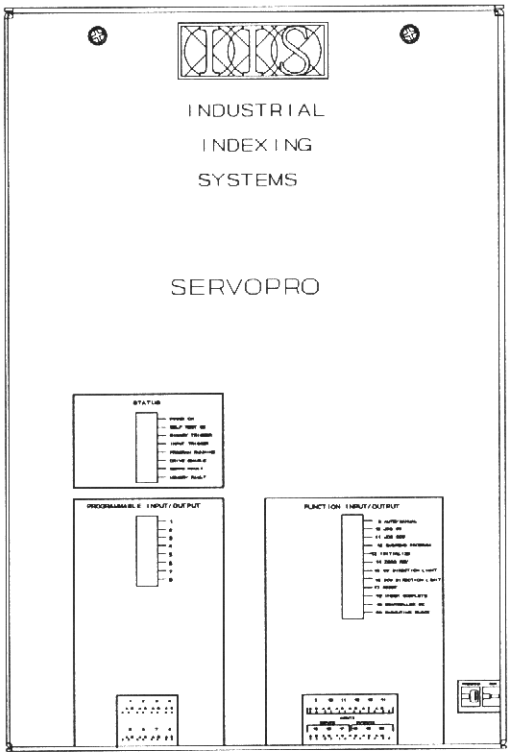
IB-15B005

SERVOPRO-I MOTION CONTROLLER FEBRUARY 1995



SERVOPRO-I SINGLE-AXIS MOTION CONTROLLER

USER'S GUIDE

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0
Approved By:

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INTRODUCTION

The Industrial Indexing Systems ServoPro-I Motion Control System are a group of controller/drive packages, brushless motor assemblies, and transformers especially suited for indexing and positioning applications.

This manual describes proper installation, operation, and troubleshooting procedures for the ServoPro-I Motion Control Systems. The manual assumes no prior knowledge of Industrial Indexing Systems' equipment. It does assume knowledge of proper mechanical, electrical, and electronic maintenance and safety procedures.

The ServoPro-I command module is designed for programming with either the OPI operator interface or an IBM-compatible personal computer. OPI operator interface programming is included in this manual. Personal computer programming is described in manual IB-15B002, *"ServoPro Programming With The Personal Computer"*

The manual uses a variety of highlighted blocks to emphasize important information. Always pay careful attention to this information. The types of highlighted blocks used are:

WARNING

USED TO ALERT THE READER TO ACTIONS OR CONDITIONS WHICH MIGHT PRESENT HAZARDS OR CAUSE INJURY TO PERSONNEL.

CAUTION

USED TO ALERT THE READER TO ACTIONS WHICH MIGHT CAUSE LOSS OF MATERIALS OR DAMAGE TO EQUIPMENT.

NOTE

Used to identify unusual or unexpected conditions or to point out the need for alternate procedures. It is also used for emphasis when a CAUTION or WARNING is not required.

Industrial Indexing Systems fully supports all equipment it manufactures and supplies. If there are any problems with this equipment or if assistance is required for installation or operation, contact our Integrated Technical Services Department.

Assistance and training are available in our factory, for a fee. In addition, Industrial Indexing Systems can custom configure ServoPro-I Motion Control Systems for O.E.M. applications.

Information in this manual is subject to change without prior notification.

SECTION 1 – DESCRIPTION

The Industrial Indexing Systems ServoPro-I Single-axis Motion Control Systems are a group of integrated servo motion control systems especially suited for indexing and positioning applications. The positioning controller, brushless servo drive, I/O Functions, and power supply are designed as a single package. The complete ServoPro-I system consists of the controller, a brushless servo motor, and a variety of accessories such as cables, operator interface unit, thumbwheel modules and transformers.

1.1 INDEXING DRIVE SYSTEM OVERVIEW

An indexing drive system (or indexing system) may be used in a variety of applications where accurate movement or positioning is required. A basic system consists of the main components illustrated in **Figure 1.1**.

1. Input Device: The input device provides data to the control module. It is the interface between the operator (or system computer or programmable logic controller) and the indexing system. In a given system, there may be several input devices.

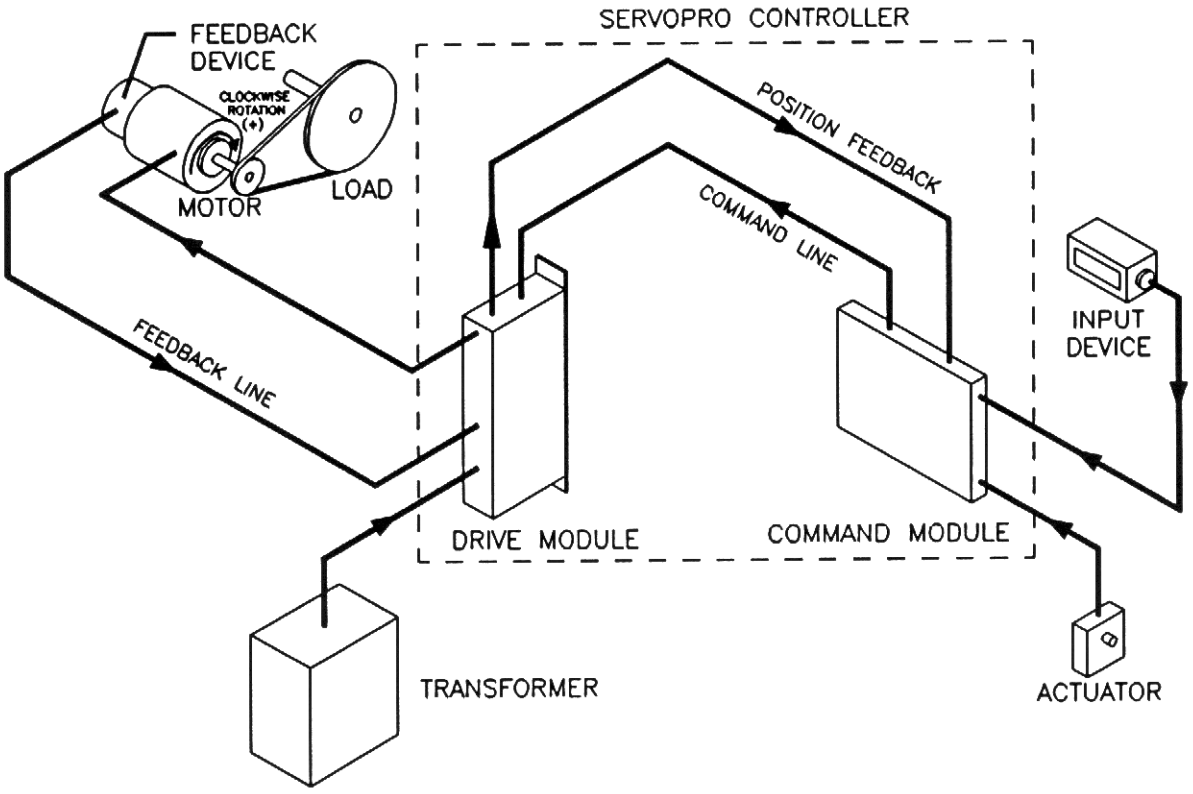


Figure 1.1 - Basic Indexing System

2. Actuator: The actuator supplies the signal which causes the control module to initiate the specified commands.

3. Command Module: The command module is the portion of the controller which receives data from the input device and issues commands to the drive module. It also accepts information from the feedback device (after conversion through the drive module). The programming and settings of the command module determine what types of commands are issued to the drive module in response to the data inputs and feedback.

4. Drive Module: The drive module portion of the controller (also called a servo-amplifier) converts AC input power from the transformer into DC power and amplifies a low voltage velocity command signal from the command module into the necessary voltage and current to cause the motor shaft to rotate. The amount of power and polarity (positive or negative) of the voltage supplied to the motor is determined by the command signals from the command module. The drive module also translates the feedback signals into quadrature pulses for use by the command module.

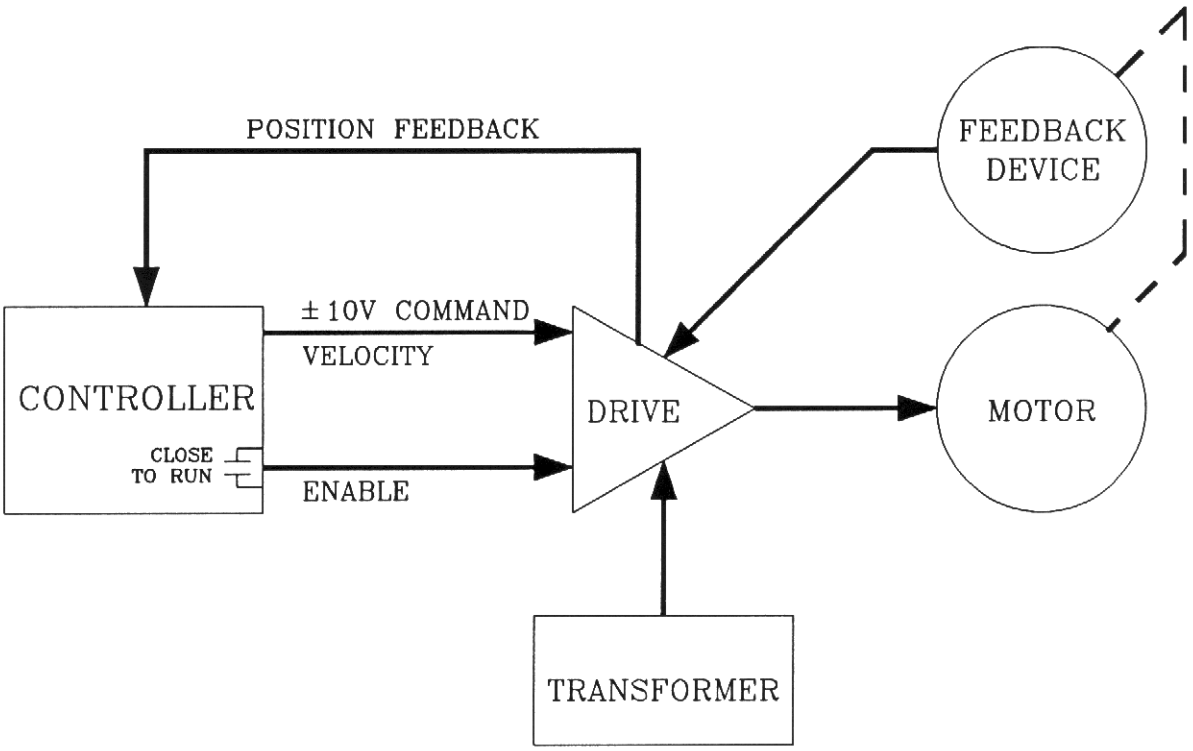


Figure 1.2 - Position Loop

5. Transformer: The transformer converts prime supply voltage into the required input voltage for the drive module and isolates the drive module from the prime supply ground.

6. Motor: The motor is the device being controlled by the indexing system. The system controls the position and speed of motor shaft rotation.

7. Load: The load is the object of the motion. It absorbs the work energy of the motor.

8. Feedback Device: The feedback device monitors the position of the motor shaft and sends this information to the command module (after conversion through the drive module). (Refer to **Figure 1.2**.)

The components of the basic indexing drive system form two information loops. The position loop is a closed-loop which consists of the command module, drive module,

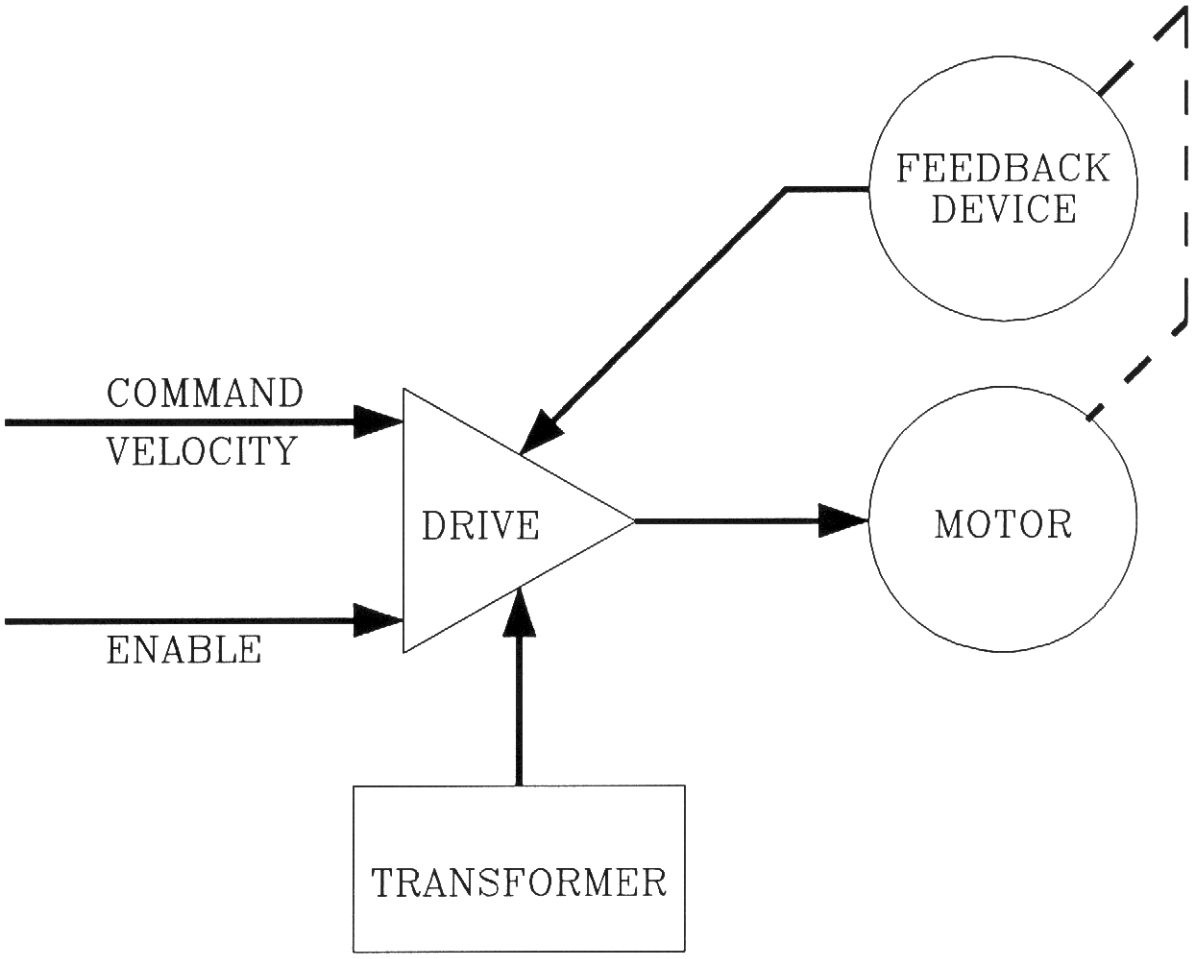


Figure 1.3 - Velocity Loop

motor, and feedback device. (The ServoPro-I motion control systems uses an encoder as the feedback device.) The command module, after receiving data from the input device, sends a command to the drive module, which causes the motor shaft to move. This motion is monitored by the feedback device, which sends data to the drive module. The drive module converts the feedback signals into data and sends it to the command module which in turn will generate and send a command to the drive module.

The velocity loop is also a closed-loop system (refer to **Figure 1.3**). An input voltage to this loop changes the voltage applied to the motor (the drive module output), and therefore changes the speed of the shaft rotation. This new speed will cause a change in feedback signals to the drive module, which will change the drive module output, etc.

The position loop and velocity loop are independent loops, but the command module uses the velocity loop to achieve movement to the desired position. When data is received by the command module specifying a movement, the command module calculates the time required to accelerate to maximum speed and to decelerate from maximum speed. It then calculates the time at maximum speed necessary to complete the movement. This information is then transmitted to the drive module by the command module.

1.2 ServoPro-I MOTION CONTROL SYSTEMS

This manual describes all of the major components and many of the accessory components of the ServoPro-I Motion Control System. This includes the ServoPro-I controllers (command module and drive modules), motors, transformers, operator interface units, thumbwheel remotes, and cables.

1.2.1 PRE-ENGINEERED SYSTEMS

The combination of a specific command module and drive module are designated as a ServoPro-xxxxI-LM controller where "xxxx" designates the size of the system as measured by input wattage. A complete ServoPro-I system will include the controller plus a motor assembly (motor plus feedback device) and is designated by the same number less the "-LM" suffix. The transformers used with the ServoPro-I system can be used to provide power to one or more units and is designated by the output wattage of the transformer.

Each of these systems has been pre-engineered and pre-tested to offer system-level performance. The components of each system are selected to work properly with each other at the rated performance levels.

Selection of a ServoPro-I Motion Control System depends on the system requirements of speed, torque, peak torque, horsepower, and physical size. The specifications for all ServoPro-I systems are contained in the appendices to this manual. Refer to **Paragraph 1.2.2** and **Section 1.7** for details on reading these specifications.

1.2.2 ORDER/SHIPPING CORRELATION

When an order is placed with Industrial Indexing Systems, Inc., the control systems are specified as "ServoPro-I" with the appropriate numerical designations followed by I (ie. ServoPro-1000I). However, when the units are shipped, the individual components are specified — rather than the system designations — to make sure that all items are supplied properly. If several ServoPro-Is are ordered, there will be similar components in the shipment with no cross reference as to which control system they belong to.

To avoid confusion and potential error when the units are assembled by the customer, **Appendix B** of this manual includes Bills of Materials and specifications for all ServoPro-I Motion Control Systems currently supplied by Industrial Indexing Systems, Inc. Similarly, the appendices for other Industrial Indexing Systems' motion device systems manuals contain complete List of Materials and specifications for those systems.

The List of Materials for a ServoPro-I system includes the motor part number, the drive module part number, and the manual part number. (The command module is common to all ServoPro-I systems.) The List of Materials also shows the part number (drawing number) for the setup specifications. The setup specifications are used to configure the drive module compensation package to match the appropriate motor assembly and are unique for a given ServoPro-I.

CAUTION

THE INDIVIDUAL DRIVE MODULES USED WITH THE SERVOPRO-I SYSTEM ARE ALSO USED WITH INDUSTRIAL INDEXING SYSTEMS'. HOWEVER, THE DRIVE MODULES WILL BE SUPPLIED WITH DIFFERENT INPUT OR INTERFACE CIRCUIT BOARDS DEPENDING ON THE SYSTEM. IF BOTH SERVOPRO-I AND SERIES 7 MDPAK SYSTEMS ARE INCLUDED IN THE SAME ORDER, MAKE SURE THE CORRECT DRIVE IS MATCHED WITH EACH SYSTEM.

NOTE

When a shipment is received, the components should be identified according to the appropriate system before they are installed.

1.3 COMPONENTS

The ServoPro-I Motion Control Systems are based on the use of brushless motors with encoders as feedback devices. Each drive module is matched to the motor for the specific application. Each drive module is used with only one motor assembly. Transformers, however, can be used with one or more drive modules, depending on the wattage requirements of the drive modules.

The ServoPro-I system consists of the controller (command module and drive module) and motor. Dimensions and specifications for each of the controllers and motors are contained in **Appendix C**. (The encoders — used as feedback devices — are an integral part of the motor assembly.)

1.3.1 CONTROLLER

The ServoPro-I controller consists of the command module and the drive module. One command module design is common to all ServoPro-I systems. The drive module varies based on the system requirements. **Figure 1.4** shows the assembled controller with the drive module attached to the command module and the mounting bracket.

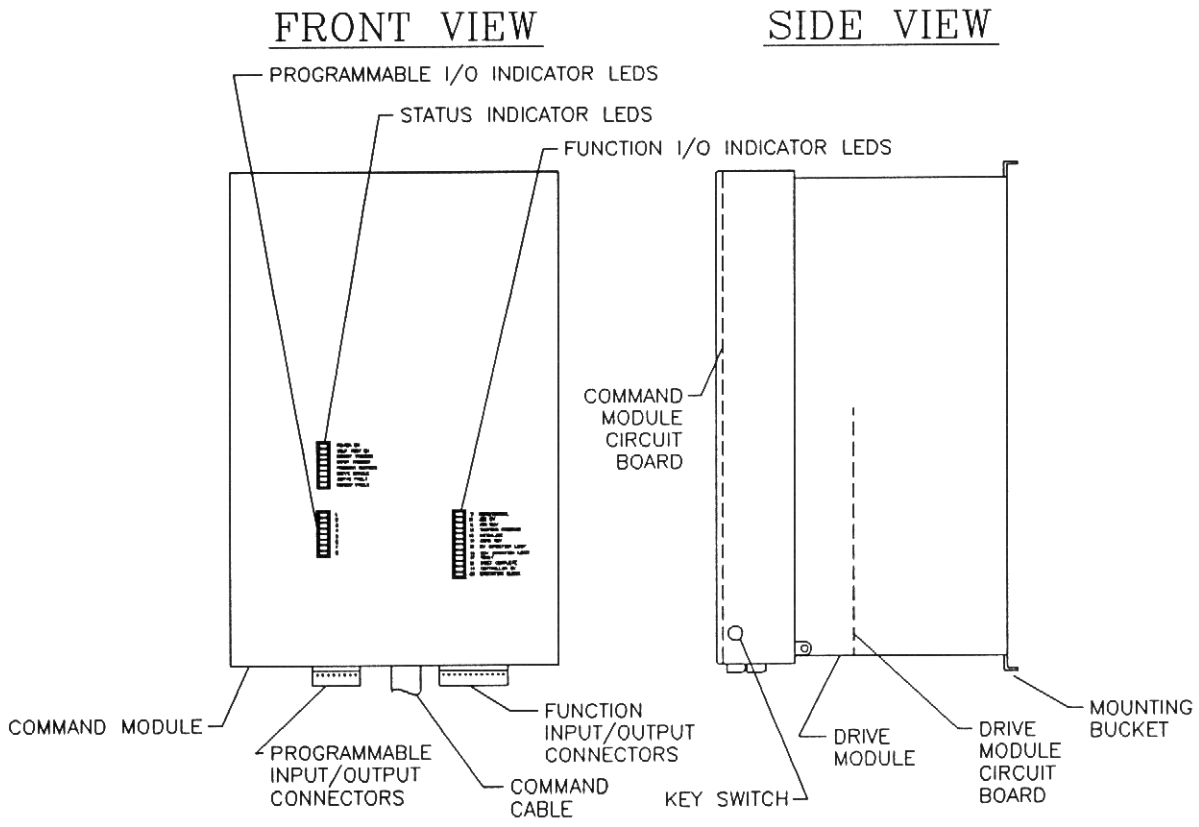


Figure 1.4 - ServoPro-I Controller

1.3.1.1 Command Module

The command module consists of a single circuit board mounted inside a metal cover. Several LEDs on the solder-side of the circuit board are used to present a display of the operating status of the system (refer to **Figure 1.4**). Optically-isolated input and output modules are mounted on the component-side of the board along with the various system connectors (refer to **Figure 1.8**).

Status Indicator LEDs: This group of eight LEDs illuminate to indicate the status of various operating conditions for the controller. By observing these LEDs, the operator can determine if the system is operating and can also make certain diagnostic conclusions. (Refer to **"Section 4 - Controls and Operation"** and **"Section 5 - Troubleshooting"** for additional details on these LEDs.)

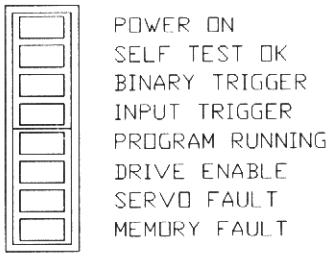


Figure 1.5
Status Indicator LEDs

Programmable I/O Indicator LEDs: Each of these eight LEDs will be illuminated when its corresponding input or output module is actuated. The LED will remain on as long as the input or output is actuated. The LEDs are numbered 1 through 8 and correspond to I/O positions K1 through K8 respectively (refer to **Figure 1.8**). (Any of these I/Os can be either an input or an output based on user selection. Refer to **"Section 4 - Controls and Operation"** for additional details on these LEDs.)

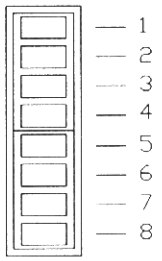


Figure 1.6
Programmable I/O
Indicator LEDs

Function I/O Indicator LEDs: Each of these twelve LEDs will be illuminated when its corresponding input or output module is actuated. The LED will remain on as long as the input or output is actuated. The LEDs are numbered 9 through 20 and correspond to input module positions K9 through K17 and output module positions K18 through K20 respectively (refer to **Figure 1.8**). (These are function specific inputs and outputs. Refer to **"Section 4 - Controls and Operation"** for additional details on these LEDs.)

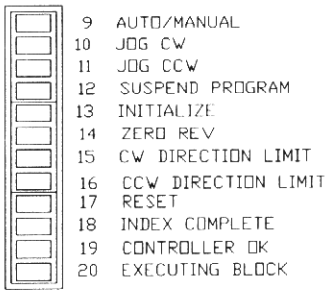


Figure 1.7
Function I/O
Indicator LEDs

Key Switch: This two position switch selects the RUN or PROGRAM operating modes for the command module. The key can be removed from the switch in either position to prevent unauthorized use.

Input/Output Connectors: These connectors are separate pieces supplied with the ServoPro-I. Each connector provides screw-clamp terminals for either 8 or 12 wires (4 or 6 input or output relays).

Mounting Bracket: The mounting bracket is an optional accessory available from Industrial Indexing Systems which can be used to support the ServoPro-I controller. (Refer to **"Section 2 - Installation"** and **Appendix C.**)

Function Input/Output Modules: Each of these input and output modules serve specific functions as described in **"Section 4 - Controls and Operation"**. Positions 9 through 17 are inputs; positions 18 through 20 are outputs. Each position can utilize either an AC or a DC optically-isolated module. (Refer to **"Section 1.7 - Specifications"** for module specifications.)

DIP Switch Assembly (S2): This 8-position DIP (Dual In-line Package) switch assembly is used to match the command module to specific operating conditions. Switch position #1 selects Operator Interface or personal computer programming. Switch position #2 is used to enable the password protection to prevent unauthorized use when key switch is not used. Switch position #3 selects outputs state on switch over (PROG-RUN). Switch postion #4 enable CACR digital drive usage. Switch position #5 is used to select the test mode for the command module. Switch position #6 is used to select the current limit option. Switch position #7 is used to select the continuous drive enable option. Switch position #8 is used to select single-turn or multi-turn initialization. (Refer to **"Section 4 - Controls and Operation"** and **"Section 5 - Troubleshooting"** for additional information on the functions of the DIP switch assembly.)

Feedback Pulse Indicator LEDs: These three LEDs — one for each feedback signal channel — illuminate each time a feedback pulse is received from the drive module and are used for diagnostic purposes. (The drive module receives position information from the encoder and transmits two quadrature pulse streams and a marker pulse stream to the command module.)

Programmable Input/Output Modules: Each of these I/O modules (positions 1 through 8) may be specified as inputs or outputs. Each position can utilize either an AC or DC optically-isolated input module or output module. (Refer to **"Section 1.7.3 - Input and Output Modules"** for module specifications.)

Power Fuses: There is one 220 VAC fuse for each input power leg.

Programmable Input/Output Connector Block: This connector block accepts one or two 8-terminal input/output connectors for wiring connections for the eight Programmable I/Os. The silk screen on the cover shows which terminals are associated with each I/O (refer to **"Section 2 - Installation"**).

Command Cable: The command cable connects to the command module circuit board at the location shown (refer to **Figure 1.8**). The other end plugs into the command cable connector on the drive module circuit board and is keyed for proper orientation.

Function Input/Output Connector Block: This connector block accepts one or two 12-terminal input/output connectors for wiring connections for the twelve Function I/Os. The silk screen on the cover shows which terminals are associated with each I/O (refer to **"Section 2 - Installation"**).

Peripheral Port: This 15-pin connector provides an input connection for the peripheral thumbwheel input modules. All peripheral thumbwheel modules are daisy-chained (connected in series). Each has one male and one

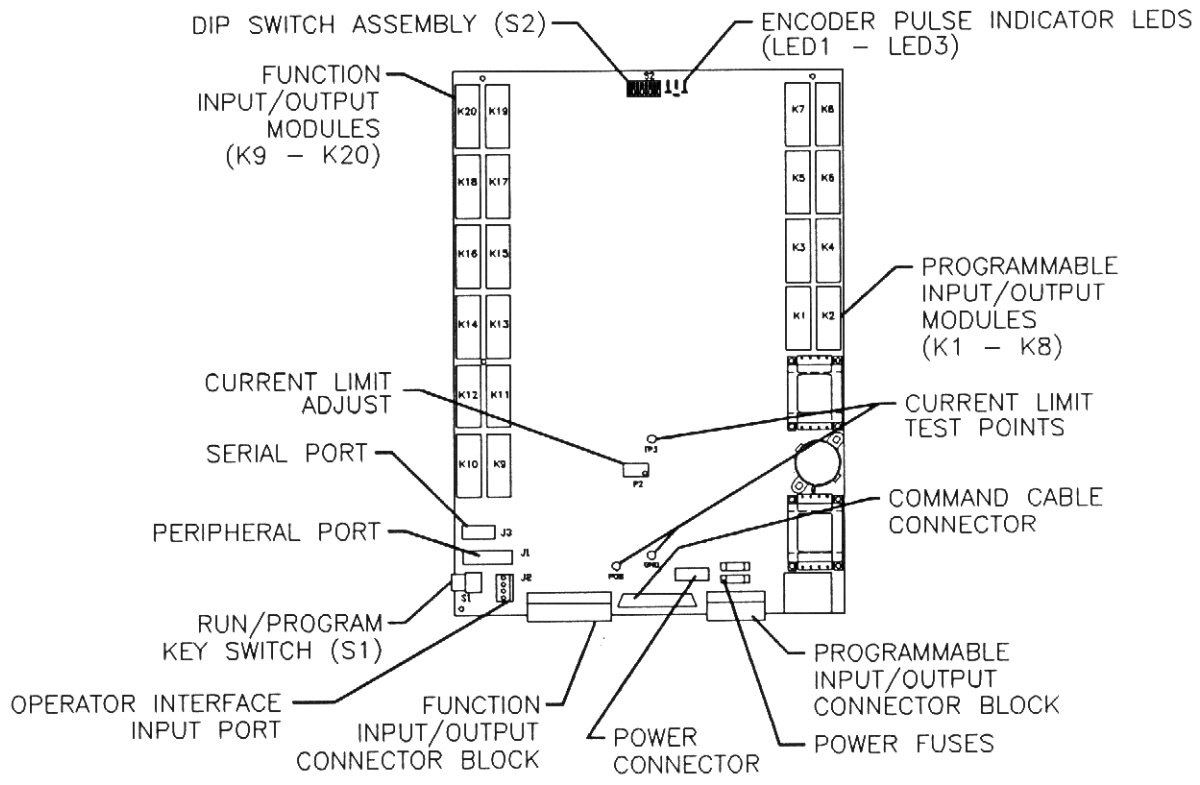


Figure 1.8 - Command Module Circuit Board

female peripheral port. The peripheral cable from the male connector on the first thumbwheel module connects to the female connector on the command module. The cable from the male peripheral port on each succeeding thumbwheel module connects to the female peripheral port on the previous module. Up to four modules can be connected to the command module and will be powered from the command module.

Operator Interface Input Port: This four-pin connector is used for communication with the OPI-1 or OPI-5 operator interface device. The female end connector on communications cable C-957yyy or the attached communications cable on the OPI-5 plugs into this male connector.

Serial Port: This 9-pin connector is the interface between the command module and a personal computer used for programming (refer to manual IB-15B002 *"ServoPro Programming With The Personal Computer"*).

1.3.1.2 Drive Module

The drive module converts the signals from the command module and the power from the transformer into usable energy to rotate the motor shaft. The drive module has its power supply, control section, driver section, and output stage integrated into one chassis. Access to any setup, fault indication, or reset components requires lowering of the command module and removal of the drive module cover.

WARNING

HIGH VOLTAGES MAY BE PRESENT IN THE DRIVE MODULE EVEN WITH THE POWER DISCONNECTED. USE EXTREME CAUTION WHEN ACCESSING THE INTERIOR OF THE DRIVE.

1.3.1.3 Setting Parameters

Industrial Indexing Systems' BSD7 servodrives use all-digital controls. The parameters are preset at the factory for nominal applications. In some cases, a custom set of parameters may be preset into the drive. If parameters need to be verified or changed, refer to the following section. Parameters are set by means of easy-to-use pushbutton switches and LED monitor display on the servodriver's front panel, or by using an optional serial communciation adaptor.

1.3.1.4 Using the Pushbutton Switches

To change settings, lift up the acrylic panel at the bottom of the servodrives front panel until it is locked in its upward position.

After making parameter settings using the pushbuttons, lower the acrylic panel to its protective position. A slight force is needed to unlock the panel from its upward position.

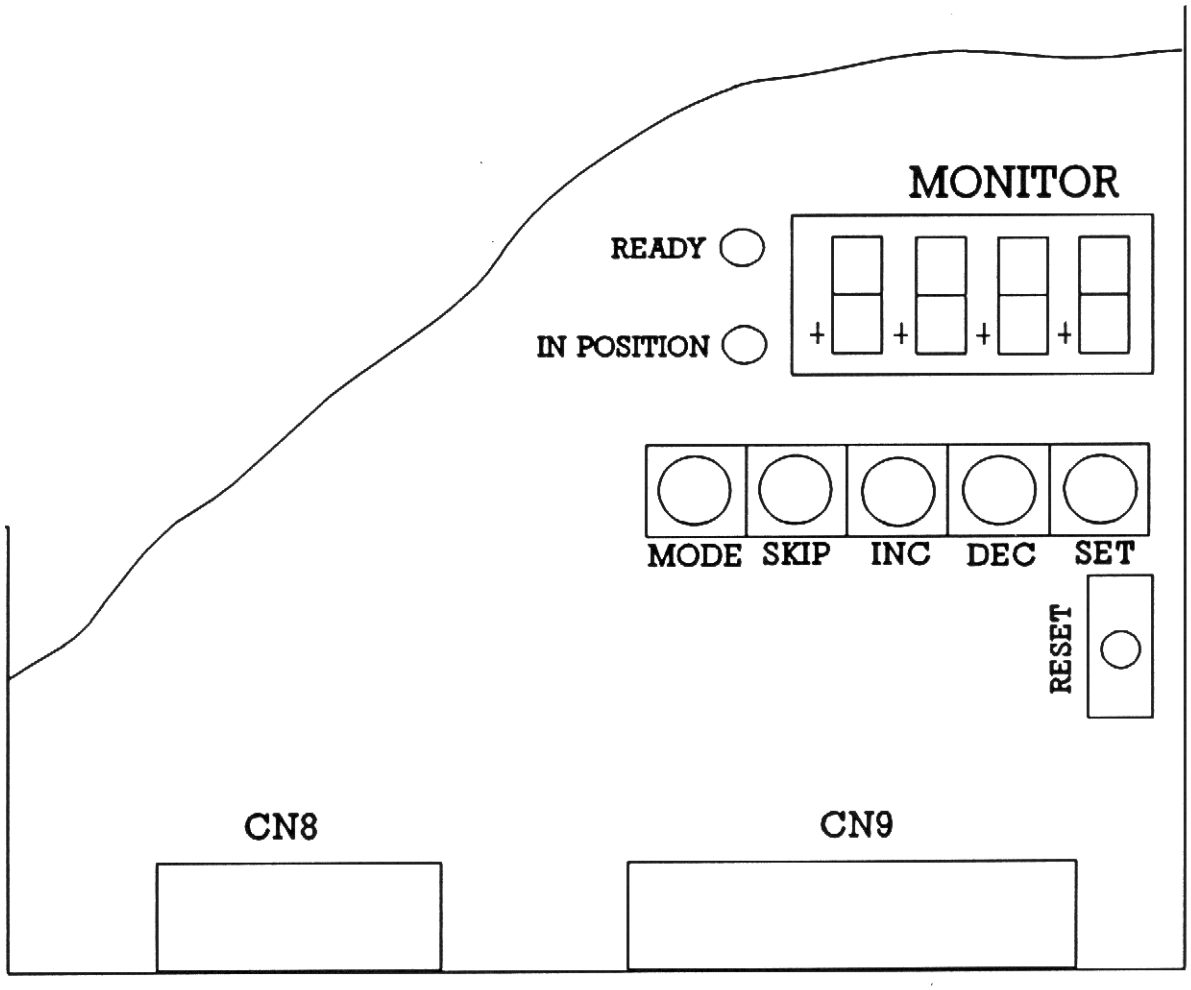


Figure 1.9 - Servo Drive Monitor & Pushbuttons

1.3.1.5 Monitor Display Characters and Switch Functions

MONITOR LED: Displays <Parameter name>, <Parameter value> and <Operation state>. **Table 1.1** lists alphabet characters and numerals used for display.

Numerals	Alphabet Characters			
0	A	I	p	v
1	B	J	Q	W
2	b	K	q	X
3	C	L	R	Y
4	D	M	r	Z
5	d	N	S	-
6	E	n	T	(minus)
7	F	O	t	+ (plus)
8	G	o	U	/
9	H	P	V	•

Table 1.1 - LED Display Characters

- <Parameter value> is either a numeric value or alternative selection. See parameter descriptions and menu map for details.
- The display will change continually if any switch is pressed and held for more than one second.
- The display blinks when it changes from <Parameter name> to <Parameter value>, or from <Parameter value> to <Parameter name>.

[MODE] Button:

- When <Parameter name> is displayed:
  Each press of the MODE button causes the next succeeding <Parameter name> to be displayed. The MODE button sequences forward through the menu.
- When <Parameter value> or <Operation state> are displayed:
  Pressing the MODE button causes the display to change to next <Parameter name>.
- If the displayed <Parameter value> was modified, pressing the [MODE] button temporarily saves the <Parameter value> until the power is removed. Only the [SET] button stores <Parameter value> in the nonvolatile memory.

[SKIP] Button:

- When <Parameter name> is displayed:
  Each press of the [SKIP] button causes the previous <Parameter name> to be displayed. The [SKIP] button sequences backwards through the menu.

- When <Parameter name> is displayed:
  Display changes to <Operation state> when [MODE] and [SKIP] switches are pressed simultaneously. The programming menu is also set to the top.

[INC]/[DEC] Switch:

- When <Parameter value> is displayed:
  The lowest digit of <Parameter value> increases or decreases, or items for alternative selection are displayed alternately, as you press the [INC]/[DEC] switches. The displayed contents are reflected in the control of the system, but are not stored in nonvolatile memory. Accordingly, the contents will be lost when power is disconnected. All <Parameter values> return to the state before operation of these switches when power is reconnected. To store data in the system's nonvolatile memory, press the [SET] switch when <Parameter value> is displayed.

- When <Parameter value> is displayed:
  The higher digit of <Parameter value> increases or decreases (step change) by one when the [INC] or [DEC] and [SKIP] switches are pressed simultaneously. This is primarily used for large changes in the <Parameter values>.

[SET] Switch:

- When <Parameter name> is displayed:
  Pressing the [SET] button causes the display to change to <Parameter value>.

- When <Parameter value> is displayed:
  Pressing the [SET] button causes the <Parameter value> currently being displayed to be stored in the system's nonvolatile memory. After storing, the display moves to the next <Parameter name>.

CAUTION

TO SAVE THE REVISED PARAMETER VALUE IN NONVOLATILE MEMORY, DISPLAY THE <PARAMETER VALUE> AND PRESS THE [SET] SWITCH. ONLY THOSE PARAMETERS BEING DISPLAYED WILL BE SAVED IN NONVOLATILE MEMORY. IF THE REVISED CONTENTS ARE NOT SAVED IN NONVOLATILE MEMORY, THEY WILL BE LOST WHEN POWER TO THE SYSTEM IS DISCONNECTED, AND THE VALUE THAT WAS LAST [SET] INTO NONVOLATILE MEMORY WILL BE USED.

1.3.2 MOTOR ASSEMBLIES

Figure 1.10 shows a representative illustration and the typical location of the components which will need to be accessed during installation or operation of the motor assembly.

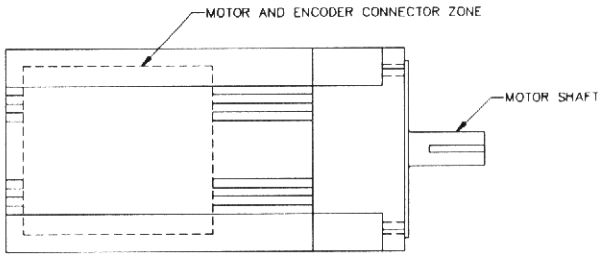


Figure 1.10
Motor Assembly

Motor/Drive Connector: The drive connector is used for the power supply cable from the drive module to the motor.

Encoder Connector: This connector is used for the encoder cable from the drive module. In the ServoPro-I Motion Control Systems, the encoder sends all signals to the drive module through CN8. The drive module transmits an output signal to the command module through CN9.

1.3.3 TRANSFORMERS

The ServoPro-I Motion Control Systems use a variety of transformers to match the load requirements of the various system configurations and available prime supply voltages. An isolation transformer is recommended on the incoming main power to eliminate any possible safety hazard and/or damage to the drive module in the event of a grounding fault on the output. Each of the transformers supplies 230 VAC output to the drive module. They also have additional taps for 207 VAC and 253 VAC outputs (± 10%) which can be used when the supply voltage is too high or too low. The transformers may be panel-mounted or free-standing. Refer to **Appendix E** for mounting type, specifications, dimensions, and wiring configurations for the transformers.

Transformers can be used to supply power to one or more ServoPro-I systems. The only restriction is that the output power of the transformer must be equal to or greater than the combined input power of the ServoPro-I systems. Refer to **"Section 2 - Installation"** for details on connecting the transformer to multiple ServoPro-I systems.

1.3.4 CONNECTING CABLES

There are a variety of cables used with the ServoPro-I systems. Each is used for a specific application. (Refer to **"Section 2 - Installation"** for interconnection details.)

C-320yyy The encoder cable attaches between the encoder connector on the motor assembly and the drive module. When the AC-100095

connector interface is present, it is inserted between the drive module and the encoder cable.

NOTE

The connecting cables are considered optional equipment and must be ordered separately. The "yyy" designation at the end of each cable number is to be replaced by the length of the cable in feet.

C-653yyy This motor cable attaches between the motor/drive connector on the motor and the drive module through a customer supplied terminal strip for drive modules greater than 3000 watts and less than 3700 watts.

C-659yyy This motor cable attaches between the motor/drive connector on the motor and the drive module through a customer supplied terminal strip for drive modules equal to or less than 2000 watts.

C-805yyy This power cable provides power from the drive module to the command module for drives of greater than 1000 watts.

C-806yyy This power cable provides power from the drive module to the command module for drives of 1000 watts or less.

C-901yyy This peripheral cable attaches between each of the thumbwheel modules and between the first thumbwheel module and the command module.

C-957yyy This communication cable attaches from the OPI-1 operator interface to the operator interface connector on the command module.

C-975yyy This Communication cable attaches from the serial port on the command module to a 9-pin serial port on a personal computer.

C-976yyy This Communication cable attaches from the serial port on the command module to a 25-pin serial port on a personal computer.

Refer to **Appendix F** for drawings of each of the connecting cables.

1.3.5 SERVOPRO-I CONFIGURATIONS

ServoPro-I will detect presence of one of three drive types.

1.	RAD02-XXXX	Analog	1024 PPR	Gain = 16
2.	BSD7-XXXX	Digital	2000 PPR	Gain = 8
3.	CACR-XXXX	Digital	1024 PPR	Gain = 16

The type and PPR will be displayed on power up screen under the SFO and Rev. level.

If in main menu, pressing F4 will re-display the power up screen.

NOTE

To select CACR-XXXX drive you still need to turn "on" S2-4 and leave it "off" for either RAD02-XXXX or BSD7-XXXX drive. (Refer to Section 4.1.4).

When switching from one drive type to another the digital compensation will be reset.

When the ServoPro is powered up with no drive connected the "servo fault" LED will flash. This situation is contrary to what happened in previous revisions of firmware before SFO9103RC.

1.4 AUXILIARY DEVICES

The auxiliary devices associated with the ServoPro-I Motion Control System include the thumbwheel remote modules and the operator interface (OPI-1 or OPI-5). If system parameters are to be changed, one or more of these devices must be available. In addition, the operator interface can be used as a programming device (refer to "**Section 3 - Programming With Operator Interface**").

1.4.1 TWR-400A Thumbwheel MODULE

The TWR-400A thumbwheel remote module provides input data as determined by the system program. The ServoPro-I Motion Control System can have up to four thumbwheel modules connected to it. Each thumbwheel module must be uniquely identified as TW1, TW2, TW3, or TW4 — two modules cannot have the same identity.

Thumb Wheels: The operator interface of the TWR-400A consists of six sealed thumbwheel switches (refer to **Figure 1.11**). The first switch alternates between a plus and minus sign (used to indicate rotation direction.) The other five switches have digits from "0" to "9". Turn the first thumbwheel to "+" for clockwise rotation or to "-" for counterclockwise rotation (assuming positive engineering units). Turn the other five thumbwheels to the digits representing the desired value in engineering units.

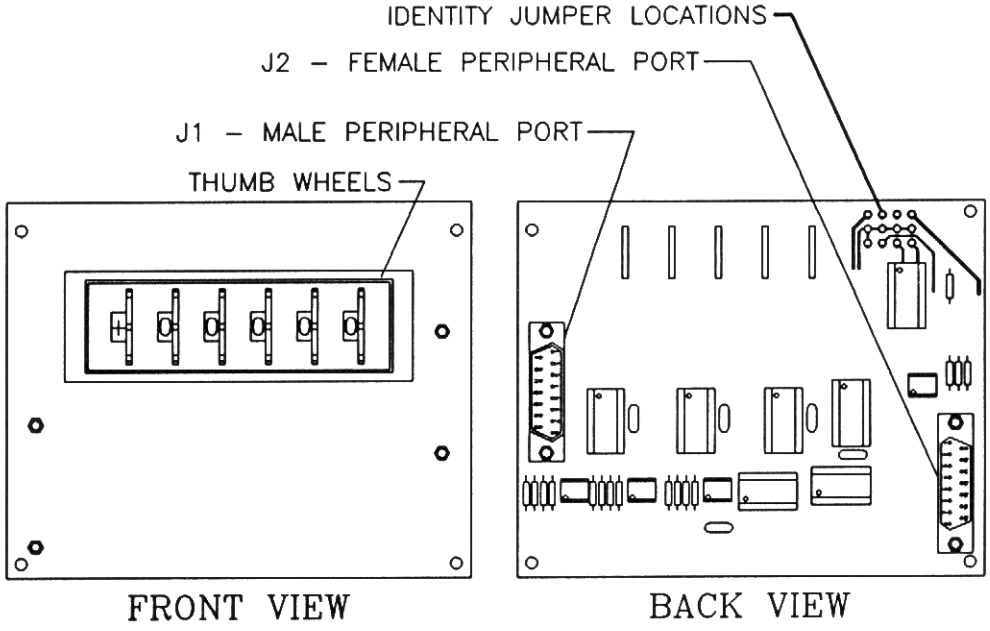


Figure 1.11 - TWR-400A Thumbwheel Input Module

J1 - Male Peripheral Port and J2 - Female Peripheral Port: The thumbwheel module is daisy-chained (connected in series) with other thumbwheel modules and the command module using the two peripheral ports provided on the module and C-901yyy peripheral cables. (The ports are bi-directional serial ports.) Power for the modules is provided from the command module.

Identity Jumpers: Four jumper locations are provided on the back of the TWR-400A thumbwheel module (refer to **Figure 1.12**). As produced, the thumbwheel is configured as TW1 with a solder trace from hole "A" to hole "1". Other identities are achieved by cutting this trace and providing a jumper at the desired identity location.

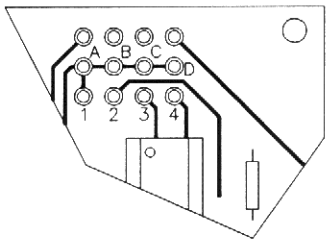


Figure 1.12
Jumper Locations

1.4.2 OPERATOR INTERFACE PROGRAMMING/INPUT DEVICE

The OPI-1 and OPI-5 operator interface devices are used for both programming and data input during operations of the ServoPro-I Motion Control System. The units are identical except that the OPI-1 is panel mounted and is usually an integral part of the system control panel while the OPI-5 is mounted in its own enclosure and is usually used as a remote device for programming or occasional parameter changes.

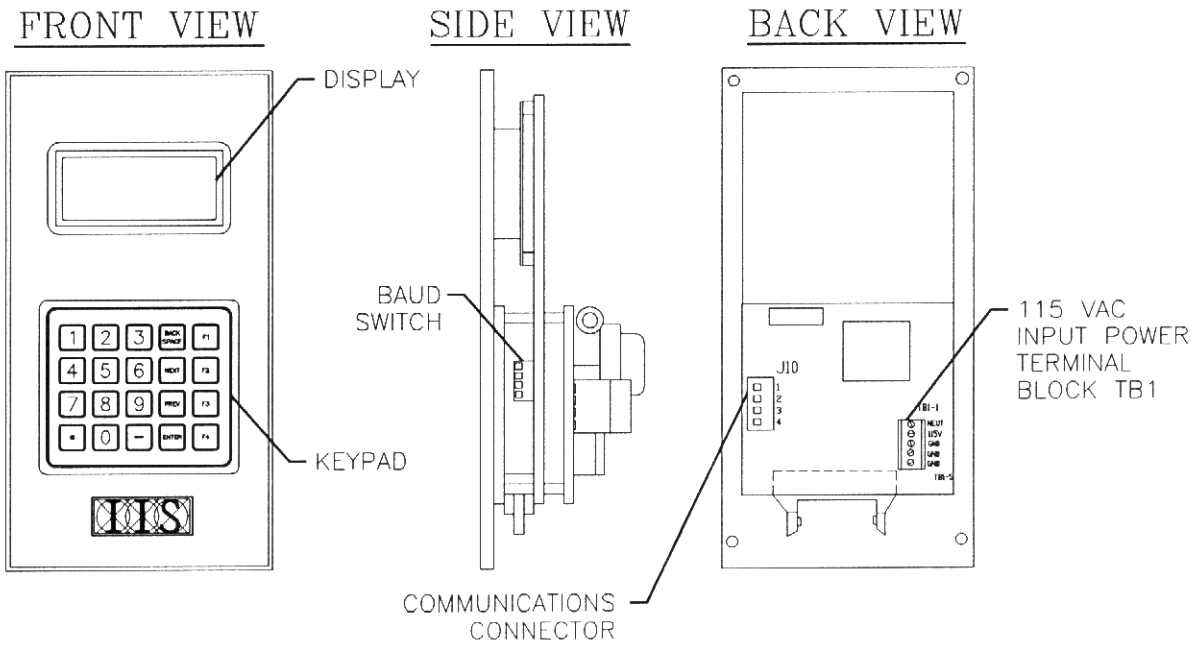


Figure 1.13 - OPI-1 Panel-mount Operator Interface

1.4.2.1 OPI-1 Panel-mount Operator Interface

Display: The four-line liquid crystal display reflects the menu and programming information used by or entered by the operator.

Keypad: The touch-panel keypad is used by the operator to enter data and make programming selections. It consists of 10 numeral keys plus decimal point and minus sign keys, four function keys ([F1] through [F4]) used to make various selections during the programming procedure, and four special function programming keys ([BACK SPACE], [NEXT], [PREV], and [ENTER]).

Baud Switch: This four-position DIP (Dual In-line Package) switch is used to set the OPI-1 to the proper communications settings of 4800 Baud with 8 data bits and 1 stop bit. (Refer to **"Section 2 - Installation"** for proper switch settings.)

Communications Connector (J10): This four-pin connector is the attachment location for the C-957yyy communications cable which connects the OPI-1 to the ServoPro-I command module. (Refer to **"Section 2 - Installation"** for connection details.)

Terminal Block TB1: This five-terminal terminal block is the attachment location for the 115 VAC input power required to operate the OPI-1. (Refer to **"Section 2 - Installation"** for connection details.)

1.4.2.2 OPI-5 Portable Operator Interface

The OPI-5 portable operator interface (refer to **Figure 1.14**) is identical to the OPI-1 panel-mount operator interface except it is mounted in its own enclosure for portability. The Baud Switch is factory set to the proper settings for communication with the ServoPro-I command module.

Communications Cable: This 10' cable is internally connected to the J10 communications connector. The free end has a four-pin connector suitable for connecting to the operator interface input port on the ServoPro-I-I command module.

Power Cord: This 6' power cord is internally connected to terminal block TB1. The free end has a standard 115 VAC, 15 Amp, grounded plug for insertion into a grounded receptacle.

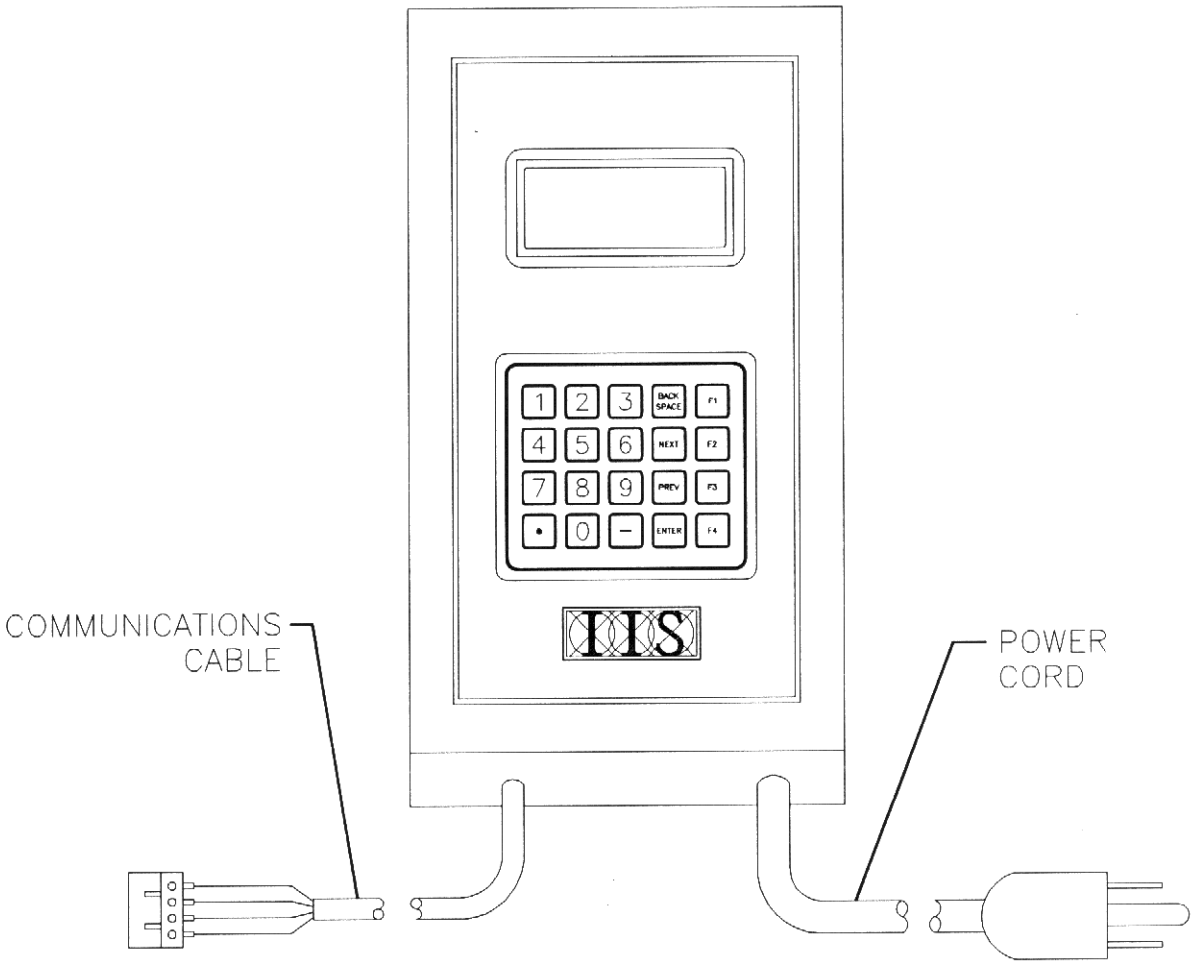


Figure 1.14 - OPI-5 Portable Operator Interface

1.5 SYSTEM OPERATIONS

The ServoPro-I Motion Control System has three types of operations: Run (which includes automatic operation and manual operation), Programming, and Test.

1.5.1 RUN

The ServoPro-I Motion Control System will operate when the key switch is in the RUN position. The OPI may be used to enter RUN MODE by selecting [F3] and [F4] to exit RUN MODE when the key switch is set to program. The status of Input #9 - Auto/Manual determines whether the system will operate automatically or manually. If Input #9 is OFF, the system will be in manual operation only. The allowable commands are: "Jog Clockwise", "Jog Counterclockwise", "Initialize" and "Reset" which are explained later in this section. Refer to **"Section 4 - Controls and Operation"** for details on manual operations of the ServoPro-I Motion Control System.

If Input #9 is ON, the system will operate in automatic mode. The operations of the system will be controlled by the various inputs as defined by the system program. All functions of the system described in this section are available in automatic operation. Refer to **"Section 4 - Controls and Operation"** for details on automatic operations of the ServoPro-I Motion Control System.

NOTE

RUN — including all manual or automatic operations — will be terminated and the motor shaft will decelerate to zero speed if the key switch is turned to PROGRAM.

If switch position #7 on DIP switch S2 is OFF, the drive will always be disabled upon entering PROGRAM mode and enabled when entering RUN mode. If DIP switch position #7 is ON, the RUN/PROGRAM key switch will not affect the state of the drive enable.

1.5.1.1 Execution Methods

During automatic operations, the ON status of programmable inputs #1 through #8 will cause the related program blocks to be executed based on the defined execution mode. If the execution mode was defined as "Input Trigger", the block numbered the same as one of the inputs will begin executing (when the system detects a change in state from OFF to ON for that input). Only block numbers 1 through 8 are permitted.

If the execution mode was defined as "Binary Trigger", Inputs #1 through #7 are assigned a binary number as shown in **Table 1.2**. When the system detects a change in state for Input #8 (the "MOVE" input) from OFF to ON, the block will be executed which corresponds to the binary number represented by the sum of the binary number of all the Inputs (#1 through #7) which are ON. The maximum block number is 127 — "0" is not used. (Refer to **"Section 3 - Programming with Operator Interface"**, **"Section 4 - Controls and Operation"**, and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for additional details on the execution mode and the programmable inputs.)

Table 1.2
Binary Codes

USER I/O #	BINARY CODE
1	1
2	2
3	4
4	8
5	16
6	32
7	64

NOTE

The Binary Trigger definition only applies to the start of block execution. Once a program is running, the programmable inputs are defined as inputs (or outputs) #1 through #8 for the various program functions such as *Wait for Input* and *Search for Input*. Inputs #1 through #7 will again be viewed as a binary code and Input #8 will again be viewed as the MOVE input after the block execution is complete. The Input #8 signal must be edge-triggered (the system must see a transition from OFF to ON in Input #8 after the block execution ends) before it will read the other inputs for their binary code and begin execution of a new block.

1.5.1.2 Engineering Units

All movement data is communicated to the ServoPro-I Motion Control System in terms of "Engineering Units". Engineering units are defined as any conversion which can be expressed as units per motor shaft revolution. They do not have to be a specific distance unit such as inches or millimeters. For example, if a trimming machine can work on pieces that are always located on multiples of 5/16" apart, the engineering units could be the number of 5/16" moves per shaft revolution. (Refer to **"Section 3 - Programming with Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on setting engineering units.)

NOTE

The default engineering units value is 1.000. This value will be used by the system if no other value is programmed.

Engineering units may be positive or negative. If they are negative, all standard direction conventions are reversed. With positive engineering units, a positive data entry causes:

Position: Final position is clockwise from the 0.0 position. Shaft rotation direction will depend on starting position.

Index: Shaft will rotate clockwise.

1.5.1.3 Digital Compensation

The programming function allows the command module to customize the digital compensation of the drive module by altering the "Proportional Gain" (P), "Integral" (I), and "Differential" (D) terms. These terms can be adjusted to customize the system's response, stability and steady state control.

NOTE

The system response is the performance exhibited due to an input command. The system response will be affected by the load and/or input command.

Stability is the effort put forth to control the load undergoing sudden changes without braking into oscillation or resonance.

The systems steady state control is the rejection observed in the presence of significant disturbance.

The controller (on power up) defaults to a proportional gain system. The default gain value of 8 provides an overall system gain of 1 which will produce a POS OUT signal of 24 volts per revolution of the encoder. The value can be set in a range of: 1 to 256. P = 256 will produce a POS OUT signal of 24 volts per 1/16 revolution of the encoder shaft. P = 1 will produce a POS OUT signal of 24 volts per 16 encoder revolutions. Altering the proportional gain value will change the system's response and rigidity.

The integral term is introduced into the ServoPro-I system when the proportional gain cannot compensate for steady-state errors. The valid range for the integral term is -127 to +127 (default value is 0). The actual amount added is system dependent because the integral term introduces an anticipated error. During steady-state operations, it reduces the position error, thus providing more accurate position tracking. During acceleration or deceleration ramps, it can increase the system responsiveness by tending to overshoot the commanded value.

The differential term is introduced into the ServoPro-I system to control the rate of change. It has the effect of rounding the acceleration and deceleration ramps to reduce overshoot of the commanded value. The valid range for the differential term is -127 to +127 (default value is 0). The actual amount added is system dependent. The differential term

benefits the ServoPro-I system by reducing overshoot and providing more stability and better response by damping oscillations. Because the differential term suppresses oscillations, the proportional gain term can be increased to provide a more responsive system.

1.5.1.4 Current Limit

The current limit option is enabled by placing switch position 6, on the dip-switch assembly S2 on the command module, in the ON position.

> *** NOTE ***
>
> **This switch is only read on Power-Up.**

The peak current output from the drive can be reduced from the standard 200% for 400 through 3700 watt drives down to 20% of rated current by adjusting the voltage at TP3. The voltage at TP3 is adjusted by potentiometer P2. The allowable voltage range at TP3 is 0.60V DC to 10V DC.

