ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Emerson Motion Control PCM-15* at our website: ***Click HERE***

PCM-15 Ratio Controller
Operator's Manual

OMRON
OLS ELECTRONIC MOTION CONTR

P/N 400284-00 Rev.: A2
Date: Sept. 1, 1995

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PCM-15 Ratio Controller
Operator's Manual

Information furnished by EMERSON EMC is believed to be accurate and reliable. However, no responsibility is assumed by EMERSON EMC for its use. EMERSON EMC reserves the right to change the design or operation of the equipment described herein and any associated motion products without notice. EMERSON EMC also assumes no responsibility for any errors that may appear in this document. Information in document is subject to change without notice.

P/N 400284-00

Rev.: A2
Date: Sept. 1, 1995

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Customer Services:

EMERSON EMC offers a wide range of services to support our customer's needs. Listed below are some examples of these services.

Service Support (612) 474-8833

Emerson Electronic Motion Control's products are backed by a team of professionals who will service your installation wherever it may be. Our customer service center in Minneapolis, Minnesota is ready to help you solve those occasional problems over the telephone. Our customer service center is available 24 hours a day for emergency service to help speed any problem solving. Also, all hardware replacement parts, should they ever be needed, are available through our customer service organization. Need on-site help? Emerson EMC provides on-site service, in most cases, the next day. Just call Emerson EMC's customer service center when on-site service or maintenance is required.

Training Services (612) 474-1116

Emerson EMC maintains a highly trained staff of instructors to familiarize customers with Emerson EMC's products and their applications. A number of courses are offered, many of which can be taught in your plant upon request.

Application Engineering (612) 474-1116

An experienced staff of factory application engineers provide complete customer support for tough or complex applications. Our engineers offer you a broad base of experience and knowledge of electronic motion control applications.

Bulletin Board System (612) 474-8835

Emerson EMC maintains a BBS which provides you access to software updates, and technical information and services.

Communications protocol: 300-14,400 baud, N, 8, 1

FAX (612) 474-8711

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table of Contents

Customer Services ii
Overview-PCM-15 Ratio Controller 1
Navigating PCX Software 3
Installing Your PCM-15 5
Inputs 5
Outputs 5
PCM-15 Features 7
Axis ID Description 7
Axis ID Setup 7
Master Axis Description 8
Master Axis Setup 8
Global External Input Time Limit 12
Global External Input Time Limit Setup 13
Internal Input and Output Lines 13
Internal Input/Output Setup 16
Synchronized Jog 17
Synchronized Jog Setup 17
Programmable Limit Switches (PLS) 17
PLS Setup 18
User Registers 20
User Registers Setup 21
Equations 21
Equation Setup 22
User Messages 23
Messages Setup 23
Building Your Program 25
Time Base (Indexes And Homes) 27
Programming Functions 27
C Compound Next Index 27
D Dwell Time 30
E End Program 30
F Set Maximum Following Error 30
H Call Home 30
I Call Index 30
O Set Outputs 30
P Call Program 31
Q Set Maximum Torque Output 32
R Wait For Counter 32
S Start Counter 32
T Time Base 32
J, W Jump/Wait 32
Using Jump/Wait Statements in a Program 33
Jump Commands 34
Wait For Input Commands 35
/ + - * ^ Math Operators 36
Using Math Operators in a Program 36
= Load Value 37

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Using Load Value in a Program 37
B Conditional Branches 38
Using Conditional Branches in a Program 39
DC Drive Command 39
Using Drive Commands in a Program 40
I, PJ Program Index, Program Jog 40
LB Labels 42
Using a Label in a Program 42
M Math Equation 42
Using Math Equations in a Program 42
RT Real-Time Clock 43
ST Stop Motion 43
Using the Stop Motion Command in a Program 43
WI Write Index, WJ Write Jog 44
Using WJ Write Jog in a Program 44
Using WI Write Index in a Program 44
Transmit Data (X) 45
Flying Cutoff Programs 47
Set-up Sequence 48
Drive Parameters 50
Master Axis 50
Indexes 51
Program 52
Suspend/Resume Functions 55
Suspend Screen Parameters 55
Run Program On Suspend 55
Program Number 56
Automatically Clear After Program 56
Automatically Resume 56
Automatically Return After Resume 56
Automatically Suspend Upon Fault 57
Multi Axis Synchronization 58
Encoder Operation 60
Application Examples 61
PCM-15 Input/Output Functions 65
PCM-15 Input Functions 65
PCM-15 Output Functions 67
Appendix A - List of Figures A-1

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Overview-PCM-15 Ratio Controller

This manual provides setup and programming information for the PCM-15 Ratio Controller. The PCM-15 Ratio Controller is an Application Module that attaches to the front of any EMERSON EMC FX Positioning Servo Drive and adds the ability to combine indexes, dwell times, and other functions to form a complete motion sequence, or "program". But the most important feature is the ability to provide motion ratioed to an external signal from an encoder or another PCM-15. This external signal is referred to as a "Master Axis". The features provided by the PCM-15 Ratio Controller include:

- **256 indexes** (as opposed to 32 indexes in the base FX drive)
- **99 programs** and a maximum of 1,024 program steps
- **Indexes in a program** that follow an external time base
- **Dwell times** between any two program steps (not just between indexes as in the basic FX drive)
- **"Electronic Lineshaft"** follower mode
- **Wait to continue function** that halts program flow until selected internal and/or external input lines become active
- **"Flying Cutoff"** mode
- **Jump function** to other parts of the program depending on the condition of the selected internal and/or external input lines
- **Synchronized Jog and Home** motions
- **Programmable internal and external output lines** that become active depending on program instructions
- **Programmable Limit Switch option** for programmable output lines
- **Change maximum following error function** during a program
- **Change maximum torque function** during a program
- **Suspend/Resume Program function** that records existing program data at time of interruption and permits later completion of the interrupted program
- **Compound Index function** that changes motor velocity at completion of compounded index distance to velocity of next index without stopping
- **Logic, math, and branching functions** that control program flow based on current conditions
- and many more.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The firmware revision on a PCM-15 module necessary for all of the programming features in this manual is A5 or higher. You can find the revision number of your module by looking at the serial number sticker located on the side of the module. The revision number is found in the “REV” field.

The PCX version that is shipped with this Application Module will work with previous revisions of EMERSON EMC Application Modules and FX Drives. However, some of the features described in this manual will not be available for use with earlier equipment and will not appear on screen when on-line with PCX6.05.

It is important that you become familiar with “PCX Software Setup and Operation” in the FX Drive Operator’s Installation and Programming Manual (P/N 400282-00). It provides the basic information needed to set up and program the FX drive using PCX software (ver. 6.5 or above).

The FX Drive’s firmware is disabled whenever an Application Module such as the PCM-15 Ratio Controller is attached. Therefore, the FX Drive’s firmware can be any version since the programming features reside in the Application Module’s non-volatile memory.

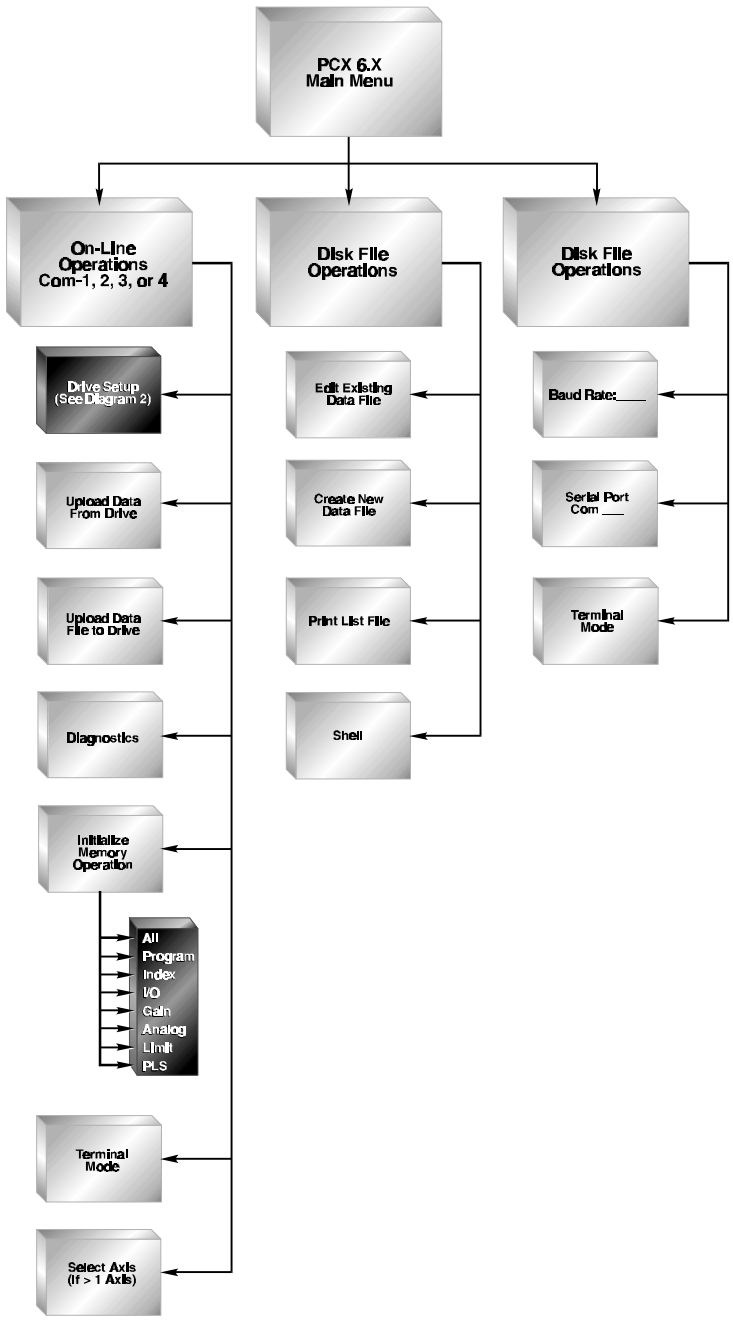
The PCM-15 stores FX Drive setup parameters within the PCM-15 module. This allows you to transfer the PCM-15 to another FX Amplifier without losing setup parameters.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Navigating PCX Software

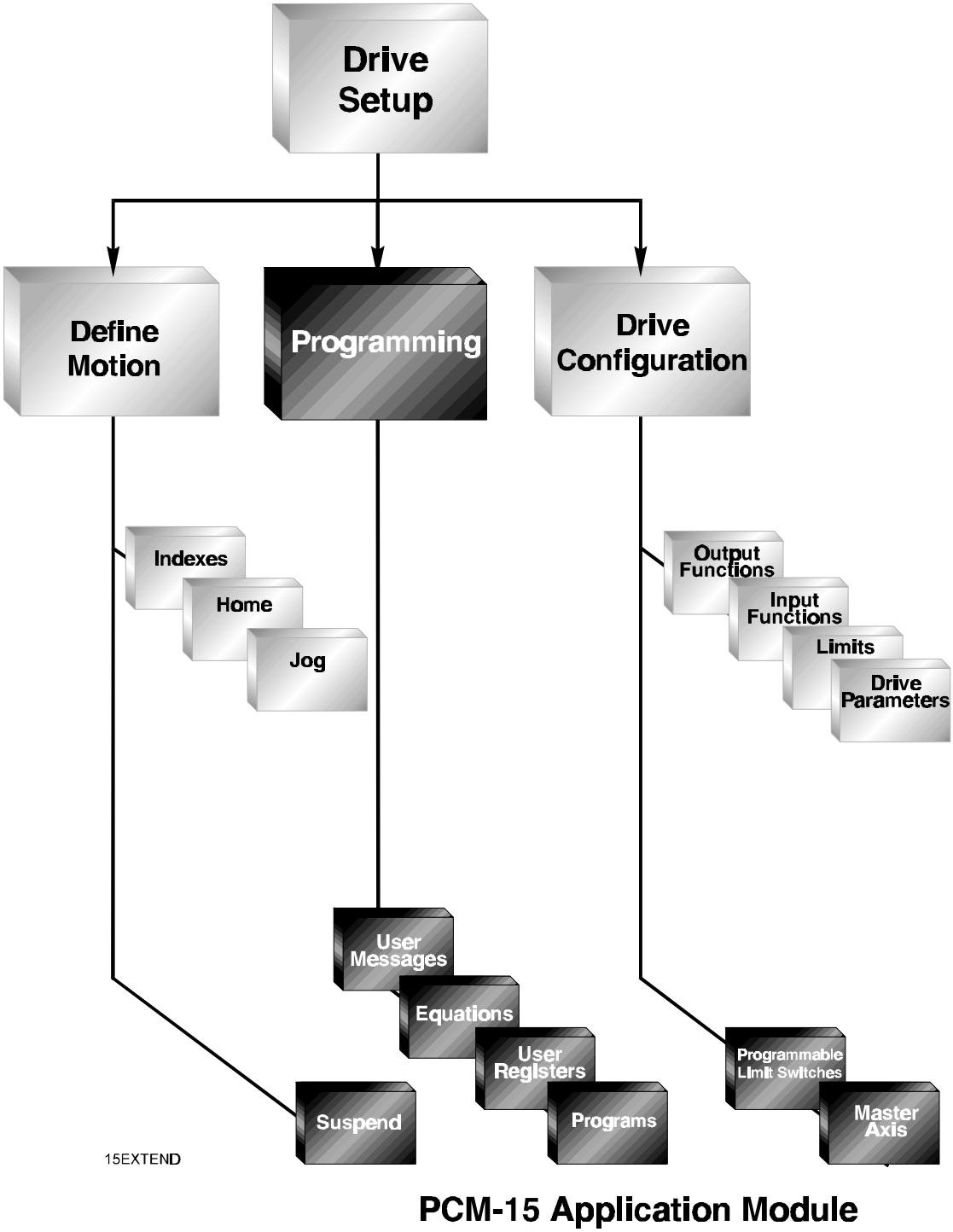
Adding a PCM-15 Ratio Controller to an FX Drive gives you several additional features in PCX. The hierarchy menu diagrams in Figures 1 and 2 show the additional features in the shaded blocks.

Figure 1
PCX Hierarchy Diagram 1



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 2
PCX Hierarchy Diagram 2



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Installing Your PCM-15

The PCM-15 Ratio Controller attaches to the front of any FX Amplifier with two locking arms. All electrical connections (except I/O) are made via the 48 pin connector.

The PCM-15 is equipped with 8 input lines and 4 output lines, doubling the I/O capability of the standard FX drive. All inputs and outputs are optically isolated for +10.5 to +30 VDC operation. Each input and output line has 2 screw terminals associated with it to provide for either current sinking or current sourcing operation.

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.

The first 8 pairs of terminals (numbered 13 - 20) are inputs and the last 4 pairs of terminals (numbered 21 - 24) are outputs. The outputs are capable of sinking or sourcing 200 mA. You must limit the output current to less than or equal to 200 mA per line. See Figure 3 for I/O connection examples.

Inputs

Inputs require an external voltage/current source for operation. This voltage source must be in a range of 10.5 to 30 VDC. The (-) lead of the external power supply must be connected to enclosure or safety ground.

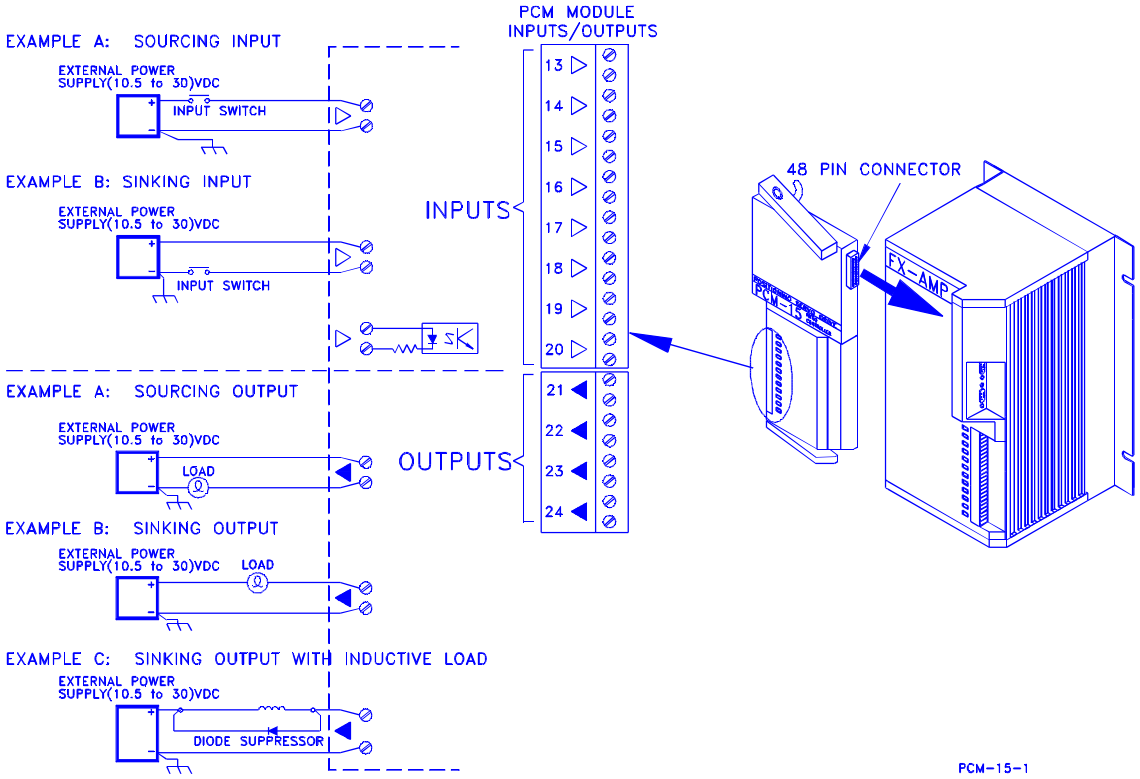
Outputs

Outputs are similar to inputs in that they can be connected to either sinking or sourcing type loads. Outputs require an external isolated supply voltage, usually the same supply as the inputs. Each output can sink or source 0.2 amps DC. The (-) lead of the external power supply must be connected to enclosure or safety ground.

If inductive loads such as DC relay coils are connected to the outputs, a diode suppression must be installed in parallel with the load coil with its cathode towards the positive end of the external power.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 3
PCM-15 Connection to an FX Drive



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PCM-15 Features

Each of the following PCM-15 features must be set up before you can use them in a program. The appropriate menu for each feature can be found under the PCX menu whose title follows the feature. Individual setup information for each feature is covered in this chapter.

- **Axis ID Description** (Drive Setup, Drive Configuration, Parameters Menu)
- **Master Axis** (drive setup, drive configuration, master axis)
- **Global External Input Time Limit** (Drive Setup, Drive Configuration, Limits Menu)
- **Internal Input Lines** (Drive Setup, Drive Configuration, Input Functions Menu)
- **Internal Output Lines** (Drive Setup, Drive Configuration, Output Functions Menu)
- **Programmable Limit Switch Operations** (Drive Setup, Drive Configuration, Programmable Limit Switches Menu)
- **User Registers** (Drive Setup, Define Motion, Programming, User Registers Menu)
- **Equations (and Math Operations)** (Drive Setup, Define Motion, Programming, Equations Menu)
- **User Messages** (Drive Setup, Define Motion, Programming, User Messages)

Axis ID Description

The following applies to all PCX entries:
If you make an entry and press the up or down arrow keys instead of the <Enter> key, PCX will ignore your entry and restore the existing data to the screen.

This function allows you to enter a unique, 32 character, alphanumeric description for each axis in your system that will be displayed at the top of each PCX screen. The descriptions allow you to quickly identify an axis by it's function in a multi-axis system. The axis description will also be displayed to the right of the axis ID on the "Select Drive Screen" when more than one FX Drive is communicating with PCX.

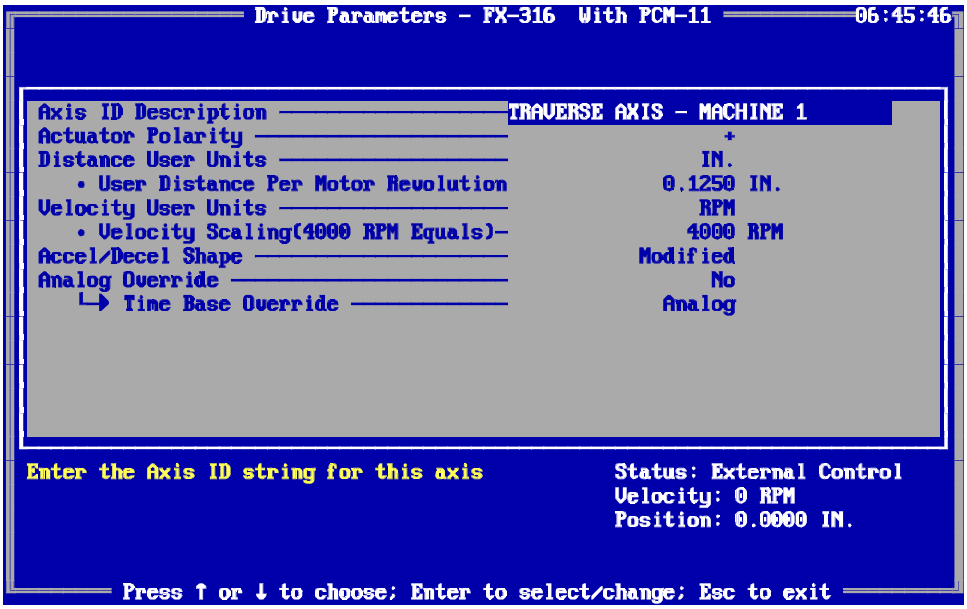
Axis ID Setup

The Axis ID Description is entered in Drive Setup, Drive Configuration, Parameters. Move the cursor to the Axis ID Description line in the Parameters Menu and type the description for that axis. After you have typed the description, press the <Enter> key to transmit the information to the drive.

