525 PROGRAMMABLE MOTION CONTROLLER INSTALLATION and OPERATION MANUAL

EMERSON
MOTION CONTROL

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Date: August 25, 1997

525 Programmable Motion Controller

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Disclaimer:

The installer is responsible for any damage that may occur when upgrading FX Drives in the field.

This document has been prepared to conform to the current release version of the FX Positioning Drive system. Because of our extensive development efforts and our desire to further improve and enhance the product, inconsistencies may exist between the product and documentation in some instances. Call your customer support representative if you encounter an inconsistency.

Introduction

Product Overview

The Emerson Motion Control 525 PMC (Programmable Motion Controller) is a complete closed-loop position controller for use with external analog or digital servo drives in positioning applications. The 525 PMC accepts all current PCM Application Modules and peripherals in the Emerson Motion Control FX product line.

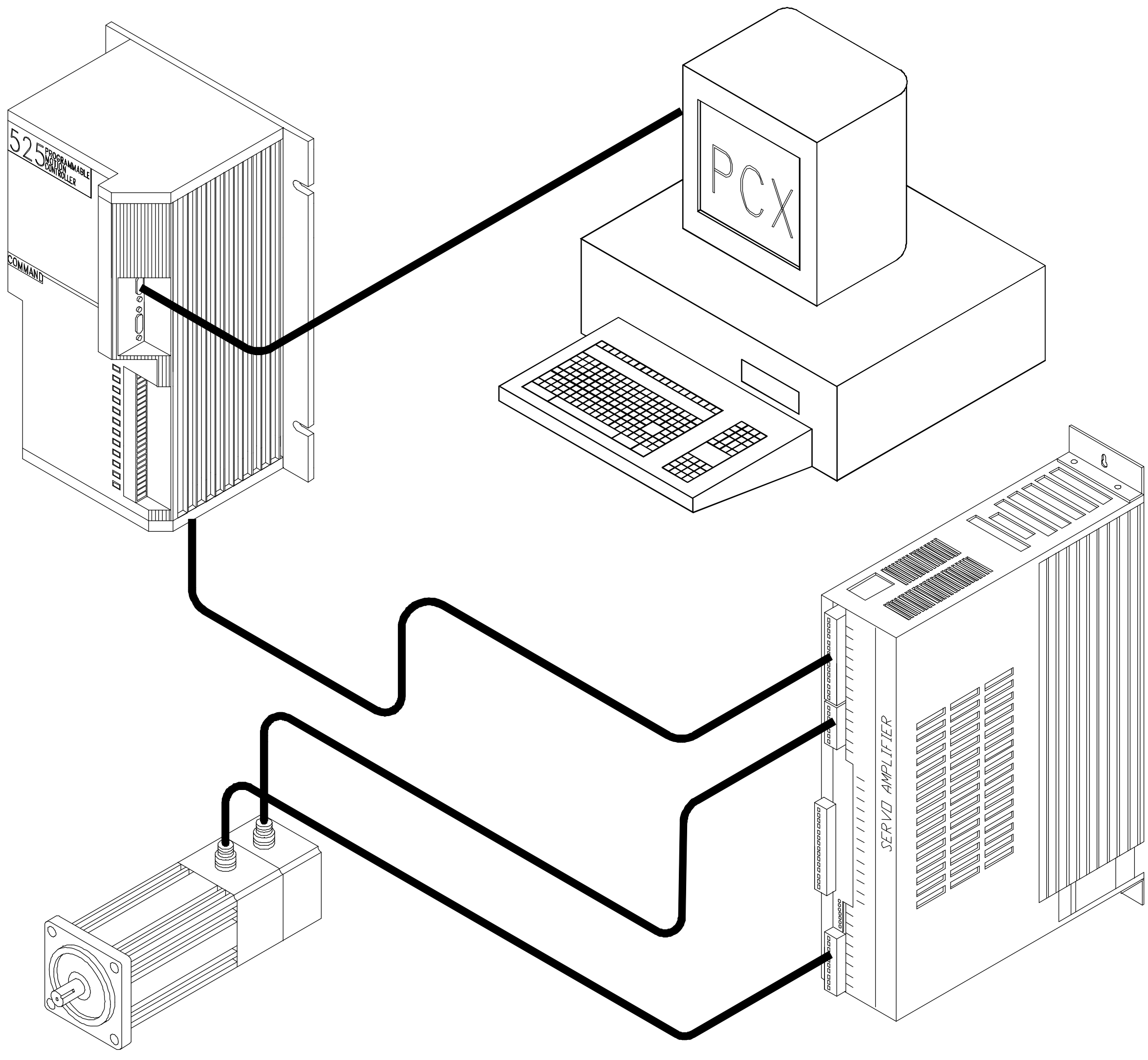


Figure 1 Typical 525 PMC Configuration

The 525 PMC outputs an analog velocity command signal and accepts encoder feedback signals closing the position loop around an external servo drive.

The 525 PMC uses PCX Version 6.02 or newer for setup, calibration and programming. A single PCX program can control multiple axes including a mixture of Positioning Drives and 525 PMC's.

All 525 PMC gain settings are pre-programmed and can be changed from PCX software (see PCX 6.X Operators Manual P/N 400240-01). A fine position loop adjustment is provided on the front of the 525 PMC which allows you to fine tune the system without requiring a personal computer. The servo amplifier and the 525 relationship is determined by a programmable command voltage to RPM ratio with a default of 10 volts = max RPM of the motor.

The 525 PMC is designed accept a series of application modules called "PCM" modules. The PCMs are attached by simply plugging them onto the front of the 525 PMC. The PCM modules are designed to share the 525's power supply and include 12 additional optically isolated inputs/outputs (making a total of 24).

The 525 PMC can operate with either 115 or 220 VAC single phase power (switch selectable). The 525 PMC includes a pulse follower mode (see "Operating Modes" on page 4).

External Drive Interface

The 525 PMC is designed to be used with common servo drive systems. A perfect match is a servo drive that has a +/- 10 volt input equalling +/- maximum velocity and an encoder feedback signal that equates to the actual motor position.

Command Signals

The 525 PMC command signal tells the servo amplifier (by the polarity and level of the command) how fast and in what direction to move. The feedback position is compared to the command position to determine whether the motor is doing what it has been commanded to do. If an error between command and feedback exists, the error is multiplied by a programmable gain and used to add or subtract the command to the amplifier.

The input velocity scaling of the external drive must match the 525 PMC command output scaling. By using the PCX system calibration screens, you can modify the Calibrated Velocity and the Calibrated Velocity Command Voltage. Using these values the 525 PMC is able to provide the proper command voltage with minimum error.

Some drives have little or no speed regulation below 10% to 40% of the command signal. Although this may be ok for simple velocity control, the 525 PMC must control the speed from zero to ± full velocity. Without low speed regulation the 525 PMC cannot accelerate to the commanded speed without gross positional errors and a possible fault condition.

The ability to accelerate or decelerate a load is a function of the external drive. The 525 PMC will linearize the velocity profile through positional feedback control. The overall performance of the 525 PMC is tied directly to the drive's performance. The 525 PMC's ability to generate a command signal in excess of any particular drive's capability does not mean that the 525 PMC can improve that drive's capability to produce torque.

Special compensation of a specific amplifier may be required to accommodate a specific application or load mismatch. Consult with the amplifier manufacturer for specific details.

Operating Modes

The 525 PMC offers three standard modes of operation: Indexing, Pulse and Analog.

Indexing Mode

The indexing mode allows up to thirty-two different indexes or positions to be pre-programmed and stored in non-volatile memory. These indexes and other commands such as stop and jog are selected by the drive's input/output (I/O) lines from devices such as PLCs or operator push buttons. I/O connections can be used for stand alone operation or in conjunction with one of the two control modes.

Another powerful feature of the indexing mode allows ASCII serial commands to be received through the standard RS423 serial interface. This interface port allows you to down-load new positional data such as distance, velocity, position etc.. The ASCII serial commands work with the RS232C serial interface on an IBM (or compatible) personal computer (PC) or programmable logic controller (PLC) with an ASCII or basic module.

Pulse Mode

In the pulse mode the 525 PMC responds to a pulse train representing externally generated incremental position change commands. These commands are normally in the form of CW or CCW direction pulses. This mode is commonly used to when replacing stepper motors.

Analog Mode

In the analog mode the 525 PMC responds to a conventional +/- 10 volt signal. Most variable speed drives and servo amplifiers on the market today receive commands via analog input.

Installation

Installation Overview

The following installation requirements, methods and procedures are provided to ensure reliable and trouble free installation and operation of your Emerson Motion Control 525 PMC.

The methods and procedures are outlined on the following pages and include site requirements, safety, power and fusing requirements, wire and transformer sizing, noise suppression and I/O wiring.

The installer has the responsibility to comply with the safety requirements of the system. This includes installing the system with an appropriate master interlock switch for emergency shut down, using the proper wire and if necessary, transformer sizes to fit the system. This section will provide you with the information to complete a trouble free installation.

Safety

WARNING

The user is responsible for providing emergency interlock switches that will remove AC power from the system any time the equipment is not running, or when the emergency stop is activated. This is to eliminate the possibility of electrocution or unwanted movement of the motor. The safety ground connections should only be disconnected for servicing, and only after all AC power has been removed. Even after the removal of AC power, there is a possibility of stored energy in the drives that must be dissipated before servicing. Failure to follow proper safety procedures can cause death or serious injury.

Disconnecting AC power does not immediately remove the stored energy in the bus capacitance and the external drive may continue to operate until this energy is dissipated. The time it takes to dissipate the energy in the bus capacitance greatly depends on the current being drawn out of the capacitors.

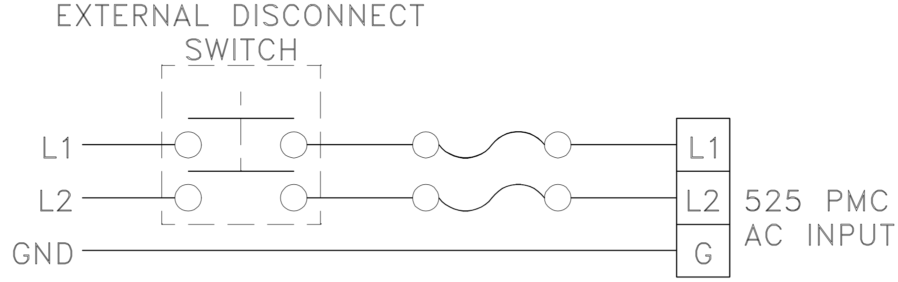


Figure 1 External Disconnect Example

AC Input Line

The AC line voltage of the input power must be within the specified range and free of voltage transients that exceed this range. If this is not the case, additional AC line conditioning may be required.

The AC input lines are connected to the 3-position terminal strip (L1, L2, GND) located on the bottom plate of the 525 PMC. Power to the 525 PMC and the external drive must be applied at the same time. To ensure proper operation after removing power, wait a minimum of 10 seconds before re-applying power.

NOTE: The application of AC power to the 525 PMC must be simultaneous with application of AC power to the controlled external drive.

Grounding

The 525 PMC is internally grounded. The primary function of proper chassis grounding is to ensure that the earth ground is connected to the AC ground input of the chassis. Ground connections must be made from the chassis ground terminal on each piece of equipment to a unique single point ground.

Connections should use the same gauge wire as the power input wire to the device and not be shared with any other equipment. The motor cable should contain a motor frame ground wire of at least the same gauge as the armature power conductors.

All electrical cabinets and machine elements must be ground bonded together. 2 shows a typical grounding arrangement. To ensure proper grounding techniques, please observe the recommendation of the IEEE Ground Book, ANSI Standards, and the National Electrical Code.

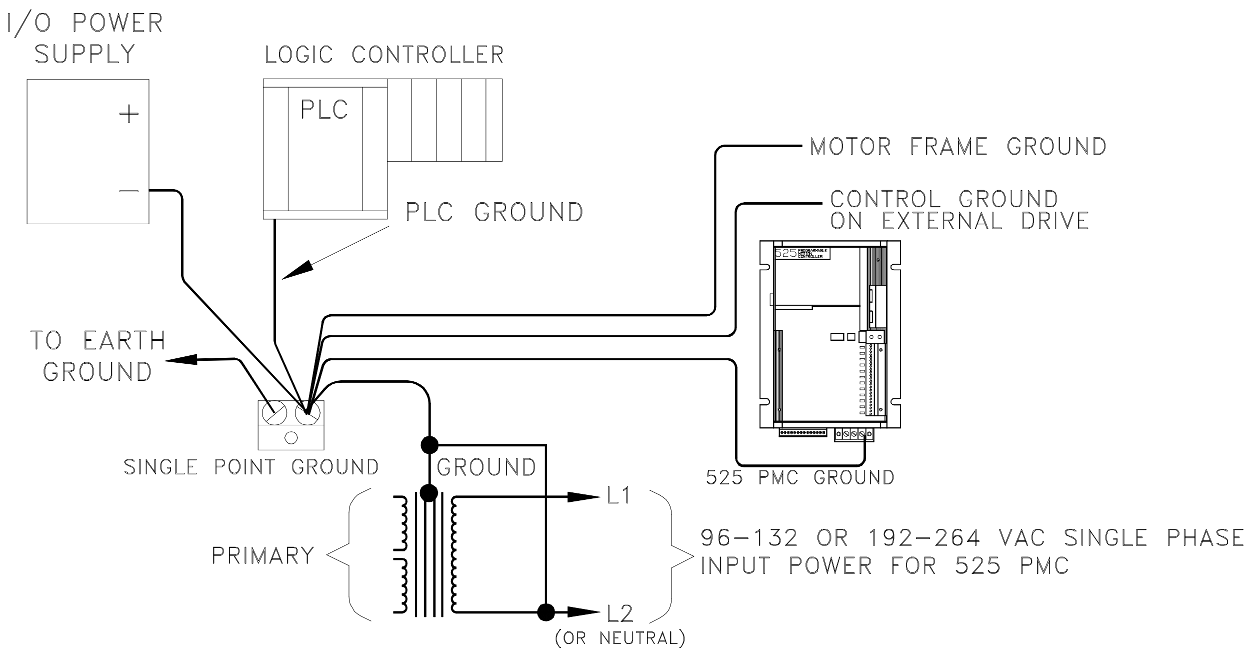


Figure 2 System Grounding illustration

Electrical Noise

If any sensitive electronic equipment (i.e. digital computer, test equipment, etc.) is operating on the same line as the 525 PMC additional EMI/RFI filtering may be required to reduce the effects of conducted noise. Effects of electrical noise on the electronic equipment is greatly reduced when the techniques outlined below are closely followed.

1. Do not run low power control signals and high power wiring in the same raceway.

NOTE: If mixing wires cannot be avoided, then the low voltage control input and output wiring must be shielded. The shield for these wires should only be connected to ground at the source end of the cable.

