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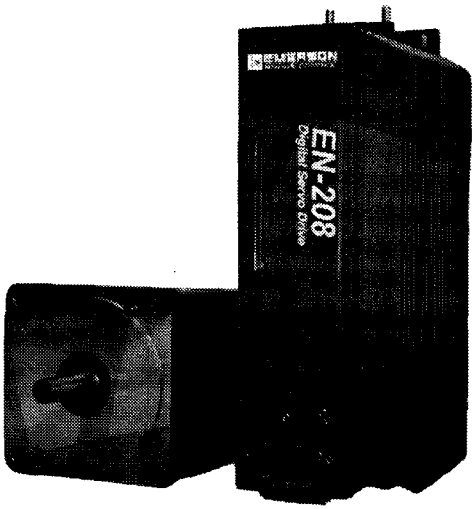
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E Series Drives Basic Installation Manual



EMERSON
MOTION CONTROL

E Series Drives Basic Installation Manual



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Customer Services:

EMERSON Motion Control offers a wide range of services to support our customers' needs. Listed below are some examples of these services.

Service Support (612)-474-8833

EMERSON Motion Control's products are backed by a team of professionals who will service your installation wherever it may be. Our customer service center in Minneapolis Minnesota is ready to help you solve those occasional problems over the telephone. Our customer service center is available 24 hours a day for emergency service to help speed any problem solving. Also, all hardware replacement parts, should they ever be needed, are available through our customer service organization.

Need on-site help? EMERSON Motion Control provides on-site service, in most cases, the next day. Just call our customer service center when on-site service or maintenance is required.

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

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

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Software updates can be obtained from the EMERSON BBS. 300 - 28,800 Baud, N, 8, 1.

EMERSON Internet Website

www.emersonemc.com

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 degrees C 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.

Declaration of Conformity

Manufacturer's Name:	EMERSON Motion Control
Manufacturer's Address:	1365 Park Road Chanhassen, MN 55317 USA

Declares That The Following Products:

Products Description:	E Series Digital Servo Drive
Model Number:	EN-204, EN 208, EN-214
System Options:	This declaration covers the above products with the ALP-130 Backup Logic Power Supply and ECI-44 Screw Terminal Interface.

Designed and manufactured in accordance with the following European harmonized national and international standards.

Electomagnetic 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

Supplementary Information

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.

Bradley Schwartz

December 2, 1997

Bradley Schwartz/ VP Engineering — *Date*

European Contact — Sobetra Automation
Langeveldpark Lot 10
P. Dasterleussraat 2
1600 St. Pieters leeuw, Belgium

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Introduction

Product Overview

An E Series Digital Servo System consists of an EN Brushless Servo Drive, an MG (Magna series) Brushless Servo Motor and connecting cables. Each E Series Drive is compatible with up to three different MG motors depending on the drive model.

Velocity, torque and position of an E Series Drive can be controlled by an external controller. The control signals may be analog voltage, pulse train (CW & CCW), pulse train and direction or quadrature pulses.

There are three Digital Servo Drive models in the E Series: The EN-204, which supplies 4.5 ARMS, the EN-208, which supplies 9.0 ARMS and the EN-214, which supplies 13.0 ARMS.

The only mechanical difference between the three E Series Drive models is the heatsink size. The mounting footprint is the same for all three models.

Manual Overview

This manual is intended for people who are experienced with servo drives and want to quickly get their E Series Drive installed and set up on their system. This manual does not cover EMC's PowerTools software which is available separately from Emerson Motion Control by calling (612) 474-1116.

Operating Modes

You can set up your E Series Drive to operate in the following operating modes using the Quick Touch Setup method:

- Analog Command Mode (±10VDC = ± maximum velocity or ± peak torque) with six possible setup combinations.
- Pulse Follower Mode (pulse and direction at 8192 pulses/revolution).

The operating mode is selected using the Reset/Setup button to choose one of seven pre-defined setups (this is referred to as the "Quick Touch Setup" in this manual).

The following operating modes are also available but require Emerson Motion Control's PowerTools software:

- Velocity Preset Mode (four defined velocity presets)
- Summation Mode (Sumation of analog command and Velocity Presets)
- Pulse Follower Mode (Pulse/Pulse)
- Pulse Follower Mode (Quadrature)

EN Drive Features

- Digital drive design using DSP, ASIC and surface mount technologies
- 90 to 264 VAC input power
- Quick Touch Setup
- Small mounting footprint
- Auxiliary logic power supply option
- Internal shunt resistor with option for external shunt
- 5 optically isolated inputs and 3 optically isolated outputs
- Built-in RS-232 to RS-485 converter for multi-drop applications
- RS-232/485 serial communications interface using industry standard Modbus™ protocol up to 19.2 kbaud
- Diagnostic and operating mode display
- Extensive fault sensing and diagnostics including storage and time stamping of the last 10 faults
- 500 µs maximum input response time for command and input functions
- Peak torque up to 3 times continuous torque rating
- Sinusoidal commutation for efficiency and smooth motion
- Smooth velocity regulation
- No potentiometers or selector switches
- No tuning needed for no-load to 10:1 inertia mismatch
- High performance tuning based on inertia, friction and response with PowerTools Software (available separately)
- High resolution encoder
- Four velocity presets
- Programmable pulse follower ratio
- Removable connectors for easy installation
- Single cable connection to Emerson Motion Control's AXIMA 2000 and 4000 multi-axis controller

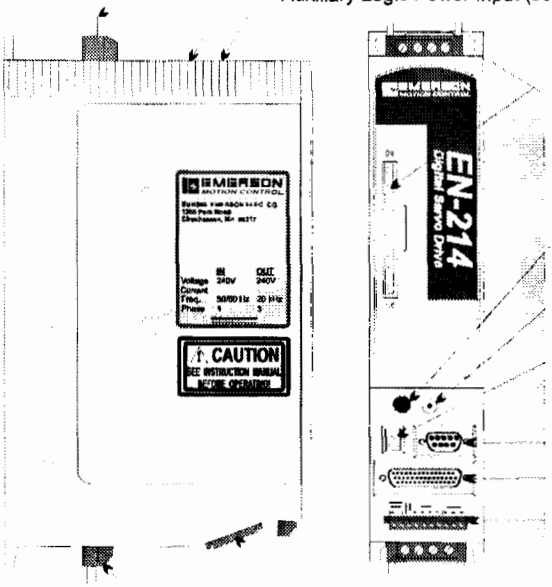


Figure 1 *EN Drive Hardware Features*

⚠ WARNING

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 2 minutes 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 in this case 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.

Installation

Safety Precautions

The EN Drive is intended for professional incorporation into a complete system. If you install the drive incorrectly, it may present a safety hazard. The product uses high voltages and currents, carries a high level of stored electrical energy, and 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

The EN Drive is intended to be mounted in an enclosure which prevents access except by trained and authorized personnel, and which prevents the ingress of contamination. The EN Drive 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.

Setting Up, 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 EN Drive hardware and software are designed and tested to a high standard, and failures are very unlikely. However the level of integrity offered by the EN Drive control functions – for example, run/stop and maximum speed limit – 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.

Electromagnetic Compatibility (EMC)

The EN Drive is designed to high standards of EMC. Under extreme conditions the EN Drive might cause or suffer from disturbance due to electromagnetic interaction with other equipment. It is the responsibility of the installer to ensure that the equipment or system into which the EN Drive is incorporated complies with the relevant EMC legislation in the country of use.

The following instructions provide you with installation guidance designed to help you meet the requirements of the EMC Directive 89/336/EEC.

Although Emerson Motion Control cannot guarantee your system will meet tested emission or immunity requirements, adhering to the following guidelines will greatly improve the electromagnetic compatibility of your system.

- Choose an enclosure made of a conductive material such as steel, aluminum or stainless steel.
- Devices mounted to the enclosure mounting plate, which depend on their mounting surfaces for grounding, must have the paint removed from their mounting surfaces and the mating area on the mounting plate to ensure a good ground.
- If grounding is required for cable grommets, connectors and/or conduit fittings at locations where cables are mounted through the enclosure wall, paint must be removed from the enclosure surface at the contact points.
- AC line filter input and output wires and cables should be shielded, and all shields must be grounded to the enclosure.

Although final responsibility for EMC compliance rest with the machine builder, we are including the following installation suggestions. They describe the components that were used and how they were installed during the EMC compliance testing.

If you need to meet EMC compliance requirements, EMI/RFI line filters must be used to control conducted and radiated emissions as well as improve conducted immunity.

Physical location of these filters is very important in achieving these benefits. The filter output wires should be kept as short as possible (12" suggested) and routed away from the filter input wires.

Achieving Low Impedance Connections

Immunity can be improved and emissions reduced by maintaining the components of the installation at the same ground potential. Establishing zero potential difference between components requires a low impedance connection between the components.

This can be achieved by bringing the conductive surfaces of the components into direct contact. Over the short term this can be very effective. Over an extended period of time, degradation of the connection may occur due to corrosion. Corrosion can occur when a material reacts with the atmosphere or when two dissimilar materials react with each other. Therefore component materials should be conductive, compatible and exhibit good atmospheric corrosion resistance.

Bringing components into direct contact cannot always be achieved. In these situations a conductor must be relied upon to provide a low impedance path between components. The impedance of the conductor is dependent on conductivity and frequency. Conductors that provide a low impedance path at low frequencies may not provide a low impedance path at higher frequencies.

A good rule of thumb to follow when specifying conductors for high frequency applications is to use a metal strap with a length to width ratio that is less than 3:1.

A low impedance connection should exists between the following components, but not limited to:

- Enclosure and mounting plate
- Servo amplifier chassis and mounting plate
- EMI/RFI AC line filter chassis and mounting plate
- Other interface equipment chassis and mounting plate
- Other interface equipment chassis and electrical connectors
- Enclosure and conduit fittings or electrical connectors
- Enclosure mounting plate and earth ground
- Motor chassis and conduit fittings or electrical connectors
- Encoder chassis and electrical connector

Note: It is critical that you keep the filter inputs routed away from any electrical noise sources to prevent noise from being induced into them and carried out of the enclosure.

The AC line filters used during Emerson's compliance testing are listed below. These filters are capable of supplying the drive input power to the specified drive under maximum output power conditions.

Table 1 Filter Part Numbers

Drive	Schaffner Part #	Emerson Part #
EN-204	FN-2070-16*	960305-01
EN-208	FN-2070-16	960305-01
EN-214	FN-258-16	960304-01

* Filters rated for lower current are available from Schaffner®, such as FN-2070-10 (10 amps), but have not been tested by Emerson.

To contact Schaffner, see vendor contacts on page 69.

Note: EMC criteria cab be met in installations where multiple drives are supplied through a single filter, however, it is the installers responsibility to verify EMC compliance. Questions on this subject should be directed to the filter manufacturer.

Note: The filter characteristics of most three phase line filters will suffer if the phase to phase loading is unbalanced.

Shielded motor, feedback, serial communications and external encoder cables were used for Emerson's compliance testing and are necessary to meet the EMC requirements. Each cable shield was grounded at the enclosure wall by the type of grommet described earlier and shown in the figure below.

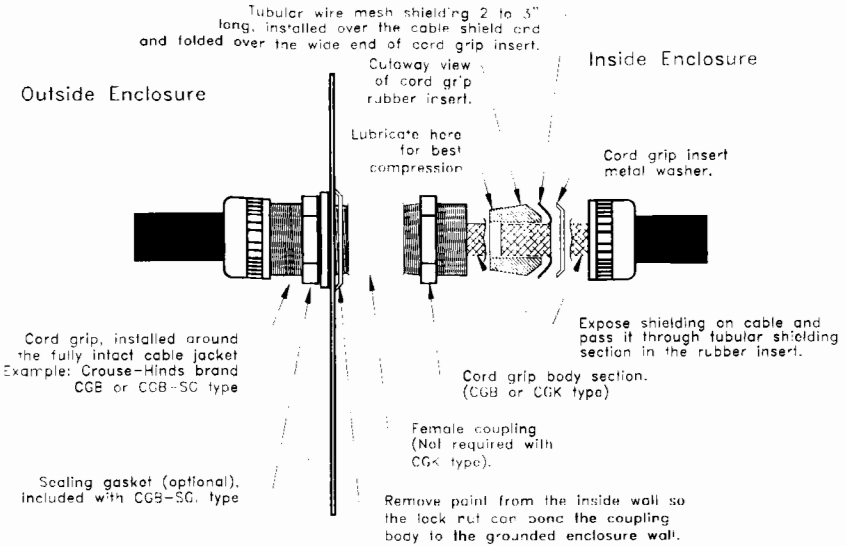


Figure 2 *Through Wall Shield Grommet*

Table 1 *Grommet Part Numbers*

Cable Type	Emerson Cable Model	Shielded Cable Grommet Kit Part #
Motor Cable, 16 Ga	CMDS	CGS-050
Motor Cable, 12 Ga	CMMS	CGS-038
Feedback Cable	CFOS	CGS-038
Flex Motor Cable, 16 Ga	CMDF	CGS-050
Flex Motor Cable, 12 Ga	CMMF	CGS-063
Flex Feedback Cable	CFEF	CGS-075
External Encoder	ENCO	CGS-038
AC Power	user supplied	user supplied

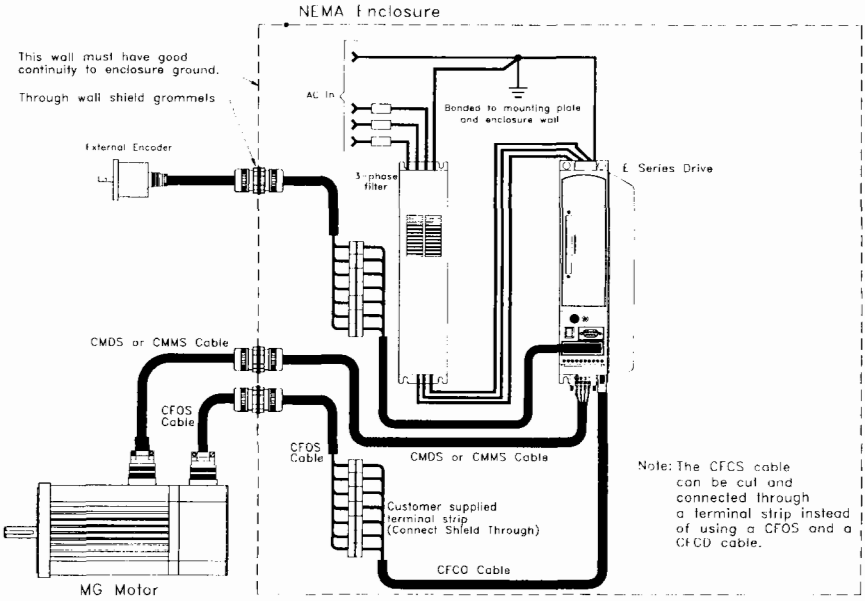


Figure 3 *AC Filter and Cable Connections*

Environmental Considerations

If your EN Drive 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 or equivalent enclosure as a minimum.