The voltage to % current relationship is as follows:

$$\%current = 200\left(\frac{V_{TP3}}{10}\right)$$

(400 - 3700 watts)

> *** NOTE ***
>
> If the current limit option is disabled (factory setting switch position 6 of dipswitch assembly S2), then the full 200% of rated current will be available, the voltage reference at TP3 is ignored. See figure 1.8 for locations of TP3 and P2 on the circuit board.

1.5.2 PROGRAM

The program mode is active when the key switch is turned to PROGRAM. This mode is used for all system programming and entering of setup data. Programming can be done with an OPI-1 or OPI-5 operator interface as described in "**Section 3 - Programming with Operator Interface**" or with an IBM-compatible personal computer as described in manual IB-15B002 *"ServoPro Programming With The Personal Computer"*. Refer to the appropriate section for complete programming information.

1.5.3 TEST

The test mode is a special diagnostic mode used in troubleshooting the system. When power is applied to the system with switch position 5 ON located at DIP switch assembly S2 on the command module circuit board, the system will be put into the test mode. The operator can then use the operator interface to request and view selected system status data. (Refer to **"Section 5 - Troubleshooting"** for detailed information on use of the test mode.)

1.6 SYSTEM FUNCTIONS

The ServoPro-I Motion Control System provides a full range of single-axis indexing-system functions to allow maximum flexibility for the user. This section presents a description of each of these functions. Refer to **"Section 1.7 - Specifications"** for a summary of all application limits. Refer to **"Section 3 - Programming with Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on programming each type of function.

The primary function of the motion control system is to regulate motor shaft rotation. The system controls the speed and amount of shaft rotation. It also controls the acceleration and deceleration rates so the entire motion of the motor shaft (and, therefore, the load attached to the motor shaft) is under the control of the ServoPro-I system. This control depends on the system functions being executed, the controls chosen for the functions, and the setup parameters established for the system.

The sequence of functions and any function controls are established when the program is developed. They will remain the same until the program is changed, although a program can have a variety of blocks (program step sequences) which will implement based on which inputs are actuated. Thus one program can be written containing a variety of movement options. The machine controls (or manual controls) can be used to actuate the desired inputs which will cause each of these blocks to execute as explained in **Paragraph 1.5.1**. (Also refer to **"Section 4 - Controls and Operation"**.)

NOTE

There are a maximum of 127 steps allowed in a program. These steps can be combined into as many blocks as required, but the total of all steps in all blocks is limited to 127.

1.6.1 INDEXING/POSITIONING

There are two basic types of incremental movement: indexing and positioning. An "*Index*" is a movement relative to the location of the shaft when the movement is started. A "*Position*" is a movement relative to a fixed 0.0 location. The amount of movement for either *Index* or *Position* can be fixed (established in the program) or can be read from a thumbwheel module or operator interface during the execution of the program.

NOTE

All distance data is entered in terms of "Engineering Units".

If the distance input is taken from a thumbwheel module, the module will automatically be scanned by the program. If the distance input is to be taken from the operator interface, the system will prompt the operator for the required data on the operator interface display.

CAUTION

To avoid possible problems, the settings of the modules should not be changed while the program is operating since the thumb-wheel modules are automatically scanned as required and an incorrect reading could be taken while the thumb wheels are being changed.

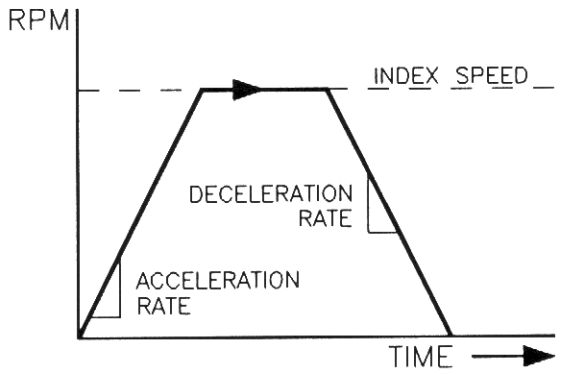


Figure 1.15
Normal Index Cycle

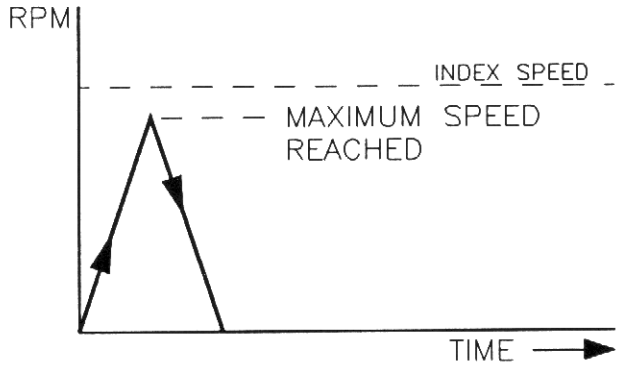


Figure 1.16
Short Index Cycle

The command module calculates the time required to reach the set distance allowing for the set acceleration/deceleration ("Ramp") rate and controls the motor accordingly. **Figure 1.15** shows a normal motor indexing/positioning motion cycle. **Figure 1.16** shows a cycle where there is not enough time to reach "Index Speed". In this case, the command module only allows the motor to accelerate and decelerate as much as necessary to reach the desired index/position distance. When possible, the system parameters should be set to achieve the type of curve shown in **Figure 1.15** with one-third of the cycle for acceleration, one-third at index speed, and one-third for deceleration. This type of curve minimizes the RMS power required by the system.

1.6.1.1 Modified Sine Indexing/Positioning

The ServoPro-I Motion Control System provides the capability of altering the normal trapezoidal ramp shape during *Index* or *Position* commands. This "modified sine" acceleration and deceleration (refer to **Figure 1.17**) helps reduce the torque load on the motor by altering the amount of speed change required as the system starts to accelerate or decelerate, thereby generating less strain on the motor and load.

The system allows nine different "degrees" of modified sine ramp rates in addition to the standard (Degree 0) trapezoidal ramp. The desired degree of modified sine ramp is selected when the system is programmed (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"*).

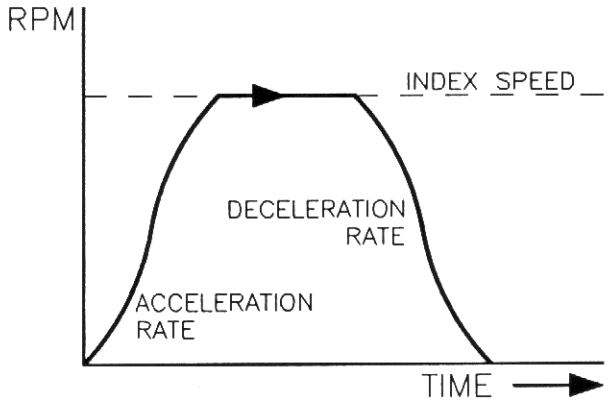


Figure 1.17
Modified Sine Index Cycle

Degree 0 is the normal trapezoidal shape with no modification. Degree 1 through Degree 9 increasingly modify the ramp shape with Degree 9 being the maximum modification. The proper modified sine ramp for a given system will depend on the operating characteristics of the system including the load, inertia, system losses, and desired speed and acceleration. The proper degree of modified sine must be determined by experimentally trying various settings.

NOTE

The "degree" of modified sine refers to the relative amount of modification. This "degree" should not be confused with angular degrees. "Modified Sine" refers to the shape of the ramp and a "degree" is the shape selected. This is not the Sine of an angular number of degrees. This modification will alter the times and speeds involved in the motion profile while keeping the displacement (position) constant.

1.6.1.2 Search For Input

The *Index* or *Position* command can be further modified by the use of the *Search For Input* (*Search For I/O*) command. The *Search For Input* control function (sometimes referred to as registration) is a "feed-to-sensor" function for indexing or positioning on an external switch or sensor. During the programming operations, a variety of parameters are established which define the *Search For Input* command (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"*). These parameters are:

Search Distance: The maximum distance to be traveled — after decelerating to the set speed — if the input is not actuated.

Post Distance: The distance to be traveled after the input is actuated.

Input Number: Which programmable input is to be used.

I/O ON/OFF: Which state (ON or OFF) of the input is considered as energized for the purposes of this command.

Speed: The speed of the motor at which the *Search for Input* function will start after it decelerates from the index speed.

NOTE

The *Search For Input* speed must be equal to or less than the *Index* or *Position* speed for this command to operate properly (or the system will only execute a move command). The system only searches for the input when it is operating at the search speed.

When the *Search For Input* control is used in the program, the *Index* or *Position* command will cause the motor shaft to rotate as it normally does for the specified *Index* or *Position* distance. However, the system will only decelerate (at the preset ramp rate) to the *Search For Input* speed instead of decelerating to zero speed. The system will continue to move at this speed until the designated input is actuated. When the input is actuated (either turned ON or OFF as dictated by the "I/O ON/OFF" parameter), the system will move and decelerate as necessary to travel the desired "Post Distance". At the end of this distance, the system will be at zero speed.

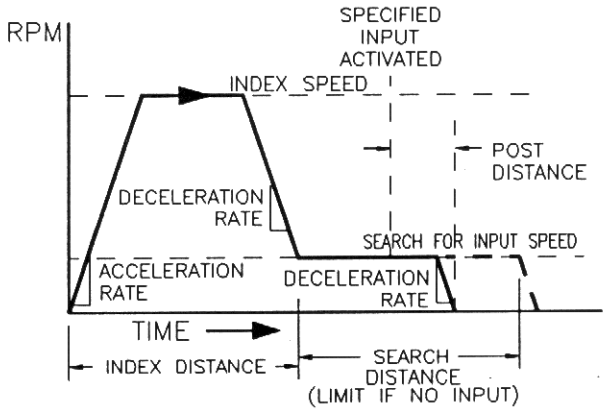


Figure 1.18
Index Cycle With Search For Input

If the input does not actuate, the movement will be terminated when the "Search Distance" is reached. The system will immediately decelerate at the preset ramp rate until it reaches zero speed.

1.6.1.3 Set 0.0 and Clear 0.0

All *Position* movements are relative to a 0.0 location. This 0.0 location is the angle of the motor shaft when power is applied to the system. This location can be changed when the system is initialized (refer to **Paragraph 1.6.2**). Once the initialized command is executed, the system will retain the initialized location as the 0.0 location (angle) until the system power is turned off.

The 0.0 location can also be changed temporarily through the use of the *Set 0.0* command. When this command is executed, the present angle of the motor shaft becomes the 0.0 location. All *Position* commands will be executed relative to the 0.0

location thus established until the system power is turned off, the *Initialize* command is executed, or the *Clear 0.0* command is executed.

The *Clear 0.0* command clears any temporary 0.0 location established with the *Set 0.0* command. The system will return to using the 0.0 location established when power was applied to the system or when the system was initialized.

1.6.2 INITIALIZE

The *Initialize* command rotates the motor shaft (resolver shaft) to the mechanical 0.0 angle. The *Initialize* speed, acceleration, and direction are entered when the system parameters are established (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"*).

> **NOTE**
>
> **The *Initialize* function can be used with either single turn or multi-turn applications. Set switch position 8 on DIP switch assembly S2 on the command module to OFF for single-turn initialization or to ON for multi-turn initialization.**

For single-turn applications, when the *Initialize* command is executed, the motor shaft will move in the direction and at the speed and acceleration specified until it reaches the 0.0 mechanical angle. If the motor is within 5 degrees of the 0.0 location, the command module will drive the motor shaft in the shortest direction to the 0.0 location.

When the system involves multiple turns, it is necessary to find the specific turn which has the 0.0 location, a zero revolution (0 Rev) input must be utilized in the system. This input is typically actuated by a switch or sensor which is configured in the system equipment to indicate which turn of that equipment has the 0.0 angle in it.

For example, in lead screw systems, locate a zero revolution switch at one end of the lead screw. Set the *Initialize* rotation direction for the rotation which will drive the lead screw nut toward the switch. When *Initialize* is executed, the motor drives toward the switch. When the switch closes, the 0 Rev input is actuated and the command module assigns the present motor rotation as the 0.X rotation. The motor begins deceleration to come to a rest, then it rotates back and stops at the mechanical 0.0 absolute angle in the 0.XX rotation.

CAUTION

THE SWITCH WHICH ACTUATES THE ZERO REV INPUT MUST BE MAINTAINED IN THE ACTUATED STATE FOR ANY SYSTEM POSITION PAST THE SWITCH IN THE DIRECTION OF INITIALIZATION. IF THE SWITCH IS NOT MAINTAINED, THE SYSTEM WILL STILL TRY TO INITIALIZE IN THE SET DIRECTION, EVEN IF IT IS BEYOND THE SWITCH LOCATION, WHICH COULD RESULT IN SYSTEM DAMAGE.

NOTE

If the Zero Rev input is already activated when the *Initialize* command is executed, the motor will first move off the zero revolution switch by turning opposite the programmed direction. It will then reverse direction (to the programmed direction) to activate the Zero Rev input and will finally move to 0.0 on the resolver.

The search for the zero revolution switch can be programmed to occur to a speed of 3400 RPM. Caution should be used when searching for the zero revolution switch at high speeds because, when the switch closes, the motor will decelerate at the programmed Initialize Ramp rate until it reaches zero speed. At 500 RPM index speed and 10 revolutions/sec/sec deceleration, it takes 0.83 seconds for the motor to reach zero speed. The motor has turned 3.5 turns, causing a 3.5 turn overshoot beyond the zero revolution switch. The system will index back to the 0.0 angle in the 0.0 turn as defined by initial activation of the Zero Rev input.

The ServoPro-I system can successfully initialize to 0.0 at any speed to 3400 rpm, provided the mechanical system can tolerate the overshoot of the 0.0 angle at the higher speeds.

NOTE

If the system does not provide consistent timing for recognition of the Zero Rev input and if the resolver zero is just after the zero revolution switch contact position, the revolution chosen as the 0.X revolution might be inconsistent. This can be corrected by adjusting the zero revolution switch so the contact position occurs earlier.

1.6.3 JOG

The *Jog* function is a manual function only. It is not available in the automatic operating mode. The two jog inputs (*Jog CW* and *Jog CCW*) are not affected by a negative value for engineering units. *Jog CW* will always cause the motor shaft to turn clockwise; *Jog CCW* will always cause the motor shaft to turn counterclockwise.

The *Jog* speed and acceleration (ramp) are entered when the system parameters are established (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"*). When either of the jog inputs is actuated, the motor shaft will accelerate at the ramp rate until it reaches the *Jog* speed. It will continue to rotate at this speed as long as the input is actuated unless it reaches one of the directional limits (*CW Direction Limit* or *CCW Direction Limit*). When the *Jog* input is released or the *Direction Limit* input is actuated, the motor shaft will decelerate at the *Jog* ramp rate until it reaches zero speed.

1.6.4 PROGRAM CONTROLS

There are a number of control commands which can be used in the system program to provide greater system capability. These commands affect how the program runs. Refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on the parameters for each of these commands.

Wait Time: This command provides a delay of up to 10 seconds before execution of the next step in the block. The delay can be programmed in increments of .001 seconds (1 millisecond) and has a resolution (accuracy) of .001 second.

Wait Till Stop: This command causes the system program to wait until the current move command is completed before executing the next step in the block. The move command can be either an *Index* or *Position* command.

Wait Position: This command causes the system program to wait until the motor shaft reaches the specified position relative to the 0.0 location before executing the next step in the block. This position does not have to be the final position specified in the previous move command.

Wait Distance: This command causes the system program to wait until the motor shaft travels the specified incremental distance relative to the starting position of the previous command before executing the next step in the block. This distance does not have to be the total distance specified in the previous move command.

Wait For Input (Wait I/O): This command causes the system program to wait until the specified input is energized before executing the next step in the block. The input can be specified as energized when the input is turned ON or when it is turned OFF. The program will wait until it detects the correct state after the *Wait I/O* command has been issued. Therefore, if the specified energized state is OFF, the program must see the specified input change from ON to OFF after the *Wait I/O* command is executed. If the input is already OFF when the command is executed, the command will not wait and will execute the next step.

Turn On/Off: This command causes the specified programmable output (#1 through #8) to be turned ON or OFF. The I/O position must be set up as an output and have an appropriate AC or DC input module. This command can also be used to turn the drive module ON or OFF.

Do While: This command causes the program to repeat the steps between the *Do While* and *End While* command until the specified condition is met. This continuous loop of command steps can be terminated after a specific number of repetitions, when a specified input is energized (edge-triggered ON or OFF), or by an *Exit Block* command. If it is ended after *Count* or input energizing, the program will go on to the next step in the block. If it is ended by an *Exit Block* command, the block execution will be terminated.

Reset: The *Reset* function is an external function. When this input is turned ON, the program will immediately terminate execution and, if it is turning, the motor shaft will decelerate to zero.

Suspend: The *Suspend* input is an external function. When the input is turned ON the system will temporarily suspend the execution of the programmed block. If motion is taking place, the motor will decelerate to zero speed and wait until the input is turned OFF. When the input is turned OFF, the motion and program will resume.

CAUTION

THE *SUSPEND* INPUT SHOULD NOT BE USED AS AN EMERGENCY STOP FUNCTION.

1.7 SPECIFICATIONS

NOTE

Refer to "Appendix B - ServoPro-I Specifications" and "Appendix E - Transformers" for detailed information on the various system components.

1.7.1 ServoPro-I SPECIFICATIONS

ServoPro-I bills of materials and specifications are included in **Appendix B**. The list of materials includes the motor part number, the drive module part number, the drive module setup drawing number, and the manual part number. The specifications are included in a separate chart in **Appendix B**. Motor and drive module dimensions are contained in the drawings in **Appendix C**. Drive module setups are included in **Appendix D**.

Read the motor number, drive module number, and drive module setup for the specific ServoPro-I from the list of materials in **Appendix B**. To determine mounting dimensions, refer to the motor and drive module with the designated part numbers in the dimension charts in **Appendix C**. To determine proper drive module setup, refer to the appropriate drawing in **Appendix D**.

The Speed/Torque curve included on the specifications sheet (refer to **Figure 1.19**) is representative of the performance characteristics of the system (as opposed to just the motor or just the drive module). The system must operate within the limits of this curve or the system may develop servo faults.

In addition, the rms torque value for the various motor accelerations, decelerations, and steady states will be limited to the T, value on the curve. The specification chart lists the key system specifications as derived from the Speed/Torque curve.

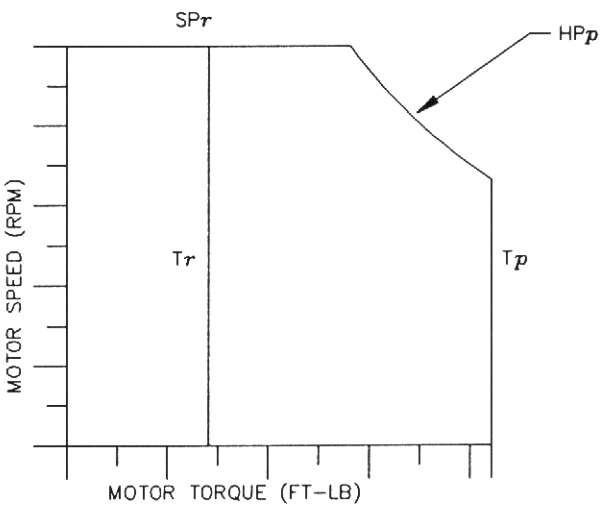


Figure 1.19
ServoPro-I Speed/Torque Curve

1.7.2 GENERAL

Ambient temp.	0° to 40°C Motor	0° to 50°C Drive
Humidity	90%RH max. No condensation	
Altitude	1,000 m max. above sea level	
Installation environment	IP-65 Standard IP-67 Optional	Indoors, no dust accumulations, metal particles or corrosive gases. No splashing with liquids.
Vibration	1.0G max	0.5G max
Shock	50G, 3 times	1.5G max
Control power specifications	220^{+10}_{-20} VAC 1 phase 50/60 Hz	
Main power specifications	220^{+10}_{-20} VAC 3 phase 50/60 Hz	

Motor/Drive MDPAK7-	R400	R750	R1000	R1500	R2000	R3000
Motor type BLM7-	R0400	R0750	R1000	R1500	R2000	R3000
Driver type BSD7-	R0400	R0750	R1000	R1500	R2000	R3000
Rated output (W)	400	750	1000	1500	2000	3000
Driver peak motor current A RMS/phase	6.8	11.7	16.4	24.2	29.9	46.8
Driver rated motor current A RMS/phase	2.6	4.5	6.3	9.3	11.5	18.0
Rated torque (lb-ft) (lb-in) (N-m)	1.88 22.6 2.55	3.52 42.3 4.77	4.70 56.4 6.37	7.04 84.5 9.54	9.40 113.0 12.74	14.23 170.7 19.30
Maximum torque (lb-ft) (lb-in) (N-m) See **Figure 1.20**	4.90 58.8 6.64	9.17 110.0 12.43	12.25 147.0 16.61	18.33 220.0 24.85	24.50 294.0 33.22	37.00 444.0 51.18
Rated speed	1500 rpm					
Maximum speed	2000 rpm					
Feedback encoder	2000 pulse per revolution with index					
Inertia ($lb\text{-}ft\text{-}sec^2$) ($lb\text{-}in\text{-}sec^2$) ($Kg\text{-}m^2$)	.000192 2.3×10^{-3} 2.6×10^{-4}	.000537 6.3×10^{-3} 7.3×10^{-4}	.000766 9.2×10^{-3} 10.4×10^{-4}	.00100 1.2×10^{-2} 13.6×10^{-4}	.00200 2.4×10^{-2} 27.1×10^{-4}	.00275 3.3×10^{-2} 37.3×10^{-4}
Motor weight lb [kg]	16 [7]	26 [11]	29 [13]	34 [15]	53 [24]	64 [29]
Driver weight lb [kg]	18 [8]	18 [8]	18 [8]	18 [8]	20 [9]	22 [10]

Table 1.3 General Specifications

Motor/Drive MDPAK7-	R3700	M3700
Motor type BLM7-	R3700	M3700
Driver type BSD7-	R3700	R3700
Rated output (W)	3700	3700
Driver peak motor current A RMS/phase	54.6	54.6
Driver rated motor current A RMS/phase	21.0	21.0
Rated torque (lb-ft) (lb-in) (N-m)	17.36 208.0 23.54	17.36 208.0 23.54
Maximum torque (lb-ft) (lb-in) (N-m) See **Figure 1.20**	45.13 542.0 61.19	45.19 542.0 61.19
Rated speed	1500 rpm	
Maximum speed	2000 rpm	
Feedback encoder	2000 pulse per revolution with index	
Inertia ($lb\text{-}ft\text{-}sec^2$) ($lb\text{-}in\text{-}sec^2$) ($Kg\text{-}m^2$)	.00342 $4.2x10^{2}$ $46.3x10^{4}$	.00480 $5.8x10^{-2}$ $65.1x10^{-4}$
Motor weight lb [kg]	78 [35]	78 [35]
Driver weight lb [kg]	22 [10]	22 [10]

Table 1.3 General Specifications Cont.

1.7.2.1 Overload Thermal Protection Characteristic

The MDPAK7 overload thermal protection is an electronic thermal function designed to detect overload current and to estimate the extent of subsequent motor temperature rise.

CAUTION

IF THE OVERLOAD THERMAL PROTECTION IS ACTIVATED, THE MOTOR MUST BE ALLOWED TO COOL FOR AT LEAST 10 MINUTES.

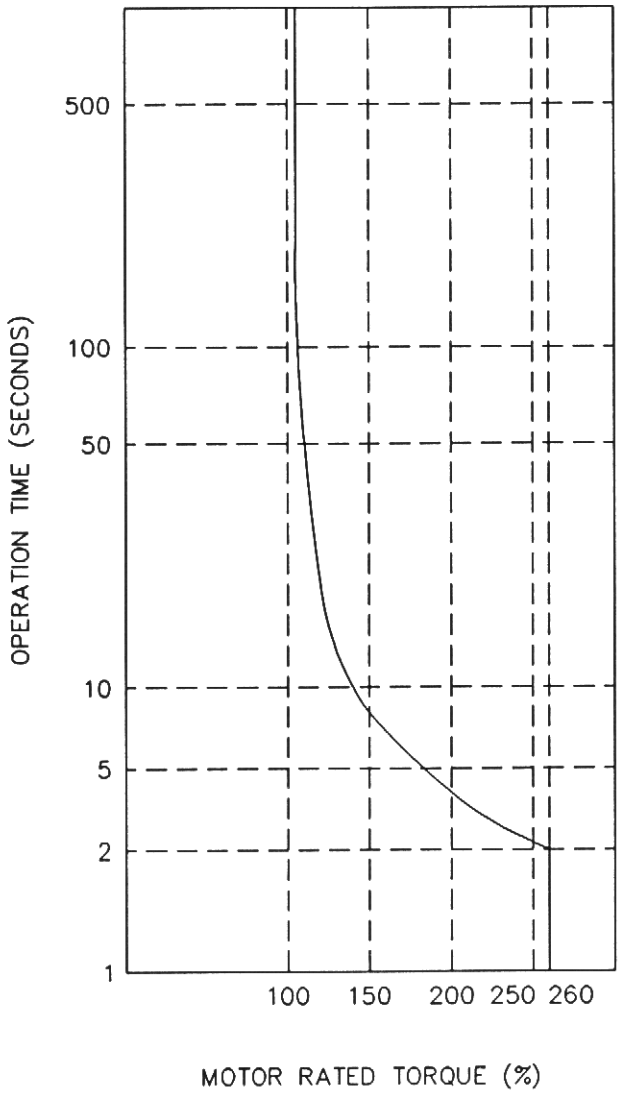


Figure 1.20

1.7.3 INPUT AND OUTPUT MODULES

DC INPUT MODULE (**IDC5**)

Input Voltage Range	10 to 32 VDC 15 to 32 VAC
Input Current at Max. Line	25 ma
Input allowed for No Output	1 ma (3 V)
Isolation Input-to-output	4000 V_{rms}
Turn-on Time	5 ms max.
Turn-off Time	5 ms max.

AC INPUT MODULE (**IAC5**)

Input Voltage Range	90 to 140 VAC
Input Current at Max. Line	11 ma
Input allowed for No Output	3 ma (45 V)
Isolation Voltage (Input-to-output)	4000 V_{rms}
Turn-on Time	20 ms max.
Turn-off Time	20 ms max.

DC OUTPUT MODULE (**ODC5**)

Operating Voltage Range	5 to 60 VDC
Current Rating (at 70°F)	2 amps
One Second Surge	5 amps
Output Voltage Drop	1.6 max.
Off-state Leakage at Max. Voltage	1 ma
Isolation Voltage (Input-to-output)	4000 V_{rms}
Turn-on Time	100 microseconds
Turn-off Time	750 microseconds

AC OUTPUT MODULE (**OAC5**)

Operating Voltage Range	12 to 140 VAC
Current Rating (at 70°F)	2 amps
One Cycle Surge	80 amps peak
Minimum Load Current	20 ma
Output Voltage Drop	1.6 max. peak
Off-state Leakage at Nominal Voltage (60 Hz)	5 ma_{rms}
Isolation Voltage (Input-to-output)	4000 V_{rms}
Operating Frequency	25 to 65 Hz
Turn-on Time	100 microseconds
Turn-off Time	750 microseconds

1.7.4 MOTION PARAMETERS

ENGINEERING UNITS	-999,999 to 999,999
JOG	
SPEED	1 to 3400 RPM†
ACCELERATION	1 to 800 revs/sec/sec
INITIALIZE	
SPEED	1 to 3400 RPM†
ACCELERATION	1 to 800 revs/sec/sec
INDEX/POSITION	
SPEED	1 to 3400 RPM†
ACCELERATION	1 to 800 revs/sec/sec
DISTANCE	1/4096 to 2000 turns
POSITIONING RESOLUTION	1/4096 Turns (Analog) 1/8000 Turns (Digital)
ABSOLUTE ACCURACY	±.001 Revolutions

†Maximum Speed Depends on ServoPro-I Package (refer to specifications chart in Appendix B)

INPUT/OUTPUT TIMING	
DC Input Voltage to Input Sense	5 ms maximum (Input Module).
DC Input Sense to Motor Motion	10 ms maximum.
Timer Resolution	1 ms with maximum delay of 10sec.

SECTION 2 – INSTALLATION

The various components which make up ServoPro-I Motion Control Systems may be supplied as loose components, as assembled systems, or as a combination of each. This section assumes that all components have been supplied as individual, unmounted components.

2.1 MOUNTING

CAUTION

ALL SERVOPRO-I COMPONENTS MUST BE MOUNTED IN ENCLOSURES WHICH ARE SUITABLE TO PROTECT THE COMPONENTS FROM THE SURROUNDING ENVIRONMENT. THERE MUST BE ADEQUATE AIR FLOW TO PREVENT OVERHEATING.

2.1.1 CONTROLLERS

Mounting dimensions for the assembled controller (command module plus drive module) are shown in **Appendix C**. Refer to **Appendix C** for the cutout size and mounting hole locations.

Separate each controller (drive module and command module assembly) from any adjoining controllers by a space of 2" (50.8 mm). Allow at least 4" (101.6 mm) clearance above and below the cabinets for air flow and wiring.

1. Determine the mounting dimensions for each drive module. (Refer to **Appendix C** for mounting dimensions of the drive modules.)

2. Provide the appropriate hardware to mount the drive modules. Make sure the support is adequate for the total weight of the drive.

3. Mount the drive modules. Make sure the unit is securely attached and adequately supported.

NOTE

As shipped from Industrial Indexing Systems, the command module mounting hardware is attached to the drive module (refer to Figure 2.1). If the drive module is replaced or purchased separately, it will be necessary to transfer this hardware to the new drive module. Refer to "Appendix G - Installation of Mounting Hardware" for details on assembling the mounting hardware to the drive module.

4. Locate the command module over the drive module so the quarter-turn fasteners line up with their mounting holes. Make sure the two pivot holes on the command module are lined up with the pivot spacers.

5. Insert and close the quarter-turn fasteners.

6. Insert the shoulder screws through the command module pivot into the tapped hole in the mounting hardware.

7. Tighten the shoulder screws until the pivots start to draw toward the mounting hardware. **DO NOT OVER-TIGHTEN!!**

8. Open the command module by releasing the quarter-turn fasteners and pivoting the module open.

CAUTION

TO AVOID DAMAGE TO THE COMMAND MODULE COVER WHEN OPENING THE COVER FOR ACCESS TO THE CIRCUIT BOARD OR DRIVE MODULE, DO NOT ALLOW THE COVER TO DROP OPEN. DO NOT USE THE OPEN COVER AS A SHELF FOR HOLDING PARTS OR TEST EQUIPMENT.

Each of the input and output module locations can accept either AC or DC modules. Locations #9 through # 17 must be input modules. Locations #18 through #20 must be output modules. Locations #1 through #8 can be either input or output modules as determined during programming. (Refer to **Figure 2.2** for input/output module locations. Refer to **"Section 1.7 - Specifications"** for AC and DC input and output module specifications. Refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on specifying the programmable I/Os as either inputs or outputs.)

9. Insert an AC or DC input or output module into each of the 20 I/O locations on the command module circuit board.

10. Carefully close the command module cover. Fasten the quarter-turn fasteners to the mounting hardware.

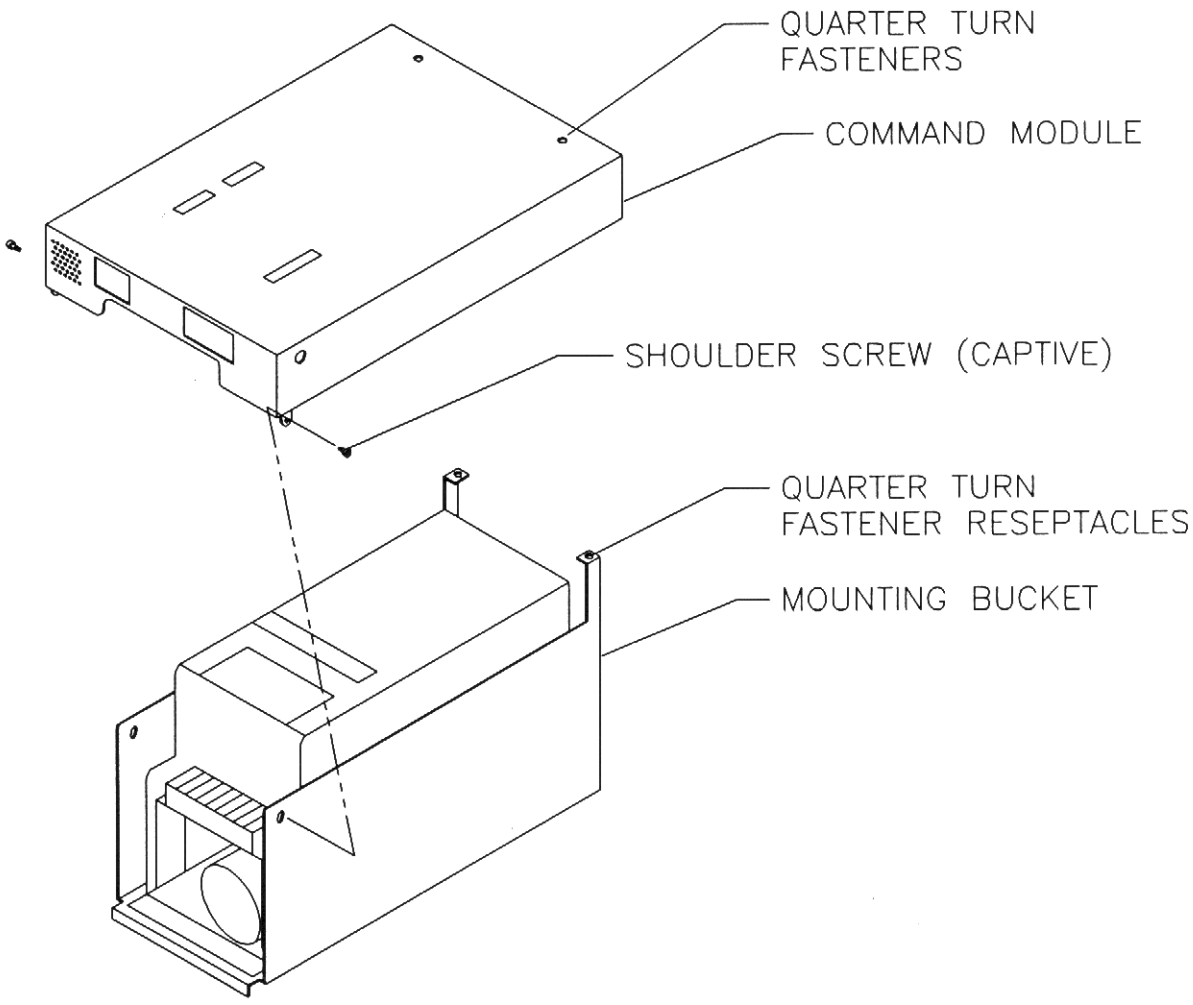


Figure 2.1 - Assembling Command Module To Drive Module

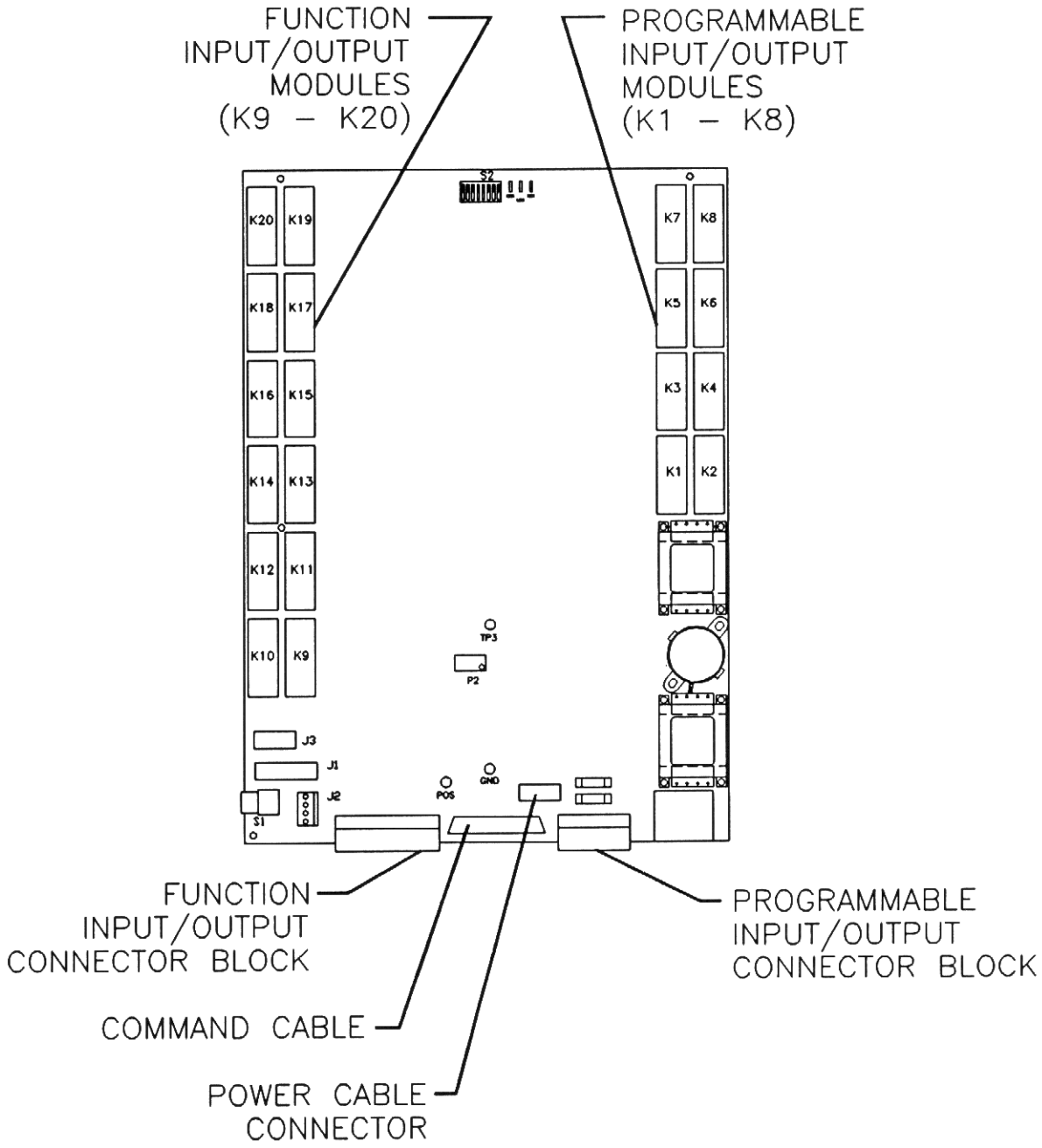


Figure 2.2 - Input/Output Module and Connector Locations (Inside View of ServoPro-I Command Module)

2.1.2 DRIVER COOLING CONSIDERATIONS IN AN UNVENTILATED CABINET

When the servo driver is installed in an unventilated cabinet, all necessary heat dissipation must be done using the cabinet's surface. Use the following formula to calculate the cabinet-surface area required for convection cooling.

$$S = \frac{1.95 \times P(W)}{50 - Tmax\ (°C)}$$

Where,
- $S(ft^2)$: Cabinet surface area except its bottom
- $P(W)$: Total heat dissipation for all servo drivers mounted in cabinet. Heat dissipation equals 10% of the motor's rated capacity.
- $Tmax\ (°C)$: Maximum temperature around cabinet

Example: Two 1 kW drivers are to be installed in a cabinet and the maximum outside ambient temperature is 40°C (104°F).

$$P(W) = (0.1 \times 1000) + (0.1 \times 1000)\ 200$$

$$S = \frac{1.95 \times 200}{(50 - 40)} = 40\ (ft^2)$$

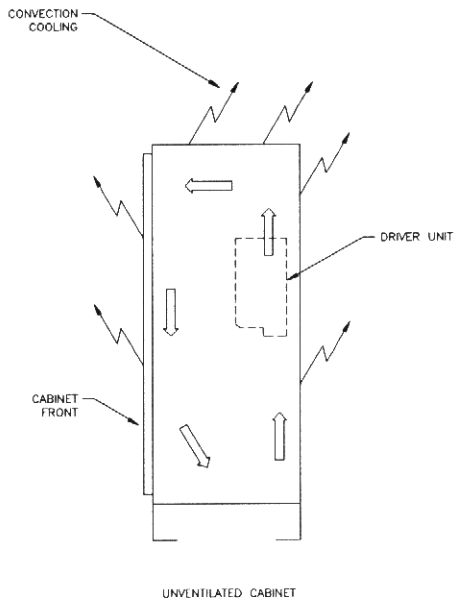


Figure 2.3

2.1.3 DRIVER COOLING CONSIDERATIONS IN A VENTILATED CABINET

When a fan-cooled cabinet is used to house the servo drivers, all heat dissipation must be removed be means of a fan that circulates air from the cabinet's inlet to outlet. The following blower capacity is necessary:

$$Q = \frac{1.88\ P(W)}{50 - Tmax}$$

Where, $Q(ft^3/min)$: Fan's capacity
$P(W)$: Total heat dissipation for all servo drivers mounted in cabinet. Heat dissipation equals 10% of MDPAK7 rated capacity.
$Tmax\ (°C)$: Maximum temperature around cabinet.

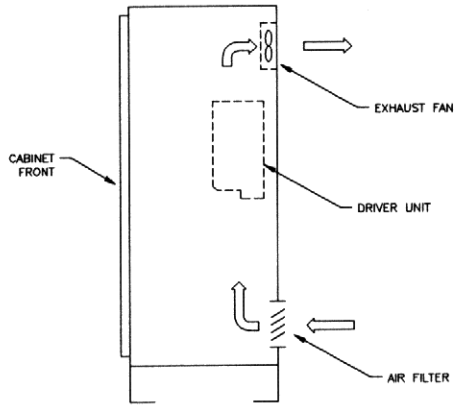
Example: Two 1 kW drivers are to be installed in a cabinet and the maximum ambient temperature is 40°C (104°F).

$$P(W) = (0.1 \times 1000) + (0.1 \times 1000)$$

$$S = \frac{1.88 \times 200}{(50 - 40)} = 38\ (ft^3/min)$$

NOTE

When forced ventilation is used, be sure to protect against loss of ventilation as a result of air filter or duct blockage.



FORCED VENTILATION CABINET

Figure 2.4

2.1.4 TRANSFORMER

Mounting dimensions for the transformers used with the ServoPro-I Motion Control System are shown in **Appendix E**. A typical mounting pattern for a free-standing transformer is shown in **Figure 2.5**.

1. Lay out the mounting location.

2. Provide the appropriate holes and hardware to mount the transformer. Make sure the support is adequate for the weight of the transformer.

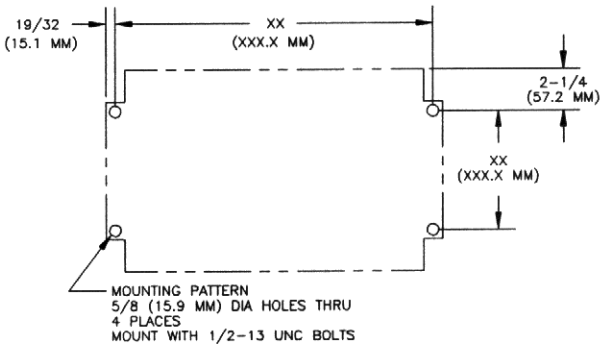


Figure 2.5
Typical Transformer Mounting Pattern

2.1.5 MOTOR

CAUTION

DO NOT DISASSEMBLE THE MOTOR. UNAUTHORIZED DISASSEMBLY MAY CAUSE SERIOUS REDUCTION IN PERFORMANCE AND WILL NULLIFY THE WARRANTY.

Motor mounting will depend on the application and the system being indexed. All ServoPro-I Motion Control System brushless motors are designed for front face mounting (refer to **Appendix C**).

1. Lay out the mounting holes for the motor and attach the motor to the desired mount.

CAUTION

WHEN MOUNTING MOTORS, MAKE SURE THE MOTOR IS PROPERLY ALIGNED. IT MUST BE MOUNTED SQUARELY SO THE FACE IS FLUSH AGAINST THE MOUNTING SURFACE. THE SHAFT MUST NOT BE TWISTED OR BOUND IN ANY WAY. THE SYSTEM MUST NOT SUBJECT THE MOTOR TO IMPACT LOADS. COMPLETE SYSTEM INSTALLATION, WIRING, AND TESTING BEFORE THE LOAD IS ATTACHED TO THE MOTOR SHAFT.

2. Attach the load to the motor shaft.

2.1.5.1 Precautions For Installing the Servo Motor

1. The motor is designed to be used in an atmosphere free of corrosive or flammable liquids and gases, free from accumulations of liquids, dust and metal particles. IP65 sealing is standard on all motors. Optional IP67 sealing is available for demanding environments.

2. The servomotors are hot to the touch when running at full capacity. Case temperatures of over 100°C are possible. Keep all materials not capable of withstanding 100°C temperatures away from the motor. The motor must have at least 6 inches of free air space from all surfaces for proper operation.

CAUTION

USE PROTECTIVE GUARDS TO PREVENT HUMAN CONTACT WITH ROTATING COMPONENTS AND HOT MOTOR SURFACES.

3. Do not disassemble the motor. Disassembly may cause damage to internal encoder or rotor magnets.

4. Do not paint the motor. The surfaces of the motor are specially designed to dissipate heat. Painting may cause motor overheating and failure.

5. When connecting the load to the servo motors shaft be sure to observe the thrust and radial load guidelines for that particular motor. See **Appendix C** for thrust and radial load specifications.

6. Do not use a rigid coupling to connect the motor shaft to the load. Contact IIS for coupling recommendations.

7. Never apply high voltage directly to the motor or encoder. The motor is designed to be driven by the appropriate driver.

8. Do not connect a motor to a driver other than the one specifically designed for the motor. Damage to the motor and/or driver may result. Always match the motor and driver wattage for proper operation. See **Section 1** for specifications and **Appendix B** for proper combinations.

9. Do not subject the motor shaft to a sharp blow. Do not force the motor shaft axially in or out of the motor case. Excessive sharp blows or axial loading may damage the encoder. See **Section C** for maximum axial loading.

2.1.6 TWR-400A THUMBWHEEL MODULE

The TWR-400A is designed for mounting to an enclosed panel. Refer to **Figure 2.6** for mounting dimensions.

1. Lay out the locations of the display cutout and four mounting holes for each thumbwheel module.

2. Drill the mounting holes (clearance holes for #6 screws) and cut out the panel openings for each thumbwheel module.

3. Mount the modules to the back of the panel using four #6 x 1-5/8" round-head screws with lock washers, spacers, and nuts as shown in **Figure 2.6**.

WARNING

THE TWR-400A THUMBWHEEL INPUT MODULE HAS NO MOUNTING BEZEL OR OTHER COSMETIC FRAME FOR THE THUMBWHEEL CUTOUT. THEREFORE, IT IS IMPORTANT THAT THE CUTOUT BE MADE ACCURATELY AND THAT ALL EDGES BE LEFT SMOOTH AND FREE OF BURRS TO PREVENT POTENTIAL INJURY.

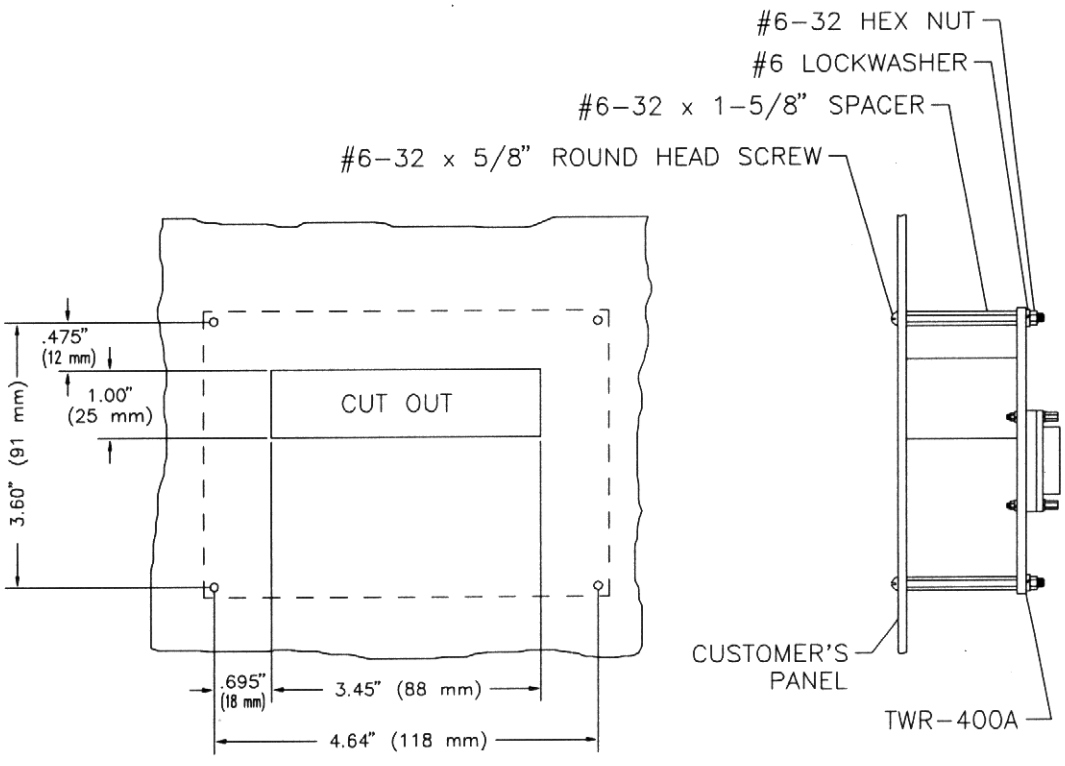


Figure 2.6 - TWR-400A Thumbwheel Input Module Installation

4. Carefully tighten all nuts. **DO NOT OVER-TIGHTEN!**

Each thumbwheel module is configured at the factory to be TW1. The ServoPro-I Motion Control System can only have one thumbwheel module configured as each of TW1, TW2, TW3, and TW4. If multiple thumbwheel modules are being used, modules TW2, TW3, and TW4 must be properly identified for the command module. Make sure each module identity is unique.

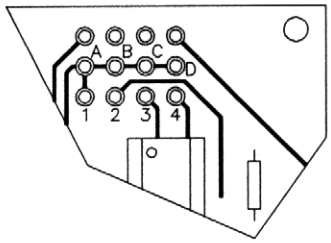


Figure 2.7
Thumbwheel Identity Jumper Locations

5. For thumbwheel modules TW2, TW3, and TW4, cut the trace between the holes identified as "1" and "A" in **Figure 2.7**.

> **NOTE**
> **The hole identification numbers and letters are for reference purposes only and do not appear on the thumbwheel module.**

6. Solder a jumper between holes "2" and "B" for TW2, or between holes "3" and "C" for TW3, or between holes "4" and "D" for TW4.

2.1.7 OPI-1 PANEL-MOUNT OPERATOR INTERFACE

The OPI-1 panel-mount operator interface is designed for mounting to an enclosed panel. Refer to **Figure 2.8** for mounting dimensions.

1. Lay out the locations of the cutout and the four mounting holes.

2. Drill the four mounting holes (clearance holes for #6 screws) and cut out the hole for the operator interface.

3. Mount the operator interface to the panel using four #6 round-head screws with lock washers, and nuts as shown in **Figure 2.8**.

4. Carefully tighten all nuts. **DO NOT OVER-TIGHTEN!**

5. Check the settings of the four switch positions on the Baud Switch to make sure they are correct. The settings should be:

POSITION 4	OFF
POSITION 3	ON
POSITION 2	OFF
POSITION 1	OFF

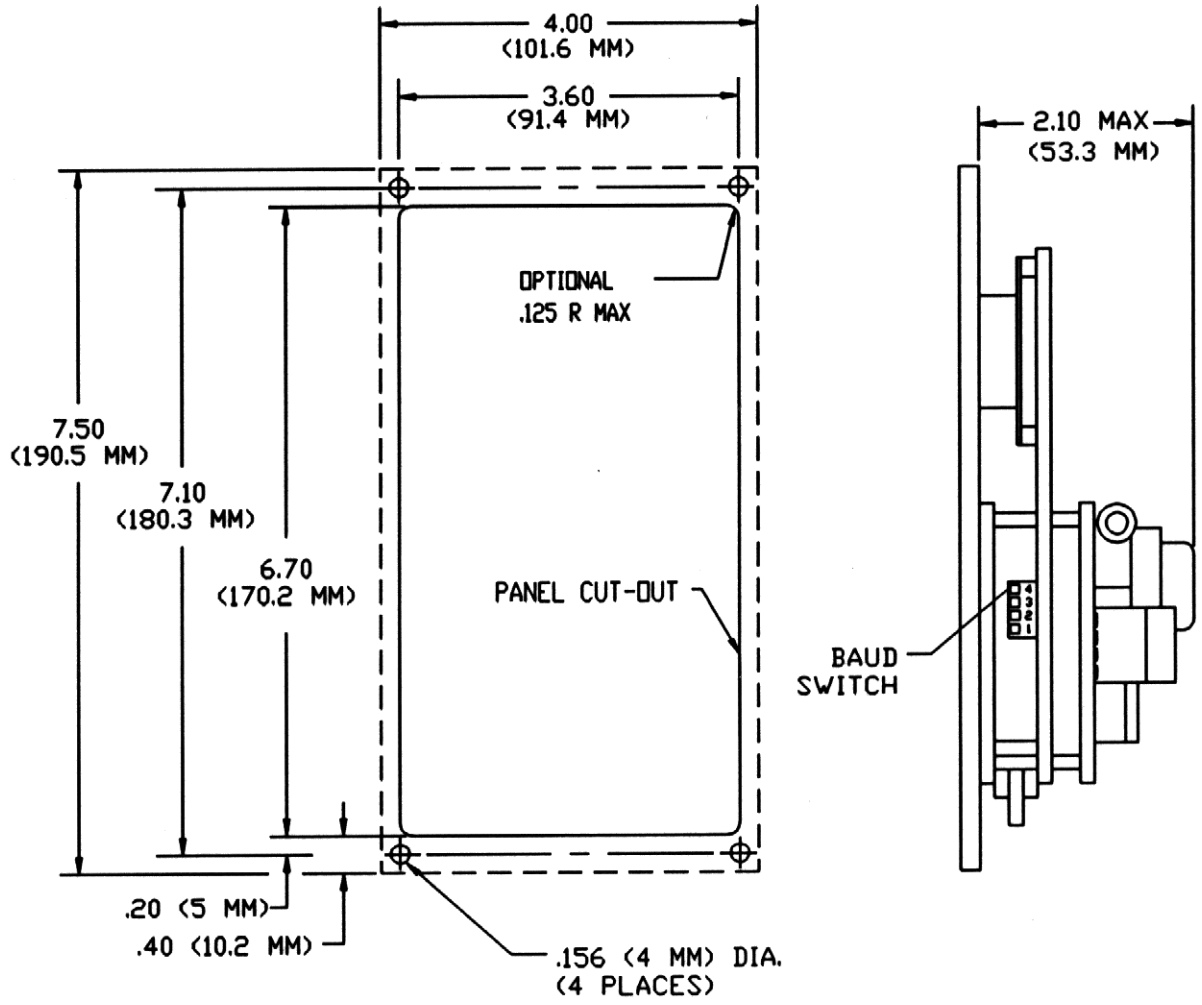


Figure 2.8 - OPI-1 Operator Interface Installation

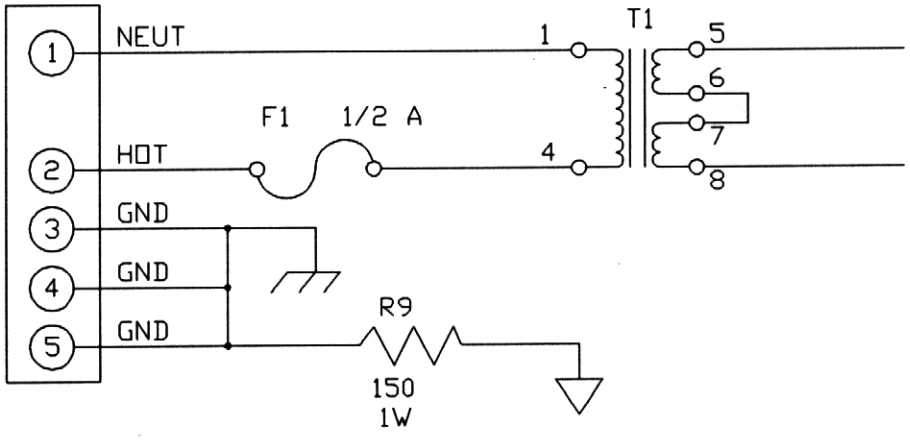


Figure 2.8a

2.2 ELECTRICAL CONNECTIONS

WARNING

DO NOT TURN ON ANY POWER TO THE SYSTEM UNTIL ALL ELECTRICAL CONNECTIONS HAVE BEEN COMPLETED.

Figure 2.9 shows typical system component interconnections. The interconnections assume the use of an AC-100095 connector interface. Details of this circuit board are provided in **Appendix C**.

2.2.1 DRIVE MODULE CONNECTIONS

The cable numbers in **Figure 2.9** are for specific Industrial Indexing Systems' cables used with the ServoPro-I Motion Control System. (The 'yyy' which makes up the last three places of the cable number is the length of the cable in feet.) Drawings for each of these cables are contained in **Appendix F**.

CAUTION

FOR PROPER OPERATION, THE MAXIMUM CABLE LENGTH CONNECTING THE DRIVE MODULE TO THE MOTOR MUST NOT EXCEED 100'.

1. Plug connector J1 on the AC-100095 connector interface board to connector CN8 on the drive module. (A spade lug is provided for quick disconnect purposes.) Attach the ground connector to the "E" terminal.

2. Attach the command cable from the command module to the CN9 connector on the drive module. Make sure the cable is properly seated in the connector.

2.2.1.1 Wiring Precautions

1. Be careful when wiring the motor and driver to one another, to the power supply, ground and the positioning controller. Miswiring not only will prevent the motor/driver from producing optimum results, it can also cause the system and its components to fail.

2. **Figure 2.9** illustrates a sample wiring configuration that will ensure optimum performance. Refer to it when connecting your system's components.

3. Keep your system's control power, servo bus power and motor wiring separate (at least 12 in [30 cm]) from the control circuit and sensor wires. If these wires must cross, run them at right angles.

4. To prevent line surges from damaging system components, connect a surge suppressor (RC filter for ac; diode for dc) to all solenoid coils, magnet contactors and relay coils.

5. Wiring between the driver and the motor should not exceed 30 meters (100 ft).

6. The motor's ground wire must be connected to terminal E of the driver, not directly to ground.

7. The driver's terminal E must be connected directly to ground using at least 12 AWG wire [5.5 min^2].

8. It is recommended, but not required, that an isolation transformer be installed between the power supply and the servodriver. This device will significantly reduce the likelihood of damage to the driver as a result of ground faults or current leaks.

9. Connect power to the positioning controller and driver control power before connecting power to the servo bus or connect both simultaneously. Do not connect servo bus power first.

10. Use twisted-pair wires to connect an external regenerative resistor to the system, if such a device is used.

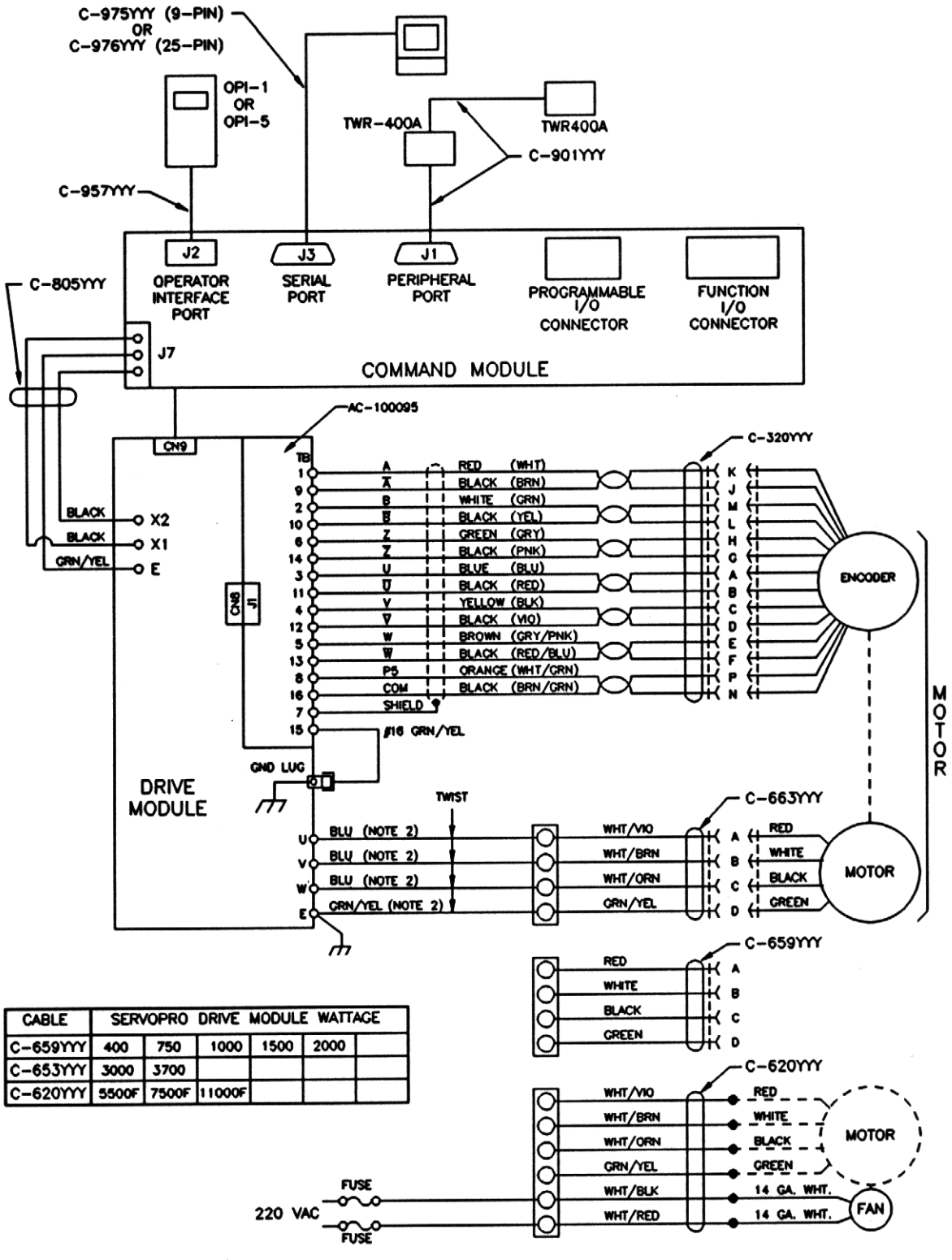
11. Use shielded wires for all signal lines.

