



GEK-11028

INSTRUCTIONS

DC-3032

SCR POWER UNIT ASSEMBLY

5-60 HP, THREE PHASE

**USED WITH
ADJUSTABLE SPEED
DRIVES**

GENERAL  ELECTRIC

WARNING

SINCE HIGH VOLTAGES ARE PRESENT IN MANY LOCATIONS WITHIN THE SCR DRIVE, EXTREME CARE MUST BE EXERCISED IN THE SELECTION AND USE OF TEST INSTRUMENTS. WHETHER THE AC SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGES TO GROUND WILL BE PRESENT AT MANY POINTS. OPERATORS SHOULD NOT STAND ON GROUNDED SURFACES OR BE IN CONTACT WITH GROUND WHEN APPLYING TEST INSTRUMENTS TO TEST POINTS. EXTREME CARE SHOULD BE TAKEN WHILE ATTEMPTING TO ADJUST, TROUBLESHOOT OR MAINTAIN ANY DRIVE SYSTEM DESCRIBED HEREIN.

CONTENTS

	Page
INTRODUCTION/RECEIVING AND STORAGE/MAINTENANCE	1
DESCRIPTION	2
SPECIFICATIONS	3
HOW THE SCR POWER UNIT WORKS	4
INSTALLATION PRECAUTIONS/INSTALLATION	8
INTERCONNECTION WIRING	10
SETUP AND ADJUSTMENT	13
TROUBLESHOOTING	17

LIST OF ILLUSTRATIONS

Figure		Page
1	SCR Power Unit Assembly	2
2	Rectifier Bridge Schematic	5
3	Typical Waveforms	5
4	Regulator Block Diagram	6
5	Fan and Cover	9
6	SCR Power Unit Assembly Diagram	11
7	SCR Power Unit Assembly with Fan	12
8,9	SCR Power Unit Assembly with Cover/with Cover Removed	12
10	Oscilloscope Trace After Adjustment	20

LIST OF TABLES

Table		Page
I	Service Deviations	3
II	Power Rating Data	10
III	Voltage Check List	17
IV	Troubleshooting Chart	18

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.

INTRODUCTION

This instruction manual is a guide to the setup, operation, maintenance and troubleshooting for the DC-3032 Power Unit Assembly (SCR Conversion-Driver-Regulator Unit).

This equipment has been factory tested and adjusted so as to require only minor adjustment during installation and

set-up. Should further information be desired or should a particular problem arise which is not covered sufficiently for the purchaser's purpose, the matter should be referred to the General Electric Company, Speed Variator Products Department, Erie, Pennsylvania.

RECEIVING AND STORAGE

Place the equipment under adequate cover immediately upon receipt. The packing cases are NOT suitable for out-of-doors or unprotected storage. Examine each shipment carefully on its arrival and check it against the packing list. Promptly report any shortage or damage incurred in shipping to the carrier and to the nearest Industrial Equipment sales office of the General Electric Company.

If the equipment is not to be installed immediately, store it under cover in a clean, dry location away from any area where construction work is in progress, and protect the equipment from low temperatures and rapid or extreme variations in temperature or humidity. Take care to prevent the accumulation of moisture, dust, or dirt in the equipment during storage or installation, since these contaminants are detrimental to the equipment insulation.

This equipment may be stored at ambient temperatures of -20 C to 70 C for a period of up to one year. Air must be free of chemical and electrically conductive contaminants, and other conditions must be such that no moisture condensation occurs in or on the equipment.

In addition, when a control that has been in operation and will be shutdown for either a short or extended period of time, it is recommended the environmental conditions be maintained the same as when in operation. Power supplies, ventilation or heating, and air conditioning (if used) should be left on during the downtime to prevent large changes in temperature and possible moisture condensation.

MAINTENANCE

Maintenance of the SCR Power Unit is primarily a matter of periodic inspection and cleaning of the components.

After removing the a-c power, clean the exterior and interior of the unit by vacuuming or blowing accumulated dust and dirt. Do not use a high-pressure air hose, as this may damage the electrical components.

Check all electrical connections for tightness and examine the electrical contacts on the contactors. Both copper and silver contacts discolor and become roughened during normal operation. Generally, contacts will not require attention but, if prominent beads form, due to severe arcing, dress the contact face with a fine file. Do not use sandpaper or emery cloth, and never oil any part of the power unit.

DESCRIPTION

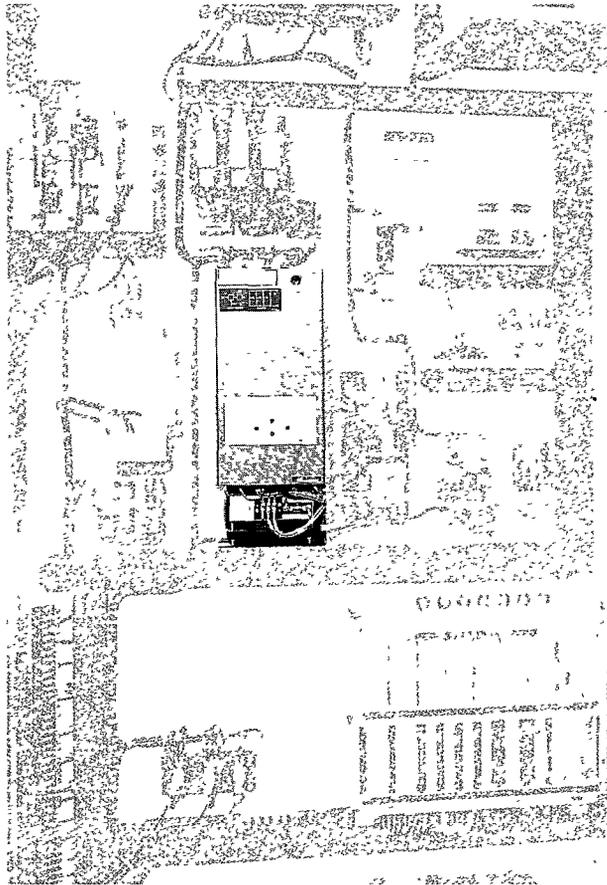
The DC-3032 Power Unit Assembly (commonly referred to as conversion unit or power unit) is the control center of the drive system and functions as:

1. System regulator,
2. SCR Driver
3. SCR Power Conversion.

Available for 5 to 30 HP at 230 VAC and 5 to 60 HP at 460 VAC, the Power Unit utilizes three controlled SCR's and four diodes in converting three phase a-c power into an adjustable full wave rectified d-c supply. This all-electric unit contains two heat sinks on which are mounted the SCR's and diode rectifiers. The heat sinks support three printed circuit boards containing the protective, firing, and regulating circuits which control the SCR's (which in turn control the speed of the d-c motor). The Power Unit is open at the bottom and top to allow proper ventilation. Forced

ventilation is provided for drives rated 20 HP and above at 230 VAC and 40 HP and above at 460 VAC. In addition, all 460 VAC conversion units will contain side mounted transformers (STA) and various circuit protective devices, increasing its physical width to 11.75" as compared to 8.50" for the 230 VAC units.

Four potentiometers which control the setting of zero speed, IR compensation, acceleration time and current limit, are mounted in the conversion unit. The control knobs for these potentiometers are located on the front of the unit and are accessible through the front cover so that they can be adjusted while the unit is operating. These potentiometers are labeled ZERO ADJ, IR COMP, TIME ACCEL, and CUR LIMIT. The unit also contains a phase-sequence indicating light. The a-c supply fuses are mounted behind the unit cover for drives rated 5-15 HP at 230 VAC. Panel mounted fuses are supplied for all other ratings.



