INSTALLATION - OPERATION - MAINTENANCE

IC DRIVER/ REGULATOR

S-22

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

GENERAL ELECTRIC

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SECTION I

GENERAL

1.1 SCOPE OF MANUAL

This instruction manual is furnished as a guide to the start-up, check-out, and operation of the drive system. It includes a detailed description of the IC Driver Regulator and general troubleshooting guides. Refer to the other attached manuals and the system diagrams for detailed instructions on special function cards which may be included in the IC Driver Regulator rack. For more information on the power conversion modules and motor field exciters, refer to the appropriate instruction manual.

This manual is structured around a four quadrant (regenerative) drive with the Instrument/Diagnostic modification and a Motor Field Control provided for operation in the constant horsepower region. Those sections peculiar to these modifications are so noted and may be ignored if these modifications were not ordered. Refer to the system drawings to determine the modifications furnished.

SECTION II

DESCRIPTION

A speed regulated drive consists of at least a speed reference, a speed feedback, a driver regulator, a power conversion module, a motor, a motor field exciter or motor field control and relay logic. The driver/regulator receives inputs from the reference, feedback and relay logic, and provides the appropriate signals to the power conversion module to control the power applied to the motor.

2.0 PRINTED CIRCUIT CARDS

The elements on a driver/regulator are described below. For convenience, an alphabetical list of the nomenclature used in this instruction manual is included at the end of this section.

2.1.1 Card Location Table: The IC Driver/Regulator is a panel mounted assembly which contains a set of printed circuit cards mounted in a card rack, a ready-to-run/reset indicator located in the lower left hand corner of the card rack and a power assembly bolted underneath.

For a one quadrant (non-regenerative) drive, from left to right the printed circuit cards are:

Name	Nomenclature	Number	Slot Location
20V Power Supply	PS	193X257AAG01	B
Gate Control	GC	193X262AAG01	C
Phase Control	PC	193X259AAG01	D
Monitor	M	193X261ACG01	E
Driver Coordination	DC	193X260BAG01	F
Standard Regulator	R	193X267BAG01	G
* Diagnostic	D	193X275AAG01	H
* Instrument	I	193X295AAG01	K

For a four quadrant (regenerative) drive, from left to right the printed circuit cards are:

Name	Nomenclature	Number	Slot Location
20V Power Supply	PB	193X257AAG01	B
Gate Control	GC	193X262AAG01	C
Phase Control	PC	193X259ACG01	D
Monitor	M	193X261ACG01	E
Quadrant Control	QC	193X270AAG01	F
Driver Coordination	DC	193X260ABG01	G
Standard Regulator	R	193X267BAG01	H
* Diagnostic	D	193X275AAG01	J
* Instrument	I	193X295AAG01	L

* Optional - supplied only if ordered.

2.1.2 20V Power Supply: The 20V Power Supply card receives unregulated ±30 volt DC from the rectifier card in the Power Assembly and provides regulated ±20 volt DC for the Driver/Regulator, and up to 100 mA of external load. It also provides the unregulated power to activate the solid state switches on the Regulator card. The Power Supply outputs are fused with 1.5A instrument fuses located on the front of the PS card. Both fuses will clear, removing all power from the cards, if an overload or overvoltage condition exists on either the positive or the negative output.

2.1.3 Gate Control: The Gate Control card contains the oscillator for "burst" firing, a circuit to control the length of the burst train, and the steering logic to either inhibit all pulses or direct the firing signals to the Power Module forward or reverse. The firing signals originate from the Phase Control card and the steering inputs come from the Quadrant Control card. The outputs go through the RPL and SPL connectors to the forward and reverse Power Modules. For one quadrant drives only one Power Module is provided, and the firing signals are always steered toward this power module thru the RPL connector. The terms RPL and SPL are only connector designations - they have no special significance.

2.1.4 Phase Control: The Phase Control card has the line comparators synchronizing networks, the ramp generators and the input which convert the reference signal from the Driver Coordination card to six outputs phase shifted in time for use by the Gate Control card. 50 Hz operation is selected by connecting tab 26 to tab 27 on this card.

