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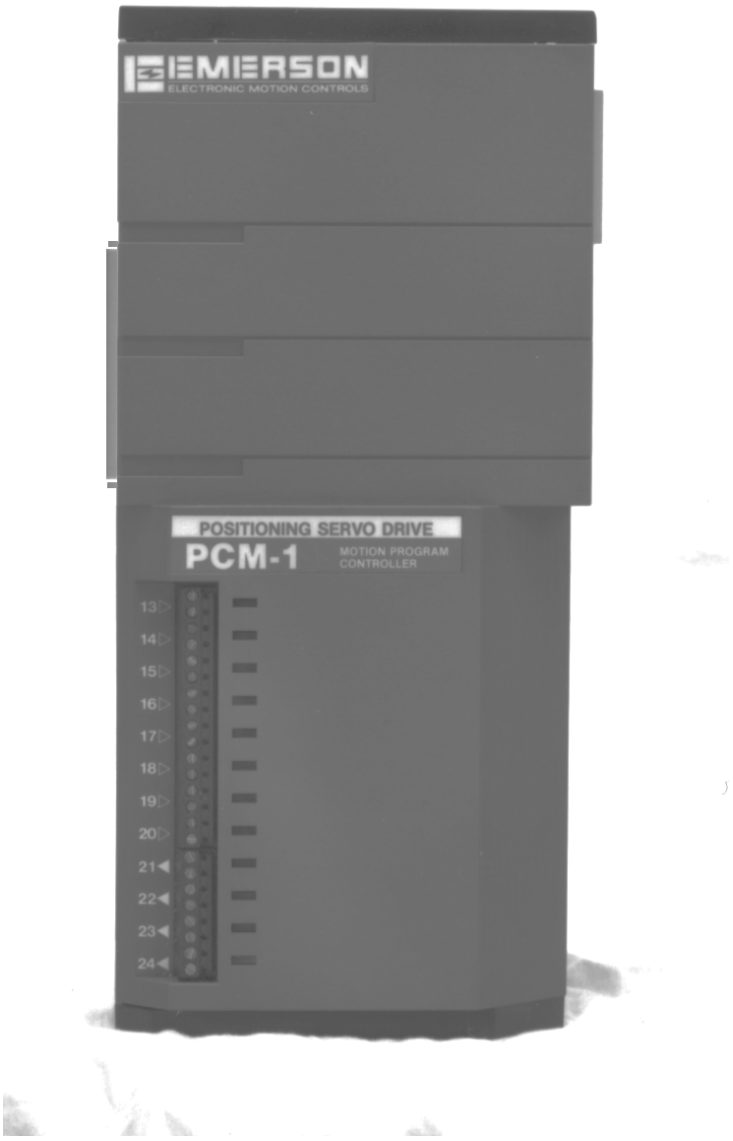
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IOM-1 AND PCM-1 APPLICATION MODULES
OPERATORS MANUAL
INSTALLATION AND PROGRAMMING



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IOM-1 AND PCM-1 APPLICATION MODULES
OPERATORS MANUAL
INSTALLATION AND PROGRAMMING

Emerson EMC
1365 Park Road
Chanhassen, MN 55317

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1.1 Overview Of The IOM-1 and PCM-1 Application Modules

This manual provides setup and programming information for the IOM-1 and PCM-1 application modules when used with an **FX drive** (if you are using a **DX drive**, see manual P/N 400240-00). It is important that you become familiar with Section 4 of the FX Drive Operators Manual (P/N 400282-00) which provides the basic information needed to setup and program the FX drive using PCX software (ver. 6.5 or above).

Both application modules (IOM-1 and PCM-1) provide I/O expansion and a parallel interface port for operation with a T-16 Numeric Display, Thumbwheel or Parallel Communications with a PLC. (See Parallel Interface in section 1.9 of this manual.) However, the PCM-1 module has some additional features which are listed below:

PCM-1 Additional Features:

- The PCM-1 provides memory expansion and the additional capability for complex motion programs and Suspend/Resume functions.

1.2 Installing Your Application Module

The application modules attach to the front of any FX Amplifier with two locking arms. All signals needed to communicate between the FX drive and the PCM module are made via the 48 pin connector.

The modules are equipped with 8 inputs and 4 outputs which double the I/O capability of the standard FX drive. All inputs and outputs are optically isolated for +10 to +30 vdc operation. Each input and output has 2 screw terminals associated with it to provide for either sinking or sourcing operation.

The first 8 pairs of designated terminals are inputs and the last 4 pairs of terminals are outputs. The outputs are capable of sinking or sourcing 200 mA. You must limit the output current or less than or equal to 200 mA per line. See Figure 1-1 I/O connection examples.

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

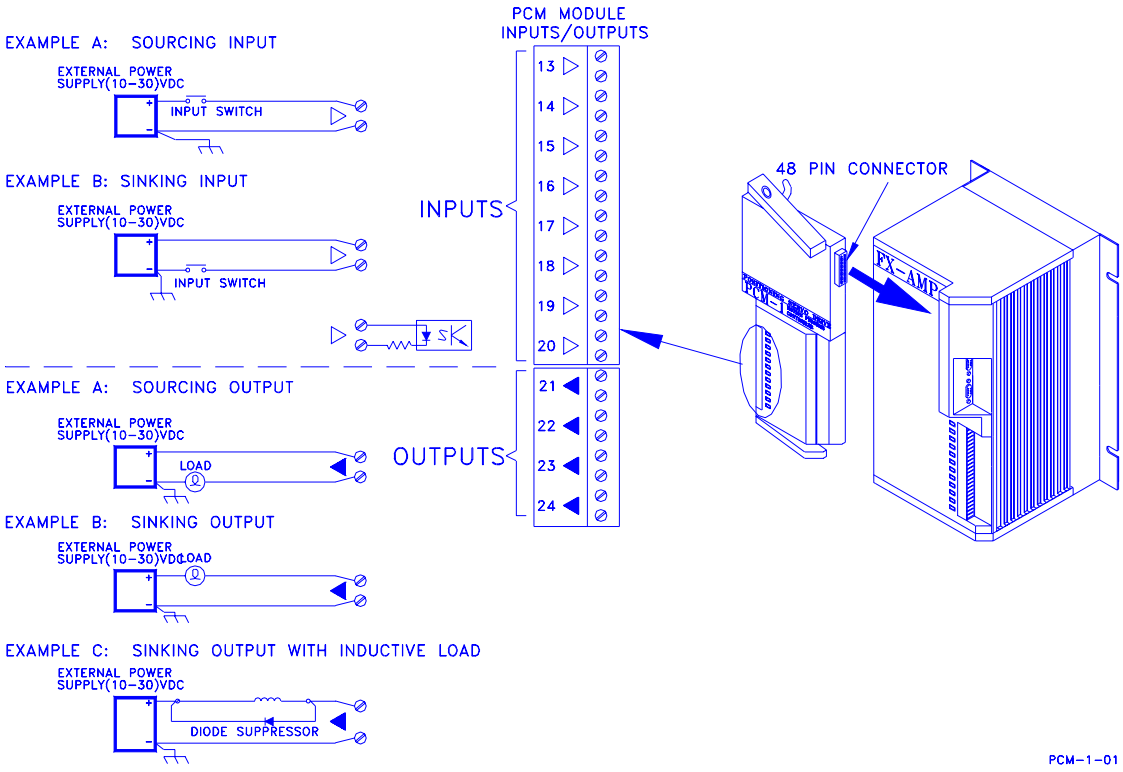


Figure 1-1
IOM-1 or PCM-1 Application Module Connection To An FX-Drive

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1.2.1 Inputs

Inputs require an external voltage source for operation. This voltage source must be in the range of 10 to 30 vdc. The negative (-) lead of the external power supply must be connected to the enclosure or safety ground.

1.2.2 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 negative (-) lead of the external power supply must be connected to enclosure or safety ground.

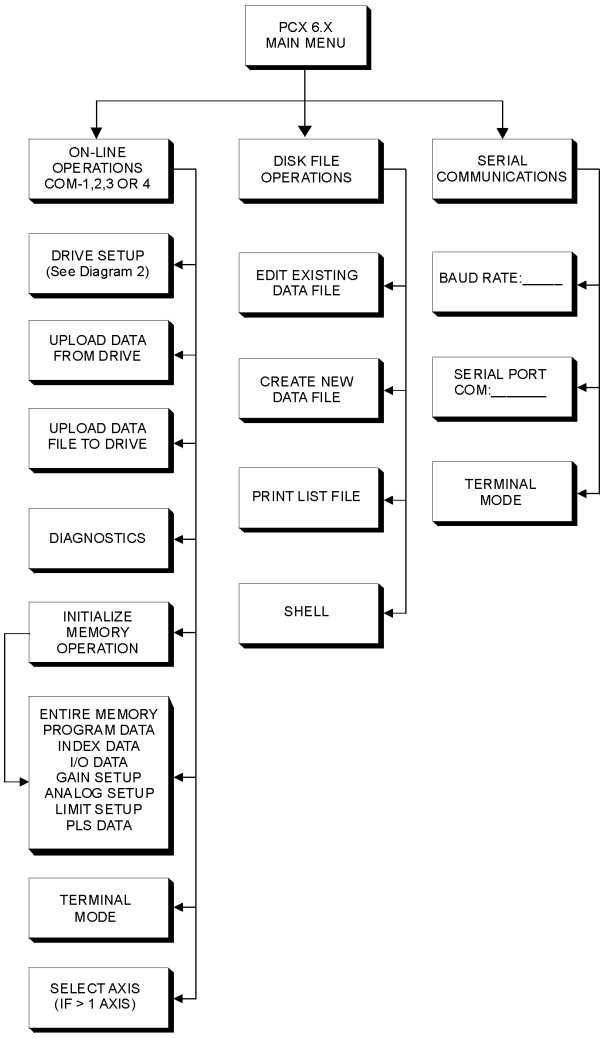


Figure 1-2
PCX Hierarchy Diagram 1

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

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

1.3 Additional PCX Features

Adding a IOM-1 or PCM-1 Application Module to an FX drive gives you several additional features in PCX. The hierarchy menu diagrams below show the additional features in the shaded blocks.

