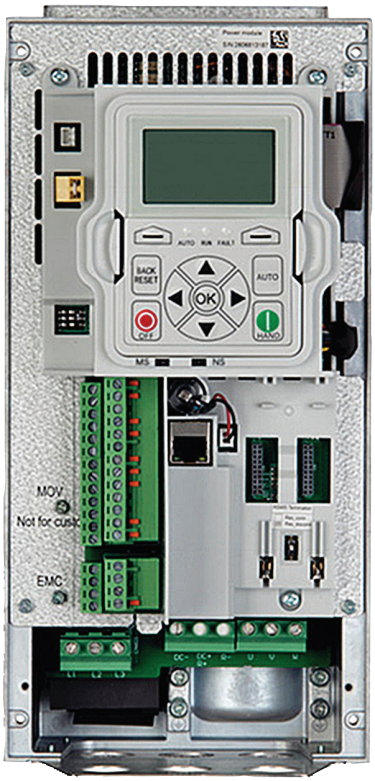
Copeland™ Commercial HVACR
Variable Frequency Drive – EVH Series

Installation Manual



EMERSON™

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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 whenrequired. 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

- **It is strongly recommended to read through this entire manual for safe and correct installation**
- 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 EVH Overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations, and the Copeland EVH Series open drive catalog numbering system.

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 set-up the Emerson Copeland commercial HVACR variable frequency drive (VFD), EVH 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 VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Receiving and Inspection

The Copeland EVH 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.

Real Time Clock Battery Activation

To activate the real time clock (RTC) functionality in the EVH VFD, the RTC battery (already mounted in the drive) must be connected to the control board.

Simply remove the primary drive cover, locate the RTC battery directly below the keypad, and connect the white 2-wire connector to the receptacle on the control board.

Figure 1. RTC Battery Connection

Table 1. 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

EMERSON.

Cat. No.: EVH-3443D3-R21BEN

Style No.:3-5330-001A

Copland™ EVH VFD Factory ID: Plant 11

VT		Input	Output
1.1KW	U (V~)	380-440 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	3.1	3.3
1.5HP	U (V~)	440-500 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	2.8	3
Enclosure Rating		TYPE 1 / IP 21	

User installation manual:2020ECT-37

Serial No.: XX20J0001

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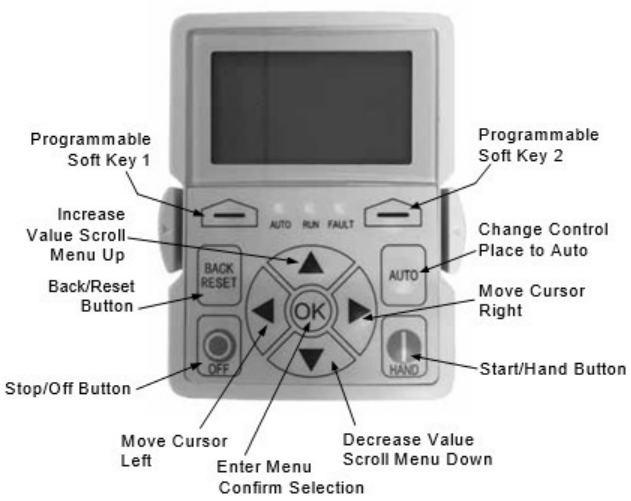
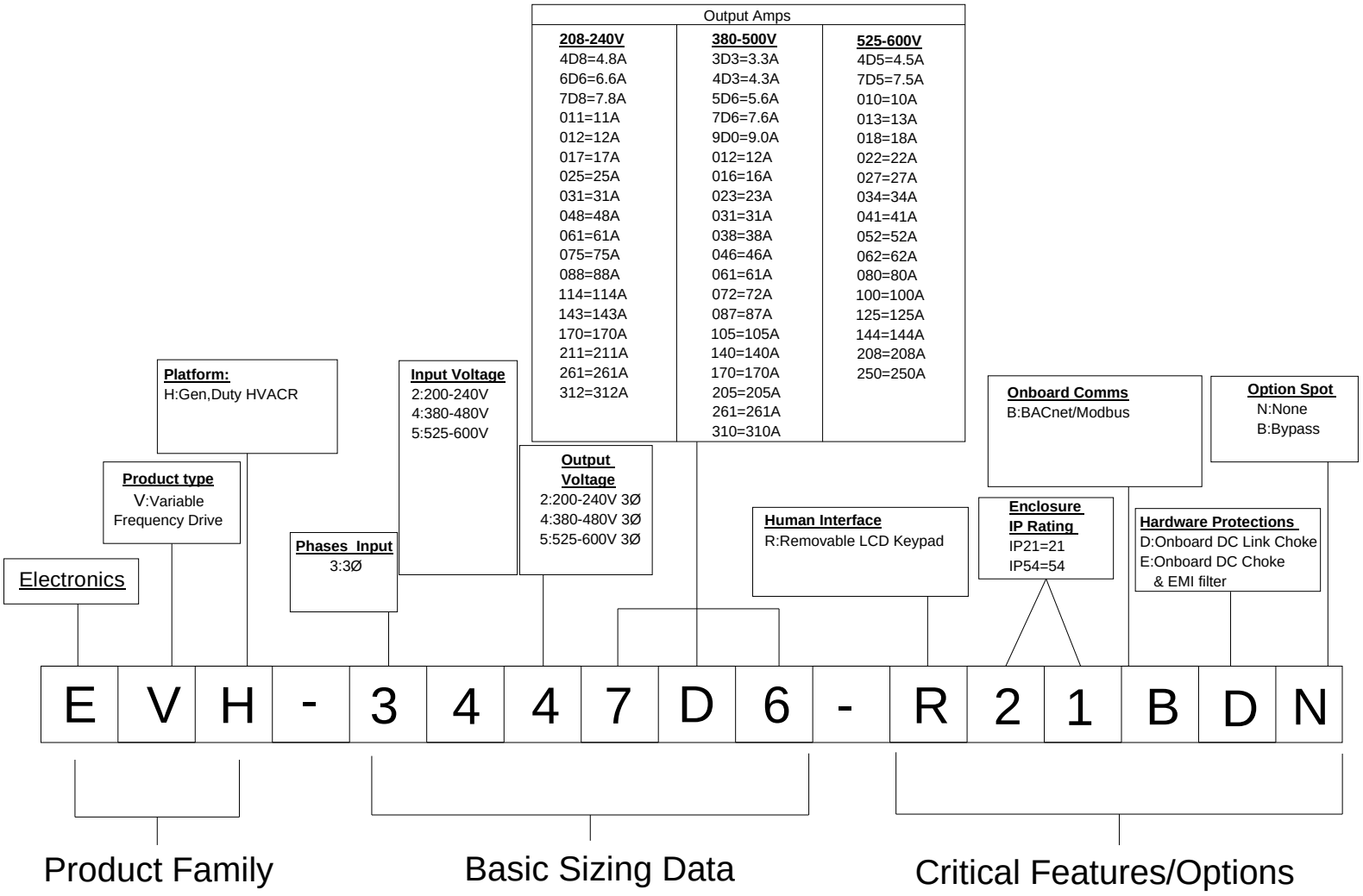
N.W.: XX.XX KG G.W.: XX.XX KG

20201015 Assembled in Dominican Republic

Keypad Button Overview

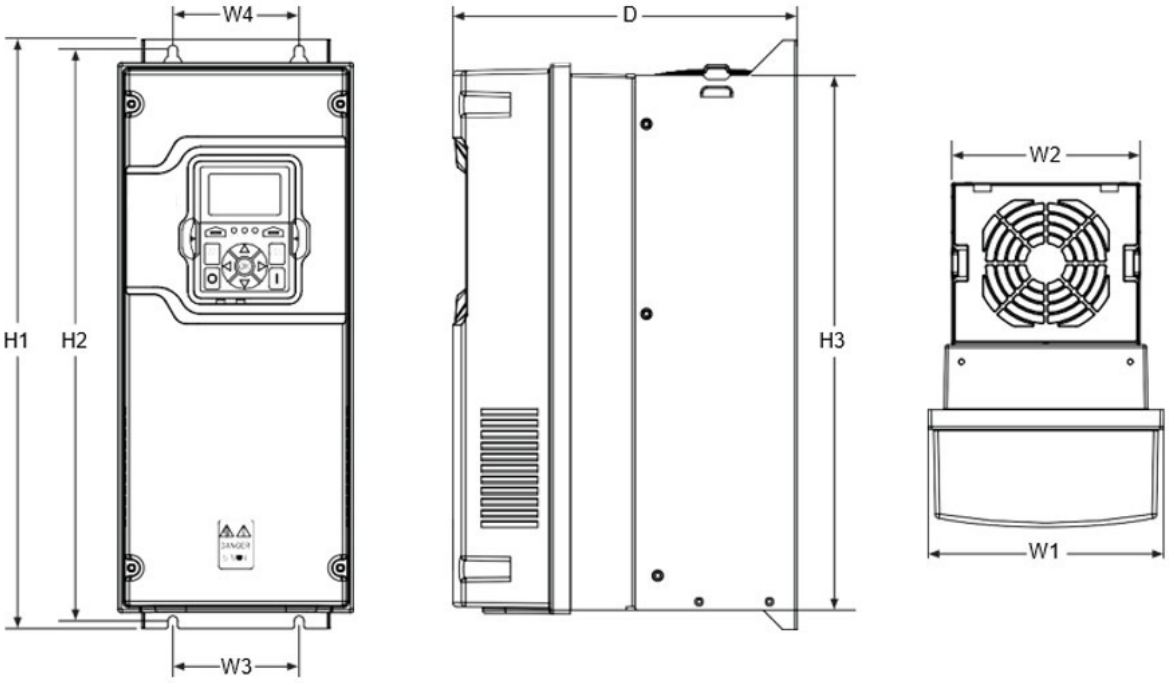


Nomenclature:



Step 2 — Copeland EVH Drive Installation

Dimensions and Weights



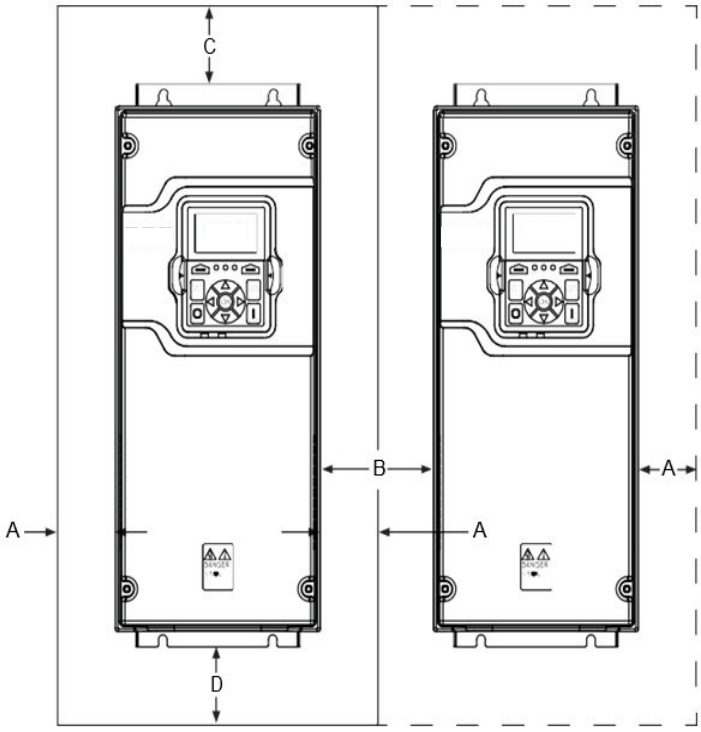
Approximate dimensions in inches (mm)

Frame size	D	H1	H2	H3	W1	W2	W3	W4	Ø	Weight lb (kg)
FR1	7.91 (200.9)	12.87 (327.0)	12.28 (312.0)	11.50 (292.0)	6.02 (153.0)	4.80 (122.0)	3.94 (100.0)	3.94 (100.0)	0.28 (7.0)	14.33 (6.5)
FR2	9.63 (244.7)	16.50 (419.0)	15.98 (406.0)	14.96 (380.0)	6.61 (167.8)	5.28 (134.0)	3.54 (90.0)	3.54 (90.0)	0.28 (7.0)	23.37 (10.6)
FR3	10.44 (265.1)	21.97 (558.0)	21.46 (545.0)	20.41 (518.5)	8.06 (204.6)	7.24 (184.0)	4.92 (125.0)	4.92 (125.0)	0.35 (9.0)	49.82 (22.6)
FR4	11.57 (294.0)	24.80 (630.0)	24.31 (617.5)	23.26 (590.7)	9.36 (237.7)	9.13 (232.0)	8.07 (205.0)	8.07 (205.0)	0.35 (9.0)	77.60 (35.2)
FR5	13.41 (340.7)	34.98 (888.5)	29.65 (753.0)	27.83 (707.0)	11.34 (288.0)	11.10 (282.0)	8.66 (220.0)	8.66 (220.0)	0.35 (9.0)	154.32 (70.0)
FR6	14.61 (371)	40.75 (1035)	33.27 (845)	31.38 (797)	19.13 (486)	18.90 (480)	15.75 (400)	15.75 (400)	0.35 (9.0)	246.91 (112)

Mounting

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

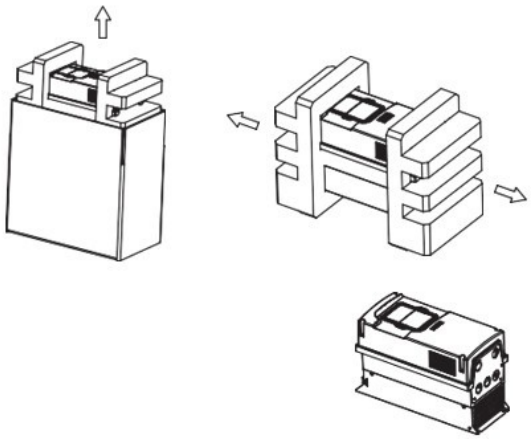
- Minimum clearances A and B for drives with Type 12 (IP54) enclosure is 0mm (in) for FR1, FR2, FR3, FR4.
- The below guidelines apply unless testing has been completed to validate a design outside of these recommendations. This work must be done in collaboration with Emerson Application Engineering.



