Copeland™ Commercial HVACR Variable Frequency Drive – EVM Series

Installation Manual

EMERSON™

Table of Contents

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Climate.Emerson.com/CopelandVariableFrequencyDrives

Safety Precautions

WARNING	ELECTRICAL SHOCK HAZARD Disconnect and lock out power before servicing. Discharge all capacitors before servicing. Use compressor with grounded system only. Molded electrical plug must be used when required. Refer to original equipment wiring diagrams. Electrical connections must be made by qualified electrical personnel. Failure to follow these warnings could result in serious personal injury.

Before Performing the Installation

- **<u>It is strongly recommended to read through this entire manual for safe and correct installation.</u>**
- Disconnect the power supply of the device.
- Ensure that the devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit the device.
- Cover or enclose any adjacent live components.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalization.
- The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the extra- low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2.
- Deviations of the input voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure.
- This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, and so on).
- Depending on their degree of protection, adjustable frequency drives may contain live bright metal parts, moving or rotating components, or hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation, or incorrect operation of motor or adjustable frequency drive may cause the failure of the device and may lead to serious injury or damage.
- The electrical installation must be carried out in accordance with the relevant regulations (for example, with regard to cable cross sections, fuses, PE).
- Installations containing adjustable frequency drives must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the adjustable frequency drives using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- Never touch live parts or cable connections of the adjustable frequency drive after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs.

Step 1 — Copeland EVM Overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the Copeland EVM Series open drive.

It is recommended to read through the entire document before attempting to install the drive.

Use QR code on table of contents page to reach our EVH AE bulletin for supporting information that is not included in this manual.

How to Use this Manual

The purpose of this manual is to provide you with information necessary to install, start up, and setup the Emerson Copeland commercial HVACR variable frequency drive (VFD), EVM drive. To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the Copeland EVM VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Receiving and Inspection

The Copeland EVM VFD has met a stringent series of factory quality requirements before shipment. It is possible that packaging or equipment damage may have occurred during shipment. After receiving your Copeland VFD, please check for the following:

Check to make sure that the package includes the install manual, quick start guide, and accessory packet. The accessory packet includes:

- Rubber grommets
- Control cable grounding clamps
- Additional grounding screw

Inspect the unit to ensure it was not damaged during shipment.

Make sure that the part number indicated on the nameplate corresponds with the catalog number on your order.

If shipping damage has occurred, please contact and file a claim with the carrier involved immediately.

If the delivery does not correspond to your order, please contact your Emerson electrical representative.

Note: Do not destroy the packing. The template printed on the protective cardboard can be used for marking the mounting points of the Copeland VFD on the wall or in a cabinet.

Common Abbreviations

Abbreviation	Definition
VT	Variable torque with low overload rating (110%)
I_H	High Overload(150%)
I_L	Low Overload(110%)
VFD	Variable Frequency Drive

Rating Label/Carton Label

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Cat. No.: EVM-3222D5-E20EFN			
Style No.: 3-5001-101A			
Copeland™ EVM VFD		Factory ID : Plant 11	
CT/VT		Input	Output
0.25HP/ 0.5HP (0.18KW/ 0.37KW)	U(V~)	200-240 3Ø	0~Vin 3Ø
	F(Hz)	50/60 Hz	0-400 Hz
	I (A)	2.1/3.3	1.6/2.5
Enclosure Rating		IP20 / UL Open Type IP20 / NEMA 1 / UL Type 1 with NEMA 1 kit installed	

User installation manual:2020ECT-36

Serial No.: XX20J0001

UL CERTIFIED SAFETY US·CA E518704

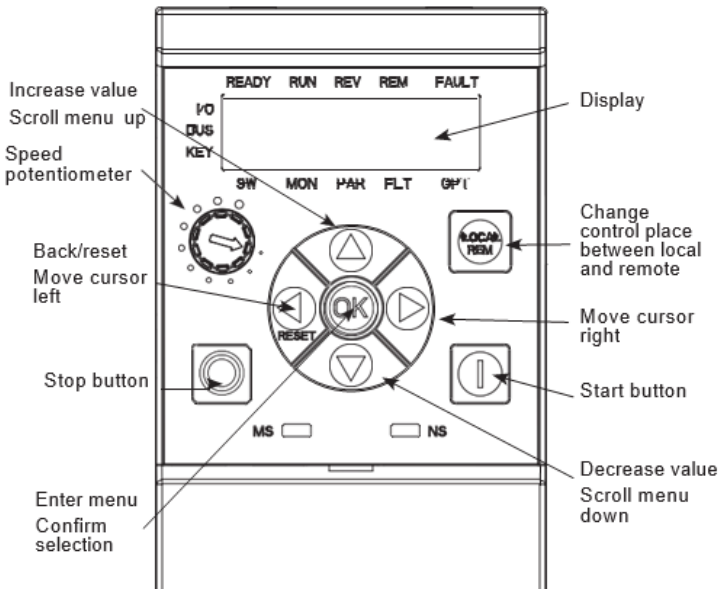
TÜVRheinland CERTIFIED www.tuv.com ID 0600000000

Contains FCC ID: 2ADXE-HY-40R204PC

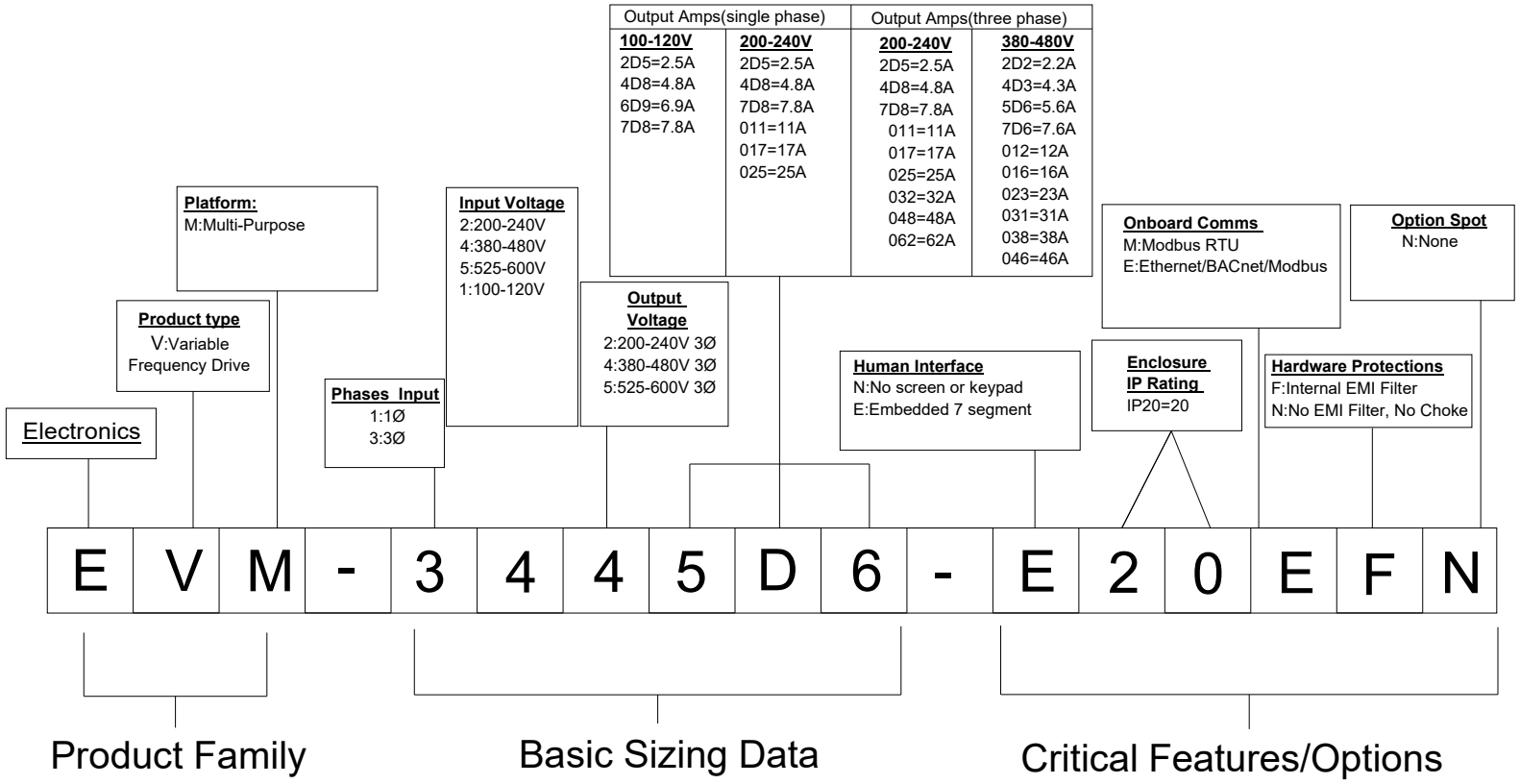
Field installed conductors must be copper rated at 75°C

20201015 Assembled in Dominican Republic

Keypad Button Overview

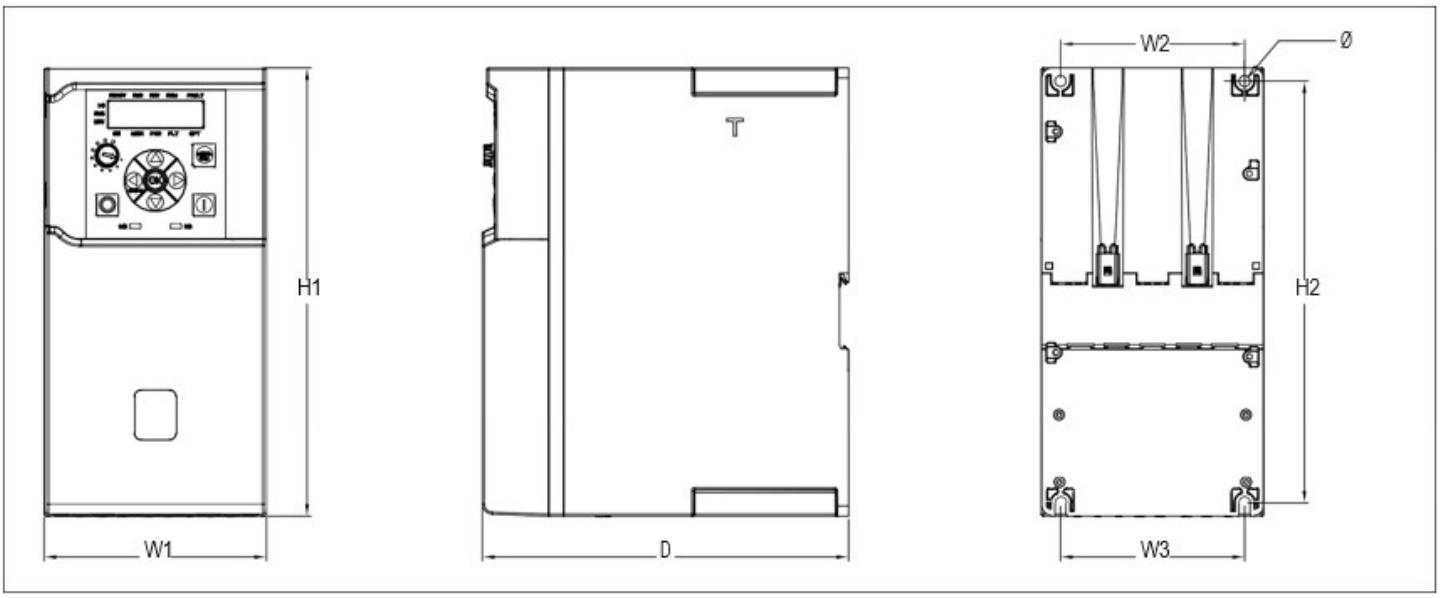


Nomenclature:



Step 2 — Copeland EVM Drive Installation

Dimensions and Weights



Approximate mounting dimensions in inches (mm)

Approximate dimensions in inches (mm)

Frame size	D	H1	H2	W1	W2	W3	Ø	Weight lb (kg)
FR1	7.09 (180	5.98 (152)	5.51 (140)	2.83 (72)	2.26 (57.5)	2.26 (57.5)	0.20 (5.2)	2.6 (1.2)
FR2	7.09 (180	8.66 (220)	8.15 (207)	4.29 (109)	3.56 (90.5)	3.56 (90.5)	0.22 (5.5)	5.7 (2.6)
FR3	7.09 (180	10.24 (260)	9.72 (247)	5.12 (130)	4.57 (116)	4.57 (116)	0.22 (5.5)	8.2 (3.7)
FR4	7.68 (195	11.81 (300)	11.06 (281)	7.24 (184)	6.3 (160)	6.3 (160)	0.24 (6)	13.9 (6.3)

Mounting

For mounting space guidelines please follow the below diagram and table. Then find the correct frame size mounting instructions.