2. Connecting both ends of a shielded cable to ground may cause a ground loop condition.
3. Keep all wires in the system as short as possible, with consideration for troubleshooting and repair.
4. Follow the recommended grounding arrangements.
5. Suppression devices should be used on relays and coils as outlined in the following section.
6. If control signal and high power wiring must cross, make sure they cross at a 90 angle.

Magnetic Coil Noise

All relay coils, solenoid coils, electrical brakes and similar devices must be suppressed. The placement of the noise suppressor should be as close to the coil as possible.

In the case of DC coils, a diode is installed across the coil in a direction that will cause the voltage transient to be supressed by the diode.

Figure 3 Magnetic Coil Noise (DC Line)

In the case of AC coils a capacitor and resistor are installed across the coil to suppress the unwanted transient.

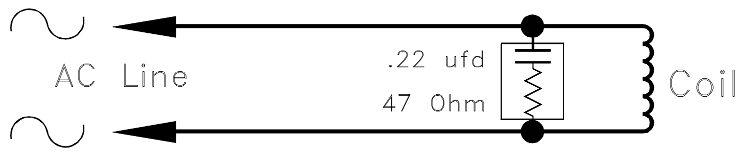


Figure 4 Magnetic Coil Noise (AC Line)

The specific values of resistance and capacitance may vary depending on the inductance of the coil. Consult the relay manufacturer for the proper values to use. These suppressor networks greatly extend the life of the contacts controlling the coil because the transient energy, which can easily reach 1000 volts, shunts through the suppressor rather than arcing across the controlling contacts as they open.

I/O Wiring Layout

All signals to and from the 525 PMC must be connected with an electrical grade insulated wire to withstand the application environment. Although each signal input and output was designed for high noise immunity, careful wire routing within the enclosure will help cut down electrical noise between I/O lines and noise emitting conductors.

High voltage (>50V) must be separated from low voltage wiring in order to minimize cross talk. High voltage signals should be run in a separate conduit physically separated from the low voltage signals. In addition, any high current carrying conductors should be twisted to minimize noise emission.

Conductor lengths should be as short as possible to reduce noise and losses in the system. Input/output wiring can be safeguarded against noise by a shielded cable. Brake leads should be treated as power conductors and run within the armature conduit or raceway.

Shielding

When shielding cable it is important to know the difference between the types of shielding available. A braid shield is the most effective way to minimize the effects of Electro-Magnetic Interference (EMI). A foil shield is the most effective way to minimize Radio Frequency Interference (RFI).

A cable that provides both types of shielding is preferred, however, a braided shield alone will usually provide adequate protection. To reduce chances of ground loops, shields should be grounded only on one end, preferably at the signal source.

Selecting An Enclosure

The Emerson Motion Control 525 PMC is designed for the industrial environment. However, no sophisticated electronic system can tolerate certain atmospheric contaminants such as moisture, oils, conductive dust, chemical contaminants and metallic particles. Therefore, if the 525 PMC is going to be subjected to this type of environment, it must be back mounted verticality in a metal NEMA type 12 enclosure. Proper ventilation and filtering must also be provided. If the equipment environment is above 80 F, cooling should be considered.

Enclosure Size

The size of the enclosure will determine how long it takes the temperature inside to rise. It will also affect the thermal transfer of the enclosure. Normally, the larger the enclosure the better the thermal transfer. Thermal transfer is also affected by venting, forced air cooling, and the enclosure material.

Encoder Feedback

The 525 PMC utilizes an xe "ENCODERS:Incremental Encoder" incremental encoder as the feedback device from the motor. The type of encoder used must have two complimentary channels electrically spaced 90 from each other. These encoder channels are usually designated as CHA and CHB. To fully utilize the motion controller, the encoder must have a third complimentary channel that has a once per revolution output called Mark, or Index.

Emerson Motion Control can provide two encoder configurations for use with the 525 PMC.

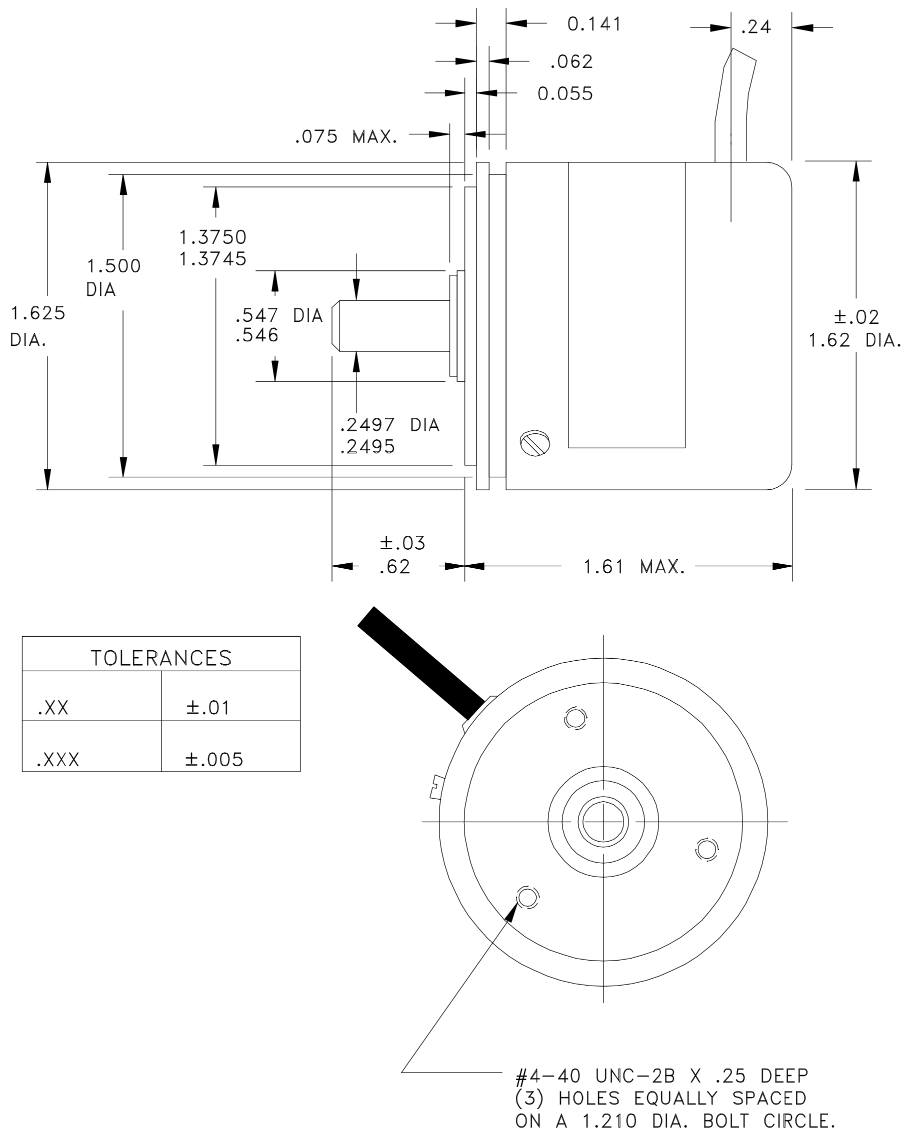


Figure 5 Encoder Model SDC-15-1, 1024 Line Density

NOTE: The use of a flexible coupling is required between the encoder and the motor shaft.

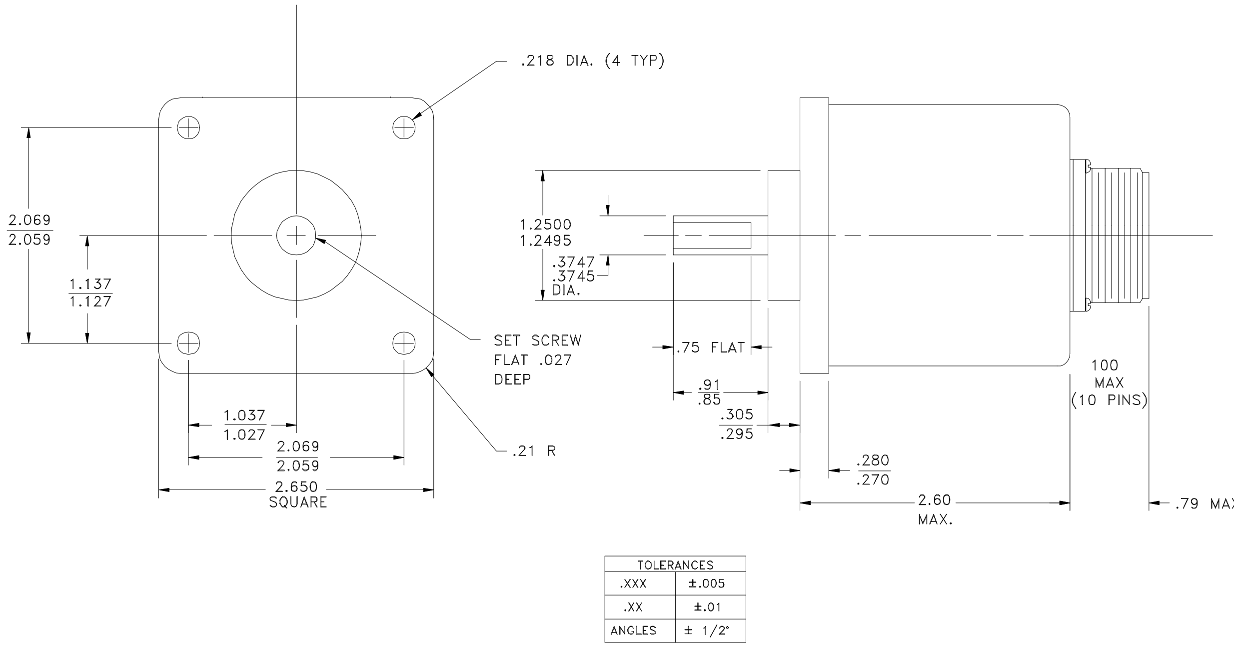


Figure 6 Encoder, Model SDC-25-1, 1024 Line Density

NOTE: The use of a flexible coupling is required between the encoder and the motor shaft.

Encoder Sine Wave Signals

A graphic illustration of the encoder signals from either the SDC-15-1 or SDC-25-1 is shown below.

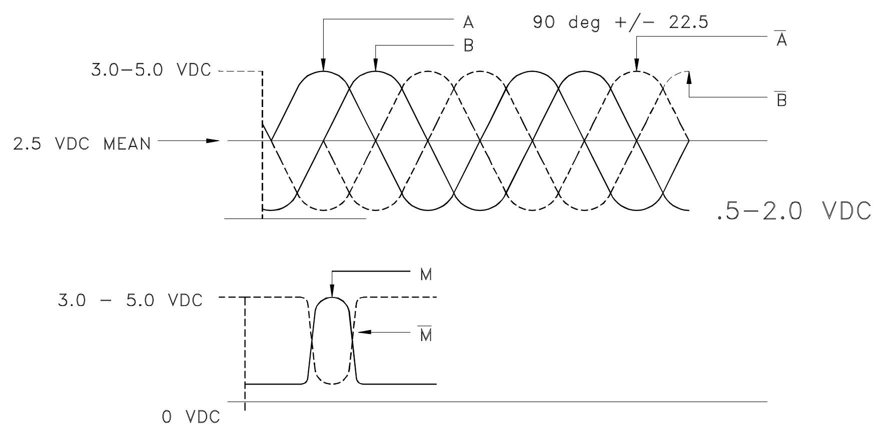


Figure 7 Typical Encoder Signals - Sine Wave Output

A line on an encoder would be 360° of signal change of either A or B.

Encoder Square Wave Signals

Sine wave signals are recommended because they are least affected by long cable lengths so that signal deterioration is negligible. TTL style encoders can also be connected to the 525 PMC. The signal levels for TTL encoders are similar to the desired amplified sine wave signals.

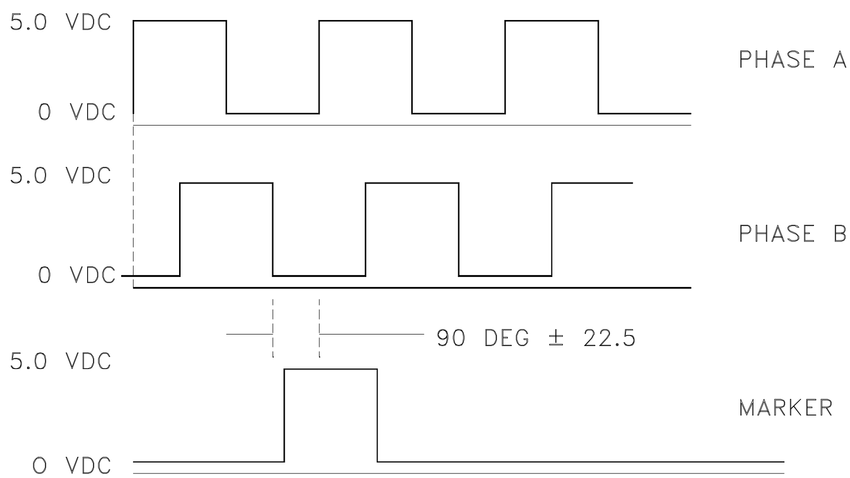


Figure 8 Typical Encoder Signals - Square Wave Output

Encoder Signal Quality

Any distributed capacitance in the interface cabling reacts to this frequency as an impedance to couple unwanted signals on the adjacent lead. Extreme care must be taken to minimize these unwanted effects. If care is not taken the resultant signal to the 525 PMC could look like this:

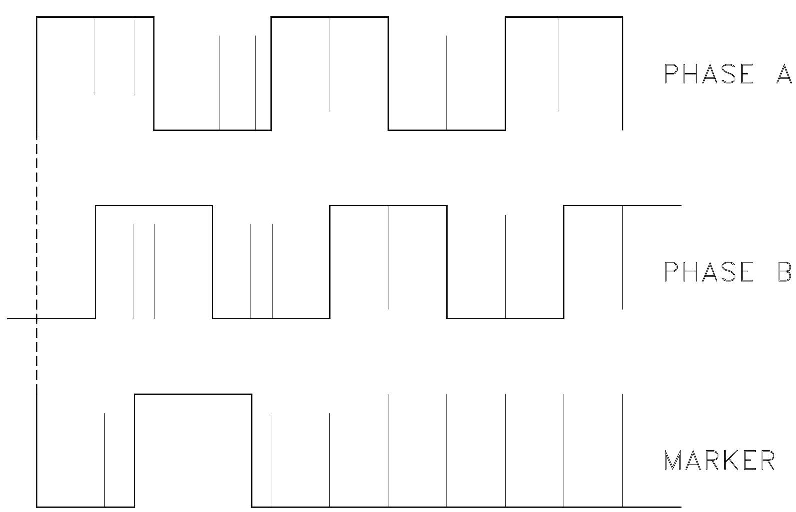


Figure 9 Encoder Signals As A Result Of Noise

The 525 PMC can not decode this properly. These signals are deteriorated because of cross coupling through the cabling. The signals have to be as shown in figure 8.