Because the Axis ID description is stored in the Application Module's non-volatile memory, the module will retain its Axis ID Description information when moved to another FX Drive.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 4
Drive Parameters Screen



Master Axis Description

An external Master Axis can become the basic source for motion control of a Follower Axis (your FX Drive equipped with a PCM-15). The basis of operation is determined by the relationship of the external master axis encoder or drive, to the follower axis motor.

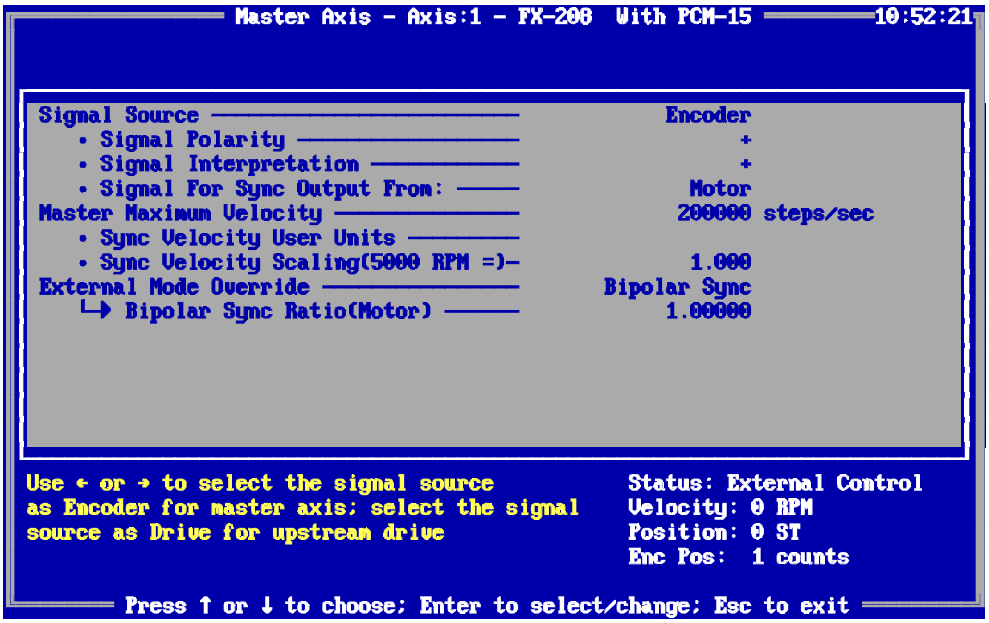
The Master Axis is typically an Emerson SCS-2 encoder which produces 4000 steps per revolution or it can be a customer supplied encoder of any line density yielding the appropriate steps per revolution.

Master Axis Setup

The base number system used for the FX Drive is binary and 12 bits. Resolution is one part in 4096. Since this number may be difficult to work with because of user engineering units, the drive electronics allow for a conversion to any number from 50 to 25,000, with the default being 4000.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 5
Master Axis Screen



Master Axis Screen Parameters

To set up a relationship between the Master Axis and the Follower Axis (your FX Drive and PCM-15), select Drive Setup, Drive Configuration, then Master Axis.

Signal Source

Select the origin of the signals used for Master Axis positional information using the (+) or (-) keys to toggle between Drive and Encoder.

When a follower axis is receiving its synchronization source from an FX Drive lead axis, the count source becomes the binary 4096 counts per turn.

Signal Polarity

Defines the direction of the synchronization encoder that corresponds to a positive master position change. Clockwise is indicated with a (+); counterclockwise is indicated with a (-). CW and CCW motion of the Master Axis is defined while facing the encoder shaft.

Signal Interpretation

Use the arrow keys to toggle between the choices. The Signal Interpretation feature allows you to define how the follower reacts to clockwise and counterclockwise motion of the synchronization encoder.

The following signal interpretation modes do not apply to the bipolar sync (”Electronic Lineshaft”) modes of operation. Signal interpretation modes apply only to ratio synchronization during a program.

1. Mode #1 (+ and -): When the master axis moves either CW or CCW, the follower axis will move in its commanded direction. If the master axis changes direction the follower axis will continue in the original commanded direction. The follower axis will not reverse direction.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2. Mode #2 (+): The follower will only react to synchronization pulses when the master axis runs in the CW direction. CCW master axis pulses are ignored.

3. Mode #3 (-): The follower will only react to synchronization pulses when the master axis runs in the CCW direction. CW master axis pulses are ignored.

4. Mode #4 (COMP +): The follower will only react to synchronization pulses when the master axis runs in the CW direction. The drive counts the pulses received in the CCW direction and ignores that exact number of CW pulses before follower motion in the CW direction occurs.

   This feature compensates for master axis motion in the opposite (CCW) direction. For example, the master stops, then inadvertently backs up due to conveyer slack, vibration, etc.

5. Mode #5 (COMP -): The follower axis will only react to synchronization pulses when the master axis runs in the CCW direction. The drive counts the pulses received in the CW direction and ignores that exact number of CCW pulses before follower motion in the CCW direction occurs.

   This feature compensates for master axis motion in the opposite (CW) direction.

Signal For Sync Output From:
Use the arrow keys to toggle between the choices. If you select Motor, your FX Drive will output a sync signal to the next FX Drive based on the performance of its own motor. If you select Upstream Drive, your FX Drive will output a signal that comes from the motor of the preceding amplifier.

Encoder pulses are passed to all amplifiers in the synchronization chain. How you answer this question has no effect on the encoder signal.

The next FX Drive and PCM-15 will only operate with this pulse train if you set that drive up with Drive Signal Source as Drive.

Master Maximum Velocity
The Master Maximum Velocity is the maximum frequency that the master axis signal source is expected to produce when running at its' full speed. To calculate the master maximum velocity, use the following formula:

$$\text{Master Max Velocity} = \frac{(MV)\,(MS)}{60\ \text{Sec}/\text{Min}}$$

MV = Master Axis Maximum Velocity (RPM)
MS = Master Steps/Rev

If Encoder is master: Master's Steps/Rev = (Encoder Line Density)*(4)

If Drive is Master: Master's Steps/Rev = 4096

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

For example: The master axis is a 1000 line encoder and rotates at a maximum speed of 3000 rpm, and, when quadratured, produces 4000 steps per revolution. Then:

$$\frac{(3000\ \text{RPM})\ (4000\ \text{Steps}/\text{Rev})}{60\ \text{Seconds}} = 200{,}000\ \text{Steps per Second}$$

Maximum frequency into drive cannot exceed 210 Khz or steps/second.

This value is the master encoder velocity at which synchronized time base and real time base are equal. This parameter is used to calculate actual follower velocity while running in synchronized time base.

Sync Velocity User Units
This parameter sets the units to be associated with all Sync velocities. User Units can be any three letter combination, such as PCT, RPM, FPM, etc.

Sync Velocity Scaling (Max RPM Equals)
This parameter sets the sync velocity entry that will produce maximum velocity of the drive when the Master Axis signal source is at maximum. When an index is running in Sync Time Base, the velocity is specified in user units.

The default value is 1.000. A setting of 0.500 in an index velocity means the drive will accel to half of maximum velocity.

External Mode Override
External mode override works in conjunction with Input Function #38 to override the current mode of operation. When Input Function #38 is assigned and active, the drive will exit its' current operating mode and default to the mode selected with this parameter. Use the arrow keys to toggle between the three modes of operation, which are: Analog Velocity, Analog Torque or Bi-Polar Sync.

Analog Velocity/Torque
When set to Analog Velocity or Torque Mode, the drive will respond to a conventional 10VDC signal. In either of the two analog modes a 10VDC signal is equated to either (CW) or (CCW) maximum programmed velocity or maximum full peak torque rating.

If you enable Analog Torque Mode and apply a voltage between 0 and 10 VDC to the command connector[1], the FX Drive will attempt to produce torque equal to:

$$\text{Max Torque X}\ \frac{\text{Applied Voltage}}{10\ \text{VDC}} = \text{Actual Torque}$$



If there is no physical resistance to the torque at the motor shaft, the motor will very quickly accelerate to maximum speed.

1 *See "Analog Input Wiring" in chapter 3 of the FX Drive Operators manual.*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Bi-polar Sync ("Electronic Lineshaft")
When set to bi-polar sync, this parameter allows for direct movement of the FX Drive motor ratioed to the sync encoder. This mode moves the motor shaft in direct response to encoder or drive signals. This means immediate velocity without ramping in your FX Drive. If the Master Axis accelerates very quickly, your FX Drive and motor will try to follow just as quickly. Too fast an acceleration by the Master Axis could result in "F" (Follow Error) faults.

Bi-polar Sync Ratio (motor)
The Bipolar Sync Ratio is the relationship of the Follower Axis position to the Master axis position. If the Bipolar Sync Ratio is set to 3, for every 1 count of the Master Axis, there will be 3 counts of the Follower Axis. Thus, the Bipolar Sync Ratio would be 3:1.

Global External Input Time Limit

An optional time limit has been added to the Wait for Input Function. This new function will prevent program execution from waiting indefinitely at a Wait for Input program statement when a required sensor input is not received.

The time limit, entered in seconds, will monitor any instance of Wait for Input, Wait for Single Input, or Wait for Input Pattern Match and move to the next step in the program if an input is not received before the time limit expires. This time limit function, if used, times and monitors all external input lines and all program functions that use any form of Wait for External Input. The time limit resets after each wait statement and applies to all lines in use.

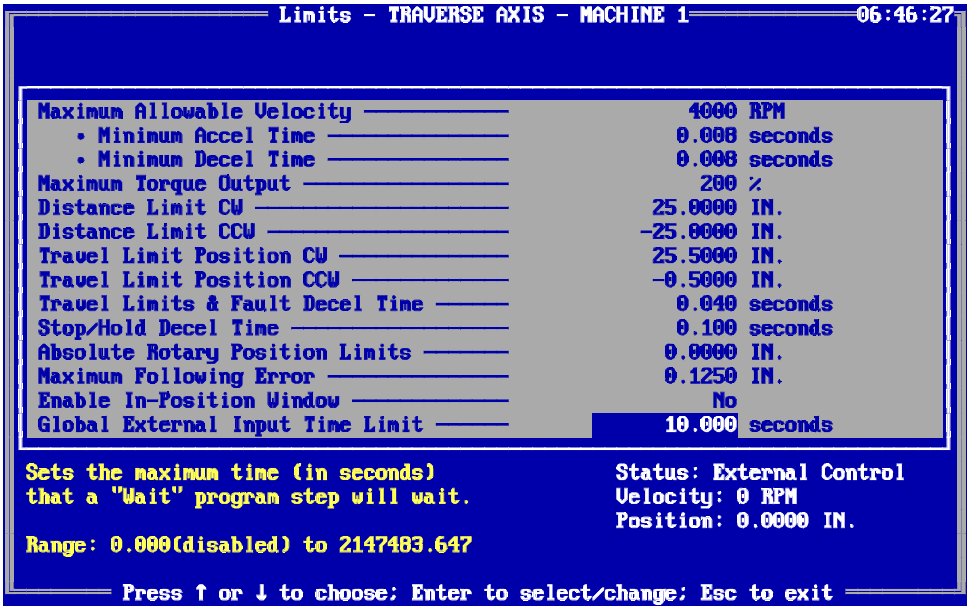
If your application requires that individual input lines have different time limits, a separate program sub-section can be written to monitor the critical lines with time limits that are specific to that part of the program. (See the description of the Real-Time Clock (RT) under Direct Drive Commands of this manual).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Global External Input Time Limit Setup

Select Drive Configuration, Limits Menu. Move the cursor to the “Global External Input Time Limit” line and enter the time limit needed in seconds. Minimum time monitored will be .001 seconds; maximum time is 2,147,483.647 seconds (or 24.8 days). After making the entry, press the <enter> key.

Figure 6
Global External Input Time Limit Setup



Internal Input and Output Lines

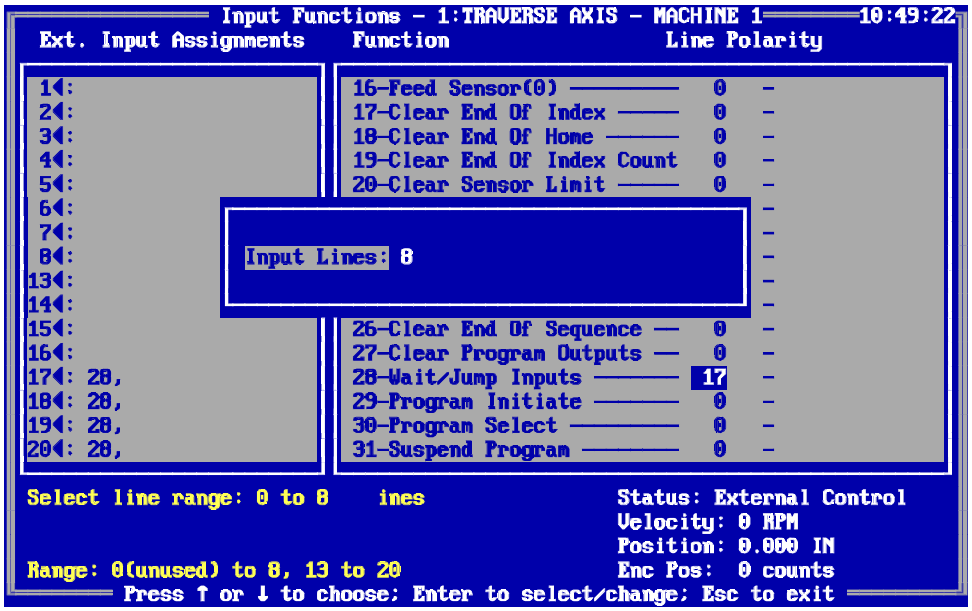
This feature enables the drive to signal itself without using hardware input or output lines. For example; If your application requires the drive to be flagged that a particular step has been completed while a program is running, you can simply assign an internal output to flag an internal input.

There are 16 internal input and 16 internal output lines available, giving you access to a total of 32 input (16 hardware and 16 internal) and 24 output (8 hardware and 16 internal) lines per FX Drive with a PCM-15. The internal input lines support Jump and Wait statement conditions. The Jump and Wait inputs can also be overlapped between the hardware lines and the internal lines.

For example, if input function #28 (Jumps/Wait Inputs) is assigned to hardware line 17, and 8 input lines are selected, then the Inputs would be assigned to hardware lines 17-20 along with internal input lines I1-I4. Half would be assigned to hardware inputs and half would be assigned to internal inputs (see Figure 7 and 8).

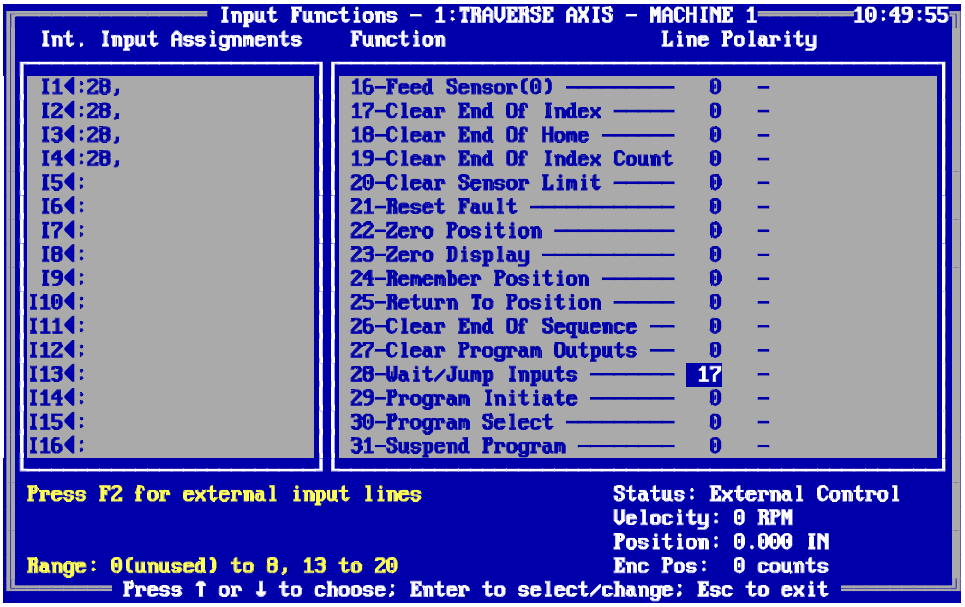
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 7
Hardware (External) Input Line Assignments



Press the F2 key to display the internal input lines.

Figure 8
Software (Internal) Input Line Assignments

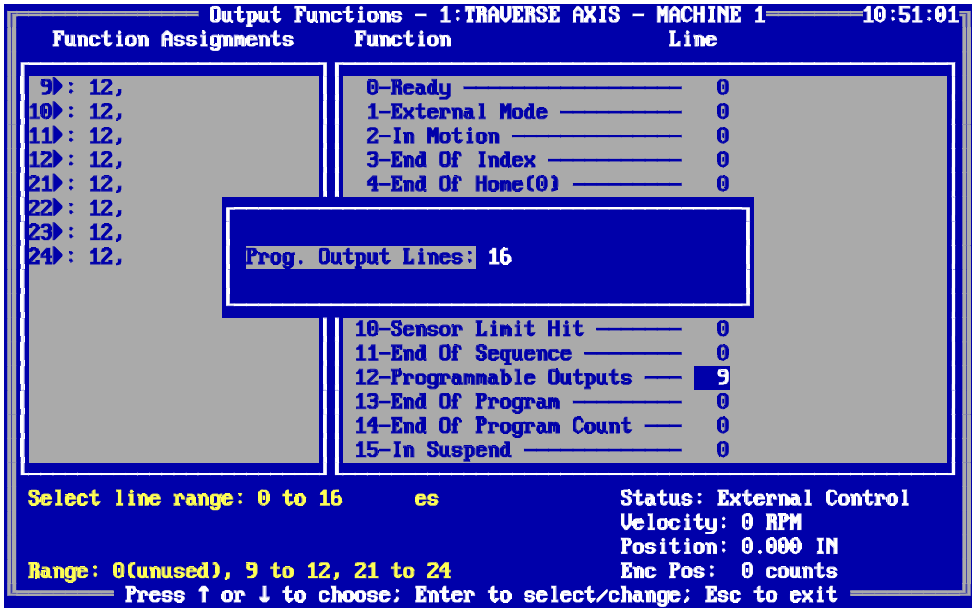


The maximum number of PGO lines is 16; the maximum number of Jump/Wait Input lines is 8.

Similarly, the internal output lines support programmable outputs (PGOs). The PGOs can be overlapped between the hardware output lines and the internal output lines. For example, if output #12 (PGOs) is assigned to hardware line 9, and sixteen output lines are selected, then the PGOs would be assigned to hardware output lines 9, 10, 11, and 12, along with internal output lines 1 through 12.

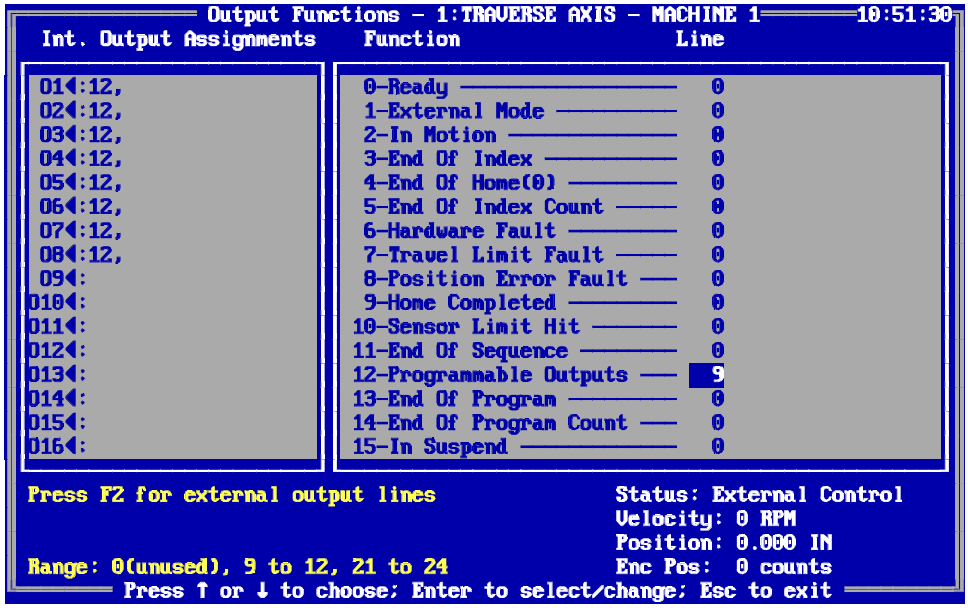
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 9
Internal Output Line Assignments



Press the F2 key to display the internal output lines.

Figure 10
Internal Output Line Assignments



The “internal” lines are assigned just as normal hardware lines with the following differences:

Internal Inputs are designated by I1 through I16 (i.e., letter “I”, not numeral 1).

Internal Outputs are designated by O1 through O16 (i.e., letter “O”, not numeral Ø).