2.1.5 Monitor: The Monitor card contains the circuits to detect a DC Power fuse failure, incorrect phase sequence or loss of phase, open Power Module thermostat (module overtemperature), or an instantaneous overcurrent trip. When a trip occurs the Monitor fault relay, F, will open, one of the three Monitor indicators will latch on, and a signal, 1STP, is sent to the Driver Coordination card to initiate a drive shutdown. After a trip condition has been cleared, the card is reset by pushing the RTR/Reset button located in the left hand corner of the Driver/Regulator.

2.1.6 Quadrant Control: The Quadrant Control card receives information from the Driver Coordination card and performs the logic to select the proper power module and control the transfer from one power module to the other. The commutation detection logic and input line impedance compensation circuits are on this card.

2.1.7 Driver Coordination: The Driver Coordination card amplifies the isolated armature voltage signal from the Resistance Isolator in the Power Assembly and the current feedback signal from the Power Module(s). It contains the driver current limit and voltage limit adjustment and provides the proper signals to the Phase Control and Quadrant Control cards to maintain the armature voltage proportional to the driver reference from the Standard Regulator card.

2.1.8 Standard Regulator: The Standard Regulator card receives a speed reference and speed feedback from the System and provides the proper reference to the Driver Coordination card to maintain the speed proportional to the reference. It also contains a linear time section, a feedback scaling section, a current limit section, an auxiliary preset reference and static switches to control the preconditioning and reference as determined by the external relay logic. Eight system adjustments are also on this card. See section 3.3, Adjustments.

** Four Quadrant only

2.1.9 Diagnostic Card: If ordered, the Diagnostic Card is used to setup and checkout the drive.

Located on the front of the Diagnostic card is LR, the local test reference slide potentiometer, a six station pushbutton assembly, and a red transfer indicator.

The potentiometer is a zero center pot which will run the drive forward when pushed up from center and reverse when pulled down. The LR may be preset to a selected value by monitoring instrument position 1 with all pushbuttons out.

The top four pushbuttons are used to select any one of four operating modes, three test modes and one normal operation. The switch is mechanically interlocked to prevent more than one mode position from being selected at one time. After a mode has been selected, it is locked in until depressed to release.

The firth button down, MOTR, is used to pickup and dropout the motor loop contactor in the different test modes. Refer to the test mode descriptions for its exact function.

The last button, STEP, is a momentary pushbutton which will apply a small step reference change to the regulator.

The diagnostic card may be completely removed from the drive by connecting GTB21 to GTB22 (located on the Power Assembly).

2.1.10 Instrument Card: If ordered, the Instrument Card is used in conjunction with the Diagnostic card to monitor important signals internal to the IC Driver/Regulator.

2.2 POWER ASSEMBLY, PA

The power assembly consists of a low voltage transformer and rectifier card mounted behind the assembly, a resistance isolator RI mounted in the power assembly, a power terminal board with two connectors and a control terminal board.

2.2.1 Power Terminal Board (from left to right):

H1	115V AC required for low voltage transformer
H2	115V AC for low voltage transformer
NDC	Negative DC buss from the P1 terminal of the rev. power module
NDCF	Negative DC buss from the P2 terminal of the forward power mod
PDC	Positive DC buss from the P2 terminal of the referse module
PDCF	Positive DC buss from the P1 terminal of the forward module
AC3	3-Phase AC line from the T3 terminals of the power module
AC2	3-Phase AC line from the T2 terminals of the power module
AC1	3-Phase AC line from the T1 terminals of the power module

If a four quadrant drive is not provided, only one power module is furnished, and NDC will be connected NDCF and PDC will be connected to PDCF.