Encoder Feedback Cables

The encoder must be connected to the motor so a clockwise rotation of the motor shaft, as viewed from the shaft end of the motor, will cause a count up condition. The cable drawings below (for the two types of encoders EMC supplies) assume that CW motor rotation will cause CW encoder shaft rotation. This is the case if the encoder is mounted on the rear of the motor.

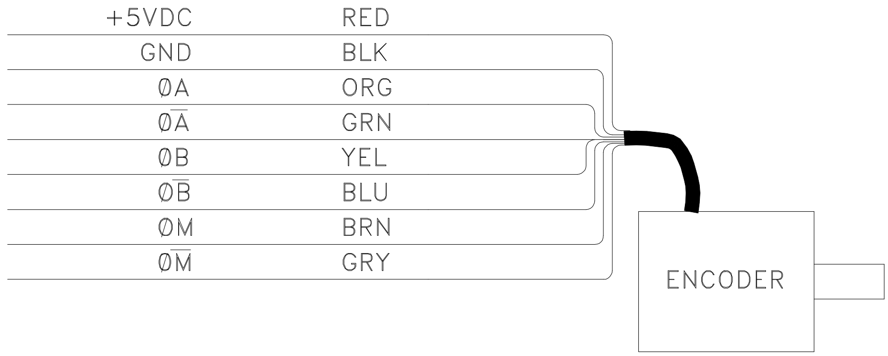


Figure 10 Model SDC-15-1 Encoder Connections

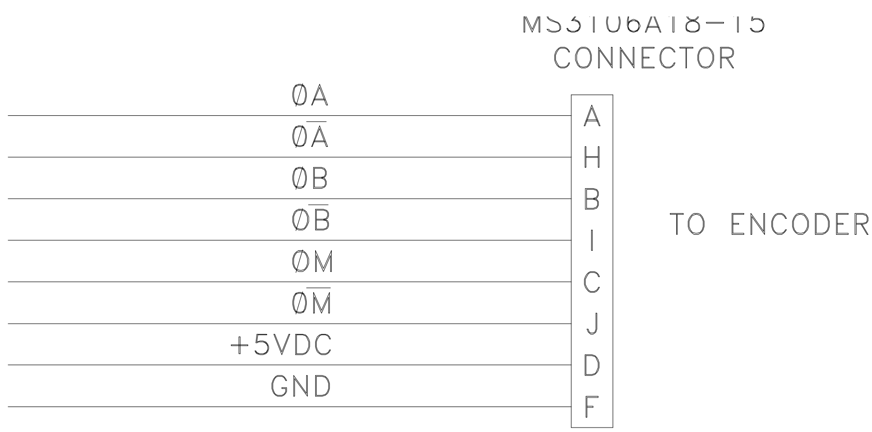


Figure 11 Model SDC-25-1 Encoder Connections

External Drive Connections To The 525 PMC

The 525 PMC has two keyed, detachable terminal blocks on the bottom of the unit for connecting the external drive and encoder. The terminal blocks are divided into two sections of 13 (1-13 & 14-26). Connections should be made using wire no larger than 18ga. The following is a breakdown of the signals available at the terminal blocks.

Connector Pin#	Signal Description
1	Encoder signal input A
2	Encoder signal input A not
3	Encoder signal input B
4	Encoder signal input B not
5	Encoder signal input M
6	Encoder signal input M not
7	Encoder +5VDC Supply
8	Encoder Shield & Command Shield
9	Encoder Ground
10	Command (+)
11	Command (-)
12	Feedback current (+)
13	Feedback current (-)
14	Input 1 (+)
15	Input 1 (-)
16	Input 2 (+)
17	Input 2 (-)
18	Reserved for future use
19	Reserved for future use
20	Shield
21	Drive enable NORMALLY ON (-) EMITTER
22	Drive enable NORMALLY OFF (-) EMITTER
23	Drive enable (+) Common Collector (dirve enable only)
24	Drive reset NORMALLY ON (-) EMITTER
25	Drive reset NORMALLY OFF (-) EMITTER
26	Drive reset (+) Common Collector (drive reset only)

Signal Discriptions

Encoder input signals

The encoder input signals - A, A not, B, B not, M, M not are directly connected to the motor encoder. The signals should have a minimum 2.5 V and a maximum 5.0 VDC peak to peak voltage with a 2.5 VDC reference. Sine wave encoders are recommended due to their inherent noise immunity. Square wave encoders can also be used if care in cable selection is taken.

Encoder +5VDC supply

+5VDC and ground is provided to power the encoder. Maximum current output is 150 ma. If the encoder to be used exceeds this limit an external power supply will have to be provided and grounded to the encoder ground on the terminal block.

Shield

Two shield terminals are provided as a connection point for cable shields. These two terminals are connected internally to the input power ground terminal on the unit. Shields should be connected on one end only, preferably at the 525 PMC.

Command (+) and Command (-) Output

Command (+) and Command (-) is the analog output signal from the 525 PMC to the external drive's velocity command input. This signal can be scalable from +/-5 volts = maximum velocity to +/-12 volts = maximum velocity at a minimum load impedance of 4.7K. The Command (-) signal has a ground reference to the input power ground of the 525 PMC.

NOTE: It is important that the control ground on the amplifier is connected to the input power ground on the 525 PMC.

Command Output Polarity

A positive voltage out of the command output must cause a clockwise rotation of the motor shaft as viewed from the shaft end. The encoder should turn clockwise as viewed from the shaft. This will ensure a positive count within the 525 PMC.

Signal Path

The command (-) output is internally connected to ground within the 525 PMC. Consequently, the (-) input to the external drive must have a ground reference. The figures below show the two most typical connections to an external drive.

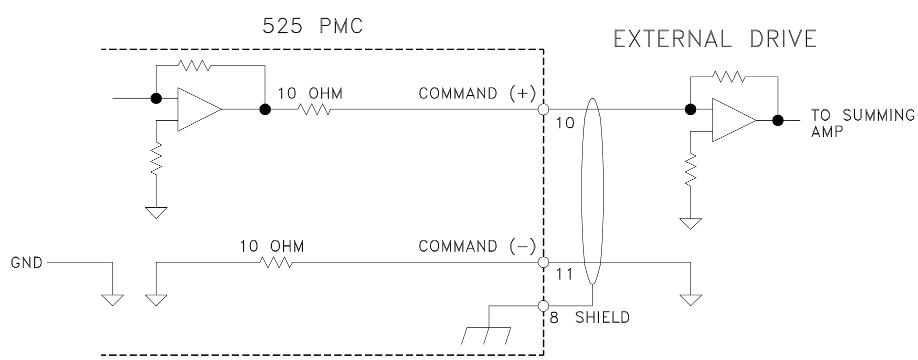


Figure 12 Single Ended Input Configuration

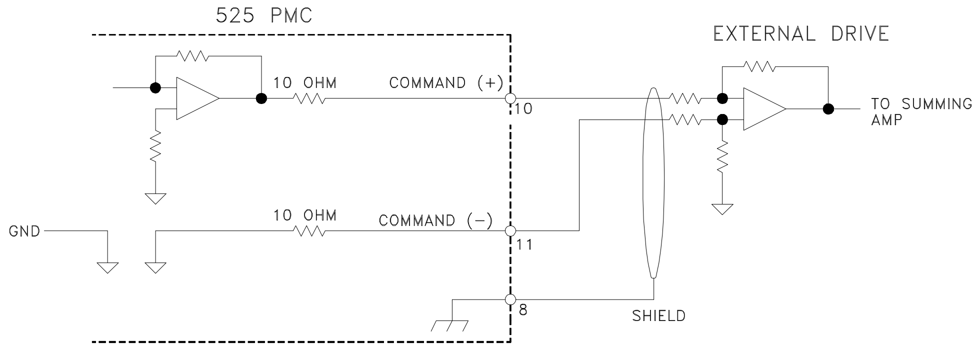


Figure 13 Differential Input Configuration

Feedback Current

Feedback current (+) and Feedback current (-) are inputs to allow the 525 PMC to monitor the motor current via the voltage proportional to current output on the external drive amplifier. This analog input is scaled at +/-5VDC = continuous current and +/-10VDC = peak current. Fault times range from 4-10 seconds at slightly greater than continuous current to 2-4 seconds at peak current. This is a high impedance input which is referenced to logic ground. Scaling of this input is programmable.

Inputs 1 & 2:

Inputs 1 & 2 allow for external drive's fault indications to be sent to the 525 PMC. A fault on Input 1 will produce a "9" on the display of the 525 PMC and a fault on Input 2 will produce a "11". Polarity of these inputs is programmable. If one or both of these inputs are not used they should have their polarity set at (-) with the "Setup Menu" of PCX (see PCX 6.X manual) or with serial commands. Typical input configuration is shown in 14.

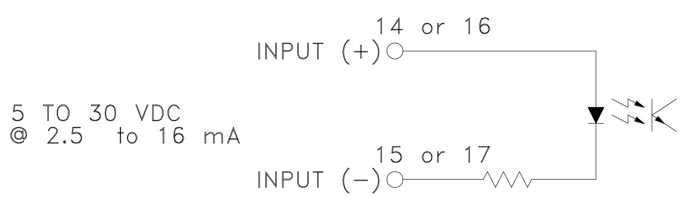


Figure 14 Input Polarity

Drive Enable Outputs

The drive enable outputs allow the 525 PMC to disable the external drive during power up, a bridge inhibit or a fault condition. The output is provided with both normally on and normally off outputs. To utilize the normally on output connect between drive enable (+) and normally on drive enable (-). Consequently, to utilize the normally off output connect between drive enable (+) and normally off drive enable (-). The (+) indicates the collector of an optical isolator while the (-) indicates the emitter.

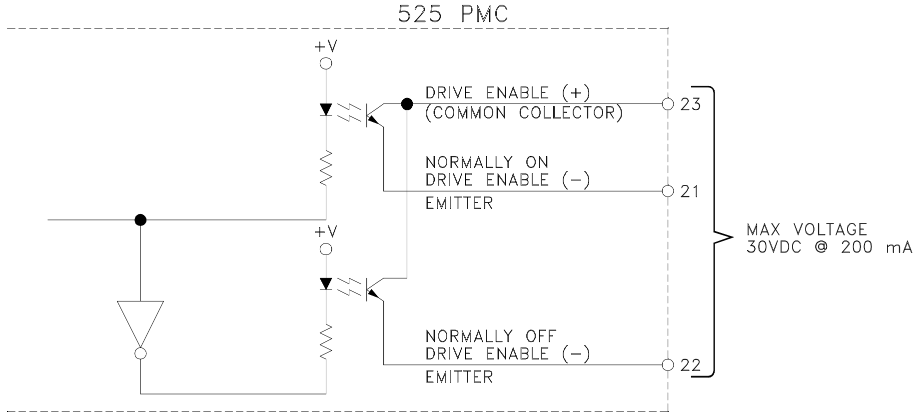


Figure 15   Drive Enable Outputs

During a reset, bridge inhibit or a fault the normally on output is off and the normally off output is on. During operation the normally on output is on and the normally off output is off.

Drive Reset Outputs

The drive reset outputs allow the 525 PMC to reset the external drive after a fault. The output is provided with both normally on and normally off outputs. To utilize the normally on output connect between drive reset (+) and normally on drive reset (-). Consequently, to utilize the normally off output connect between drive reset (+) and normally off drive reset (-). The (+) indicates the collector of an optical isolator, while the (-) indicates the emitter as shown below.

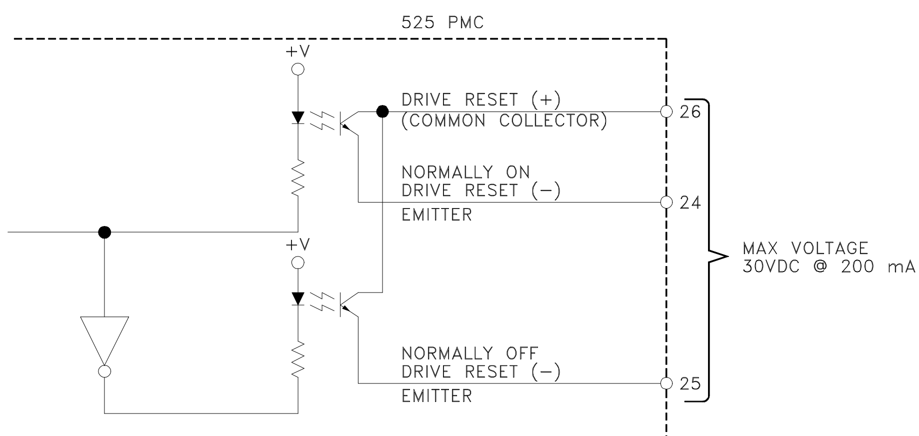


Figure 16   Drive Reset Outputs

During a reset the normally on output is on and the normally off output is off. After completion of the reset and during operation, the normally on output is off and the normally off output is on.

Minimum System Configuration

The following diagram illustrates the minimum 525 PMC system configuration.

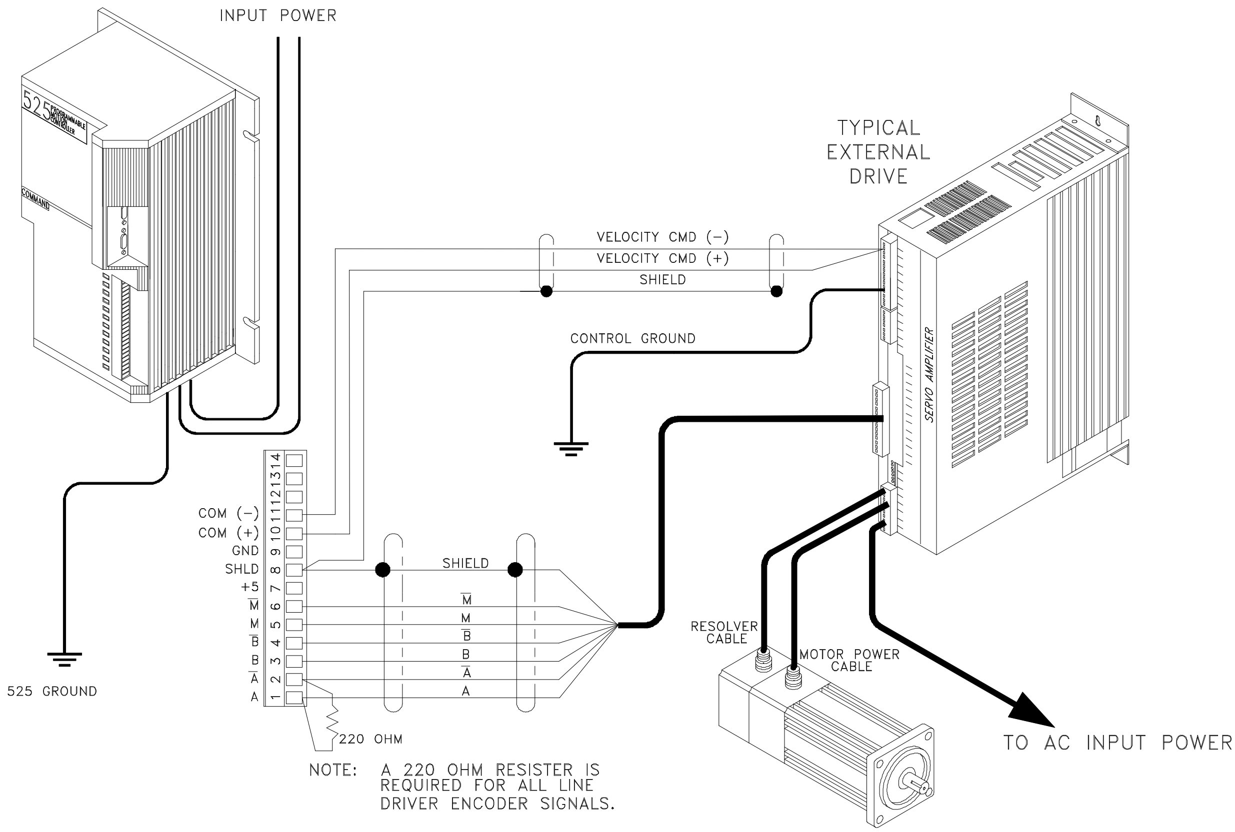


Figure 17 Minimum System Configuration

A positive command voltage to the external drive must cause CW motion of the motor as viewed from the shaft end of the motor. This is a minimum interface with no optional I/O shown (i.e., thermal fault, drive fault and brake output). Ensure that the fault input polarities are set normally off to prevent unwanted faults.