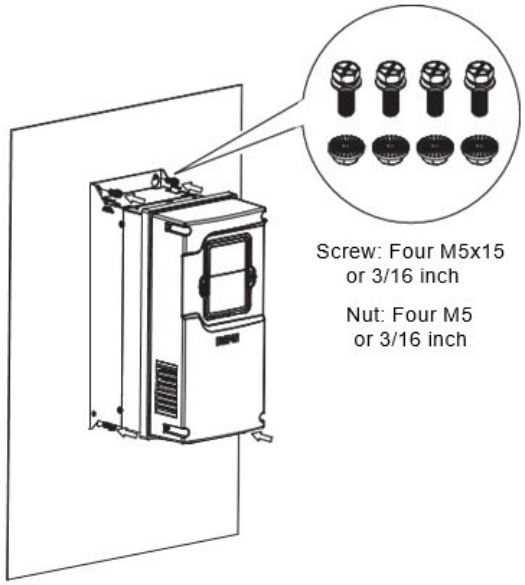
Frame size	A [@] In (mm)	B [@] In (mm)	C In (mm)	D In (mm)	Cooling air required CFM (m^3/h) [@]
FR1	0.79 (20)	1.58 (40)	3.94 (100)	1.97 (50)	14 (24)
FR2	1.18 (30)	2.36 (60)	6.30 (160)	2.36 (60)	55 (94)
FR3	0	0	7.87 (200)	3.15 (80)	85 (144)
FR4	0	0	11.81 (300)	3.94 (100)	153 (260)
FR5	3.15 (80)	6.30 (160)	11.81 (300)	7.87 (200)	232 (395)
FR6	3.15 (80)	6.30 (160)	15.75 (400)	12.99 (330)	230V: 435 (739) 480V/600V: 400 (679)

FR1 Mounting Instructions

Step 1: Lift the drive out from the carton. Remove the packaging.

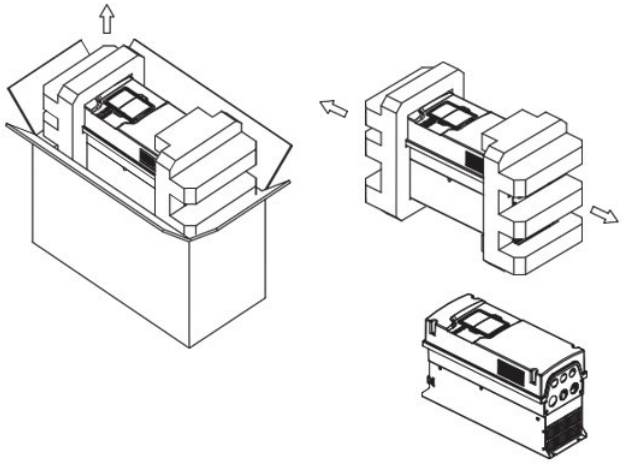


Step 2: Attach the drive to the mounting plate with four M5x15 or 3/16 inch screws and four M5 or 3/16 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

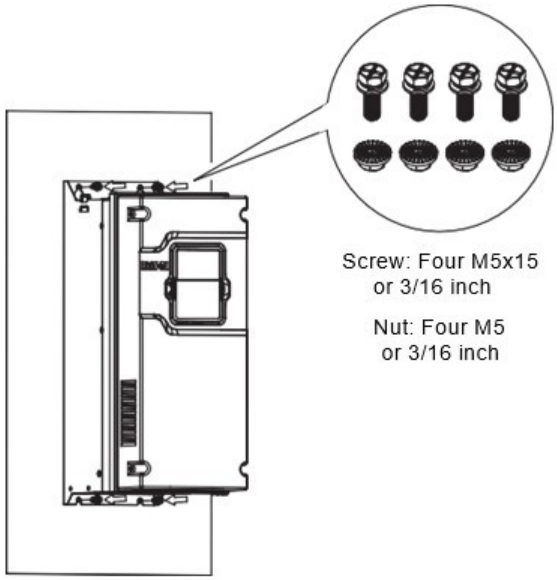


FR2 Mounting Instructions

Step 1: Lift the drive out from the carton. Remove the packaging.

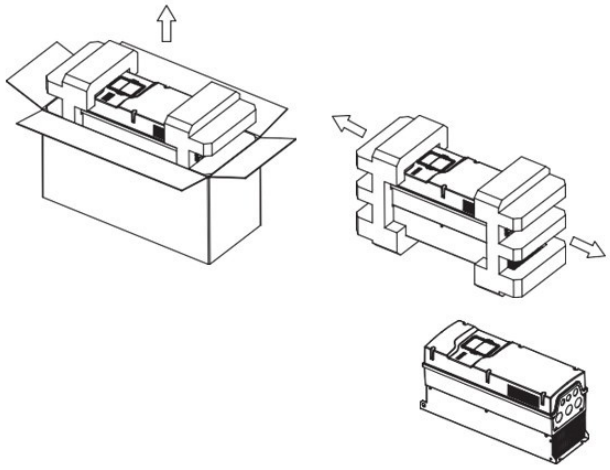


Step 2: Attach the drive to the mounting plate with four M5x15 or 3/16 inch screws and four M5 or 3/16 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

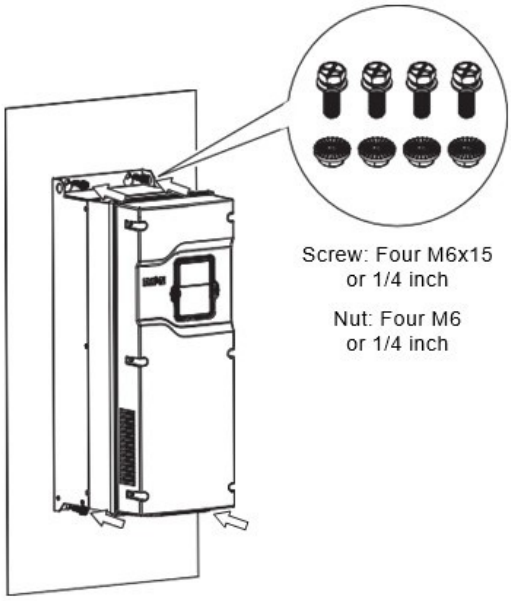


FR3 Mounting Instructions

Step 1: Lift the drive out from the carton. Remove the packaging.

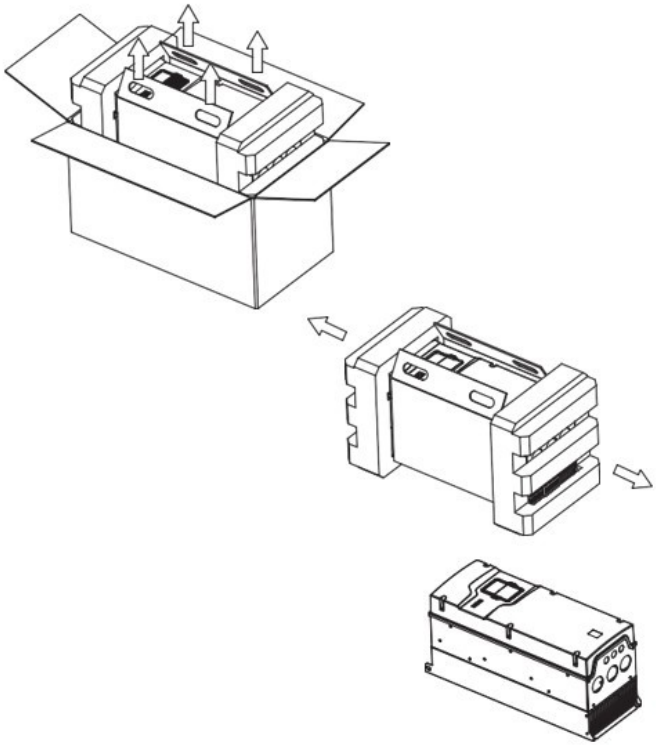


Step 2: Attach the drive to the mounting plate with four M6x15 or 1/4 inch screws and four M6 or 1/4 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

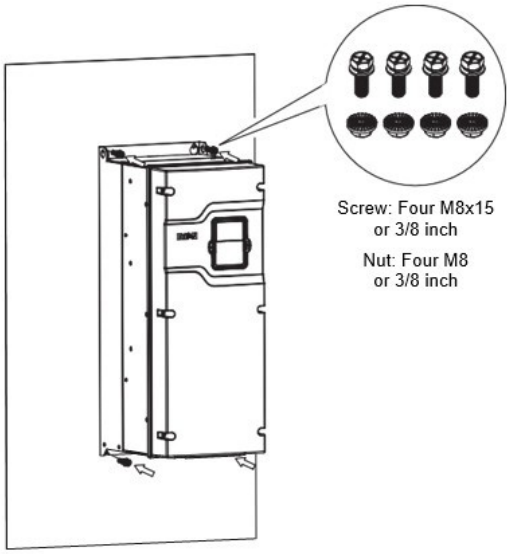


FR4 Mounting Instructions

Step 1: Lift the drive out from the carton. Remove the packaging.

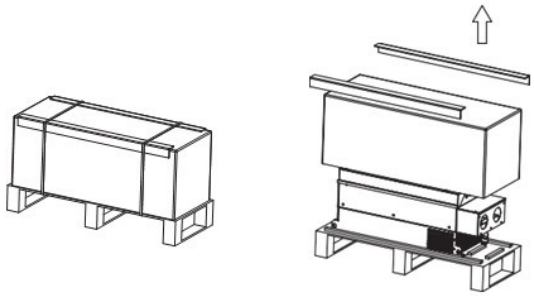


Step 2: Attach the drive to the mounting plate with four M8x15 or 3/8 inch screws and four M8 or 3/8 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

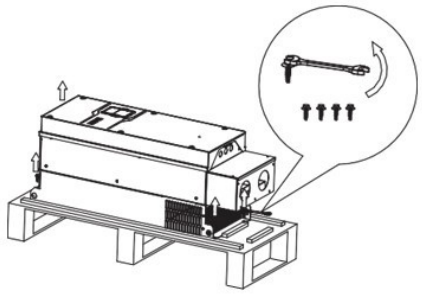


FR5 Mounting Instructions

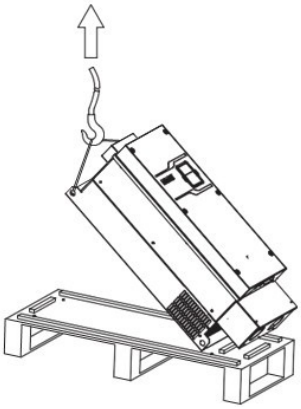
Step 1: Remove the carton from the drive.



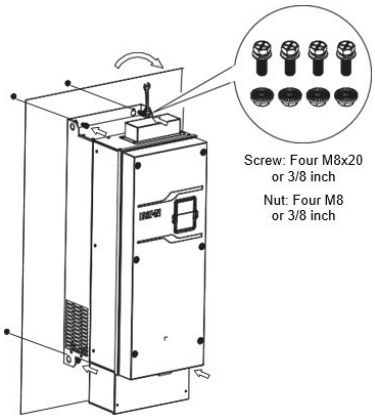
Step 2: Remove the four screws (used to fix the drive to the pallet) with an M8 or 3/8 inch wrench



Step 3: Use a hook to lift the drive.

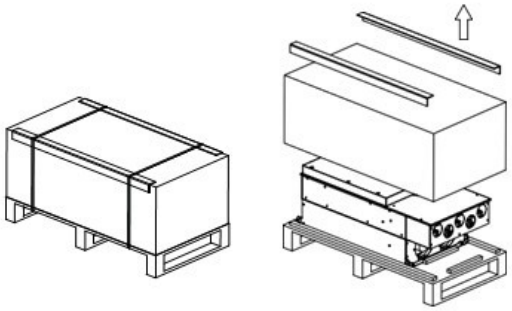


Step 4: Attach the drive to the mounting plate with four M8x20 or 3/8 inch screws and four M8 or 3/8 inch nuts with an M8 or 3/8 inch wrench. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

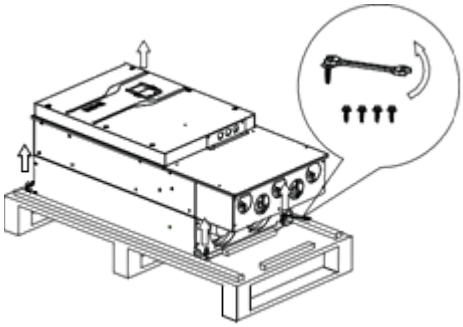


FR6 Mounting Instructions

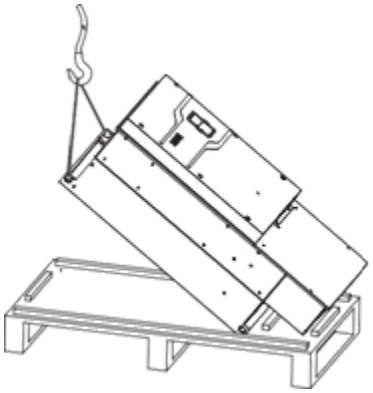
Step 1: Remove the carton from the drive



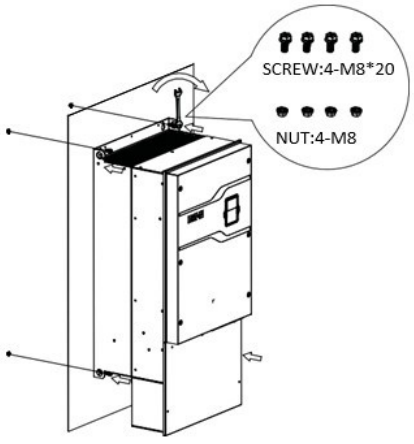
Step 2: Remove the four screws (used to fix the drive to the pallet) with an M8 or 3/8-inch wrench.



Step 3: Use a hook to lift the drive.