All output lines, both hardware lines and internal lines, can be assigned to connect to input lines on the Input Function Screen. This allows you to attach a hardware or internal output line directly to an input line (hardware or internal) to allow outputs to trigger inputs without the need for external wiring.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



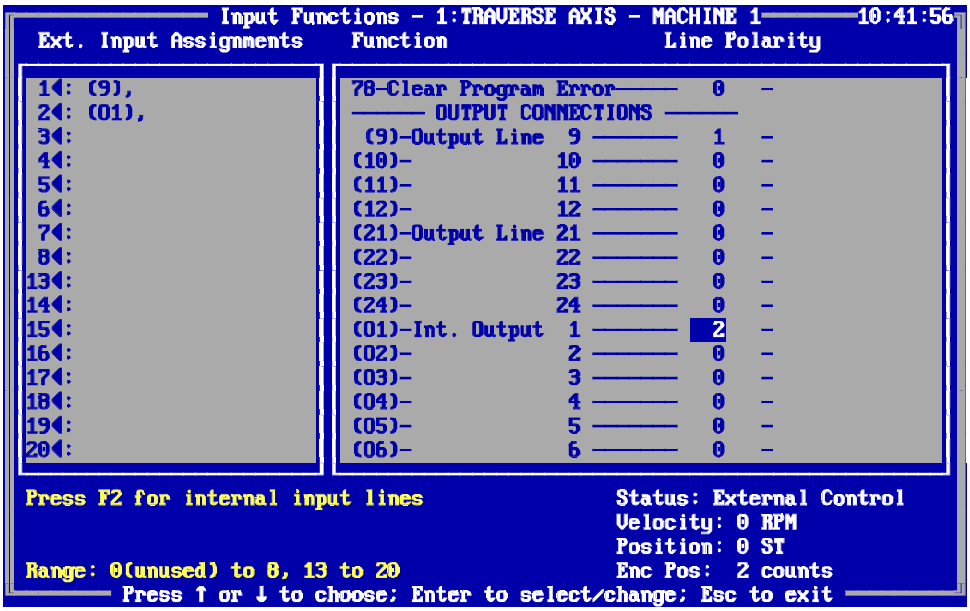
If you assign an internal or hardware output line to trigger a hardware input line, the LED on the FX Drive or PCM-15 associated with that line will not glow when the logic makes the line active. Only externally supplied current draw will cause the LED to light up.

Internal Input/Output Setup

To equip a hardware or internal output line that internally enables either a hardware or internal input line, select Drive Setup, Drive Configuration, Input Functions and move the cursor to the end of the menu to the section labeled “Output Connections”.

If you want to assign a hardware or internal **output** line to an **input** line (either hardware or internal), move the cursor to the output line you wish to use and enter the number of the input line (1 - 8, 13 - 20 or I1 - I16) that you want the output line to connect to. The input line that you designate will be activated any time the output line is turned on regardless of the function that turns on the output line.

Figure 11
Output Connection to an Input Line



In Figure 11, **hardware** output line #9 is **internally** connected to input line #1 and **internal** output line #O1 is connected to **hardware** input line #2. On the left side of the screen under “Input Assignments” the output number is in parentheses to the right of the input it has been assigned to.

You can monitor function assignments to Internal Input and Output Lines by pressing the <F2> key. A second line listing will be displayed on the left side of the screen, showing all the assignments for the internal lines. If an input or output line, either hardware or internal, has so many functions assigned to it that the listing scrolls off the PCX screen in the upper left corner, use the <ALT> key plus the -> or <- arrow keys to scroll through all of the assignments.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Synchronized Jog

The Synchronized Jog feature has been added to the Jog Setup screen for users of PCM-15 Ratio Control Modules.

Synchronized Jog allows you to place the FX Drive in a Jog mode and have the velocity vary according to an incoming encoder pulse train frequency. The ratio at which Sync Jog follows the encoder is set by the jog velocity scaling and the synchronization ratio set in the master axis screen.

Synchronized Jog Setup

The following procedure assumes that the encoder has been wired and mounted correctly and the FX Drive/PCM-15 Master Axis has been set up.

Before you can set up and operate a synchronized jog you must set the Analog Override parameter in the Drive Parameters Screen to “No” and the Time Base override to “Encoder”. The last item in the Drive Parameters Menu is Analog Override. Move the cursor to this parameter and enter “No”. Next move the cursor down to the Time Base Override parameter and use the right or left arrows keys to move through the three selections (Analog, Real-Time or Encoder) and choose “Encoder”.

After making the selection leave the Drive Parameters screen by pressing the <Esc> key. Now select the Input Function Menu. Move the cursor to Input Function #43, Time Base Override. Assign this function to one of the available Input Lines.

Finally, proceed to the Jog Screen. The first line now says: “Velocity Scaling: Real-Time”. Use a right or left arrow key to select Synchronized. When you make this selection, you should see the display of Jog speeds change from user engineering units to fractional decimals. The Jog speed entry now represents a percentage of maximum motor speed when the external encoder is moving at maximum speed.

Synchronized Jog will be available whenever the Input line assigned to Function #43, Time Base Override, is made active. The resulting jog motor speed will be a combination of the setting in the jog menu and the external encoder frequency (steps/rev. X revs./sec.). For example: If the Jog Fast speed setting is .5 and the external encoder is running at 50% of maximum speed, the sync jog speed for a FX/DXM-340 (3,000 rpm max.) would be 750 rpm (or $.5 \times .5 \times 3000 = 750$ RPM).

Programmable Limit Switches (PLS)

Programmable Limit Switch (PLS) patterns can be updated at 16 specific motor positions using the existing Programmable Output Lines (PGOs) and user units to define motor position. The pattern you set is the way the lines will look after the motor enters that position range.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A PLS pattern consists of a specific combination of **On, Off**, and **Don't Change** line conditions of the programmable output lines. Sixteen different patterns may be entered to occur at the intervals you specify. Patterns can be updated at 16 different motor positions. There are 3^8 (6561) possible patterns available. You may use a maximum of 16 output lines.

The default mask for programmable limit switch operation (all X's, meaning **Don't Change** the existing line condition) disables the PLS function. As the X's are changed to 1's or Ø's, the associated PLS pattern will become active at that motor position.

Motor position is referenced by user units. Once PLS patterns are set up the motion range of the motor is divided into sections. When the specified section is reached (from either direction), the output pattern associated with that range will activate the assigned output lines and program execution will continue. Lines set to "X" will remain unchanged. The PLS pattern remains in that state until the next range is reached by virtue of the changing motor position. However, you may set a time delay to turn off a particular pattern.

When a non-zero pulse width is entered for a given PLS pattern, the pattern will remain in that state for that amount of time. After the pulse width time has expired, the lines are set to all Ø's meaning "OFF". Lines masked with "X" remain unchanged.

If another PLS range is reached ***before*** the pulse width time expires, the new pattern is set immediately and the time delay is ignored.



The PLS functions remain active once they are enabled. There is no way to remotely enable or disable this function after patterns have been entered by PCX. The only way to disable the PLS function is through the Initialize Memory option: PLS Data.

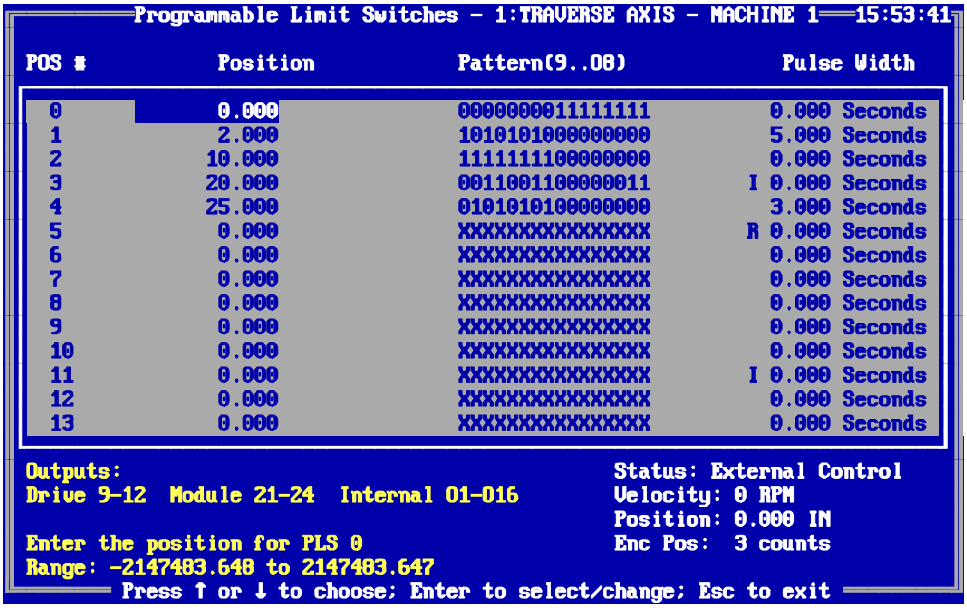
PLS Setup

Before setting up a PLS pattern you will need to assign one or more output lines (either hardware or internal) as programmable outputs. This is done in the Drive Setup, Drive Configuration, Output Functions menu. Select Output Function 12, Programmable Outputs. After you enter the line number of the hardware or internal Output Line that is the first of your programmable output lines, enter the number (quantity) of lines you want to use (maximum 16 lines) and press <Enter>.

To set a Programmable Limit Switch Pattern, select Drive Setup, Drive Configuration, Programmable Limit Switches. The screen you see will look like Figure 12.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 12
Programmable Limit Switches



Your cursor will highlight the starting point of the first position range (typically zero when starting out). Enter the first range starting position including decimal point and then press the <Enter> key. The cursor will move to the Pattern Area and highlight the first column.

This column represents the first Programmable Output line that you assigned (that line number will be shown above next to the word “Pattern”). At this point, enter a 1 to turn a line On, a Ø to turn a line Off, or an X for Don’t Change this line.

Do not press the <Enter> key at this point. You will notice that after every entry the cursor moves to the next column. Wait to press the <Enter> key until you are finished entering or correcting the desired pattern. When you have completed the pattern for this range, press the <Enter> key and the cursor will move to the Pulse Width area.

If you enter a Pulse Width (or time delay) in seconds in this field, the pattern you have just entered will come on when the motor enters this range from either direction and stay on for the amount of time you enter. When the time expires, all lines marked with a “1” will be turned off. Lines with an “X” will not be changed.

However, if the motor is moving through the range faster than the Pulse Width you have selected, the next range pattern will be set on the output lines as soon as that range is entered. Only lines marked with “X” in the next range will not be changed.

After you enter the pulse width (or Ø for the pattern to remain until the motor enters the next range), press <Enter>. The cursor will move to the next PLS starting point.

In the example screen in Figure 12, assuming a 25 inch linear range is active, the PLS pattern will show all lines off when the motor position goes below 2.000 in., including positions less than zero. The pattern will remain as in position 4, when the motor position is over 25.000 inches.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If PLS positions are entered such that the sections are out of sequential order, PCX immediately sorts the positions in ascending numerical order after you enter a position and updates the display automatically.

Remember that the pattern will change according to 1) the position the motor enters, and 2) the direction that position is approached from. If the motor moves from 3.000 inches to 1.000 inches, the pattern will go from four lines ON, four lines OFF to four lines OFF, four lines ON as the position becomes less than 2.000 inches.

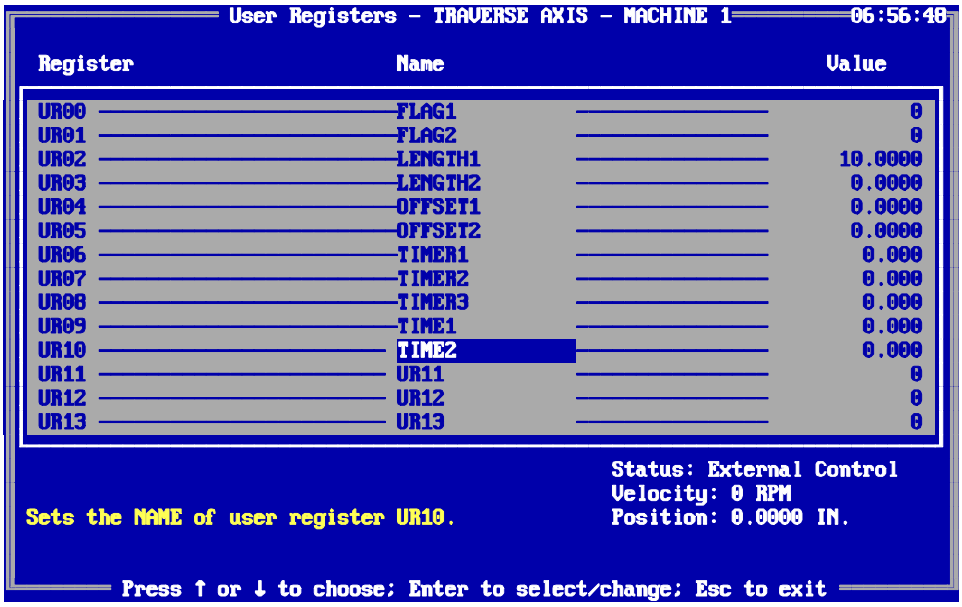
User Registers

User Registers act as “workspaces” for the storage of data. Examples of stored data include:

- FX drive variables that are used in math equations.
- Values to be used in conditional branches in programs.
- Flags or counters that act as progress monitors in programs.

For example: The system you are programming may need to monitor the number of times a particular index has been executed. When the number of index executions exceeds that value (we will use 20 for this example), then a larger value needs to be assigned to the index distance. (Assume the axis is picking up objects from a stack and the stack height is getting progressively lower). User Register URØØ is given the label “FLAG1”, along with a default value of Ø, and User Register URØ2 is given the label “LENGTH1”, along with a default value of 10.000 in.

Figure 13
User Registers Setup Screen



The program is then set up to increment User Register “FLAG1” by a value of 1 each time the index is run. After each index, the program compares the value of “FLAG1” against the constant value of 20. When “FLAG1” exceeds 20, User Register “LENGTH1” is made equal to the sum of “LENGTH1” + 2.000 in. (using the WI Write Index Parameter program step discussed later). Then

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

"FLAG1" is reset to Ø, and the program continues. As the program continues to run, each time "FLAG1" exceeds 20, User Register "LENGTH1" will increased by 2.000 in.

User Registers Setup

To assign default values and descriptive names to user registers, select Drive Setup, Define Motion, Programming, User Registers. You can assign user names of up to sixteen (16) characters to each of the 64 individual registers, as well as default numeric data values with up to five (5) decimal places.

The column on the left side of the screen displays the user register number (URØØ through UR63). The center column displays the user defined register name (maximum 16 characters), and the column on the right displays the user defined register default value (up to 5 decimal places).

Once you set the number of decimal places by entering a value, the user register will retain this number of decimal places until changed by an entry from this menu.

Register names must start with an alpha character rather than a numeric character. For example: A1 would be accepted; 1A would not.

Any value later stored by action in a program in any particular register will automatically be stored with that register's default number of decimal places. Remember, the decimal place accuracy of the register storing the data may not be the same as the default accuracy of the number BEING stored. If incoming data has more decimal places than the register was set up for, the excess numbers are truncated, not rounded off. This may affect the accuracy of some of your calculations.

Equations

Equations and math operations are used to modify the content of user registers. The values stored in the registers may later be used to change motion parameters during a program, such as index distance, velocity, dwell time, or the number of times an index repeats itself. Equations are assembled using any valid register identifier followed by an equals (=) sign, followed by the operation desired.

User registers and constants can be used with any of nine math operators simply by typing them in the Equations Setup screen. You can define up to 16 math equations (numbered Ø through 15) in this manner, each equation having a maximum of 64 characters (including spaces). Once you enter the equation, PCX downloads the equation to the PCM-15 when you exit from the Equations Menu.

SQRT takes a single argument which must be enclosed in parentheses, e.g., SQRT(LENGTH). However, this argument may be an expression containing other operations, e.g., SQRT (LENGTH-OFFSET).

The following characters or character strings are the valid math operators:

+	addition
-	subtraction
*	multiplication
/	division
=	equals
^	exponent of a value or register, e.g., Length ^ 3
SQRT	square root* of a value
(	left paren*
)	right paren*

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Math equations are accessed within a program by entering the Program Step Code “M” at the appropriate program step to select Math Function. You then select an equation to execute from the popup list on the screen. After you select the equation, PCX displays part or all of the equation in the description field in the program screen. (See the “M - Math Equation” program function on page 42.



The math used in these calculations is 32 bit, fixed decimal point. When numbers with greater resolution than the number of decimal places are used, excess characters are truncated, NOT rounded off. Because of a limit in the memory dedicated to math functions, overflow can occur with heavy use of exponent (^) and SQR- ROOT functions. An overflow condition during program execution is considered a math error.

If a math error occurs while processing a math equation during program execution, the **Program Error Output** is turned on but program execution is **not** interrupted. You can view the following information on the diagnostics screen by pressing the <F10> key:

The **Program Error Output** is cleared by the **Clear Program Error Input.**

Lengthy and complex equations (especially those with exponents and square roots) require significant processing time, as much as 3 msecs. per equation. Be aware that non-motion steps still go through the microprocessor and occupy processing time.

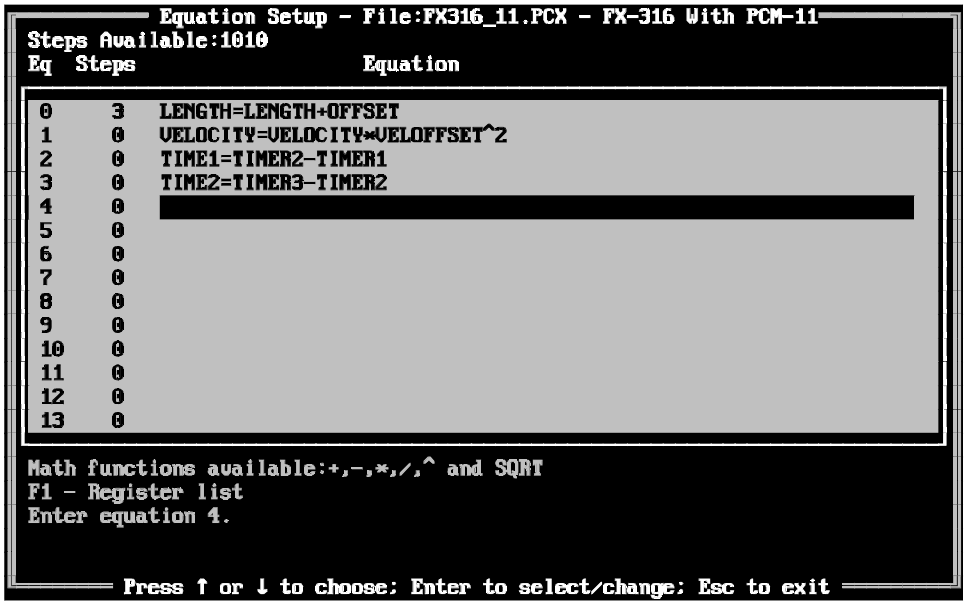
Equation Setup

To enter a math equation for later recall and execution during a program, select Drive Setup, Define Motion, Programming, Equations.

Equations are entered by:

- selecting a User Register for storing the equation results,
- adding an equals (=) sign,
- completing the rest of the equation using other register names and math operators.

Figure 14
Equations Screen



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If you need to recall the names of the registers you have set up, just press the F1 key and a list will appear on the screen. Although the cursor will highlight one of the names, you will need to press the <Esc> key and manually enter the name of the register you want to work with.

If you enter the name of a register that does not exist, a caution screen will appear telling you that PCX couldn't find that register. You have the opportunity at that point of fixing the error before the equation is compiled and execution is attempted.

PCX constantly updates and displays the remaining number of available program steps on the programming screen. PCX 6.5 has the capacity of 1,024 program steps for all programs combined. There are a maximum of 100 programs (numbered Ø through 99), and a limit of 255 steps in a single program.

Equations use some of this space and the amount taken is shown on the top of the Equations Screen. The amount per equation is shown next to each equation.

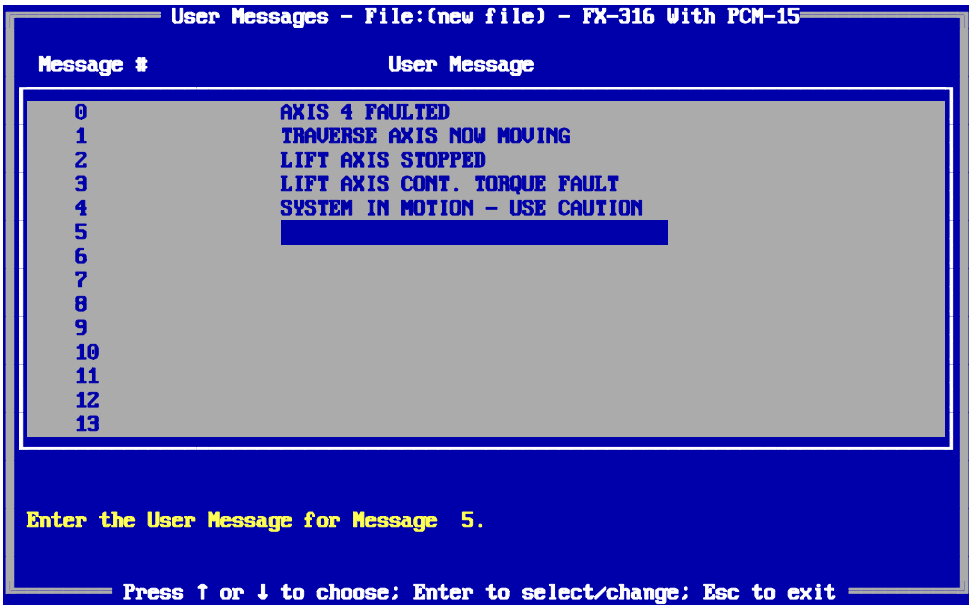
User Messages

Sixteen unique 32 character (including spaces) user messages may be defined and used in PCX programs to assist in monitoring FX Drive performance and program progress. Each of these messages may be sent to the FX Drive Serial Port "A" along with corresponding numeric data such as following error, current velocity, current position, etc. This allows you to watch program progress in PCX terminal mode to see what program portion triggers specific messages.

