Servo Interface Module

(SIM)

Operations Manual

P/N 88-004313-02

Compumotor Corporation

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Chapter 1

INTRODUCTION

1.1 OVERVIEW

The Servo Interface Module (SIM), shown in Figure 1-1, is an Indexer-to-servo converter that allows you to control operation of either AC or DC servo drive systems using a Compumotor Indexer and common stepper motor commands. It is a self-contained unit that is useful in applications where a stepper motor cannot provide sufficient torque or speed or where a stepper motor lacks the dynamic response required for proper and consistent operation. It is useful in a variety of other applications where you desire to maintain the simplicity of stepper motor control commands as your primary method of programming. The SIM is the perfect choice for these situations because it allows you to concentrate on motion profiles with confidence that your programmed commands will be followed precisely.

1.2 FUNCTIONAL DESCRIPTION

The SIM works with standard 500- or 1000-line encoders with quadrature A and B phase outputs. Pulse resolution in either case is 1000 steps per revolution, since the SIM multiplies the signal received from the encoder by two when you configure the unit for a 500-line encoder (see section 2.3). The SIM also provides encoder power for use with encoders that require 5-volt input power.

The SIM receives stepper motor controls (pulse trains) from a Compumotor Indexer and provides an analog output of ±10 volts to a servo amplifier (see Figure 1-2). The stepper motor control signals provided to the SIM should be 5-volt logic levels.

The SIM will accept a single pulse train on the STEP input to control distance or velocity and a DIRECTION input.