Operating Modes

The primary operating mode is the indexing mode. The indexing mode is available at all times and is independent of any alternative operating mode switch settings. The two variations of the indexing mode are shown in 0. Switches 3 and 4 of the four position dip switch are used to configure the alternative operating modes.

Table 1 Indexing Modes

Mode	Control	Interface	Command Device
Indexing	Index, Home, Jog	Inputs/Outputs 10 to +30VDC Optically Isolated (sink or source)	Relay logic, Operator Control Panel or PLC
Indexing	Index, Home, Jog & Motion Programming	RS423/422/232C Serial Interface XMIT/REC ASCII	Personal Computer ASCII Unit on PLC ASCII Terminal

In addition to the indexing mode, four alternative operating modes are also available (see 2). These modes are called Pulse/Pulse, Pulse Direction Analog Velocity and Analog Torque.

Table 2 Alternative Modes

Mode	Control	Interface	Command Device
Pulse/ Direction	Position Increments	Pulse & Direction TTL Logic Levels	Motion Generator, Indexer, CNC
Pulse/Pulse	Position Increments	CW & CCW Pulses TTL Logic Levels	Motion Generator, Indexer, CNC
Analog	Velocity	Zero to ±10 VDC	Velocity Controller
Analog	Torque	Zero to ±10 VDC	Velocity Controller

NOTE: Indexing operations may be performed in all modes under serial control.

Mode Selection

18 defines the switch settings for the four alternative modes of operation.

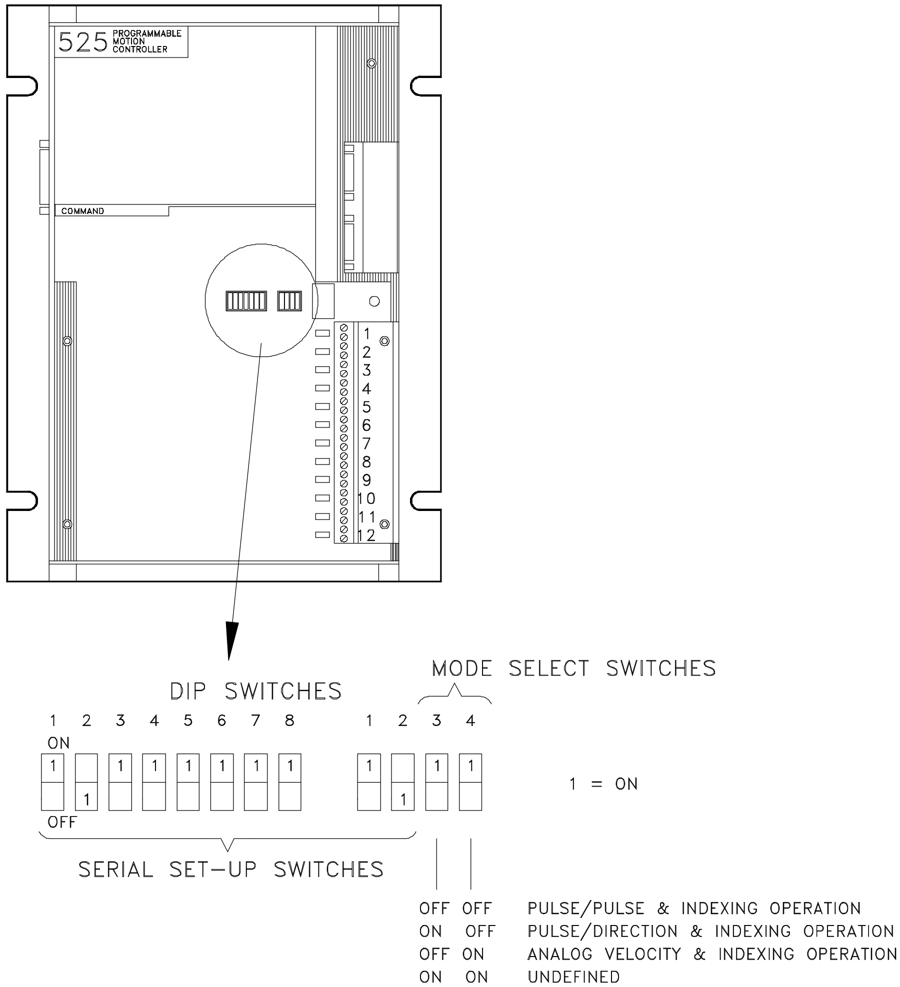


Figure 18 Dip Switches/Mode Selection (Factory Defaults Shown)

Pulse Mode

In the Pulse mode the 525 PMC responds to a serial pulse train representing externally generated incremental position change commands. This mode is commonly used to control DC stepper motors or numeric controlled (CNC) machinery. The Pulse/Pulse or Pulse/ Direction operation are provided so that pulse inputs are converted to velocity and distance.

With the Pulse/Pulse option two inputs are configured for clockwise and counter clockwise pulses. Pulses on the CW pulse input line cause the motor shaft to rotate CW and pulses on the CCW pulse input line cause CCW rotation of the motor shaft.

In the Pulse/Direction option the same input lines are used. However, one input line is configured for the control pulses and the other input line is used to control the direction. If there is no current flowing in the direction input, pulses on the pulse input line will cause CCW rotation.

In either pulse mode, once motion is initiated with these inputs, motion in the opposite directions can not be achieved until motion in the initiated direction has been stopped by stopping the incoming pulses.

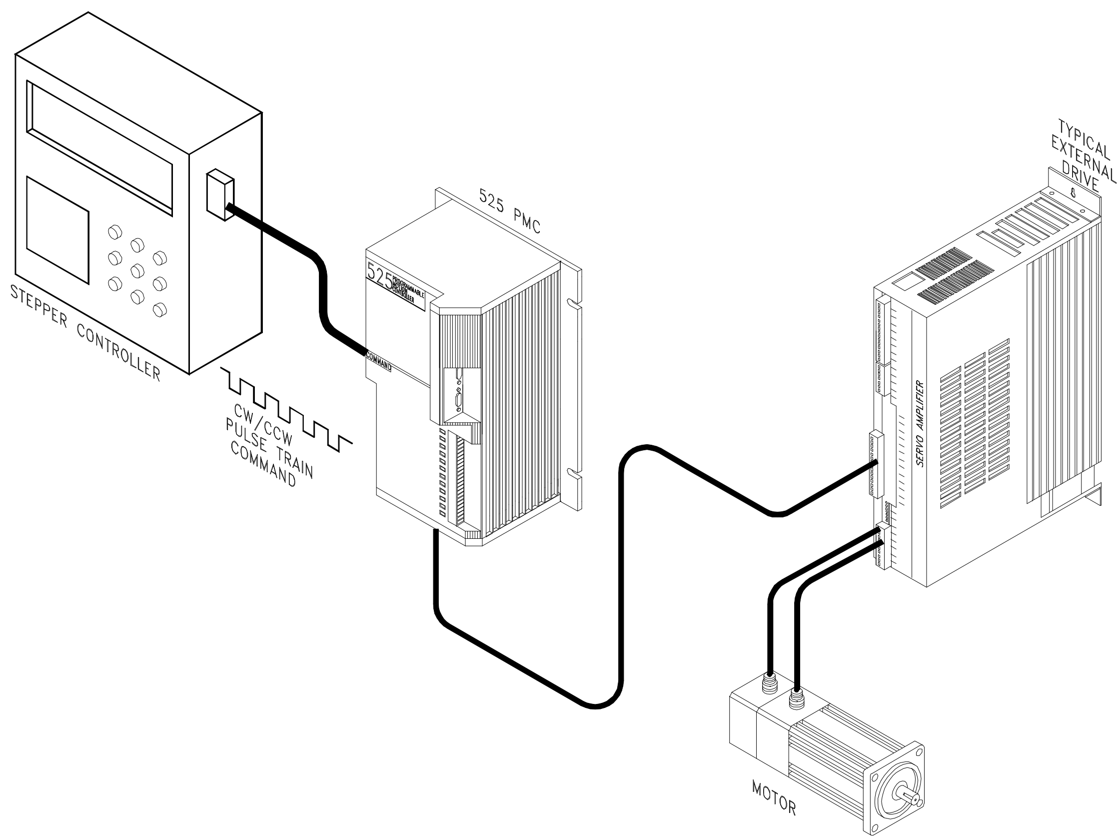


Figure 19 Pulse Mode

In a pulse train application the pulses are fed into the CW and CCW inputs on the 15 pin DB style command connector (pins 4, 2 and 5, 3 respectively). The inputs can be used for sinking or sourcing current; this requires two connections per input. In either case (sinking or sourcing), the noise immunity is improved when the normal state of the input does not cause current to flow in the optical coupler.

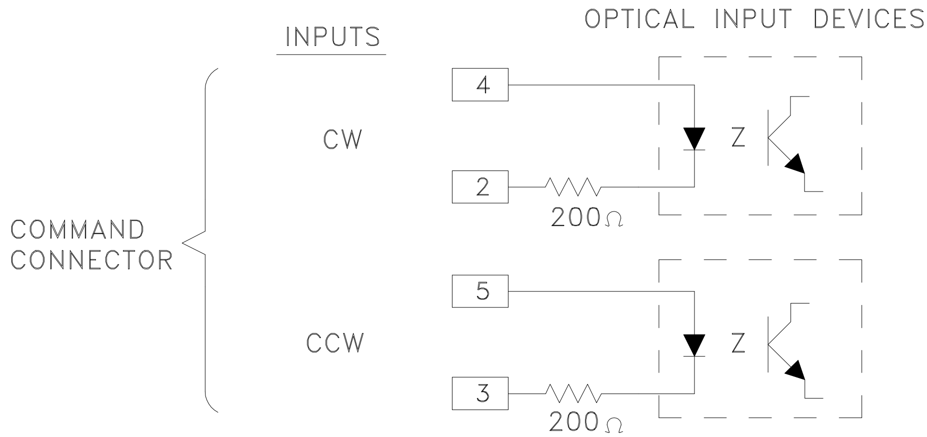
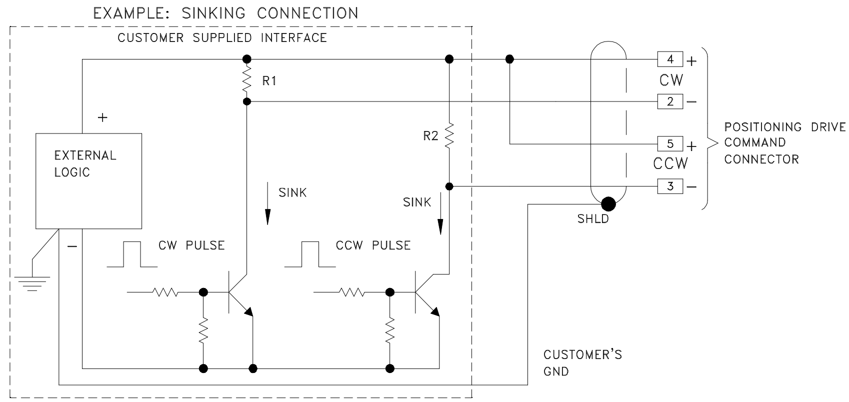


Figure 20 Command Connector Circuit

Current should only flow when a motion pulse is applied by the external pulse generator and each voltage pulse must be at least 1.5 micro seconds wide and between 2.4 and 5.5 VDC (TTL compatible) to be accepted as a valid pulse. The user's signal driver must be able to supply 25mA (either sinking or sourcing). If open collector logic devices are used in a sinking connection, pull-up resistors may be necessary.

The speed of the system is based on the pulse frequency and can be changed by changing the value of "Steps Per Revolution" in the PCX Parameters screen (see PCX manual). the maximum pulse frequency is 210 KHz.

NOTE: CW rotation of the motor is established with the operator facing the shaft end of the motor.



*NOTE: WHEN USING OPEN COLLECTOR LOGIC DEVICES FOR SINKING CONNECTIONS, PULL-UP RESISTORS (R1, R2) MAY BE REQUIRED.

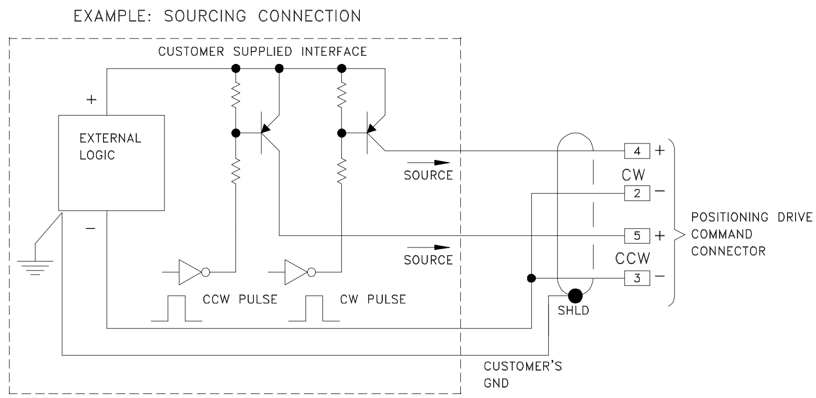


Figure 21 Example Of Sinking/Sourcing Connections

Any connections between the customer supplied interface (stepper controller, etc.) and the command connector should be made through a shielded cable. The shield of this cable should be connected to the customer interface ground (source end). If no shield connection is available at the source end, then the shield connection on the command connector (15 pin) may be used. Keep in mind that this shield connection is connected internally to chassis ground of the drive.

