PREAMP CARD IS USED,
TP5 WILL FOLLOW (BUT INVERTED)
TP4 IN STEPS D & E. TP6 IS THEN
FOR SPECIAL APPLICATIONS.

e. On systems with a G01 Preamp Card, use the VOM and the TRP (CCW), verify that when TP4 is negative that TP6 clamps at a minimum of +.5 and TP5 follows TP4 but is opposite polarity. (for G02 see paragraph 4.5.1).

TDS f. With the VOM monitoring TP12 (lockout #2) turn TRP CW and verify that the minimum of +5 volts is measured. With lockout #2 at TP12 still measuring a minimum of +5 volts, verify that lockout #1 at TP11 is approximately 0 V.

NOTE

WHEN THE FAULT INDICATOR IS OFF,
BOTH LOCKOUTS WILL BE ON, I.E.,
A MINIMUM OF + 5 VOLTS.

TDS g. With the VOM monitoring TP11 (lockout #1) turn TRP CCW and verify that the minimum of +5 volts is measured. With lockout #2 at TP11 still measuring a minimum of +5 volts verify that lockout #2 at TP12 is approximately 0 V.

TDS h. With the TRP fully CW, using the VOM, verify that a minimum of +.8V is measured at TJ19, 20 and 21 and of approximate equal values; this verifies Firing pulses 1, 2 and 3 are present. (Approximately +.6 with no Firing Pulses.)

TDS i. With the TRP fully CCW, using the VOM, verify that a minimum of +.8V is measured at TJ22, 23 and 24 and of approximate equal values; this verifies Firing Pulses 4, 5 and 6 are present.

TDS j. Adjustable Voltage Exciter (AVE) Adjustment (if supplied). With the TRP at zero and the VOM monitoring TP19 (-300V scale DC) verify that the voltage measured is the same as called for on the test data sheet for motor full field voltage ±10%. Turn the TRP fully CW and verify that the weak field voltage on TP19 is as listed on the test data sheet.

NOTE

FOR A FIXED FIELD "CVE" (NO AVE) VERIFY
THE VOLTAGE IS AS PER TEST DATA SHEET
VOLTAGE BY MEASURING, WITH VOM, ON ACMTB1
(-) TO ACMTB2 (+) ON -300 SCALE.

(1) If required, to set the Minimum Field voltage, first perform the following calculation

NP WEAK FLD CURR X NP FLD RES X .9 =
MIN FLD VOLT. SETTING

With the VOM still monitoring TP19 adjust the "MIN FLD" potentiometer to the above calculated value.

4.4.3 Static Current Feedback Test

This part of the test will check out the current limit and instantaneous over current (IOC) circuits under these conditions; power disconnected from SCR module, test reference from TRP, de-activated main preamplifier regulator and a simulated dc current feedback signal.

a. Set the TRP to 0, SW1 to C and SW2 to U.

TDS b. With the VOM monitoring TP9 (+) slowly turn the TRP CW; the voltage at TP9 will increase and then start to decrease. At the point where TP9 just starts to decrease, measure and record (less than -1V) the voltage on TP7 (this is the dc equivalent voltage required to start current limit).

TDS c. Still monitoring TP7 continue turning the TRP CW until the "FAULT INDICATOR" extinguishes; record the voltage at this point. This voltage is the equivalent of the static IOC trip point. Turn the TRP to 0 and press the "FAULT RESET" button; the "FAULT INDICATOR" illuminates.

d. Repeat steps b and c with the TRP in the opposite direction (CCW). The readings should be within 15% in both directions.

TDS e. Verify that the TP7 voltages observed are as listed on the test data sheet. Current limit is normally set at 150% unless otherwise specified. IOC is normally set at 2.5 times the value set for current limit.

4.4.4 VOLTAGE REGULATOR TEST (SET VOLTAGE LIMIT)

This part of the test checks the following functions with the main preamplifier disconnected, the TRP supplying the reference to the driver causing the system to act as a voltage regulator, not a speed regulator. The field is fixed so the drive cannot run above base speed.

This test is normally used as a troubleshooting tool if the drive is not running normally. It can determine if the drive is functioning properly. It also can be used to detect:

Proper voltage limit
Proper tachometer connection and level
Noise on tach or main reference signal
Proper polarity and signal levels of
auxiliary signals such as position
regulators, current feedback signals
or follower references

CAUTION

WHEN OPERATING DRIVE IN THE TEST OR MANUAL MODE, CONTINUALLY OBSERVE THE MACHINE TRAVEL TO AVOID HITTING THE ELECTRICAL AND/OR MECHANICAL LIMITS.

a. Verify TRP is set to 0, place SW1 to D and SW2 to U.

TDS b. With the VOM monitoring TP8 turn TRP fully CW and verify that the voltage feedback signal is approximately the same as listed on the test data sheet. Return TRP to zero.

TDS c. Alternate Voltage Limit Adjustment Procedure

Place/disconnect main AC power input to the drive off; "FAULT INDICATOR" extinguishes. Connect VOM (+300 V scale) between P1 and Driver Regulator common. Re-apply main AC input to drive and, with the TRP turned fully CW, verify that +260V is measured. If other than +260V is measured, adjust the Voltage Limit potentiometer until +260V is measured. Return TRP to zero. Verify that the voltage is of opposite polarity and of approximate equal amplitude when the TRP is turned fully CCW. Check and record Voltage feedback signal on TP8 with TRP fully CW. Place/switch main AC input power to the drive off and then disconnect VOM.

4.4.5 DYNAMIC CURRENT LIMIT

This part of the test will adjust current limit and IOC when no test data sheet is available or some other value of current limit is required with power applied to the SCR module, preamplifier is set for unity gain and the reference is from the TRP.

CAUTION

THE FOLLOWING PRECAUTION SHOULD BE TAKEN:

1. NO MOTOR ROTATION DURING TEST.

2. DO NOT EXCEED 5 SEC. WITH CURRENT APPLIED.

3. DO NOT REPEAT MORE THAN THREE TIMES WITHOUT ROTATING MOTOR SHAFT.

4. DETERMINE DESIRED CURRENT LIMIT SETTING BEFORE STARTING.

a. Verify the main three phase input power to the drive system is switched off/disconnected.

b. Verify TRP is set to 0, place SW1 to D, SW2 to U.

c. Remove the line fuses on the CVE (static exciter) or AVE field supply to the motor field.

d. To determine the current limit setting (DC equivalent voltage at TP7) take the resistance value of the DRS resistor (the DRS resistance can be one or more resistors in parallel) and multiply by the desired motor armature current value from the motor data nameplate (in amps).

EXAMPLE: Desired current limit 150% (percent of motor rated)
Motor armature rated amps 50
DRS resistance .01 ohms
75a x .01 ohms = .75 at TP7

The above example indicates that 100% rated armature current (motor nameplate data) plus 25 amps equals 150% current limit times DRS value.

e. Apply AC input power to the drive and with the VOM monitoring TP7 press and hold "FIELD LOSS BYPASS" button and press and release "FAULT RESET" button.

CAUTION

IF THE MOTOR STARTS TO ROTATE AT ANY TIME DURING THIS TEST, RELEASE THE "FIELD LOSS BYPASS" BUTTON AND PRESS THE "FAULT RESET" BUTTON.

TDS f. Turn TRP in a CW direction until voltage stops increasing and quickly adjust the Current Limit potentiometer to the calculated DC value. Release "FIELD LOSS BYPASS" button. Turn TRP in CCW direction and check for balanced operation of reverse current limit. Switch off/disconnect AC input power to the drive and replace fuses removed in step c.

TDS g. With the value measured on TP7 the IOC setting can be checked and readjusted to 2.5 times the current limit value by following 4.4.3

4.4.6 NORMAL RUNNING FINAL ADJUSTMENTS.

This part of the test checks speed balance, maximum speed, minimum speed, slow speed relay point (SSR) and any other auxilliary signals/commands with the system operating in its normal configuration.

a. Switch off/disconnect AC input power to the drive system. Verify the TRP is set to 0 and place SW1 to U (NORMAL) and SW2 to C (NORMAL).

NOTE

REMOTE DIRECTION AND SPEED COMMAND FUNCTIONS WILL BE USED FOR THIS PART OF THE TEST. ON TAPE CONTROL SYSTEMS USE THE MANUAL MODE (IF SUPPLIED). ALL EXTERNAL REFERENCE AMPLIFIERS MUST HAVE BEEN ZEROED.

b. Connect the VOM (300V) leads between P1 and the common test jack in the regulator. Attach mechanical tach to motor shaft to measure motor speed (RPM).

c. Apply AC power to the drive system and select the reverse direction. Slowly increase the speed reference input until the VOM indicates that rated armature voltage (240VDC) has been reached or top speed obtained.