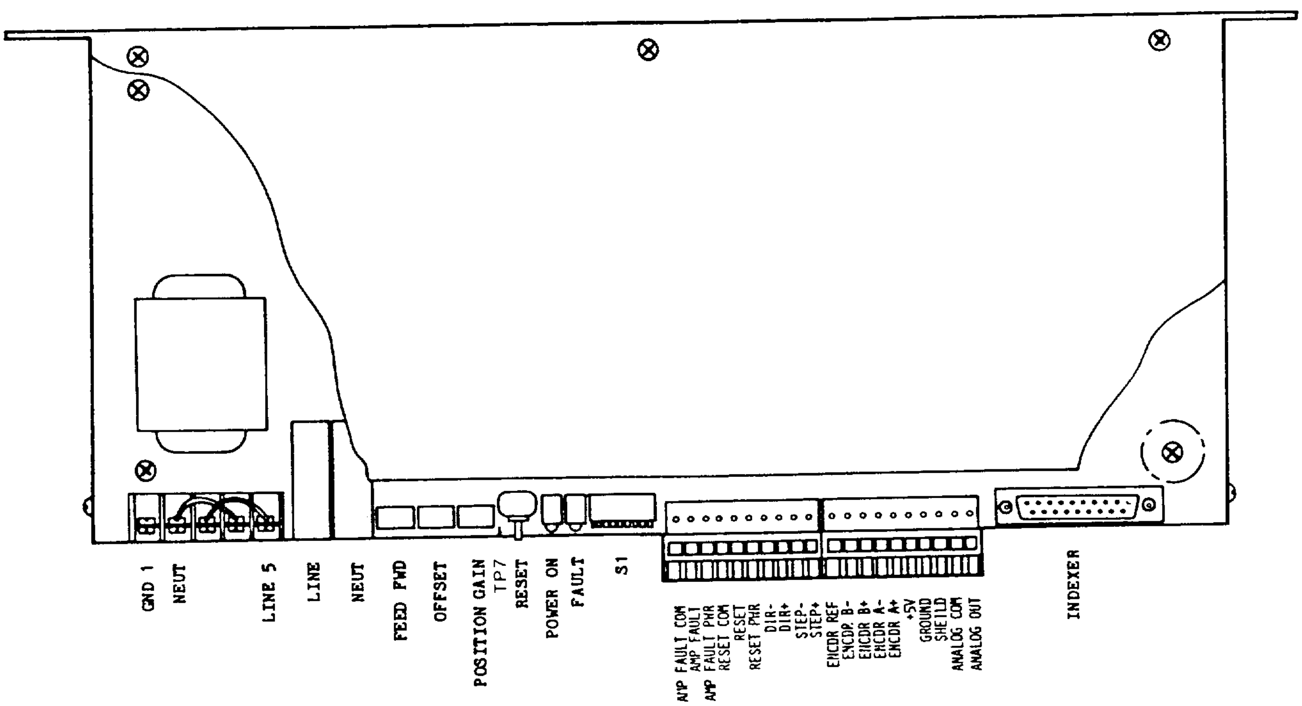

Figure 1-1. Servo Interface Module

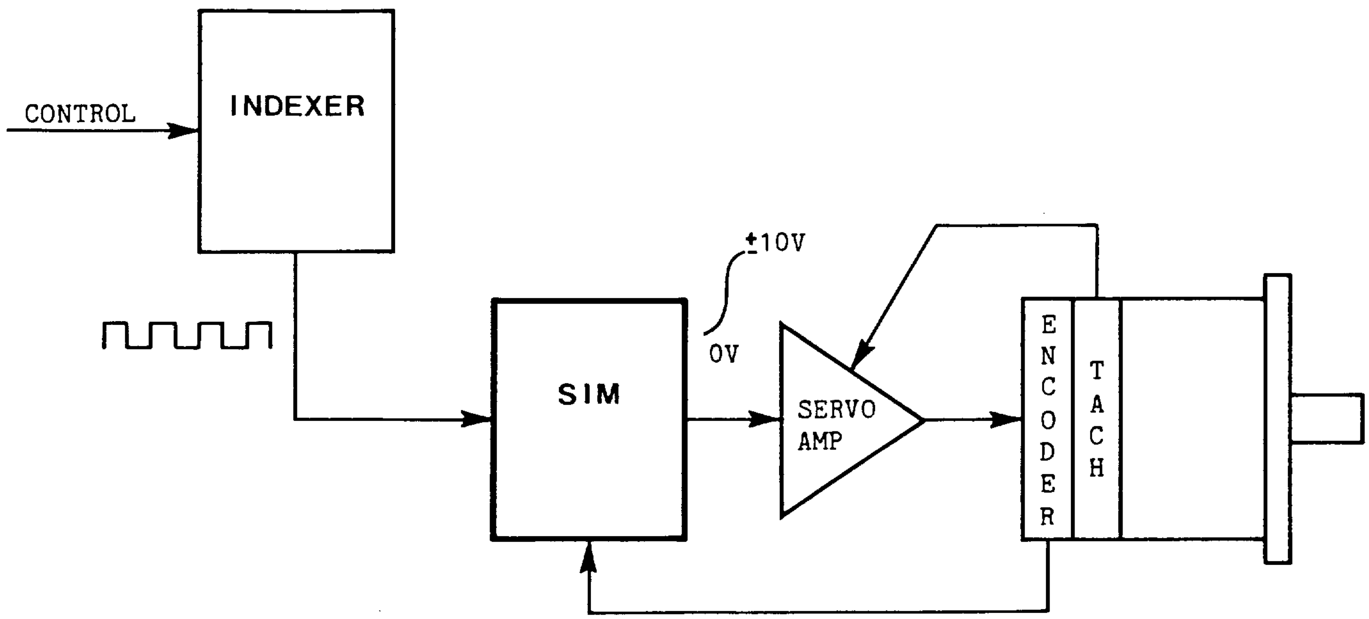

Figure 1-2. Typical SIM Application

1.3 THEORY OF OPERATION

Figure 1-3 is a simplified block diagram of the SIM. As shown in this figure, an internal counter counts up or down depending on the level of the direction input. The value in the counter is a representation of the error between commanded and actual position. As pulses are received, the value in the counter increases. This value is fed into a digital-to-analog converter that produces an analog voltage proportional to the error. This will cause the servo drive to begin turning the motor in the proper direction at a velocity proportional to the positional error. This proportion is adjustable by a potentiometer labeled Position Loop Gain.

When the servo drive begins to turn, the encoder begins producing pulses. The SIM's internal up/down counter counts these encoder pulses in the opposite direction as the pulse input. This causes the servo motor to move one encoder pulse for each pulse received until the error is zero.