WARNING

The "STOP" I/O function must be held "Active" to prevent motion. if the "Stop" I/O function is not held "Active", the operator must stop incoming command voltage to avoid motion. Failure to follow proper safety procedures can cause death or serious injury.

Analog Mode (Velocity or Torque)

In the Analog mode (torque or velocity) the servo amplifier responds to a conventional ±10 volt DC signal. Most variable speed drives and servo amplifiers on the market today receive commands via this type of signal.

When the DIP switches are set to enable the analog mode the display character of the 525 PMC will be an (A). In analog mode a 0 to 10 volt command signal is equated to 0 to maximum velocity or peak torque.

The 525 PMC can receive external input commands and serial commands while in analog mode. For example: When in analog mode and you initiate an index, home or jog command via an input the (A) on the diagnostic display will be replaced with an (E) and the requested motion occurs. Upon completion of the requested motion the 525's operating mode will automatically change back to analog mode (A).

You can also temporally change the operating mode by sending an SC=1 (serial command) to the 525 PMC. This would disable analog control and enable serial control displaying an (E.) on the diagnostic display at which time the 525 PMC would be able to receive motion commands via serial commands or inputs. Upon completion of the requested motion the 525's operating mode will automatically change back to analog mode (A). To change the 525's operating mode serially, use the SC=0 command.

In either of the two analog modes of operation a ±10 VDC signal is equated to either (CW) or (CCW) maximum programmed velocity in the velocity mode or CW or CCW full peak torque rating in the torque mode. The mode of operation can be selected via the mode select switches on the front of the 525 PMC.

NOTE: CW rotation is defined while facing the shaft end of the motor.

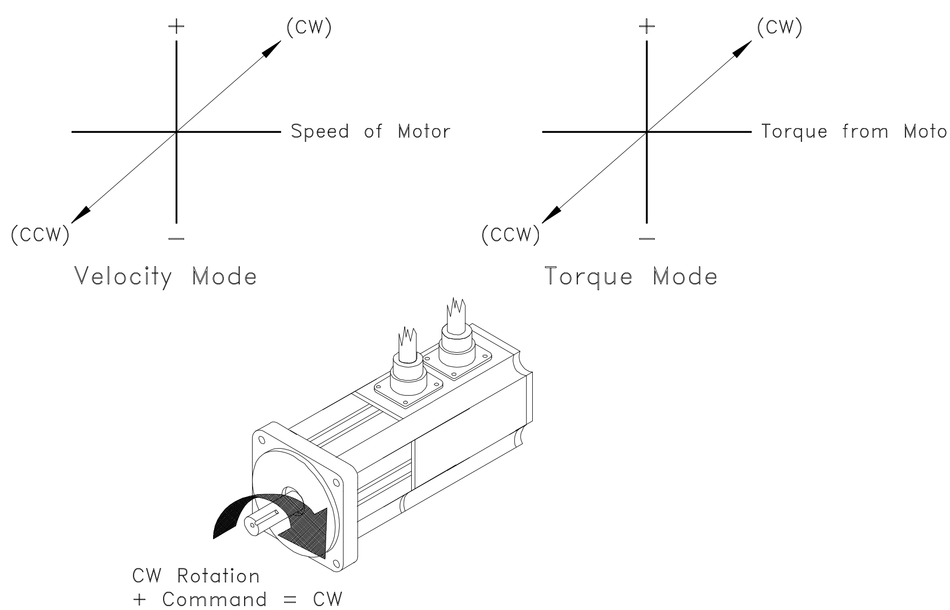


Figure 22 Analog Velocity/Torque Mode

In velocity mode the ±10 VDC command signal is connected through the 15 pin DB style command connector. The input circuit of the 525 is a differential input amplifier with the following characteristics:

- Application of a + voltage to pin 7 with respect to pin 13 (GND) will produce either a CW motion or torque in the CW direction as viewed from the shaft end of the motor.
- Application of a - (negative) voltage to pin 7 with respect to pin 13 (GND) will produce a CCW motion or CCW torque. The opposite conditions are true if the analog voltage is applied to pin 6 with respect to pin 13. The analog voltage can also be applied between pins 6 and 7 for a true differential input.

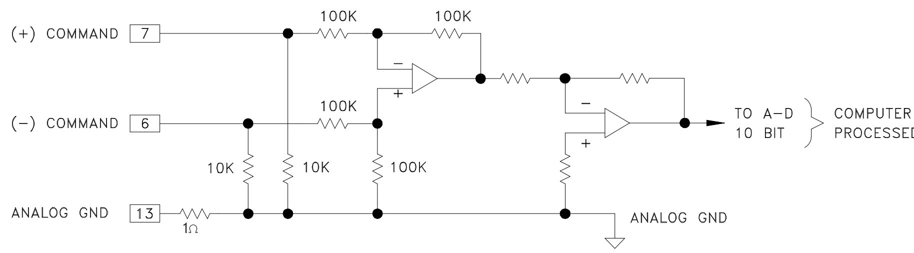


Figure 23 Command Input Circuit

CAUTION

Voltages on pins 6 or 7 must not exceed ±12 VDC with respect to pin 13, analog ground

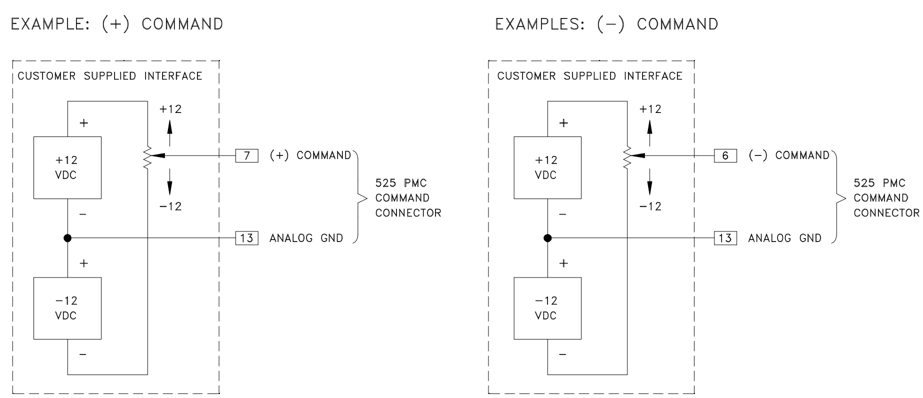


Figure 24 15 Pin Command Connector

NOTE: Both the hardware and software position travel limits are active if they are set up.

WARNING

The "STOP" I/O function must be held "Active" to prevent motion. if the "Stop" I/O function is not held "Active", the operator must stop incoming command voltage to avoid motion. Failure to follow proper safety procedures can cause death or serious injury.

Serial Interface

All 525 PMC's are equipped with two RS423 serial interface connectors which are RS232C/RS422 signal compatible. The serial interface has a DIP switch selectable baud rate ranging from 110 to 19200 bps and is connected using a simple three wire hook-up; transmit, receive and signal ground. Transmission is accomplished using standard printable ASCII characters. This means that the 525 PMC can also communicate over the serial interface with a remote terminal.

Serial A

All programming is done through the "Serial A" connector. The serial cable should be shorter than 50ft in order to comply with RS232 specifications. However, longer cable lengths can be possible at slower baud rates. (Less than 4800 bps).

Serial B

The 525 PMC also includes a second 9 pin RS423 serial connector designated as "Serial B", which is used for a multi-drop networking scheme to other drives. This second connector cannot be used for programming other than in a multi-drop set up.

Multi-Drop Configuration

When using multi-drop configuration, the 525 PMC can automatically detect when there are other units "down the line" and redirect its serial signals to the appropriate drives or 525's. The serial commands are sent to the appropriate unit based on the axis identifier dip switch settings. Each 525 PMC in a multi-drop configuration must have a unique axis identifier code and must be set up for full duplex mode.

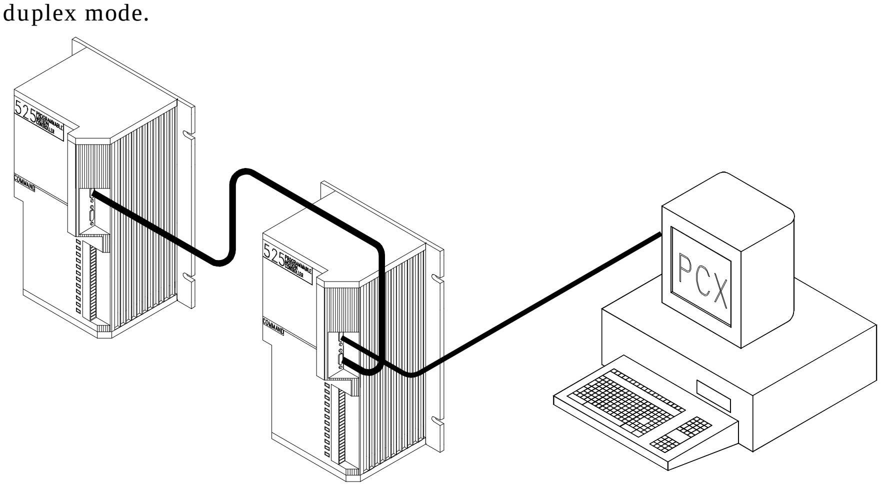


Figure 25   Multi-Drop Connection

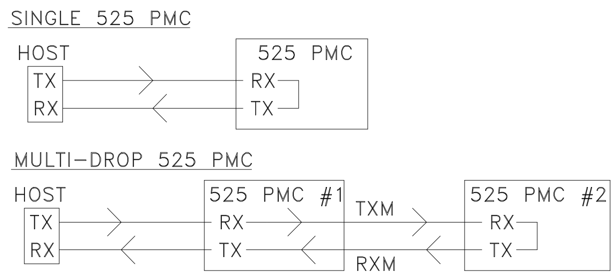
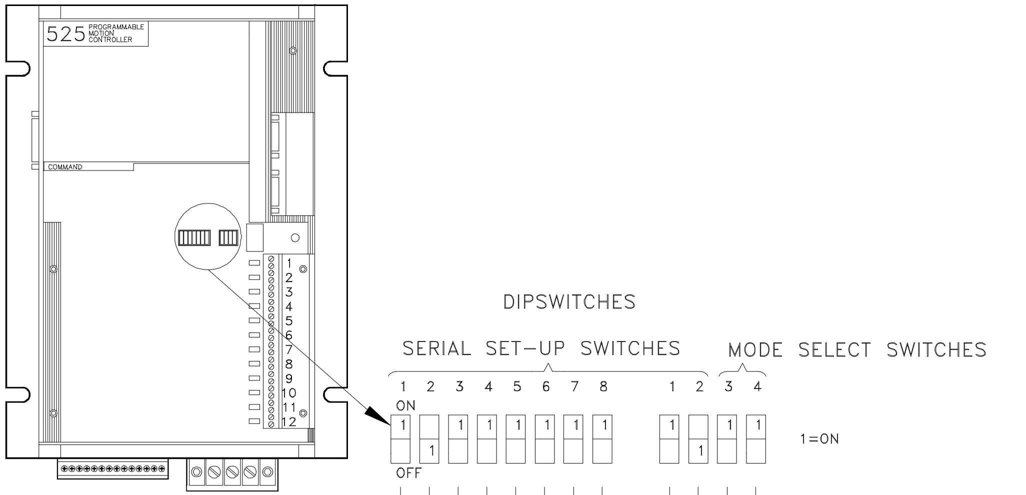


Figure 26   Serial Signal Flow Diagrams

Dip Switch Settings

The DIP switch numbers and their corresponding functions are shown below.



BAUD RATE

OFF	OFF	OFF	110
ON	OFF	OFF	300
OFF	ON	OFF	1200
ON	ON	OFF	2400
OFF	OFF	ON	4800
ON	OFF	ON	9600
OFF	ON	ON	19.2K
ON	ON	ON	RESERVED

OFF	OFF	PULSE/PULSE
ON	OFF	DIRECTION
OFF	ON	ANALOG VELOCITY
ON	ON	ANALOG TORQUE

AUTO LINE FEED ON/OFF

HALF DUPLEX=ON
FULL DUPLEX=OFF

AXIS IDENTIFIER

OFF	OFF	OFF	OFF	OFF	NONE REQUIRED
ON	OFF	OFF	OFF	OFF	AXIS 1
OFF	ON	OFF	OFF	OFF	AXIS 2
ON	ON	OFF	OFF	OFF	AXIS 3
OFF	OFF	ON	OFF	OFF	AXIS 4
ON	OFF	ON	OFF	OFF	AXIS 5
OFF	ON	ON	OFF	OFF	AXIS 6
ON	ON	ON	OFF	OFF	AXIS 7
OFF	OFF	OFF	ON	OFF	AXIS 8
ON	OFF	OFF	ON	OFF	AXIS 9
OFF	ON	OFF	ON	OFF	AXIS A
ON	ON	OFF	ON	OFF	AXIS B
OFF	OFF	ON	ON	OFF	AXIS C
ON	OFF	ON	ON	OFF	AXIS D
OFF	ON	ON	ON	OFF	AXIS E
ON	ON	ON	ON	OFF	AXIS F
OFF	OFF	OFF	OFF	ON	AXIS G
ON	OFF	OFF	OFF	ON	AXIS H
OFF	ON	OFF	OFF	ON	AXIS I
ON	ON	OFF	OFF	ON	AXIS J
OFF	OFF	ON	OFF	ON	AXIS K
ON	OFF	ON	OFF	ON	AXIS L
OFF	ON	ON	OFF	ON	AXIS M
ON	ON	ON	OFF	ON	AXIS N
OFF	OFF	OFF	ON	ON	AXIS O
ON	OFF	OFF	ON	ON	AXIS P
OFF	ON	OFF	ON	ON	AXIS Q
ON	ON	OFF	ON	ON	AXIS R
OFF	OFF	ON	ON	ON	AXIS S
ON	OFF	ON	ON	ON	AXIS T
OFF	ON	ON	ON	ON	AXIS U
ON	ON	ON	ON	ON	AXIS V

Figure 27 Dip Switches (Factory Defaults Shown)

Dip Switch Function Descriptions

Baud rate switches

Switches 1, 2 and 3 of the eight position DIP switch are used to match the baud rate of the drive to the baud rate of the programming device. If the two baud rates are not the same, serial communication will not be possible.

Axis identifier switches

Switches 4, 5, 6, 7 and 8 are used to distinguish between drives in a multi-axis application. This allows each axis to be programmed individually over the same multi-drop serial cable.