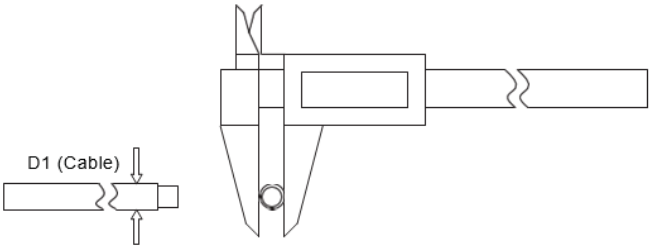


Step 4: Attach the drive to the mounting plate with four M8x20 or 3/8-inch screws and four M8 or 3/8-inch nuts with an M8 or 2/8-inch wrench. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

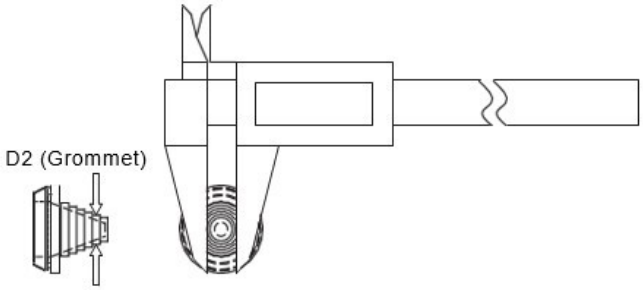


Rubber Grommet Installation Instructions

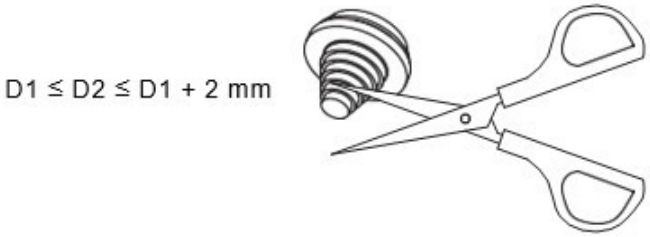
Step 1:



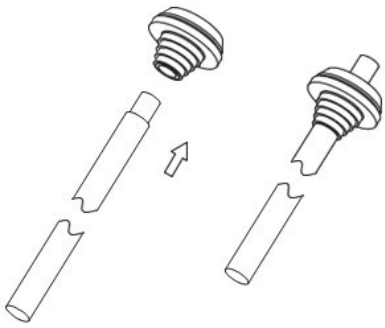
Step 2:



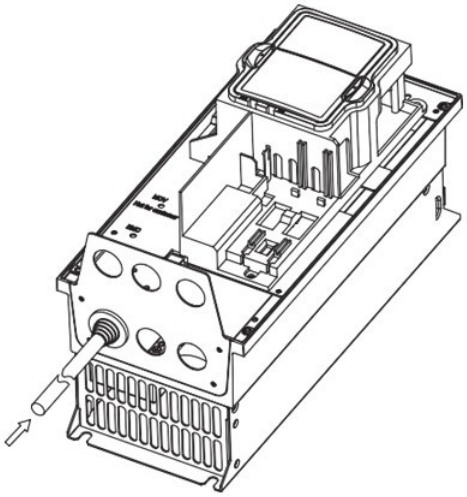
Step 3



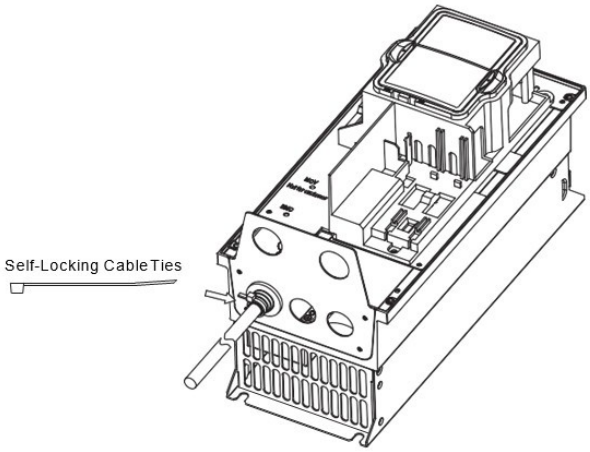
Step 4:



Step 5:



Step 6:



Power Wiring Selection

Motor cable connections are made to terminals U, V, and W.

Cable selection: Power and motor leads

- Use UL approved heat-resistant copper cables only
- 75 °C or higher for all units rated
- Line voltage/mains should be Class 1 wire only outside North America
- Refer to the following tables for cable sizing guidelines
    - o North America 208 V to 240 V: Page 22
    - o North America 380 V to 500 V: Page 24
    - o All other International 380 V to 600 V: Page 25

Line (Mains) and motor cable installation

The input line and motor cables must be sized in accordance with the rated EVH drive input and output current.

If motor temperature sensing is used for overload protection, the output cable size may be selected based on the motor specifications.

Maximum symmetrical supply current is 100,000 A RMS for all size EVH Drives.

Input protection

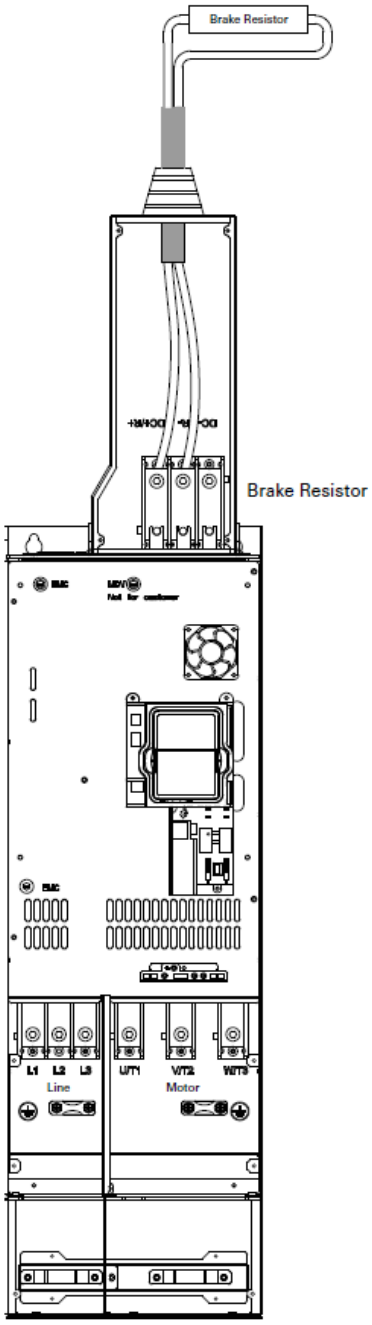
Input protection devices are rated based on the EVH drive rated input and output current. For UL and cUL/CSA, refer to Appendix D for proper sizing. For gG/gL (IEC 60269-1), refer to Appendix B for proper sizing.

Consult with service representative for further information about input protection requirements.

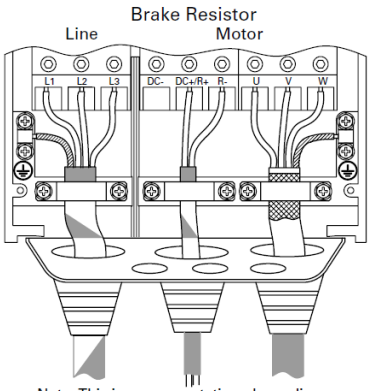
Brake chopper connection

Dynamic braking resistor connections are made to the R+ and R- terminal on the drive. Wire size should be followed according to the wattage being transferred. Below are images of the locations for wiring.

FR5 design

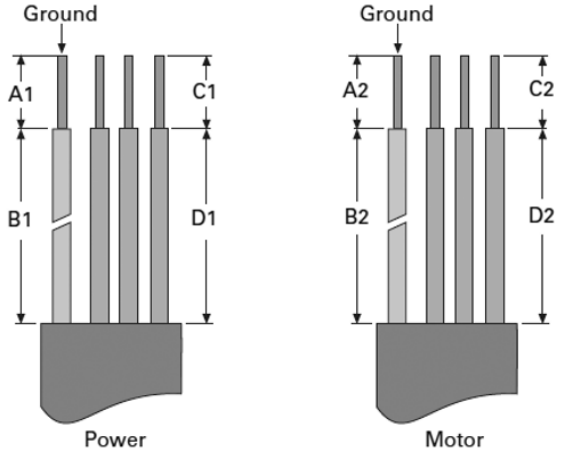


Brake resistor wiring



Note: This is a representation, depending on frame size, the image could change.

Input Power and Motor Cable Stripping Lengths



Size	Power Wiring in Inches (mm) A1	B1	C1	D1	Motor Wiring in Inches(mm) A2	B2	C2	D2
FR1	0.39 (10)	1.77 (45)	0.39 (10)	1.38 (35)	0.39 (10)	1.77 (45)	0.39 (10)	1.38 (35)
FR2	0.59 (15)	1.77 (45)	0.59 (15)	1.77 (45)	0.59 (15)	1.57 (40)	0.59 (15)	1.57 (40)
FR3	0.59 (15)	1.57 (40)	0.59 (15)	1.97 (50)	0.59 (15)	1.57 (40)	0.59 (15)	1.97 (50)
FR4	0.98 (25)	2.56 (65)	0.98 (25)	4.72 (120)	0.98 (25)	2.56 (65)	0.98 (25)	4.72 (120)
FR5	1.10 (28)	6.10 (155)	1.10 (28)	9.45 (240)	1.10 (28)	6.10 (155)	1.10 (28)	9.45 (240)
FR6	0.98 (25)	4.72 (120)	0.98 (25)	7.87 (200)	0.98 (25)	4.72 (120)	0.98 (25)	7.87 (200)

Power Connection Tightening Torque

Frame Size	Power wire in-lb (Nm)	Ground wire in-lb (Nm)	Control wire in-lb (Nm) @
FR1	5.3 (0.6)	10 (1.1)	4.5 (0.5)
FR2	15.6 (1.8)	10 (1.1)	4.5 (0.5)
FR3	40 (4.5)	10 (1.1)	4.5 (0.5)
FR4	95 (10.7)	14 (1.6)	4.5 (0.5)
FR5	354 (40.0)	35 (4.0)	4.5 (0.5)
FR6	480 (54.2)	35 (4.0)	4.5 (0.5)

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

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 / Type 12) 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 in accordance with Table below.

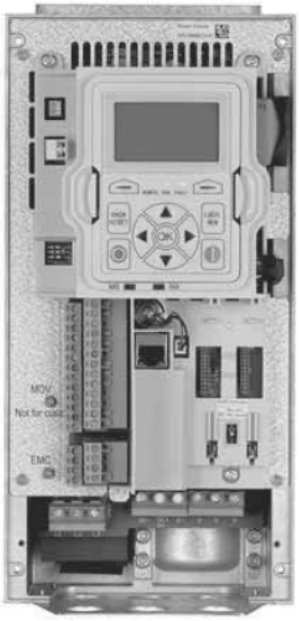
Spacing between parallel motor cables

Cable length	Distance between cables
Less than 164 ft (50 m)	1 ft (0.3 m)
Less than 657 ft (200 m)	3 ft (1.0 m)

Power wiring notice

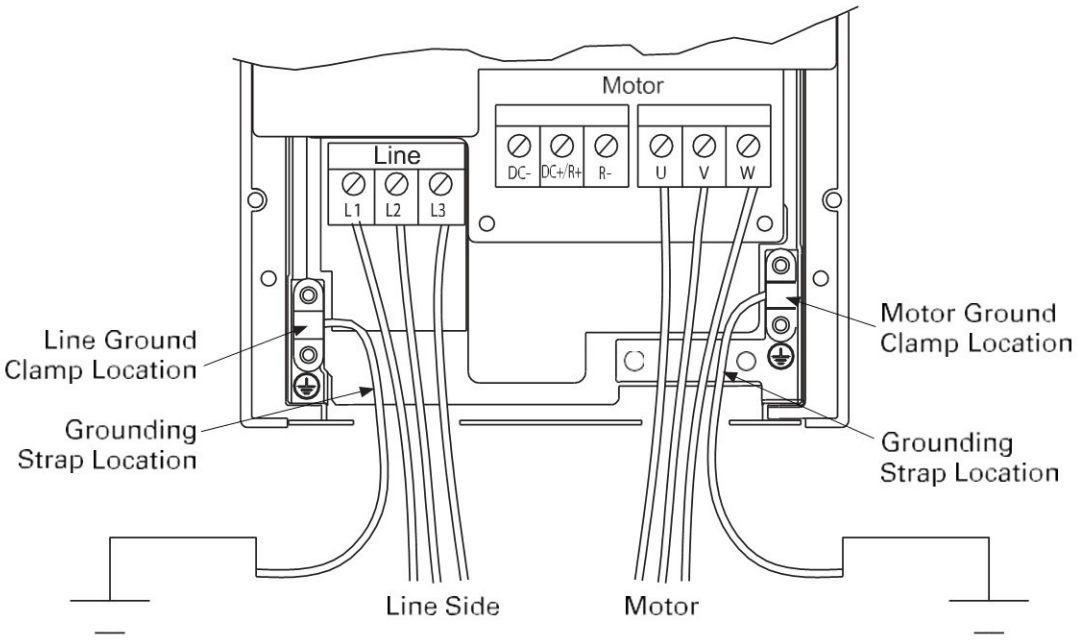
Do not discard the plastic bag containing the wiring hardware.

1. Remove the A-cover by removing (4) screws, then lifting the A-cover away from the base
2. Remove power wiring protection plate. Use power/motor cable tables
3. Add attachable grounding clamps (qty 2), one on each side of drive
4. Pass motor, input power wires/cables through base wiring plate
5. If shielded cable is used, connect the shields of input power and motor cables shields to ground
6. Wire power terminals (L1, L2, L3), motor terminal (U, V, W), and grounding terminals per the Figure above for ground wiring. It is recommended for power and motor leads to be in separate conduit 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/Type 12) as the enclosure.



Ground Wiring

Warning!
Connect only in a voltage-free state!

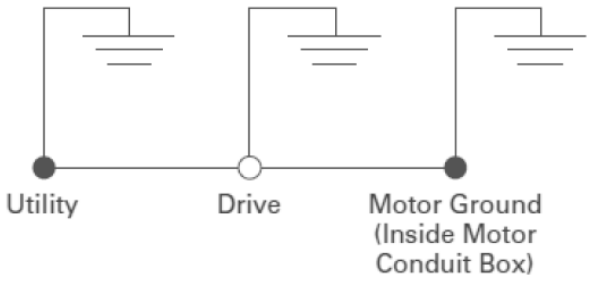


Note: Do not wire motor leads to R+, R–. This will cause damage to the drive.

Note: ① Actual layout may vary slightly by frame.

Ground Wiring

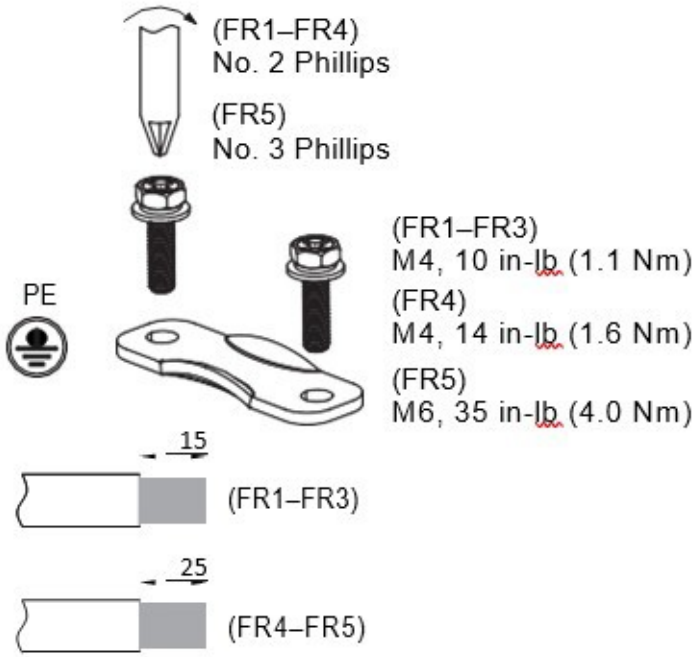
- Run motor cables in separate conduit
- DO NOT RUN CONTROL WIRES in same conduit
- Cables sized per below tables for Cables & Fuses
- Provide dedicated wire for low impedance ground between drive and motor. DO NOT USE conduit as ground



CAUTION

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

Clamp Install: For screw torques and wire stripping by frame please see the picture below.