POWER UNIT ASSEMBLY (10 HP, 230 VAC UNIT SHOWN IN A CD 300 APPLICATION)

Figure 1

SPECIFICATIONS

POWER SUPPLY

Voltage – 230 VAC, $-5 + 10\%$, 3 Phase
or 460 VAC, $-5 + 10\%$, 3 Phase

Frequency – 60 Hertz ± 1 Hz
50 Hertz ± 1 Hz

REGULATION

Voltage – 1 percent.

Speed – 5 percent (with optimum adjustment or IR compensation by purchaser).

Regulation is specified under steady-state conditions and with constant line voltage, frequency, and ambient temperature. These variables are referred to as “service deviations” Table I, and if varied could affect steady-state armature volts or motor speed.

Specified performance does not apply to transient changes in load or ambient conditions, or when connected-load inertia is in excess of twice motor inertia (referred to the motor shaft).

EFFICIENCY

The efficiency (a-c to d-c) of the SCR conversion unit is approximately 97 percent at full load, full speed, and is high even at light load, low speed. The over-all drive efficiency is the product of the conversion and motor efficiency, or approximately 80 percent.

POWER FACTOR

75 percent at full load, full speed.

SERVICE FACTOR

1.0 (unless otherwise noted).

OVERLOAD

150 percent of rated motor current, one minute maximum.

MINIMUM LOAD

Five percent rated current (motor losses approximately five percent current).

COOLING

Forced cooling is provided for 20–30 HP, 230 VAC and 40–60 HP, 460 VAC drives. All others are convection cooled. All Nema 12 applications require forced cooling (fan).

TABLE I

SERVICE DEVIATIONS

Variable	Change in Variable	Change in Rated Volts/Speed
Voltage (a-c)	$-5, + 10\%$	15%
Frequency	2%	
Ambient Temp	15°C	

SERVICE CONDITIONS

Ambient temperature of 10C to 40C (50F to 104F).

Altitude – sea level to 3,300 feet.

CURRENT LIMIT

Adjustable from 80-150 percent rated current.

ACCELERATION CONTROL

Adjustable from 2.5-10 seconds (zero to top speed) when 150 percent torque is sufficient to accelerate the load to rated speed in 2.5 seconds or less. Deceleration time is at a fixed rate of three seconds. If normal coasting time exceeds three seconds, the load characteristics determine deceleration time.

PROTECTION

Current-Limiting Fuses – Provide short-circuit protection for the power unit and purchaser’s wiring in the event of rectifier failure or control-circuit shorts. (Mounted in the power unit for ratings of 5-15 HP at 230 VAC only).

Static IOC – An internal circuit providing d-c fault-current protection for the motor and power unit.

SPECIFICATIONS (CONT'D)

Current Limit — Limits operating overloads to 150-percent rated (or less as adjusted).

Phase Sequence — indicating light “on” for correct sequence.

Heatsink Thermal Switch — provides capability for system shutdown at high heatsink temperature.

IMPROVED SPEED REGULATIONS (TACHOMETER FEEDBACK)

When this option is ordered providing a tachometer and the tachometer-feedback unit for the power unit, speed regulation may be improved as follows.

Speed regulation — One percent of motor base speed for a 95 percent load change — over a 30/1 speed range. Speed change due to service deviations is improved to three percent.

HOW THE SCR POWER UNIT WORKS

AC TO DC POWER CONVERSION

The power conversion circuit of the SCR drive consists of a three-phase, full-wave rectifier bridge (see Fig. 2). The negative legs of the rectifier bridge contain silicon-controlled rectifiers, while the positive legs contain diodes or uncontrolled rectifiers. The SCR conversion unit has a two-fold function, to rectify the a-c voltage to a d-c voltage, and to control the d-c voltage level.

A diode rectifier will conduct current in only one direction, blocking the voltage in the opposite direction. A rectifier bridge consisting of only diode rectifiers will convert an a-c voltage into a d-c voltage having an average value of 1.35 (for a three-phase bridge) times the rms value of the a-c voltage. The rectifiers block current flow in the reverse direction such that it is impossible to regenerate power back into the a-c line.

The function of controlling the d-c voltage level is obtained by using silicon-controlled rectifiers in the negative legs of the rectifier bridge. An SCR in a solid-state, semiconductor which is basically a rectifier, but can also block voltage in the forward direction (anode positive with respect to cathode) until “fired” by a gate signal. It then switches to a highly conductive state having a very low forward voltage drop. The SCR remains in the conductive state even after the gate signal is removed, until the forward voltage is removed. It then reverts to a blocking state in the forward direction. The sinusoidal a-c voltage waveform satisfies these conditions in that each alternate half cycle causes the anode

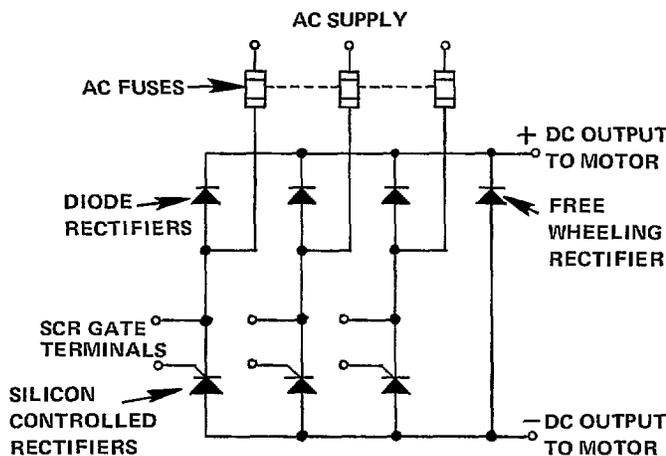
to swing positive with respect to the cathode to permit conduction, and the other half cycle reverses this voltage to turn the SCR off. A positive firing signal is applied to the gate of the SCR at the proper point in time to turn the SCR on. Controlling the point in time (with respect to the a-c supply voltage) when this gate signal is applied to the SCR controls the output voltage which can be obtained.

Figure 3 shows the output voltage and current waveform of a three-phase SCR conversion unit. It can be seen that as the firing pulses are advanced toward the zero time point, the average output voltage of the SCR conversion unit is increased.

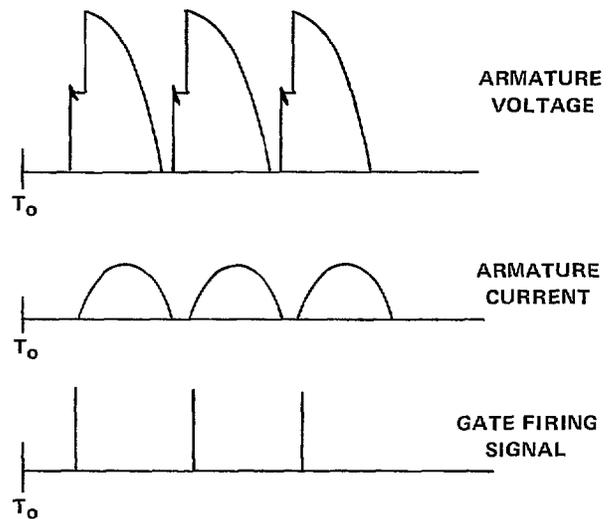
An SCR has a minimum forward current level, called holding current, which is required for the SCR to stay in a conducting state. This means that the SCR conversion unit cannot be controlled if its output is open-circuited.

A diode rectifier, called a commutating or free-wheeling rectifier, is connected across the d-c terminals of the power-conversion bridge. This diode provides a free-wheeling path for current produced by the induced voltages in the d-c motor armature during phased-back operation. It prevents this free-wheeling current from flowing through a controlled-rectifier leg. If this were allowed, the SCR would fail to turn off when the supply voltage goes negative and control would be lost. The free-wheeling rectifier also acts to reduce motor-armature ripple current.

