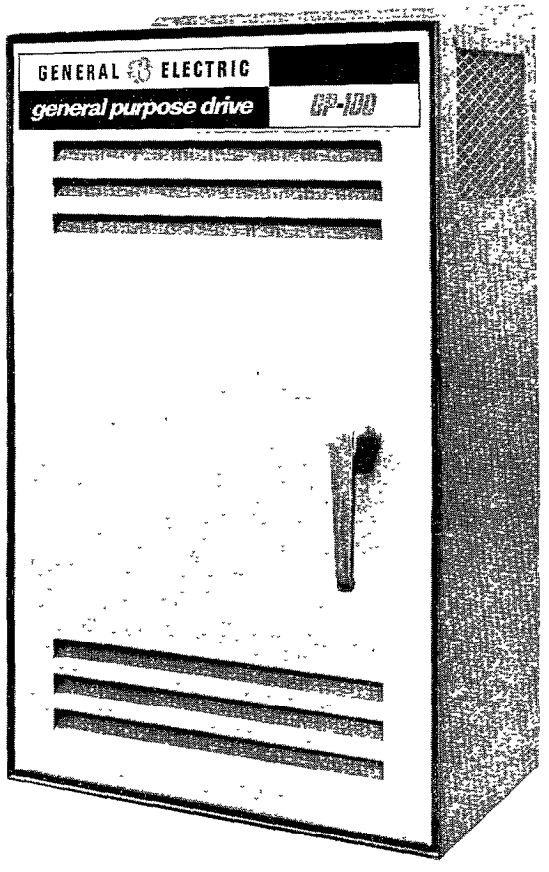
INSTRUCTIONS

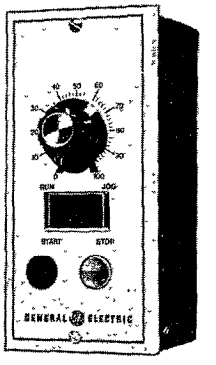
GEK—22954

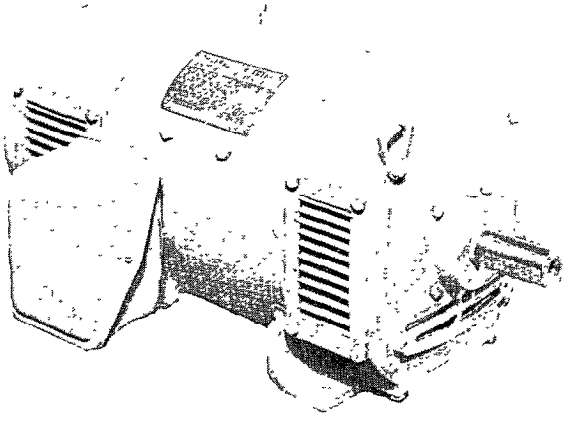
GP-100*

ADJUSTABLE SPEED DRIVE

5—60HP, THREE PHASE







GENERAL ELECTRIC

WARRANTY

GP-100 SCR DRIVE

The Company warrants to the original Purchaser for its own use that each new GP-100 SCR drive to be delivered hereunder will be free from defects in material, workmanship and title and will be of the kind and quality designated or described in the contract. The foregoing warranty is exclusive and in lieu of all other warranties whether written, oral or implied including any warranty of merchantability or fitness for purpose.

If it appears within one (1) year from date of original purchase for use that any part of the GP-100 SCR drive is defective in material or workmanship, and the Purchaser notifies the Company promptly, the Company shall thereupon correct any such defect, at its option, either by repairing any defective part or parts or by making available at the Company's plant, a repaired or replacement part.

NOTE: The Warranty is void if the conversion unit enclosure is removed or if the unit is tampered with in any way.

The conditions of any test shall be mutually agreed upon and the Company shall be notified of, and may be represented at, all tests that may be made If requested by the Company, the Purchaser will ship any inoperative GP-100 unit (power conversion and regulator assembly), with shipping charges prepaid, to the Company at its plant at 1100 Lawrence Parkway, Erie, Pennsylvania 16501 and the Purchaser will ship any other defective part or parts of the GP-100 SCR drive, with shipping charges prepaid, to the plant, warehouse or service shop designated by the Company

The liability of the Company to the Purchaser (except as to title) arising out of the supplying of the GP-100 SCR drive, or its use, whether on warranty, contract or negligence, shall not in any case exceed the cost of correcting defects or furnishing new or remanufactured parts as hereinabove provided, and upon the expiration of the warranty periods indicated above, all such liability shall terminate The Company shall have no liability for any GP-100 SCR drive, or any part thereof, which becomes defective or inoperative because of improper application, or because of operation of the GP-100 SCR drive in excess of the Company's published ratings, or because of accident, misuse, abuse, or repairs or alterations on the part of the Purchaser or any third party other than the Company The Company shall have no liability whatever under this warranty if the GP-100 SCR drive is operated with any drive motor other than the motor originally shipped by the Company for use with this equipment, and the Company shall have no liability for replacing any fuses which may fail for any reason. The Company shall not be responsible for, and shall not provide under this warranty, any installation services or adjustments for either original equipment or replacement equipment at the user's location. This warranty shall run only to the original Purchaser of the equipment for its own use and shall not be transferable to any other parties. The foregoing shall constitute the sole remedy of the Purchaser and the sole liability of the Company.

It is understood that the Company has the right to make changes in design at any time and that the Company reserves the right to replace assemblies or parts, pursuant to this warranty, with assemblies or parts which shall be functionally similar, but which may incorporate such changes in design, and that the Company shall not be responsible for any rewiring or other adjustments which may be necessary in order to accommodate such replacement assemblies or parts.

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.

ERRATA SHEET
Number One

GP-100*
ADJUSTABLE SPEED DRIVE
5—60HP, THREE PHASE

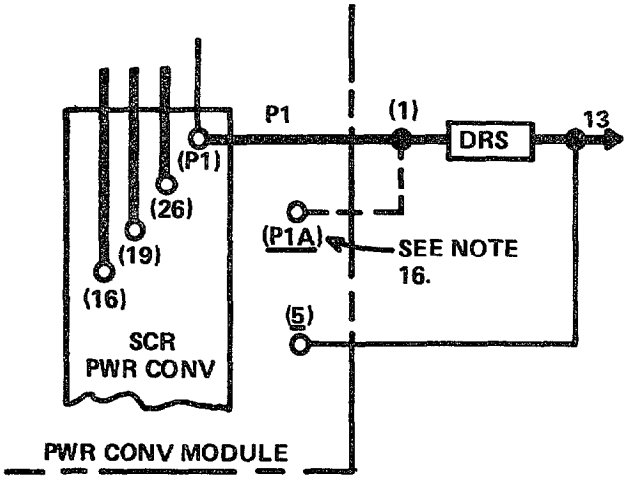
ERRATA SHEET: Affects GEK-22954
Pages 33 and 34

This errata sheet should be attached inside the front cover of GEK-22954 and retained as a part of this book.

The instruction book text should be changed in accordance with information contained in this errata sheet.

FIGURE 19 ELEMENTARY DIAGRAM — Page 33

On the elementary diagram add the dashed connection line ((P1A) to DRS (1)) and label and add note 16 after note 15 as indicated below:



16. On 460VAC drives a wire is connected from DRS (1) to 2TB (P1A).

SPARE AND RENEWAL PARTS — Page 34

In the "Conversion Unit" line under "Catalog Number" block, add as indicated below:

FROM: 331X232AB_ _ _

TO: 331X232_ _ _ _ _
331X232_ _ _ _ _

In the "Conversion Unit" line, to the right of "Part" add as indicated below:

FROM: "G01, G02, G03, G04, G05 and G06"

TO: ABG01, ABG02, ABG03, BAG04, BAG05 and BAG06.

GP-100*

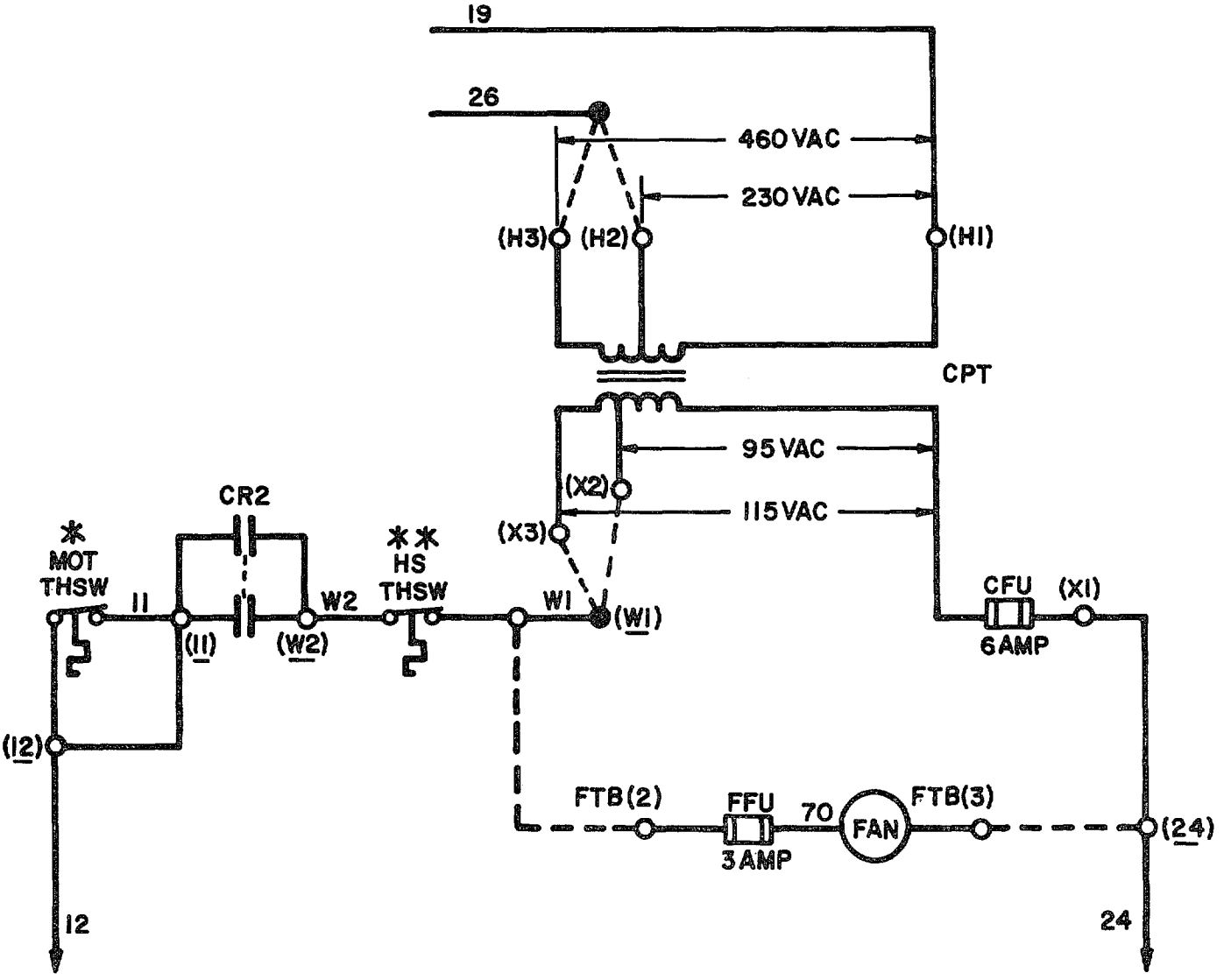
ADJUSTABLE SPEED DRIVE

5—60HP, THREE PHASE

ERRATA SHEET: FIGURE 19, PAGE 33

THE ERRATA SHEET SHOULD BE ATTACHED INSIDE THE FRONT COVER OF GEK—22954 AND RETAINED AS A PART OF THIS BOOK.