Duplex switch

Switch 1 of the four position DIP switch sets either half or full duplex mode. In half duplex mode the serial data is not echoed back to the programming device for conformation or display. In full duplex mode the data is echoed back to the programming device, allowing the data to be verified. In most cases full duplex is the preferred mode of operation.

NOTE: All drives in a multi-drop configuration must be set to full duplex mode.

Auto line feed

Switch 2 is used to determine if a line feed character should be echoed back to the programming device when a carriage return is received. This will alter the line spacing on the programming monitor.

Framing information

When using serial communication, the data must be sent as a string of continuous bits. This string of data bits must be "framed" by start and stop bits so that valid data can be recognized. The framework which the drive will recognize is as follows:

1 start bit
8 data bits
1 stop bit

The high order data bit is ignored by the drive. A parity bit may therefore be sent to the drive along with only seven data bits. When transmitting, the drive will always send a zero for the eighth data bit.

Serial Cables

The maximum allowable length of serial cable used with the 525 PMC is 50 feet. This limitation is a result of the following statement from the EIA RS-232C specification:

"The use of short cables (each less than approximately 50 feet or 15 meters) is recommended; however, longer cables are permissible, provided that the resulting load capacitance measured at the interface point and including the signal terminator, does not exceed 2500 picofarads".

In 525's, the signal terminator capacitance is approximately 1000pf and a typical cable capacitance runs about 30pf/ft. Therefore, the cable length should be limited to 50 feet. Longer serial interface cables are not recommended.

In multi-drop configurations, the ground reference (earth ground) for each communicating device must be at the same potential. The further apart the communicating devices, the more difficult this is to achieve. Therefore, it is a good idea to keep the multi-drop loop as short as possible. This condition is not as critical if all of the communicating devices are optically isolated.

It is very important that the serial cables are not altered in the field. It is also important to follow any recommendations given in the product manuals on how to connect or terminate these cables.

NOTE: As a general rule, the minimum cable bend radius is ten times the cable outer diameter.

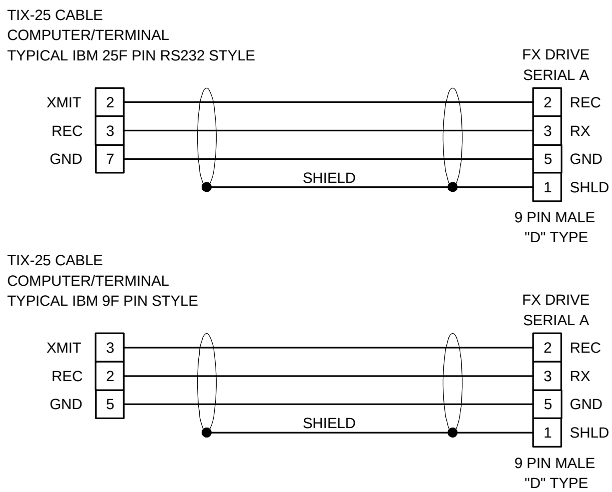


Figure 28 TIX-XXX & TIA-XXX Wiring Diagrams (525 PMC To IBM Serial Port)

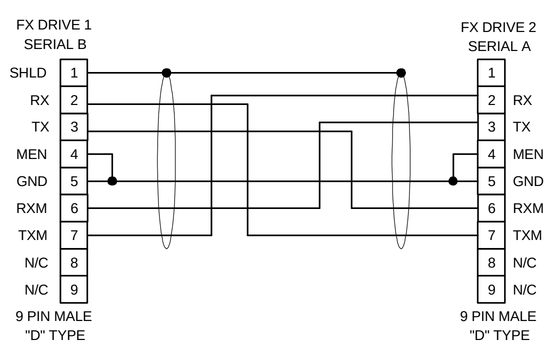


Figure 29 DD-XXX Wiring Diagram (Multi-Drop Cable)

NOTE: For wiring diagrams of Emerson Motion Control T-60 (NMA-XXX), T-61 (NMB-XXX) or T-21 refer to the operators manual that accompanied that device.

Input Output Interface

The 525 is equipped with 8 inputs and 4 outputs which operate on +10 to +30 vdc. Each input and output has 2 screw terminals associated with it to provide for either sinking or sourcing operation. The first 8 pairs of designated terminals are inputs and the last 4 pairs of terminals are outputs (see 30). The outputs are capable of sinking or sourcing 200 mA. It is the operators responsibility to limit the output current to less than or equal to 200 mA.

These inputs and outputs allow for proper timing and coordination between the 525's motion and other machine control functions. The inputs and outputs typically are connected to the machine's programmable logic controller (PLC) or external drive. These inputs and outputs can also be connected to limit switches, and/or switches and indicators on an operator's control panel.

A wide range of input/output control functions are provided. The functions used are assigned to any of the input/output lines. This is accomplished through either serial interface commands or by using the PCX software provided with the 525. Inputs may be programmed as normally off or normally on. In addition, more than one function may be assigned to the same input line.

Inputs and outputs for control and status are wired to a detachable terminal strip which makes servicing easy. All I/O wiring must be done with 18 to 24 gauge wire and must be industrial grade insulated wire that will withstand the environment of the application. The use of larger gauge wire will cause the I/O terminals to prematurely fatigue.

NOTE: To improve noise immunity, Emerson Motion Control recommends using twisted pair wire for the I/O wiring. In extremely electrically noisy environments, shielded, twisted pairs should be used with the shield connected to the safety ground via a low impedance conductor.

Each input and output to the control unit is designed to have high noise immunity. However, this does not mean that high voltage, noise emitting wiring on the rest of the application can be run adjacent to the control inputs. Precautions outlined in the "ELECTRICAL NOISE" section (page 2-4) should be followed.

An LED indicator is associated with each input and output. The input and output indicators are on if current is flowing in the associated line.

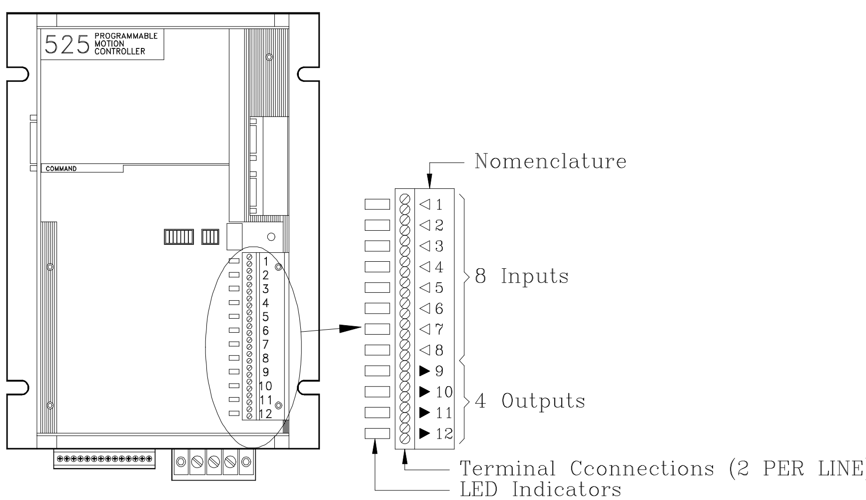


Figure 30 I/O Nomenclature

Input and Output Functions

The basic drive can be configured from a list of 21 input functions and 10 output functions. When a IOM/PCM module is added the number of available I/O functions is increased.

NOTE: For detailed description of I/O functions see PCX PROGRAMMING MANUAL P/N 400240-01.

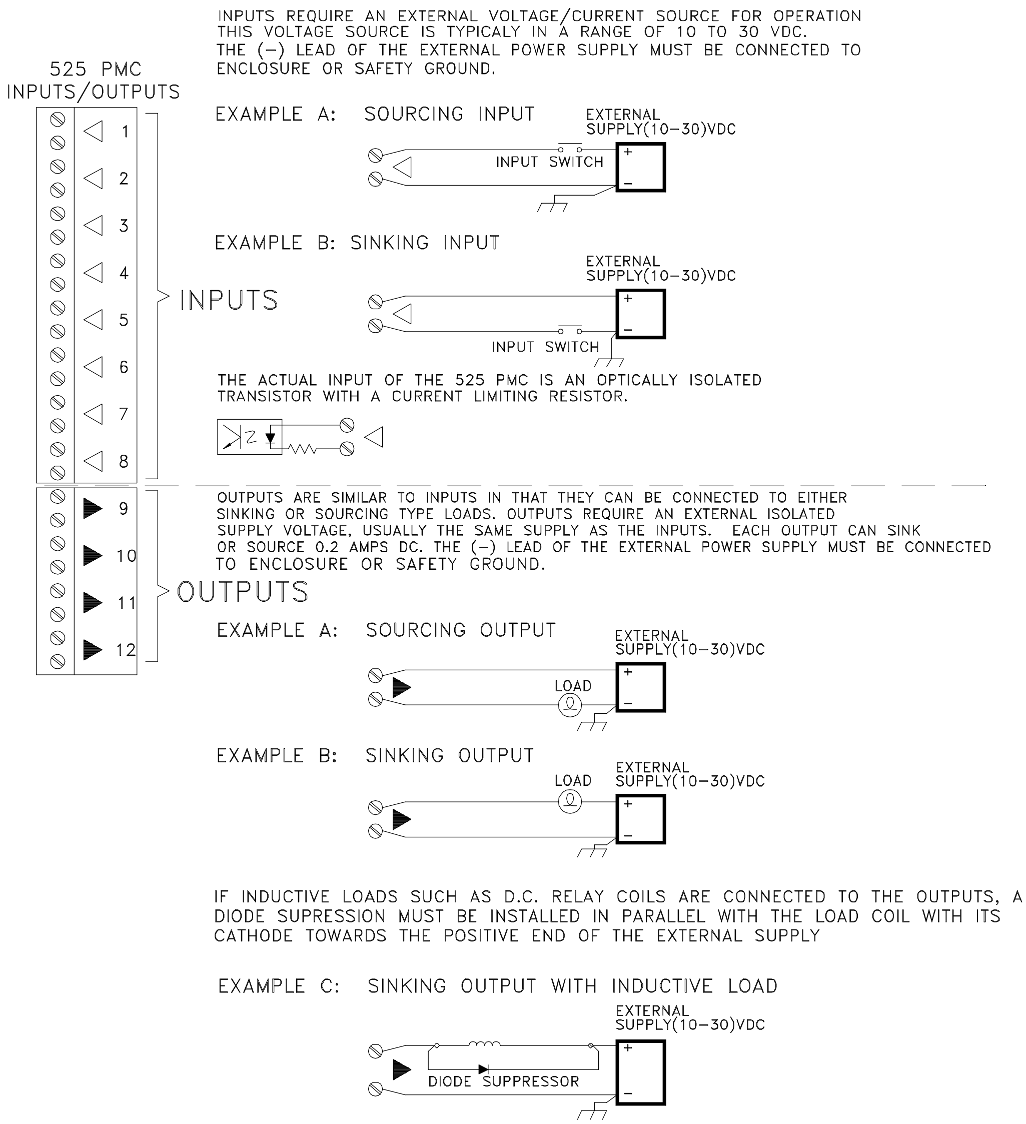


Figure 31 Input and Output Wiring, Sinking and Sourcing

NOTE: 18 to 24 gauge wire should be used for I/O wiring. The use of larger gauge wire will cause the I/O terminals to prematurely fatigue. DC common should be grounded to the single point ground.

NOTE: The DC Common of the I/O power supply must be grounded to the safety ground.

Installation of Application Modules

The IOM-1 and PCM application modules allow for memory expansion, I/O expansion and more complex motion programming capability. The IOM-1 and PCM application modules (Programmable Control Module) attach to the front of the drive amplifier with two locking arms. All electrical connections (except I/O) are made via the 48 pin connector.

NOTE: For programming and operation of the PCM Modules, see "PCX VERSION 6.X OPERATORS" Manual P/N 400240-01.

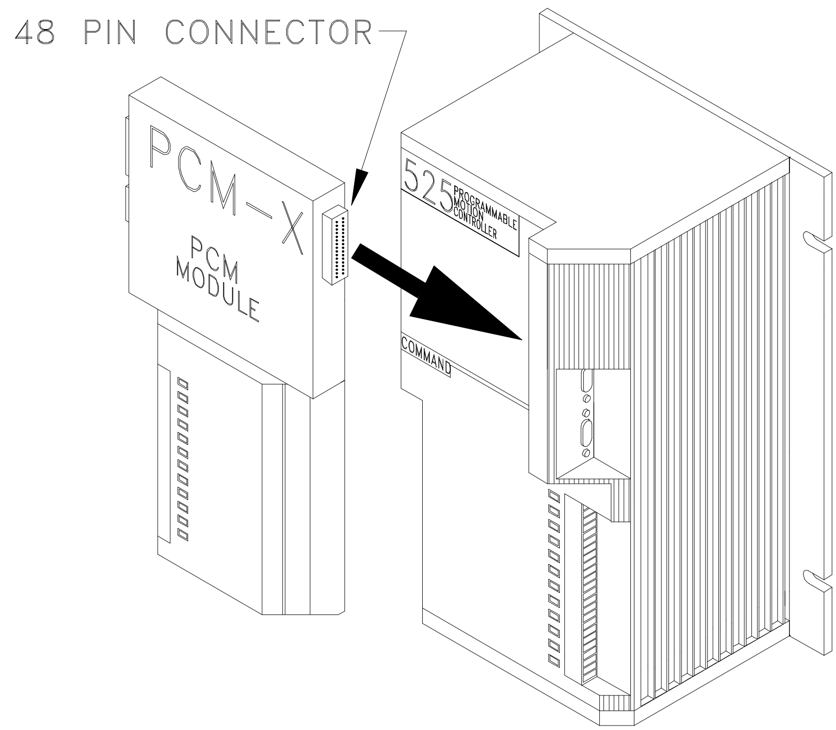


Figure 32 IOM/PCM Module Connection

PCM Modules I/O Connections

All PCM application modules are equipped with 8 inputs and 4 outputs which are optically isolated for +10 to +30 vdc operation. Each input and output has 2 screw terminals associated with it to provide for either sinking or sourcing operation. The first 8 pairs of designated terminals are inputs and the last 4 pairs of terminals are outputs. The outputs are capable of sinking or sourcing 200 mA. It is the users responsibility to limit the output current to less then or equal to 200 mA.

Adding a IOM-1 or a PCM module will double the I/O capabilities of the 525 PMC. The number of input lines are increased from 8 to 16 and the number of output lines is increased from 4 to 8.

The inputs and outputs allow for proper timing and coordination between the drive's motion and other machine control functions. The inputs and outputs typically are connected to the machine's programmable logic controller (PLC) or relay logic system, however, these inputs and outputs can also be connected to limit switches, and/or switches and indicators on an operator's control panel.