12. Use twisted-pair shielded wires for the encoder cable and pulse cable to positioning controller.

13. The motor is rated for IP65 or IP67 sealing. If the motor is used in such an environment, be sure the cables to the motor are properly sealed. Standard IIS cables are not IP67 rate. Consult factory for details.

CAUTION

NEVER RUN MOTOR CABLES PARALLEL TO ENCODER CABLES UNLESS 12 IN (30 CM) APART FROM EACH OTHER. IF CABLES MUST CROSS, RUN THEM AT RIGHT ANGLES.



CABLE	SERVOPRO DRIVE MODULE WATTAGE					
C-659YYY	400	750	1000	1500	2000	
C-653YYY	3000	3700				
C-620YYY	5500F	7500F	11000F			

Figure 2.9 - ServoPro-I Wiring Configuration

2.2.2 MOTOR CONNECTIONS

1. Attach the resolver cable (C-320yyy) from the drive module to the motor encoder connector. Make sure both connectors are properly seated. **[LIMIT = 100']**

The motor cable used will depend on the size of the ServoPro-I package. Motor cable C-659YYY is used for applications with drive modules of 2,000 watts or less. Motor cable C-653YYY is used for applications with drive modules of 3,000 watts and 3,700 watts.

Motor cables C-653yyy and C-659yyy have a connector at the motor end only. The other end should be wired to a four-terminal terminal strip. The four wires carry the three-phase power and ground from the drive to the motor.

2. Provide a four-terminal or six-terminal terminal strip for connection of the motor cable.

3. Connect terminals U, V, and W on the drive to the terminal strip using appropriately sized blue wires for terminals U, V, and W and green wire for terminal E. Twist the wires together (refer to **Figure 2.12** and **Figure 2.13**).

4. Attach the wires from the non-connector end of the motor cable to the terminal strip. Make sure they are attached to the proper terminals (refer to **Figure 2.9**).

5. Attach the connector-end of the motor cable (C-653yyy or C-659yyy) to the motor connector.

2.2.3 TRANSFORMER CONNECTIONS

CAUTION

ALL TRANSFORMERS USED WITH SERIES 5 POWER SUPPLY PACKAGES MUST BE HEAVY-DUTY, ISOLATION, THREE-PHASE TRANSFORMERS.

The transformers used with ServoPro-I Motion Control Systems are special heavy-duty isolation transformers designed not to lower the output voltage under high load conditions. They will accept 230 VAC/3ϕ/60 Hz or 460 VAC/3ϕ/60 Hz , delta-connected, primary input power (refer to **Figure 2.10**).

The transformers have three sets of wye-connected, secondary output power taps — 207 VAC, 230 VAC, and 253 VAC (230 VAC $\pm$10%). These taps allow modification of the voltage input to the drives (refer to **Figure 2.11**). The 253 VAC taps would be used when low plant distribution voltage or excessive power drain from the drives results in a low input voltage. 207 VAC taps are used when the input voltage is constantly high.

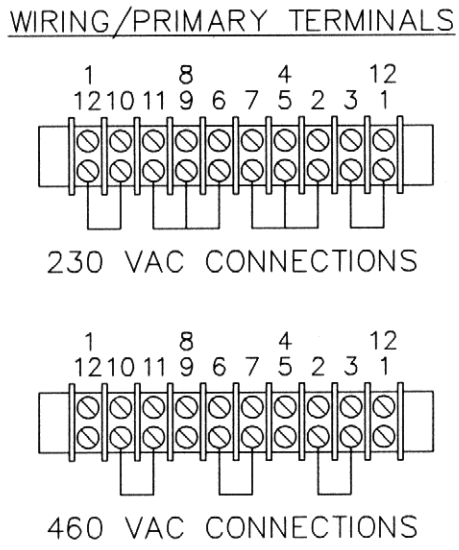


Figure 2.10
Transformer
Primary Connections

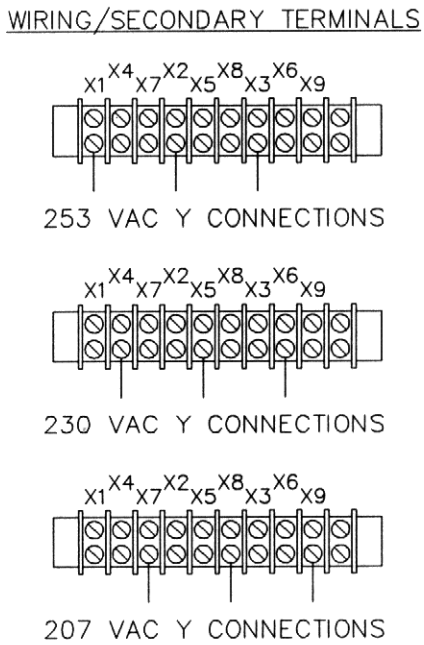


Figure 2.11
Transformer
Secondary Connections

The ServoPro-I drive modules have two voltage inputs. The main supply voltage is three-phase, 230 VAC; the control voltage is single-phase, 230 VAC. (Both voltages can be taken from the same transformer secondary taps.)

The control voltage connects to terminals "X1" and "X2" on the drive module input. The main supply power connects to terminals "L1", "L2", and "L3". (Refer to **Figure 2.12** and **Figure 2.13**.) Both the control voltage and the main supply voltage must be connected to the drive module and the drive module must be grounded for proper operation.

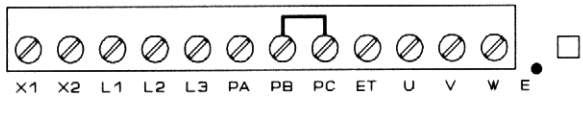


Figure 2.12
Input Terminals For
300 Watt Up To and
Including 1000 Watt Drives

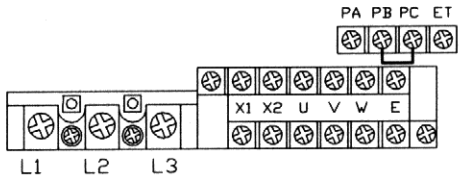


Figure 2.13
Input Terminals For
1500 Watt Up To and
Including 11000 Watt Drives

1. Connect the 230 VAC secondary terminals from the transformer to the input power terminals (L1, L2, L3) on the drive module using black wires. When the transformer is being connected to multiple drive modules, the input wires to the drive modules should be connected as shown in **Figure 2.11**.

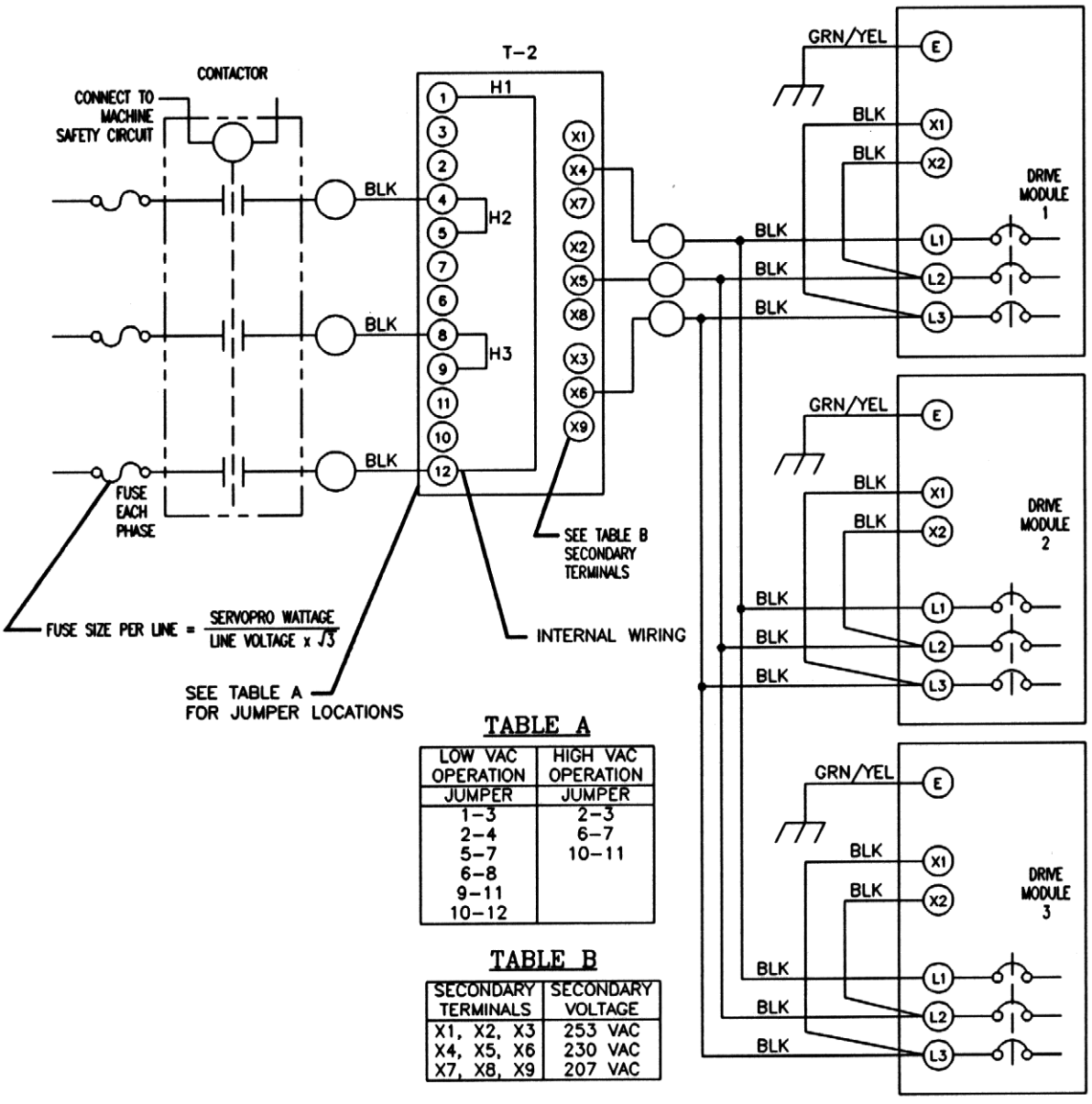


TABLE A

LOW VAC OPERATION JUMPER	HIGH VAC OPERATION JUMPER
1–3	2–3
2–4	6–7
5–7	10–11
6–8	
9–11	
10–12	

TABLE B

SECONDARY TERMINALS	SECONDARY VOLTAGE
X1, X2, X3	253 VAC
X4, X5, X6	230 VAC
X7, X8, X9	207 VAC

Figure 2.14 - Power Connections to Multiple Drive Modules

WARNING

OBSERVE ALL FEDERAL, STATE, AND LOCAL ELECTRICAL CODES WHEN INSTALLING THE PRIME SUPPLY POWER TO THE TRANSFORMER. DO NOT TURN ON THE ELECTRICAL DISCONNECT UNTIL ALL WIRING IS COMPLETE.

2. Connect the 230 VAC secondary terminals from the transformer to the control power terminals (X1, X2) on the drive module using appropriately sized black wires. When the transformer is being connected to multiple drive modules, the input wires to the drive modules should be connected as shown in **Figure 2.11**.

3. Connect the input power from the plant distribution system to the transformer primary connections using black wires. Provide a separate fused disconnect for the supply voltage.

2.2.3.1 Optional Transformers

The drive module operates directly from a 3 phase power source provided the voltage and frequency specifications in **Section 3** are met. Although it is not required, it is recommended that a 3 phase isolation transformer be used to isolate the power mains from the servo system.

IIS offers a complete line of isolation transformers that not only provide isolation but also provide primary and secondary taps to optimize line voltage conditions. Open frame and enclosed transformers are available. Both the 1 phase control power and 3 phase servo bus power can be connected to the transformer secondary.

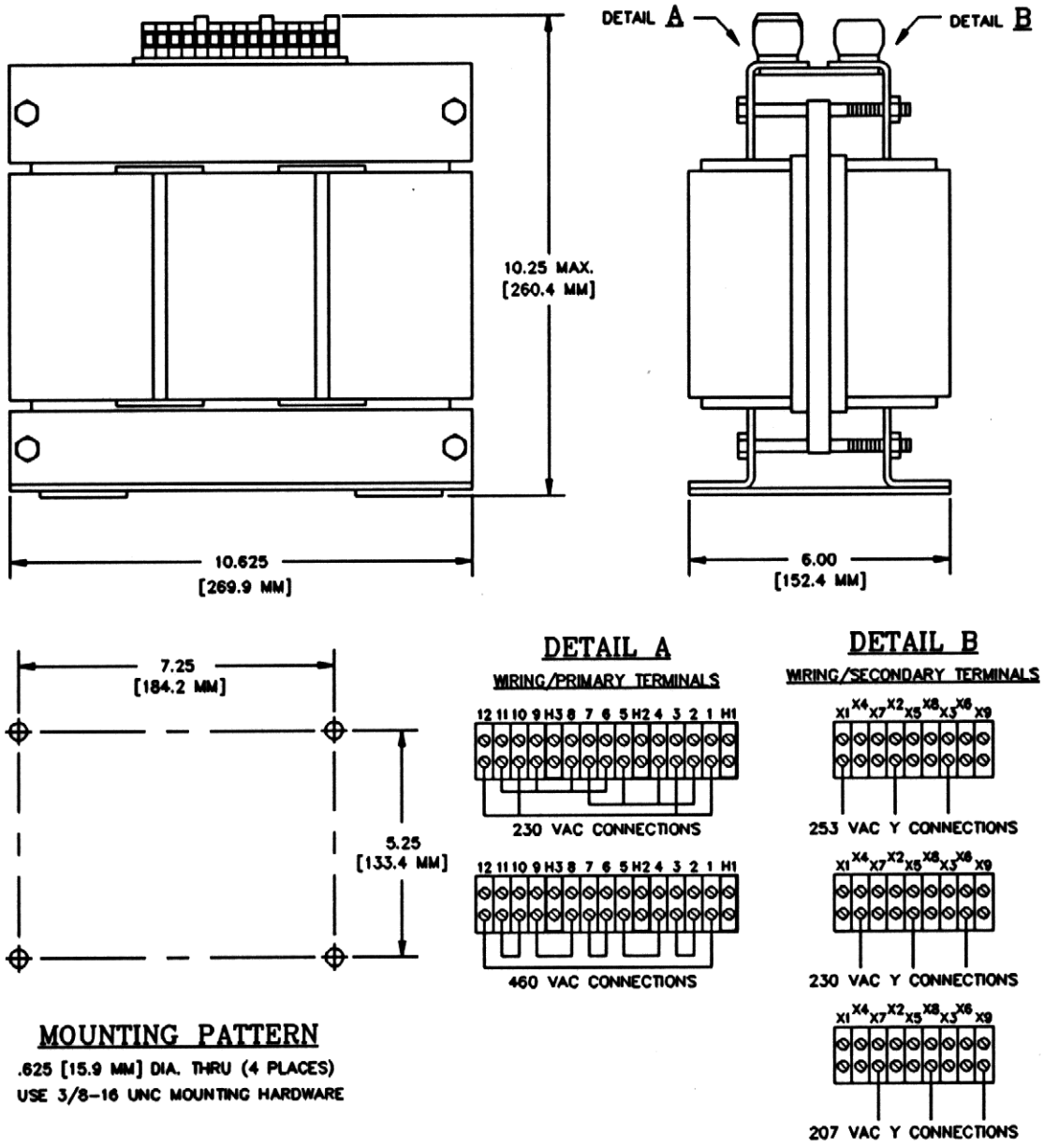
This section shows the standard transformers offered by IIS. Transformers with different primary voltages and frequencies are available. Consult the factory for specific requirements.

Several drive modules can be powered with a single transformer. Power rating of the transformer is determined as follows:

$$P_{OUT} = \frac{P_1 + P_2 + P_x}{.9} = (\text{WATTS})$$

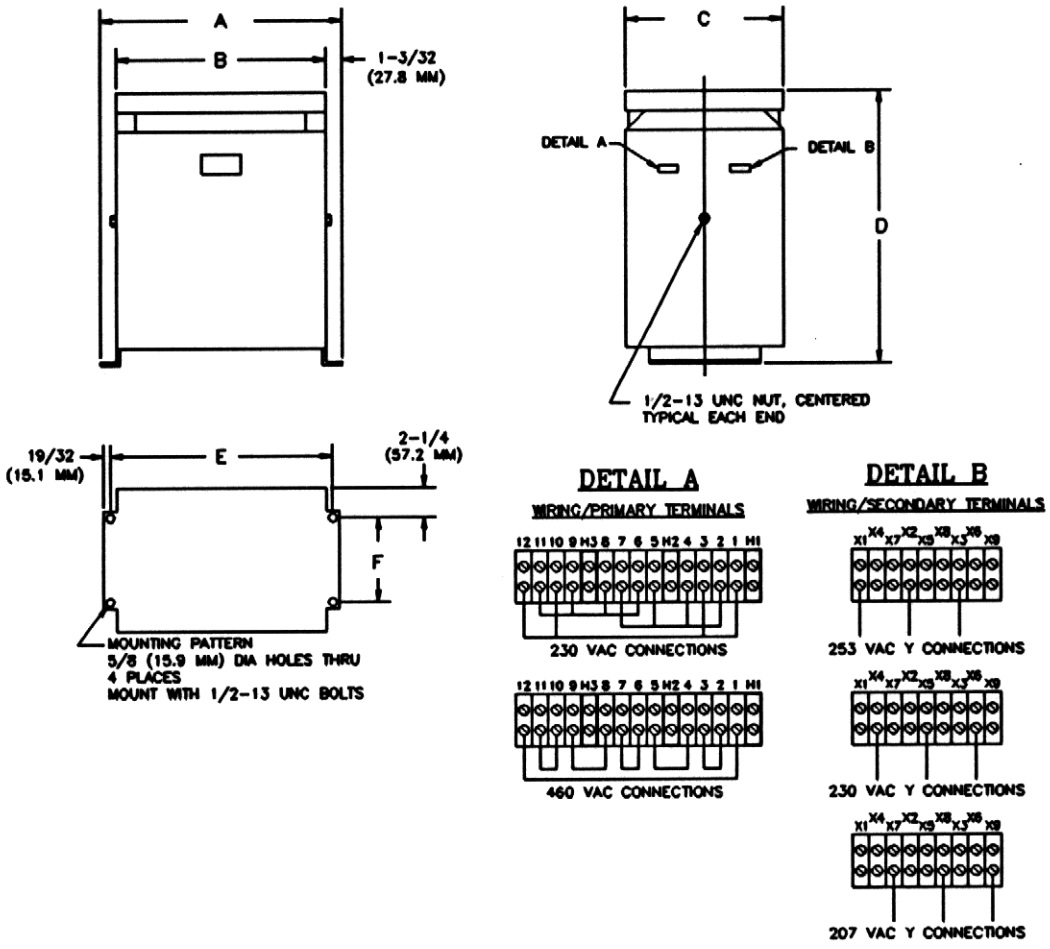
P_{OUT} = Output power of transformer (Watts)
P_x = Rated output power of drive module

Select a transformer with at least as much power output as P_{OUT} above from **Figure 2.15** or **Figure 2.16**.



TRANSFORMER	FREQ. (HZ)	PHASE	OUTPUT POWER (WATTS)	TEMP. RISE (°C)	WEIGHT (LBS.)
T-300/3-3	60	3	1000	150	80
T-300/5-3	60	3	1500	150	80
T-300/7.5-3	60	3	2200	150	80

Figure 2.15 - Panel-Mount Transformer Dimensions and Connections



TRANSFORMER	FREQ. (HZ)	PHASE	OUTPUT POWER (WATTS)	TEMP. RISE (°C)	WEIGHT (LBS.)	A	B	C	D	E	F
TE-300/7.5-3	60	3	2250	150	110	18.19 (462)	16.00 (406)	8.00 (203)	21.00 (533)	17.00 (432)	3.50 (89)
TE-300/15-3	60	3	4500	150	125	18.19 (462)	16.00 (406)	8.00 (203)	21.00 (533)	17.00 (432)	3.50 (89)
TE-300/30-3	60	3	9000	150	175	22.19 (564)	20.00 (508)	12.00 (305)	21.00 (533)	21.00 (533)	7.50 (191)
TE-300/58-3	60	3	15000	150	216	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)
TE-300/75-3	60	3	22500	150	400	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)
TE-300/95-3	60	3	28500	150	400	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)

DIMENSIONS = INCHES
(MILLIMETERS)

Figure 2.16 - Free-Standing Transformer Dimensions and Connections

2.2.4 GROUND CONNECTIONS

CAUTION

THE SERVOPRO-I MOTION CONTROL SYSTEMS REQUIRE VERY SPECIFIC GROUNDING CONNECTIONS. CAREFULLY FOLLOW ALL PROCEDURES IN THIS SECTION BEFORE ATTEMPTING TO OPERATE THE INDEXING SYSTEM.

1. Provide an electrical-ground terminal strip for grounding of all related systems.

2. Connect the electrical-ground terminal strip to electrical ground using cable sized for the entire load.

3. Connect the ground terminal ("E") from the drive module to the electrical-ground terminal strip using appropriately sized green wire.

4. Connect the ground wire from the command module to the electrical ground terminal strip.

2.2.5 AUXILIARY DEVICE CONNECTIONS

1. Connect one end of the C-957yyy cable to the operator interface input port (J2) on the command module.

CAUTION

THE SERVOPRO-I DRIVE MODULE IS DESIGNED FOR 220 VAC INPUT VOLTAGE. CONTACT THE INDUSTRIAL INDEXING SYSTEMS INTEGRATED TECHNICAL SERVICES DEPARTMENT FOR ADVICE BEFORE USING THE 207 VAC OR 253 VAC SECONDARY TAPS ON THE TRANSFORMER.

NOTE

Previously, the ground terminal ("E") on the drive module should have been connected to the terminal strip used for the drive end of motor cable C-653yyy or C-659yyy using green wire twisted with the blue power wires. Also make sure that the ground wire from the AC-100095 connector interface has been connected to ground terminal ("E") on the drive module.

2. Connect the other end of the C-957yyy cable to the J10 communications connector on the OPI-1 operator interface.

3. Connect 110V AC to TB1 (see figure 2.8a).

4. Connect one C-901yyy peripheral cable between the first TWR-400A thumbwheel module and the command module peripheral port (J1).

5. Connect one C-901yyy peripheral cable between the second TWR-400A thumbwheel module and the first TWR-400A thumbwheel module.

6. Repeat Step 4 for the third and fourth TWR-400A thumbwheel modules.

2.2.6 INPUT/OUTPUT MODULE CONNECTIONS

The connections for the input and output modules are made to the input/output connector blocks at the bottom of the command module cover. These blocks accept the 8-pin and 12-pin input/output connectors which are supplied separately (refer to **"Section 1 - Description"** and **"Appendix G - Installation of Mounting Hardware"**). Each connector accepts wires for two adjacent input and/or output modules. **Figure 2.17** shows the location of the specific connections for each of the input/output module locations.

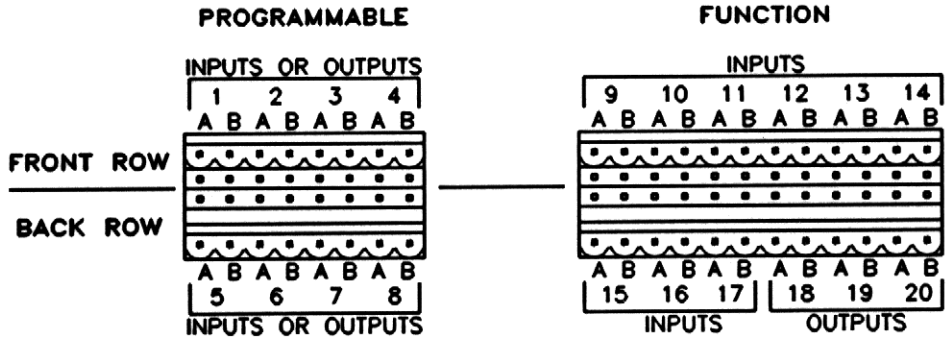


Figure 2.17 - Input/Output Connector Blocks

1. Determine the type of module (AC or DC, input or output) at each of the I/O module locations.

2. Connect the input/output modules to the appropriate system control components following the guidelines for each type of module shown in **Figure 2.18.**

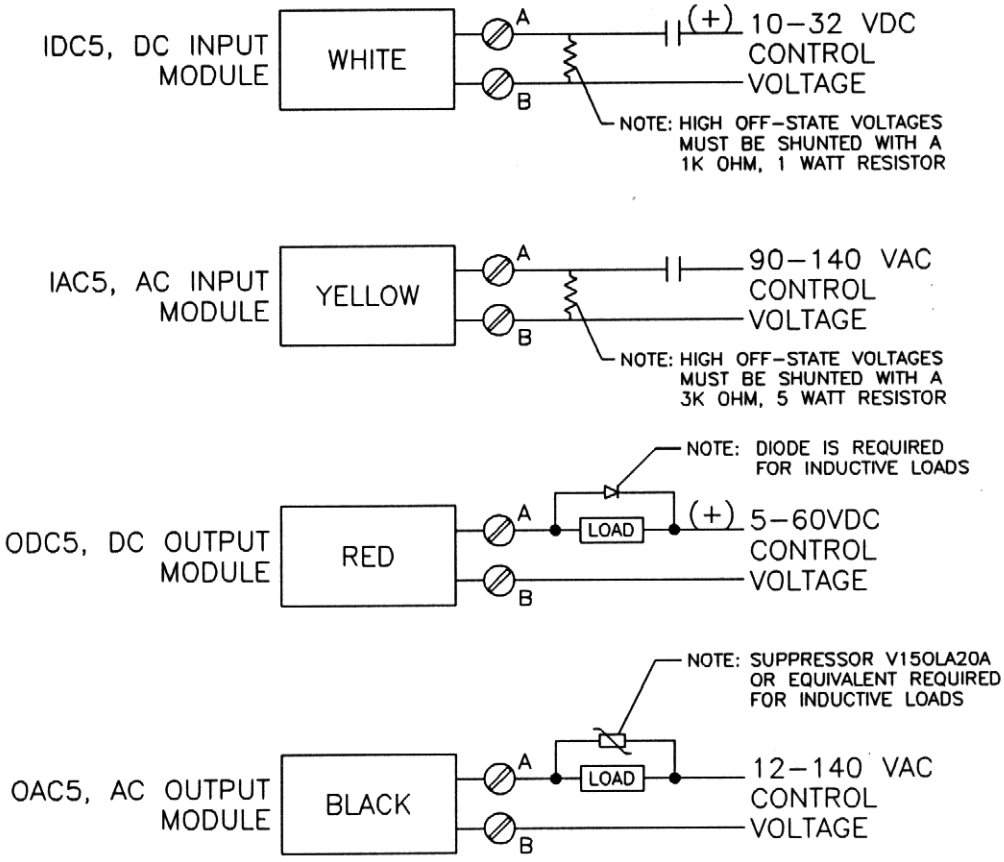


Figure 2.18 - Input and Output Module Connections

2.3 DRIVE MODULE SETUP

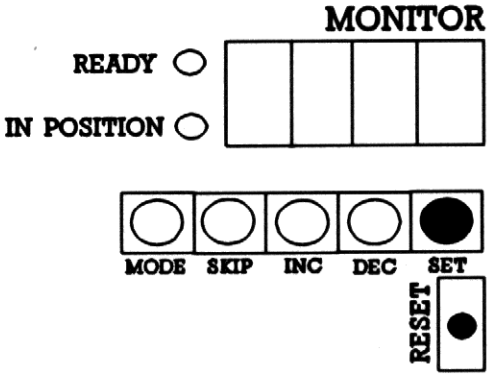
Each drive module must be set up to match a specific motor assembly.

All parameters are preset at the factory for nominal applications. In some cases, a custom set of parameters may be preset into the drive. If a custom set of parameters has been preset into the drive, a drawing with a part number starting with SU-49XXXX will be included in the system technical manual (TM-XXXXXX). Initializing all parameters using the following procedure will cause all parameters to go to the default values.

- How to initialize

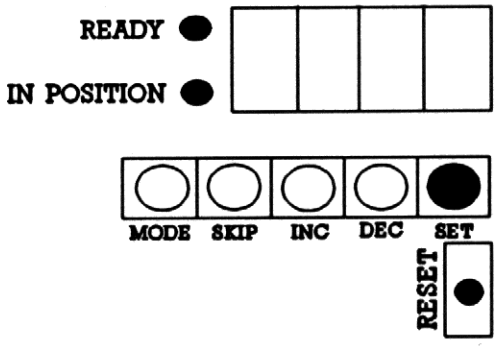
1) Turn control power off. Press [Set] and [Reset] switches, simultaneously.

CONTROL POWER OFF



2) Turn control power on while pressing the [SET] and [RESET] switches.

CONTROL POWER ON



3) Release both switches at once. Initializing is completed when characters appear in the monitor LED.

CONTROL POWER ON

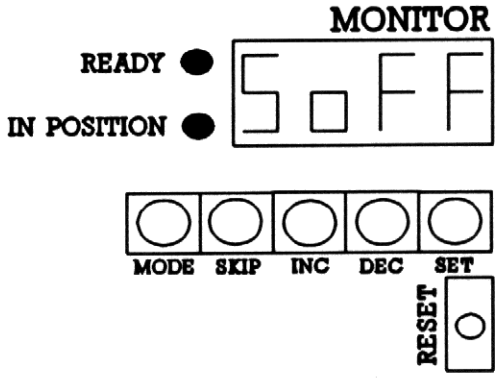


Figure 2.19

CAUTION

WHEN THE SERVODRIVER IS INITAILIZED, ALL SYSTEM PARAMETERS ARE RESET TO THE DEFAULT VALUES. IF THE APPLICATION REQUIRES OTHER PARAMETER SETTINGS, MAKE NECESSARY CHANGES AFTER INITIALIZING THE SYSTEM.

2.3.1 OPERATION EXAMPLES (▒▒ indicates flashing display)

Example 1) Changing display <Parameter name>

Switch operation	[MODE] [MODE] [SKIP] [SKIP]
Display	CtrL → CHG → AUto → CHG → Ctrl

Example 2) Changing display <Parameter name> then viewing <Parameter value>

Switch operation	[MODE] [SET] [MODE]
Display	SSCL → SLL → ▒LL → 1234 → ▒LL → S1

Example 3) Changing display <Parameter name> then move to top of menu <Operation state>

Switch operation	[MODE] [SKIP + MODE]
Display	Adt → tyPE → SoFF

Example 4) Changing <Parameter value> (Coarse tuning) and saving in nonvolatile memory

Switch operation	[SET] [SKIP + INC][SKIP + INC][SKIP + DEC] [SET]
Display	SLL → ▒LL → 1234 → 1334 → 1434 → 1334 → ▒LL → S1

Example 5) Changing <Parameter value> (Fine tuning) and saving in nonvolatile memory

Switch operation	[SET]	[INC]	[INC]	[DEC]	[SET]
Display	SLL → SLL → 1234 → 1235 → 1236 → 1235 → SLL → FLt				

Example 6) Changing <Parameter value> (Alternative) and saving in nonvolatile memory

Switch operation	[SET]	[INC]	[INC]	[INC]	[DEC]	[SET]
Display	AoUt → AoUt → SPd → trq → SPd → trq → SPd → AoUt → FLt					

Example 7) Changing <Parameter value> (Fine tuning) without saving in nonvolatile memory

Switch operation	[SET]	[INC]	[INC]	[DEC]	[MODE]
Display	SLL → SLL → 1234 → 1235 → 1236 → 1235 → SLL → FLt				

Example 8) Changing <Parameter value> (Alternative) without saving in nonvolatile memory

Switch operation	[SET]	[INC]	[INC]	[INC]	[DEC]	[MODE]
Display	AoUt → AoUt → SPd → trq → SPd → trq → SPd → AoUt → FLt					

CAUTION

IN EXAMPLES 7 AND 8, THE CHANGES MADE HAVE AN IMMEDIATE EFFECT ON THE OPERATION OF THE DRIVE BUT ARE NOT STORED IN NONVOLATILE MEMORY. CHANGES WILL BE LOST IF POWER IS REMOVED.

PARAMETER PROGRAMMING MENU

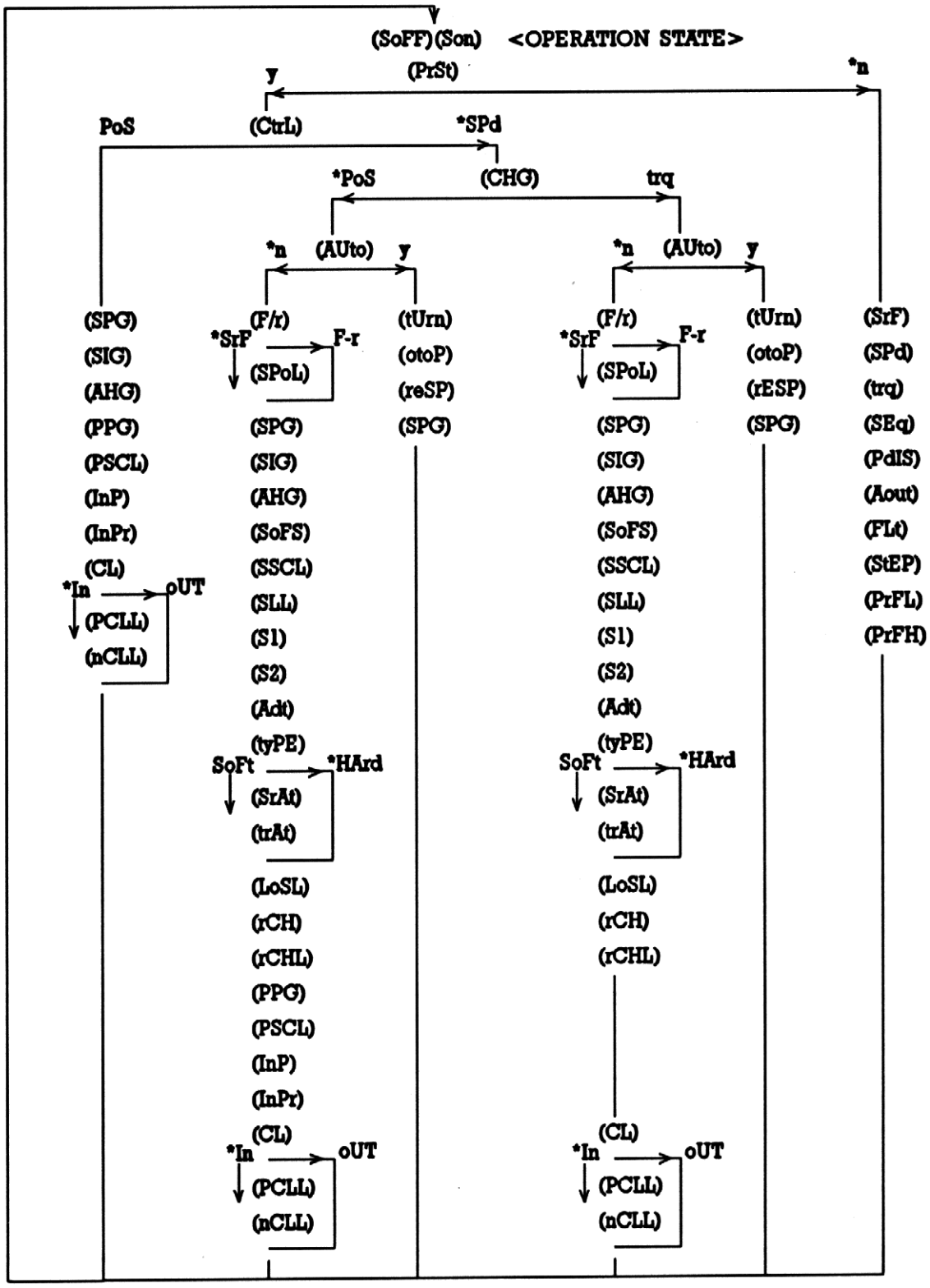


Figure 2.20

2.4 SYSTEM PARAMETERS

The motor/drive is preset at the factory to run in External Position Loop Mode (EPLM) for use with an IIS positioning system. The default parameters for this mode of operation are listed in **Appendix D**.

In some cases the parameters have been modified at the factory for specific application requirements. If the parameters have been modified from the defaults, a separate setup drawing (SU-49XXXX) will be included with the system documentation.

WARNING

MODIFYING THE DRIVE PARAMETERS SHOULD ONLY BE ATTEMPTED BY A QUALIFIED TECHNICIAN. INCORRECT SELECTIONS OR ADJUSTMENTS CAN SIGNIFICANTLY EFFECT THE DRIVE'S PERFORMANCE AND FUNCTION. IMPROPER SETTINGS MAY CAUSE ERRONEOUS MACHINE MOTIONS AND PERSONAL INJURY.

USE PARTICULAR CAUTION WHEN SETTING THE DRIVE GAIN PARAMETERS SPG, SIG, AHG AND PPG. IMPROPER SETTING CAN RESULT IN SEVERE MOTOR AND MACHINE VIBRATION.

2.4.1 SYSTEM PARAMETER DESCRIPTIONS

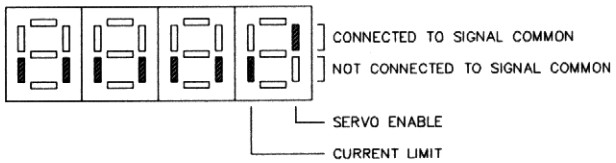
The system parameters shown in the following list are the parameters that may need to be adjusted for proper External Position Loop operation. All parameters not listed are set to their default values. A complete list of parameters is shown in **Appendix D**.

Parameter name	Valid mode	Contents of parameter	Default settings
Speed loop gain S P G	EPLM	Parameter value range: 0 0 0 . 0 - 9 9 9 . 9 Used to set proportional gain for the speed control loop. The greater the value, the faster the response. However, too rapid a response results in unstable control. See **Section 2.6.1** for details about optimum settings.	xxxx
Speed loop integral gain S I G	EPLM	Parameter value range: 0 . 0 0 0 - 9 . 9 9 9 Used to set integral gain for the speed control loop. The greater the value, the faster the response. However, too rapid a response results in unstable control. See **Section 2.6.1** for details about optimum settings.	xxxx

xxxx Default parameter value depends on motor/drive size. See **Appendix D** for default settings.

Parameter name	Valid mode	Contents of parameter	Default settings
Speed loop differential gain A H G	EPLM	Parameter value range: 0. 0 0 0 - 1. 0 0 0 0 Used to set differential gain for the speed control loop. The greater the value, the better the response in case of a mechanical load disturbance. However, too greater a value results in unstable control. See **Section 2.6.1** for details about optimum settings.	xxxx
Speed command offset S o F S	EPLM	Parameter value range: +0 1 0 0 / -0 1 0 0 rpm Used to set offset of analog speed command.	0 0 0 0
Speed command scaling S S C L	EPLM	Parameter value range: 0 4 2 0 - 4 2 0 0 rpm Used to set command speed for a 10 VDC command input.	2 0 0 0
Low speed signal output level L o S L	EPLM	Parameter value range: 0 0 0 0 / 0 1 0 0 rpm Used to set the speed for outputting low speed signal TB1-8.	0 0 3 0
Current limit command condition C L	EPLM	Parameter selection: o U t, I n The driver has the ability to limit the maximum motor current (torque). The limit can be set internally by setting parameter CL = In; then programming PCLL and nCLL to a percent of rated current (torque). If CL = oUT the current (torque) is limited using an external analog voltage. Parameter current limit: I n External current limit command: o U t	I n
Positive current limit level (CCW) P C L L	EPLM	Parameter value range: 0 0 0 0 / 0 2 6 0 Positive current limit value, if C L = I n.	0 2 6 0
Negative current limit level (CW) n C L L	EPLM	Parameter value range: 0 0 0 0 / 0 2 6 0 Negative current limit value, if C L = I n.	0 2 6 0

2.5 MONITOR DISPLAY FUNCTIONS

Parameter name	Valid mode	Contents of parameter	Default settings
Speed reference display S r F	ALL	Parameter value range: 4 0 0 0 / -4 0 0 0 rpm Displays the commanded or reference speed into the drive. Speed display is in RPM with (-) being CW.	S S S S
Actual speed display S P d	ALL	Parameter value range: 4 0 0 0 / -4 0 0 0 rpm Displays actual motor speed in rpm with (-) being CW.	S S S
Motor torque command t r q	ALL	Parameter value range: 2 6 0 % / -2 6 0 % Displays instantaneous torque being commanded to motor (-) is CW.	T T T
Input signal monitor S E q	ALL	Used to monitor the on/off state of control input signals.  	8 8 8 8
Position display P d I S	ALL	Parameter value range: -9 9 9 9 / 9 9 9 9 Motor position is displayed on LED monitor. The number is reset to 0 0 0 0 when power is applied. The value increases as the motor-shaft turns CCW, and decreases as it turns CW. Display is calibrated as 2000 bits/rev.	PPPP
Analog monitor output A o U t	EPLM	Parameter selection: S P d, t r q Used to select the signal to be applied to analog monitor output (see **Section 2.6.2**). S P d: Speed feedback signal t r q: Current command signal	S P d
Fault history F L T	ALL	Parameter values: Fault code Used to display the last fault recorded. See **Section 5.1.1** for Fault codes.	F F F

Parameter name	Valid mode	Contents of parameter	Default settings
Step operation cycle S t E P	ALL	Parameter value range: 0 0 0 0 / 0 0 6 3 If a value other than 0 0 0 0 is set to this parameter, forward or reverse motor-shaft revolution immediately starts as Servo on CN9-33 is turned on, at the internally set speed or the speed set by means of the external analog speed command CN9-16. This parameter is not stored in the system's memory, even if [Set] is pressed.	0 0 0 0
P r F L	ALL	Position Command (Low Part)	0 0 0 0
P r F H	ALL	Position Command (High Part)	0 0 0 0

2.6 START-UP

CAUTION

BEFORE TURNING POWER ON THE SYSTEM FOR THE FIRST TIME, VERIFY ALL WIRING OF THE MOTOR/DRIVE PER THE CONNECTION DIAGRAMS IN APPENDIX F OF THIS MANUAL.

NOTE

All driver system parameters have been preset at the factory to the settings shown in Appendix D. If the complete system supplied by the factory requires settings other than the defaults, a special parameter setting drawing will be supplied in the system manual. If the parameters don't match the parameter settings in the manual, call the factory for assistance.

2.6.1 PARAMETER SETTINGS

Setting the system response involves adjustment of five basic parameters. In a closed loop system, the parameters do interact with each other and the mechanical system. Adjustment of these parameters should only be attempted by a qualified technician or with telephone support from the IIS factory.

The five parameters are:

1. Positioning controller Position Loop Gain.

   All IIS positioning controllers have the ability to adjust the Position Loop Gain to meet the application requirements. The driver has 2000 pulses per revolution of the motor which results in 8000 PPR in the positioning controller. Most applications are run with a Position Loop Gain of 20 Volts/motor revolution or 20 Volts/8000 counts. Consult the technical manual for the positioning controller and set the Position Loop Gain to approximately 20 Volts/8000 counts.

   The Position Loop Gain will need to be set higher for fast high acceleration rate applications and set lower for slower moving high inertia loads.

2. Driver Speed Command Scaling SSCL.

   The SSCL or Speed Command Scaling is the DC scale factor of the driver. The DC gain is measured in (command volts / RPM of the motor). The default setting is 10 Volts/2000 RPM. This setting will run applications that require motor speeds up to the rated speed which is 1500 RPM. In applications that require higher motor speeds, the SSCL must be raised such that (SSCL = 1.25 x desired speed).

3. Driver Speed Loop Gain SPG.

   The SPG or Speed Loop Gain is the DC closed loop gain of the speed loop. The higher the gain the better the load mechanical motion actually follows the command profile. In general, the SPG would be higher in large inertia systems or in very high response systems. Too high a gain will, however, result in oscillation. Too low a gain will result in a sluggish response.

4. Driver Speed Loop Integral Gain SIG.

   The SIG or Speed Loop Integral Gain is the frequency response setting for the speed loop. The higher the number the higher the frequency response. In general, low inertia high response systems require higher settings with the risk of oscillation if the setting is too high. Lower settings will result in a more stable response in high inertia systems.

5. Speed Loop Differential Gain AHG.

   The AHG or Speed Loop Differential Gain sets the response of the system to external disturbances. The higher the value the more responsive the system. AHG can be used to dampen the system response to torque or speed changes. The AHG parameter will generally round off the sharp transitions in the motion profile. Lower values will result in a more stable system.

If it is determined that the factory settings in **Appendix D** are not adequate for the application, use **Table 2.1** as a guideline for initial gain parameter settings.

Load inertia/motor inertia	1	3	5	10
S P G	30	50	80	80
S I G	0.2	0.2	0.2	0.1
A H G	0.3	0.3	0.3	0.3

Table 2.1

2.6.2 PARAMETER ADJUSTMENTS

1. Turn on the driver control power only and verify all parameter settings are set to the defaults shown in **Appendix D.**

2. Modify the SPG, SIG and AHG parameters per **Table 2.1** to establish a baseline setting for the gain parameters.

3. Set the SSCL parameter for the desired motor speed per **Section 2.6.1.**

4. Set the positioning controller Position Loop Gain per the instruction manual provided with the positioning controller. Use the guidelines in **Section 2.6.1** to set the Position Loop Gain.

5. Turn off system power.

6. Turn on system power including position controller, drive control power and servo bus power.

7. Connect an oscilloscope to the MON and COM test points on the monitor board. See **Figure 2.21**.

8. Set the A o u t parameter to S P d using the keypad/display. This will program the MON test point to be motor actual speed.

9. Start position controller motion sequence using the manual supplied with position controller.

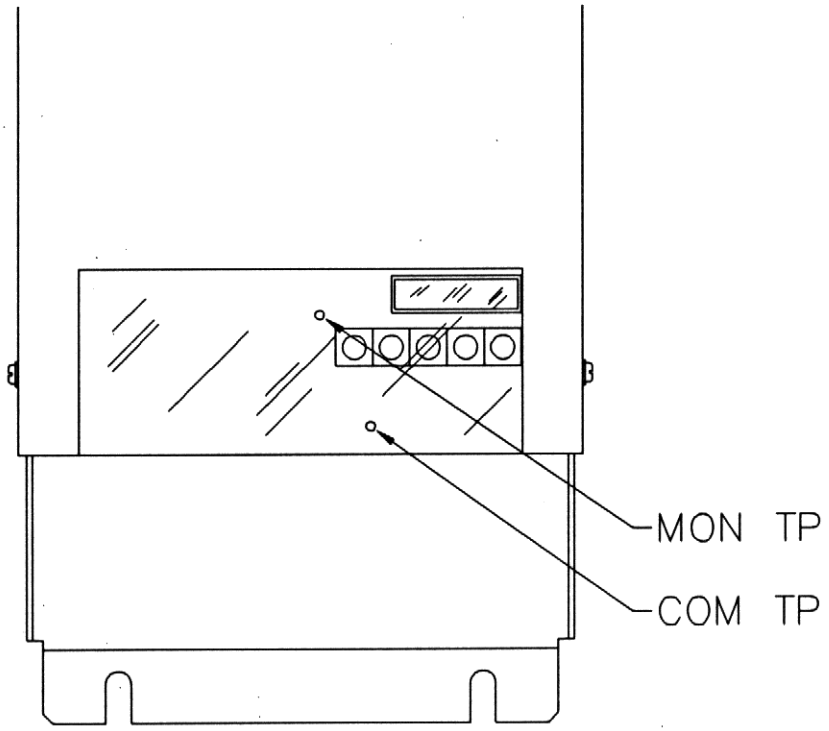


Figure 2.21

10. Monitor the oscilloscope trace and adjust parameter SPG with the goal of obtaining the ideal profile shape shown in **Figure 2.22**. Use **Figure 2.23 and Figure 2.24** to adjust SPG. Generally raising the SPG will sharpen the profile shape until the gain is too high and the system becomes unstable.

11. Monitor the oscilloscope trace and adjust parameter SIG with the goal of obtaining the ideal profile shape shown in **Figure 2.22**. Use **Figure 2.25 and Figure 2.26** to adjust SIG. Generally raising the SIG will eliminate large low frequency oscillations. Too high a setting in SIG will cause the system to become unstable.

12. Monitor the oscilloscope trace and adjust parameter AHG with the goal of obtaining the ideal profile shape shown in **Figure 2.22**. Use **Figure 2.27 and Figure 2.28** to adjust AHG. Generally raising the AHG will dampen any settling disturbance or ringing. Too high a setting in AHG will cause the system to become unstable.

13. Be sure to press the SET button on all final parameter settings so they are recorded in non-volatile memory.

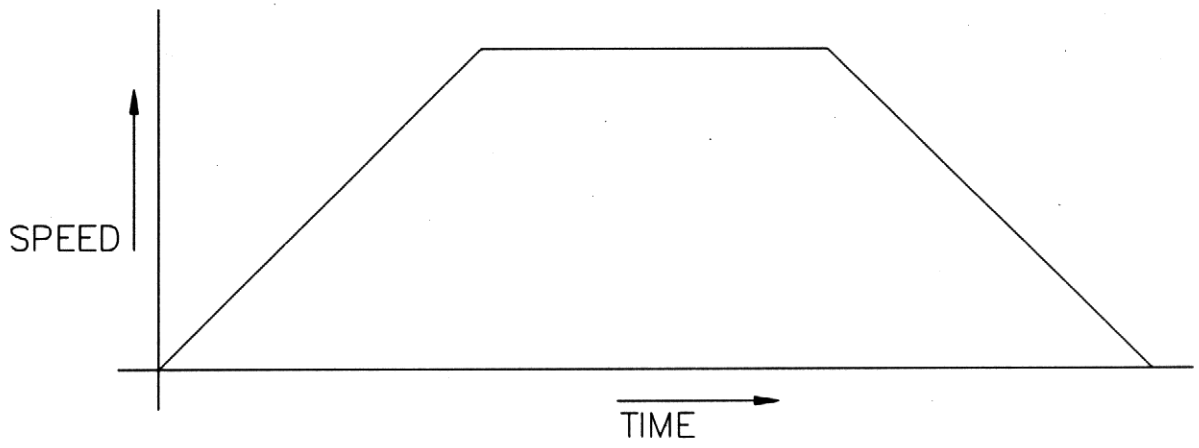


Figure 2.22 - Ideal Profile Shape

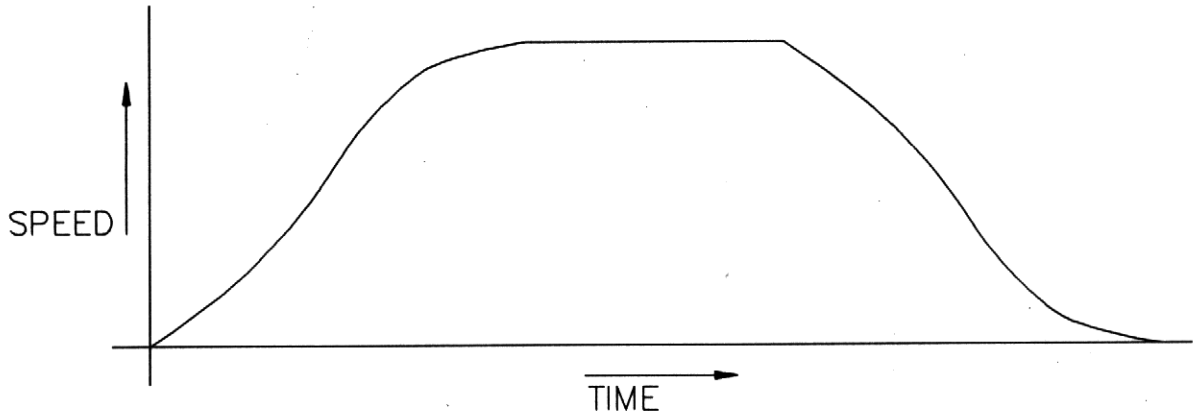


Figure 2.23 - SPG Too Low

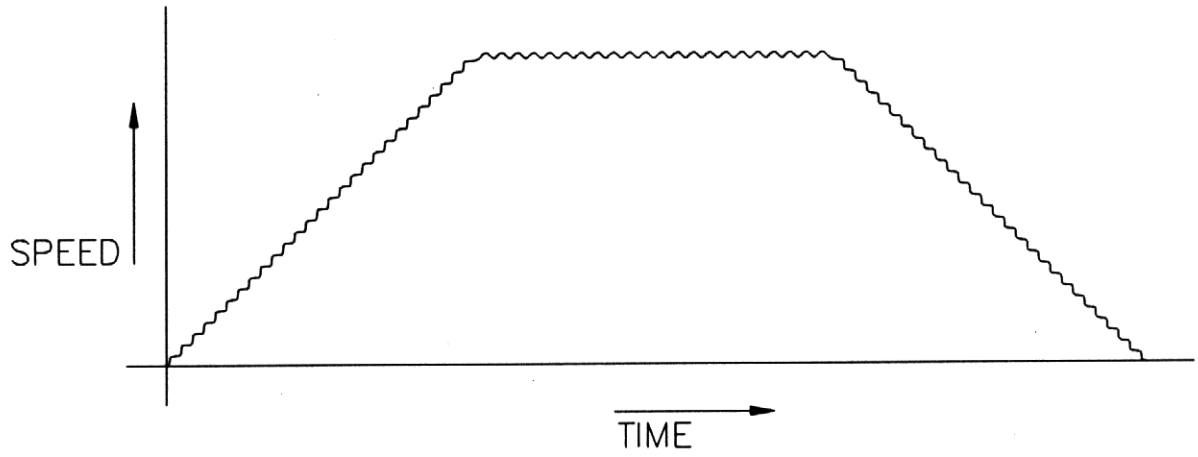


Figure 2.24 - SPG Too High

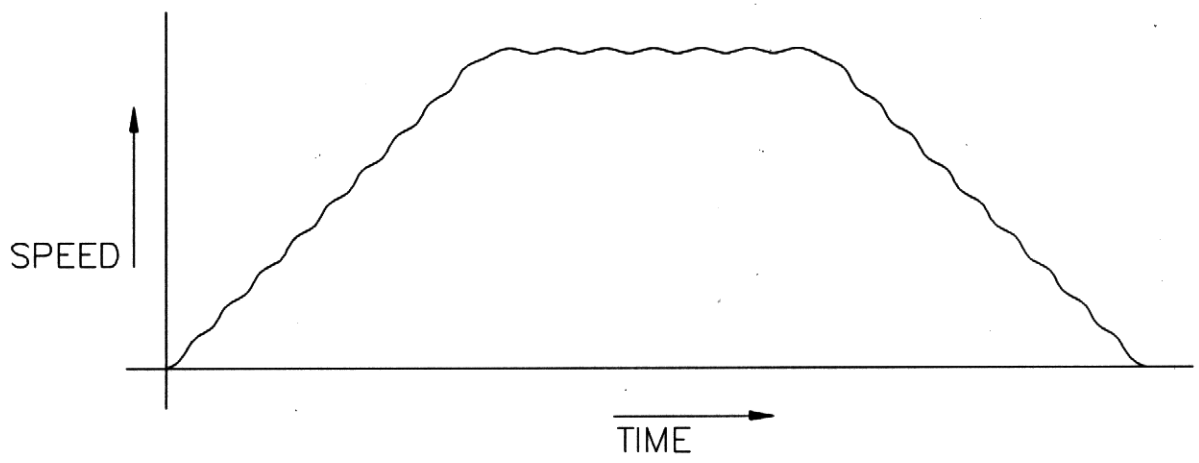


Figure 2.25 - SIG Too Low

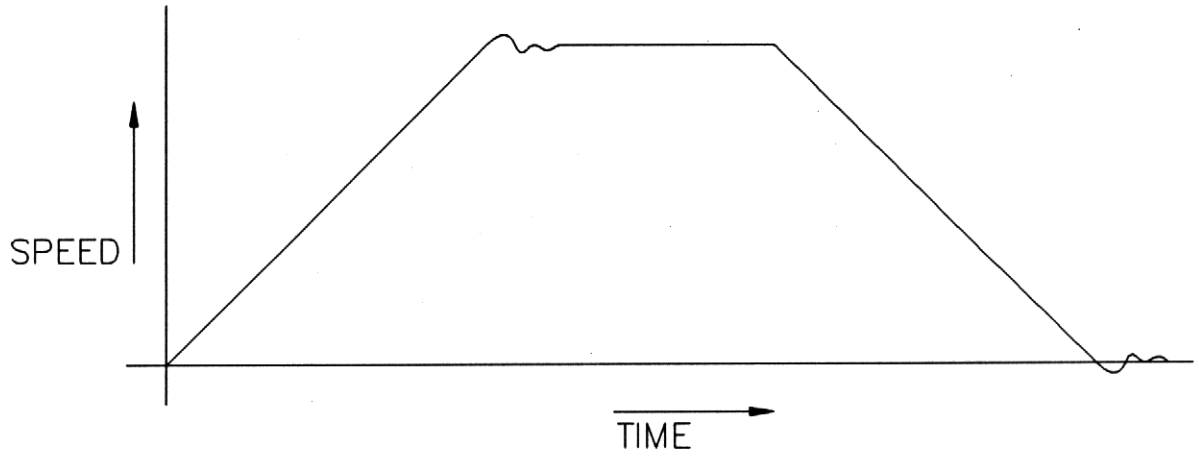


Figure 2.26 - SIG Too High

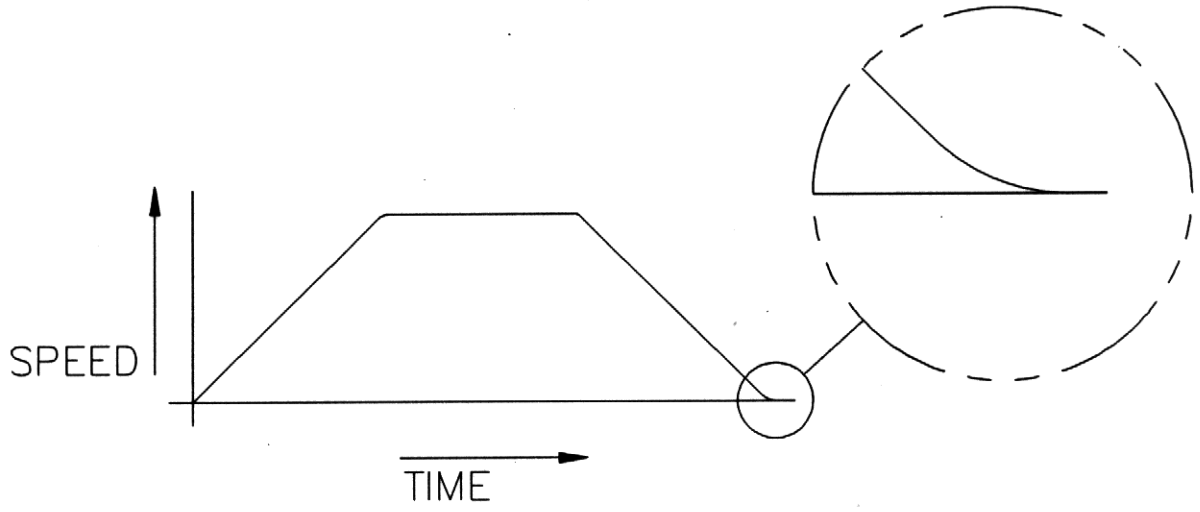


Figure 2.27 - AHG Too Low

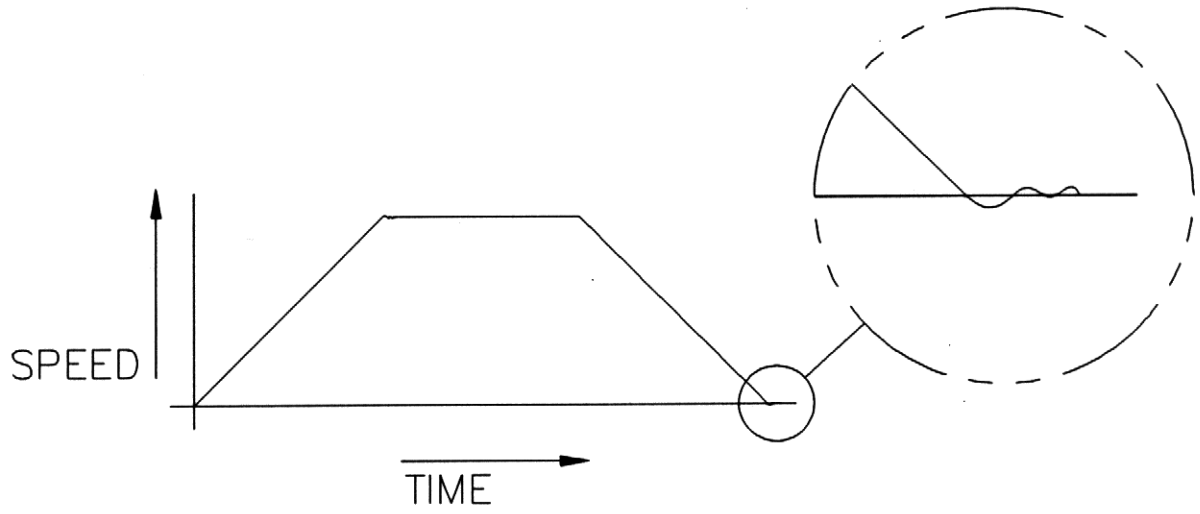


Figure 2.28 - AHG Too High

SECTION 3
PROGRAMMING WITH OPERATOR INTERFACE

Setup information and block commands may be programmed through the Operator Interface (OPI-1 or OPI-5) while in the PROGRAM system operating mode. Put the ServoPro-I Motion Control System into the PROGRAM system operating mode by turning the PROGRAM/RUN key switch on the side panel.