- **For EVM Drives utilizing an option card, allow 2.76in. (70mm) for dimension A for the option card enclosure.**
- The below guidelines apply unless testing has been completed to validate a design outside of these recommendations. This work must be done in collaboration with Emerson Application Engineering.

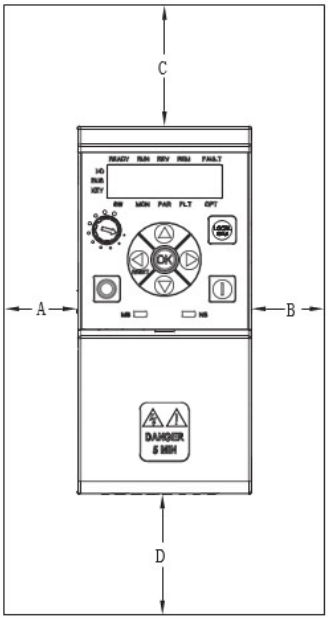


Table 2. Approximate Space Requirements in inches (mm)

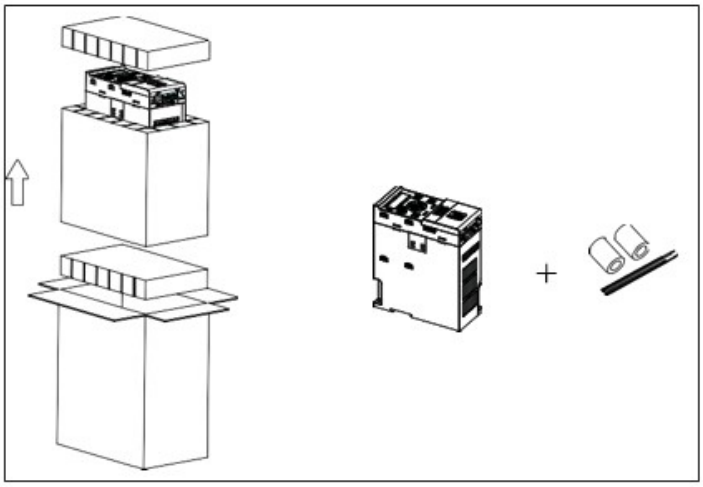
		Mounting clearance				Airflow
Input voltage	**Frame size**	**A in. (mm)**	**B in. (mm)**	**C in. (mm)**	**D in. (mm)**	**CFM (m3/h)**
100 Vac to 120 Vac, 50/60 Hz 1 phase	FR1	0	0	1.97 (50)	1.97 (50)	14.83 (25.2)
	FR2	0	0	1.97 (50)	1.97 (50)	24.72 (42)
200 Vac to 240 Vac, 50/60 Hz 1 phase	FR1	0	0	1.97 (50)	1.97 (50)	14.83 (25.2)
	FR2	0	0	1.97 (50)	1.97 (50)	37.43 (63.6)
	FR3	0	0	1.97 (50)	1.97 (50)	42.37 (72)
200 Vac to 240 Vac, 50/60 Hz 3 phase	FR1	0	0	1.97 (50)	1.97 (50)	14.83 (25.2)
	FR2	0	0	1.97 (50)	1.97 (50)	24.72 (42)
	FR3	0	0	1.97 (50)	1.97 (50)	42.37 (72)
	FR4	0	0	1.97 (50)	1.97 (50)	75.56 (128.4)
380 Vac to 480 Vac, 50/60 Hz 3 phase	FR1	0	0	1.97 (50)	1.97 (50)	14.83 (25.2)
	FR2	0	0	1.97 (50)	1.97 (50)	37.43 (63.6)
	FR3	0	0	1.97 (50)	1.97 (50)	58.61 (99.6)
	FR4	0	0	1.97 (50)	1.97 (50)	57.56 (97.8)
525 Vac to 600 Vac, 50/60 Hz 3 phase	FR2	0	0	1.97 (50)	1.97 (50)	37.43 (63.6)
	FR3	0	0	1.97 (50)	1.97 (50)	58.61 (99.6)
	FR4	0	0	1.97 (50)	1.97 (50)	57.56 (97.8)

Note: For EVM Drives utilizing an option card, allow 2.76in. (70mm) for dimension A for the option card enclosure

FR1 Mounting Instructions

Step 1:

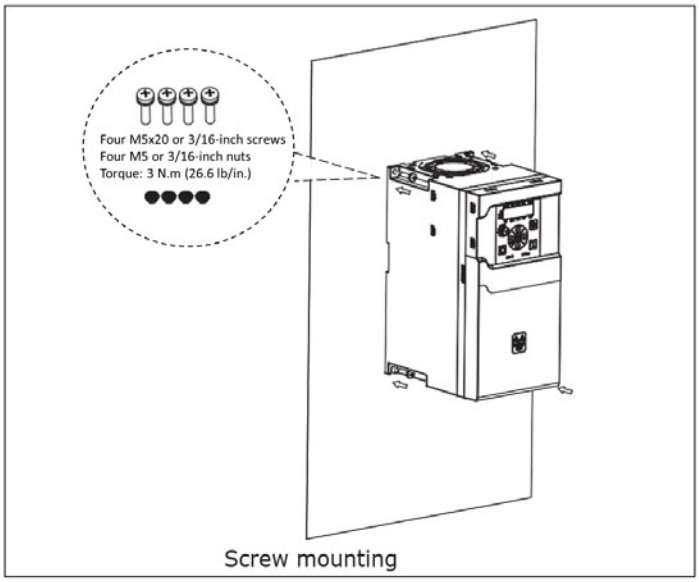
Lift the drive out from the carton and remove the packaging. The magnetic cores and cable ties are only included in EMI version drive.

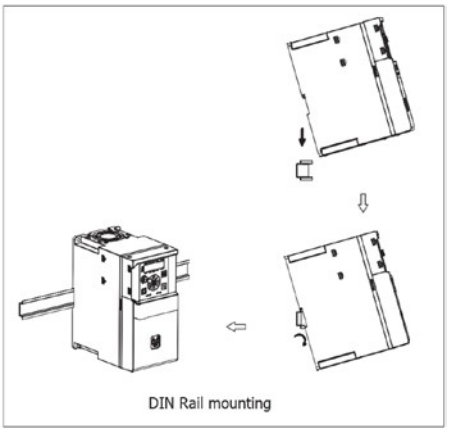


Step 2:

Screw mounting: Attach the drive to the mounting plate with two M5x20 (or 3/16 in.) screws and two M5 (or 3/16 in.) nuts. The opening dimension on the mounting plate should follow required dimensions (refer to the dimension drawing in Table 1 of this document).

DIN Rail mounting: Lift the drive at an angle about 30 degrees. Align the top hooks of drive DIN rail mounting slot with DIN rail top edge. Push down and rotate the drive to clip the bottom hooks on the bottom DIN rail edge.





Step 3: (EMI version only)

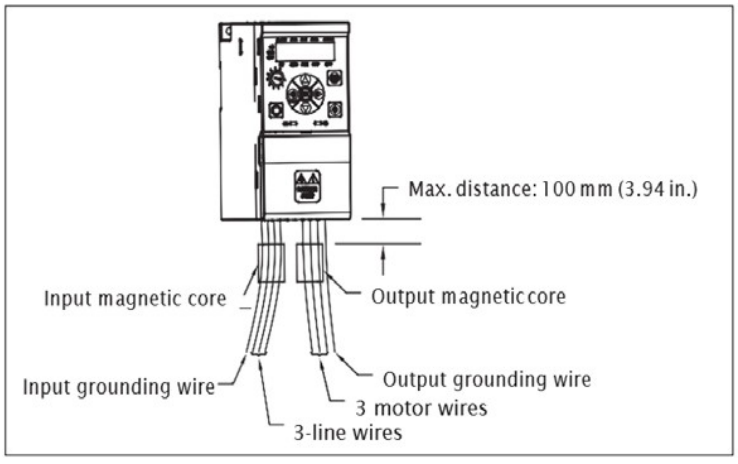
Input wiring:

• 1P FR1 EMI version: Run the input wires (two line wires+one grounding wire) through the input magnetic core before connecting to the input terminal block (L2/L3) and grounding hole. Tie the input magnetic core to the input wires with a cable tie.
• 3P 230/480 V FR1 EMI version: Run the input wires (three line wires + one grounding wire) through the input magnetic core before connecting to the input terminal block (L1/L2/L3) and grounding hole. Tie the input magnetic core to the input wires with a cable tie

Output wiring:

• All1P/3P FR1 EMI version: Run three motor wires through the output magnetic core before connecting to the output terminal block. The output grounding wire should not run through the output magnetic core. Tie the output magnetic core to the output wires with a cable tie.

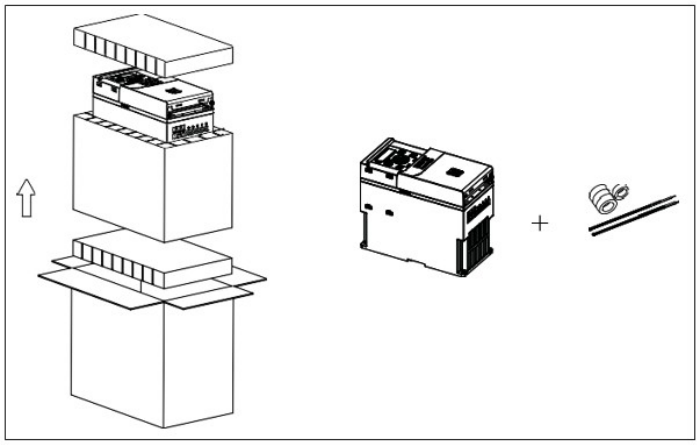
The maximum distance between the input/output magnetic core's top surface is 100 mm (3.94 in.). All EVM non-EMI version drives do not have input/output magnetic cores.



FR2 Mounting Instructions

Step 1:

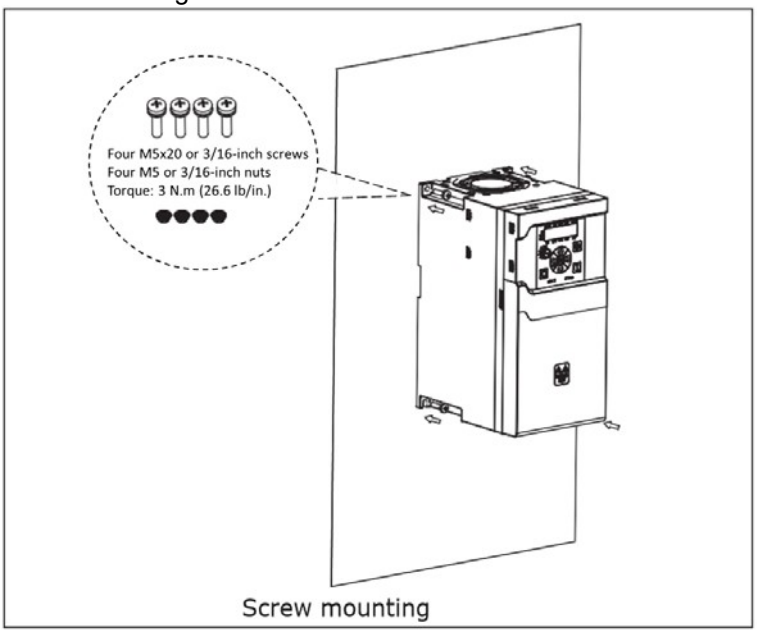
Lift the drive out from the carton and remove the packaging. The magnetic cores and cable ties are only included in EMI version drive.