TDS d. If rated armature voltage is reached on field weakened drives, prior to top speed, slowly adjust the crossover pot located on the AVE assembly in such a direction that the armature voltage begins to decrease. At this point, again increase the speed reference input pot to rated armature voltage. Continue to adjust both the crossover pot and speed reference until top speed is reached at rated armature voltage with the speed reference input pot at maximum.

e. If top speed is reached on field weakened drives before rated armature voltage is obtained, adjust the crossover pot (on the AVE) in such a direction to increase the armature voltage. Continue the adjustments until the results of step d are obtained.

TDS f. For systems that do not have field weakening (NO AVE), but have a static exciter (CVE), adjust "MAX SPEED" to give rated armature voltage (240VDC) with the normal full speed reference voltage applied. If field trimming is provided, adjust field for top speed at rated armature voltage.

NOTE

THE ARMATURE VOLTAGE MAY VARY 10 VOLTS BETWEEN FORWARD AND REVERSE AT TOP SPEED.

g. With the drive in "FORWARD" and with a full speed reference input, check the "SPEED BALANCE" by noting the RPM on tachometer. Then select the opposite direction and note the RPM on tachometer. Determine the difference in readings between the two directions and adjust the"SPEED BALANCE" pot in a direction to match the two readings.

NOTE

IF THE ABOVE ADJUSTMENT AFFECTS THE MAX SPEED SETTING, IT MAY BE NECESSARY TO READJUST MAX SPEED.

4.4.6.1 SIGNAL LEVEL DETECTOR CARD FUNCTIONS ADJUSTMENT (IF SUPPLIED)

a. The method of adjustment is dependent upon the normal circuit function, either normally picked up (indicator illuminated) or dropped out (indicator extinguished). Consult the System Elementary Diagrams for each circuit function and its normal operating state.

TDS b. Normally Picked Up Adjustment

1. Energize the system and while monitoring the function under test (RPM, voltage or current) slowly increase the function until the card indicator illuminates, noting the value at which it illuminated.

2. While still monitoring the function under test slowly decrease the function until the card indicator extinguishes noting the value at which it extinguished. This is the drop-out point that the function should be set to operate. If required, readjust the associated "GAIN" potentiometer to the specified drop-out point for that function.

TDS c. Normally Dropped Out Adjustment

1. Energize the system and, while monitoring the function under test (RPM, voltage or current), slowly increase

the function until the card indicator extinguishes, noting the value at which the indicator extinguished.

2. While still monitoring the function under test, slowly decrease the function until the card indicator illuminates, noting the value at which it illuminates. This is the pick-up point that the function should be set at to operate. If required, readjust the associated "GAIN" potentiometer to the specified pick-up point for that function. For detailed information, see Instruction Book, GEK-22950.

4.4.6.2 TACHOMETER MONITOR CARD ADJUSTMENT (IF SUPPLIED)

NOTE

THIS CARD IS ELECTRICALLY INTERLOCKED TO THE FAULT RELAY. THE CARD MUST BE IN THE DRIVE TO OPERATE THE DRIVE.

a. Apply power to the drive system and slowly increase the SPEED CONTROL until motor reaches rated top speed. If drive trips prior to reaching motor rated top speed, turn the "TRIP SPEED" potentiometer CW five turns, reset the system and increase "SPEED CONTROL" until rated top speed is reached.

b. To check trip, with the drive motor operating at rated top speed, slowly adjust the "TRIP SPEED" potentiometer CCW until the drive system shuts off.

c. Restart the drive and, with the motor operating at 85% top speed, adjust the "TRIP SPEED" potentiometer, counting the turns, CCW, until the drive trips.

d. Readjust the "TRIP SPEED" potentiometer CW to twice the number of turns counted in step c.

e. Sharply accelerate drive up to motor rated top speed and no trip should occur. For detailed information, see Instruction Book, GEK 22942.

4.5 SYSTEM OPERATING ADJUSTMENTS

System operating adjustments should be made with the end device performing its normal tasks. If gear shifting is used, the machine should be run through the gear ranges while performing its function. All special purpose equipment/controls such as "TAPE OVERRIDE ADJUSTMENTS" should be set at this time.

a. "TIMING ADJ" - Readjust for desired response.

b. "RESPONSE" - If drive is not stable after desired speed is reached, turn the "RESPONSE" pot slightly CCW until it becomes stable.

NOTE

THE ABOVE PROCEDURE COVERS THE COMPLETE INSTALLATION SET-UP OF A SPEED REGULATOR. THIS ENTIRE LIST OF TESTS NEEDS TO BE DONE ONLY WHEN A GIVEN DRIVE IS SET-UP FOR THE FIRST TIME. ANY POTS IDENTIFIED AS BEING FACTORY SET SHOULD NOT BE RESET.

4.5.1 G02 PREAMPLIFIER (SPEED OR VOLTAGE REGULATOR)

a. Speed Regulator: TP5 will be of opposite polarity than TP4 when TRP is fully CW (-) and CCW (+). The ZERO ADJ should be set for 0V on TP5 with no input reference. To check for correct polarity input, when dc tachometer is supplied, TP4 voltage should be opposite in polarity of TP18 voltage with SW1 Dn and SW2 up.

b. Voltage Regulator: TP5 will be equal but of opposite polarity of TP4. The ZERO ADJ should be set for 0V on TP5 with no reference input. TP6 will be equal but of opposite polarity to TP8.

TEST CONDITIONS	SWITCH #1	SWITCH #2	TEST CHECKS (INSTR.BOOK PARA # REFERENCE)
SCR POWER OFF - NO REFERENCE	CENTER	CENTER	READY-ON/FAULT-OFF LIGHT CIRCUITS. (4.4.1.c)
TEST REFERENCE POT. SCR POWER OFF, UNITY GAIN PREAMP	CENTER	DOWN	STATIC TEST CHECK LINEAR TIME (4.4.2.c),PREAMP (4.4.2.d), LOCKOUTS (4.4.2.f &g), FIRING PULSES (4.4.2.h&i),SET MINI-MUM MOTOR FIELD (4.4.2.j).
SCR POWER OFF	CENTER	UP	CHECK STATIC CURRENT LIMIT (4.4.3.b), IOC (4.4.3.c)
SCR POWER ON, MOTOR FIELD FIXED, TEST REFERENCE POT, PREAMP INOPERATIVE	DOWN	UP	CHECK CURRENT LIMIT, DYNAMICALLY (4.4.5) VOLTAGE REGULATOR RUN AS VOLTAGE REGULATOR. SET VOLTAGE LIMIT (4.4.4.b), TACHOMETER INPUT
SCR POWER ON, TEST REFERENCE POT, NORMAL REGULATOR - BASE SPEED, SLIGHT MOTOR FIELD WEAKENING	DOWN	CENTER	RUN FROM TEST POT AS SPEED REGULATOR
NORMAL (REMOTE CONTROL)	UP	CENTER	RUN NORMALLY

TABLE 4-1 DIAGNOSTIC PROCEDURE

Test Switch #1 (Normal Drive Operating Condition-Up)

CENTER = a) No power available to pick-up contactor.

b) Normal reference source disconnected.

c) Normal current feedback isolated by 330 ohms.

d) Normal AVE voltage feedback isolated by 5.6K.

DOWN = a) Test reference applied to preamp.

b) Normal current feedback.

c) Picks up contactor (MA) from test switch.

UP = a) Normal reference applied.

b) Contactor (MA) picked up by normal RUN function.

c) Normal current feedback.

3) Normal voltage feedback to AVE.

Test Switch #2 (Normal Drive Operating Condition-Center)

CENTER = a) Normal preamp gain.

UP = a) Preamp output deactivated.

b) Current feedback reference from test pot.

c) Test pot reference to driver coordination input.

DOWN = a) Preamp gain is unity.

b) Test pot reference applied to preamp.

c) Test pot reference applied to AVE input in place of normal voltage feedback.

TABLE 4-2 DIAGNOSTIC SWITCH FUNCTIONS

SECTION V
MAINTENANCE

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. IF POWER OFF MAINTENANCE IS BEING PERFORMED, VERIFY ALL POWER TO THE DRIVE SYSTEM IS SWITCHED OFF OR DISCONNECTED. RECOMMEND POWER SWITCHES BE RED TAGGED DURING POWER OFF MAINTENANCE.

5.1 MECHANICAL

The power units only mechanical maintenance is checking and changing the air filter drive enclosure (if supplied) as required.

Motor maintenance is covered by the motor instruction book supplied with the motor and should be followed in all cases.