Insert the key into the key switch and turn it to PROGRAM. DIP switch position #7 on S2 of the command module must be OFF. When first applying power, the initial screen on the OPI will display the company and product identification. The Main Menu screen will then appear as shown in **Figure 3.1**. Press the [F1] key to begin programming setup information or press the [F2] key to begin programming block steps (commands) or press [F3] to enter RUN MODE. Press [F4] to display revision level.

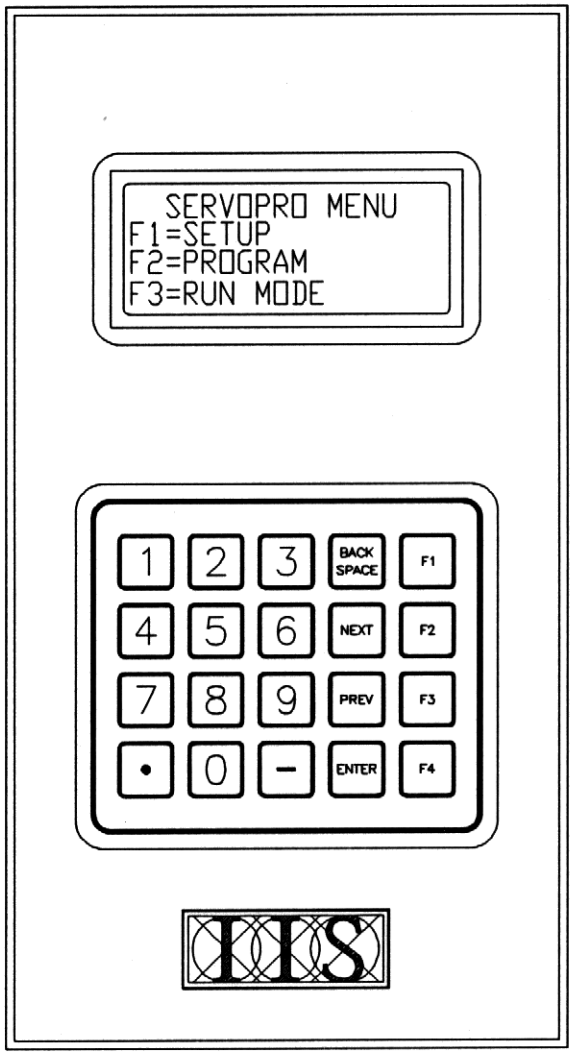


Figure 3.1 - Operator Interface

The Operator Interface keypad contains three groups of keys (refer to **Figure 3.1**):

1. The numeric keys ([0] - [9]), along with the decimal point key [.] and the negative key [-]. These keys are used to enter fixed parameter values.

2. The display control keys [BACK SPACE], [NEXT], [PREV], and [ENTER]. These keys alter the displayed screen in defined ways:
   - [BACK SPACE] causes the cursor to move back one space.
   - [NEXT] displays the next screen or an alternate parameter value.
   - [PREV] displays the previous screen or an alternate parameter value.
   - [ENTER] changes the value of the parameter and/or the display.

3. The function keys [F1], [F2], [F3], and [F4]. The functions of these keys are defined in the Operator Interface displays.

The Operator Interface display shows up to four lines of information. There are two symbols with specific meanings:

* The asterisk indicates that either a selection is possible using the [NEXT]/[PREV] keys, or that a continuation of the function is possible using the [ENTER] key.

[ ] The cursor prompts for parameter value entry.

3.1 SETUP PARAMETERS

Setup parameters define system function values in the ServoPro-I Motion Control System. Refer to **Table 3.1** for a summary of the setup parameters.

Table 3.1 - Setup Parameter Summary

SETUP PARAMETERS	ENTRY METHOD FIXED = Numeric Keys SELECT = [NEXT]/[PREV] Keys	DESCRIPTION
Engineering Units	FIXED	System movement data units.
Jog Speed and Ramp	FIXED	Maximum speed and rate of acceleration and deceleration during Jog operation.
Initialize Speed and Ramp	FIXED	Maximum speed, direction, and rate of acceleration and deceleration during Initialize operation.
Execution Mode	SELECT	Defines how execution begins during automatic operations.
Digital Compensation (Proportional Gain, Integral, and Differential)	FIXED	Compensation for encoders.
Erase Blocks	FUNCTION KEYS	Resets block memory.
Setup Passwork SET_CODE_____ PROG_CODE_____	FIXED	Sets up codes for password protection option.

3.2 PROGRAMMING SETUP INFORMATION

Press the [F1] key while viewing the Main Menu screen to put the ServoPro-I Motion Control System into the Setup programming mode. Use the Setup programming mode to change the values of the setup parameters. Also, while in the Setup programming mode, it is possible to erase all of the existing program blocks. (Refer to **"Section 3.3 - Block Commands"** for more information on program blocks.) Unauthorized entry into the setup can be prevented using the key switch or password authorization.

The ServoPro-I Motion Control System contains default values for all of the setup parameters. It is not necessary to program the setup values to operate the system, if the default values are acceptable. After the setup parameter values are programmed, they are stored in nonvolatile memory and do not need to be programmed again, unless they need to be changed.

Programming the setup parameters through the Operator Interface (OPI) follows a general pattern. **Figure 3.2** shows a block diagram of the steps for changing a setup parameter as outlined in this section.

The steps for changing a setup parameter are:

1. Display the Setup *parameter* screen.
2. Access the Setup *entry* screen and change the value of the parameter.

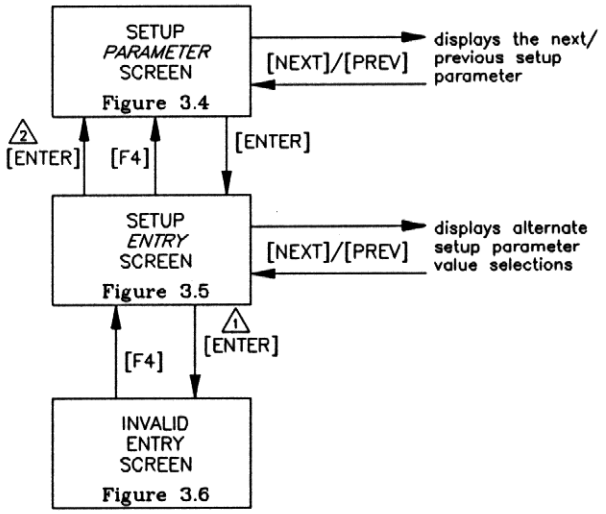


Figure 3.2
Programming Setup Parameter Values Block Diagram

The setup parameter and the current value for that parameter are displayed on a Setup *parameter* screen (refer to **Figure 3.3**). The actions that are permitted while the Setup *parameter* screen is displayed are:

```
SETUP              *
UNITS PER TURN:
1.000
F4=MAIN MENU
```

Figure 3.3
Setup *Parameter* Screen

1. Press [ENTER] to display the Setup *entry* screen.
2. Press [NEXT] or [PREV] to access a different Setup *parameter* screen.
3. Press [F4] to display the Main Menu.

Access the different setup parameters by pressing the [NEXT] or [PREV] key while viewing the Setup *parameter* screen. The [NEXT] key displays the parameter which is next on the list; the [PREV] key displays the previous parameter from the list. The list order of the setup parameters is as follows:

1. Engineering Units
2. Jog Speed and Ramp
3. Initialize Speed and Ramp
4. Execution Mode
5. Digital Compensation
6. Erase Program Blocks
7. Password Authorization

This list forms a continuous loop so that, if the [NEXT] key is pressed at the Password Authorization *parameter* screen, the Engineering Units *parameter* screen is displayed. Likewise, if [PREV] is pressed at the Engineering Units *parameter* screen, the Password Authorization *parameter* screen is displayed.

The Setup *entry* screen (refer to **Figure 3.4**) is displayed by pressing [ENTER] while viewing the Setup *parameter* screen. The actions that are permitted while the Setup *entry* screen is displayed are:

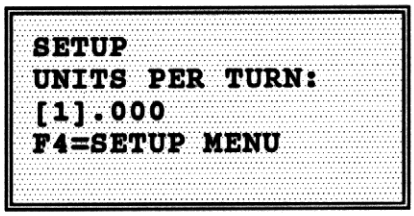


Figure 3.4
Setup *Entry* Screen

1. Display a new value using the numeric keys or the [NEXT]/[PREV] keys, depending on the setup parameter (refer to **Table 3.1**).
2. Press [ENTER] to input the parameter value and display the Setup *parameter* screen.
3. Press [F4] to display the Setup *parameter* screen without changing the current value of the parameter.

If a value which is invalid is entered for the Setup parameter, the Invalid Entry screen is displayed showing the range of valid parameter values (refer to **Figure 3.5**). The action that is permitted while the Invalid Entry screen is displayed is:

Figure 3.5
Invalid Entry Screen

1. Press [F4] to display the Setup *entry* screen.

In this section, each Setup *parameter* screen will be shown with a list of possible action options to take while viewing the screen. The Setup *entry* screen will then be shown with a list of the actions to take to change the value of the parameter and other possible action options to take while viewing the screen.

NOTE

The action options listed along the side of the sample screens are options and do not need to be taken. Pressing an Operator Interface key which is not listed in the action options will have no effect.

3.2.1 ENGINEERING UNITS

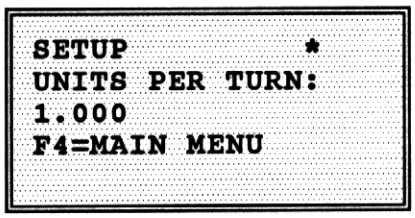
Movement data is communicated with the ServoPro-I Motion Control System in terms of "Engineering Units". Engineering units are defined as any conversion which can be expressed as units per motor shaft revolution. They do not have to be a specific distance unit such as inches or millimeters.

NOTE

The default engineering units value is 1.000.
The valid range for engineering units is -999999 to 999999.

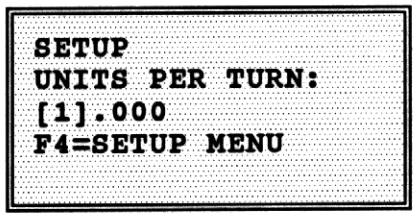
Negative engineering units will cause the motor shaft rotation to be opposite the standard rotation for the sign of the distance input.

The Engineering Units *parameter* screen is the first screen displayed when the [F1] function key is pressed while viewing the Main Menu. It can also be accessed by pressing the [PREV] key in the Jog Speed and Ramp *parameter* screen or the [NEXT] key in the Erase Program Blocks *parameter* screen.



Engineering Units *parameter* screen

1. Press [ENTER] to display the Engineering Units *entry* screen.
2. Press [NEXT] to display the Jog Speed and Ramp *parameter* screen.
3. Press [PREV] to display the Erase Program Blocks *parameter* screen.
4. Press [F4] to display the Main Menu.



Engineering Units *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value. Use the decimal point [.] key as needed.
2. Press [ENTER] to input the engineering units value and display the Engineering Units *parameter* screen.
3. Press [F4] to display the Engineering Units *parameter* screen without changing the current value of engineering units.

3.2.2 JOG SPEED AND RAMP

The jog speed is the maximum speed at which the motor will turn when it is under a "Jog CW" or "Jog CCW" command. The jog ramp rate is the rate of both acceleration and deceleration when the motion control system is executing a jog sequence. Refer to **"Section 4 - Controls and Operations"** for more information on jog operations.

NOTE

The default jog speed is 1.
The valid range for jog speed is 1 to 3400 RPM.
Check the maximum speed for the motor used in Appendix B.

The default jog ramp rate is 1.
The valid range for jog ramp rate is 1 to 800 revs/sec/sec.

To access the Jog Speed and Ramp *parameter* screen, press the [NEXT] key in the Engineering Units *parameter* screen or the [PREV] key in the Initialize Speed and Ramp *parameter* screen.

```
SETUP                *
JOG SPEED: 1
JOG ACCEL: 1
F4=MAIN MENU
```

Jog Speed and Ramp *parameter* screen

1. Press [ENTER] to display the Jog Speed and Ramp *entry* screen.
2. Press [NEXT] to display the Initialize Speed and Ramp *parameter* screen.
3. Press [PREV] to display the Engineering Units *parameter* screen.
4. Press [F4] to display the Main Menu.

NOTE

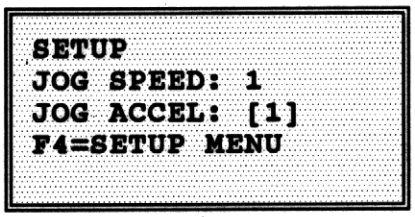
There are two cursor positions on the Jog Speed and Ramp *entry* screen: one for Jog Speed input and one for Jog Ramp input.

```
SETUP
JOG SPEED: [1]
JOG ACCEL: 1
F4=SETUP MENU
```

Jog Speed and Ramp *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for jog speed.
2. Press [ENTER] to input the jog speed value and move the cursor to jog ramp input position.
3. Press [F4] to display the Jog Speed and Ramp *parameter* screen without changing the current value of jog speed and jog ramp.

If a value which is invalid is entered for Jog Speed, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 3400 RPM.



Jog Speed and Ramp *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for jog ramp (**JOG ACCEL**).

2. Press [ENTER] to input the jog ramp (**JOG ACCEL**) value and display the Jog Speed and Ramp *parameter* screen.

3. Press [F4] to display the Jog Speed and Ramp *parameter* screen without changing the current value of jog speed and jog ramp.

If a value which is invalid is entered for Jog Ramp, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 800 revs/sec/sec.

3.2.3 INITIALIZE SPEED AND RAMP

The initialize speed dictates the direction of the motor rotation and the maximum speed at which the motor will turn when it is under an "Initialize" input command. The initialize ramp rate is the rate of both acceleration and deceleration when the Servopro Motion Control System is executing an initialize sequence.

NOTE

The default initialize speed is 1.
The valid range for initialize speed is -3400 to 3400 RPM.
Check the maximum speed for the motor used in Appendix B.

The default initialize ramp rate is 1.
The valid range for initialize ramp rate is 1 to 800 revs/sec/sec.

Negative speeds turn the motor clockwise and positive speeds turn the motor counterclockwise during an initialize command. Refer to **"Section 4 - Controls and Operations"** for more information on initialize operations.

To access the Initialize Speed and Ramp *parameter* screen, press the [NEXT] key in the Jog Speed and Ramp *parameter* screen or the [PREV] key in the Execution Mode *parameter* screen.

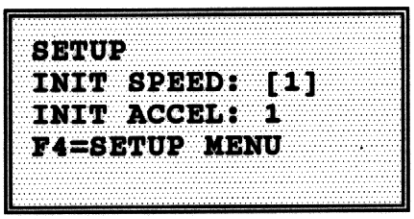
```
SETUP                *
INIT SPEED: 1
INIT ACCEL: 1
F4=MAIN MENU
```

Initialize Speed and Ramp *parameter* screen

1. Press [ENTER] to display the Initialize Speed and Ramp *entry* screen.
2. Press [NEXT] to display the Execution Mode *parameter* screen.
3. Press [PREV] to display the Jog Speed and Ramp *parameter* screen.
4. Press [F4] to display the Main Menu.

NOTE

There are two cursor positions on the Initialize Speed and Ramp *entry* screen: one for Initialize Speed input and one for Initialize Ramp input.



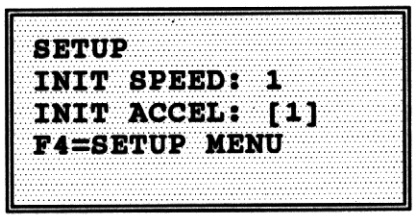
Initialize Speed and Ramp *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for initialize speed.

2. Press [ENTER] to input the initialize speed value and move the cursor to the initialize ramp input position.

3. Press [F4] to display the Initialize Speed and Ramp *parameter* screen without changing the current value of initialize speed and initialize ramp.

If a value which is invalid is entered for Initialize Speed, the Invalid Entry screen is displayed showing that the range of valid values is -3400 to 3400 RPM.



Initialize Speed and Ramp *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for initialize ramp (**INIT ACCEL**).

2. Press [ENTER] to input the initialize ramp (**INIT ACCEL**) value and display the Initialize Speed and Ramp *parameter* screen.

3. Press [F4] to display the Initialize Speed and Ramp *parameter* screen without changing the current value of initialize speed or initialize ramp.

If a value which is invalid is entered for Initialize Ramp, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 800 revs/sec/sec.

3.2.4 EXECUTION MODE

The Execution Mode defines how the ServoPro-I Motion Control System begins execution of the programmed blocks of steps during automatic operations (refer to **"Section 4 - Controls and Operations"** for a description of automatic operations). There are two execution modes:

Input Trigger Mode: The eight Programmable Input/Output (I/O) locations are scanned. If there is a change of state from OFF to ON, the block number corresponding to the I/O number which changed state will begin execution.

Binary Trigger Mode: The last Programmable I/O (#8) is defined as the MOVE input. When the MOVE input changes state from OFF to ON, the block number corresponding to the binary code on Programmable I/O #1 through #7 will begin execution. For example, if I/O #2 and I/O #6 are ON when MOVE changes from OFF to ON, block number 34 (binary 2 for I/O #2 plus binary 32 for I/O #6) will begin execution. Refer to **Table 3.2** for a summary of binary codes. (Refer to **"Section 4 - Controls and Operations"** for more information on the Programmable I/Os.) The highest block number (all I/Os ON) is 127.

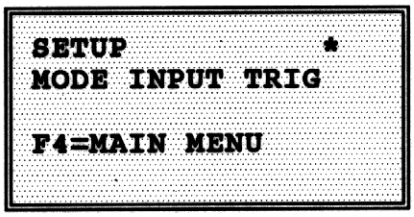
NOTE

The default execution mode is Input Trigger.

To access the Execution Mode *parameter* screen, press the [NEXT] key in the Initialize Speed and Ramp *parameter* screen or the [PREV] key in the Digital Compensation *parameter* screen.

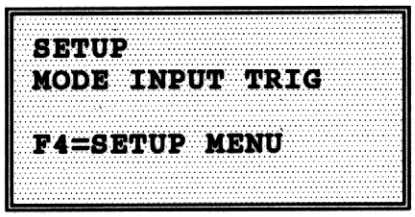
Table 3.2 - Binary Code Summary

USER I/O #	BINARY CODE
1	1
2	2
3	4
4	8
5	16
6	32
7	64



Execution Mode *parameter* screen

1. Press [ENTER] to display the Execution Mode *entry* screen.
2. Press [NEXT] to display the Digital Compensation *parameter* screen.
3. Press [PREV] to display the Initialize Speed and Ramp *parameter* screen.
4. Press [F4] to display the Main Menu.



Execution Mode *entry* screen

1. Press [NEXT] or [PREV] to display the alternate execution mode selection (**BINARY TRIG**).
2. Press [ENTER] to input the execution mode and display the Execution Mode *parameter* screen.
3. Press [F4] to display the Execution Mode *parameter* screen without changing the current execution mode.

3.2.5 DIGITAL COMPENSATION

Digital compensation is used to compensate for the differences between encoders. Refer to **"Section 1 - Description"** for detailed information about proportional gain, the integral term and the differential term (P, I, and D terms).

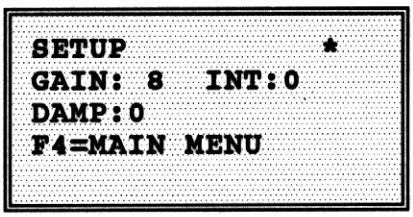
NOTE

The default gain setting is 8.
The valid range for gain is 1 to 256.

The default integral term is 0.
The valid range for the integral term is -127 to 127.

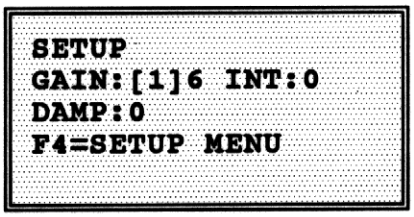
The default differential term is 0.
The valid range for the differential term is -127 to 127.

To access the Digital Compensation *parameter* screen, press the [NEXT] key in the Execution Mode *parameter* screen or the [PREV] key in the Erase Program Blocks *parameter* screen.



Digital Compensation *parameter* screen

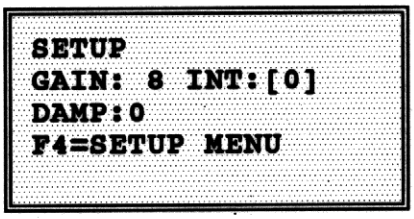
1. Press [ENTER] to display the Digital Compensation *entry* screen.
2. Press [NEXT] to display the Erase Program Blocks *parameter* screen.
3. Press [PREV] to display the Execution Mode *parameter* screen.
4. Press [F4] to display the Main Menu.



Digital Compensation *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for the proportional gain (**GAIN**).
2. Press [ENTER] to input the gain setting and move the cursor to the integral term input position.
3. Press [F4] to display the Digital Compensation *parameter* screen without changing the current gain setting.

If a value which is invalid is entered for Gain, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 256.



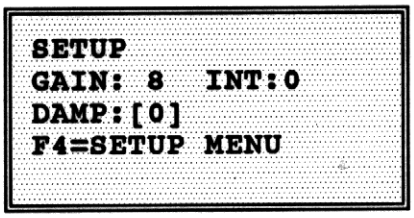
Digital Compensation *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for the integral term (**INT**).

2. Press [ENTER] to input the integral term and move the cursor to the differential term input position.

3. Press [F4] to display the Digital Compensation *parameter* screen without changing the current integral term.

If a value which is invalid is entered for INT, the Invalid Entry screen is displayed showing that the range of valid values is -127 to 127.



Digital Compensation *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for the differential term (**DAMP**).

2. Press [ENTER] to input the differential term and display the Digital Compensation *parameter* screen.

3. Press [F4] to display the Digital Compensation *parameter* screen without changing the current differential term.

If a value which is invalid is entered for DAMP, the Invalid Entry screen is displayed showing that the range of valid values is -127 to 127.

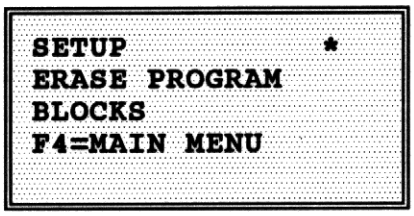
3.2.6 ERASE PROGRAM BLOCKS

CAUTION

EXECUTING THE ERASE PROGRAM BLOCKS FUNCTION DESTROYS ALL PROGRAM BLOCK INFORMATION. PROGRAM BLOCKS WILL NEED TO BE RE-PROGRAMMED BEFORE AUTOMATIC OPERATIONS CAN RESUME.

Erase Program Blocks is a function which allows the user to erase all of the steps (commands) in all of the program blocks. Refer to **"Section 3.4 - Programming Block Commands"** for information on programming block steps.

To access the Erase Program Blocks *parameter* screen, press the [NEXT] key in the Digital Compensation *parameter* screen or the [PREV] key in the Engineering Units *parameter* screen.

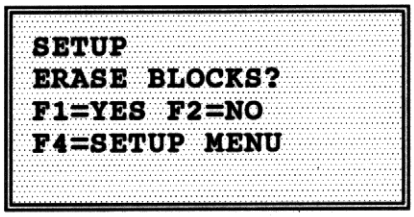


Erase Program Blocks *parameter* screen

1. Press [ENTER] to display the first Erase Program Blocks *entry* screen.
2. Press [NEXT] to display the Engineering Units *parameter* screen.
3. Press [PREV] to display the Digital Compensation *parameter* screen.
4. Press [F4] to display the Main Menu.

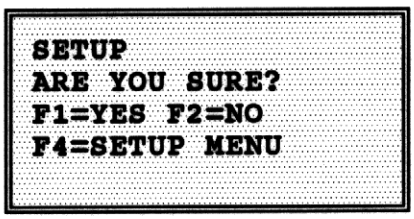
NOTE

There are two Erase Program Blocks *entry* screens to prevent accidental erasure. Choose YES ([F1]) in both screens to erase the program blocks.



Erase Program Blocks *entry* screen

1. Press [F1] to continue with the Erase Program Blocks function.
2. Press [F2] or [F4] to discontinue the Erase Program Blocks function and display the Erase Program Blocks *parameter* screen.



Erase Program Blocks
entry screen

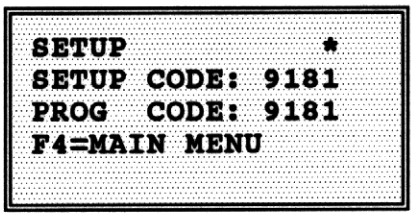
1. Press [F1] to continue with the Erase Program Blocks function. THIS WILL ERASE ALL PROGRAM BLOCK STEPS and display the Erase Program Blocks *parameter* screen.

2. Press [F2] or [F4] to discontinue the Erase Program Blocks function and display the Erase Program Blocks *parameter* screen.

3.2.7 PASSWORD AUTHORIZATION

Password protection when entering the SETUP MODE or exiting the RUN MODE can be enabled by setting DIP switch (S2) position #2 ON. A password may be any code from 0 to 9999. One code can be used for entering the SETUP MODE and a different code for exiting RUN MODE. Authorization to exit RUN MODE will protect program MODE. The default password codes are 9181. New password codes can be entered while in the SETUP MODE.

To access the Password Authorization codes *parameter* screen, press the [NEXT] key in the Erase Program screen or the [PREV] key in the Engineering Units *parameter* screen.

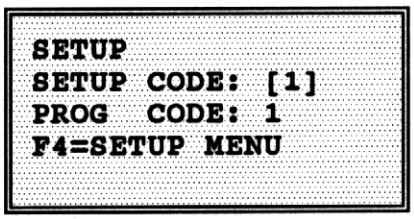


Password Authorization Codes *parameter* screen

1. Press [ENTER] to display the Password Authorization *entry* screen.
2. Press [NEXT] to display the Engineering Units *parameter* screen.
3. Press [PREV] to display the Erase Program *parameter* screen.
4. Press [F4] to display the Main Menu.

NOTE

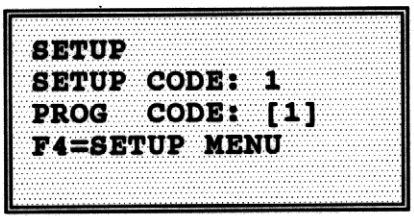
There are two cursor positions on the Password Authorization and Ramp *entry* screen: one for Setup password code input and one for program password code input.



Password Authorization Code *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for setup code.
2. Press [ENTER] to input the setup code value and move the cursor to the program code value.
3. Press [F4] to display the Password Authorization *parameter* screen without changing the current value of setup and program password codes.

If a value which is invalid is entered for a passwork code, the Invalid Entry screen is displayed showing that the range of valid values is 0 to 9999.



Password Authorization Code *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new value for a password code (SETUP or PROG) (**INIT ACCEL**).

2. Press [ENTER] to input the password code value and display the Password Code *parameter* screen.

3. Press [F4] to display the Password Code *parameter* screen without changing the current value of either password code.

3.3 BLOCK COMMANDS

Block commands are used to define a sequence of actions which the ServoPro-I Motion Control System may execute during automatic operation. Refer to **Table 3.3** for a summary of commands. The commands are programmed into block steps, which are user defined to fit specific applications.

NOTE

Many block command parameters may be entered during programming or during block execution. If entered during block execution, the value may be input from the Operator Interface keypad or one of four thumb-wheel modules. Use the [NEXT]/[PREV] keys during programming to select KYPD or TW1, TW2, TW3, TW4.

Table 3.3 - Block Command Summary

COMMAND	PARAMETERS	ENTRY OPTIONS PROG = Enter in Program mode RUN = Enter during execution	DESCRIPTION
POSITION	Position Top Speed Ramp Rate Degree	PROG, RUN PROG, RUN PROG, RUN PROG	An absolute move to the position. (Relative to 0.0).
INDEX	Index Top Speed Ramp Rate Degree	PROG, RUN PROG, RUN PROG, RUN PROG	An incremental move to the index. (Relative to current position).
SEARCH FOR I/O	Search Dist. Max. Post Sensor Dist. Speed I/O ON I/O OFF	PROG, RUN PROG, RUN PROG, RUN PROG PROG	Continue a move until input is ON/OFF or maximum search distance is travelled. Travel post distance after input ON/OFF.
SET 0.0			Force current position to be 0.0
CLR 0.0			Clear set 0.0 and return system to absolute 0.0
WAIT TIME (ms)	Time	PROG, RUN	Programmed delay.
WAIT TILL STOP			Wait to execute next step until motion is done.
WAIT POSITION	Position	PROG, RUN	Wait to execute next step until position is reached.
WAIT DISTANCE	Distance	PROG, RUN	Wait to execute next step until distance is travelled.
WAIT I/O (INPUT)	I/O ON I/O OFF	PROG PROG	Wait for specified input condition.
TURN ON/OFF	I/O ON I/O OFF Drive ON Drive OFF	PROG PROG PROG PROG	Turn the output or drive amp ON or OFF.

COMMAND	PARAMETERS	ENTRY OPTIONS PROG = Enter in Program mode RUN = Enter during execution	DESCRIPTION
DO WHILE	Count I/O ON I/O OFF Do Until Exit BATCH	PROG, RUN PROG PROG PROG PROG, RUN	Repeat the steps between DO WHILE and END WHILE until condition is met.
END WHILE			End of DO WHILE loop.
EXIT BLK IF I/O (INPUT)	I/O ON I/O OFF	PROG PROG	Terminate block execution if input is energized.
EXIT BLOCK			Terminate block execution.
PRESET BATCH	BATCH COUNT	PROG, RUN	Set the counter to be used by the DO WHILE BATCH Command.

3.3.1 BLOCK COMMAND CATEGORIES

Block commands fall into one of three categories:

WAIT commands — The specified condition of a wait command must be satisfied before the ServoPro-I Motion Control System will execute the next command in the block. The wait commands are:

- WAIT TILL STOP
- WAIT POSITION
- WAIT DISTANCE
- WAIT TIME (ms)
- WAIT I/O

MOTION commands — Motion commands are either INDEX or POSITION commands. The ServoPro-I Motion Control System checks the status of the motor before attempting to execute a motion command. If the motor is already busy, the system waits to execute the next motion command until the motor is no longer busy. The motion commands are:

- INDEX
- POSITION

IMMEDIATE commands — These commands are executed immediately if the system is not executing a wait command. They are executed whether the motor is busy or not. The immediate commands are:

- SET 0.0
- CLR 0.0
- TURN ON/OFF
- DO WHILE
- END WHILE
- EXIT BLK IF I/O
- EXIT BLOCK

The only command that does not fit into any of the above categories is the SEARCH FOR I/O command. This command sets up information to be used by the system to execute the search at the end of an index or position motion. The SEARCH FOR I/O command is treated like a motion command in that it is not executed while the motor is busy.

3.3.2 BLOCK COMMAND EXECUTION

During execution of the block commands, the ServoPro-I Motion Control System does not necessarily complete a command before the next one is executed. When an immediate command follows a motion command, the system executes the immediate command before the motion command is complete. Immediate commands are always completed before the next command in the list is executed.

For example, consider this block of steps:

1.1 INDEX
1.2 WAIT TILL STOP
1.3 TURN I/O ON

The motor will index the specified distance, wait for the motor to stop moving, and then turn on the specified I/O. Now, consider this block of steps:

1.1 INDEX
1.2 TURN I/O ON
1.3 WAIT TILL STOP

The motor will start the index, turn the specified I/O on while the system is still indexing, and then after the index is complete wait for the motor to stop.

3.3.3 BLOCK COMMAND SEQUENCING

During block command programming (refer to **"Section 3.4 - Programming Block Commands"**), commands are inserted and deleted into block steps. The block commands are then executed during automatic operation in sequential order, beginning with the "top", or lowest step number, of the block.

Figure 3.6A shows an example of two blocks. Block #1 contains three steps. The WAIT POSITION command is in Step #1 and the TURN ON/OFF command is in Step #2. Step #3 contains the END OF BLOCK command. The END OF BLOCK command is automatically inserted into every block and cannot be deleted. Block #2 has not been programmed with commands and contains only the END OF BLOCK command.

Figure 3.6B shows the blocks after the INDEX command is inserted into Block #1, Step #3 - the END OF BLOCK command has moved to Step #4.

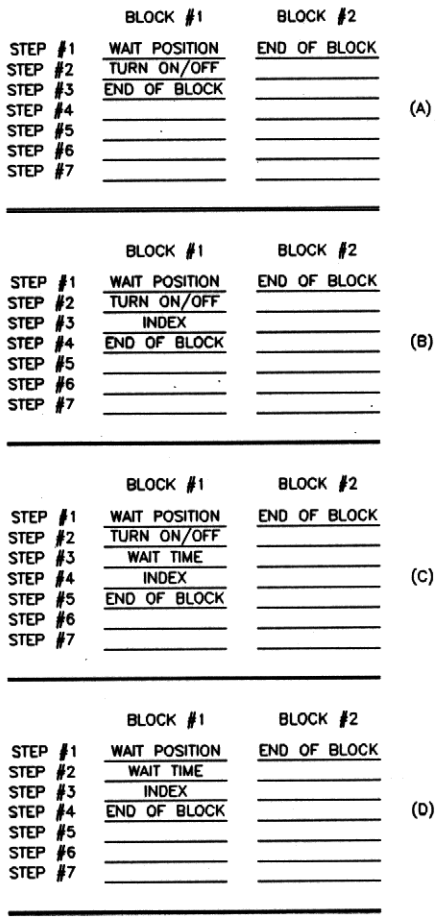


Figure 3.6
Block Command Insertion and Deletion

Figure 3.6C shows what happens after another command - WAIT TIME - is inserted into Block #1, Step #3. Inserting a command into a step "pushes down" the following commands into higher step numbers. Likewise, deleting a command from a step "pushes up" the following commands into lower step numbers.

Figure 3.6D shows the blocks after the TURN ON/OFF command is deleted from Block #1, Step #2.

3.4 PROGRAMMING BLOCK COMMANDS

Press the [F2] key while viewing the Main Menu screen on the Operator Interface (refer to **Figure 3.7**) to put the ServoPro-I Motion Control System into the Program mode. Use the Program mode to program blocks of steps (commands) that define a sequence of actions which the ServoPro-I Motion Control System may execute during automatic operations.

NOTE

Block steps must be programmed before the ServoPro-I Motion Control System can operate in the automatic mode.

A total of 127 steps may be programmed. Blocks may contain any number of steps, as long as the total number of steps in all blocks does not exceed 127. There could be 127 blocks defined with one step each, or there could be 1 block defined with 127 steps, or any combination in between.

After the blocks are programmed they are stored in nonvolatile memory and do not need to be programmed again, unless the user application changes. They may ALL be erased by using the Erase Program Blocks function in the Setup mode (refer to **"Section 3.2 - Programming Setup Information"**).

Programming block steps through the Operator Interface follows a general pattern. **Figure 3.8** shows a block diagram of the programming block steps as outlined in this section. Command parameter values are defined and the commands are then entered into the block steps. The command parameter value may be entered during programming or, in many cases, it may be entered through one of four different thumbwheel modules or through the Operator Interface keypad during execution.

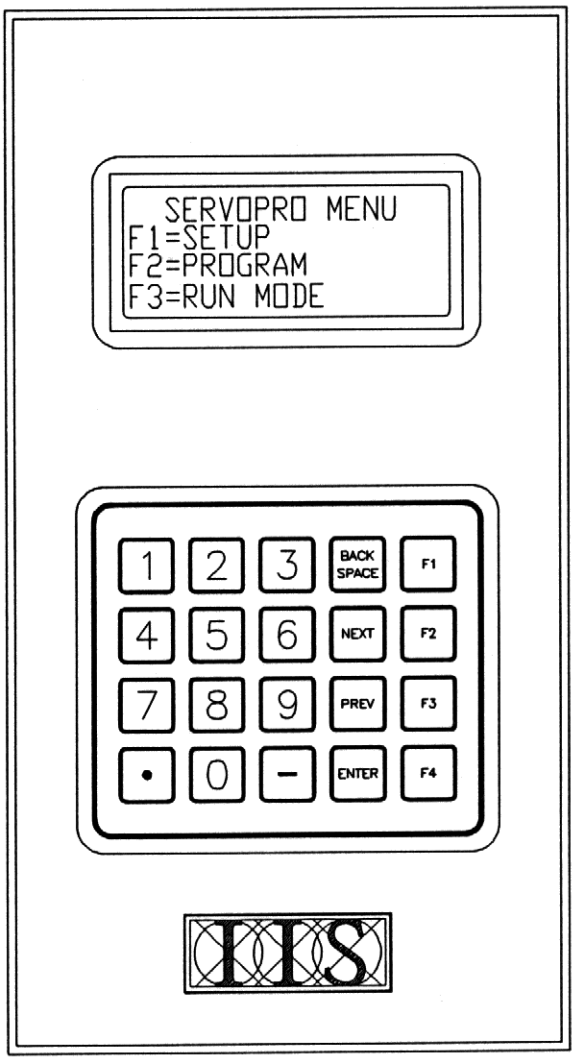
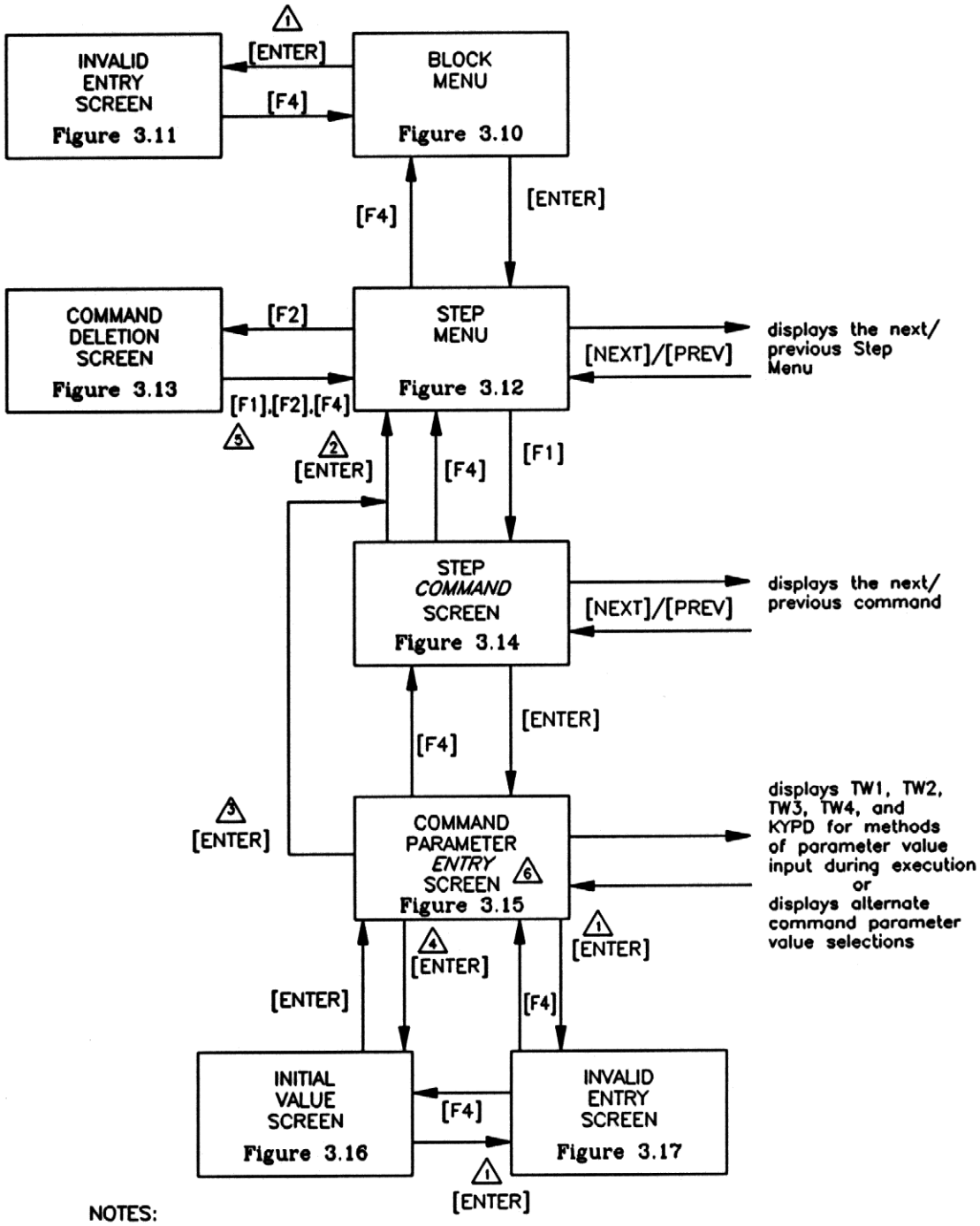


Figure 3.7
Operator Interface



NOTES:

1. If the value is out of the valid range.
2. Commands with no parameters are inserted into the block step.
3. Commands with parameters are inserted into the block step.
4. If KYPD is selected for method of parameter value input during execution.
5. Command is deleted from the block step.
6. Commands have different numbers of parameters and there are cursor positions on the command entry screen for each parameter. The command is inserted into the block step only when the last parameter value is a valid entry.

Figure 3.8 - Programming Block Commands Block Diagram

The steps for programming a block are:

1. Enter the block number in the Block Menu screen.

2. Insert and/or delete commands as needed using the Step Menu, the Step *command* screens, and the Command Parameter *entry* screen.

The first screen after pressing [F2] in the Main Menu requires the block number entry. The actions possible while the Block Menu screen (**Figure 3.9**) is displayed are:

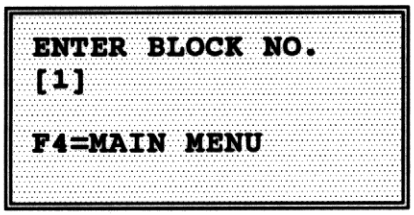


Figure 3.9
Block Menu Screen

1. Press the numeric keys ([0] - [9]) to display a new block number.
2. Press [ENTER] to display the Step Menu.
3. Press [F4] to display the Main Menu.

If a value which is invalid is entered for the block number, the Invalid Entry screen (**Figure 3.10**) is displayed showing the range of valid values.

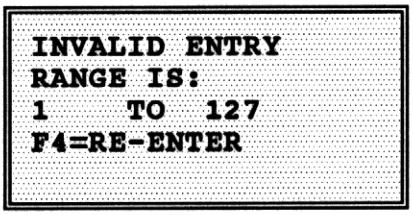


Figure 3.10
Invalid Entry Screen

1. Press [F4] to return to the Block Menu screen.

The Step Menu displays the command currently in the displayed block and step number (refer to **Figure 3.11**). (BLK.STP 1.3 refers to block number 1 and step number 3.)

NOTE

The End Of Block command is automatically inserted into every block and cannot be deleted.

Commands are inserted into the currently displayed step number. Commands already present in the block at the current or later step numbers are "pushed" down. That is, if a command is inserted into step 1, the command that was in step 1 is moved to step 2, the command in step 2 is moved to step 3, and so on. When a command is deleted, the commands are similarly "pushed" up. The actions that are allowed while viewing the Step Menu are on the following page.

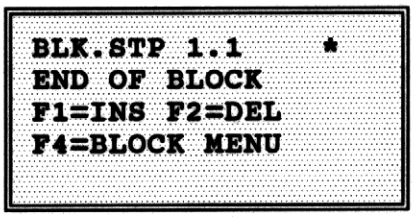


Figure 3.11
Step Menu Screen

1. Press [F1] to display a Step *command* screen.

2. Press [F2] to display the Command Deletion screen. This two-step deletion process prevents accidental deletion if [F2] is pressed by mistake.

3. Press [NEXT] or [PREV] to access the next or previous Step Menu.

4. Press [ENTER] to change or view the parameter values of the command displayed in the current Step Menu (refer to **"Paragraph 3.4.17 - Changing Block Command Parameter Values"**).

5. Press [F4] to display the Block Menu.

Press [NEXT] or [PREV] to display the commands in the block. For example, if the Step Menu currently displayed is BLK.STP 1.1, press [NEXT] to display the BLK.STP 1.2 Step Menu or [PREV] to display the last Step Menu in that block. If the Step Menu currently displayed is BLK.STP 3.4, press [NEXT] to display the BLK.STP 3.5 Step Menu or [PREV] to display the BLK.STP 3.3 Step Menu.

The Command Deletion screen (**Figure 3.12**) permits deletion of the current BLK.STP command. The actions that are allowed while viewing the Command Deletion screen are:

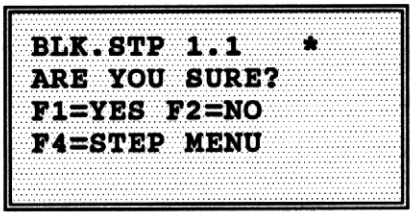


Figure 3.12
Command Deletion Screen

1. Press [F1] to delete the current BLK.STP command and display the Step Menu.

2. Press [F2] or [F4] to display the Step Menu without deleting the current BLK.STP command.

The Step *command* screen (**Figure 3.13**) displays a command that may be entered into the block step. For many commands, before the command can be entered into the block step, the command parameter values must be entered in the Command Parameter *entry* screen. The actions that are allowed while viewing the Step *command* screen are:

Figure 3.13
Step *Command* Screen

1. Press [ENTER] to display the Command Parameter *entry* screen, if the command has parameters associated with it (refer to **Table 3.3**).

2. Press [ENTER] to enter the command into the block step and display the Step Menu, if the command does not have parameters associated with it (refer to **Table 3.3**).

3. Press [NEXT] or [PREV] to display a different Step *command* screen.

4. Press [F4] to display the Step Menu.

Access the different commands by pressing the [NEXT] or [PREV] key while in a Step *command* screen. The [NEXT] key displays the command which is next on the list; the [PREV] key displays the previous command from the list. The list order of the commands is as follows:

1. POSITION
2. INDEX
3. SEARCH FOR I/O
4. WAIT TIME (ms)
5. EXIT BLK IF I/O
6. WAIT TILL STOP
7. WAIT POSITION
8. WAIT DISTANCE
9. SET 0.0
10. CLR 0.0
11. TURN ON/OFF
12. DO WHILE
13. END WHILE
14. EXIT BLOCK
15. WAIT I/O
16. PRESET BATCH

This list forms a continuous loop so that, if the [NEXT] key is pressed at the WAIT I/O *command* screen, the POSITION *command* screen is displayed. Likewise, if [PREV] is pressed at the POSITION *command* screen, the WAIT I/O *command* screen is displayed.

The Command Parameter *entry* screen (**Figure 3.14**) allows the command parameter value to be changed. The actions possible while viewing the Command Parameter *entry* screen are on the next page.

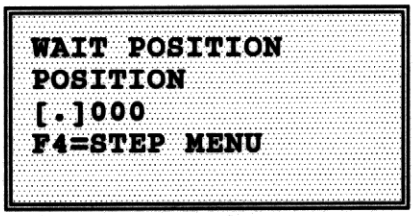


Figure 3.14
Command Parameter
***Entry* Screen**

1. Press the numeric keys ([0] - [9]) to display a new value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution (refer to **Table 3.3** for parameters which allow this). **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the parameter value or the method of parameter value input. The cursor is moved to the next parameter input position if there are more parameters associated with the command. (Refer to **Table 3.3** for the number of parameters associated with each command.) If there are no more parameters, the command is entered into the block step and the Step Menu is displayed.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the command parameter value during execution, an Initial Value screen is displayed prompting for an initial parameter value (refer to **Figure 3.15**).

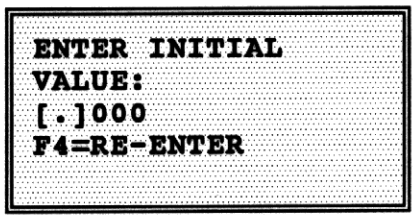


Figure 3.15
Initial Value Screen

1. Press the numeric keys ([0] - [9]) to display a new initial command parameter value.

2. Press [ENTER] to input the initial parameter value. The cursor is moved to the next parameter input position if there are more parameters associated with the command (refer to **Table 3.3** for the number of parameters associated with each command). If there are no more parameters, the command is entered into the block step and the Step Menu is displayed.

3. Press [F4] to display the Command Parameter *entry* screen without moving the cursor.

If a value which is invalid is entered for the Command Parameter, the Invalid Entry screen is displayed showing the range of valid parameter values (refer to **Figure 3.16**). The action that is permitted while viewing the Invalid Entry screen are:

Figure 3.16
Invalid Entry Screen

1. Press [F4] to display the Command Parameter *entry* screen.

In this section, each Step *command* screen is shown with a list of possible action options to take while viewing the screen. The Command Parameter *entry* screen(s) is then be shown with a list of the actions to take to change the value of the parameter and other possible action options to take while viewing the screen. Initial Value screens are shown for the command parameters which have them.

NOTE

The action options which are listed along the side of the sample screens are options and do not need to be taken. Pressing an Operator Interface key which is not listed in the action options will have no effect.

3.4.1 POSITION

A "Position" movement is one which uses "Home" or 0.00 as the starting point. The position which is programmed is relative to the "Home" position. The final position is controlled by the sign (plus or minus) of the programmed value, but the direction of movement depends on the starting point relative to the "Home" position.

NOTE

POS, SPEED, and ACCEL can be input during execution through one of four possible thumb-wheel modules or the Operator Interface keypad.

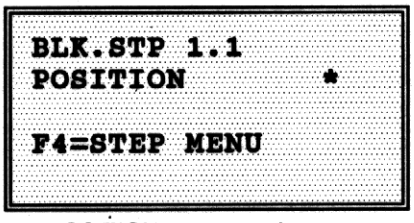
NOTE

The POSITION *entry* screen has four parameter cursor positions:
POS for position input
SPEED for position movement speed input
ACCEL for position movement ramp rate input
DEG for the position movement modified ramp angle

The POSITION command requires input of four parameter values:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
POS (Position)	The position desired relative to the "Home" position.	Position cannot exceed 2000 revs (+ or -).
SPEED	The maximum speed the motor will turn during a position movement.	1 to 3400 RPM.
ACCEL (Ramp Rate)	The rate of both acceleration and deceleration during a position movement.	1 to 800 revs/sec/sec.
DEG (Degree)	The degree of the sine angle modifying the transitions between acceleration and deceleration and the steady-state speeds of the motor.	0 to 9 degrees. A degree of zero specifies normal positioning (no modification); a degree of 1 - 9 specifies "Modified Sine Positioning".

To access the POSITION *command* screen, press the [NEXT] key while viewing the WAIT I/O *command* screen or the [PREV] key while viewing the INDEX *command* screen.



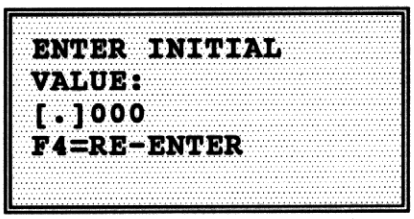
POSITION *command* screen

1. Press [ENTER] to display the POSITION *entry* screen.
2. Press [NEXT] to display the INDEX *command* screen.
3. Press [PREV] to display the WAIT I/O *command* screen.
4. Press [F4] to display the Step Menu.

POSITION *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new position value. Use the decimal point [.] as needed.
2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.
3. Press [ENTER] to input the position value and move the cursor to the SPEED input position.
4. Press [F4] to display the Step Menu without entering the command into the block step.

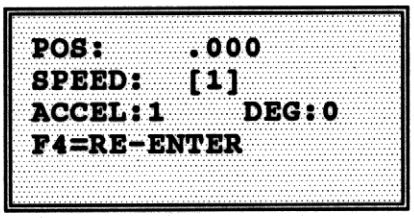
If the **KYPD** option is chosen as the method of entering the position value during execution, an Initial Value screen is displayed prompting for an initial position value.



1. Press the numeric keys ([0] - [9]) to display a new initial position value. Use the decimal point [.] key as needed.
2. Press [ENTER] to input the initial position value and move the cursor to the SPEED input position.
3. Press [F4] to display the POSITION *entry* screen without moving the cursor.

If a value which is invalid is entered for POS, the Invalid Entry screen is displayed showing that the range of valid values is -2000 to 2000 revs.

To access the SPEED input cursor position, press [ENTER] while the cursor is at the POS input position.



POSITION *entry* screen

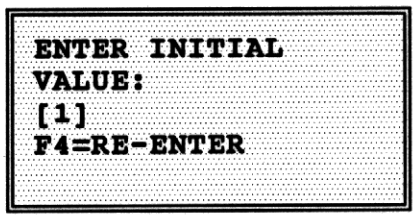
1. Press the numeric keys ([0] - [9]) to display a new position movement speed value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the speed value and move the cursor to the ACCEL input position.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the position movement speed value during execution, an Initial Value screen is displayed prompting for an initial speed value.



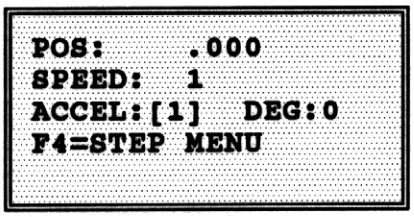
1. Press the numeric keys ([0] - [9]) to display a new initial speed value.

2. Press [ENTER] to input the initial speed value and move the cursor to the ACCEL input position.

3. Press [F4] to display the POSITION *entry* screen without moving the cursor.

If a value which is invalid is entered for SPEED, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 3400 RPM.

To access the ACCEL input cursor position, press [ENTER] while the cursor is at the SPEED input position.



POSITION *entry* screen

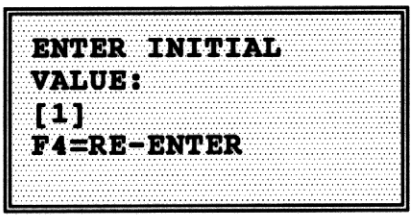
1. Press the numeric keys ([0] - [9]) to display a new position movement ramp rate value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the ramp rate value and move the cursor to the DEG input position.

4. Press [F4] to display the Step Menu without entering the command into the block.

If the **KYPD** option is chosen as the method of entering the position movement ramp rate value during execution, an Initial Value screen is displayed prompting for an initial ramp rate value.



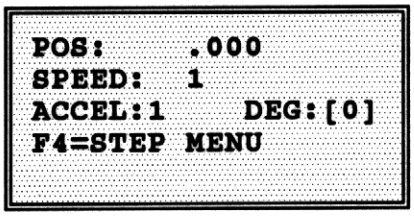
1. Press the numeric keys ([0] - [9]) to display a new initial ramp rate value.

2. Press [ENTER] to input the initial ramp rate value and move the cursor to the DEG input position.

3. Press [F4] to display the POSITION *entry* screen without moving the cursor.

If a value which is invalid is entered for ACCEL, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 800 revs/sec/sec.

To access the DEG input cursor position, press [ENTER] while the cursor is at the ACCEL input position.



POSITION *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new position movement degree value.

2. Press [ENTER] to input the degree value, enter the POSITION command into the block step, and display the Step Menu.

3. Press [F4] to display the Step Menu without entering the command into the block step.

If a value which is invalid is entered for DEG, the Invalid Entry screen is displayed showing that the range of valid values is 0 to 9.

3.4.2 INDEX

An "Index" movement is one which uses its present location as the starting point. The index which is programmed is relative to that present location starting point. The direction of the movement is controlled by the sign (plus or minus) of the programmed value.

NOTE

IDX, SPEED, and ACCEL can be input during execution from one of four possible thumb-wheel modules or the Operator Interface keypad.

NOTE

The INDEX *entry* screen has four parameter cursor positions:
IDX for position input
SPEED for index movement speed input
ACCEL for index movement ramp rate input
DEG for the index movement modified ramp angle

The INDEX command requires input of four parameter values:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
IDX (Index)	The position desired relative to the current position.	Position cannot exceed 2000 revs (+ or -).
SPEED	The maximum speed the motor will turn during an index movement.	1 to 3400 RPM.
ACCEL (Ramp Rate)	The rate of both acceleration and deceleration during an index movement.	1 to 800 revs/sec/sec.
DEG (Degree)	The degree of the sine angle modifying the transitions between acceleration and deceleration and the steady-state speeds of the motor. (Refer to **"Section 1 - Description"**).	0 to 9 degrees. A degree of zero specifies normal indexing (no modification); a degree of 1 - 9 specifies "Modified Sine Indexing".

To access the INDEX *command* screen, press the [NEXT] key while viewing the POSITION *command* screen or the [PREV] key while viewing the SEARCH FOR I/O *command* screen.

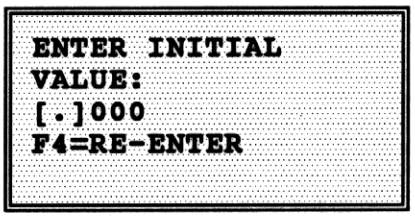
INDEX *command* screen

1. Press [ENTER] to display the INDEX *entry* screen.
2. Press [NEXT] to display the SEARCH FOR I/O *command* screen.
3. Press [PREV] to display the POSITION *command* screen.
4. Press [F4] to display the Step Menu.

INDEX *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new position value. Use the decimal point [.] as needed.
2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.
3. Press [ENTER] to input the position value and move the cursor to the SPEED input position.
4. Press [F4] to display the Step Menu without entering the command into the block step.

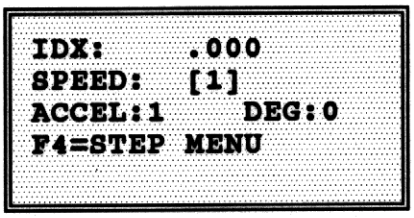
If the **KYPD** option is chosen as the method of entering the position value during execution, an Initial Value screen is displayed prompting for an initial position value.



1. Press the numeric keys ([0] - [9]) to display a new initial position value. Use the decimal point [.] key as needed.
2. Press [ENTER] to input the initial position value and move the cursor to the SPEED input position.
3. Press [F4] to display the INDEX *entry* screen without moving the cursor.

If a value which is invalid is entered for IDX, the Invalid Entry screen is displayed showing that the range of valid values is -2000 to 2000 revs.

To access the SPEED input cursor position, press [ENTER] while the cursor is at the IDX input position.



INDEX *entry* screen

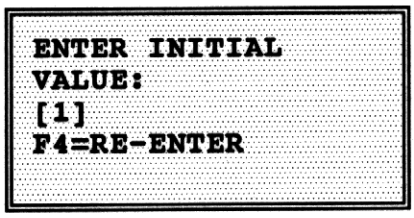
1. Press the numeric keys ([0] - [9]) to display a new index movement speed value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the speed value and move the cursor to the ACCEL input position.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the index movement speed value during execution, an Initial Value screen is displayed prompting for an initial speed value.



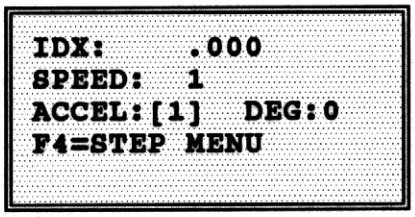
1. Press the numeric keys ([0] - [9]) to display a new initial speed value.

2. Press [ENTER] to input the initial speed value and move the cursor to the ACCEL input position.

3. Press [F4] to display the INDEX *entry* screen.

If a value which is invalid is entered for SPEED, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 3400 RPM.

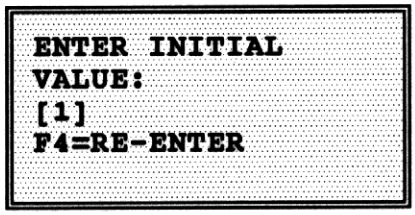
To access the ACCEL input cursor position, press [ENTER] while the cursor is at the SPEED input position.



INDEX *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new index movement ramp rate value.
2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.
3. Press [ENTER] to input the ramp rate value and move the cursor to the DEG input position.
4. Press [F4] to display the Step Menu without entering the command into the block.

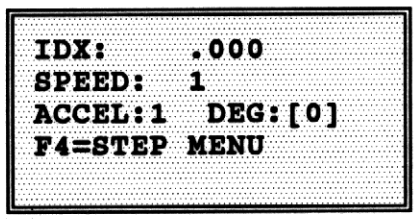
If the **KYPD** option is chosen as the method of entering the index movement ramp rate value during execution, an Initial Value screen is displayed prompting for an initial ramp rate value.



1. Press the numeric keys ([0] - [9]) to display a new initial ramp rate value.
2. Press [ENTER] to input the initial ramp rate value and move the cursor to the DEG input position.
3. Press [F4] to display the INDEX *entry* screen.

If a value which is invalid is entered for ACCEL, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 800 revs/sec/sec.

To access the DEG input cursor position, press [ENTER] while the cursor is at the ACCEL input position.



INDEX *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new index movement degree value.
2. Press [ENTER] to input the degree value, enter the INDEX command into the block step, and display the Step Menu.
3. Press [F4] to display the Step Menu without entering the command into the block step.

If a value which is invalid is entered for DEG, the Invalid Entry screen is displayed showing that the range of valid values is 0 to 9.

3.4.3 SEARCH FOR I/O

The "Search for I/O" function is a "feed-to-sensor" function for indexing or positioning on an external switch or sensor. A position or index movement is continued at the Search for I/O function speed until a defined Programmable Input/Output location is energized (turned ON or OFF) or until the maximum search distance is travelled. The maximum search distance serves as a default limit. It prevents the search from continuing past the defined number of revolutions if the defined input does not energize. The ServoPro-I Motion Control System will travel the post distance after the defined input has been energized. The SEARCH FOR I/O command must come before a POSITION or INDEX command.

NOTE

The SEARCH FOR I/O command has two *entry* screens:
I/O ON/OFF *entry* screen for I/O energized state input
SEARCH FOR I/O *entry* screen.

The SEARCH FOR I/O *entry* screen has four parameter cursor positions:
SRCH DIST for search distance input
POST DIST for post distance input
I/O for User Input/Output number input
SPEED for the Search for I/O function speed input

NOTE

SRCH DIST, POST DIST, and SPEED can be input during execution from one of four possible thumb-wheel modules or the Operator Interface keypad.

The SEARCH FOR I\O command requires input of five parameter values:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
SRCH DIST (Maximum Search Distance)	The distance the search will continue for if the defined input is not energized.	Position cannot exceed 2000 revs (+ or -).
POST DIST (Post Distance)	The distance that will be travelled after the defined input is energized.	Position cannot exceed 2000 revs (+ or -).
I/O (Input/Output)	The number of the defined Programmable I/O.	1 to 8.
I/O ON/OFF	The state in which the defined input is considered energized.	ON or OFF.
SPEED	The maximum speed of the motor during the Search for I/O function.	1 to 3400 RPM.