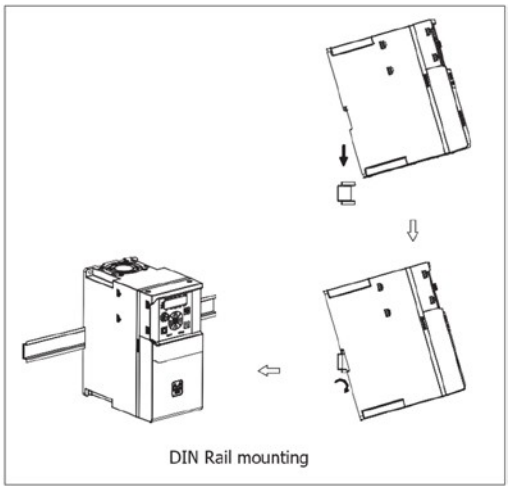


Step 2:

Screw mounting: Attach the drive to the mounting plate with four M5X20 (or 3/16 in.) screws and four M5 (or 3/16 in.) nuts. The opening dimension on the mounting plate should follow required dimensions (refer to the dimensions in Table 1).

DIN Rail mounting: Lift the drive at an angle about 30 degrees. Align the top hooks of drive DIN rail mounting slot with DIN rail top edge. Push down and rotate the drive to clip the bottom hooks on the bottom DIN rail edge.





Step 3: (EMI version only)

Input wiring:

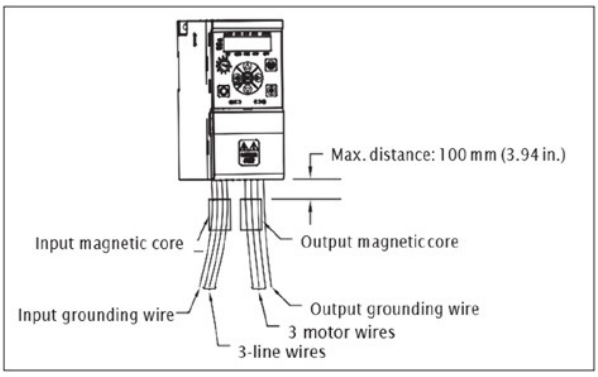
• 1P FR2 EMI version: Run the input wires (two line wires + one grounding wire) through the input magnetic core before connecting to the input terminal block (L2/L3) and grounding hole. Tie the input magnetic core to the input wires with a cable tie.

• 3P 230/480 V FR2 EMI version: Run the input wires (three line wires + one grounding wire) through the input magnetic core before connecting to the input terminal block (L1/L2/L3) and grounding hole. Tie the input magnetic core to the input wires with a cable tie.

• 3P 575 V FR2 EMI version: Does not have input magnetic core. Connect the three line wires to the input terminal block (L1/L2/L3) directly.

Output wiring:

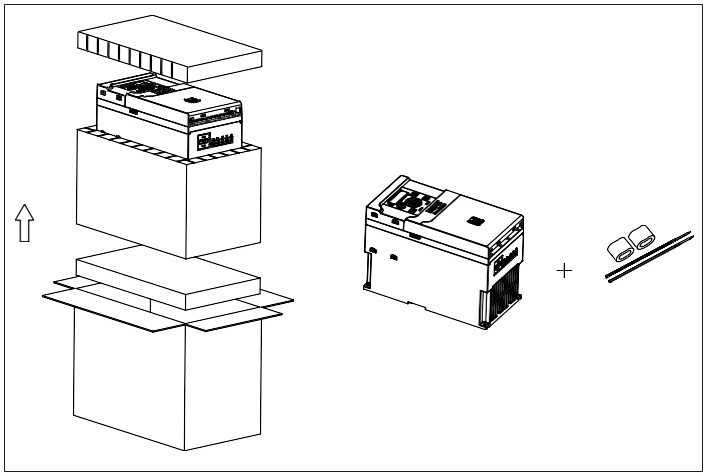
• All1P/3P FR2 EMI version: Run three motor wires through the output magnetic core before connecting to the output terminal block. The output grounding wire should not run through the output magnetic core. Tie the output magnetic core to the output wires with a cable tie. The maximum distance between the input/output magnetic core's top surface is 100 mm (3.94 in.). All EVM non-EMI version drives do not have input/output magnetic cores.



FR3 Mounting Instructions

Step 1:

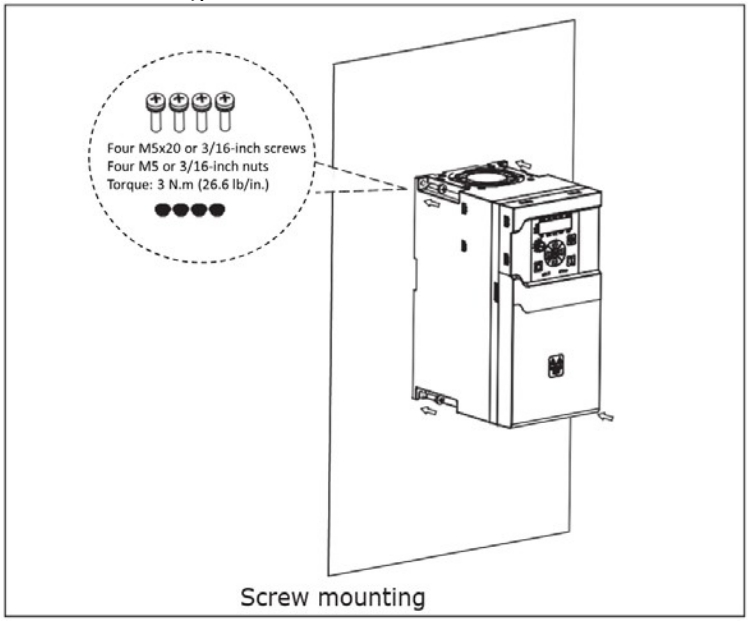
Lift the drive out from the carton and remove the packaging. The magnetic cores and cable ties are only included in EMI version drive.

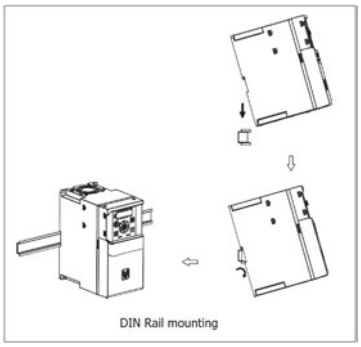


Step 2:

Screw mounting: Attach the drive to the mounting plate with four M5X20 (or 3/16 in.) screws and four M5 (or 3/16 in.) nuts. The opening dimension on the mounting plate should follow required dimension (refer to the dimension drawing in Table 1 of this document)

DIN Rail mounting: Lift the drive at an angle about 30 degrees. Align the top hooks of drive DIN rail mounting slot with DIN rail top edge. Push down and rotate the drive to clip the bottom hooks on the bottom DIN rail edge





Step 3: (EMI Version Only)

Input wiring:

• 1P FR3 EMI version: Run the input wires (two line wires+one grounding wire) through the input magnetic core before connecting to the input terminal block (L2/L3) and grounding hole. Tie the input magnetic core to the input wires with a cable tie.

• 3P 230/480 V FR3 EMI version: Run the input wires (three line wires + one grounding wire) through the input magnetic core before connecting to the input terminal block (L1/L2/L3) and grounding hole. Tie the input magnetic core to the input wires with a cable tie.

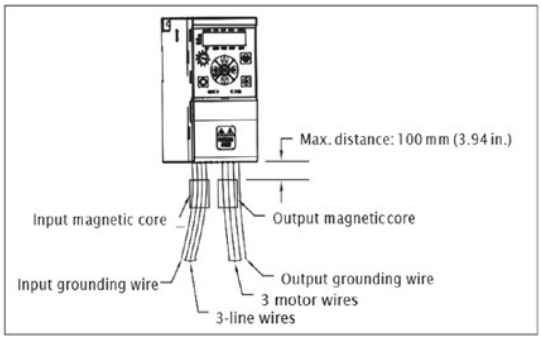
• 3P 575 V FR3 EMI version: Run the input wires (three line wires) through the input magnetic core before connecting to input terminal block (L1/L2/L3). The input grounding wire should not run through the input magnetic core. Tie the input magnetic core to the input wires with a cable tie.

Output wiring:

• 1P FR3 EMI Version: Does not have an output magnetic core. Connect three motor wires to the output terminal block directly.

• 3P 230/480/575 V FR3 EMI Version: Run three motor wires through the output magnetic core before connecting to output terminal block. The output grounding wire should not run through the output magnetic core. Tie the output magnetic core to the output wires with a cable tie.

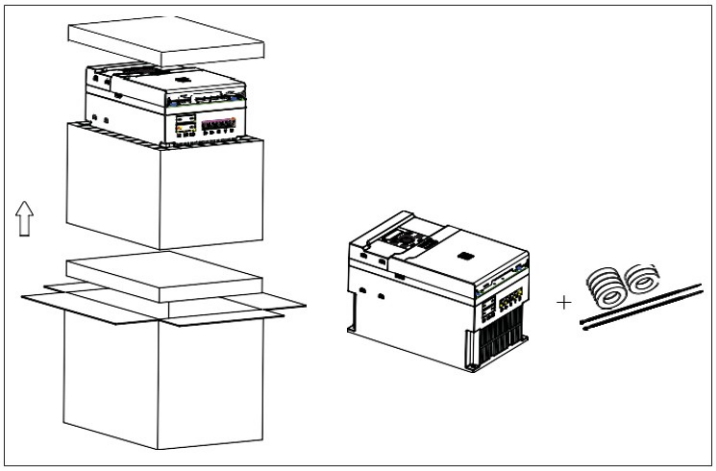
The maximum distance between the input/output magnetic core's top surface is 100 mm (3.94 in.). All EVM non-EMI version drives do not have input/output magnetic cores.



FR4 Mounting Instructions

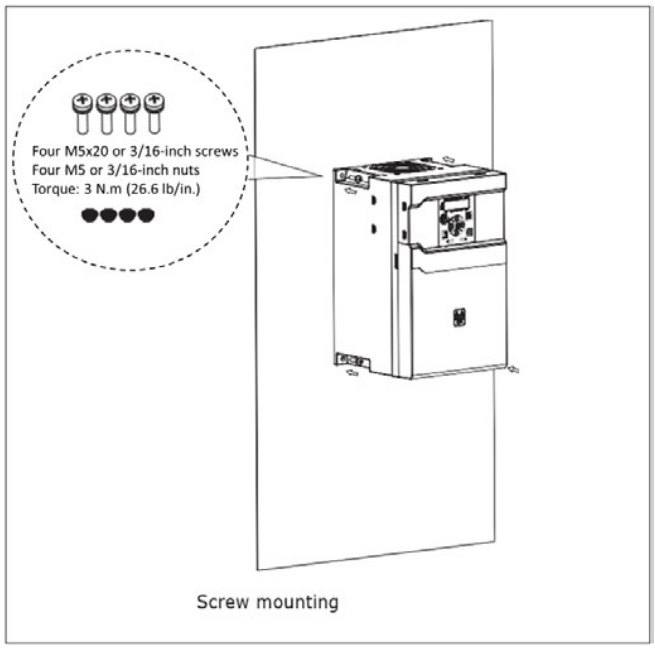
Step 1:

Lift the drive out from the carton and remove the packaging. The magnetic cores and cable ties are only included in EMI version drive.



Step 2:

Screw mounting: Attach the drive to the mounting plate with four M5x20 (or 3/16 in.) screws and four M5 (or 3/16 in.) nuts. The opening dimension on the mounting plate should follow required dimension (refer to the dimension drawing in the instruction leaflet).



