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Model 5240 INSTRUCTION MANUAL
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SECTION 1

INTRODUCTION

WARNING - DANGEROUS VOLTAGES

VOLTAGE LEVELS WITHIN THIS PRODUCT CAN EXCEED 120 VAC AND 50 VDC. THESE VOLTAGE LEVELS CAN CAUSE SERIOUS INJURY OR BE FATAL, THEREFORE FOLLOW GOOD ELECTRICAL PRACTICES, APPLICABLE ELECTRICAL CODES AND THE CONTENTS OF THIS MANUAL.

1.1 General

This manual outlines Installation/Set-up, Programming, Troubleshooting, and Maintenance procedures for Pacific Scientific's Model 5240 Stepping Motor Indexer/Driver Package. It also contains specifications for the 5240.

This package is designed for use with Pacific Scientific's SIGMA Line of hybrid stepping motors. The package will control either the standard SIGMA Line hybrid stepping motors or the high-performance SIGMAX enhanced hybrid stepping motors. These motors are two phase.

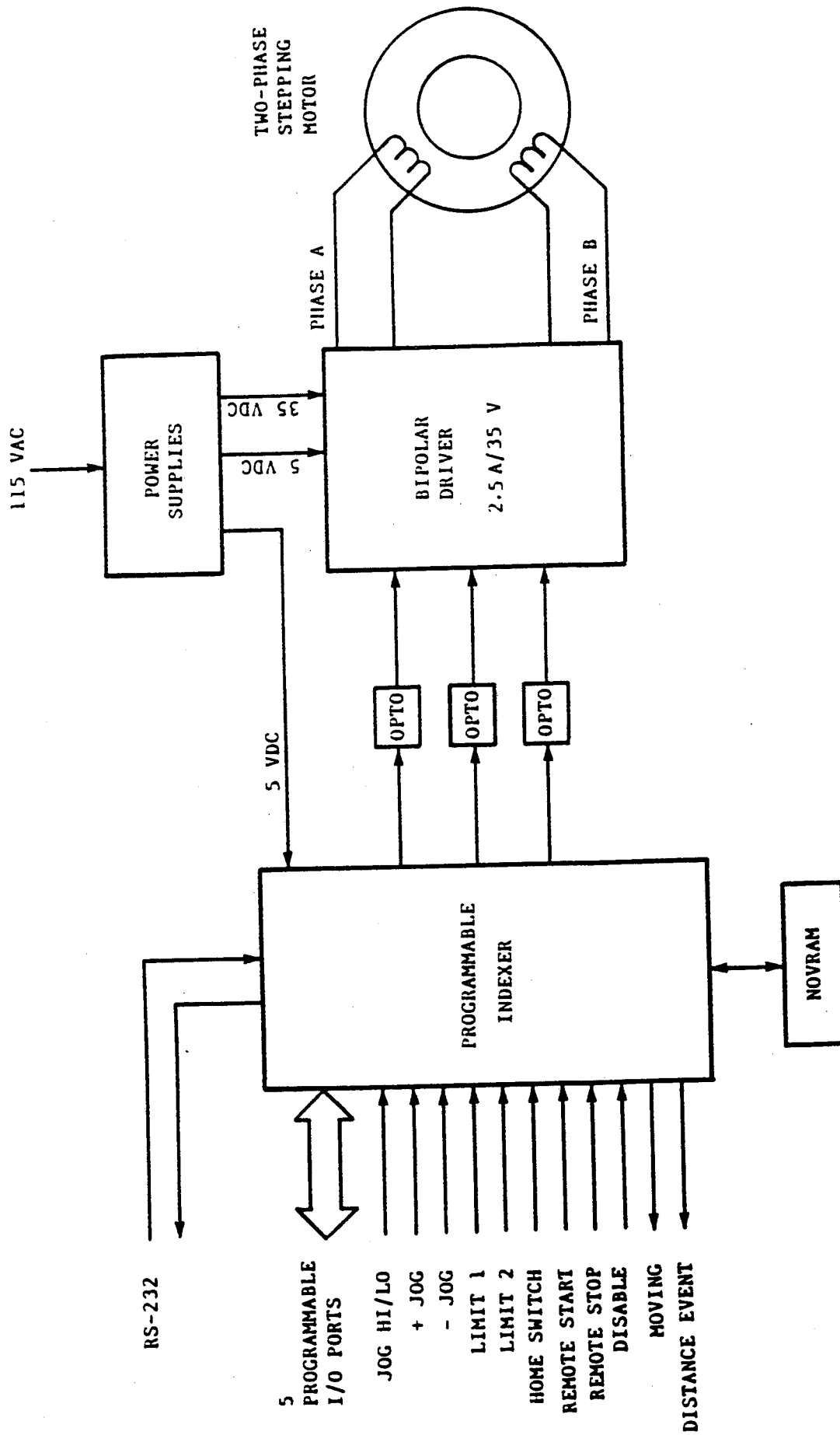
1.2 Overview of Operation

Figure 1.1 is a functional block diagram of the 5240. The package contains a programmable indexer, two phase bipolar chopper driver, and all necessary power supplies.

The driver is a two-phase, bipolar configuration. High-frequency chopper current control is obtained by using MOSFET transistors. The output is rated for 2.5 A per phase at 35V. Idle current reduction is switch selectable and will reduce the output current to 1.25 A if no motion occurs for 0.1 seconds. The driver incorporates full short-circuit protection. Optical isolation separates the driver from the indexer to provide better noise immunity and prevent ground loops.

Pulse and direction information for the driver are generated by the indexer. The indexer is programmed via an RS-232 serial port and 256 bytes of non-volatile memory are provided for program storage. Baud rate for the RS-232 is selectable via three jumpers.

Dedicated I/O is provided along with user programmable I/O. The dedicated I/O includes Jog control inputs, Remote Stop and Go inputs, Limit and Home switch inputs, and Status outputs. The programmable I/O consists of five bidirectional ports.



FUNCTIONAL BLOCK DIAGRAM

FIGURE 1.1

The 5240 operates directly off a 115 VAC line. A built-in transformer provides isolation from the line. The internal power supplies generate 5 VDC and 35VDC for the driver. A separate 5VDC supply, isolated from the driver supplies, provides power for the indexer and the I/O.

The 5240 can be operated in either programmed mode or immediate mode. In immediate mode, commands are executed as soon as they are received. In programmed mode, commands are stored in the non-volatile memory and are executed by "running" the program.

The set of commands is diverse and allows the user to program a wide range of motion profiles. The commands include both incremental and absolute position moves with trapezoidal velocity profiles. The acceleration/deceleration and maximum velocity parameters are user programmable. A constant velocity command is also available.

Conditional and unconditional jump commands allow looping. The programmable I/O allows the indexer to interface to other pieces of equipment such as programmable controllers or limit switches.

A homing command allows the user to incorporate a home limit switch into their equipment for use as an absolute mechanical reference point.

1.3 Features

- RS-232 serial communications port
- Microprocessor-based design
- Non-volatile memory for program storage
- Five programmable bidirection I/O ports
- Transformerless, direct 115 VAC line operation
- Optical isolation for improved noise immunity
- Integrated package for ease of installation and use

SECTION 2
SPECIFICATIONS

2.1 General

Step Size:	Full or Half
Velocity:	3 steps/minute to 10,000 steps/sec
Distance:	65,535 full steps for incremental move ±32,767 full steps for absolute move
Initial Velocity:	0 to 2550 steps/sec
Direction:	+ or -
Jog Lo Speed:	30 to 2,550 steps/sec
Jog Hi Speed:	300 to 2,550 steps/sec
Wait Time:	0 to 65,535 milliseconds (65.5 seconds)
Serial Interface:	
Type	RS-232
Baud Rate	300,600,1200,1800,2400,4800,9600 (Jumper Selectable)
Parity	None
Data Word	10 bit (8 data, 1 start, 1 stop)

2.2 Electrical

Input Voltage	115 VAC (±10%), single phase, 60 Hz
Input Current	1 A
Bus Voltage	35 VDC (nominal)
Output Phases	2
Output Current	2.5 A per phase 1.25 A per phase with idle current reduction active
Chopper Frequency	17 kHz

2.3 Environmental

This unit is of "open frame" design and is intended to be placed within a cabinet. The cabinet should be ventilated by filtered or conditioned air to prevent the accumulation of dust and dirt on the unit's electronic components. The air should also be free of corrosive or electrically conductive contaminants.