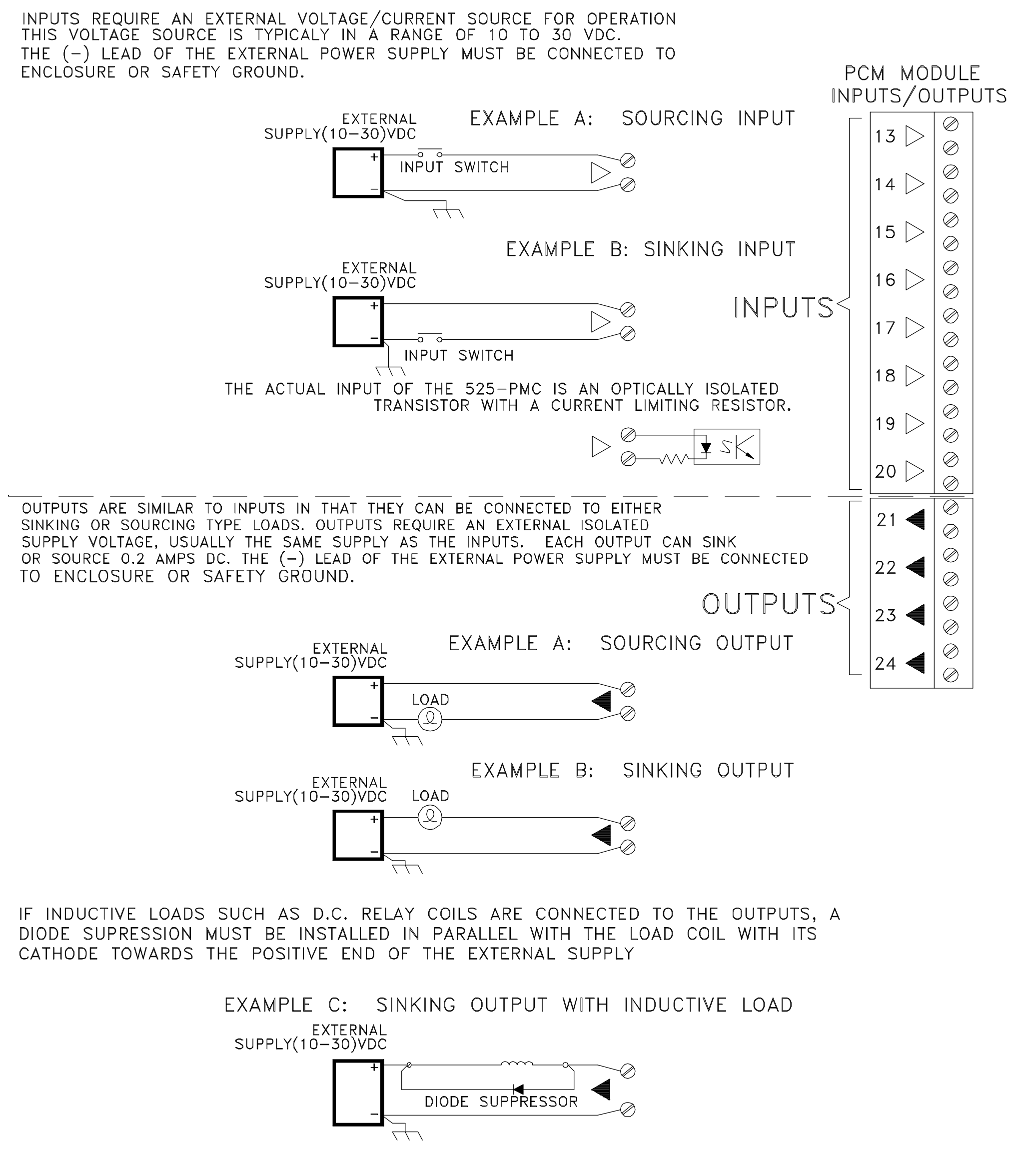


Figure 33 I/O Connections (IOM-1 And PCM Modules)

NOTE: 18 to 24 gauge wire must be used for I/O wiring. The use of larger gauge wire will cause the I/O terminals to prematurely fatigue.

Fault Polarity and Calibration

Overview

The PCX 4.5 software package provided with each 520 PMC allows setting the polarity of the inputs on the drive interface terminal strips. It also allows for system calibration.

Fault Polarity

The Fault Input polarity feature allows the user to adapt the 520 PMC to various fault output schemes. The polarity can either be set to the "+" condition (normally on) or to the "-" condition (normally off). Normally on indicates that current through the input electronics is the operating condition and that interruption of that current will yield a fault. Normally off indicates that the absence of current through the input electronics is the operating condition and that the addition of current will yield a fault. A fault on Input 1 will produce a "9" on the display and a fault on Input 2 will produce a "11" on the display. If the application does not use the fault inputs, both must be set to the "-" condition.

Setting the Fault Input Polarity

The 520 PMC Fault Polarity can be setup by moving through PCX to the fault input setup screen. follow the sequence below to arrive at the proper screen.

select: On-line Operations (COM1 or COM2), Drive Setup, Drive Configuration 520 PMC Setup, Fault Input Setup

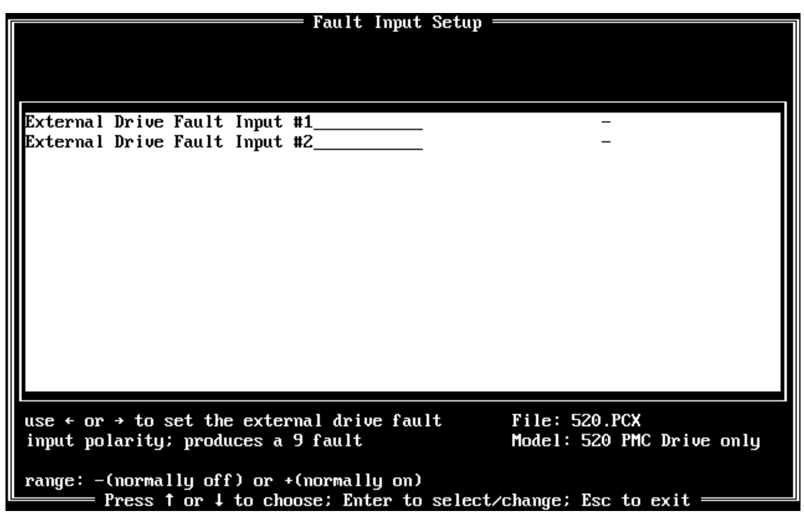


Figure 1 Fault Input Setup (Fault 9)

The cursor is then located on the polarity of either Input. Use the UP/DOWN arrows to position the cursor on the desired input to be changed. Use the LEFT/RIGHT arrows to toggle the polarity to "+" and "-". Once the desired polarity is shown, enter a carriage return to enter the polarity.

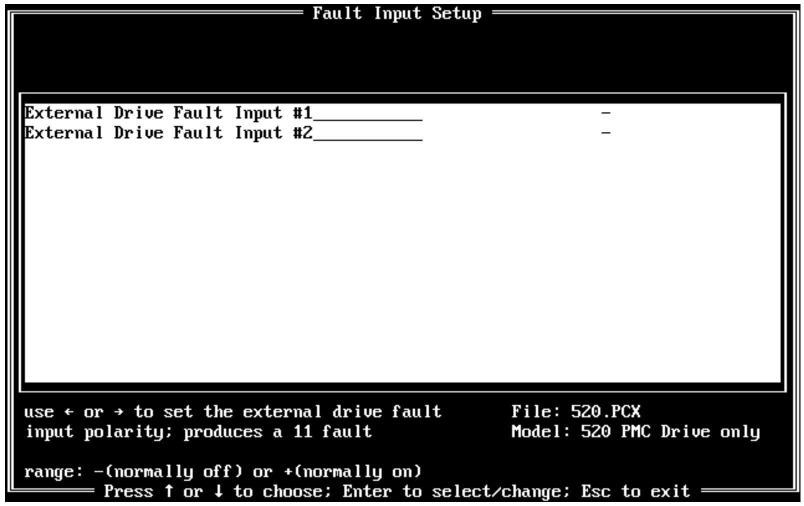


Figure 2 Fault Input Setup (Fault 11)

System Calibration

The System Calibration feature allows you to setup the calibration and loop gain of the 520 PMC/external drive combination to maximize system performance. Enter the Calibrate Velocity (maximum drive velocity) and the Calibrate Velocity Command Voltage (command voltage required to produce maximum velocity). With these two parametersyou, the 520 PMC calculates the proper command voltage needed to produce the desired motion profile. The Encoder Lines Per Revolution is currently fixed at 1024.

You can jog the motor at various velocities through the Calibrate Jog Velocity selection. By monitoring the Following Error when jogging at various velocities, you can "fine tune" the system so a perfect match between the 520 and the external drive is achieved. "Fine tuning" may consist of slightly altering the Calibrate Velocity or Calibrate Velocity Command Voltage on the 520 or by altering the command scaling or the offset adjustments on the external drive.

In addition, pre-programmed indexes may be executed to allow monitoring and adjustment of Position Loop Gain. Position Loop Gain should be set as low as possible to permit satisfactory operation while not creating an instability in the system. In some circumstances, modification of the external drive may be required to allow for proper operation.

Lastly, the Position Loop Gain Adjustment Range is setup. This parameter limits the amount of Loop Gain adjustment from the UP/DOWN switch located on the front of the 520 PMC. By setting this parameter to 0%, the UP/DOWN switch has no effect on Position Loop Gain. By setting this parameter to 100%, the UP/DOWN switch has full Position Loop Gain adjustment capabilities.

Setting the System Calibration

After following the examples in the "Setting the Fault Input Polarity" section, proceed to the 520 PMC Setup Options menu. By moving the cursor to the System Calibration position and entering a carriage return, the user enters the System Calibration menu as shown below.

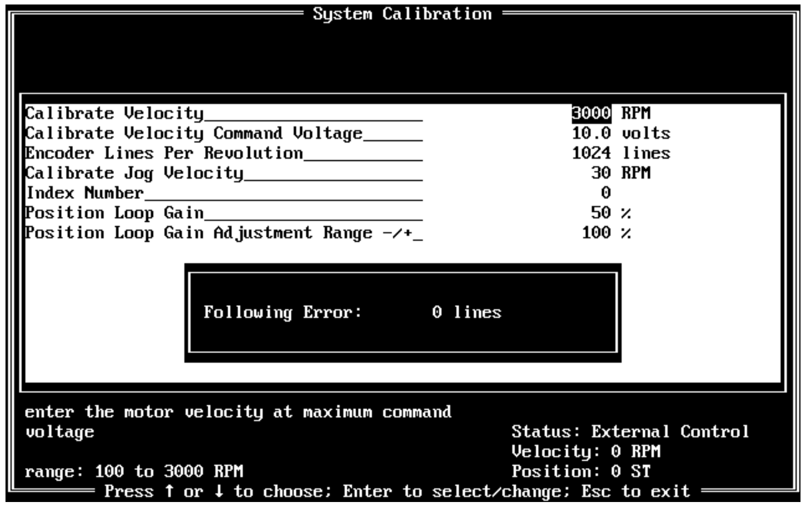


Figure 3 System Calibration (Calibrate Velocity)

Position the cursor on the Calibrate Velocity selection. Enter the maximum velocity of the external drive at the maximum velocity command voltage followed by a carriage return. The cursor will now be positioned on the Calibrate Velocity Command Voltage as shown below.

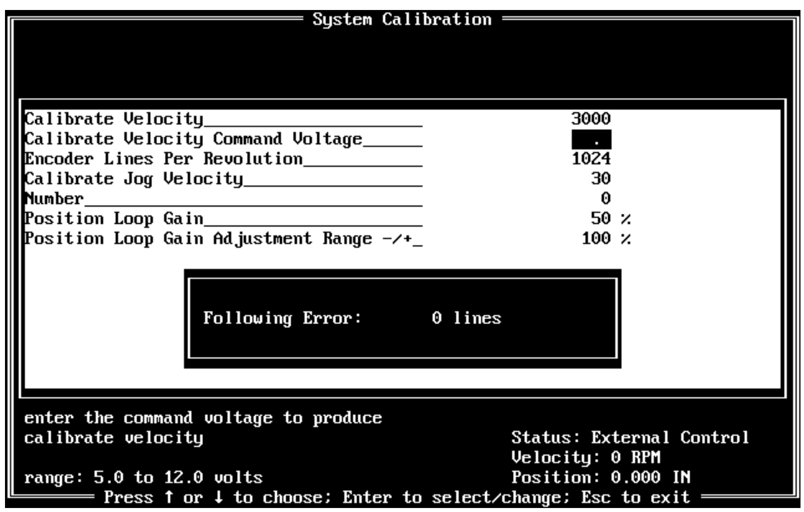


Figure 4 System Calibration (Command Voltage)

Enter the command voltage necessary to produce the Calibrate Velocity just entered in volts followed by a carriage return. If unsure about these two parameters, consult the owners manual of the external drive. The cursor will now be positioned on the Encoder Lines Per Revolution.

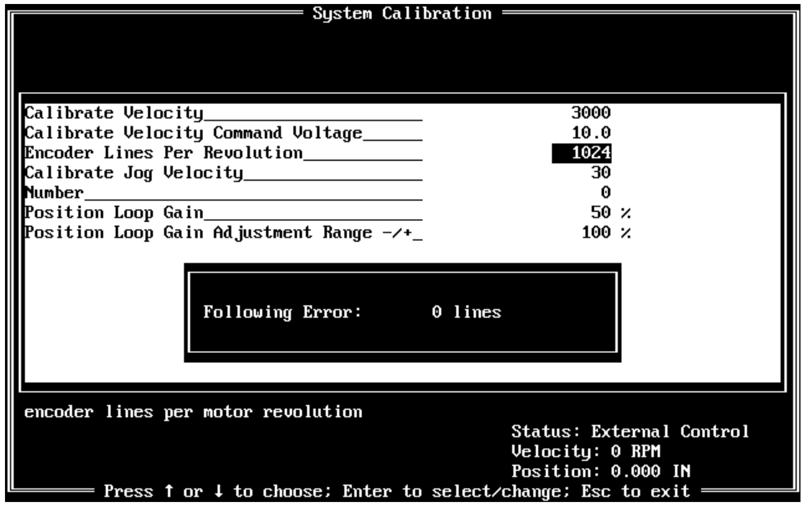


Figure 5 System Calibration (Encoder Lines)

This default value is fixed at 1024 lines per revolution and may be altered. Enter a carriage return and the cursor will now be positioned on the Calibrate Jog Velocity selection.