In addition to Position Loop Gain, another adjustment, called Feed Forward, provides an analog level proportional to the frequency of incoming pulses that is summed with the Position Loop Gain signal. This signal reduces following errors and allows higher velocities.

When no pulses are being received from the Indexer and the error is zero, the analog output should be at zero volts. The OFFSET potentiometer allows adjustment of this offset and also allows compensation for any imbalance in the servo drive.

The 10-volt analog output can command motor speeds up to 3300 RPM with scale factors from 3 volts per 1000 RPM to 9 volts per 1000 RPM. The adjustments provided for Position Loop Gain and Feed Forward allow all PWM and SCR servo drives, AC or DC, to be accommodated and used at maximum performance under closed-loop control.

Diagnostic information is provided by an open-collector output that gives an error signal when a fault is pending. A fault condition exists when there is a 16,000-count deviation between the Indexer command and the encoder feedback. The fault diagnostic signal is activated when the command-to-feedback deviation exceeds 8,000 counts, which should allow sufficient time

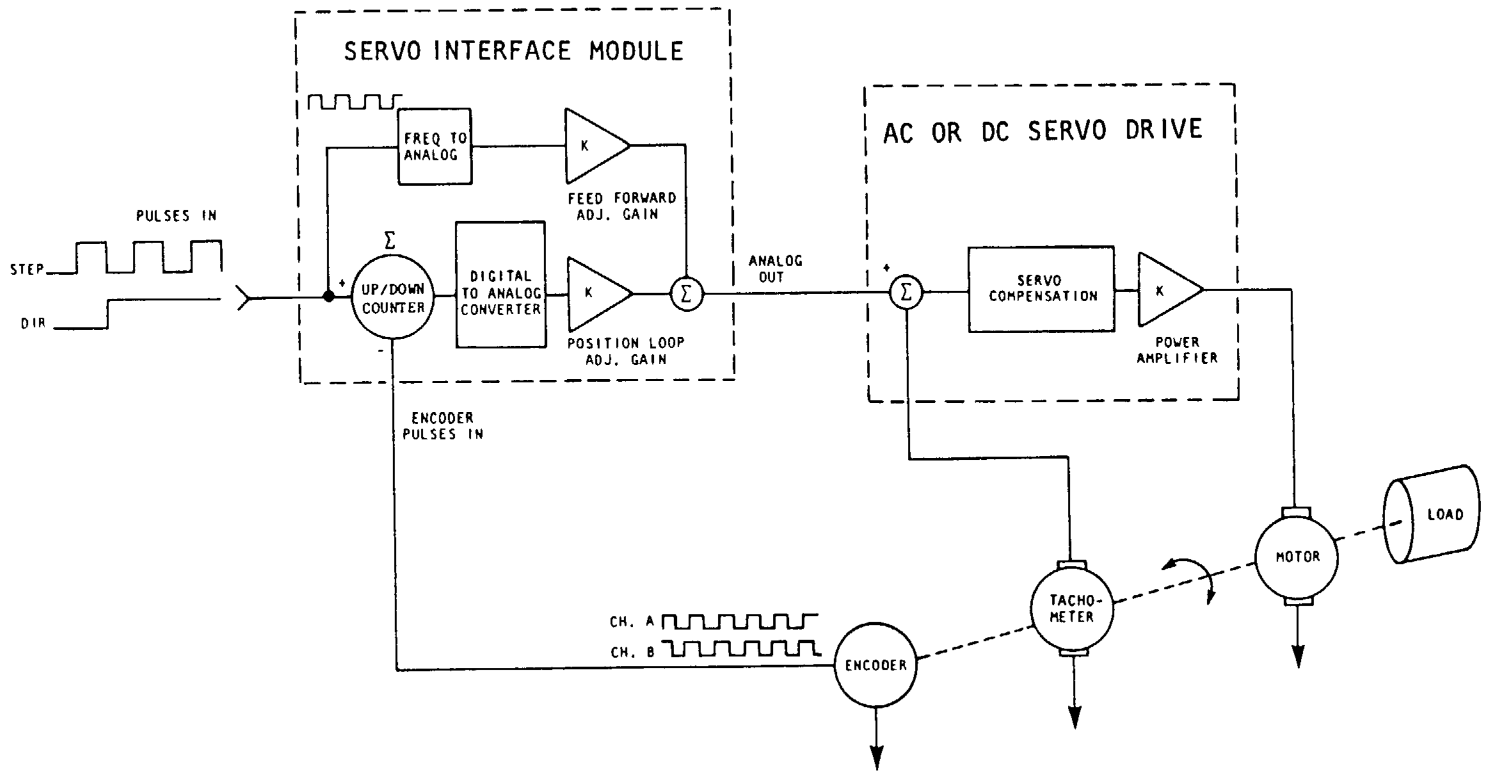

Figure 1-3. Servo Interface Module Block Diagram

for corrective action to be taken by the control without loss of synchronization. The SIM also has a board-mounted LED to indicate that control power is present and test points to provide diagnostic and setup information.

1.4 SPECIFICATIONS

The technical specifications of the SIM are summarized in Table 1-1.

Table 1-1. Technical Specifications

Item	Description
Height	11 1/4 in.
Width	6 in.
Depth	2 in.
Resolution	1000 steps/rev
Input Power	115 or 230 VAC,50/60 Hz, 50 VA
Input	5-volt TTL-level pulses (optically isolated). 10 microsec minimum duration for direction, 500 nsec minimum for step
Analog Output	± volts, 5 mA max, non-isolated