Step 3: (EMI version only)

Input wiring:

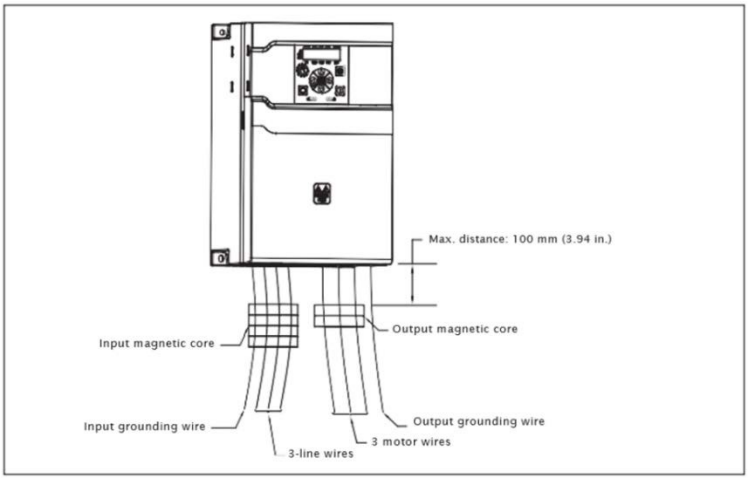
3P 230/480 V FR4 EMI version: Run the input wires (three line wires + one grounding wire) through the input magnetic core before connecting to the input terminal block (L1/L2/L3) and grounding hole. Tie the input magnetic core to the input wires with a cable tie.

3P 575 V FR4 EMI version: Run the input wires (three line wires) through the input magnetic core before connecting to input terminal block (L1/L2/L3). The input grounding wire should not run through the input magnetic core. Tie the input magnetic core to the input wires with a cable tie.

Output wiring:

3P 230/480/575 V FR4 EMI Version: Run three motor wires through the output magnetic core before connecting to output terminal block. The output grounding wire should not run through the output magnetic core. Tie the output magnetic core to the output wires with a cable tie.

The maximum distance between the input/output magnetic core's top surface is 100 mm (3.94 in.). All EVM non-EMI version drives do not have input/ output magnetic cores.



Mounting Instruction for Option Cards

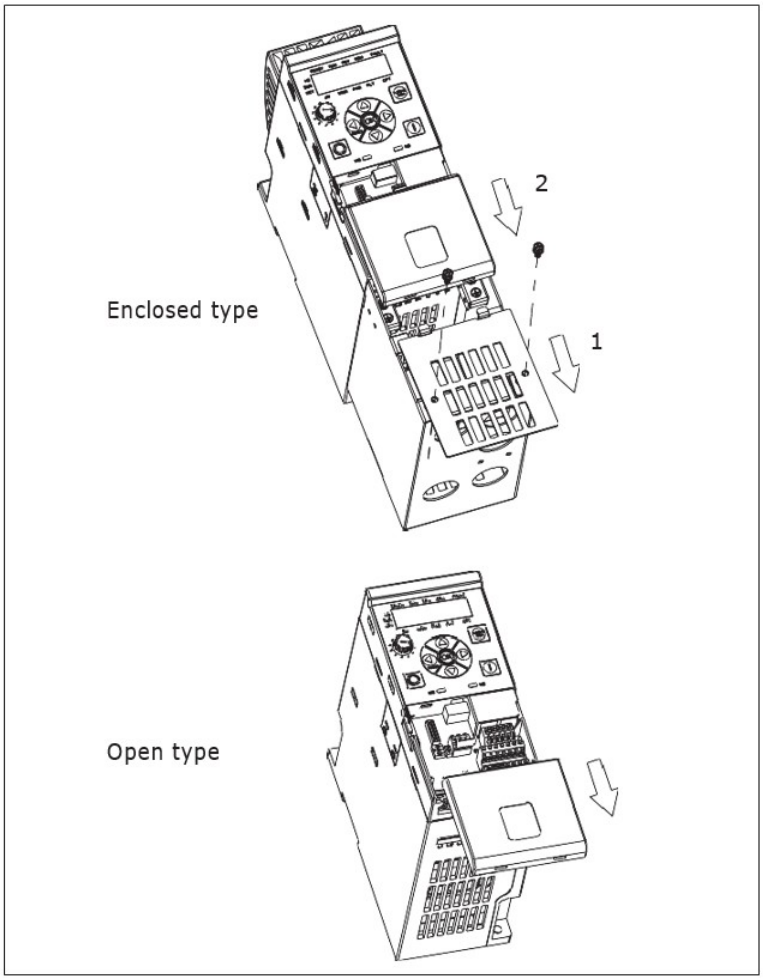
Step 1:

For enclosed type:

Remove the front cover (1) from the NEMA 1 kit then remove the terminal cover (2) from the drive.

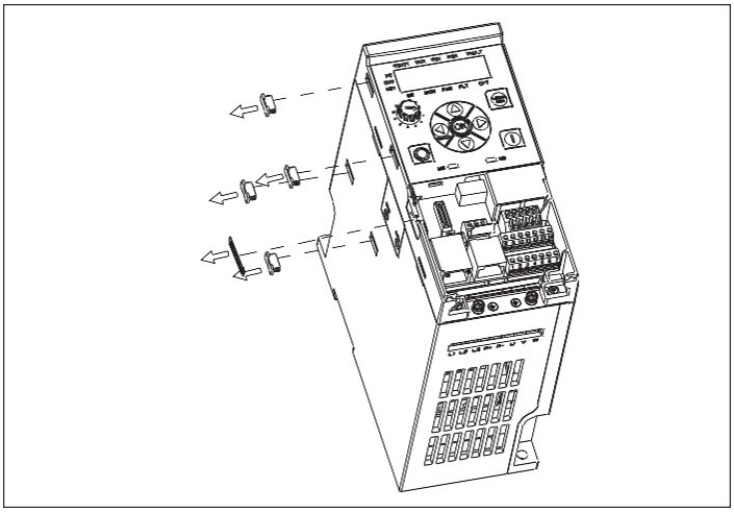
For open type:

Only remove the terminal cover.



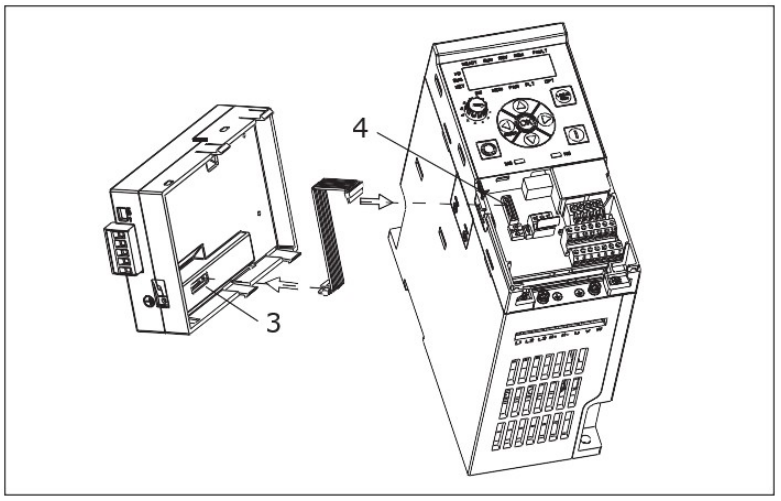
Step 2:

Remove the option card port label and four snap covers from the drive.



Step 3:

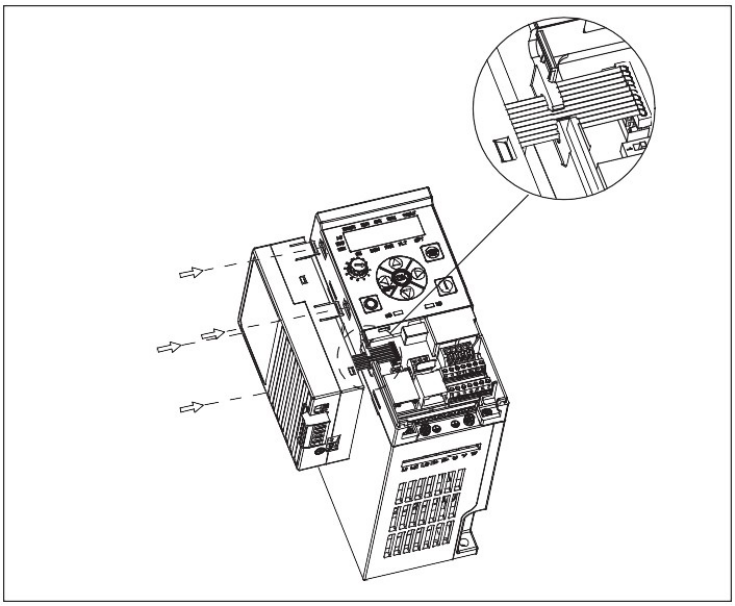
Connect the cable to option card connector (3) and MCU board connector (4).



Continue on next page

Step 4:

Clamp the cable with the optional card port. Mount the option card to the drive by inserting the four snaps into the slots on drive.



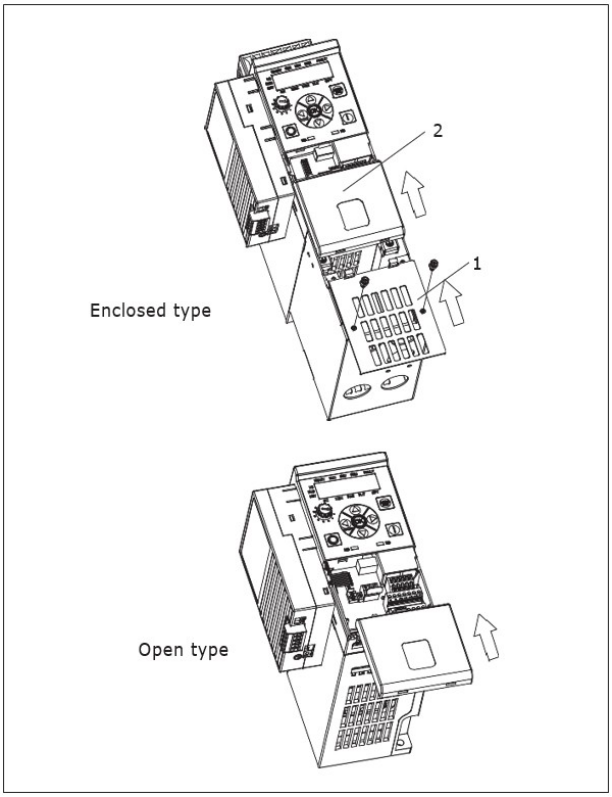
Step 5:

For enclosed type:

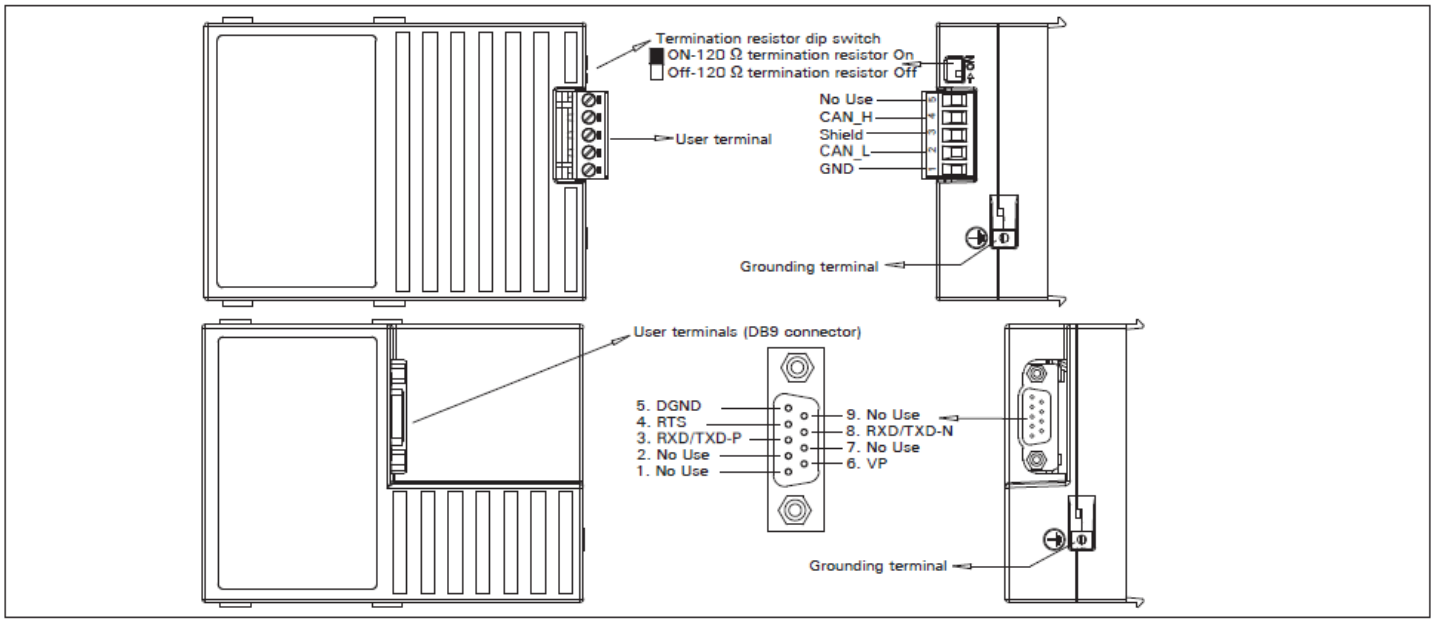
Install the terminal cover (1) to the drive then install the front cover (2) to the NEMA 1-kit.