Messages Setup

Select Drive Setup, Define Motion, Programming, User Messages. A list of all the User Messages now appears with User Message URØØ highlighted. Up to 32 characters may be entered for each message. When finished with your entries, exit the screen by hitting the <Esc> key.

Figure 15
Messages Screen



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

After you have defined your messages you can use them in steps in your program with the “X” command (see “X” - Write to an FX Drive Serial Port function in this section). User Messages can be combined with the contents of User Registers in a serial string and sent to the FX drive serial port “A”.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Building Your Program

Indexes are described in the FX Drive Operator's Installation and Programming Manual, section "PCX Software Setup and Operation" (P/N 400282-00).

Motion Programs are a series of indexes that have been previously set up that you combine with other programming steps to create a motion profile. Each motion program provides a series of movements in conjunction with other machine functions. The movements are used to perform a particular machine operation.

Multiple programs can be created using PCX software and stored in the PCM-15, each designed for a different machine function. The PCM-15 is capable of storing up to 256 indexes, 100 motion programs (Ø to 99), and a maximum of 1024 program steps in the non-volatile memory.

The number of available programs and average number of steps per program are directly related to each other. The memory is set up such that if you require 100 programs (maximum), each program can have an average of 10 program steps each. If the number of programs is reduced to a minimum, you could have as many as 255 steps in a single program.

A motion program is created by entering program functions in the order in which they are to be executed. A motion program is made up of function codes, some of which are listed across the bottom of the PCX program screen. To see the complete list of available codes when you are in the program screen lower half, press the <F1> key. A pop-up screen will display all of the function codes.

As you enter steps in a program, the function codes and function data (index numbers, program numbers, dwell times, etc.) are displayed on the program screen so you can easily follow the program sequence.

You may use any index or program which you have previously created to build your program. The example motion program shown in Figure 16 could be accomplished with one program; however, two programs have been used to show the use of the Call Program (P) function. In this example, program numbers 1 and 2 are used and index numbers 1, 2, 3, 4, and 5 are used.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 16
Motion Program Example

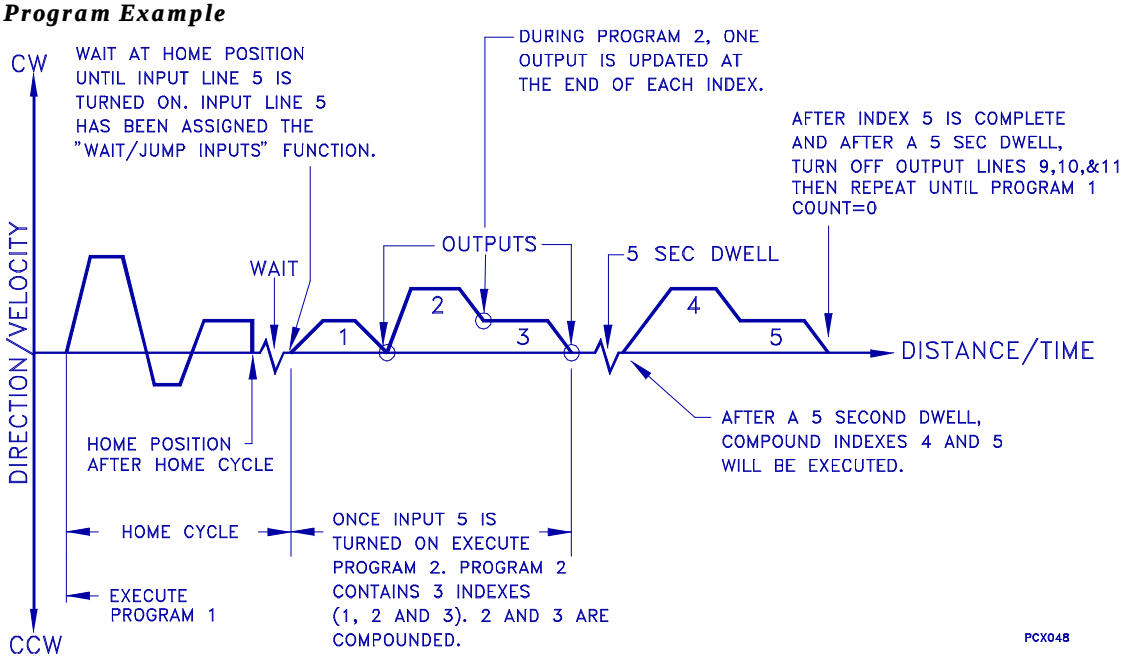
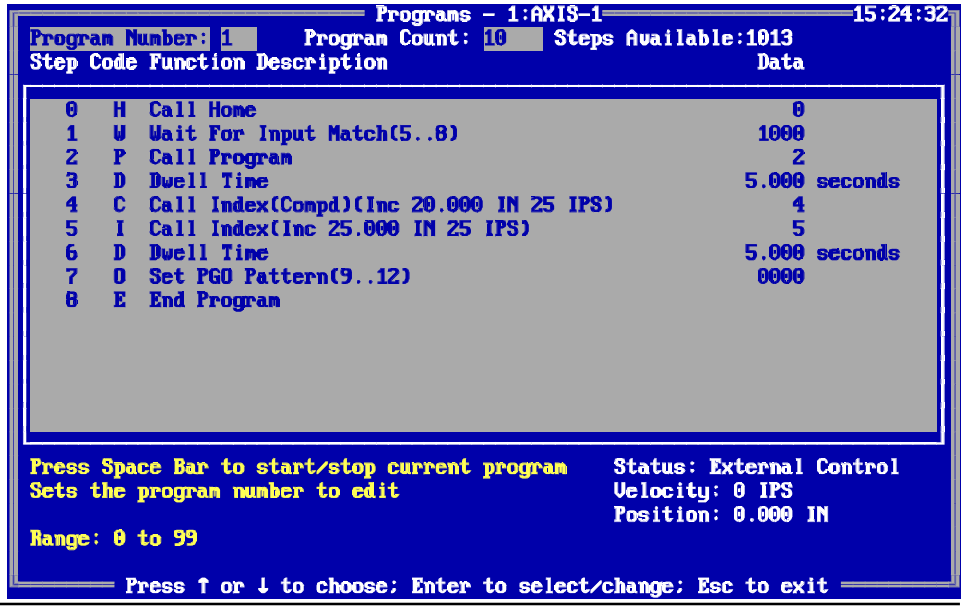


Figure 17 and 18 show the program setup screens used to generate the motion program in Figure 16 . The program count determines how many times the program will be executed. In this example the program count for Program 1 is 10. This means everything within Program 1 will repeat 10 times including Program 2. If the program count is set equal to zero, the program will not execute. If the program count is set equal to 65535 or larger, the program will execute indefinitely.

The program function codes determine the actual moves to be executed. Each function will be performed in the sequence that is shown in the program screen. Once you enter the sequence, you can download the program to the FX drive by pressing the <Esc> key, or by moving the cursor up to the Program Number position using the arrow keys. The upper left corner of the screen will display a “BUSY” message during the download.

Figure 17
Program Example

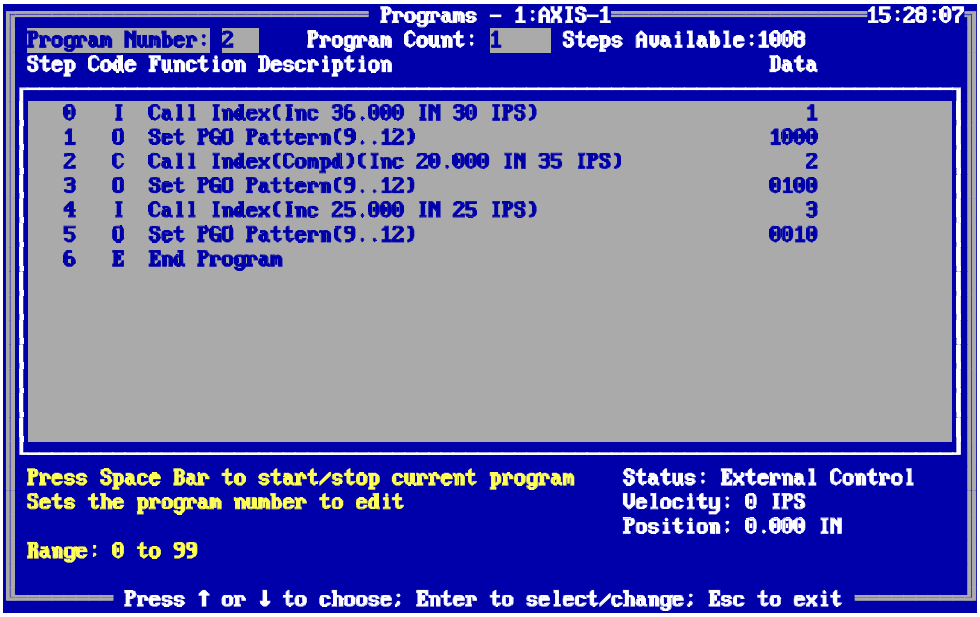


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

In the example shown in Figure 17, Program 1 is the main program and Program 2 is called as a subroutine of Program 1. This call can be seen in step 2 of Program 1.

Figure 18
Program Example

The program sequence is stored in non-volatile memory under Program 1 and 2 (shown in the upper left portion of the menu screen). After Program 1 has repeated ten times (Program Count =10), the Drive will stop and wait for the next command.



Time Base (Indexes And Homes)

The “Time Base” feature is available from the Index and Home screens and can be set to Real Time, Synchronized or Analog.

The Time Base feature relates to the velocity scale factor pre-determined by drive parameters. If you select Time Base Synchronized, then you program index, jog and home velocities based on the sync scale factor. The PCX program screens will show the scale factors you choose.

To run a synchronized index you must call the index from a program. The program must toggle the time base from Real Time to Synchronized prior to running the index.

Programming Functions

Each program function has a designated single or double letter function code that is used when creating a program. This section describes the functions.

C Compound Next Index

The Compound Index feature allows you to link two indexes together without stopping motion between the indexes.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

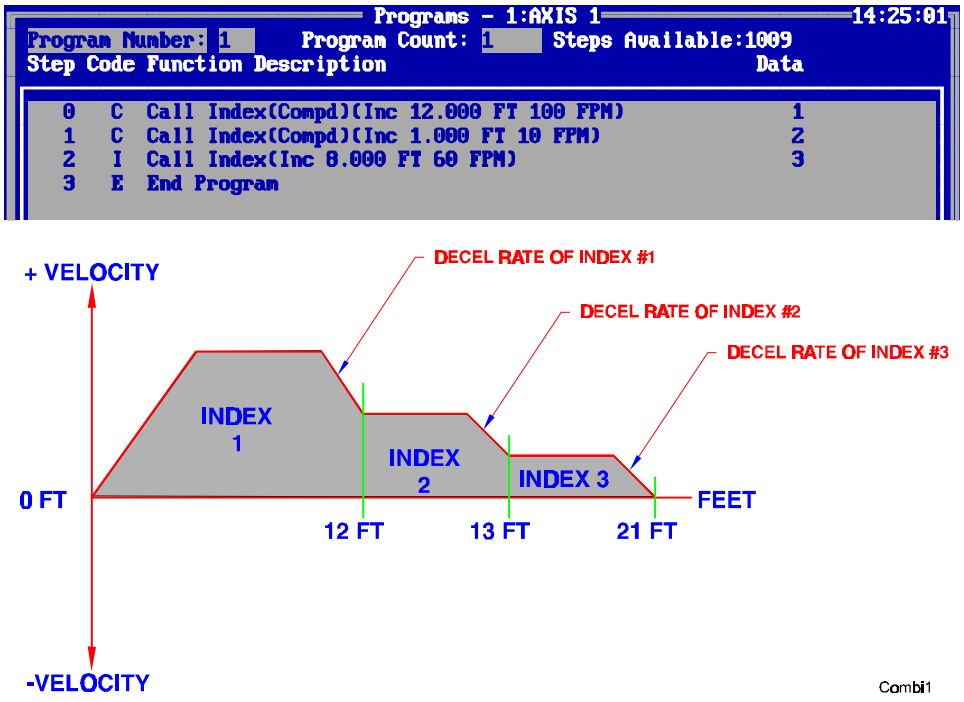
You cannot compound into index #0 under any circumstances or into index #63 if you have a PCM-14 on your FX drive.

A Compound Index is an index whose final velocity is not zero, but the velocity of the next index. Because a Compound Index ends by accelerating or decelerating to a velocity, not a dead stop, that compounded index cannot be used again as a regular index. However, identical Compound Index sequences can be repeated in a program. Three Compound Index examples are shown below:

Example 1: You can use the Compound Index feature to run special Indexes which have different velocities and distances.

In this example, the drive will accelerate at the Index #1 acceleration rate until it reaches the velocity of Index #1. Then, after this distance in Index #1, the drive decelerates at the deceleration rate of Index #1 to the velocity of Index #2, without coming to a stop.

Figure 19
Compound Index Example #1



The drive will continue at that velocity until it approaches the programmed distance of Index 2, then decelerate at the Index #2 deceleration rate to the Index #3 programmed velocity. It will continue at that velocity until it approaches the programmed distance of Index #3, at which time it will decelerate at the Index #3 deceleration rate and stop.

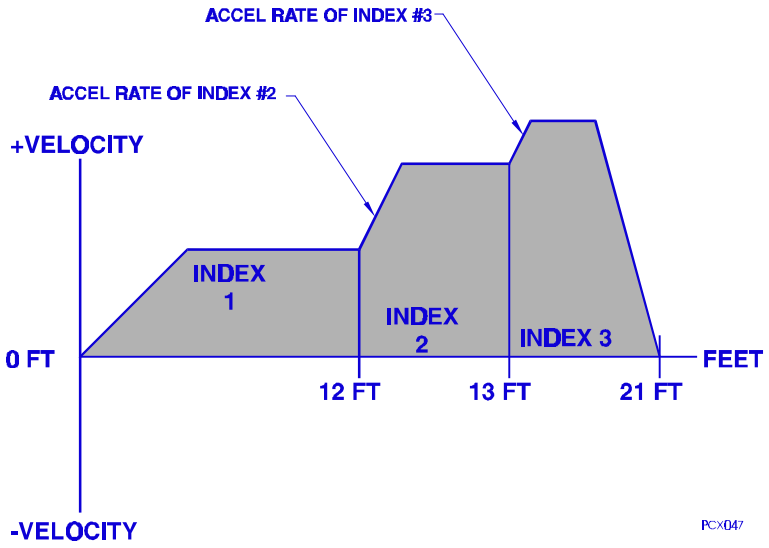


When using multiple compound indexes within the same program, all compound index directions must be the same. The direction of movement is set by the first of the compound indexes and is not scanned again until the next index is initiated that is outside the compound ones.

Example 2: This example is much the same as #1, except in this compound index the drive will accelerate instead of decelerate at the end of each individual index.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 20
Example #2, Compound Index Motion Profile

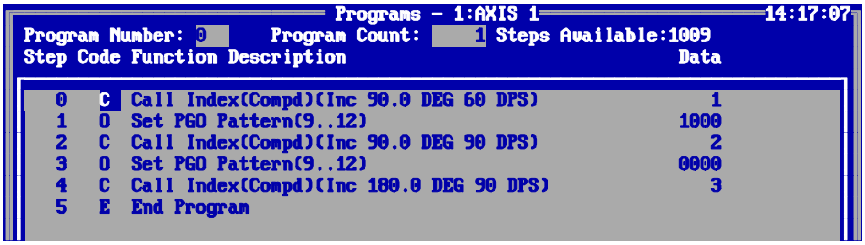


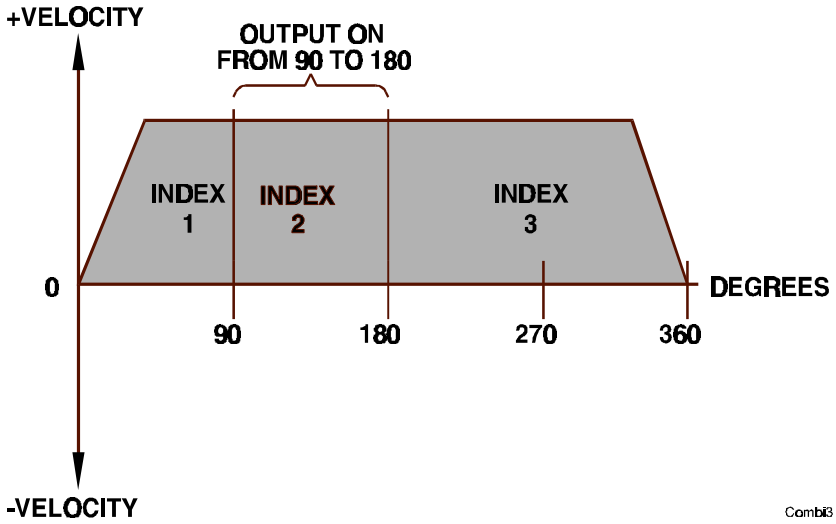
After completing Index #1, the drive will accelerate at the acceleration rate of Index #2 until it reaches the programmed velocity of Index #2. After completing Index #2 the drive will accelerate to the programmed velocity of Index #3 and move at that velocity until it approaches the programmed distance, at which time it will decelerate at the Index #3 deceleration rate and stop.

Example 3: Use the compound index feature to turn an output on, then off

Figure 21
Compound Index Example #3

Index number 0 may not be used as a compound index sequence.





Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

without stopping motion. Each index is incremental, has a count of 1, and has the same velocity.

D Dwell Time

The Dwell Time function allows the program to pause for a number of seconds between program functions. Time may be directly entered or recalled from one of the 64 user registers. Minimum time is 1 ms; maximum time is 65.535 seconds.

E End Program

This function is used to designate the end of a program. It may be used more than once when using the Jump commands. The END function is also used to terminate programs prior to the last program step.

F Set Maximum Following Error

This function overrides the “Maximum Following Error” which is set up in the “Limits” screen. When the program has completed, Following Error is reset to the value programmed in the Limits screen. This function is often used with the “Q, Set Maximum Torque” function. A large value entered here prevents the drive from faulting out during a “Torque” move.

H Call Home

The Call Home function is used to initiate a previously programmed Home Cycle. There are two Home Cycles that can be called within a program.

I Call Index

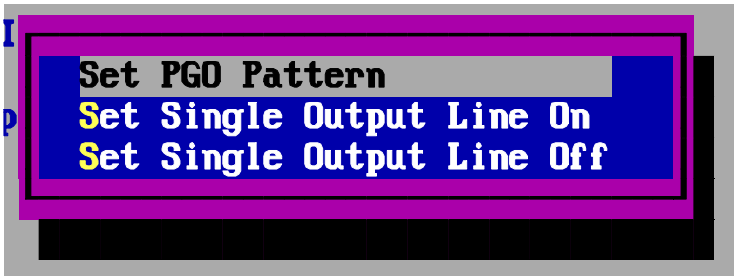
The Call Index function is used to initiate the execution of an index. When this function is used, the index number must also be given. After you enter an index number in the data field, PCX will display that index’s distance and speed.

O Set Outputs

Entering “O” in a program step will display a sub-menu in the middle of the program screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 22
Programmable Output Options



1. Set PGO pattern.

   Before this function can be used, you must first assign Output Function #12 “Programmable Outputs” to one or more internal and/or external output lines. This function allows you to change the status of any or all of the programmable outputs you assigned in the output function screen.

   Once selected, the cursor will move to the data field where zeros that represent the programmable outputs are displayed. The leftmost zero represents the first programmable output line and the others follow in numerical sequence. If you enter a one, that output will be forced on.

   If you enter a zero, that output will be forced off. These outputs will remain in this pattern until they are updated. If you enter an “X” for any line, that line state will not be changed.

2. Set single output line ON:
   Turns any output, hardware or internal, on. Output remains in this state.

3. Set single output line OFF:
   Turns any output, hardware or internal, off. Output remains in this state.

P Call Program

The Call Program function is used to initiate a program from within a program. You can use the “P” function to call additional programs as sub-routines of your original program. This is called “Nesting”. PCX allows you to nest up to 30 programs under any one Program Call function before returning to the original program.



Use care in constructing programs that create a continuous loop condition by “Nesting” programs. When nesting programs, your program must return to the “Master” program somewhere in the loop to prevent programs from becoming stacked up in memory.

For example: You initiate Program #1, which uses the “P” function to call Program #2, which uses the “P” to call Program #3, which uses the “P” function to again call Program #2. This continuous loop condition could cause the memory to get stacked up, causing the drive to drop out of the program and return to external mode or register a “Ø” fault on the diagnostic display.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To avoid this condition, make all of your program calls from your original program (Program #1 in this example). Then use the Jump function (J) right after the “P” function calling Program #3 to jump back to “P” function calling Program #2. This will allow the memory (RAM) to clear and the loop to continuously run program #2 and #3 from Program #1.