2.2.2 Control Terminal Board (from left to right):

Location	Nomen.	
GTB1	COIL	Output from the Diagnostic card to the coil of the pilot relay for the MD contactor
GTB2	-20V	-20V DC up to 100 mA from the power supply for external use
GTB3	+20V	+20V DC up to 100 mA from the power supply for external use
GTB4	SR	System reference input to Regulator card
GTB5	FCR	Test reference output from Diagnostic to Motor Field Control or MFC (if supplied).
GTB6	FB+	Tachometer feedback input to Regulator which is positive when drive is running in forward direction
GTB7	COMP	Current compensation output from Regulator to MFC (if supplied)
GTB8	COM	Driver/Regulator common - connect to external ground in appropriate location
GTB9	FB-	Tachometer feedback input to Regulator which is negative when drive is running in forward direction
GTB10	F	Normally open contact from internal
GTB11	F	Fault relay on Monitor. Held closed in normal operation. Normally connected in drive protective relay logic
GTB12	FCM	Input from MFC to Instrument to monitor field control performance
GTB13	CFB	Output from Quadrant Control of Driver Coordination in one quadrant drives proportional to motor armature current to operate external current load meter (50 μa movement) if ordered
GTB14	SFB	Output from Regulator to MFC proportional to tachometer feedback to drive the overspeed and tach loss section of the motor field control
GTB15	SYS	Input from MFC to Monitor which will shutdown drive in event of field loss, tachometer loss or reversal, or overspeed. May also be used for E-STOP, if supplied
GTB16	FCI	Output from Diagnostic to MFC to prevent operation in constant horsepower range in certain test modes
GTB17	-30V	Unregulated negative voltage return from Power Supply for ORR, OAPR and OSR switch inputs
GTB18	ORR	Input to Regulator which will release driver/regulator preconditioning when connected to -30V through the appropriate relay contact(s).
GTB19	OAPR	Input to Regulator which will activate the adjustable preset reference on the Regulator card when connected to -30V through the appropriate relay contact(s)
GTB20	OSR	Input to regulator which will apply the system reference SR to the regulator when connected to -30V through the appropriate relay contact(s).
GTB21	PI	A normally closed contact located on the Diagnostic
GTB22	PO	card normally inserted between the STOP and the START pushbuttons, with PI connected to the STOP and PO connected to the START. If the Diagnostic card is not provided, these two points are jumpered together.

2.2.3 Located on the Power Assembly are two round plugs SPL and RPL. RPL, the right hand plug, is connected through a harness to the forward conversion module and SPL is connected to the reverse module if supplied.

2.3 SYSTEM ADJUSTMENTS:

	Nomen.	Card Location	
	APR	R	If connected, an Auxiliary Preset Reference which may be connected to provide either a timed or untimed signal (JOG, THREAD) into the regulator when OAPR is connected to -30V.
	TIM-	R	An adjustment to control the time required to linearly decelerate from top speed in the forward direction
	TIM+	R	An adjustment to control the time required to linearly accelerate to top speed in the forward direction
	SMAX	R	An adjustment to set the maximum speed of a drive by adjusting the strength of the feedback
	RESP	R	An adjustment to control the responsiveness of the drive
	ILIM	R	If connected, an adjustment to set the maximum steady-state current to be delivered to the motor. Normally set at 150% of rated motor current
	DAMP	R	An adjustment, which in conjunction with the RESP pot, controls the overshoot or damping factor of the drive system
	COMP	R	An adjustment to improve the load regulation of a voltage regulated drive by compensating for the IR drop of the motor. When a Motor Field Control is furnished, this adjustment is used to compensate the field control for the IR drop of the motor.
	VLIM	DC	A factory-set adjustment to limit the max. voltage applied to the motor. Level should not normally exceed 1.15 times the RMS value of the applied 3-phase line
	LR	D	An adjustable local test reference used in place of the system reference in some diagnostic modes.
**	LINE	QC	An adjustment to compensate for the per unit AC line impedance. This adjustment is factory set.