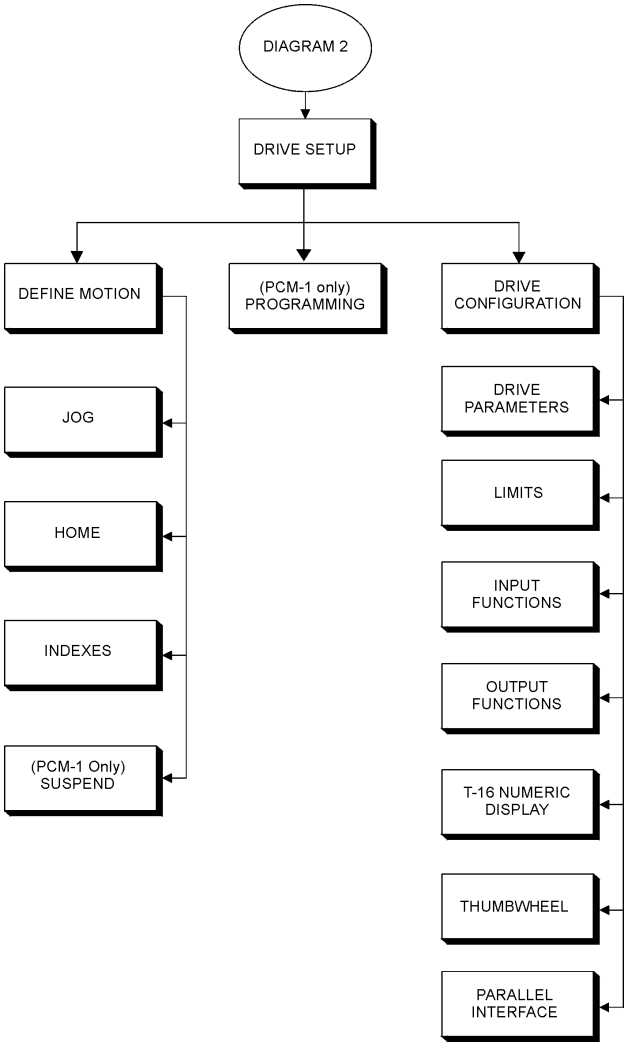


Figure 1-3
PCX Hierarchy Diagram 2

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1.4 Understanding Motion Programs

Motion Programs are a series of indexes that have been previously setup and that you combine with various 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 cycle.

> ***NOTE:***
> 1. *The IOM-1 Application Module does not have the features described in sections 1.4 through 1.8.*
> 2. *Indexes are described in the FX Drives Setup And Operation Manual, section 4 (P/N 400282-00).*

Multiple programs can be created using PCX software and stored as computer files, each designed for a different machine function. The PCM-1 is capable of storing up to 255 indexes, 100 motion programs (0 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), they can have an average of 10 program steps each. There is a maximum of 255 steps available for any one program.

1.5 How To Create A Program

Two additional features (“Programs” and “Suspend”) are available when a PCM-1 is added to the basic drive. These features are found in the Define Motion menu in PCX.

A program sequence is created by listing the program functions in the order in which they are to be executed. PCX software provides a standard program format in which the program functions can be easily listed. The program sequence list is made up of function codes designed to minimize the key strokes.

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 read through the program sequence.

The example program sequence shown in Figure 1-4 could be accomplished with one program; however, two programs have been used to show the use of the Call Program (P) command. In this example, program numbers 1 and 2 are used and index numbers 1, 2, 3, 4 and 5 are used.

Figure 1-5 and 1-6 show the program setup screens used to generate the motion profile in Figure 1-4. The program count determines how many times the program will be executed. In this example the program count is 10. This means everything within Program 1 will repeat 10 times including Program 2. If the program number is set equal to zero, the program will not execute. If the program number is set equal to 65535, the program will be executed indefinitely.

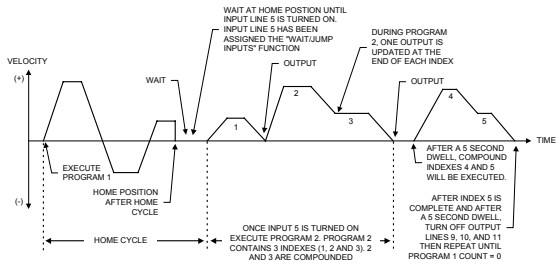


Figure 1-4
Motion Profile Example

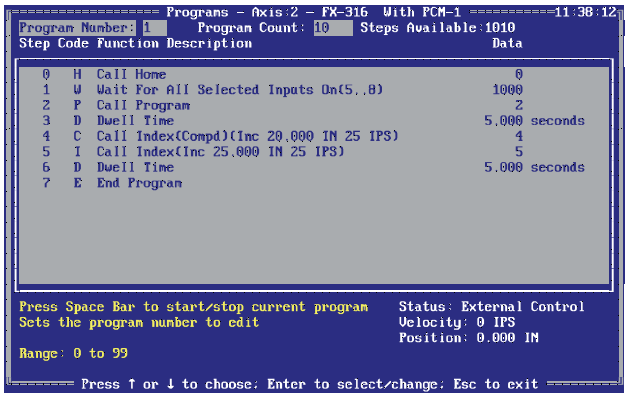


Figure 1-5
Program Setup Example

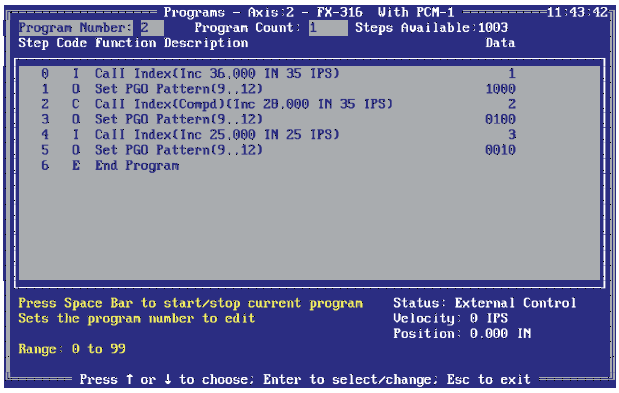


Figure 1-6
Program Setup Example

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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 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.

In the example shown in Figure 1-5, 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.

> ***NOTE:***
> *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.*

1.5.1 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 most commonly used program functions.

Compound Next Index (C)
The Compound Index feature allows you to link two or more indexes together without stopping motion between each index.

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 index **cannot** be used again as a regular index. However, identical compound index sequence 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 accel rate until it reaches the velocity of Index #1. Then the drive decelerates (at the appropriate decel time calculated by the drive) at the decel rate of Index #1 to the velocity of Index #2, without coming to a stop.

The drive will continue at that velocity until it approaches the programmed distance of Index 2, then decelerate (at the appropriate time calculated by the drive) at the Index #2 decel 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 (calculated by the drive) it will decelerate at the Index #3 decel rate and stop after moving Index #3's programmed distance.

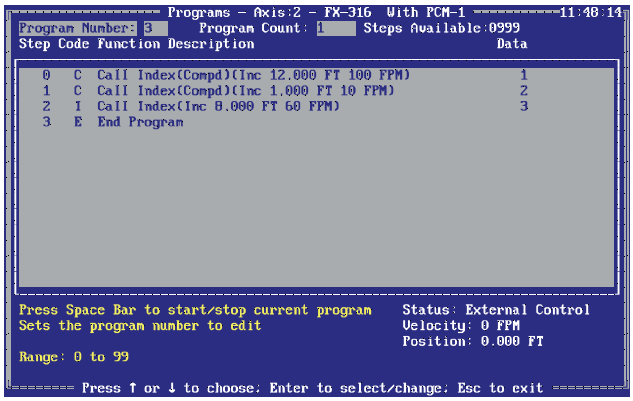


Figure 1-7
Compound Index Example #1

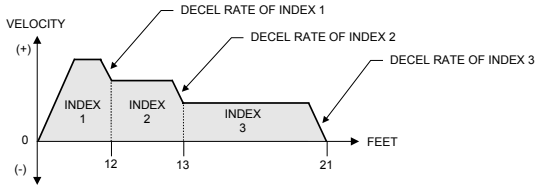


Figure 1-8
Compound Index Motion Profile

IMPORTANT

Individual Indexes used to make up a compound index motion profile in a program, must all have the same direction of movement. The direction of movement is set when the first index of a compound index motion profile is initiated and cannot be changed until the next index that is outside that compound index motion profile is initiated.