5.2 ELECTRICAL

The electrical maintenance for the drive system is divided into a "Power OFF" and "Power ON" inspection procedure.

5.2.1 Power Off (every six months)

a. Check all electrical connections for tightness.
b. Look for signs of poor connections or overheating (arcing, discoloration).
c. Manually check cooling fans for easy rotation.

5.2.2 Power On

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE.

a. Power On (Every month)
With drive system operating at top speed (full input reference), measure and record the voltage feedback signal on TP8 and Regulator "Common". The recorded measurement should be within .5 volts of the initial measurement recorded during installation and test of the equipment. If the measurement difference is greater than .5 volts DC, refer to Section VI.

5.2.2 Power On (con'd)

b. Power On (Every six months)
With the drive system operating, measure/record and compare the following functions with previous test data. If any significant differences are noted, re-adjustment or replacement may be in order. Refer to the appropriate step in Section IV for test/adjustment.

1. +20VDC
2. -20VDC
3. Pre-amplifier Reference Input, Forward/Reverse Maximum
4. Timing (in seconds)
5. Current Limit
6. Firing Pulses, 1 thru 6 - Pulse width
7. UJT, EMIT, 1, 2 and 3
8. Current Feedback
9. Top Speed (RPM) Forward-Reverse

5.2.3 Spare Cards

It is recommended that on-hand spare cards be interchanged with original cards every six months.

5.3 SCR REPLACEMENT PROCEDURE (PRESS PAK CELLS)

In the event of an SCR cell failure, the following steps are required for replacement of the press pak cell on the heatsink assembly.

If minimized down time is a critical factor, it is recommended that a complete Power Conversion Submodule (one phase consisting of two SCRs with heatsinks, pulse transformer card and suppression components) be an "on the shelf" spare.

5.3.1 Power Conversion Assembly

a. Remove the ac input cable (T1, T2 or T3) to the failed phase submodule and disconnect the associated plug (LCA, CCA or RCA).

b. Remove the nut and washer from each extreme top and bottom stud that hold the failed phase submodule to main assembly frame (see Figure 5-1, Part A), and slide the phase submodule out.

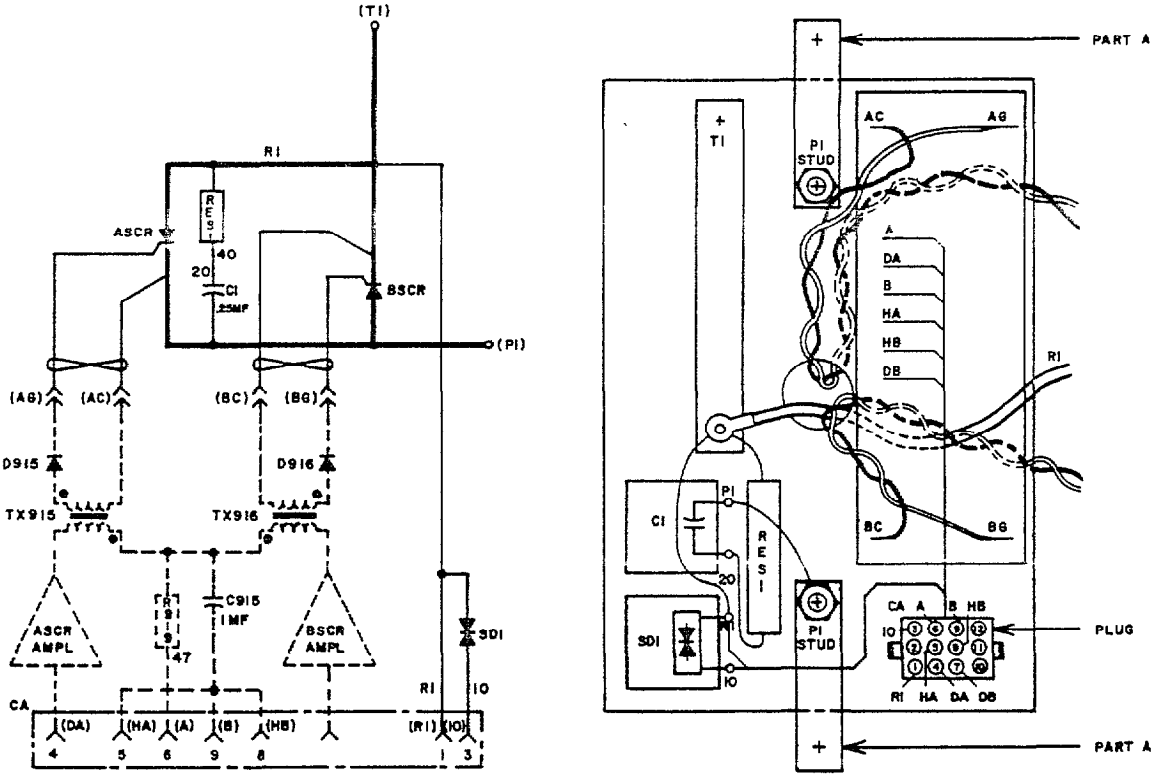


FIGURE 5-1 ONE PHASE SUBMODULE

c. SCR Cell Replacement

1. Reference Figure 5-2 for parts identification.

2. Remove the associated SCR gate (white) and cathode (red) twisted leads with spade connectors from the stab-ons on the pulse transformer card.

3. Remove the two nuts and the connector (part 16) that connect the two smaller heatsinks together.

4. On the failed SCR small heatsink remove the two nuts and washers (parts 15 & 20) and remove the failed cell.

5. Clean the heatsinks surface with a clean soft cloth and inspect the surfaces to make sure they are smooth.

6. Take the new replacement cell, twist the cell leads together, crimp on the female spade terminals, insert gate leads thru hole and apply a small amount of "Burndy Penetrox A" (or equivalent joint compound) to the small hole on each side of the cell (with a dab on top) so that under pressure the compound will cover only the raised center circular surface on each side.

7. Place new cell in the same orientation as the failed cell and place on the roll pin of the heatsink so the roll pin is in the center hole of the cell.

8. Place the two washers and nuts (parts 20 & 15) back on the studs and tighten each nut finger tight so the heatsinks are parallel.

9. Check that the cell hole is still over the roll pin.

10. With the nuts finger tight, use a wrench and tighten each nut 1/6th of a turn (alternate between nuts) until the nuts have completed 5/6 turns each, making sure the stud does not turn when tightening nuts. Inspect the assembly to make sure that the heatsinks are aligned equally and parallel with each other.