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.

Branch circuit short circuit protection

Integral solid-state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.

480 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 500 volts maximum, when protected by UL and cUL/CSA Listed devices mentioned below with an A.I.C. rating of 100 kA minimum.

- Class RK5, Class J, Class T or equivalent fuses
- Thermal-magnetic circuit breakers
- Magnetic only circuit breakers

Refer to the following information for recommended ratings.

Protection ratings—480 V drive series

Frame size	EVH Base Model	Maximum fuse rating	Maximum thermal-magnetic breaker rating	Magnetic only circuit breakers: Maximum magnetic breaker rating
1	**EVH-3443D3-R.....**	600 V, 10 A	480 V, 15 A	480 V, 7 A
	EVH-3444D3-R.....	600 V, 10 A	480 V, 15 A	480 V, 15 A
	EVH-3445D6-R.....	600 V, 15 A	480 V, 15 A	480 V, 15 A
	EVH-3447D6-R.....	600 V, 15 A	480 V, 15 A	480 V, 25 A
	EVH-344009-R.....	600 V, 15 A	480 V, 15 A	480 V, 25 A
	EVH-344012-R.....	600 V, 15 A	480 V, 15 A	480 V, 25 A
2	**EVH-344016-R.....**	600 V, 35 A	480 V, 35 A	480 V, 50 A
	EVH-344023-R.....	600 V, 60 A	480 V, 60 A	480 V, 70 A
	EVH-344031-R.....	600 V, 80 A	480 V, 80 A	480 V, 100 A
3	**EVH-344038-R.....**	600 V, 90 A	480 V, 90 A	480 V, 100 A
	EVH-344046-R.....	600 V, 100	480 V, 100 A	480 V, 100 A
	EVH-344061-R.....	600 V, 150	480 V, 150 A	480 V, 100 A
4	**EVH-344072-R.....**	600 V, 175	480 V, 175 A	480 V, 250 A
	EVH-344087-R...	600 V, 200	480 V, 200 A	480 V, 250 A
	EVH-344105-R.....	600 V, 300	480 V, 300 A	480 V, 400 A
5	**EVH-344140-R.....**	600 V, 350	480 V, 350 A	480 V, 400 A
	EVH-344170-R.....	600 V, 400	480 V, 400 A	480 V, 400 A
	EVH-344205-R.....	600 V, 400	480 V, 400 A	480 V, 400 A
6	**EVH-344261-R.....**	600 V, 400	480 V, 400 A	480 V, 400 A
	EVH-344310-R.....	600 V, 400	480 V, 400 A	480 V, 400 A

Notes: These ratings are based off the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing.

230 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 240 volts maximum when protected by UL and cUL/CSA Listed devices mentioned below with an A.I.C. rating of 100 kA minimum.

- Class RK5, Class J, Class T or equivalent fuses
- Thermal-magnetic circuit breakers
- Magnetic only circuit breakers

Refer to the following information for recommended ratings.

Protection ratings—230 V drive series

Frame size	EVH Base Model	Maximum fuse rating	Maximum thermal-magnetic breaker rating	Magnetic only circuit breakers: Maximum magnetic breaker rating
1	**EVH-3224D8-R.....**	600 V, 15 A	480 V, 15 A	480 V, 15 A
	EVH-3226D6-R.....	600 V, 20 A	480 V, 20 A	480 V, 25 A
	EVH-3227D8-R.....	600 V, 20 A	480 V, 20 A	480 V, 25 A
	EVH-322011-R.....	600 V, 30 A	480 V, 30 A	480 V, 30 A
	EVH-322012-R.....	600 V, 30 A	480 V, 30 A	480 V, 30 A
2	**EVH-322017-R.....**	600 V, 40 A	480 V, 40 A	480 V, 50 A
	EVH-322025-R.....	600 V, 40 A	480 V, 40 A	480 V, 50 A
	EVH-322031-R.....	600 V, 40 A	480 V, 40 A	480 V, 50 A
3	**EVH-322048-R.....**	600 V, 125 A	480 V, 125 A	480 V, 150 A
	EVH-322061-R.....	600 V, 150 A	480 V, 150 A	480 V, 150 A
4	**EVH-322075-R.....**	600 V, 200 A	480 V, 200 A	480 V, 250 A
	EVH-322088-R.....	600 V, 225 A	480 V, 225 A	480 V, 250 A
	EVH-322114-R.....	600 V, 300 A	480 V, 300 A	480 V, 400 A
5	**EVH-322143-R.....**	600 V, 400 A	480 V, 400 A	480 V, 400 A
	EVH-322170-R.....	600 V, 400 A	480 V, 400 A	480 V, 400 A
	EVH-322211-R.....	600 V, 400 A	480 V, 400 A	480 V, 400 A
6	**EVH-322261-R.....**	600 V, 400 A	480 V, 400 A	480 V, 400 A
	EVH-322312-R.....	600 V, 400 A	480 V, 400 A	480 V, 400 A

Notes: These ratings are based off the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing.

575 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 volts maximum, when protected by UL and cUL/CSA Listed devices mentioned below with an A.I.C. rating of 100 kA minimum.

- Class RK5, Class J, Class T or equivalent fuses
- Thermal-magnetic circuit breakers (see Note below)
- Current limiting circuit breakers (for FR1-3 only)

Note: When protected by UL and cUL/CSA Listed Thermal-magnetic circuit breakers:

- FR1–3 are only suitable for use on a circuit capable of delivering not more than 35,000 rms symmetrical amperes, 600 volts maximum
- FR4–6 are only suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical amperes, 600 volts maximum

Refer to the following information for recommended ratings.

Protection ratings—575 V drive series

Frame size	EVH Base Model	Maximum fuse rating	Maximum thermal-magnetic breaker rating	Maximum current limiting breaker ratings
1	**EVH-3554D5-R.....**	600 V, 10 A	600 V, 15 A	600 V, 15 A
	EVH-3557D5-R.....	600 V, 20 A	600 V, 20 A	600 V, 20 A
	EVH-355010-R.....	600 V, 30 A	600 V, 30 A	600 V, 30 A
2	**EVH-355013-R.....**	600 V, 35 A	600 V, 35 A	600 V, 35 A
	EVH-355018-R.....	600 V, 60 A	600 V, 60 A	600 V, 60 A
	EVH-355022-R.....	600 V, 80 A	600 V, 80 A	600 V, 80 A
3	**EVH-355027-R.....**	600 V, 80 A	600 V, 90 A	600 V, 90 A
	EVH-355034-R.....	600 V, 80 A	600 V, 100 A	600 V, 100 A
	EVH-355041-R.....	600 V, 80 A	600 V, 150 A	600 V, 150 A
4	**EVH-355052-R.....**	600 V, 150 A	600 V, 175 A	N/A
	EVH-355062-R.....	600 V, 150 A	600 V, 200 A	N/A
	EVH-355080-R.....	600 V, 150 A	600 V, 300 A	N/A
5	**EVH-355100-R.....**	600 V, 200 A	600 V, 225 A	N/A
	EVH-355125-R.....	600 V, 200 A	600 V, 225 A	N/A
	EVH-355144-R.....	600 V, 200 A	600 V, 300 A	N/A
6	**EVH-355208-R.....**	600 V, 400 A	600 V, 400 A	N/A

Notes: These ratings are based off the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing.

Field wiring

- The field installed conductors for this drive should be 75 ° C or higher copper wire
- The enclosure openings provided for conduit connections in the field shall be closed by UL Listed conduit fittings with same type rating as the enclosure (Type 1/Type 12)

Cable and Fuse Guidelines

North America cable and fuse sizes—208 Vac to 240 Vac ratings

Frame size	208V input current (VT/I_L)	NEC motor amp rating at 230 V	NEC motor amp rating at 208 V	NEC wire Current (VT/I_L) at 40 °C	Recommend fuse rating @	NEC wire size (AWG) Line and motor	NEC wire size (AWG) Ground	Terminal connection size (AWG) Line and motor	Terminal connection size (AWG) Ground
FR1	4.4	4.2	4.6	4.8	10	14	14	24–10	18–10
	6.1	6	6.6	6.6	10	14	14	24–10	18–10
	7.2	6.8	7.5	7.8	10	14	14	24–10	18–10
	10.2	9.6	10.6	11	15	14	14	24–10	18–10
	11.6	—	—	12.5	15	12	12	24–10	18–10
FR2	16.3	15.2	16.7	17.5	20	10	10	20–6	12–6
	23.2	22	24.2	25	30	8	10	20–6	12–6
	29	28	30.8	31	35	8	10	20–6	12–6
FR3	44.2	42	46.2	48	60	6	6	6–2	14–4
	56	54	59.4	61	80	4	6	6–2	14–4
FR4	64.6	68	74.8	75	100	3	4	6–1/0	10–1/0
	78	80	88	88	110	2	4	6–1/0	10–1/0
	94.3	104	114	114	125	1/0	3	6–1/0	10–1/0
FR5	129	130	143	143	175	3/0	3	1/0–350 kcmil	8–250 kcmil
	157	154	169	170	200	4/0	3	1/0–350 kcmil	8–250 kcmil
	189	192	211	211	250	300	3	1/0–350 kcmil	8–250 kcmil
FR6	242.8	248	273	261	400	2*2/0	3	2*(1/0–300 kcmil)	3–300 kcmil
	290.3	312	343	312	400	2*4/0	3	2*(1/0–300 kcmil)	3–300 kcmil

Notes:

- Line and motor cable size is selected according to UL 508C Table40.3 for copper conductor rated 75 °C. Use only with copper wire rated 75 °C here. Size requirements for other different wire types are defined in the National Electrical Code®, ANSI/NFPA® 70.
- Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C Table 6.4.
- If power cubes or bypass are used, a UL listed Class RK5, J, T or equivalent fuse is recommended.

International cable and fuse sizes—208 Vac to 240 Vac Ratings

Frame size	208 V input current (VT/IL)	Current (VT/IL) at 40 °C	Fuse rating (gG/gL)	Mains and motor cable Cu (mm²)	Terminal cable size Main terminal Cu (mm²)	Earth terminal Cu (mm²)
FR1	4.4	4.8	6	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	6.1	6.6	10	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	7.2	7.8	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	10.2	11	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	11.6	12.5	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
FR2	16.3	17.5	20	3*4+4	0.5–16	4–16
	23.2	25	32	3*4+4	0.5–16	4–16
	29	31	32	3*6+6	0.5–16	4–16
FR3	44.2	48	50	3*16+16	16–35	2.5–25
	56	61	63	3*16+16	16–35	2.5–25
FR4	64.6	75	80	3*25+16	16–50	6–50
	78	88	100	3*35+16	16–50	6–50
	94.3	114	125	3*50+25	16–50	6–50
FR5	129	143	160	3*70+35	50–185	10–120
	157	170	200	3*95+50	50–185	10–120
	189	211	250	3*150+95	50–185	10–120
FR6	242.8	261	400	2*(3*70+35)	2*(50–150)	35–150
	290.3	312	400	2*(3*95+50)	2*(50–150)	35–150

Notes:

- Line and motor cable size is selected according to IEC 60364-5-52:2009 Table B.52.4 for copper conductor with PVC insulation with a wiring condition of ambient temperature 30 °C in air and an installation method of “B2” (cables in conduit and cable trunking systems). For other wiring conditions, please refer to the standard of IEC 60364-5-52:2009 for suitable cable sizes.
- Earthing conductor size is determined by the cross-sectional area of phase conductors according to IEC/EN 61800-5-1:2007 Table 5. So, if phase conductor size is changed, earthing conductor size should also be changed accordingly.
- If power cubes or bypass are used, a Class gG/gL fuse is recommended.

North America cable and fuse sizes – 440 Vac to 500 Vac ratings

						NEC wire size (AWG)		Terminal connection size (AWG)	
Frame size	**Amp suffix**	**Input current (VT/I_L)**	**NEC motor amp rating at 460 V**	**Current (VT/I_L) at 40 °C**	**Recommended fuse rating**	**Line and motor**	**Ground**	**Line and motor**	**Ground**
FR1	3D3	2.8	3	3	10	14	14	26–10	18–10
	4D3	3.2	3.4	3.4	10	14	14	26–10	18–10
	5D6	4.5	4.8	4.8	10	14	14	26–10	18–10
	7D6	7.1	7.6	7.6	10	14	14	26–10	18–10
	9D0	8.4	—	7.6	15	14	14	26–10	18–10
	012	10.2	11	11	15	14	14	26-10	18–10
FR2	016	13	14	14	20	12	12	20–6	12–6
	023	19.6	21	21	30	10	10	20–6	12–6
	031	25.2	27	27	35	8	8	20–6	12–6
FR3	038	31.7	34	34	50	6	8	6–2	14–4
	046	37	40	40	60	6	8	6–2	14–4
	061	48.1	52	52	80	4	6	6–2	14–4
FR4	072	59.3	65	65	100	4	4	6–1/0	10–1/0
	087	70.3	77	77	110	3	4	6–1/0	10–1/0
	105	87.6	96	96	125	1	3	6–1/0	10–1/0
FR5	140	114.4	124	124	175	2/0	3	1/0–350 kcmil	8–250 kcmil
	170	144	156	156	200	3/0	3	1/0–350 kcmil	8–250 kcmil
	205	166.1	180	180	250	250 kcmil	3	1/0–350 kcmil	8–250 kcmil
FR6	261	226.4	240	240	400	2*2/0	3	2*(1/0–300 kcmil)	3–300 kcmil
	310	284.9	302	302	400	2*4/0	3	2*(1/0–300 kcmil)	3–300 kcmil

Notes:

- Line and motor cable size is selected according to UL 508C Table 40.3 for copper conductor rated 75 °C. Use only with copper wire rated 75 °Chere. Size requirements for other different wire types are defined in the National Electrical Code, ANSI/NFPA 70.
- Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C Table 6.4.
- If power cubes or bypass are used, a UL listed Class RK5, J, T or equivalent fuse is recommended.