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.

After completing Index #1, the drive will accelerate at the accel 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 (calculated by the drive) it will decelerate at the Index #3 decel rate.

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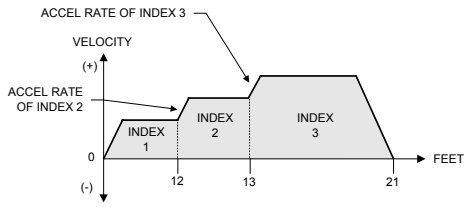


Figure 1-9

Example 3: Use the compound index feature to turn an output on then off without stopping motion. Each index is incremental, has a count of 1, and has the same velocity.

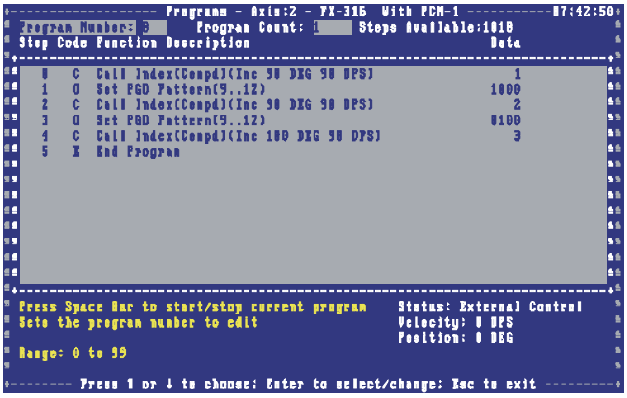


Figure 1-10

> ***NOTE:***
> *Index number 0 may not be used as a compound index sequence.*

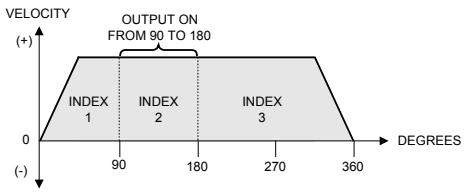


Figure 1-11

D Dwell Time
The Dwell Time function allows the user to pause for a number of seconds between other program functions. 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" for the Drive, which is setup in the "Limits" screen. When the program has completed, the "Following Error" is reset to the value set 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 used to initiate a previously set up Home Cycle. There are two Home Cycles that can be selected when called from 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 entering the index number, PCX will display the index type, distance velocity.

J Jump Commands
Before this command can be used in a program, Input Function #28 "Wait/Jump Input" must be assigned to one or more input lines (see "Input Functions" Section 4 of the FX Drives Manual). To select this option, enter "J" in the program step and select either Jump Always or Jump on Input Pattern (PGO).

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



Figure 1-12
Jump Command Options

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Jump On Input Pattern (PGI)
If you select Jump On Input Pattern, you can then select one of four Jump options shown in.



Figure 1-13
Jump Command Functions

Jump Command Function Descriptions:

1 The "Jump If Input On" command causes program execution to skip to the designated program step if the specified input lines are ALL on. If any of the specified lines are off, the program execution moves to the next step.

2 The "Jump If Any Input On" command causes program execution to skip to the designated program step if ANY of the specified input lines are on. If all of the specified lines are off, the program execution moves to the next step.

3 The "Jump If Input Off" command causes program execution to move to the designated program step if ALL of the specified input lines are off. If any of the specified lines are on, the program execution moves to the next step.

4 The "Jump If Any Input Off" command causes program execution to skip to the designated program step if ANY of the specified input lines are off. If all of the specified lines are on, the program execution moves to the next step.

Once the Jump 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 lines 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.

O Set Outputs
Before this function can be used, you must assign Output Function #12 "Programmable Outputs" to one or more 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. To use this function, type the letter "O" at the selected program step.

The cursor will move to the data field where zeroes that represent the programmable outputs are displayed. The left-most 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.

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 caution 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.

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 (STACK) 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 setup in the "Limits" screen. When the program has completed, the original value is restored. If you use a low value for "Q" (less than 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.

W Wait For Input
Before this command can be used in a program, you must assign Input Function #28 "Wait/Jump Input" to one or more input lines (see Input Functions, Section 1.7 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 1-14.

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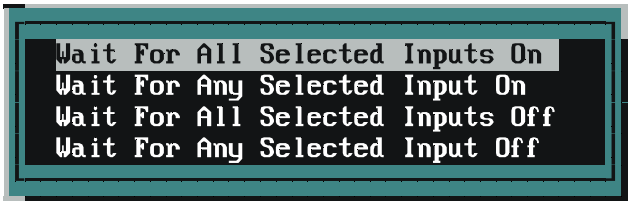


Figure 1-14
Wait For Input Command Options

Wait For External Input Function Descriptions:

1 When the "Wait For All Selected Inputs On" function is selected, program execution is held at this step until the selected inputs are activated simultaneously.

2 When the "Wait For Any Selected Input On" function is selected, program execution is held at this step until the input you designate is activated.

3 The "Wait For All Selected Inputs Off" function is very similar to function number 1, except that program execution is held at this step until the selected inputs are turned off simultaneously.

4 When the "Wait For Any Selected Input Off" function is similar to function number 2, except that program execution is held at this step until the input you designate is Off.

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.

1.6 Suspend/Resume Functions

The Suspend Function is used to temporarily 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 and is initiated with input function #32.

When a suspend command is received, the FX drive will discontinue motion using the stop/hold decel ramp. 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 at the end of the suspended index 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.

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, the new information will not be retained. You can clear suspended memory by using input function #33 (Abort Suspend), or a hardware stop command, input function #11.

> ***NOTE:***
> *Index number 0 may not be used as a compound index sequence.*

1.6.1 Suspend Screen Parameters

When you select the suspend option from the "Define Motion" screen, the suspend data entry screen shown in Figure 1-15 is displayed.

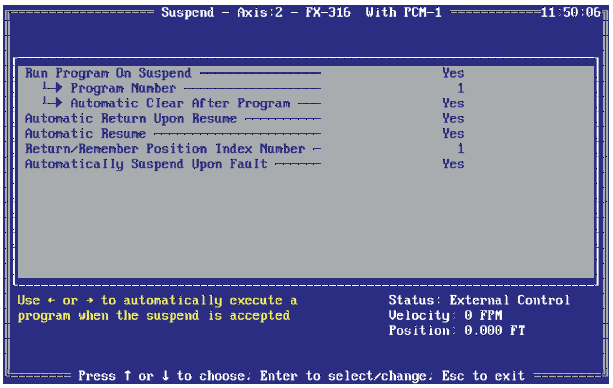


Figure 1-15
Suspend Screen

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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.

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. When used with the "Run Program On Suspend" feature, the automatic program will be executed before the automatic resume occurs.

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. When this index is setup as an absolute index with a count the motor will return to the position where the suspend occurred, then 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 accepted, the current position will be saved to this index. All other index information should be setup by the operator. **This index must be setup as an absolute index.**

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 fault-suspend capability applies only to the following faults:

1 fault – RMS current 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 after fault may only occur in a situation where suspends are allowed, i.e. Programs. Unlike other suspend conditions however, a fault-initiated suspend 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.

The "Out Of Index" output (output #45) is used to indicate that the motor position is within the faulted index 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 fault initiated suspend, or is moved backwards before the faulted position where the suspend was activated.

> ***NOTE:***
> *All suspend functions and rules apply to fault initiated suspends.*

1.7 PCM-1 Input Functions

The following input functions are available in addition to the input functions listed in the FX Drives Operators Manual (P/N 400282-00) when a PCM-1 is employed with a FX Drive.

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.

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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 setup 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. (e.g., If four lines are selected for PGO’s, this input function requires for lines to clear the PGO’s.

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.

29 Program Initiate

Executes the selected program.

30 Program Select Lines

This input function allows you to select a program with Input Lines and sets the starting Input Lines 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 in the Programs Section of this manual for a complete discussion.

32 Resume Program

Resumes the execution of a suspended program. See Suspend/Resume in Programs Section of this manual.

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).

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 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 activated, this function will clear all programmable output lines. See Input function #27 to clear individual programmable output lines.

78 Clear Program Error

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

1.8 PCM-1 Output Functions

The following list of output functions are available in addition to the output functions listed in the FX Drives Operators Manual (P/N 400282-00) when a PCM-1 is employed with an FX Drive.

11 End Of Sequence

This output comes On after the completion of a motion sequence. 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 when 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.

13 End Of Program

This output is activated after each completion of 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 input function is active. Also see Suspend/Resume in the Programs section of this manual.

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.

1.9 Parallel Interface

An FX drive equipped with an IOM-1 or PCM-1 can support a T-16 Numeric Display, a Thumbwheel or Parallel Programming with the 37 pin “D” type socket connector on the side of the module.

Figure 1-16 shows the options that are available in the Drive Configuration menu. These options include T-16 Numeric Display, Thumbwheel, and Parallel Interface.