11. Reassemble all hardware and re-install submodule.

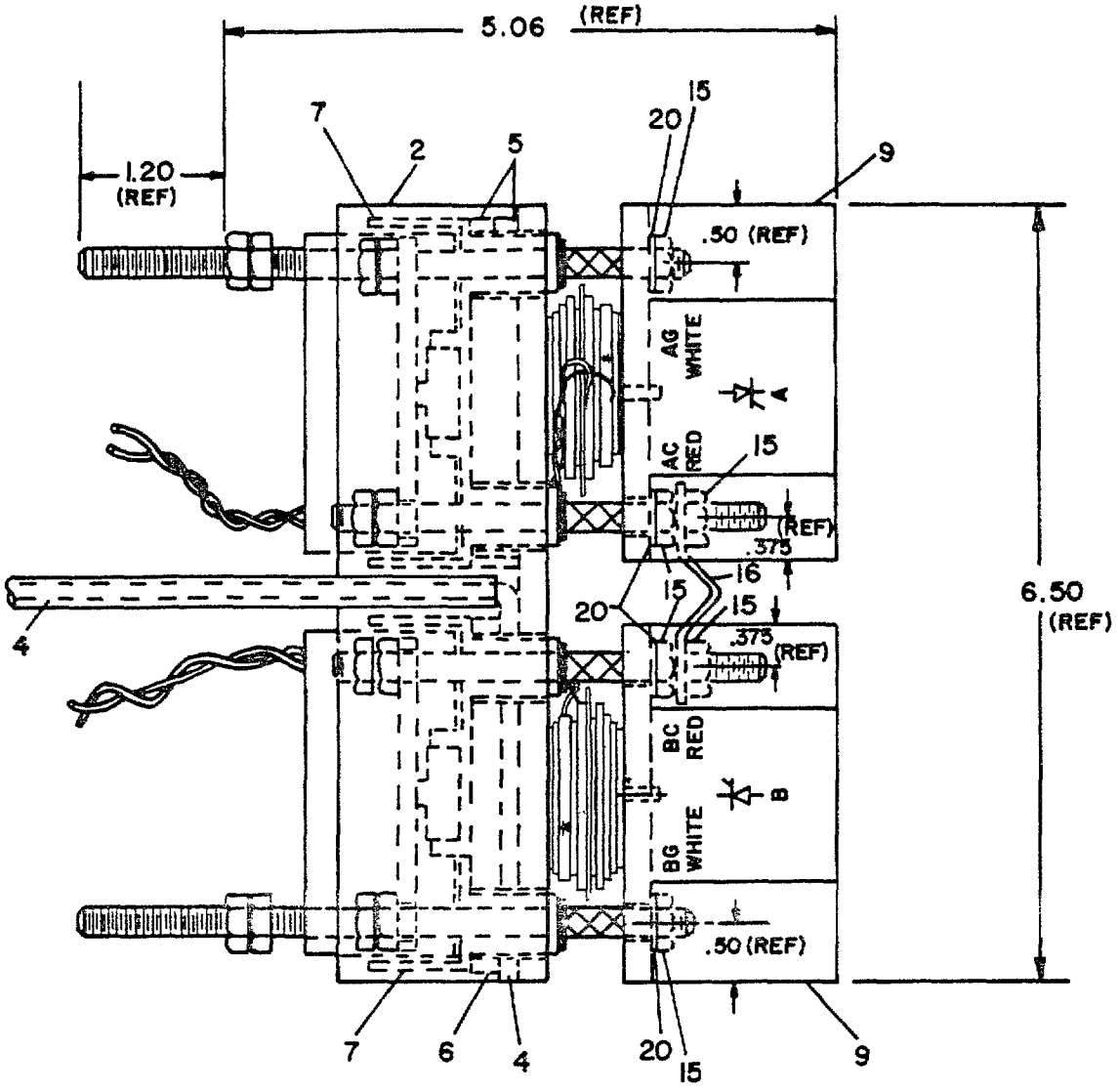


FIGURE 5-2 CELL AND SINK ASSEMBLY

SECTION VI
TROUBLESHOOTING

6.1 GENERAL

These troubleshooting procedures assume that the system has been installed and checked out and has been operating properly prior to a malfunction. Fast efficient troubleshooting of the drive system is based on a thorough knowledge of the theory of operation plus well kept maintenance records that will provide trend data indicating the possible area of the problem. All measurements should be compared with checkout values. If temporary malfunctions/problems occur, that seem to disappear or self-correct themselves, the incoming three phase a-c power should be checked for proper amplitude and phase at times of peak loading in the facility/building. Should repeated fuse and/or SCR failures occur, the three phase a-c input power should be checked for high level spikes or extreme short duration power variations. During troubleshooting when a card or subassembly is found or suspected of being bad, it is recommended that prior to replacing the card/subassembly the inputs be checked for proper values. This will exclude the chance of further damage to the replacement item due to causes beyond the suspected item. If line fuses or SCR's have failed, it is recommended that the power conversion module be disconnected by placing SW1 to C, and the system test, Section IV, be used to check for proper operation prior to connecting up the power conversion module after failed components are replaced and power is reapplied.

6.1.1 Electrical

The electrical troubleshooting procedures are divided into three parts; Drive Systems operating but not properly, Drive Systems not operating, and Drive Systems stopped while running. The following checklists, in conjunction with logical problem analysis, will help locate the malfunction with a minimum of effort. Use the Functional Flow Diagram (Figure 9-1) when analyzing the problem. If in troubleshooting the inputs are found to be good but the outputs are bad, then the malfunction is assumed to be located. To use the checklist correctly, first select the proper checklist depending on the type malfunction indicated - Operating or Not Operating. Using this checklist, locate the type of malfunction indicated under the left-hand column, "Indication". The right-hand column "Check/Adjust/Replace" lists, in logical order, the steps to be taken. When a step or action is completed and the malfunction still occurs, proceed to the next step. If the step located the problem area, troubleshoot, isolate and correct the malfunction. Retune/Adjust as required using Section IV.

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

INDICATION	CHECK/ADJUST/REPLACE
Fault Indicator fails to illuminate or illuminates momentarily. (4.4.1c)	Check the following for momentary illumination: 1. Loss of phase. a. AC line fuses (if supplied) b. Internal CB to "ON" and check three phase input. c. Improper phase sequence to drive input. 2. Motor field connected. 3. AVE or CVE fuses good. 4. Field Loss relay operating. 5. CPT fuse good. 6. Check for 268 VAC on AVE TB1 and 3. 7. Loss of tachometer signal. 8. Replace AVE or CVE assembly.
Press Fault Reset button - if illuminates, problem is noise pickup or external logic problem.	Check the following for no illumination: 1. ±20 Power Supply a. ±20 on TP1 and -20 on TP2. b. Fuses on ±20 pwr supply. c. Inputs to power supply card. d. Replace ±20 power supply card. 2. Fault Indicator lamp a. +16 or more on BTB 8(+) to BTB 7. b. Replace lamp. 3. External E Stop signal. a. No voltage on 2TB9(+) to 8 with no E Stop command. b. Jumper in place when no external circuit. 4. RX500 Relay a. +16 on TP10 b. Check wiring. c. Replace Aux Function card.
Improper or no voltage at TP3 (4.4.2b)	Check the following: 1. Diagnostic test switches SW1 to C, SW2 to D. 2. TRP fully CW. 3. -20 on IDT card terminal S to common. 4. Approx -7.5 on IDT card terminal K to common. 5. Check wiring to Preamplifier and Test cards. 6. Replace IDT card.

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

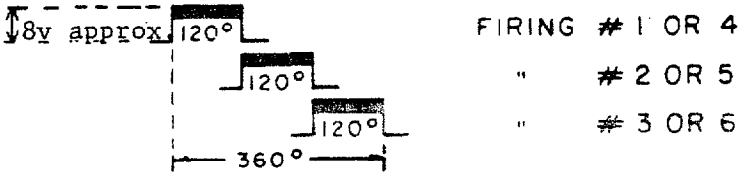
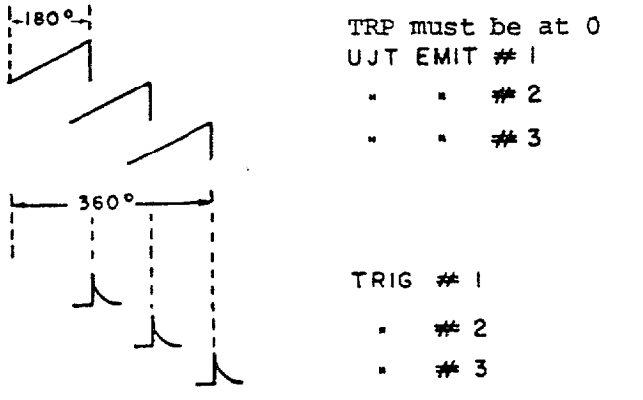
INDICATION	CHECK/ADJUST/REPLACE
Improper or no voltage on Preamp. card (4.4.2c thru e)	1. Check wiring to test card. 2. Replace Preamplifier card.
Improper or no voltage on Driver Coordination card. (4.4.2 f and g)	1. Check Driver Coordination card test jacks for proper voltages. 2. Press and hold Fault Reset button and check for both Lockouts being on. 3. Replace Aux Function card - if not on, replace Driver Coordination card.
Missing Firing Pulses or not equal amplitude. (4.4.2 h and i)	NOTE AN OSCILLOSCOPE IS REQUIRED FOR THE FOLLOWING CHECKS: 1. With the oscilloscope (scope), verify the Firing Pulses (1, 2, and 3 or 4, 5, and 6) are of proper time duration, equal amplitude and phase relationship as indicated below:  When a Firing Pulse amplitude is approximately twice its normal value, it indicates an open circuit in the output wiring or pulse transformer card (no load). 2. With the scope, verify that the TRIG #1, 2, and 3 and UJT EMIT #1, 2, and 3 are as indicated below: 

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

INDICATION	CHECK/ADJUST/REPLACE
	3. When the TRIG 1, 2, and 3 and the UJT EMIT 1, 2, and 3 are present and of proper relationship, replace the Phase Control Adder card. If any of the Trigger or UJT EMITTER Signals are missing or improper, replace the Phase Control card.
Improper field voltage (4.4.2j)	1. Verify that SW1 & SW2 are in proper position. 2. Verify that TRP is set at 0. 3. Check 3TB1-3 for proper AC input voltage (268VAC for 120VDC field). 4. Insure proper connection of A-B jumper on AVE. 5. Remove wire from 3TB11. Voltage value on TP19 should remain the same. 6. Remove jumper A-B on AVE card. Adjust Min Fld pot. Voltage should vary smoothly from 0 to about 60% of desired voltage. If not,check phasing (wire to 3TB9-13, 3TB1-3 and 3TB-14 should be per the wiring diagram). 7. Reset Min Fld to original value. Replace A-B jumper and 3TB-11 wire. 8. Observe TP19 on scope. Almost a full half wave (at least 150°) should appear. 9. Replace AVE card.
Improper MIN FLD (4.4.2j)	1. Readjust MIN FLD pot. 2. Verify proper phasing(per 6 above). 3. Replace AVE card. 4. Check ±20V and common-connections at 3TB.
Crossover pot ineffective. (4.4.2j) (Motor field won't weaken)	1. Verify that SW1 & SW2 are in proper position. 2. Check 3TB-11 on AVE to insure presence of proper voltage (normal crossover point is about 8 volts at 3TB-11). 3. Check A-B jumper on AVE card for good connection. 4. Replace AVE card.