International cable and fuse sizes—380 Vac to 440 Vac ratings

Frame size	Amp suffix	400 V input current (VT/I_L)	Current (VT/I_L) at 40 °C	Fuse rating (gG/gL) @	Terminal cable size: Mains and motor cable Cu (mm^2)	Terminal cable size: Main terminal Cu (mm^2)	Terminal cable size: Earth terminal Cu (mm^2)
FR1	3D3	3.1	3.3	6	3*1.5+1.5	0.2–6 solid or	0.75–6
	4D3	4	4.3	6	3*1.5+1.5	0.2- 4 standard	0.75–6
	5D6	5.2	5.6	10	3*1.5+1.5		0.75–6
	7D6	7.1	7.6	16	3*1.5+1.5		0.75–6
	9D0	8.4	9	16	3*1.5+1.5		0.75–6
	012	11.2	12	16	3*1.5+1.5		0.75–6
FR2	016	15	16	20	3*4+4	0.5–16	4–16
	023	21.5	23	25	3*4+4	0.5–16	4–16
	031	29	31	32	3*6+6	0.5–16	4–16
FR3	038	35.2	38	40	3*16+16	16–35	2.5–25
	046	42.6	46	50	3*16+16	16–35	2.5–25
	061	55.7	61	63	3*16+16	16–35	2.5–25
FR4	072	65.7	72	80	3*25+16	16–50	6–50
	087	79.4	87	100	3*35+16	16–50	6–50
	105	97	105	125	3*50+25	16–50	6–50
FR5	140	129	140	160	3*70+35	50–185	10–120
	170	157	170	200	3*95+50	50–185	10–120
	205	189	205	250	3*120+70	50–185	10–120
FR6	261	246.2	261	400	2*(3*70+35)	2*(50–150)	35–150
	310	292.4	310	400	2*(3*95+50)	2*(50–150)	35–150

Notes:

- Line and motor cable size is selected according to IEC 60364-5-52:2009 Table B.52.4 for copper conductor with PVC insulation with a wiring condition of ambient temperature 30 °C in air and an installation method of “B2” (cables in conduit and cable trunking systems). For other wiring conditions, please refer to the standard of IEC 60364-5-52:2009 for suitable cable sizes.

- Earthing conductor size is determined by the cross-sectional area of phase conductors according to IEC/EN 61800-5-1:2007 Table 5. So, if phase conductor size is changed, earthing conductor size should also be changed accordingly.

- If power cubes or bypass are used, a Class gG/gL fuse is recommended.

North America cable and fuse sizes—525 Vac to 600 Vac ratings

Frame size	575 V Input current (VT/IL)	NEC motor amp rating at 575 V	Current (VT/IL) at 40 °C	Recommended fuse rating C	Nec wire size (AWG) Line and motor	Ground	Terminal connection size (AWG) Line and motor	Ground
FR1	4.2	3.9	4.5	10	14	14	26–10	18–10
	7	6.1	7.5	10	14	12	26–10	18–10
	9.3	9	10	15	14	10	26–10	18–10
FR2	12.5	11	13.5	20	12	10	20–6	12–6
	16.7	17	18	30	10	10	20–6	12–6
	20.4	22	22	35	10	8	20–6	12–6
FR3	25.2	27	27	40	6	8	6–2	14–4
	31.7	32	34	45	6	8	6–2	14–4
	38.2	41	41	50	6	6	6–2	14–4
FR4	48.1	52	52	70	4	6	6–1/0	10–1/0
	57.4	62	62	80	4	6	6–1/0	10–1/0
	73	77	80	125	2	4	6–1/0	10–1/0
FR5	91.3	99	100	150	1/0	4	1/0–350 kcmil	8–250 kcmil
	114.1	125	125	175	2/0	4	1/0–350 kcmil	8–250 kcmil
	132.9	144	144	200	3/0	4	1/0–350 kcmil	8–250 kcmil
FR6	202.8	192	208	400	2*1/0	3	2*(1/0–300 kcmil)	3–300 kcmil
	243.8	242	250	400	2*2/0	3	2*(1/0–300 kcmil)	3–300 kcmil

Notes:

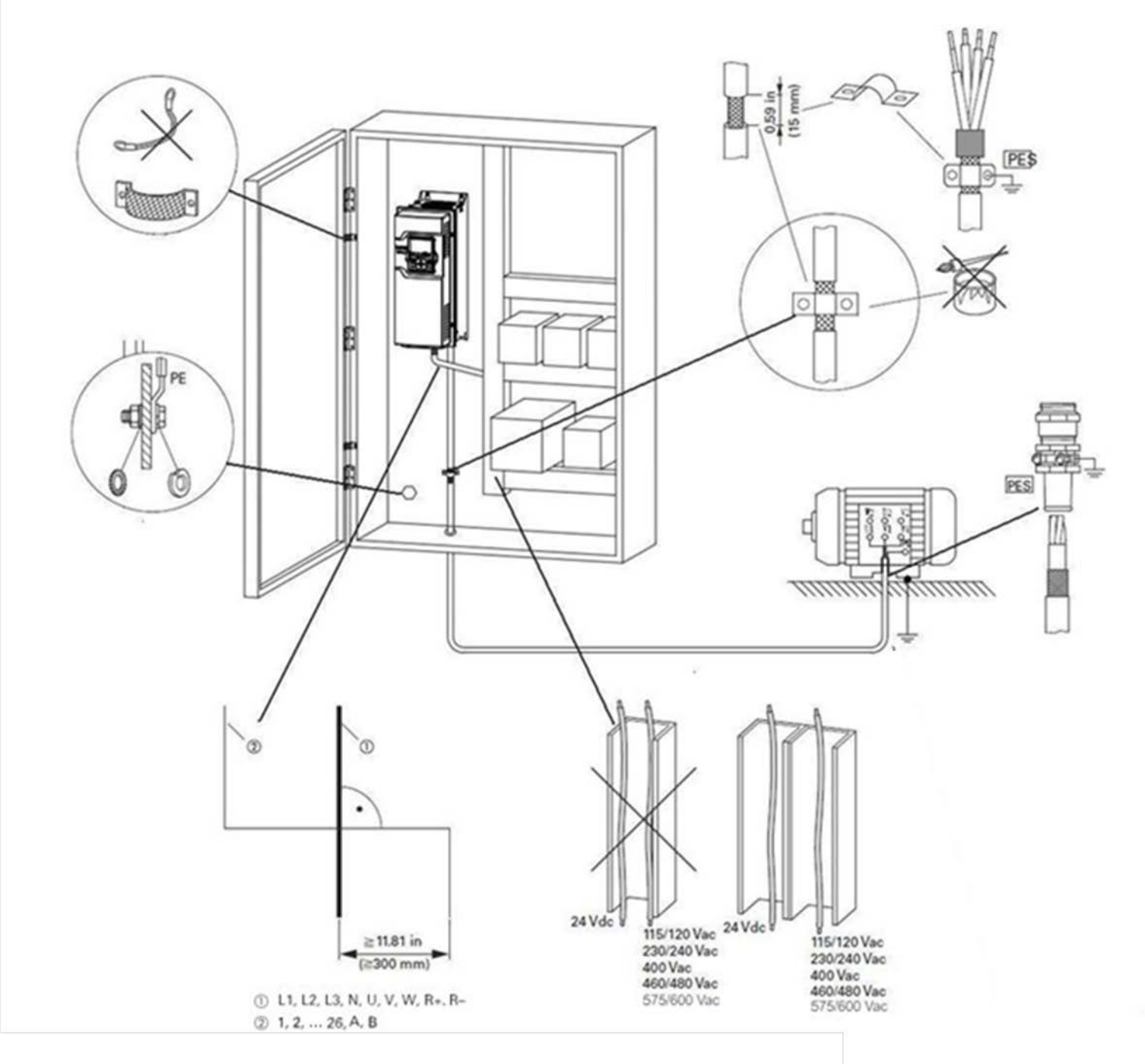
- Line and motor cable size is selected according to UL 508C Table 40.3 for copper conductor rated 75 °C. Use only with copper wire rated 75 °C here. Size requirements for other different wire types are defined in the National Electrical Code, ANSI/NFPA 70.

- Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C Table 6.4.

- If power cubes or bypass are used, a UL listed Class RK5, J, T or equivalent fuse is recommended.

Drive to Motor Connection Panel Mount

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



Notes: 1. Power cable: L1, L2, L3 and U, V, W.

2. Control and signal lines: 1 to 36, fieldbus connection Large-area connection of all metallic control panel components. Mounting surfaces of frequency inverter and cable shielding must be free from paint. Connect the cable shielding in the output of the frequency inverter with a large surface area contact to the ground potential (PES). Large-area cable shield contacts with motor. Large-area earth connection of all metallic parts.

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. 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 conductor must have a cross-section of at least 10 mm2
- the protective 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 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 in the figure on Previous Page.

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.

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

Free or non-screened connection cables should not be any longer than about 300 mm.

1st Environment 2nd environment EMC levels according to EN 61800-3 (2004)

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

Notes: [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.

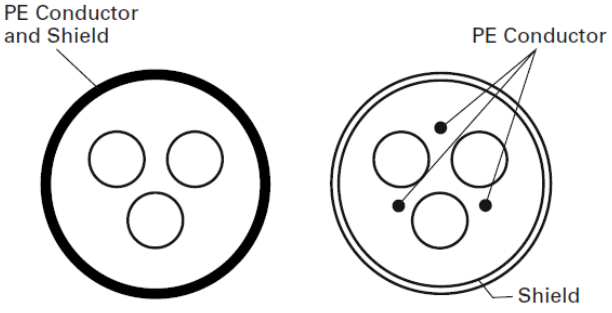
Motor power cable EMC guidelines

Item	Directive
Product	IEC 61800-2
Safety	UL 508C, 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 10 m motor cable length
	Category C3: with internal filter maximum of 50 m motor cable length
	575V Series:
	Category C3: with internal filter maximum of 10 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 Screw with a simple procedure described below.

In addition on FR2 and FR4 the MOV screw is required to be removed, see Figure below for FR2 & FR4.

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.

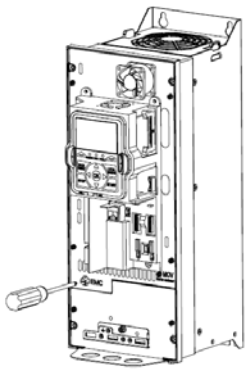
After disconnecting the supply, wait at least five minutes before removing the cover to allow the intermediate circuit capacitors to discharge.

WARNING

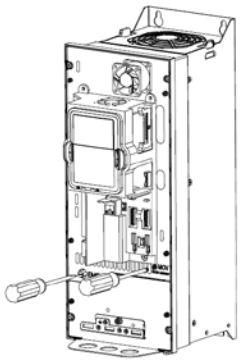
Failure to follow these instructions will result in death or serious injury.

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.

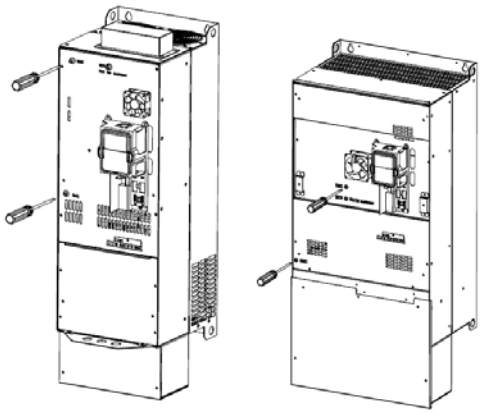
Locations of EMC Screw in Frame 1 and Frame 3



Locations of EMC and MOV Screws for Frame 2 and Frame 4



Locations of the EMC Screws in Frame 5 and Frame 6



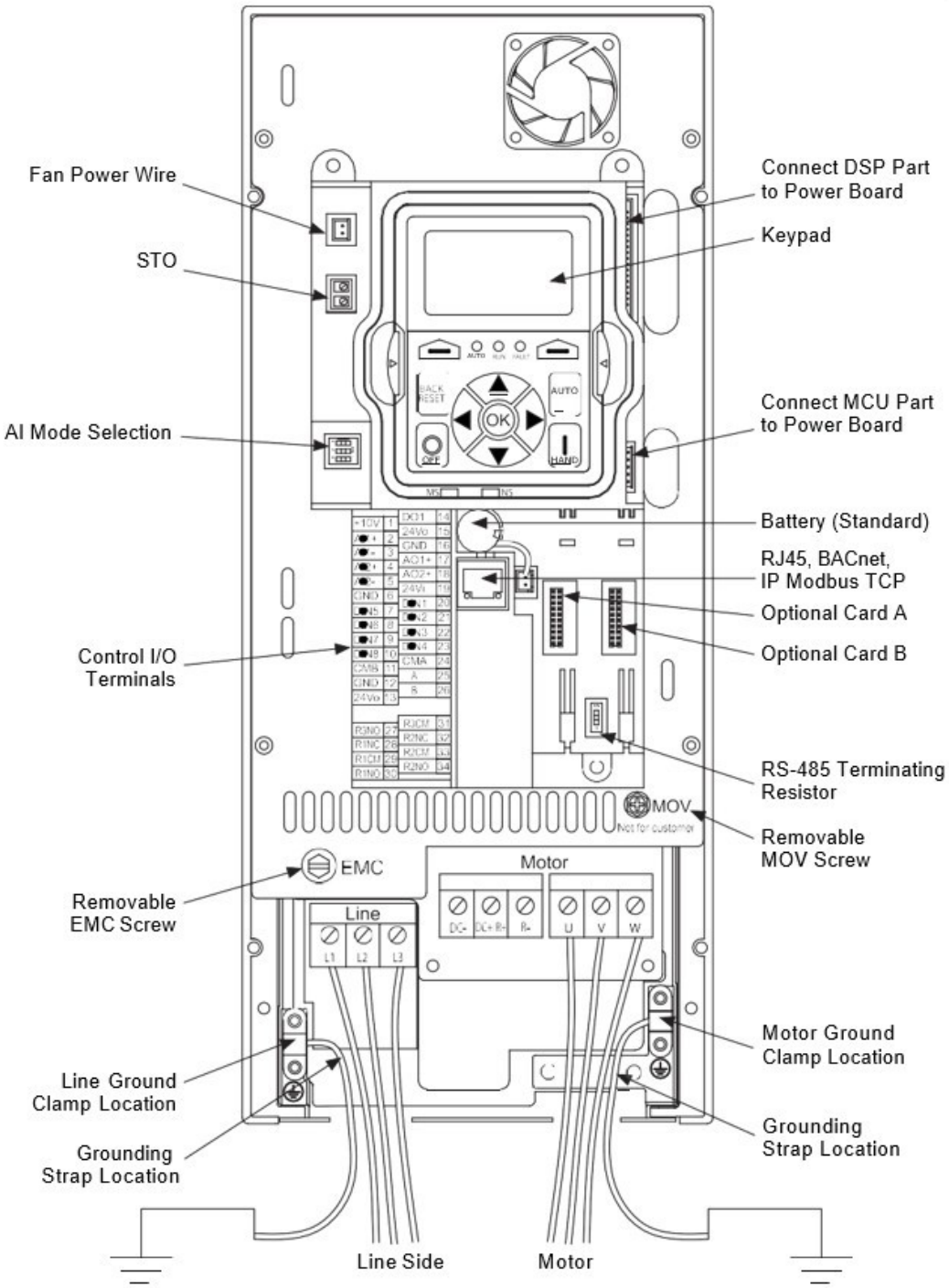
Verifying Rotation

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 Layout

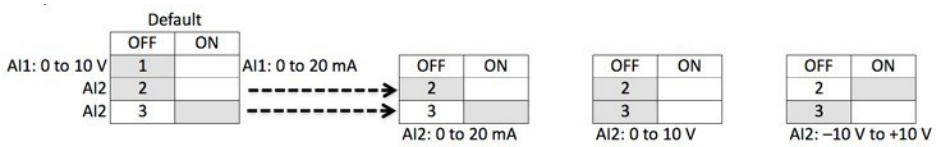
+10V	1	DO1	14
AI1+	2	24Vo	15
AI1-	3	GND	16
AI2+	4	AO1+	17
AI2-	5	AO2+	18
GND	6	24Vi	19
DIN5	7	DIN1	20
DIN6	8	DIN2	21
DIN7	9	DIN3	22
DIN8	10	DIN4	23
CMB	11	CMA	24
GND	12	A/+	25
24Vo	13	B/-	26