The unit is cooled by natural convection. To insure proper cooling, maintain the spacing recommendations outlined in Section 3.2. Also sufficient air flow must be maintained to keep the cabinet's internal ambient temperature within the unit's ratings given the power dissipation estimates listed in Section 2.5.

The following specifications apply to the 5240 package:

OPERATING TEMPERATURE	0°C to 50°C
HUMIDITY	10% to 90%, non-condensing
ALTITUDE	1500 Meters (5000 Feet)
STORAGE TEMPERATURE	-55°C to 70°C

2.4 Mechanical

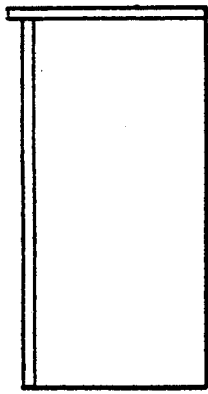
Figure 2.1 shows the mechanical outline of the 5240. Three slots are provided for mounting the unit on a vertical surface. The unit must be mounted vertically to insure proper cooling. The unit weighs approximately 6 pounds and should be mounted accordingly.

All interface signals to the unit are made via plug-in connectors. I/O signals are interface via the top connector J1 which is a male DB-25 connector. The RS-232 connector, J2, is a female DA-9. Motor connections are made to connector J3 which is a plug-in, screw terminal connector. Connector J4 located at the bottom of the front panel is also a plug-in, screw terminal connector and used for 115 VAC power input.

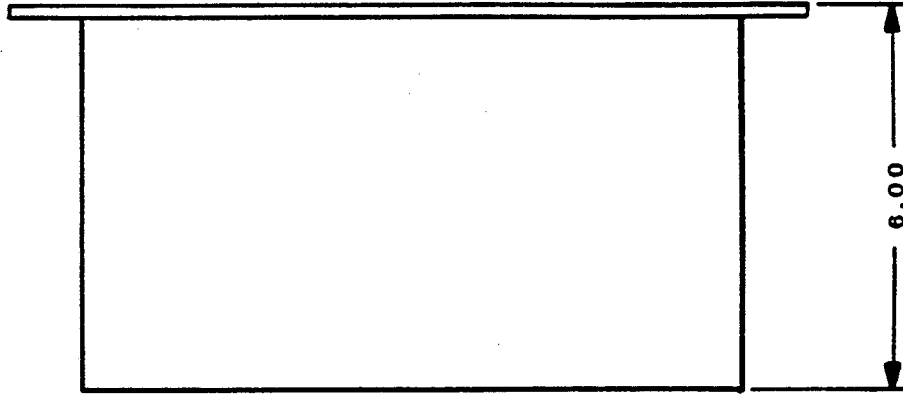
2.5 Power Dissipation

The power dissipated by the 5240 is a function of its power output. The output power is approximately proportional to the stepping motor speed. The power dissipated by the 5240 at zero speed and maximum speed are given below to aid in calculating the power losses generated by the 5240 in an application.

Zero Speed	20 watts dissipated
Maximum Speed	40 watts dissipated

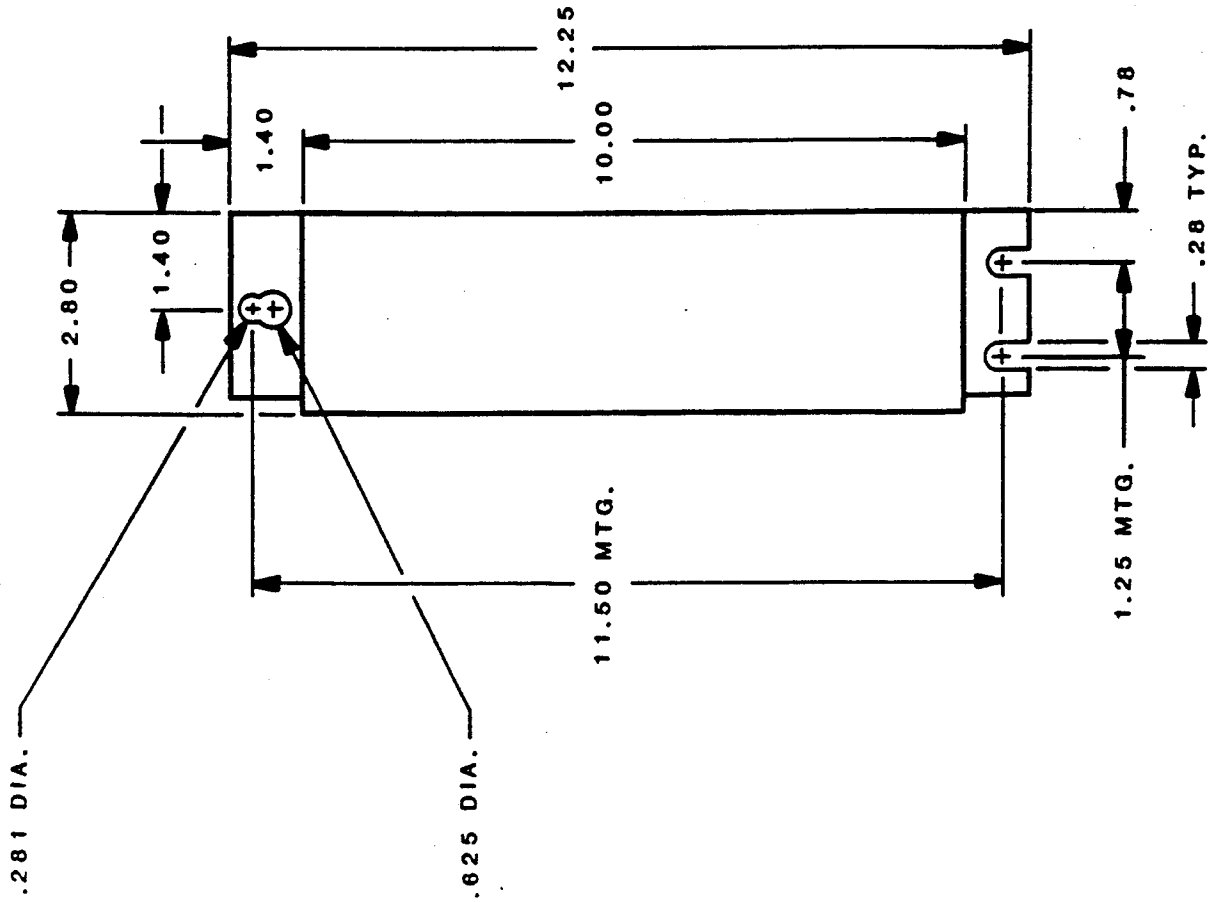


TOP VIEW



SIDE VIEW

FRONT VIEW



MECHANICAL
OUTLINE

FIGURE 2.1

SECTION 3

INSTALLATION/SET-UP

Due to the wide variety of uses for the 5240, it is the responsibility of the user or those applying the unit to determine the suitability of this product for any intended application. In no event will Pacific Scientific Company be responsible or liable for indirect or consequential damage resulting from the use of this product.

The figures, tables, and examples shown in this manual are intended solely to supplement the text. Because of the varied requirements of any particular application, Pacific Scientific Company cannot assume responsibility or liability for actual use based upon the illustrative uses and applications included in this manual.

WARNING

DANGEROUS VOLTAGES, CURRENTS, TEMPERATURES, TORQUES, FORCES, AND ENERGY LEVELS CAN EXIST IN THE PRODUCT AND ITS ASSOCIATED STEPPING MOTOR. EXTREME CAUTION AND CARE SHOULD BE EXERCISED IN THE APPLICATION OF THIS EQUIPMENT. ONLY QUALIFIED INDIVIDUALS SHOULD WORK ON THIS EQUIPMENT AND ITS APPLICATION.