If the ambient temperature inside the enclosure will exceed 104° F (40° C), you must consider supplementary cooling.

⚠ CAUTION

Failure to maintain the ambient temperature within allowable specifications will result in reduced product life and/or erratic or dangerous operation.

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. Consult your enclosure manufacture for application details.

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.

- To avoid problems associated with EMI (electromagnetic interference), you should route high power lines (AC 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.
- The minimum cable bend radius is ten times the cable outer diameter.
- Ground wires should not be shared with other equipment. 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 RC networks.

Typical Installation

The figure below shows a typical installation using an Emerson Motion Control AXIMA 4000 Multi-axis Controller, three EN Drives and an Emerson Motion Control Motion Interface Panel.

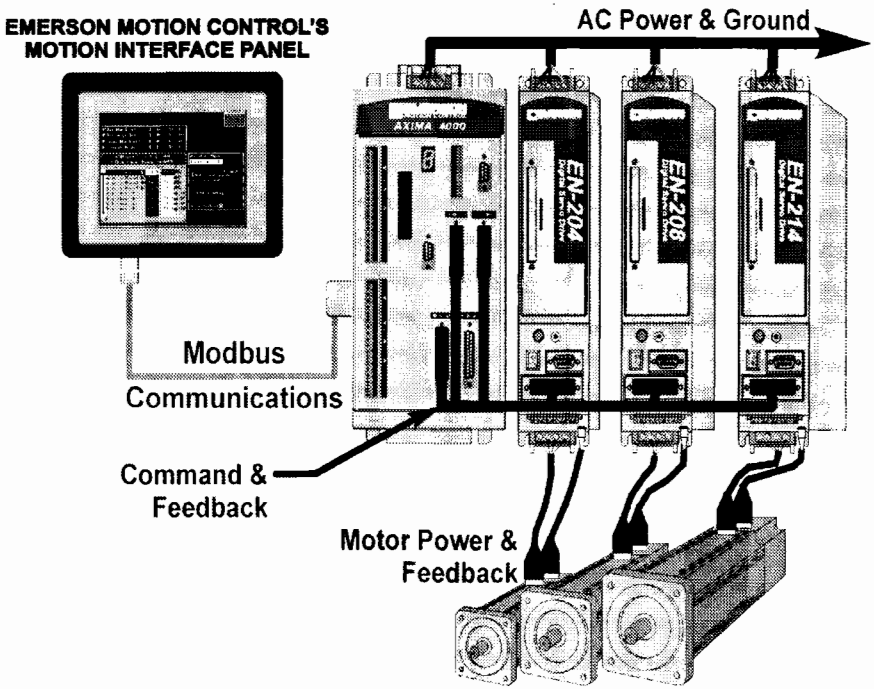


Figure 4 *Typical Installation*

Overview of Cables

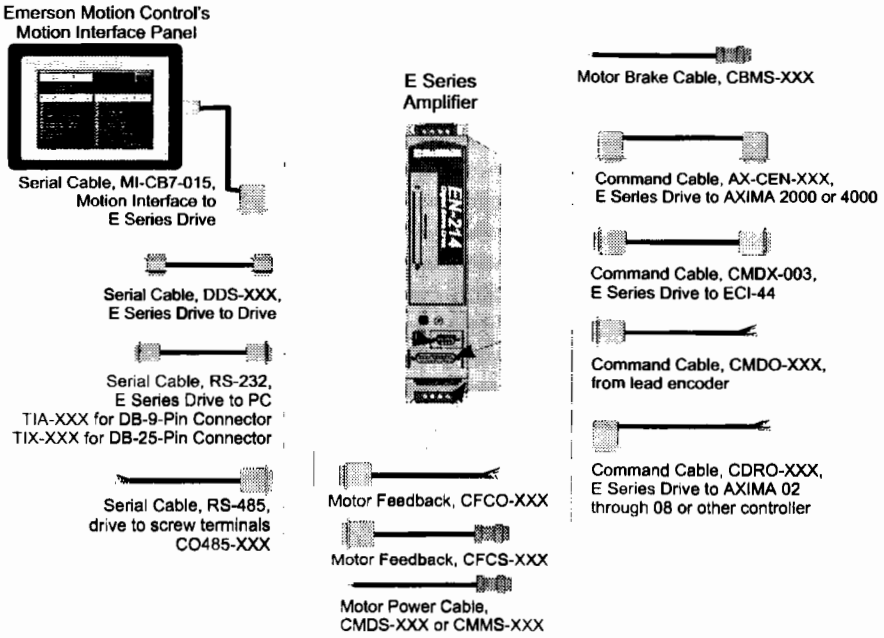
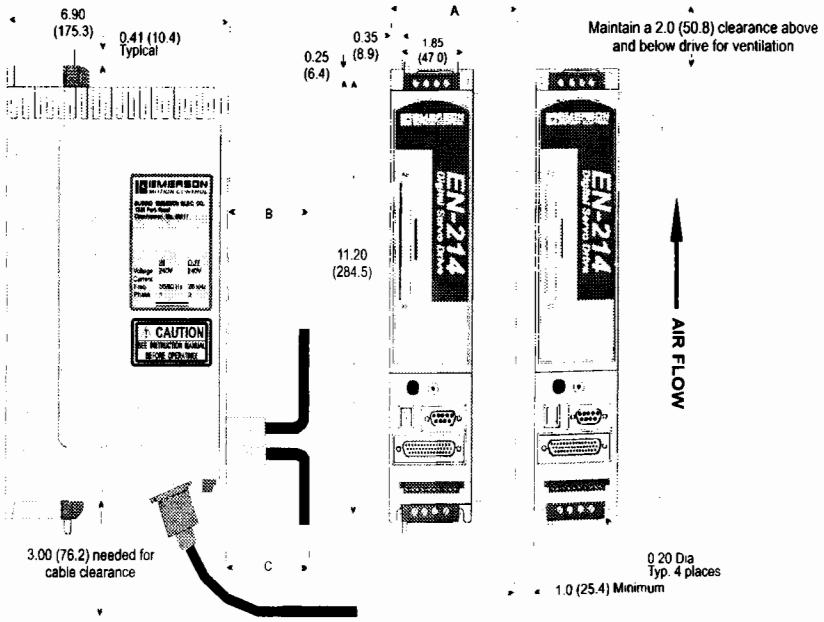


Figure 5 Overview Of Cables

Mechanical Installation

Drive Mounting

EN Drives must be back mounted vertically on a metal surface such as a NEMA enclosure. A minimum spacing of two inches must be maintained above and below the EN Drive for ventilation. Additional space may be necessary for wiring and cable connections.



Dimensions in ( ) are millimeters

Model	A
EN-204	2.93 (74.4)
EN-205	3.43 (87.1)
EN-214	3.93 (99.8)

Model	B	C	
All Drive Models	TIA Cable CO485-XXX	CMDX CMDO	AX-CEN CDRO
	2.5 (63.5)	3.5 (88.9)	1.75 (44.5)

Figure 6 Drive Mounting Diagram

Motor Mounting

Motors should be mounted with the connectors pointed downward to provide added protection against dust and water damage.

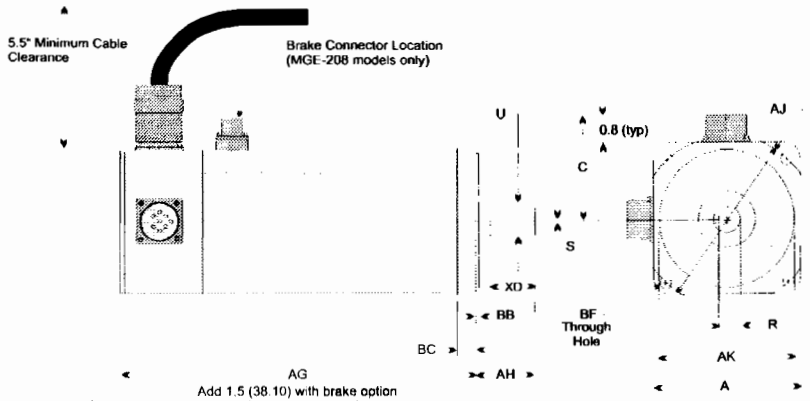


Figure 7 MGE-205 and 208 Dimensions

MGE-205 and 208 Mounting Dimensions Inches (mm)

	AG	A	BC	AH	U Max	XD	S Min	R	C Max	AJ	BB	AK	BF
205	5.60 (143.0)	2.25 (57.2)	.46 (11.2)	1.20 (30.5)	.375 (9.525)	.563 (14.3)	1.27 (3.23)	.563 (14.30)	2.0 (2.00)	2.625 (66.68)	.063 (1.60)	1.502 (38.15)	.205 (5.21)
208	6.75 (171.4)	2.25 (57.2)	.46 (11.2)	1.20 (30.5)	.375 (9.525)	.563 (14.3)	1.27 (3.23)	.563 (14.30)	2.0 (2.00)	2.625 (66.68)	.063 (1.60)	1.502 (38.15)	.205 (5.21)

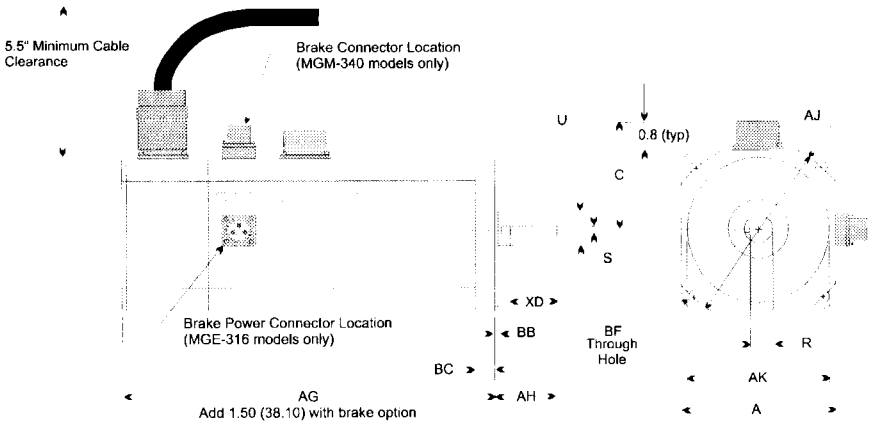


Figure 8 MGE-316 and MGM-340 Dimensions

MGE-316 and MGM-340 Mounting Dimensions inches (mm)

	AG	A	BC	AH	U Max	XD	S Min	R	C Max	AJ	BB	AK	BF
316	7.24 (184.0)	3.31 (84.0)	.44 (11.2)	1.21 (30.7)	.4997 (12.69)	.90 (22.9)	.1265 (3.213)	.42 (10.7)	2.50 (64.0)	3.875 (98.43)	.06 (1.600)	2.877 (73.08)	.233 (66.0)
340	10.24 (260.1)	3.50 (89.0)	.44 (11.2)	1.20 (30.6)	.5512 (14.000)	.787 (20.0)	.197 (5.00)	.429 (10.90)	2.50 (64.0)	3.937 (100.00)	.118 (3.00)	3.150 (80.01)	.276 (7.01)

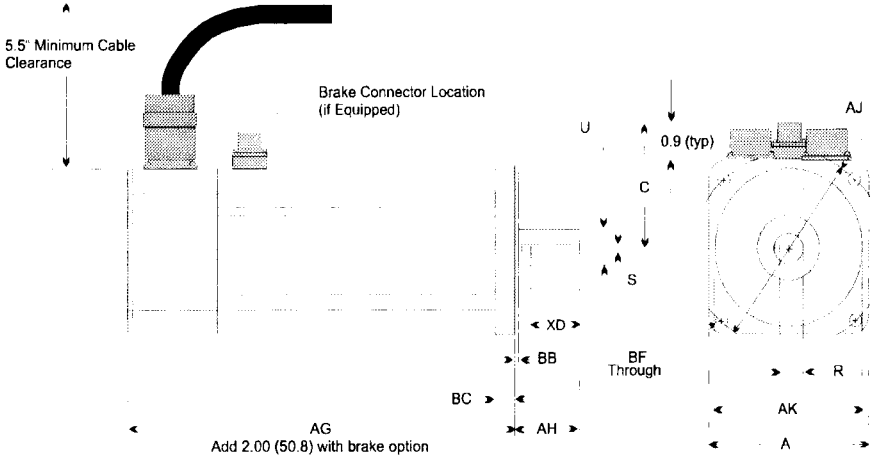


Figure 9 MGE/M-455, 490 and 4120 Dimensions

MGE-455, 490 and 4120 Mounting Dimensions inches (mm)