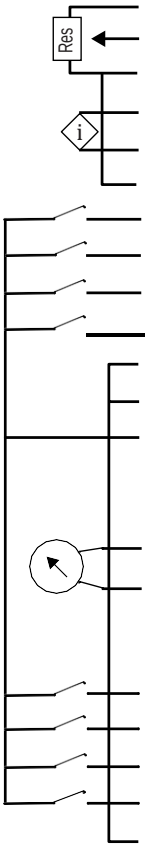
R3NO	27	R3CM	31
R1NC	28	R2NC	32
R1CM	29	R2CM	33
R1NO	30	R2NO	34



Factory-Set Control Terminal Functions

I/O Connection





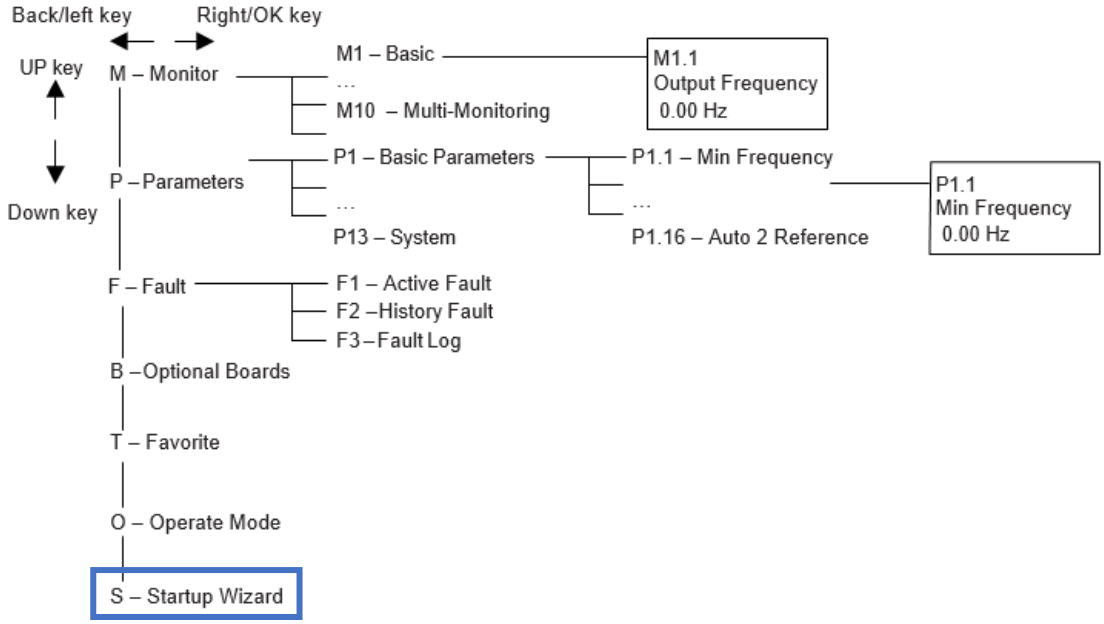
External Wiring	Pin	Signal Name	Signal	Default Setting	Description
	1	+10V	Ref. Output Voltage	-	10VDC Supply Source
	2	AI1+ a	Analog Input 1	0-10V	Voltage Speed Reference (Programmable to 4-20mA)
	3	AI1-	Analog Input 1 Ground	-	Analog Input 1 Common (Ground)
	4	AI2+a	Analog Input 2	4-20mA	Current Speed Reference (Programmable to 0-10V)
	5	AI2-	Analog Input 2 Ground	-	Analog Input 2 Common (Ground)
	6	GND	I/O Signal Ground	-	I/O Ground for Reference and Control
	7	DIN5	Digital Input 5	Preset Speed B0	Sets frequency output to Preset Speed 1
	8	DIN6	Digital Input 6	Fire Mode	Enables drive into Fire Mode
	9	DIN7	Digital Input 7\TI+	Bypass Start	Enables drive into Bypass mode waiting for drive start
	10	DIN8	Digital Input 8\TI-	Force Auto	Input forces drive into Auto Control place
	11	CMB	DI5 to DI8 Common	Grounded	Allows source input
	12	GND	I/O Signal Ground	-	I/O Ground for Reference and Control
	13	24Vo	+24VDC Output	-	Control voltage output (100mA Max)
	14	DO1	Digital Output 1	Ready	Shows the drive is ready to run
	15	24Vo	+24VDC Output	-	Control voltage output (100mA Max)
	16	GND	I/O Signal Ground	-	I/O Ground for Reference and Control
	17	AO1+	Analog Output 1	Output Frequency	Shows Output frequency to motor 0 - 60Hz (4-20mA)
	18	AO2+	Analog Output 2	Motor Current	Shows Motor current of motor 0-FLA (4-20mA)
	19	24Vi	+24VDC Input	-	External control voltage input
	20	DIN1	Digital Input 1	Run Forward	Input starts drive in forward direction (start enable)
	21	DIN2	Digital Input 2	Run Reverse	Input starts drive in reverse direction(start enable)
	22	DIN3	Digital Input 3	External Fault	Input causes drive to fault
	23	DIN4	Digital Input 4	Fault Reset	Input resets active faults
	24	CMA	DI1 to DI4 Common	Grounded	Allows source input
	25	A	RS-485 Signal A/+	-	Fieldbus Communication (Modbus, BACnet)
	26	B	RS-485 Signal B/-	-	Fieldbus Communication (Modbus, BACnet)
	27	R3NO	Relay 3 Normally Open	Fault	Relay output 3 shows VFD is Faulted
	28	R1NC	Relay 1 Normally Closed	Bypass Run	Relay output 1 shows VFD is in a bypass run state
	29	R1CM	Relay 1 Common		
	30	R1NO	Relay 1 Normally Open		
	31	R3CM	Relay 3 Common	Fault	Relay output 3 shows VFD is Faulted
	32	R2NC	Relay 2 Normally Closed	Run	Relay output 2 shows VFD is in a drive run state
	33	R2CM	Relay 2 Common		
	34	R2NO	Relay 2 Normally Open		

Notes

- The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and CMB 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). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.
- AI1+ and AI2+ block that it can support 10K 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 EVH 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-1466. Information for Items 6-13 can be found in Copeland Mobile or OPI for the specific compressor model. For general motors, on the nameplate.

Item	Description	
1	Startup Wizard	Press OK?
2	Application	0 = basic 1 = PID 2 = Advanced
3	Language	0 = English 1 = Chinese 2 = Deutsch
4	Real Time Clock	yy.mm.dd hh:mm:ss
5	Daylight Saving	0 = Off 1 = EU 2 = US
6	Min Frequency	Min: 0.00Hz Max: Max Frequency
7	Max Frequency	Min: Min Frequency Max: 400. 00Hz
8	Motor Nom Current	Min: 0.1A Max: 500.0A
9	Current Limit	Min: Ih*1/ 10 Max: Ih*2
10	Motor Nom Speed	Min: Ih*1/ 10 Max: Ih*2
11	Motor PF	Min: 0.30 Max: 1.0
12	Motor Nom Voltage	Min: 180V Max: 690V
13	Motor Nom Frequency	Min: 30.00 Hz Max: 400. 00 Hz
14	Accel Time 1	Min: 0.1 sec Max:3000.0 sec
15	Decel Time 1	Min: 0.1 sec Max:3000.0 sec
16	Hand Control Place	0 = Keypad 1 = I/O Terminal Start 1 2 = I/O Terminal Start 2 3 = Feildbus
17	Hand Reference	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Feildbus 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = Min(AI1,AI2) 16 = Max(AI1,AI2) 17 = PID1 Control Output 18 = PID2 Control Output

Item	Description	
18	Auto 1 Control Place	0 = I/O terminal Start 1 1 = Fieldbus 2 = I/O terminal start 2 3 = Keypad
19	Auto 1 Reference	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Feildbus 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = Min(AI1,AI2) 16 = Max(AI1,AI2) 17 = PID1 Control Output 18 = PID2 Control Output
20	Bypass Enabled	0 = Disabled 1 = Enabled
21	Application Mini-Wizard	Press OK?

Now the Startup Wizard is done. It wont 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.

PID and Advanced Application Mini-Wizard

The PID Mini-Wizard is activated in the Quick Setup menu. This Wizard assumes that you are going to use the PID controller in the “one feedback/one setpoint” mode. The control place will be I/O A and the default process unit “%.” The PID Mini-Wizard asks for the following values to be set:

PID Mini-Wizard values

Item	Description	
20	PID 1 Process Unit	Select Units
21	PID1 Process Unit Min	Min: –99999.99 Max: PID1 Process Unit Max
22	PID1 Process Unit Max	Min: PID1 Process Unit Min Max: 99999.99
23	PID 1 Set Point 1 Source	Select Function
24	PID 1 Keypad Set Point 1	Min: PID 1 Process Unit Min Max: PID 1 Process Unit Max
25	PID 1 Feedback 1 Source	Select Input
26	PID 1 Feedback 1 Min	Min: –200% Max: 200%
27	PID 1 Feedback 1 Max	Min: –200% Max: 200%

Bypass Unit Information

All products are enclosed VFDs that convert 3-phase AC input power into 3-phase output power for controlling motors. Some configurations incorporate bypass circuits. All models are enclosed in either a wall-mounted or a floor standing enclosure using Metal or Plastic cover designs. All models contain a short-circuit protective device, fuses, thermal-magnetic circuit breaker or compact motor controller (CMC), and an associated disconnect handle/operator. All designs are suitable for use in compartments handling conditioned air. These devices may be marked for “Service Entrance”. Operating Mode defines the type of motor control: VFD or Bypass. VFD is when the motor is under speed control from the VFD, Bypass is when the motor is run “across the line” at fixed/full base speed.

Control mode defines the method/source used to start the motor and control the speed of the motor when operating on the VFD. The VFD can be programmed for many methods but the default control mode is HAND-OFF-AUTO. The default setup is that the HAND-OFF-AUTO selection is made from the Keypad Buttons. Other selection programming is available.

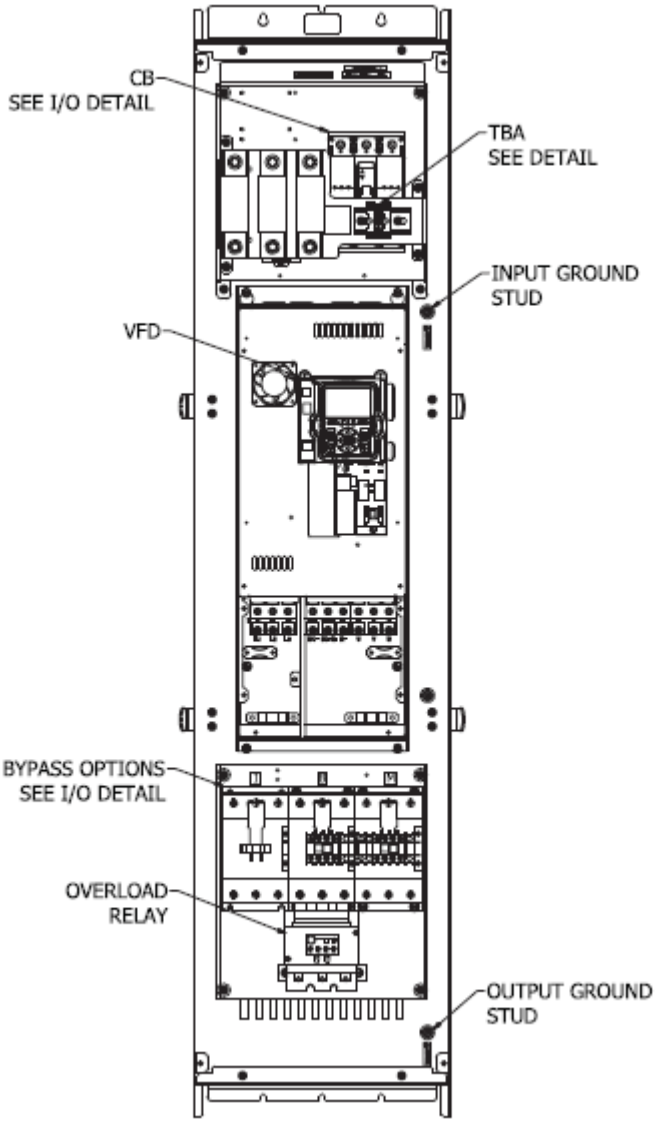
A bypass unit contains a VFD drive with a 24 Vdc bypass control circuit. It also includes 24 Vdc power supply and 24 Vdc VFD output and bypass contactors.