HOW THE SCR POWER UNIT WORKS (CONT'D)



RECTIFIER BRIDGE SCHEMATIC
Figure 2



TYPICAL WAVEFORMS
Figure 3

The conversion unit contains the silicon-controlled rectifiers, together with transient-voltage protective circuits. The SCR's and diodes are mounted on aluminum cooling fins. These fins serve to transmit the heat produced inside the rectifiers to the surrounding air. The conversion unit is convection cooled or forced cooled depending on the horsepower rating of the drive.

Standard current-limiting fuses are placed in the a-c supply lines to the rectifier bridge.

A Thyrector* and other transient-voltage protective components are contained within the unit. A Thyrector is a special selenium rectifier which breaks down to limit high-voltage transients, similar to but more sharply than a Thyrite* resistor. It "passes" the energy of the transient and then reheels itself. The Thyrector is selected with a voltage breakdown less than the transient-voltage rating of the SCR's and diodes. Series resistor-capacitor networks are connected in shunt across each SCR and the d-c output. These provide a low-impedance path parallel to the rectifier to further limit transient voltage spikes.

Noise-suppression capacitors are connected across the gate to cathode of each SCR to prevent misfiring from extraneous signals.

* Trademark of the General Electric Company.

SCR FIRING CIRCUIT

The firing circuits in the conversion unit provide pulses to the gate circuits of the three controlled rectifiers to "fire" them at the correct phase angle, as determined by the signal from the amplifier.

Each firing circuit consists of a pulse transformer, unijunction transistor, a capacitor, and a constant current supply. The firing circuit is controlled by a unijunction transistor. A unijunction is a special type of transistor that behaves similar to a switch; it is either full "on" or full "off". The unijunction transistor can be turned "on" by applying a voltage signal of sufficient magnitude to its input.

Operation of each of the three firing circuits is as follows: the amplifier determines the level of a constant current supply. The constant current linearly charges the capacitor, which is connected to the input of the unijunction transistor. When the voltage across the capacitor is large enough, the unijunction transistor turns "on". The capacitor discharges through the unijunction transistor into the primary of the pulse transformer. The pulse of power is passed on to the secondary winding of the transformer which is coupled directly to the SCR gate circuit.

If the amplifier output is decreased, the magnitude of the constant current supply is reduced; the capacitor takes a

HOW THE SCR POWER UNIT WORKS (CONT'D)

longer time to charge, and the unijunction transistor turns on later in the cycle. Hence, the SCR's fire closer to the end of the cycle and the average d-c output voltage is decreased.

The firing circuits are synchronized with the a-c supply such that the firing pulses to the three SCR's are spaced 1/3 cycle apart. The SCR's will remain in the conducting state after the signal is removed, until the anode-to-cathode voltage is reversed.

MOTOR SHUNT FIELD EXCITATION

Excitation for the motor shunt field may be obtained from a part of the full-wave rectifier bridge used to control the motor armature circuit or an external exciter may be supplied.

The motor shunt field may be connected between one a-c line and the positive side of the full-wave rectifier bridge. The positive side of this bridge contains three diode rectifiers. Two diode rectifiers furnish two-thirds power to the motor shunt field, while the other diode rectifier acts as a commutating or free-wheeling diode. This diode provides a free-wheeling path for the current produced by the induced voltages in the motor shunt field. External exciters can either be controlled or uncontrolled voltage.

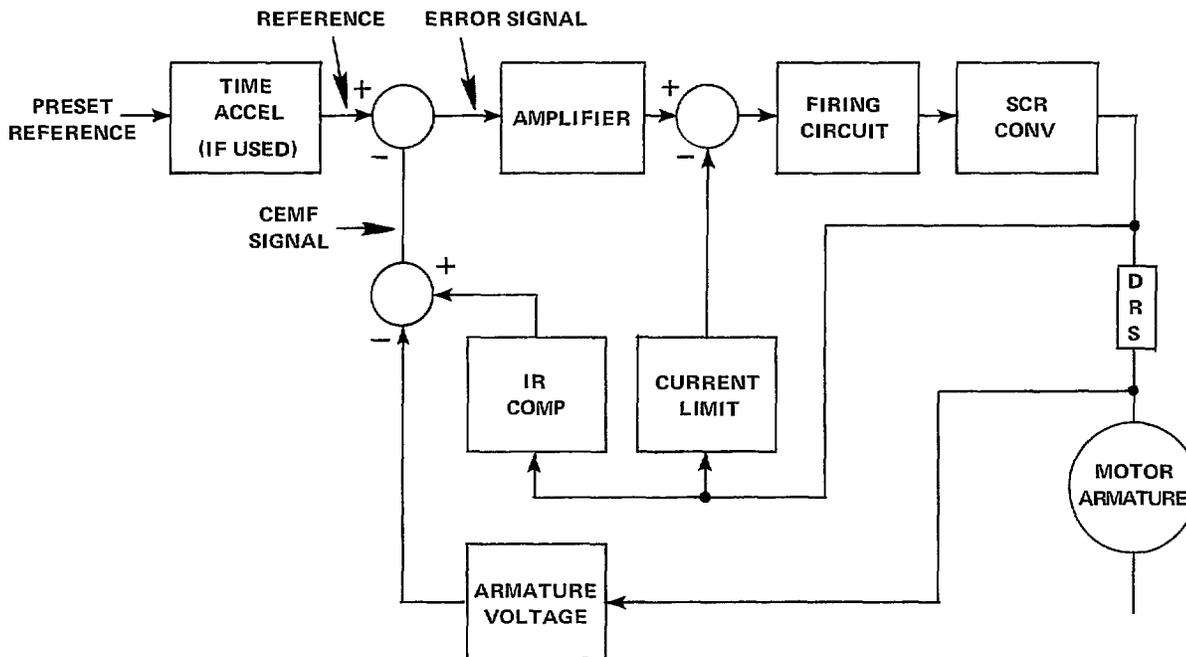
REGULATOR (REFER TO PAGE 11)

Figure 4 is a block diagram of the SCR drive regulator. There are two feedback signals used in this regulator. The primary signal is from the d-c output voltage of the SCR conversion unit, and the second is an IR compensation signal. This IR compensation signal is obtained from the voltage drop across the armature resistor DRS, and is proportional to armature current. The magnitude of the compensation signal is established by the IR COMP potentiometer.

When these two feedback signals are combined, their difference is a measure of motor CEMF, which is very closely related to motor speed. Thus, the combination of these two signals provides a feedback which is a good approximation of motor speed.

When this "net" feedback signal is compared to the regulator reference voltage, the resulting signal is called the error signal. The level of the error signal is very small and requires amplification (by the amplifier) before it can be used to control the firing circuit.

The output of the amplifier controls the value of current delivered by the constant current source in the firing circuit. As the error signal increases, the magnitude of the capacitor



REGULATOR BLOCK DIAGRAM

Figure 4

HOW THE SCR POWER UNIT WORKS (CONT'D)

constant charging current increases. With a rapid charging rate, the capacitor is charged quickly and the firing pulse occurs early in the cycle. This results in turning the SCR's "on" at an earlier point in the a-c wave, increasing the average d-c output voltage.

TIMED ACCELERATION

The timed acceleration function is inserted between the preset reference voltage and the regulator references as shown in Figure 4. It consists essentially of a constant current source and a capacitor. When this current source is used to charge the capacitor, its voltage will increase approximately linearly with time at a rate (2.5 to 10 seconds) set by the TIME ACCEL potentiometer.

Whenever the preset reference is at a higher value than the regulator reference, the timing circuit becomes operative. If the value of preset reference is reduced below the regulator reference voltage the capacitor in the TIME ACCEL circuit will discharge at a fixed exponential rate, reducing the regulator reference voltage.

Under these conditions, the drive will decelerate to the new preset speed at this rate, assuming that this rate is slower than the normal coasting time of the drive and its connected load.

For a "drive stop" command, the capacitor may be discharged by shorting terminal board points 5 and 12 in that condition.