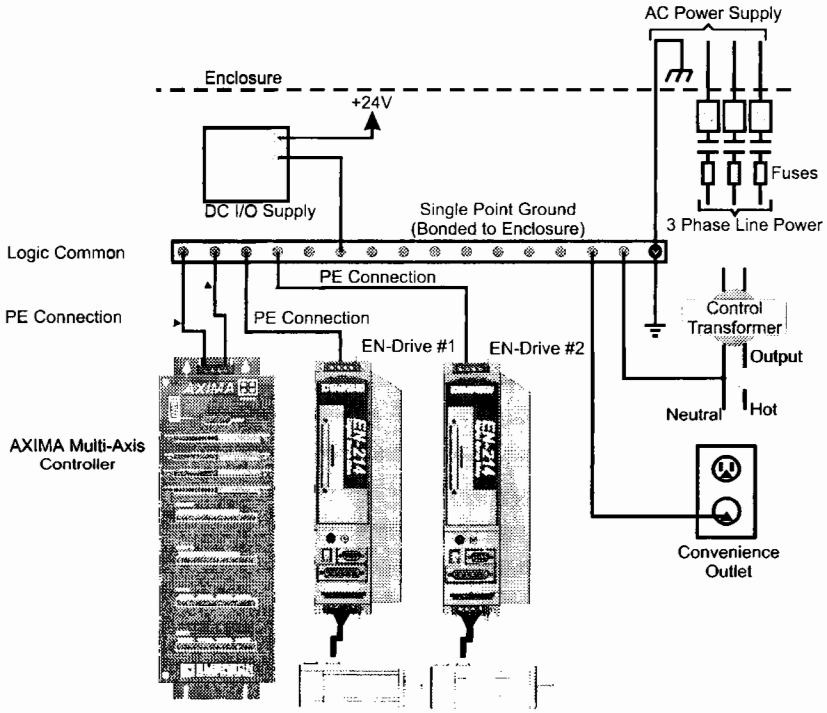
	AG	A	BC	AH	U Max	XD	S Min	R	C Max	AJ	BB	AK	BF
455	8.61 (218.7)	5.00 (127.0)	.53 (13.5)	190 (48.2)	.6245 (15.862)	1.50 (38.1)	.1875 (4.763)	.51 (13.0)	3.20 (81.3)	5.875 (149.23)	.10 (2.50)	4.500 (114.30)	3/8-16 UNC
490	11.11 (282.10)	5.00 (127.0)	.53 (13.5)	190 (48.2)	.8750 (22.225)	1.50 (38.1)	.1875 (4.763)	.77 (19.6)	3.20 (81.3)	5.875 (149.23)	.10 (2.50)	4.500 (114.30)	3/8-16 UNC
4120	13.61 (345.70)	5.00 (127.0)	.53 (13.5)	190 (48.2)	.8750 (22.225)	1.50 (38.1)	.1875 (4.763)	.77 (19.6)	3.20 (81.3)	5.875 (149.23)	.10 (2.50)	4.500 (114.30)	3/8-16 UNC

MGM-455, 490 and 4120 Mounting Dimensions mm (inches)

	AG	A	BC	AH	U Max	XD	S Min	R	C Max	AJ	BB	AK	BF
455	216.0 (8.59)	121.0 (4.764)	13.0 (.51)	50.5 (1.99)	19.000 (.7480)	40.0 (1.58)	6.00 (.236)	15.5 (.61)	70.3 (2.77)	145.00 (5.709)	3.00 (.118)	110.10 (4.331)	10.00 (.394)
490	281.7 (11.09)	121.0 (4.764)	13.0 (.51)	50.5 (1.99)	24.000 (9.449)	37.1 (1.46)	7.963 (.3135)	19.9 (.78)	70.3 (2.77)	145.00 (5.709)	3.00 (.118)	110.10 (4.331)	10.00 (.394)
4120	343.1 (13.59)	121.0 (4.764)	13.0 (.51)	50.5 (1.99)	24.000 (9.449)	37.1 (1.46)	7.963 (.3135)	19.9 (.78)	70.3 (2.77)	145.00 (5.709)	3.00 (.118)	110.10 (4.331)	10.00 (.394)

Electrical Installation

System Grounding



Note: The aluminum heatsink is electrically connected to the PE terminal.

Figure 10 Grounding Diagram

AC Power Supply Requirements

The examples below show AC power connections for single phase and three phase E Series Drives. These examples are shown for reference only. Local electrical codes should be consulted before installation.

Note: The maximum voltage applied to the drive terminals must not exceed 264 VAC phase to phase and phase to PE ground. This can be accomplished by referencing the AC supply to earth ground.

If the distribution transformer is configured as shown in Figure 11 or Figure 12, the AC power supply can be connected directly to the amplifier terminals.

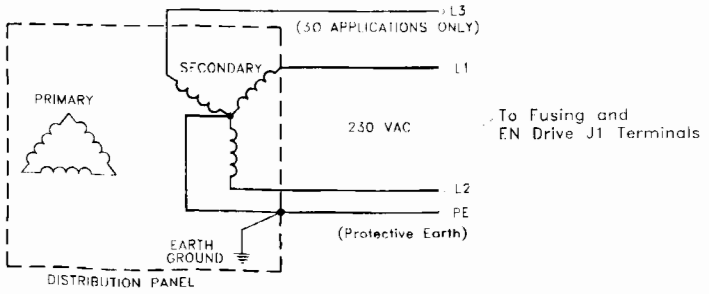


Figure 11 *Example 1: Earth Grounded WYE Distribution Transformer.*

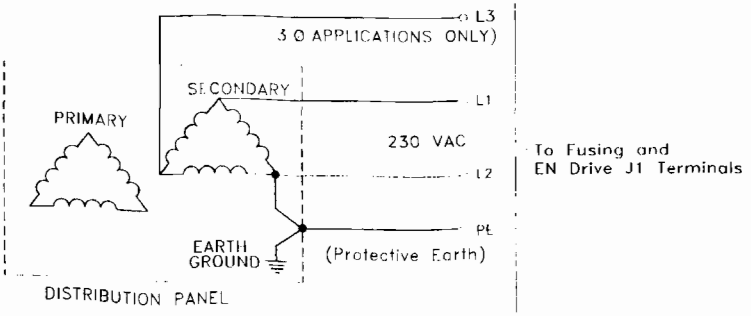


Figure 12 *Example 2: Earth Grounded Delta Distribution Transformer.*

If the distribution transformer is configured as shown in Figure 13 or Figure 14, an isolation transformer is required.

If an isolation transformer is used between the power distribution point and the drives, the transformer secondary must be grounded for safety reasons as shown in the figures below.

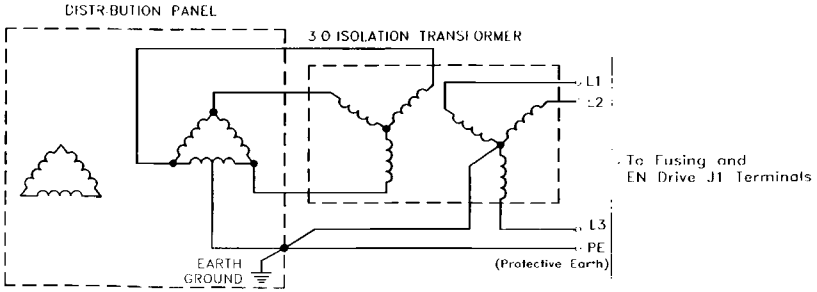


Figure 13 *Example 3: Three Phase Delta / Delta (With Midphase GND) Distribution to a Three phase WYE / WYE Isolation Transformer.*

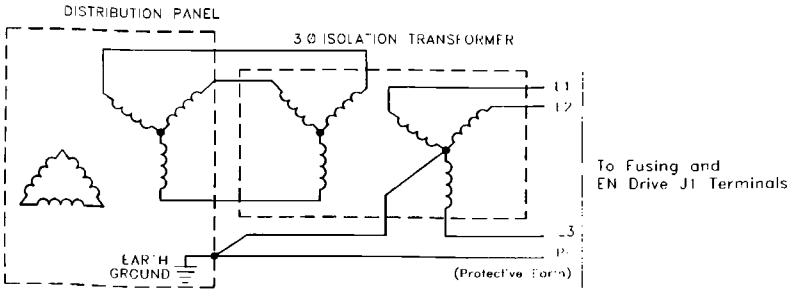


Figure 14 *Example 4: Three phase Delta / WYE (ungrounded) Distribution to a Three Phase WYE / WYE Isolation Transformer*

Transformer Sizing

If your application requires a transformer, use the following table for sizing the KVA rating. The values in the table are based on "worst case" power usage and can be considered a conservative recommendation. You can downsize the values only if the peak power usage is less than the transformer continuous power rating. Other factors that may influence the required KVA rating are high ambient temperatures (>40°C) and drive operation near the maximum speeds.

Table 2 Transformer KVA Ratings

Drive/Motor Combination	Suggested KVA Rating
EN-204/MGE-205	0.8
EN-204/MGE-208	1.5
EN-204/MGE-316	2.3
EN-208/MGE-316	2.3
EN-208/MGE/M-340	3.9
EN-208/MGEM-455	4.9
EN-214/MGE/M-455	4.3
EN-214/MGE/M-490	6.0
EN-214/MGE/M-4120	6.5

At speeds near the maximum operating speed, transformer output voltage drop may become a critical issue for proper operation. Typically, higher KVA transformers have lower voltage drop (due to lower impedance).

AC Line Fusing and Wire Size

You must incorporate over current protection for the incoming AC power with the minimum rating shown here. EMC recommends Bussman or Littlefuse in the following types: KTK-R, KTK.

Table 3 AC Fusing and Wire Gauge Sizes

Drive Model	External AC Line Fuse	Recommended Minimum AC/PE Line Wire Gauge
EN-204	15 Amp 1Ø	14 AWG
EN-208	20 Amp 1Ø	12 AWG
EN-214	20 Amp 3Ø	12 AWG

⚠ WARNING

The Protective Earth (PE) wire connection is mandatory for human safety and proper operation. This connection must not be fused or interrupted by any means. Failure to follow proper PE wiring can cause death or serious injury.

AC Input Power Connections

The EN-204 and EN-208 drives require 90 to 264 VAC single phase power. The EN-214 can operate with single or three phase 90 to 264 VAC. If single phase power is used with the EN-214, you must de-rate the output power available by 20%.

Table 4 AC Power Specifications

Drive Model	Voltage Range (VAC)	Phasing	Frequency (Hz)	Inrush Current (Amps)	
				1st Cycle	2nd Cycle
EN-204	90-264	1 Ø	47-63	140 (8 ms)	50 (8 ms)
EN-208	90-264	1 Ø	47-63	140 (8 ms)	50 (8 ms)
EN-214	90-264	1 or 3 Ø	47-63	100 (5 ms) 3Ø	40 (5ms) 3Ø

The four position AC power connector (J1) is located on top of the drive. The wiring diagram below shows single and three phase connections. EN-204, EN-208 use only L1 and L2. L3 is connected on EN-214 drives using three phase power.

Note: Per UL requirements, this product is suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical amperes, 240 Volts maximum.

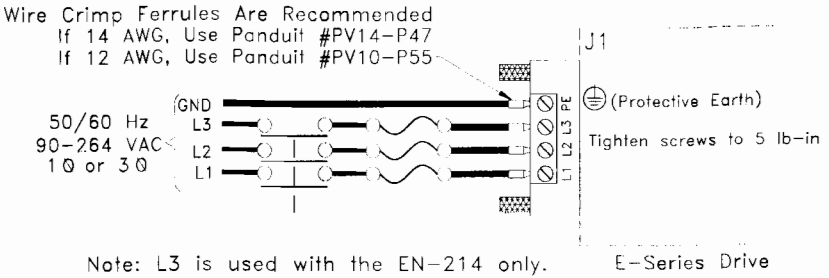


Figure 15 AC Power Wiring Diagram

CAUTION

Do not connect or disconnect AC power by inserting or removing the four position AC power connector. Using the connector in this manner will damage the connector making it unusable.

Auxiliary Logic Power Wiring

An auxiliary logic supply allows the EN Drive to retain motor position information and serial communications when the main AC power supply is disconnected. You must reset the drive, either using the reset button or a reset input, after AC power is re-applied if the backup supplies have been active.

Note: Emerson Motion Control offers a power supply (model #ALP-130) that supplies enough power for one E Series Drive with an FM module (See "ALP-130 Power Supply" on page 25.)

The auxiliary logic power connector is accessed through a plastic punch-out tab located on top of the drive that reads "BUS/AUX". The auxiliary logic power for each EN drive must be individually transformer isolated from the AC supply. The voltage range is **127 to 373 VDC, @** 23 watts. This can be accomplished by rectifying and filtering 90 to 264 VAC as shown in Figure 16.

⚠ WARNING

Do not connect AC power directly into the auxiliary logic connector. You must wire this connection correctly with "transformer isolated" 127 to 373 VDC power. Failure to do so can cause death, serious injury or equipment damage. Also, use caution when removing the plastic punch-out tab. AC power must be disconnected for at least 30 seconds before removing the tab.