To access the SEARCH FOR I/O *command* screen, press the [NEXT] key while viewing the INDEX *command* screen or the [PREV] key while viewing the WAIT TIME (ms) *command* screen.

```
BLK.STP 1.1
SEARCH FOR I/O *

F4=STEP MENU
```

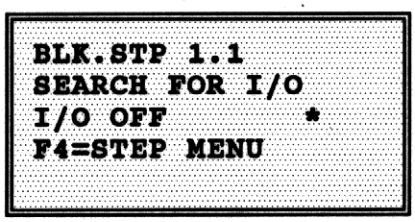
SEARCH FOR I/O *command* screen

1. Press [ENTER] to display the I/O ON/OFF *entry* screen.
2. Press [NEXT] to display the WAIT TIME (ms) *command* screen.
3. Press [PREV] to display the INDEX *command* screen.
4. Press [F4] to display the Step Menu.

```
BLK.STP 1.1
SEARCH FOR I/O
I/O ON          *
F4=STEP MENU
```

I/O ON/OFF *entry* screen

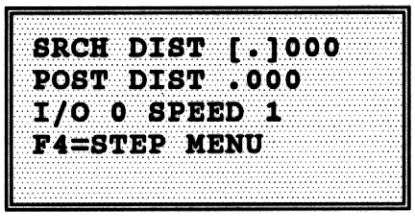
1. Press [ENTER] to input the ON state as the energized state and display the SEARCH FOR I/O *entry* screen.
2. Press [NEXT] or [PREV] to display the alternate energized state selection.
3. Press [F4] to display the Step Menu without entering the command into the step block.



I/O ON/OFF *entry* screen

1. Press [ENTER] to input the OFF state as the energized state and display the SEARCH FOR I/O *entry* screen.
2. Press [NEXT] or [PREV] to display the alternate energized state selection.
3. Press [F4] to display the Step Menu without entering the command into the step block.

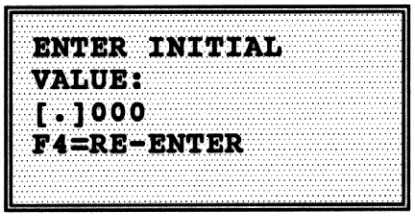
To access the SEARCH FOR I/O *entry* screen, press [ENTER] while viewing the I/O ON/OFF *entry* screen.



SEARCH FOR I/O *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new distance value. Use the decimal point [.] as needed.
2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.
3. Press [ENTER] to input the search distance value and move the cursor to the POST DIST input position.
4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the search distance value during execution, an Initial Value screen is displayed prompting for an initial position value.



1. Press the numeric keys ([0] - [9]) to display a new initial search distance value. Use the decimal point [.] key as needed.
2. Press [ENTER] to input the initial search distance value and move the cursor to the POST DIST input position.
3. Press [F4] to display the SEARCH FOR I/O *entry* screen without moving the cursor.

If a value which is invalid is entered for SRCH DIST, the Invalid Entry screen is displayed showing that the range of valid values is -2000 to 2000 revs.

To access the POST DIST input cursor position, press [ENTER] while the cursor is at the SRCH DIST input position.

SEARCH FOR I/O *entry* screen

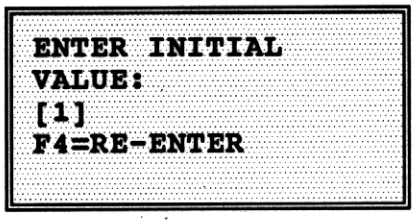
1. Press the numeric keys ([0] - [9]) to display a new post distance value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the post distance value and move the cursor to the I/O input position.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the post distance value during execution, an Initial Value screen is displayed prompting for an initial post distance value.



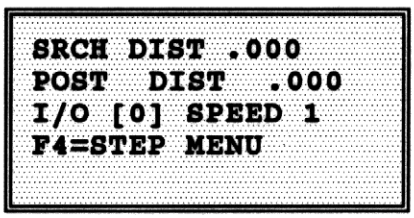
1. Press the numeric keys ([0] - [9]) to display a new initial post distance value. Use the decimal point [.] key as needed.

2. Press [ENTER] to input the initial post distance value and move the cursor to the I/O input position.

3. Press [F4] to display the SEARCH FOR I/O *entry* screen.

If a value which is invalid is entered for POST DIST, the Invalid Entry screen is displayed showing that the range of valid values is -2000 to 2000 revs.

To access the I/O input cursor position, press [ENTER] while the cursor is at the POST DIST input position.



SEARCH FOR I/O *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new Programmable Input/Output location number.
2. Press [ENTER] to input the I/O number and move the cursor to the SPEED input position.
3. Press [F4] to display the Step Menu without entering the command into the block.

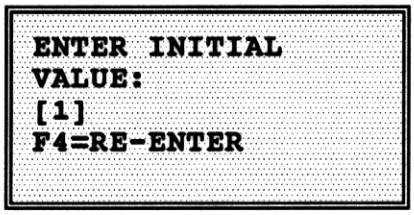
If a value which is invalid is entered for I/O, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 8.

To access the SPEED input cursor position, press [ENTER] while the cursor is at the I/O input position.

SEARCH FOR I/O *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new Search for I/O function speed value.
2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.
3. Press [ENTER] to input the speed value, enter the SEARCH FOR I/O command into the block step, and display the Step Menu.
4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the Search for I/O function speed value during execution, an Initial Value screen is displayed prompting for an initial speed value.



1. Press the numeric keys ([0] - [9]) to display a new initial speed value.
2. Press [ENTER] to input the initial speed value, enter the SEARCH FOR I/O command into the block step, and display the Step Menu.
3. Press [F4] to display the SEARCH FOR I/O *entry* screen without moving the cursor.

If a value which is invalid is entered for SPEED, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 3400 RPM.

3.4.4 WAIT TIME (ms)

The WAIT TIME command provides a programmed delay. When the ServoPro-I Motion Control System executes the WAIT TIME command, it will wait the specified number of milliseconds (ms) until it begins execution of the next command.

NOTE

TIME can be input during execution from one of four possible thumbwheel modules or the Operator Interface keypad.

The WAIT TIME command requires input of one parameter value:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
TIME	The number of milliseconds the ServoPro-I Motion Control System will wait before execution of the next command.	1 to 10,000 ms. Resolution is 1 ms.

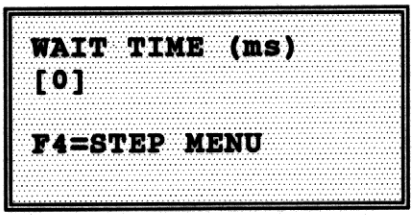
To access the WAIT TIME *command* screen, press the [NEXT] key while viewing the SEARCH FOR I/O *command* screen or the [PREV] key while viewing the EXIT BLK IF I/O *command* screen.

```
BLK.STP 1.1
WAIT TIME (ms) *

F4=STEP MENU
```

WAIT TIME *command* screen

1. Press [ENTER] to display the WAIT TIME *entry* screen.
2. Press [NEXT] to display the EXIT BLK IF I/O *command* screen.
3. Press [PREV] to display the SEARCH FOR I/O *command* screen.
4. Press [F4] to display the Step Menu.



WAIT TIME *entry* screen

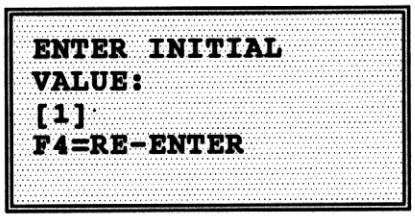
1. Press the numeric keys ([0] - [9]) to display a new time value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the time value, enter the WAIT TIME command into the block step, and display the Step Menu.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the time value during execution, an Initial Value screen is displayed prompting for an initial time value.



1. Press the numeric keys ([0] - [9]) to display a new initial time value.

2. Press [ENTER] to input the initial time value, enter the WAIT TIME command into the block step, and display the Step Menu.

3. Press [F4] to display the WAIT TIME *entry* screen.

If a value which is invalid is entered for TIME, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 10000 ms.

3.4.5 EXIT BLK IF I/O

The EXIT BLK IF I/O command forces termination of block execution if the defined input is energized (turned ON or OFF).

The EXIT BLK IF I/O command requires input of two parameter values:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
I/O (Input/Output)	The number of the defined input.	1 to 8.
I/O ON/OFF	The state in which the defined input is considered energized.	ON or OFF.

NOTE

The END BLK IF I/O command has two *entry* screens:
I/O ON/OFF *entry* screen for I/O energized state input
END BLK IF I/O *entry* screen for User Input/Output connection number input.

To access the EXIT BLK IF I/O *command* screen, press the [NEXT] key while viewing the WAIT TIME (ms) *command* screen or the [PREV] key while viewing the WAIT TILL STOP *command* screen.

```
BLK.STP 1.1
EXIT BLK IF I/O*

F4=STEP MENU
```

EXIT BLK IF I/O *command* screen

1. Press [ENTER] to display the I/O ON/OFF *entry* screen.
2. Press [NEXT] to display the WAIT TILL STOP *command* screen.
3. Press [PREV] to display the WAIT TIME (ms) *command* screen.
4. Press [F4] to display the Step Menu.

I/O ON/OFF *entry* screen

1. Press [ENTER] to input the ON state as the energized state and display the EXIT BLK IF I/O *entry* screen.
2. Press [NEXT] or [PREV] to display the I/O OFF energized state selection.
3. Press [F4] to display the Step Menu without entering the command into the step block.

I/O ON/OFF *entry* screen

1. Press [ENTER] to input the OFF state as the energized state and display the EXIT BLK IF I/O *entry* screen.
2. Press [NEXT] or [PREV] to display the I/O ON energized state selection.
3. Press [F4] to display the Step Menu without entering the command into the step block.

To access the EXIT BLK IF I/O *entry* screen, press [ENTER] while viewing the I/O ON/OFF *entry* screen.

EXIT BLK IF I/O *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new input/output number.
2. Press [ENTER] to input the input/output number, enter the EXIT BLK IF I/O command into the block step, and display the Step Menu.
3. Press [F4] to display the Step Menu without entering the command into the block.

If a value which is invalid is entered for I/O, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 8.

3.4.6 WAIT TILL STOP

The WAIT TILL STOP command forces the ServoPro-I Motion Control System to wait until the current movement command is complete before executing the next step in the block.

NOTE

The WAIT TILL STOP command has no parameters associated with it and there is no WAIT TILL STOP *entry* screen.

To access the WAIT TILL STOP *command* screen, press the [NEXT] key while viewing the EXIT BLK IF I/O *command* screen or the [PREV] key while viewing the WAIT POSITION *command* screen.

1. Press [ENTER] to enter the WAIT TILL STOP command into the block step and display the Step Menu.
2. Press [NEXT] to display the WAIT POSITION *command* screen.
3. Press [PREV] to display the EXIT BLK IF I/O *command* screen.
4. Press [F4] to display the Step Menu without entering the command into the block step.

3.4.7 WAIT POSITION

The WAIT POSITION command forces the ServoPro-I Motion Control System to wait until the motor travels to the specified position relative to the 0.0 location before beginning execution of the next step in the block. The WAIT POSITION command must follow a POSITION or INDEX command.

NOTE

POSITION can be input during execution from one of four possible thumbwheel modules or the Operator Interface keypad.

The WAIT POSITION command requires input of one parameter value:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
POSITION	The position desired relative to the "Home" or 0.0 location.	Position cannot exceed 2000 revs (+ or -).

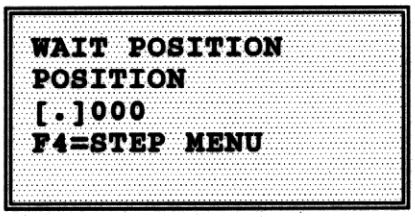
To access the WAIT POSITION *command* screen, press the [NEXT] key while viewing the WAIT TILL STOP *command* screen or the [PREV] key while viewing the WAIT DISTANCE *command* screen.

```
BLK.STP 1.1
WAIT POSITION  *

F4=STEP MENU
```

WAIT POSITION *command* screen

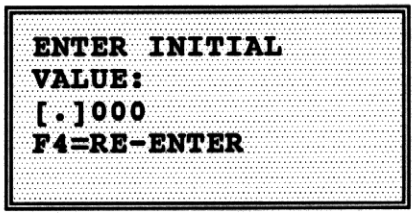
1. Press [ENTER] to display the WAIT POSITION *entry* screen.
2. Press [NEXT] to display the WAIT DISTANCE *command* screen.
3. Press [PREV] to display the WAIT TILL STOP *command* screen.
4. Press [F4] to display the Step Menu.



WAIT POSITION *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new position value. Use the decimal key [.] as needed.
2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.
3. Press [ENTER] to input the position value, enter the WAIT POSITION command into the block step, and display the Step Menu.
4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the position value during execution, an Initial Value screen is displayed prompting for an initial position value.



1. Press the numeric keys ([0] - [9]) to display a new initial position value.
2. Press [ENTER] to input the initial position value, enter the WAIT POSITION command into the block step, and display the Step Menu.
3. Press [F4] to display the WAIT POSITION *entry* screen.

If a value which is invalid is entered for POSITION, the Invalid Entry screen is displayed showing that the range of valid values is -2000 to 2000 revs.

3.4.8 WAIT DISTANCE

The WAIT DISTANCE command forces the ServoPro-I Motion Control System to wait until the motor travels the specified incremental distance relative to the starting position of the previous initiated move before executing the next step in the block. If the ServoPro-I-I Motion Control System is not moving at the time this command is encountered, the command is ignored.

NOTE

DISTANCE can be input during execution from one of four possible thumb-wheel modules or the Operator Interface keypad.

The WAIT DISTANCE command requires input of one parameter value:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
DISTANCE	The incremental distance to travel relative to the start of the previous motion.	Position cannot exceed 2000 revs (+ or -).

To access the WAIT DISTANCE *command* screen, press the [NEXT] key while viewing the WAIT POSITION *command* screen or the [PREV] key while viewing the SET 0.0 *command* screen.

```
BLK.STP 1.1
WAIT DISTANCE  *

F4=STEP MENU
```

WAIT DISTANCE *command* screen

1. Press [ENTER] to display the WAIT DISTANCE *entry* screen.
2. Press [NEXT] to display the SET 0.0 *command* screen.
3. Press [PREV] to display the WAIT POSITION *command* screen.
4. Press [F4] to display the Step Menu.

WAIT DISTANCE *entry* screen

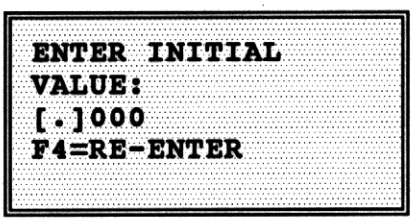
1. Press the numeric keys ([0] - [9]) to display a new distance value. Use the decimal key [.] as needed.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the distance value, enter the WAIT DISTANCE command into the block step, and display the Step Menu.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the distance value during execution, an Initial Value screen is displayed prompting for an initial distance value.



1. Press the numeric keys ([0] - [9]) to display a new initial distance value.

2. Press [ENTER] to input the initial position value, enter the WAIT DISTANCE command into the block step, and display the Step Menu.

3. Press [F4] to display the WAIT DISTANCE *entry* screen.

If a value which is invalid is entered for DISTANCE, the Invalid Entry screen is displayed showing that the range of valid values is -2000 to 2000 revs.

3.4.9 SET 0.0

The SET 0.0 command forces the current position of the motor to be an absolute 0.0 (also referred to as a "floating home"). The "floating home" will be 0.0 for all subsequent positioning movements until a CLR 0.0 (Clear 0.0) command is issued.

NOTE

The SET 0.0 command does not have any parameters associated with it and there is no SET 0.0 *entry* screen.

To access the SET 0.0 *command* screen, press the [NEXT] key while viewing the WAIT DISTANCE *command* screen or the [PREV] key while viewing the CLR 0.0 *command* screen.

SET 0.0 *command* screen

1. Press [ENTER] to enter the SET 0.0 command into the block step and display the Step Menu.
2. Press [NEXT] to display the CLR 0.0 *command* screen.
3. Press [PREV] to display the WAIT DISTANCE *command* screen.
4. Press [F4] to display the Step Menu without entering the command into the block step.

3.4.10 CLR 0.0

The CLR 0.0 (Clear 0.0) clears the set 0.0 ("floating home") and returns the ServoPro-I-I Motion Control System to the initialized absolute 0.0.

NOTE

The CLR 0.0 command does not have any parameters associated with it and there is no CLR 0.0 *entry* screen.

To access the CLR 0.0 *command* screen, press the [NEXT] key while viewing the SET 0.0 *command* screen or the [PREV] key while viewing the TURN ON/OFF *command* screen.

CLR 0.0 *command* screen

1. Press [ENTER] to enter the CLR 0.0 command into the block step and display the Step Menu.
2. Press [NEXT] to display the TURN ON/OFF *command* screen.
3. Press [PREV] to display the SET 0.0 *command* screen.
4. Press [F4] to display the Step Menu without entering the command into the block step.

3.4.11 TURN ON/OFF

The TURN ON/OFF command turns the defined Programmable Input/Output location or the drive module ON or OFF.

The TURN ON/OFF command requires input of one or two parameter values (DRIVE ON/OFF or I/O ON/OFF and I/O):

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
I/O (Input/Output)	The number of the defined output.	1 to 8.
I/O ON/OFF or **DRIVE ON/OFF**	Specifies the output to be turned ON or OFF.	I/O ON or I/O OFF or DRIVE ON or DRIVE OFF.

NOTE

The TURN ON/OFF command has two *entry* screens:
TURN ON/OFF *entry* screen for specifying the output
I/O *entry* screen for User Input/Output connection number input

To access the TURN ON/OFF *command* screen, press the [NEXT] key while viewing the CLR 0.0 *command* screen or the [PREV] key while viewing the DO WHILE *command* screen.

```
BLK.STP 1.1
TURN ON/OFF     *

F4=STEP MENU
```

TURN ON/OFF *command* screen

1. Press [ENTER] to display the TURN ON/OFF *entry* screen.
2. Press [NEXT] to display the DO WHILE *command* screen.
3. Press [PREV] to display the CLR 0.0 *command* screen.
4. Press [F4] to display the Step Menu.

NOTE

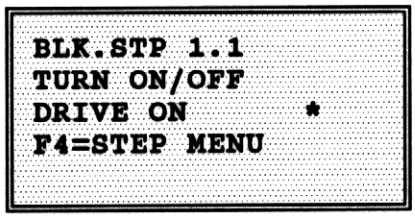
Programmable outputs will be TURNED OFF when entering MANUAL MODE or upon energizing the RESET INPUT

TURN ON/OFF *entry* screen

1. Press [ENTER] to specify I/O ON as output and display the I/O *entry* screen.
2. Press [NEXT] to display the I/O OFF selection of the TURN ON/OFF *entry* screen.
3. Press [PREV] to display the DRIVE OFF selection of the TURN ON/OFF *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.

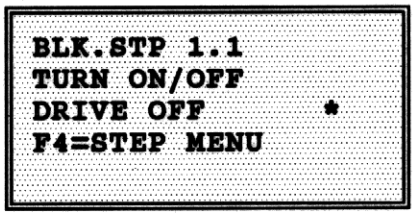
TURN ON/OFF *entry* screen

1. Press [ENTER] to specify I/O OFF as output and display the I/O *entry* screen.
2. Press [NEXT] to display the DRIVE ON selection of the TURN ON/OFF *entry* screen.
3. Press [PREV] to display the I/O ON selection of the TURN ON/OFF *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.



TURN ON/OFF *entry* screen

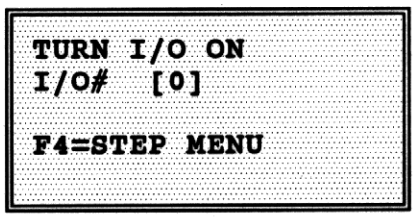
1. Press [ENTER] to specify DRIVE ON as output, enter the TURN ON/OFF command into the block step, and display the Step Menu.
2. Press [NEXT] to display the DRIVE OFF selection of the TURN ON/OFF *entry* screen.
3. Press [PREV] to display the I/O OFF selection of the TURN ON/OFF *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.



TURN ON/OFF *entry* screen

1. Press [ENTER] to specify DRIVE OFF as output, enter the TURN ON/OFF command into the block step, and display the Step Menu.
2. Press [NEXT] to display the I/O ON selection of the TURN ON/OFF *entry* screen.
3. Press [PREV] to display the DRIVE ON selection of the TURN ON/OFF *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.

To access the I/O *entry* screen, press [ENTER] while viewing the TURN ON/OFF *entry* screen with an I/O ON or I/O OFF output selection.



I/O *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new output number.
2. Press [ENTER] to input the output number, enter the TURN ON/OFF command into the block step, and display the Step Menu.
3. Press [F4] to display the Step Menu without entering the command into the block.

If a value which is invalid is entered for I/O, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 8.

3.4.12 DO WHILE

The DO WHILE command is an instruction to repeat the program steps between the DO WHILE command and the END WHILE command until the specified condition is met. There are four conditions in which may be specified to control the execution of the loop:

1) I/O The DO WHILE loop will be repeated while the I/O is in the specified state, (State may be specified as ON or OFF). The I/O state is checked before each pass thru the DO WHILE loop.

2) COUNT The DO WHILE loop will be repeated COUNT number of times.

3) UNTIL EXIT The DO WHILE loop will be repeated until a terminating condition occurs. These conditions are:

3.1 Change from AUTO to MANUAL mode.
3.2 RESET input is ON.
3.3 CW or CCW limit switch input is ON.
3.4 Following error has occurred.
3.5 Keyswitch is set to PROGRAM mode.

4) BATCH The BATCH COUNTER for the ServoPro-I can be used by different program blocks using the DO WHILE BATCH command.

The BATCH COUNTER is decrement once every loop of the DO WHILE BATCH -> ENDWHILE portion of the block. The program will stop looping when the BATCH COUNTER reaches the value zero and then execute the next command after the ENDWHILE. When the next DO WHILE BATCH command is encounter and the BATCH COUNTER is zero, the BATCH COUNTER will be restarted with its specified value.

If execution of the block is terminated before the DO WHILE BATCH loop has been completed, the BATCH COUNTER will not be modified on restarting a DO WHILE BATCH loop. It will resume down counting at its previous count value so the program can complete the batch.

If the situation rises where BATCH COUNTER needs to restart at its' original value or some other value for one loop, the PRESET BATCH can be utilized (refer to **Section 3.4.16**).

NOTE

COUNT, BATCH, & PRESET VALUES can be input during execution from one of four possible thumb-wheel modules or the Operator Interface keypad.

The DO WHILE command requires input of one or two parameter values:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
I/O (Input/Output)	The number of the defined output.	1 to 8.
COUNT	The number of times to repeat the DO WHILE loop.	1 to 32767.
UNTIL EXIT	No parameters needed.	
BATCH COUNT	The count value to be used if BATCH COUNTER is zero.	1 to 32767

To access the DO WHILE *command* screen, press the [NEXT] key while viewing the TURN ON/OFF *command* screen or the [PREV] key while viewing the END WHILE *command* screen.

DO WHILE *command* screen

1. Press [ENTER] to display the DO WHILE *entry* screen.
2. Press [NEXT] to display the END WHILE *command* screen.
3. Press [PREV] to display the TURN ON/OFF *command* screen.
4. Press [F4] to display the Step Menu.

DO WHILE *entry* screen

1. Press [ENTER] to select UNTIL EXIT as the Do While loop termination condition, enter the DO WHILE command into the block step, and display the Step Menu.
2. Press [NEXT] to display the I/O ON selection of the DO WHILE *entry* screen.
3. Press [PREV] to display the COUNT selection of the DO WHILE *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.

DO WHILE *entry* screen

1. Press [ENTER] to select I/O ON as the Do While loop termination condition and display the I/O *entry* screen.
2. Press [NEXT] to display the I/O OFF selection of the DO WHILE *entry* screen.
3. Press [PREV] to display the DO UNTIL selection of the DO WHILE *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.

DO WHILE *entry* screen

1. Press [ENTER] to select I/O OFF as the Do While loop termination condition and display the I/O *entry* screen.
2. Press [NEXT] to display the COUNT selection of the DO WHILE *entry* screen.
3. Press [PREV] to display the I/O ON selection of the DO WHILE *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.

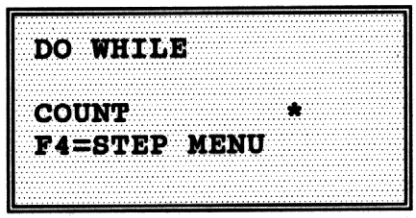
To access the I/O *entry* screen, press [ENTER] while viewing the I/O ON or I/O OFF selections of the DO WHILE *entry* screen.

I/O *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new input number.
2. Press [ENTER] to input the input number, enter the DO WHILE command into the block step, and display the Step Menu.
3. Press [F4] to display the Step Menu without entering the command into the block.

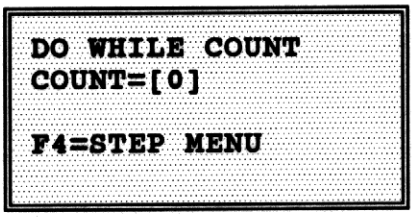
If a value which is invalid is entered for I/O, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 8.

To access the COUNT selection of the DO WHILE *entry* screen, press [NEXT] while viewing the I/O OFF selection of the DO WHILE *entry* screen, or press [PREV] while viewing the UNTIL EXIT selection of the DO WHILE *entry* screen.



DO WHILE *entry* screen

1. Press [ENTER] to choose loop repetition as the Do While loop termination condition and display the COUNT *entry* screen.
2. Press [NEXT] to display the UNTIL EXIT selection of the DO WHILE *entry* screen.
3. Press [PREV] to display the I/O OFF selection of the DO WHILE *entry* screen.
4. Press [F4] to display the Step Menu without entering the command into the step block.



COUNT *entry* screen

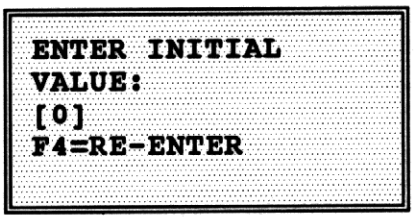
1. Press the numeric keys ([0] - [9]) to display a new count value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. **TW1, TW2, TW3, TW4,** (thumbwheel #1 - thumbwheel #4) and **KYPD** (Operator Interface keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the count, enter the DO WHILE command into the block step, and display the Step Menu.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the **KYPD** option is chosen as the method of entering the count value during execution, an Initial Value screen is displayed prompting for an initial count value.

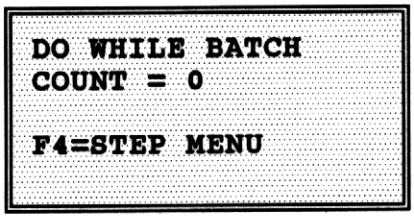


1. Press the numeric keys ([0] - [9]) to display a new initial count value.

2. Press [ENTER] to input the initial count value, enter the DO WHILE command into the block step, and display the Step Menu.

3. Press [F4] to display the COUNT *entry* screen.

If a value which is invalid is entered for COUNT, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 32767.



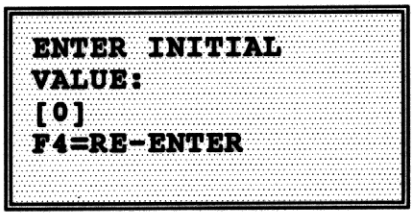
1. Press the numeric keys [0] - [9] to display a new count value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. TW1, TW2, TW3, TW4, (which are thumbwheels #1 to #4) and KYPD (Operator Interface Keypad) will be sequentially displayed as the [NEXT]/[PREV] keys are pressed.

3. Press [ENTER] to input the BATCH COUNT. Enter the DO WHILE command into the block step, and display the step menu.

4. Press [F4] to display the Step Menu without entering the command into the block step.

If the KYPD option is chosen as the method of entering the count value during execution, an Initial value screen is diplayed, prompting for an initial count value.



1. Press the numeric keys [0] - [9] to display a new initial count value.

2. Press [ENTER] to input the initial count value, [ENTER] the DO WHILE command into the block step, and display the Step Menu.

3. Press [F4] to display the Count Entry screen.

If an invalid value is entered for COUNT, the Invalid Entry screen is displayed, showing the range of valid values (1 to 32767).

3.4.13 END WHILE

The END WHILE command specifies the end of the DO WHILE loop.

NOTE

The END WHILE command does not have any parameters associated with it and there is no END WHILE *entry* screen.

To access the END WHILE *command* screen, press the [NEXT] key while viewing the DO WHILE *command* screen or the [PREV] key while viewing the EXIT BLOCK *command* screen.

1. Press [ENTER] to enter the END WHILE command into the block step and display the Step Menu.
2. Press [NEXT] to display the EXIT BLOCK *command* screen.
3. Press [PREV] to display the DO WHILE *command* screen.
4. Press [F4] to display the Step Menu without entering the command into the block step.

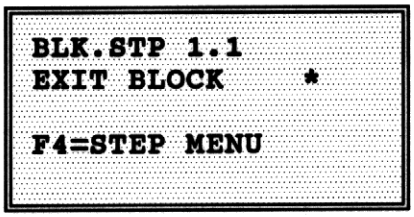
3.4.14 EXIT BLOCK

The EXIT BLOCK command forces termination of block execution.

NOTE

The EXIT BLOCK command does not have any parameters associated with it and there is no EXIT BLOCK *entry* screen.

To access the EXIT BLOCK *command* screen, press the [NEXT] key while viewing the END WHILE *command* screen or the [PREV] key while viewing the WAIT I/O *command* screen.



1. Press [ENTER] to enter the EXIT BLOCK command into the block step and display the Step Menu.
2. Press [NEXT] to display the WAIT I/O *command* screen.
3. Press [PREV] to display the END WHILE *command* screen.
4. Press [F4] to display the Step Menu without entering the command into the block step.

3.4.15 WAIT I/O

The WAIT I/O command provides a programmed wait until the defined Programmable Input/Output location is energized (turned ON or OFF).

The WAIT I/O command requires input of two parameter values:

COMMAND PARAMETER	DESCRIPTION	VALID ENTRIES
I/O (Input/Output)	The number of the defined input.	1 to 8.
I/O ON/OFF	The state in which the defined input is considered energized.	ON or OFF.

NOTE

The WAIT I/O command has two *entry* screens:
I/O ON/OFF *entry* screen for I/O energized state input
WAIT I/O *entry* screen for User Input/Output connection number input

To access the WAIT I/O *command* screen, press the [NEXT] key while viewing the EXIT BLOCK *command* screen or the [PREV] key while viewing the PRESET BATCH *command* screen.

```
BLK.STP 1.1
WAIT I/O      *

F4=STEP MENU
```

WAIT I/O *command* screen

1. Press [ENTER] to display the I/O ON/OFF *entry* screen.
2. Press [NEXT] to display the PRESET BATCH *command* screen.
3. Press [PREV] to display the EXIT BLOCK *command* screen.
4. Press [F4] to display the Step Menu.

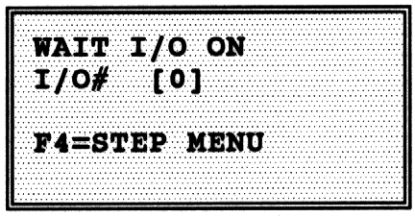
I/O ON/OFF *entry* screen

1. Press [ENTER] to input the ON state as the condition state and display the WAIT I/O *entry* screen.
2. Press [NEXT] or [PREV] to display the I/O OFF state selection.
3. Press [F4] to display the Step Menu without entering the command into the step block.

I/O ON/OFF *entry* screen

1. Press [ENTER] to input the OFF state as the condition state and display the WAIT I/O *entry* screen.
2. Press [NEXT] or [PREV] to display the I/O ON state selection.
3. Press [F4] to display the Step Menu without entering the command into the step block.

To access the WAIT I/O *entry* screen, press [ENTER] while viewing the I/O ON/OFF *entry* screen.



WAIT I/O *entry* screen

1. Press the numeric keys ([0] - [9]) to display a new Programmable Input/Output number.
2. Press [ENTER] to input the input number, enter the WAIT I/O command into the block step, and display the Step Menu.
3. Press [F4] to display the Step Menu without entering the command into the block.

If a value which is invalid is entered for I/O, the Invalid Entry screen is displayed showing that the range of valid values is 1 to 8.

3.4.16 PRESET BATCH

PRESET BATCH command can be used to modify the BATCH COUNTER before the next DO WHILE BATCH loop has been started.

PRESET BATCH command will reset the BATCH COUNTER to zero.

When the next DO WHILE BATCH command starts up, the BATCH COUNTER will be restarted with the value programmed into the PRESET BATCH command. (Refer to **Section 3.4.12.4** for more detail on the BATCH COUNTER operation.)

> **NOTE**
> If the value programmed into the PRESET BATCH command is zero, the BATCH COUNTER will reset to zero but the value used to restart the next DO WHILE BATCH command will be the original value associated with that DO WHILE BATCH command.

The preset batch value will only be used once per DO WHILE BATCH command loop. If the PRESET BATCH command has not been executed after finishing the DO WHILE BATCH command loop and another DO WHILE BATCH command is started, the original batch value for that particular DO WHILE BATCH command will be used.

Since the BATCH COUNTER is universal to all blocks, the PRESET BATCH and DO WHILE BATCH commands can be in separate blocks. More than one PRESET BATCH command can be programmed into the ServoPro-I at one time.

To access the PRESET BATCH command screen, press the [NEXT] key while viewing the WAIT I/O command screen or the [PREV] key while viewing the POSITION screen.

PRESET BATCH *entry* screen

1. Press [ENTER] to display the PRESET BATCH entry screen.
2. Press [NEXT] to display the POSITION command screen.
3. Press [PREV] to display the WAIT I/O command screen.
4. Press [F4] to display the Step Menu.

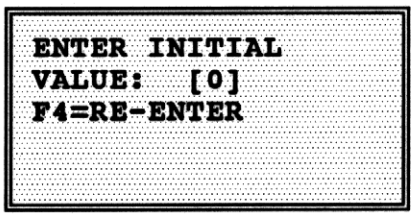
1. Press the numeric keys [0] - [9] to display a new BATCH count value.

2. Press [NEXT] or [PREV] to specify the method for parameter value input during execution. TW1-TW4 (thumbwheels 1-4), and KYPD (Operator Interface Keypad) will be sequentially displayed as the [NEXT] or [PREV] keys are pressed.

3. Press [ENTER] to input the BATCH count. Enter the DO WHILE command into Block Step, and display the Step Menu.

4. Press [F4] to display the Step Menu without entering the command into the Block Step.

If the KYPD option is chosen as the method of entering the count value during execution, an Initial Value screen is displayed, prompting for an initial PRESET BATCH count value.



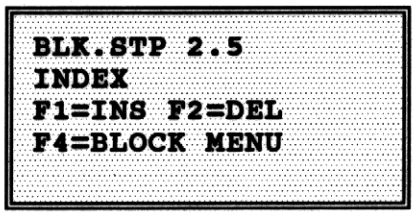
1. Press the numeric keys [0] - [9] to display a new initial count value.

2. Press [ENTER] to input the initial count value. Enter the DO WHILE command into the Block Step, and display the Step Menu.

3. Press [F4] to display the PRESET BATCH count entry screen.

3.4.17 CHANGING BLOCK COMMAND PARAMETER VALUES

To change or view the parameter values of a command which has already been inserted into a block step, press [ENTER] while viewing the appropriate Step Menu. For example, to change or view the parameter values of the Index command in block 2, step 5:



1. Press [ENTER] to change or view the Index command parameter values.

To change the parameter values the remaining steps are identical to those described for programming block commands in this section. The command will remain in the current BLK.STP after the parameter values have been input.

To simply view the values, do not change the displayed values in the Command Parameter *entry* screen(s). Otherwise, follow the steps described for programming block commands in this section.

SECTION 4 – CONTROLS AND OPERATION

4.1 CONTROLS

All operating controls for the ServoPro-I Motion Control System are on the command module. Additional setup and troubleshooting controls are also located on the drive panel (refer to **"Section 5 - Troubleshooting"**).

4.1.1 KEY SWITCH

The key switch is used to change the control system from the RUN mode to the PROGRAM mode. When the switch is turned to the PROGRAM mode, the motor will immediately decelerate to zero speed and the system will reset.

When the key switch is turned to RUN mode, the system will either operate in MANUAL or AUTOMATIC based on the status of Input #9. System operations will begin when the necessary input is actuated.

The key can be removed from the switch in either the RUN or PROGRAM position.

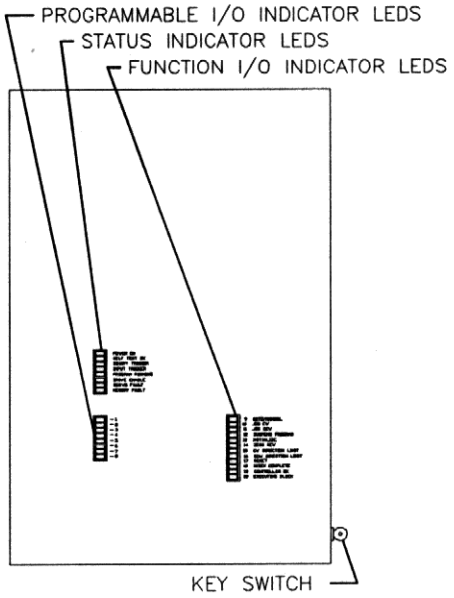


Figure 4.1 - Command Module Controls

4.1.2 STATUS LEDS

There are eight status LEDs which provide an indication of the overall system conditions at any given time (refer to **Figure 4.2**).

POWER ON: ON indicates there is power to the ServoPro-I system.

SELF TEST OK: ON indicates the operating system passed diagnostic checks and found no errors. Flashing indicates the configured operator interface or thumbwheel module is missing.

BINARY TRIGGER MODE: ON indicates the execution mode is binary trigger.

INPUT TRIGGER MODE: ON indicates the execution mode is input trigger.

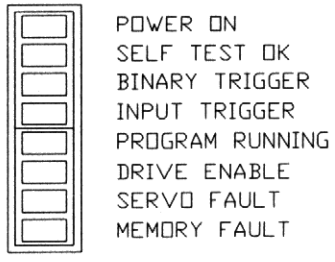


Figure 4.2 Status LEDs

PROGRAM RUNNING: ON indicates the controller is running the user program. FLASHING indicates controller is in RUN and no blocks have been programmed.

DRIVE ENABLE: ON indicates the drive module is on. The drive module is turned on automatically during the transition to RUN mode or when motion is commanded. It is turned off if there is a servo fault or if it receives a programmed command to turn off.

SERVO FAULT: ON indicates a fault in the servo loop (refer to **Section 1.7**). The fault is cleared when the RESET input (#17) is energized or when the key switch is changed from RUN to PROGRAM and back to RUN. FLASHING indicates a drive fault was received from the drive module (refer to **"Section 5 - Troubleshooting"**).

MEMORY FAULT: ON indicates nonvolatile memory is corrupt after self-test memory check is performed when power is first applied. FLASHING indicates a problem with the program or configured values.

4.1.3 INPUTS AND OUTPUTS

There are eight Programmable I/Os (#1 through #8) on the command module circuit board. Their function depends on the system program and the modules inserted in each position. When any of these inputs or outputs is ON, the related LED on the face of the command module will be ON.

There are also twelve additional Function I/Os (#9 through #20) on the command module circuit board. These I/O locations have assigned functions. I/Os #9 through #17 are inputs and I/Os #18 through #20 are outputs. When any of these inputs or outputs is ON, the related LED on the face of the command module will be ON.

INPUTS

#9 MANUAL/AUTO When the input is ON, the RUN execution mode is automatic. When the input is OFF, the RUN execution mode is manual.

#10 JOG CW When the input is ON, and the execution mode is MANUAL, the motor will accelerate in a clockwise direction at the programmed JOG RAMP to the programmed maximum JOG SPEED. It will continue to move at this speed until the input is turned off. When the input is removed, the motor will decelerate at the JOG RAMP until it reaches zero speed.

#11 JOG CCW When the input is ON, and the execution mode is MANUAL, the motor will accelerate in a counterclockwise direction at the programmed JOG RAMP to the programmed maximum JOG SPEED. It will continue to move at this speed until the input is turned off.

When the input is removed, the motor will decelerate at the JOG RAMP until it reaches zero speed.

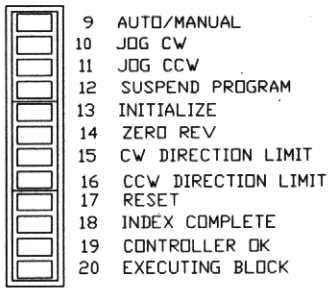


Figure 4.3
Function I/O
Indicating LEDs

#12 SUSPEND PROGRAM When this input is ON, the system will temporarily suspend the execution of a programmed block and any associated motion. When the input is turned OFF, the motion and program will resume.

CAUTION

THE SUSPEND PROGRAM INPUT SHOULD NOT BE USED AS AN EMERGENCY STOP FUNCTION.

#13 INITIALIZE When this input is ON, the motor will jog to the 0.0 location Refer to **"Section 1 - Description"** and **Paragraph 4.2.3** for details on the *Initialize* procedure.

#14 ZERO REV This input is used for initialization in multi-turn systems. When it first comes ON, it indicates to the system that the switch or sensor denoting the revolution for the 0.0 location has been actuated. (The Input will remain ON as long as the switch or sensor is made.)

#15 CW DIRECTION LIMIT When ON in Manual mode, it indicates that the switch or sensor denoting the end of allowable travel in the clockwise direction has been reached. The motor will decelerate to zero speed when this input is actuated. This input has no effect in the counterclockwise direction. In Auto mode, the motor will decelerate to zero speed, and the Block execution will be terminated.

#16 CCW DIRECTION LIMIT When ON in Manual mode, it indicates that the switch or sensor denoting the end of allowable travel in the counterclockwise direction has been reached. The motor will decelerate to zero speed when this input is actuated. This input has no effect in the clockwise direction. In Auto mode, the motor will decelerate to zero speed, and the Block execution will be terminated.

#17 RESET — When this input is ON in Manual mode, the motor will decelerate to zero speed. When this input is ON in Auto mode, the motor will decelerate to zero speed, and the Block executing will be terminated. The reset in either mode will clear a servo fault and enable the drive.

OUTPUTS

#18 INDEX COMPLETE — This output is actuated at the end of an *Index* or *Position* movement. It is OFF until the first move and then turns OFF at the beginning of each successive move.

#19 CONTROLLER OK — This output is ON when the controller diagnostic check, performed when power is first turned on, is satisfactory. It is OFF when the diagnostic check is not satisfactory or if any fault occurs.

#20 BLOCK EXECUTING — This output is ON while the system is executing a program block. It is OFF when exiting a block. It is ON when the block execution is suspended.

4.1.4 DIP SWITCH S2

The 8-position DIP switch (S2) on the command module is used to set various system variables (refer to **Figure 4.4**). The setting of the switch positions is read when the system is powered up. Changes to the switch positions will not take affect until the system power has been turned off and back on again.

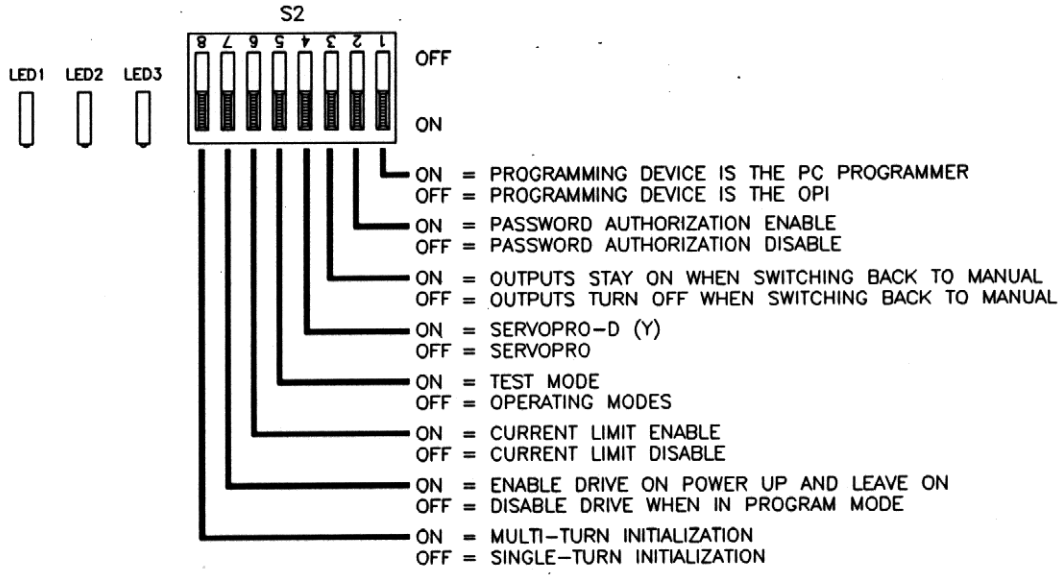


Figure 4.4 - DIP S2 Switch Position Settings

4.2 MANUAL OPERATIONS

Manual operation of the ServoPro-I Motion Control System is possible in the RUN system operating mode. To operate the system manually, the Auto/Manual Input (Function I/O #9) must be set to manual or OFF. While in the manual mode, the system will wait for a transition from OFF to ON at the Jog CW Input (Function I/O #10), the Jog CCW Input (Function I/O # 11), or the Initialize Input (Function I/O #13). These events are discussed in detail in this section.

4.2.1 JOG CLOCKWISE

When the Jog CW (clockwise) Input (Function I/O #10) changes from OFF to ON, the system will:

1. Set the speed and ramp rate (acceleration/deceleration rate) to the programmed jog speed and ramp rate (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on programming the jog speed and ramp rate.)

2. Command the motor to jog in the clockwise direction.

The system will continue the jog motion until one of the following events occurs:

1. Jog CW Input (Function I/O #10) goes from ON to OFF.

2. Reset Input (Function I/O #17) goes from OFF to ON.

3. Servo Fault occurs (refer to **"Section 5 - Troubleshooting"**).

4. CW Direction Limit Input (Function I/O #15) goes from OFF to ON.

5. PROGRAM/RUN key switch changes to PROGRAM.

In all cases, the system will force the motor to decelerate at the ramp rate until the speed is 0 RPM. Additionally, if the PROGRAM/RUN key switch is changed to PROGRAM (DIP switch position #7 on switch S2 is OFF), the system will exit the RUN mode and disable the drive.

4.2.2 JOG COUNTERCLOCKWISE

When the Jog CCW (counterclockwise) Input (Function I/O #11) changes from OFF to ON, the system will:

1. Set the speed and ramp rate (acceleration/deceleration rate) to the programmed jog speed and ramp rate (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on programming the jog speed and ramp rate.)

2. Command the motor to jog in the counterclockwise direction.

The system will continue the jog motion until one of the following events occurs:

1. Job CCW (Function I/O #10) changes from ON to OFF.

2. Reset Input (Function I/O #17) goes from OFF to ON.

3. Servo Fault occurs (refer to **"Section 5 - Troubleshooting"**).

4. CCW Direction Limit Input (Function I/O #16) goes from OFF to ON.

5. PROGRAM/RUN key switch changes to PROGRAM.

In all cases, the system will force the motor to decelerate at the ramp rate until the speed is 0 RPM. Additionally, if the PROGRAM/RUN key switch is changed to PROGRAM (DIP switch position #7 on switch S2 is OFF), the system will exit the RUN system mode and disable the drive.

4.2.3 INITIALIZE

When the Initialize Input (Function I/O #11) changes from OFF to ON, the system will:

Case 1: Dip switch position #8 on switch S2 is OFF.

1. Set the speed, ramp rate (acceleration/deceleration rate), and direction to the programmed initialize speed, ramp rate, and direction (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on programming the initialize speed, ramp rate, and direction.)

2. Execute a POSITION command to position the motor to absolute zero.

3. Wait for the motor to stop.

Case 2: Dip switch position #8 on switch S2 is ON (multi turn initialization).

1. Set the speed, ramp rate (acceleration/deceleration rate), and direction to the programmed initialize speed, ramp rate, and direction (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for details on programming the initialize speed, ramp rate, and direction.)

2. If the Zero Rev Input (Function I/O #14) is ON, the motor will jog in the direction that is opposite to the specified initialize direction. Motion will continue in this direction until the Zero Rev Input goes from ON to OFF. When the Zero Rev Input goes from ON to OFF, the motor will decelerate at the ramp rate until the speed is 0 RPM.

3. The motor will jog in the specified initialize direction until the Zero Rev Input goes from OFF to ON. When the Zero Rev Input goes from OFF to ON, the motor will decelerate at the ramp rate until the speed is 0 RPM.

4. Execute a POSITION command to position the motor to absolute zero.

5. Wait for the motor to stop.

One of the following events will terminate the Initialize function:

1. Reset Input (Function Input/Output #17) goes from OFF to ON.

2. Servo Fault occurs (refer to **"Section 5 - Troubleshooting"**).

3. CW Direction Limit Input (Function Input/Output #15) goes from OFF to ON.

4. CCW Direction Limit Input (Function Input/Output #16) goes from OFF to ON.

5. PROGRAM/RUN key switch changes to PROGRAM.

In all cases, the system will force the motor to decelerate at the ramp rate until the speed is 0 RPM. Additionally, if the PROGRAM/RUN key switch is changed to PROGRAM (DIP switch position #7 on switch S2 is OFF), the system will exit the RUN system operating mode and disable the drive.

4.3 AUTOMATIC OPERATIONS

Automatic operation of the ServoPro-I Motion Control System is possible in the RUN system operating mode. To operate the ServoPro-I Motion Control System automatically, the Auto/Manual Input (Function I/O #9) must be set to auto or ON. If there are no programmed blocks of commands, the Program Running LED flashes. If programmed blocks of commands exist, the Program Running LED is turned ON.

While in the automatic operation mode, the ServoPro-I Motion Control System waits for a change in state of one of the following inputs:

1. **Programmable Input/Output (I/O) #1 - #8.**
   A change from OFF to ON in the I/O #1 - #8 (in Input Trigger mode) or in the MOVE (I/O #8) input (in Binary Trigger mode) causes execution of the programmed block of steps. (Refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for information on execution modes.)

2. **Auto/Manual Input** (Function I/O #9).
   A change from Auto to Manual (ON to OFF) terminates execution of any block steps and places the ServoPro-I Motion Control System into the manual operation mode.

3. **Reset Input** (Function I/O #17).
   A change from OFF to ON terminates execution of all block steps. Also turns on the drive if a servo fault had occurred (refer to **"Section 5 - Troubleshooting"**). User outputs will turn off.

4. **Suspend Program Input** (Function I/O #12).
   A change from OFF to ON temporarily suspends execution of the programmed block and current motion. A change from ON to OFF resumes execution of the block with the step which was interrupted.

5. **PROGRAM/RUN Key Switch.**
   A change from RUN to PROGRAM terminates execution of the programmed block and current motion.

Block steps are executed consecutively without pause unless the step command forces a wait. Movements are not be completed before the next step command is executed, unless the next command is another motion command (refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for a discussion of block command execution). The block and step number currently being executed is shown in the Operator Interface (OPI) display.

Also while in the automatic operation mode, data entry for command parameter values is possible through one of four thumbwheel modules or the Operator Interface keypad. (Refer to **"Section 3 - Programming With Operator Interface"** and manual IB-15B002 *"ServoPro Programming With The Personal Computer"* for information on how to designate a parameter value for entry in the RUN system operating mode.)

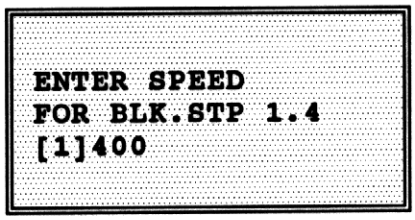
4.3.1 PARAMETER VALUE INPUT FROM THUMBWHEEL MODULES

If **TW1, TW2, TW3,** or **TW4** was selected during programming as the method of input during execution for a command parameter value, the ServoPro-I Motion Control Unit scans the thumbwheel modules. The Control Unit then makes the data available to use in the required steps during execution. If the specified thumbwheel module is not connected or is not working, the minimum value of the valid range of the parameter is defaulted to.

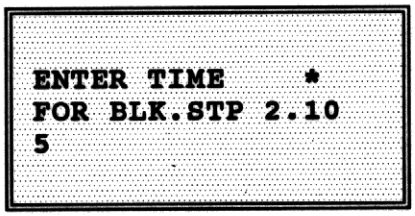
4.3.2 PARAMETER VALUE INPUT FROM OPERATOR INTERFACE

If **KYPD** was selected during programming as the method of input during execution for a command parameter value, the control unit displays an input screen on the Operator Interface (OPI) while in the RUN system operating mode for the value input. If more than one command parameter value was selected as **KYPD** entry, the control unit allows a scroll through the input displays using the [NEXT/PREV] keys on the OPI. For example, if **KYPD** is selected for SPEED in block 1, step 4, and for TIME in block 2, step 10 the OPI display would appear as:

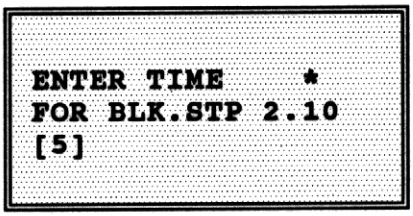
1. Press [ENTER] to access the screen to enter the parameter value.
2. Press [NEXT] or [PREV] to display the BLK.STP 2.10 input screen.



1. Press the numeric keys ([0] - [9]) to display a new parameter value.
2. Press [ENTER] to input the parameter value and display the BLK.STP 2.10 input screen.



1. Press [ENTER] to access the screen to enter the parameter value.
2. Press [NEXT] or [PREV] to display the BLK.STP 1.4 input screen.



1. Press the numeric keys ([0] - [9]) to display a new parameter value.
2. Press [ENTER] to input the parameter value and display the BLK.STP 1.4 input screen.

If a value is not entered through the OPI in the RUN system operating mode before block execution, or if the Operator Interface is not connected, the value defaults to the Initial Value entered during programming of the block steps *or* to the last value entered during execution, whichever was the most previous.

SECTION 5 – TROUBLESHOOTING

The Industrial Indexing Systems ServoPro-I Motion Control Systems are designed to provide reliable service with minimum down time and maintenance. In case of failure, the system is designed for replacement of an entire component. It is recommended that an inventory of spare parts be maintained for the system.

NOTE

To prevent system problems, inspect the system frequently to make sure all connections are tight. Also check for motor vibration and overheating.

5.1 MEASUREMENT TEST POINTS

Measuring signal	T (torque command)	N (speed feedback signal)
Measuring points	Analog monitor output test points "MON" (TP2), and "COM" (TP4) signal common, are located on the drive control board next to CN9.	
Measuring level	Max. ±10V/± max. torque	Max. ±10V/±max. speed
Parameter setting	Set AoUt to trq.	Set AoUt to SPd.

5.1.1 FAULT MESSAGES

Message	Fault Code	Item	Cause	Check	Action
o C	0001	Over-current	Excessive current in the main circuit.	Fault or short in main circuit cable between motor and drive ground.	Check external wiring of main circuit.
				Defective drive.	Replace drive.
				Short inside motor.	Measure resistance between motor leads and frame. If 10KΩ or less, replace motor.

Message	Fault Code	Item	Cause	Check	Action
o P	0010	Over-voltage	High input power voltage.	Check power voltage.	Use correct power voltage.
			A large load inertia was decelerated too quickly.	Check load conditions and operating pattern.	Decrease load inertia & increase deceleration time.
U P	0011	Under-voltage	Low power voltage.	Check power voltage and wiring.	Use correct power voltage.
				Check servo on sequencing with main power application.	Correct sequencing. Servo on cannot be applied until 1 sec after main power application.
o L	0100	Over-load	Load torque exceeds rated motor torque.	Measure voltage of torque command (MON to COM test points with A.Vt = trq). RMS average 3.3V results in an overload.	Reduce load torque or increase motor/drive size so that RMS average of "T" torque command is 3.3V maximum.
				Hunting oscillation due to improper gain adjustment.	Adjust driver gain to eliminate vibration. - See **Section 2.6.1.**
			Improper connection of main circuit between motor and drive.	Check connections.	Correct main circuit wiring.
			Machine run with brake on.	Check brake circuit.	Continue to use motor/brake if brake works properly and the specified level of braking torque is present. Replace motor/brake.
			Deteriorated lubrication due to degraded grease on bearings.	Abnormal resistance when motor shaft is turned by hand.	Replace motor.

Message	Fault Code	Item	Cause	Check	Action
o H	0101	Drive over-heat, regen-erative resistor over-heat	Driver overheats due to high ambient temp.	Ambient temp. exceeds 50°C (122°F).	Lower temperature below 50°C.
			Regenerative energy is excessive because regeneration frequency is too high with large load inertia.	Check load conditions and operation pattern.	Install an external regeneration discharge resisitor (option) suitable for operating conditions.
					Decrease regenerative energy by changing motion or load conditions.
S E r	0110	Encoder abnor-mal	Wrong connection; break in encoder circuit.	Check encoder wiring. Be sure encoder wiring is not routed next to power wiring.	Correct encoder wiring. Separate encoder wiring from power wiring.
o S	0111	Over-speed	Drive abnormal. Encoder abnormal.	Check if encoder signal is correct by using the Pdls parameter.	Replace drive or motor/encoder.
E E r (Internal Position Loop Control)	1000	Exces-sive position error	Load is too large using internal position control; command and actual positions have excessive discrepancy.	Check load conditions and operation pattern.	Decrease load to reduce position error.
L L o C	1001	Motor lock	Motor is locked.	Check for mechanical problem.	Remove locking load from motor.
o t r (Internal Position Loop Control)	1010	Over-travel	Input of fwd/rvs overtravel limit switch is open to signal common.	Check operation command.	Correct overtravel condition.
P r E r	1100	ROM abnor-mal	Defective ROM in the driver.	Be sure ROM is inserted securely.	Initialize parameters.

5.1.2 COMMAND MODULE PULSE INDICATOR LEDS

The ServoPro-I drive module sends three quadrature encoder pulse streams to the command module — the two quadrature streams and a marker pulse which occurs once per revolution. There are three LEDs on the command module next to DIP switch S2. One LED is for each of the pulse streams.

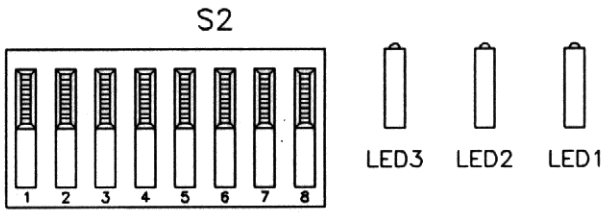


Figure 5.1
Encoder Pulse Indicator LEDs

The LEDs for channels 1 and 2 flash each time a pulse is received on the corresponding stream. The LED for channel 3 turns on once per revolution. For clockwise rotation, channel 1 is the leading quadrature pulse stream; channel 2 is the lagging stream; and channel three is the marker pulse. For counterclockwise rotation, channel 2 is the leading quadrature pulse stream; channel 1 is the lagging stream; and channel three is the marker pulse.

5.2 SYSTEM CHECKS

WARNING

DISCONNECT ALL ELECTRICAL POWER AND FOLLOW PROPER LOCKOUT PROCEDURES BEFORE MAKING ANY ADJUSTMENTS OR REPAIRS.

This section is designed to assist trained personnel in identifying and correcting system malfunctions. It is important to have a thorough knowledge of the equipment as found in this manual before attempting to use this troubleshooting guide. When a problem occurs, first read the appropriate sections of this manual to make sure that the components are installed properly and are being operated correctly. Follow the checks included in this manual, in sequence.

5.2.1 PRELIMINARY CHECKS

NOTE

Check for fault indications before turning the control power off to the drive module. All fault indications will reset when control power is turned off.

1. If this is an initial installation, check all installation procedures to make sure they have been followed properly.

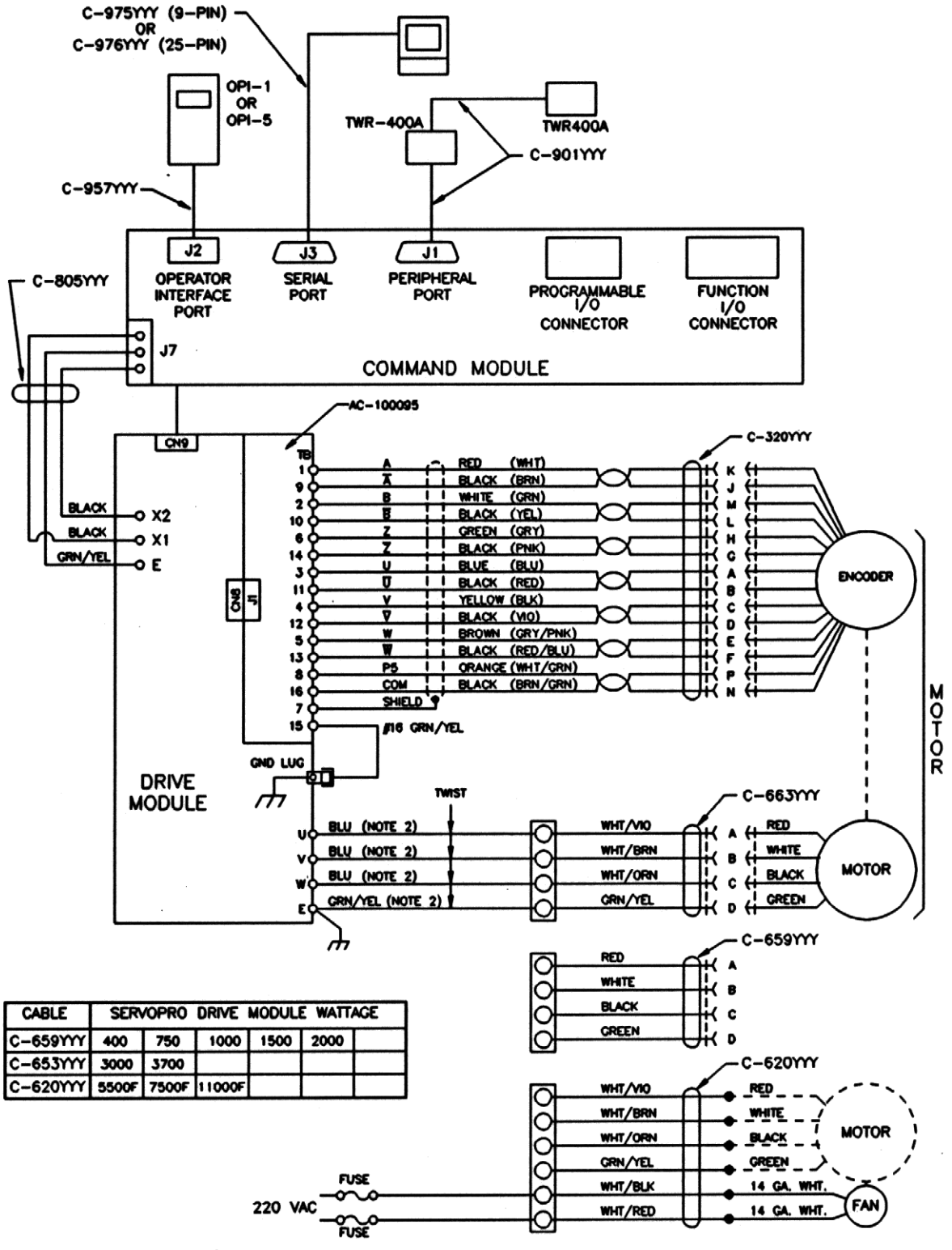
2. Check to make sure 220 VAC power is being supplied to the system controller. Check to make sure power plugs, if present, are securely inserted in their respective sockets and supply disconnects are turned on. Check all fuses.