Velocity Reference	3 to 9 volts/1000 RPM, 10 Kohm minimum impedance
Feedback	500- or 1000-line incremental encoder, quadrature A and B channels
Maximum Speed	3300 RPM
Position Register Capacity	±16,000 counts
D/A Capacity	±2,000 counts

Chapter 2

INSTALLATION AND OPERATION

2.1 OVERVIEW

This chapter provides the following information for installing and operating the SIM:

a. Input/output connections
b. Setup
c. Phasing
d. Calibration
e. Troubleshooting

2.2 INPUT/OUTPUT CONNECTIONS

The functions of all SIM input and output connectors are listed in Tables 2-1 through 2-4 and are shown in Figure 2-1, which is a typical SIM installation. The specifications for all inputs and outputs for the terminal setup are listed in Table 2-5.

Table 2-1. Terminal Block TB1 Terminal Numbers and Descriptions

Pin No.	Function 110V	220V
1	GND	GND
2	Neutral	Neutral
3	Line	Jump to pin 4
4	Neutral	Jump to pin 3
5	Line	Line

Table 2-2. Connector J1 Pin Assignments

Pin No.	Function	Pin No.	Function
1	Step+	6	Reset
2	Step-	7	Reset common
3	Direction+	8	Amp fault PWR
4	Direction-	9	Amp fault
5	Reset PWR	10	Amp fault - common

Table 2-3. Connector J2 Pin Assignments

Pin No.	Function	Pin No.	Function
1	Analog out	6	Encoder A+
2	Analog Common	7	Encoder A-
3	Shield	8	Encoder B+
4	Logic Gnd	9	Encoder B-
5	+ 5V	10	Encoder reference

Table 2-4. Connector J3 Pin Assignments

Pin No.	Function	Pin No.	Function
1	Step	14	Step return
2	Direction	15	Direction return
3	NC	16	NC
4	NC	17	NC
5	NC	18	NC
6	NC	19	Fault reset return
7	Fault reset	20	NC
8	NC	21	NC
9	Drive fault	22	Slip fault return
10	Slip fault	23	NC
11	NC	24	NC
12	NC	25	NC
13	NC		

Note: NC = No connection

2.3 SETUP

The operating configuration of the SIM is determined by the setting of eight on-board DIP switches. The correct switch position for each configuration is shown in Table 2-6. Input voltage may be either 110 VAC or 220 VAC. The unit is set up for either input voltage by the way TB1 pins 1-5 are configured (as shown in Figure 2-2).