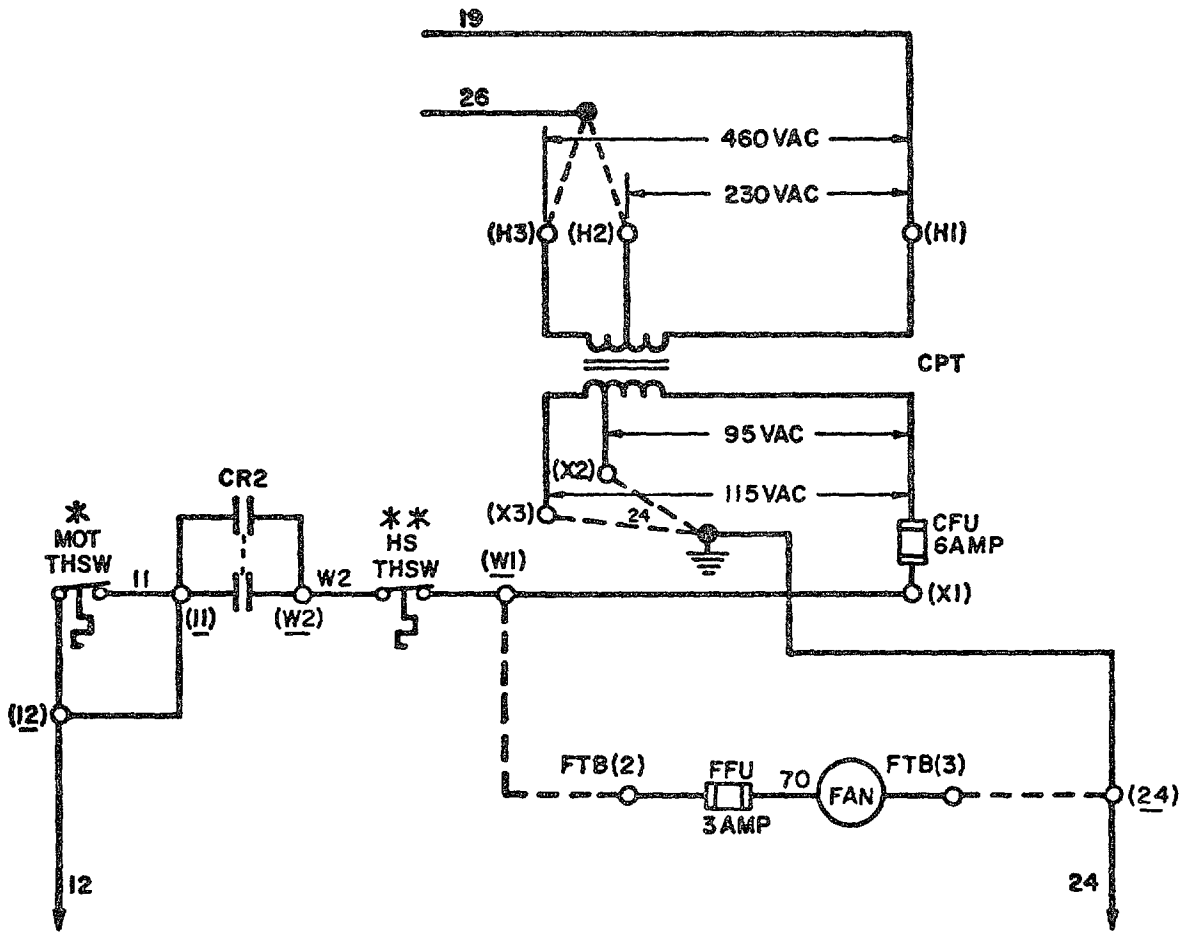
THIS PARTIAL CIRCUIT NOW APPEARS ON THE ELEMENTARY DIAGRAM, FIG. 19, PAGE 33.



* Trademark of General Electric Co., U.S.A

(OVER)

IN THE EVENT LOCAL CODES REQUIRE THE 115V AC CONTROL CIRCUIT BE GROUNDED, THEN CONNECT THESE COMPONENTS AS SHOWN BELOW:



REMOVE TWO WIRES EACH MARKED CPT–X1 FROM TERMINAL BOARD (X1) ON CPT TRANSFORMER.

REMOVE TWO WIRES EACH MARKED CPT–X FROM EITHER TERMINAL BOARD POINT (X2) OR (X3) ON CPT TRANSFORMER.

CONNECT THE TWO WIRES MARKED CPT–X1 TO EITHER TERMINAL BOARD POINT (X2) (50 HZ CONNECTION) OR (X3) (60 HZ CONNECTION) ON CPT TRANSFORMER, CHANGE THE WIRE NUMBER TO CPT–X.

CONNECT THE TWO WIRES MARKED CPT–X TO POINT CPT–X1 ON CPT TRANSFORMER AND CHANGE THE WIRE NUMBERS TO CPT–X1.

THESE CHANGES WILL ENABLE TRANSFORMER CPT TERMINAL X3 (60 HZ CONNECTION)OR X2 (50 HZ CONNECTION) ON CIRCUIT 24 TO BE GROUNDED IF THIS IS A REQUIREMENT OF A LOCAL CODE.

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

GENERAL ELECTRIC

PRINTED IN U.S.A.

GEK-22954 Errata Sheet No. 2 (11/75)

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

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 installation, setup, operation, maintenance and troubleshooting for the SCR drive.

If any modifications or special applications are required other than those covered in this instruction book, please contact the General Electric Company prior to implementation to preclude faulty operation or misapplication of the equipment. Failure to do so could nulify your warranty. (See Warranty Statement)

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, HANDLING, AND STORAGE

RECEIVING

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.

HANDLING

The SCR drive can be transported by lift trucks with forks completely under the base of the packing case.

STORAGE

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 temperature 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 drive is primarily a matter of periodic inspection and cleaning of the three drive components; the power unit, motor, and operator's station.

After removing the a-c power, clean the exterior and interior of the power 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.

Keep the outside of the operator's station free from grease and dirt, and do not oil the devices.

Motor ventilation openings must be kept free of dirt to allow adequate ventilation. Refer to the motor instruction book for lubrication recommendations.

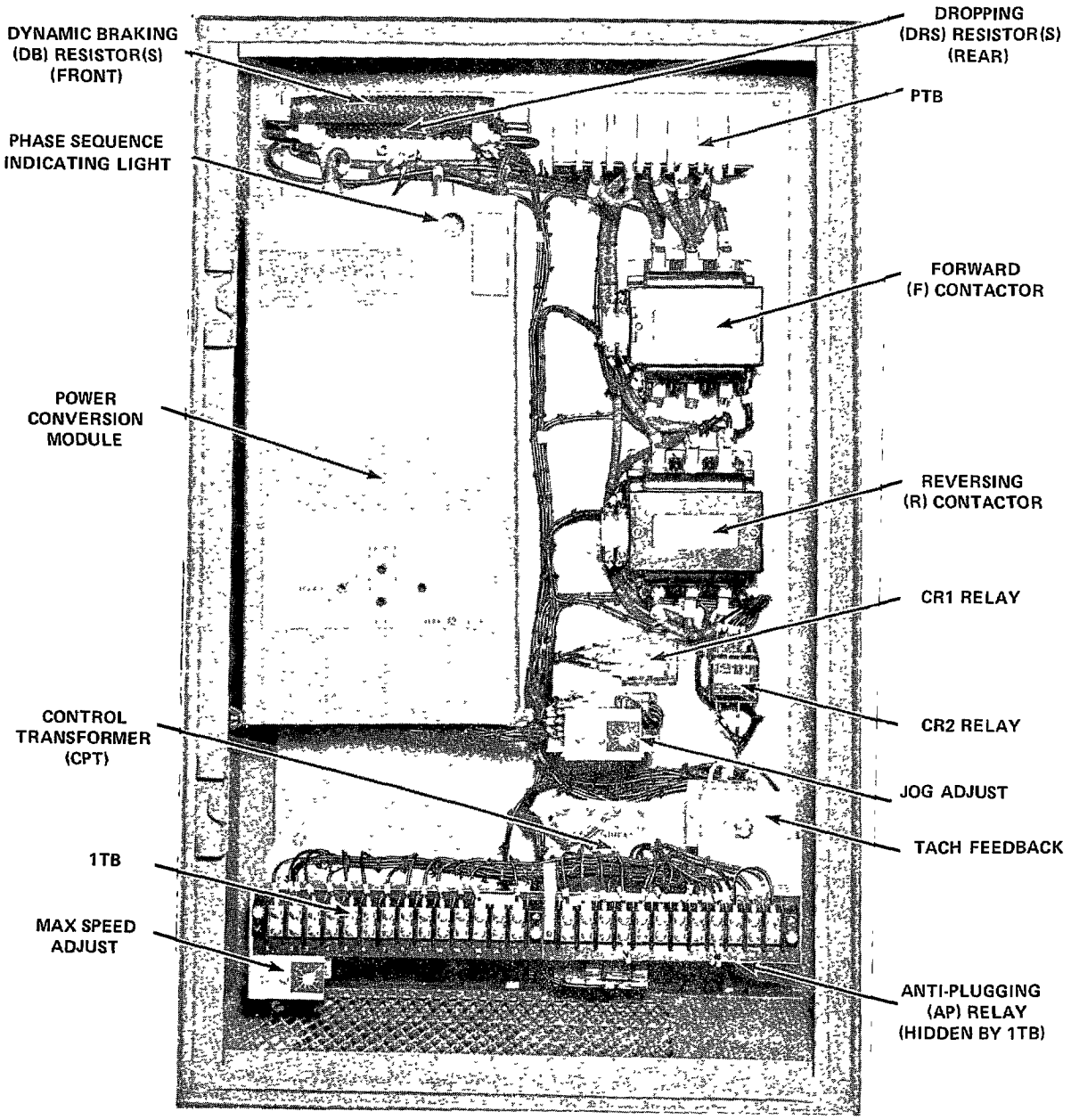


Fig. 1. Small Cabinet

(15HP, 230VAC Power Unit
with All Modifications Shown)

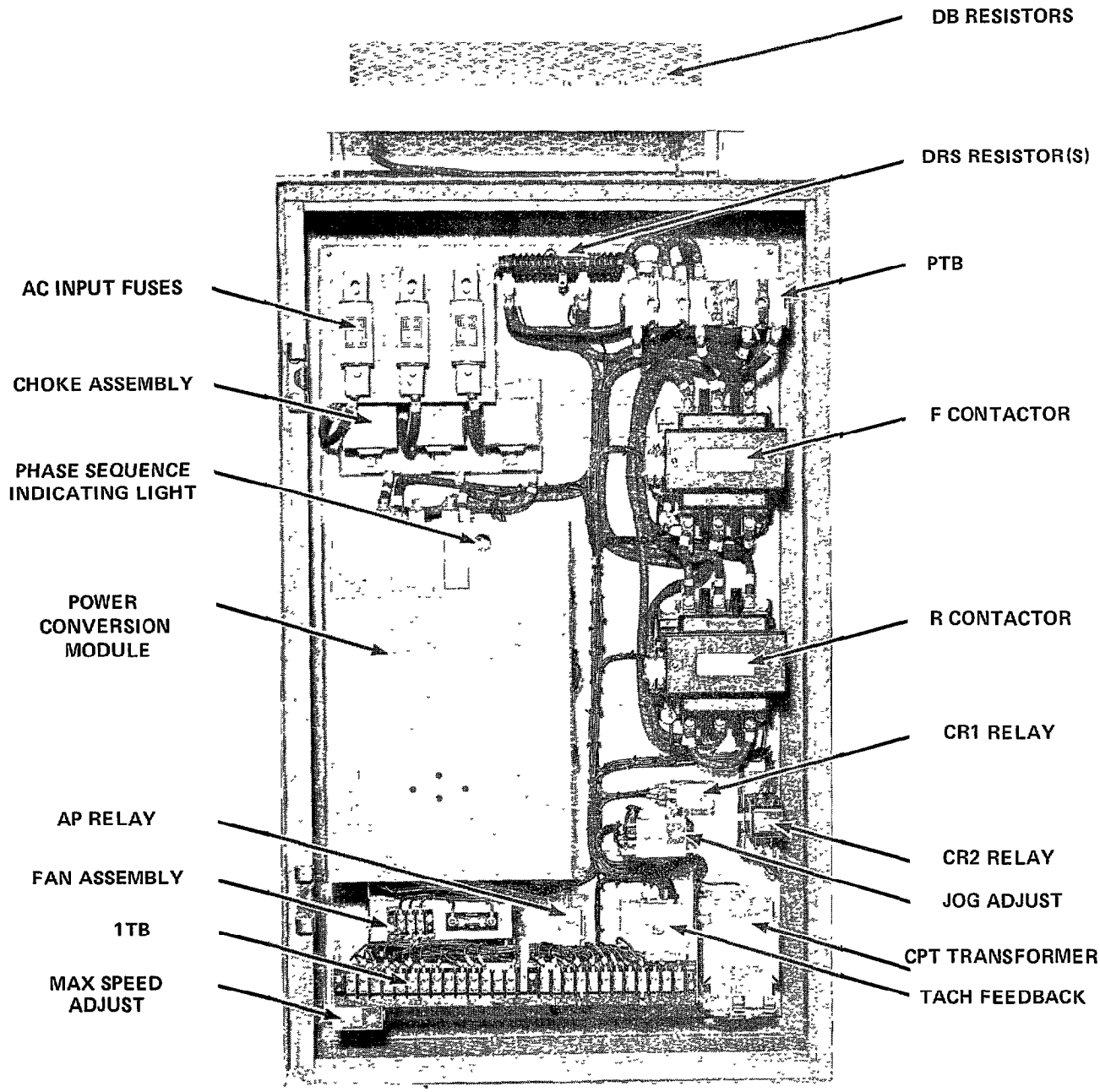


Fig. 2. Large Cabinet

(60HP, 460VAC Power Unit
with All Modifications Shown)

DESCRIPTION

BASIC DRIVES

The DC3032 SCR Adjustable-Speed Drive is a packaged, all-electric-drive, operated from three phase a-c power. The drive consists of:

1. A wall-mounted power unit which contains the conversion unit, necessary magnetic contactors, relays, and resistors. The unit provides conversion of incoming a-c power to d-c power, as well as necessary regulator functions.