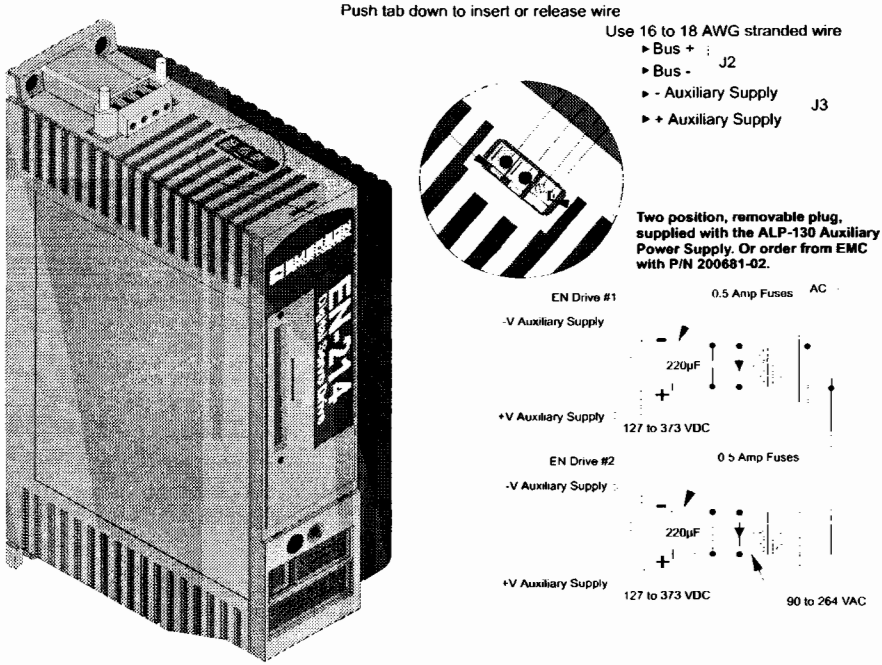


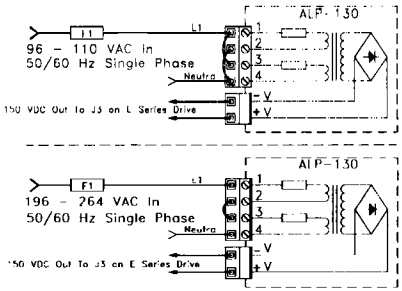
Figure 16 *Location of the Auxiliary Connector and Wiring Diagram*

Table 5 Auxiliary Power Supply Requirements

System	Power	Voltage
EN Drive Only	15 watts	127 to 373 VDC (Transformer Isolated, Rectified and filtered, 90 to 264 VAC)
EN Drive with FM Module	23 watts	

ALP-130 Power Supply

The ALP-130 supplies enough power for one E Series Drive with an FM module. The ALP-130 comes complete with the hardware necessary for mounting to most DIN rail mounting tracks and includes the screw terminal plug connector to mate with the auxiliary supply receptacle on the drive. Use 16 to 18 AWG, 300V minimum, insulated, stranded wire for AC in and DC out wiring.



Customer Fusing

120 VAC (F1)	230 VAC (F1)
KTK 4/10 KTK 5/10 KTK 6/10	KTK 2/10 KTK 3/10

Figure 17 ALP-130 Wiring Diagram

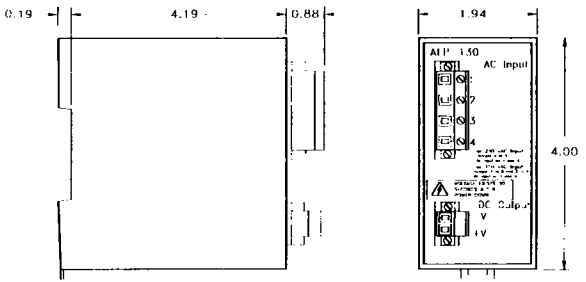


Figure 18 ALP-130 Mounting Dimensions

External Shunt Option Wiring

The DC Bus (J2) connector (see page 24) allows access to the DC bus for applications requiring an external shunt regulator.

Note: The external shunt regulator must be able to sense the DC bus voltage and switch the shunt resistor in and out of the circuit as needed to maintain acceptable bus voltage.

The shunt power rating required is determined by the application.

The connection for an external shunt regulator is between Bus- and Bus+.

External Shunt Regulator Requirements:

- Shunt trip On voltage: 395 to 410 VDC
- Shunt trip Off voltage: 380 to 390 VDC
- Minimum resistance: 22 Ohms (limited by J2 connector current rating)
- Power Requirements: Application dependent

Note: You should mount the external shunt so that the heat it generates does not affect the drive.

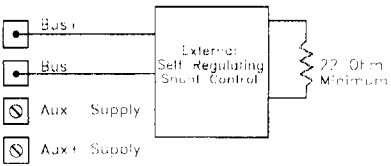


Figure 19 *External Shunt Wiring Diagram (Refer to Figure 16 For Location of Connector)*

CAUTION

Use caution when removing the plastic punch-out tab. AC power must be disconnected for at least 5 minutes before removing the tab and/or connecting the DC Bus wires.

Motor Wiring

MG motors are equipped with up to 3 male MS style connectors, one for stator connections, one for encoder connections and one for the brake (if so equipped).

Stator connections from the EN Drive to the motor are made with either the CMDS (2" and 3" motors) or CMMS (4" motors) cable. Both cables have a female MS style connector on the motor end and four individual wires and shield that connect to the motor power connector on the bottom of the drive.

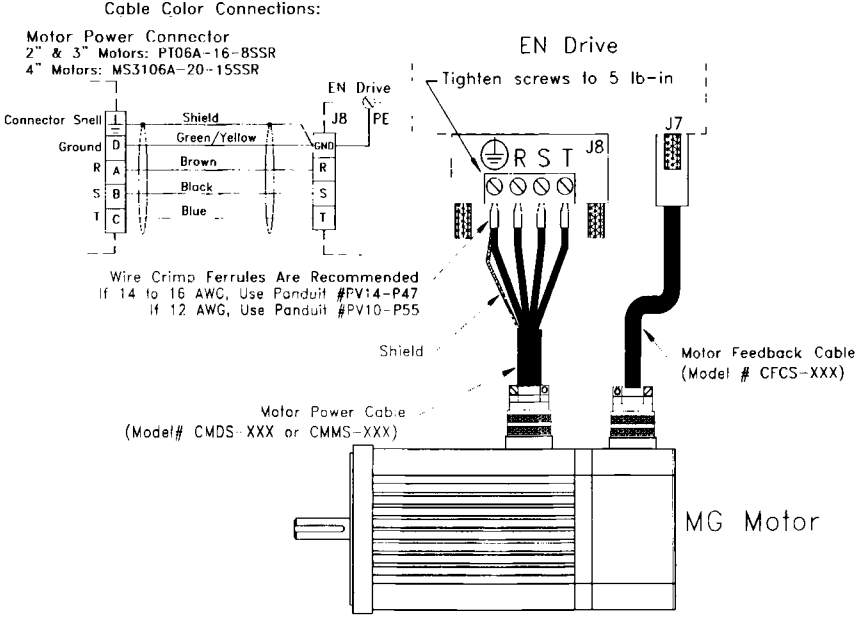


Figure 20 Motor Cable Connections.

Motor Feedback Wiring

Encoder feedback connections are made with the CFCS cable. This cable has an MS style connector on the motor end and a 26 pin high density D connector on the drive end.

For A, $\overline{A}$, B, $\overline{B}$ and Z, $\overline{Z}$ pairs, the CFCS cable uses low capacitance (~10 pf/ft) wire to get a characteristic impedance of 120 ohms. This impedance match is important to minimize signal loss and ringing.

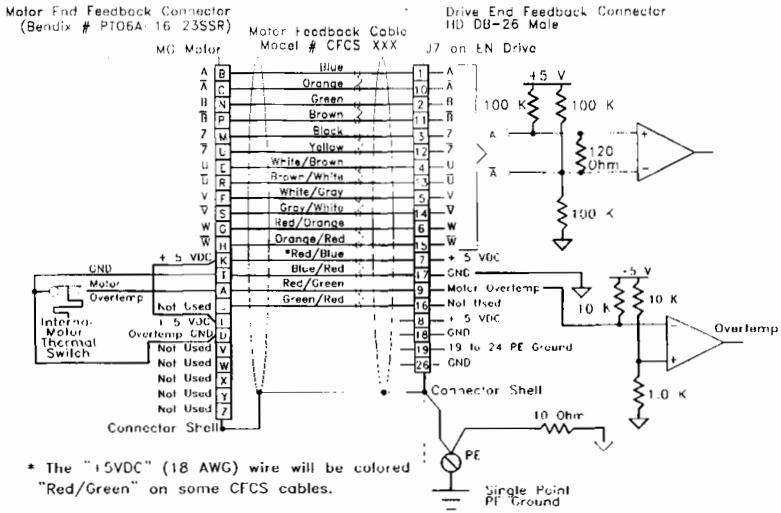


Figure 21 Motor Feedback Connector Pin-Out

Note: For non-Emerson motors the thermal switch minimum requirements are as follows:
Operation = Open on rise
V(min) = 10VDC
I(min) = 1mA
If a thermistor is used, the motor fault will occur when the thermistor resistance is approximately 1.0 k ohm.

Brake Wiring

MG motors equipped with brakes have a three pin MS style connector. The EMERSON brake power cable (model CBMS-xxx) has an MS style connector on the motor end and three wire leads on the other end (see wiring diagram below).

You must provide a separate DC power supply rated at +24VDC with a 2 amp minimum current capacity for the brake. If you use this voltage source to power other accessories such as I/O or more than one brake, you must increase its' current capability.

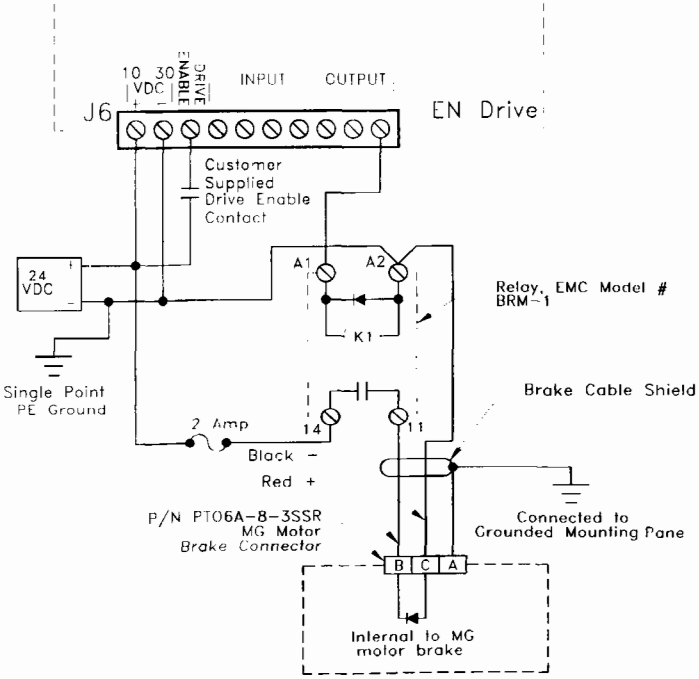


Figure 22 *MGE / M Motor Brake Wiring Diagram Using J6 (Input / Output Connector)*

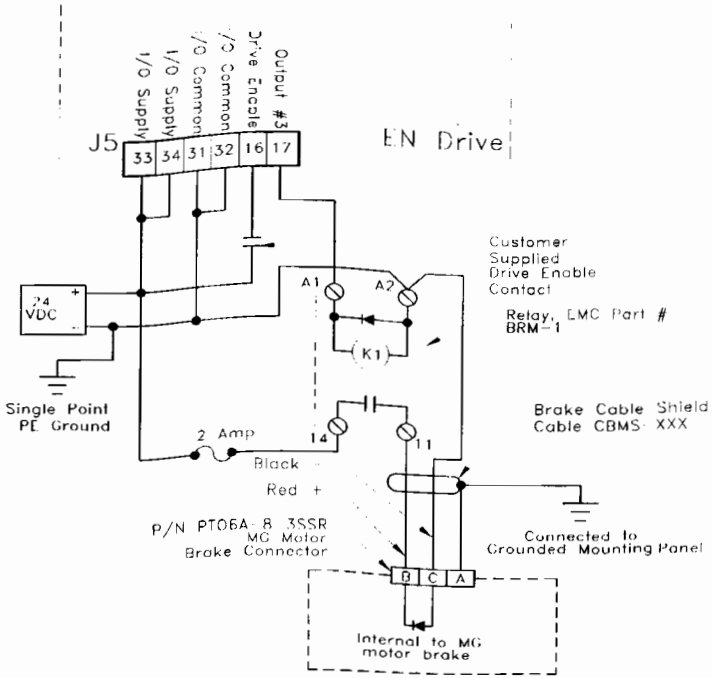


Figure 23 ***MGE/M Motor Brake Wiring Diagram Using J5 (44 Pin Command Connector)***

Input/Output And Drive Enable Wiring

E Series Drives are equipped with five optically isolated input lines (one dedicated to a drive enable function) and three 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 200 mA.