For open type:

Only install the terminal cover to the drive.

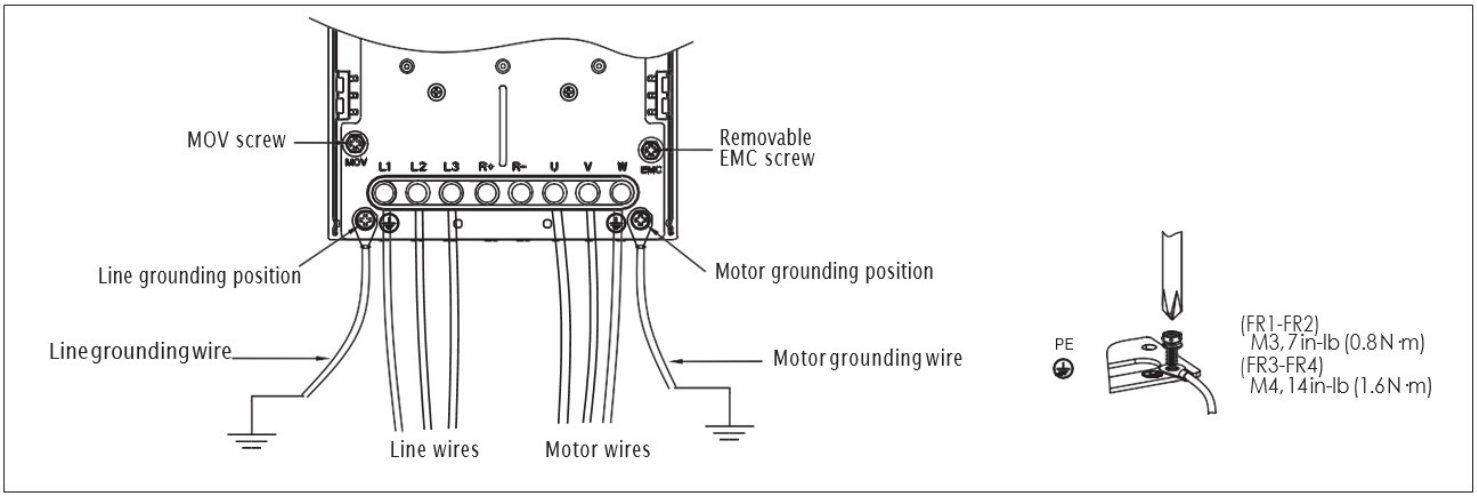


Option Card Wiring Instruction



Ground Wiring

Warning!
Connect only in voltage-free state!



Input power and motor cable stripping lengths

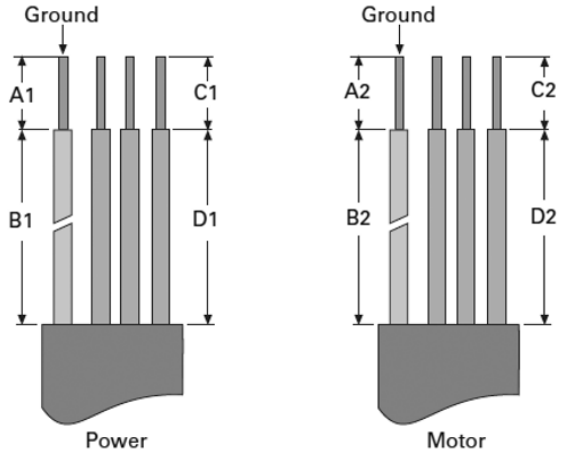


Table 3. Stripping Lengths

	Power Wiring in Inches (mm)				Motor Wiring in Inches (mm)			
Size	**A1**	**B1**	**C1**	**D1**	**A2**	**B2**	**C2**	**D2**
FR1	0.39 (10)	2.76 (70)	0.3 (10)	2.76 (70)	0.39 (10)	2.76 (70)	0.39 (10)	2.76 (70)
FR2	0.47 (12)	2.76 (70)	0.4 (12)	2.76 (70)	0.47 (12)	2.76 (70)	0.47 (12)	2.76 (70)
FR3	0.47 (12)	3.54 (90)	0.4 (12)	3.54 (90)	0.47 (12)	3.54 (90)	0.47 (12)	3.54 (90)
FR4	0.79 (20)	4.53 (115)	0.7 (20)	4.53 (115)	0.79 (20)	4.53 (115)	0.79 (20)	4.53 (115)

Power Connection Tightening Torque

Frame Size	Power wire in-lb (Nm)	Ground wire in-lb (Nm)	Control wire in-lb (Nm)
FR1	4.4 (0.5)	7.1 (0.8)	1.73 (0.2)
FR2	10.5 (1.2)	7.1 (0.8)	1.73 (0.2)
FR3	10.5 (1.2)	14.2 (1.6)	1.73 (0.2)
FR4	33 (3.73)	14.2 (1.6)	1.73 (0.2)

Notes:

- Strip the motor and power cables as shown above.
- Both UL and IEC tools may be used
- Applies to strained wire, solid wire, or ferrule installations

Circuit Breaker Sizing

The circuit breaker selected must be in accordance with the National Electric Code (NEC) Requirements. The NEC determines that circuit breakers should handle 80% of their rated capacity for continuous loads and 100% for intermittent loads. NEC Articles 210.20, 215.3, and 430 address the NEC requirements in more detail. For safety reasons it is recommended to assume all loads are continuous.

To explain the process for finding the minimum breaker size necessary, please complete the following:

1. Find your total current load of the circuit (ex: 13.7)
2. Multiply your current load by 1.25 to find your minimum breaker size (ex: 13.7*1.25=17.125)
3. Find the correct breaker to match the size you found in #2. If it is not a standard size, per the NEC, select the next standard size up. For our example we would select a 20A breaker.

Cable and Fuse Guidelines

UL Cable Fuse Sizes

		Output rating	Input rating	UL application							
Input voltage	Frame size	VT/I_L current amps	VT/I_L current amps	Recommended fuse (Class J, T, CF or CC) (max rating) 100 kAIC①	Recommended miniature inverse-time molded-case circuit breaker (max rating) 10/14 kAIC①	Recommended Type E CMC (max rating) 65 kAIC②	Recommended inverse-time molded-case circuit breaker (max rating) 100 kAIC (open type only for 3-phase)①	NEC wire size line and motor AWG	NEC wire size ground AWG	Terminal size line and motor AWG	Terminal size ground AWG
100 Vac to 120 Vac 50/60 Hz 1-phase	FR1	2.5	10	30	30	\	30	14	10	18-8	16-8
		4.8	20	70	63	\	70	10	8	18-8	16-8
	FR2	6.9	26.4	90	63	\	90	8	8	20-6	12-6
		7.8	30	125	63	\	125	8	6	20-6	12-6
200 Vac to 240 Vac 50/60 Hz 1-phase	FR1	2.5	6.5	15	15	\	15	14	14	18-8	16-8
		4.8	11	30	30	\	30	14	10	18-8	16-8
		7.8	17	60	63	\	60	10	8	18-8	16-8
	FR2	11	23	80	63	\	80	10	8	20-6	12-6
		17.5	35	125	63	\	125	8	6	20-6	12-6
	FR3	25.3	49.6	200	\	\	200	6	6	20-6	8-6
200 Vac to 240 Vac 50/60 Hz 3-phase	FR1	2.5	3.3	6	5	6.3	15	14	14	18-8	16-10
		4.8	5.8	15	10	6.3	15	14	14	18-8	16-10
		7.8	9.4	20	15	10	15	14	12	18-8	16-10
		11	13.2	30	20	16	20	12	10	18-8	16-10
200 Vac to 240 Vac 50/60 Hz 3-phase	FR2	17.5	20.1	40	30	25	30	10	10	20-6	12-8
		25.3	29.1	60	40	32	45	8	10	20-6	12-8
	FR3	32.2	37	70	50	40	50	8	8	20-6	10-8
	FR4	48.3	53.1	100	\	\	80	4	8	20-2	8-6
		62.1	68.3	125	\	\	100	3	6	20-2	8-6

Notes:

· Can be any UL listed types with the same ratings.

UL Cable Fuse Sizes (continued)

		Output rating	Input rating	UL application							
Input voltage	Frame size	VT/I, current amps	VT/I, current amps	Recommended fuse (Class J, T, CF or CC) (max rating) 100 kAIC①	Recommended miniature inverse-time molded-case circuit breaker (max rating) 10/14 kAIC①	Recommended Type E CMC (max rating) 65 kAIC②	Recommended inverse-time molded-case circuit breaker (max rating) 100 kAIC (open type only for 3-phase)①	NEC wire size line and motor AWG	NEC wire size ground AWG	Terminal size line and motor AWG	Terminal size ground AWG
380 Vac to 480 Vac 50/60 Hz 3-Phase	FR1	2.2	2.6	6	4	6.3	15	14	14	18-8	16-10
		4.3	5.2	10	8	6.3	15	14	14	18-8	16-10
		5.6	6.7	15	10	10	15	14	14	18-8	16-10
		7.6	9.1	30	15	10	15	14	10	18-8	16-10
	FR2	12	14.4	30	20	16	20	12	10	20-6	12-8
		16	19.2	40	25	25	30	10	10	20-6	12-8
		23	27.6	60	32	32	40	8	10	20-6	12-8
	FR3	31	35.7	70	\	40	50	8	8	20-6	10-8
	FR4	38	43.7	70	\	50	70	6	8	20-2	8-6
		46	52.9	80	\	58	80	4	8	20-2	8-6
525 Vac to 600 Vac 50/60 Hz 3-Phase	FR2	7.5									
		10									
		13.5									
	FR3	18									
	FR4	22									
		27									

Notes:

· Can be any UL listed types with the same ratings.