3. Check to make sure there are no fault indicators illuminated. Correct any indicated problems.

4. Make sure the drive module and motor are correctly matched.

5. Make sure the machine is not jammed or otherwise mechanically preventing the indexing system from operating.

6. Check the set up on all parameters to be correct as listed in **Appendix B** for the appropriate drive and motor.



CABLE	SERVOPRO DRIVE MODULE WATTAGE					
C-659YYY	400	750	1000	1500	2000	
C-653YYY	3000	3700				
C-620YYY	5500F	7500F	11000F			

Figure 5.2 - Typical System Electrical Connections

7. Check for loose or broken wires.

8. If there are no fault indications, check the line voltage input and verify that there is control voltage at terminals X1 and X2. Also check the following test points at the command module (to signal common):

   a. P15 = +15 VDC
   b. N15 = -15 VDC
   c. P5 = +5 VDC

9. Check the DC bus voltage level (bus bars across the output transistors). The voltage should be 310 VDC +7%/-10%.

10. Physically check circuit board components looking for burned, broken, or otherwise damaged components.

If the motor is not responding smoothly, the type of problem can indicate the area of the problem. Use the following guides for directing system checks.

MOTOR DOES NOT RUN

a. Check that there is power on the DC bus.

b. Check to make sure there are no fault indicators illuminated. Correct any indicated problems and reset the fault by turning the drive module power OFF and then ON again.

c. With all power off, check all fuses.

d. With all power off, check all encoder, motor, and command cable connections to make sure they are secure.

MOTOR RUNS ERRATICALLY OR IS UNSTABLE

a. With all power off, check all cable connections to make sure they are secure.

b. Check to make sure the brushless motor is correctly phased.

c. Check for correct motor/drive module setup (refer to **Appendix B**).

d. Check to make sure the motor loading has not changed. Look for possible binding or jamming in the system.

MOTOR HAS LITTLE OR NO TORQUE

a. Check to make sure encoder signals are present. Check the pulse indicating LEDs on the command module.

b. Check to make sure there are no fault indicators illuminated. Correct any indicated problems and reset the fault by turning the drive module power OFF and then ON again.

c. Check to make sure all power voltages are present.

d. If using current limit option, check current limit test point

5.2.2 SYSTEM TEST/VELOCITY LOOP

The velocity loop test removes the controller from the loop for the purpose of testing the motor and drive module. In this test, the drive module is manually enabled and a velocity command voltage is applied to the drive module by means of a Volt Ohm Meter (V.O.M.) command input.

WARNING

THIS TEST CAUSES THE MOTOR TO TURN. MAKE SURE THAT THE MECHANICAL LOAD IS DISCONNECTED, OR WILL ACCEPT MOVEMENT IN BOTH DIRECTIONS WITHOUT DAMAGE TO THE EQUIPMENT, AND THAT ALL PERSONNEL ARE CLEAR BEFORE STARTING THIS TEST.

1. Remove system power.

2. Remove the command cable from the connector on the command module.

3. Using a short jumper wire, temporarily short together the "COM" (#7) and "START" (#8) at the connector. This step causes the drive module (amplifier) to turn "On" manually.

4. Apply system power. The motor should be stationary and should resist any attempt to turn the motor shaft.

NOTE

Since this is a feedback system, there will always be some slight drift to the motor shaft when it is tested in this manner. However, the motor will not be free to be turned by hand.

5. Set a V.O.M. for use as an ohmmeter using the R × 1 resistance scale.

6. Connect the positive meter lead (red wire) to the "POS" (#1) and the negative meter lead (black wire) to the "SIG COM" (#14) at the connector end. This applies voltage (approximately 0.5 volts) into the drive input acting as a velocity command.

RESULT: **The motor should accelerate sharply to a controlled speed in a clockwise direction and decelerate sharply when either meter lead is removed.**

7. Reverse the meter leads to the "POS" (#1) and "SIG COM" (#14) test points. This changes polarity of the velocity command.

RESULT: **The motor should accelerate sharply to a controlled speed in a counterclockwise direction and decelerate sharply when either meter lead is removed.**

8. If all tests pass, the velocity loop is functioning correctly.

9. Remove all temporary jumpers, replace all disconnected wires, and connect the drive connector to the controller.

Items to check if test fails:

a. Troubleshooting of position loop.
b. Power supply voltages.
c. Motor armature wiring and polarity.
d. Reference Voltages

5.2.3 POWER CHECKS

1. With system power on, verify the following voltages at the drive module circuit board terminals:

   a. 220 VAC ±7% at L1 to L2
   b. 220 VAC ±7% at L2 to L3
   c. 220 VAC ±7% at L1 to L3
   d. 220 VAC ±7% at X1 to X2

2. Failure of any of the voltages in Step 1 indicates inadequate power to the drive module. Check all fuses, circuit breakers, and wiring. Check the transformer input and output voltages.

5.2.4 MOTOR CHECKS

A brushless motor has no brushes or tachometer feedback. It is, therefore, difficult to determine if a motor has failed using only a V.O.M. Use the following checks to verify the motor condition.

1. Remove all system electrical power.

2. Remove the motor/drive connector from the motor.

3. Check the resistance of all connector points. All points — except "D" — should have a resistance to ground greater than 10,000 ohms.

4. Check the motor cable for possible short circuits or broken (open) wires.

5. Check the resistance of terminals U, V, and W on the drive module. These points should have a resistance to ground greater than 10,000 ohms. These points should be checked with both polarities of the V.O.M. If the test fails, replace the drive module.

6. Short all phases of the winding and rotate the motor shaft by hand. There should be a firm, smooth movement of the shaft. If this test fails, it may indicate a shorted or open winding.

7. Open all phases of the winding and rotate the motor shaft by hand. The movement should be easier than in Step 6, but the motor shaft should still move smoothly. If this test fails, it again may indicate a shorted or open winding.

5.2.5 POSITION LOOP TEST

The position loop test is used to verify that the controller and feedback device (encoder) are functioning properly. The controller and encoder are placed in a condition where the encoder signals are fed back to the controller. As the encoder is rotated, a corresponding voltage can be measured at the test points on the controller.

1. Remove system power.

2. Put ServoPro-I into TEST MODE by turning Switch Position #5 on DIP switch S2 to ON, turning power OFF to the system, and then turning power ON again.

3. Leave the cover in the open position.

4. Connect a DC volt meter to the test points on the command module. Connect the positive meter lead to the "POS" test point and the negative meter lead to the "GND" test point.

CAUTION

FULL SCALE VOLTAGE FOR THIS TEST MUST NOT EXCEED ± 12 VDC.

5. Apply system power.

6. The meter reading should be 0.0 VDC ±0.1 VDC.

7. Turn the motor shaft 1/4 turn clockwise. The volt meter should indicate a voltage of +6 VDC ±1 VDC.

8. Turn the motor shaft back to the starting point. The volt meter should indicate 0.0 VDC ±0.1 VDC.

9. Turn the motor shaft 1/4 turn counterclockwise. The volt meter should indicate a voltage of -6 VDC ±1 VDC.

10. Continue to turn the motor shaft in a counterclockwise direction. The voltage should increase negatively to -12.0 VDC ±1 VDC. When the motor has been turned 180 degrees from the starting point, the voltage will suddenly change polarity to +12 VDC. As the motor continues turning in a counterclockwise direction, the voltage will decrease toward 0.0 VDC. When the motor has been turned 360 degrees (back to the starting point), the voltage should again be 0.0 VDC ±1 VDC. The cycle should repeat if the motor shaft continues to be turned in a counterclockwise direction.

11. Remove all temporary jumpers, replace all disconnected wires, and connect the command cable to the drive module.

12. Failure of the above test (as shown by incorrect voltages or no voltages) indicates a problem in the position sensing circuitry (encoder, cable, or command module).

Items to check if test fails:

a. Secure encoder connections at motor.
b. Encoder reference and encoder feedback signals.
c. Failed command module circuit board.
d. Failed encoder.
e. Open or shorts in feedback device cables.

5.2.6 ENCODER TEST

1. Apply power to the command module.

2. Rotate the resolver (motor) slowly.

RESULT: **The channel 1 and channel 2 encoder pulse LEDs should flash at the same rate, but not at the same time. The channel 3 encoder pulse LED should flash off once per revolution.**

Items to check if test fails:

a. Make sure that resolver connector is secure.
b. Check the cable for shorts.
c. Check the cable for breaks.

5.3 SYSTEM TEST OPERATIONS

The system test operations provide a diagnostic tool in which the operator interface is used to display the current status of the ServoPro-I system. To enter the test mode, turn the power OFF to the command module, set switch position #5 on DIP switch S2 to ON, and turn the power ON to the command module. When the power is turned ON, the system will recognize that the test operations have been activated and the following screen is displayed:

```
IIS ServoPro
Firmware Rev:
 SFO910_R_
```

The Test identification screen is then displayed:

```
TEST MODE    *

 PRESS NEXT
```

1. Press [NEXT] or [PREV] to continue.

Test operations contain five screens. The screens are displayed on the Operator Interface in the order shown below.

1. The first diagnostic screen dynamically displays the state of all the Inputs/Outputs (I/O's). A "1" indicates that the input or output is ON. A "0" indicates that the input or output is OFF.

```
I/O STATUS:
(1-8)    01110000
(9-16)   10000000
(17-20)  0101
```

1. Press [NEXT] or [PREV] to continue.

2. The second screen displays the resolver position and the state of the marker (the encoder position may be between 0 and 8000, and the marker may be ON or OFF):

```
ENCODER POS:
2100
MARKER: OFF
```

1. Press [NEXT] or [PREV] to continue.

3. The third screen displays the values on thumbwheel module #1 through thumbwheel module #4 (NOT AVAIL indicates that the thumbwheel module is not connected):

```
TW1:  311
TW2:  NOT AVAIL
TW3:  NOT AVAIL
TW4:  47
```

1. Press [NEXT] or [PREV] to continue.

4. The Output Test permits changing the state of an output. The current output states are displayed in the following screen. A "1" indicates that the output is ON. A "0" indicates that the output is OFF.

```
OUTPUT TEST
(1-8)    [0]1110000
(18-20)   101
F4=TEST MENU
```

1. Press [ENTER] to change the state of the output position which has the cursor on it.
2. Press [NEXT] or [PREV] to move the cursor to the next or previous output position.
3. Press [F4] to continue.

5. The final screen dynamically displays the state of the key switch (PROGRAM or RUN):

```
KEY=PROGRAM
```

1. Press [NEXT] or [PREV] to continue.

APPENDIX A
GLOSSARY

Block: A numbered group of sequential steps in the controller memory whose start of execution is tied to an input number. The block performs a system function as defined by its user.

Brushless: A type of direct-current-excited synchronous motor that utilizes a field-excitation system which eliminates the need for collector rings and brushes.

Closed Loop: A regulating device in which the actuator position is sensed, and a signal proportional to this position (feedback position) is compared with a signal proportional to the desired actuator position (command position). The difference between these signals is the error signal. The error signal causes a change in the actuator so as to force this difference to be zero.

Controller: The device which receives data from various input devices and issues commands to the drive.

Daisy Chain: A means of connecting devices by buses which transmit in both directions simultaneously.

Digital Compensation: A numerical value placed in the controller's position loop algorithm to overcome inherent or external conditions affecting the stability of the loop.

Edge Triggered: An electronic circuit which must sense the initial change in a voltage before it is actuated.

Encoder: A converter in which the exact angular position of a shaft is sensed and converted to digital form.

Engineering Units: The type of units by which distance or position in a system is measured. Engineering units are entered as the number of units per revolution of the feedback device.

Feedback Device: Device which monitors shaft position by sending signals to the controller as the shaft rotates.

Following Error: The difference between where the command module has attempted to position the motor shaft and where the drive module has placed the motor shaft. If the difference goes beyond a defined limit, the controller will display a SERVO FAULT.

Index: To move the motor shaft an incremental distance from the current position.

Initialize: To move in order to find a "HOME" or absolute 0.00 reference location.

Jog: A move sequence in which the motor shaft only rotates as long as it receives an input.

LED: Light-Emitting Diode. Also known as solid-state lamp. A semiconductor diode that converts electric energy to light.

Memory Fault: The controller has detected a problem in the memory that stores the blocks (nonvolatile memory) during a test sequence.

Mode: A functional state of the controller that determines the reaction of the controller to its inputs and the behavior of its outputs.

Optically Isolated: Indicates an I/O which uses a coupling device in which a light-emitting diode, energized by an input signal, is optically coupled to a photodetector.

Parameters: Predefined data which is used in the execution of a command.

PLC: Programmable Logic Controller.

Position: To move the motor to an absolute location in reference to a previously established 0.00 point (HOME).

Programmable Logic Controller: An electronic device that scans on/off type inputs and controlson/off type outputs. The relationship between the inputs and outputs are programmable by the user.

Quadrature: When relating to a shaft encoder, indicates that there are two oscillating outputs whose frequencies are 90° out of phase.

Regeneration Circuit: The circuit which causes the excess system energy to be directed to the regeneration resistor.

Regeneration Resistor: The resistor used by the system power supply to dissipate energy when the system motor is decelerating.

ServoPro-I Command: A command designed to begin or perform a function as defined in the set of capabilities for the ServoPro-I. It usually needs parameters that modify the function and provide flexibility.

Step: One sequential part of a block that contains one ServoPro-I command and its associated parameters.

Transformer: An electrical component used to convert electrical energy from one or more alternating-current circuits to one or more others by magnetic induction.

NOTES

APPENDIX B
SERVOPRO-I SPECIFICATIONS

ServoPro-I List of Materials

ServoPro-I Specifications

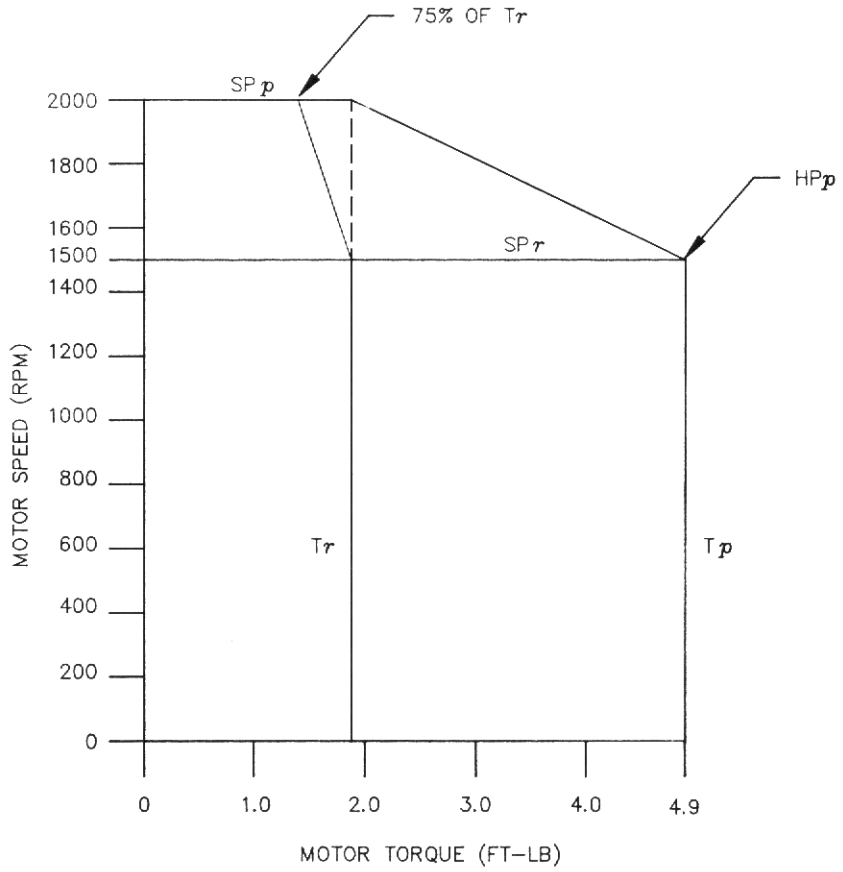
SERVOPRO-I LIST OF MATERIALS

MOTOR PART NUMBER	DRIVE MODULE PART NUMBER	SETUP DRAWING NUMBER	MANUAL PART NUMBER
BLM7-R0400	BSD7-R0400	SU-049001	IB-15B005
BLM7-R0750	BSD7-R0750	SU-049002	IB-15B005
BLM7-R1000	BSD7-R1000	SU-049003	IB-15B005
BLM7-R1500	BSD7-R1500	SU-049004	IB-15B005
BLM7-R2000	BSD7-R2000	SU-049005	IB-15B005
BLM7-R3000	BSD7-R3000	SU-049008	IB-15B005
BLM7-R3700	BSD7-R3700	SU-049006	IB-15B005
BLM7-M3700	BSD7-R3700	SU-049006	IB-15B005

SERVOPRO-I™ SPECIFICATIONS

DRAWING NUMBER	DESCRIPTION
SERVOPRO-R0400D	INTEGRATED SERVO PACKAGE
SERVOPRO-R0750D	INTEGRATED SERVO PACKAGE
SERVOPRO-R1000D	INTEGRATED SERVO PACKAGE
SERVOPRO-R1500D	INTEGRATED SERVO PACKAGE
SERVOPRO-R2000D	INTEGRATED SERVO PACKAGE
SERVOPRO-R3000D	INTEGRATED SERVO PACKAGE
SERVOPRO-R3700D	INTEGRATED SERVO PACKAGE
SERVOPRO-M3700D	INTEGRATED SERVO PACKAGE

DATE	SYM	REVISION RECORD	DR	CK	CK
16FEB95	0	ECN 94-269	DAD		



SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

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LIST OF MATERIALS

DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO-R0400DLM	1
MOTOR ASSEMBLY	BLM7-R0400	1
DRIVE	BSD7-R0400	REF
MANUAL	IB-15B005	REF

MOTOR DRIVE SPECIFICATIONS

RATED TORQUE	Tr	1.88	FT-LB
PEAK TORQUE	Tp	4.90	FT-LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	1.40	HP
ROTOR INERTIA	Jm	0.000192	FT-LB-SEC^2
OUTPUT POWER	W	400	WATT

CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE 2-17-95
MATERIAL	-------
FINISH	--------

TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: DAD		DRAWING NUMBER: SERVOPRO-R0400D
TOLERANCES: X.X± ----- / X.XX± ---- / X.XXX± -- ; ANGULAR ± --	AutoCAD FILE LOCATION: Q:\CAD\MDPAK7		
	B	DATE: 16FEB95 / SCALE: ---	SHEET NO.: 1 OF 1 / REVISION: 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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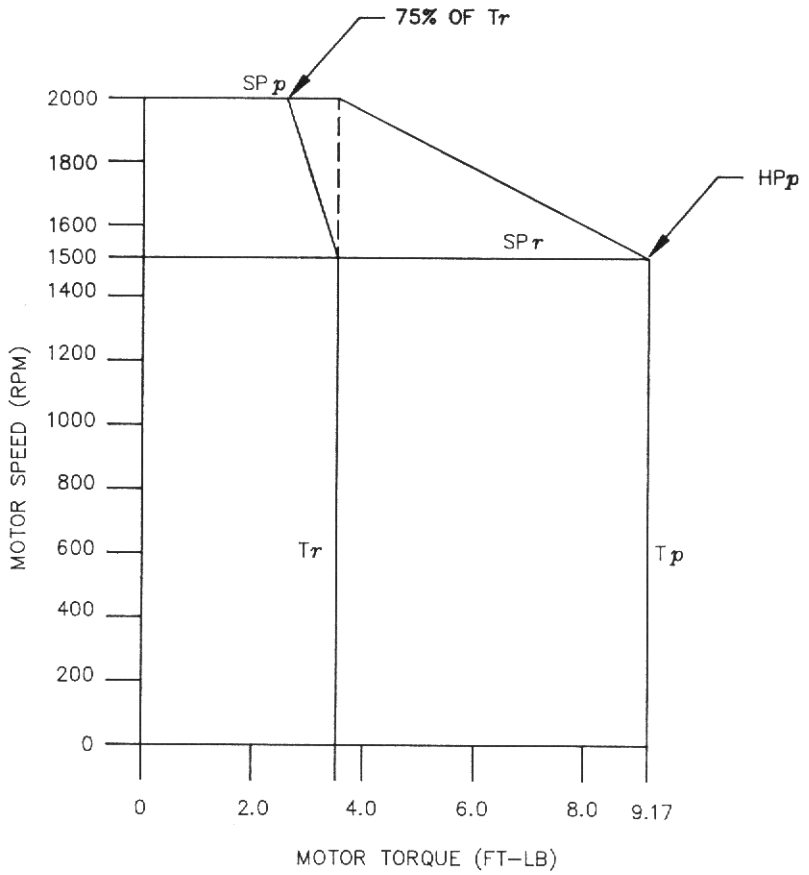

SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

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LIST OF MATERIALS

DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO-R0750DLM	1
MOTOR ASSEMBLY	BLM7-R0750	1
DRIVE	BSD7-R0750	REF
MANUAL	IB-15B005	REF

MOTOR DRIVE SPECIFICATIONS

RATED TORQUE	Tr	3.52	FT-LB
PEAK TORQUE	Tp	9.17	FT-LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	2.61	HP
ROTOR INERTIA	Jm	0.000537	FT-LB-SEC^2
OUTPUT POWER	W	750	WATT

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APPROVED BY | DATE

MATERIAL: ---

FINISH: ---

TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES: X.X± ---- ; X.XX± --- ; X.XXX± -- ; ANGULAR ± --

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AutoCAD FILE LOCATION: Q:\CAD\MDPAK7
DRAWING NUMBER: SERVOPRO-R0750D
B | DATE: 16FEB95 | SCALE: --- | SHEET NO.: 1 OF 1 | REVISION: 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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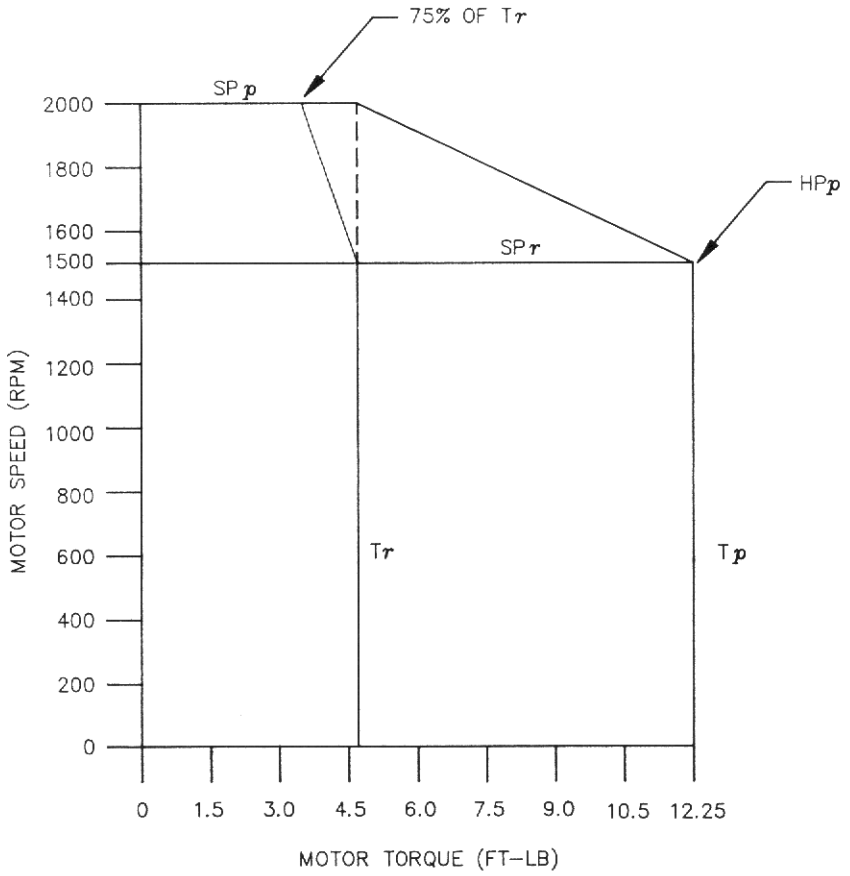

SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

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LIST OF MATERIALS

DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO–R0400DLM	1
MOTOR ASSEMBLY	BLM7–R1000	1
DRIVE	BSD7–R1000	REF
MANUAL	IB–15B005	REF

MOTOR DRIVE SPECIFICATIONS

RATED TORQUE	Tr	4.70	FT–LB
PEAK TORQUE	Tp	12.25	FT–LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	3.5	HP
ROTOR INERTIA	Jm	0.000766	FT–LB–SEC^2
OUTPUT POWER	W	1000	WATT

CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE 2-22-95
MATERIAL	-------
FINISH	--------

TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY CAD		DRAWING NUMBER SERVOPRO–R1000D
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B	DATE 16FEB95	SCALE ----	SHEET NO. 1 OF 1 / REVISION 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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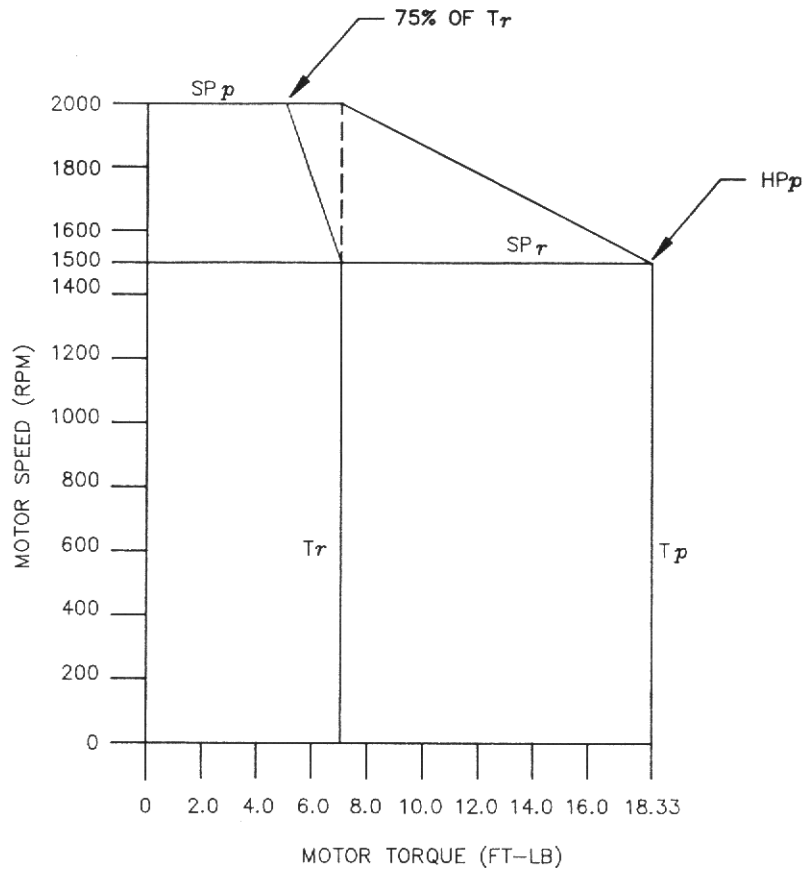

SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

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LIST OF MATERIALS		
DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO-R1500DLM	1
MOTOR ASSEMBLY	BLM7-R1500	1
DRIVE	BSD7-R1500	REF
MANUAL	IB-15B005	REF

MOTOR DRIVE SPECIFICATIONS			
RATED TORQUE	Tr	7.04	FT-LB
PEAK TORQUE	Tp	18.33	FT-LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	5.23	HP
ROTOR INERTIA	Jm	0.001000	FT-LB-SEC^2
OUTPUT POWER	W	1500	WATT

CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____
APPROVED BY Cathy Coffee DATE 2-27-95
MATERIAL ---------
FINISH ---------

TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES
X.X± ----- ANGULAR ± --
X.XX± ---
X.XXX± --

DRAWN BY: DAD
AutoCAD FILE LOCATION: Q:\CAD\MDPAK7
DRAWING NUMBER: SERVOPRO-R1500D
B | DATE 16FEB95 | SCALE --- | SHEET NO. 1 OF 1 | REVISION 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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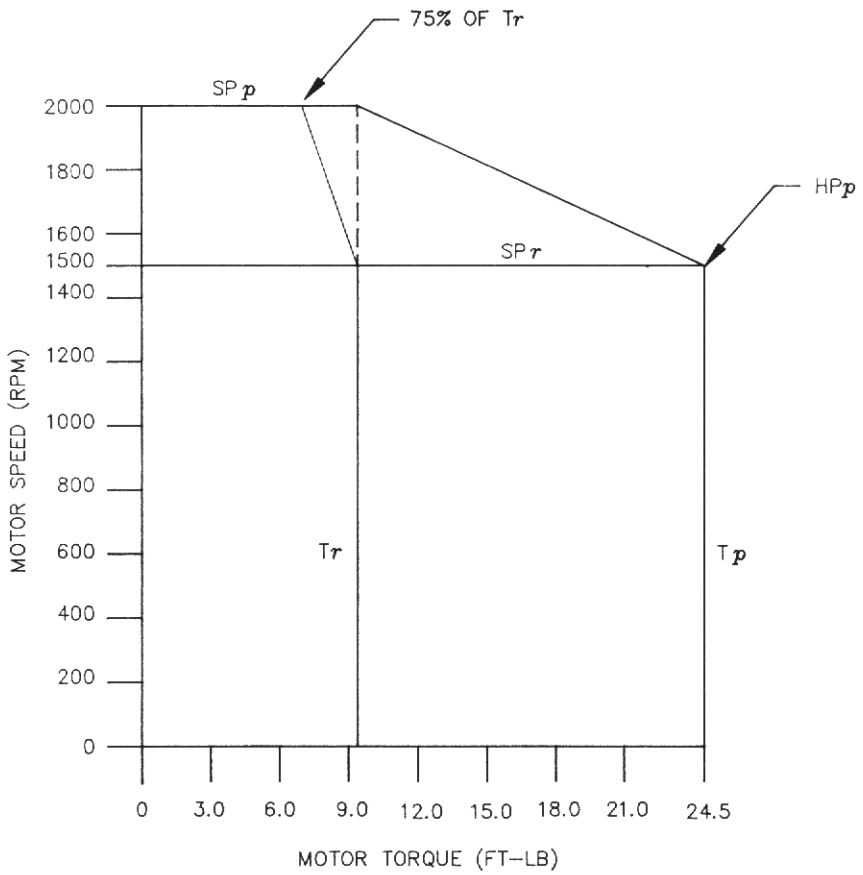

SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

LIST OF MATERIALS		
DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO-R2000DLM	1
MOTOR ASSEMBLY	BLM7-R2000	1
DRIVE	BSD7-R2000	REF
MANUAL	IB-15B005	REF

MOTOR DRIVE SPECIFICATIONS			
RATED TORQUE	Tr	9.4	FT-LB
PEAK TORQUE	Tp	24.5	FT-LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	7.00	HP
ROTOR INERTIA	Jm	0.002000	FT-LB-SEC^2
OUTPUT POWER	W	2000	WATT

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APPROVED BY — DATE 2-27-95

APPROVED BY — DATE

MATERIAL: ---

FINISH: ---

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TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± ----- ANGULAR ± --- ; X.XX± --- ; X.XXX± ---

DRAWN BY: CAD

AutoCAD FILE LOCATION: Q:\CAD\MDPAK7

DRAWING NUMBER: SERVOPRO-R2000D

B | DATE 9/02/93 | SCALE --- | SHEET NO. 1 OF 1 | REVISION 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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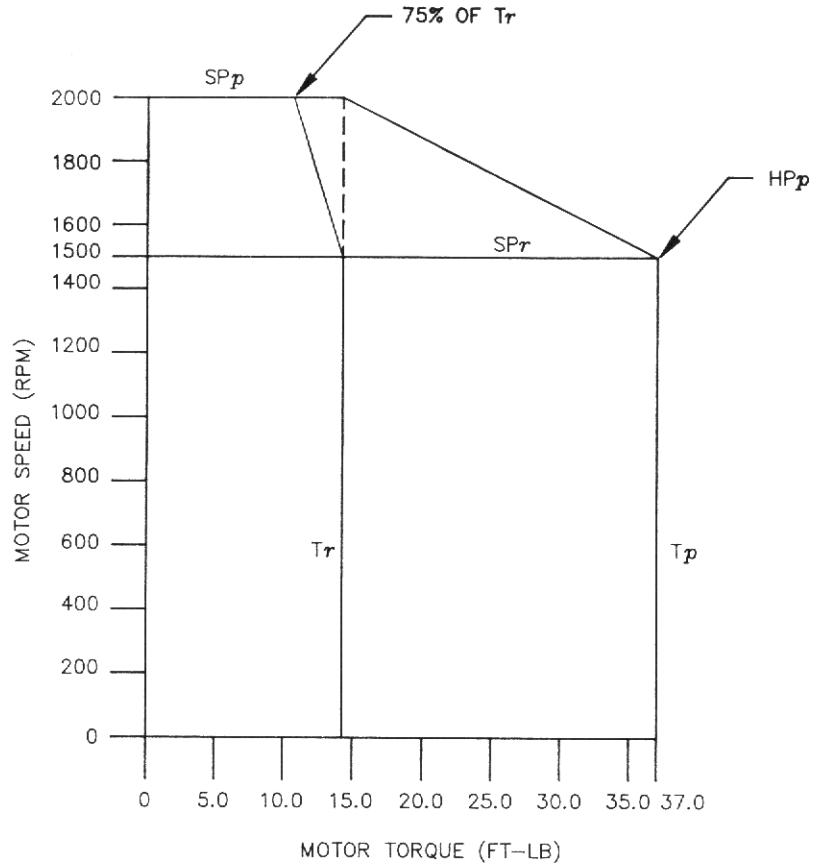

SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

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LIST OF MATERIALS

DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO–R3000DLM	1
MOTOR ASSEMBLY	BLM7–R3000	1
DRIVE	BSD7–R3000	REF
MANUAL	IB–15B005	REF

MOTOR DRIVE SPECIFICATIONS

RATED TORQUE	Tr	14.23	FT–LB
PEAK TORQUE	Tp	37.0	FT–LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	10.6	HP
ROTOR INERTIA	Jm	0.00275	FT–LB–SEC^2
OUTPUT POWER	W	3000	WATT

CHECKED BY | DATE

APPROVED BY | DATE 2-20-95

APPROVED BY | DATE

MATERIAL: ———

FINISH: ———

TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± ——— ; X.XX± ——— ; X.XXX± —— ; ANGULAR ± ——

DRAWN BY: CAD/DAD

AutoCAD FILE LOCATION: Q:\CAD\MDPAK7

DRAWING NUMBER: SERVOPRO–R3000D

B | DATE 16FEB95 | SCALE ——— | SHEET NO. 1 OF 1 | REVISION 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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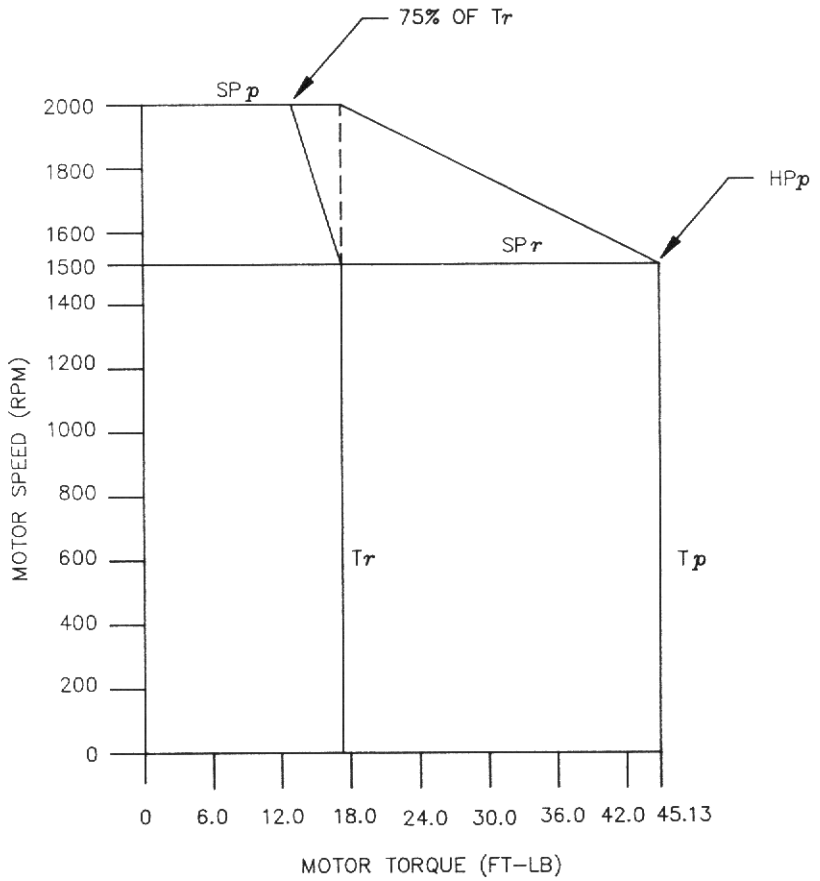

SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

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VICTOR, NEW YORK 14564
(716) 924-9181 FAX: (716) 924-2169

LIST OF MATERIALS

DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO-R3700DLM	1
MOTOR ASSEMBLY	BLM7-R3700	1
DRIVE	BSD7-R3700	REF
MANUAL	IB-15B005	REF

MOTOR DRIVE SPECIFICATIONS

RATED TORQUE	Tr	17.36	FT-LB
PEAK TORQUE	Tp	45.13	FT-LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	12.89	HP
ROTOR INERTIA	Jm	0.00342	FT-LB-SEC^2
OUTPUT POWER	W	3700	WATT

CHECKED BY | DATE

APPROVED BY | DATE 2-22-95

APPROVED BY | DATE

MATERIAL ---------

FINISH ---------

TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± ----- ; X.XX± ---- ; X.XXX± -- ; ANGULAR ± --

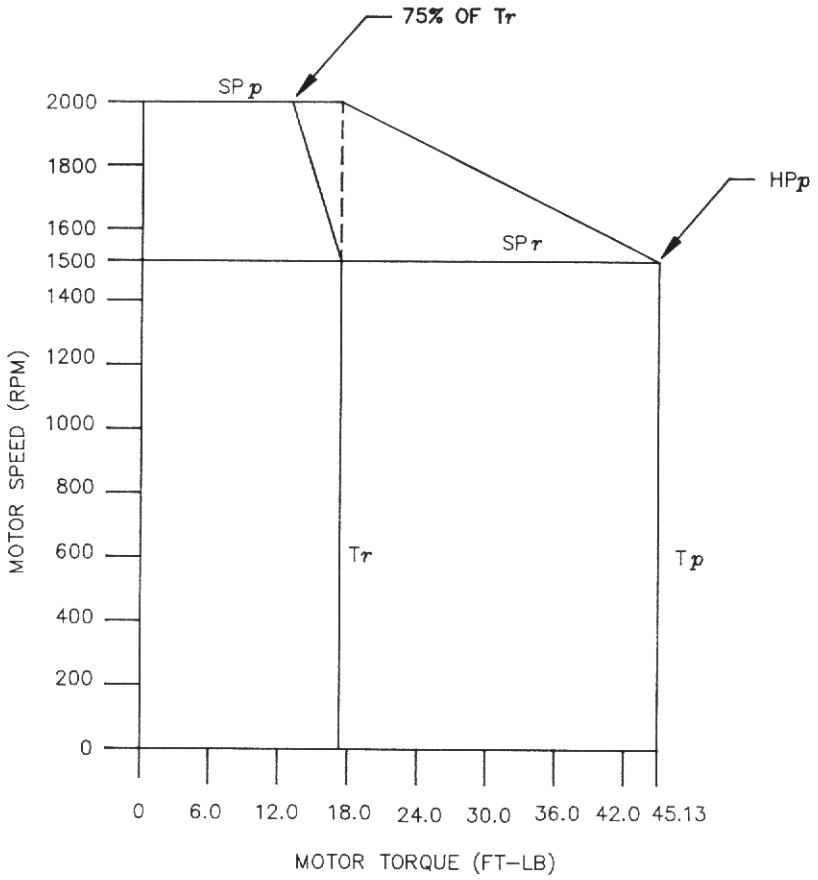
DRAWN BY: DAD

AutoCAD FILE LOCATION: Q:\CAD\MDPAK7

DRAWING NUMBER: SERVOPRO-R3700D

B | DATE 16FEB95 | SCALE ---- | SHEET NO. 1 OF 1 | REVISION 0

DATE	SYM	REVISION RECORD	DR	CK	CK
16FEB95	0	ECN 94–269	DAD		



SPEED TEST POINT SCALING: SPEED (RPM) = $\frac{\text{OUTPUT VOLTS}}{10}$ * SSCL (PARAMETER SSCL DEFAULTS TO 2000 RPM)

TORQUE TEST POINT SCALING: TORQUE (%) = $\frac{\text{OUTPUT VOLTS}}{10}$ * 260% (RATED TORQUE)

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626 FISHERS RUN
VICTOR, NEW YORK 14564
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LIST OF MATERIALS

DESCRIPTION	PART NUMBER	QTY
CONTROLLER ASSEMBLY	SERVOPRO–M3700DLM	1
MOTOR ASSEMBLY	BLM7–M3700	1
DRIVE	BSD7–R3700	REF
MANUAL	IB–15B005	REF

MOTOR DRIVE SPECIFICATIONS

RATED TORQUE	Tr	17.36	FT–LB
PEAK TORQUE	Tp	45.13	FT–LB
RATED SPEED	SPr	1500	RPM
PEAK SPEED	SPp	2000	RPM
PEAK HORSEPOWER	HPp	12.89	HP
ROTOR INERTIA	Jm	0.0048	FT–LB–SEC^2
OUTPUT POWER	W	3700	WATT

CHECKED BY — DATE

APPROVED BY — DATE

APPROVED BY — DATE 2-22-95

MATERIAL ———

FINISH ———

TITLE: INTEGRATED SERVO PACKAGE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± ——— ANGULAR ± ——
X.XX± ———
X.XXX± ——

DRAWN BY: DAD

AutoCAD FILE LOCATION: Q:\CAD\MDPAK7

DRAWING NUMBER: SERVOPRO–M3700D

B | DATE: 16FEB95 | SCALE: ——— | SHEET NO.: 1 OF 1 | REVISION: 0

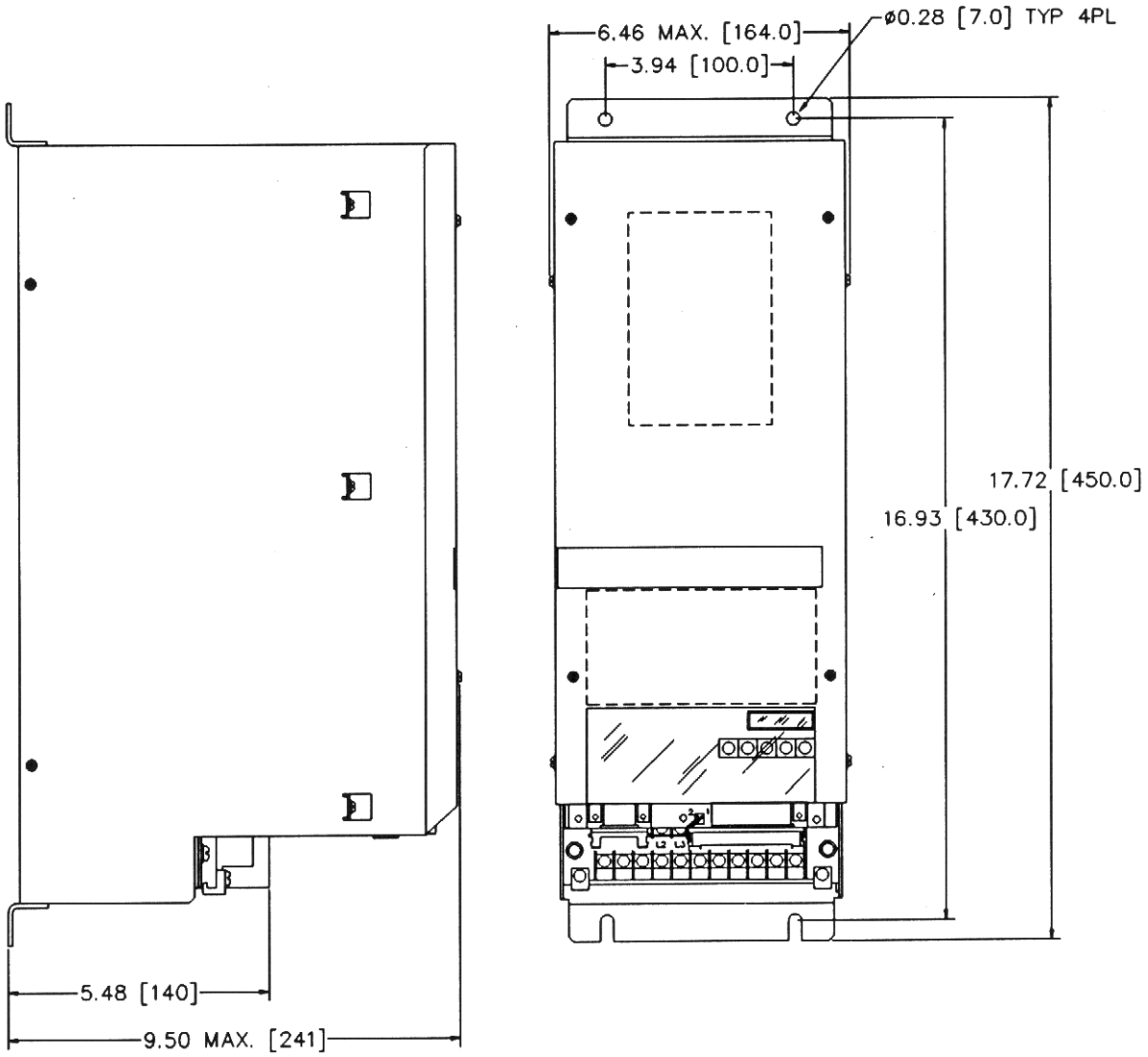
APPENDIX C
SERVOPRO-I COMPONENTS

ServoPro-I Drive Dimensions

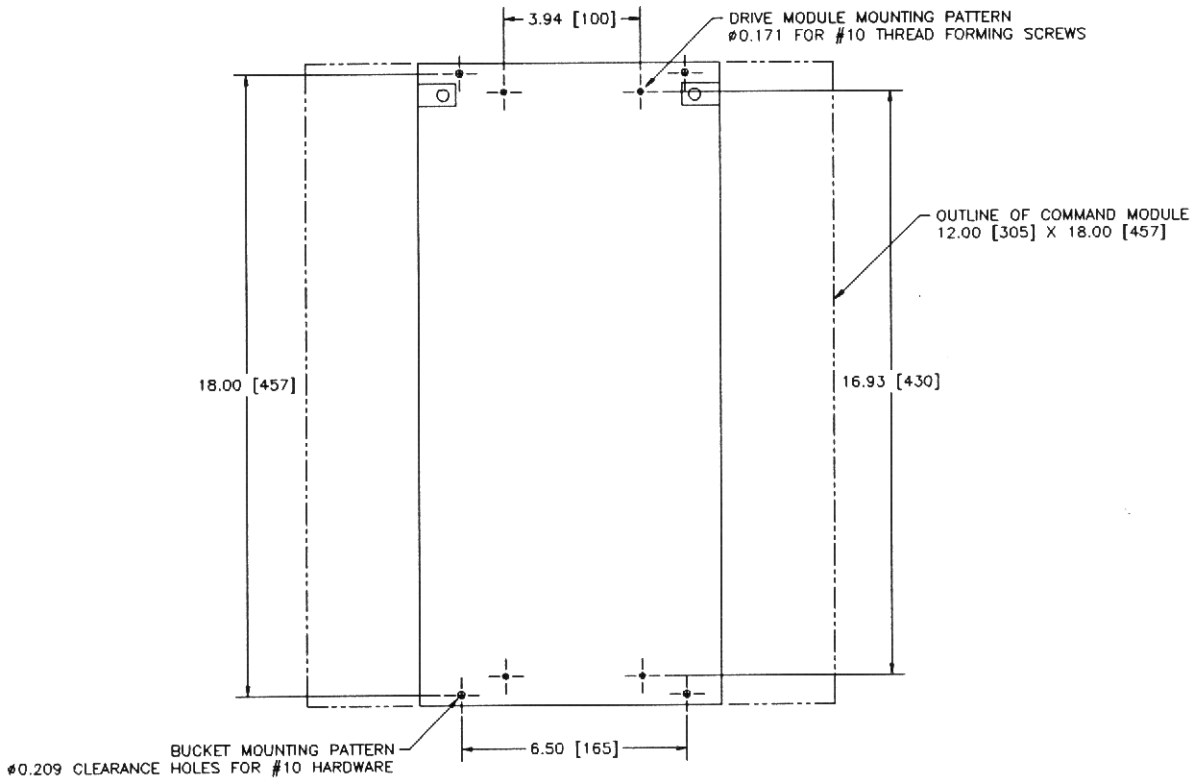
Motor Dimensions and Connections

DRIVE DIMENSIONS

BSD7 SERVODRIVER EXTERNAL DIMENSIONS
BSD7-R0400 THRU BSD7-R3700 DRIVERS



BSD7-R0400 THRU BSD7-R3700 DRIVERS MOUNTING PLATE

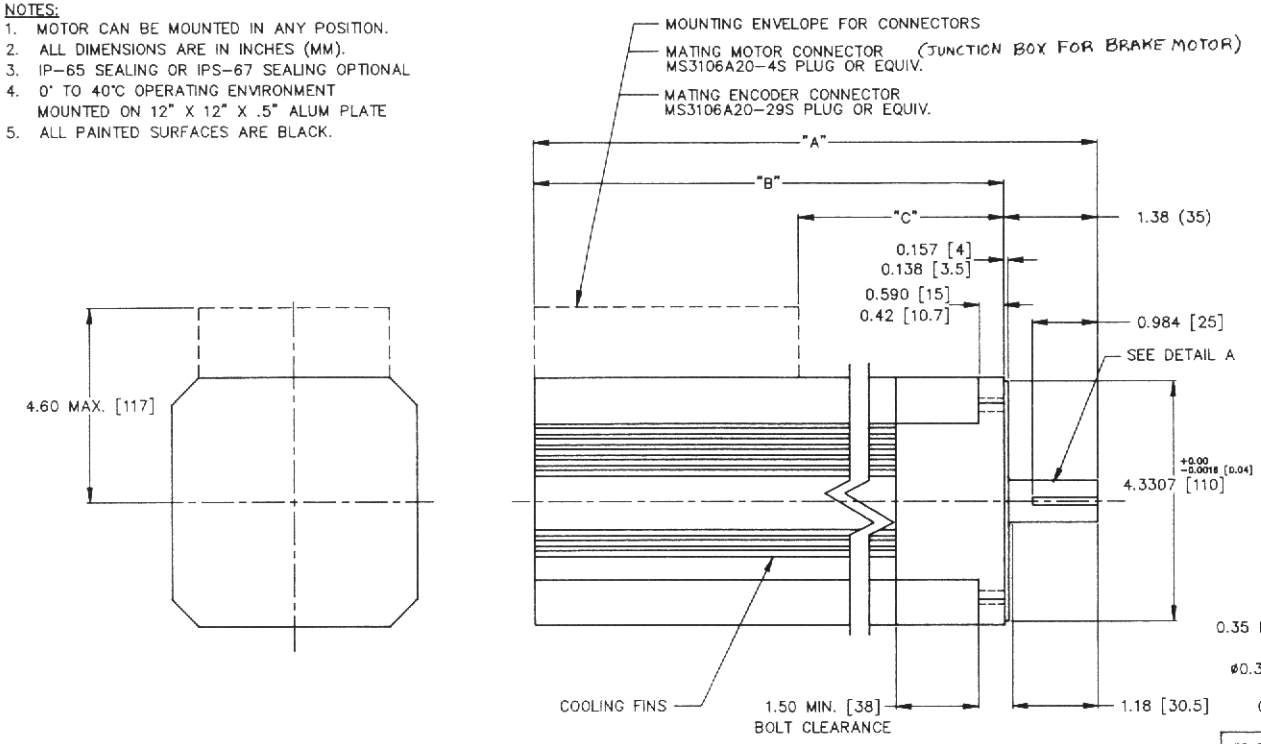


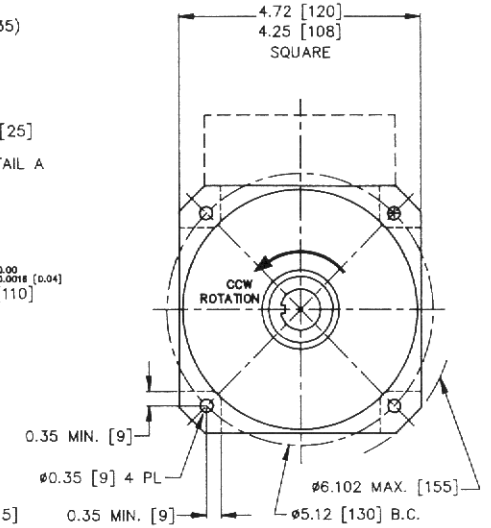
MOTOR DIMENSIONS AND SHAFT LOADING

DRAWING NUMBER	DESCRIPTION
IM-BLM7	MOTOR OUTLINE

NOTES:
1. MOTOR CAN BE MOUNTED IN ANY POSITION.
2. ALL DIMENSIONS ARE IN INCHES (MM).
3. IP-65 SEALING OR IPS-67 SEALING OPTIONAL
4. 0° TO 40°C OPERATING ENVIRONMENT MOUNTED ON 12" X 12" X .5" ALUM PLATE
5. ALL PAINTED SURFACES ARE BLACK.

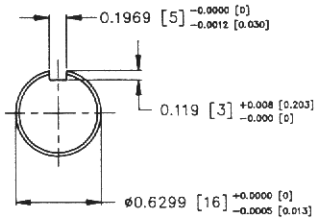
DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	DD	ELS
05/26/94	A	PER ECN 94-140	DAD	ELS	
05/01/95	B	PER ECN 95-120	CWB	EB	
09/04/96	C	PER ECN 96-237	EB		
02/17/97	D	PER ECN 97-057	CWB		





IIS PART NO.	WATTS	"A" DIM MAX	"B" DIM MAX	"C" DIM
BLM7-R400	400W	10.63 [270]	9.25 [235]	2.76 [70]
BLM7-R750	750W	12.80 [325]	11.41 [290]	4.92 [125]
C BLM7-H0750	750W	12.80 [325]	11.41 [290]	4.92 [125]
C BLM7B-H0750	750W	14.52 [369]	13.15 [334]	6.89 [175]

DETAIL "A"



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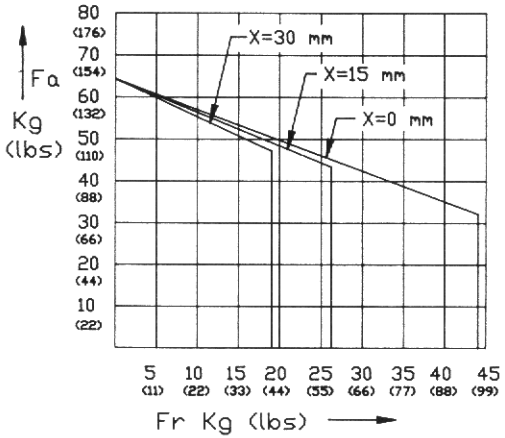
APPROVED BY ELS	DATE 01/94
APPROVED BY ELS	DATE 06/94
MATERIAL -----	
FINISH -----	

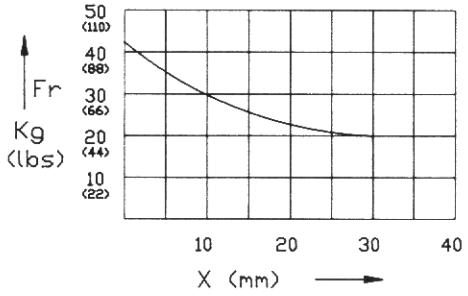
TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BAIER		DRAWING NUMBER IM-BLM7
TOLERANCES: X.X± .01, X.XX± .01, X.XXX± .005; ANGULAR ± --	AutoCAD FILE LOCATION Q:\DFTG\MDPAK7\MOTOR		
	B	DATE 12/06/93	SCALE ---	SHEET NO. 1 OF 10	REVISION D

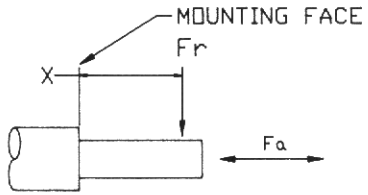
DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ELS
05/26/94	A	PER ECN 94-140	DAD	ELS	
05/01/95	B	PER ECN 95-120	CWB	CB	
09/04/96	C	PER ECN 96-237	EB	EB	
02/17/97	D	PER ECN 97-057	CWB	CB	



THRUST LOAD



RADIAL LOAD



R0400 & R0750

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CHECKED BY E.BAIER	DATE 01/94
APPROVED BY ELS	DATE 01/94
APPROVED BY ELS	DATE 06/94
MATERIAL ----------	
FINISH ----------	

TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES: X.X± ---- ANGULAR ±--- ; X.XX± ---- ; X.XXX± --

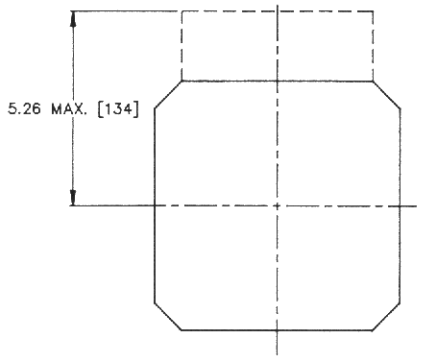
DRAWN BY: BAIER
AutoCAD FILE LOCATION: Q:\DFTG\MDPAK7\MOTOR

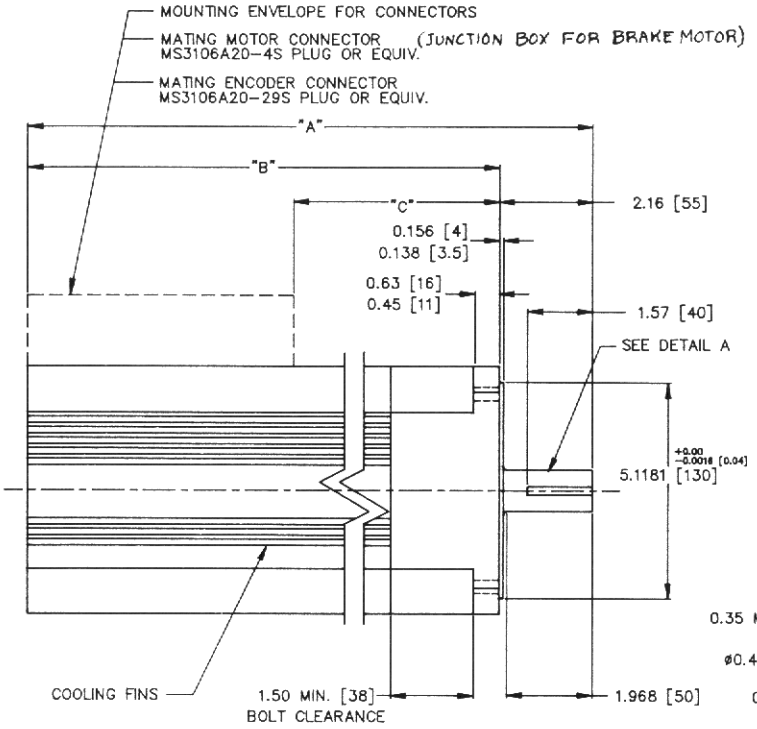
DRAWING NUMBER: IM--BLM7

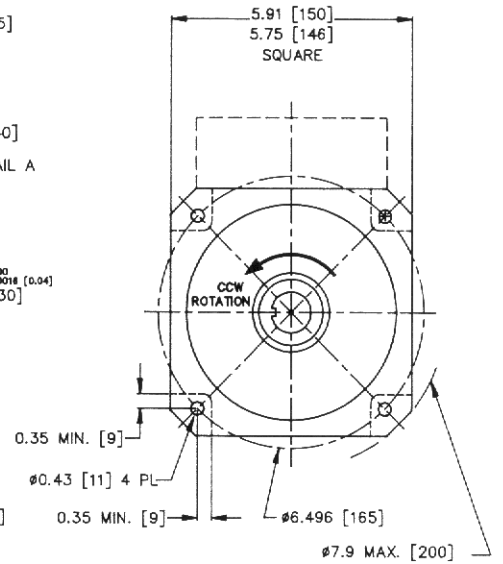
B | DATE 12/06/93 | SCALE 3=1 | SHEET NO. 7 OF 10 | REVISION D

NOTES:
1. MOTOR CAN BE MOUNTED IN ANY POSITION.
2. ALL DIMENSIONS ARE IN INCHES (MM).
3. IP-65 SEALING OR IPS-67 SEALING OPTIONAL
4. 0° TO 40°C OPERATING ENVIRONMENT MOUNTED ON 12" X 12" X .5" ALUM PLATE
5. ALL PAINTED SURFACES ARE BLACK.