TABLE 6-1 DRIVE SYSTEM NOT OPERATING

INDICATION	CHECK/ADJUST/REPLACE
Improper Crossover balance between forward & reverse.	1. If armature voltage at top speed forward is more than ±12 volts different than armature voltage at top speed reverse, it is recommended that AVE card be replaced.
Unable to set desired current limit level. (4.4.3c)	1. Verify SW1 and SW2 are in proper position. Turning TRP should produce a d.c. voltage at TP7 and TP9. 2. Check connections to jack D on IDT card. 3. Check TJ15 on aux. function card. A voltage of about 6 volts here should cause TP9 voltage to start to decrease. 4. If there is a voltage at TP7 and adjustment of the CURR. LIMIT pot does not cause the TJ15 voltage to change, replace aux. function card. 5. If there is more than 6 volts at TJ15 and TP9 voltage (about 8V) does not decrease, replace aux. function card.
Improper current limit balance. (4.4.3d)	1. If the balance is greater than 15%, it is recommended that the aux. function card be replaced if system performance will be affected.
Improper IOC operation. (4.4.3c)	1. If the IOC cannot be made to trip by following 4.4.3c, verify good connection between MX14 and 2C18 on card receptacles. 2. Replace aux. function card. 3. Replace driver coordination card.
Tach Monitor trip or IOC trip or circuit breaker trip or input fuses blown	1. Motor/machine binding, locked rotor, motor stalled or in machine mechanical limits.

TABLE 6-2 DRIVE SYSTEM OPERATING

INDICATION	CHECK/ADJUST/REPLACE
IOC Trips	1. Check a-c input for proper value per test data sheet. 2. Check current feedback signal for balanced operation. 3. Check armature voltage for 0 volts with MA open or improper output at TP5 & 6. 4. Check motor field voltage for rated value. 5. Check ±20V power supplies. 6. Check relay circuit of command that caused trip. 7. Check for unsuppressed relay or contactor causing noise spike at TP7. 8. Check for jumper between tabs 23 and 25 on Driver Coordination receptacle. 9. Increase Timing Adjustment 1 second (CW). 10. Adjust IOC slightly CW. 11. Adjust current limit slightly CCW. 12. Check motor/machines for binding. 13. Replace Driver Coordination card. 14. Replace Auxiliary Function card. 15. Replace Phase Control card.
Tach Monitor Trips at low speed.	1. Check for loss of tach. 2. Check for proper tach polarity (if d.c. tach). 3. Readjust zero align pot. 4. Check for Motor/Machine binding.
Cannot reach top speed	1. Check armature voltage with full reference applied. a. Voltage too high: (approx. at voltage limit) 1. Check voltage feedback. 2. Check crossover setting (if AVE used). 3. Check Minimum Field voltage/current (if AVE used). b. Voltage normal or low: 1. Check speed reference input. 2. Readjust Maximum Speed pot. 3. Check Voltage Limit setting. 4. Check for Current Limiting. 5. Check tachometer input voltage. 6. Check Speed Balance. 7. Check TP4, if 10.5V or higher, check tach input.resistor range selection. 2. Replace Pre-amplifier card.
Overspeed	1. Check Maximum Speed setting. 2. Check all auxiliary speed control devices. 3. Check input and output of pre-amplifier card. (if provided) 4. Check Field Loss Relay circuit. 5. Check tach feedback voltage. 6. Check "Speed Limit" pot setting.

TABLE 6-2 DRIVE SYSTEM OPERATING

INDICATION	CHECK/ADJUST/REPLACE
Motor Runaway or overspeed trip.	1. Check Tach Motor Field leads for continuity. 2. Check tach feedback voltage by setting IDT to operate as a voltage regulator. 3. Check field loss relay circuit (if used).
Motor rotates with zero reference input	1. Check for 0 volts at Pre-amplifier input. 2. Check for 0 volts at Timing output. 3. Check for +.5 volts at Minus Driver Reference output. 4. Check for -.5 volts at Plus Driver Reference output. 5. Check for .5 volts or less on Driver Coordination output. 6. Check Bias on UJT emitters #1, 2 and 3. 7. Check Firing trains #1 thru #6. 8. Remove LCA, CCA and RCA connectors. 9. Locate and replace faulty SCR module by monitoring Current Feedback with scope.
System does not respond to command A. Drive will not respond to a change in direction command	1. Check for proper reference input. 2. Check direction relay circuit selected. 3. Check for outputs at: a. Timing output. b. ±Driver references. c. Driver Coordination output. d1. Lockout #1 and #2. d2. Check Current Balance for minimum output with no feedback.
B. SL indication illuminates at zero speed command.	1. Visually check MA contactor mode - open or closed. a. MA open; check for armature voltage (should be zero). b. MA closed; check SL relay. c. Check SL circuit. d. Replace signal level detector (SL) card.
Motor/Machine unstable/erratic	1. Check three phase AC input power. 2. Check Pre-amplifier outputs for 60hz noise. Peak to peak 60hz signal of more than 0.5 volts peak to peak will cause erratic operation. 3. Run drive with IDT set to operate system as a voltage regulator. If drive is still erratic, replace aux. function, driver coordination or phase control card.

TABLE 6-2 DRIVE SYSTEM OPERATING

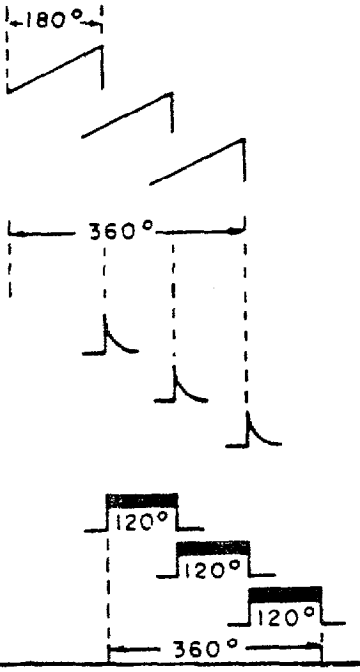
Indication	Check/Adjust/Replace
Motor/Machine unstable/ erratic (con'd)	4. Check speed reference input for noise pickup (with scope). 5. Check tach feedback signal for noise. 6. Check current feedback signal for noise. NOTE THE FOLLOWING LEADS SHOULD BE TWISTED PAIRS: REFERENCE INPUT, TACH AND CURRENT FEEDBACKS. 7. Adjust the "Response" pot slightly CCW. 8. Using the scope, check for noise on the following test points: a. Incoming reference. b. Timing output. c. ±Driver References. d. Driver Coordination output. e. Common. f. Lockouts 1 and 2. g. ±20VDC. 9. Using the scope, check the following signals for proper width and time relationship to each other:  TRP at 0 UJT EMIT # 1 " " # 2 " " # 3 TRIG # 1 " # 2 " # 3 FIRING # 1 OR 4 " # 2 OR 5 " # 3 OR 6

TABLE 6-2 DRIVE SYSTEM OPERATING

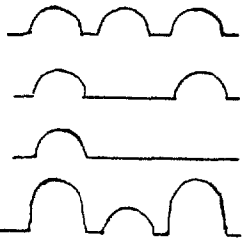
Indication	Check/Adjust/Replace
Motor/Machine unstable/erratic	10. Uncoupled motor from load/machine and recheck for instability/erratic operation of motor.
SCR not firing/ conducting.	Check for the following signals using a scope: 1. Verify that all three current feedback pulses (per direction) are present and of equal amplitude on TP7 as indicated below:  proper SCR firing. one SCR not firing. two SCR's not firing. unbalanced firing. 2. With Test Switch #1 in Center position and Test Switch #2 in Down position, verify that Firing Signals are present on the output of each Pulse Transformer card on the SCR module (white wire gate - red scope probe common).
Motor/Machine stops during operation	Refer to Table 6-3