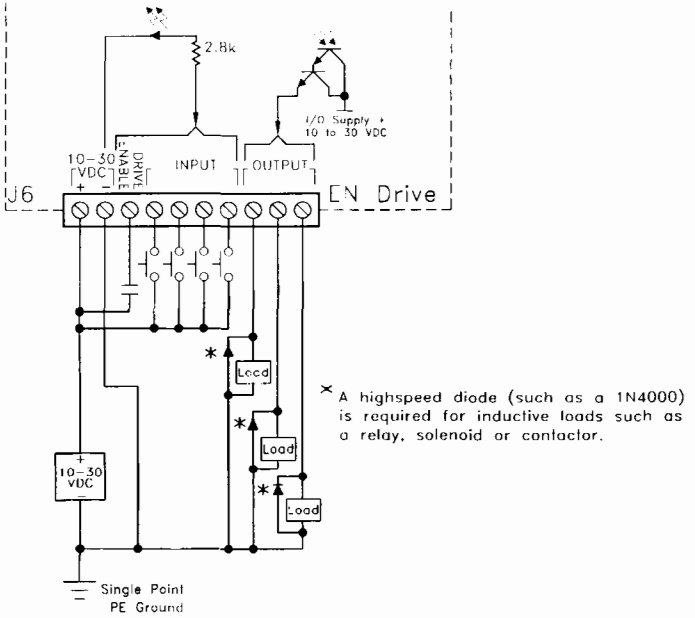


Figure 24 Input/Output Sourcing Wiring Diagram

The I/O connector is a ten pin removable terminal block. #18 to 24 AWG stranded wire is recommended.

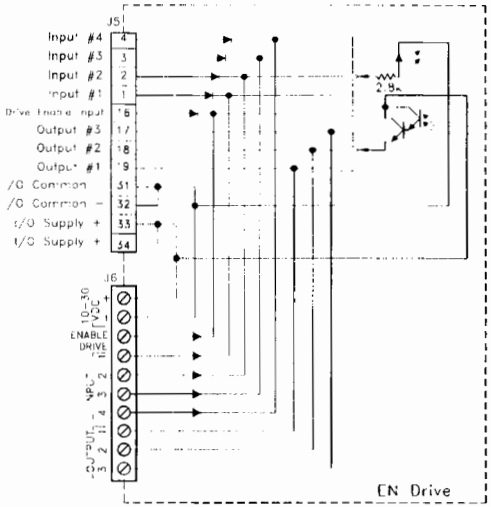


Figure 25 Internal Connections Between J5 and J6

Note: If a load is applied to the same output signal on both J5 and J6, the sum total current loading must be limited to 200mA per output signal.

Command Connector Wiring

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

If you are interfacing your E Series Drive(s) with an AXIMA 2000 or 4000 Multi-axis Controller, simply connect the 44 pin connector of your AX-CEN cable to the E Series Drive and the 25 pin connector to the AXIMA Multi-axis Controller (2000 or 4000).

If you are interfacing your E Series Drive(s) with an AXIMA or a non EMERSON controller, you may use the optional External Connection Interface (ECI-44) which provides a convenient screw terminal connection strip. Connect one end of the CMDX command cable to your E Series Drive and the other end to the ECI-44 (see ECI-44 on page 36)

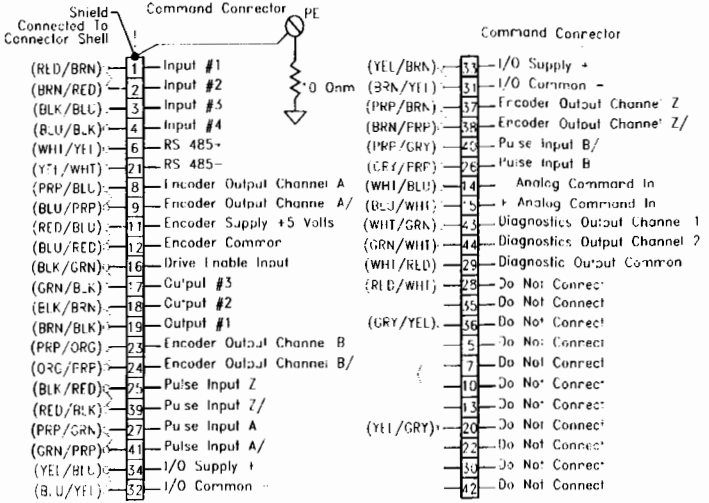


Figure 26 *Command Connector (J5) Pin-Out and CMDO-XXX Wire Colors*

Table 6 *Command Connector Signals*

Function	Pin Numbers	Electrical Characteristics
Inputs & 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 200mA
I/O Supply	33, 34	10 - 30 VDC @ 1 Amp Max.
I/O Common	31, 32	I/O return
Pulse Inputs	25, 26, 27, 39, 40, 41	Differential line driver input, or TTL (Single ended).
Encoder Supply	11	+5 Volts (200mA) 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 Max. Analog diagnostic, ref. to pin 29
Diagnostic Output Common	29	0.0 Volts, 10 ohms away from PE
RS 485 ±	6, 21	Parallel with serial connector

Command Cables, Models CDRO and CMDO

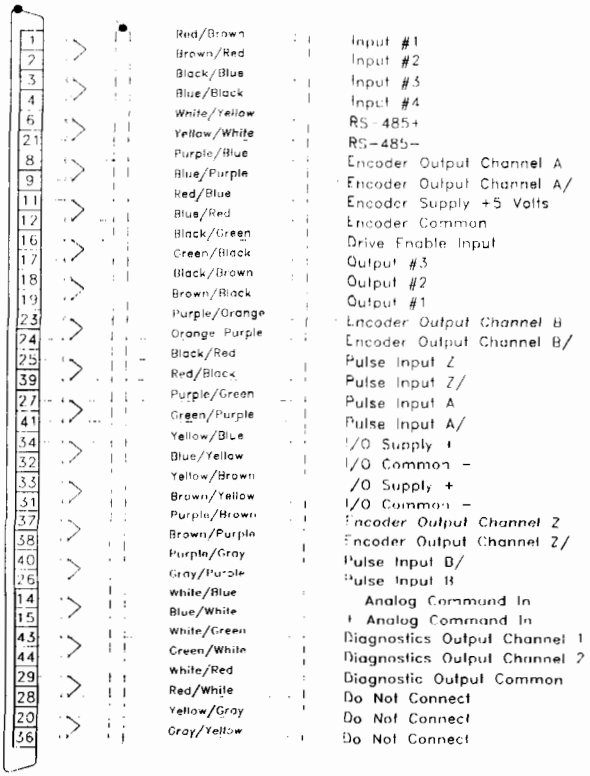


Figure 27 *CMDO-XXX Cable Wiring Diagram, E Series Drive to Lead Encoder*

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

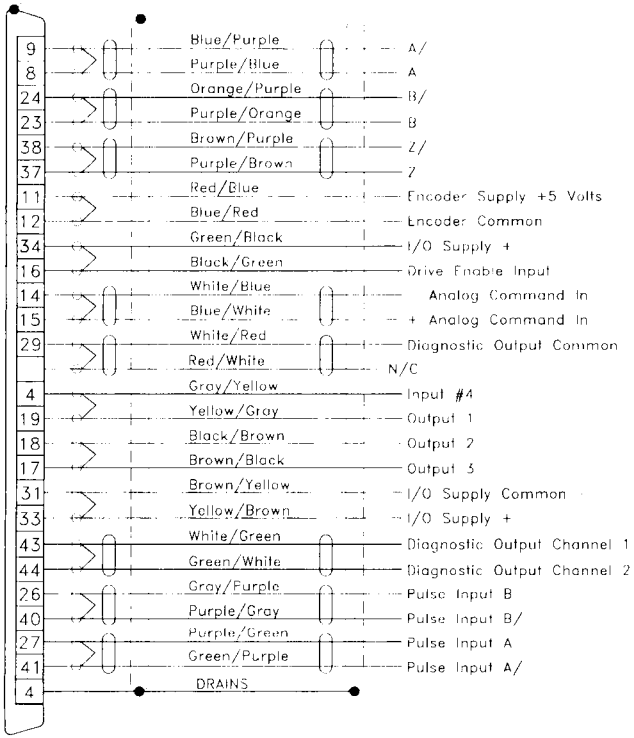


Figure 28 *CDRO-XXX Cable Wiring Diagram, E Series Drive to AXIMA 02 Through 08 or Other Controller*

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 (see mounting dimensions below).

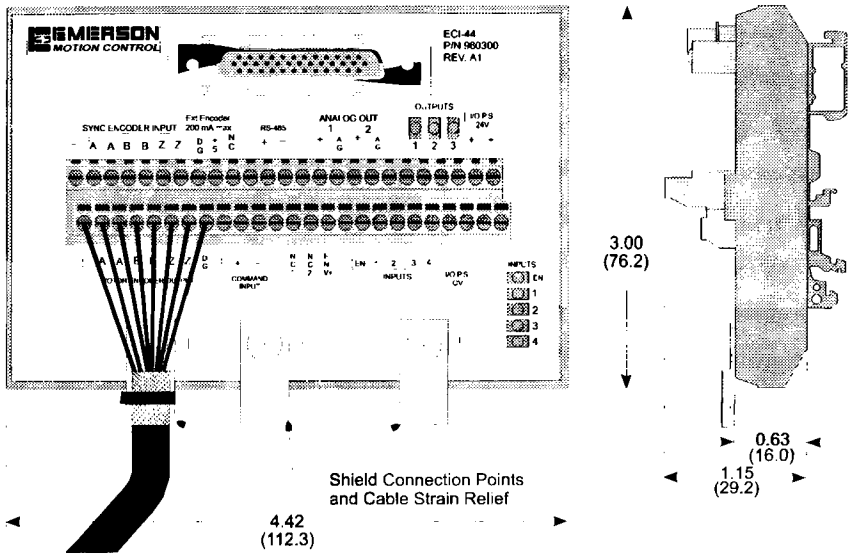


Figure 29 *ECI-44 Mounting Dimensions, inches (mm)*

Note: Shield connection points are connected to the shell of the 44 pin "D" connector on the ECI-44.

Use 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.

Analog Command Wiring

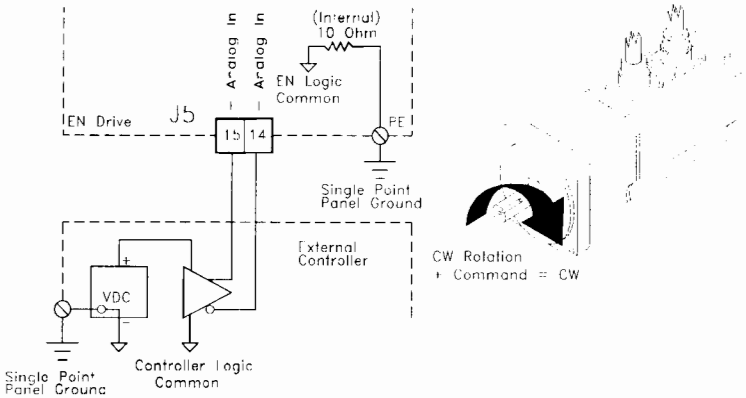


Figure 30 Analog Command, Differential Wiring Diagram

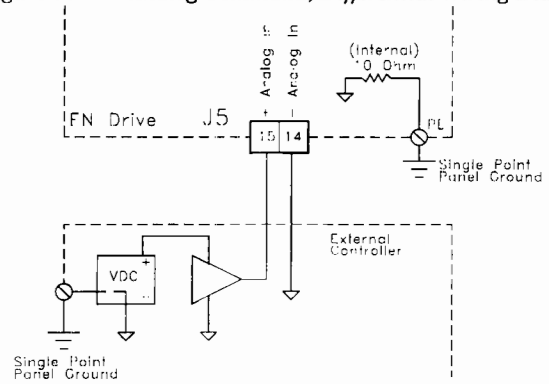


Figure 31 Analog Command, Single Ended Wiring Diagram

Pulse Mode Wiring

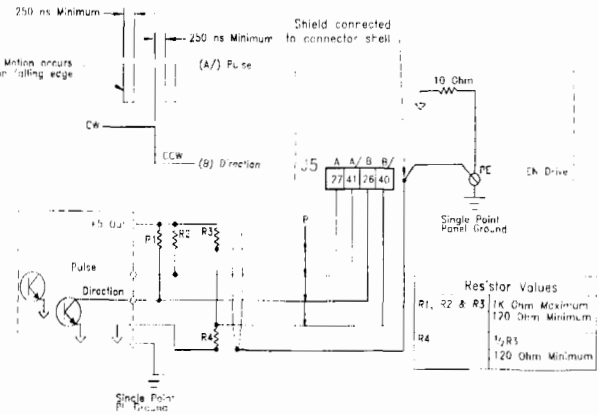
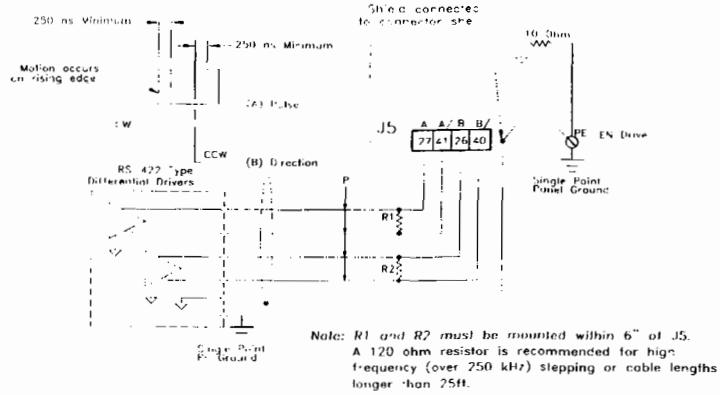


Figure 32 *Pulse Mode Wiring, Single Ended Connection*



Note: R1 and R2 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 33 *Pulse Mode Wiring, Differential Connection*

Encoder Output Wiring

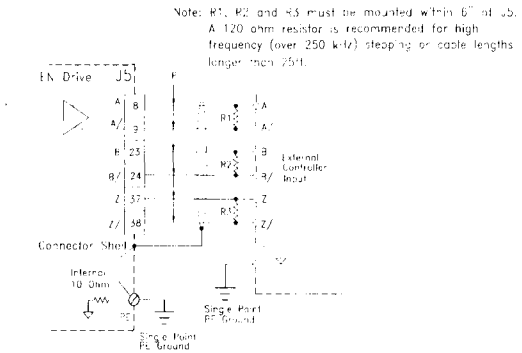


Figure 34 Command Connector Encoder Output Wiring



Figure 35 Direction Convention

Serial Communications

Serial communications with the E Series Drive 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 (see command connector on page 32).