CURRENT LIMIT

The current limit signal is obtained from the voltage across a dropping resistor (DRS) located in the armature loop, external to the power unit assembly. This voltage is proportional to the motor armature current. The magnitude of the

current limit feedback signal is adjusted by the "CUR LIMIT" potentiometer.

When the armature current feedback signal increases to the limit setting, it acts to retard the charging rate of the capacitor in the firing circuit. The unijunction transistor fires later and the SCR's are phased back (turn on later in the cycle) until the armature current is reduced to the level determined by the setting of the CUR LIMIT potentiometer.

STATIC IOC CIRCUIT

A static instantaneous-overcurrent circuit senses armature current. When current exceeds approximately 300 percent, this circuit prevents the SCR's from firing and so reduces output voltage to zero in 1/3 cycle.

The circuit is reset by momentarily connecting terminal board points 13 and 5 on 2TB (see page 11).

TACHOMETER FEEDBACK

The tachometer generator provides a voltage-feedback signal proportional to motor speed. This voltage-feedback signal is fed into a full-wave rectifier bridge which makes the feedback signal insensitive to the polarity of the tachometer-generator output voltage. A resistor bridge, located immediately after the full-wave rectifier bridge, reduces the tachometer-generator output voltage to a suitable value. The output of the resistor bridge is then fed to points 1 and 5 on the power unit terminal board 2TB.

The armature-voltage feedback is disconnected by removing the jumper between terminal board points 9 and 10 on 2TB thus permitting the tachometer generator to control the drive. Since the tachometer generator provides an accurate speed signal, the IR comp circuit is not required and "IR COMP" is set to zero (CCW).

INSTALLATION PRECAUTIONS

VOLTAGE TRANSIENTS

In order to obtain maximum reliability and life from your power unit, there are certain precautions that should be followed during the application, installation, and use of this equipment.

When silicon rectifiers (diodes) and silicon controlled rectifiers (SCR's) are subjected to voltage transients (spikes) in excess of their maximum rating, even for extremely short periods of time, they are apt to be permanently damaged. Destructive voltage transients (in excess of those for which the drive is protected) may be produced by interrupting relay coils, brake-solenoid coils, transformer primaries and other inductive electrical devices.

To ensure maximum protection of the power unit, the following practices must be followed:

1. Always stop the SCR Drive by opening the d-c armature loop first (drive stop pushbutton) before removing a-c power.

2. Do not switch associated power on control-transformer primaries while the SCR Drive is operating (see No. 1 above).

3. Avoid switching transformers and other heavy loads on the a-c line while the SCR Drive is operating (see No. 1 above).

4. Do not run SCR Drive interconnecting wires in the same conduit runs or in close proximity to other control equipment wires.

5. Use a control transformer to supply a-c power to auxiliary relays and devices.

6. If external magnetic devices are used to control the magnetic circuit of the SCR Drive, use an RC suppression circuit (47-ohm, 2-watt, molded composition resistor connected in series with a 0.25 mfd, 600-volt, d-c capacitor) connected directly across the coil of each device.

INSTALLATION

GENERAL

When the equipment is installed, check all accessible factory-made connections for tightness, since connections may become loose during shipping or storage. If the power unit is used as a voltage follower verify that the time acceleration jumper (2TB terminal board points 4 to 4A) has been removed and linear time should be set at max. or "9". Whenever tach feedback is being used check that the jumper between terminal board points 9 and 10 (on 2TB in the power unit) has been removed.

CAUTION

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

LOCATION

The power unit is suitable for use in most factory areas where other industrial equipment is installed. Install the

power unit in a well ventilated area which is not subject to ambient temperatures above 40 C (104 F). Avoid locations subject to steam vapors, oil vapors, chemical fumes, excessive moisture, or excessive dirt, dust, or lint.

If this equipment is used with a motor suitable for hazardous locations, install the unit away from the hazardous area. Make sure that there is clearance around the outside of the enclosure to allow a normal flow of cooling air.

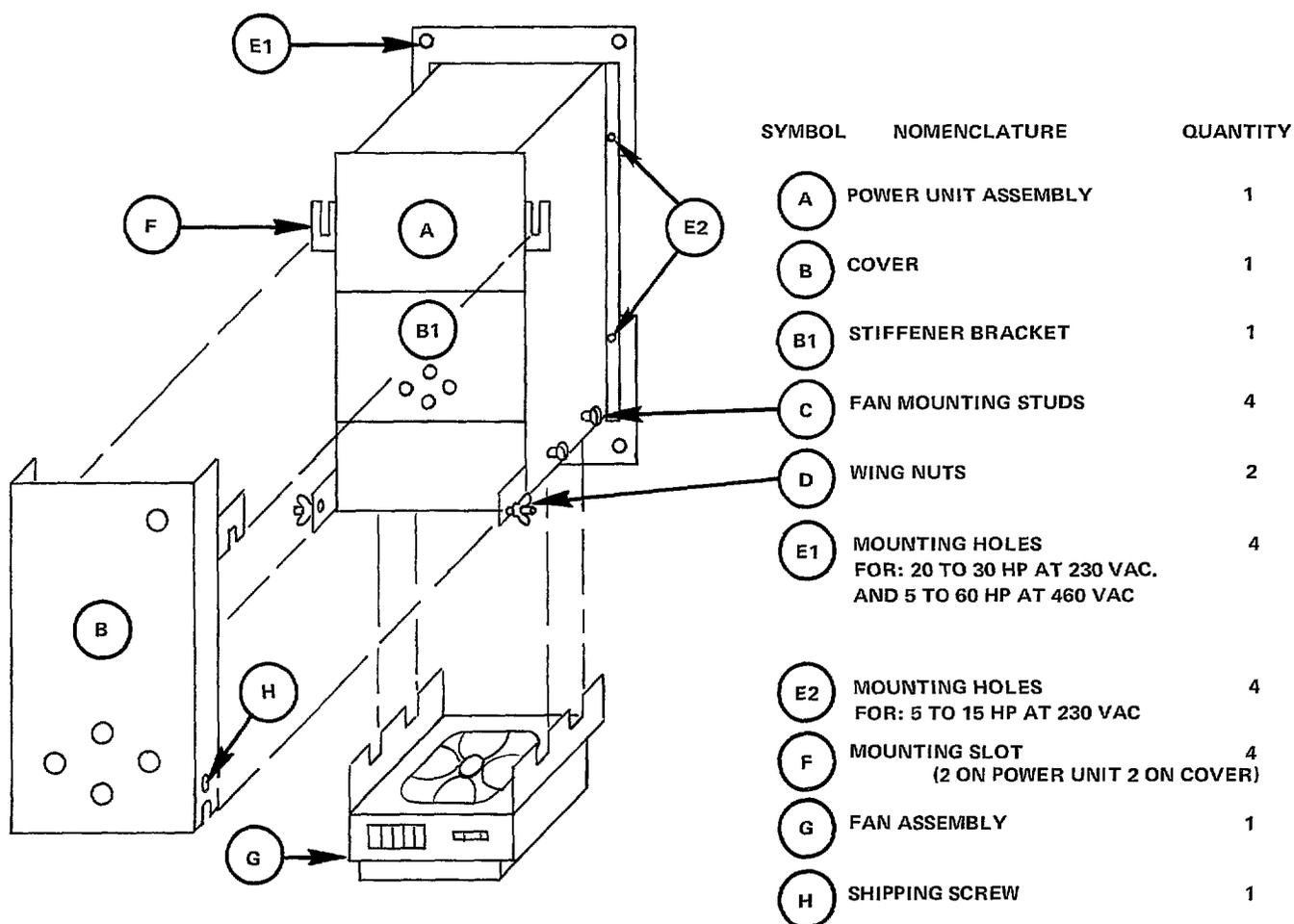
WARNING

NEVER INSTALL THE UNITS WHERE HAZARDOUS, INFLAMMABLE OR COMBUSTIBLE VAPORS OR DUST ARE PRESENT.