** Four Quadrant only

2.4 INDICATORS

Nomen.	Location	
T1	PM	Each power conversion module contains these three indicators. When three phase power is applied to the power module(s) these indicators are on.
T2	PM	
T3	PM	
RTR	CARD RACK	The Ready-to-Run indicator is combined with the fault reset pushbutton, and is located in the bottom left hand corner of the printed circuit card rack. When the fault relay F located on the Monitor card is picked up, the Ready-to-Run light will be illuminated.
SYS	M	The system monitor indicator SYS will illuminate when any of the following occurs: 1. Incorrect phase sequency/phase loss is applied to the drive 2. One fuse is open in the DC buss or AC line 3. An external signal applied to SYS (GTB15) exceeding +10 volts. * 4. Both the NORM and the MOTR buttons on the Diagnostic card are depressed. * 5. The MOTR button is depressed and the TREF button on the Diagnostic card is either depressed or released. If a Motor Field Control (MFC) is supplied, SYS will also illuminate when: 6. Motor field loss is detected. 7. Incorrect tachometer polarity or tach loss exists. 8. Motor RPM exceeded maximum allowable speed. 9. MFC input fuse open.
IOC	M	The instantaneous overcurrent trip indicator IOC will illuminate whenever the motor current transiently exceeds approximately 400% of the motor nameplate rating.
TEMP	M	The power module overtemperature indicator TEMP will illuminate whenever the protective thermostat in the power module(s) open.
RESET	CARD RACK	The fault reset pushbutton is combined with the RTR (Ready-to-Run) light in the lower left-hand corner of the card rack. Depressing the Reset button will drop out the F relay and reset the SYS, IOC, and TEMP indicators on the Monitor card. If the indicators do not remain off when Reset is released, the fault condition has not been corrected.
TRANSFER	D	The Transfer indicator on the Diagnostic card illuminates whenever a different test mode is selected on the Diagnostic card. Refer to section 3.7.8 for details.

2.5 TEST POSTS

Each test post is isolated from the signal is it monitoring by a 15K ohm resistor. This allows adjacent posts to be accidentally connected together without causing a drive malfunction. This series resistance will, however, cause the voltage measured at the test post to reach slightly lower than the actual voltage due to the internal resistance.

CAUTION

VOLTAGE MEASUREMENTS SHOULD NOT BE MADE DIRECTLY ON THE CARD RECEPTACLE PINS. A MISCONNECTION COULD EASILY DAMAGE THE EQUIPMENT.

Nomen.	Location	
+20V	PS	Connected to the 20V Power Supply outputs.
-20V	PS	They will normally read ±20V DC whenever 115V AC is
COM	PS	applied at H1 and H2.
1F1	GC	Connected to the outputs from the Gate Control to the
1R1	GC	SCR's in the forward and reverse power modules.
1F4	GC	1F1 is the output to the #1 SCR in the forward
1R4	GC	module, 1R3 is the output to the #3 SCR
1F2	GC	in the reverse module. The 1 prefix indicates
1R2	GC	that firing occurs when the signal is high.
1F5	GC	When measured with an oscilloscope,
1R5	GC	the outputs will be as
1F3	GC	shown in Section 4.4
1R3	GC	
1F6	GC	
1R6	GC	
OIP	M	Connected to the initial pulse output of the Phase Control. Each time a firing signal is generated by the Phase Control, this output dips low. When measured with an oscilloscope, the output will be as shown in Figure 1.
DERR	M	Connected to the output of the driver voltage error amplifier, on the Driver Coordination card.
+5V	M	Connected to +5V DC internal power buss. It will normally read between 4 and 6 volts whenever ±20V DC is available.
SR	M	Connected to system reference input (GTB4).
TR	M	Connected to the timed reference output of the linear time section on the Standard Regulator.
SFB	M	Connected to the system feedback output of the feedback scaling amplifier on the Regulator.
DR	M	Connected to the driver reference, the output from the Regulator into the Driver Coordination, which determines the amount of DC voltage applied to the motor.
CFB	M	Connected to the current feedback output from the Quadrant Control card, which is proportional to armature current.
1CST	M	Connected to the drive shutdown input on the Monitor card. When this point is positive, all outputs to the Power Conversion module(s) are removed.