Q Set Maximum Torque Output

This function overrides the “Maximum Torque Output” which is set up in the “Limits” screen. When the program has completed, the original value is restored. If you use a low value for “Q” (less then 100%) you may need to set a high value for following error (F). This will avoid faulting the drive if it runs into a condition requiring more torque than it is allowed to deliver.

R Wait For Counter

An (R) code allows you to wait for the number of counts you enter before moving on to the next program step. Enter the desired number of counts in the data field. Counting is determined by the CW(+) and CCW(-) rotation of the sync encoder as viewed from the shaft end of the sync encoder. The count originates from the last Start External Counter (S) or Wait For Counter (R) code.

S Start Counter

An (S) code resets and starts the internal counter for counting the external encoder pulses. The SCS-2 with 2 (1000 line) channels produces 4000 counts/steps per revolution.

T Time Base

This code determines whether the Time Base for any programming function placed after the Time Base code in a program (including Dwells and Homes) is Synchronized (sync encoder), Real Time (normal) or Analog. It is important to remember that if you want a limited number of program steps done in Synchronized mode, you must restore the Time Base to Real Time after those program steps.

J, W Jump/Wait

The Jump and Wait For External Input Functions include unconditional jumps to another program step, jumps if an input line pattern is matched, or a jump/wait on a single input line being made active, whether that line has been assigned as an External Input Line or not. The statements “Jump If Input Match” and “Wait For Input Match” are satisfied if the input line pattern of active lines (hardware and/or internal) matches the specified pattern exactly. In addition, a “don’t care” character, “X”, is available to mask off from the pattern any input lines whose condition should be ignored at this point.

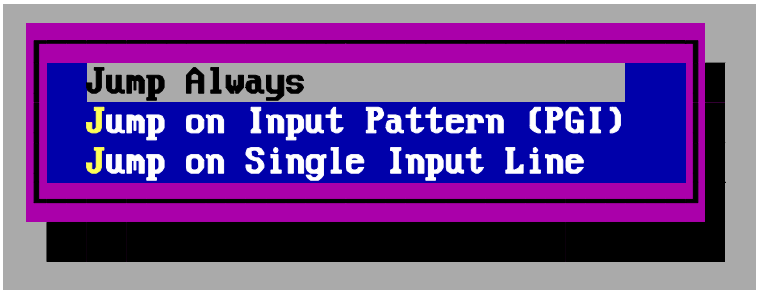
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Using Jump/Wait Statements in a Program

When the "J" command is entered as a program step, PCX displays the screen shown in Figure 23. The first choice, Jump Always, means exactly that, an unconditional jump to another statement number or label.

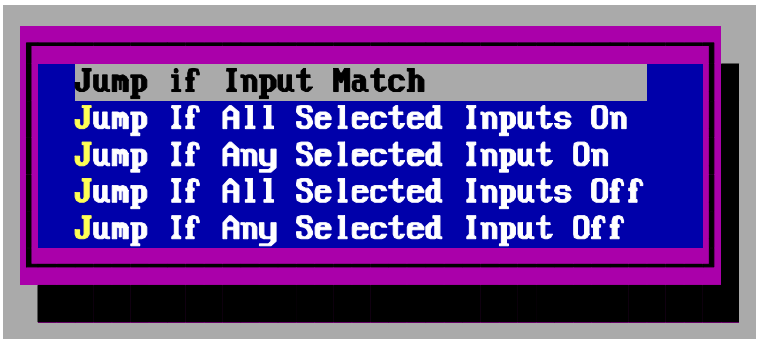
The second choice, Jump on Input Pattern (PGI), brings up another window with these match selections:

Figure 23
Jump Command Options



The first and third choices in Figure 24 are alike in that they are asking for an AND condition of the selected Input Lines before jumping to the destination program step. In other words, the Jump will be made if, for example, selected Lines 1 AND 3 AND 4 are ALL on or off, depending on your selection. A numeral 1 looks for that Input Line to be on or off; the letter X causes that Input Line condition to be ignored.

Figure 24
"Jump If" Options



The second and fourth choices are alike in that they are asking for an OR condition of the selected Input Lines before jumping to the destination program step. That is, the Jump will be made if Line 1 OR Line 3 OR Line 4 is on or off, depending on your selection. Again, a numeral 1 looks for that Input Line to be on or off; the letter X causes that Input Line condition to be ignored.

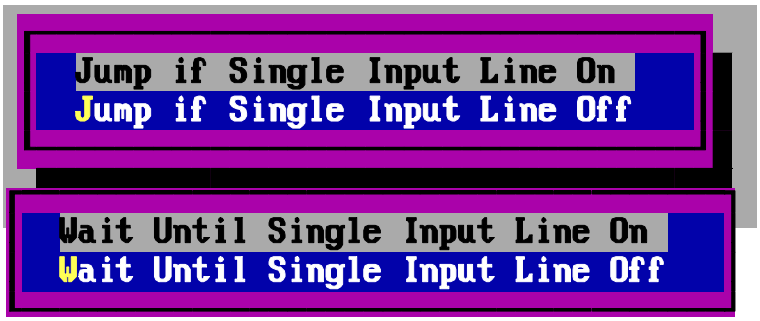
The fifth choice, Jump if Input Match, will then ask you for an Input Line pattern to match before Jumping, with numeral 1 representing a Line ON, numeral Ø representing a Line OFF, and X representing a Line whose condition is ignored by this statement. This choice will Jump program execution to the specified program step if and only if the exact PATTERN is matched line for line. If any of these conditions are not met, program execution proceeds to the next step in the sequence.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Another feature of both jumps and waits is the ability to monitor a single input line (hardware or internal) that is independent (or part of) of the existing jump/wait pattern (i.e. Programmable Input (PGI) Pattern). The following four jump/wait options are available.

Wait for External Input Functions are very similar, except that program execution is halted at that spot in the program until the desired Input Line condition is met. If the condition is not met, program execution proceeds immediately to the next step.

Figure 25
Jump/Wait Single Input

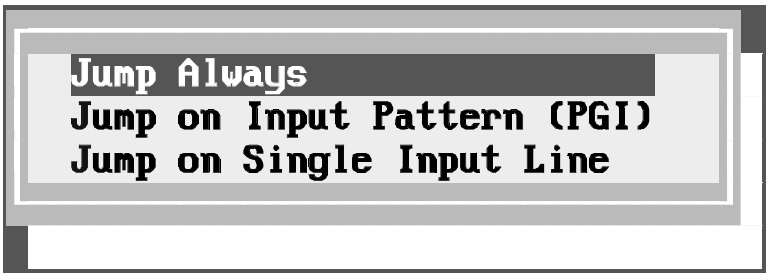


Jump Commands

To select this option, enter "J" in the program step. Then select one of three Jump options shown in Figure 26.

The "Jump Always" command is an unconditional jump statement that causes program execution to move immediately to the specified program step.

Figure 26
Jump Command Options



The "Jump on Input Pattern (PGI)" command causes program execution to skip to the designated program step if the specified input lines match the pattern you have selected. If the specified lines do not match that pattern the program continues to the next step in the program.

Before this command can be used in a program, Input Function #28 "Wait/Jump Input" must be assigned to one or more hardware or internal input lines (see "Input Functions" section).

Once the Jump Command has been selected, the cursor will move to the center of the PCX screen. The zeroes that appear in this field correspond with the number of Input Lines selected with Input Function #28. The left-most zero corresponds to the first input line selected.

You may now choose which lines to monitor during this step by entering a (1) in the field corresponding to the input line you wish to monitor. Any field that has a zero or an "X" will cause that input line to be ignored during execution of this step.

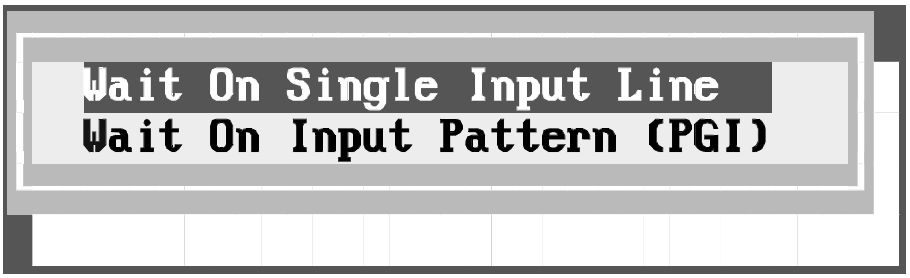
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The "Jump on Single Input Line" command causes program execution to jump to the designated program step if the specified input line matches the condition you set in the next screen. This line can be **any** input line and is not restricted to those lines assigned to Input function #28, Wait/Jump Inputs. If the specified line does not match the condition (On or Off), the program continues to the next step.

Wait For Input Commands

Before this command can be used in a program, you must assign Input Function #28 "Wait/Jump Input" to one or more hardware or internal input lines (see Input Functions, of this Manual). To use Wait For External Input when editing or writing a program, enter W as a program step. When you have entered the W, the screen will offer the choices shown in Figure 27.

Figure 27
Wait for Input Command Options



When the "Wait On Single Input Line" function is selected, the system will hold program execution at this step until the designated input line meets the On or Off condition you select in the next screen. This line can be any hardware or internal input line and is not restricted to those lines assigned to Input Function #28, Wait/Jump Inputs.

When the "Wait On Input Pattern (PGI)" function is selected, the system will hold program execution at this step until the input pattern you designate in the pop up menu is satisfied. These lines are restricted to those that you have assigned as "Wait/Jump" inputs.

Once the Wait Command has been selected and a choice made from the pop-up screen, the cursor will then move to the center of the PCX screen. Zeroes will appear in this field that correspond to the number of External Lines selected in the Input Function Screen. The left-most zero will correspond to the first line selected.

You now choose which lines to monitor during this step. You make this choice by entering a "1" in the field corresponding to the line whose state you wish to monitor. Any field that has a zero or an "X" will cause that line to be ignored during execution of this step.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

/ + - * ^ Math Operators

The equation screen allows you to set up complex equations to be entered, stored, and recalled for execution in a program. You may also perform single step math operations on any of the User Registers as a step in a program.

These operations are stored as simple program steps and do not infringe on the storage capacity for the more complex math equations. Any of the following math operators may be used as program step commands:

/ : divide
+ : add
- : subtract
* : multiply
^ : exponent

Using Math Operators in a Program

To enter a math operator as a step in a program, move the cursor to the desired program step and type the math operator you wish to work with (/, +, -, *, ^,) and press <Enter>. PCX will display a window displaying the user registers. Select the user register in which you want to store the results and press <Enter>. A second window will pop-up which again displays the user registers with the added option **"Immediate Value"**.

Figure 28
Load Value Setup Options



If you select **Immediate Value** you then enter the value that you want to use to modify the register when the program encounters this step.

Any immediate value between -2,147,483,648 and 2,147,483,247 will be accepted.

For example, to add a count of 1 to user register "Flag1", the program step would appear as:

+ FLAG1 = FLAG1 + 1

If you want to add the contents of register "OFFSET1" to register LENGTH1, the program step would appear as:

+ LENGTH1 = LENGTH1 + OFFSET1

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

= Load Value

This function replaces the contents of a User Register with an immediate value, the value of the contents of another register, or the value of a drive parameter. The contents of the changed register may now be used as a new drive parameter, etc.

Using Load Value in a Program

This function is selected by entering the equals (=) sign as a program step. When the equals sign is used, a popup window shows four choices:

Load Immediate Value

If you select this option, PCX will display a pop-up window showing the first 16 of the 64 User Data Registers. You can then select the register in which the information will be stored. As with other PCX lists, the first letter of the variable name can be typed for quicker access. Once you select the register, PCX prompts you for the immediate value that you want stored.

Copy User Register

If you select this option, PCX prompts you to choose which User Register to change. When you select the User Register to be changed, PCX then prompts you for the User Register whose contents are to be copied INTO the first. Remember, the first register selected under this command is the one whose contents will be set equal to the second register chosen. Values are re-scaled to the format of the destination (first) register if the decimals are different.

With the drive parameters above, the value loaded into any user register will be adjusted to the number of decimal places of the destination register. Each register works with the number of decimal places that were assigned when the default data was assigned.

Get Drive Command Data

This option enables the program to interrogate the FX Drive at this step in the program and store the response in a register. As before, PCX first asks for the register to use for data storage. Once you specify the register, you may use any two-letter FX Drive command query, along with the corresponding command modifier. (See FX Drives Serial Commands Manual P/N 400255-00).

Again, ensure that the response to your query will fit properly in the register you selected. Data with more than the register's number of decimal places will be truncated, not rounded off, so care should be taken to avoid errors that may result.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Read Drive Parameter Data

When this option is is selected you will be prompted for the User Register to use for storage. The next four screen clips present a list of possible FX Drive parameters to be read:

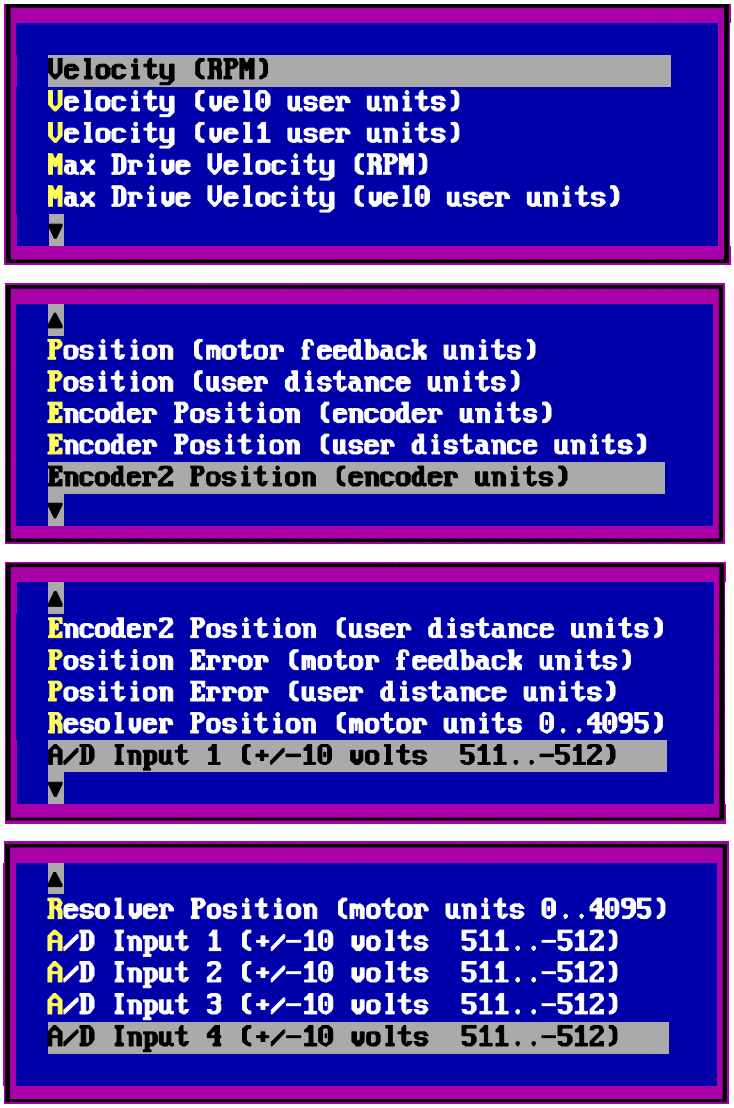


Figure 29
Read Drive Parameters

B Conditional Branches

Conditional branches are set up as steps in a PCX program to establish conditions that can change the program execution. This function tests the contents of two user registers and branches to a step number or label if the condition is true. Otherwise, the next consecutive program step is executed. The contents of the selected user registers are tested against one of the following conditions:

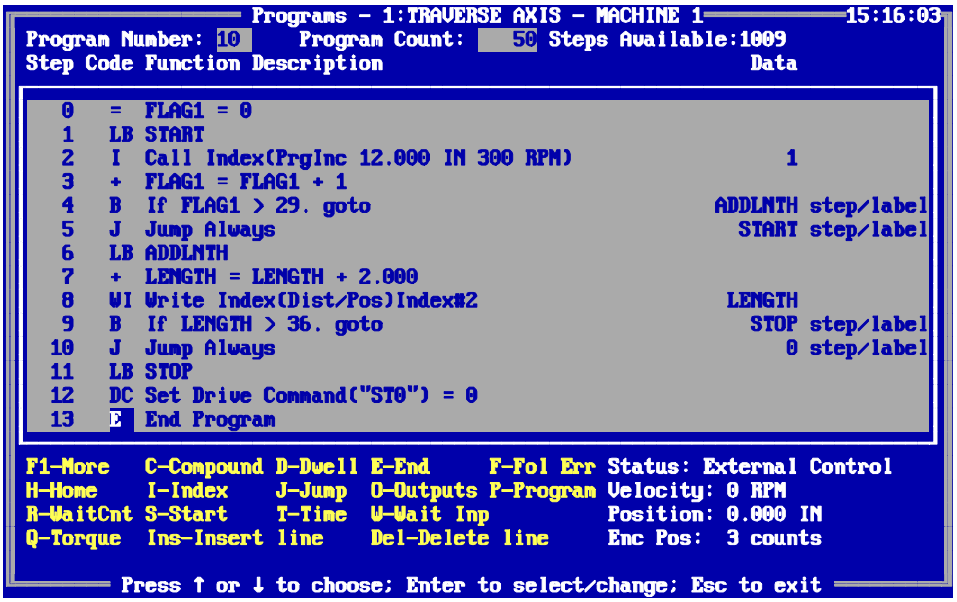
>	greater than
<	less than
=	equal to
> =	greater than or equal to
< =	less than or equal to

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Using Conditional Branches in a Program

Figure 30 shows a sample program that uses conditional branch commands in steps 4 and 9.

Figure 30
Sample Program Using a Conditional Branch



To insert a Branch condition in your program, move the cursor to the spot where the branch is to be made and enter the letter B. Now PCX will display four menu windows (one at a time) to set up the conditional branch.

The first window selects the register to be compared. The second window sets the branching condition. The third window sets the register or immediate value, to match against the first register. The fourth window sets the step number or label to branch to if the condition is met.

As mentioned above, if the specified condition is not met, the program proceeds to the next consecutive step.

DC Drive Command

The DC program step sends drive commands from within the program to the FX Drive. Any serial drive command (except Index Initiate or Program Initiate) can be issued from a program. With drive commands, the data accompanying the drive command can be either “immediate” (i.e., a constant entered at the program step line), or the current value of a User Register.

This would allow, for example, a change of Maximum Following Error (”ME=XXX”) at a specific point in the program sequence. After executing the motions that required the change, the Maximum Following Error can be reset to its default value with another execution of this command.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Using Drive Commands in a Program

When in the program setup menu and in the specific program you want to modify, move the cursor to the correct program step location. Enter “DC” as a program step command. The program screen will pop up a menu which allows you to chose either “Immediate Value” or one of your user registers.

If “Immediate Value” is chosen, you are then prompted for the serial command you’d like to enter (e.g., “ME” for maximum error). The cursor will then move over to the data field. You enter the appropriate data in this field.

If a user register is chosen, the value of that register is then added to the command string sent to the drive.



You must be aware of the units in use and any possible scaling of values when using drive commands in a program. See the FX Drives Serial Commands Manual (P/N 400255-00) for detailed descriptions of available drive commands and their ranges.



Execution commands, such as Index Initiate or Program Initiate, are not supported and will be ignored. When you run a program, the FX Drive will not look for an Initiate command until the program is completed. Because of this structure, Initiate commands will not receive a response and will not be acted on when sent in the middle of a program. The sole exception to this rule is the Stop Motion command, “ST”.

I, PJ Program Index, Program Jog

An important feature of the PCM-15 Ratio Controller is the ability to initiate motion from the program and execute subsequent non-motion program steps **during** the motion. The program can monitor control parameters such as position and velocity and perform other operations based on these parameters while the motor is in motion.

There are three ways to start the FX Drive in motion and execute non-motion program steps during the motion.

First is the Program Jog command, which starts motion based on the serial jog parameters set up in the Jog screen. This Jog motion is continued until a Stop Motion command is executed in the program sequence, until the program terminates or another motion program step is commanded. At that time the motor will change to the speed called for in that motion step (index, another jog or other motion command).

The other two ways of initiating motion are to call a Program Incremental Index or a Program Absolute Index. Program Indexes are called with “I” just as normal indexes. Program Indexes are programmed in the Index setup screen (under “Define Motion”) from two new index types, Program Incremental and Program Absolute. With these two index types, the FX Drive initiates motion based on index parameters entered in the index screen and continues motion until the index is complete or until a subsequent program step calls another index or jog.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

When selecting Program Index Incremental or Program Index Absolute as the desired Index Type, the index count is automatically assumed to be 1.

A flag for Program Indexes allows the Program Index to complete its move before allowing a subsequent program step to affect motion. This flag is set in the Index screen. Motion will not be aborted if “Yes” is entered for the “Run Until Index Complete” parameter. Instead, the program will start the Program Index and remain at the beginning of the next step which affects motion until the previous Program Index completes, at which time the program will start executing the next motion. If the entry is <NO>, the program index will abort as soon as program flow meets a subsequent motion step or call to another program.

If any other index follows a program index (and the entry is <NO>), the Program Index is aborted when the second index is called. The index distance starts from this position and the accel/decel ramps of the second index are used. This is very similar to the way compound indexes are handled, except that the first index is aborted.

Example: If a normal Incremental index of 4000 ST immediately follows a Program Incremental index of 8000 ST, the FX drive would immediately ramp from 0 to the velocity of the normal index and move only 4000 ST. If subsequent program steps do not affect motion, the Program Indexes run the entire distance as would any normal Incremental or Absolute index.