WARNING

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

INSTALLATION (CONT'D)



DC3032 FAN AND COVER (DRAWING NOT TO SCALE)

Figure 5

THE POWER UNIT COVER (B)

Supplied as an integral part of the power unit, two versions of the cover are available (230 and 460 VAC) varying only in physical size.

CAUTION

COVER SHOULD BE IN PLACE DURING NORMAL OPERATION.

The four control potentiometers (IR Comp, Cur Lim, Time Accel, Zero Adj), are accessible through holes located in the lower half of the cover. A larger hole (upper right hand side of cover) permits viewing of the phase sequence indicating light. On rare occasions the cover may have to be removed (for maintenance or troubleshooting). Whenever this is necessary the following procedure should be utilized:

1. Remove all a-c power and remove the shipping screw from the right side of the cover.
2. Loosen wing nuts (D).
3. Slide cover upward till its mounting slots disengage.
4. Pull cover clear.
5. Apply power if necessary.

WARNING

DO NOT REMOVE COVER WHILE A-C POWER IS APPLIED.

INSTALLATION (CONT'D)

THE FAN ASSEMBLY (G)

Provided for 20-30 HP, 230VAC, 40-60 HP, 460VAC and all Nema 12 application drives, the fan assembly is fused and prewired. It may be removed as follows:

1. Remove all a-c power.
2. Remove external wiring from fan terminal board.
3. Loosen 4 mounting screws (C).
4. Lower fan assembly and remove.

INTERCONNECTION WIRING

GENERAL

All internal electrical connections between devices in the unit have been made at the General Electric factory. For exact external connection and wiring information refer to the elementary and interconnection diagrams supplied with the equipment.

Wire sizes for interconnections should be selected in accordance with the ampere requirements shown in Table II, and in accordance with local and national electrical codes. All reference and feedback leads should be twisted pairs with seven turns per foot of length.

Refer to page 8, "Installation Precautions" before installing interconnection wiring.

GROUNDING

No part of the a-c or d-c electrical circuit may be grounded unless a line isolating transformer is used on the a-c input,

and then only at one point. If a follower voltage is used and is not isolated from the a-c line, the SCR drive must be equipped with a line isolating transformer.

It is recommended that the power unit, operator's station, and d-c motor enclosures be grounded in accordance with NEC or local code requirements.

AC POWER CONNECTION

1. Make certain that the input voltages and frequency of the available power supply agree with the rating on the drive nameplate.

2. Electrical codes generally require the use of a fused disconnecting switch or circuit breaker in the a-c power line ahead of the SCR drive and transformer (if used). This disconnecting device also provides a convenient method of removing field excitation from the d-c motor when the drive is not in use, and allows complete removal of power for routine maintenance and inspection.

TABLE II POWER RATING DATA

AC Line Volts	230							460									
	5	7½	10	15	20	25	30	5	7½	10	15	20	25	30	40	50	60
Horsepower (HP)																	
Typical Motor Sh Fld Amps	1.0	1.0	1.5	1.5	1.5	1.7	1.4	1.0	1.3	1.5	1.7	2.0	2.0	2.0	1.7	2.5	1.7
† Typical DC Line Amps	21	28	36	54	71	91	107	9	14	18	26	35	42	50	68	84	101
† Typical AC Line Amps	20	26	34	50	65	84	98	9	14	18	25	34	40	47	63	78	93