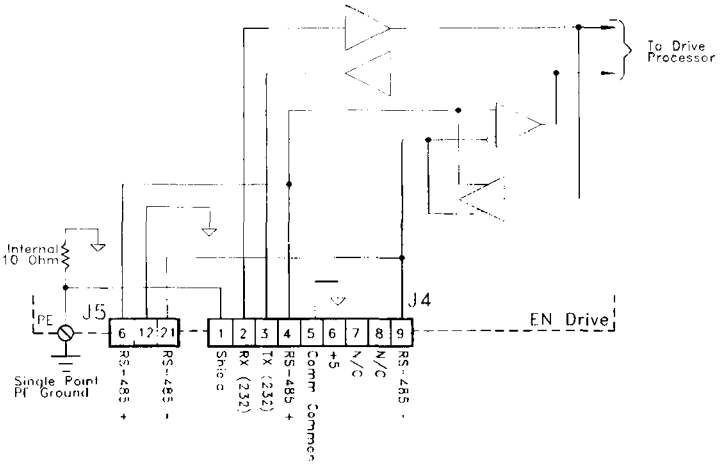


Figure 36 RS-232 and RS-485 Internal Connections

CAUTION

When connecting the serial port of your PC to the serial port of the EN Drive, verify that your PC's ground is the same as the EN Drive PE ground. Failure to do so can result in damage to your PC and/or your EN Drive.

This is not necessary with a battery-powered portable PC.

Modbus Communications

The E Series Drive's 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.

Multi-Drop Communications

The RS-485 option (pins 4 and 9) is provided for multi-drop configurations. EMERSON provides a special multi-drop serial cable which allows you to easily connect two or more E Series Drives.

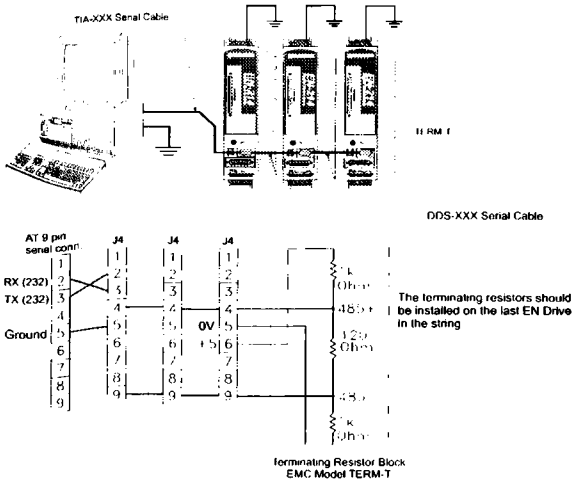


Figure 37 *Multi-Drop Wiring Diagram with RS-232 master*

Quick Touch Setup

Overview

With "Quick Touch Setup" you can select one of eight pre-defined setups using the Reset/Setup Button. The default pre-defined setup is setup 0 (disabled). Pre-defined setups 1 through 7 automatically assign the operating mode and input and output functions as shown below.

Pre-defined Setup Selection

Table 7 Pre-defined Setups

Setup #	Operating Mode	Input line #1	Input Line #2	Input Line #3	Input Line #4	Output Line #1	Output Line #2	Output Line #3
0	Disabled	N/A	N\A	N/A	N/A	N/A	N/A	N/A
1	Analog Velocity A ±10 V = Max Velocity	CW Limit A-ON	CCW Limit A-ON	Reset A-ON	Stop A-ON	Drive Ok	In Motion	Foldback Active
2	Analog Torque A ±10 V = Peak Torque	CW Limit A-ON	CCW Limit A-ON	Reset A-ON	Stop A-ON	Drive Ok	In Motion	Foldback Active
3	AXIMA Analog Velocity ±10 V = Max Velocity	CW Limit A-OFF	CCW Limit A-OFF	Reset A-ON	N/A	Drive Ok	CW Limit	CCW Limit
4	AXIMA Analog Torque ±10 V = Peak Torque	CW Limit A-OFF	CCW Limit A-OFF	Reset A-ON	N/A	Drive Ok	CW Limit	CCW Limit
5	Analog Velocity B ±10 V = Max Velocity	CW Limit A-OFF	CCW Limit A-OFF	Reset A-ON	Stop A-OFF	Drive Ok	Foldback Active	Brake
6	Analog Torque B ±10 V = Peak Torque	CW Limit A-OFF	CCW Limit A-OFF	Reset A-ON	Stop A-OFF	Drive Ok	Foldback Active	Brake
7	Pulse Direction	CW Limit A-OFF	CCW Limit A-OFF	Reset A-ON	Stop A-OFF	Drive Ok	Foldback Active	Brake

- A-ON = Active On (10-30 VDC)
- A-OFF = Active Off (0-3 VDC)

The Reset/Setup Button, located on the front of the E Series Drive, is a dual purpose Button. Its' primary function is fault condition reset. Its' secondary function is the selection of a pre-defined setup, the motor model and the drive address.

Pre-defined Setup Descriptions

Setup 0 (Disabled - Default)

This is the factory setup. The drive cannot be enabled and no input or output functions are assigned.

Setup 1 (Analog Velocity)

The drive will respond to a conventional ±10 volt DC signal applied to the analog command input of the command connector as a velocity command. Input and output functions are assigned "Active On" so no I/O wiring is needed for operation.

+10V = Max motor velocity CW (+), -10V = Max motor velocity CCW (-)

Setup 2 (Analog Torque)

The drive will respond to a conventional ±10 volt DC signal applied to the analog command input of the command connector as a torque command. Input and output functions are assigned "Active On" so no I/O wiring is needed for operation.

5V = Motor continuous torque, 10V = Motor peak torque (2 times continuous)
+ Voltage = CW (+), - Voltage = CCW (-)

⚠ CAUTION

Unexpected high speed motor shaft rotation will occur in setup 2 and setup 6 if the commanded torque exceeds the torque required to overcome the mechanical load. This can cause equipment damage or human injury.

Setup 3 (AXIMA Analog Velocity)

This is the preferred setup for operating in velocity mode with Emerson Motion Control's AXIMA Multi-axis Controller. The drive will respond to a conventional ±10 volt DC signal applied to the analog command input of the command connector as a velocity command. This mode assigns input and output functions as shown in Table 7.

+10V = Max motor velocity CW (+), -10V = Max motor velocity CCW (-)

Setup 4 (AXIMA Analog Torque)

This is the preferred pre-defined setup if you wish to operate in torque mode and you are interfacing with an EMC AXIMA Multi-axis Controller. The motor will respond to a conventional ±10 volt DC signal applied to the analog command input of the command connector as a torque command.

This mode assigns input and output functions as shown in Table 7.

5V = Motor continuous torque, 10V = Motor peak torque (2 times continuous)
+V = CW (+), -V = CCW (-)

Setup 5 (Analog Velocity B)

The drive will respond to a conventional ±10 volt DC signal applied to the analog command input of the command connector as a velocity command.

This setup assigns input and output functions as shown in Table 7, which includes an output assignment for brake control.

+10V = Max motor velocity CW (+), -10V = Max motor velocity CCW (-)

Setup 6 (Analog Torque B)

The drive will respond to a conventional 0 to ±10 volt DC signal applied to the analog command inputs of the command connector as a torque command.

This setup assigns input and output functions as shown in Table 7, which includes an output assignment for brake control.

5V = Motor continuous torque, 10V = Motor peak torque (2 times continuous)
+V = CW (+), -V = CCW (-)

Setup 7 (Pulse/Direction)

The drive will respond to pulses representing incremental position change commands and a DC voltage level representing direction commands.

Default command resolution = 8192 pulses per motor revolution.

The *Following Error Limit* is enabled and set at 0.2 revolutions.

This mode assigns input and output functions as shown in Table 7, which includes an output assignment for brake control.

Motor Selection

Each E Series Drive is compatible with three different MG motors. When selecting a motor using the Quick Touch Setup, you will only be allowed to select a compatible motor size for your drive.

Table 8 Motor Selection.

Drive and Motor	Display
EN-204 with MGE-205	
EN-204 with MGE-208	
EN-204 with MGE-316	
EN-208 with MGM-316	
EN-208 with MGM-340	
EN-208 with MGM/E-455	
EN-214 with MGM/E-455	
EN-214 with MGM/E-490	
EN-214 with MGM/E-4120	

Drive Address

The E Series drive may be used in a multi-drop communication configuration. To support multi-drop communications, each node (drive) must have a unique Modbus address. You can assign the drive address with the Quick Touch Setup. Drive addresses have two digits. Each digit is displayed (tens first, ones second) and selected one at a time. Drive address range is 1 to 99. A maximum of 32 nodes (drives) may be used in a single multi-drop system.

CAUTION

Selecting a pre-defined setup may affect the operating mode and input/output functions assignments. These changes may cause unwanted motion which may result in personal injury or equipment damage.

Quick Touch Setup Procedure

You can use the Quick touch Setup Procedure to change the pre-defined setup, motor model, and/or drive address for your EN Drive.

Please note the following:

- The Drive Enable input must be off (drive disabled) for you to enter the Quick Touch Setup Procedure.
- Remember to complete the End/Save Sequence in order for your new selections to be saved.
- If you abort the setup before completing the End/Save Sequence, the drive will use the existing setup.
- You can use this procedure to change one, two or all three quick touch setup parameters (pre-defined setup, motor model and drive address).

1. **To select a Pre-defined Setup:**

   A. Press and hold the Reset/Setup Button.

      a. The drive will display each number of the two digit drive address for two seconds (tens first, ones second). Continue to hold the Reset/Setup Button.

      b. The drive will display a triple bar character for four seconds. Continue to hold the Reset/Setup Button.

      c. The drive will display each Pre-defined Setup, numbered from zero through seven, one at a time beginning with zero (the setups are found in Table 7).

      d. Each setup number will be displayed for two seconds until all have been displayed.

      e. Continue to hold the Reset/Setup Button to make no setup selection and go to motor selection.

B. To select a Setup, release the Reset/Setup Button when the drive displays the setup you want.

   a. The number selected will flash three times to confirm the setup number selected.

   b. The drive will then display a triple bar character for four seconds.

   c. Press and hold the Reset/Setup Button to enter the Motor Selection Sequence (step 2), or...

   d. Do nothing to go to the End/Save Sequence.

2. To select a motor for your drive:

A. Continue to hold the Reset/Setup Button.

   a. The drive will display only the valid motor selections. Each selection will be displayed for two seconds (see Table 8 for motor selection letters).

   b. Continue to hold the Reset/Setup Button to make no motor selection and go to drive address selection.

B. Release the Reset/Setup Button when the letter that corresponds to the correct.

   a. The letter selected will flash three times to confirm your selection.

   b. The drive will then display a triple bar character for four seconds.

   c. Press and hold the Reset/Setup Button while the triple bar is displayed to enter the Drive Address Selection Sequence or...

   d. Do nothing to move to the End/Save Sequence.

3. To select a unique address for your drive:

A. Continue to hold the Reset/Setup Button.

   a. The drive will display the valid address number for the tens' digit showing each for two seconds.

B. Release the Reset/Setup Button when you see the number you want for the tens' place digit in your address.

   a. The number selected will flash three times to confirm your selection.

b. The drive will then display a triple bar number for four seconds.

C. Press and hold the Reset/Setup Button while the drive displays the triple bar.

c. The drive will display the valid address number for the ones' digit showing each for two seconds.

D. Release the Reset/Setup Button when you see the number you want for the ones' place digit in your address.

a. The number you selected will flash three times to confirm your selection.

b. The drive will now enter the End/Save Sequence.

4. To save your selections:

A. The drive will indicate the End/Save sequence by illuminating all segments of the display.

B. Press and hold the Reset/Setup Button within four seconds of the drive illuminating all segments.

C. Continue to hold the Reset/Setup Button.

a. The drive turns off EACH segment of the display one at a time.