3.1 Unpacking and Inspection

Remove the 5240 from its shipping carton and check the items against the packing list. A nameplate located on the side of the unit identifies the unit by model number, serial number, and date code.

Inspect the unit for any physical damage that may have been sustained during shipment. All claims for damage whether concealed or obvious must be made to the shipper by the buyer as soon as possible after receipt of the unit.

Remove all packing materials from the unit. If the unit is to be stored, it should be stored in a clean, dry place. The storage temperature must be between -55°C and 70°C . To prevent damage during storage, it is recommended that the unit be stored in its original shipping carton after completing inspection for damage.

3.2 Mounting

Figure 2.1 shows the mechanical outline of the 5240. Mounting is accomplished by three slots located on the unit. The unit must be mounted vertically on a flat, solid surface taking into account its weight of approximately 6 pounds.

The unit should not be subjected to excessive vibration or shock. The environment should be free of corrosives, moisture, and dust. Refer to Section 2.3 for the environmental specifications of the 5240. To insure proper cooling, there must be a minimum unobstructed space of 4 inches above and below the unit and 1 inch on each side.

Since this unit is of "open frame" construction, it should be located within an enclosure to protect it from physical or environmental damage. The unit will fit in a standard 8 inch deep NEMA enclosure for industrial applications.

3.3 I/O Definitions

The I/O of the 5240 is described below. Refer to Table 3.1 for a summary of I/O definitions and pin-outs. Refer to Figure 3.1 for interconnection wiring to the I/O. Figure 3.3 contains schematics of the various I/O hardware.

J1 Connector [I/O Interface]

J1-21 [DISABLE]

This input disables the driver. In the disabled state, the chopping is disabled and both phase currents go to zero.

J1-5 [K1]
-3 [Y1]

-4 [K2]
-15 [Y2]

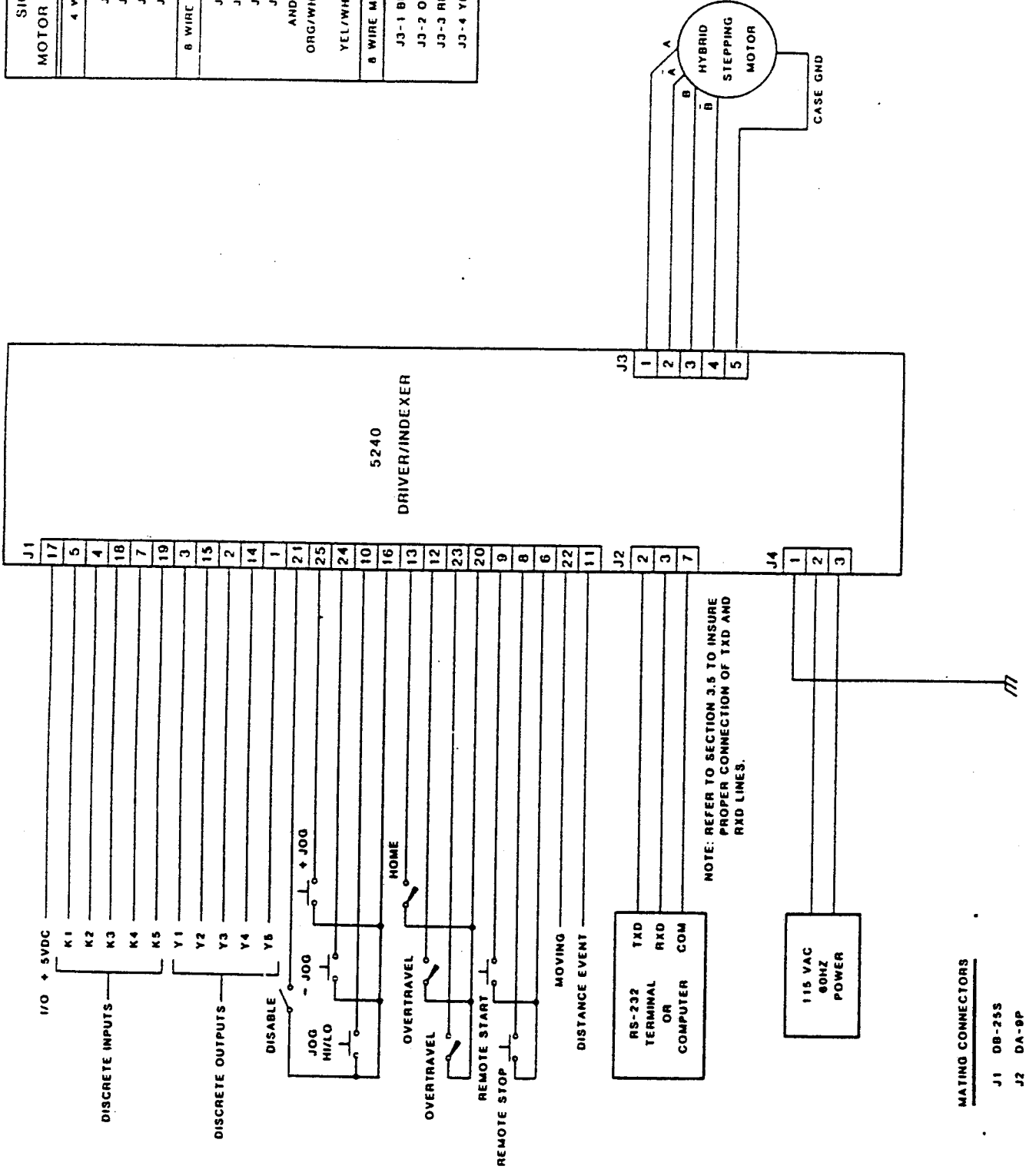
-18 [K3]
-2 [Y3]

-7 [K4]
-14 [Y4]

-19 [K5]
-1 [Y5]

These terminals provide access to the five user programmable bidirectional I/O ports. The five input ports are K1 thru K5 and the five output ports are Y1 thru Y5. The output ports can be set to the high or low state by the Y command. The input ports can be read by the K command. The input ports can also be used with the jump on port command U. It is important to note that these ports are internally bidirectional as shown in Figure 3.3. The state of an output port is actually determined by the wire ORed combination of the associated input port and Y command setting. The result returned by the K command is also determined by the wire ORed combination. To simplify operation and avoid confusion, it is recommended that each port be used as input only or output only. Refer to the K and Y command definitions in Section 4.2 for further information on these ports.