2. An adjustable-speed d-c drive motor.

3. An operator's station which contains the speed-setting potentiometer and the necessary operating push-buttons.

The conversion unit is the control center of the drive. This unit contains two heat sinks on which are mounted the SCRs and diode rectifiers. The heat sinks support three printed circuit boards containing the protective, firing, and regulating circuits which control the SCRs (which in turn control the speed of the d-c motor). The conversion 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. 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 conversion unit 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 conversion unit also contains a phase-sequence indicating light. The a-c supply fuses are mounted behind the conversion unit cover for drives rated 5–15 HP at 230 VAC. Panel mounted fuses are supplied for all other ratings. The warranty is void if the unit is tampered with in any way (see WARRANTY).

The operator's station will contain a maximum of five controls:

1. Speed Control Potentiometer,
2. Start Pushbutton,
3. Stop Pushbutton,
4. Run-Jog Switch,
5. Forward-Reverse Switch,

of which 1–4 are included in the basic drive.

MODIFICATIONS

Tachometer Feedback

If improved speed regulation is ordered, the tachometer-feedback unit will be shipped with the power unit. Connection of only four leads is done at time of installation. Complete instructions are included under INSTALLATION.

Jog (Deletion)

If jog is deleted, the run-jog switch will be omitted from the operator's station.

Dynamic Braking (DB)

If dynamic braking is ordered, the braking resistor and related power wiring will be supplied as an integral part of the power unit.

Reversing (Selective Rotation) with Dynamic Braking (DB)

Anti-plugging protection, forward-reverse contactors and dynamic braking are provided, when ordered, as an integral part of the power unit. Direction may be selected before starting with the forward-reverse switch mounted on the operator's station.

Line Transformer

If a transformer is ordered it will be shipped separately for mounting and wiring by the purchaser. Transformer ratings, catalog numbers and connection diagrams are included in the APPENDIX.

SPECIFICATIONS

BASIC DRIVES

Power Supply

Voltage — 230VAC, –5 +10%, 3 Phase
or 460VAC, –5 +10%, 3 Phase

Frequency — 60Hertz ±1Hertz
(50 hz special orders).

Speed vs Torque

Typical data for speed versus torque is shown below:

Motor Enclosure	Percent Rated Speed			
	100-60	50	40	5
	Percent Continuous Torque (Or Rated Amps)			
DP	100	94	87	45
TE	100	95	92	82

NOTE

THE VALUES TABULATED REPRESENT AN AVERAGE FOR 5 TO 60HP MOTORS. IF CONTINUOUS TORQUE GREATER THAN THAT LISTED IN THE TABLE IS REQUIRED, SUPPLEMENTARY VENTILATION OR A DERATED MOTOR MAY BE REQUIRED. REFER TO THE COMPANY FOR SPECIFIC DATA OR RECOMMENDATION.

Speed Regulation

The speed regulation is five percent of motor base speed for a 95-percent load change over the 20/1 speed range (with optimum adjustment of IR compensation by the purchaser). Speed regulation is specified under steady-state conditions and with constant line voltage, frequency, and ambient temperature.

Steady-state motor speed may also be affected by changes in line voltage, frequency, and ambient temperature. These variables (other than load) are referred to as "service deviations".

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

Variable	Change	Speed Change in Percent of Rated
Voltage	–5, +10%	15%
Frequency	2%	
Ambient Temp	15C	

Acceleration Control

Adjustable Time

Total accelerating time (to full speed) is adjustable from 2.5 - 10 seconds. This complete time range is only available when 150-percent rated torque is sufficient to accelerate the drive and load to rated speed in 2.5 seconds or less — Modifications by adding special capacitors.

Decelerating time (when preset speed is reduced) is at a fixed rate of three seconds. If normal coasting time exceeds three seconds, the load characteristics determine deceleration time.

Current Limit

Adjustable from 80-150-percent rated current. Timing may be set at minimum (or disabled) and current limit used to control accelerating (and running) torque - or the current limit may be used with timed acceleration, providing a maximum current (torque) limit.

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.

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

Current Limit — Limits operating overloads to 150-percent rated (or less as adjusted) for protection of motor and power unit, (see "Overload" on Page 9).

Under voltage — A-c operated d-c line contactor protects against automatic restarting following a-c power interruption.

Phase Sequence — Indicating light "on" for correct sequence.

Loss of Phase Protection — Provides system shutdown upon loss of one or more phases.

Thermal Switches — Provide system shutdown for high temperatures. (heatsink and motor).

Control Power Transformer — Fused 115VAC control supply.

Dynamic Braking

When dynamic braking is provided, the drive system shall be capable of braking a load (whose inertia equals that of the motor) at an initial current of 150 percent of rated armature current from full speed to standstill three times in rapid sucession with the dynamic braking resistor initially at ambient temperature.

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

The SCR drive power factor is approximately 75 percent at full load, full speed, and is reduced with speed.

Service Factor

The service factor is 1.0.

Overload

150 percent of rated motor torque, one minute maximum.

Minimum Load

Five percent rated power-unit current.

Drive will generally operate satisfactorily without load coupled to the motor because motor losses approximate five percent current.

Service Conditions

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

Altitude — sea level to 3,300 feet.

Cooling

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

Jog

Jog is at an independent, preset speed, adjustable from 1/10 — 1/3 rated speed.

MODIFICATIONS

Improved Speed Regulation (Tachometer Feedback)

When this modification is ordered providing an a-c 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 (see page 8) is improved to three percent.

INSTALLATION PRECAUTIONS

VOLTAGE TRANSIENTS

In order to obtain maximum reliability and life from your SCR Drive, 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 (SCRs) 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 SCR Drive, the following practices should be followed:

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

2. Do not switch associated power or 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 capacitator) connected directly across the coil of each device.

For a particular application, some of the steps listed above may not be necessary. Also, where extensive relaying is proposed, additional problems may be encountered. It is suggested that a sketch or drawing of the proposed circuits be sent to the General Electric Company for recommendations.

INSTALLATION

GENERAL

Location and mounting of the SCR drive components is described in this section. When the equipment is installed, check all accessible factory-made connections for tightness, since connections may become loose during shipping or storage.

NOTE

ALL MODIFICATION KITS ORDERED SHOULD BE INSTALLED PRIOR TO MOUNTING THE POWER UNIT.

POWER UNIT

Two enclosures are available for the power unit, depending on the rating of the drive. Refer to "Dimensions" in the Appendix for outline dimensions.

Location

The SCR drive 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 the power unit is used with a motor suitable for hazardous locations, install the power 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.

Mounting

Mount the power-unit enclosure on any firm, reasonable flat, vertical surface, by means of the mounting holes at the top and bottom of the enclosure. The mounting holes are suitable for 3/8 inch mounting bolts and flat washers (the use of four bolts per enclosure is recommended).

Conduit Entrance

Conduit entrance can be made through the top or bottom of the power unit enclosure, Refer to Fig. 3, page 14 for recommended conduit runs and entries.

All external power connections are made to terminal boards located near the top of the enclosure. The external control connections are made to terminal boards located near the bottom of the enclosure.

OPERATOR STATION

The operator's station must be disassembled for mounting and wiring. First, remove the two screws securing the cover to the operator's station enclosure and then remove the cover (with the control devices mounted on the cover) from the enclosure. See Fig. 7, page 17.

For convenience and ease of wiring, a pictorial wiring decal is provided on the back of the front cover plate that coincides with the group number ordered. All external wiring must be connected as the decal indicates.

Location

The SCR drive operator's station is suitable for use in most factory areas and should belocated in a position most convenient for the machine operator. Avoid locations subject to steam vapors, oil vapors, chemical fumes, excessive moisture, or excessive dirt, dust, or lint.

WARNING

NEVER INSTALL THE OPERATOR'S STATION WHERE HAZARDOUS, INFLAMMABLE, OR COMBUSTIBLE VAPORS OR DUSTS ARE PRESENT.

The operator's station should be in a position which is convenient for the machine operator.

Conduit Entrance

The knock-out plug in the operator's station enclosure may accept conduit from either the top or bottom by rotation of the enclosure.

When using either rigid or thin-wall conduits, it is generally easier to attach the unit to the end of the conduit before locating and installing the mounting screws.

Mounting

Mount the back of the operator's station in the desired location on any firm, reasonably flat surface, by means of the mounting holes provided. The mounting holes are suitable for either wood screws or No. 10 machine screws.

DC MOTOR

A separate instruction book is provided giving information on location, conduit entrance and mounting of the d-c motor. The motor should be mounted on the driven machine (or as appropriate for the installation) before proceeding with wiring, setup, and adjustment.

Do not couple the motor to the load until after preliminary setup instructions have been completed.

POWER UNIT MODIFICATIONS

Tachometer Feedback Kit

Mount the kit as shown in Fig. 8 page 17, terminating the four numbered leads (from the tachometer kit) as identically numbered terminal points (9, 10, 13 and 28) on 1TB. Remove the jumper between points 9 and 10 on 2TB.

FOLLOWER DRIVE MODIFICATION

Follower Voltage Signal

The following voltage signal required by the SCR drive is 5 ma at 20 volts d-c, maximum. If the follower source voltage is higher than 20, a two-watt series resistor

must be added and separately mounted by the purchaser. The value of this resistance may be determined as follows:

Series Resistance (Ohms)=(Signal Voltage – 20) x 200

The maximum follower-signal voltage permissible is 250 volts d-c. This signal must have less than 1.0 percent a-c rms ripple . An armature voltage signal from a rectifier drive is not an acceptable follower signal without adequate filtering and isolation.

The follower signal must be isolated from the a-c line or, alternately, the SCR drive must be equipped with a line isolating transformer.

Refer to Fig. 9, page 18 for interconnection information.

Removal of Timed Acceleration

Since timed acceleration is generally not desireable on follower drives, it should be removed (see note 2 on Fig. 19, page 33) and the time acceleration control turned to a maximum setting.

INTERCONNECTION

GENERAL

All internal electrical connections between devices in the power unit have been made at the General Electric factory, except connections for the tachometer-feedback-unit modification, since this component is shipped separately for installation by the purchaser.

REFER TO PAGE 10, "INSTALLATION PRECAUTIONS" BEFORE INSTALLING INTERCONNECTION WIRING.

INTERCONNECTION OF DRIVE COMPONENTS

Electrical interconnections are required between the power unit and motor and between the power unit and operator's station, as shown on Fig. 3, page 14. Figure 3 shows the conduit runs required for these interconnections. Table I, page 15 shows the number of wires required for each conduit run as shown in Fig. 3. 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.

Proceed to install conduit runs 1 through 3 in accordance with this tabulation.

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 voltage and frequency of the available power supply agree with the rating on the power-unit nameplate located on the inside of the power-unit enclosure. If an a-c line transformer is to be used, refer to step 4.

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. The disconnecting switch and fuse (or circuit breaker) should be selected in accordance with the national electrical code and/or local code requirements based on the power input data on the SCR drive nameplate. This data is summarized in Table II, page 15 to aid in the selection of disconnecting devices, fuses, and wire sizes.

3. A-c power connection from the disconnecting device to the power unit may now be made in accordance with conduit run 3 as shown in Table I.

4. If the available power supply is other than that shown on the power unit data nameplate, it will be necessary to use a line transformer between the disconnecting device and the power unit. This transformer will be separately mounted by the purchaser. The appendix provides complete information on both auto and isolating transformers for use with SCR drives, including required kva, dimensions, connections, and catalog numbers.

FINAL CHECK

After all electrical connections have been made, complete the installation as follows:

1. Recheck all connections, using the Interconnection Chart, Table I, page 15. Recheck the transformer connections (if used) and connections to the disconnecting device (if used).

2. Reassemble the operator's station. Carefully dress the interconnecting wire into the back of the station so that the device assembly may be installed. Keep the wires away from sharp edges and do not force the device assembly into place. Replace the station cover.