If a Program Index follows Program Jog, the jog motion is aborted when the index is called and the FX Drive ramps to the velocity of the index using Serial Jog Ramps. Motion does not stop between Program Jog and the Program Index. If Program Jog follows a Program Index, the index motion is aborted when the jog is called and the motor will change speed to Serial Jog Speed without stopping.

If changes are made to serial Jog parameters during a Suspend condition, these changes affect Program Jog. The changes take effect as soon as the program is resumed, including changes in direction!

Program Index and Program Jog support compounding motion. This means that a Program Index can be compounded into another index or jog. If the next program step is Program Jog then the accel/decel ramps of the jog are used in transitioning to the jog velocity. If the next program step is a Program Index or a normal index, the transition is handled just as in normal compound indexes. A Program Index may also be used as an index to be compounded into.

Notes On Program Index And Program Jog:

1. A Program Index, when set to Run Until Complete, will complete the index before other motion steps execute and before a call to another program.

2. A Program Index, when NOT set to Run Until Complete,will abort the Program Index and will stop before another index begins, and before a call to another program.

3. If Program Jog is running and the program calls another program which makes changes to Serial Jog parameters, those changes are permanent until modified deliberately by a program or by an operator.

4. If a Program Index is running at the time an END program statement is reached by any program or sub-program, that Program Index is aborted and motion is stopped, regardless of Run to Complete - Yes or No.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. Motion is always stopped at the END statement on the LAST execution of the main program, that is, one that is initiated by I/O or serial commands.

6. When Program Indexes or Program Jogs are stopped when reaching an END statement, the STOP/HOLD Decel ramp (from the Limits Menu) is used. If this is too abrupt, you can use the "DC" command in a program to change that ramp during the program, and to reset it to default values later on.

LB Labels

The LB command allows you assign an alpha-numeric label to program steps. This allows more convenient and obvious program writing by clearly identifying the function of the more significant program steps. Each alphanumeric label has an associated text string (up to eight characters) which is stored in the FX Drive as the data corresponding to the Label Program Step.

The PCX software ensures that all labels are unique in each program. However, the same label can be used in different programs on the same drive.

If an extra program step is inserted in a program with labels, two things are done by PCX:

1. As with other program steps, the step numbers of all labels below the inserted line will be incremented by one.

2. Any jumps to the labels below the inserted line are also incremented by one step. PCX will adjust all jumps to point to the new step number of the label.

Using a Label in a Program

Program labels cause a slight increase in program execution time. Large numbers of setup labels may possibly have an adverse effect on system performance.

Select the Program Menu and the program you wish to modify. Move the cursor to the point where you want to add a Step Label. Enter "LB". PCX will pause and prompt you for the 8 character label. When you have completed the entry, press the <Enter> key, followed by the <Esc> key. This action will send the label information to the FX Drive and the PCM-15 Module.

M Math Equation

Math operations during a program allow index or program parameters to be adjusted according to stored instructions and current conditions. This function calls a previously defined and stored equation for immediate execution (entered in the Equations and Math Setup Screen). (See "Equations" and "Equation Setup", Pages 21-23.)

Using Math Equations in a Program

When "M" is entered as a program step, PCX pops-up a window displaying all of the stored equations. Simply highlight the desired equation and press the <Enter> key. The selected equation will be entered as a program step and the cursor will move to the next program step.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

RT Real-Time Clock

RT is a direct drive command that you can use in a program to determine the elapsed time between two or more events. When you use RT to retrieve the current time from the system clock, be aware of the following constraints:

1. The realtime timer ranges from -2147483 . . . to 0 . . . to +2147483 ms.

2. RT rolls over from the maximum response of +2147483 ms. to -2177483 ms. every 70 minutes.

To use RT to track elapsed time, use three User Registers, UR28, UR29, and UR30 (for example):

```
DC                          RT = UR28
 *          (intermediate steps between timing points)
DC                          RT = UR29
M                           UR30 = UR29 - UR28
```

UR30 is the time between the two events in milliseconds.

Check to be sure that you have not crossed over the rollover point:

```
IF UR30 > = 0
                            THEN TIME = UR30
ELSE
                            TIME = UR30 + 4294966 (ms.)
```

Now that you have an elapsed time between event, you can use the value in user register TIME as a condition for branching, or similar decision making.

ST Stop Motion

Since using Program Jog could cause infinite motor shaft rotation, the Stop Motion program step ST allows motion to stopped BY the program. This program step uses the Stop/Hold Decel Ramp specified in the Limits screen to bring the motor to a halt.

But only motion is stopped by this step, and only at this point. Program execution continues. The next program step will be immediately executed.

Using the Stop Motion Command in a Program

At the appropriate program step, enter “ST”. When the program reaches that step, the drive will initiate a ramp to zero velocity and immediately go on to the next program step.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

WI Write Index, WJ Write Jog

This command allows a program to change index or jog parameters such as distance, velocity, acceleration rate, deceleration rate and dwell time while the program is running.

Using WJ Write Jog in a Program

To change Program Jog parameters (the same as Serial Jog parameters), enter "WJ" as a program step. A small window will pop up, allowing you to select Serial Jog Velocity, Accel Time, or Decel Time. When a selection is made, a second window appears, allowing you to choose Immediate Value or the value of any of the 64 User Registers. If Immediate Value is chosen, you will be prompted to enter the value for the parameter you wish to change. Parameter units are the same as found in the "Jog" setup screen.

If you choose any of the User Registers, the Jog parameter will be set to the value found in that register. (Remember, User Register decimal places are set when each Register is defined.)

When any serial jog parameter is changed on the fly during program execution (e.g., if the jog velocity is changed while running Program Jog), the FX Drive would immediately ramp to the new velocity using the jog accel/ decel ramps.

Using WI Write Index in a Program

To change Program Index Parameters, enter "WI" as a program step. A small window appears showing the following parameter choices:

Dist/Pos
Velocity
Accel Time
Decel Time
Count

A second window appears, showing Immediate Value and all of your User Registers. This selection will be the source for the parameter data to be changed.

If Immediate Value is chosen, the screen then prompts for the Index Number whose data will be changed. After choosing an Index, the program will ask for the new parameter data to be entered for this index.

If a User Register is selected, the program then asks you for the index Number whose parameter will be made equal to that register.

Unlike changes to Jog Parameters which are immediately accepted and executed, Index parameter changes are not recognized after entry until the next time that index is initiated. For example, if Index 34 distance is changed while Index 34 is running, the actual distance traveled will not change until Index 34 is run again (this is because the distance is set at the beginning of the index execution).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Transmit Data (X)

This command transmits data in an ASCII format via Serial Port “1A” to a device such as a programmable display. The display would then show the serial “message” in large alphanumeric characters for easy viewing by machine operators.



When on-line with an FX Drive, do not attempt to initiate a Program that uses the “X” command from the PCX program screen. You must initiate the program from the Terminal mode (always available on-line by pressing <ALT><D>). Also, do not initiate PCX while connected to a drive that is already running a program with an “X” command.

Any stored User Message may be followed by the contents of any User Register. When the “X” program step is entered, PCX prompts you for either Register Data, User Message or Both.

If you select User Message, a window pops up displaying your pre-defined user messages. Highlight the message you want to send and press <Enter>.

If you select Register Data, a window pops up displaying your User Registers. Highlight the register whose data you want to send after the message and press <Enter>.

If you select Both, first the User Register pop-up window is displayed. Then after selecting a User Register, the user message window is displayed.

When this step is encountered in a program, the data you have specified will be immediately transmitted to the FX Drive serial port “1A” in ASCII format.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

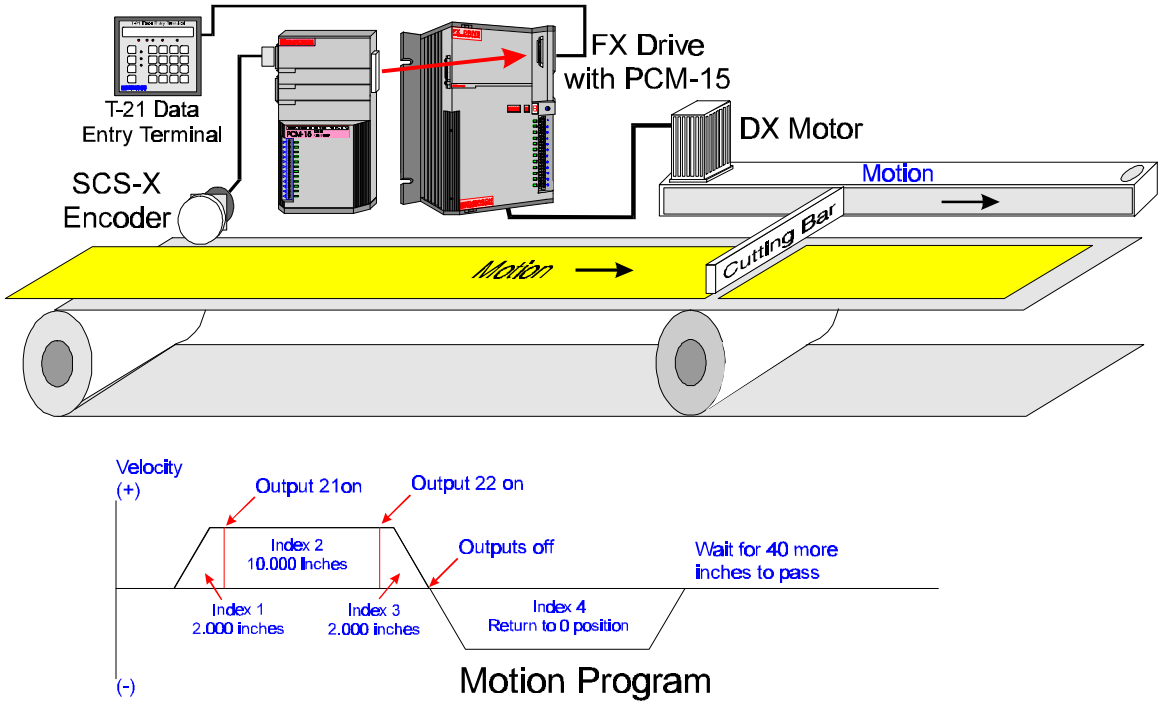
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Flying Cutoff Programs

Some applications that require a moving product to be cut to a specific length also need to have the cutting mechanism track the product as it moves along a linear path. This type of application has often been referred to as "Flying Cutoff" to denote that the cutting action takes place over a finite period of time while the cutter stays synchronized to the moving product, typically some sort of web. (The opposite to this is a cut-to-length system that cuts the product while it is at a stop, usually with some type of plunge cut mechanism.) A typical flying cutoff system is shown below.

In this system, the master axis is represented by a synchronization encoder which is driven by the moving web (cardboard, plywood, urethane foam, etc.). The point of contact with the web is a precision wheel of a specific circumference (such as 12.000 inches per revolution) that rotates at web speed.

Figure 31
Flying Cutoff System



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A flying cutoff program first resets the internal counter that is reading the output of the encoder, then calls a cut move synchronized to the web speed, and, at the same time begins counting towards the next length. The cutting mechanism accelerates to a speed that is synchronized at a one to one ratio to the web speed in order that the cut be uniform and straight. When the cutting action is complete, the mechanism decelerates to a stop, the time base in the FX drive is set to internal and a non-synchronized index back to the starting point is executed. At this point, the drive waits for the encoder to furnish the counter with the right number of encoder counts to equal the desired cut length. When the count is reached, the program is complete and control goes back to the very first step (Start/Reset Counter) and the cycle is performed again.

Set-up Sequence

Step 1: Calculate the maximum velocity of the master axis encoder in steps/second. This value is entered as the Master Maximum Velocity in the Master Axis screen.

Example: The Master Axis encoder is driven by a measuring wheel riding on the product whose circumference is 12 inches.

If the product maximum linear speed is 600 ft./min., then the encoder shaft speed is equal to:

$$Vmax = \frac{600 ft / min.}{1 ft./encoder} = 600 \text{ RPM } (10 \text{ revs./sec.})$$

Therefore if you use an SCS-4 encoder with 3,000 lines per rev. (or 12,000 steps per rev.), then 120,000 is entered as Master Maximum Velocity.

$$Vmax \text{ (steps / sec.)} = 10 \text{ rev./sec. X } 3000 \text{ (encoder lines / rev.) X } 4 \text{ (encoder steps / line)}$$
$$Vmax = 120{,}000 \text{ steps / sec.}$$

Step 2: Calculate the maximum linear velocity of the master axis in user units.

Vlm max (in./sec.) = 600 ft./min X 1 min./60 sec. X 12 in./ft.

Vlm max (in./sec.) = 120 in./sec.

Step 3: Calculate the maximum linear velocity of the follower axis in user units.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Example: If the follower axis is driven by an FX-455 with a 4:1 speed reducer, then the maximum output velocity of the reducer is 3,000 rpm (max. speed for an FX-455) ÷ 4 = 750 rpm. If the reducer output shaft drives a belt with a pulley with a circumference of 12 inches, the maximum follower axis linear velocity is:

Vlf max (in/sec) = 750 (rev/min) X 12.000 (in/rev) X 1 min./60 sec.

Vlf max (in/sec) = 150 in./sec.

Step 4: Use the maximum velocity values calculated in steps 2 and 3 to determine the ratio between the follower maximum speed and the master maximum speed. This value will be entered in the Master Axis screen in PCX as the Sync Velocity Scaling.

Example: Using the results of steps 2 and 3

Sync Velocity Scaling (Ratio) = (Follower Max. Speed)/(Master Max. Speed)
= 150.0 in./sec. ÷ 120.0 in./sec.
= 1.250

This number represents the velocity ratio between the two axes, master and follower, when both are at their respective maximum speeds. By using this ratio as a starting point, we are able to enter index velocity in terms of the ratio between the two axes. Now the cut moves can be made with index velocity settings of 1.000 and provide matched movement with the product to be cut.

Enter 1.250 for Sync Velocity Scaling.

Enter “RAT” for Sync Velocity User Units.

Step 5: Now we will calculate the Wait for Master Axis Steps parameter. This number sets the length to be cut in the Flying Cutoff Program and will be entered in the Program screen.

Example: Calculate the value to use for 40 inch parts.

$$\text{Wait for Master Axis Steps (encoder steps)} = \frac{40\text{in. X } 3000 \text{ lines / rev. X } 4\text{in./rev.}}{12.0\text{in./rev. (encoder wheel circ.)}}$$

Wait for Master Axis Steps = 40,000 encoder steps

Step 6: Create the individual indexes that will make the cut motion, turn on and off the cutting mechanism, and return the cutting mechanism back to the starting point. The indexes that move the cutter during the actual cutting action will be synchronized to the web-driven encoder, while the index that returns the cutter back to the starting point will be internally time-based. The synchronized indexes will use a velocity

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

(ratio) of 1.000 to ensure that the follower will be at matched speed with the master during the cut. (A velocity of 1.100 would have the follower axis move slightly faster than the master axis during the index.)

Drive Parameters

This first screen shows the drive parameters for the example system. Each revolution of the motor produces 3.000 in. of belt movement (12.000 in. per pulley rev ÷ 4 (speed reducer with 4:1 ratio). When the motor speed is 3,000 rpm (50 revs./sec.), the belt speed is 150.0 in./sec - IPS (50.0 revs./sec. X 3.000 in. per motor rev.).

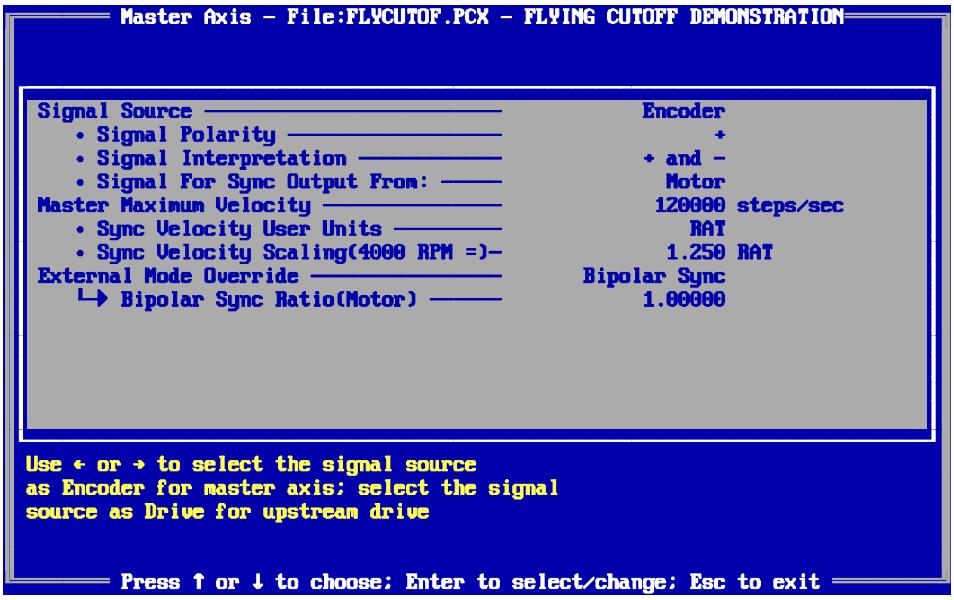
Figure 32
Drive Parameters Screen

Master Axis

Master Maximum Velocity is 120,000 steps/sec. (calc. earlier). Sync Velocity User Units is any three letter designator. Here we are using “RAT” for ratio.

Enter 1.250 for Sync Velocity Scaling.

Figure 33
Master Axis Screen



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Indexes

Shown here are the indexes used to move the cutting mechanism axis with the product to be cut. The total tracking distance is 14.000 inches, the amount of distance necessary to bring the mechanism up to sync speed with the web, make the cut, and decel the cutter assembly to a stop. Three indexes are used so that programmable outputs can be turned on at easily specified points in the cut move to trigger and then retract the cutter. The fourth index is used to return the cutter back to the zero position as fast as possible.

Figure 34
Index 1 Screen

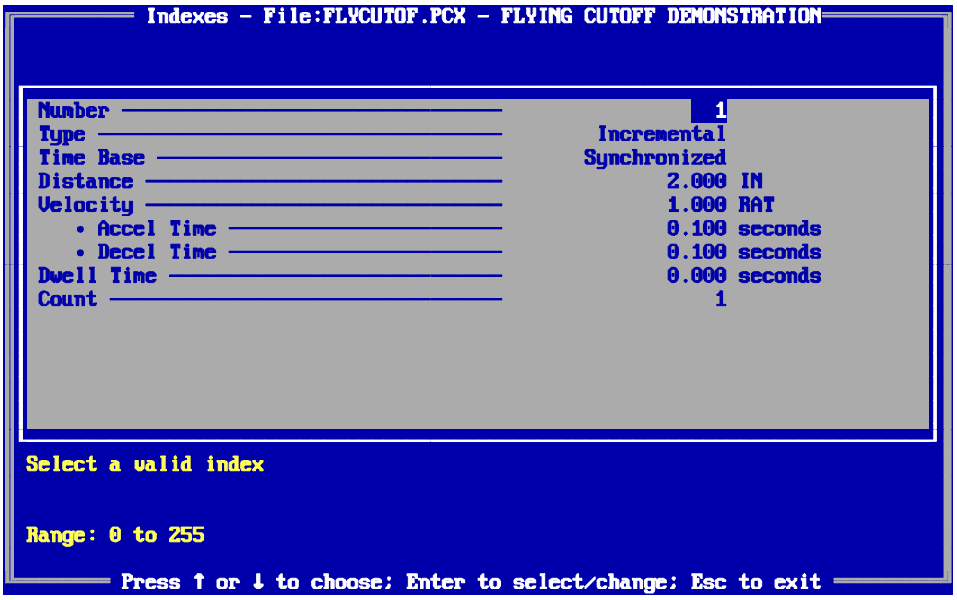
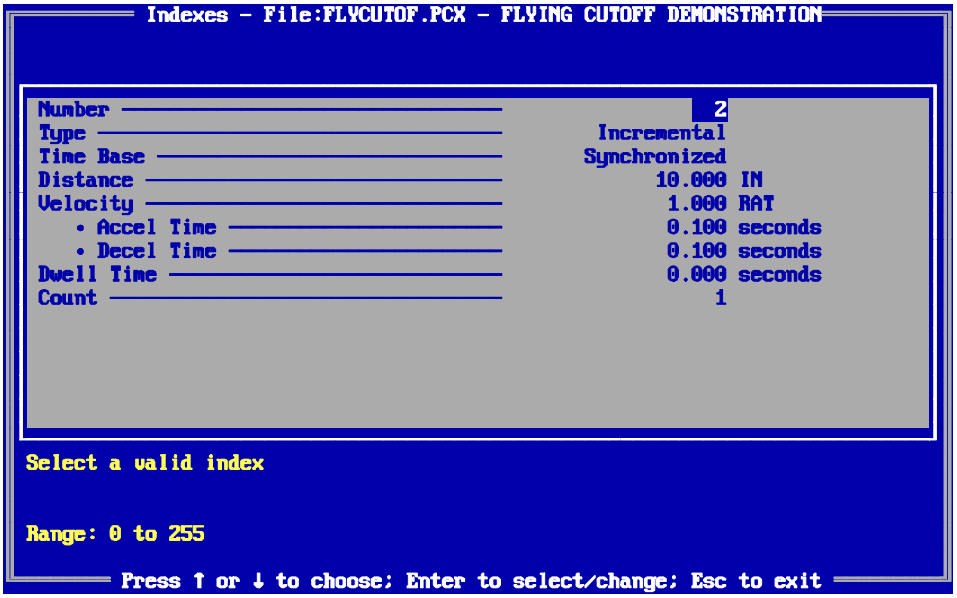