TABLE 6-3 SYSTEM TROUBLESHOOTING

INDICATION	CHECK/ADJUST/REPLACE
Drive was running and stopped. (Reset Button has not been pushed.)	A. Was power momentarily interruped? If so, the normal cycle to start the drive should be re-initiated. B. When normal restart will not work, observe the power unit indicating lights. 1. If Ready-on Fault-off light is on. a. Check for reference voltage at TP3 using the instrument card or test card. If there is no reference voltage check the indicating lights on the (Run, Forward, Reverse, etc.) relays (if supplied) in the drive unit. If the relay light is on, the external source of reference is probably at fault. Check the reference voltage source as required. If the relay light is OFF, check the relay circuit - if power is on the relay, replace the Relay Card. If no power is on the relay check the external relay pickup signal. Check the 115V supply - voltage and fuse. (With an AVE, loss of 115V power will cause the field power supply to shut off and drop the field loss relay.) No 115V power will drop out MRX and MD - Loop Contactor - and drive will not run. b. If there is reference voltage at TP-3, there should be the same but reverse polarity voltage at TP-4. If there is no voltage at TP-4 the linear time section of the Preamplifier card is not working. Check test points 1 and 2 for plus and minus 20V power. If OK, replace the preamplifier card. If the power supply has failed, shut down power and check the power supply card fuses - if failed, insert the spare fuse (on power supply) and recheck - if fuse blows again check power supply load for overloads. If the fuse is OK and unfused 24VAC power to the card is present, replace the power supply card. c. Drives using AC tach feedback - 193X227BBG01-Pre-Amp. Card. Check the output of the preamplifier TP-5 and TP-6. If TP-4 is positive, TP-5 should be approximately -.5V, TP6 should be approximately 50 times TP4 or a maximum of approximately -11V. If

INDICATION	CHECK/ADJUST/REPLACE
Drive was running and stopped. (Reset Button has not been pushed.) Cont'd.	TP-4 is negative TP5 should be approximately 50 times TP-4 volts or a maximum of approximately 11 volts and TP-6 should be approximately +.5V. Drives using DC tach or voltage feedback 193X227BBG02, Pre-Amp. card. Test same as above but TP-5 should be 50 times TP-4 output or 11V max. with inverted polarity. If the above checks fail and the ±20V power supply checks OK B1b above, the preamplifier has failed and the card should be replaced. d. With preamplifier outputs at either TP5 or TP6 in excess of .5 volts, TP9 should read a positive output with a maximum of +9 volts. If there is no output or the output does not rise above +.5 volts the drive will not produce armature voltage TP8. With no output, check that there is no current feedback signal at TP7 and no output of the current limit amplifier TJ15. Signals at these points could suppress the output at TP9. If there is no false signal at these points, replace the coordination card. e. If check d above found a false current feedback at TJ15, the output of the current limit amplifier, check TP7, the I feedback. If TP7 is zero-since the drive is not running, there should be no output from current feedback amplifier at TJ15. Replace the Aux function card. f. Check TP12 and 11 lockouts. If both lockouts show approximately 5 volts output the drive will not run. Check that the IOC voltage TP 10 is approximately 18VDC. If it is at this voltage and both lockouts are up, replace the coordination card. If the 10C voltage TP10 is down the Fault-Off light should not be lit. (The light is ON for the fault we are investigating.

INDICATION	CHECK/ADJUST/REPLACE
Drive was running and stopped. (Reset Button has not been pushed.) Cont'd.	g. Check delayed +20VDC firing power supply TP13. If no firing voltage is there or below 18VDC, replace the aux. function card. h. Normally a drive which has the Ready ON light ON, but stops running will have one of the problems listed and checked above. The Phase Control, Phase Control Adder and Gate Pulse Transformer cards (on power modules) will not normally fail on all three phases at once and the drive would have stopped while in operation and the Fault OFF light would be OFF should one or two phases fail in these cards when running.
Ready ON-Fault OFF light is OFF - Indicating the drive shut down on a fault. DO NOT PUSH RESET BUTTON UNTIL FAULT CAUSE HAS BEEN DETERMINED BELOW.	A. Reversed phase sequence - drive would not have been running if this fault exists - OMIT check. B. If tach monitor card TM is used in the drive 1. Check card is firmly in socket - if it has vibrated, out drive will shut down. Shut off all speed reference to drive and if out - push in firmly and press Reset Button and Fault OFF light should indicate Ready ON. 2. Tach has been lost - wire broken - brushes worn, etc. Light on TM card should be ON. Shut off all speed reference to drive and push reset button - light on TM card should go off and Ready-Run light go ON. Run drive as voltage regulator - see page and check for proper tach voltage TP18. 3. Overspeed has occurred and light is ON on TM Card. If test 2 above shows the tach to be performing correctly, then an overspeed probably occurred. Take all speed reference off the drive, push Reset button light on TM card should go OFF and Ready on light come ON. Put reference on the drive and slowly bring up the referenced voltage to maximum and watch that the actual motor speed does not exceed the max. speed specified for the motor and system.

INDICATION	CHECK/ADJUST/REPLACE
Ready ON-Fault OFF light is OFF - Indicating the drive shut down on a fault. DO NOT PUSH RESET BUTTON UNTIL FAULT CAUSE HAS BEEN DETERMINED BELOW.	3. Cont'd. If the TM card trips out before reaching the normal top speed readjust (see page 4-11) or replace the TM card if not adjustable. If the drive TM does not trip out at top speed and max reference again recheck the adjustment (See page 4-11). To be sure the unit is set for 10-15% above the max normal operating speed - if it was set slightly low readjust and operate the drive normally. 4. Recheck the reference system to be sure an actual overspeed reference is <u>never</u> possible Correct reference system if faulty. C. <u>Loss of Phase</u> Check the line voltage at the incoming studs on the conversion module. Should be 460VAC & balanced. A 10-20% unbalance will indicate a faulty power source or bad isolation transformer, and must be corrected for the drive to run. A bad phase (above) or loss of phase will shut the drive down. If no phase is lost, trace that phase back through the starter and circuit breaker or fuse. If fault is located shut down and correct with new starter, fuses or circuit breaker. D. <u>Open Circuit Breaker</u> Observe whether the breaker is open. If open, excessive current has been detected. Shut off all power. All SCRs should be checked for shorts (see page 6-10) Replace as required. If no shorts are found inspect motor commutator and breakers for wear or flashover evidence or damages - service as required. If all OK reset breaker and reapply power and slowly operate the drive system. If the system is OK, proceed to operate normally. If the breaker opens again, recheck the electronic current limit and IOC adjustments statically (see page 4-6). If not able to adjust, replace the Aux. function card. If drive runs but all SCRs do not fire in both directions (use scope to check current pulses), check and replace

INDICATION	CHECK/ADJUST/REPLACE
	D. Cont'd. any bad SCR gate pulse card or module, Phase control card of Phase control adder. E. External E-Stop or Fault System If any external circuit such as an emergency stop button has been operated +20V to common shall appear at 2TB9. Reset or correct the external fault and 2TB9 should go to OV and push Reset button. Drive should operate manually. F. Loss of Field (Field Loss Relay Dropped Out) With an AVE, check field volts TP19 . Should be around 115V. With a CVE check terminal volts at ACM1 & ACM2. Should read around 300VDC. If field voltage is low or off, remove all power and check field fuses. If blown check field ohms for shorts or low ohms - see motor name-plate data. If bad correct fault and replace fuse. If OK remove and check field power supply for shorted diode or SCRs. Correct, replace fuse and run drive normally. G. Instantaneous Overcurrent (IOC) Tripped Remove all speed reference. Voltage at TP10 should be below 2 volts if the IOC has tripped Pushing Reset button will light Ready ON light and make TP10 volts rise to near 18VDC. Before operating, check to IOC and current limit statically (see page 4-6); if misadjusted correct per Test Record Sheet. If current limit does not work the IOC will trip - replace Aux. function card Check motor for commutator or brush problems - if all OK operate the drive normally.