† Rated at 100% load

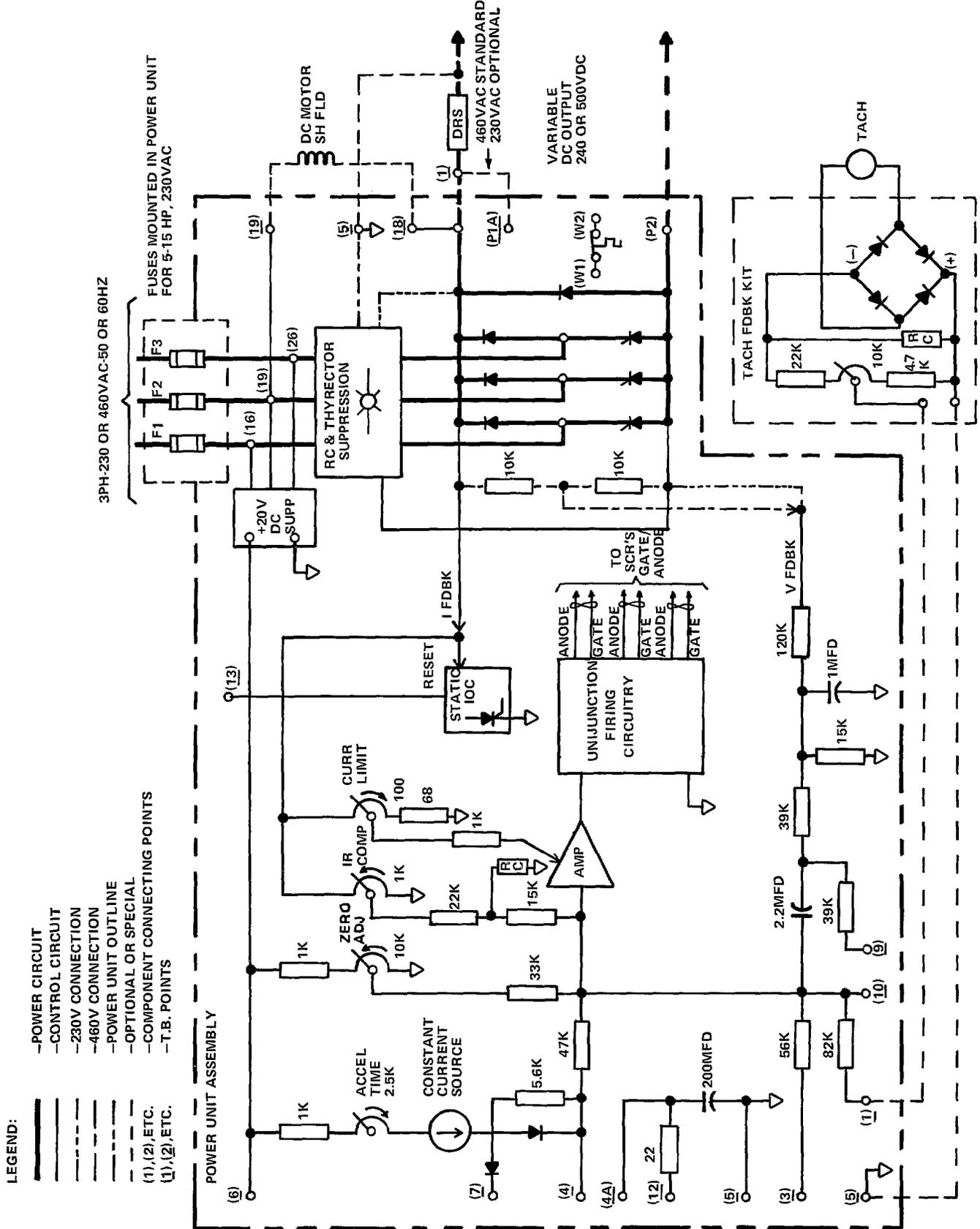


Figure 6 POWER UNIT ASSEMBLY DIAGRAM – WITH TACH FEEDBACK OPTION

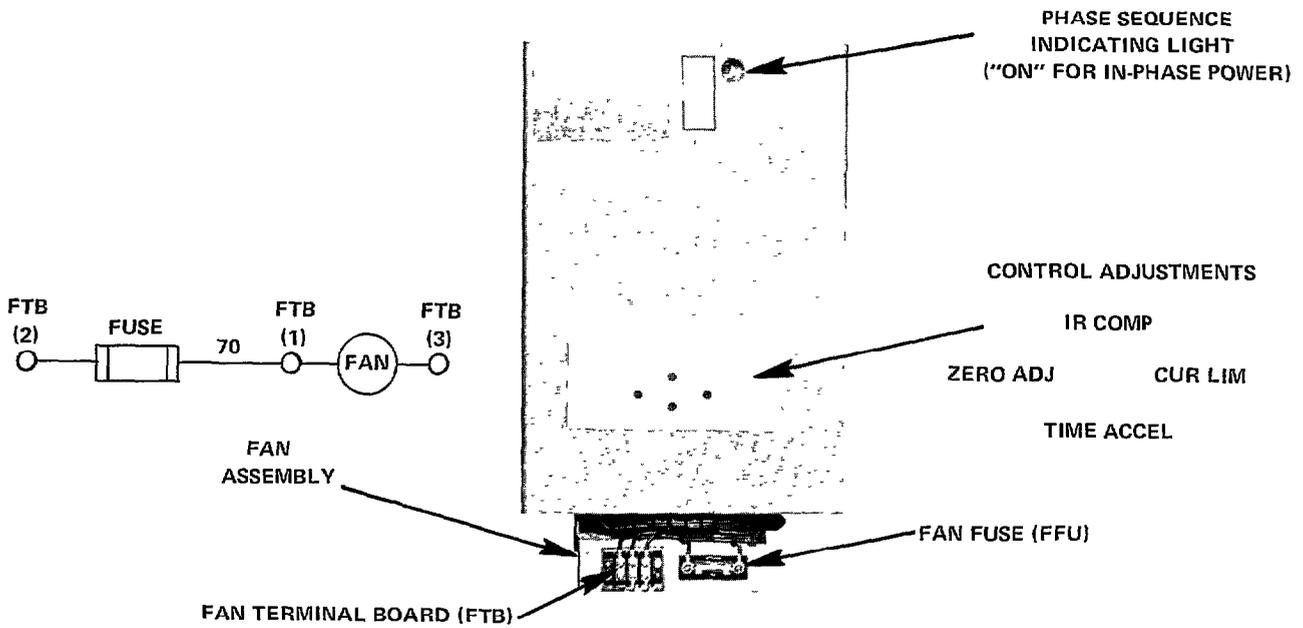


Figure 7 DC3032 POWER UNIT ASSEMBLY WITH FAN (460 VAC, 60 HP UNIT SHOWN)

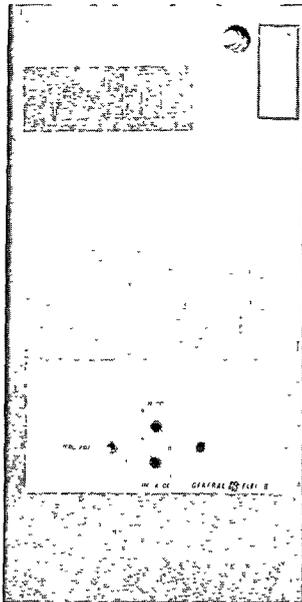


Figure 8 POWER UNIT ASSEMBLY WITH COVER
(230VAC, 15HP Unit Shown)

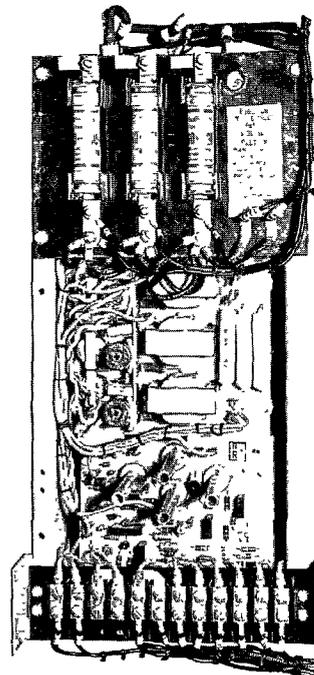


Figure 9 POWER UNIT ASSEMBLY WITH COVER AND
STIFFENER BRACKET REMOVED
(230VAC, 15HP Unit Shown)

NOTE

THE MAIN AC LINE FUSES ARE MOUNTED ON THE CONVERSION UNIT FOR 230 VAC, 5-15 HP DRIVES, AND PANEL MOUNTED FOR ALL OTHER RATINGS.

SETUP AND ADJUSTMENT

FOR THE POWER UNIT ASSEMBLY IN A DRIVE

SETUP INSTRUMENTS AND TOOLS

A 500 volt, d-c voltmeter and a screwdriver will suffice to set up and adjust this SCR drive. However, if optimum drive performance is required, it is recommended that a hand tachometer and a d-c ammeter of appropriate rating also be available. The required ammeter rating may be determined from the tabulation of d-c motor current in Table II, page 10. Other test equipment that may be required for auxiliary functions and devices or detailed troubleshooting are listed below:

Volt-ohm Meter (VOM), 3 ranges

Minimum: X1, X10, X100; 20,000 ohm per volt d-c sensitivity.

Oscilloscope (SCOPE) with ground isolating plug.

DC Ammeter, 0 to 300 amps, adjustable range, clamp-on type.

RPM Measuring Device.

PRELIMINARY

1. Open the front door of the power unit enclosure. Check to see that motor is not coupled to the load and is free to rotate.
2. Connect the voltmeter across the d-c output, P1 to P2, of the power unit.
3. Connect the ammeter (if used) in series with the d-c motor.
4. Close the incoming line to the power unit.
5. If phase sequence light is not "on", remove power and interchange any two a-c power leads.

WARNING

THIS EQUIPMENT IS AT LINE VOLTAGE ANY TIME THE INCOMING LINE IS CLOSED, WHETHER THE UNIT IS IN OPERATION OR NOT IN OPERATION. AC POWER MUST BE DISCONNECTED (ALL AC LINES) FROM THE POWER UNIT BEFORE IT IS SAFE TO TOUCH ANY INTERNAL PARTS OF THIS EQUIPMENT.

SPEED RANGE (MOTOR NOT COUPLED TO MACHINE)

NOTE:

IF TACHOMETER-FEEDBACK IS BEING USED, OMIT THIS PROCEDURE AND SUBSTITUTE "TACHOMETER FEEDBACK" PAGE 15.

To adjust the speed range of the drive complete the following steps:

1. Set the speed reference to zero.
2. Start the drive.
3. Adjust the minimum speed (by means of the ZERO ADJ potentiometer on the power unit) so that the motor just turns over.
4. Back off the minimum speed setting until the motor just stops.
5. Increase the speed reference to 100 percent (full CW) and observe the d-c armature voltage on the voltmeter. This voltage should be approximately 240 VDC for a 230 VAC drive and approximately 500 VDC for a 460 VAC drive with no load on the motor.
6. If this voltage is not correct, use a screwdriver to adjust the MAX SPEED rheostat until the d-c armature voltage is within the required limits. Turning the rheostat shaft clockwise increases armature voltage and speed.
7. Stop the drive.
8. If the direction of motor rotation is not correct, remove a-c power, and then interchange motor armature leads at the power-unit terminal-board.

TIME ACCELERATION

(MOTOR NOT COUPLED TO MACHINE)

An adjustable, timed-acceleration circuit is provided as standard equipment on all units. The time required to accelerate from standstill to top rated speed is continuously adjustable from approximately 2.5 to 10 seconds.

Set the desired acceleration time by adjusting the TIME ACCEL potentiometer located on the front of the unit.

SETUP AND ADJUSTMENT (CONT'D)

FOR THE POWER UNIT ASSEMBLY IN A DRIVE

Turning this potentiometer clockwise increases the acceleration time. It may be necessary to readjust the MAX SPEED potentiometer in the power unit after the acceleration time has been set.