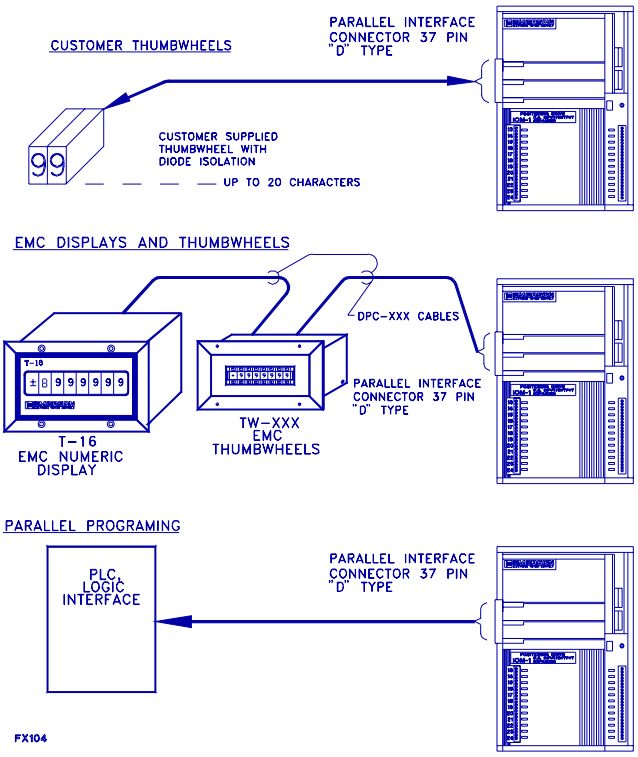


Figure 1-16

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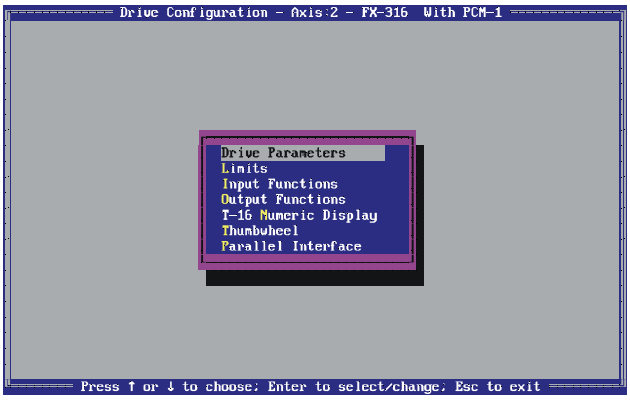


Figure 1-17
Drive Configuration Options

standard AC power, requiring 96-132 VAC and a maximum current of 1 Amp. It connects to the parallel interface port of an IOM-1 or PCM-1 module with an Emerson DPC cable. The DPC cable is available in the following lengths:

Cable Model #	Length
DPC-003	3 FT
DPC-006	6 FT
DPC-015	15 FT
DPC-025	25 FT
DPC-050	50 FT

> ***NOTE:***
> *Keep the length of the DPC cable as short as possible. Also, do not run parallel interface wiring adjacent to high voltage wiring.*

1.9.1 T-16 Setup And Operation

The T-16 is used to display drive parameters on a seven digit numeric display. The T-16 is powered by

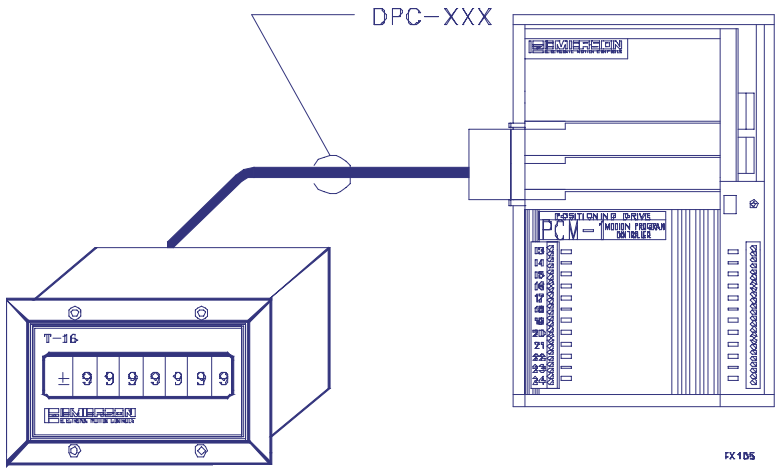


Figure 1-18
T-16 Cable Connection

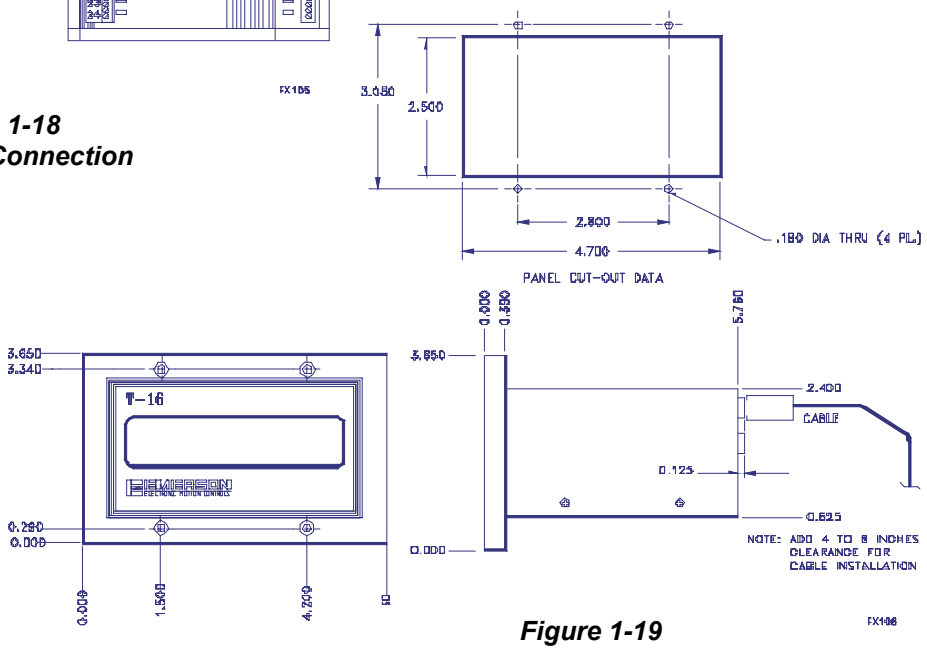


Figure 1-19
T-16 Mounting Information

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Figure 1-20 shows the set up screen for the T-16 Numeric Display.

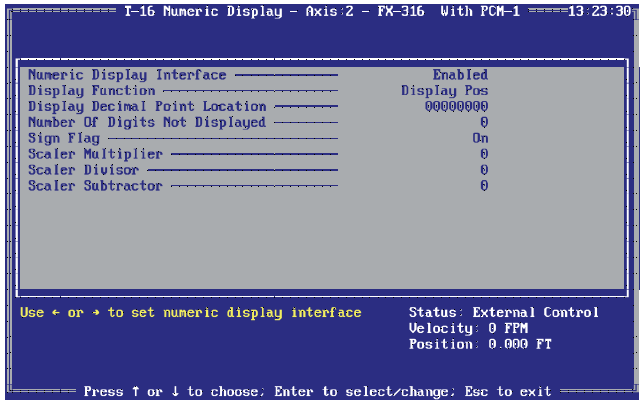


Figure 1-20
T-16 Numeric Display Setup Screen

T-16 Setup Screen Parameter Descriptions

Numeric Display Interface
In order for the T-16 Numeric display to function, this parameter must be enabled. If this Parameter is disabled the T-16's display will not light-up. A T-16 and a thumbwheel may be enabled at the same time, but parallel programming can not. Enabling either the parallel interface of the T-16 display will automatically disable the other.

Display Function
The numeric display may be setup to display any of the following positioning drive functions.

- **Display Position**
  This function displays motor position in user units and is typically used in conjunction with input function #23 (zero display). Input function 23 resets the T-16 display to zero while the Command Position and the Feedback Position functions (described below) are not affected.

- **Command Velocity**
  This function displays the programmed velocity of the drive.

- **Index Count**
  This function displays a decremental number of repetitions remaining until the programmed index count reaches zero.

- **Index Dwell Time**
  This function displays the decremental programmed dwell time.

- **Command Position**
  This function displays the current position of the motor as defined by the program parameters.

- **Feedback Position**
  This function displays the current position of the motor as defined by the feedback resolver.

- **Encoder Distance**
  This function displays the continuos position of the External sync encoder.

- **Program Count**
  This function displays a decremental number of remaining repetitions of the program count.

- **Index Number**
  This function displays the number of the index that is currently active.

- **Program Number**
  This function displays the number of the program that is currently active.

- **Sync Velocity**
  This option is not available with the IOM-1 and PCM-1 modules.

- **Motor Current**
  This function displays the amount of current being used to index the load.

Display Decimal Point Location
The user may place a decimal point at a fixed location on the numeric display. This option can be used to make the display show meaningful information.

Number Of Digits Not Displayed
Sometimes the least significant digits on the numeric display are insignificant. This option provides a way to eliminate those digits (right to left) from the display.