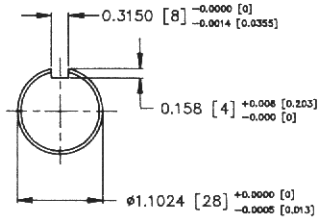
DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ELS
05/26/94	A	PER ECN 94-140	DAD	ELS	
05/01/95	B	PER ECN 95-120	CWB	CB	
09/04/96	C	PER ECN 96-237	EB	X	
02/17/97	D	PER ECN 97-057	CWB	CB	







DETAIL "A"



IIS PART NO.	WATTS	"A" DIM MAX	"B" DIM MAX	"C" DIM
BLM7-R1000	1000W	13.78 [350]	11.62 [295]	4.61 [117]
BLM7-R1500	1500W	14.66 [373]	12.50 [318]	5.47 [139]

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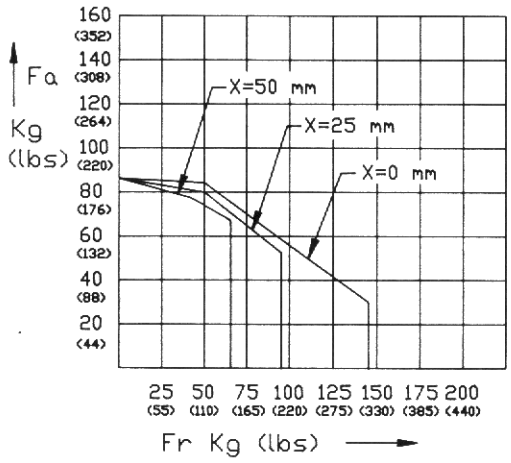
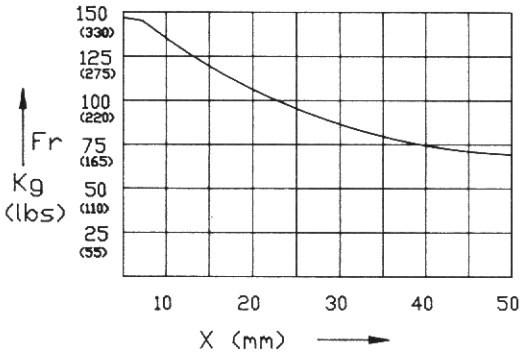
CHECKED BY E.BAIER	DATE 01/94
APPROVED BY ELS	DATE 01/94
APPROVED BY CWB	DATE 06/94
MATERIAL	
FINISH	

TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BAIER
TOLERANCES	AutoCAD FILE LOCATION Q:\DFTG\MDPAK7\MOTOR
X.X± ----- ANGULAR	DRAWING NUMBER IM-BLM7
X.XX± --- ± --	B DATE 12/06/93 SCALE --- SHEET NO. 3 OF 10 REVISION D
X.XXX± --	

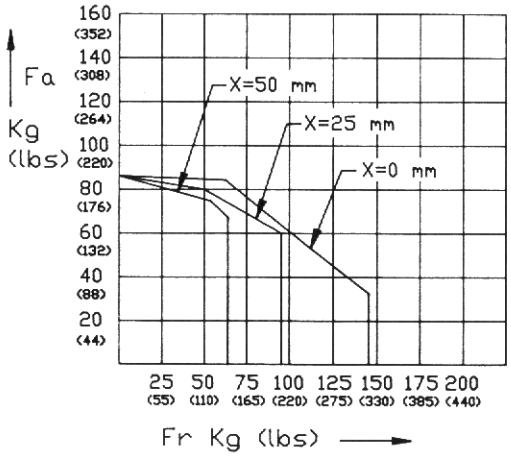


THRUST LOAD

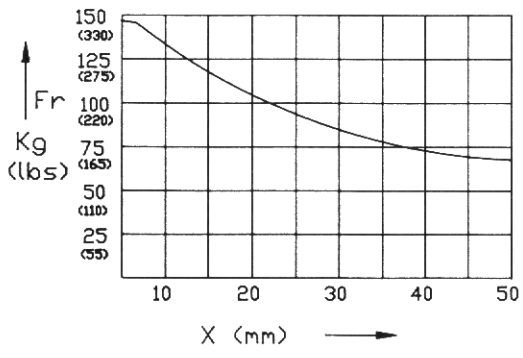


RADIAL LOAD

R1000



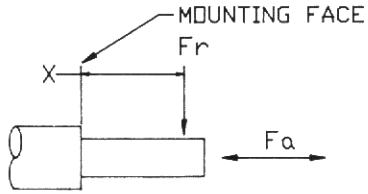
THRUST LOAD



RADIAL LOAD

R1500

DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ELS
05/26/94	A	PER ECN 94-140	DAD	ELS	
05/01/95	B	PER ECN 95-120	CWB	RB	
08/04/96	C	PER ECN 96-237	EB		
02/17/97	D	PER ECN 97-057	CWB	RB	



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CHECKED BY	E.BAIER
DATE	01/94
APPROVED BY	ELS
DATE	01/94
APPROVED BY	ELS
DATE	06/94
MATERIAL	----------
FINISH	----------

TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES

X.X± ----- ANGULAR

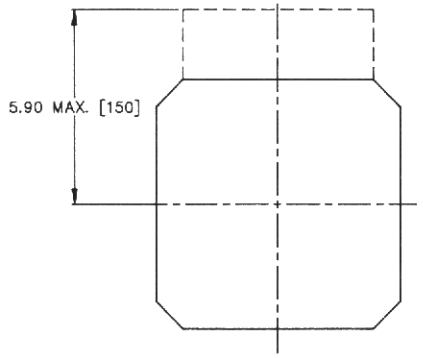
X.XX± --- ± --

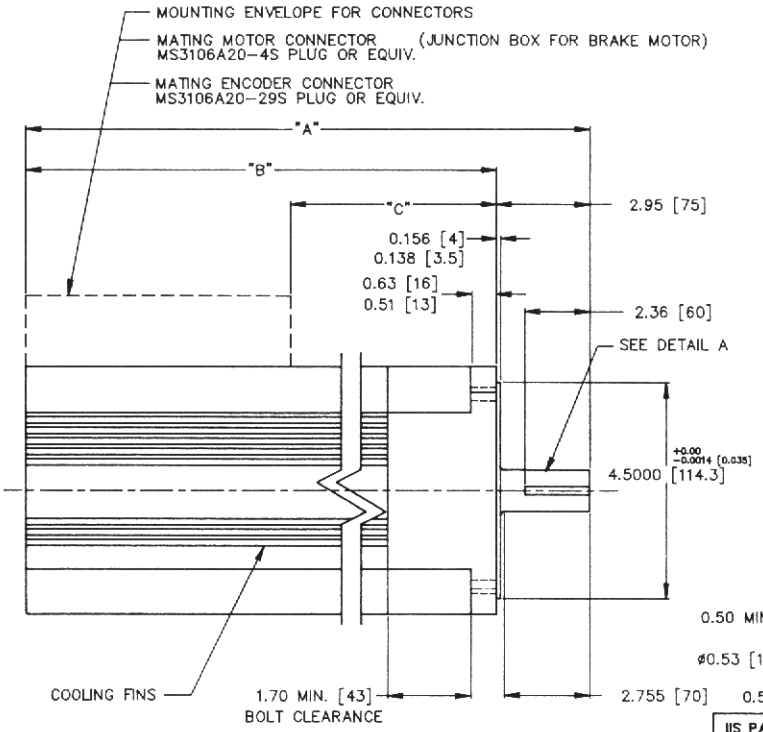
X.XXX± --

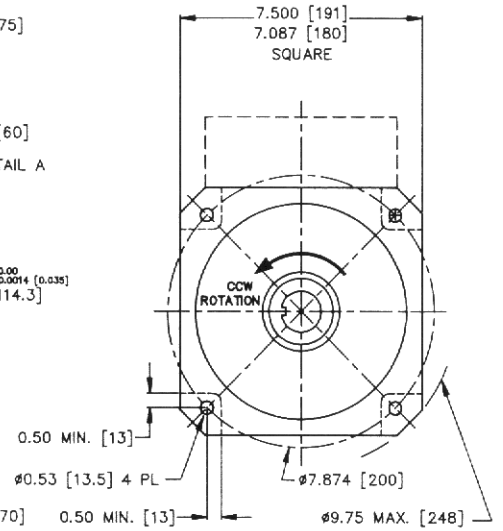
DRAWN BY	BAIER
AutoCAD FILE LOCATION	Q:\DFTG\MDPAK7\MOTOR
DRAWING NUMBER	IM-BLM7
B	
DATE	12/06/93
SCALE	3=1
SHEET NO.	OF 10
REVISION	D

NOTES:
1. MOTOR CAN BE MOUNTED IN ANY POSITION.
2. ALL DIMENSIONS ARE IN INCHES (MM).
3. IP-65 SEALING OR IPS-67 SEALING OPTIONAL
4. 0° TO 40°C OPERATING ENVIRONMENT MOUNTED ON 12" X 12" X .5" ALUM PLATE
5. ALL PAINTED SURFACES ARE BLACK.

DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ELS
05/26/94	A	PER ECN 94-140	DD	ELS	
05/01/95	B	PER ECN 95-120	CWB		
09/04/96	C	PER ECN 96-237	EB		
02/17/97	D	PER ECN 97-057	CWB		

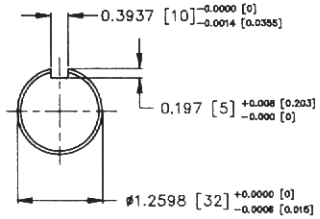






IIS PART NO.	WATTS	"A" DIM MAX	"B" DIM MAX	"C" DIM
BLM7-R2000	2000W	16.57 [421]	13.60 [346]	6.14 [156]
BLM7-R3000	3000W	17.95 [455]	15.00 [380]	7.60 [193]
BLM7B-R3000	3000W	19.52 [496]	16.57 [421]	14.19 [360]
BLM7-R3700	3700W	19.49 [495]	16.55 [420]	9.09 [231]
BLM7-M3700	3700W	17.33 [440]	14.38 [365]	11.06 [281]

DETAIL "A"



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CHECKED BY E.BAIER	DATE 01/94
APPROVED BY ELS	DATE 01/94
APPROVED BY ELS	DATE 06/94
MATERIAL ----------	
FINISH ----------	

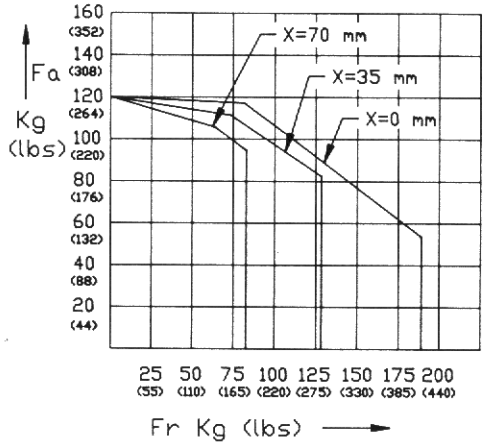
TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES: X.X± ------ ANGULAR ±--- X.XX±--- X.XXX±--

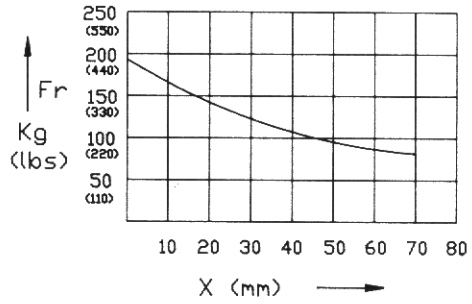
DRAWN BY BAIER
AutoCAD FILE LOCATION Q:\DFTG\MDPAK7\MOTOR

DRAWING NUMBER IM-BLM7

B | DATE 12/06/93 | SCALE --- | SHEET NO. 5 OF 10 | REVISION D

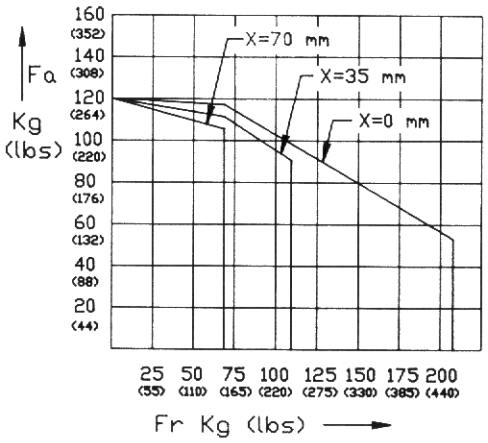


THRUST LOAD

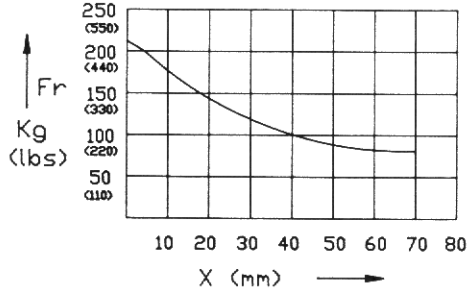


RADIAL LOAD

R2000



THRUST LOAD



RADIAL LOAD

⚠ R3000, R3700 & M3700

DATE	SYM	REVISION RECORD	DR	CK	CK
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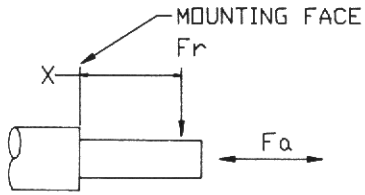
05/26/94	A	PER ECN 94-140	DAD	ELS	
05/01/94	B	PER ECN 95-120	CWB		
09/04/96	C	PER ECN 96-237	EB		
02/17/97	D	PER ECN 97-057	CWB	eb	



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CHECKED BY E.BAIER	DATE 01/94	
APPROVED BY ELS	DATE 01/94	
APPROVED BY ELS	DATE 06/94	

TITLE: MOTOR OUTLINE

MATERIAL: ----------

FINISH: ----------

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± ----- ANGULAR ± --- ; X.XX± --- ; X.XXX± ---

DRAWN BY: BAIER

AutoCAD FILE LOCATION: Q:\DFTG\MDPAK7\MOTOR

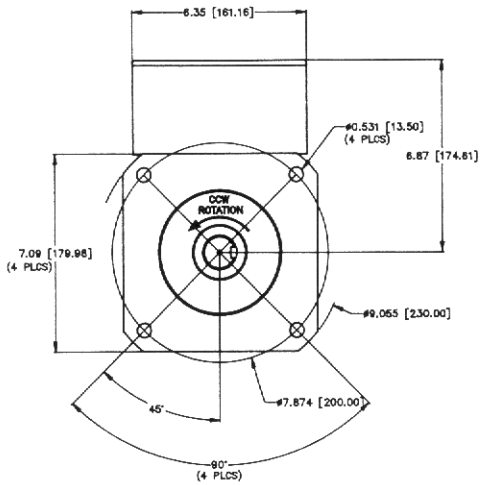
B | DATE 12/06/93 | SCALE 3=1

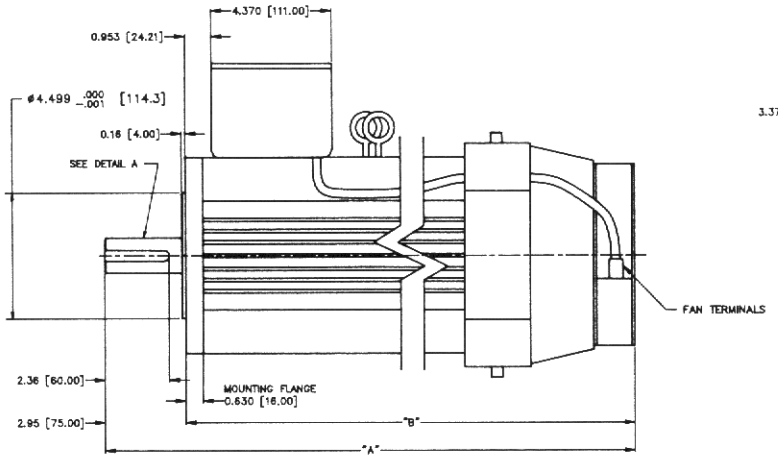
DRAWING NUMBER: IM-BLM7

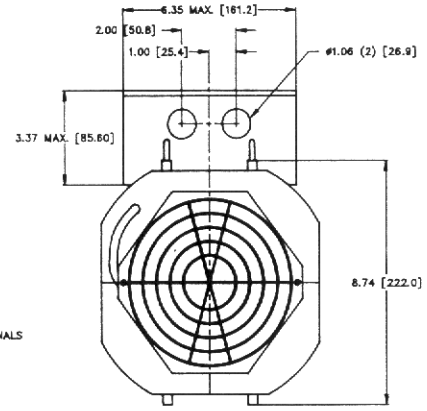
SHEET NO. OF 10 | REVISION D

NOTES:
1. MOTOR CAN BE MOUNTED IN ANY POSITION.
2. ALL DIMENSIONS ARE IN INCHES (MM).
3. IP-65 SEALING OR IPS-67 SEALING OPTIONAL
4. 0° TO 40°C OPERATING ENVIRONMENT
   MOUNTED ON 12" X 12" X .5" ALUM PLATE
5. ALL PAINTED SURFACES ARE BLACK.

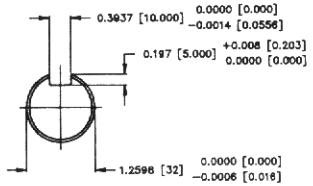
DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ELS
05/26/94	A	PER ECN 94-140	DD	ELS	
05/01/95	B	PER ECN 95-120	CWB	B	WES
09/06/96	C	PER ECN 96-237	EB		
02/17/97	D	PER ECN 97-057	CWB	EB	







DETAIL "A"
ENLARGED



IIS PART NO.	WATTS	"A" DIM MAX	"B" DIM MAX
BLM7-R5500F	5500	19.29 [490]	16.34 [415]
BLM7-R7500F	7500	21.85 [555]	18.89 [480]

INDUSTRIAL INDEXING SYSTEMS, Inc.
626 FISHERS RUN
VICTOR, NEW YORK 14564
(716) 924-9181 FAX: (716) 924-2169

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APPROVED BY	DATE
MATERIAL	----------
FINISH	----------

TITLE: MOTOR OUTLINE

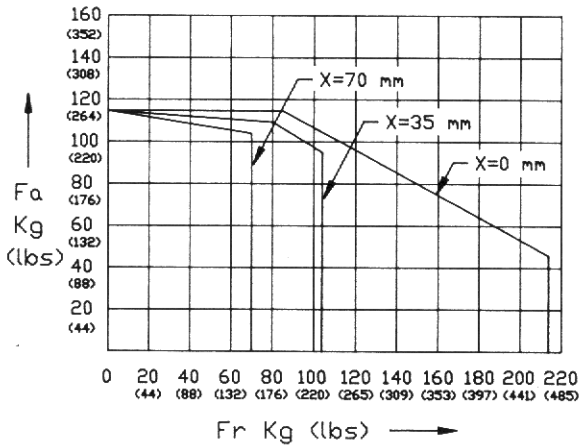
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES: X.X± ------ ANGULAR ± --- ; X.XX± --- ; X.XXX± --

DRAWN BY: BOWMAN
AutoCAD FILE LOCATION: Q:\DFTG\MDPAK7\MOTOR

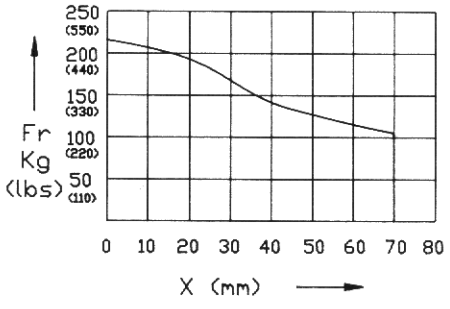
DRAWING NUMBER: IM-BLM7

B | DATE 12/06/93 | SCALE --- | SHEET NO. 7 OF 10 | REVISION D

DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ES
05/26/94	A	PER ECN 94-140	DAD	ELS	
05/01/95	B	PER ECN 95-120	CWB	N/A	
09/04/96	C	PER ECN 96-237	EB		
02/17/97	D	PER ECN 97-057	CWB	EB	

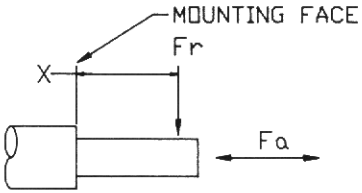


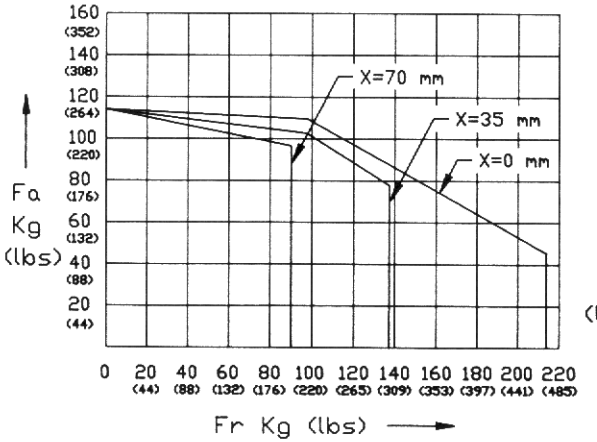
THRUST LOAD



RADIAL LOAD

R5500





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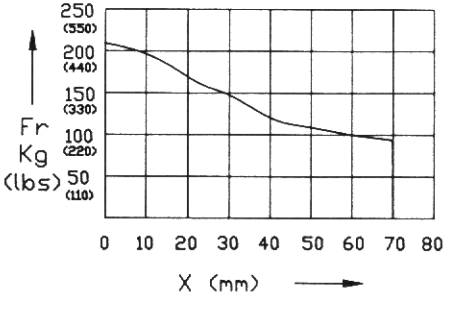

RADIAL LOAD

R7500

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APPROVED BY | DATE
MATERIAL: ----------
FINISH: ----------

TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES: X.X± ---- ANGULAR ± --; X.XX± ---; X.XXX± ---

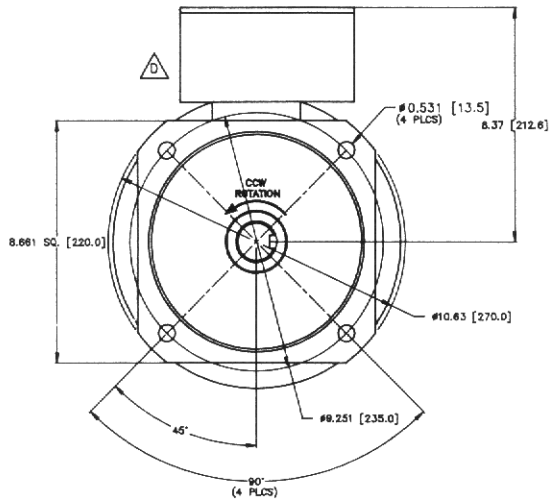
DRAWN BY: BOWMAN
AutoCAD FILE LOCATION: Q:\DFTG\MDPAK7\MOTOR

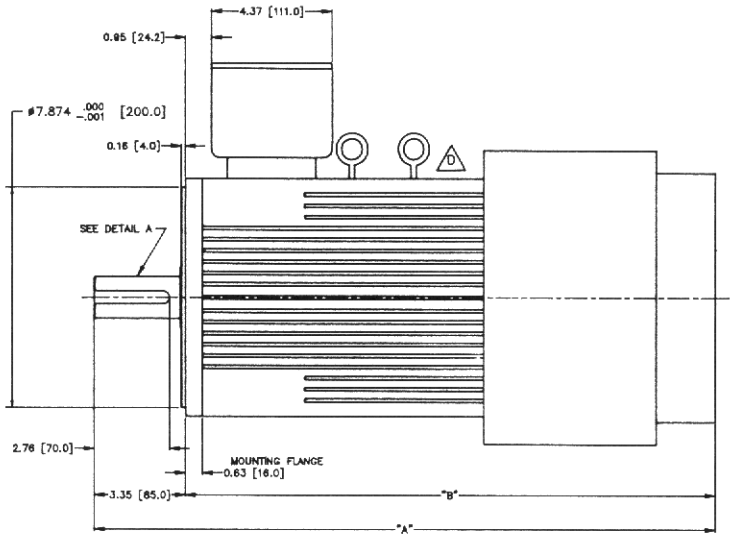
DRAWING NUMBER: IM-BLM7

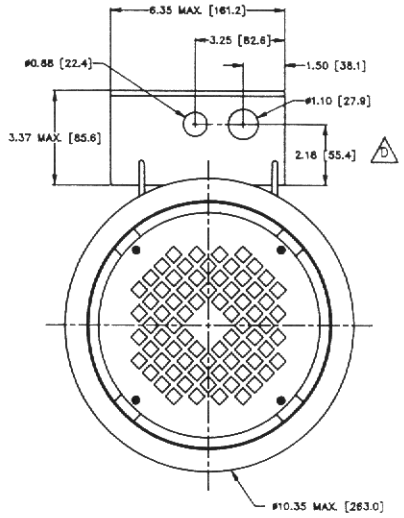
B | DATE: 12/06/93 | SCALE: 3=1 | SHEET NO.: 9 of 10 | REVISION: D

NOTES:
1. MOTOR CAN BE MOUNTED IN ANY POSITION.
2. ALL DIMENSIONS ARE IN INCHES (MM).
3. IP-65 SEALING OR IPS-67 SEALING OPTIONAL
4. 0° TO 40°C OPERATING ENVIRONMENT
   MOUNTED ON 12" X 12" X .5" ALUM PLATE
5. ALL PAINTED SURFACES ARE BLACK.

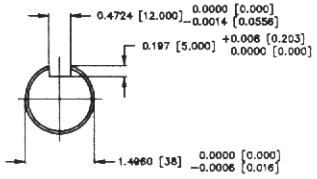
DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ELS
05/26/94	A	PER ECN 94-140	DD	ELS	
05/01/95	B	PER ECN 95-120	CWB	EB	
09/04/96	C	PER ECN 96-237	EB	JC	
02/17/97	D	PER ECN 97-057	CWB		







DETAIL "A"
ENLARGED



B	IIS PART NO.	WATTS	"A" DIM MAX	"B" DIM MAX
	BLM7-R11000F	11000	22.59 [573.87]	19.25 [488.87]

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APPROVED BY	DATE
MATERIAL	
FINISH	

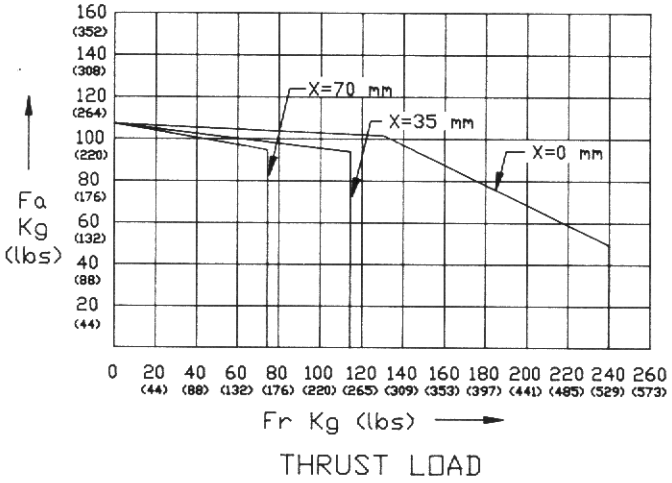
TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES
X.X± ----- ANGULAR ± --
X.XX± ---
X.XXX± ---

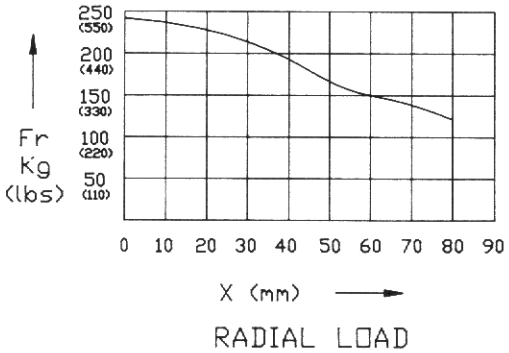
DRAWN BY: BOWMAN
AutoCAD FILE LOCATION: Q:\DFTG\MDPAK7\MOTOR
DRAWING NUMBER: IM-BLM7

B	DATE	SCALE	SHEET NO.	REVISION
	12/06/93	---	9 OF 10	D

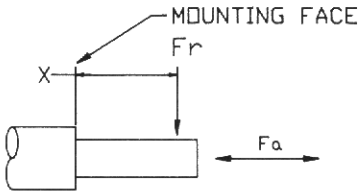
DATE	SYM	REVISION RECORD	DR	CK	CK
12/06/93	0	PER ECN 93-272	EB	EB	ELS
05/26/94	A	PER ECN 94-140	DAD	ELS	
05/01/95	B	PER ECN 95-120	CWB	[illegible]	[illegible]
09/04/96	C	PER ECN 96-237	EB	[illegible]	
02/17/97	D	PER ECN 97-057	CWB	[illegible]	



THRUST LOAD



RADIAL LOAD



Ⓑ R11000

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APPROVED BY	DATE
MATERIAL	----------
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(716) 924-9181 FAX: (716) 924-2169

TITLE: MOTOR OUTLINE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BOWMAN		DRAWING NUMBER IM-BLM7
TOLERANCES: X.X± ----- ANGULAR ± -- ; X.XX± --- ; X.XXX± --	AutoCAD FILE LOCATION Q:\DFTG\MDPAK7\MOTOR		
	B	DATE 12/06/93 SCALE 3=1	SHEET NO. OF 10 REVISION D

APPENDIX D
DRIVE PARAMETER DEFAULTS

DRAWING NUMBER	DESCRIPTION
SU-049001	Amplifier Setup, MDPAK7-R400/ServoPro-R400D
SU-049002	Amplifier Setup, MDPAK7-R750/ServoPro-R750D
SU-049003	Amplifier Setup, MDPAK7-R1000/ServoPro-R1000D
SU-049004	Amplifier Setup, MDPAK7-R1500/ServoPro-R1500D
SU-049005	Amplifier Setup, MDPAK7-R2000/ServoPro-R2000D
SU-049008	Amplifier Setup, MDPAK7-R3000/ServoPro-R3000D
SU-049006	Amplifier Setup, MDPAK7-R3700/ServoPro-R3700D
SU-049006	Amplifier Setup, MDPAK7-M3700/ServoPro-M3700D

SU-049001
MDPAK7-R400/SERVOPRO-R400D

PARA	DESCRIPTION	DEFAULT
PrSt	Parameter Set	n
Ctrt	Control Type	SPd
CHG	Control Change	PoS
AUto	Auto Tuning	n
Fr	Forward/Reverse	SrF
SPoL	Speed Polarity	P
SPG	Speed Loop Proportional Gain	016.8
SIG	Speed Loop Integral Gain	0.178
AHG	Speed Loop Differential Gain	0.323
SoFS	Speed Command Offset	0000
SSCL	Speed Command Scale	2000
SLL	Speed Level Limit	2000
S1	Speed Command 1	0000
S2	Speed Command 2	0000
Adt	Acel/decel Time	00.00
TyPE	Acel/decel Type	HArd
SrAt	Quasi S Acel Rate	010.0
trAt	Quasi S Acel Rate	010.0
LoSL	Low Speed Signal Output	0030
rCH	Speed Signal Output Condition	CnSt
rCHL	Speed Signal Output Level	2000
PPG	Position Loop Gain	0.400
PSCL	Position Command Scaling	2000
1nP	Position Complete Output	nHyS
1nPr	Position Complete Range	0000
CL	Current Limit	In
PCLL	Positive (CCW) Current Limit	0260
nCLL	Negative (CW) Current Limit	0260

SU-049002
MDPAK7-R750/SERVOPRO-R750D

PARA	DESCRIPTION	DEFAULT
PrSt	Parameter Set	n
Ctrt	Control Type	SPd
CHG	Control Change	PoS
AUto	Auto Tuning	n
Fr	Forward/Reverse	SrF
SPoL	Speed Polarity	P
SPG	Speed Loop Proportional Gain	024.8
SIG	Speed Loop Integral Gain	0.178
AHG	Speed Loop Differential Gain	0.323
SoFS	Speed Command Offset	0000
SSCL	Speed Command Scale	2000
SLL	Speed Level Limit	2000
S1	Speed Command 1	0000
S2	Speed Command 2	0000
Adt	Acel/decel Time	00.00
TyPE	Acel/decel Type	HArd
SrAt	Quasi S Acel Rate	010.0
trAt	Quasi S Acel Rate	010.0
LoSL	Low Speed Signal Output	0030
rCH	Speed Signal Output Condition	CnSt
rCHL	Speed Signal Output Level	2000
PPG	Position Loop Gain	0.400
PSCL	Position Command Scaling	2000
1nP	Position Complete Output	nHyS
1nPr	Position Complete Range	0000
CL	Current Limit	In
PCLL	Positive (CCW) Current Limit	0260
nCLL	Negative (CW) Current Limit	0260

SU-049003
MDPAK7-R1000/SERVOPRO-R1000D

PARA	DESCRIPTION	DEFAULT
PrSt	Parameter Set	n
Ctrt	Control Type	SPd
CHG	Control Change	PoS
AUto	Auto Tuning	n
Fr	Forward/Reverse	SrF
SPoL	Speed Polarity	P
SPG	Speed Loop Proportional Gain	027.6
SIG	Speed Loop Integral Gain	0.178
AHG	Speed Loop Differential Gain	0.323
SoFS	Speed Command Offset	0000
SSCL	Speed Command Scale	2000
SLL	Speed Level Limit	2000
S1	Speed Command 1	0000
S2	Speed Command 2	0000
Adt	Acel/decel Time	00.00
TyPE	Acel/decel Type	HArd
SrAt	Quasi S Acel Rate	010.0
trAt	Quasi S Acel Rate	010.0
LoSL	Low Speed Signal Output	0030
rCH	Speed Signal Output Condition	CnSt
rCHL	Speed Signal Output Level	2000
PPG	Position Loop Gain	0.400
PSCL	Position Command Scaling	2000
1nP	Position Complete Output	nHyS
1nPr	Position Complete Range	0000
CL	Current Limit	In
PCLL	Positive (CCW) Current Limit	0260
nCLL	Negative (CW) Current Limit	0260

SU-049004
MDPAK7-R1500/SERVOPRO-R1500D

PARA	DESCRIPTION	DEFAULT
PrSt	Parameter Set	n
Ctrt	Control Type	SPd
CHG	Control Change	PoS
AUto	Auto Tuning	n
Fr	Forward/Reverse	SrF
SPoL	Speed Polarity	P
SPG	Speed Loop Proportional Gain	023.5
SIG	Speed Loop Integral Gain	0.178
AHG	Speed Loop Differential Gain	0.323
SoFS	Speed Command Offset	0000
SSCL	Speed Command Scale	2000
SLL	Speed Level Limit	2000
S1	Speed Command 1	0000
S2	Speed Command 2	0000
Adt	Acel/decel Time	00.00
TyPE	Acel/decel Type	HArd
SrAt	Quasi S Acel Rate	010.0
trAt	Quasi S Acel Rate	010.0
LoSL	Low Speed Signal Output	0030
rCH	Speed Signal Output Condition	CnSt
rCHL	Speed Signal Output Level	2000
PPG	Position Loop Gain	0.400
PSCL	Position Command Scaling	2000
1nP	Position Complete Output	nHyS
1nPr	Position Complete Range	0000
CL	Current Limit	In
PCLL	Positive (CCW) Current Limit	0260
nCLL	Negative (CW) Current Limit	0260

SU-049005
MDPAK7-R2000/SERVOPRO-R2000D

PARA	DESCRIPTION	DEFAULT
PrSt	Parameter Set	n
Ctrt	Control Type	SPd
CHG	Control Change	PoS
AUto	Auto Tuning	n
Fr	Forward/Reverse	SrF
SPoL	Speed Polarity	P
SPG	Speed Loop Proportional Gain	036.1
SIG	Speed Loop Integral Gain	0.178
AHG	Speed Loop Differential Gain	0.323
SoFS	Speed Command Offset	0000
SSCL	Speed Command Scale	2000
SLL	Speed Level Limit	2000
S1	Speed Command 1	0000
S2	Speed Command 2	0000
Adt	Acel/decel Time	00.00
TyPE	Acel/decel Type	HArd
SrAt	Quasi S Acel Rate	010.0
trAt	Quasi S Acel Rate	010.0
LoSL	Low Speed Signal Output	0030
rCH	Speed Signal Output Condition	CnSt
rCHL	Speed Signal Output Level	2000
PPG	Position Loop Gain	0.400
PSCL	Position Command Scaling	2000
1nP	Position Complete Output	nHyS
1nPr	Position Complete Range	0000
CL	Current Limit	In
PCLL	Positive (CCW) Current Limit	0260
nCLL	Negative (CW) Current Limit	0260

SU-049008
MDPAK7-R3000/SERVOPRO-R3000D

PARA	DESCRIPTION	DEFAULT
PrSt	Parameter Set	n
Ctrt	Control Type	SPd
CHG	Control Change	PoS
AUto	Auto Tuning	n
Fr	Forward/Reverse	SrF
SPoL	Speed Polarity	P
SPG	Speed Loop Proportional Gain	032.4
SIG	Speed Loop Integral Gain	0.178
AHG	Speed Loop Differential Gain	0.323
SoFS	Speed Command Offset	0000
SSCL	Speed Command Scale	2000
SLL	Speed Level Limit	2000
S1	Speed Command 1	0000
S2	Speed Command 2	0000
Adt	Acel/decel Time	00.00
TyPE	Acel/decel Type	HArd
SrAt	Quasi S Acel Rate	010.0
trAt	Quasi S Acel Rate	010.0
LoSL	Low Speed Signal Output	0030
rCH	Speed Signal Output Condition	CnSt
rCHL	Speed Signal Output Level	2000
PPG	Position Loop Gain	0.400
PSCL	Position Command Scaling	2000
1nP	Position Complete Output	nHyS
1nPr	Position Complete Range	0000
CL	Current Limit	In
PCLL	Positive (CCW) Current Limit	0260
nCLL	Negative (CW) Current Limit	0260

SU-049006
MDPAK7-R3700/M3700/SERVOPRO-R/M3700D

PARA	DESCRIPTION	DEFAULT
PrSt	Parameter Set	n
Ctrt	Control Type	SPd
CHG	Control Change	PoS
AUto	Auto Tuning	n
Fr	Forward/Reverse	SrF
SPoL	Speed Polarity	P
SPG	Speed Loop Proportional Gain	033.2
SIG	Speed Loop Integral Gain	0.178
AHG	Speed Loop Differential Gain	0.323
SoFS	Speed Command Offset	0000
SSCL	Speed Command Scale	2000
SLL	Speed Level Limit	2000
S1	Speed Command 1	0000
S2	Speed Command 2	0000
Adt	Acel/decel Time	00.00
TyPE	Acel/decel Type	HArd
SrAt	Quasi S Acel Rate	010.0
trAt	Quasi S Acel Rate	010.0
LoSL	Low Speed Signal Output	0030
rCH	Speed Signal Output Condition	CnSt
rCHL	Speed Signal Output Level	2000
PPG	Position Loop Gain	0.400
PSCL	Position Command Scaling	2000
1nP	Position Complete Output	nHyS
1nPr	Position Complete Range	0000
CL	Current Limit	In
PCLL	Positive (CCW) Current Limit	0260
nCLL	Negative (CW) Current Limit	0260

APPENDIX E
TRANSFORMERS

Transformer Specifications

Panel-mount Transformer Dimensions and Connections

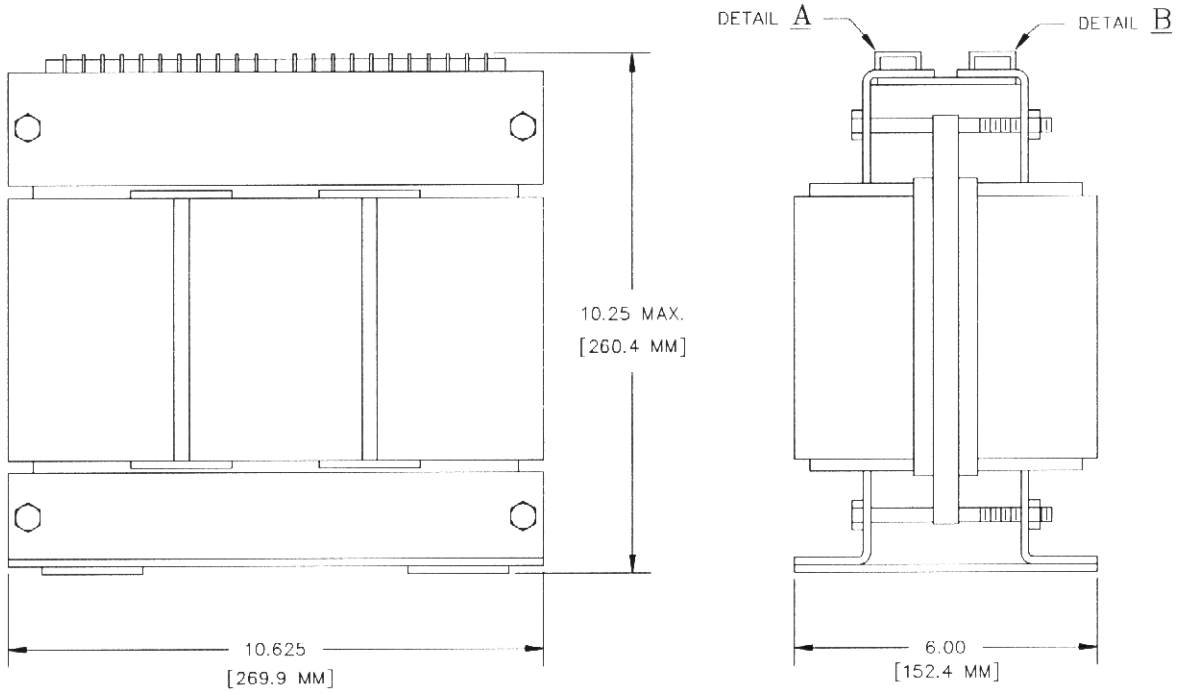
Free-standing Transformer Dimensions and Connections

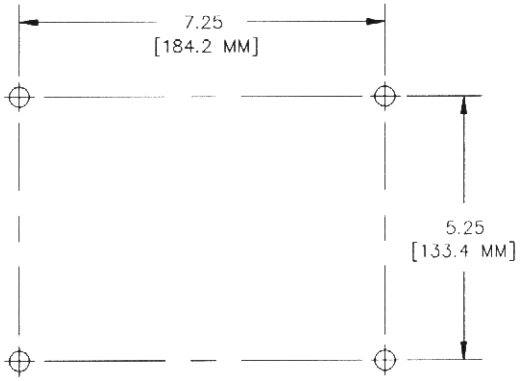
TRANSFORMER SPECIFICATIONS

TRANSFORMER	OUTPUT POWER (Watts)	INPUT PHASES	PM*	FS*	PRIMARY TERMINAL CURRENT (Amps)		SECONDARY TERMINAL CURRENT (Amps)		
					230 VAC	460 VAC	253 VAC	230 VAC	207 VAC
T-300/3-3	1000	3	X		3	6	3	3	3
T-300/5-3	1500	3	X		5	2.5	5	5	5
T-300/7.5-3	2200	3	X		7.5	3.7	7.5	7.5	7.5
TE-300/7.5-3	2250	3		X	7.5	3.7	6.8	7.5	8.3
TE-300/15-3	4500	3		X	15	7.5	13.7	15	16.7
TE-300/30-3	9000	3		X	30	15	27.4	30	33.5
TE-300/58-3	15000	3		X	57.7	28.8	52.5	57.7	64.1
TE-300/75-3	22500	3		X	67.7	33.9	61.6	67.8	75.3
TE-300/95-3	30000	3		X	95	47.5	86.4	95	105

*NOTE: PM = Panel Mount, FS = Free-standing

PANEL-MOUNT TRANSFORMER DIMENSIONS AND CONNECTIONS



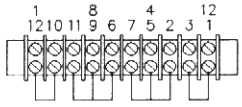


MOUNTING PATTERN

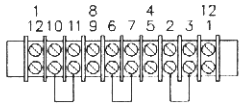
.625 [15.9 MM] DIA. THRU (4 PLACES)
USE 3/8–16 UNC MOUNTING HARDWARE

DETAIL A

WIRING/PRIMARY TERMINALS



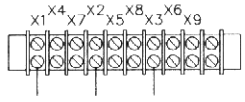
230 VAC CONNECTIONS



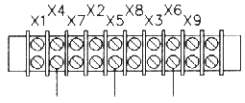
460 VAC CONNECTIONS

DETAIL B

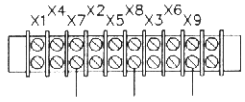
WIRING/SECONDARY TERMINALS



253 VAC Y CONNECTIONS



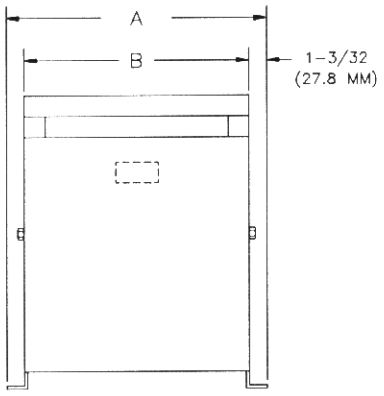
230 VAC Y CONNECTIONS

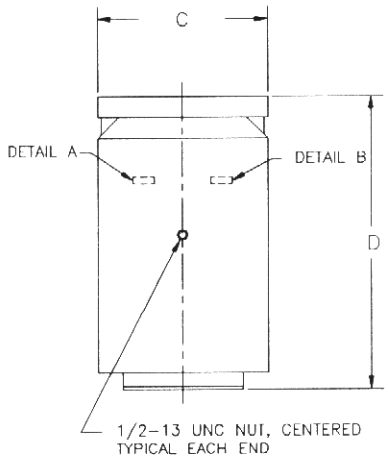


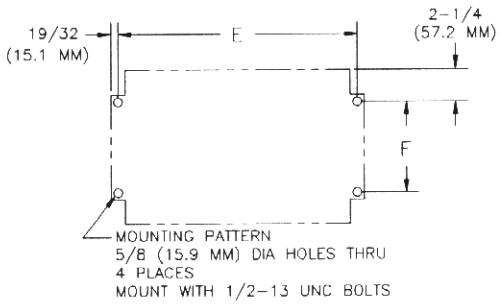
207 VAC Y CONNECTIONS

TRANSFORMER	FREQ. (HZ)	PHASE	OUTPUT POWER (WATTS)	TEMP. RISE (°C)	WEIGHT (LBS.)
T–300/3–3	60	3	1000	150	80
T–300/5–3	60	3	1500	150	80
T–300/7.5–3	60	3	2200	150	80

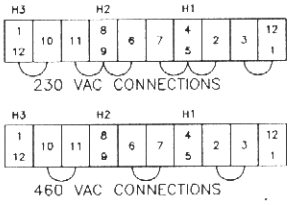
FREE-STANDING TRANSFORMER DIMENSIONS AND CONNECTIONS



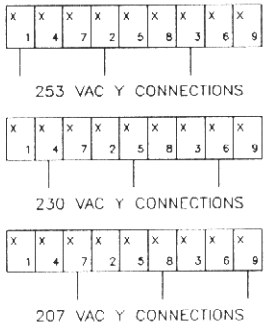




DETAIL A
WIRING/PRIMARY TERMINALS



DETAIL B
WIRING/SECONDARY TERMINALS



TRANSFORMER	FREQ. (HZ)	PHASE	OUTPUT POWER (WATTS)	TEMP. RISE (°C)	WEIGHT (LBS.)	A	B	C	D	E	F
TE-300/7.5-3	60	3	2250	150	110	18.19 (462)	16.00 (406)	8.00 (203)	21.00 (533)	17.00 (432)	3.50 (89)
TE-300/15-3	60	3	4500	150	125	18.19 (462)	16.00 (406)	8.00 (203)	21.00 (533)	17.00 (432)	3.50 (89)
TE-300/30-3	60	3	9000	150	175	22.19 (564)	20.00 (508)	12.00 (305)	21.00 (533)	21.00 (533)	7.50 (191)
TE-300/58-3	60	3	15000	150	216	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)
TE-300/75-3	60	3	22500	150	400	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)
TE-300/95-3	60	3	30000	150	400	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)

DIMENSIONS = INCHES
(MILLIMETERS)

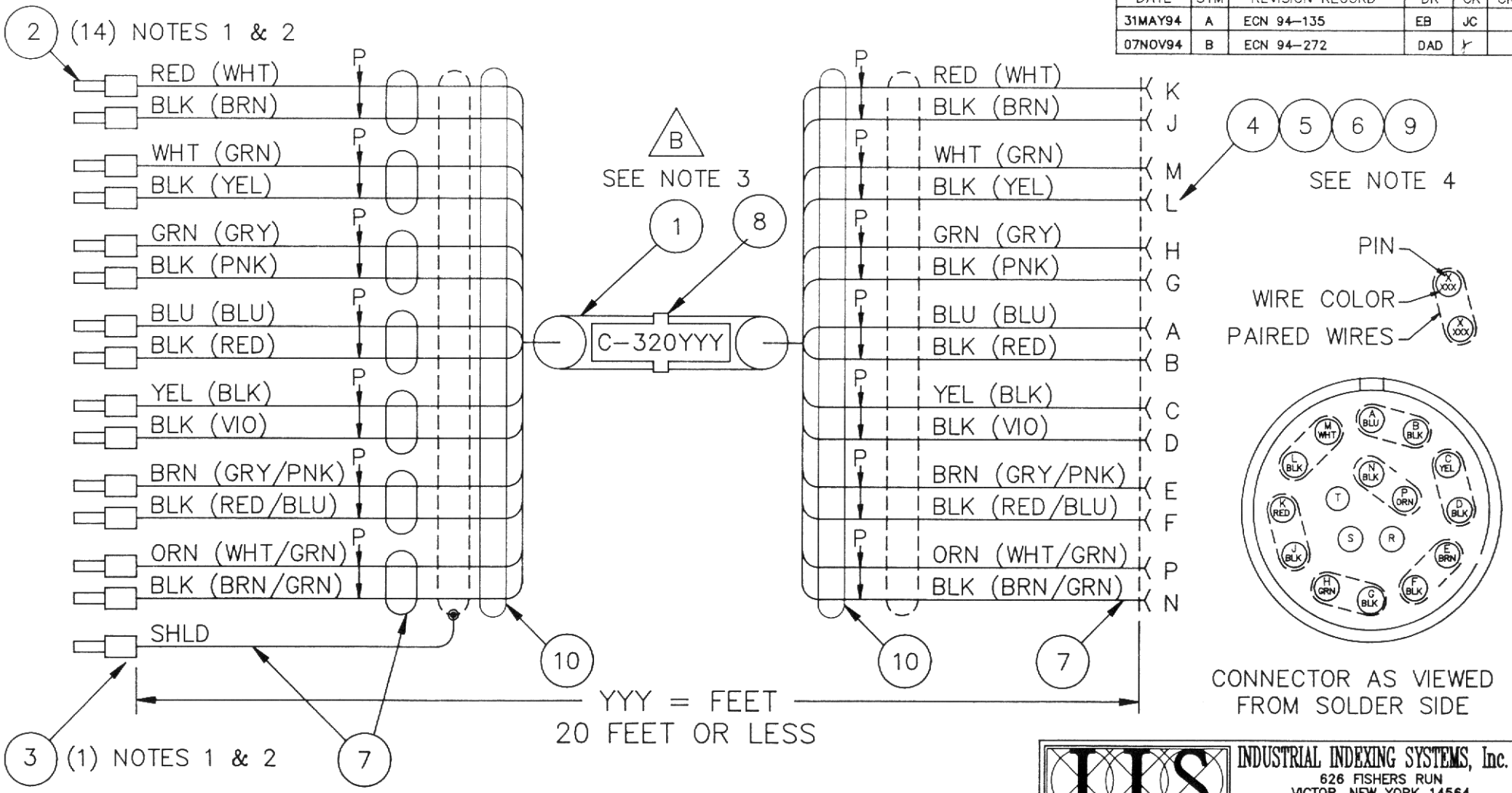
APPENDIX F
CONNECTING CABLES

DRAWING NUMBER	DESCRIPTION
C-320YYY	Encoder Cable
C-653YYY	Motor Cable
C-659YYY	Motor Cable
C-805YYY	Power Cable
C-806YYY	Power Cable
C-901YYY	Peripheral Cable
C-957YYY	Communication Cable
C-975YYY	Communication Cable
C-976YYY	Communication Cable

C-320YYY
BILL OF MATERIALS

COMPONENT	REFERENCE	DESCRIPTION
8307	1	CABLE, 7 TW PAIR, SHLD, 22 AWG
6907.0	2	FERRULE, #20, ORN
4631.0	3	FERRULE, #16, RED
MS3106A20-29S	4	CONNECTOR, MS, CABLE, 17 PIN
97-3057-1012-1	5	STRAIN RELIEF, #20 SHELL SIZE
9779-513-10	6	BOOT, MS, .56 O.D. CABLE
FIT221-1/8	7	HEATSHRINK TUBING, 1/8 IN
PLM1M	8; MARK C-320 LENGTH IN FEET	CABLE TIE LABEL
9779-513-8	9	BOOT, MS, .44 O.D. CABLE
FIT221-1/2	10	HEATSHRINK TUBING, 1/2 IN.

DATE	SYM	REVISION RECORD	DR	CK	CK
31MAY94	A	ECN 94-135	EB	JC	
07NOV94	B	ECN 94-272	DAD		



NOTES:

1. INSTALL ITEM 2 & 3 USING WEIDMULLER CRIMP TOOL PZ4 OR EQUIV
2. ALTERNATE CONSTRUCTION; STRIP AND TIN 1/4"
3. COLORS SHOWN (COLOR) INDICATES ASSEMBLIES MANUFACTURED WITH RAW MATERIAL "P/N 35814"
4. ITEM 6 SUPPLIED AS PART OF CONNECTOR, ITEM 4.

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CHECKED BY	DATE		
APPROVED BY ELS	DATE 1/93		
APPROVED BY JBC	DATE 1/93		
MATERIAL -----		TITLE: CABLE, ENCODER	
FINISH -----		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY D.A.DAUNCE
		TOLERANCES X.X± ----- X.XX± ---- X.XXX± --- ANGULAR ± ---	AutoCAD FILE LOCATION CABLES
			B DATE 23JAN93 SCALE -----
			DRAWING NUMBER C-320YYY
			SHEET NO. 1 OF 1 REVISION B

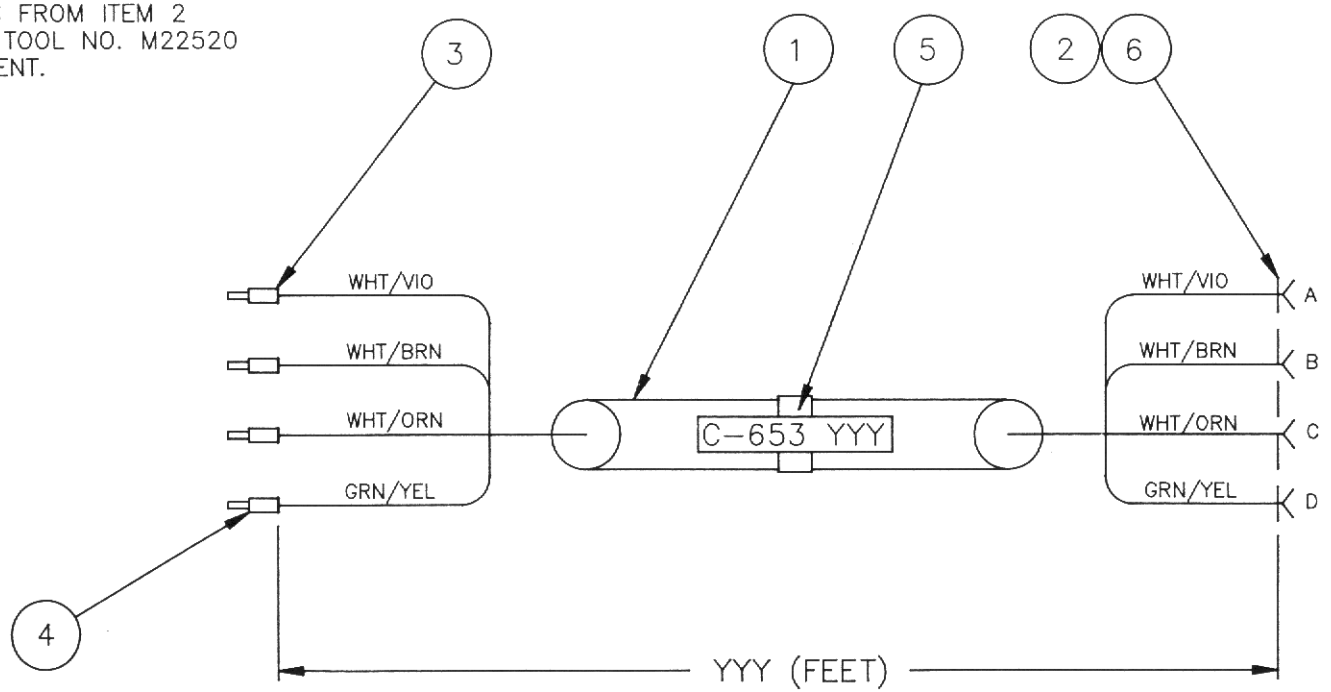
C-653YYY
BILL OF MATERIALS

COMPONENT	REFERENCE	DESCRIPTION
S72443	1	CABLE, 6 COND, 12 AWG
MS3106A20-4S	2	CONNECTOR, CABLE, 4 PIN FEMALE
4633.0	3	FERRULE, #12, GRA
4632.0	4	FERRULE, #14, BLU
PLM1M	5; MARK C-653 LENGTH IN FEET	CABLE TIE LABEL
97-3057-1012-1	6	STRAIN RELIEF, #20 SHELL SIZE

DATE	SYM	REVISION RECORD	DR	CK	CK
8/14/90	A	ECN-89-0195	EB	JC	JF
9/29/93	B	ECN-93-0267	MC	EB	WEI

NOTES:

1. INSTALL ITEMS 3 & 4 USING WEIDMULLER CRIMP TOOL PZ-4 OR EQUIVALENT.
2. ALTERNATE CONSTRUCTION: STRIP & TIN .25"
3. INSTALL PINS FROM ITEM 2 USING DMC TOOL NO. M22520 OR EQUIVALENT.