IEC Cable Fuse Sizes

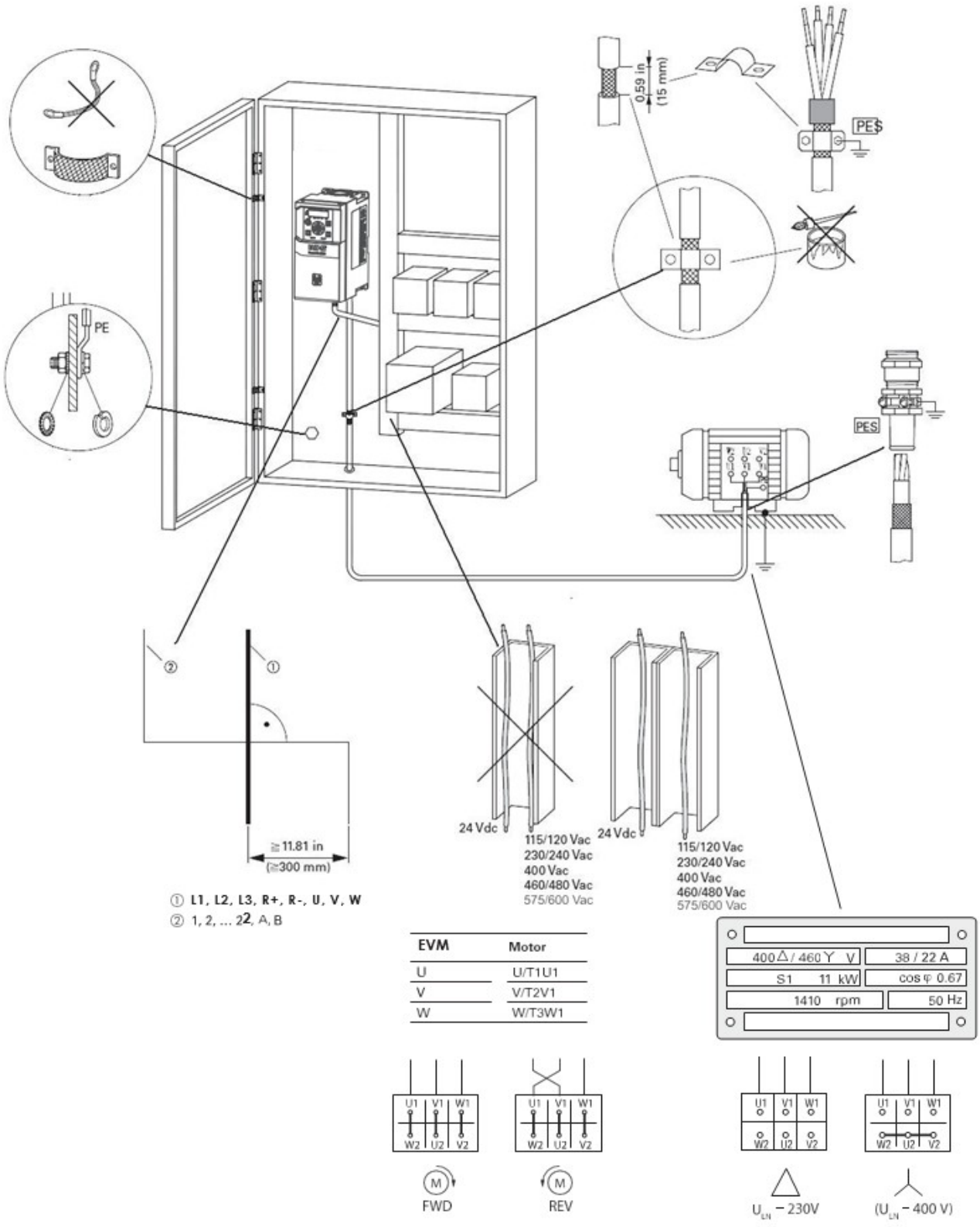
		Output rating	Input rating	IEC application							
Input voltage	Frame size	VT/I$_L$ current amps	VT/I$_L$ current amps	Recommended fuse (max rating) 100 kAIC	Recommended miniature circuit breaker (max rating) 10/14 kAIC	Recommended Type E CMC (max. rating) 65 kAIC	Recommended circuit breaker (max rating) 100 kAIC (open type only for 3-phase)	IEC cable size line and motor mm^2	IEC cable size ground mm^2	Terminal size line and motor mm^2	Terminal size ground mm^2
100 Vac to 120 Vac 50/60 Hz 1-phase	FR1	2.5	10	30	30	\	30	2.5	2.5	0.2-6	1-6
		4.8	20	70	63	\	70	6	6	0.2-6	1-6
	FR2	6.9	26.4	90	63	\	90	10	10	0.5-16	1-10
		7.8	30	125	63	\	125	10	10	0.5-16	1-10
200 Vac to 240 Vac 50/60 Hz 1-phase	FR1	2.5	6.5	15	15	\	15	2.5	2.5	0.2-6	1-6
		4.8	11	30	30	\	30	2.5	2.5	0.2-6	1-6
		7.8	17	60	63	\	60	6	6	0.2-6	1-6
	FR2	11	23	80	63	\	80	6	6	0.5-16	1-10
		17.5	35	125	63	\	125	10	10	0.5-16	1-10
	FR3	25.3	49.6	200	\	\	200	16	16	0.5-16	1.5-6
200 Vac to 240 Vac 50/60 Hz 3-phase	FR1	2.5	3.3	6	5	6.3	15	2.5	2.5	0.2-6	1.5-6
		4.8	5.8	15	10	6.3	15	2.5	2.5	0.2-6	1.5-6
		7.8	9.4	20	15	10	15	2.5	2.5	0.2-6	1.5-6
		11	13.2	30	20	16	20	4	4	0.2-6	4-10
	FR2	17.5	20.1	40	30	25	30	6	6	0.5-16	4-10
		25.3	29.1	60	40	32	45	10	10	0.5-16	6-10
	FR3	32.2	37	70	50	40	50	10	10	0.5-16	10-16
	FR4	48.3	53.1	100	\	\	80	25	16	0.535	10-16
		62.1	68.3	125	\	\	100	35	16	0.535	10-16

IEC Cable Fuse Sizes (continued)

		Output rating	Input rating	IEC application							
Input voltage	Frame size	VT/I$_h$ current amps	VT/I$_h$ current amps	Recommended fuse (max rating) 100 kAIC	Recommended miniature circuit breaker (max rating) 10/14 kAIC	Recommended Type E CMC (max. rating) 65 kAIC	Recommended circuit breaker (max rating) 100 kAIC (open type only for 3-phase)	IEC cable size line and motor mm^2	IEC cable size ground mm^2	Terminal size line and motor mm^2	Terminal size ground mm^2
380 Vac to 480 Vac 50/60 Hz 3-Phase	FR1	2.2	2.6	6	4	6.3	15	2.5	2.5	0.2-6	1.5-6
		4.3	5.2	10	8	6.3	15	2.5	2.5	0.2-6	1.5-6
		5.6	6.7	15	10	10	15	2.5	2.5	0.2-6	1.5-6
		7.6	9.1	30	15	10	15	2.5	2.5	0.2-6	1.5-6
	FR2	12	14.4	30	20	16	20	4	4	0.5-16	4-10
		16	19.2	40	25	25	30	6	6	0.5-16	4-10
		23	27.6	60	32	32	40	10	10	0.5-16	4-10
	FR3	31	35.7	70	\	40	50	10	10	0.5-16	6-10
	FR4	38	43.7	70	\	50	70	16	16	0.535	10-16
		46	52.9	80	\	58	80	25	16	0.535	10-16
525 Vac to 600 Vac 50/60 Hz 3-phase	FR2	7.5									
		10									
		13.5									
	FR3	18									
	FR4	22									
		27									

Drive to Motor Connection Panel Mount

EMC-Compliant setup – 230Vac, 460/480 Vac, 600 Vac



Cable routing

If conduit is being used for wiring, use separate conduits for line voltage (mains), motor cables, and all interface/control wiring.

To meet the UL requirements, if conduit is being used for wiring, the enclosure openings provided for conduit connections in the field shall be closed by UL listed conduit fittings with the same type rating (Type 1) as the enclosure.

Avoid running motor cables alongside or parallel to any other wiring. If it is necessary to run motor cables with other wiring, then maintain spacing between motor cables and other wiring.

Wiring the VFD

If three or more motor cables are used, each conductor must have its own overcurrent protection.

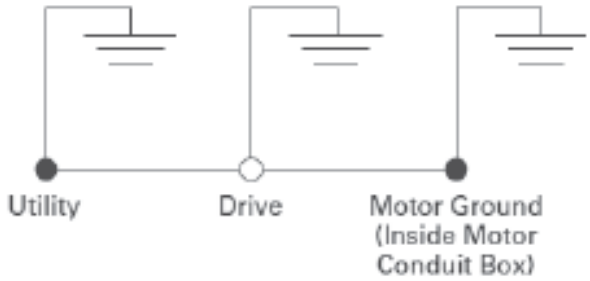
Note: Do not wire motor leads to R+, R–. This will cause

damage to the drive.

Note: Actual layout may vary slightly by frame.

Ground wiring

- Run motor cables in separate conduit
- DO NOT RUN CONTROL WIRES in same conduit
- Cables sized per Appendix B
- Provide dedicated wire for low impedance ground between drive and motor. DO NOT USE conduit as ground



CAUTION

Improper grounding could result in damage to the motor and/or drive and could void warranty.

Checking the cable and motor insulation

1. **Check the motor cable insulation as follows:**
   - Disconnect the motor cable from terminals U, V and W of the EVM drive and from the motor
   - Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor
   - The insulation resistance must be >1M ohm
2. **Check the input power cable insulation as follows:**
   - Disconnect the input power cable from terminals L1, L2 and L3 of the EVM drive and from the utility line feeder
   - Measure the insulation resistance of the input power cable between each phase conductor as well as between each phase conductor and the protective ground conductor
   - The insulation resistance must be >1M ohm
3. **Check the motor insulation as follows:**
   - Disconnect the motor cable from the motor and open any bridging connections in the motor connection box
   - Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed (1.1 * 2* Sqrt (2) X Vdc).
   - The insulation resistance must be >1M ohm

EMC Installation

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has been completed.

The responsibility to meet the local system EMC limit values and electromagnetic compatibility requirements is the responsibility of the end user or the system operator. This operator must also take measures to minimize or remove emissions in the environment concerned (see Figure below). He must also use means to increase the interference immunity of the system devices.

In a drive system (PDS) with frequency inverters, you should take measures for electromagnetic compatibility (EMC) while doing your planning, because changes or improvements to the installation site, which are required in the installation or while mounting, are normally associated with additional higher costs.

The technology and system of a frequency inverter cause the flow of high frequency leakage current during operation. All grounding measures must therefore be implemented with low impedance connections over a large surface area.

With leakage currents greater than 3.5 mA, in accordance with VDE 0160 or EN 61800-5-1, either

- the protective earthing conductor must have a cross-section of at least 10 mm2 Cu
- the protective earthing conductor must be open-circuit monitored, and the supply must be automatically disconnected in case of discontinuity of the protective earthing conductor, or
- the second protective earthing conductor must be fitted

For an EMC-compliant installation, we recommend the following measures:

- Installation of the frequency inverter in a metallic, electrically conducting enclosure with a good connection to earth
- Shielded motor cables (short cable lengths)
- Ground all conductive components and housings in a drive system using as short a line as possible with the greatest possible cross-section (Cu-braid)

EMC measures in the control panel

For EMC-compatible installation, connect all metallic parts of the device and the switching cabinet together over broad surfaces and so that high-frequencies will be conducted. Mounting plates and cabinet doors should make good contact and be connected with short HF-braided cables. It is recommended to avoid using painted surfaces (anodized, chromized). An overview of all EMC measures is provided below.

Install the frequency inverter as directly as possible (without spacers) on a metal plate (mounting plate).

Route input and motor cables in the switch cabinet as close to the ground potential as possible. This is because free moving cables act as antennas.

When laying HF cables (for example, shielded motor cables) or suppressed cables (for example, input supply cables, control circuit and signal cables) in parallel, a minimum clearance of 11.81 in (300 mm) is recommended in order to prevent the radiation of electromagnetic energy. Separate cable routing is also recommended when large voltage potential differences are involved. Any necessary crossed cabling between the control signal and power cables should be implemented at right angles (90 degrees).

It is recommended to never lay control or signal cables in the same duct as power cables. Analog signal cables (measured, reference and correction values) should be shielded.

Note: The shielded cables need to be grounded according to section “Screen earth kit” to grounding.

Earthing

The ground connection (PE) in the cabinet should be connected from the input supply to a central earth point (mounting plate). All protective conductors should be routed in star formation from this earth point and all conductive components of the PDS (frequency inverter, motor reactor, motor filter, main choke) are to be connected.