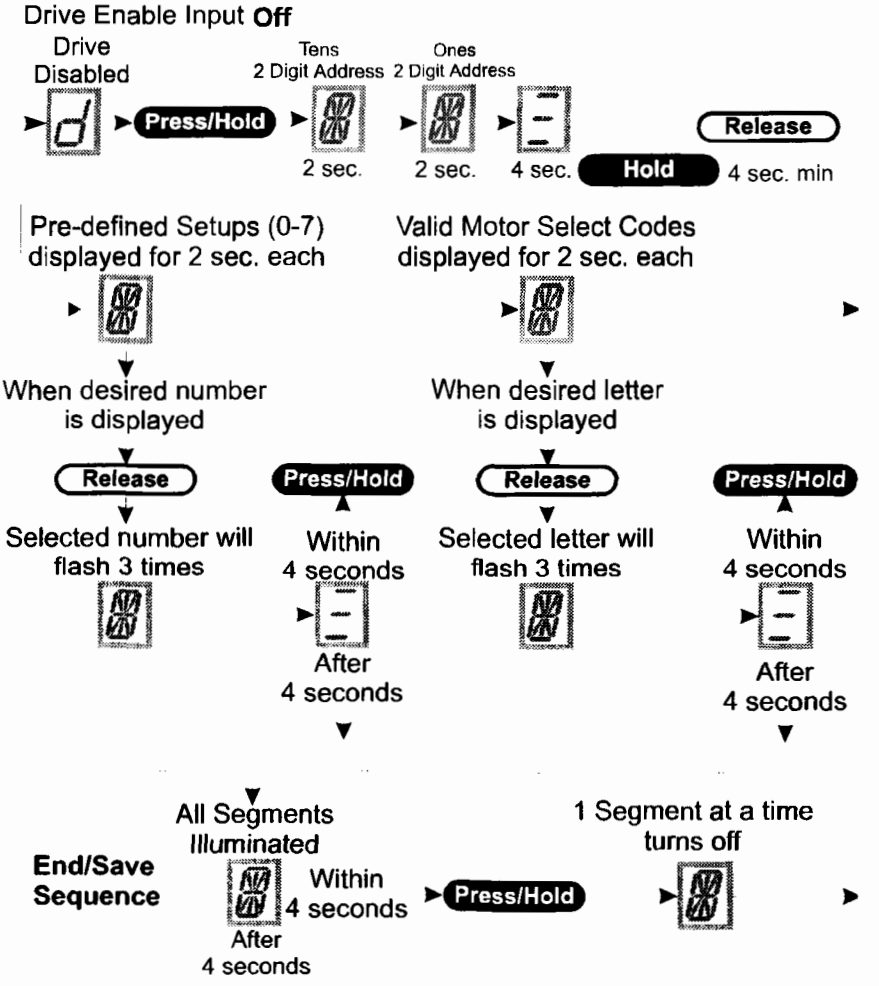
b. Do not release the Reset/Setup Button or your selections will not be saved.

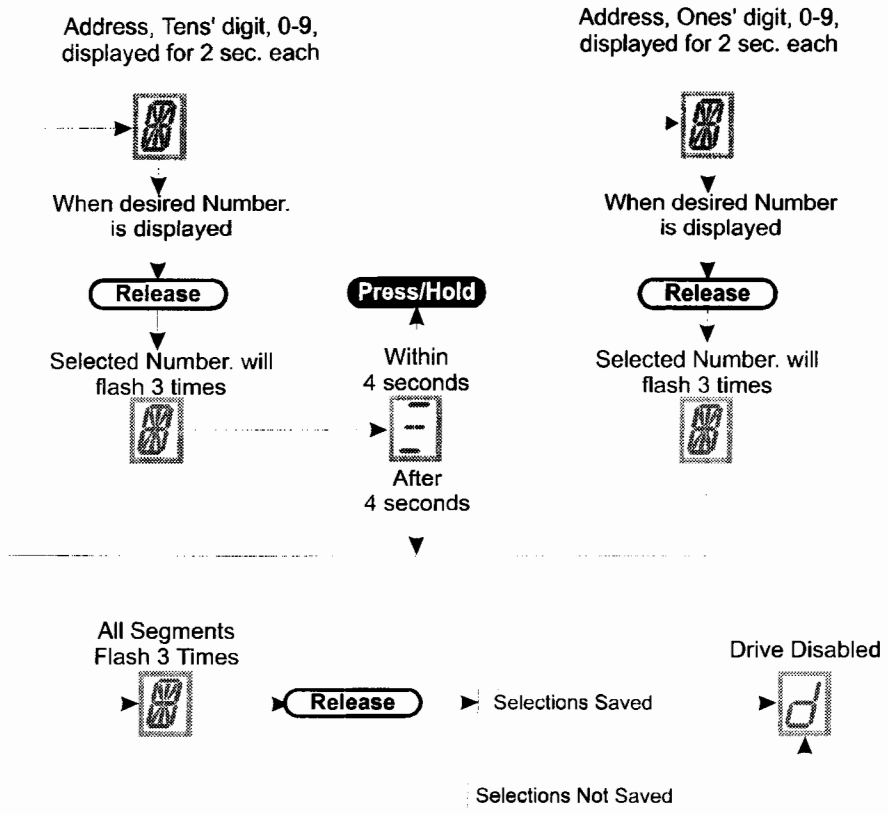
c. After all segments are turned Off, the display will then flash all segments three times indicating the end of the procedure.

D. Release the Reset/Setup Button.

a. The drive will display the character (d), indicating drive disabled.

b. Your EN Drive is now operational with your new selections and will clear the (d) symbol when you activate the Drive Enable input.


Drive Enable Input Off
Drive Disabled
Press/Hold
Tens 2 Digit Address
Ones 2 Digit Address
2 sec.
2 sec.
4 sec.
Hold
Release
4 sec. min
Pre-defined Setups (0-7) displayed for 2 sec. each
When desired number is displayed
Release
Selected number will flash 3 times
Press/Hold
Within 4 seconds
After 4 seconds
Valid Motor Select Codes displayed for 2 sec. each
When desired letter is displayed
Release
Selected letter will flash 3 times
Press/Hold
Within 4 seconds
After 4 seconds
End/Save Sequence
All Segments Illuminated
Within 4 seconds
After 4 seconds
Press/Hold
1 Segment at a time turns off


Address, Tens' digit, 0-9,
displayed for 2 sec. each
When desired Number.
is displayed
Release
Selected Number. will
flash 3 times
Press/Hold
Within
4 seconds
After
4 seconds
Address, Ones' digit, 0-9,
displayed for 2 sec. each
When desired Number
is displayed
Release
Selected Number. will
flash 3 times
All Segments
Flash 3 Times
Release
Selections Saved
Selections Not Saved
Drive Disabled

Input/Output Functions

The EN Drive has eleven input and twelve output functions available. Input and output function line assignments are determined by the pre-defined setup (see Pre-defined Setups on page 43). Changes to these assignments can only be made using the E Series PowerTools Software.

Input Functions

Drive Enable (Not Programmable)

The Drive Enable input provides hardware control of the power stage. When the input is high (+10 to 30 VDC) the power stage can be enabled, when the input is low the power stage is disabled and cannot be overridden.

CW and CCW Travel Limits

These input functions cause the drive to decelerate the motor to zero velocity using the default stop/travel limit deceleration ramp of 100 ms/kRPM. If the motor is in torque mode when either travel limit becomes active, the drive will change to velocity mode and decelerate the motor to a stop.

Once stopped, the drive will hold the motor in position. No motion is possible until the travel limit is inactivated.

⚠ CAUTION

If a velocity or command signal is present and the drive is enabled when the travel limit is inactivated, the motor will immediately move at command velocity or torque. Any velocity or torque command should be removed before the travel limit is inactivated.

Stop

This input function causes the motor to decelerate to zero velocity using the default stop/travel limit deceleration ramp of 100 ms/kRPM. Once stopped, the position will be maintained as long as the Stop input function remains active.

Reset

This input is used to reset fault conditions and is logically OR'ed with the Reset/Setup Button. A rising edge pulse is required to reset faults.

Velocity Preset Lines 1 and 2[1]

The Velocity Preset Lines are used to select one of the four pre-defined velocities using the binary selection patterns shown in Table 9.

If you select a different Preset Velocity, the drive will immediately ramp to the new velocity using the new acceleration ramp without stopping.

Table 9 Velocity Presets

Velocity Preset 2 Input Function	Velocity Preset 1 Input Function	Result
Inactive	Inactive	Run at velocity preset #0
Inactive	Active	Run at velocity preset #1
Active	Inactive	Run at velocity preset #2
Active	Active	Run at velocity preset #3

Torque Limit Enable[1]

This input function, when active, causes the torque loop to limit its commanded torque to the value of the torque limit parameter.

Torque Mode Enable[1]

This input function, when active, will enable analog torque mode regardless of the previous operating mode. You should use this function to override preset velocity mode only, since unwanted operation may result. When this input function is inactive, the drive will immediately return to its previous operating mode.

Brake Release[1]

This input function will release the brake under all conditions. If this input function is active, the brake output function is switched to active (i.e. release brake). This overrides all other brake control, thus allowing the brake to be released while a fault is active or the power stage is disabled.

Brake Control[1]

This input function, when active, will engage the brake unless overridden by the Brake Release input function. This input lets you externally engage the

1.This input function can be assigned only through Emerson's PowerTools Software.

brake, while allowing the drive to also control the brake during fault and disabled conditions.

Output Functions

CW and CCW Travel Limits

These outputs are active when a Travel Limit input becomes active. See CW and CCW Travel Limits input function explanation in the input section on page 52.

Brake

This output function is used to control the motor holding brake. If the Brake Output is Off, the brake is mechanically engaged.

Foldback Active

This output function is active when the drive is limiting motor current. If the commanded RMS current to the motor exceeds 100% of the continuous rating for a period of time determined by parameter settings, the current foldback circuit will limit the current delivered to the motor to 80% of the continuous rating.

Drive OK

This output function is active whenever no fault condition exists. Travel limits and the Drive Enable have no effect on this output function.

In CW Motion

This output function is active whenever the motor is turning at a velocity greater than the In Motion Velocity user parameter in the CW direction.

In motion default velocity = 10 RPM

In CCW Motion

This output function is active whenever the motor is turning at a velocity greater than the In Motion Velocity user in parameter the CCW direction.

In motion default velocity = 10 RPM

Fault[1]

This output function is active whenever a drive fault condition exists (see Fault Codes in the Troubleshooting section). The travel limits will cause this output function to be active.

At Velocity[1]

This output function is active whenever the motor is at the desired velocity (i.e. acceleration or deceleration is complete). This output is only associated with Velocity Preset velocities.

Torque Limit Active[1]

This output is active if the commanded torque exceeds the user specified Torque Limit value.

Velocity Limiting Active[1]

This output is activated when the commanded velocity exceeds 112.5% of the maximum motor velocity as shown in the motor/drive specification table on page 65. If the AC voltage parameter is set to 115 VAC, the maximum motor velocity is 1/2 the value shown in the motor/drive specification table. The maximum commanded velocity is internally limited to this value.

Shunt Active[1]

This is a real time indicator of the internal shunt activity in the drives that have an internal shunt (EN-208 and EN-214). On the EN-204 drives, this output merely indicates when the bus voltage is high enough to warrent adding an external shunt.

1.This output function can be assigned only through Emerson's PowerTools Software.

Troubleshooting

Diagnostic Display

The diagnostic display on the front of the drive show drive status and fault codes. When a fault condition occurs, the drive will display the fault code, overriding the status code. See the table on the following page for a list of fault codes.

The decimal point is on when the drive is enabled and the stop input is inactive. This indicates that the drive is ready to receive commands and any motion command will cause motion.

Table 10 Diagnostic Display Status Codes.

Display Indication	Status	Description
b	Brake Engaged (output off)	Motor brake is mechanically engaged.
d	Disabled	Power Stage is disabled
P	Position	Waiting for command (Pulse Mode)
V	Velocity	Velocity mode operation
T	Torque	Torque mode operation
Decimal Point	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 over voltage and amplifier or motor over temperature can be reset with the Reset/Setup Button. Other faults such as a logic supply fault can only be reset by cycling power off (wait until the display turns off), then power on.

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

The CW/CCW Limit faults are automatically cleared when the fault condition is removed. The table below lists all the fault codes in priority order from highest to lowest. This means that if two faults are active, the higher priority fault will be displayed.

Table 11 Display Fault Codes

Display	Fault	Action to Reset	Bridge Disabled
W	Watchdog timer	Button	Yes
T	Power-up self test failure	Power	Yes
N	Non-volatile memory invalid	Button	Yes
U	Invalid configuration	Power	Yes
2	Power stage fault	Button	Yes
H	High DC bus fault	Button	Yes
L	Low DC bus fault	Button	Yes
P	Encoder State	Power	Yes
E	Encoder line fault	Power	Yes
M	Motor over temperature fault	Button	Yes
S	RMS shunt power fault	Button	Yes
O	Over speed fault	Button	Yes
F	Following error fault (position mode)	Button	Yes
L	CW/CCW limit (velocity or Torque)	Auto	No

Watchdog Timer

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

Power Up Self-Test Failure

This fault indicates that the power up self-test has failed.

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

This fault code should not normally occur when using an MG series motor. If this fault occurs, please call Emerson Motion Control service for assistance.

Power Stage Fault

This fault is generated when a power stage over-temperature, over-current or under voltage gate 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.

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., large load and 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 the AC power. A 50 ms debounce time exists 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 mis-wiring.

RMS Shunt Power Fault

This fault is generated when RMS shunt power dissipation is greater than the design rating of the internal shunt in the drives that have an internal shunt (EN-208 and EN-214). On the EN-204 drives, this indicates that the application requires an external shunt.

Over Speed Fault

This fault occurs in any of three circumstances:

- When the actual motor speed exceeds 150% of the maximum motor speed as shown in the motor/drive specification table. This maximum overspeed value is not dependent on the applied AC voltage parameter.
- When the actual motor speed exceeds the user entered overspeed limit parameter. This parameter can be changed with the PowerTools software.
- In pulse mode operation, when the frequency input actually received generates a motor command speed in excess of 13000 RPM. The input frequency that will cause this is dependent on the command pulse per motor revolution setting. For example: With a pulse command ratio of 10 pulses per motor revolution. the first pulse received will cause this overspeed fault to occur.

Following Error Fault

This fault is generated when the following error exceeds the following error limit (default following error limit is .2 revs). This is typically used in pulse follower mode.

CW/CCW Limit

This fault is caused when either the CW or CCW Limit input function is active.

Diagnostic Outputs

The diagnostic outputs are located on the front of the drive allow you to measure drive parameters. There are two diagnostic output channels associated with these test points.