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CHECKED BY J.C.	DATE 8/90
APPROVED BY J.T.F.	DATE 8/90
APPROVED BY WEI	DATE 11/22/97
MATERIAL ---------	
FINISH ---------	

TITLE: CABLE-MOTOR

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY E. BAIER		DRAWING NUMBER C-653YYY
TOLERANCES: X.X± ---- X.XX± --- X.XXX± -- ANGULAR ± --	AutoCAD FILE LOCATION G:\CAD\CABLES		
	B	DATE 8/15/90	SCALE ---
			SHEET NO. 1 OF 1
			REVISION B

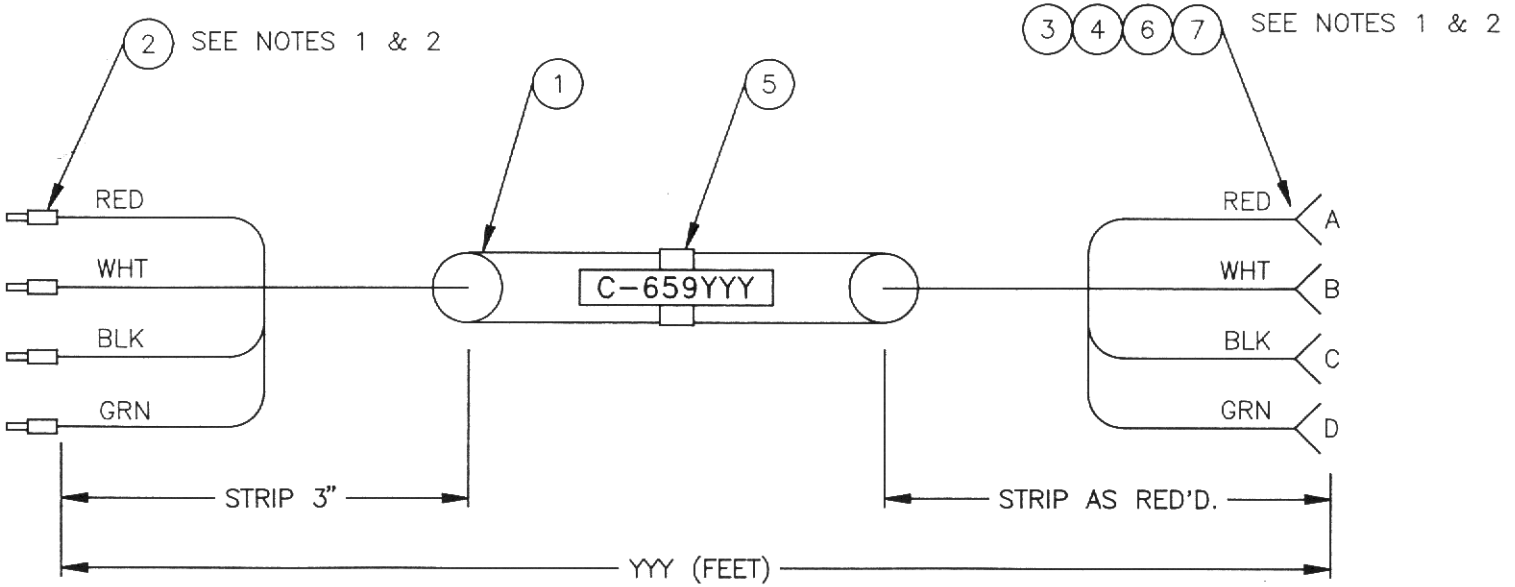
C-659YYY
BILL OF MATERIALS

COMPONENT	REFERENCE	DESCRIPTION
SJO-14/4	1	CABLE, 4 COND, 14 AWG
4632.0	2	FERRULE, #14, BLU
MS3106A20-4S	3	CONNECTOR, CABLE, 4 PIN FEMALE
97-3057-1012-1	4	STRAIN RELIEF, #20 SHELL SIZE
PLM1M	5; MARK C-659 LENGTH IN FEET	CABLE TIE LABEL
9779-513-12	6	BOOT, MS, .63 O.D. CABLE
9779-513-10	7	BOOT, MS, .56 O.D. CABLE

NOTES:

1. INSTALL ITEM 2 USING WEIDMULLER CRIMP TOOL PZ-4 OR EQUIVALENT.
2. ALTERNATE CONSTRUCTION STRIP & TIN .25"

DATE	SYM	REVISION RECORD	DR	CK	CK
12/18/90	A	ECN-90-0221	ME	JTF	
9/29/93	B	ECN-93-0267	MC	85	WEI



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CHECKED BY E.B.	DATE 12/90
APPROVED BY J.T.F.	DATE 12/90
APPROVED BY WEI	DATE 11/93
MATERIAL ---------	
FINISH ---------	

TITLE: COMMAND CABLE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY MIKE E.		DRAWING NUMBER C-659YYY
TOLERANCES: X.X± ----- ANGULAR ± -- ; X.XX± --- ; X.XXX± --	AutoCAD FILE LOCATION G:\CAD\CABLES		
	B	DATE 12/18/90	SCALE ---
			SHEET NO. 1 OF 1
			REVISION B

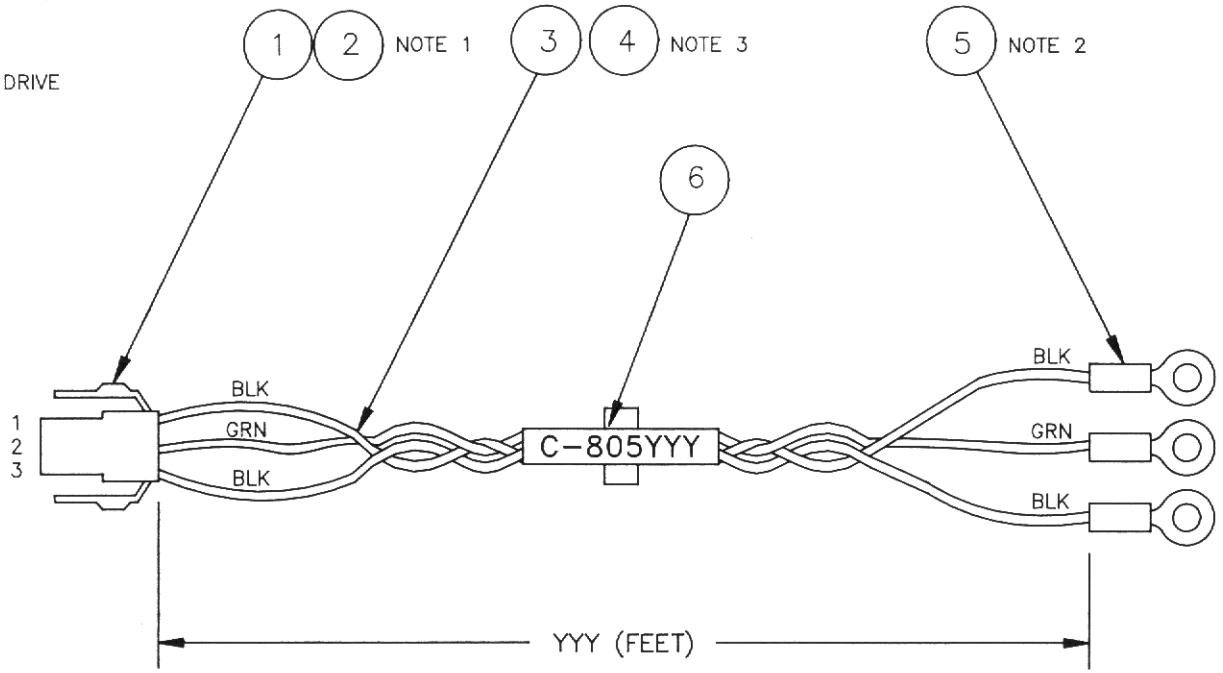
C-805YYY
BILL OF MATERIALS

COMPONENT	REFERENCE	DESCRIPTION
1-640518-0	1	CONNECTOR, SOCKET HOUSING
350666-1	2	PIN, CONNECTOR, FEMALE
AWG-18-BLK	3	WIRE, #18 MTW, BLACK, STRANDED
AWG-18-GRN	4	WIRE, #18 MTW, GREEN, STRANDED
PV14-8R	5	RING LUG, #8
PLM1M	6; MARK C-805 LENGTH IN FEET	CABLE TIE LABEL

NOTES:

1. INSTALL ITEM 2 USING AMP CRIMPING TOOL #90327 OR EQUIVALENT
2. INSTALL ITEM 5 USING PANDUIT CRIMPING TOOL CT550 OR EQUIVALENT
3. TWIST WIRES TOGETHER APPX. 1 TWIST PER 2 INCHES
4. APPLICATIONS: SERVOPRO TO TOSHIBA DRIVE AC POWER

DATE	SYM	REVISION RECORD	DR	CK	CK
9/29/93	A	ECN-93-0267	MC	EB	WJ



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CHECKED BY J.C.	DATE 5/90
APPROVED BY C.M.E.	DATE 5/90
APPROVED BY WJ	DATE 11/93
MATERIAL ---------	
FINISH ---------	

TITLE: CABLE, MOTOR

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BAIER		DRAWING NUMBER C-805YYY
TOLERANCES: X.X± ----- X.XX± --- X.XXX± --	ANGULAR ± --	AutoCAD FILE LOCATION G:\CAD\CABLES	
		B DATE 5/09/90	SCALE --- SHEET NO. 1 OF 1 REVISION A

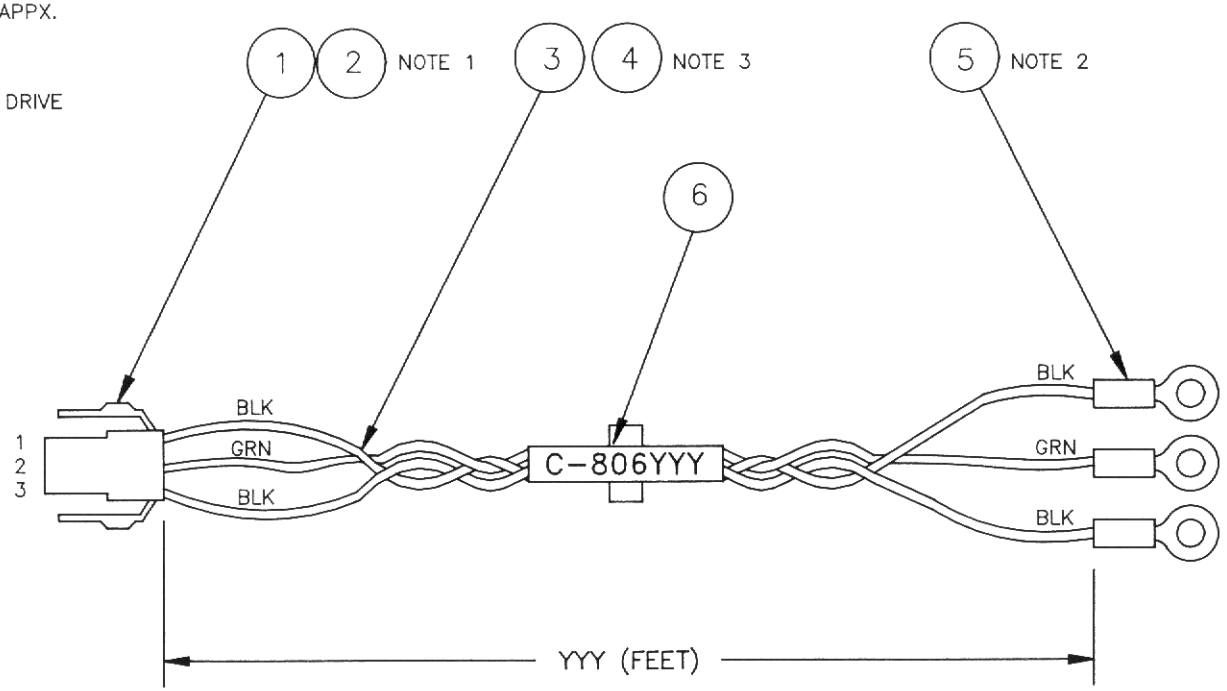
C-806YYY
BILL OF MATERIALS

COMPONENT	REFERENCE	DESCRIPTION
1-640518-0	1	CONNECTOR, SOCKET HOUSING
350666-1	2	PIN, CONNECTOR, FEMALE
AWG-18-BLK	3	WIRE, #18 MTW, BLACK, STRANDED
AWG-18-GRN	4	WIRE, #18 MTW, GREEN, STRANDED
PV14-6R	5	RING LUG, #6
PLM1M	6; MARK C-806 LENGTH IN FEET	CABLE TIE LABEL

DATE	SYM	REVISION RECORD	DR	CK	CK
10/01/93	A	ECN-93-0267	MC	EB	UE

NOTES:

1. INSTALL ITEM 2 USING AMP CRIMPING TOOL #90327 OR EQUIVALENT
2. INSTALL ITEM 5 USING PANDUIT CRIMPING TOOL CT550 OR EQUIVALENT
3. TWIST WIRES TOGETHER APPX. 1 TWIST PER 2 INCHES
4. APPLICATIONS: SERVOPRO TO TOSHIBA DRIVE AC POWER



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CHECKED BY J.C.	DATE 5/90
APPROVED BY C.M.E.	DATE 5/90
APPROVED BY WLX	DATE 11/93
MATERIAL ----------	
FINISH ----------	

TITLE: CABLE, MOTOR

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BAIER		DRAWING NUMBER C-806YYY
TOLERANCES: X.X± ----- ANGULAR ± --- ; X.XX± --- ; X.XXX± --	AutoCAD FILE LOCATION G:\CAD\CABLES		
	B	DATE 5/09/90	SCALE ---	SHEET NO. 1 OF 1	REVISION A

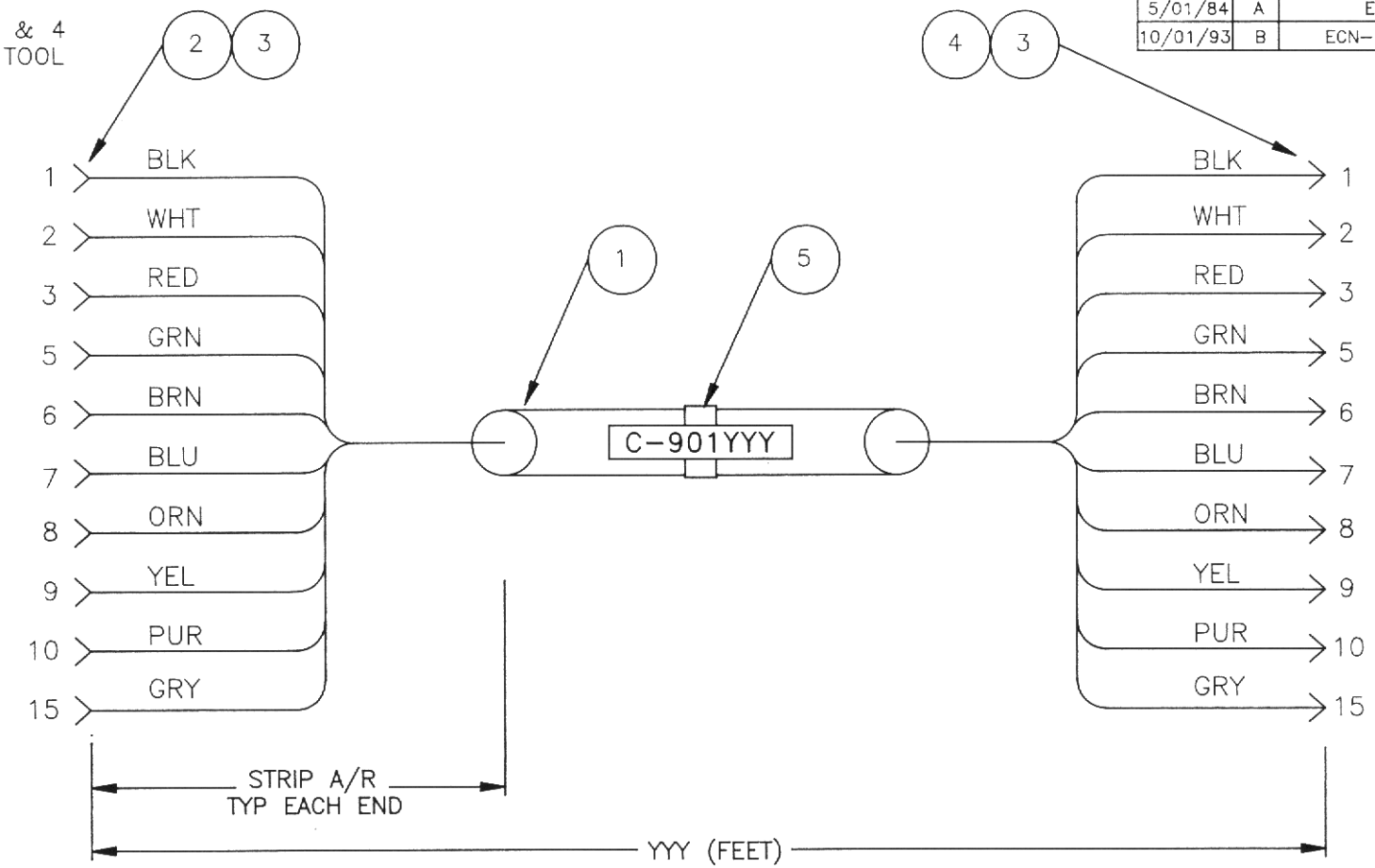
C-901YYY
BILL OF MATERIALS

COMPONENT	REFERENCE	DESCRIPTION
8456	1	CABLE, 10 COND, 22 AWG
745205-3	2	AMP CONNECTOR FEMALE, 15 PIN
206471-1	3	CONNECTOR, HOOD, 15 PIN
745207-3	4	AMP CONNECTOR MALE, 15 PIN
PLM1M	5; MARK C-901 LENGTH IN FEET	CABLE TIE LABEL

NOTES:

1. INSTALL ITEM 2 & 4 USING AMP IDT TOOL OR EQUIVALENT.

DATE	SYM	REVISION RECORD	DR	CK	CK
5/01/84	A	ECN–	SS	ELS	
10/01/93	B	ECN–93–0267	MC	WEJ	



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CHECKED BY J.C	DATE 5/84
APPROVED BY E.L.S.	DATE 5/84
APPROVED BY WEJ	DATE 11/22/93
MATERIAL ----------	
FINISH ----------	

TITLE: COMMUNICATIONS CABLE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY SCOTT STELL		DRAWING NUMBER C-901YYY
TOLERANCES: X.X± ---- X.XX± --- X.XXX± -- ANGULAR ± --	AutoCAD FILE LOCATION G:\CAD\CABLES		
	B	DATE 2/10/83 SCALE ---	SHEET NO. 1 OF 1 REVISION B

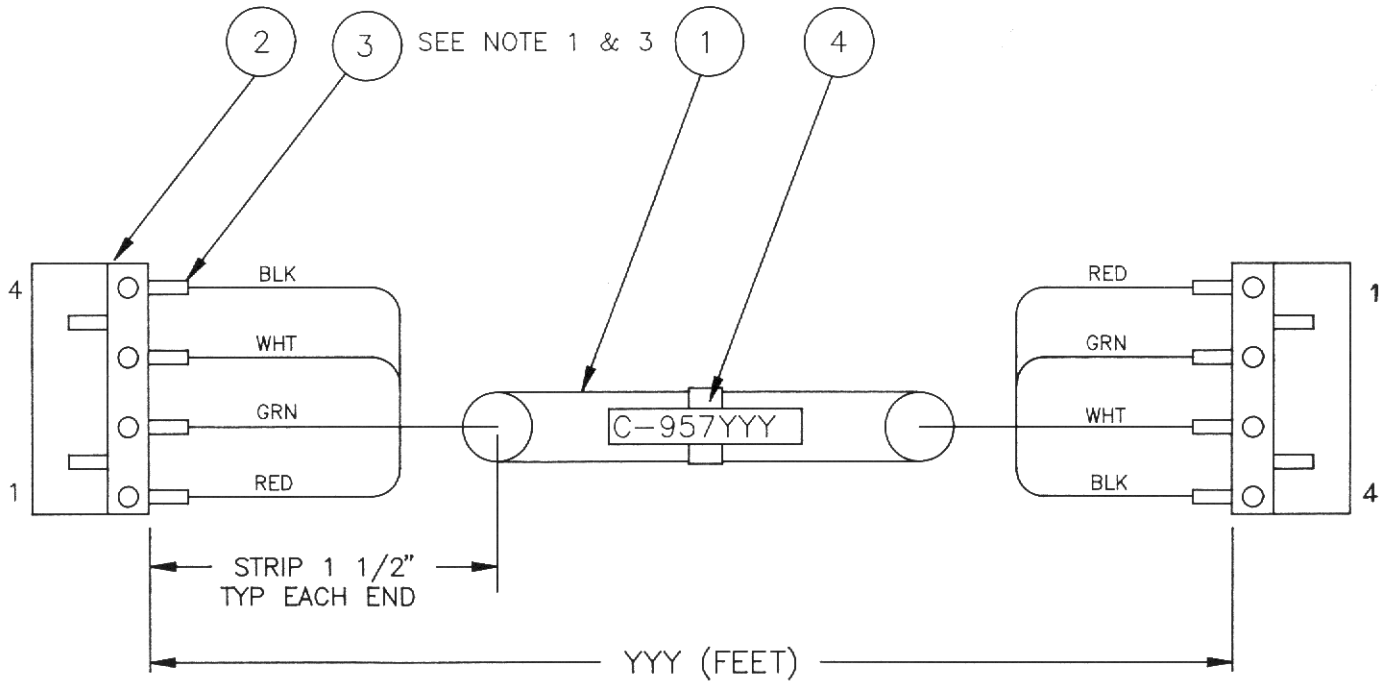
C-957YYY
BILL OF MATERIALS

COMPONENT	REFERENCE	DESCRIPTION
1174	1	CABLE, 4 COND. #22 AWG
25.320.3453.1	2	CONNECTOR, PLUG, 4 PIN
6907.0	3	FERRULE, #20, ORN
PLM1M	4; MARK C-957 LENGTH IN FEET	CABLE TIE LABEL

DATE	SYM	REVISION RECORD	DR	CK	CK
3/89	A	ECN-89-0074	EB	CME	
9/29/93	B	ECN-93-0267	MC	93	WEJ

NOTES:

1. ALTERNATE CONSTRUCTION: STRIP & TIN .25"
2. PIN NUMBERS SHOWN FOR REFERENCE ONLY.
3. CRIMP FERRULES USING WEIDMULLER CRIMP TOOL PZ-4 OR EQUIVALENT.



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CHECKED BY E.B.	DATE 8/89
APPROVED BY C.M.E.	DATE 8/89
APPROVED BY WEJ	DATE 11/22/93
MATERIAL ----------	
FINISH ----------	

TITLE: CABLE COMMUNICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY E. BAIER		DRAWING NUMBER C-957YYY
TOLERANCES: X.X± ---- X.XX± ---- X.XXX± -- ANGULAR ± --	AutoCAD FILE LOCATION G:\CAD\CABLES		
B	DATE 3/13/87	SCALE ---	SHEET NO. 1 OF 1 / REVISION B

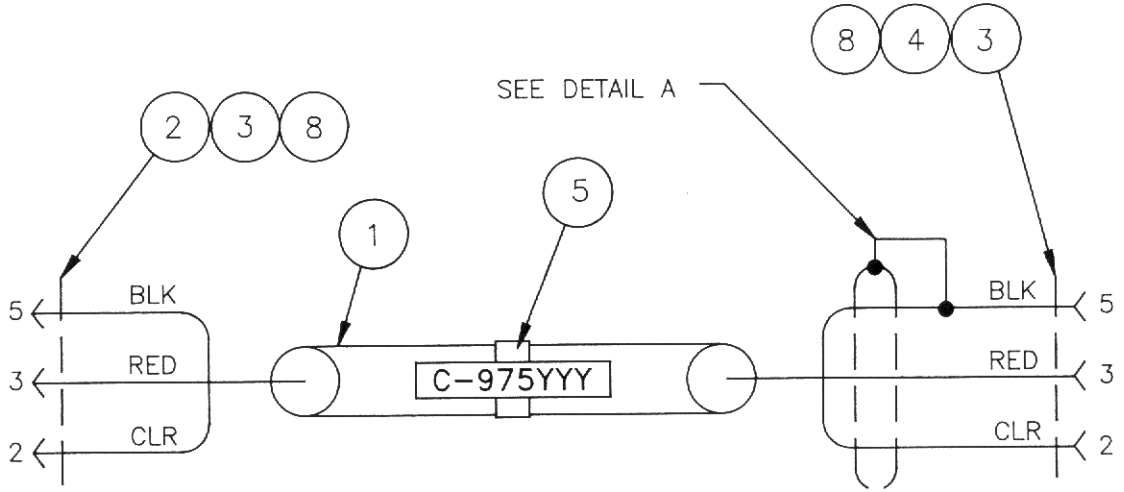
C-975YYY
BILL OF MATERIALS

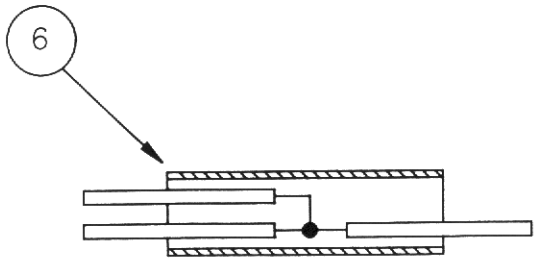
COMPONENT	REFERENCE	DESCRIPTION
8771	1	CABLE, 3 COND SHLD, 22 AWG
745201-3	2	CONNECTOR, FEMALE, 9 PIN
FKH1	3	HOOD, CONNECTOR, 9 PIN D
745203-3	4	AMP CONNECTOR MALE 9 PIN
PLM1M	5; MARK C-975 LENGTH IN FEET	CABLE TIE LABEL
FIT221-3/32	6	HEATSHRINK TUBIN, 3/32 IN
FVS1Y5	8	LOCKING SCREW, USE ON FHKH HOOD

DATE	SYM	REVISION RECORD	DR	CK	CK
5/17/91	A	ECN-91-0052	MFE	JC	EB
4/3/92	B	ECN-92-0061	MFE		
9/29/93	C	ECN-93-0267	MC	WEJ	

NOTES

1. INSTALL ITEMS 2 AND 3 USING AMP IDT TOOL OR EQUIVALENT.





DETAIL 'A'

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CHECKED BY E.B.	DATE 5/91
APPROVED BY J.C.	DATE 5/91
APPROVED BY WEJ	DATE 11/93
MATERIAL ----------	
FINISH ----------	

TITLE: CABLE, COMMUNICATIONS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BAIER		DRAWING NUMBER C-975YYY
TOLERANCES: X.X± ----- X.XX± --- X.XXX± -- ANGULAR ± --	AutoCAD FILE LOCATION G:\CAD\CABLES		
B	DATE 6/15/90	SCALE ----	SHEET NO. 1 OF 1 / REVISION C

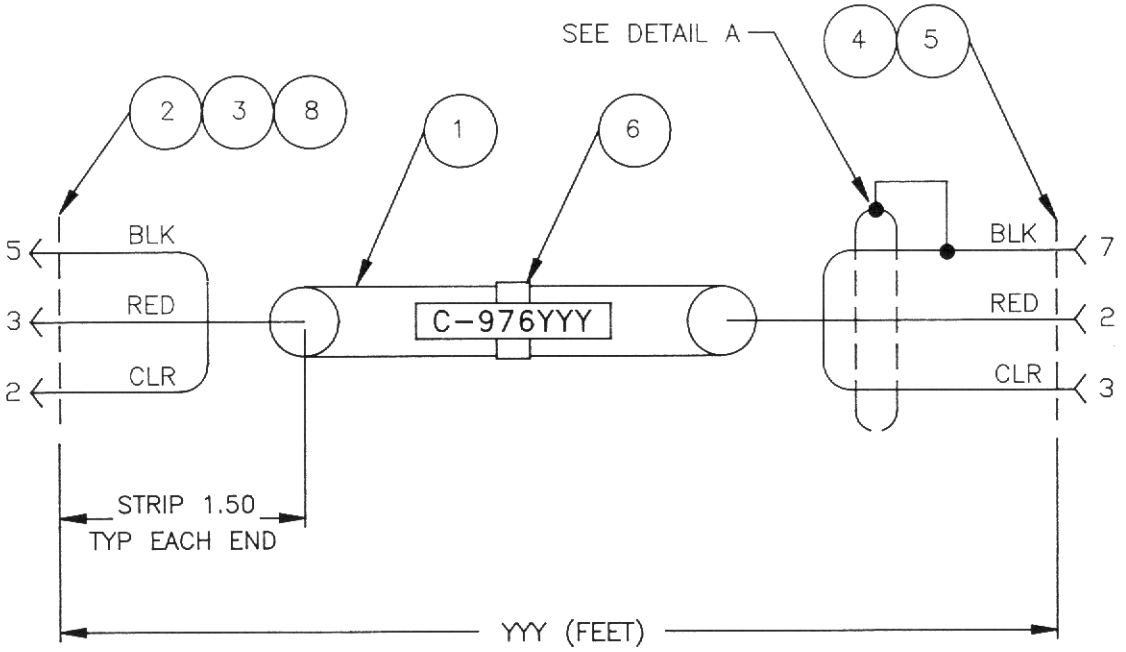
C-976YYY
BILL OF MATERIALS

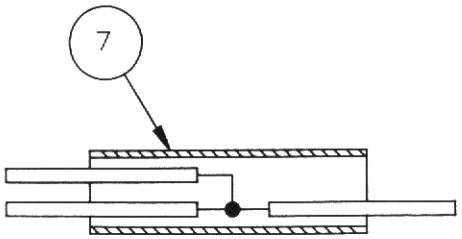
COMPONENT	REFERENCE	DESCRIPTION
8771	1	CABLE, 3 COND SHLD, 22 AWG
745203-3	2	AMP CONNECTOR MALE 9 PIN
FKH1	3	HOOD, CONNECTOR, 9 PIN D
745209-3	4	CONNECTOR, FEMALE, 25 PIN D
745134-1	5	CONNECTOR HOOD, 25 PIN
PLM1M	6; MARK C-976 LENGTH IN FEET	CABLE TIE LABEL
FIT221-3/32	7	HEATSHRINK TUBING, 3/32 IN
FVS1Y5	8	LOCKING SCREW, USE ON FKH HOOD

NOTES:

1. INSTALL ITEM 2 & 4 USING AMP IDT TOOL OR EQUIVALENT.

DATE	SYM	REVISION RECORD	DR	CK	CK
11-3-90	A	ECN-90-0216	EB	JTF	JC
5-17-91	B	ECN-91-0052	MFE		
12/21/92	C	ECN-92-0343	MFE	EB	JC
9/29/93	D	ECN-93-0267	MC	WE	





DETAIL 'A'

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CHECKED BY J.T.F.	DATE 11/90
APPROVED BY J.C.	DATE 11/90
APPROVED BY E.B.	DATE 12/92
MATERIAL ---------	
FINISH ---------	

TITLE: COMMUNICATIONS CABLE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES
X.X± ----
X.XX± ----
X.XXX± --
ANGULAR ± --

DRAWN BY: MIKE E.
AutoCAD FILE LOCATION: G:\CAD\CABLES

DRAWING NUMBER: C-976YYY

B | DATE 6/15/90 | SCALE ---- | SHEET NO. 1 OF 1 | REVISION D

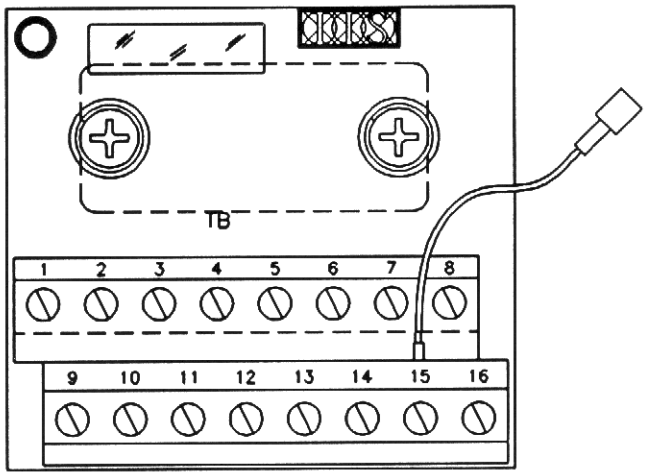
MINIMUM RECOMMENDED WIRE GUAGES

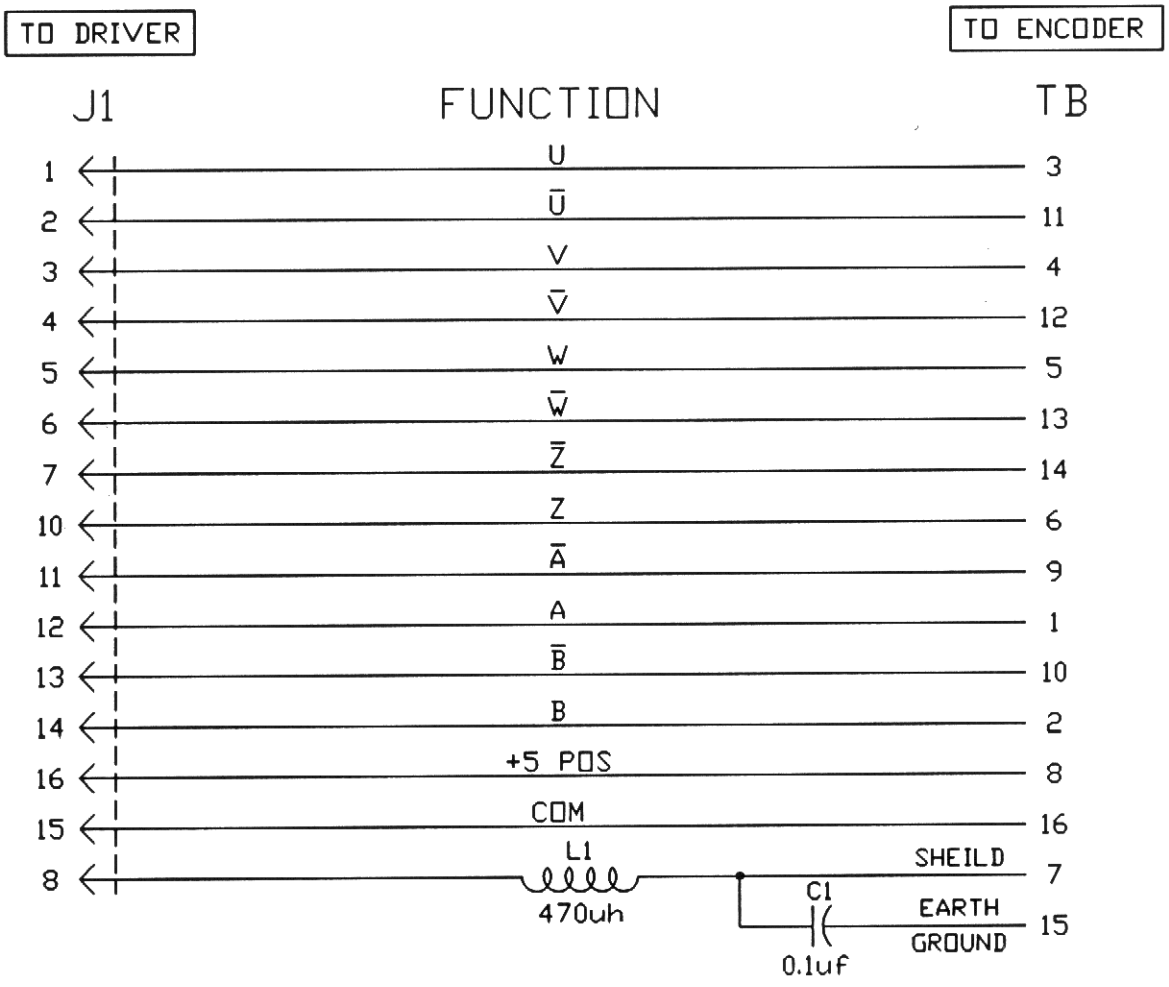
MOTOR/DRIVE	MOTOR CABLE	SERVO BUS POWER	CONTROL POWER	EARTH GROUND (E)	ENCODER CABLE
SERVOPRO-R400I	14 AWG (3.5 mm^2)	14 AWG (3.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)
SERVOPRO-R750I	14 AWG (3.5 mm^2)	14 AWG (3.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)
SERVOPRO-R1000I	14 AWG (3.5 mm^2)	14 AWG (3.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)
SERVORPO-R1500I	14 AWG (3.5 mm^2)	14 AWG (3.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)
SERVOPRO-R2000I	14 AWG (3.5 mm^2)	14 AWG (3.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)
SERVOPRO-R3000I	12 AWG (3.5 mm^2)	12 AWG (3.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)
SERVOPRO-R3700I	12 AWG (5.5 mm^2)	12 AWG (5.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)
SERVOPRO-M3700I	12 AWG (5.5 mm^2)	12 AWG (5.5 mm^2)	16 AWG (2.2 mm^2)	12 AWG (5.5 mm^2)	24 AWG (.2 mm^2)

CAUTION

WHEN SELECTING THE ENCODER CABLE BE SURE TO USE A LOW CAPACITANCE CABLE WITH A BRAIDED OVERALL SHIELD. (CONDUCTOR RESISTANCE PER FOOT X CABLE

AC-100095 CABLE ADAPTOR





NOTES

APPENDIX G
INSTALLATION OF MOUNTING HARDWARE

As shipped from Industrial Indexing Systems, the ServoPro-I drive module has the mounting hardware for the command module assembled to it. If the mounting hardware is not attached, such as when replacing the drive module, the mounting hardware must be assembled to the drive module to allow mounting of the command module.

Follow the procedures in this appendix for mounting the hardware to the drive module. Refer to **"Section 2 - Installation"** for command module mounting instructions and input/output connector wiring instructions.

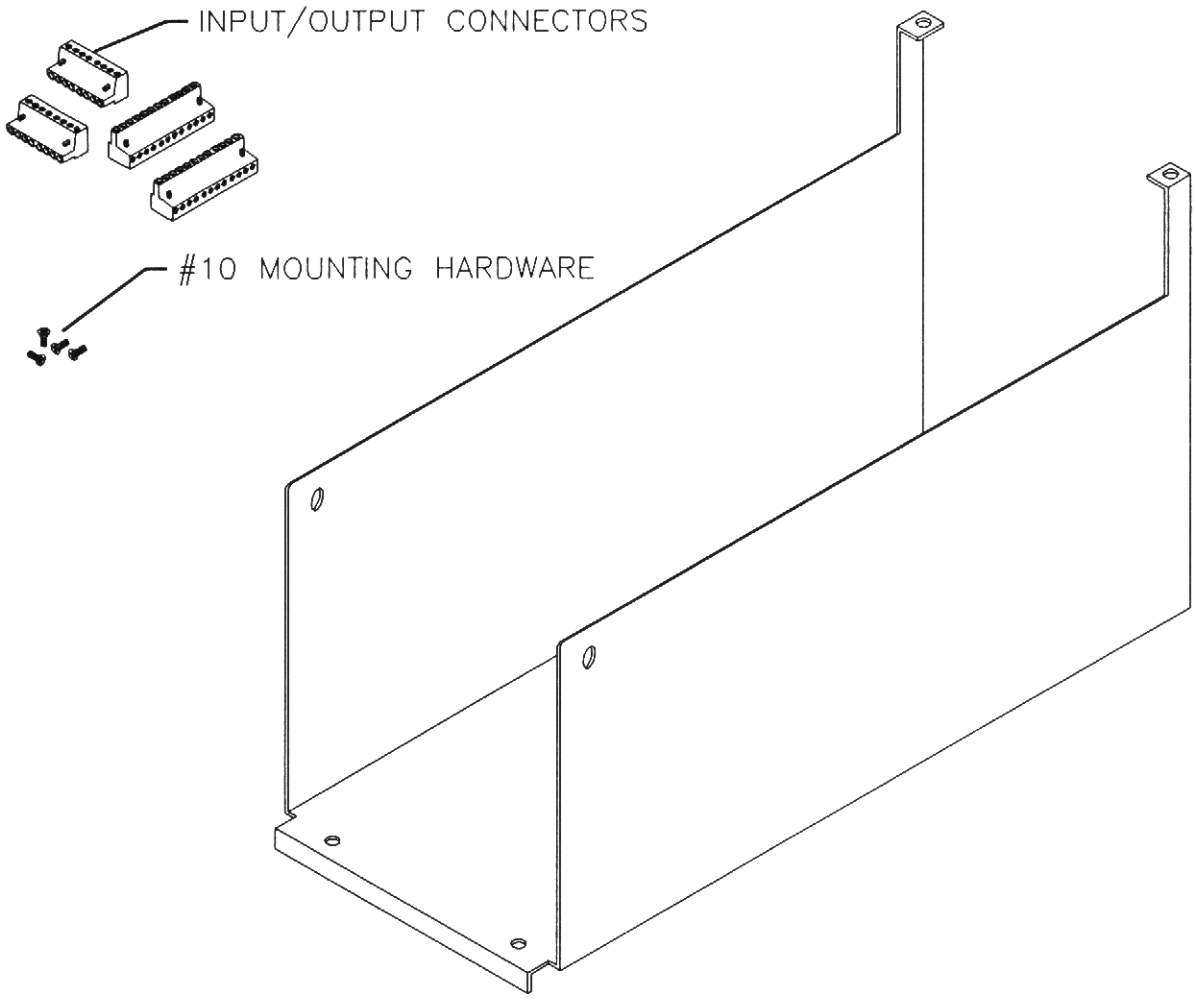


Figure G.1 - Drive Module Hardware Package Contents

1. Align shoulder screws with their mates at the bucket sides.

2. Fasten shoulder screws until the tab begins bending and STOP, DO NOT OVERTIGHTEN.

3. Attach the other end of the opening protector cord to the screw provided at the right side of the bucket (refer to **Figure G.2**).

4. Close ServoPro-I command module and tighten quarter turn screws.

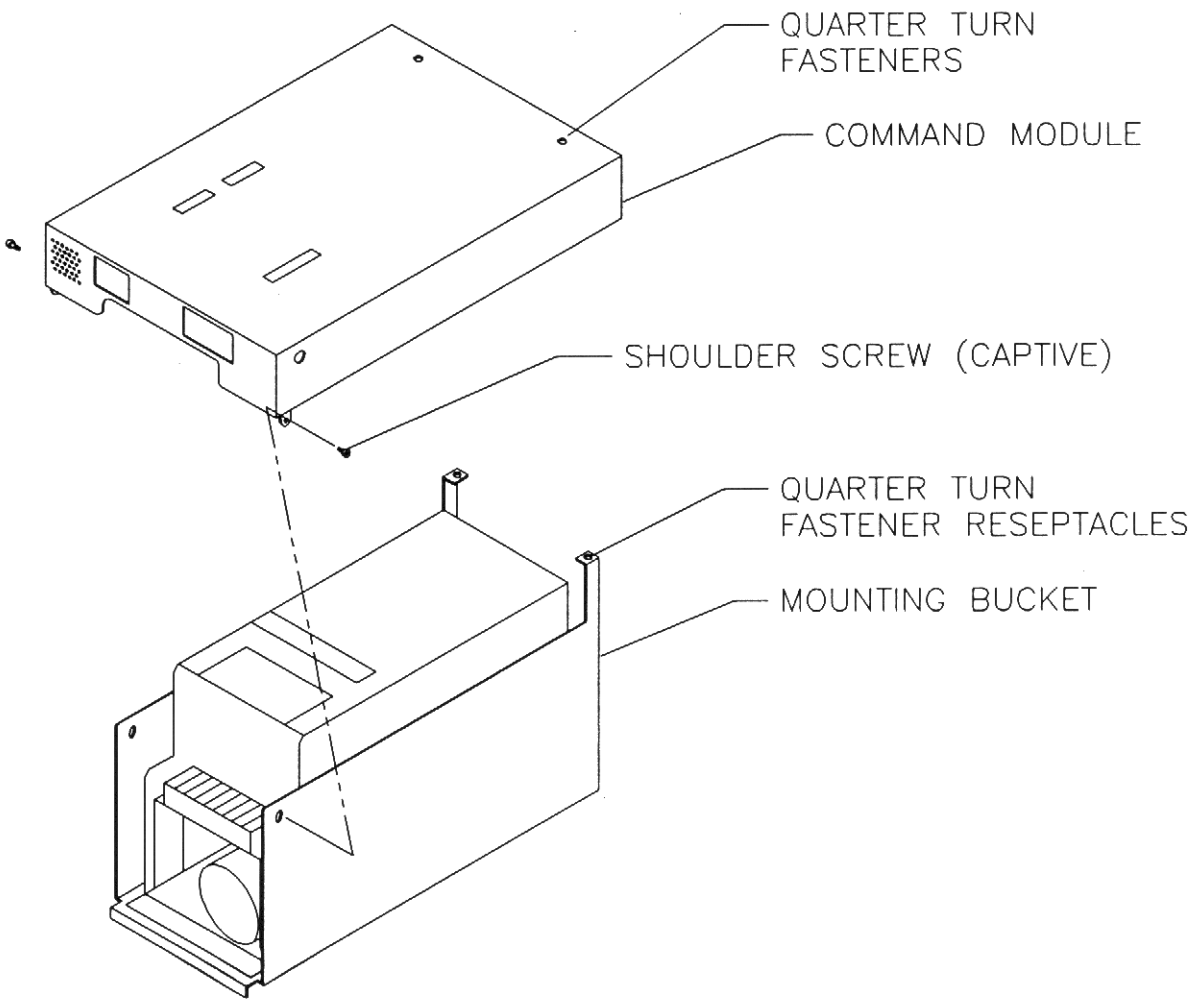


Figure G.2 - Controller Exploded-View Assembly

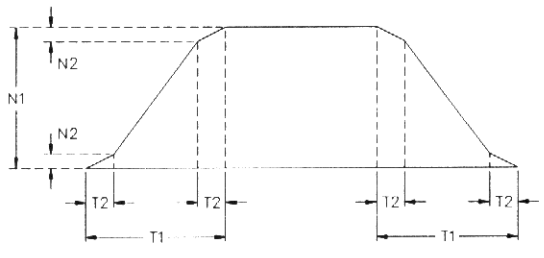
APPENDIX H
SYSTEM PARAMETERS

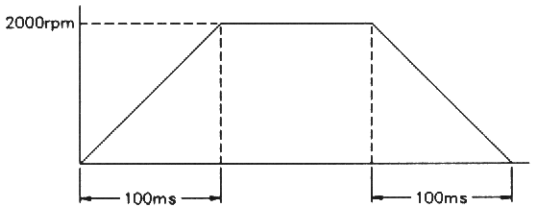
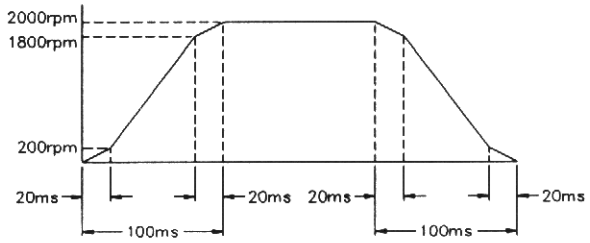
Parameter name	Valid mode	Contents of parameter	Default settings
Control type 1 C t r L	ALL	Parameter selection: S P d, P o S Used to select basic mode of operation of drive. Select S P d for SCM, TCM or EPLM modes. Select P o S for IPLM.	S P d
Control type 2 C H G	SCM, TCM, EPLM	Parameter selection: P o S, t r q Used to further select mode of operation if C t r L = S P d. Select P o S for SCM or EPLM modes. Select t r q for TCM. Hardware input CN9-34 is used to further select drive operation as follows: When C H G = P o S & CN9-34 = open; the drive is in SCM or EPLM depending on other parameters and hardware inputs. When C H G = P o S & CN9-34 = connected to signal common; the drive is in position lock of SCM mode. When C H G = t r q & CN9-34 = connected to signal common; the drive is in TCM mode. When C H G = t r q & CN9-34 = open; the drive is in SCM or EPLM.	P o S
Auto tuning enable A U t o	SCM, TCM, IPLM	Parameter selection: y or n Automatically sets three parameters of speed loop gain: S P G, S I G and A H G. See **Section 2** for details on automatic tuning.	n
Auto tuning movable range t U r n	SCM, TCM, IPLM	Parameter value range: 0 0 0 0 - 0 0 5 0 Revs Used to set the number of motor-shaft revolutions when performing automatic tuning. The motor turns in both directions within the range set.	0 0 1 0
Auto tuning rotation speed o t o P	SCM, TCM, IPLM	Parameter value range: 0 0 0 0 - 2 0 0 0 Used to set motor rpm when performing automatic tuning. The motor turns in both direction at the set speed.	0 5 0 0

Parameter name	Valid mode	Contents of parameter	Default settings
Auto tuning response level r E S P	SCM, TCM, IPLM	Parameter value range: 1,2,3 This sets the target response level for automatic tuning. 1. High response (motor step response guideline, 20mS) 2. Medium response (motor step response guideline, 30mS) 3. Low response (motor step response guideline, 40mS)	0 0 0 3
Forward/ reverse type F / r	SCM, EPLM	Parameter selection: S r F, F - r Used to select the direction of motor-shaft rotation. When S r F is selected, motor direction is determined by polarity of voltage used in external analog speed command. Voltage polarity and motor direction are determined by S P o L. When F - r is selected: motor direction is determined by user settings for Forward start or Reverse start control inputs. Voltage polarity of analog speed command is ignored. F/r must be set to SrF for EPLM.	S r F
Analog command polarity S P o L	SCM, TCM, EPLM	Parameter selection: P, n Used to set polarity of analog command input. When S P o L is P positive voltage on analog command input results in CCW rotation or CCW torque depending on mode of operation. Negative voltage is CW. When S P o L is n positive voltage on analog command input results in CW rotation or CW torque depending on mode of opeartion. Negative voltage is CCW. S P o L must be set to P for EPLM.	P

Parameter name	Valid mode	Contents of parameter	Default settings
Speed loop gain S P G	SCM, EPLM, IPLM	Parameter value range: 0 0 0 . 0 - 9 9 9 . 9 Used to set proportional gain for the speed control loop. The greater the value, the faster the response. However, too rapid a response results in unstable control. See **Section 2.6.1** for details about optimum settings.	xxxx
Speed loop integral gain S I G	SCM, EPLM, IPLM	Parameter value range: 0 . 0 0 0 - 9 . 9 9 9 Used to set integral gain for the speed control loop. The greater the value, the faster the response. However, too rapid a response results in unstable control. See **Section 2.6.1** for details about optimum settings.	xxxx
Speed loop differential gain A H G	SCM, EPLM, IPLM	Parameter value range: 0. 0 0 0 - 1. 0 0 0 Used to set differential gain for the speed control loop. The greater the value, the better the response in case of a disturbance. However, too greater a value results in unstable control. See **Section 2.6.1** for details about optimum settings.	xxxx
Speed command offset S o F S	SCM, EPLM	Parameter value range: +0 1 0 0 / -0 1 0 0 rpm Used to set offset of analog speed command.	0 0 0 0
Speed command scaling S S C L	SCM, EPLM	Parameter value range: 0 4 2 0 - 4 2 0 0 rpm Used to set command speed for a 10 VDC command input.	2 0 0 0
Speed limit level S L L	ALL	Parameter value range: 0 0 1 0 / 2 1 0 0 rpm Used to limit the motor's speed.	2 0 0 0
Speed command 1 S 1	SCM	Parameter value range: 2 0 0 0 / -2 0 0 0 rpm Used to set the command speed "Speed 1". If the speed limit level has been set, the speed is limited to that level. This value is selected as the speed command only after control input pin "speed 1" has been connected to signal common (CN9-36).	0 0 0 0

xxxx Default parameter value depends on motor/drive size. See **Appendix D** for default settings.

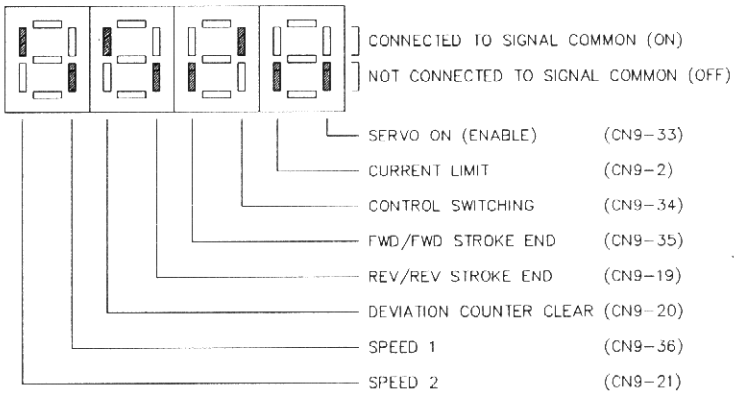
Parameter name	Valid mode	Contents of parameter	Default settings
Speed command 2 S 2	SCM	Parameter value range: 2 0 0 0 / -2 0 0 0 rpm Used to set the command speed "Speed 2". If the speed limit level has been set, the speed is limited to that level. This value is selected as the speed command only after control input pin "speed 2" has been connected to signal common (CN9-21).	0 0 0 0
Acel/Decel shape t Y P E	SCM	Parameter selection: S o F t, H A r d Used to select linear or Quasi-S-shaped acceleration/deceleration rate. Select: H A r d for linear shape Select: S o F t for Quasi-S-shaped	H A r d
Acceleration/ deceleration time A d t	SCM	Parameter value range: 0 0. 0 0 / 3 0. 0 0 sec Used to set the total time for the acceleration/deceleration rate when selecting the internal speed setting.	0 0. 0 0
Quasi-S-shaped acceleration/ deceleration rate S r A t	SCM	Parameter value range: 0 1 0. 0 / 0 4 0. 0 % Used to set the speed change point for the S-shaped acceleration/deceleration. The change acel/decel rate speed setpoint is specified as S r A t % of command speed S1, S2 or analog input.	0 1 0. 0
Quasi-S-shaped acceleration/ deceleration time t r A t	SCM	Parameter value range: 0 1 0.0 / 0 4 0. 0 % Used to set the speed change time for the S-shaped acceleration/deceleration. The change acel/decel rate time setpoint is specified as t r A t % of total acel/decel time A d t.  N1 = S 1, S 2 or Analog speed command N2 = N1 * S r A t / 100 T1 = A d t T2 = T1 * t r A t / 100	0 1 0. 0

Parameter name	Valid mode	Contents of parameter	Default settings
Note: Acceleration/deceleration shape and time can be set by means of parameters type S r A t, t r A t and A d t. Linear acc/dec  Speed command: 2000 rpm t Y P E : H A r d A d t : 0 0. 1 0 Quasi-S-shaped acc/dec  Speed command: 2000 rpm t Y P E : S o F t A d t : 0 0. 1 0 t r A t : 0 2 0. 0 S r A t : 0 1 0. 0			
Low speed signal output level L o S L	ALL	Parameter value range: 0 0 0 0 / 0 1 0 0 rpm Used to set the speed for outputting low speed signal CN9-38.	0 0 3 0
Speed reach signal output condition r C H	SCM, EPLM	Parameter selection: C n S t, S r F This is used to set conditions for outputting the speed reach signal CN9-23. C n S t: The speed set by the parameter "speed reach signal output level" is used as the speed reached value. S r F: This is invalid when in the TCM. When in the SCM, the analog speed command is used as the speed reached value.	C n S t
Speed reach signal output level r C H L	SCM, EPLM	Parameter value range: 0 1 0 0 / 2 0 0 0 rpm This setting is valid when the parameter "speed reach signal output condition" is set to C n S t.	2 0 0 0

Parameter name	Valid mode	Contents of parameter	Default settings
Position loop gain P P G	SCM, IPLM	Parameter value range: 0. 0 0 0 / 9. 9 9 9 Used to set proportional gain for the position control loop. The greater the value, the faster the response. However, too high a value results in unstable control.	0. 0 0 0
Position command scaling P S C L	IPLM	Parameter value range: 0 1 0 0 / 4 0 0 0 Used to set the number of command pulses per motor-shaft revolution. This parameter should be set according to the required positioning resolution and speed reduction ratio of the machine. Motor travel (rev.) = Command pulse number (p) / PSCL Motor speed (rps) = Command pulse frequency (pps) / PSCL	2 0 0 0
Positioning completed signal output condition n P	IPLM	Parameter selection: n H y S, H y S Used to select output condition for sending the completed signal CN9-23. n H y S: Positioning completed signal immediately goes off when position error pulse exceeds positioning completed range, and comes on when it returns within the range. H y S: Positioning completed signal goes off when position error pulse exceeds positioning completed range by 10 pulses, and immediately comes on when it returns within the range.	n H y S
Positioning completed range n P r	IPLM	Parameter value range: 0 0 0 0 / 9 9 9 9 pulses Positioning completed signal CN9-23 is output when position error enters positioning completed range.	0 0 0 0

Parameter name	Valid mode	Contents of parameter	Default settings
Current limit command condition C L	ALL	Parameter selection: o U t, I n The MDPAK7 driver has the ability to limit the maximum motor current (torque). The limit can be set internally by setting parameter CL = In and then programming PCLL and nCLL to a percent of rated current (torque). If CL = oUT the current (torque) is limited using an external analog voltage. Parameter current limit: I n External current limit command: o U t	I n
Positive current limit level (CCW) P C L L	ALL	Parameter value range: 0 0 0 0 / 0 2 6 0 Positive current limit value, if C L = I n.	0 2 6 0
Negative current limit level (CW) n C L L	ALL	Parameter value range: 0 0 0 0 / 0 2 6 0 Negative current limit value, if C L = I n.	0 2 6 0

MONITOR DISPLAY FUNCTIONS

Parameter name	Valid mode	Contents of parameter	Default settings
Speed reference display S r F	ALL	Parameter value range: 4 0 0 0 / -4 0 0 0 rpm Displays the commanded or reference speed into the drive. Speed display is in RPM with (-) being CW.	S S S S
Actual speed display S P d	ALL	Parameter value range: 4 0 0 0 / -4 0 0 0 rpm Displays actual motor speed in rpm with (-) being CW.	S S S
Motor torque command t r q	ALL	Parameter value range: 2 6 0 % / -2 6 0 % Displays instantaneous torque being commanded to motor (-) is CW.	T T T
Input signal monitor S E q	ALL	Used to monitor the on/off state of control input signals.  	8 8 8 8
Position display P d I S	ALL	Parameter value range: -9 9 9 9 / 9 9 9 9 Motor position is displayed on LED monitor. The number is reset to 0 0 0 0 when power is applied. The value increases as the motor-shaft turns CCW, and decreases as it turns CW.	PPPP
Analog monitor output A o U t	EPLM	Parameter selection: S P d, t r q Used to select the signal to be applied to analog monitor output (see **Section 2.6.2**). S P d: Speed feedback signal t r q: Current command signal	S P d

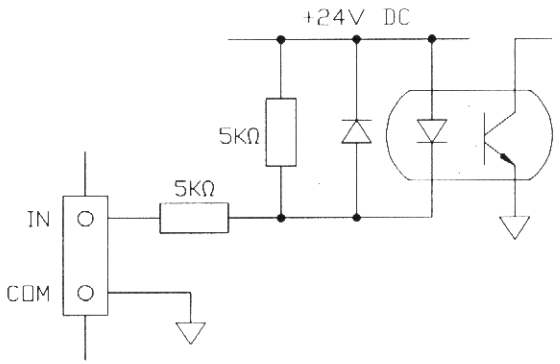
Parameter name	Valid mode	Contents of parameter	Default settings
Fault history F L T	ALL	Parameter values: Fault code Used to display the last fault recorded. See **Section 5.1.1** for Fault codes.	F F F
Step operation cycle S t E P	ALL	Parameter value range: 0 0 0 0 / 0 0 6 3 If a value other than 0 0 0 0 is set to this parameter, forward or reverse motor-shaft revolution immediately starts as Servo on CN9-33 is turned on, at the internally set speed or the speed set by means of the external analog speed command CN9-16. S t E P parameter is move time where t(sec) = S t E P * .25. This parameter is not stored in the system's memory, even if [Set] is pressed.	0 0 0 0
P r F L	ALL	Position Command (Low Part)	0 0 0 0
P r F H	ALL	Position Command (High Part)	0 0 0 0

NOTES

APPENDIX I
INTERFACING CIRCUITS

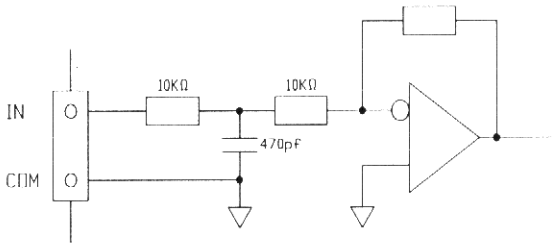
I. CONTROL INPUT CIRCUIT

MAX VOLTAGE OPEN: 25 VDC
MAX CURRENT "ON": 5 MA
MAX "ON" VOLTAGE: 2 VDC
MIN "OFF" VOLTAGE: 22 VDC



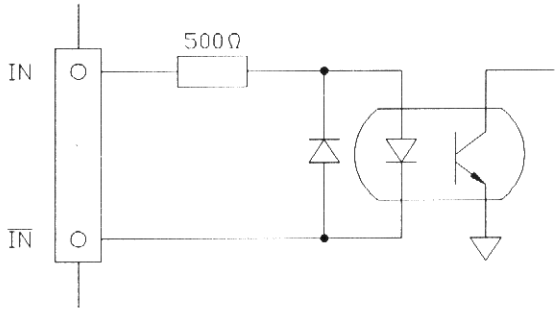
II. ANALOG COMMAND INPUT CIRCUIT

MAX INPUT VOLTAGE: ±10 VDC
INPUT RESISTANCE: 20 KΩ



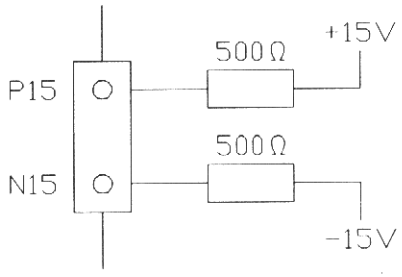
III. PULSE COMMAND INPUT CIRCUIT

MAX INPUT CURRENT: 15 MA
MIN INPUT CURRENT "ON": 5 MA
MAX INPUT CURRENT "OFF": 0.1 MA



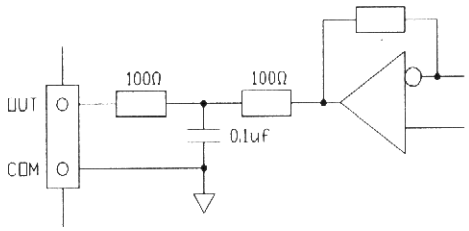
IV. POWER SUPPLY FOR ANALOG COMMAND

OPEN CIRCUIT VOLTAGE: ±15 VDC ±5%
MAX LOAD CURRENT: 10 MA



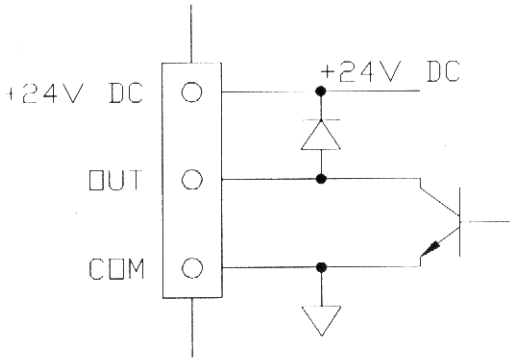
V. ANALOG MONITOR CIRCUIT

MAXIMUM OUTPUT VOLTAGE: ±10 VDC
MAXIMUM OUTPUT CURRENT: 5 MA



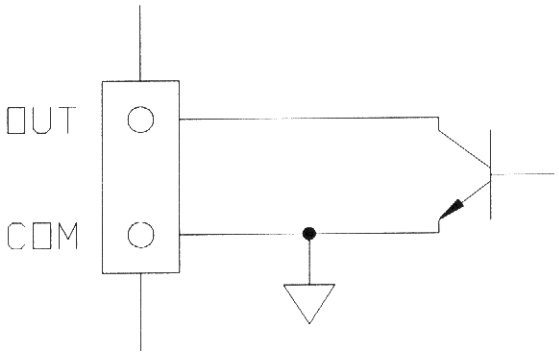
VI. CONTROL OUTPUT CIRCUIT

MAXIMUM VOLTAGE: 24 VDC
MAXIMUM CURRENT: 50 MA
MAXIMUM "OFF" LEAKAGE: .1 MA

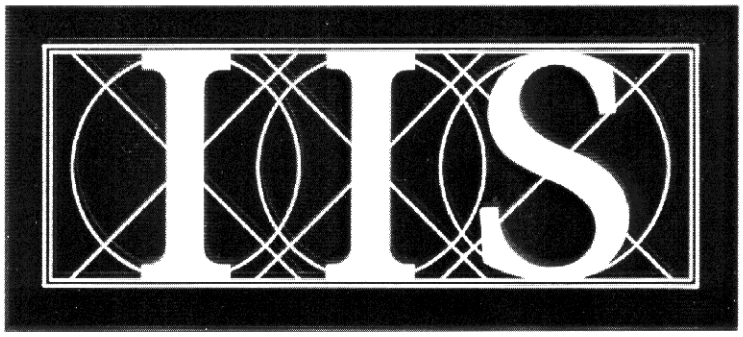


VII. FAULT CODE OUTPUT CIRCUIT

MAXIMUM VOLTAGE: 24 VDC
MAXIMUM CURRENT: 50 MA
MAXIMUM "OFF" LEAKAGE: 0.1 MA



IB-15B005



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