Nomen.	Location	
VFB	M	Connected to the isolated armature voltage output on the Driver Coordination which is proportional to the DC voltage out of the conversion module(s).
PCR	M	Connected to the phase control reference, the output of the Driver Coodination into the Phase Control which determines the phase angle where the SCR's in the conversion module will be fired.
SEL	M	The select test post is connected to a moveable jumper to allow voltage measurements to be safety made at any card receptable pin. A 15K ohm resistor is in series with the test post SEL and the jumper. The jumper is normally connected to tab 13 of the Standard Regulator card.
SYNC	M	Connected to a line synchronized output of the Phase Control card to provide line synchronization for portable oscilloscopes.
COM	M	Driver/Regulator common.
** OFE	QC	Connected to the driver error polarity detector on the Quadrant Control card. If this point is high, SCR firing signals are applied to the reverse module; if low, they are applied to the forward module.
** VR	QC	Connected to the output of the voltage ripple detector. The drive will not transfer from motoring to regenerating or back until the voltage ripple is zero.

2.6 INSTRUMENT CARD SWITCH POSITIONS (if ordered)

Pos.	Nomen.	
1	LRO	The local test reference output on the Diagnostic card which is applied to the driver regulator in certain diagnostic test modes.
2	SR	The input from the system speed reference to the linear time section of the Regulator.
3	TR	The timed system reference on the Regulator card which determines motor speed.
4	DR	The driver reference applied to the Driver Coordination card which determines motor voltage.
5	PCR	The phase control reference applied to the Phase Control card which determines the phase angle where the SCR's are to be turned on.
6	SFB	The speed feedback signal on the Regulator card which is proportional to actual motor speed.
7	CFB	The current feedback signal on the Quadrant Control card which is proportional to actual motor current.
8	VFB	The voltage feedback signal on the Driver Coordination card which is proportional to actual motor voltage.
9	RERR	The amplified difference between TR, the desired motor speed, and SFB, the actual motor speed. This difference, or regulator error, forces DR, the driver voltage reference to move in a direction to decrease the error.

** Four Quadrant only

2.6 (Continued)

Pos.	Nomen.	
10	DERR	The amplified difference between DR, the desired motor voltage, and VFB, the actual motor voltage. This difference, or driver error, forces the phase control reference, PCR, to move in a direction to reduce the error.
11	ORR	The input which releases the driver/regulator preconditioning. If ORR is positive, the drive is unable to run.
12	OSR	The input which applies the system reference, SR to the linear time section of the regulator. If OSR is positive, SR is not connected to the regulator.
13	OAPR	The input which applies the auxiliary preset reference, APR, to the regulator. If OAPR is positive, APR is not applied.
14	1STP	The output from the Monitor card to the driver coordination which will stop the drive and remove the firing signals from the SCR's.
15	SYS	The system trip input from either the MFC or other input at GTB15 which trips the SYS indicator on the Monitor card and shuts down the drive.
16	PCM	The input from the MFC at GTB12 to monitor motor field control performance.
17	+20V	The ±20V DC power supply outputs.
18	-20V	
19	SEL	Connected to the moveable jumper in the Driver/Regulator back plane.

2.7 TEST MODES

A drive system consists of four basic sections; the regulator and power conversion section, the motor and loop contactor section, the reference and relay logic section, and the system feedback and stability section. The diagnostic card programs the IC Driver/Regulator to allow each section to be set up and checked out independently.

2.7.1 The first test mode is TREG, (test regulator) with MOTR out. With TREG depressed and MOTR out; the LR pot is connected to the linear time section of the Regulator card, the system reference and APR switches are off, the system feedback is off, and unity gain feedback is connected around all integrators. The SCR pulses are locked in maximum phase-back condition, and a dummy current feedback signal proportional to the LR setting is injected into the drive. In this mode the system adjustments TIM+, TIM- and ILIM may be adjusted. If an MFC is provided, a dummy voltage signal proportional to LR is used to adjust the SMAX (max. field), SMIN (min. field), FLOSS (field loss), and CROSS (crossover) in the motor field control. The field loss and IOC shutdown circuits may also be verified.