Sign Flag
If the sign flag is off, positive values will be displayed without a + sign. Negative values are always displayed with the – sign.

Scaler Multiplier, Divisor, And Subtractor
These variables may be used to scale the positioning drive information before it is displayed on the T-16. This will provide displays that are meaningful to the operator. The relationship between the Display and the variables is as follows:

$$Display = \frac{(DI-S)(M)}{D}$$

DI = Drive information
S = Subtractor (offset)
M = Multiplier (conversion factor)
D = Divisor (sets correct decimal place)

The variables can have a value range of –32768 to 32767, only whole numbers are used. Use the divisor to setup decimal places. A value of zero (0) will disable any variable but will not create mathematical problems.

$$mm = \frac{(1in-0)(254)}{10}$$

DI = 1
S = 0
M = 254
D = 10

1.10 Thumbwheel Programming

The thumbwheel interface provides you with a non-serial interface method for making changes to specific motion functions. You can set up the Emerson EMC thumbwheel module to change velocities (in RPM only), distances/positions, dwell times, index counts and acceleration and deceleration times.

As many as 20 external BCD characters can be read into the digital drive. Once read, these characters are stored in an internal character buffer. The actual buffer has a capacity for 32 (0-31) characters to support other parallel interfaces.

The PCX software allows the digits on the thumbwheel front panel to be 'subdivided' or grouped into as many as 8 discrete fields. The fields are numbered 0 – 7 from left to right and each field can be given a specific purpose, a location, a size, and a choice of application options.

When customer thumbwheels are used, the 20 possible thumbwheel characters are read into the first 20 locations of the character buffer designated as (0-19).

1.10.1 Character Buffer

The character buffer contents can be pre-programmed via PCX software (or through serial commands) to represent distance, velocity (in RPM only), count, etc. This mode of operation has 8 lines dedicated to transfer data and 10 lines dedicated to selection of data pairs.

Since 8 lines of data are provided and each BCD digit requires 4 lines, thumbwheel digits are read two at a time. The 10 select lines allow the use of up to 10 pairs of digits (20 thumbwheel digits). Once the thumbwheel data is set active, the Executive input transfers the new data to its respective function and it becomes the active data.

An output called Error is provided as a means for the drive to tell an external device that data is out of range.

1.10.2 Thumbwheel Mounting

Emerson EMC provides thumbwheel modules in 5 different configurations, all designed for panel mounting. The mechanical mounting for all thumbwheel configurations is the same.

The mechanics of these assemblies provides up to 10 characters of thumbwheel data. This data is read into the drive's character buffer. Since the character buffer can handle 20 characters, the thumbwheel modules have been designed with jumpers that can be switched at the rear of the thumbwheel assembly.

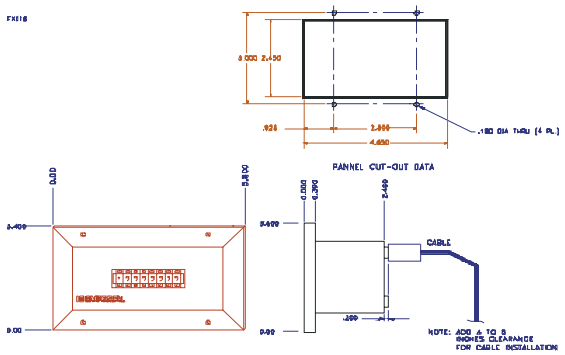


Figure 1-21 Thumbwheel Mounting Information

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1.10.3 Thumbwheel Jumpers

With the jumpers connected as shown in Figure 1-22, the thumbwheel data is read into character positions (0-9) of the FX drive character buffer. Moving the jumpers to the bottom will cause the characters to be read into positions (10-19) of the character buffer.

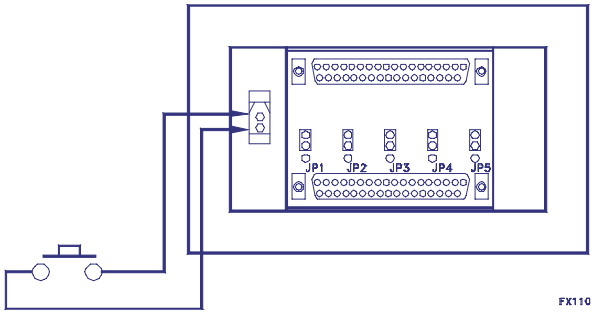


Figure 1-22
Thumbwheel Jumper Locations Data Entry Push Button

To exclude erroneous data input caused by changing data, each thumbwheel assembly is equipped with an input for a data enter push button. This input must be made for thumbwheel data to transfer to the drive.

The monetary push button switch must be provided by the customer. The mating connector and pins are provided with the thumbwheel assembly. The connections are made at the rear of the assembly (see Figure 1-19).

1.10.4 Cable Connections

Two connectors are provided to connect up to two thumbwheel modules and a numeric display (T-16) from one drive port.

The connectors on the back of the Thumbwheel and T-16 are connected in parallel so the cabling is insensitive to position. The cables themselves can be obtained in different lengths from Emerson EMC.

Cable Model #	Length
DPC-003	3 FT
DPC-006	6 FT
DPC-015	15 FT
DPC-025	25 FT
DPC-050	50 FT

> ***NOTE:***
> *Emerson EMC recommends using DPC cables no longer than 25 ft.*

1.10.5 Emerson EMC Standard Thumbwheel Configurations

The TW-XXX is available in five standard configurations (see Figure 1-23). Regardless of the configuration of your thumbwheel, the character buffer locations from left to right are designated either 0 through 9 or 10 through 19, depending on the jumper locations.

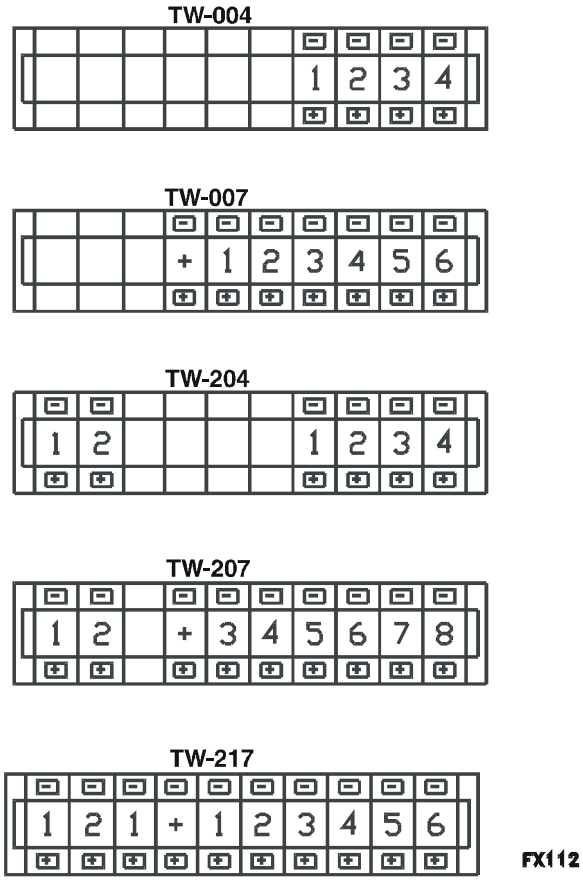


Figure 1-23
Thumbwheel Configurations

For example: If JP1 through JP5 were setup for character buffer locations 0-9, a TW-004 would use character buffer locations 6, 7, 8 and 9. Push the (+/-) buttons above and below the data windows to increment and decrement data.

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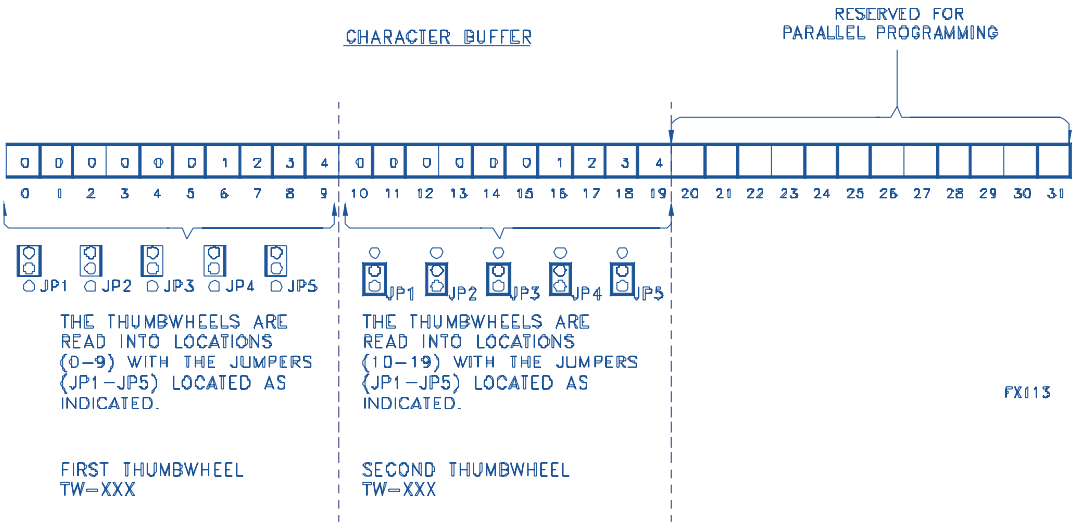


Figure 1-24
FX Drive Character Buffer Example Using A TW-004

1.10.6 Character Buffer Configuration

Since the physical construction of the thumbwheel is based on 10 characters and the different models are accomplished with spacers, data from the thumbwheels is read into the FX drive character buffer as follows:

The red LED indicator on the TW-XXX indicates that data is our of range. For example: If the 4 digits of a TW-004 were programmed as velocity and the data on the thumbwheels is greater than the maximum RPM rating of the motor when the ENTER button is pushed, the LED will light. The LED will go out when valid data is entered.

1.10.7 Thumbwheel Setup

Figure 1-25 displays the parameters in the thumbwheel setup screen. Listed below are instructions and/or descriptions for each of these parameters.

Thumbwheel Setup Screen Parameter Descriptions

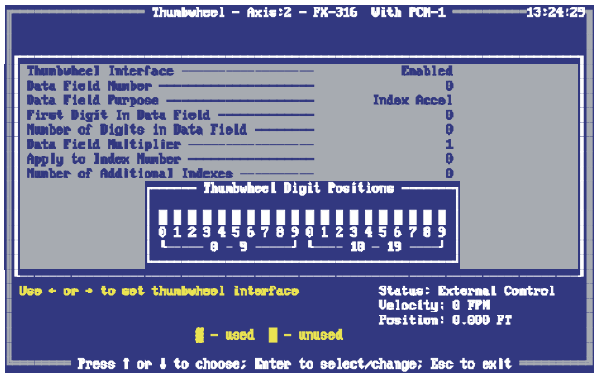


Figure 1-25
Thumbwheel Setup Screen

Thumbwheel Interface
This function must be enabled for the thumbwheel to function. The thumbwheel may be used along with an active T-16. However, the Parallel Programming feature will automatically be disabled when this function is enabled. If the Parallel Program feature is enabled both the Thumbwheel feature and the T-16 will automatically be disabled.

Data Field Number
All parameters in this setup screen will be associated with the field number that is selected. Range: 0-7

Data Field Purpose
Data Field Purpose selects the drive parameters that will be controlled by this field. Listed below are the drive parameters that can be accessed.

- **Index Accel**
  The index acceleration time from zero to full scale velocity.

- **Index Decel**
  The index deceleration time from full scale velocity to zero.

- **Index Velocity**
  Determines the velocity at which the index will run.

- **Index Dist/Pos (+/-)**
  Add direction to distance. For use with thumbwheels that have a dedicated +/- key. The +/- function will precede the first digit in this field.

- **Index Dist/Pos**
  Distance command for systems that always move in a positive direction. For use with thumbwheels that don't have a dedicated +/- key.

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- **Index Dwell**
  Controls the dwell time at the end of the index.

- **Index Count**
  Controls the number of index repetitions that will occur each time the index is initiated.

- **Index Number**
  Designates which index will be loaded with the thumbwheel data.

- **Fast Jog Velocity**
  Velocity of the motor when the Fast Jog input is active.

- **Slow Jog Velocity**
  Velocity of the motor when the Slow Jog input is active.

- **Sensor Accel**
  The accel time for any feed sensor or registration index during the move to find the sensor input.

- **Sensor Decel**
  The decel time for any feed sensor or registration index after the sensor input has been found.

- **Sensor Velocity**
  For feed sensor or registration indexes during the move to find the sensor.

- **Field Function**
  This option allows you to choose the drive parameter that data in another field will relate to. A separate field would contain any values associated with the drive parameter selected in this field.

Field Function #	Drive Parameter
0	Index Accel
1	Index Decel
2	Index Velocity
3	Index Dist/Pos (+/-)
4	Index Dist/Pos
5	Index Dwell
6	Index Count
7	Fast Jog Velocity
8	Slow Jog Velocity
9	Sensor Accel
10	10 Sensor Decel
11	Sensor Velocity
12	Index Number

First Digit In Data Field
Designates where this field begins. The digits are numbered from left to right, 0 through 9 or 10 through 19 depending on the jumper locations (JP1 through JP5). When using a thumbwheel with a +/- character, the data field starts to the right of the +/- character.

Number Of Digits Field
Defines the size of the data field. PCX will display the first digit and all other used digits so you can avoid overlapping fields.

Data Field Multiplier
Adds zeros to the right of the data in this field. Example: Accel times range from 0 to 65.535 sex. If changes could be made in whole-second increments, the Multiplier can be 1000 and the number of digits could be 2 thereby conserving digits for other uses.

Apply To Index Number
Designates which index will be affected by the data in this field.

> ***NOTE:***
> *Emerson EMC recommends using DPC cables no longer than 25 ft.*

Number Of Additional Indexes
Allows the operator to apply the data in this field to more indexes. Example: The field is configured to change the velocity of Index #3. If a value of 5 were entered into this parameter, the velocity of the next 5 indexes would also be changed. In other words the velocity of Indexes 4, 5, 6, 7, and 8 would be changed along with the velocity of Index #3.

Apply To Data Field
Used where data field purposes (e.g. Field Function and Index Function Parameters) require corresponding data fields for additional information.

Number Of Additional Data Fields
Used with the “Apply to Data Field” parameter.

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1.10.8 Thumbwheel Example

In this example, an Emerson TW-217 thumbwheel is being used to set up index velocity and distance. Two data fields are needed; field 0 and 1. The First Digit In Data Field 1 is data field location #4 which is the first digit to the right of the (+/-).

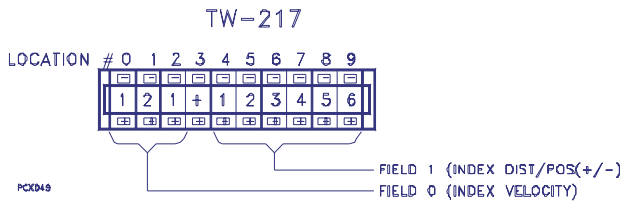
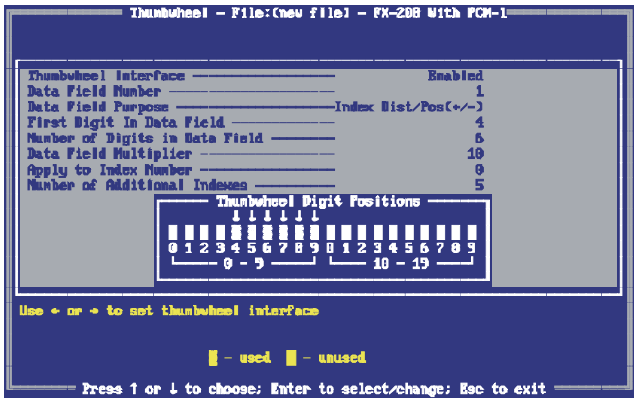


Figure 1-26



Thumbwheel Example
Index Velocity = 1210/Index Distance = 123456

Figure 1-27
Example Setup Screen

Index velocities are multiplied by 10 before being sent to the FX drive. Signed distances are used when a sign digit is available on the thumbwheel. When the data is entered as shown in Figures 1-26 and 1-27, the values will be sent to indexes 0, 1, 2, 3, 4, and 5.

1.11 Parallel Programming

Another feature of the parallel interface connector is that of parallel programming. In this mode of operation a character buffer of 32 characters is provided for you. The characters are designated as 0 through 31. These 32 characters can be pre-programmed via serial commands to represent distance, velocity (in RPM only), count, etc. The same basic functions and programming capabilities that are provided for thumbwheels are provided for this parallel interface.

The parallel interface has 8 lines dedicated to transfer data and 4 lines dedicated to selection of data pairs. Since 8 lines of data are provided, each data transfer includes two characters. The additional 4 lines allow for a selection of 16 pairs of characters.

The operation of the data lines is for BCD data. The 4 lines of pair selections are coded in binary. Four handshake lines are dedicated to accomplish data transfers. Two are inputs and two are outputs. One input (PAIR ENTER) is to tell the digital drive that the data and pair selection lines are ready for transferring to the character buffer. Once the 32-character buffer data content is programmed, another input (execute) is provided to transfer and start using any new data contained in the entire buffer.

One of the two outputs (Acknowledge) allows the digital drive to tell the external device that it has received the proper input. This output comes ON to acknowledge either of the inputs (pair Enter) or (Execute).

The second output (Error) allows the drive to tell an external device that data is out of range. The correct protocol for these handshake lines is to turn on the input, wait for the acknowledge and then shut off the inputs. The digital drive will then shut off pin 22 (Acknowledge).

The inputs and outputs from this parallel interface are not optically isolated and are relatively low voltage (5 to 15). Care must be taken to assure that electrical noise does not enter the digital drive by a careless wiring implementation of this interface. In general, the wiring should be kept short (5 to 20) feet. The wiring should be shielded with the shield connected at the external device. The wiring cannot be run adjacent to any high voltage wiring.

1.11.1 Parallel Programming I/O Circuitry

A circuit representing the inputs and outputs is shown in Figure 1-28.

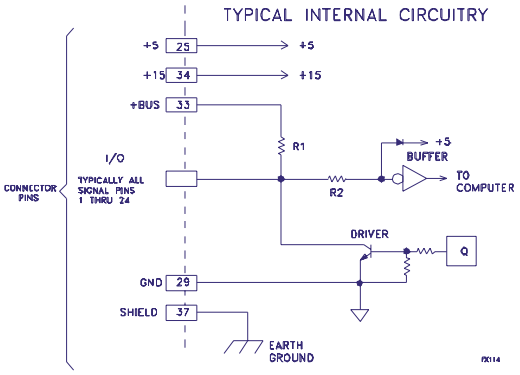


Figure 1-28
Typical Internal Circuitry

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The I/O (typical of all signal pins) has an input buffer and output drive associated with it. This is done to provide a highly flexible hardware implementation. This parallel port is used for implementation of the T-16 numeric display and thumbwheels. Since each of the signal pins can be firmware configured, different features can be achieved.

Each of the I/O pins has a pull up resistor (R1) associated with it. This pull up resistor is connected to the 37 pin connector, pin 33 (+BUS). Pin 33 (+BUS) can be connected to pin 25 (+5) for a +5 volt interface, or connected to pin 34 (+15) for a +15 volt interface. However, the preferred method is connection to the positive supply of the external device.

The ground connection (pins 29, 30, 31 and 32) must be connected to the supply ground of the external device. The shield (pin 37) is provided as an alternative place to connect the cable shield if a connecting place cannot be found at the external device. Never connect the shield at both ends.

1.11.2 Parallel Programming Character Data

> ***NOTE:***
> *Do not enter data greater than 9 per digit. For example, all grounded inputs are not allowed. If the character is used as a sign (+ or -) for Index Distance or Position, the input lines (GND/OPEN) pattern is shown.*

Inputs to the FX drive are interpreted as “ON” (active) when an input pin is grounded (connected to pins 29, 30, 31, 32 of the parallel connector.

There can be 32 characters designated as (0 to 31) entered in pairs designated as (0-15). If, for example, no wires were hooked up to the data lines 1 through 8, or pair selects 17 through 20, and a wire was connected from pin 21 (pair Enter) to pin 29 (ground), the drive would assume you are trying to enter the data 0. 0 for characters 0 and 1 and would turn On the acknowledge output. The character data must be input in simple BCD form.

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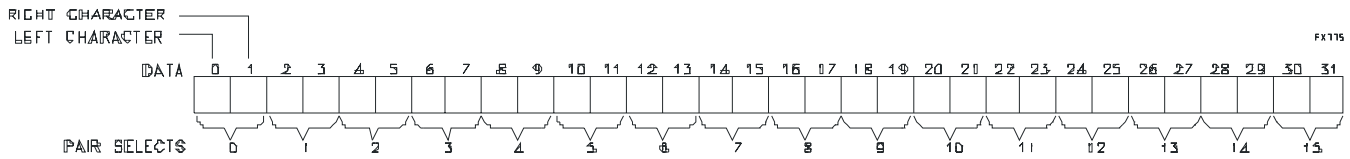


Figure 1-29
Character Data

DATA									
		LEFT				RIGHT			
LSD	**MSD**	**LSD**			**MSD**	**LSD**			**MSD**
		pin #1	#2	#3	#4	#5	#6	#7	#8
0	0	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
1	1	GND	OPEN	OPEN	OPEN	GND	OPEN	OPEN	OPEN
2	2	OPEN	GND	OPEN	OPEN	OPEN	GND	OPEN	OPEN
3	3	GND	GND	OPEN	OPEN	GND	GND	OPEN	OPEN
4	4	OPEN	OPEN	GND	OPEN	OPEN	OPEN	GND	OPEN
5	5	GND	OPEN	GND	OPEN	GND	OPEN	GND	OPEN
6	6	OPEN	GND	GND	OPEN	OPEN	GND	GND	OPEN
7	7	GND	GND	GND	OPEN	GND	GND	GND	OPEN
8	8	OPEN	OPEN	OPEN	GND	OPEN	OPEN	OPEN	GND
9	9	GND	OPEN	OPEN	GND	GND	OPEN	OPEN	GND
+	+	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
-	-	OPEN	OPEN	GND	OPEN	OPEN	OPEN	OPEN	OPEN

Table 1-1

Character Data

	LSD			MSD
	pin #17	**#18**	**#19**	**pin #20**
0	OPEN	OPEN	OPEN	OPEN
1	GND	OPEN	OPEN	OPEN
2	OPEN	GND	OPEN	OPEN
3	GND	GND	OPEN	OPEN
4	OPEN	OPEN	GND	OPEN
5	GND	OPEN	GND	OPEN
6	OPEN	GND	GND	OPEN
7	GND	GND	GND	OPEN
8	OPEN	OPEN	OPEN	OPEN
9	GND	OPEN	OPEN	GND
10	OPEN	GND	OPEN	GND
11	GND	GND	OPEN	GND
12	OPEN	OPEN	GND	GND
13	GND	OPEN	GND	GND

Table 1-2

Pair Selection Inputs

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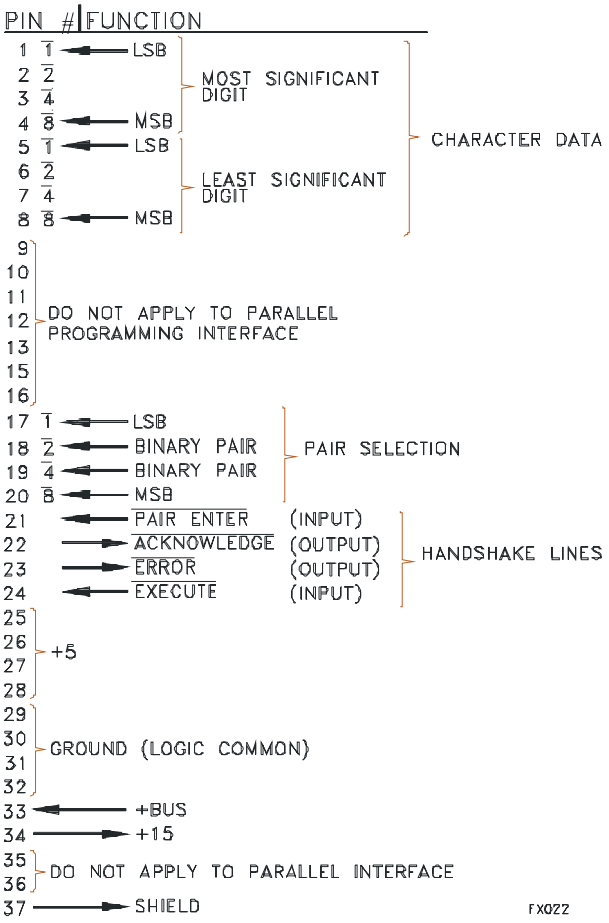


Figure 1-30
37 Pin Parallel Port

1.12 Parallel Connector

The 37 pin port may be connected directly to a PLC or computer and used as a parallel programming interface. This would allow drive parameters to be changed by a computer program rather than by an operator. In the parallel programming mode the drive is only capable of **accepting** data from the host device.

Figure 1-30 shows the pin-outs, binary value, significance, and handshaking functions for each of the pins on the parallel port. The buffer is arranged in pairs which are number 0-15. The BCD data on pins 1-8 will be downloaded to the buffer by using pins 17-20 to select the proper location in the buffer, then using pin 21 (Pair Enter) to indicate that the data lines and the pair select lines are correct, and finally using pin 24 (Execute) to activate the download.

The acknowledge output (pin #22) will be activated after the drive has received an acceptable pair enter input or execute input. The Error Output will be activated if any data is out of range.

> ***NOTE:***
> *All inputs and outputs are Low Active.*

Proper protocol would be as follows:

1 Active the BCD data inputs and the Pair Select inputs

2 Activate the Pair Enter input

3 Wait for the Acknowledge output

4 Activate the Execute input

5 Wait for the Acknowledge output

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1.12.1 Parallel Interface Wiring

The inputs and outputs from the parallel interface connector are not optically isolated and are relatively low voltage (15VDC). Care must be taken to assure that electrical noise does not enter the FX drive by a careless wiring implementation of this interface.

In general, the wiring should be kept short (5 to 20) feet. The wiring should be shielded with the shield connected at pin 37 of the parallel interface connector. The wiring must not be run adjacent to any high voltage wiring.

The thumbwheel multiplexing uses +15, +BUS, GND and Shield. These signals are provided for the parallel interface options only and cannot be used for any other purpose.

The 37-pin parallel interface connector and a typical thumbwheel wiring schematic are shown in Figure 1-31. All the necessary connections are shown. However, there are several important considerations:

1 The internal +15VDC logic supply of the drive should be used for the thumbwheel supply voltage. This connection is made by connecting pins 33 and 34 on the 37-pin connector (P2).

2 The cable used to connect the thumbwheel assembly to the 37-pin connector (P2) must not exceed 50 ft. Emerson EMC recommends 25 ft. maximum length. Also, this cable must be shielded with one end of the shield connected to pin 37 of P2. The other end of the shield must not be connected (see Figure 1-32 on the following page). Typical wire gauges used in this cable would be from 26 AWG to 32 AWG.

3 The thumbwheel digits must have the blocking diodes that are indicated on the wiring schematic. If not, the diodes can be added according to the schematic. A typical diode used for this would be a 1N914.

4 The 1, 2, 4, 8 coding for the data must be accomplished with BCD switches that are active “ON”. These are the most common variety.

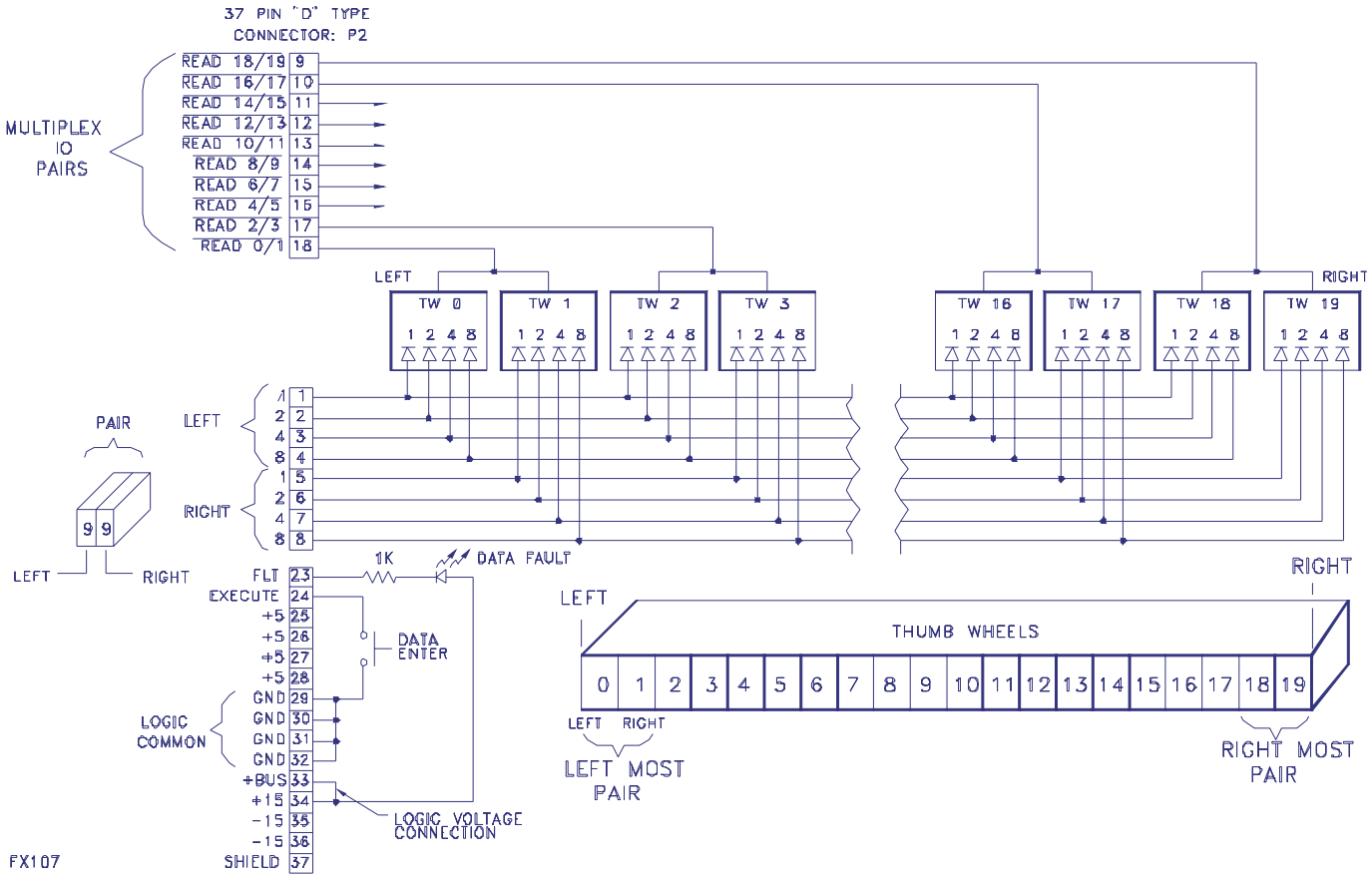


Figure 1-31

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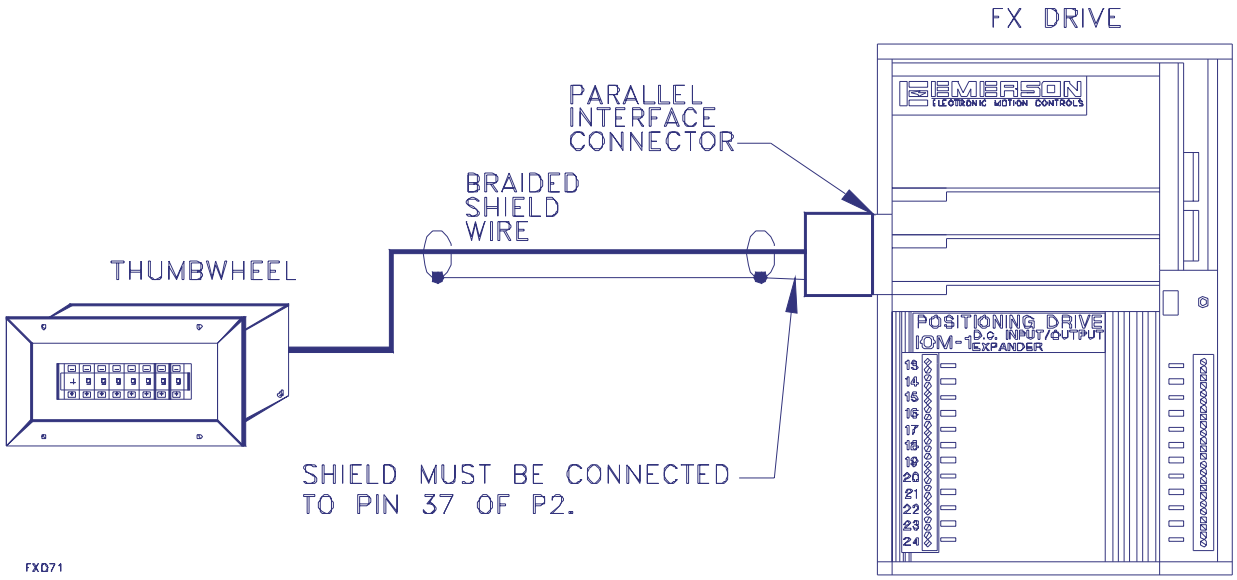


Figure 1-32
Thumbwheel Cable Connection

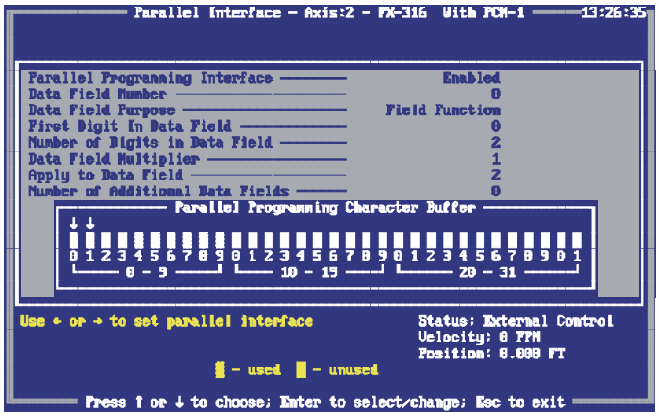


Figure 1-33
Parallel Interface Setup Screen

1.12.2

PCX is used to define field function, location, and size. Notice that the buffer is displayed with 32 characters. The parameters in this screen have been defined in the T-16 and/or Thumbwheel sections.

Parallel Programming Interface
This parameter must be enabled to use the parallel programming feature. If this feature is enabled the T-16 and the Thumbwheel will automatically be disabled.

Figure 1-34 shows that field 0 contains the first two digits in the buffer and the purpose will be Field Function. In Data Field 1, digits 2-4 represent the index number that the data in field 2 is also to use. Data Field 2 is a general purpose field that is used in conjunction with the other data fields. When the data as shown above, the index velocity of index number 55 will be changed to 1200.

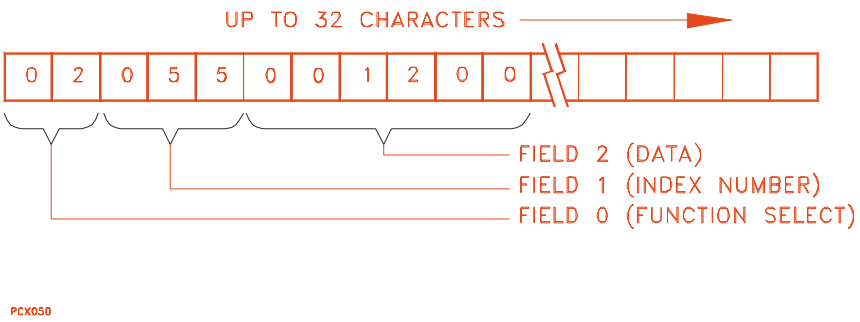


Figure 1-34
32 Character Buffer

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