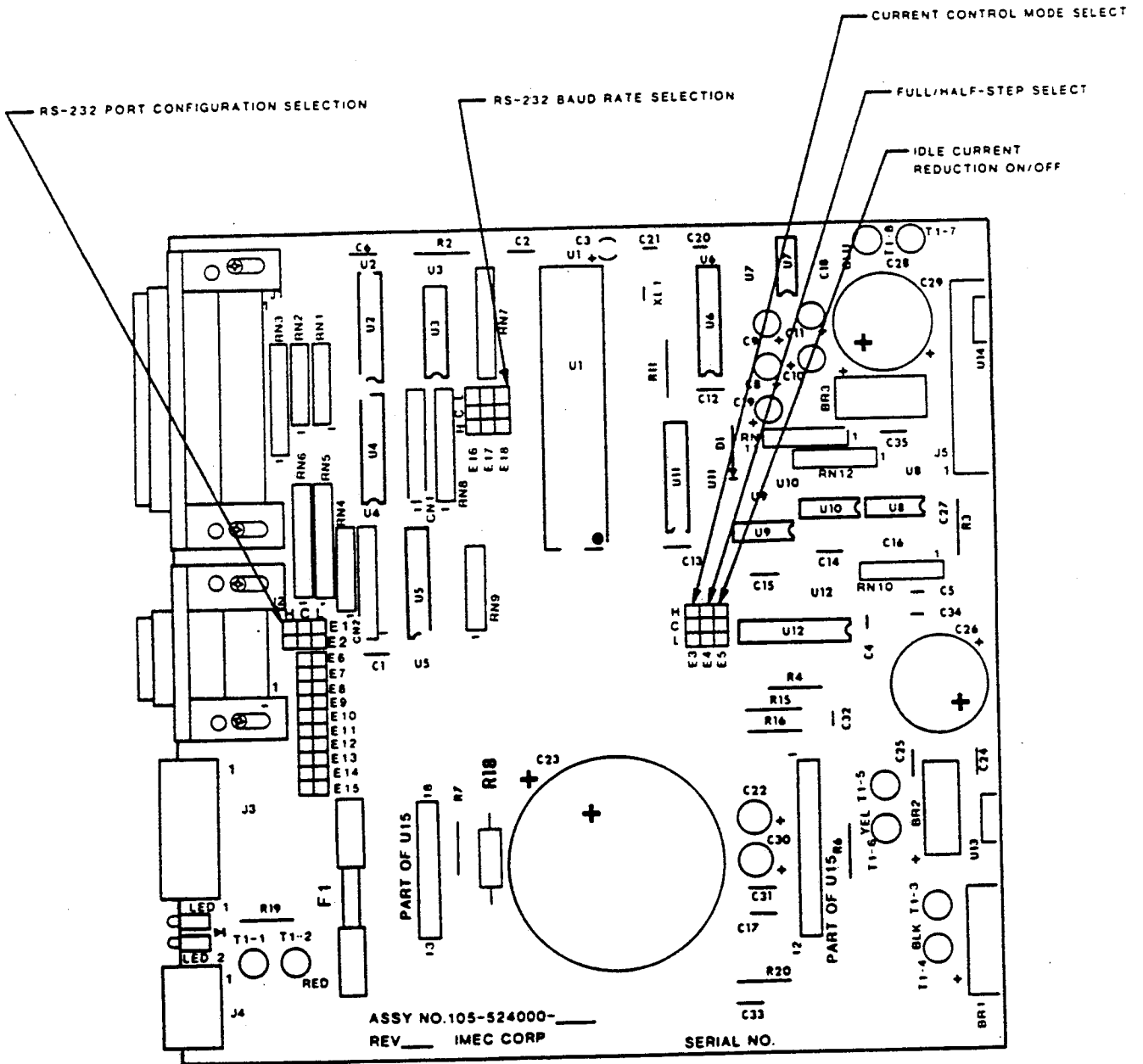
SIGMA LINE	
MOTOR CONNECTIONS	
4 WIRE MOTOR	
J3-1	BLK
J3-2	ORG
J3-3	RED
J3-4	YEL
8 WIRE MOTOR-SERIES	
J3-1	BLK
J3-2	ORG
J3-3	RED
J3-4	YEL
AND CONNECT	
ORG/WHIT TO BLK/WHIT	
YEL/WHIT TO RED/WHIT	
8 WIRE MOTOR-PARALLEL	
J3-1	BLK & ORG/WHIT
J3-2	ORG & BLK/WHIT
J3-3	RED & YEL/WHIT
J3-4	YEL & RED/WHIT



MATING CONNECTORS

- J1 DB-25S
- J2 DA-9P (SUPPLIED)
- J3 PHOENIX (SUPPLIED)
- J4 PHOENIX (SUPPLIED)

INTERCONNECTION DIAGRAM
FIGURE 3.1



LOCATION OF JUMPER SETTINGS-5240

FIGURE 3.2

The input ports are TTL compatible and have a 10 kohm pull-up resistor to +5VDC. The output ports are also TTL compatible with a source capability of 5 mA and a sink capability of 20 mA.

- J1-17 [I/O +5VDC]
- 6 [I/O +5VDC RTN]
- 16 [I/O +5VDC RTN]
- 20 [I/O +5VDC RTN]

These terminals provide +5VDC power to use with the I/O. The current capability of the +5VDC is limited by an internal 47 ohm resistor.

- J1-10 [JOG HI/LO]
- 25 [+JOG]
- 24 [-JOG]

These terminals are used to jog the stepping motor. Two jog speeds, HI and LO can be programmed into the 5240 using the ^ command. The JOG HI/LO input selects the speed to be used. A high or 5VDC input selects the LO speed. The +JOG and -JOG inputs cause the motor to move in the appropriate direction when they are driven to the low state. These inputs are TTL compatible. These inputs are pulled up to +5VDC via 10 kohm resistors.

- J1-12 [DIRECTION LIMIT]
- 23 [DIRECTION LIMIT]

These inputs are direction specific stop inputs which are intended for use with overtravel limit switches. Motor motion will cease in the appropriate direction when either of these inputs is forced to the low state. These inputs are TTL compatible and are pulled up to +5VDC via 10 kohm resistors. Example: The motor is running in the + direction and hits the Direction Limit which will decelerate the motor to a stop. All further commands for motion in the + direction will be ignored. All - direction commands will be executed so that the motor can be backed off the limit switch.

- J1-13 [HOME SWITCH]

This input is used by the H command to provide an absolute mechanical reference position for the indexer. It is normally wired to a limit switch which is placed at an appropriate "home" or reference position on the machining. Refer to the H command definition in Section 4.2 for further information on this input. This input is TTL compatible and is pulled up to +5VDC via a 10 kohm resistor.

- J1-9 [REMOTE START]

This input can be used to initiate execution of a stored program. Forcing this input to the low state will initiate the execution of the program beginning at address 0. The input only has to be held low 5 ms to initiate program execution. This input is equivalent to issuing a G 0

command over the RS-232 link. This input is TTL compatible and is pulled up to +5VDC via a 10 kohm resistor.

J1-8 [REMOTE STOP]

This input can be used to terminate motor motion. The motor will be decelerated to a stop when this input is forced low for 5 ms or more. If a program was being executed, program execution will be terminated. This input is equivalent to issuing a S command over the RS-232 serial link. This input is TTL compatible and is pulled up to +5VDC via a 10 kohm resistor.

J1-22 [MOVING]

This output is forced low while the motor is being commanded to move. If the motor falls out of synch, but is still being commanded to move this output will be low. The output goes high when no motor motion is being commanded. This output is TTL compatible and has a source capability of 5 mA and a sink capability of 20 mA.

J1-11 [DISTANCE EVENT]

This output indicates that the motor position has passed an event position programmed by the O command. The output will be toggled each time the programmed distance event is passed through. Refer to the O command in Section 4.2 for further information on this output. The output is TTL compatible and has a source capability of 5 mA and a sink capability of 20 mA.

J2 Connector [RS-232 Interface]

J2-2 [RS-232 TXD/RXD]

J2-3 [RS-232 RXD/TXD]

These terminals are the RS-232 output (TXD) and input (RXD). The function of the pins depends upon the setting of jumpers E1, E2.

J2-2 TXD, J2-3 RXD --> E1 in H-C position, E2 in L-C position
J2-2 RXD, J2-3 TXD --> E1 in L-C position, E2 in H-C position

J2-15 [RS-232 COMMON]

-7 [RS-232 COMMON]

These terminals are the common for the RS-232 communications signals on J2-2 and 3. These common points are at the same potential as the I/O +5VDC RTN terminals.

J3 Connector [Motor]

J3-1 [PHASE A]

-2 [PHASE /A]

-3 [PHASE B]

-4 [PHASE /B]

These terminals are for connection of a SIGMA Line two phase stepping motor. Proper wiring of the motor is

important, double check these connections prior to applying power.

J3-5 [MOTOR GROUND]

This terminal is the ground connection point for the motor frame.

J4 Connector [115 VAC Power]

J4-1 [GROUND]

This terminal is the safety ground point for the unit. This terminal MUST be tied to earth ground to prevent shock hazard.

J4-2 [115 VAC LINE 1]

-3 [115 VAC LINE 2]

These terminals are the 115 VAC line inputs. No special phasing of the inputs is necessary.

WARNING

THE J4 CONNECTOR SHOULD NEVER BE PLUGGED OR UNPLUGGED WITH 115 VAC POWER APPLIED. SUCH ACTION PRESENTS A SHOCK HAZARD AND ALSO WILL DAMAGE THE CONNECTOR PINS DUE TO ARCING. ALWAYS INSURE THAT 115 VAC POWER IS OFF BEFORE INSTALLING OR REMOVING THE J4 CONNECTOR.