3. Recheck the motor connections, carefully tape, and insert them in the conduit box. Replace the conduit-box cover.

4. Install protective fuses in the a-c disconnect (if used).

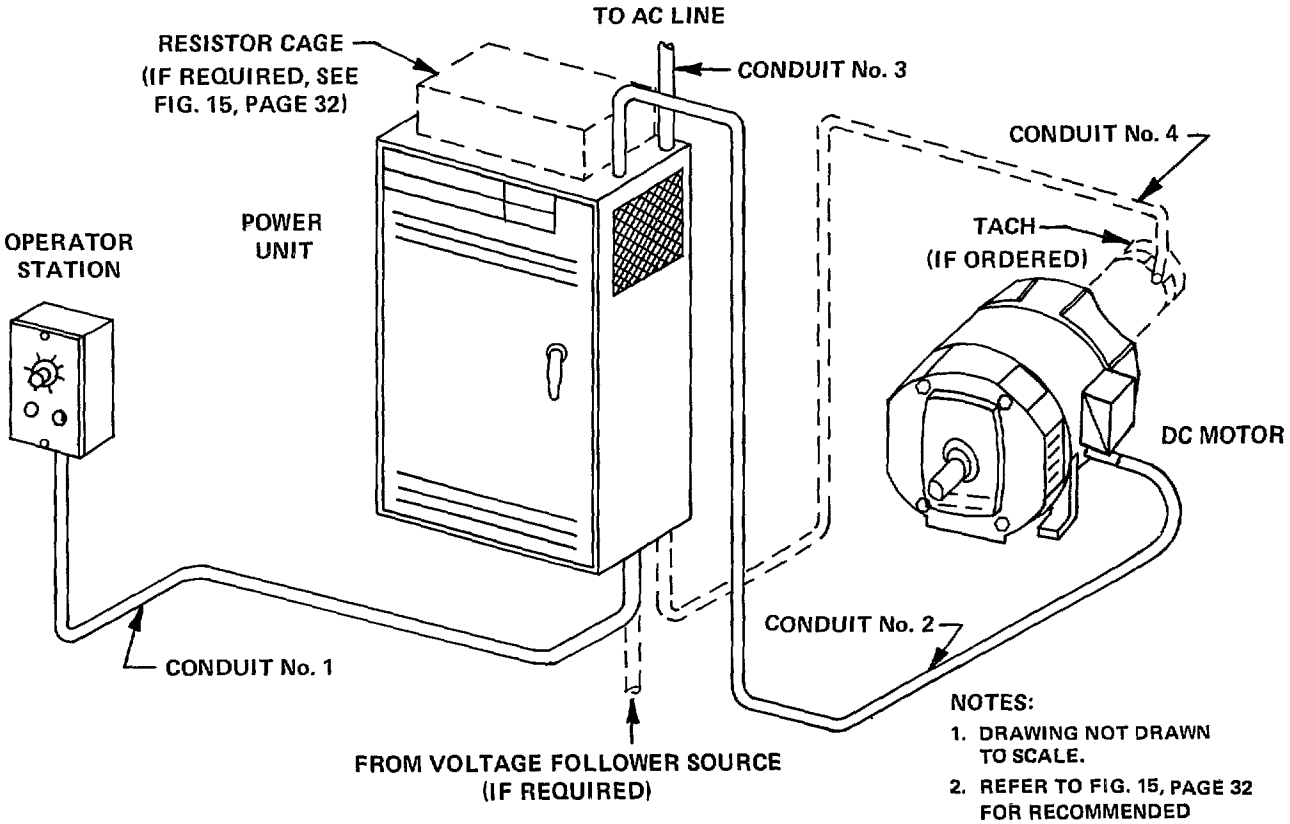


Fig. 3. Interconnection of SCR Drive

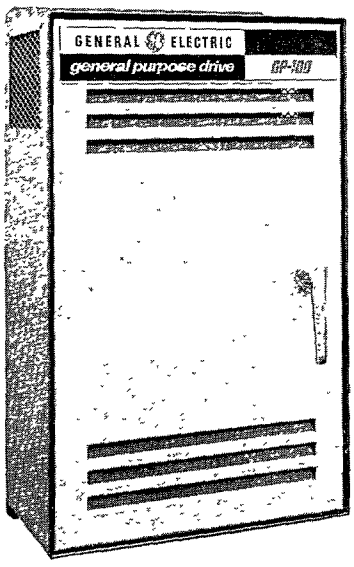


Fig. 4. W20 Enclosure

(15HP, 230V Power Unit Shown)

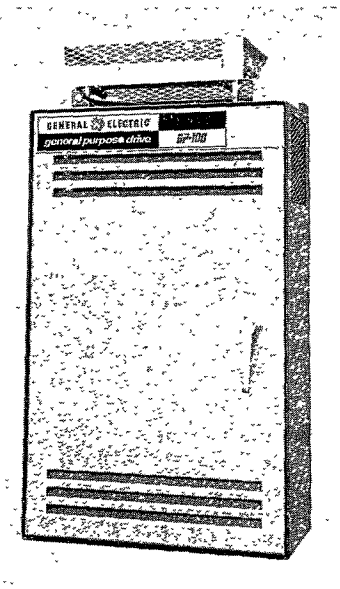


Fig. 5. W25 Enclosure

(60HP, 460V Power Unit Shown)

TABLE I

INTERCONNECTION CHART

Conduit or Route Number	Description	Wire No.	Connection Points * From Power Unit	Connection Points * To	Remarks
3 ↓	3 Phase AC Line Supply	L1 L2 L3	L1 L2 L3	AC Phase 1 ↓ 2 ↓ 3	
2 ↓	Adjustable DC Voltage Output	A1 A2	PTB(A1) PTB(A2)	DC Motor A1 A2	Insulate all Motor Connections with PVC Tape
	DC Motor Series Fld (when used)	S1 S2	PTB(S1) PTB(S2) Remove Jumper PTB(S1, S2)	S1 S2	The Series Field may be wired in at the Motor Conduit Box for Non-Reversing Drives only by Connecting wire S1 to A2 and bringing S2 back to PTB(2) in the power unit.
	DC Motor Thermal Sw (when used)	11 12	1TB(11) 1TB(12)	P2 P1	When Motor Thermal Switch is used remove Jumper between 1TB(11) and 1TB(12).
	DC Motor Shunt Fld	18 19	1TB(18) 1TB(19)	F1 ↓ F2	
4 ↓	Tachometer	9 10	1TB(9) 1TB(10)	Tach Feedback ↓	+ if using DC Tach — if using DC Tach
1 ↓	Operator Station		Refer to Page 16 for Operator Station Interconnection Information		

* Explanation of Termination Nomenclature:

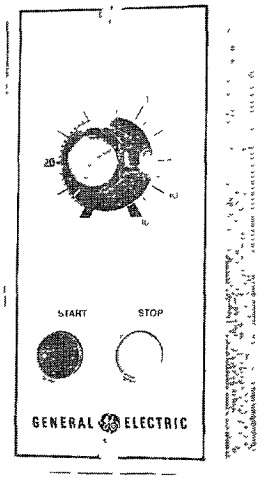
1. When designated as (example) PTB(A1), PTB implies terminal board P, and A1 is the connecting point on that terminal board.
2. All nomenclature not preceeded by the letters TB are located on devices.

NOTE: FOR APPROPRIATE WIRE SIZE INFORMATION, CONSULT LOCAL AND NATIONAL CODES AND REFER TO TABLE II FOR AMPERE RATINGS.

TABLE II POWER UNIT RATING DATA

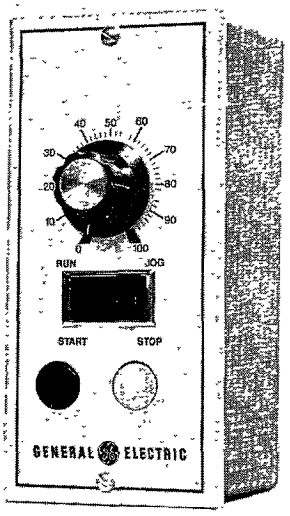
AC Line Volts	230							460									
Horsepower (HP)	5	7½	10	15	20	25	30	5	7½	10	15	20	25	30	40	50	60
Typical Motor Sh Fld Amps	1.0	1.0	1.5	1.5	1.5	1.7	1.4	1.0	1.3	1.5	1.7	2.0	2.0	2.0	1.7	2.5	1.7
† Typical DC Line Amps	21	28	36	54	71	91	107	9	14	18	26	35	42	50	68	84	101
† Typical AC Line Amps	20	26	34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

† Rated at 100% load



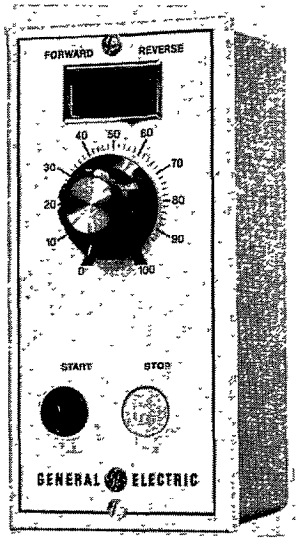
NON-REVERSING

WIRE NO	CONNECTION POINTS	
	FROM POWER UNIT	TO OPERATOR STATION
3	1TB(3)	2PB(3)
4	1TB(4)	2PB(1)
7	1TB(7)	TB(2)
12	1TB(12)	1PB(1)
13	1TB(13)	TB(1)
41	1TB(8)	TB(3)



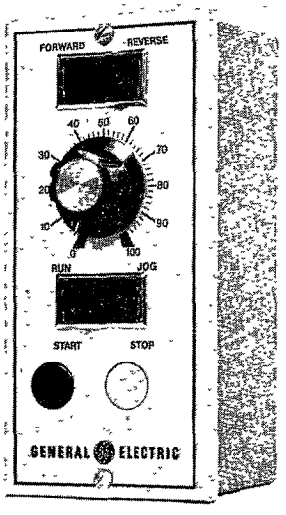
NON-REVERSING
WITH JOG

WIRE NO	CONNECTION POINTS	
	FROM POWER UNIT	TO OPERATOR STATION
3	1TB(3)	2PB(3)
4	1TB(4)	1SW(2)
7	1TB(7)	TB(2)
12	1TB(12)	1PB(1)
13	1TB(13)	TB(1)
14	1TB(14)	1SW(6)
41	1TB(8)	TB(3)



REVERSING

WIRE NO	CONNECTION POINTS	
	FROM POWER UNIT	TO OPERATOR STATION
1	1TB(1)	2SW(4)
2	1TB(2)	2SW(5)
3	1TB(3)	2PB(3)
4	1TB(4)	2SW(1)
5	1TB(5)	2SW(6)
6	1TB(6)	2SW(3)
7	1TB(7)	TB(2)
12	1TB(12)	1PB(1)
13	1TB(13)	TB(1)
41	1TB(8)	TB(3)



REVERSING
WITH JOG

WIRE NO	CONNECTION POINTS	
	FROM POWER UNIT	TO OPERATOR STATION
1	1TB(1)	2SW(4)
2	1TB(2)	2SW(5)
3	1TB(3)	2PB(3)
4	1TB(4)	2SW(1)
5	1TB(5)	2SW(6)
6	1TB(6)	2SW(3)
7	1TB(7)	TB(2)
12	1TB(12)	1PB(1)
13	1TB(13)	TB(1)
14	1TB(14)	1SW(6)
41	1TB(8)	TB(3)

Fig. 6. Interconnection of Operator's Stations

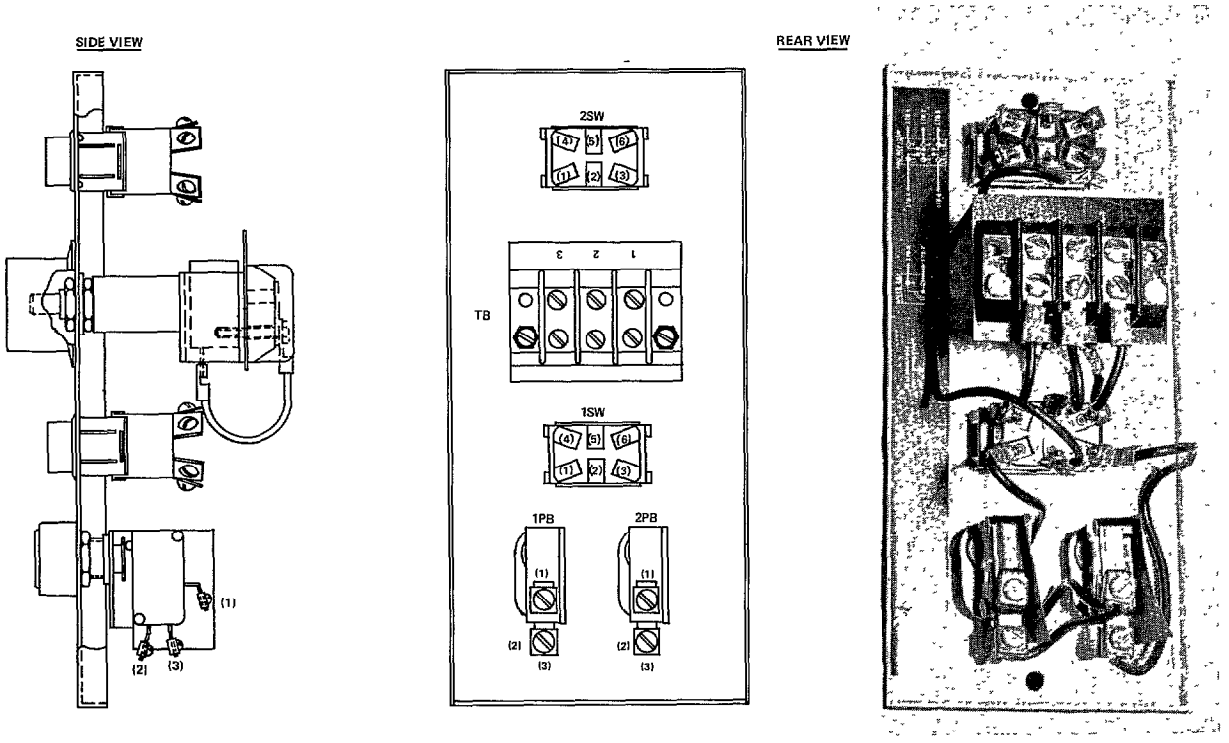
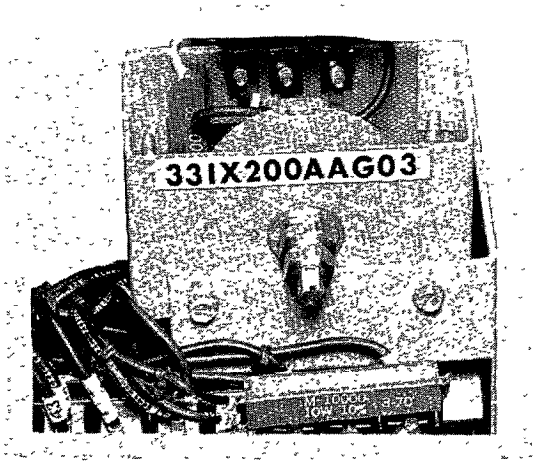