2.7.2 The second test mode is TREF (test reference) with MOTR out. With TREF depressed and MOTR out, the SCR pulses are locked off, and local unity gain feedbacks are inserted around each integrator. LR has no effect. In this mode, the system reference(s) and relay logic may be checked out, including the motor loop contactor and limit switches without the motor shaft turning. The APR adjustment in the IC Driver/Regulator is set.

2.7.3 The third test mode is TREG with MOTR in. In this mode, the LR is substituted for the system reference(s) and a local gain loop is substituted for the system feedback in the regulator. The motor loop contactor has been picked up, and the Motor Field Control, if used, is locked in full field operation. The SCAL (speed calibrate) and the direction of motor rotation is verified.

2.7.4 The fourth test mode is TREF with MOTR in. In this mode, the LR is disconnected and the system reference(s) are applied. A local feedback is substituted for the system feedback and the MFC is locked in full field. The motor will operate as a voltage regulator under the commands from the system reference and relay logic.

2.7.5 The fifth test mode is TFBK (test feedback) with MOTR in. In this mode, the LR is substituted for the system reference(s) but the IC Driver/Regulator and the MFC are operating in normal mode. The SMAX, DAMP, COMP, and RESP adjustments in the IC Driver/Regulator and the SLIM (max. speed trip) adjustments in the MFC are set.

2.7.6 The last test mode is TFBK with MOTR out. In this mode LR is substituted for the system reference(s) and local feedbacks are substituted for the system feedback. SCR pulses are not inhibited. This test mode is normally used only for trouble shooting the IC Driver/Regulator.

2.7.7 For normal operation depress NORM (normal) and leave MOTR out.

2.7.8 TRANSFER:

When transferring from mode to mode, internal circuitry will prevent the drive from operating in the new mode until the motor voltage is down to a safe level. The transfer circuit is initiated whenever a mode is released or the MOTR button is selected or released. Transfer will not be complete until a new mode has been selected and the motor voltage is at a safe level. During transfer, the red indicator will be on. When the indicator goes out, the drive is operating under the control of the new mode.

If an attempt is made to transfer into or out of test mode TREG with MOTR in, a system trip will be generated, opening the F relay on the monitor card and illuminating the SYS indicator. The trip may be reset by depressing the RTR/Reset indicator.

If an attempt is made to operate in the normal mode with MOTR depressed, a system trip will be initiated as above. To clear the trip, release the MOTR button and depress the RTR/Reset indicator.

2.8 STANDARD PARAMETER SELECTIONS

Several design parameters may be modified in the IC Driver/Regulator by selectively adding wire jumpers between pins in the backplane. A list of these standard selections is shown below. In addition to these standards, additional parameter modifications may have been furnished to meet a particular drive requirement. Refer to the system elementary to determine exactly what has been furnished on a particular drive. These selections have been made at the factory and will not normally need to be changed.

Standard Selections for:	Connect on:
Phase Control Card	
1a. 60 Hz	None
1b. 50 Hz	26 - 27
Driver Coordination Card	
2a. Driver Curr. Limit, less than 75HP	None
2b. Driver Curr. Limit, more than 75HP	20 - 32
2c. No Driver Current Limit	20 - 31
Regulator Card	
3a. 20V System Reference	15 - 26X
3b. 10V System Reference	None
3c. 3V System Reference	25X - 26X
4a. No Auxiliary Reference	None
4b. Timed Auxiliary Reference forward	23X - 29X, 30X - 31
4c. Timed Auxiliary Reference reverse	23X - 29X, 2 - 30X
4d. Untimed Aux. Reference forward	24X - 29X, 2 - 30X
4e. Untimed Aux. Reference reverse	24X - 29X, 30X - 31
5a. No Linear Time	None
5b. .5 - 3 Sec. Linear Time	20X - 27X
5c. 3 - 30 Sec. Linear Time	20X - 28X
Tachometer Feedback between	
6a. 43 - 62V DC	13X - 14X, 17 - 18
6b. 60 - 115V DC	13X-14X, 17-18, 14-15, 18X-19X
6c. 100 - 200V DC	14X - 15X, 15X - 18
6d. 190 - 380V DC	14X-15X, 15X-18, 14-15, 18X-19X
6e. 26 - 48V AC	11-19, 13X-14X, 17-18
6f. 47 - 85V AC	11-19, 13X-14X, 17-18,14-15,15X-19X
6g. 82 - 152V AC	11-19, 14X-15X, 15X-18
6h. 151-275V AC	11-19, 14X-15X, 15X-18, 14-15, 1[illegible]
6i. Voltage Regulator	3 - 14, 15 - 18X
7a. No Load Regulator Compensation	None
7b. Load Regulation Compensation	5X - 12
8a. Low Response Range	None
8b. Normal Response Range	6 - 16
9a. No Regulator Current Limit	None
9b. Regulator Current Limit	9X - 16