Avoid ground loops when installing multiple frequency inverters in one cabinet. Make sure that all metallic devices that are to be grounded have a broad area connection with the mounting plate.

Screen earth kit

Cables that are not shielded work like antennas (sending, receiving). Make sure that any cables that may carry disruptive signals (for example, motor cables) and sensitive cables (analog signal and measurement values) are shielded apart from one another with EMC-compatible connections.

The effectiveness of the cable shield depends on a good shield connection and a low shield impedance.

It is recommended to use only shields with tinned or nickel-plated copper braiding. Braided steel shields are unsuitable.

Control and signal lines (analog, digital) should be grounded on one end, in the immediate vicinity of the supply voltage source (PES).

International EMC protection cable requirements

The screened cables between the variable frequency drive and the motor should be as short as possible.

- Connect the screening, on both sides and across a large area (360° overlap), to the protective earth (PE). The power screening protective earth (PES) connection should be in the immediate proximity of the variable frequency drive and directly on the motor terminal box
- Prevent the screening from becoming unbraided, e.g., by pushing the opened plastic sheath over the end of the screening or with a rubber grommet on the end of the screening. As an alternative, in addition to a broad area cable clip, you can also twist the shielding braid at the end and connect to protective ground with a cable clip. To prevent EMC disturbance, this twisted shielding connection should be made as short as possible
- Screened three- or four-wire cable is recommended for the motor cables. The green/yellow line of a four-wire cable connects the protective ground connections from the motor and the variable frequency drive and therefore minimizes the equalizing current loads on the shielding braid
- If there are additional subassemblies in a motor feeder (such as motor contactors, overload relays, motor reactor, sinusoidal filters or terminals), the shielding of the motor cable can be interrupted close to these subassemblies and connected to the mounting plate (PES) with a large area connection

Unsheilded or sheilded connection cables should not be any longer than about 200 mm.

Environment EMC levels

Cable Type	Category C2	Category C3	Category C4 ②
Line voltage/mains	1	1	1
Motor cable	3 ③	3	3
Control cable	4	4	4

[1] For EMC C2&C3 requirements on EVM drive, use provided core with input&output wires going through it once. Refer to section “FR1 mounting instructions”,”FR2 mounting instructions”,”FR3 mounting instructions” ,”FR4 mounting instructions”

[2] For installations in IT systems, it is necessary to modify the EMC protection to EMC level C4. See the following page for the procedure.

[3] 360° earthing of the shield with cable glands in motor end needed for EMC Level C2. See the following page for the procedure.

[4] Control cable needs to follow the section “screen earth kit” to grounding.

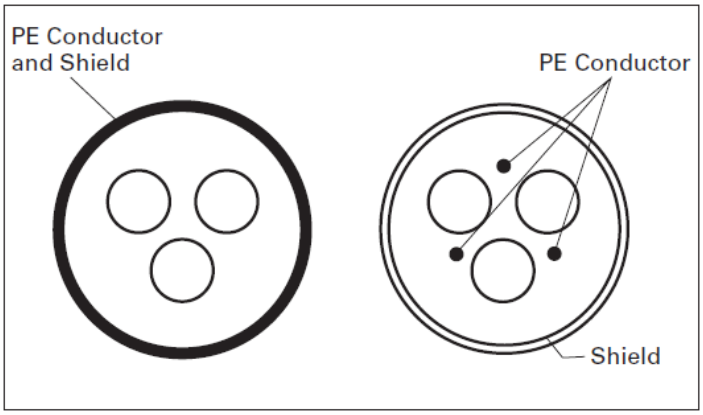
Motor power cable EMC guidelines.

Item	Directive
Product	IEC 61800-2
Safety	UL 61800-5-1, IEC/EN 61800-5-1
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3, 2nd environment
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	230/480V Series:
	Category C1: is possible with external filter connected to drive. Please consult factory
	Category C2: with internal filter maximum of 5 m motor cable length
	Category C3: with internal filter maximum of 25 m motor cable length

Cable categories

Cable category	Description (All cables are rated for the specific operating voltage)
1	Intended for fixed installation
2	Symmetrical power cable equipped with a concentric protection wire.
3	Symmetrical power cable with compact low-impedance shield. Recommended cable transfer impedance of 1–30 MHz max. See figure below.
4	Screened cable equipped with compact low-impedance shield

Cable description



Installation in corner-grounded network and IT system

Corner grounding and IT system are allowed for all the drive types.

In these circumstances the EMC protection class must be changed to level C4. This is done by removing the built-in EMC and MOV screws with a simple procedure described below.

⚠WARNING

Do not perform any modifications on the AC drive when it is connected to mains.

⚠WARNING

Electric shock hazard—risk of injuries! Carry out wiring work only if the unit is de-energized.

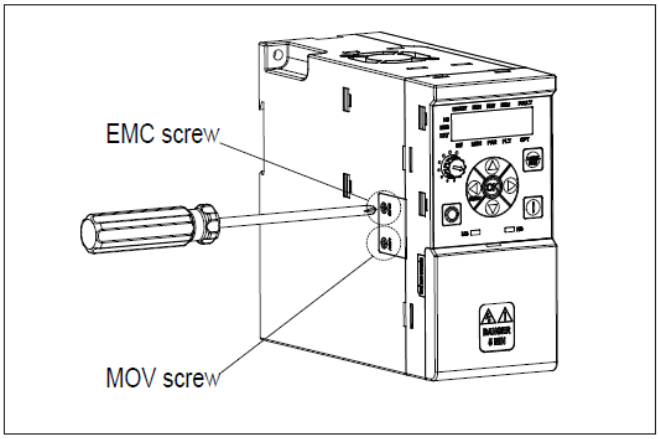
After disconnecting the supply, wait at least five minutes before removing the cover to allow the intermediate circuit capacitors to discharge.

⚠WARNING

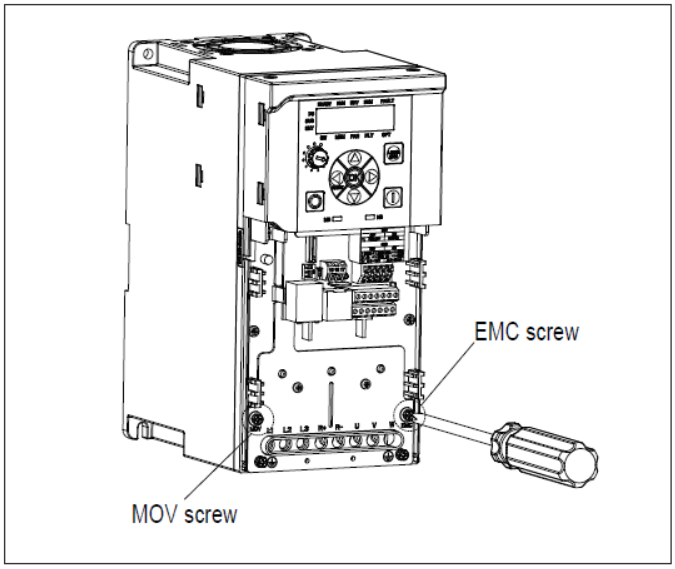
Failure to follow these instructions will result in death or serious injury.

Remove the main cover of the AC drive and remove the EMC/MOV screws depending on frame size (see following Figures). Once the screw is removed, it can be reconnected to re-engage the EMC protection.

Location of the EMC/MOV screw in frame 1.



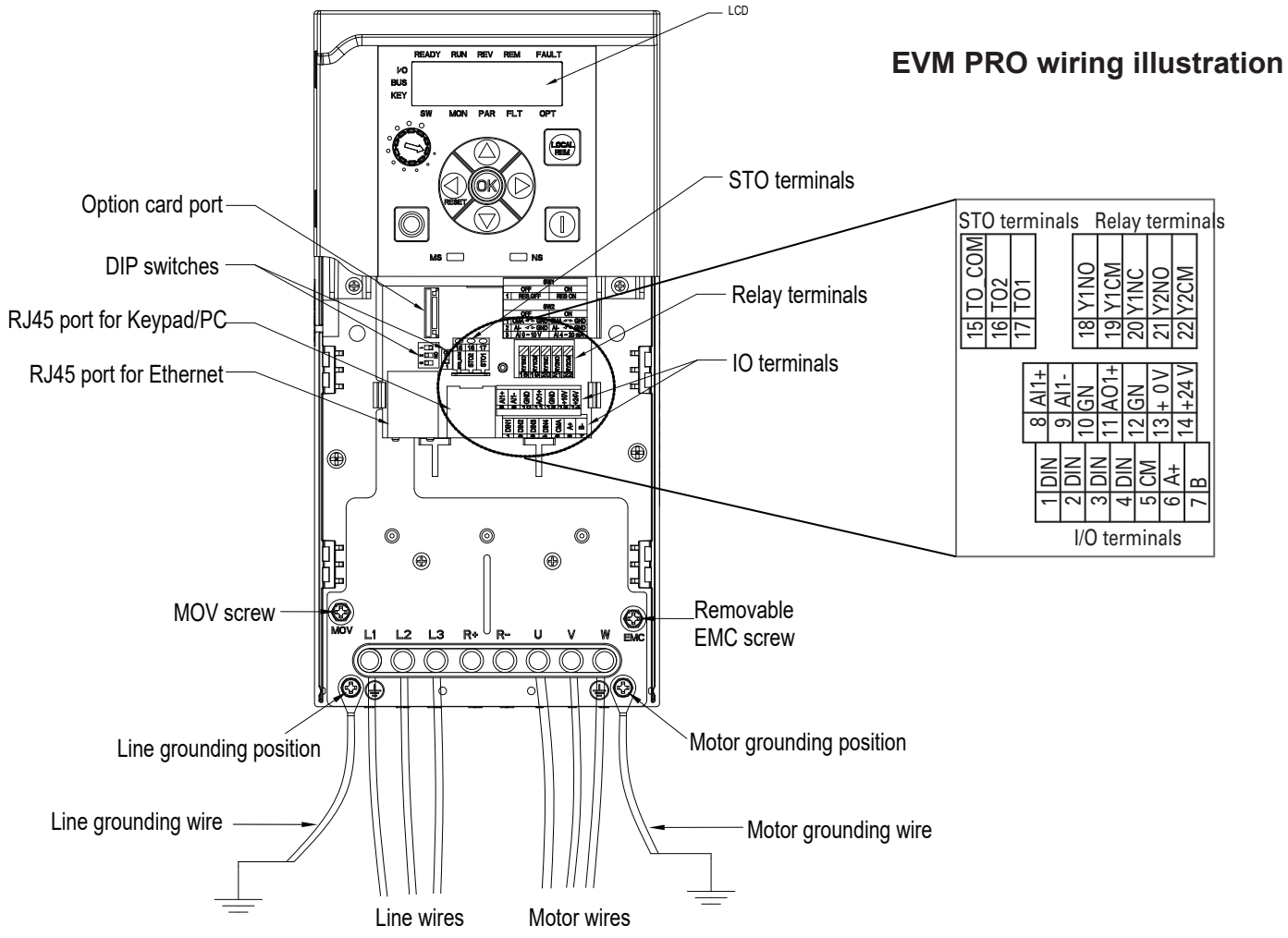
Location of the EMC/MOV screws in frame 2-4.