Input Device Choices: MMP, CB, Non-fusible disconnect with separately mounted fuses
Operator Controls: VFD Keypad only.
Optional: 3-position VFD-OFF-BYPASS selector switch and VFD Keypad
Operation Modes: Without the selector switch option, the operation mode is selected by the keypad as: Bypass, Off or VFD

With the selector switch option: The mode is determined by the selector switch on the front of the unit. VFD position– the keypad determines the mode as described above.
BYPASS position–Forced Bypass mode – motor starts in bypass immediately. OFF position – Force off mode
Control Modes: Start/Stop of VFD or Bypass: Via the VFD keypad HOA keys and remote run contacts wired directly to VFD logic PCB
Speed Ref for VFD: HOA operation: via VFD keypad or remote speed signal wired to VFD logic PCB
Bypass Options: VFD Isolation contactor or VFD isolation switch or VFD isolation fuses
Light option: Single Multi-color pilot light: VFD Run, VFD Fault, Bypass Run and Bypass Run and VFD faulted.

Component locations

Typical locations of key components are shown on the connection diagram provided with the unit. Some examples are shown below.



Installation and mounting notes

- Weights and lifting provisions are shown on the dimension drawing provided with the unit.
- Attach “load-rated” hooks or shackles to lifting eyes on back panel.
- Always maintain a maximum of 45 degrees between the lifting cables and the vertical plane.
- Do not pass ropes or cables through the lifting eyes as sharp edges may cause excessive wear and possible failure.
- Select or adjust rigging lengths to compensate for unequal weight distribution of the load to keep unit in the upright position.
- Spreader bar recommended for installation.

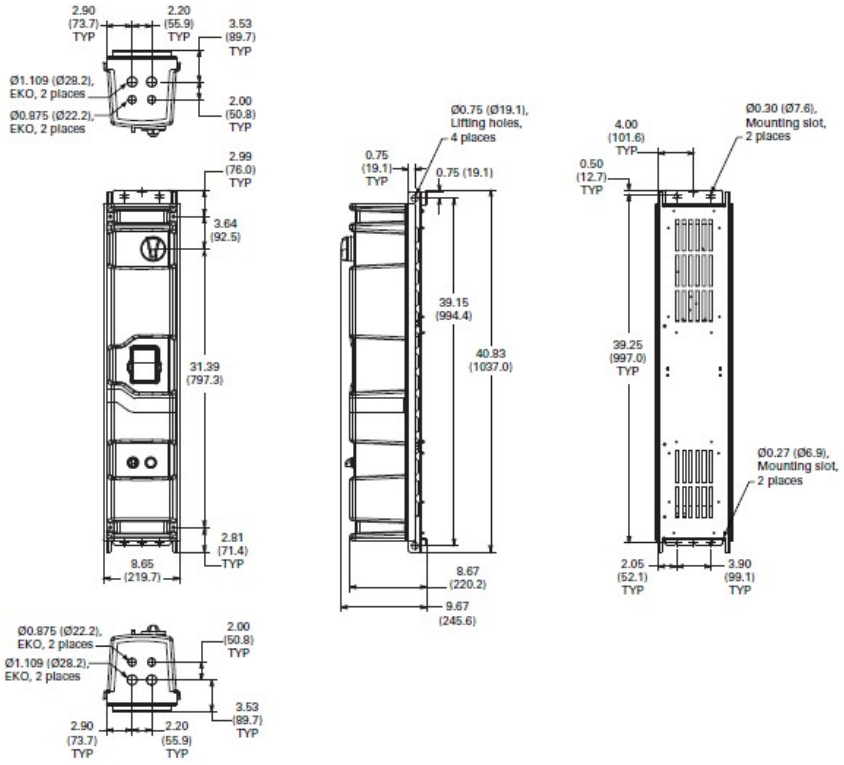
Mounting hardware

Mounting hardware is shown on the drawing supplied with the unit.

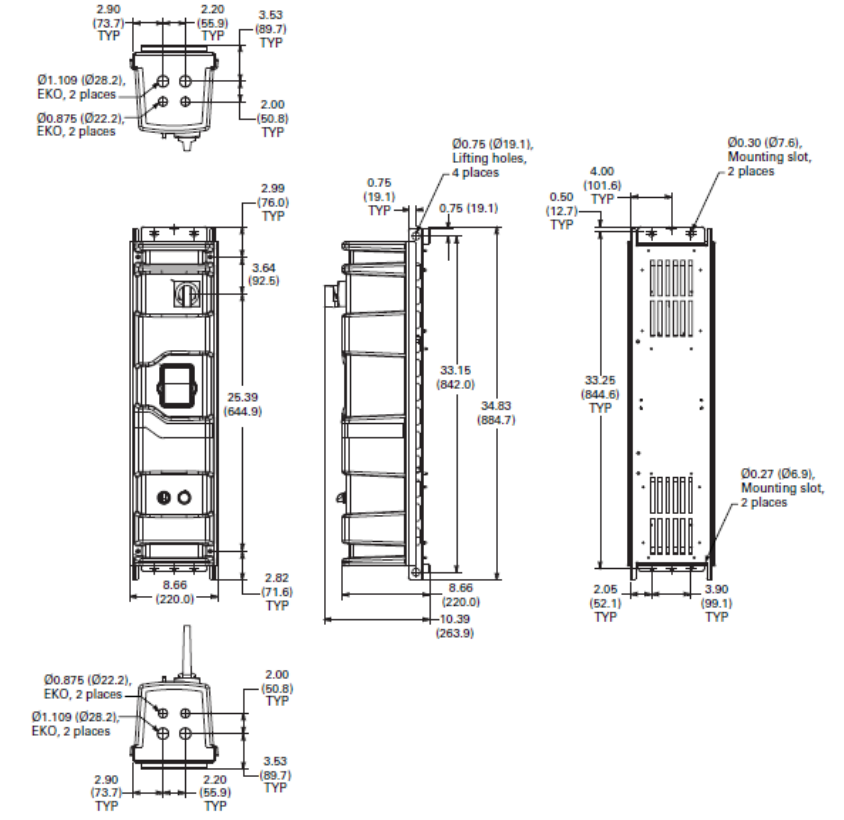
Dimensional Drawings

For drives with bypass option there are 9 possible enclosures sizes/styles available. They are identified by the following alpha numeric/codes: H1, H1S, H2, H2S, H3, H3X, H4, CX and DX.

H1

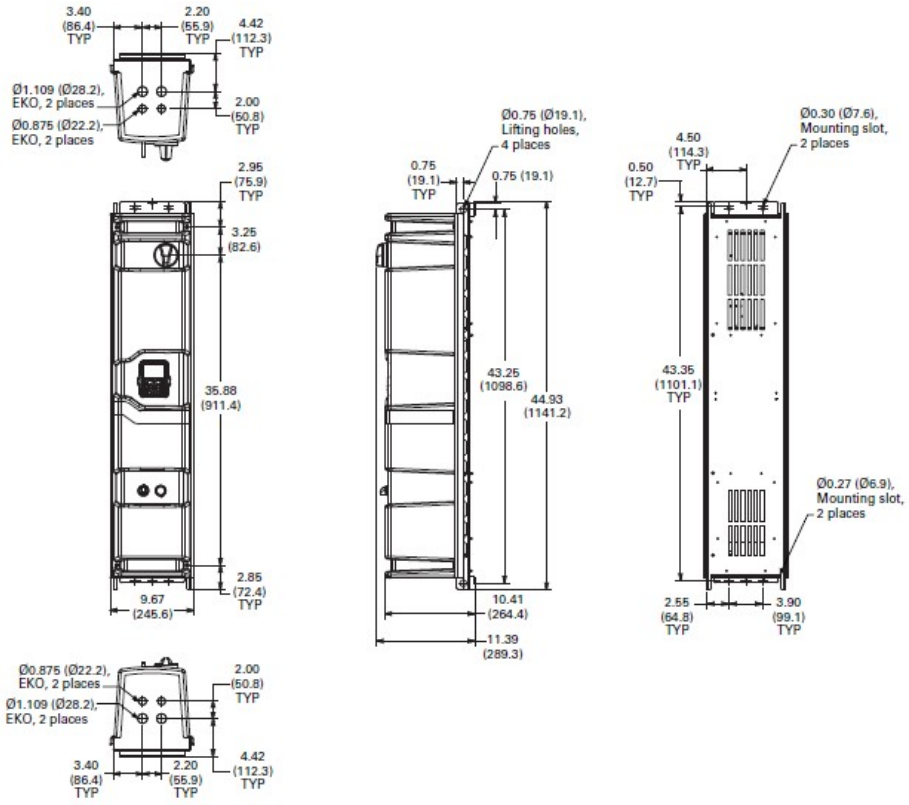


H1S

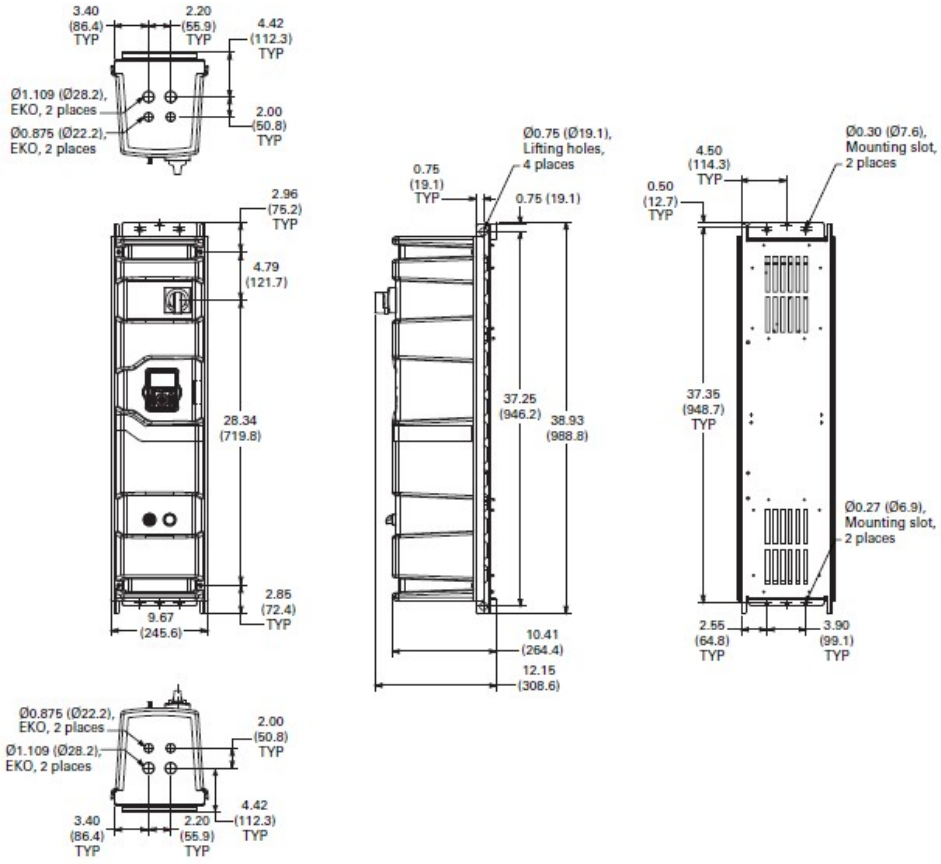


Approximate dimensions in inches (mm)

H2

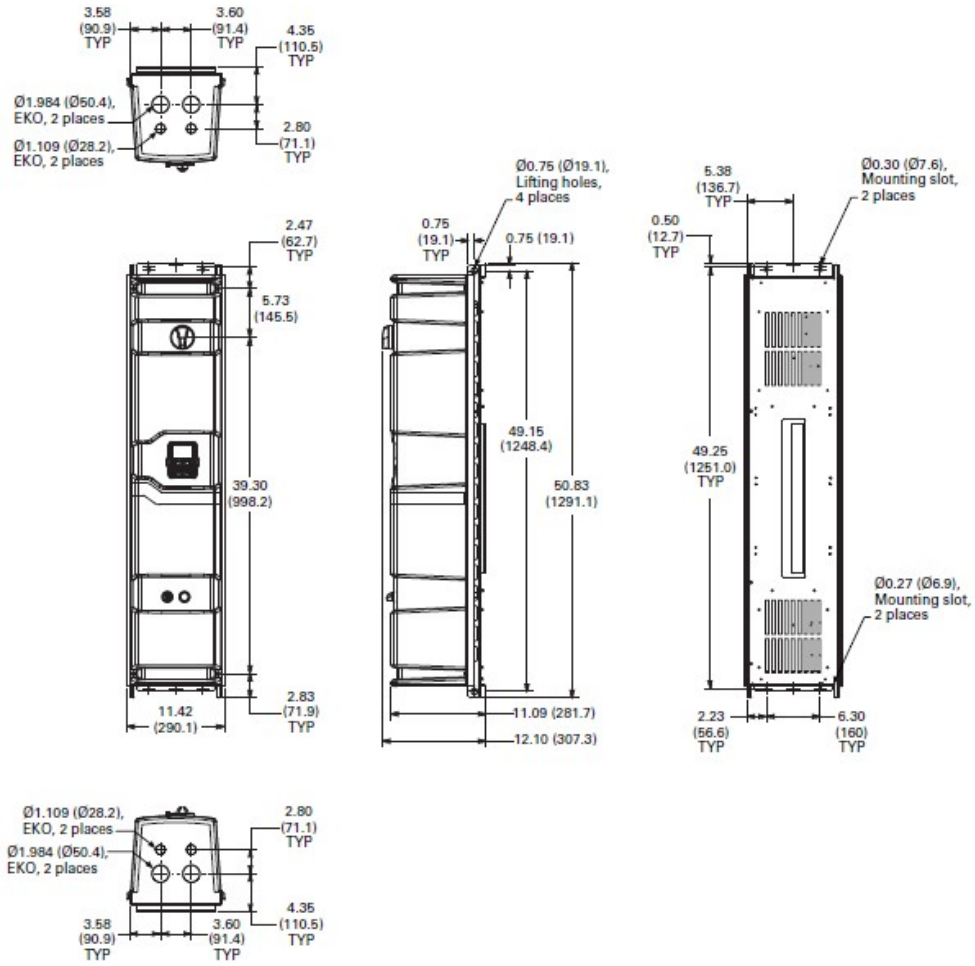


H2S

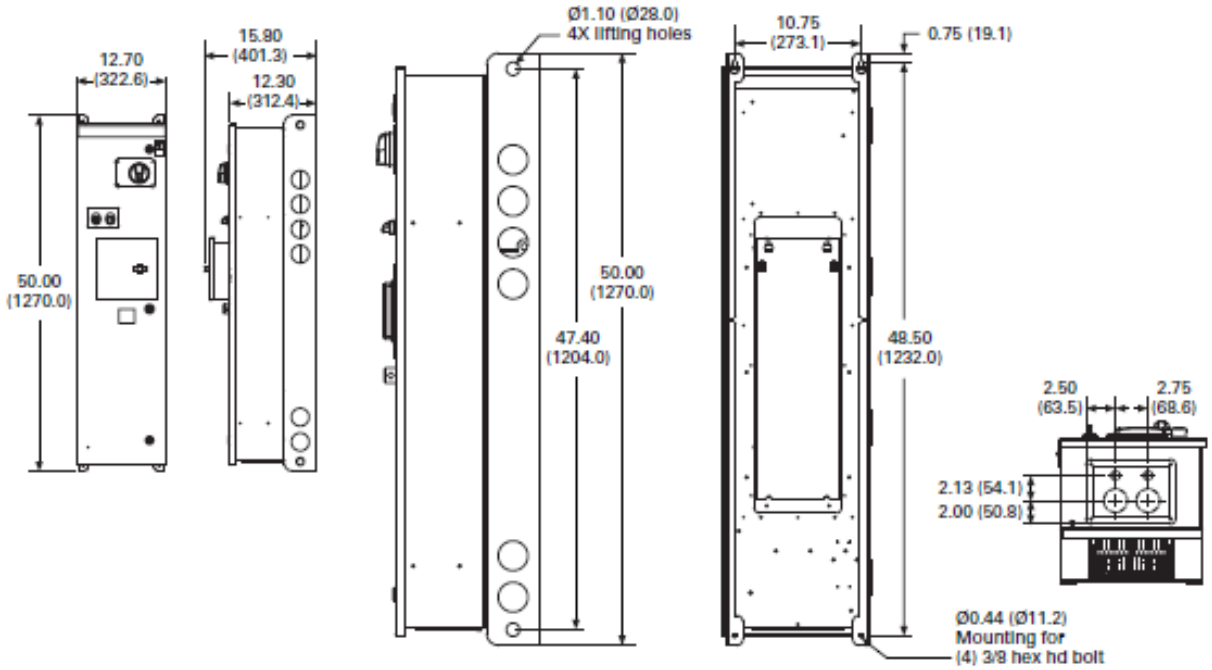


Approximate dimensions in inches (mm)