Default assignments:

Output 1 = Velocity Feedback
± 10V = ± 6000 RPM

Output 2 = Torque Command
± 10V = ± 300% of continuous motor torque

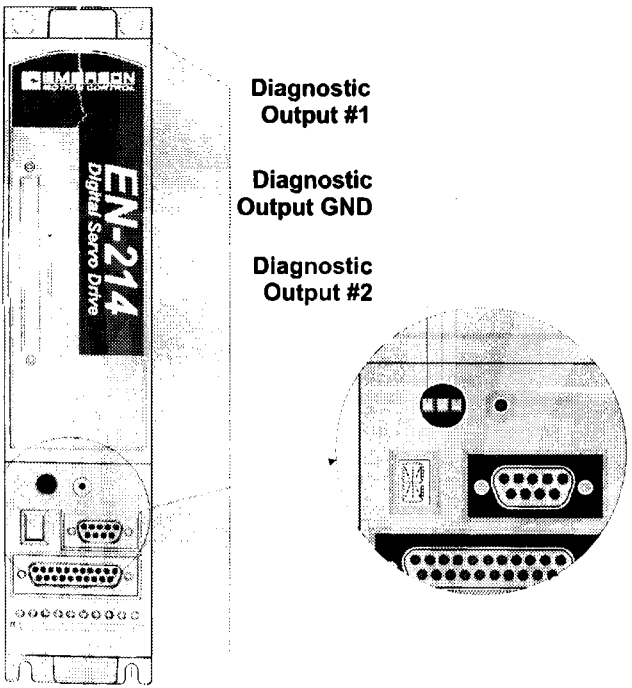


Figure 38 *Diagnostic Output Test Points*

Specifications

AC Power

90 - 264 VAC, 47 - 63 Hz
1Ø for EN-204 and EN-208
1Ø or 3Ø for EN-214

Control Inputs

Analog:

Command: ±10 VDC (differential)
13 bit, 100k ohm impedance
Motor temp. sensor: 0 to +5 VDC
(single ended) 10k ohm impedance

Digital Inputs (5):

Optically isolated
+10 to +30 VDC
2.8 kohm impedance
Sourcing inputs (active high)
Max. Input Response Time: 500 µs

Input Debounce:

Range: 0 to 2000 ms

Control Outputs

Diagnostic analog outputs (2):

±10 VDC (single ended)
Output impedance: 250 ohms
10 bit, 800 µs update

Default assignments:

Output 1 = Velocity Feedback
10V/6000 RPM
Output 2 = Torque Command
10V = 300% motor torque

Digital outputs (3):

+10 to +30 VDC optically isolated
Current sourcing, 200 mA max.
leakage: 20 nA max.

Drive Encoder Output

Differential line driver, RS-422 compatible.
Resolution is 1:1 of the motor's encoder (MG motors = 2048 lines/ motor rev.). 50mA per line source/sink
120 ohm term resistor recommended for cables > 25 ft.

Power Supply Output

+5 VDC 250mA maximum for master encoder usage.

Drive Ingress Protection Rating

IP 20 specification

Cooling Method

EN-204 and 208: Convection
EN-214: Internal fan on heatsink controlled by 70° C thermal switch

Environmental (Amplifier)

Ambient temp. range for rated output:

0° C to 40° C (32° F to 104 F°)

Maximum operating temperature:

50° C (122° F) with derating.

Storage Temperature:

-25° C to 75° C (-13° F to 167° F)

Maximum altitude for rated output:

1000 meters (3280 feet)

Humidity:

10 to 95% non-condensing.

Derating

Temperature:

Operation in ambient temperature over 50° C (122° F) not recommended. Drive output power must be derated by 3%/°C between 40° C and 50°C

Single phase operation:

The EN-214 drive output power rating is reduced by 20%.

Altitude derating:

Above 1000 meters reduce output by 1% per 100 meters.

Auxiliary Logic Power Input

127 to 370 VDC
Drive only: 20 watts
Drive with FM: 30 watts

Auxiliary power supply available from Emerson Motion Control (#ALP-130).

Pulse Mode

5V Open collector, TTL, Differential RS-422 line driver compatible.

Impedance: 18k ohm each line to common.

Maximum input frequency:

Pulse/Pulse mode: 2.0 MHz.
Pulse/Direction: 2.0 MHz.
Quadrature: 2 MHz/channel (8MHz count rate)

Minimum pulse width: 250 ns

Minimum setup time 250 ns

Minimum hold time after clocking edge 100 ns

Serial Interface

RS-232 or RS-485

Internal RS-232 to RS-485 converter

Modbus protocol with 32 bit data extension

9600 or 19.2 k baud

Fault Detection Capability

Watchdog timer
Power-up self test failure
Non-volatile memory invalid
Invalid Configuration
Power Stage Fault
High DC bus
Low DC bus
Encoder State
Encoder Line Fault
Motor over temperature
RMS shunt power fault
Over speed
Following error (position mode)
CW/CCW limit

Drive/Motor Combination Specifications

Table 12 Drive / Motor Specifications

Drive Model	Motor Model	Cont. Torque lb-in (Nm)	Peak Torque lb-in (Nm)	Power HP @ Rated Speed (kWatts)	Inertia lb-in-sec^2 (kg-cm^2)	Max speed RPM	Max Accel Rate ms/krpm (no load)	Encoder resolution lines/rev	Motor Kc VRMS/ krpm	Motor Kt lb-in/ARMS (Nm/ARMS)
EN-204	MGE-205	5.2 (0.59)	15.6 (1.76)	0.38 (0.28)	0.000084 (0.095)	5000	0.770	2048	28.3	4.1 (0.46)
	MGE-208	9.1 (1.03)	27.3 (3.09)	0.64 (0.48)	0.000144 (0.163)	5000	0.650	2048	28.3	4.1 (0.46)
	MGE-316	18.6 (2.10)	55.8 (6.22)	1.01 (0.75)	0.000498 (0.562)	4000	1.130	2048	37.6	5.5 (0.62)
EN-208	MGE-316	18.6 (2.10)	55.8 (6.22)	1.00 (0.76)	0.000498 (0.562)	4000	0.910	2048	37.6	5.5 (0.62)
	MGM-340	48 (5.65)	144.0 (16.27)	2.00 (1.49)	0.00125 (1.414)	3000	1.090	2048	55.0	8.0 (0.90)
	MGE/M-455	68 (7.68)	204.0 (23.05)	2.46 (1.83)	0.00338 (3.819)	3000	2.680	2048	60.0	8.8 (0.99)
EN-214	MGE/M-455	68 (7.68)	204.0 (23.05)	2.46 (1.83)	0.00338 (3.819)	3000	1.890	2048	60.0	8.8 (0.99)
	MGE/M-490	100 (11.30)	208 (23.50)	3.75 (2.80)	0.00648 (7.319)	3000	3.380	2048	58.9	8.6 (0.97)
	MGE/M-4120	132 (14.92)	257 (29.03)	5.33 (3.97)	0.00938 (10.593)	3000	4.290	2048	71.8	10.5 (1.19)

Table 13 MG Motor Holding Brake Specifications

Motor Model	Holding Torque lb-in (Nm)	Added Inertia lb-in-sec2 (kg-cm2)	Added Weight lb (kg)	Coil Voltage (VDC)	Coil Current (Amps)	Mechanical Disengagement Time (ms)	Mechanical Engagement Time (ms)
MGE-2XXCB	30 (3.4)	0.000025 (0.00129)	1.8 (0.55)	24 (±10%)	0.48 (±10%)	25 ms	40 ms
MGE-316CB MGM-340CB	50 (5.6)	0.00015 (0.0005)	2.4 (1.1)	24 (±10%)	0.52 (±10%)	100 ms	250 ms
MGE/M-455CB MG-490CB MG-4120CB	220 (24.9)	0.000412 (0.0030)	5.8 (2.6)	24 (±10%)	0.88 (±10%)	100 ms	250 ms

Table 14 Drive / Motor Weights

Drive	Weight lb (kg)
EN-204	6.4 (2.9)
EN-208	7.7 (3.5)
EN-214	8.9 (4.0)
Motor	**Weight lb (kg)**
MGE-205	3.0 (1.36)
MGE-208	4.0 (1.8)
MGE-316	8.3 (3.8)
MGE/M-340	14.6 (6.6)
MGE/M-455	18.5 (8.4)
MGE/M-490	27.0 (12.3)
MGE/M-4120	38.0 (17.3)

Table 15 Axial / Radial Loading

Motor Model	Max Radial Load (lb.)	Max. Axial Load (lb.)
MGE-205	20	15
MGE-208	20	15
MGE-316	40	25
MGM-340	40	25
MGE/M-455	100	50
MGE/M-490	100	50
MGE/M-4120	100	50

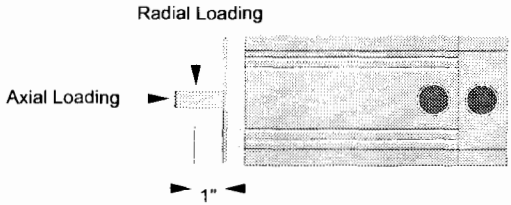


Figure 39 Axial / Radial Loading

Speed Torque Curves

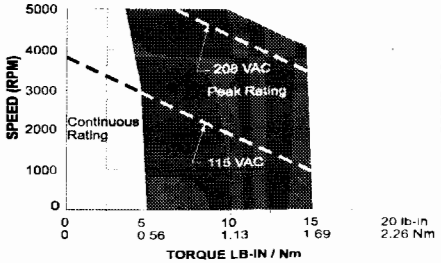
- Continuous ratings of the MG motors are based on 100°C motor case temperature and 25°C ambient temperature with the motor mounted to an aluminum mounting plate as shown in the table below.

Table 16 Mounting Plates

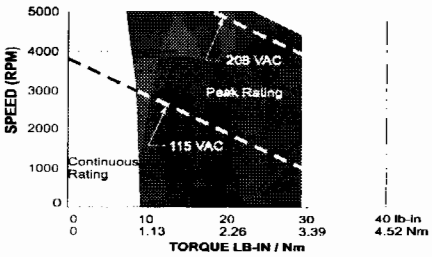
Motor	Mounting Plate Size
MG-205 & 208	6" x 6" x .25"
MG-316 thru 490	10" x 10" x .375
MG-4120	12" x 16" x .5"

- Speed torque curves are based on 230 VAC (3 Ø on EN-214) drive operation.
- All specifications are ±5% due to motor parameter variations.

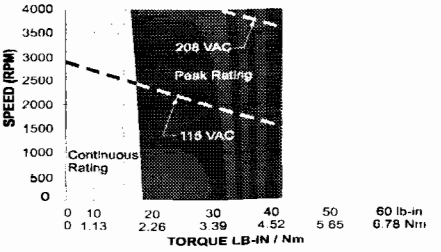
MG-205 with EN-204



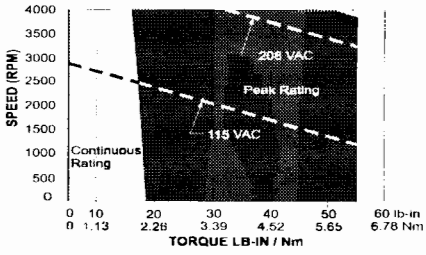
MG-208 With EN-204



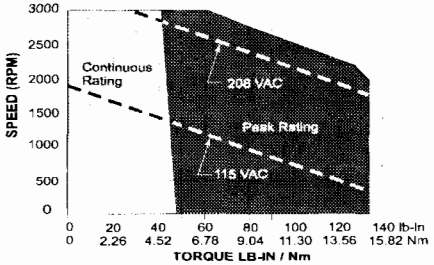
MG-316 with EN-204



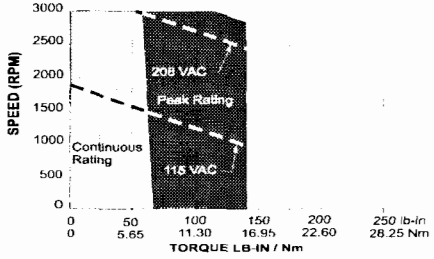
MG-316 with EN-208



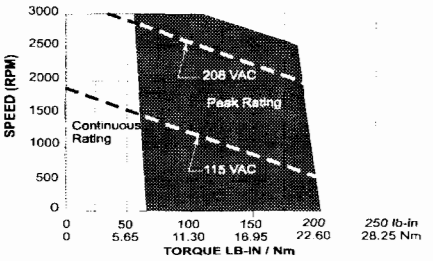
MG-340 with EN-208



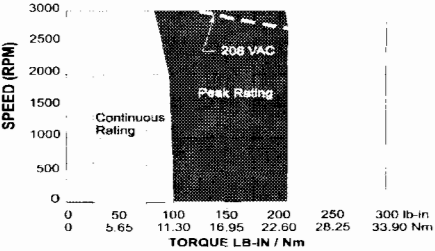
MG-455 with EN-208



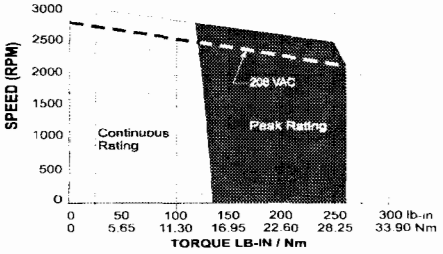
MG-455 with EN-214



MG-490 with EN-214



MG-4120 with EN-214



Vendor Contact Information

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

Cooper Industries, Inc.
Crouse-Hinds Division (Cable Shield Grommets)
(315) 477-5531

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