Figure 35
Index 2 Screen



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 36
Index 3 Screen

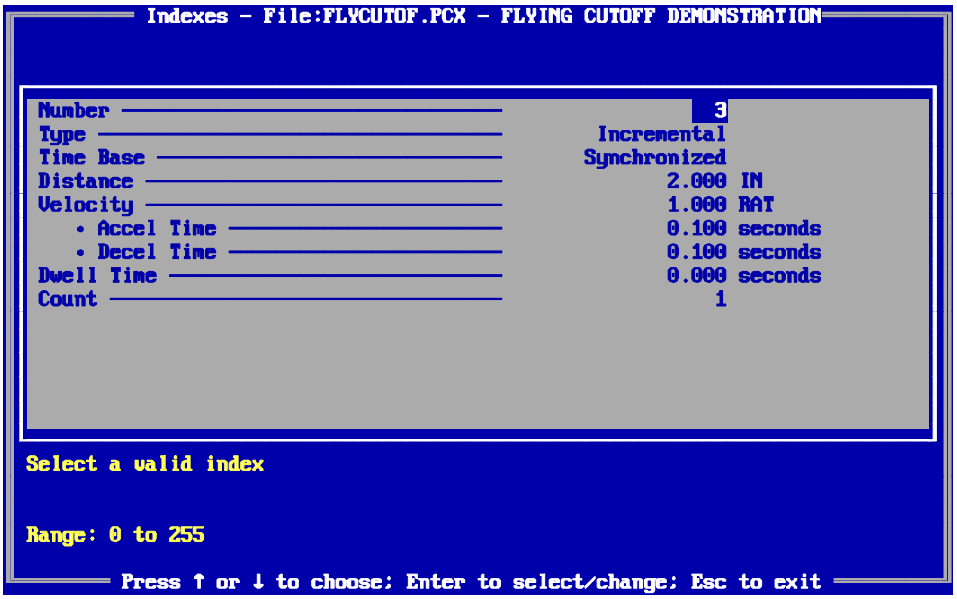
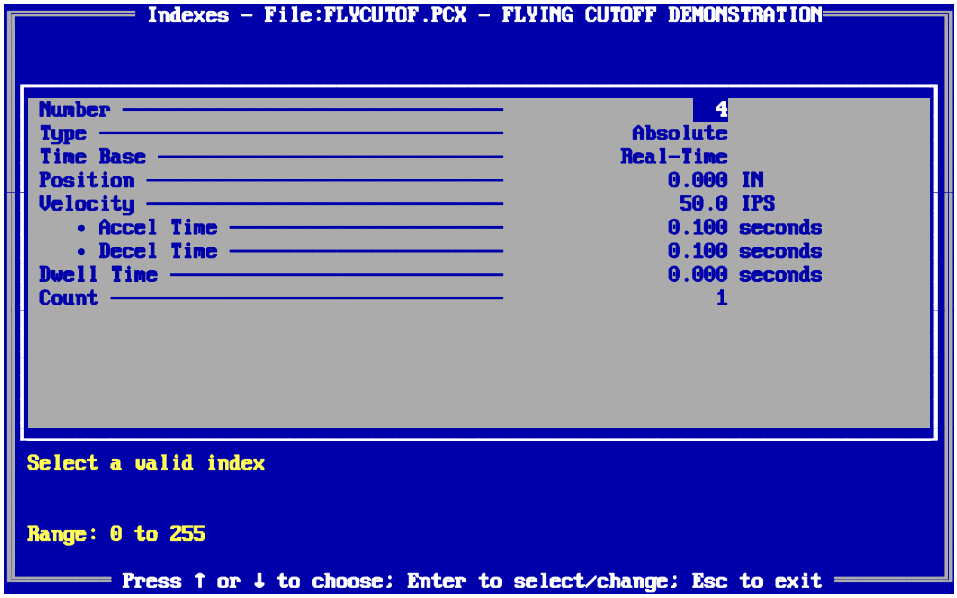


Figure 37
Index 4 Screen

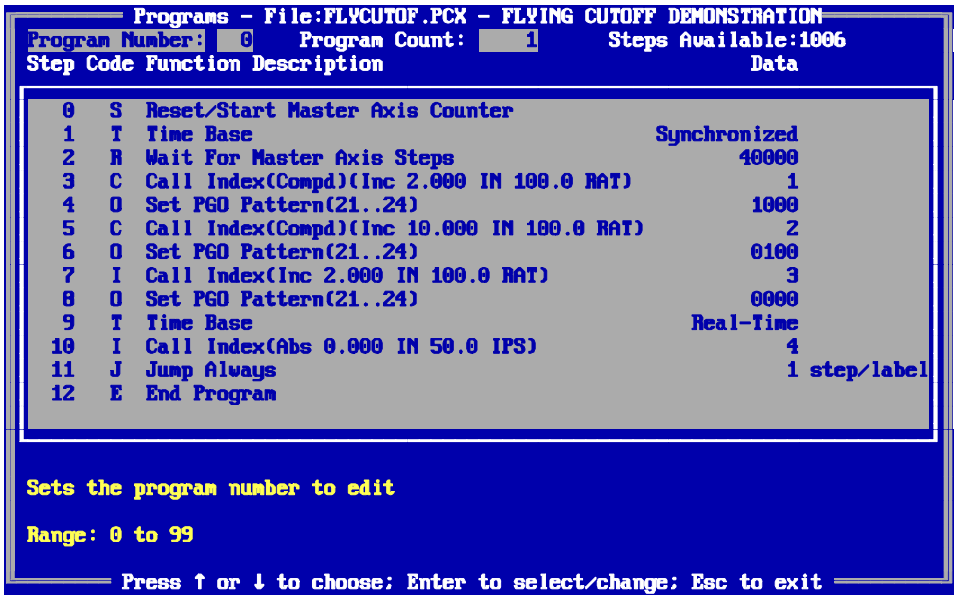


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Program

The last task to perform in PCX is the combining of the defined indexes and I/O functions into a program. The following is a suggested sequence for the example system:

Figure 38
Program Screen, Flying Cutoff Example



Step 0: S Reset/Start Master Axis Counter

The program initializes the internal counter that will monitor the encoder pulse count. The ensuing pulses will represent actual product length.

Step 1: T Time Base - Synchronized

Sets the time base in the FX Drive to use the encoder as the clock for speed. Distance is still kept as a result of the motor's own feedback.

Step 2: R Wait for Master Axis Steps - 40000

Sets distance to be cut. Per the calculations above, 40000 steps is equal to 40.000 inches of product length. The program pauses at this step until the encoder has transmitted 40000 pulses to the PCM-15. When the count of 40,000 is reached, program execution passes to the next step.

Step 3: C Call Index/Compound Next Index - 1

Starts Index 1. Compounds this index into the next one the program encounters, in this case, Index 2. Compounding means that the final velocity of this index is NOT zero, but the velocity of Index 2.

Step 4: O Set Outputs 21 22 23 24 1000

Turns on Output Line 21 to trigger the cutter and start the cutting action.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Step 5: C Call Index/Compound Next Index - 2

Starts Index 2. During the last two steps, the motor did not stop between indexes and turned on Programmable Output Line 21. This index will be compounded into the next one the program encounters, Index 3. The final velocity of this index is NOT zero, but the velocity of Index 3.

Step 6: O Set Outputs 21 22 23 24 0100

Turns off Output Line 21 and turns on Output Line 22. Stops the cutter and may start another process. (Steps 5 and 6 are optional.)

Step 7: I Call index 3

Starts Index 3 which will bring the motor to a halt in 2.000 inches prior to returning to the start point. Since this is a Call Index function and not a compound function, the final velocity of Index 3 is zero and the motor will stop.

Step 8: O Set Outputs 21 22 23 24 0000

Turns off all output lines.

Step 9: T Time - Real-Time

Sets the FX clock to internally based real-time. Any subsequent indexes will be executed independent of the encoder signal (and, therefore, independent of the web movement).

Step 10: I Call Index 4

Starts Index 4, an absolute index that will bring the motor back to the zero position regardless of starting point. Now the system is ready to make another cut.

Step 11: J Jump to Step Number 1

Jump (always) back to set the time base to synchronized and repeat the program. The counter was reset when the R Wait for Master Axis Steps step was executed, and has been counting towards the next piece during all following steps.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Suspend/Resume Functions

The Suspend Function is used to temporally suspend the operation of a running program and is initiated with Input Function #31. The Resume Function causes the system to finish the program that was suspended. Resume is initiated with Input Function #32.

When a Suspend command is received, the FX Drive will stop motion using the Stop/Hold Decel ramp entered in the Limits screen. The motor position will then be stored in a Return To Position Index, and the interrupted program task will be stored in the memory of the drive. The drive will now accept and execute new motion commands such as Jog, Home, Index, or Program Initiate. This can continue until a Resume command is received.

Upon receiving a Resume command, the drive will continue the execution of the program which was suspended. If an index was in progress when the suspend occurred, any index distance remaining at the end of the Suspend ramp will be executed by the Resume function, regardless of the motor position at the time of Resume.

If you move the motor in any way during a Suspend function, and you want the motor position to be the same as if the Suspend had not occurred, you must run a “Return To Position Index” before you initiate a Resume function. You must have previously set up this index as an absolute index with the speed and ramps you wish to use for the Return to Suspended Position move, along with a repeat count of 1. The index you set up is the one you select when you enter “Return/Resume Index Number” in the Suspend/Resume screen.

Suspend, Resume, Return to Position, and Clear Suspend functions are activated through input functions in the I/O.

A Suspend will not be accepted while a Hold cycle is active, while a previous Suspend is active, or a decel ramp is in progress. The memory for the Suspend function will only hold one event. If you attempt a Suspend command after the drive has already been suspended and the Suspend memory not cleared, the new information will not be retained. You can clear suspended memory by using the Abort Suspend Function (Input Function #33), or a hardware Stop command (Input Function #11).

Suspend Screen Parameters

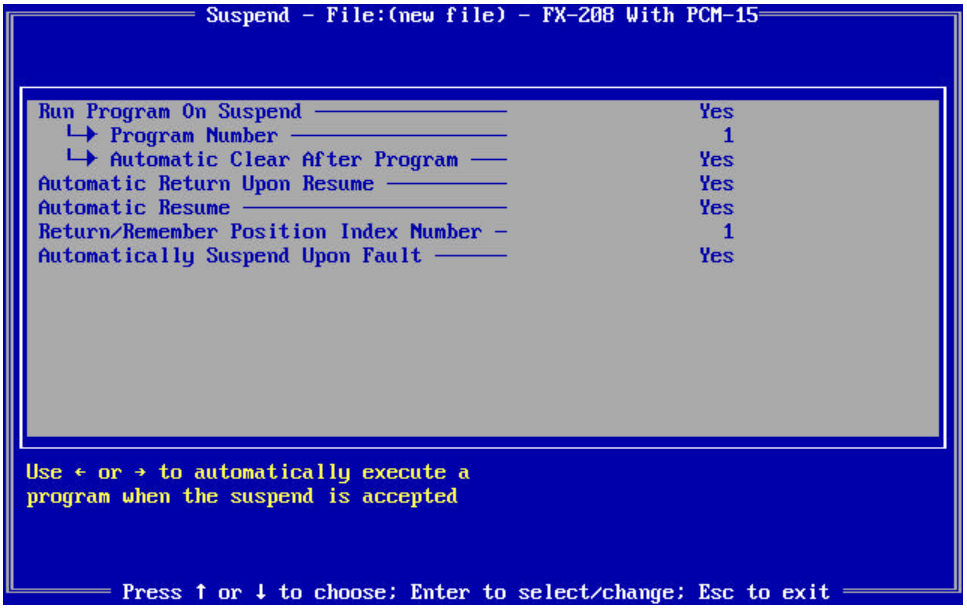
When you select the Suspend option from the “Define Motion” screen, the Suspend data entry screen shown in Figure 32 is displayed.

Run Program On Suspend

This feature allows another program to be automatically initiated when a Suspend is accepted. After the FX Drive stops on Suspend, the program you specify in the program number parameter will be executed without the need for a Program Initiate.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 39
Suspend Screen



Program Number

This parameter determines which program is to be initiated when a suspend is accepted and the “Run Program On Suspend” feature is used.

Automatically Clear After Program

This feature may be used to automatically clear a Suspend cycle. When used with the Run Program On Suspend feature, the program you selected will be executed before the Automatic Clear occurs. Once a Suspend cycle is cleared, the original program will not be resumed and the controller will be free to accept another Suspend input or motion command. When this feature is not used, a Resume input is needed to clear the Suspend cycle.

Automatically Resume

This feature will cause the drive to resume a suspended program without the need for a Resume input following the Run Program On Suspend program.

Automatically Return After Resume

This feature causes the “Return Index Number” index to be automatically initiated when a Resume input is accepted. When a Suspend input is accepted and the motor stops, the current position is stored in the index position specified by the “Return Index Number” value. To perform properly this index must be set up as an absolute index with a count of one. Then the motor will return to the position where the Suspend occurred, and continue with the original program.

Return/Remember Position Index Number

This parameter determines which index is to be initiated when a Resume is accepted and the “Automatically Return After Program” feature is used. When a Suspend input is accepted, the current position will be saved to this index. All other index information should be set up by the operator. This index must be set up as an absolute index.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Automatically Suspend Upon Fault

This function allows a fault to be handled without losing the current program setup or motor position. When this function is enabled, the following conditions apply:

1. A Suspend is automatically executed following a reset of a qualified fault. After the drive has been reset, operation is identical to a normal Suspend.

2. The Suspend-Upon-Fault capability applies only to the following faults:

   1 fault - RMS current or Continuous Torque Exceeded fault
   5 fault - Motor temperature fault
   6 fault - Bridge circuit breaker is open or low AC voltage
   7 fault - Amplifier bridge temperature fault
   F fault - Following error fault only.

3. The Suspend Upon Fault may only occur in a situation where Suspends are allowed, i.e. Programs. Unlike other Suspend conditions however, a Suspend Upon Fault may occur during the ramp down portion of an index which occurs in a program.

4. When a fault occurs during a Suspend function, the program which was running during the Suspend is terminated. However, the Suspend remains active following a fault reset.

All suspend functions and rules apply to fault initiated suspends.

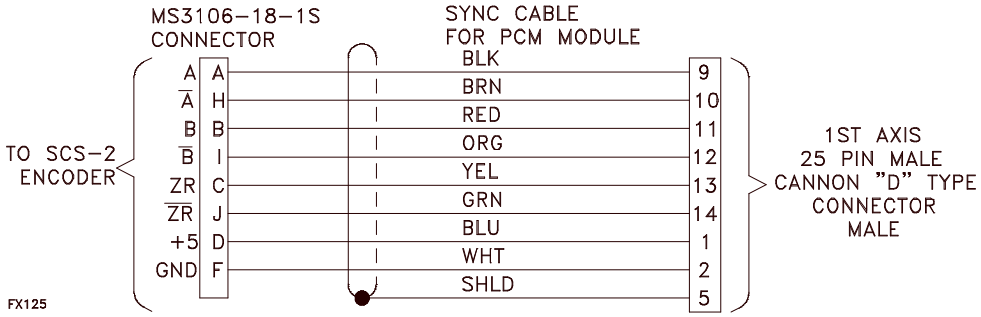
The “Out Of Index” output (output #45) is used to indicate that the motor position is within the faulted index distance when a Suspend occurs as a result of a fault. This output will become active if the motor moves past the end of an index during a Suspend Upon Fault, or is moved backwards before the faulted position where the Suspend was activated.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Multi Axis Synchronization

If an external encoder is used as a master signal source, the connection of the external encoder to the first axis is accomplished with the MSC-XXX cable. As many as 10 axis can be synchronized to a single encoder.

Figure 40
MSC-XXX Encoder Cable Wiring Diagram

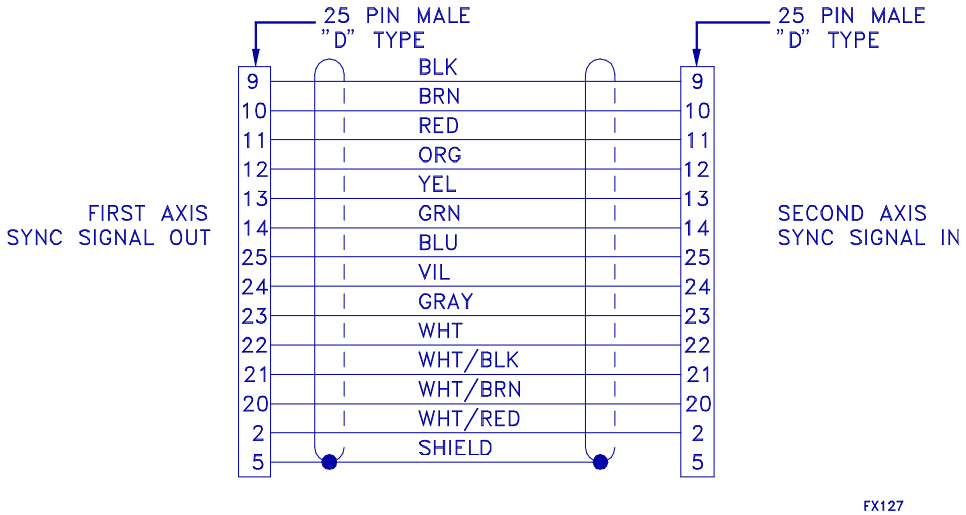


The MSC-XXX cable is provided in different lengths.

MSC-015 = 15 FT.
MSC-025 = 25 FT.
MSC-050 = 50 FT.

For some applications another digital drive could be the master signal source. This is the purpose of the second connector on the PCM-15. The first axis can provide the synchronization signal for the second axis. The SSC-XXX cable is a symmetrical cable and its ends can be interchanged.

Figure 41
SSC-XXX Multi Drop Sync Cable Wiring Diagram

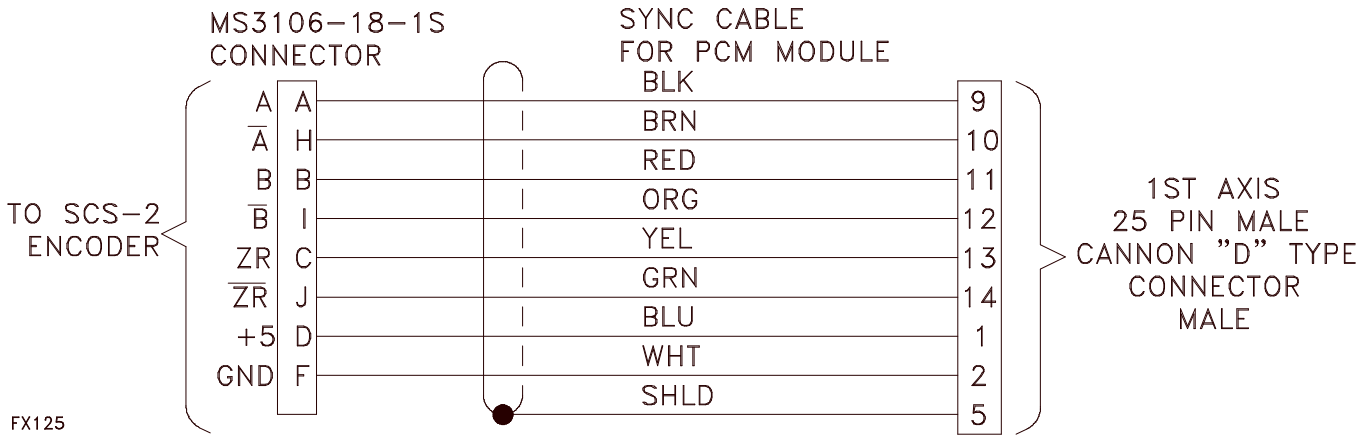


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The SSC-XXX cable and is available in different lengths.

SSC-003 = 3 FT.
SSC-006 = 6 FT.
SSC-010 = 10 FT.

Figure 42
Second Axis Application

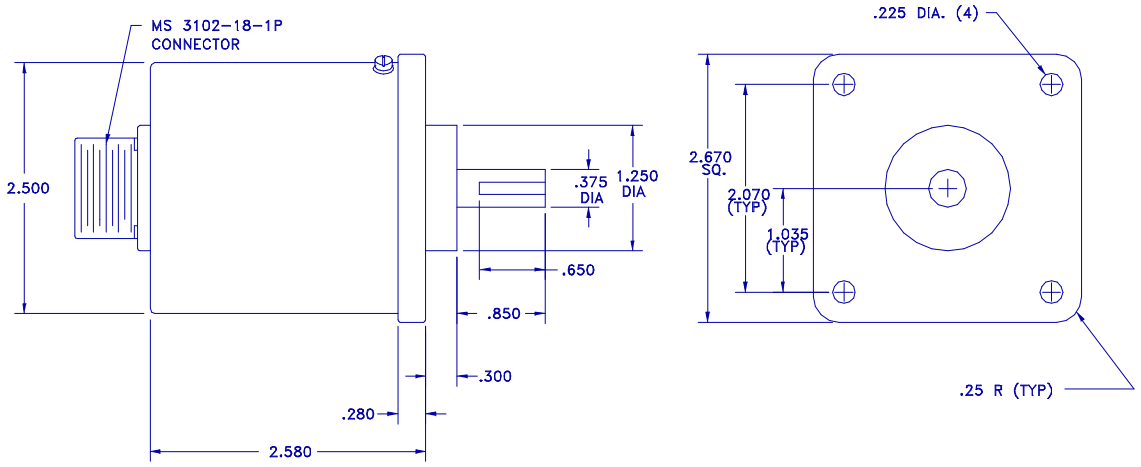


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Encoder Operation

The SCS-2 sync encoder is a two channel amplified sine wave encoder. Each of the channels has 1000 lines. The PCM-15 inputs are A, A {complement}, B and B {complement}. Quadrature encoding of these two signals produces a signal whose frequency is 4 times the line count. One revolution of the sync encoder produces the equivalent of 4000 counts/steps per revolution.