The power unit also provides fixed time deceleration. With the drive running at rated (preset) speed, if the operator's speed-control potentiometer is quickly turned to a lower speed (or to zero), the drive will decelerate to this new speed in three to four seconds, assuming that the coasting time of the drive (and load) is less than three seconds. It follows that, if the load has high inertia and a long coast time, the decelerating time will be longer than three seconds as determined by the load inertia.

If timed acceleration is not desired for any reason, disable the timed acceleration circuit by removing the jumper between points 4 and 4A on 2TB terminal board, and turn the time accel potentiometer to maximum (full clockwise).

CURRENT LIMIT (MOTOR COUPLED TO LOAD)

A current-limit circuit is standard on all units. This circuit provides protection against excessive armature current and overload during acceleration and normal operation. The current limit is adjustable from approximately 80 percent to 150 percent of the rated armature current by means of the CUR LIMIT potentiometer.

CAUTION

UNDER NO CONDITIONS SHOULD THIS EQUIPMENT BE OPERATED IN EXCESS OF 150 PERCENT RATED ARMATURE CURRENT. FAILURE TO OBSERVE THIS LIMIT MAY RESULT IN OPENING OF THE LINE FUSE OR PERMANENT DAMAGE TO THE SCR'S AND POWER RECTIFIERS.

Normally the current limit is set at 150 percent rated current. However, current limit can also be used to control acceleration of the motor, and maximum accelerating torque can be adjusted between 80 and 150 percent rated. Adjust the current limit to the desired value by means of the CUR LIMIT potentiometer located on the front of the unit. Turning this potentiometer clockwise increases the current limit setting from approximately 80 to 150 percent of rated armature current.

IR COMPENSATION (MOTOR COUPLED TO LOAD)

NOTE

IF TACHOMETER FEEDBACK HAS BEEN ORDERED, OMIT THIS PROCEDURE.

Simplified Adjustment

The simplified adjustment of IR compensation is recommended where any one or more of the following conditions may exist.

1. It is difficult or impossible to change the driven machine load during the setup procedure.
2. Where machine load does not change significantly.
3. Where speed regulation (due to load change) of 5-10 percent is acceptable.

The simplified adjustment of IR compensation is made by simply setting the IR COMP potentiometer at a setting of 1 to 3.

If optimized adjustment of the IR compensation is required, set as indicated and proceed to the next step.

Optimized Adjustment

1. Start the drive.
2. Increase the speed reference so that the motor is rotating at approximately half rated speed.
3. Adjust the driven machine for minimum load conditions. The value should not be less than five percent of rated current for smooth operation.
4. Read and record the motor speed by using a hand tachometer. Motor speed may be conveniently read by removing the dust cap on the commutator end motor bearing.
5. Adjust the driven machine for maximum load (not exceeding 100 percent rated torque), and again read motor speed by using the hand tachometer.
6. If the "maximum-load" speed is less than the "minimum-load" speed, turn the IR COMP potentiometer clock-

SETUP AND ADJUSTMENT (CONT'D)

FOR THE POWER UNIT ASSEMBLY IN A DRIVE

wise until they are equal.

7. Repeat Steps 3, 4, 5 and 6.

8. Increase the speed reference to 100% and readjust the MAX SPEED potentiometer so that the motor is running at the maximum speed required for the application, but not in excess of the rated speed on the motor nameplate.

TACHOMETER FEEDBACK (MOTOR NOT COUPLED TO LOAD)

NOTE

FOLLOW THIS PROCEDURE ONLY IF TACHOMETER FEEDBACK HAS BEEN ORDERED.

WARNING

EXCESSIVE SPEED CAN CAUSE DAMAGE TO MOTORS AND SERIOUS INJURY TO PERSONNEL.

BEFORE ATTEMPTING TO OPERATE THE DRIVE.

1. VERIFY THAT THE TACHOMETER WIRING IS CONNECTED WITH PROPER POLARITY BEING FED BACK TO THE DRIVE.

2. THE MOTOR FIELD SHOULD BE CHECKED TO MAKE SURE IT IS CONNECTED, AT THE MOTOR AND AT THE DRIVE.

3. ANY OVERSPEED OR FIELD-LOSS PROTECTION, WHEN PROVIDED, SHOULD BE CONNECTED.

1. Turn the IR COMP potentiometer on the front of the unit to the extreme counter-clockwise position (ZERO).

2. Turn the MAX SPEED rheostat clockwise to the mid-point of its travel.

3. Turn the TACH FEEDBACK potentiometer on the tachometer-feedback unit to the extreme counter-clockwise position.

4. Set the speed reference to zero.

5. Start the drive.

6. Adjust the ZERO ADJ potentiometer (located on the unit) so that the motor begins to rotate; then, "back off" the adjustment until the motor just turns over.

7. Turn the speed reference to 100 percent speed.

8. Turn the TACH FEEDBACK potentiometer clockwise until the drive is running at the maximum speed required for the application. Drive speed may be measured directly by using a hand tachometer, or the voltmeter may be connected across the tach voltage feedback signal to obtain an indication of speed.

9. Stop the drive.

Proceed with the setup procedure on timed acceleration and current limit shown on Page 13 & 14. IR compensation procedure is not required since the IR COMP signal is not used with tachometer feedback. Make certain that the IR comp pot is turned fully CCW.

FOLLOWER DRIVES

NOTE

FOLLOW THIS PROCEDURE ONLY IF THE DRIVE IS TO BE USED AS A FOLLOWER (FOLLOWING AN EXTERNAL VOLTAGE SIGNAL).

1. Remove metal jumper from points 4 to 4A on 2TB terminal board.

2. Follow the setup and adjustment procedure previously specified for either voltage-regulated or tachometer-feedback drives, as appropriate.

3. Tracking Adjustment.

If the drive is to closely follow the signal voltage, the following adjustments must be made for tracking.

a. Apply zero speed reference and set the speed tracking pot to the 50% mark.

b. Start the drive.

SETUP AND ADJUSTMENT (CONT'D)

FOR THE POWER UNIT ASSEMBLY IN A DRIVE

- c. Apply 100% speed reference.

d. Adjust the speed tracking pot for the required speed ratio between master and follower drives (do not exceed voltage limit).

e. Cause the follower-signal voltage to be reduced to the minimum operating value expected on this application. This signal level should not require the drive to operate below 1/20 rated speed.
- f. Adjust the ZERO ADJ potentiometer to establish the same speed ratio between the master (follower signal) and the follower drive as existed with 100% follower signal.
- g. Repeat steps (c) through (f) until satisfactory tracking is obtained.

TROUBLESHOOTING

GENERAL

Nearly all of the problems encountered in initial startup of adjustable-speed-drive equipments are caused by improper interconnection wiring. If difficulty is encountered, the first step should be a careful recheck of all interconnecting wiring in accordance with the Interconnection Chart.

In the event that this check does not disclose the problem, proceed to the Troubleshooting Chart, Table IV, performing each step in the sequence indicated.

WARNING

THIS EQUIPMENT IS AT LINE VOLTAGE ANY TIME AC POWER IS CONNECTED TO THE POWER UNIT, WHETHER THE EQUIPMENT IS IN OPERA-

TION OR NOT IN OPERATION. ALL THREE PHASES OF THE AC POWER LINE MUST BE DISCONNECTED FROM THE POWER UNIT BEFORE IT IS SAFE TO TOUCH ANY INTERNAL PARTS OF THIS EQUIPMENT.

If the equipment operates, but operates improperly, refer to that portion of the Troubleshooting Chart.

NOTE

DO NOT CHANGE ANY OF THE SETUP ADJUSTMENTS WITHOUT FIRST MAKING A NOTE OF THE SETTING SO THAT YOU CAN RETURN THE CONTROL TO THIS SETTING. THIS PROCEDURE WILL MINIMIZE TIME IN CORRECTING DIFFICULTY.