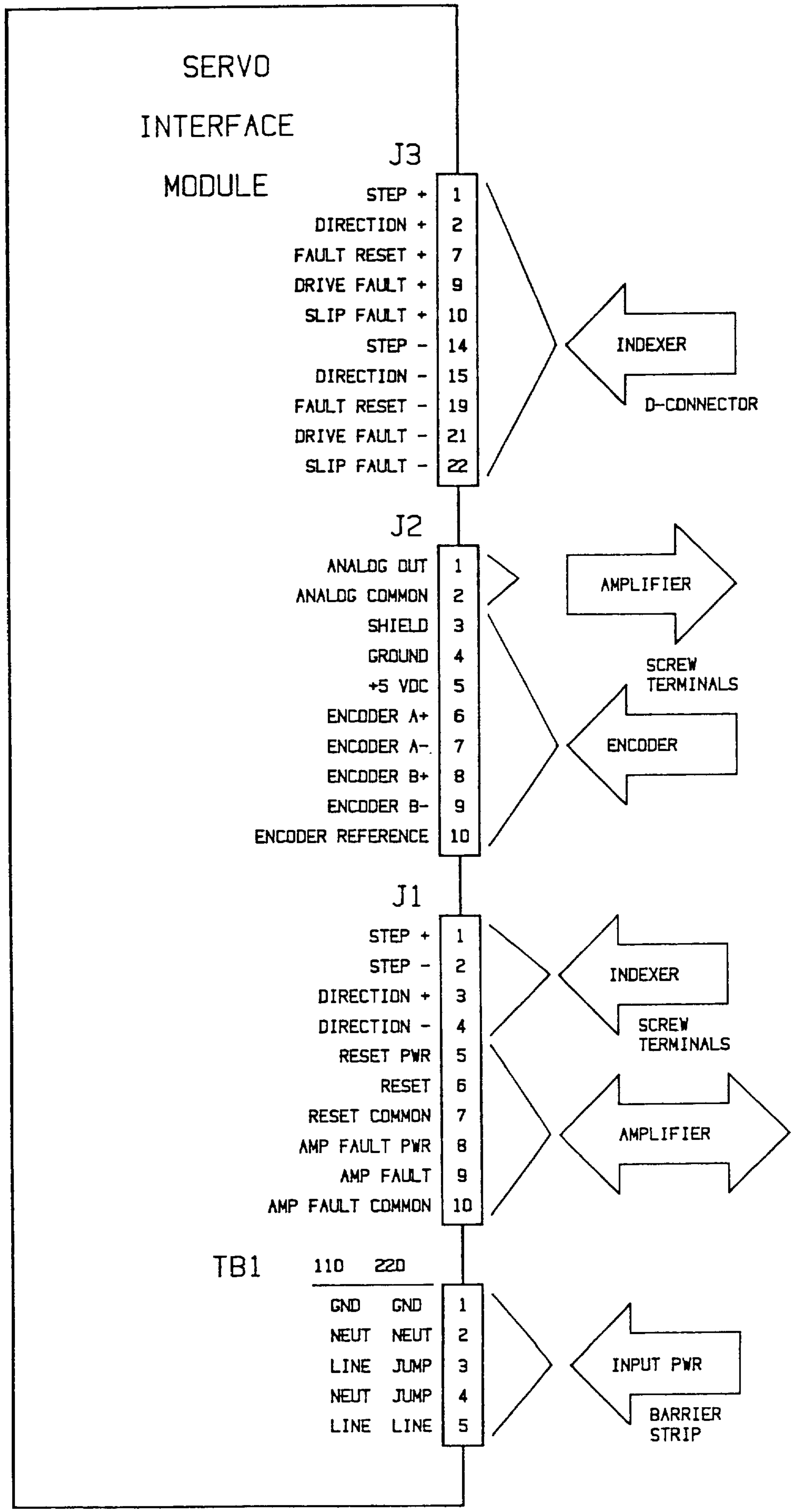

Figure 2-1. SIM Input and Output Connectors

Table 2-5. Input/Output Specifications

Signal	Description
	INPUT SIGNALS - TERMINAL STRIP
Step	Isolated current loop input 15 mA, 500-nsec minimum pulse width. Rising edge initiates step increment
Direction	Isolated current loop input 15mA, 10-microsec minimum pulse width. Presence of current causes clockwise motion.
Fault Reset	Resets SIM fault when external 12-15 VDC source and 12-15 V return are connected across Reset power and Reset Common, respectively. Dip Switch Setting: S1-4 OFF - unit reset when power not applied to Reset S1-4 ON - unit enabled when power not applied to reset
AMP Fault	Resets amplifier when external 12-15 VDC source and 12-15V return are connected across Amp Fault Power and Amp Fault Common, respectively. Dip Switch Setting: S1-3 OFF - Drive Fault transistor will conduct S1-3 ON - Drive Fault transistor will not conduct
Encoder A + and A-, B+ and B-	Channel inputs from encoder. 500/1000 lines Minimum level for logic 1 = 0.55 x encoder power voltage Maximum level for logic 0 = 0.45 x encoder power voltage
Encoder Power and Common	5-15 VDC at <2 mA
	OUTPUT SIGNALS - INDEXER CONNECTOR
Drive Fault	Depends on setting of sense switches Output ON (conducting) - minimum current 8 mA Output OFF - maximum current 500 microAmps
Slip Fault	Becomes active when counter error exceeds 8000 counts Output ON (conducting) - minimum current 8 mA Output OFF - maximum current 500 microAmps

Table 2-5. Input/Output Specifications (Continued)

Signal	Description
	OUTPUT SIGNALS - TERMINAL STRIP
Analog Output	Nominally ±10 VDC with respect to ground, adjustable with gain and feed forward controls Maximum output current 5 mA
	PERFORMANCE DETAILS
Maximum Encoder bandwidth	55 kHz equivalent to 3300 rpm with 1000-line encoder
DAC count maximum	±2000
Slip Fault Error	±8000 counts
Position Register Capacity	±16,000 counts

Table 2-6. DIP Switch Settings

Segment	Function	OFF	ON
-1	Analog Output Scale	±10V	±5V
-2	Not Used	--	--
-3	Drive Fault Sense	High True	Low True
-4	Reset Sense	High True	Low True
-5	Fault Power	12-15 V	5 V
-6	Reset Power	12-15 V	5 V
-7	----	---	---
-8	Encoder Resolution	1000 line	500 line