6.1.1.1 Checking SCR's

WARNING

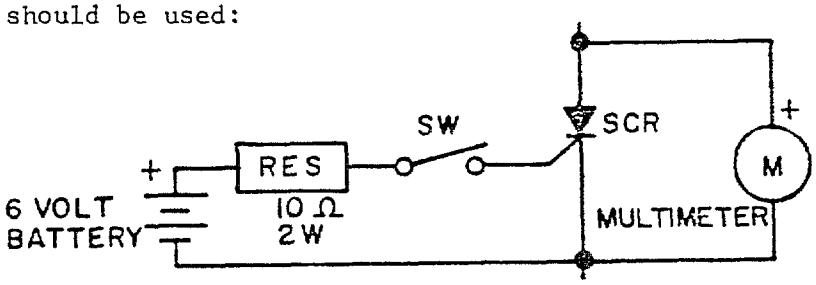
ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE SYSTEM.

a. Disconnect the AC power and make sure the loop contactor (MA) is open.

b. Using a multi-meter selected to read ohms on the times-1K scale, check the forward and reverse resistance of each individual SCR cell. This is done by reading across power terminals T1 and P1, T2 and P1, T3 and P1. (See conversion module elementary diagram.) Good or faulty SCR's will give the following typical readings:

SCR Description	Forward Reading	Reverse Reading
Good SCR	100K to Infinity	100K to Infinity
Shorted SCR	Zero	Zero
Inoperative SCR	1 to 2K	100K to Infinity
Open SCR	100K to Infinity	100K to Infinity

c. Since an open SCR will give about the same resistance reading as a good SCR, another method must be used to find this type of fault. It should be pointed out however, that practically all cells fail by shorting and very few by opening. If an open SCR is suspected, or if it is desired to check the switching operation of an SCR, the following circuit should be used:



The multi-meter is selected to read ohms on the 1K scale, and is connected to read the forward resistance of the SCR. When switch SW is closed, the forward resistance of a good SCR will change from a high value (100K to infinity) to a low value (1 to 10K). When the switch is opened, a good SCR will revert to its high forward resist-

ance or blocking state, if the holding current (Multimeter battery) source is momentarily removed. A faulty SCR will not switch, remaining in either an open or a conducting state.

d. If any SCR's are suspected of being faulty from the above resistance checks, the SCR conversion module should be removed from the case. After the SCR cathode and gate leads have been disconnected, recheck the forward and reverse resistances before replacing the SCR heat sink assembly. This should be done before any SCR is definitely classified as damaged or faulty, since a fault in another SCR or another part of the circuitry can produce a faulty reading from a good SCR before it is disconnected from the circuit.

6.1.2 Mechanical

Mechanical troubleshooting of the system is very limited. The following areas, mechanical in nature, would result in symptoms that would tend to lead you in the direction of an electrical problem but are solely mechanical:

1. Mechanical binding.
2. Improper equipment ventilation causing overheating conditions leading to electrical component failure.
3. Foreign matter intrusion into equipment causing arcing, shorts, poor connections or overheating.
4. Loose screws or bolts due to vibration causing bad connections, binding, arcing or improper connection.
5. Lack of regularly scheduled maintenance inspection.

SECTION VII
SPARE PARTS RECOMMENDATION

7.1 GENERAL

A realistic "on hand" spares stock coupled with the Speed Variator low cost card exchange plan will lead to faster resolution of down time of the equipment in case of malfunction. By having on hand spare parts, there is no extended down time after the problem has been located (awaiting parts that must be ordered and shipped from the factory). The benefit of easily removable (plug in) printed circuit boards is is lost if it only takes a few minutes to discover the defective assembly but hours to order and procure a replacement. Therefore, from the standpoint of keeping the equipment/machine operating with a minimum of down time, readily available on hand spares are a must. The advantages coupled with the "Card Exchange Plan" are three fold:

1. Minimum down time. Waiting time for part is eliminated.
2. The lower cost of the "Card Exchange Plan".
3. No cost for time and special test equipment to troubleshoot, repair and test failed cards. The repair and testing of printed circuit cards takes special handling techniques and test equipment that most facilities do not have.

The proper evaluation of profits lost per hour of down time of the machine/system versus the cost of on hand spare parts and the time saved is a readily available figure. A high volume machine output would therefore require a larger spare parts stock to insure minimum down time. For further information on the Card Exchange Plan, contact your local General Electric Company Installation and Service Engineering Component or your District Sales Representative or the Factory at the address listed on the back cover of this instruction book.

7.2 RECOMMENDED SPARE ASSEMBLIES, SUB-ASSEMBLIES AND PRINTED CIRCUIT CARD/BOARDS

NOTE

WHEN ORDERING SPARE PARTS
BE SURE TO GIVE COMPLETE
PART NUMBER, AND ASSEMBLY
NAME TO INSURE FAST AND
EFFICIENT SERVICE.

The following is a list of recommended spare parts:

Assembly/Sub-assembly	Quantity
±20 volt DC Power Supply Card	1
Pre-amplifier Card	1
Driver Coordination Card	1
Phase Sub-module Cell Panel (heat sink included)	2
Auxiliary Function Card	1

7.3 RECOMMENDED SPARE COMPONENTS

Component	Quantity
Line Fuses	4
*Power Supply Fuses	2
Other Fuses	1 of each
Command/Control Relays (small/plug in)	1 each type

NOTE

ALL MOTOR SPARE PARTS AS PER RECOMMENDATION OF THE DC MOTORS INSTRUCTION BOOK INCLUDED IN THE DOCUMENTATION SUPPLIED SHOULD BE ON HAND.

*There are two spare fuses mounted on the heat sink of the power supply.

SECTION VIII
DOCUMENTATION/DRAWINGS FURNISHED

8.1 GENERAL

The following types of documentation/drawings are normally supplied with your adjustable speed drive to aid in the installation and operation of your system. For the exact list of documentation/drawings supplied, see the "List of Equipment" sheets provided with the equipment.

8.1.1 Documentation

a. Instruction Manual
b. Direct Current Motors and Generators Instruction
c. Control Devices Instructions/Bulletin (if applicable)
d. Tachometer Instruction/Bulletin
e. Printed Circuit Card Interchangeability Information
f. Test Data Sheet

8.1.2 Drawings/Prints

8.1.2.1 DC Motors

a. Connection Diagram
b. Outline

8.1.2.2 Power Unit

a. Elementary Diagram
b. Connection and Interconnection Diagram
c. Elementary Diagram, Driver Regulator
d. Connection Diagram, Driver Regulator