Fig. 7. Operator Station (all options shown)



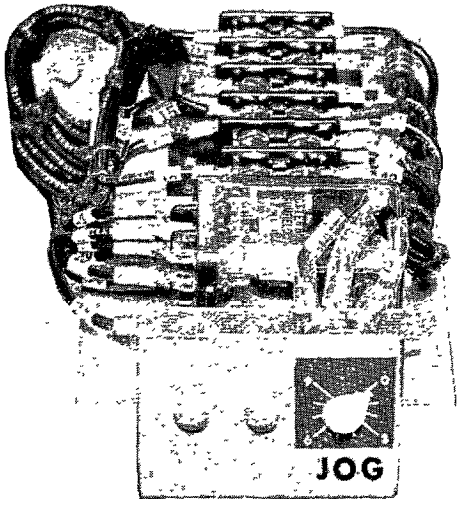
Mount the tachometer feedback kit as indicated in the photo and terminate the four leads as follows:

Wire No.	Connect To	Remarks
9	1TB(9)	Tach Input
10	1TB(10)	Tach Input
13	1TB(13)	Kit Output (Common)
28	1TB(28)	Kit Output

Remove the metal jumper from 2TB(9) to 2TB(10).

When using a DC tachometer, verify that the tach connection to 1TB(9) is of a positive (+) polarity (DC) when the motor is rotating in the desired direction.

Fig. 8. Tachometer Feedback Modification



1. Calculate value of series resistance (page 12) and add to circuit.
2. Connect voltage follower leads as shown at the left (bottom).
3. Disconnect wire 40 from jog kit terminal board and insulate with tape.
4. Remove metal jumper from 2TB(4, 4A). (Removing time acceleration).

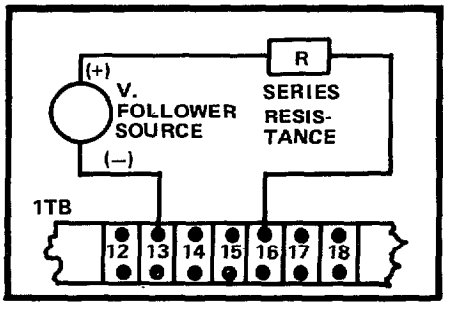


Fig. 9. Voltage Follower Modfication

(Top: wire 40 removed, Bottom: voltage follower circuit connection)

SETUP AND ADJUSTMENT

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 15.

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 armature at points A1 and A2. Point A1 is positive.

3. Connect the ammeter (if used) to points P2 and S2 on PTB, removing the metal jumper.

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 THE TACHOMETER-FEEDBACK MODIFICATION HAS BEEN ORDERED, OMIT THIS PROCEDURE AND SUBSTITUTE "TACHOMETER FEEDBACK" PAGE 21.

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

1. Set the SPEED potentiometer on the operator's station to zero.

2. Depress and release the START pushbutton.

3. Adjust the minimum speed (by means of the ZERO ADJ potentiometer on the conversion unit) so that the motor just turns over.

4. Back off the minimum speed setting until the motor just stops.

5. Turn the SPEED potentiometer on the operator's station to 100 percent (full CW) and observe the d-c armature voltage on the voltmeter. THis voltage should be approximately 220 VDC for a 230 VAC drive and approximately 460 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. Depress and release the STOP pushbutton.

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 (PTB) points A1 and A2.

TIMED ACCELERATION (MOTOR NOT COUPLED TO MACHINE)

An adjustable, timed-acceleration circuit is provided as standard equipment on all SCR drives. 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 conversion unit. 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 SCR drive also provides fixed timed 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, and turn the TIME ACCEL potentiometer to maximum.

CURRENT LIMIT (MOTOR COUPLED TO LOAD)

A current-limit circuit is standard on all SCR drives. 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 located on the front of the conversion unit.

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 conversion 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 on the conversion unit 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 by momentarily depressing the START button.

2. Turn the SPEED potentiometer 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 on the conversion unit clockwise until they are equal.

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

8. Turn the SPEED potentiometer to its maximum clockwise position and readjust the MAX SPEED potentiometer in the power unit, 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.

Jog (Motor Coupled to Load)

1. Place the RUN-JOG switch on the operator's station to the JOG position and verify that the SPEED potentiometer is set at zero.

2. Depress and hold the START pushbutton and, at the same time, use a screwdriver to adjust the JOG SPEED potentiometer to the desired jog speed. Turning the potentiometer shaft clockwise increases the jog speed.

3. Release the START pushbutton.

MODIFICATIONS

Refer to the interconnection section for modification wiring and installation information.

Tachometer Feedback
(Motor Not Coupled to Load)

NOTE

FOLLOW THIS PROCEDURE ONLY IF THE IMPROVED SPEED-REGULATION MODIFICATION (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. THE CONNECTIONS OF THE TACHOMETER-FEEDBACK MODIFICATION SHOULD BE CHECKED AT THE TERMINAL BOARD, KIT, AND TACHOMETER TO MAKE SURE THEY ARE CONNECTED.

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

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 midpoint of its travel.

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

4. Set the SPEED potentiometer on the operator's stator to zero.

5. Depress and release the START pushbutton on the operator's station.

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 potentiometer on the operator's station 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 a-c voltmeter may be connected across points 1TB(9, 10) in the power unit to obtain an indication of speed.

9. Depress and release the STOP pushbutton on the operator's station.

Proceed with the setup procedure on timed acceleration and current limit shown on Page 19. 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 wire number 40 from the jog kit terminal board number 40. Cover the wire terminal with electrical tape to avoid any electrical contact between the wire and other components.

2. Calculate the value of the series resistor (if required — see page 12) and add it to the circuit (see page 18).

3. Connect the follower signal between points 1TB — 16 and 13(+) — see page 18.

4. Remove metal jumper from 2TB(4, 4A).

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

6. Tracking Adjustment

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

a. Turn the SPEED control potentiometer to the ZERO SPEED position (Full CCW) and the MAX SPEED potentiometer to the 50% mark.

b. Apply the maximum follower signal voltage that will be encountered on this application.

c. Depress and release the START pushbutton.

d. Turn the SPEED control potentiometer slowly to the 100 percent speed position.

e. Adjust the MAX SPEED potentiometer for the required speed ratio between the master and GP-100 follower drives.

f. Cause the follower-signal voltage to be reduced to the minimum operating value expected on this application. This signal level should not require the SCR drive to operate below 1/20 rated speed.

g. Adjust the ZERO ADJ potentiometer on the conversion unit to establish the same speed ratio between the master (follower signal) and the SCR drive as existed with "full" follower signal.

h. Repeat steps (d) through (g) until satisfactory tracking is obtained.

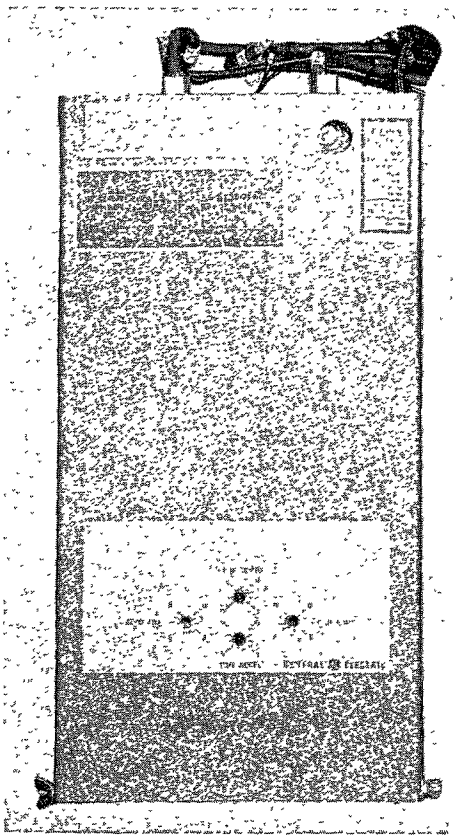


Fig. 10. Conversion Unit with Cover (230VAC, 15HP Unit Shown)

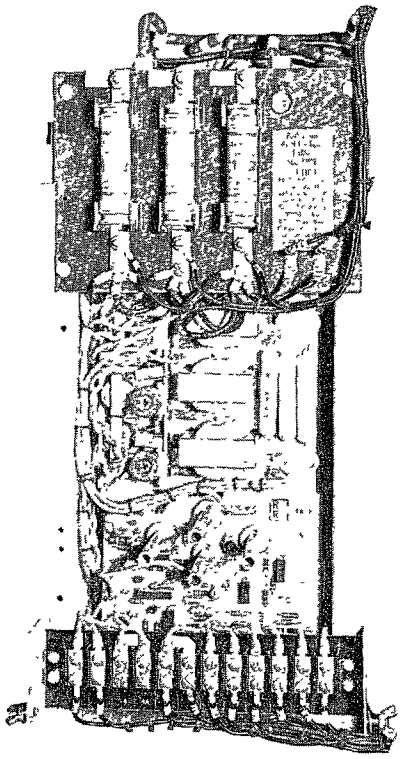


Fig. 11. Conversion Unit with Cover Removed (230VAC, 15HP Unit Shown)

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.

OPERATION

NON-REVERSING DRIVES

Apply a-c power to the SCR drive by closing the a-c line disconnecting device (if used). Set the desired preset speed on the SPEED potentiometer on the operator's station. Depress and release the START pushbutton on the operator's station and the drive will accelerate to preset speed, either linearly with respect to time or under current limit, depending upon adjustments. Alternately, the SPEED potentiometer may be set initially at zero, the START button depressed and released, and the drive-speed controlled manually by the SPEED potentiometer during acceleration.

Depress and release the STOP pushbutton on the operator's station and the drive will coast to rest at a rate determined by the friction and inertia present in the drive system. If the dynamic-braking modification has been added, operation of the STOP pushbutton on the operator's station will cause the drive to rapidly brake to a stop.

Sudden, excessive overloads (300 percent) or d-c faults (shorts) will cause the static IOC circuit to stop the drive. Reset by pressing the STOP pushbutton; remove the condition causing the overload, and restart.

REVERSING DRIVES

Apply a-c power to the SCR drive by closing the a-c line disconnecting device (if used). Select the required direction of rotation with the FORWARD-REVERSE selector switch. Set the desired preset speed on the SPEED potentiometer on the operator's station. Depress and release the START pushbutton on the operator's station and the drive will accelerate to preset speed, either linearily with respect to time or under current limit, depending upon adjustments. Alternately, the SPEED potentiometer may be set initially at zero, the START button depressed and released, and the drive-speed controlled manually by the SPEED potentiometer during acceleration.

If the FORWARD-REVERSE selector switch is operated with the drive running at preset speed, the drive will coast to rest, or dynamic brake to rest if this modification has been ordered. Depressing and releasing the START button will now cause the drive to accelerate to preset speed in the reverse direction.

If the START pushbutton is held depressed while operating the FORWARD-REVERSE selector, the faults (shorts) will cause the static IOC circuit to stop the drive. Reset by pressing the STOP pushbutton; remove condition causing overload and restart.

JOG

The operator's station will be equipped with a JOG-RUN selector switch. When this selector switch is in the JOG position, depressing and holding the START button will cause the drive to accelerate and run at a preset jog speed. The jog speed is set independently of the run speed by means of an internal potentiometer in the power unit.

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, Table I, page 15.

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 OPERATION 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 titled "Operational Problems."