3.4 Interconnection Wiring

Figure 3.1 illustrates the interconnection wiring of the 5240 to a stepping motor, RS-232 terminal, and I/O equipment. This figure includes information on mating connectors and wire sizes.

Wiring sizes, wiring practices, and grounding/shielding techniques described in this manual are intended as a guideline only. Due to the variety of applications served by this product, no single method of interconnection is universally applicable. The information included in this manual represents common industrial wiring practices and should prove satisfactory in the majority of applications. However, local electrical codes, special operating conditions, or system configurations should take precedence over the information provided herein.

To reduce the possibility of noise pickup, power and signal wiring should be routed separately. Signal wiring should be shielded. Motor phase wiring should be twisted to reduce radiated noise.

To minimize shock hazard, all components should be connected to a common earth ground point.

3.5 Plug Jumper Settings

The 5240 has 7 sets of plug jumpers to select various features and options. Figure 3.2 shows the locations of these plug jumpers. Note that the cover must be removed to access these plug jumpers. These settings should be made prior to mounting the 5240 since the cover is not readily removable when the unit is mounted.

WARNING

DANGEROUS VOLTAGES EXIST INSIDE THE UNIT. DO NOT APPLY POWER WHILE THE COVER IS REMOVED. DO NOT REMOVE THE COVER WHILE POWER IS APPLIED.

RS-232 Baud Rate (E16, E17, E18)

There are 3 plug jumpers used to set the baud rates of the RS-232 serial port. There are 7 baud rates available. Table 3.2 summarizes the jumper settings. The state of these jumpers is only read on power-up hence they must be set prior to applying power.

RS-232 Port Configuration (E1, E2)

These plug jumpers allow the output (TXD) and input (RXD) functions to be swapped between J2-2 and 3. This allows flexibility in adapting to different RS-232 cables and RS-232 communication devices.

<u>CONFIGURATION</u>	<u>E1</u>	<u>E2</u>
J2-2 TXD, J2-3 RXD	H-C	L-C
J2-2 RXD, J2-3 TXD	L-C	H-C

NOTE: The factory default setting is J2-2 RXD, J2-3 TXD.

Current Control (E3)

The driver has two modes of current control; recirculating and non-recirculating. The recirculating mode is recommended. Jumper E3 sets the mode.

RECIRCULATING MODE E3 in L-C position

NON-RECIRCULATING MODE E3 in H-C position

NOTE: The factory default setting is RECIRCULATING.

Idle Current Control (E5)

This feature if enabled will reduce the phase current to 1.25 A if no motor motion is commanded for 0.1 seconds. The current will be boosted back to 2.5 A on the next command for motion. This feature can be used in applications where the torque required to hold position is safely met by 1.25 A of phase current. Operating at 1.25 A versus 2.5 A reduces the motor heating during position hold by 75%. Depending upon the application, this can result in a large reduction in motor heating.

IDLE CURRENT REDUCTION ON E5 in H-C position

IDLE CURRENT REDUCTION OFF E5 in L-C position

NOTE: The factory default setting is ON.

Full-/Half-step (E4)

This jumper configures the driver for full or half step operation.

FULL-STEP OPERATION E4 in H-C position

HALF-STEP OPERATION E4 in L-C position

NOTE: The factory default setting is HALF-STEP.

3.6 Initial Power Up

Every 5240 is burned-in and fully tested before leaving the factory. However, it is possible that damage has been sustained by the unit during shipment. This procedure should be followed to insure that the unit has not sustained shipping damage and has been installed properly.

The initial power up sequence makes use of a terminal to communicate with the 5240 over the RS-232 serial port. This procedure assumes that the software parameters are set to factory default values.

WARNING

THIS INITIAL POWER UP PROCEDURE SHOULD BE PERFORMED WITH THE MOTOR SHAFT DISCONNECTED FROM THE LOAD. IMPROPER WIRING OR UNDISCOVERED SHIPPING DAMAGE COULD RESULT IN UNDESIRED MOTOR MOTION. BE PREPARED TO REMOVE POWER IF EXCESSIVE MOTION OCCURS.

- (1) Verify that the unit is wired and mounted per instructions in this manual. Be especially careful in checking the 115

VAC input connections and the motor connections.

- (2) Verify that the plug jumper settings are per the following:

E16	Set to match the baud rate of
E17	the terminal being used to
E18	communicate with the 5240.
E1	Set to the appropriate configur-
E2	ation for the terminal and cable
	being used.
E5	H-C
E4	L-C
E3	L-C

- (3) Unplug the J3 motor connector. Make sure 115 VAC power is OFF when you do this.
- (4) Apply 115 VAC power. Verify that the green power LED is on.
- (5) Send two "space" characters to the 5240 via the serial port. The 5240 should respond with the message:

Sigma Products/Pacific Scientific
285-1 V1.05 23

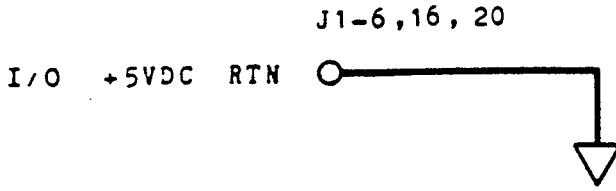
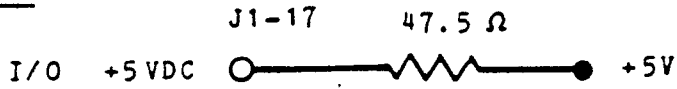
Refer to Section 5 if there is no response.

- (6) Send "Q" character to 5240. Response should be:
- M = 5(150), F = 400, V = 5009
- (7) Remove 115 VAC power from the unit.
- (8) Plug the J3 motor connector into the unit.
- (9) Apply 115 VAC power to the unit.
- (10) Force the +JOG input to the low state. The motor should rotate slowly. Force the JOG HI/LO input to the low state. The motor should rotate faster. Place JOG HI/LO back in the high state. The motor should rotate at a slower speed. Allow the +JOG input to return to the high state. Motor rotation should cease.
- (11) Force the -JOG input to the low state. The motor should rotate slowly in a direction opposite that which occurred with +JOG low. Allow the -JOG input to return to the high state and verify that motor motion ceases.
- (12) Send the command R2000 <cr> to the 5240 via the serial link. The motor should begin to rotate. Send R-2000 <cr>. The

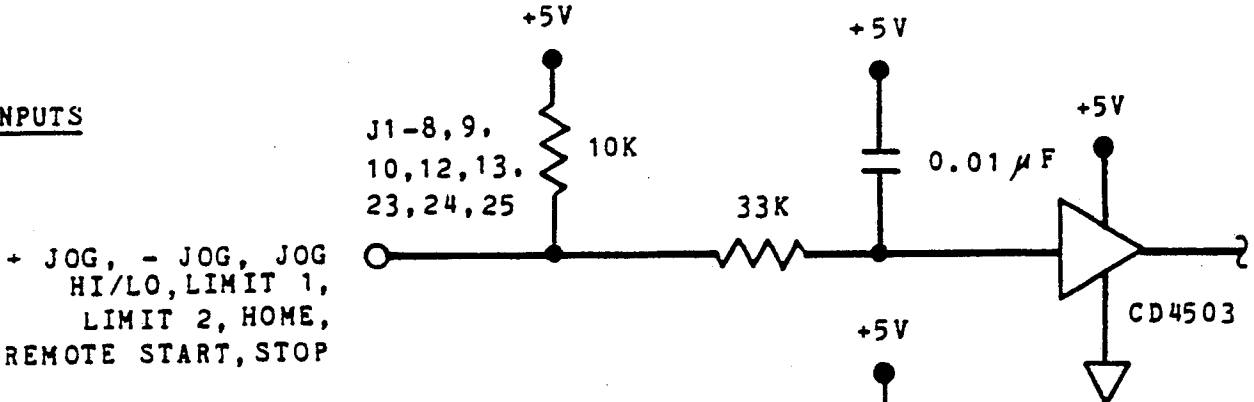
motor rotation should reverse direction. Send R0<cr>.
Motor motion should cease.