2.8 (Continued)

	Top Speed/Base Speed, Ratio between	
10a.	.9 - 1	10 - 11X, 8 - 15
10b.	1 - 1.10	10 - 11X
10c.	1.1 - 1.15	10 - 11X, 8 - 11X
10d.	1.15 - 1.3	10 - 11X, 8 - 9
10e.	1.3 - 1.45	10X - 11X, 8 - 15
10f.	1.45 - 1.6	10X - 11X
10g.	1.6 - 1.75	10X - 11X, 8 - 11X
10h.	1.75 - 2	10X - 11X, 8 - 9
10i.	2 - 2.25	8 - 15
10j.	2.25 - 2.55	None
10k.	2.55 - 2.7	8 - 11X
10l.	2.7 - 3.0	8 - 9
10m.	3.0 - 3.25	10X - 15, 8 - 9
10n.	3.25 - 3.75	10 - 10X, 8 - 15

2.9 TABLE OF ABBREVIATIONS

The following is an alphabetical list of all abbreviations used in this instruction with a cross reference to where it may be located (terminal board, test post, instrument switch position or card assembly) and its normal voltage or condition. For these signals which vary as a function of the operating conditions the typical top speed condition is indicated with an asterisk. Polarities are as shown when drive is operating as forward rotating motor at rated load.

Abbrev.	Name	Type	Normal State	Location TB	TP	I	Card/Asm.
AC1	3Ø AC	Input	230/460	AC1			
AC2	3Ø AC	Input	230/460	AC2			
AC3	3Ø AC	Input	230/460	AC3			
APR	Aux. Preset Reference	Adjust.		-	-	-	R
CRB	Current Feedback	Output	+2.5*	13	M	7	
COIL	Coil MD Pilot Relay	Output		1			
COM	Common		0	8	M,PS, MFC	-	
COMP	IR Compensation	Adjust.		7			R
CROSS	Voltage Crossover	Adjust.					MFC
D	Diagnostic	Card					
DAMP	Motor Damping	Adjust.					R
DC	Driver Coordination	Card					
DERR	Driver Error		-6*		M	10	
DR	Driver Reference		+10*		M	4	
F	Fault Relay Contact		Closed	10,11			
FB+	Positive Tach Feedback	Input	+( )*	6			
FB-	Negative Tach Feedback	Input	-( )*	9			
FCI	Field Control Inhibit	Output	Open	16			
FCM	Field Control Monitor	Input	+8*	12		16	
FCR	Field Control Test Ref.	Output	0	5			

2.9 (Continued)