Figure 43
SCS-2 Encoder Mechanical/Electrical Information



SPECIFICATIONS:

POWER REQUIREMENTS: 5VDC ±5%, .2 AMPS MAX.
SIGNAL CODE: 2 CHANNEL AMPLIFIED SINE, MARK COMPLEMENTARY
RESOLUTION: 1,000 LINES PER. CHANNEL PER REVOLUTION
OUTPUT: OP-AMP.

CONNECTOR: MS 3102-18-1P

PIN	SIGNAL
A	A
B	B
C	ZR
D	+5
E	
F	GND
G	
H	$\overline{A}$
I	$\overline{B}$
J	$\overline{ZR}$

MATING CONNECTOR
MS 3106-18-1S

MECHANICAL CHARACTERISTICS

MAX SPEED: 3000 RPM
AXIAL LOAD: 40 LBS
RADIAL LOAD: 35 LBS
RUN OUT: .0005"
INERTIA: 4.1 X 10^{-4} OZ IN. SEC^2

ENVIRONMENTAL CHARACTERISTICS

OPERATING TEMPERATURE: 0° TO 70° C
RELATIVE HUMIDITY: 0% TO 95% NON-CONDENSING

FX128

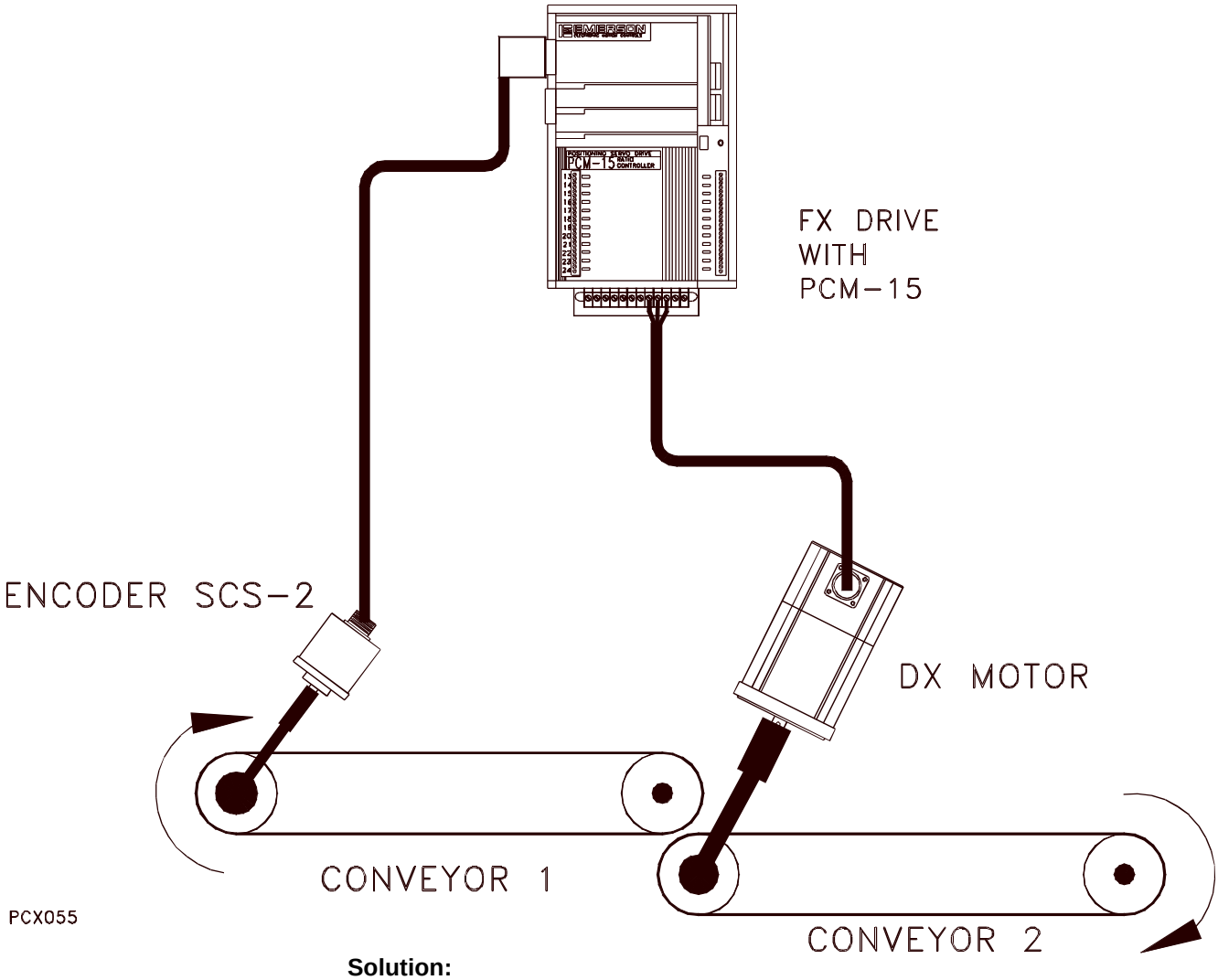
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Application Examples

Example 1: Conveyor Application

Conveyor 1 and conveyor 2 must run at the same surface velocity. Conveyor 1 is driven with a simple variable speed drive.

Figure 44
Conveyor Application W/PCM-15



Solution:

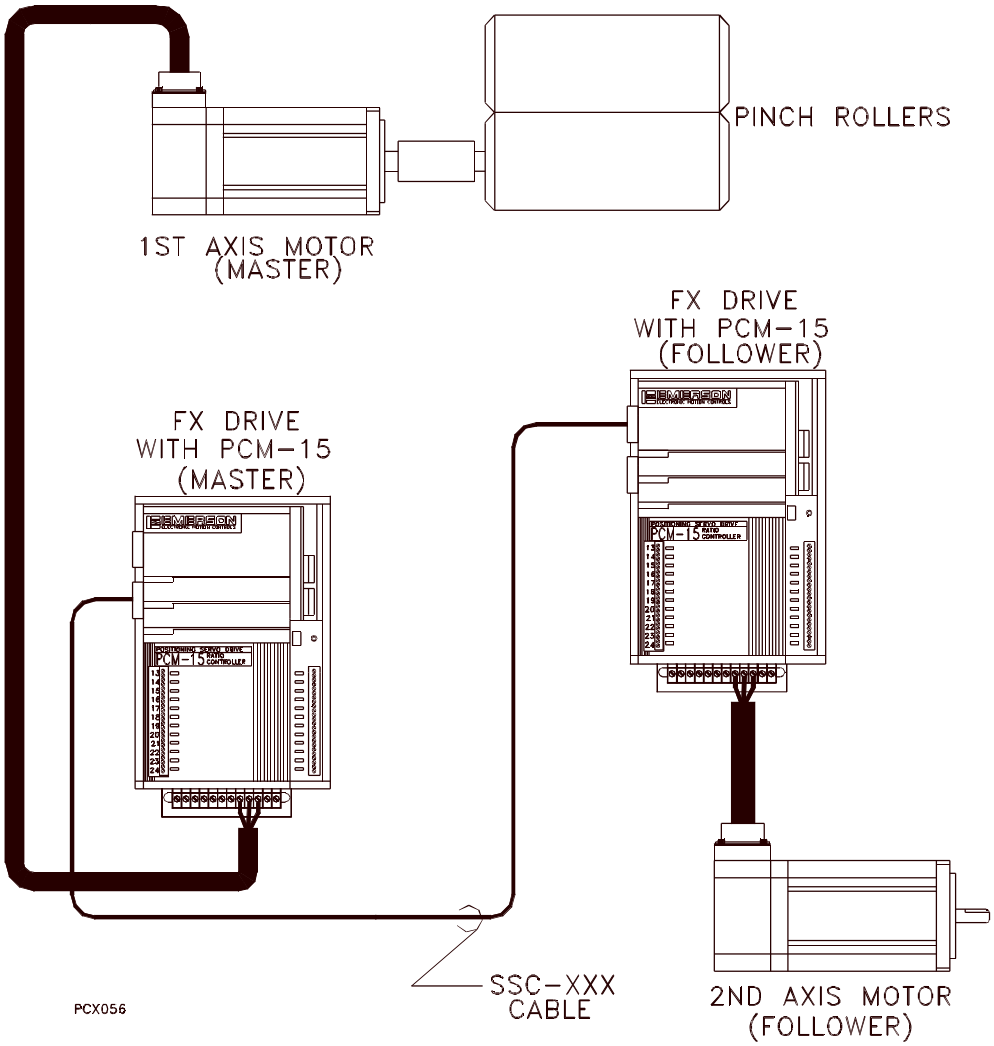
Mount the SCS-2 sync encoder on conveyor 1 and use the encoder signal as a master signal source for the drive with the PCM-15 Module for conveyor 2.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Example 2: Multi Axis Sync (Two Drives)

To synchronize a second drive to a first drive, both the lead and follower axis would be equipped with a PCM-15. No encoder is required. The FX Drive with the PCM-15 follower would have “Drive” selected as master frequency source.

Figure 45
Second Drive Application (PCM-15)

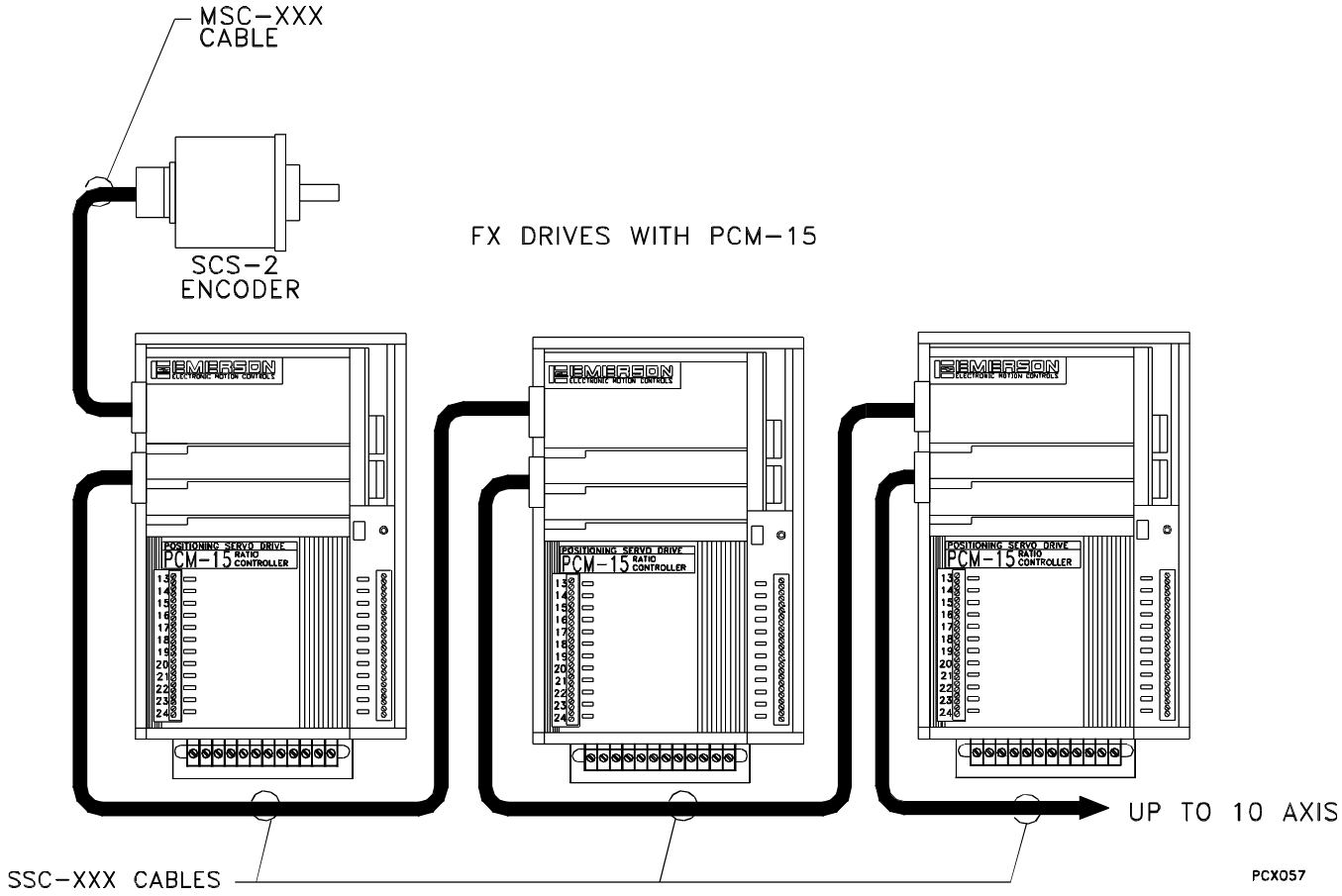


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Example 3: Multi Axis Sync (3 Drives)

If several axis are to be synchronized or ratioed to a lead encoder, than all axes would be equipped with a PCM-15. The lead encoder signals would effectively be in parallel.

Figure 46
Multiple Axis Application (PCM-15)



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PCM-15 Input/Output Functions

PCM-15 Input Functions

The following Input functions are available in addition to the input functions listed in the "FX Drives Setup and Programming Operator's Manual" (P/N 400282-00) when a PCM-15 Ratio Controller is employed with an FX Drive.

In order for the PCM-15/FX Drive to respond to an input, the selected line must draw a minimum of 2 ma. at 10.5 VDC for 3 to 7 ms. Maximum voltage to apply to an input line is 30 VDC.

22 Zero Position

Sets the current position of the motor to zero. All absolute positions will be referenced to this set zero position.

23 Zero Display

This function zeroes all position query commands (FP and CP), Absolute position is unaffected.

24 Remember Position

Stores the current position of the drive in a Return absolute index. (Default = Index 0). This index number may be changed in the Suspend Function menu.

25 Return To Position

Returns to the position defined by Remember Position input. This input uses the Return index which must be set up as an absolute index.

26 Clear End Of Sequence

Clears the End Of Sequence output. If not assigned, the End Of Sequence output will automatically clear when the next motion occurs. If this input is assigned, the output can only be cleared by activating a "Clear end of sequence" input.

27 Clear Programmable Output

Clears a Programmable Output. Each assigned Programmable Output requires a separate "Clear Programmable Output" line which corresponds to the PGO's (output function #12) in the same order. If four lines are selected for PGO's, this input function requires four lines to clear the PGO's.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

28 Wait/Jump Inputs

Used with the Wait For Input program function to stop program execution until the input line assigned with External Input is activated, and with the Jump program command to change program flow based on line conditions. Sets the starting Input Line number for multiple Wait/Jump Input Lines. If your system requires four Wait for External Input lines, you could assign any four consecutive Input Lines.

29 Program Initiate

Executes the selected program. Edge sensitive function. Must be taken from low level to high level to be recognized.

30 Program Select Lines

This input function allows you to select a program with Input Lines and sets the starting Input Line number for a number of Program Select Lines. For example: If your system requires four program select lines, you could assign any four consecutive Input Lines. If you assign the program select function to Input Line #5, then entered a 4 as the number of Program Select Lines, the Program Select function would now be assigned to Input Lines #5, 6, 7 and 8. You could now select programs 0 through 15.

The default format of the program select lines is binary. That is, the first line that you assign has a value of 1, the second a value of 2, the third a value of 4, the fourth a value of 8 and so on. The program number selected is the sum of the values of the lines activated.

Selecting program 5 in this example would require activating lines 5 (value 1) and 7 (value 4) while activating the line assigned to Input Function 29, Program Initiate. If no lines are activated, this is the same as selecting Program #0.

31 Suspend Program

Stops the execution of a program until the input line assigned with Resume is activated. See Suspend/Resume Functions Section of this manual for a complete discussion.

32 Resume Program

Resumes the execution of a suspended program. See Suspend/Resume Functions Section of this manual for a complete discussion.

33 Abort Suspend

Clears the In Suspend output and returns the drive from a suspend cycle to normal operation without the need to “resume” and completion of the suspended program. (Also see “Suspend/resume Functions” in Program section).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

34	Clear End Program

Clears the End Of Program output. If not assigned, the End Of Program output will automatically clear when further motion is initiated. If this input is assigned, an input is required to clear the output.

35	Clear End Program Count

Clears the End Of Program Count output. If not assigned, the End Of Program Count output will automatically clear when the next motion occurs. If this input is assigned, an input is required to clear the output.

36	Clear All Prog Outputs

When the line assigned to this function is activated, this function will clear (set to OFF) all programmable output lines. (See Input function #27 to clear individual programmable output lines.)

38	External Mode Override

An active input allows direct and immediate movement of the FX Drive motor using the Bi-Polar Sync Ratio setup in the Master Axis screen (see section “Master Axis Description & Setup”).

78	Clear Program Error

This input is used to clear the Program Error output (Output Function #46). If this function is assigned, this input is required to clear the output.

PCM-15 Output Functions

The following list of output functions are available in addition to the output functions listed in the “FX Drives Setup and Programming Operator’s Manual” (P/N 400282-00) when a PCM-15 is employed with an FX Drive.

11	End Of Sequence

This output comes On after the completion of a motion sequence before the last dwell time (if any). A motion sequence is completed when a Home, Index, and/or Program or a combination thereof, is executed and no further motion commands are given. This output turns OFF automatically with the next motion or when the Clear End Of Sequence is used.

12	Programmable Outputs

The output lines assigned this function can be turned On or Off with the Update Outputs programming function.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

13 End Of Program

This output is activated after each completion of all steps (motion and non-motion) in a Program. It is automatically deactivated with the next motion or when the Clear End Of Program input is used.

14 End Of Program Count

This output is activated only after a program is executed the number of times specified by the Program Count. It is automatically deactivated with the next motion or when the Clear End Of Program Count is used.

15 In Suspend

This output is activated when the Suspend Program function is active. Also see Suspend/Resume Functions section of this manual for a complete discussion.

16 End of Home (1)

This output comes On after the completion of a Home 1 cycle. It is turned Off automatically with the next motion or when the Clear End Of Home input is used.

17 At Sync

This output is active during a program when an index with External Timebase reaches sync. velocity.

18 Sync Fault Flying Cutoff Fault

This output indicates that the programmed cut length reached a count that should have initiated another flying cutoff but the FX drive was not in position to initiate the flying cutoff.

45 Out Of Index

This output is activated if the motor moves past the end of an index during a fault initiated suspend. It will also be activated if the motor has moves past the fault position.

46 Program Error

This output is activated when a math error occurs in a program, however, program execution is **not** interrupted. You can view the diagnostics screen by pressing the <F10> key to determine the type of math error. This output is cleared using the Clear Program Error Input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix A
List of Figures

Overview-PCM-15 Ratio Controller

Navigating PCX Software

Figure 1 PCX Hierarchy Diagram 1 3
Figure 2 PCX Hierarchy Diagram 2 4

Installing Your PCM-15

Figure 3 PCM-15 Connection to an FX Drive 6

PCM-15 Features

Figure 4 Drive Parameters Screen 8
Figure 5 Master Axis Screen 9
Figure 6 Global External Input Time Limit Setup 13
Figure 7 Hardware (External) Input Line Assignments 14
Figure 8 Software (Internal) Input Line Assignments 14
Figure 9 Internal Output Line Assignments 15
Figure 10 Internal Output Line Assignments 15
Figure 11 Output Connection to an Input Line 16
Figure 12 Programmable Limit Switches 19
Figure 13 User Registers Setup Screen 20
Figure 14 Equations Screen 22
Figure 15 Messages Screen 23

Building Your Program

Figure 16 Motion Program Example 26
Figure 17 Program Example 26
Figure 18 Program Example 27
Figure 19 Compound Index Example #1 28
Figure 20 Example #2, Compound Index Motion Profile 29
Figure 21 Compound Index Example #3 29
Figure 22 Programmable Output Options 31
Figure 23 Jump Command Options 33
Figure 24 “Jump If” Options 33
Figure 25 Jump/Wait Single Input 34
Figure 26 Jump Command Options 34
Figure 27 Wait for Input Command Options 35

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 28 Load Value Setup Options 36
Figure 29 Read Drive Parameters 38
Figure 30 Sample Program Using a Conditional Branch 39

Flying Cutoff Programs

Figure 31 Flying Cutoff System 47
Figure 32 Drive Parameters Screen 50
Figure 33 Master Axis Screen 50
Figure 34 Index 1 Screen 51
Figure 35 Index 2 Screen 51
Figure 36 Index 3 Screen 52
Figure 37 Index 4 Screen 52

Suspend/Resume Functions

Figure 38 Suspend Screen 56
Figure 39 MSC-XXX Encoder Cable Wiring Diagram 58
Figure 40 SSC-XXX Multi Drop Sync Cable Wiring Diagram 58
Figure 41 Second Axis Application 59
Figure 42 SCS-2 Encoder Mechanical/Electrical Information 60
Figure 43 Conveyor Application W/IBS-15 61
Figure 44 Second Drive Application (IBS-15) 62
Figure 45 Multiple Axis Application (IBS-15) 63

PCM-15 Input/Output Functions

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP