

# FM-1 Speed Module Installation Manual



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- Exact wording of any messages that appear on your screen.
- What you were doing when the problem occurred.
- How you tried to solve the problem.

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## Document Conventions

Manual conventions have been established to help you learn to use this manual quickly and easily. As much as possible, these conventions correspond to those found in other Microsoft Windows documentation.

Menu names and options are printed in bold type: the **File** menu.

Dialog box names begin with uppercase letters: the Axis Limits dialog box.

Dialog box field names are in quotes: "Field Name".

## FM-1 Speed Module Installation Manual

Button names are in *italic*: *OK* button.

Source code is printed in Courier font: `Case ERMS`.

In addition, you will find the following typographic conventions throughout this manual.

This	Represents
bold	Characters that you must type exactly as they appear. For example, if you are directed to type <b>a:setup</b> , you should type all the bold characters exactly as they are printed.
italic	Place holders for information you must provide. For example, if you are directed to type <i>filename</i> , you should type the actual name for a file instead of the word shown in italic type.
ALL CAPITALS	Directory names, file names, key names, and acronyms.
SMALL CAPS	Non-printable ASCII control characters.
KEY1+KEY2 example: (Alt+F)	A plus sign (+) between key names means to press and hold down the first key while you press the second key.
KEY1,KEY2 example: (Alt,F)	A comma (,) between key names means to press and release the keys one after the other.

# Safety Instructions

## General Warning

Failure to follow safe installation guidelines can cause death or serious injury. The voltages used in the product can cause severe electric shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to it. The installation must comply with all relevant safety legislation in the country of use.

## Qualified Person

For the purpose of this manual and product, a “qualified person” is one who is familiar with the installation, construction and operation of the equipment and the hazards

involved. In addition, this individual has the following qualifications:

- Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- Is trained in the proper care and use of protective equipment in accordance with established safety practices.
- Is trained in rendering first aid.



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## Warning

For the purpose of this manual and product, “Warning” indicates death, severe personal injury or substantial damage CAN result if proper precautions are not taken.

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## Caution

For the purpose of this manual and product, “Caution” indicates minor personal injury or property damage CAN result if proper precautions are not taken.

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## Note

For the purpose of this manual and product, “Note” indicates information about the product or the respective part of the manual which is essential to highlight.

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## Epsilon Only

For the purpose of this manual and product, the “Epsilon” symbol indicates information about the Epsilon drive specifically.

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## ***E<sub>N</sub>* E Series Only**

For the purpose of this manual and product, the “*E<sub>N</sub>*” symbol indicates information about the E Series drive specifically.

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Throughout this manual, the word "drive" refers to an Epsilon or E Series drive.



# Underwriters Laboratories Recognition



The E Series drives are marked with the “UL Recognized” label after passing a rigorous set of design and testing criteria developed by UL (UL508C). This label indicates that the UL certifies this product to be safe when installed according to the installation guidelines and used within the product specifications.

## The “conditions of acceptability” required by UL are:

- The drive ambient temperature must be 40° C (104° F) or less.
- This product is suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical amperes, 240 volts maximum.


The “UL Recognized” designation is different than a “UL Listed” designation. The “UL Listed” designation is generally applicable to stand alone products where the “UL Recognized” designation is used for components that are part of a system. E Series drives are usually considered components of a larger control system where the “UL Recognized” designating is very common and well accepted.

# CE Declaration of Conformity



The E Series drives are marked with the “Conformite Europeenne Mark” (CE mark) after passing a rigorous set of design and testing criteria. This label indicates that this product meets safety and noise immunity and emissions (EMC) standards when installed according to the installation guidelines and used within the product specifications.

# FM-1 Speed Module Installation Manual

<b>Declaration of Conformity</b>	
<b>Manufacturer's Name:</b>	EMERSON Motion Control
<b>Manufacturer's Address:</b>	1365 Park Road Chanhassen, MN 55317 USA
<b>Declares That The Following Products:</b>	
<b>Products Description:</b>	E Series Digital Servo Drive
<b>Model Number:</b>	EN-204, EN-208, EN-214
<b>System Options:</b>	This declaration covers the above products with the ALP-130 Backup Logic Power Supply and ECI-44 Screw Terminal Interface.
<b>Designed and manufactured in accordance with the following European harmonized national and international standards.</b>	
Electromagnetic Compatibility:	
EN 55011/1991 Class A Group 1, CISPR 11/1990 Class A Group 1	
EN 50082-2/1995:	IEC 1000-4-2/1995; EN 61000-4-2, 4kV CD IEC 1000-4-3/1995; EN 61000-4-3, ENV 50140/1993, 80% AM, 10V/m @ 3 m IEC 1000-4-4/1995; EN 61000-4-4, 2 kV ALL LINES IEC 1000-4-8/1993; EN 61000-4-8, 30 A/m ENV 50141/1993, 80% AM, 10V, .15-80 MHz ENV 50204/1995, Pulse, 900 MHz, 50% DTY, 200 Hz
<b>Supplementary Information</b>	
The products herewith comply with the requirements of the Low Voltage Directive (LVD) 73/23/EEC and EMC Directive 89/336/EEC	
This electronic drive product is intended to be used with an appropriate motor, electrical protection components and other equipment to form a complete end product or system. It must only be installed by a professional assembler who is familiar with requirements for safety and electromagnetic compatibility ("EMC"). The assembler is responsible for ensuring that the end product or system complies with all the relevant laws in the country where it is to be used. Refer to the product manual for installation guidelines.	
	<b>December 2, 1997</b>
Bradley Schwartz/ VP Engineering	Date
European Contact:	Sobetra Automation Langeveldpark Lot 10 P. Dasterleusstraat 2 1600 St. Pieters leeuw, Belgium

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## **Index**

# Introduction

## Overview

This chapter describes the Function Module 1 features and how to access information in this manual. Specifically, it includes:

- Features
- How this Manual is Organized
- Reference Materials



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### Note

The FM-1 is compatible with all E Series drives with part number 9605xx-05 or higher.

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The FM-1 is a compact and rugged module that attaches to the front of the E Series drive. It provides eight digital input lines and four digital output lines in addition to the four input and three output lines available on the E Series drive. The FM-1 is setup using EMERSON Motion Control's PowerTools-FM software. PowerTools-FM is an easy-to-use Microsoft® Windows®-based setup and diagnostics tool.

With the FM-1 installed, the base drive functions normally, with some additional features, including eight more inputs and four more outputs. The additional major features include; four additional Velocity presets, eight digital Torque presets, two additional Summation modes, plus an Alternate Operating mode function.

### Velocity Presets

The FM-1 offers eight Velocity Presets which operate the same as the four Velocity Presets in the E Series drives, except there

are eight presets available. These velocity presets are numbered 0 through 7 and are selectable with I/O. Each preset velocity has a ramp associated with it, which is used whether the drive has to accelerate or decelerate to achieve the selected speed.

### **Digital Torque Preset Mode**

A digital torque submode selection is available in the Torque mode. This offers eight torque presets which are selectable with I/O or Modbus and is in addition to the analog command torque mode available in the base drive.

### **Summation Modes**

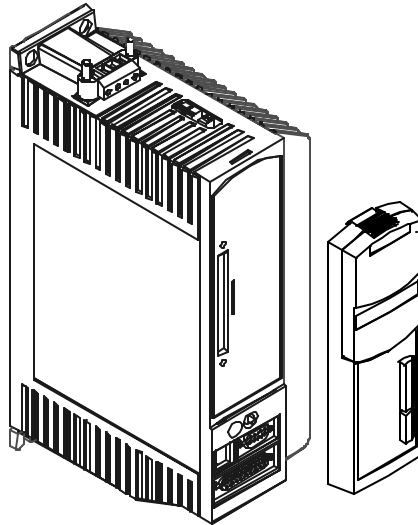
Summation mode in the FM-1 has three summation mode choices:

- Analog Velocity + Preset Velocity
- Pulse mode + Analog Velocity
- Pulse mode + Preset Velocity

The Pulse Summation modes are advantageous in applications that require pulse following plus the ability to adjust the phase relationship to the master by adding or subtracting velocity to the ratioed master pulse rate. The Analog + Preset Velocity mode operates the same as it does in the base drive.

### **Alternate Operating Mode**

The FM-1 permits two different operating modes to be set up. It normally runs according to the Operating Mode but can be switched to the Alternate Operating Mode by activating an input function. This provides the user with the flexibility to use a drive with the FM-1 in applications that previously required a complex controller.



*Figure 1: E Series Drive with Function Module FM-1*

## Features

- Three Summation modes; Pulse + Analog Velocity, Pulse + Preset Velocity and Preset Velocity + Analog Velocity
- Eight Velocity Presets
- Eight Torque Presets
- Eight optically isolated input lines
- Four optically isolated output lines
- Easy to attach and detach
- Easy-to-use Windows-based software

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- Extensive fault sensing and diagnostics, including storage and time stamping of the last 10 faults
- No tuning needed for no-load to 10:1 inertia mismatch
- High performance tuning based on inertia, friction and response
- Removable I/O connectors for easy installation
- Scalable Encoder Output
- Travel Limit functions

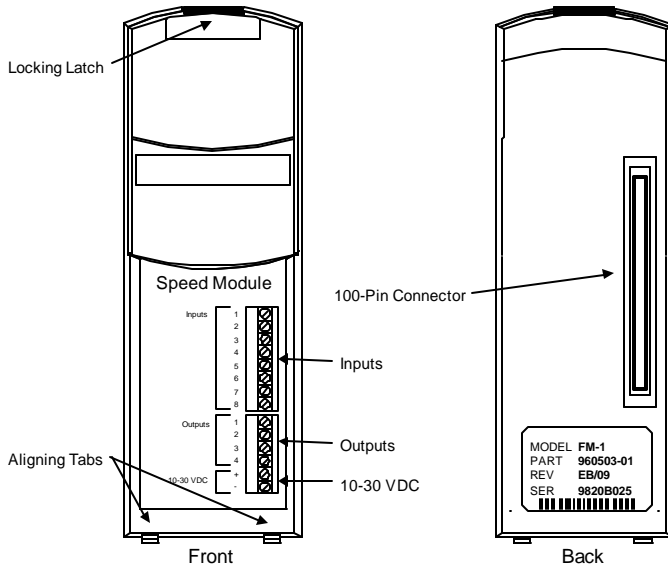


Figure 2: FM-1 Speed Module Features



# How this Manual is Organized

This manual is divided into the following major sections:

## **Introduction**

This section introduces you to the FM-1 hardware and software features, requirements and operation.

## **Safety Considerations**

This section describes a number of safety precautions that need to be addressed in a system design.

## **Installation**

This section describes the hardware features including mounting, environmental requirements, I/O wiring, serial communications, analog input wiring and drive communications.

## **Specifications**

This section contains the specifications for FM-1 and E Series drive. These include dimensions and clearances for the components. Cable pinouts are also listed.

# Reference Materials

The following related reference and installation manuals may be useful with your particular system.

- E Series Drives Reference Manual (P/N 400501-01)
- E Series Drives Installation Manual (P/N 400500-01)
- FM-1 Speed Module Reference Manual (P/N 400506-01)



# Safety Considerations

## Overview

This chapter describes the safety issues which need to be addressed in the system design when using this product. Specifically, it includes:

- Safety Precautions
- Enclosure Design
- Setting Up, Commissioning and Maintenance of Product
- Safety of Machinery

## Safety Precautions

This product is intended for professional incorporation into a complete system. If you install the product incorrectly, it may present a safety hazard. The product and system may use high voltages and currents, carries a high level of stored electrical energy, or is used to control mechanical equipment which can cause injury.

You should give close attention to the electrical installation and system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. Read and follow this safety information and the instruction manual carefully.

## Enclosure

This product is intended to be mounted in an enclosure which prevents access except by trained and authorized personnel, and which prevents the ingress of contamination. This product is designed for use in an

environment classified as pollution degree 2 in accordance with IEC664-1. This means that only dry, non-conducting contamination is acceptable.

## Setup, Commissioning and Maintenance

It is essential that you give careful consideration to changes to drive settings. Depending on the application, a change could have an impact on safety. You must take appropriate precautions against inadvertent changes or tampering. Restoring default parameters in certain applications may cause unpredictable or hazardous operation.

## Safety of Machinery

Within the European Union all machinery in which this product is used must comply with Directive 89/392/EEC, Safety of Machinery.

The product has been designed and tested to a high standard, and failures are very unlikely. However the level of integrity offered by the product's control function – for example stop/start, forward/reverse and maximum speed – is not sufficient for use in safety-critical applications without additional independent channels of protection. All applications where malfunction could cause injury or loss of life must be subject to a risk assessment, and further protection provided where needed.



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### Note

#### General warning

Failure to follow safe installation guidelines can cause death or serious injury. The voltages used in this unit can cause severe electric shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to this equipment. The installation must comply with all relevant safety legislation in the country of use.

#### AC supply isolation device

The AC supply must be removed from the drive using an approved isolation device or disconnect before any servicing work is

performed, other than adjustments to the settings or parameters specified in the manual. The drive contains capacitors which remain charged to a potentially lethal voltage after the supply has been removed. Allow at least 30 seconds after removing the supply before carrying out any work which may involve contact with electrical connections to the drive.

### **Products connected by plug and socket**

A special hazard may exist where the drive is incorporated into a product which is connected to the AC supply by a plug and socket. When unplugged, the pins of the plug may be connected to the drive input, which is only separated from the charge stored in the capacitor by semiconductor devices. To avoid any possibility of electric shock from the pins, if they are accessible, a means must be provided for automatically isolating the plug from the drive (e.g., a latching contactor).

### **Grounding (Earthing, equipotential bonding)**

The drive must be grounded by a conductor sufficient to carry the prospective fault current in the event of a fault. The ground connections shown in the manual must be followed.

### **Fuses**

Fuses or over-current protection must be provided at the input in accordance with the instructions in the manual.

### **Isolation of control circuits**

The installer must ensure that the external control circuits are isolated from human contact by at least one layer of insulation rated for use at the applied AC supply voltage.

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# Installation

## Overview

This chapter describes the installation of the FM-1. Specifically, it includes:

- Typical Installation
- Overview of Cables
- Attaching and Detaching the FM-1
- Electrical Installation
- Serial Communications

## Typical Installation

The figure below shows a typical installation using three E Series drives each equipped with an FM-1, a Motion Interface Panel and a PLC.

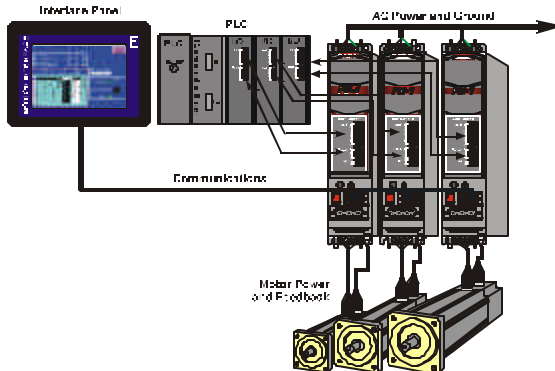


Figure 3: Typical Installation

## Overview of Cables

The following cables are used to connect various components to the E Series drive and FM-1.

Motion Interface Panel

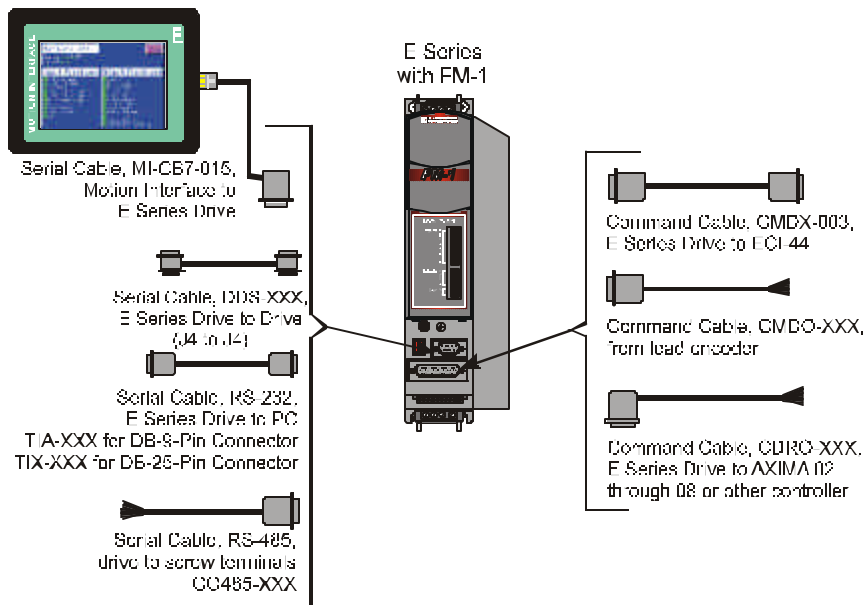


Figure 4: Overview of Cables



# Attaching and Detaching the FM-1



## Note

The FM-1 is compatible with all E Series drives with part number 9605xx-05 or higher.

Two aligning tabs, a locking latch and a 100-pin connector are used to attach the FM-1 to any E Series drive. All electrical connections between the FM-1 and the E Series drive are accomplished with the single connector located on the rear of the FM-1.

The FM-1 detects and verifies the drive serial number when its attached to an E Series drive. If an FM-1 is moved from one drive to another, it will detect the difference in serial numbers and generate an Invalid Configuration fault (see the Diagnostics and Troubleshooting section).

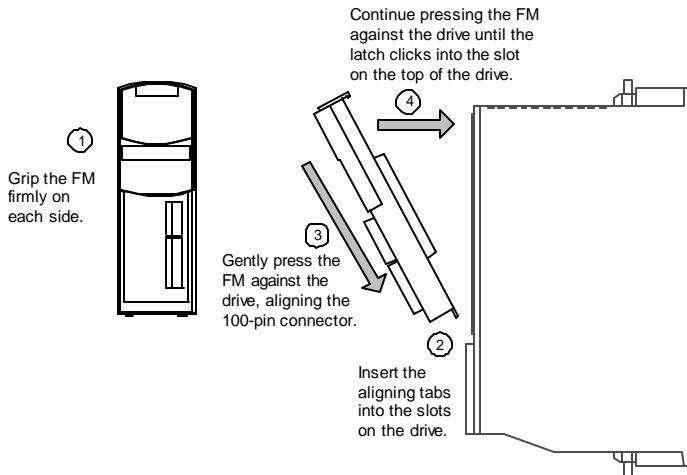


Figure 5: Attaching the FM-1 to an E Series Drive



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## Caution

Do not attach or detach the FM-1 when power is applied to the drive.

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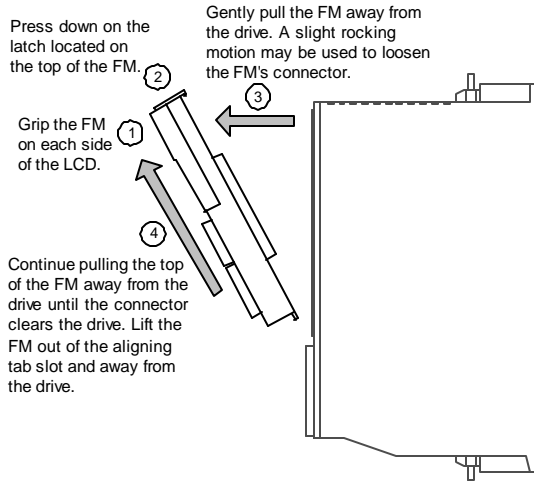


Figure 6: *Detaching the FM-1 from the Drive Connections*



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## Caution

Do not attach or detach the FM-1 when power is applied to the drive.

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# Basic Installation Notes

You are required to follow all safety precautions during start-up such as providing proper equipment grounding, correctly fused power and an effective Emergency Stop circuit which can immediately remove power in the case of a malfunction.

## Environmental Considerations

If the product will be subjected to atmospheric contaminants such as moisture, oils, conductive dust, chemical contaminants and metallic particles, you must mount it vertically in a metal NEMA type 12 enclosure.

If the ambient temperature inside the enclosure will exceed 40° C (104° F), you must consider forced air cooling to stay within UL conditions of acceptability for this UL recognized product. The amount of cooling depends on the size of the enclosure, the thermal transfer of the enclosure to the ambient air and the amount of power being dissipated inside the enclosure.

## Wiring Notes

- To avoid problems associated with EMI (electromagnetic interference), you should route high power lines (AC input power and motor power) away from low power lines (encoder feedback, serial communications, etc.).
- You should consider future troubleshooting and repair when installing all wiring. All wiring should be either color coded and/or tagged with industrial wire tabs.
- As a general rule, the minimum cable bend radius is ten times the cable outer diameter.
- All wiring and cables, stationary and moving, must be protected from abrasion.

- Ground wires should not be shared with other equipment. Also ensure that metal to metal contact is made between the enclosure ground lug and the metal enclosure.
- All inductive coils must be suppressed with appropriate devices, such as diodes or resistor/capacitor (RC) networks.

# Electrical Installation

## Input/Output Wiring

FM-1's are equipped with eight optically isolated input lines and four optically isolated output lines. They are designed to operate from a +10 to 30 VDC source. All inputs and outputs are configured as sourcing. You are responsible for choosing a load that will limit each output current to less than 150 mA.

The input lines, output lines and I/O power connectors are on removable terminal blocks. 18 to 24 AWG stranded wire is recommended.

A single power supply can be used to power the I/O on both the E Series drive and the FM-1, however, it must be wired to both the drive and the FM-1 because I/O power is not passed through the connector on the back of the FM-1. Alternatively, separate power supplies can be used to power the I/O on the drive and the FM-1 as long as they share a common ground.

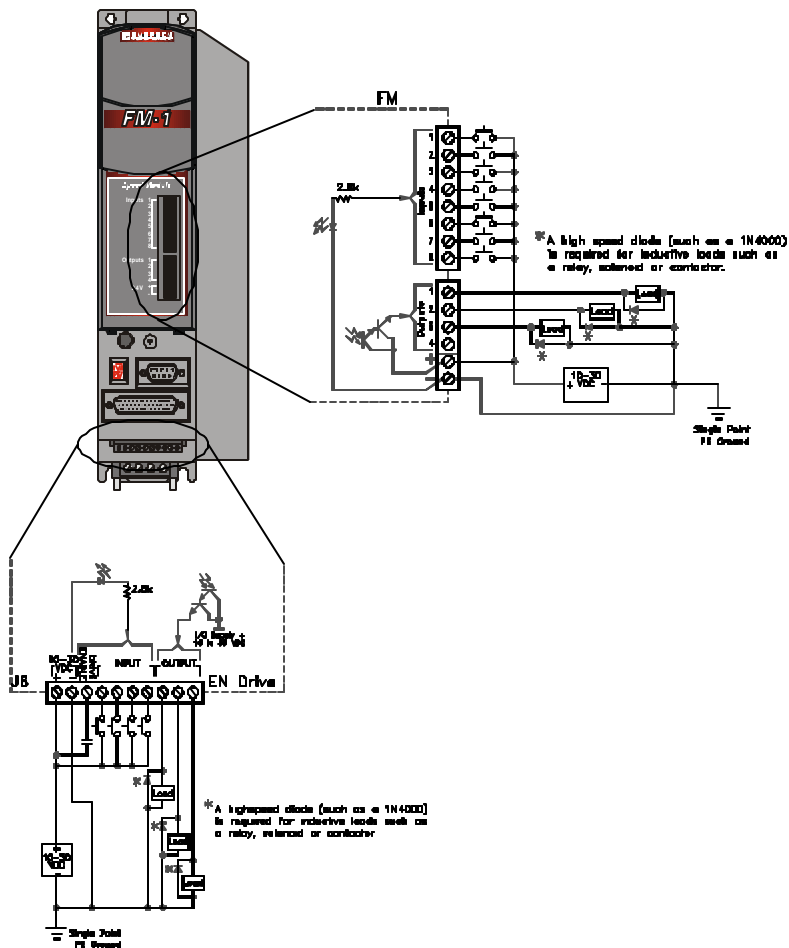


Figure 7: Input/Output Wiring Diagram

## Command Connector Wiring

All command and I/O signals are accessed using the 44-pin command connector located on the front of the E Series drive.

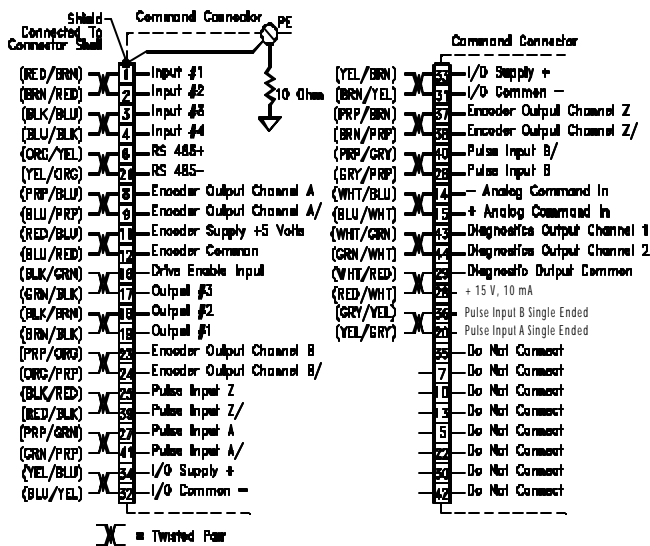


Figure 8: Command Connector (J5) and CMDO-XXX Cable



### Note

Some CMDO cables may have White/Yellow and Yellow/White wires in place of the White/Orange and Orange/White shown in the figure above (pins 6 and 21).

Function	Pin Numbers	Electrical Characteristics
Inputs and Drive Enable	1, 2, 3, 4, 16	10-30 Volts (“On”) 0-3 Volts (“Off”) optically isolated
Outputs	17, 18, 19	10-30 Volts DC sourcing 150 mA
I/O Supply	33, 34	10 - 30 VDC @ 1 Amp maximum
I/O Common	31, 32	I/O return
Pulse Inputs Differential	25, 26, 27, 39, 40, 41	5V, 200mV differential, 60 mV hysteresis, RS-422 compatible
Pulse Inputs Single Ended	20, 36	TTL, 330 ohm pull-ups to internal 5V 1.5V = low, 3.5V = high
Encoder Supply	11	+5 Volts (200 mA) fused internally
Encoder Common	12	0.0 Volts, 10 ohms away from PE
Encoder Out	8, 9, 23, 24, 37, 38	Differential line driver output (RS 422)
Analog In	14, 15	± 10 VDC differential command
Diagnostic Output	43, 44	± 10 VDC 10 mA maximum analog diagnostic, ref. to pin 29
Diagnostic Output Common	29	0.0 Volts, 10 ohms away from PE
RS 485 ±	6, 21	Same signals as the serial connector J4
+15 out	28	10 mA supply ref. to pin 29. (for test purposes only)

## Command Cables

The CMDO, CMDX and CDRO cables are all command cables that plug into the J5 command connector.

The CMDO and CMDX cables both use the same straight connector style, same color code and carry the full complement of signals available from the J5 connector. The difference is the CMDO cable has a male connector on one end with open wires on the other while the CMDX cable has male connectors on both ends.

The CDRO cable includes only the most commonly used signals to reduce the cable O.D. and has a connector at only one end. The 45 degree

## FM-1 Speed Module Installation Manual

connector design used on the CDRO cable reduces the enclosure depth requirement from 12 inches to 10 inches.

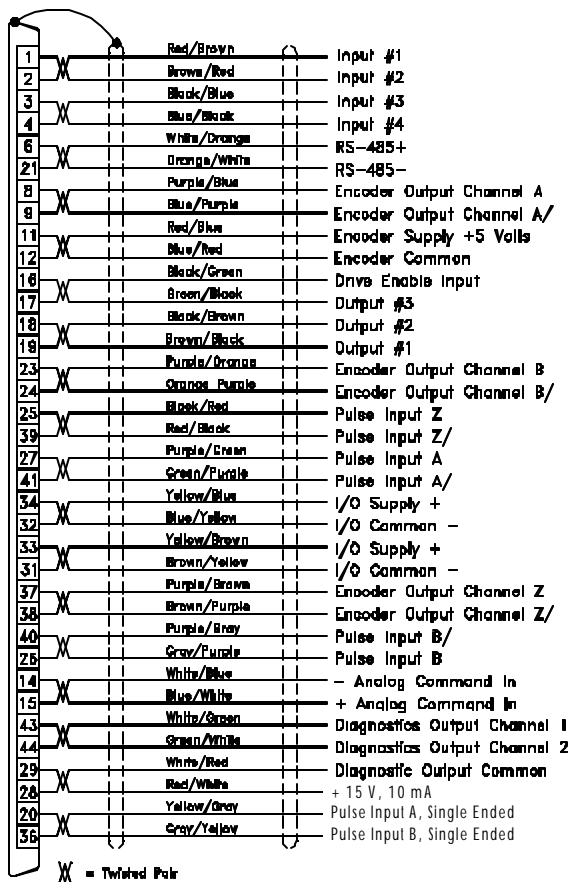


Figure 9: CMDO-XXX and CMDX-XXX Cable (18 pair cable)





## Note

Some CMDO and CMDX cables may have White/Yellow and Yellow/White wires in place of the White/Orange and Orange/White shown in the figure above (pins 6 and 21).

The CMDX and CMDO cable have the identical signal pin out and wire colors, but has a 44-pin connector on each end.

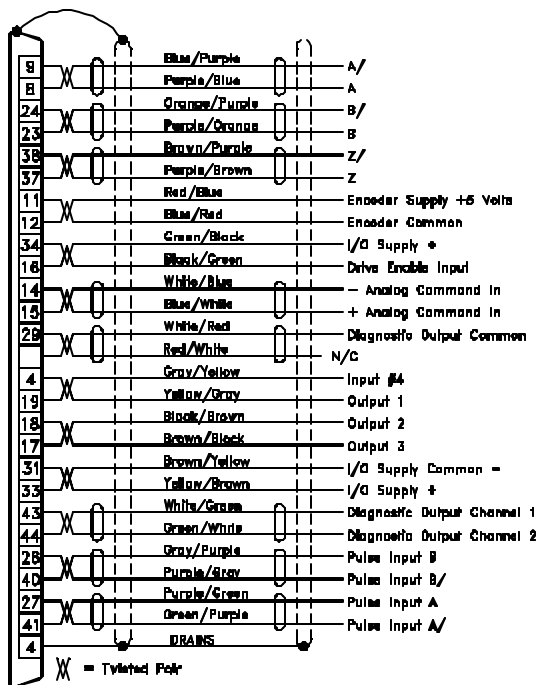


Figure 10: CDRO-XXX Cable Wiring Diagram, (13 pair cable)

## External Connector Interface (ECI-44, Optional)

The ECI-44 allows access to all command and input and output signals. The ECI-44 should be mounted close to the drive and away from any high voltage wiring. The ECI-44 comes complete with the hardware necessary for mounting to most DIN rail mounting track.

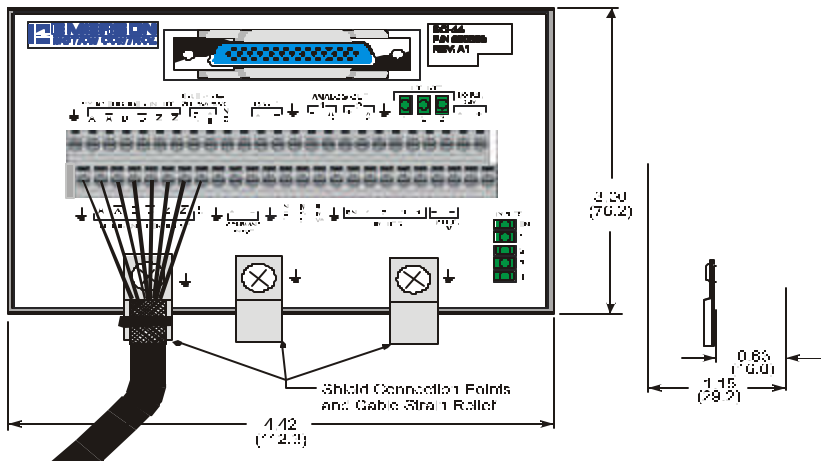


Figure 11: ECI-44 Mounting Dimensions, Inches (mm)



### Note

Shield connection points are connected to the shell of the 44-pin “D” connector on the ECI-44.

- Use the CMDX-XXX cable to connect the 44-pin “D” connector of the ECI-44 to the 44-pin J5 connector on the E Series drive.
- Use tie wraps to provide a strain relief and a ground connection at the shield connection points.

- If you do not wish to use the DIN rail mounting hardware, the ECI-44 can be disassembled and the mounting clips removed.
- The ECI-44 wire range is 18 to 24 AWG stranded insulated wire.



---

### Note

Wiring should be done with consideration for future troubleshooting and repair. All wiring should be either color coded and/or tagged with industrial wire tabs. Low voltage wiring should be routed away from high voltage wiring.

---

# FM-1 Speed Module Installation Manual

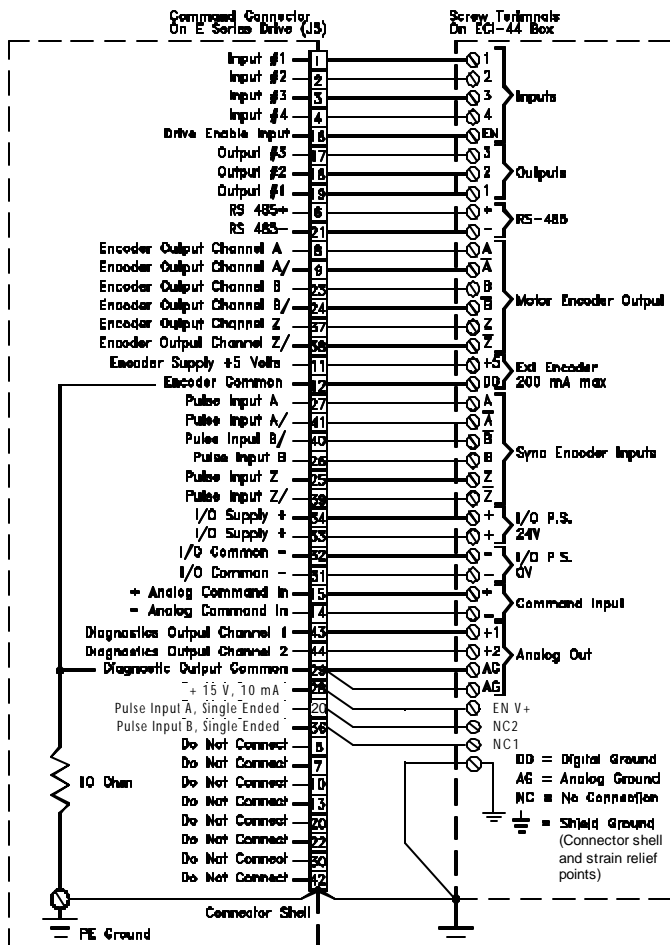


Figure 12: ECI-44 Box Signal Connections

# Analog Command Wiring

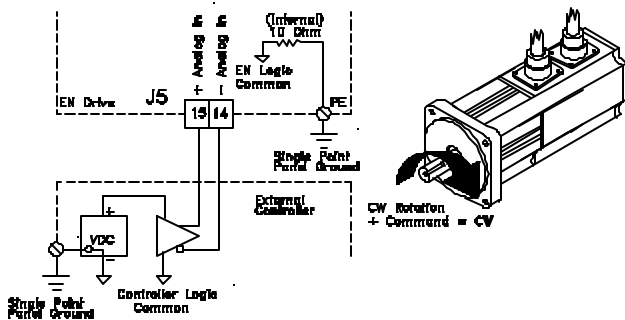


Figure 13: Analog Command, Differential Wiring Diagram

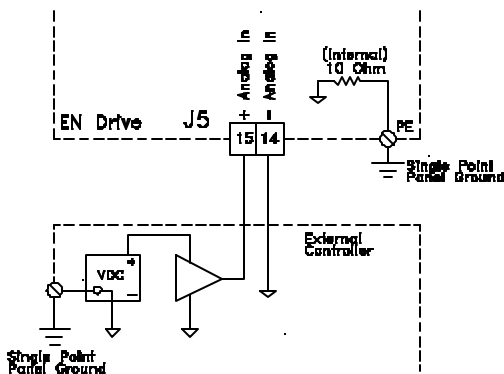


Figure 14: Analog Command, Single Ended Wiring Diagram

## Pulse Mode Wiring, Differential Inputs

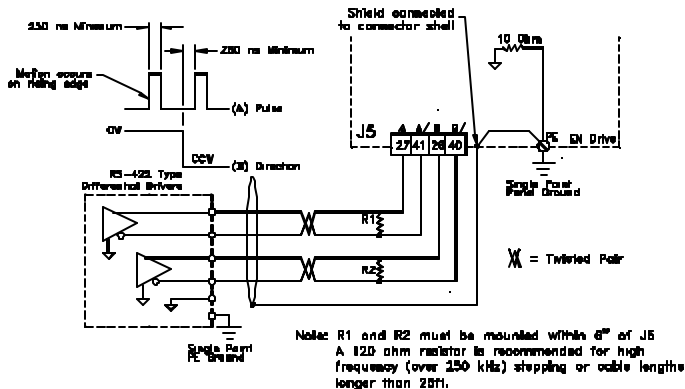


Figure 15: Pulse Mode, Differential Output to Differential Input

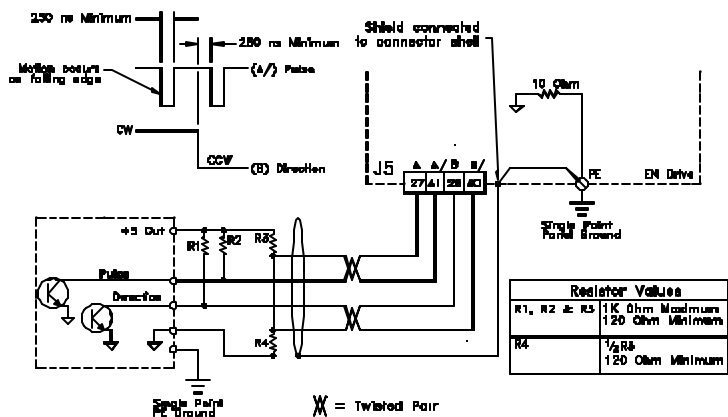


Figure 16: Pulse Mode, Single Ended Output to Differential Input

# Pulse Mode Wiring, Single Ended Inputs

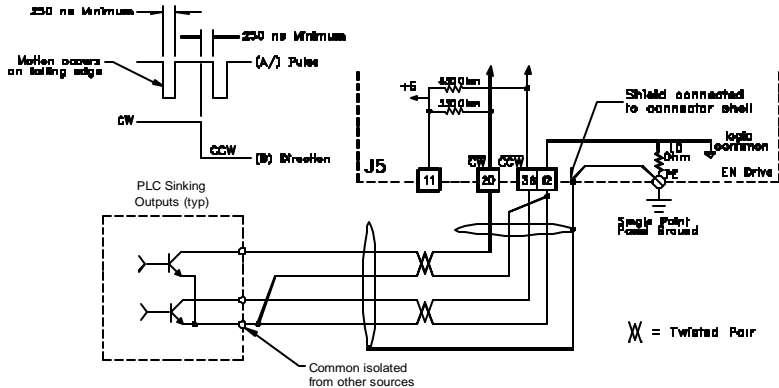


Figure 17: Pulse Mode, Single Ended Output to Single Ended Input (twisted pair cable)

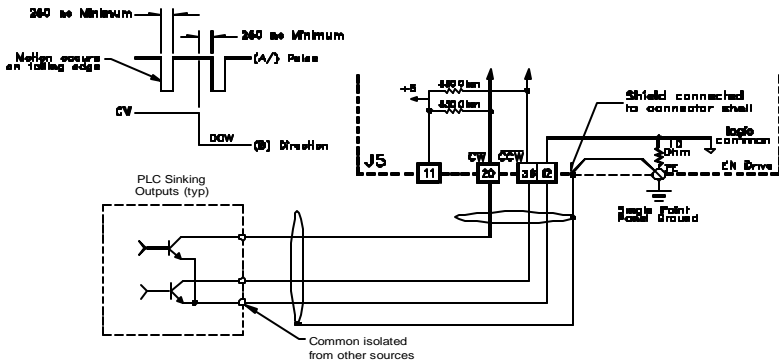


Figure 18: Pulse Mode, Single Ended Output to Single Ended Input (non-twisted pair cable)

## Encoder Output Wiring

Note: R1, R2 and R3 must be mounted within 6" of J5.  
 A 120 ohm resistor is recommended for high frequency (over 250 kHz) stepping or cable lengths longer than 25ft.

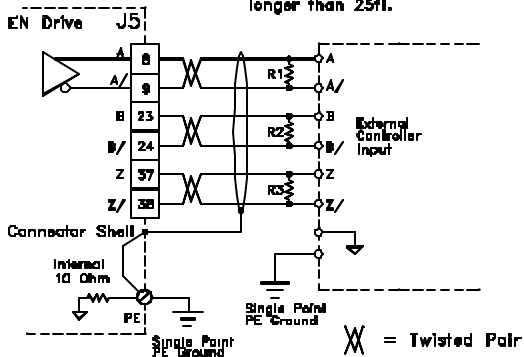


Figure 19: Command Connector Encoder Wiring Diagram

B leads A = (+) Rotation

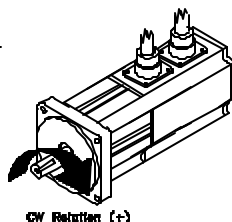
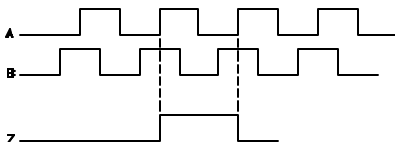


Figure 20: Direction Convention Diagram



# Serial Communications

Serial communications with the E Series drive and the FM-1 is provided through the female DB-9 connector (J4) located on the front of the drive. The serial interface is either three wire non-isolated RS-232C or two wire non-isolated RS-485. RS-485 is also available through the 44 pin command connector (J5).

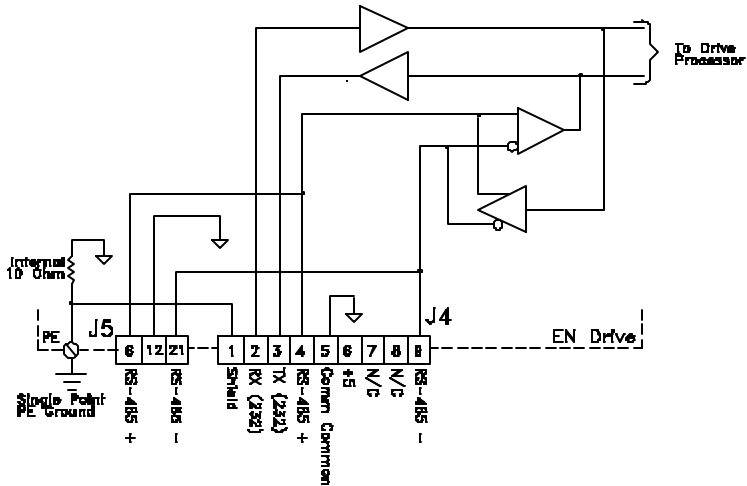


Figure 21: RS-232 and RS-485 Internal Connections



## Caution

When connecting the serial port of your PC to the serial port of the E Series drive, verify that your PC's ground is the same as the E Series drive PE ground. Failure to do so can result in damage to your PC and/or your E Series drive. This is not necessary with a battery-powered portable PC.

## Modbus Communications

The E Series drive and FM-1 system serial communication protocol is Modbus RTU slave with a 32 bit data extension. The Modbus protocol is available on most operator interface panels and PLC' s.

Serial Communications Specifications	
Max baud rate	19.2k
Start bit	1
Stop bit	2
Parity	none
Data	8

EMERSON Motion Control' s Motion Interface panels are supplied with a Modbus master communications driver.




---

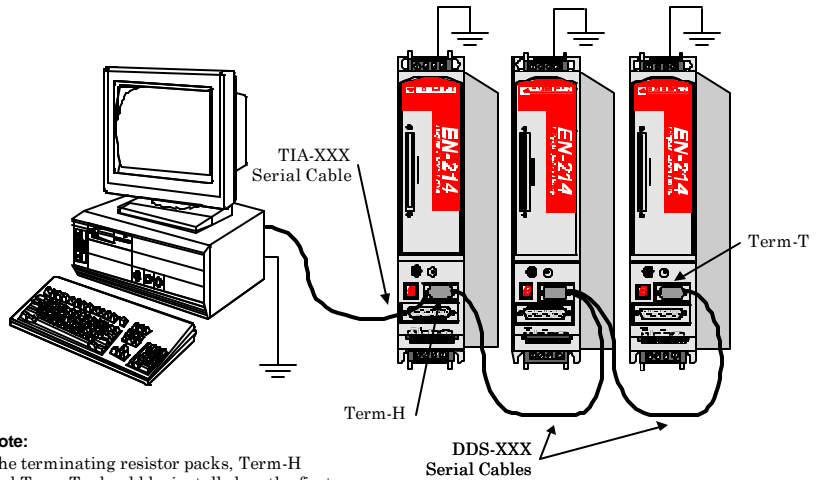
### Note

Refer to the Modbus Interface section of this manual for additional details on Modbus communications.

---

## Multi-Drop Communications

The RS-485 option (pins 4 and 9) is provided for multi-drop configurations of up to 32 FM-1 and drive systems. EMERSON Motion Control provides a special multi-drop serial cable which allows you to easily connect two or more E Series drives.



**Note:**  
 The terminating resistor packs, Term-H and Term-T, should be installed on the first (Term-H) and last (Term-T) E Series drives in the string if the total cable length is over 50 feet.

*Figure 22: Multi-Drop Wiring Diagram*



# Diagnostics and Troubleshooting






## Overview





This section provides you with guidelines and hints on troubleshooting various problems that may be encountered during setup and operation of your E Series drive and FM-1. Specifically, it includes:

- Diagnostic Display
- Fault Codes
- Diagnostics Output Test Points
- Error Messages
- Drive Faults
- Control Panel
- Troubleshooting

## Diagnostic Display

The diagnostic display on the front of the E Series drive shows drive and FM-1 status and fault codes. When a fault condition occurs, the drive will display the fault code, overriding the status code. The decimal point is “On” when the drive is enabled and the stop input is not active. This indicates that the drive is ready to run and will respond to motion commands. Commands will not cause motion unless the decimal point is “On”.

Display Indication	Status	Description
	Brake Engaged (Output "Off")	Motor brake is mechanically engaged. this character will only appear if the Brake Output function is assigned to an output line.
	Disabled	Power Stage is disabled
	Position	Waiting for command (Pulse mode)
	Velocity	Velocity mode operation
	Torque	Torque mode operation

Display Indication	Status	Description
	Summation	Summation mode operation
	RMS Foldback	Motor torque is limited to 80%
	Stall Foldback	Drive output current is limited to 80% of drive stall current
	Ready to Run	Drive enabled, no Stop input.

## Fault Codes








A number of diagnostic and fault detection circuits are incorporated to protect the drive. Some faults, like high DC bus and amplifier or motor over temperature, can be reset with the Reset/Setup button on the front of the E Series drive or the Reset input function. Other faults, such as encoder faults, can only be reset by cycling power “Off” (wait until the diagnostics display turns “Off”), then power “On”.

The drive accurately tracks motor position during fault conditions. For example, if there is a "Low DC Bus" fault where the power stage is disabled, the drive will continue to track the motor's position provided the logic power is not interrupted.

The +/- Limit faults are automatically cleared when the fault condition is removed. The table below lists all the fault codes in


## FM-1 Speed Module Installation Manual

priority order from highest to lowest. This means that if two faults are active, only the higher priority fault will be displayed.

Display	Fault	Action to Reset	Bridge Disabled
	Flash Invalid	Reprogram the FM-1 Flash	Yes
	Watchdog timer	Button or Input	Yes
	Power-up self test failure	Power	Yes
	Non-volatile memory invalid	Button or Input	Yes
	Invalid configuration	Button or Input	Yes
	Power module fault	Button or Input	Yes
	High DC bus fault	Button or Input	Yes



Display	Fault	Action to Reset	Bridge Disabled
U	Low DC bus fault	Button or Input	Yes
E	Encoder State	Power	Yes
E	Encoder line fault	Power	Yes
M	Motor over temperature fault	Button or Input	Yes
N	RMS shunt power fault	Button or Input	Yes
O	Over speed fault	Button or Input	Yes
F	Following error fault (position mode)	Button or Input	Yes
L	+/- Travel Limit	Auto	No

Display	Fault	Action to Reset	Bridge Disabled
	All "On"	Normally on for one second during power up	Yes

## Fault Descriptions



### Firmware Checksum

This fault indicates that the Firmware Checksum has failed. Use the Tools | Program Flash menu item from PowerTools to reprogram/upgrade the firmware stored in flash memory. If this problem persists, call EMERSON Motion Control. A common cause would be an interrupted F/W Flash upgrade (cable disconnected in the middle of an upgrade process).



### Watchdog Timer

The watchdog timer ensures that the firmware is operating normally. If the firmware fails to reset this timer every 10 ms, the drive hardware will be reset, all inputs and outputs will be cleared ("Off"), and a Watchdog Timer fault is generated.



### Power-Up Self-Test Failure

This fault indicates that the power-up self-test has failed. This fault cannot be reset with the reset command or reset button.



### Non-volatile Memory Invalid

At power-up the drive tests the integrity of the non-volatile memory. This fault is generated if the contents of the non-volatile memory are invalid.



## Invalid Configuration

---

The FM was not on this drive during its previous power-up and it is not known if the setup data in the FM matches the drive and motor to which the FM is now attached.

This can also happen when a FM is removed from a drive and the drive is powered-up.

To reset the fault, create or open a configuration file with the correct drive and motor selections and download the configuration to the FM or drive. If you are certain that the setup data in the FM or drive matches the system configuration, press and hold the E Series drive's Reset button for 10 seconds (until the fault is cleared).



---

## Caution

Damage may occur to the drive, motor or both if the fault is cleared using the Reset button when the setup data in the FM does not match the current drive and motor.

---



## Power Stage Fault

---

This fault is generated when a power stage over-temperature, over-current or loss of power stage logic supply occurs. This can be the result of a motor short to ground, a short in the motor windings, a motor cable short or the failure of a switching transistor.

It can also occur if the drive enable input is cycled "Off" and "On" rapidly (>10 Hz).



### **High DC Bus Fault**

---

This fault will occur whenever the voltage on the DC bus exceeds 440 VDC. The most likely cause of this fault would be an open shunt fuse, a high AC line condition or an application that requires an external shunt (e.g., a large load with rapid deceleration).



### **Low DC Bus Fault**

---

This fault will occur whenever the voltage on the DC bus drops below 96 volts. The most likely cause of this fault is a reduction (or loss) of AC power. A 50 ms debounce time is used with this fault to avoid faults caused by intermittent power disruption.



### **Encoder State**

---

Certain encoder states and state transitions are invalid and will cause the drive to report an encoder state fault. This is usually the result of noisy encoder feedback caused by poor shielding.



### **Encoder Line Fault**

---

If any pair of encoder lines are in the same state, an encoder line fault is generated. The most likely cause is a missing or bad encoder connection.



### **Motor Over Temperature Fault**

---

This fault is generated when the motor thermal switch is open due to motor over-temperature or incorrect wiring.



---

**RMS Shunt Power Fault**

---

This fault is generated when RMS shunt power dissipation is greater than the design rating of the internal shunt.



---

**Over Speed Fault**

---

This fault occurs in one of two circumstances:

1. When the actual motor speed exceeds the Overspeed Velocity Limit parameter. This parameter can be accessed with PowerTools software.
2. If the combination of command pulse frequency and Pulse Ratio can generate a motor command speed in excess of the fixed limit of 13000 RPM, an Overspeed Fault will be activated. In Pulse Mode operation and any Summation mode which uses Pulse Mode, the input pulse command frequency is monitored and this calculation is made. For example: with a Pulse Ratio of 10 pulses per motor revolution, the first pulse received will cause an Overspeed fault even before there is any motor motion.



---

**Following Error Fault**

---

This fault is generated when the following error exceeds the following error limit (default following error limit is .2 revs). With PowerTools you can change the Following Error Limit value on disable in the Position tab.



---

**+/- Limit**

---

This fault is caused when either the + or - Travel Limit input function is active.

---

**RMS Foldback**

---

The motor loading has exceeded its design capacity as indicated by the Foldback RMS value reaching 100 percent. This causes the available drive current to be reduced to 80 percent. When the loading is reduced for long enough that the Foldback RMS value drops to 70 percent, full drive current will once again be available.

---

**Stall Foldback**

---

The motor has stalled (<100 RPM) and is requiring current of more than the stall design of the drive for longer than 100 ms. The drive current is limited to 80% of the drive stall capacity until the loading is reduced or the motor turns at faster than 100 RPM.

---

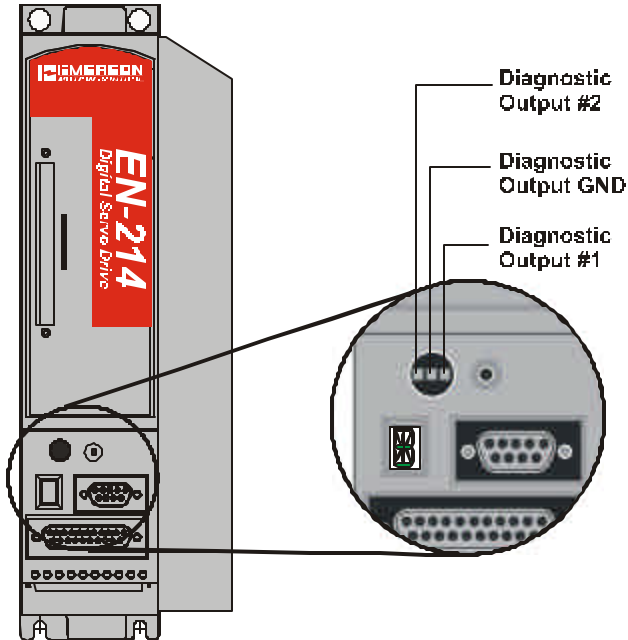
**All "On"**

---

This is a normal condition during power up of the drive. It will last for less than 1 second. If this display persists, call EMERSON for service advice.

# Diagnostic Output Test Points

The DGNE cable was designed to be use with either an oscilloscope or a meter. The wires are different lengths to avoid shorting to each other. However, if signals do get shorted to GND, the drive will not be damaged because the circuitry is protected.



*Figure 23: Diagnostic Output Test Points*

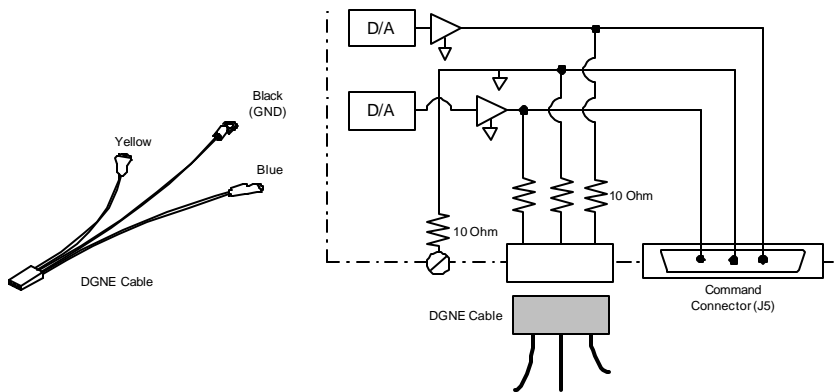


Figure 24: Diagnostic Cable (DGNE) Diagram

## Error Messages

PowerTools-FM will pop-up an error message box to alert you to any errors it encounters. These message boxes will describe the error and offer a possible solution.

## Drive Faults

The Active Drive Faults dialog box is automatically displayed whenever a fault occurs. There are two options in this dialog box: Reset Faults and Ignore Faults.

## Resetting Faults

Some drive faults are automatically reset when the fault condition is cleared. Others require drive power to be cycled or the drive to be “rebooted” to be cleared. If you wish to continue



working in the PowerTools-FM software without resetting the fault, click the Ignore Fault button.

To reset faults that can be reset with the Reset Faults button, simply click the Reset Faults button in the Drive Faults Detected dialog box or push the Reset Faults button on the front of the drive where the fault occurred.

### **Viewing Active Drive Faults**

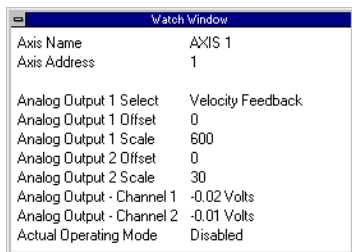
To view all active drive faults, select the View Faults command from the Device pull-down menu. The dialog box that is displayed is the same as Active Drive Faults dialog box described above.

### **Rebooting the Drive**

To reboot the drive, select the Reboot Drive command from the Device pull-down menu. This command reboots the drive attached to the active Configuration Window.

### **Watch Window**

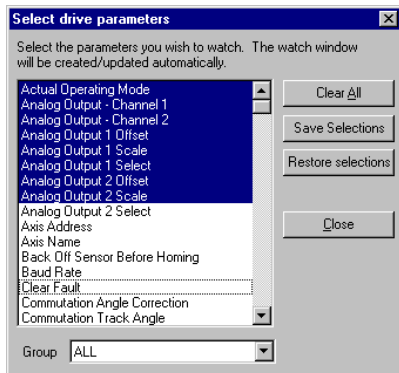
This feature allows you to customize a window to monitor drive parameters which you select from a complete list of drive parameters. From this window you can watch the parameters you selected in real time. This feature is only available when you are online with the drive.



*Figure 25: Watch Window*

The Watch Window is accessed by selecting Watch Drive Parameters from the Tools pull-down menu or by clicking on the Watch Window icon on the toolbar.

The Watch Window will automatically appear as soon as you select a parameter from the Select drive parameters dialog box. After you have selected the parameters you wish to watch, click the close button. The Select drive parameters dialog box will close and the Watch Window will remain open.



*Figure 26: Select Drive Parameters Dialog Box*

## Group

This list box enables you to view the complete list of parameters or just a group of parameters you are interested in. The groups include:

Analog Out	Fault Log	Setup
Communication	Home	Status
Digital Inputs	ID	Torque
Digital Outputs	Index	Tuning
Execution	Motor	User Def Motor
Fault Counts	Position	Velocity

---

### Clear All Button

---

This button is used to clear all the parameter selections that were previously selected.

---

### Save Selections Button

---

This button saves the parameter selections. This enables you to restore the same list of parameters for use in future online sessions.

---

### Restore Selections Button

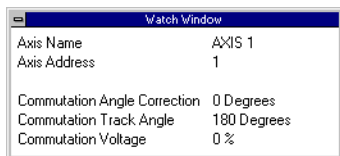
---

This button restores the parameter selections previously saved. This enables you to restore the list of parameters you created in a previous online session.

## View Motor Parameters

When online with the drive this feature allows you to display a pre-defined Watch Window to monitor three motor parameters.

These parameters are normally used when testing the setup of a User Defined Motor for commutation accuracy.



*Figure 27: View Motor Parameters Window*

The View Motor parameters Window is accessed by selecting View Motor Parameters from the Tools pull-down menu.

## Troubleshooting

The table below list the of common problems you might encounter when working with PowerTools-FM software along with the error message displayed, the most likely cause and solution.

Problem/Message	Cause	Solution
Time-out while waiting for device response. The attempted operation has been cancelled.	Loss of serial communications.	Check the serial connection to the device and try operation again.
The attached device(s) do not have valid revisions, or do not have matching revisions.	Attempting to broadcast to drive without matching firmware revisions.	Program each drive individually.
Unable to communicate with device [Address x]	The device that you are attempting to communicate with is no longer available.	Check all connections and verify that you are using the correct baud rate then try again.
The specified drive type (name) does not match the actual drive type (name). Please make necessary corrections.	The drive type you selected in the " Drive Type" list box does not match the drive you are downloading to.	Change the drive type selected in the " Drive Type" list box to match the drive you are downloading to.

## Diagnostics and Troubleshooting

Problem/Message	Cause	Solution
Non-EMERSON device attached (address). When trying to program more than one drive, only EMC drives of the same type can be attached to the network.	This error is caused When you attempting to perform an upload or download to multiple drives and one or more of the drives are not the same type.	Disconnect the device(s) that has been specified and try the operation again.
You have changed a parameter which will not take affect until the drive has been rebooted. Before you reboot the drive, you will need to save your setup to NVM. Do you wish to save your setup to drive NVM now?	See message.	Yes/No.
(Operation Name) The attempted operation has been cancelled.	Communication error.	Retry operation. Check connection to drive.
Invalid entry. The entry exceeds the precision allowed by this field. The finest resolution this field accepts is (value).	Entered a value out of range.	Enter a value within the range of that field. The status bar displays information on the currently selected object or action.
The device was disconnected during the upload. The upload was not complete.	Connection to the device was lost (a time-out occurred).	Check the connection to the device and try again.
The device was disconnected during the download. The download was not complete.	Connection to the device was lost (a time-out occurred).	Check the connection to the device and try again.



# Specifications

## Overview

This chapter describes the general specifications of the FM-1. Specifically, it includes:

- Electrical Specifications
- Dimensions and Clearances
- Cables
- Vendor Contacts

## Electrical Specifications

Power consumption: 5 W from E Series drive power supply.

Function	Electrical Characteristics
Inputs	10-30 Volts ("On") 0-3 Volts ("Off") optically isolated
Outputs	10-30 Volts DC sourcing 150 mA, optically isolated

# Dimensions and Clearances

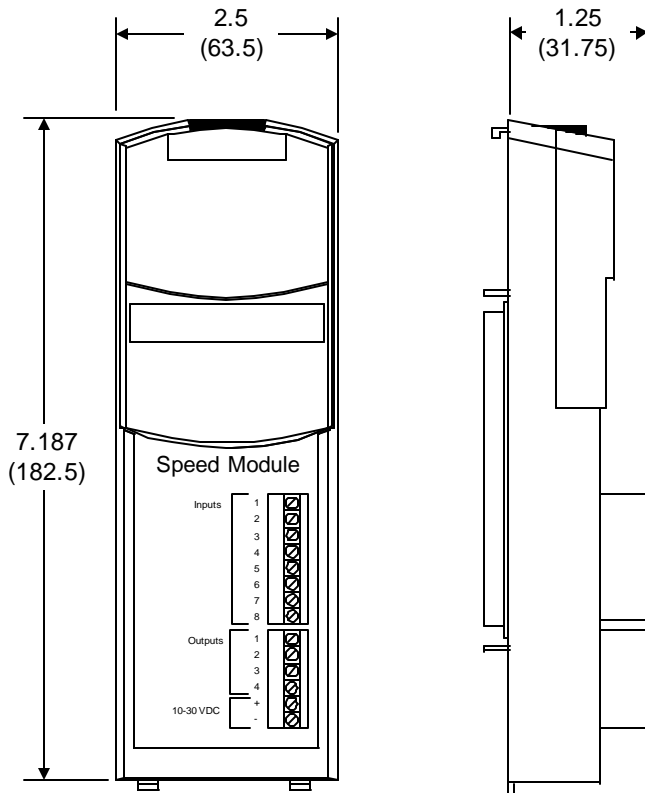


Figure 28: FM-1 Dimensions





# Cables

## CDRO-XXX

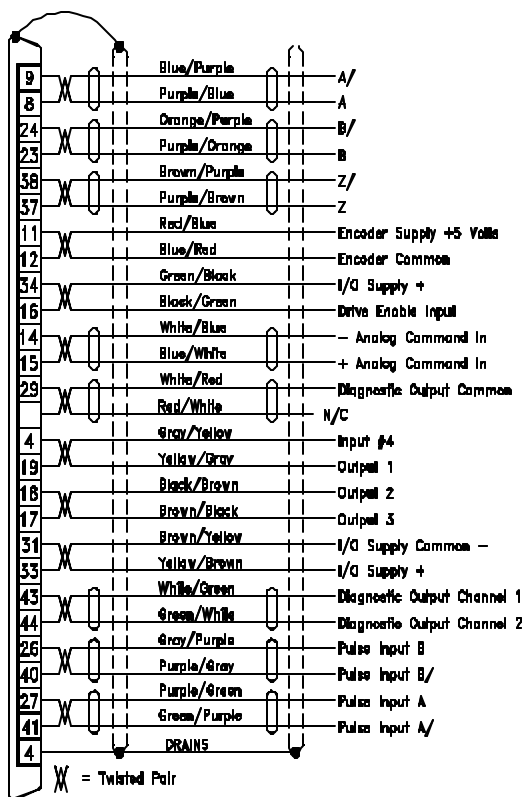


Figure 30: CDRO Cable Pinouts

## CMDO-XXX

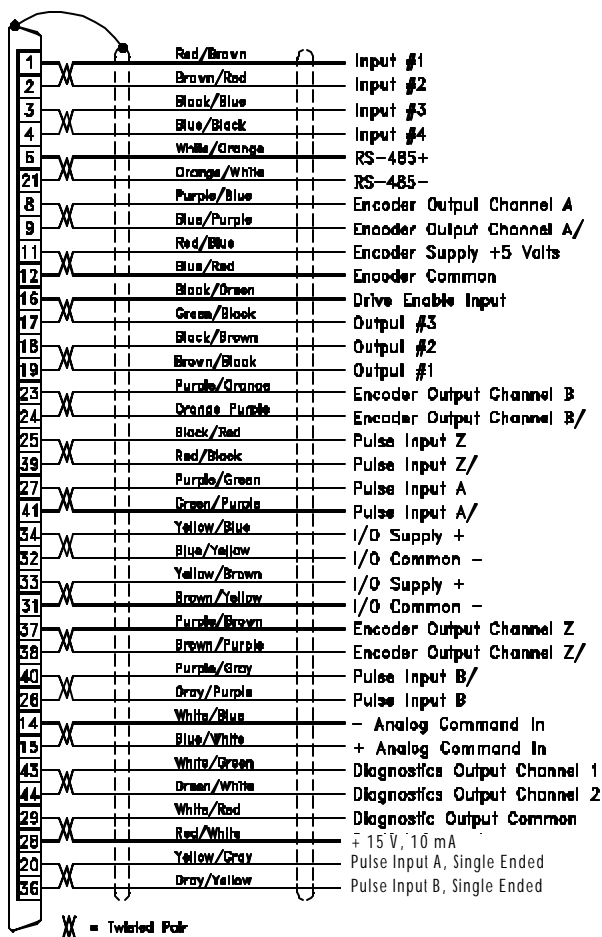


Figure 31: CMDO Cable Pinouts

## Vendor Contacts

### **AC line filters**

Schaffner

(800) 367-5566 or (201) 379-7778

Corcom

(847) 680-7400

Fax: (847) 680-8169

### **Cable shield grommets**

Cooper Industries, Inc.

Crouse-Hinds Division

(315) 477-5531

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