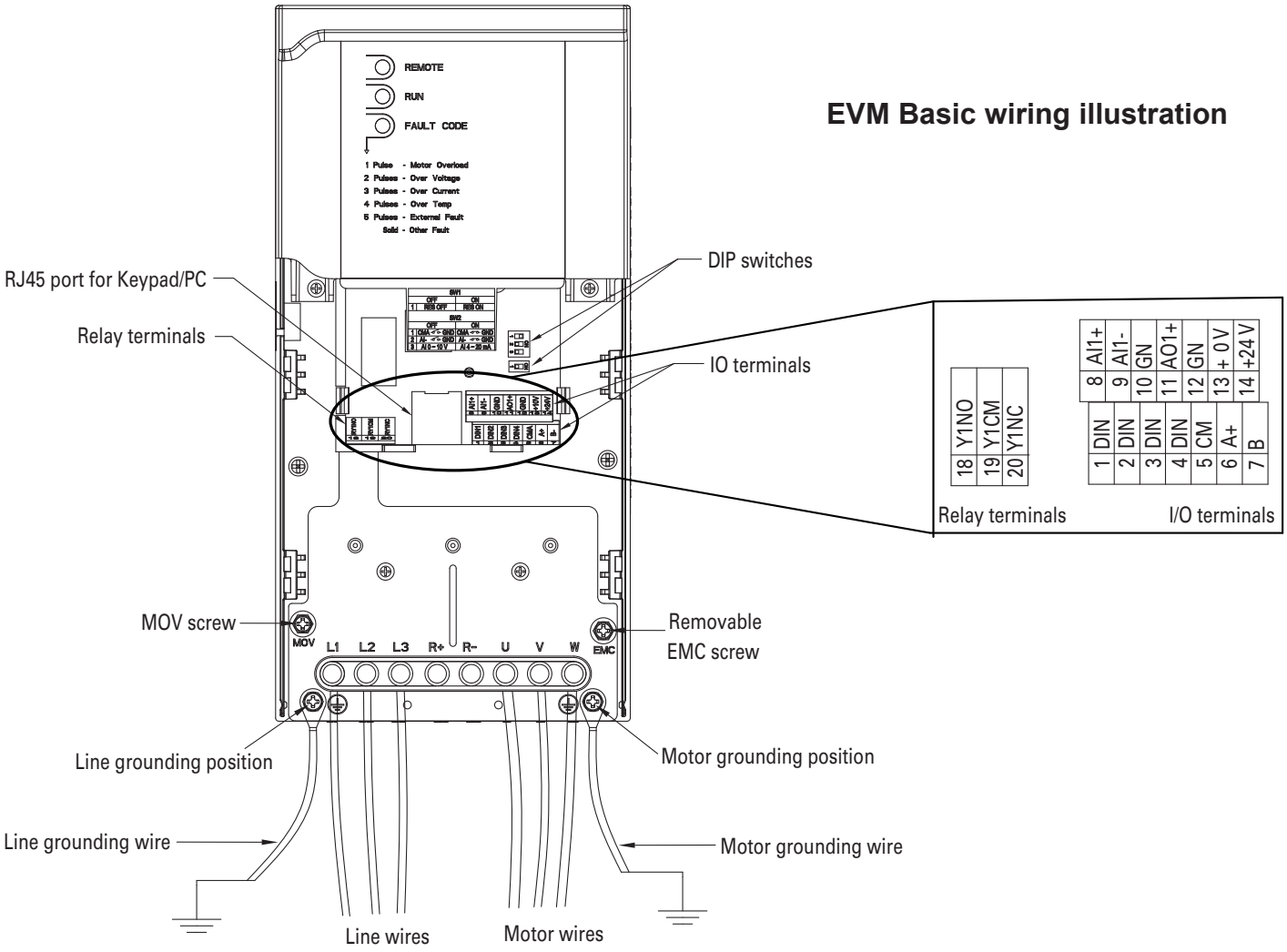
Verifying Rotation

When starting the compressor up for the first time, verify it is running in the correct direction. For pumps or compressors verify your discharge pressure starts to increase and your suction decreases. For fans make sure it is blowing air in the correct direction. If it is running in reverse, please see the box in the above diagram.

Step 3—Control board layouts



Control board layout (cont.)



Factory-Set Control Terminal Functions

I/O Connection

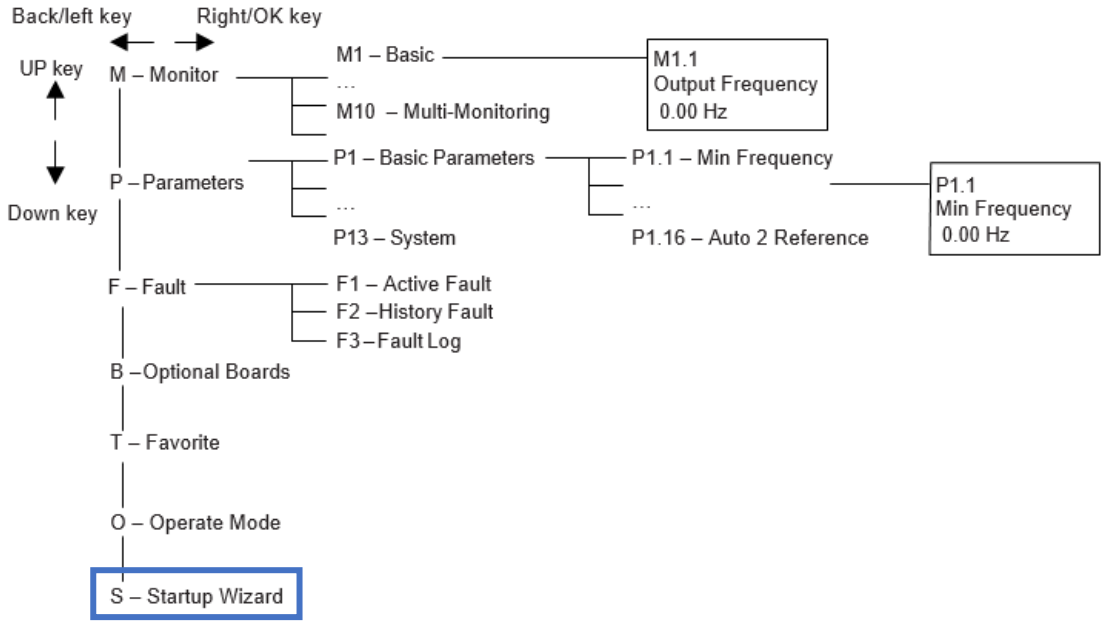
External wiring	Terminal	Short name	Name	Default setting	Description
	1	DI1	Digital input 1	Run forward	Starts the motor in the forward direction.
	2	DI2	Digital input 2	Run reverse	Start the motor in the reverse direction.
	3	DI3	Digital input 3	External fault	Triggers a fault in the drive.
	4	DI4	Digital input 4	Fault reset	Resets active faults in the drive.
	5	CMA	DI1 to DI4 common	Grounded	Allows for sourced input.
	6	A	RS-485 signal A	—	Fieldbus communication (Modbus RTU, BACNet).
	7	B	RS-485 signal B	—	Fieldbus communication (Modbus RTU, BACNet).
Res	8	AI1+ ①	Analog input 1	0 - 10 V	Voltage speed reference (programmable to 4 mA to 20 mA).
	9	AI1-	Analog input 1 ground	—	Analog input 1 common (ground).
	10	GND	I/O signal ground	—	I/O ground for reference and control.
	11	AO1+	Analog output 1	Output frequency	Shows output frequency to motor 0 - 60 Hz (4 mA to 20 mA).
	12	GND	I/O signal ground	—	I/O ground for reference and control.
	13	10 V	10 Vdc reference output	10.3 Vdc +/- 3%	10 Vdc reference voltage.
	14	24 V	24 Vdc control output	24 Vdc In/Out	Control voltage input/output (100 mA max.).
	15	STO_com	Safe torque common	—	Safe torque Off common.
	16	STO2	Safe torque Off 2	—	Safe torque Off 2 input.
	17	STO1	Safe torque Off 1	—	Safe torque Off 1 input.
	18	R1NO	Relay 1 normally open	Run	Changes state when the drive is in the run state.
	19	R1CM	Relay 1 common		
	20	R1NC	Relay 1 normally closed		
	21	R2NO	Relay 2 normally open	Fault	Changes state when the drive is in the fault state.
	22	R2CM	Relay 2 common		

Notes:

- The above wiring demonstrates a SINK configuration. It is important that CMA is wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and close the inputs to ground. When using the +10 V for AI1, it is important to wire AI1- to ground (as shown by dashed line).
- AI1+ support 10 K potentiometer.

Step 4 —Start-up and Set-up of Drive

Main menu navigation for startup



Startup Wizard

In the *Startup Wizard*, you will be prompted for essential information needed by the drive so that it can start controlling your process. In the Wizard, you will need the following keypad buttons:

Up/Down Buttons

Use these to change value

OK Button

Confirm selection and enter into next question

Back/Reset Button

If this was pressed at the first question, the startup wizard will be cancelled.

Once you have connected power to your Copeland EVM frequency converter, and the Startup Wizard is enabled, follow these instructions to easily set up your device.

Startup Wizard Instructions

For any further explanations of the below items please see Emerson AE bulletin AE-1456. Information for some items can be found in Copeland Mobile or OPI for the specific compressor model. For general motors, on the nameplate.

Par.	Par. Name	Min Value	Max Value	Default	Description
P13.1.7	Par. Password PIN	0	9999	0	Set a password: By default, the password function is not in use. If you want to activate the password, change the value of this parameter to any number between 1 and 9999. To deactivate the password, reset the parameter value to 0
P1.1	Minimum Freq	0.00 Hz	400 HZ	0.00 Hz	These define the frequency limits of the drive. These will limit other frequency parameter settings; preset speeds, jog speed, 4 mA fault preset speed, fire mode speed, and brake speed settings.
P1.2	Max Freq.	0.00 Hz	400.00 Hz	MaxFreqMFG	These define the frequency limits of the drive. The minimum frequency must be below the maximum frequency level. These will limit other frequency parameter settings; preset speeds, jog speed, 4 mA fault preset speed, fire mode speed, and brake speed settings.
P1.6	Motor Nominal Current	DriveNomCurrCT* 1/10A	DriveNomCurrCT* 2A	DriveNomCurrCT	Motor nominal nameplate full load current. Find this value on the rating plate of the motor.
P1.7	Motor Nominal Speed	300 RPM	20,000 RPM	MotorNomSpeedMFG	Motor nominal nameplate base speed. Find this value on the rating plate of the motor.
P1.8	Motor Power Factor	0.30	1.00	0.85	Motor nominal nameplate full load power factor. Find this value on the rating plate of the motor.
P1.9	Motor Nominal Voltage	180V	690V	487V	Motor nominal nameplate base voltage. Find this value on the rating plate of the motor.
P1.10	Motor Nominal Freq	8.00 Hz	400 Hz	MotorNomFreqMFG	Motor nominal nameplate base frequency. Find this value on the rating plate of the motor. This parameter sets the field weakening point (P8.4) to the same value.
P1.3	Accel. Time 1	0.10 s	3000.0 s	20.0 s	The time required for the output frequency to accelerate from zero frequency to maximum frequency (P1.2). When accelerating from different frequency levels, the acceleration time will be a fraction of the total ramp time.
P1.4	Decel. Time 1	0.10 s	3000.0 s	20.0 s	The time required for the output frequency to decelerate from maximum frequency (P1.2) to zero frequency. When decelerating from different frequency levels, the deceleration time will be a fraction of the total deceleration time.
P1.13	Remote Control Place	N.A	N.A	0	**0 = IO terminal; 1 = Fieldbus; or 3 = Keypad** Selects where the drive will look for the start command in the remote location: I/O terminals would be from the digital hard-wired inputs; fieldbus would be a communication bus; and keypad display will indicate what mode is selected
P1.14	Remote Ref.	N.A	N.A	0	**0 = AI; 1 = Drive reference pot; 2 = AI joystick; 3 = Motor pot; 4 = Maximum frequency; 5 = PI control output; 6 = Keypad; or 7 = Fieldbus reference.**
P13.5.3	Keypad Password PIN	0	9999	0	By default, the password function is not in use. If you want to activate the password, change the value of this parameter to any number between 1 and 9999. To deactivate the password, reset the parameter value to 0.
P11.6.1	Blue Tooth Enable	N.A	N.A	N.A	**0 = Disabled; or 1 = Enable.**

Now the Startup Wizard is done. It won't show again on the next power up. If you want to reset it, please set the Startup Wizard (P13.1.17) or select it from the main menu screen to enable and cycle the power to the drive.

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