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

VAC CHECK LIST		
CIRCUIT	VOLTAGE −5%, +10%	MEASURE AT
AC INPUT	230 OR 460	L1, L2, L3
CR1 COIL	115	1TB(2, 24)
CR2 COIL	230	COIL OF CR2
F COIL	115	1TB(1, 24)
R COIL	115	1TB(5, 24)
J COIL	115	1TB(14, 24)
FAN SUPPLY	115	FTB(1, 3)

VDC CHECK LIST NOTE: 1TB13 AND 2TB5 ARE THE SYSTEM COMMON			
CIRCUIT	MEASURE AT	1/8 SPD DC VOLTS 230/460	RTD SPD DC VOLTS 230/460
MOT ARM	PTB(A1, A2)	40/80	240/500
MOT SH FLD	1TB(18, 19)	160/300	160/300
MOT SER FLD	PTB(S1, S2)	0.5–1.5	0.5–1.5
DRS	1TB(13, 18)	1–1.5	1–1.5
REFERENCE	1TB(7, 13)	1–2	14–18
SUPPLY	2TB(5–6)	20	20
TG OUT	1TB(13, 18)	2–3	15–25
LINEAR TIME PRECONDITIONING	2TB(12, 5)	1–2	14–18
IOC (RESET)	2TB(13, 5)	20	20
IOC (TRIP)	2TB(13, 5)	2–3	2–3
AP (RELAY)	PTB(A1), 1TB(25)	PICKUP DROPOUT	20 6

TABLE IV TROUBLESHOOTING CHART

DRIVE DOES NOT OPERATE

Difficulty	Possible Cause	Remedy
1. No a-c power to power unit, points L1, L2 and L3.	Open disconnect, breaker, or fuse in a-c supply.	Locate and correct.
2. Blown fuse in power unit.	Shorts or grounds in wiring, open motor field circuit.	Correct wiring and replace fuse.
3. No d-c output from conversion unit (points P1-P2 on PTB).	D-c fault operating IOC circuit.	Remove fault and reset by pressing STOP button.
	No power-supply voltage 2TB (6, 5). No reference 2TB (7, 5).	Replace unit (see footnote). Check wiring to speed potentiometer and potentiometer itself. If a-c supply and reference are present, conversion unit is defective (see footnote).
	No a-c input.	See No. 1
4. No d-c output to motor (points A1-A2).	Series field not connected.	Connect series field or by-pass jumper of S1-S2 in power unit.
	F or R contactor inoperative.	Check for coil voltage at contactor. If voltage is present, replace defective contactor.
	CR relays inoperative.	Check for relay coil voltage. If voltage is present and relay inoperative, replace CR relay. If not voltage, check wiring to START-STOP pushbutton on operator's station.
	Blown fuse on control transformer	Check wiring and replace fuse.
5. Motor does not run.	Defective wiring.	Check armature and field wiring.
	No field supply (1TB 18-19). (Points S1-S2 not connected.)	Replace conversion unit (see footnote).
	Motor brushes not seated.	Free brushes in holder - see motor instructions.
	Defective motor.	Repair.
OPERATIONAL PROBLEMS		
6. Motor will not reach top speed.	Improper setup.	Recheck tachometer-feedback setup.
	Low line voltage.	Correct.
	Motor overloaded.	Reduce load.

No attempt should be made to open or repair the sealed conversion unit. The conversion unit warranty becomes void if the unit has been opened or tampered with in any way (see WARRANTY). Defective conversion units or those which fail within the warranty period should be returned to the Company as indicated in the warranty instructions.

TABLE IV TROUBLESHOOTING CHART (CONT'D)

OPERATIONAL PROBLEMS (CONT'D)

Difficulty	Possible Cause	Remedy
6. Motor will not reach top speed. (Cont'd)	Current limit set too low.	Recalibrate current limit.
	Low reference voltage (2TB 7-5).	Should be approximately 10 to 15 volts with speed potentiometer full CW. If low, check for grounds and shorts.
	High tachometer voltage (if used).	Check tachometer nameplate and setup procedure. Voltage from tachometer must not exceed 250V d-c.
	Defective conversion unit.	Replace. (see footnote)
	Zero adjust too low.	Readjust zero adjust.
	Defective auxiliary contact on for contactor.	Replace contactor.
7. Motor runs at top speed. Does not respond to speed potentiometer or has limited response.	Improper setup.	Recheck.
	Motor wired incorrectly.	Recheck wiring.
	Operator's station wired incorrectly.	Check response of reference to speed potentiometer position.
	Tachometer signal (if used) is too low.	Check tachometer nameplate and review setup procedure.
	Defective conversion unit.	Replace. (see footnote)
8. Motor jumps upon starting - will not run at low speed.	Improper setup.	Recheck.
	Operator's station wired incorrectly.	Recheck wiring. Check response of reference to speed potentiometer position.
	High breakaway torque required.	Reduce if possible.
	Incorrect phase sequence.	Interchange any two a-c lines.
	Defective conversion unit.	Replace. (see footnote)
9. Motor speed changes excessively when load is applied.	Not balanced (firing).	Check 3-phase input for current balance.
	Improper setup.	Recheck current limit and IR comp.
	Low line voltage or excessive voltage regulation in a-x line.	Correct wire or transformer size.
	Motor overloaded.	Reduce load.

No attempt should be made to open or repair the sealed conversion unit. The conversion unit warranty becomes void if the unit has been opened or tampered with in any way (see WARRANTY). Defective conversion units or those which fail within the warranty period should be returned to the Company as indicated in the warranty instructions.

TABLE IV TROUBLESHOOTING CHART (CONT'D)

OPERATIONAL PROBLEMS (CONT'D)

Difficulty	Possible Cause	Remedy
9. Motor speed changes excessively when load is applied. (Cont'd)	Defective Conversion unit.	Replace. (see footnote)
	Excessive inertia	Reduce inertia (1) (See Page 8 - Specifications.)
10. Motor speed unstable.	Improper setup.	Check for too high IR comp (set at zero if tachometer generator is used).
	Excessive inertia.	Reduce inertia (1). (See Page 8 - Specifications.)
	Not balanced (firing).	Check 3-phase input for correct balance.
	Incorrect series field connections.	Check connections.
11. Motor overheats.	Motor overloaded.	See specifications and reduce load.
	Ambient temperature above 40 C (104 F).	Reduce temperature or improve ventilation.
	Motor ventilation restricted.	Remove restrictions.
	Defective motor.	Repair.
12. Motor noise excessive.	Loose motor mounting or coupling.	Tighten.
	Damaged bearing.	Replace bearing.
	Defective conversion unit.	Replace. (see footnote)
	Phase imbalanced.	Check 3-phase input for correct balance.
13. Motor sparks excessively (some sparking is normal).	Phase imbalanced.	Check 3-phase input for correct balance.
	Motor overloaded.	Reduce load.
	Brushes worn too short.	Replace. (see footnote)
	Rough commutator.	Repair.
	Defective conversion unit.	Replace.
14. Motor stops for no apparent reason.	Sudden extreme overload or intermittent d-c fault.	Remove cause of overload or fault and reset by pressing STOP button.
See No. 1, 2, 3, 4, 5.	Fuse blowing.	Replace fuse.

No attempt should be made to open or repair the sealed conversion unit. The conversion unit warranty becomes void if the unit has been opened or tampered with in any way (see WARRANTY). Defective conversion units or those which fail within the warranty period should be returned to the Company as indicated in the warranty instructions.

(1) When gears or belts are used, the inertia can be reduced by increasing the gear or belt ratio.

HOW THE SCR DRIVE 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. 12). 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, semi-conductor 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 13 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.

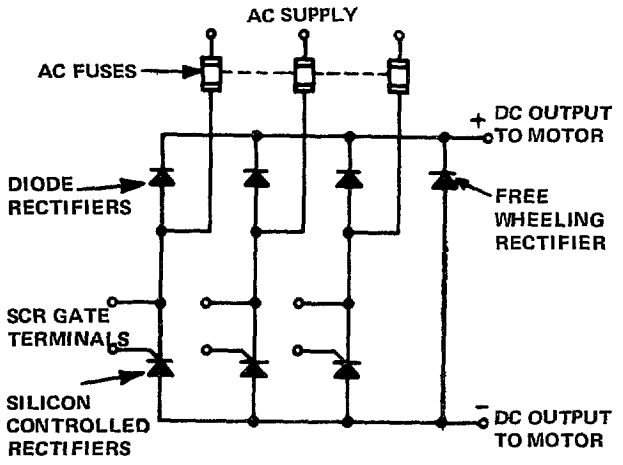


Fig. 12. Rectifier Bridge Schematic

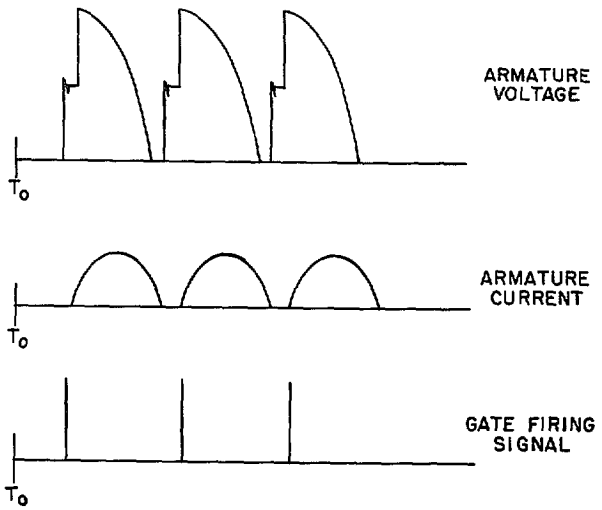


Fig. 13. Typical Waveforms

The conversion unit contains the silicon-controlled rectifiers, together with transient-voltage protective circuits. The SCRs 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 force 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.

Thyrectors* and other transient-voltage protective components are contained within the conversion 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-voltage rating of the SCRs 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.

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 longer time to charge, and the unijunction transistor turns on later in the cycle. Hence, the SCRs 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 SCRs are spaced 1/3 cycle apart. The SCRs 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 is obtained from a part of the full-wave rectifier bridge used to control the motor armature circuit.

The motor shunt field is 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.

REGULATOR

Figure 14 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.

* Trademark of the General Electric Company.

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 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 SCRs "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 reference as shown in Fig. 14. This function is inoperative except during acceleration or deceleration of the drive. When the START button is pressed, the F (or R) contactor applies the preset reference to the timed acceleration circuit. This circuit allows the regulator reference voltage to increase smoothly at a rate (2.5-10 seconds) established by the setting of the TIME ACCEL potentiometer.

The timed acceleration circuit 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. The voltage appearing on this capacitor is the regulator reference.

The total accelerating time is thus the charging time for the capacitor, and is determined by the setting of the TIME ACCEL potentiometer, which controls the value of capacitor voltage (regulator reference) is determined by the setting of the operator's SPEED 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 (by turning the SPEED potentiometer down), 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.

When the STOP button is pressed, the CR1 relay is de-energized and will discharge the capacitor in the TIME ACCEL circuit. This "resets" the circuit, assuring that the next start will find the reference voltage at zero.

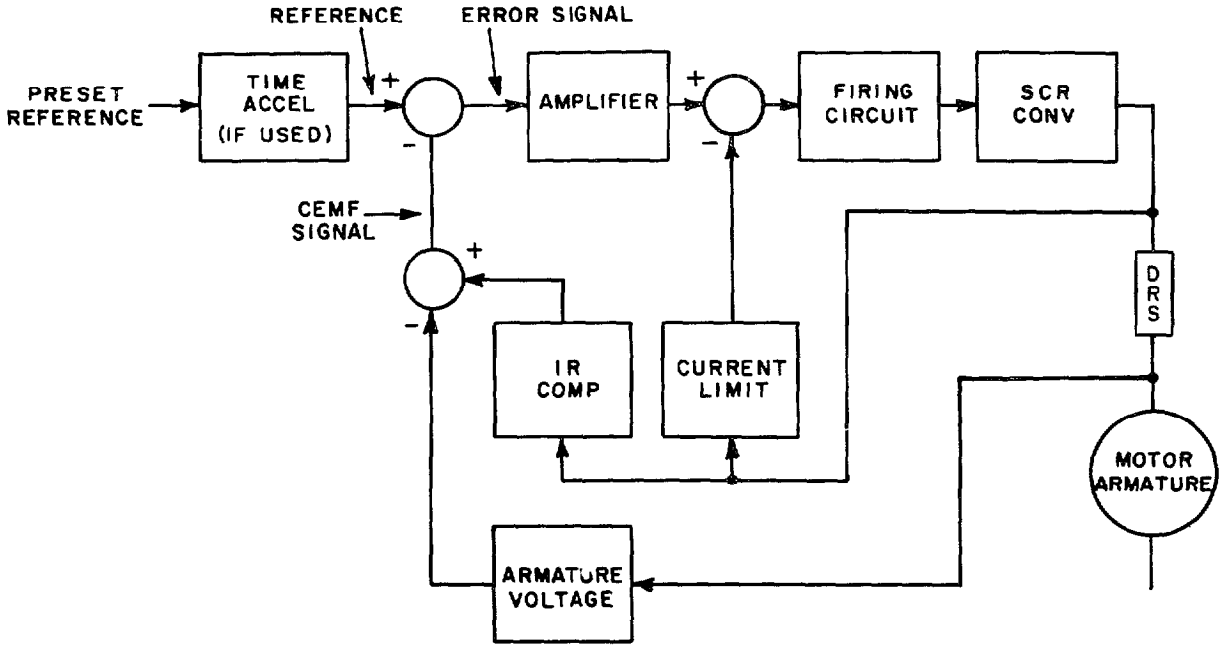


Fig. 14. Regulator Block Diagram

CURRENT LIMIT

The current limit signal is obtained from the voltage across the DRS resistor. 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 SCRs 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 SCRs from firing and so reduces output voltage to zero in 1/3 cycle.

This circuit is reset by pressing the STOP button on the operator's station.