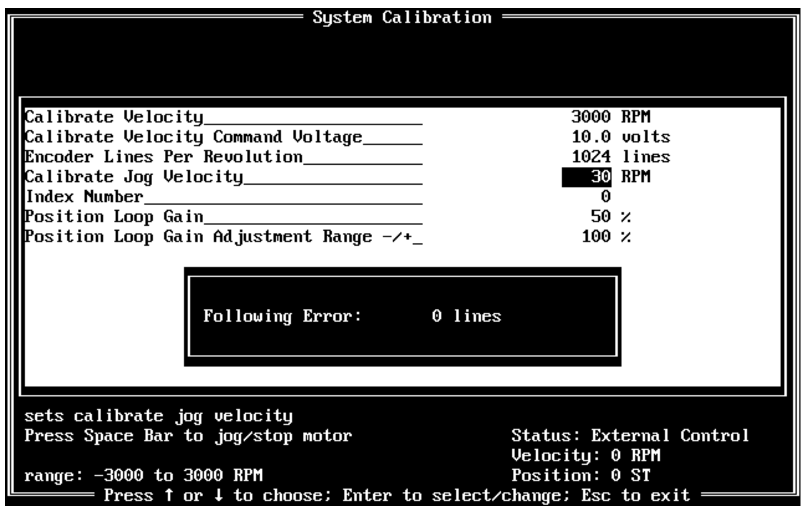


Figure 6 System Calibration (Jog Velocity)

In this position the user can jog the motor at any velocity while being able to monitor the following error scaled in encoder lines of error. It is also at this point that the offset of the external drive can be adjusted. By leaving the motor at rest, monitor the following error while adjusting the offset adjustment of the external drive. Adjust this offset to minimize the following error,preferably as close to 0 as possible. After completion of the offset adjustment, a running adjustment to "fine tune" the system is performed.

NOTE: The motor shaft must be free to rotate indefinitely during this test or else machine damage may occur. The space bar is used to start and stop motion. If unable to allow indefinite rotation, care must be taken to prevent reaching travel limits.

Enter a "Calibrate Jog Velocity" of a very low value (e.g., 30 RPM) and enter a carriage return. Ensure that the shaft of the motor is free to rotate and depress the space bar to begin motion. Observe the "Following Error". If the following error is above 2 or 3 counts, one of two things should be done. Either a small adjustment of the command scaling of the external drive is required or the "Calibrate Velocity Command Voltage" will have to be changed slightly to reduce the following error.

If using the command scaling adjustment on the external drive,(usually a pot) slowly turn the pot in one direction. If the Following Error becomes larger, turn the pot in the opposite direction. Adjust the pot to obtain the lowest Following Error possible. Increase the "Calibrate Jog Velocity" in 500 RPM increments until the maximum drive velocity is reached, adjusting the command scaling pot as necessary at each increment.

If the external drive has a fixed command scaling, the "Calibrate Velocity Command Voltage" will have to be adjusted. Change this value up or down 0.1 volts in one direction. If the"Following Error" increases, set the value 0.1 volts in the opposite direction until the"Following Error" is minimized.

If the "Following Error decreases, continue in the same direction until it is minimized. Again, step up the "Calibrate Jog Velocity" in 500 RPM increments until the maximum drive velocity is reached, adjusting the "Calibrate Velocity Command Voltage" as necessary at each increment. After completion of the "Following Error" adjustment, depress the space bar to stop the motor. Enter a carriage return to position the cursor on the "Index Number" selection. See Figure 48.

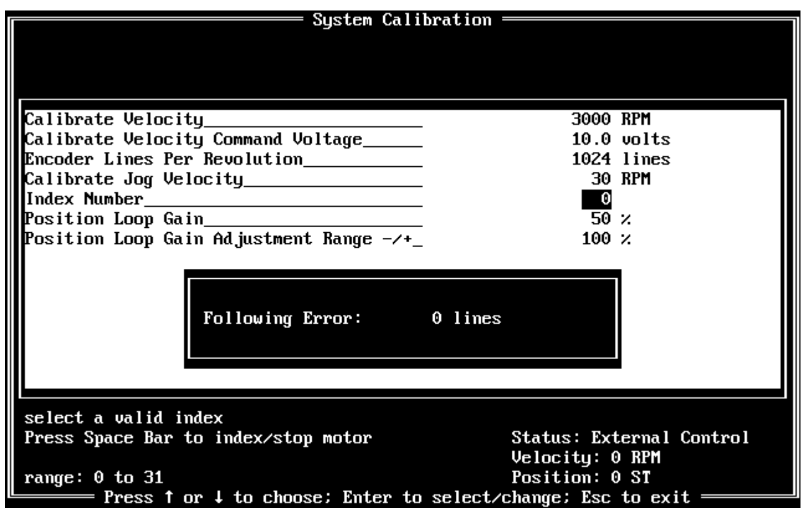


Figure 7 System Calibration (Index Number)

It is at this point that the motor should be connected to the load. Ensure that the power is removed from the external drive and connect the motor. Reapply power to the external drive. This section assumes that an index has been programmed in the "Index Setup" section of the program. This index represents the motion in the application. The purpose of running an index is to optimize the "Position Loop Gain" adjustment of the 520 PMC.

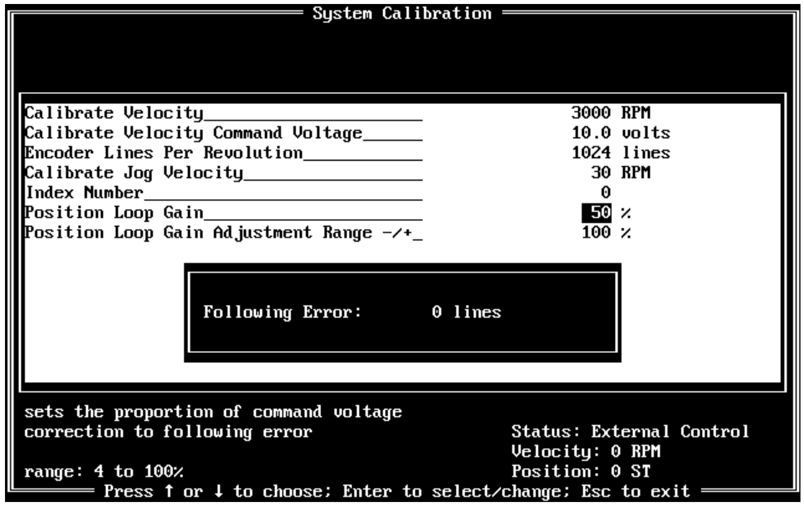


Figure 8 System Calibration (Position Loop Gain)

Refer to the appropriate section of this manual for instructions. Enter the desired index to run followed by a carriage return. Depress the space bar to begin the index. Observe the motion of the motor and the load particularly at the beginning and end of the motion.

If the motion is crisp (ie stops abruptly with little or no over shoot and not spongy), the "Position Loop Gain" is probably acceptable. If the motion is not acceptable increase the value slightly and observe the motion.

If the motor begins to oscillate, "Position Loop Gain" is too high and must be reduced. If the loop gain is left set too high, the oscillation could cause damage to the external drive or the load. To change "Position Loop Gain", enter the proper number followed by a carriage return. This may be set while the index is in motion.

In certain applications where a significant inertial mismatch exists, modifications to the external drive may be necessary to match the drive to the load. When the Position Loop Gain adjustment is complete, depress the space bar to stop motion. A carriage return continues to the next section "Position Loop Gain Adjustment Range".

The "Position Loop Gain Adjustment Range" allows you to program the amount of "Position Loop Gain" that the "Loop Gain UP/DOWN" toggle switch has on the "Loop Gain" setting. The purpose of the switch is to allow small adjustments to the "Position Loop Gain" without the need of a computer or dumb terminal. The default setting for "Position Loop Gain Range" is 100%. This means that the "UP/DOWN" toggle switch can alter the "Position Loop Gain" through the full adjustment range.

Setting the value to 50% limits the adjustment to +/- 50% of the complete range. Setting the value to 0% will not allow the "UP/DOWN" toggle to have any effect on "Position Loop Gain". To set the value, enter the desired number followed by a carriage return. See figure 43.

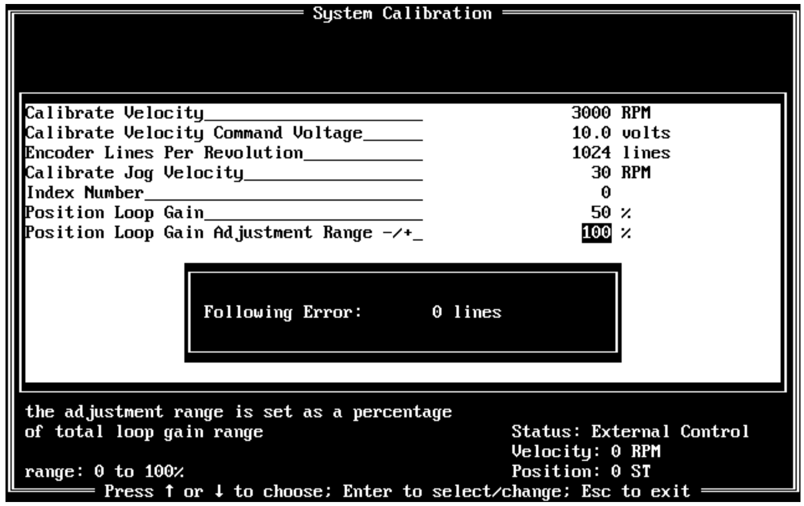


Figure 9 System Calibration (Adjustment Range)

Specifications

Environmental Characteristics Operating Temperature Relative Humidity	 0 to 45 (32 to 113 F) 0% to 95%, non-condensing
Input Power AC Voltage and Current	 96-132 VAC or 192-264 VAC, 47-63 Hz (switch selectable) single phase (Note: Factory default is 192 - 264 VAC). 1 amp @ 115 VAC, 0. 5 amp @ 230 VAC
Control Modes	1. Indexing (I/O or serial) 2. Pulse follower 3. Analog
Signal Inputs Velocity Torque	 ± 10 VDC typical (10 bit resolution speed selection) ± 10 VDC typical (10 bit resolution speed selection)
Engineering Unit Programming	yes
User Units/Rev	programmable range (200-25000)
Programming Methods	RS423 serial ASCII terminal (RS232 & RS422 compatible). Emerson Motion Control, PCX software (Via an IBM or compatible PC).
Programmable Motion Functions	Non-volatile storage for thirty-two indexes, (incremental, absolute, feed sensor or registration), jog, home, stop and hold functions. Addition programming functions are available when using a PCM module.
Input Output Lines	12 DC lines (8 input, 4 output) requires an external 10 to 30 VDC power supply. Configurable for current sinking or current sourcing by point.
Input Output Functions	Standard I/O functions can be assigned to any I/O line. Additional I/O functions available when using a PCM module.
Command Connector Pulse Mode Input	 TTL compatible, 500 nsec minimum pulse width, 210 kHz maximum frequency.
Serial Interface Baud Rates Axis Identifier Serial Commands	Two RS423 ports (serial A or B) RS232/RS422 compatible. 110 to 19,200 (see DIP Switches) 32 identifiers (see DIP Switches) Two or three character ASCII commands include all setup, status and execution commands.
Encoder Interface Capability Angular Resolution Angular Accuracy Encoder Input Frequency	No analog lock +5 volt sine wave or square wave (TTL) 2 channels & mark A, A/, B, B/ and M, M/ Requires double-ended (complimentary) input from encoder Encoder and mounting dependent. Encoder and mounting dependent. 51.2 KHz/channel max.
Weight	9.5 lbs. 525 only, add 2 lbs for PCM module.

Mounting Information

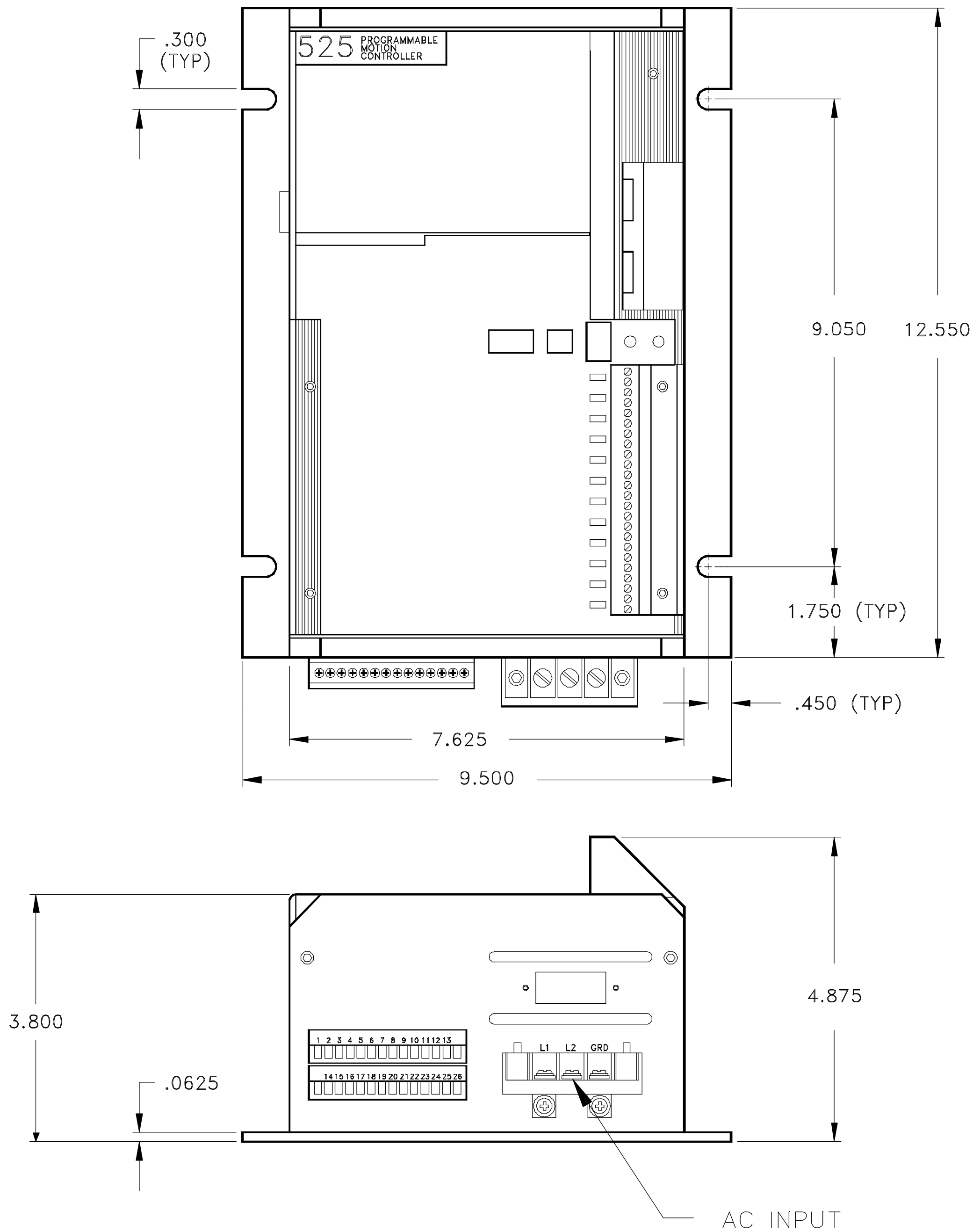


Figure 1   Mounting Information