If the unit successfully passed the above procedure, you may now try exercising the unit on your own. Refer to Section 4 for information on how to program the unit or use commands in the immediate mode.

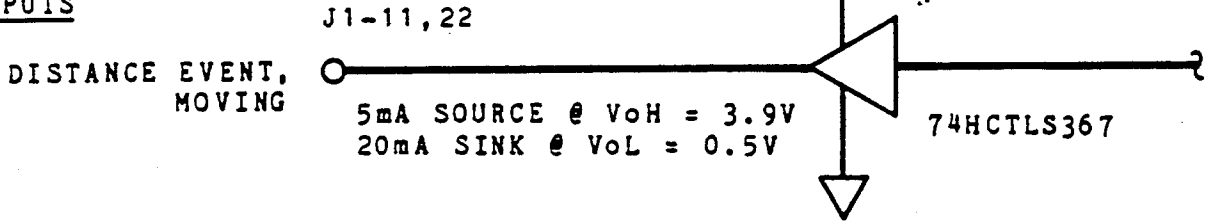
I/O POWER



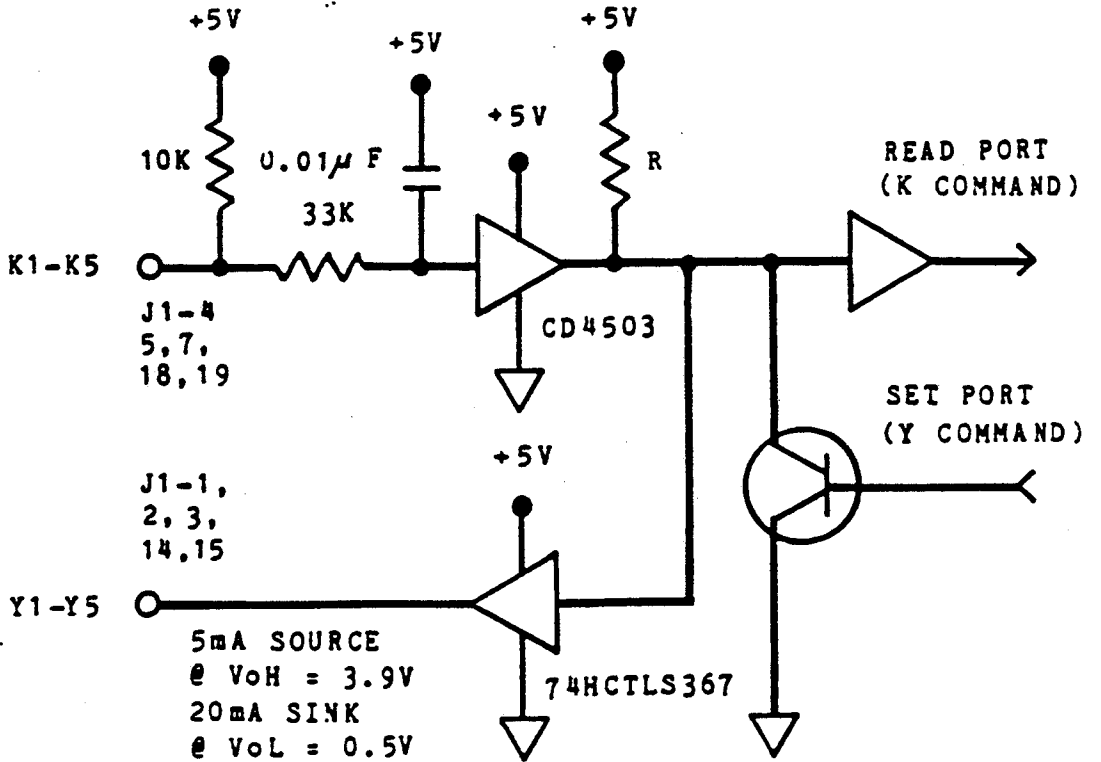
INPUTS



OUTPUTS



BIDIRECTIONAL I/O PORTS



I/O HARDWARE SCHEMATICS
FIGURE 3.3

TABLE 3.1

I/O DEFINITIONS SUMMARY AND PIN-OUTS

J1 CONNECTOR [I/O INTERFACE]

J1-1	Y5
-2	Y3
-3	Y1
-4	K2
-5	K1
-6	I/O +5VDC RTN
-7	K4
-8	REMOTE STOP
-9	REMOTE START
-10	JOG HI/LO
-11	DISTANCE EVENT
-12	DIRECTION LIMIT 1
-13	HOME SWITCH
-14	Y4
-15	Y2
-16	I/O +5VDC RTN
-17	I/O +5VDC
-18	K3
-19	K5
-20	I/O +5VDC RTN
-21	DISABLE
-22	MOVING
-23	DIRECTION LIMIT 2
-24	-JOG
-25	+JOG

J2 CONNECTOR [RS-232 INTERFACE]

J2-5	RS-232 COMMON
-2	TXD or RXD (See Section 3.5)
-3	RXD or TXD (See Section 3.5)
-7	RS-232 COMMON

ALL OTHER PINS ON J2 ARE NOT CONNECTED.

J3 CONNECTOR [MOTOR]

J3-1	MOTOR PHASE A
-2	MOTOR PHASE /A
-3	MOTOR PHASE B
-4	MOTOR PHASE /B
-5	MOTOR GROUND

J4 CONNECTOR [115 VAC POWER]

J4-1	GROUND
-2	115 VAC LINE 1
-3	115 VAC LINE 2

TABLE 3.2

RS-232 BAUD RATE SETTINGS

<u>BAUD RATE</u>	<u>E16</u>	<u>E17</u>	<u>E18</u>
9600	L-C	L-C	L-C
4800	H-C	L-C	L-C
2400	L-C	H-C	L-C
1800	H-C	H-C	L-C
1200	L-C	L-C	H-C
600	H-C	L-C	H-C
300	L-C	H-C	H-C
ILLEGAL	H-C	H-C	H-C

NOTE: The factory default setting is 9600 baud.
Jumper settings are only read at power-up.

SECTION 4

PROGRAMMING

4.1 RS-232 Serial Port

The 5240 Indexer/Driver is designed to communicate over a standard RS-232 serial link. Baud rates between 300 and 9600 are selectable using plug jumpers as described in Section 3.5. The units sends and receives 8-bit, asynchronous ASCII character codes with one start bit and one stop bit. Any standard terminal or computer with an RS-232 interface can be used to program the 5240.

For the serial link to operate properly, the output of the RS-232 5240 must be connected to the RS-232 input of the terminal or host computer. Also the input of the 5240 must be connected to the output of the terminal or computer. To simplify this interconnection, the 5240 is equipped with jumpers to allow the RS-232 to be configured with its output and input on J2-2 and 3 respectively or J2-3 and 2 respectively. Refer to Section 3.5 for further information.

4.2 Command Definitions

This section describes the commands available to control the 5240. The 5240 can be operated in two modes; immediate mode or programmed mode.

In immediate mode, commands received via the serial port are executed immediately. In programmed mode, commands are received and become part of a program stored in the non-volatile memory. The commands making up the program are executed when the program is initiated or run.

Some of the commands can be used in either mode while others are only usable in one mode. Each command definition specifies the modes in which the command is usable.

Most immediate mode commands are executed by typing the command followed by a carriage return <CR>.

Program mode is entered by typing the edit (E) command. The 5240 prompts the user with memory addresses starting at 0 or the address given with the E command. Memory addresses assigned by the 5240 are not contiguous numbers since they represent the actual byte addresses in memory.