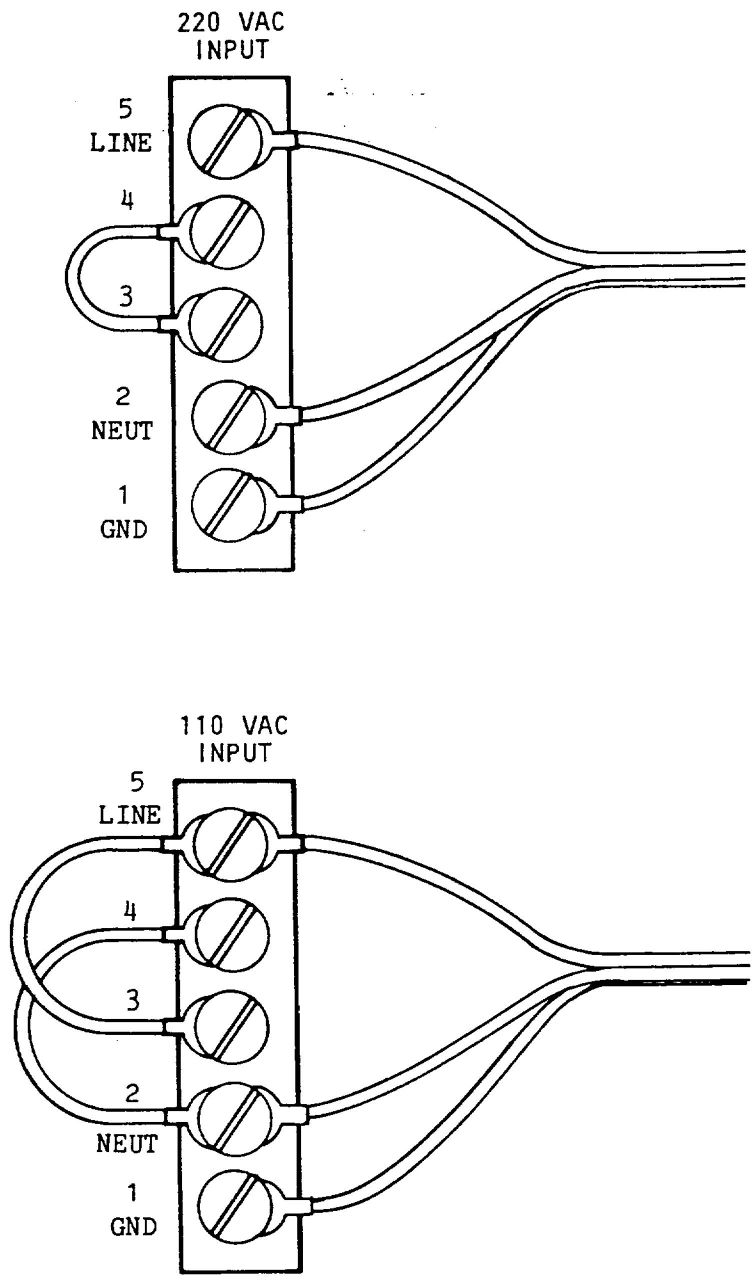

Figure 2-2. Input Voltage Selection

2.4 PHASING

For the SIM to operate properly, you must establish proper phasing between the SIM and the motor and encoder connections during installation. Proper phasing is established when an UP count generated by the SIM's internal counter causes the motor and encoder to rotate in the direction that results in the SIM receiving a DOWN count as the response from the encoder (or generating a DOWN count results in an UP count as the return from the encoder). A more detailed discussion of this operation can be found in section 1.3.

Performing the following procedure will establish proper phasing:

a. Connect and adjust the velocity servo according to instructions supplied with the servo drive. When properly installed, the drive should be capable of stable operation throughout its speed range.

b. Note direction of rotation when the drive is commanded with a small positive voltage (about 1 volt). Drives with a differential input will be able to reverse direction by interchanging plus and minus inputs.

c. Install the SIM according to the interconnection diagram shown in Figure 2-1.

d. Remove drive power from the velocity servo, but keep power applied to the SIM. Make sure the SIM's position-error registers are enabled (disconnect the RESET line).

e. Manually rotate drive shaft in the same direction noted in step b above. If the analog output voltage at J2, pin 1 (see Figure 2-1), is negative with respect to analog common (J2, pin2), the phasing is correct and you may skip to step f. If not, reverse differential inputs to the drive. Velocity servos without a differential input will require interchanging both encoder feedback channels A and B.

f. Apply power to drive. Check for stable operation, but do not command large velocities at this point.

g. Command a low velocity signal from the position controller. If the motor rotates in the desired direction, proper phasing has been established. If not, perform step h.

h. To change direction of rotation, interchange both encoder channels A and B and reverse the differential inputs to the drive. Drives without differential input require reversing all three-tach, armature and encoder channels, <u>without</u> reversing analog input to the drive.

2.5 CALIBRATION

To calibrate the SIM, adjust the three potentiometers on the front of the unit: Position Gain, Offset, and Feed Forward Gain.

a. Set Position Gain to center position. This pot can later be adjusted for desired servo response. You will note that its adjustment is not critical.

b. Connect a voltmeter on the 10-volt scale to the D/A converter output at TP7. This test point provides a signal directly proportional to position error.

c. Turn Feed Forward fully counterclockwise and command a slow speed (one rev/sec), noting the voltmeter reading. Slowly begin increasing commanded speed while watching the voltage at Test Point 7. If the voltage reaches 8.5 volts before you get to maximum speed for your system, you should start adding some Feed Forward Gain by turning the Feed Forward pot slightly clockwise. This adds a voltage proportional to incoming frequency to the analog output. You should notice a decrease in the D/A converter voltage (position error) as you increase the Feed Forward Gain (clockwise).

d. Continue to increase the commanded velocity in small steps and increase the Feed Forward pot, if necessary, to keep the D/A converter voltage under 8.5 volts.

Note

When you reach the maximum commanded speed, the D/A converter voltage should be no greater than 8.5 volts. If motor is at max. speed before the D/A reaches 8.5 volts, no feed forward adjustment is required

e. Run the drive throughout its speed range, and adjust Position Gain for smooth response.

f. Command zero speed and adjust Offset for zero volts. Reset must be held in during this adjustment.

This completes the SIM setup procedure.

Appendix A

DIMENSIONS FOR INSTALLATION