Abbrev.	Name	Type	Normal State	Location TB	TP	I	Card/Asm.
FLOSS	Field Loss	Adjust.					MFC
FMAX	Maximum Field	Adjust.					MFC
FMIN	Minimum Field	Adjust.					MFC
GC	Gate Control	Card					
GTB	Control Term. Board						
H1	115V AC	Input	115	H1			
H2	115V AC	Input	115	H2			
I	Instrument	Card					
IC	Integrated Circuit						
ILIM	Reg. Curr Limit	Adjust.					R
IOC	Instant. Curr. Trip	Indicator	OFF				M
LINE	AC Impedance Comp.	Adjust.					QC
LR	Local Test Reference	Adjust.				1	D
M	Monitor	Card					
MD	Motor Loop Contactor		CLOSED				
MFC	Motor Field Control						
MOTR	Motor Loop Test	Pushbut.	OUT				D
NDC	Negative DC Power	Input		NDC			
NDCF	Neg. DC Power Fused	Input		NDCF			
NORM	Normal Mode Operation	Pushbut.	IN				D
P1	Positive Module	Output					
P2	Negative Module	Output					
PA	Power Assembly						
PC	Phase Control	Card					
PCR	Phase Control Ref.		+6*		M	5	
PCD	Positive DC Power	Input		PDC			
PDCF	Positive DC Pow.Fused	Input		PDCF			
PI	Diagnostic Switch	Input		21			
PO	Interlock for MD	Output	↑CLOSED	22			
PS	Power Supply	Card					
QC	Quadrant Control	Card					
R	Regulator	Card					
RERR	Regulator error		0			9	
RESET	Fault Reset	Pushbut.					
RESP	Response	Adjust.					R
RPL	Forward Mod. Connector	Output					PA
RTR	Ready-to-Run	Indic.	ON				PA
SCAL	Sp.Feedback Calibrate	Adjust.					MFC
SCR	Silicon Controlled Rect.						
SEL	Selectable Test				M	19	

2.9 (Continued)

Abbrev.	Name	Type	Normal State	Location TB	TP	I	Card/Asm.
SFB	Scaled Tach Feedback		+8*	1H	M	6	MFC
SLIM	Overspeed Limit	Adjust.					R
SMAX	Maximum speed	Adjust.					PA
SPL	Reverse Mod.Connector	Output					
SR	System Reference	Input	+( )*	4	M	2	
STEP	Step Ref. for Test	Pushbut.	OUT				D
SYNC	Line Synchronization	Output	0, 5		M		
SYS	System Fault	Ind./Input	OFF	15	M	15	M
T1,T2,T3	Power Mod. Input	Indica.	ON				
TDS	Test Data Sheet						
TEMP	Module Overtemp.	Indica.	OFF				M
TBFK	Test Feedback Mode	Pushbut.	OUT				D
TIM+	Linear Time Accel.	Adjust.					R
TIM-	Linear Time Decel.	Adjust.					R
TR	Timed Reference		-10*		M	3	
TRANSFER	Mode Transfer	Indica.	OFF				D
TREF	Test Reference Mode	Pushbut.	OUT				D
TREG	Test Regulator Mode	Pushbut.	OUT				D
VFB	Voltage Feedback		-5*		M	8	
ULIM	Voltage Limit	Adjust.					DC
VR	Voltage Ripple				QC		
+5V	+5V DC Power Supply		+4 to +6		M		DC
+15V	+15V Power Supply		+14 to +16				DC
+20V	+20V DC Power Supply		+19.9 to 20.1	3	PS	17	
+30V	+30V DC Power		+20 to +40				
-15V	-15V DC Power Supply		-14 to -16				
-20V	-20V DC Power Supply		-19.9 to 20.1	2	PS	18	
-30V	-30V DC Power Supply		-20 to -40	17			
OAPR	APR Switch	Input	-30V=ON	19		13	
OFE	Forward Error		0=Fwd.		QC		
OIP	Initial Pulse		+5=Rev.		M		
ORR	Reg. Run Switch	Input	-30V=ON	18		11	
OSR	System Ref.Switch	Input	-30V=ON	20		12	
1CST	Zero Current Shutdown		0=Norm. +2=for shutdown		M		
1F1-1F6	Forward Firing Signal	Output	-20V		GC		RPL
1R1-1R6	Reverse Firing Signal	Output	-20V		GC		RPL
1STP	Controlled Stop		0=Norm +6 for Stop			14	