MAGNETIC FUNCTIONS

Depressing the START pushbutton energizes the CR1 relay which removes the current limit clamp and initiates the timed acceleration circuit (if not disabled by removal of jumper 4—4A on 2TB). The F (or R) contactor, also energized by the START pushbutton connects the motor-armature circuit to the conversion unit and applies preset reference voltage.

Depressing the STOP pushbutton drops out relay CR1 and the F (or R) contactor. Relay CR1 applies current limit and resets the timed acceleration circuit. The F (or R) contactor disconnects the motor-armature circuit from the conversion unit and removes the preset reference voltage.

Relay CR2 provides loss of phase protection (L1) by removing the 115 VAC control supply from the magnetic circuitry. Loss of phase protection for L2 and L3 is provided by the loss of excitation of the control power transformer (CPT).

When dynamic braking is furnished, the F (or R) contactor is used to connect the dynamic braking resistor to the motor armature.

On reversing drives, an anti-plugging relay, AP, is connected across the motor armature. Relay AP locks out the start circuit as long as the armature voltage is above 20 VDC for 230 VAC drives and 40 VDC for 460 VAC drives.

The jog selector switch actuates the jog relay and connects the jog reference to the regulator. It also disconnects the seal circuit(s) to the F (and R) contactor(s). Depressing the START pushbutton jogs the motor. Releasing the START pushbutton stops the motor.

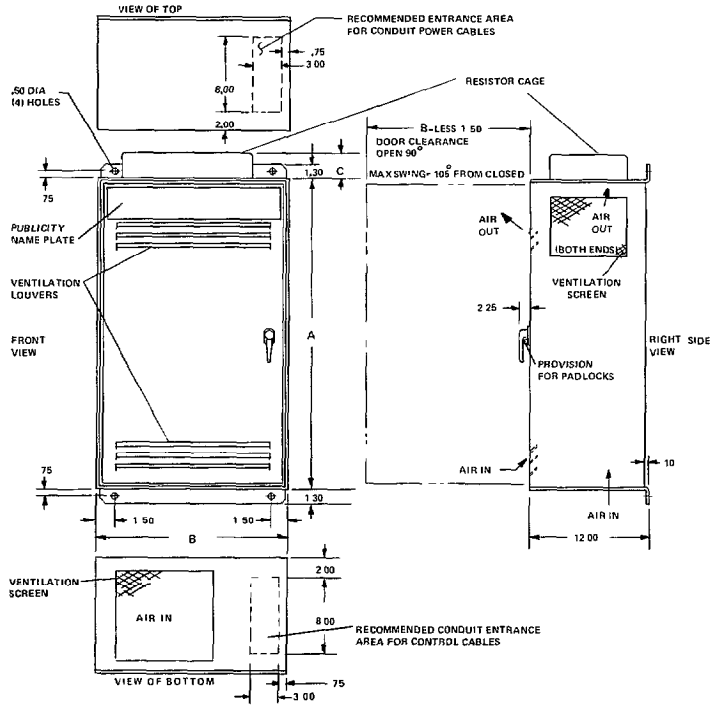
TACHOMETER FEEDBACK MODIFICATION

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 the regulator at points 1 and 5 on 2TB.

The armature-voltage feedback is disconnected by removing jumper (9 — 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).

APPENDIX

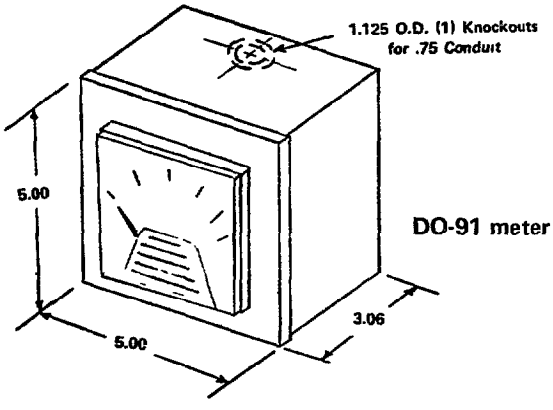
DIMENSIONS



PWR UNIT SIZE	A	B	C RESISTOR CAGE	APPROX WEIGHT (POUNDS)
W20	32.00	20.00	NO RESIST. CAGE	115 SEE NOTE No 3
W25	40.00	25.00	NO RESIST CAGE	195 SEE NOTE No 3
W25X	40.00	25.00	6.50	220 SEE NOTE No 3

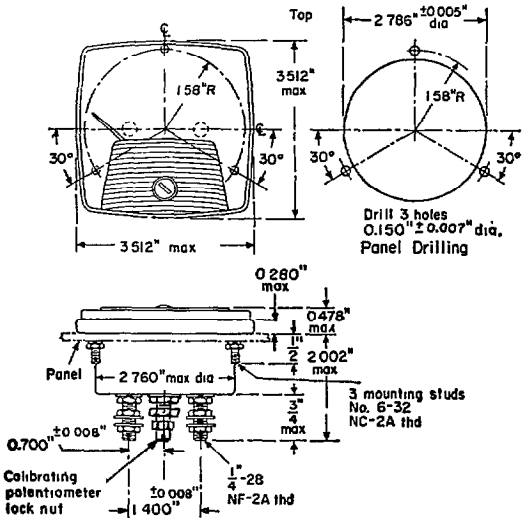
1. ALLOW AT LEAST 3 INCHES AT EACH SIDE OF ENCLOSURE FOR AIR EXHAUST AND AT LEAST 6 INCHES AT BOTTOM FOR AIR ENTRANCE.
2. DOOR HAS INTERNAL HINGES WITH REMOVABLE PINS.
3. WEIGHTS TABULATED MAY VARY ±20% DEPENDING UPON HORSEPOWER AND FUNCTIONS PROVIDED
4. VIEWS SHOW NEMA 1 (VENTILATED) GENERAL PURPOSE IN-DOOR ENCLOSURE
5. ALL DIMENSIONS ARE INCHES

Fig. 15 Power unit dimensions



DO-91 meter enclosure

Fig. 17 Speed indicator enclosure dimensions



3½-inch Type DO-91X meter

Fig. 16 Speed indicator meter dimensions

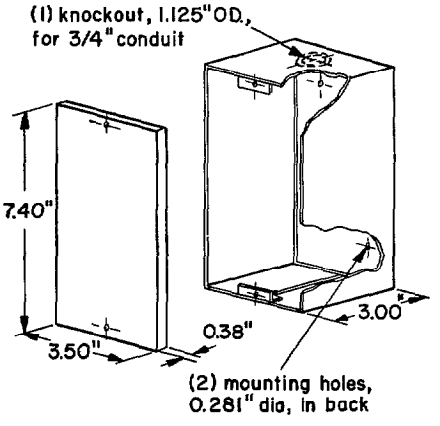
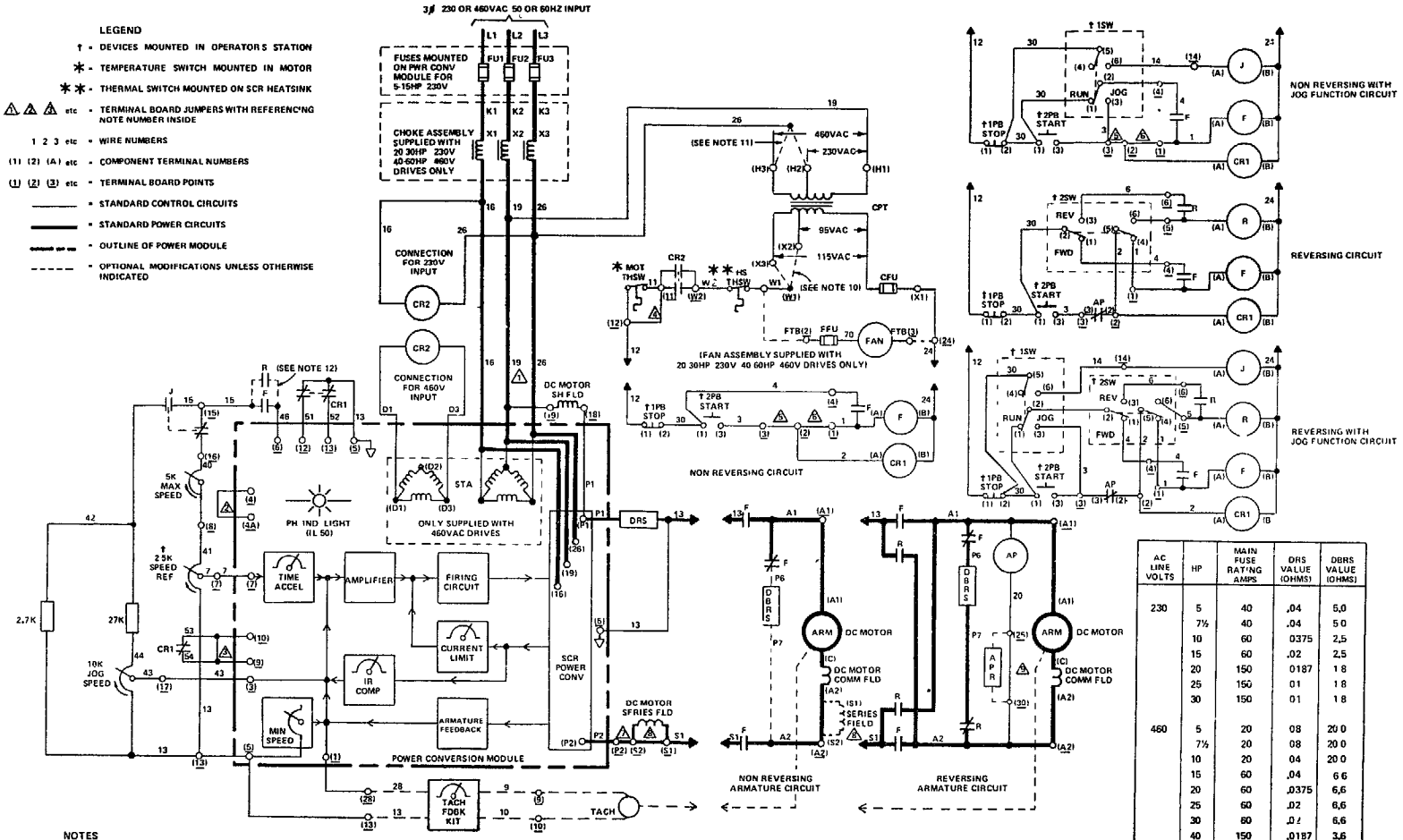


Fig. 18 Operator's station dimensions



AC LINE VOLTS	HP	MAIN FUSE RATING AMPS	DRS VALUE (OHMS)	DBRS VALUE (OHMS)
230	5	40	.04	5.0
	7½	40	.04	5 0
	10	60	0375	2,5
	15	60	.02	2,5
	20	150	0187	1 8
	25	150	01	1 8
	30	150	01	1 8
460	5	20	08	20 0
	7½	20	08	20 0
	10	20	04	20 0
	15	60	.04	6 6
	20	60	.0375	6,6
	25	60	.02	6,6
	30	60	.0	6,6
	40	150	.0187	3.6
	50	150	.01	3.6
	60	150	01	3.6

NOTES

1. WIRE NUMBER "19" MAY BE DESIGNATED AS "2" ON OLDER UNITS (5 15HP 230VAC)
2. IF TIME ACCELERATION IS NOT DESIRED REMOVE JUMPER (POINT 4 TO 4A ON 2TB)
3. WHEN TACH FEEDBACK IS USED REMOVE JUMPER (POINT 9 TO 10 ON 2TB)
4. IF TEMPERATURE SWITCH IS PROVIDED REMOVE JUMPER (POINT 11 TO 12 ON 1TB)
5 6. REMOVE JUMPERS (POINT 1 TO 2 AND POINT 2 TO 3 ON 1TB) FOR ALL REVERSING DRIVES
7. CURRENT MAY BE MONITORED BY REMOVING JUMPER (POINT P2 TO S2 ON PTB) AND INSERTING AN AMMETER/ SHUNT (IF NO INTERNAL METER SHUNT IS PROVIDED)
8. REPLACE JUMPER (POINT S1 TO S2 ON PTB) WITH MOTOR SERIES FIELD WHEN USED THE SERIES FIELD MAY BE WIRED IN AT THE MOTOR CONDUIT BOX FOR NON REVERSING DRIVES ONLY
9. REPLACE JUMPER (POINT 25 TO 30 ON 1TB) WITH APR RESISTOR FOR 460VAC DRIVES
10. CONNECT WIRE "W1" TO CPT POINT X3 FOR 60HZ X2 FOR 50HZ INPUT VERIFY CR2 COMPATIBILITY WITH LINE HZ
11. CONNECT WIRE "26" TO CPT POINT H3 FOR 460VAC H2 FOR 230VAC DRIVES
12. SUPPLIED ONLY WITH REVERSING CIRCUITS
13. STANDARD MOTOR ROTATION IS COUNTER CLOCKWISE LOOKING AT THE COMMUTATOR END
14. REFER TO THE INSTRUCTION BOOK TEXT FOR DETAILED OPERATION INSTALLATION AND ADJUSTMENT OF THE DC 3032 SCR DRIVE
15. REFER TO THE CONTRACT FOR MATERIAL TO BE SUPPLIED BY THE GENERAL ELECTRIC COMPANY THE AMOUNT OF SUCH MATERIAL IS NOT INCREASED BY ANYTHING SHOWN ON THIS DRAWING