The escape key <ESC> can be used to terminate motion or a program. It can also be used to escape from the edit mode. The 5240 will respond with # if an <ESC> is sent.

between 1 and 255. The value set is multiplied by 10 and used as the motor velocity. The b value is either 0 or 1 and sets the initial direction of rotation. The transition on the HOME SWITCH input is normally generated by a limit switch located on the equipment being driven by the motor. The position at which the switch transition occurs is used as an absolute mechanical reference point. To insure that a repeatable reference point is obtained, a special algorithm is used by this command to insure that the switch is always approached from the same direction. The algorithm works as follows:

1. Initial direction set by value of b parameter and the state of the HOME SWITCH input.
2. Motor moves at the velocity specified by nn parameter until the input changes states.
3. If a Low --> High transition occurs, the motor stops.
4. If a High --> Low transition occurs, the motor reverses direction. It proceeds in the reverse direction until a Low --> High transition occurs and then stops.

I NOT USED

J aa n JUMP TO ADDRESS, n + 1 TIMES Program

This command jumps to the specified address n + 1 times and then allows the program to continue. The value of aa must be a valid program address. The value of n can range from 0 to 255. This command cannot be nested. Only one jump counter is available for use at any instant in time.

K READ INPUT PORT Immediate, Program

This command returns a decimal number which corresponds to the 5 bit binary word defined by the the 5 input ports. K5 is the most significant bit and K1 is the least significant bit. For example, if K1 thru K5 inputs are all high the K command will return a value of 0. If the K1 thru K5 inputs were all low, a 31 would be returned by the K command.

This command is only used to return input port status to the host since the 5240 has no commands which can use the information provided by the K command.

IMPORTANT NOTE

The I/O ports on the 5240 are bidirectional. At power-up, all output ports are set low. This allows K1 thru K5 to be used as inputs i.e. the K

command will read the input port status. The Y command can be used to set any output port Y1 thru Y5 to a high state. When an output port is set low by the Y command, the output port will actually be the complement of its respective input. For example if Y1 is set low by the Y command and the K1 input state is low, the Y1 output will be high. If the K1 input state is high, the Y1 output will be low. The Y1 thru Y5 output states are actually determined by ORing the Y command state and inversion of the state of the respective K1 thru K5 inputs.

To avoid confusion, it is recommended that each bidirectional port be used as an input OR an output not both.

L aa LIST FROM ADDRESS Immediate

This command lists the program starting at address aa. If aa is left blank, the list command will start at address 0. The value of aa must be a valid command address. Twenty contiguous commands are listed at a time. If there is a gap in the instruction addresses, the L command does not "jump" the gap. Another L command specifying the beginning address of the program segment following the gap must be issued.

M n ACCELERATION/DECELERATION SLOPE Immediate, Program

This command sets the rate used when accelerating or decelerating the motor. A predefined look-up table defines the accel/decel rates available. The velocity ramps produced are "staircases" or step-wise approximations to a linear ramp. The n value specified represents the number of steps made at each step rate in the "staircase". After n steps at a given velocity, the velocity is incremented or decremented to the next velocity value in the look-up table. Larger values of n will produce lower accel/decel rates while smaller values of n will produce high accel/decel rates. Another way to view n is as ramp time rather than ramp slope. The range of n is 0 to 254. A value of 0 will eliminate any ramping.

N NOT USED

O p DISTANCE EVENT Immediate, Program

This command is used to set a Distance Event. The Distance Event output will be toggled each time the position counter reaches or passes the value p. In the program mode, the program will call the commands stored at address 200 when the position counter reaches or passes the value p. The value of p is a signed number between $\pm 32,767$. A p value of 0

disables the Distance Event and a value of -0 defines position counter value 0. The Q command can be used to examine the p value set.

P PARAMETERS STORE Immediate

This command will store the presently set values of M, F, V, and O into the non-volatile memory as the new default values used on power-up. These default values will be overridden by an A 1 command.

Q n QUERY Immediate

This command can be used to examine various parameter settings.

n = blank ---> returns M, F, V, and O values

n = 1 ---> returns position counter value

R nn RAMP TO VELOCITY Immediate, Program

This command causes the motor to ramp to the velocity specified by nn. The sign of nn defines the direction. The value of nn can range between $\pm 10,000$. The motor will run at the specified velocity until a new R command changes the velocity or motion is terminated by an <ESC> or S command. A distance move cannot be executed directly from an R command unless the R command was R 0.

S STOP Immediate, Program

This command causes the motor to ramp to a stop.

T NOT USED

U aa k LOOP ON INPUT PORT Program

This command will cause the program to loop to address aa until the port condition specified is true. Port conditions are:

<u>Port</u>	Test for Input LOW <u>k =</u>	Test for Input HIGH <u>k =</u>
K1	0	1
K2	2	3
K3	4	5
K4	6	7
K5	8	9

V nn VELOCITY Immediate, Program

This command sets the velocity used when doing an absolute or increment distance move. This value is divided by the value specified by the \ command. The range of values for nn is 14 to 10,000.

W nn WAIT Program

This command produces a delay of nn milliseconds. The value of nn is 1 to 65,535. This command, when issued during a distance move, will start when motion has stopped. High speed operation during W commands will increase the delay time by as much as 14 times the programmed value.

X NOT USED

Y n SET OUTPUT PORT Immediate, Program

This command is used to set the state of the Y1 thru Y5 output ports. The 5 output ports correspond to a 5 bit binary word with Y5 being the most significant bit and Y1 being the least significant bit. The value of n is a decimal number between 0 and 31. The binary equivalent of the n value defines the output states. For example, a Y 0 command will set all 5 Y outputs to a low state. A Y 31 command will set all 5 Y outputs to a high state. This example assumes that all 5 K inputs are high since the Y output states are determined by a logical combination of the K input states and Y command states. Refer to the K command definition for further clarification.

Z p SET POSITION COUNTER Immediate, Program

This command sets the position counter to the value p. The counter value is signed and ranges between $\pm 32,767$. The value of the position counter can be examined by the Q 1 command. The position counter is set to 0 on power-up. This command would typically be used in conjunction with the H command to initialize a system on power-up.

+ nn INCREMENTAL MOVE, POSITIVE Immediate, Program

This command will move the motor nn steps in the + direction. The velocity profile is defined by the M, F, and V parameters set. Range of nn is 0 to 65,535.

- nn INCREMENTAL MOVE, NEGATIVE Immediate, Program

Same as the + nn command except in the opposite direction.

● p ABSOLUTE MOVE Immediate, Program

This command will move the motor until the position counter value equals the value p. The velocity profile is defined by the M, F, and V parameters set. The value for p is between +32,767.

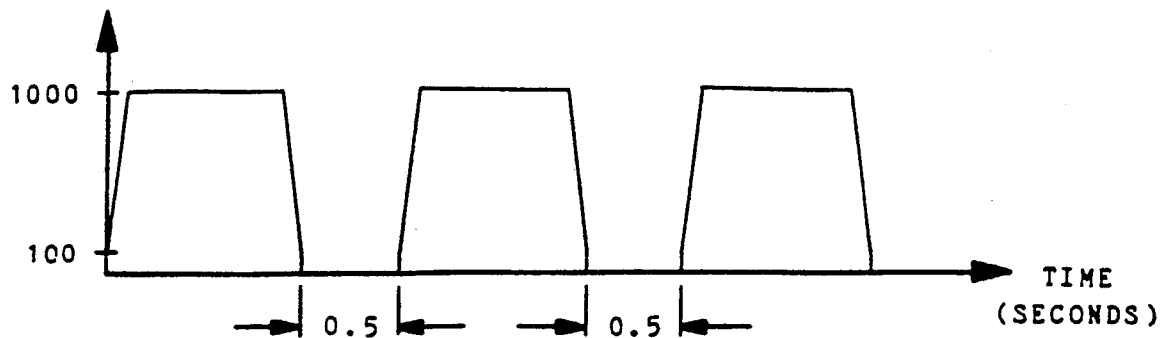
^ ll hh JOG VELOCITY Immediate

This command sets the velocity used when a JOG command is issued via the JOG inputs. The value ll is used when the JOG HI/LO input is in the LO state and the hh value is used for the HI state. The ll and hh values are multiplied by 10 to get the jog velocity in steps per second. The range of values for ll and hh is 14 to 10,000.