TABLE III

VOLTAGE CHECK LIST				
CIRCUIT	MEASURE AT	1/8 SPD VOLTS FOR 230/460	RTD SPD VOLTS FOR 230/460	COMMENTS
AC INPUT FAN SUPPLY	AC FUSES FAN T.B. (1,3)	230/460 115	230/460 115	VAC: -5, + 10%
Motor Arm	Mot. Arm	40/80	240/500	VDC
Mot. Sh. Fld.	Mot. Sh. Fld.	150/300	150/300	
Mot. Ser. Fld	Mot. Ser. Fld	0.5-1.5	0.5-1.5	
DRS	DRS	1-1.5	1-1.5	
Run Ref	T.B. (7,5)	1-2	14-18	
Jog Ref	T.B. (3,5)	0-10	0-10	
Common	T.B. (5)	0	0	
Supply	T.B. (5,6)	20	20	
Tach Input	Tach Kit			0-250 VAC or VDC MAX
Tach Out	T.B. (1,5)			0-25 VDC MAX
Linear Time Precond- itioning	T.B. (12,5)	1-2	14-18	VDC
IOC (reset)	T.B. (13,5)	20	20	
IOC (trip)	T.B. (13,5)	2-3	2-3	

TROUBLESHOOTING (CONT'D)

TABLE IV TROUBLESHOOTING CHART

Difficulty	Possible Cause	Remedy
1. Blown Fuse in power unit (5 to 15 HP, 230 VAC units only).	Shorts or grounds in wiring, open motor field circuits.	Correct wiring and replace fuse.
2. No d-c output from Points P1, P2.	No a-c input. Points L1, L2, L3. Blown fuse. D-C fault operating IOC circuit. No reference 2TB (7, 5). Defective power unit.	Correct. See No. 1 Remove fault and reset. Correct. Replace.
3. No d-c motor field Supply. Points P1, 19.	Defective power unit.	Replace.
4. Motor will not reach top speed.	Improper setup. Low line voltage. Current Limit set too low. Low reference voltage (2TB 7-5). High tachometer voltage (if used). Zero adjust too low. Defective power unit.	Recheck tachometer-feedback setup. Correct. Readjust Current Limit. Should be approximately 10 to 15 volts max. If low, check for grounds and shorts. Check tachometer nameplate and setup procedure. Voltage from tachometer must not exceed 250 volts. Readjust zero adjust. Replace.
5. Motor runs at top speed. Does not respond to speed potentiometer or has limited response.	Improper setup. Motor wired incorrectly. Operator's station wired incorrectly. Tachometer signal (if used) is too low. Defective power unit.	Recheck. Recheck wiring. Check response of reference to speed potentiometer position. Check tachometer nameplate and review setup procedure. Replace.

TROUBLESHOOTING (CONT'D)

TABLE IV TROUBLESHOOTING CHART (CONT'D)

Difficulty	Possible Cause	Remedy
6. Motor jumps upon starting - will not run at low speed.	Improper setup. Operator's station wired incorrectly. High breakaway torque required. Incorrect phase sequence. Defective power unit.	Recheck. Recheck wiring. Check response of reference to speed potentiometer position. Reduce if possible. Interchange any two a-c lines. Replace.
7. Motor speed changes excessively when load is applied.	Not balanced (firing). Improper setup. Low line voltage or excessive voltage regulation in a-c line. Motor overloaded. Defective power unit.	Check 3-phase input for current balance. Recheck current limit and IR comp. Correct wire or transformer size. Reduce load. Replace.
8. Motor speed unstable.	Improper setup. Excessive inertia. Not balanced (firing). Incorrect series field connections.	Check for too high IR comp (set at zero if tachometer generator is used). Correct. (See page 3 - Specifications.) Check 3-phase input for correct balance. Check connections.
9. Motor noise excessive	Loose motor mounting or coupling. Damaged bearing. Defective power unit. Phase imbalanced.	Tighten. Replace bearing. Replace. Check 3-phase input for correct balance.
10. Motor sparks excessively (some sparking is normal).	Phase imbalanced. Motor overloaded. Brushes worn too short. Rough commutator. Defective power unit.	Check 3-phase input for correct balance. Reduce load. Replace. Repair. Replace.

TROUBLESHOOTING (CONT'D)

TABLE IV TROUBLESHOOTING CHART (CONT'D)

Difficulty	Possible Cause	Remedy
11. Motor stops for no apparent reason.	Sudden extreme overload or intermittent d-c fault.	Remove cause of overload or fault and reset.
	Fuse blowing.	Replace fuse.
	Motor thermal shutdown.	Remove cause of overload, let motor cool and restart.

PHASE BALANCE ADJUSTMENT

The balance adjustment of the three firing circuit is performed at the factory and the rheostat shafts are sealed by means of a dab of glue. Normally, no further adjustment is required in the field; however, the following set-up procedure is recommended, should further adjustment be required.

NOTE

THE STIFFENER BRACKET MUST BE REMOVED FOR THIS ADJUSTMENT.

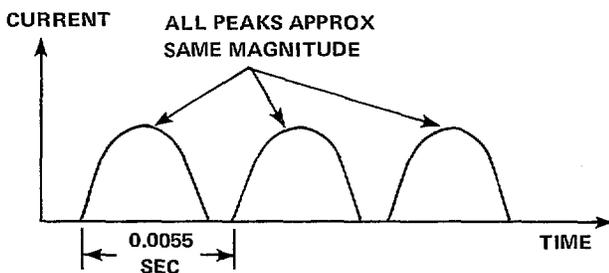
1. Connect the vertical input leads of a cathode-ray oscilloscope (CRO) across the DRS resistor, points P1 (+) and 5 (-), to monitor armature current.* The voltage drop across this resistor is approximately 1-volt d-c at rated armature current.

2. Connect the drive to the a-c line.

3. Start the drive.

4. Operate the drive at a high enough speed and load to give a display of the armature current on the CRO screen.

5. Start adjustment of the two balance rheostats from the CW position, and make small successive adjustments of each (see page 12, Figure 9).



OSCILLOSCOPE TRACE AFTER ADJUSTMENT

Figure 10

6. Adjust the two balance rheostats until all three phases are ON and all current peak amplitudes are of approximately the same magnitude (see Figure 10).

PHASE BALANCE ADJUSTMENT WITH CLAMP-ON AMMETER (NO OSCILLOSCOPE AVAILABLE)

1. Operate the drive at half speed with normal working load.

2. Using the ammeter, measure each input phase to verify that the readings are within ± 1 ampere of each other (the positioning of the ammeter around each wire should be the same for accurate measurement). If measurements are not within ± 1 ampere, perform the adjustments in Steps A and B.

A. Start adjustment of the three balance rheostats from the CW position and make small successive adjustments of each.

B. Adjust the three balance rheostats until all three phases are ON and all current amplitudes are of approximately the same magnitude.

*CAUTION

THE DRIVE IS CONNECTED DIRECTLY TO THE AC LINE, HENCE THE CRO (CHASSIS OR INPUT LEADS) MAY NOT NORMALLY BE GROUNDED. THIS MEANS THAT THERE WILL BE A VOLTAGE DIFFERENCE BETWEEN THE CRO CASE AND GROUND. IF THE CRO CHASSIS IS GROUNDED, CIRCULATING GROUND CURRENTS MAY DAMAGE THE DRIVE OR CRO.

THE CRO CHASSIS MAY BE GROUNDED ONLY IF A DIFFERENTIAL INPUT VERTICAL AMPLIFIER IS USED, OR IF THE DRIVE IS CONNECTED TO THE AC LINE THROUGH AN ISOLATION TRANSFORMER WHOSE SECONDARY WINDING IS UNGROUNDED.

General Electric Company • Speed Variator Products Department • Erie, Pennsylvania 16501

GENERAL  **ELECTRIC**

GEK-11028
1-73 (2500)