Fig. 19. Elementary Diagram — All Modifications Shown

SPARE AND RENEWAL PARTS

TABLE V SPARE AND RENEWAL PARTS LIST

PART NAME	CATALOG NUMBER		230VAC SUPPLY							460VAC SUPPLY									
			DRIVE HP							DRIVE HP									
			5	7½	10	15	20	25	30	5	7½	10	15	20	25	30	40	50	60
CONVERSION UNIT *	331X232AB___	PART QTY	G01 1	1	G02 1	1	G03 1	1	1	G04 1	1	1	G05 1	1	1	1	G06 1	1	1
CONTROL (CPT) TRANSFORMER	A = 104X156AA112	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
F CONTACTOR	A = 104X105XAG016 B = 104X105XBG016 C = 104X105XCG016	PART	A	A	B	B	C	C	C	A	A	A	B	B	B	B	C	C	C
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DRS RESISTOR	A = 104X136AD001	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	2	2	2	1	1	1	1	1	1	1	2	2	2
CR1 RELAY	A = 104X166AA038	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CR2 RELAY	A = 104X127BB008 (use 014 for 50 HZ)	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
D.B RESISTOR	A = 104X135AA006 B = 104X135AA007 C = 104X135AA008 D = 104X135AD003 E = 104X136AD018	PART	D	D	D	D	A	A	A	E	E	E	C	C	C	C	B	B	B
		QTY	1	1	2	2	2	2	2	1	1	1	3	3	3	3	3	3	3
CONTROL FUSE (CFU)	A = 104X109AA002	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LINE ** FUSE	A = 104X109AB005 B = 104X109AB006 C = 104X109AE007 D = 104X109AE008 E = 104X109AE015	PART	A	A	B	B	E	E	E	C	C	C	D	D	D	D	E	E	E
		QTY	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
TACH FDBK KIT	A = 331X200AAG03	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
FAN KIT	A = 331X297AAG01	PART					A	A	A								A	A	A
		QTY					1	1	1								1	1	1
NON-REV OP STATION	A = 331X208ABG01 or G02 W/JOG	PART	A	A	A		A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
JOG RELAY	SEE CR1 RELAY	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CHOKE ASM	A = 799C793AAG01	PART					A	A	A								A	A	A
		QTY					1	1	1								1	1	1
REVERSING OP STATION	A = 331X208ABG03 or G04 W/JOG	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AP RELAY	A = 104X131AB003	PART	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
APR RESISTOR	A = 104X123AB014	PART								A	A	A	A	A	A	A	A	A	A
		QTY								1	1	1	1	1	1	1	1	1	1
R CONTACTOR	A = 104X105XAG016 B = 104X105XBG016 C = 104X105XCG016	PART	A	A	B	B	C	C	C	A	A	A	B	B	B	B	C	C	C
		QTY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

*See SCR drive Warranty for replacing "in-warranty" failure of power conversion units.

**Fuses not included in warranty (See warranty statement).

Order spare or renewal parts from your drive supplier or nearest General Electric sales office giving complete power unit nameplate data, parts quantity and catalog number from the above tabulation.

CAUTION

USE ONLY GE CLF CLASS H FUSES FOR 230VAC, 5–15HP.
USE BUSSMAN TYPE KAC FOR ALL OTHER DRIVES.

TABLE VI TRANSFORMER DATA

USE OF TABLE

Determine transformer connection diagram from this table based on drive HP and AC line voltage. Do not use diagram on transformer nameplate.

Isolating Transformers

DRIVE HP	AC LINE VOLTS (1)	MODEL No (2)	ORDERING CAT No 104X218	KVA (4)	CONNECTION FIG No (3) (5)	APPROX DIMENSIONS (6) H	W	D	APPROX WTS (LBS)
230 VAC – 240 VDC DRIVES									
5	230	9T46Y2011G2	DC001	7.5	D	27.8	9.1	7.9	140
	460	9T46Y2012G2	DD001						
	575	9T46Y2013G2	DE001						
7½	230	9T46Y2021G2	DC002	11	D	31.9	9.1	7.9	194
	460	9T46Y2022G2	DD002						
	575	9T46Y2023G2	DE002						
10	230	9T46Y2031G2	DC003	15	D	32.2	11.6	10.1	295
	460	9T46Y2032G2	DD003						
	575	9T46Y2033G2	DE003						
15	230	9T46Y2041G2	DC004	20	D	38.2	11.6	10.1	383
	460	9T46Y2042G2	DD004						
	575	9T46Y2043G2	DE004						
20	230	9T48Y2502G89	DC005	25	B	31.0	24.0	19.5	340
	460	9T48Y2502G83	DD005						
	575	9T48Y2502G87	DE005						
25	230	9T48Y2504G89	DC006	30	B	31.0	24.0	19.5	350
	460	9T48Y2504G83	DD006						
	575	9T48Y2504G87	DE006						
30	230	9T48Y2513G89	DC007	36	B	31.0	24.0	19.5	430
	460	9T48Y2513G83	DD007						
	575	9T48Y2513G87	DE007						
460 VAC – 500 VDC DRIVES									
5	230	9T46Y2015G2	DF001	7.5	E	27.8	9.1	7.9	140
	460	9T46Y2016G2	DR001		D				
	575	9T46Y2017G2	DX001		D				
7½	230	9T46Y2025G2	DF002	11	E	31.9	9.1	7.9	194
	460	9T46Y2026G2	DR002		D				
	575	9T46Y2027G2	DX002		D				
10	230	9T46Y2035G2	DF003	15	E	32.2	11.6	10.1	295
	460	9T46Y2036G2	DR003		D				
	575	9T46Y2037G2	DX003		D				
15	230	9T46Y2045G2	DF004	20	E	38.2	11.6	10.1	383
	460	9T46Y2046G2	DR004		D				
	575	9T46Y2047G2	DX004		D				
20	230	9T48Y2502G88	DF005	25	C	31.0	24.0	19.5	340
	460	9T48Y2502G82	DR005		B				
	575	9T48Y2502G86	DX005		B				
25	230	9T48Y2504G88	DF006	30	C	31.0	24.0	19.5	350
	460	9T48Y2504G82	DR006		B				
	575	9T48Y2504G86	DX006		B				
30	230	9T48Y2513G88	DF007	36	C	31.0	24.0	19.5	430
	460	9T48Y2513G82	DR007		B				
	575	9T48Y2513G86	DX007		B				
40	230	9T48Y2516G88	DF008	50	C	31.0	24.0	19.5	450
	460	9T48Y2516G82	DR008		B				
	575	9T48Y2516G86	DX008		B				
50	230	9T48Y2523G88	DF009	61	C	33.0	32.0	22.0	700
	460	9T48Y2523G82	DR009		B				
	575	9T48Y2523G86	DX009		B				
60	230	9T48Y2526G88	DF010	82.5	C	33.0	32.0	22.0	750
	460	9T48Y2526G82	DR010		B				
	575	9T48Y2526G86	DX010		B				

Auto Transformers

DRIVE HP	AC LINE VOLTS (1)	MODEL No (2)	ORDERING CAT No 104X218	KVA (4)	CONNECTION FIG No (3), (5)	APPROX DIMENSIONS (6) H	W	D	APPROX WTS (LBS)
230 VAC – 240 VDC DRIVES									
5	460	9T21Y6581	AF001	7.5	A	24.3	7.2	6.3	81
	575	9T21Y6583	AE001			25.4			86
7½	460	9T21Y6905	AF002	11	A	27.4	7.2	6.3	106
	575	9T21Y6921	AE002			28.8	9.1	7.9	125
10	460	9T21Y6891	AF003	15	A	27.8	9.1	7.9	140
	575	9T21Y6893	AE003						
15	460	9T21Y6892	AF004	20	A	28.9	9.1	7.9	155
	575	9T21Y6894	AE004			31.9			194
20	460	9T21Y6906	AF005	25	A	32.9	9.1	7.9	207
	575	9T21Y6917	AE005			32.2	11.6	10.1	290
25	460	9T21Y6907	AF006	30	A	32.2	11.6	10.1	285
	575	9T21Y6818	AE006			34.2			335
30	460	9T21Y6908	AF007	36	A	34.2	11.6	10.1	335
	575	9T21Y6919	AE007			36.2			384
460 VAC – 500 VDC DRIVES									
5	230	9T21Y6581	AF001	7.5	A	24.3	7.2	6.3	81
	575	9T21Y6582	AR001			22.7	4.9	4.6	58
7½	230	9T21Y6905	AF002	11	A	27.4	7.2	6.3	106
	575	9T21Y6909	AR002			23.7	4.9	4.6	67
10	230	9T21Y6891	AF003	15	A	27.8	9.1	7.9	140
	575	9T21Y6910	AR003			23.3	7.2	6.3	76
15	230	9T21Y6892	AF004	20	A	28.9	9.1	7.9	155
	575	9T21Y6911	AR004			26.4	7.2	6.3	95
20	230	9T21Y6906	AF005	25	A	32.9	9.1	7.9	207
	575	9T21Y6912	AR005			28.4	7.2	6.3	115
25	230	9T21Y6907	AF006	30	A	32.2	11.6	10.1	285
	575	9T21Y6920	AR006			25.8	9.1	7.9	125
30	230	9T21Y6908	AF007	36	A	34.2	11.6	10.1	335
	575	9T21Y6913	AR007			27.8	9.1	7.9	140
40	230	9T48Y9192	AF008	61	A	31.9	9.1	7.9	194
	575	9T21Y6915	AR008	50					
50	230	9T48Y9192	AF009	61	A	31.0	24.0	19.3	340
	575	9T21Y6915	AR009			30.1	11.6	10.1	242
60	230	9T48Y9193	AF010	82.5	A	31.0	24.0	19.3	430
	575	9T21Y6916	AR010			33.2	11.6	10.1	316

(1) For other voltage ratings, refer to the company.

(2) All models are 60 hertz only.

(3) NEMA and ASA standard lead marking used. "H" leads are higher voltage leads, "X" leads are lower voltage leads.

(4) KVA ratings shown are transformer ratings for the connection shown.

(5) These connection diagrams, not those shown on transformer nameplates, must be used for SCR drives.

(6) Mounting extnesion on wall-mounted transformers is included in the given dimensions.

(7) Isolating transformers for 20 HP and above are floor mounted. All others are wall-mounted.

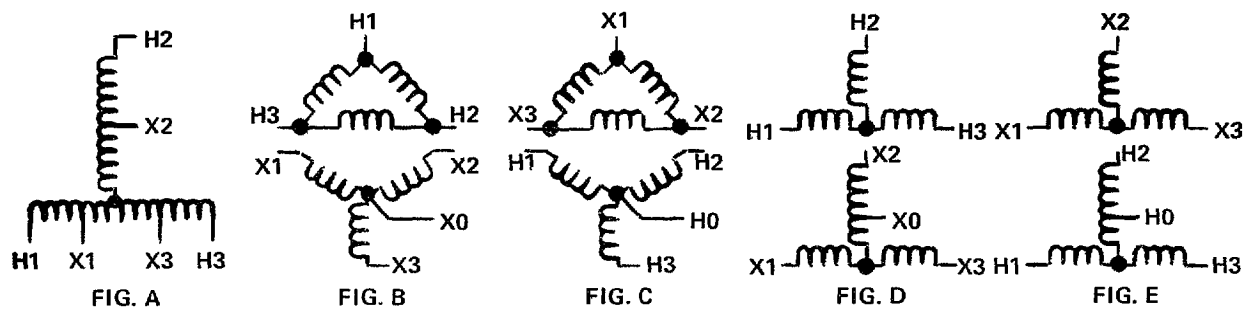


Fig. 20. Transformer Connection Diagrams

PHASE BALANCE ADJUSTMENT

The balance adjustment of the three firing circuits 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.

1. Connect the vertical input leads of a cathode-ray oscilloscope (CRO) across the DRS resistor, points P1 (+) and 13(−), 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. Depress the START pushbutton.

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.

6. Adjust the two balance rheostats until all three phases are ON and all current peak amplitudes are of approximately the same magnitude (see Fig. 21).

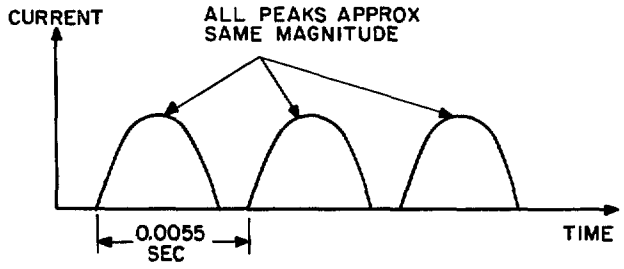


Fig. 21. Oscilloscope trace after adjustment

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.

NOTES

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