\ n DIVIDE Immediate, Program

This command causes all speeds during ramping and constant velocity to be divided by the value of n. The value of n is between 1 and 255.

VELOCITY (SPS)

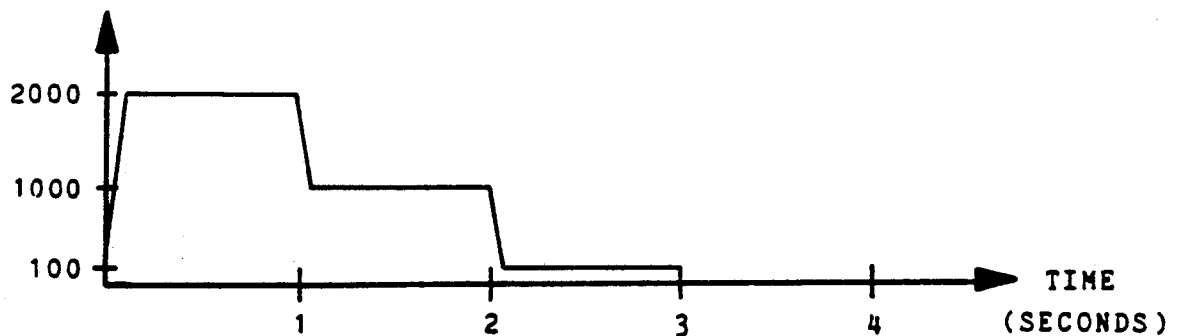


MULTIPLE MOVES

```
0 M5  
2 F100  
5 V1000  
8 +1000  
11 W500  
14 J 8 2
```

THIS PROGRAM ILLUSTRATES THE USE OF THE JUMP ON COUNTER COMMAND TO PRODUCE MULTIPLE MOVES.

VELOCITY (SPS)



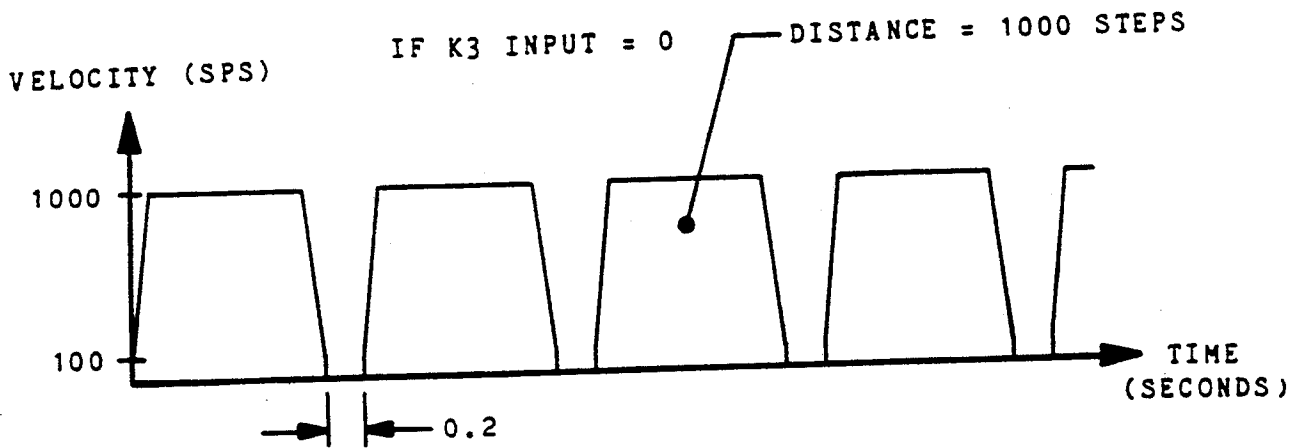
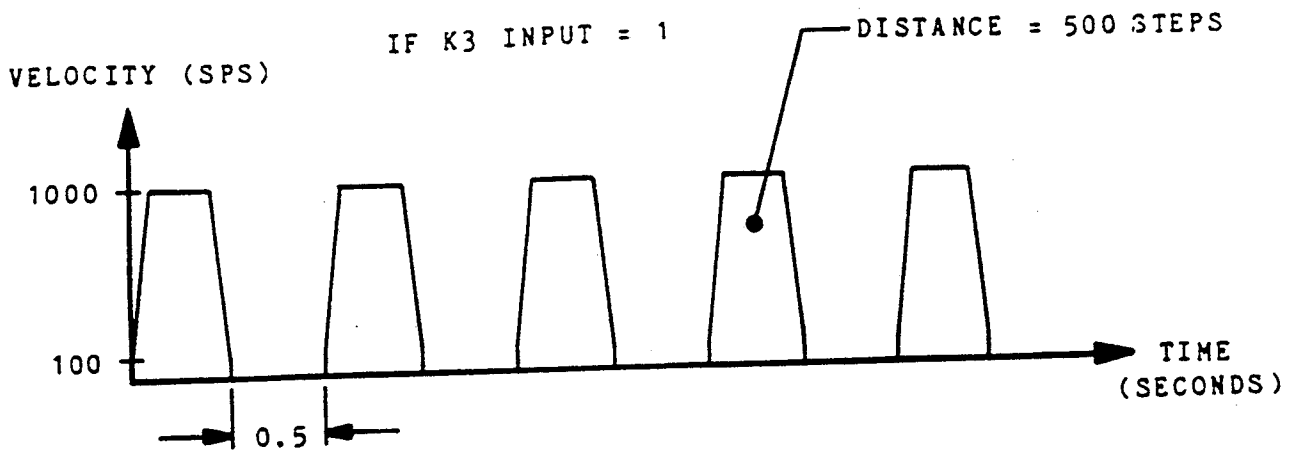
MULTIPLE SPEED PROFILE

```
0 M5  
2 F100  
5 R2000  
8 W1000  
11 R1000  
14 W1000  
17 R100  
20 W1000  
23 R0
```

THIS PROGRAM ILLUSTRATES THE USE OF THE RAMP TO VELOCITY COMMAND. COMPLEX VELOCITY PROFILES CAN BE GENERATED USING THIS COMMAND.

PROGRAMMING EXAMPLES

FIGURE 4.1



CONDITIONAL JUMPS

0	M5
2	F100
5	V1000
8	+500
11	W500
14	U 8 4
17	+1000
20	W200
23	G17

THIS PROGRAM ILLUSTRATES THE CONDITIONAL JUMP ON AN INPUT STATE.
THE K3 INPUT IS USED TO SELECT WHICH PROFILE IS USED.

PROGRAMMING EXAMPLES

FIGURE 4.1 (CONT.)

TABLE 4.1
COMMAND SUMMARY

<u>Command</u>	<u>Description</u>	<u>Modes</u>	<u>Notes</u>
A 1	ALL CLEAR	I	1
C n	CURRENT ENABLE	I,P	1
E aa	EDIT FROM ADDRESS	I	1
F nn	START/STOP VELOCITY	I,P	1
G aa b	GO FROM ADDRESS, TRACE	I	1
H nn b	HOME	I	1
J aa n	JUMP TO ADDRESS, n + 1 TIMES	P	
K	READ INPUT PORT	I,P	
L aa	LIST FROM ADDRESS	I	
M n	ACCEL/DECEL SLOPE	I,P	2
O p	DISTANCE EVENT	I,P	
P	PARAMETERS STORE	I	1
Q n	QUERY	I	
R nn	RAMP TO VELOCITY	I,P	
S	STOP	I,P	3
U aa k	LOOP ON INPUT PORT	P	
V nn	VELOCITY	I,P	1
W nn	WAIT	P	
Y n	SET OUTPUT PORT	I,P	
Z p	SET POSITION COUNTER	I,P	
+ nn	INCREMENTAL MOVE, POSITIVE	I,P	1
- nn	INCREMENTAL MOVE, NEGATIVE	I,P	1
● P	ABSOLUTE MOVE	I,P	1
^ ll hh	JOG VELOCITY	I	1
\ n	DIVIDE	I,P	1

1. Command should not be executed with motion in progress.
2. Slope can be changed during Ramp to Velocity moves.
3. May be executed at any time.