8.1.3 Auxiliary/Special Devices Diagram

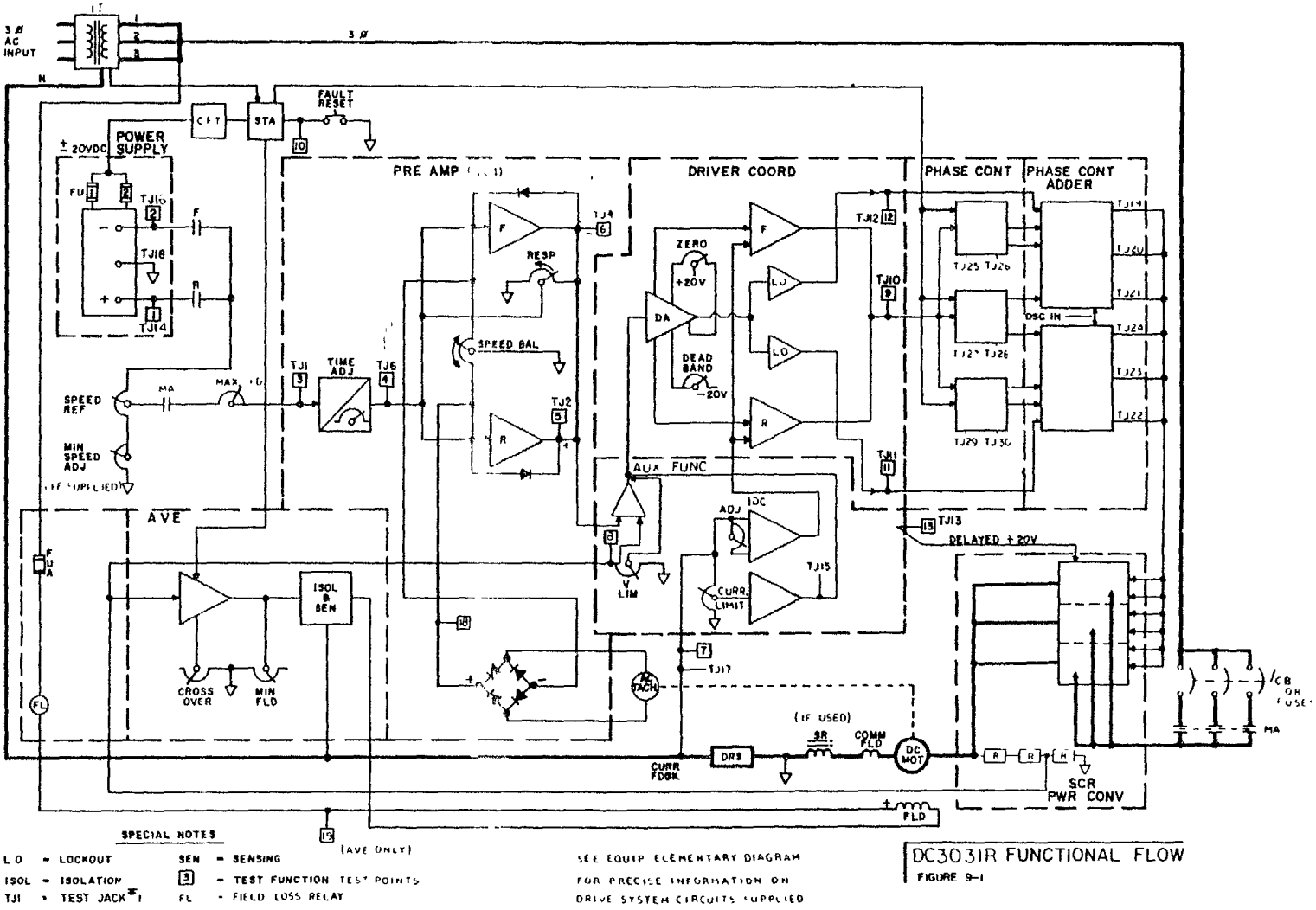

3 Ø AC INPUT
POWER SUPPLY
± 20VDC
FAULT RESET
STA
PRE AMP
DRIVER COORD
PHASE CONT
PHASE CONT ADDER
SPEED REF
MIN SPEED ADJ
TIME ADJ
SPEED BAL
RESP
ZERO
+20V
DEAD BAND
-20V
AUX FUNC
V LIM
CURR. LIMIT
DELAYED +20V
OSC IN
AVE
ISOL & BEN
CROSS OVER
MIN FLD
AC TACH
CURR FDBK
DRS
COMM FLD
DC MOT
SCR PWR CONV
FLD
MA
(IF USED)
(AVE ONLY)
SPECIAL NOTES
L O = LOCKOUT
ISOL = ISOLATION
TJI = TEST JACK #I
SEN = SENSING
= TEST FUNCTION TEST POINTS
FL = FIELD LOSS RELAY
SEE EQUIP ELEMENTARY DIAGRAM FOR PRECISE INFORMATION ON DRIVE SYSTEM CIRCUITS SUPPLIED
DC3031R FUNCTIONAL FLOW
FIGURE 9-1

Figure 9-1

See DC3031R functional flow diagram for circuit location of test points and test jacks, with full normal input reference applied.

TP	TJ	APPROX. VOLT
1	14	+20
2	16	-20
3	1	±7.5V
4	6	±7.5
5	2	-.5 FOR*
		+10 REV = top speed
6	4	+.5 REV**
		-10 FOR = top speed
7	17	.5V @ 100% curr.
8	-	9V @ 250V arm.
9	10	+8V max.
10	-	+17V = no fault
11	11	0-
		+6
12	12	+6
		0
13	-	+20
18	-	Tach Volts/2
19	-	120 VDC (AVE only)
	15	6.5V at current limit
	18	0 (com)
	26	
	28	trigger pulse (see Table 6-1,
	30	Sect. 4.4.2 h&i.
	25	
	27	UJT emitters (see Table 6-1,
	29	Sect. 4.4.2 h&i.
	19	
	20	
	21	Firing pulse trains (see Table 6-1,
	22	Sect. 4.4.2 h&i.
	23	
	24	

NOTE: Unused test points may be used for special functions, check system elementary.

* G02 Preamplifier (Speed Reg) TP5 will be -10V with TRP fully CW(FOR.) and +10V with TRP fully CCW(REV.).

** G02 Preamplifier (Voltage Reg) TP6 will be equal but of opposite polarity to TP8 with TRP fully CW or CCW.

FIGURE 9-2 Voltage and Signal Levels vs. test points/test jacks.

GENERAL ELECTRIC COMPANY – DIRECT CURRENT MOTOR & GENERATOR PRODUCTS DEPARTMENT
ERIE, PENNSYLVANIA 16531

GENERAL ELECTRIC

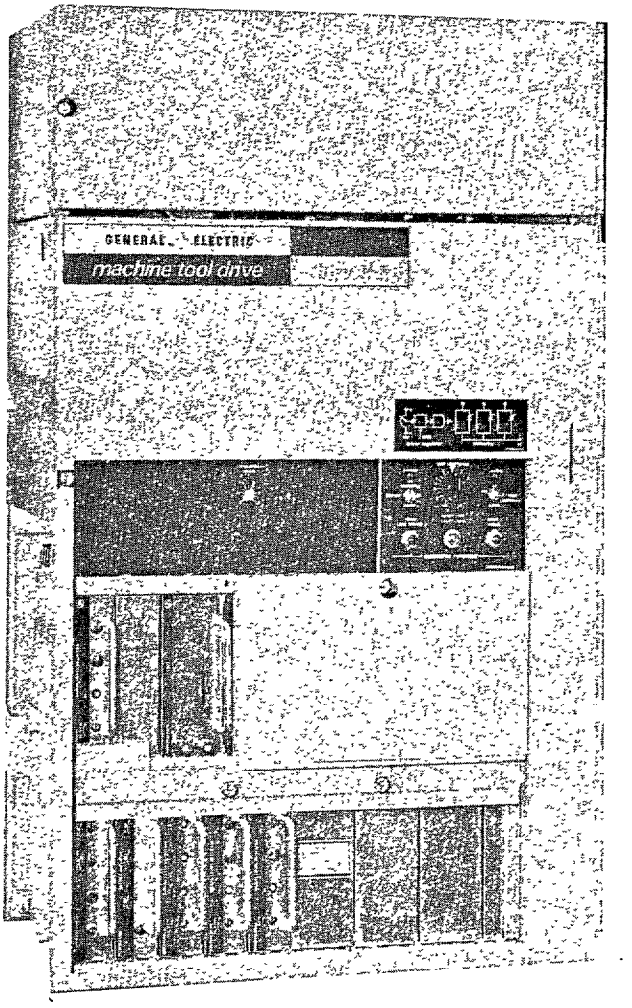
INSTRUCTIONS GEK-11080

Same as GEK 22955 except for this cover sheet

MACHINE TOOL DRIVE - SPINDLE

DC - 3031R

INSTALLATION - OPERATION - MAINTENANCE



These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company

GENERAL ELECTRIC

SIMPLIFIED START-UP AND CHECKOUT PROCEDURE

IF ANY DIFFICULTIES ARE ENCOUNTERED DURING START-UP AND CHECKOUT, REFER TO SECTION 4 OF INSTRUCTION BOOK FOR DETAILED START-UP AND CHECKOUT PROCEDURE.

WARNING

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE A.C. SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS THROUGHOUT THE DRIVE.

1. VERIFY THAT THE 3-PHASE A.C. POWER INPUT TO THE DRIVE IS OF THE PROPER VALUE AS LISTED ON THE EQUIPMENT DATA NAMEPLATE (–5, +10%).

2. SET TEST REFERENCE POTENTIOMETER TO ZERO, SWITCH No. 1 TO CENTER, SWITCH No. 2 TO CENTER; THIS DISCONNECTS POWER FROM SCR MODULE AND DISCONNECTS ALL REFERENCE INPUTS.

3. APPLY MAIN A.C. POWER TO THE DRIVE SYSTEM. "READY-ON/FAULT-OFF" INDICATOR ILLUMINATES (THE A.C. CIRCUIT BREAKER IN THE TOP HALF OF THE DRIVE SYSTEM MUST BE SWITCHED ON – WHEN SUPPLIED). THIS INDICATOR WHEN ILLUMINATED INDICATES THE FOLLOWING:

   A. THREE PHASE POWER IS APPLIED AND IS IN THE PROPER PHASE SEQUENCE.

   B. DRIVE FUSES ARE NOT OPEN.

   C. MOTOR FIELD IS ENERGIZED AND FIELD LOSS RELAY IS PICKED-UP.

NOTE

IF THE INDICATOR FAILS TO ILLUMINATE, INTERCHANGE ANY TWO TRANSFORMER INPUT PHASES ONCE: IF INDICATOR IS STILL OUT PROCEED TO THE TROUBLE-SHOOTING TABLE 6–1.

4. VERIFY TEST REFERENCE POTENTIOMETER IS SET TO 0, PLACE SWITCH No. 1 TO DOWN AND SWITCH No. 2 TO UP SWITCH POSITION. USE TEST REFERENCE POTENTIOMETER IN CW AND CCW DIRECTION TO VERIFY PROPER MOTOR OPERATION.

5. SET TEST REFERENCE POTENTIOMETER TO 0, SWITCH No. 1 TO UP SWITCH POSITION, SWITCH No. 2 TO CENTER; THIS PROVIDES NORMAL SYSTEM OPERATION.