H3

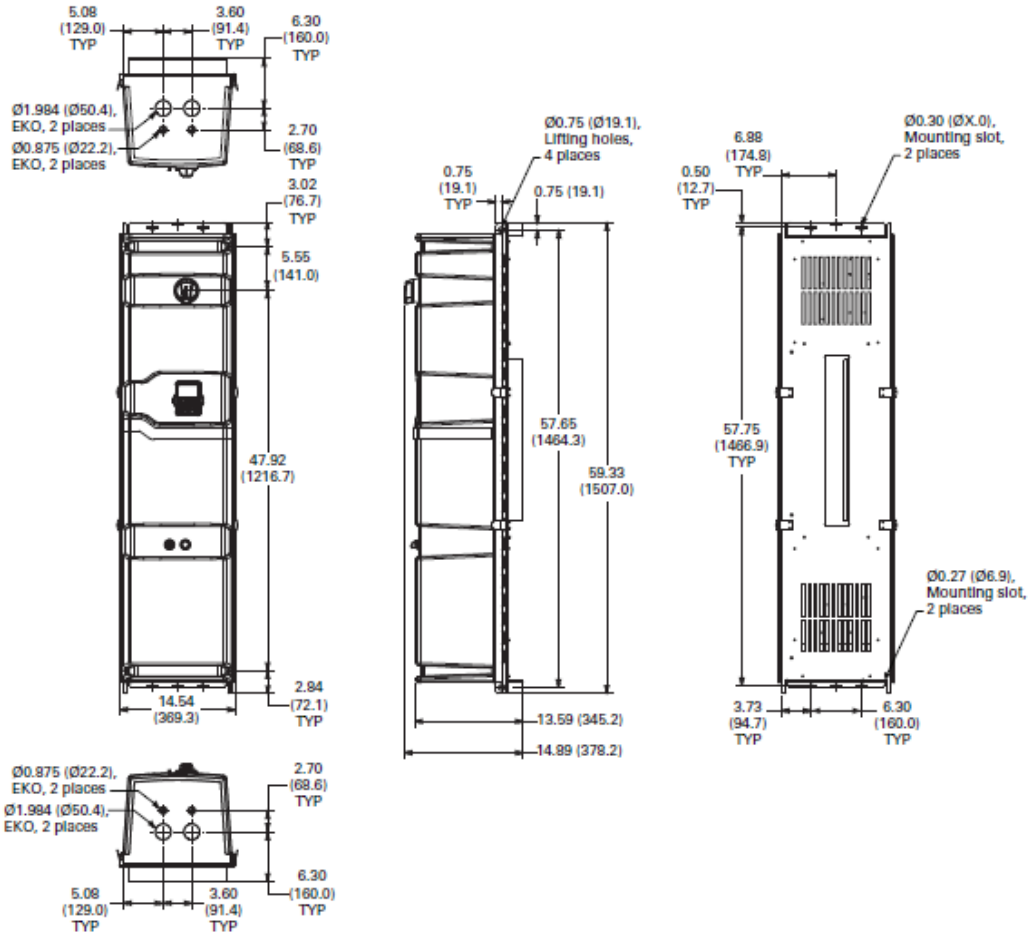


H3X – IP54

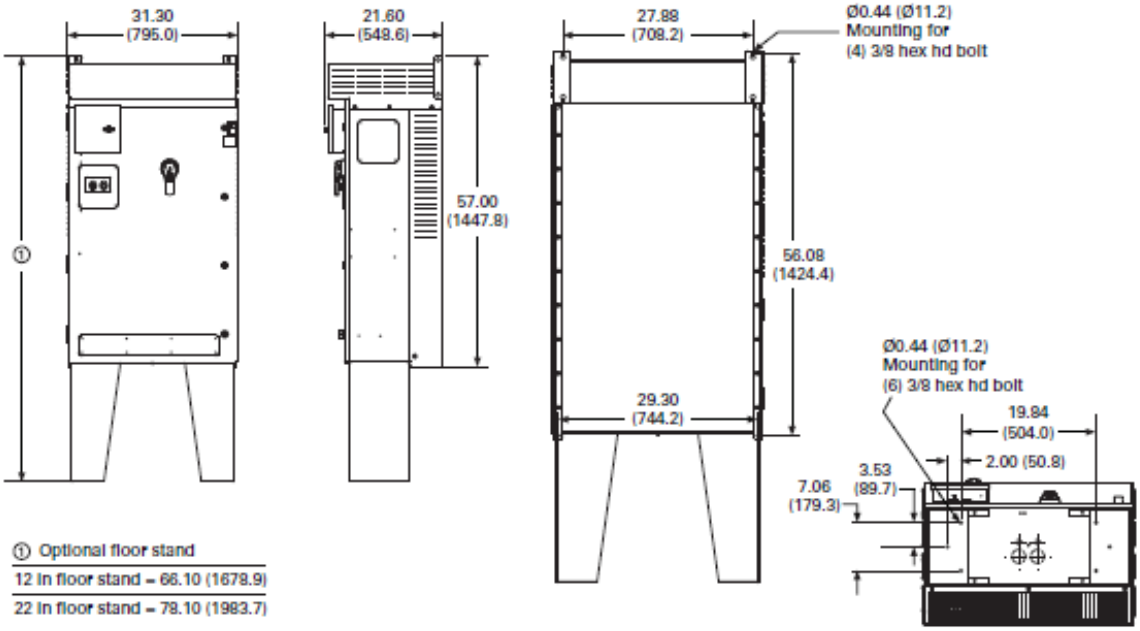


Approximate dimensions in inches (mm)

H4

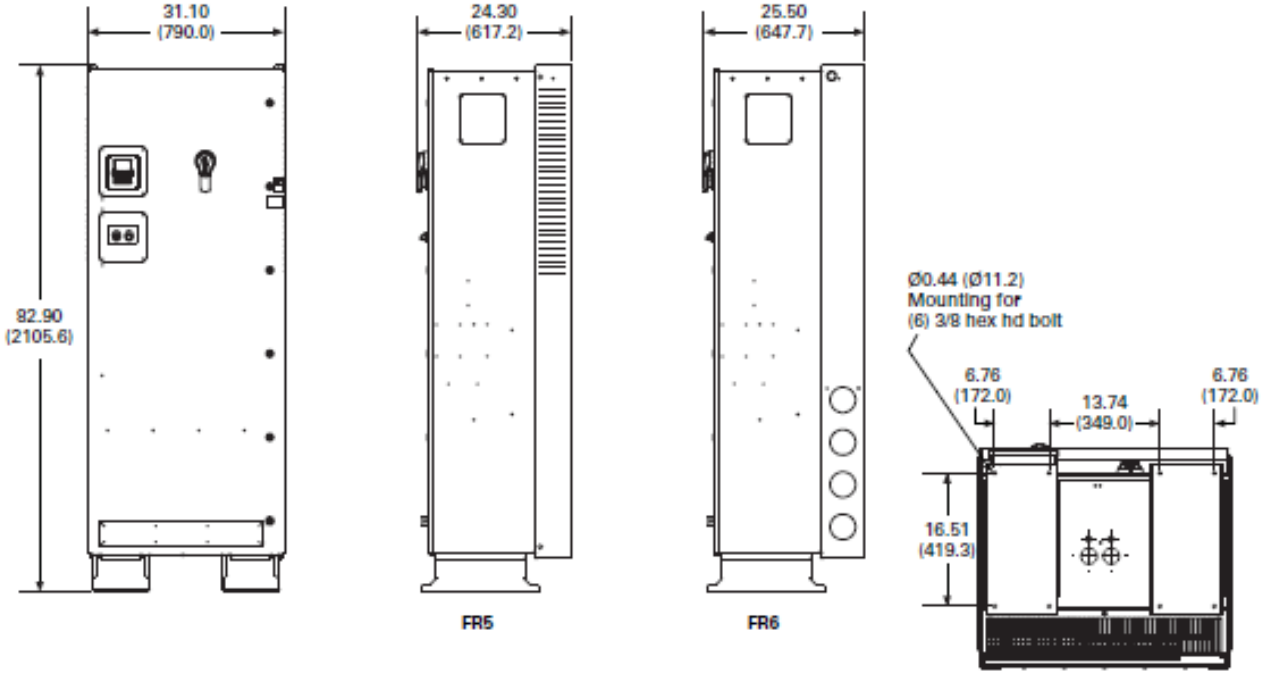


CX-IP54

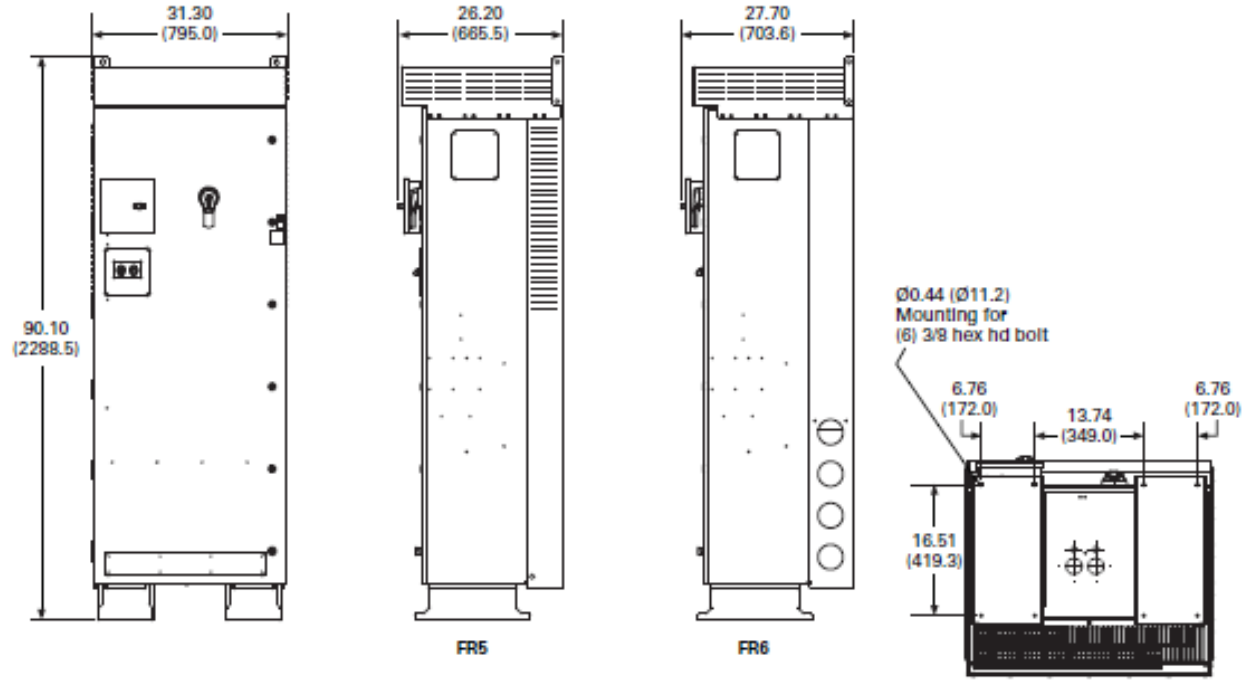


Approximate dimensions in inches (mm)

DX-IP21



DX-IP54



Approximate dimensions in inches (mm)

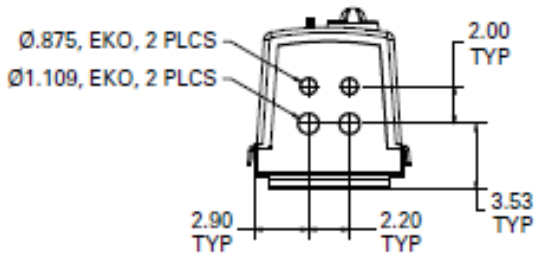
Wiring

A drawing containing the schematic and connections is provided inside the documentation packet with each unit.

- All wires must be copper and rated 75 °C.
- See schematic provided with unit for details and control logic.
- Enclosure must be grounded using input and output studs provided.
- This equipment must be installed in compliance with the National Electrical Code and all state/local codes.
- Use multiple conduits to separate control wiring from incoming power wiring.
- Remote auto start contact and 4–20 mA auto speed signal connections are made directly to VFD control module.
- Component size and locations may be slightly different than shown.
- Motor connections that are made to VFD power terminals U,V and W, ground using clamp supplied.

Conduit plates

Some models have removable conduit plate for wiring ease. See outline drawing supplied with unit to determine if they have the plates. An example is shown below.

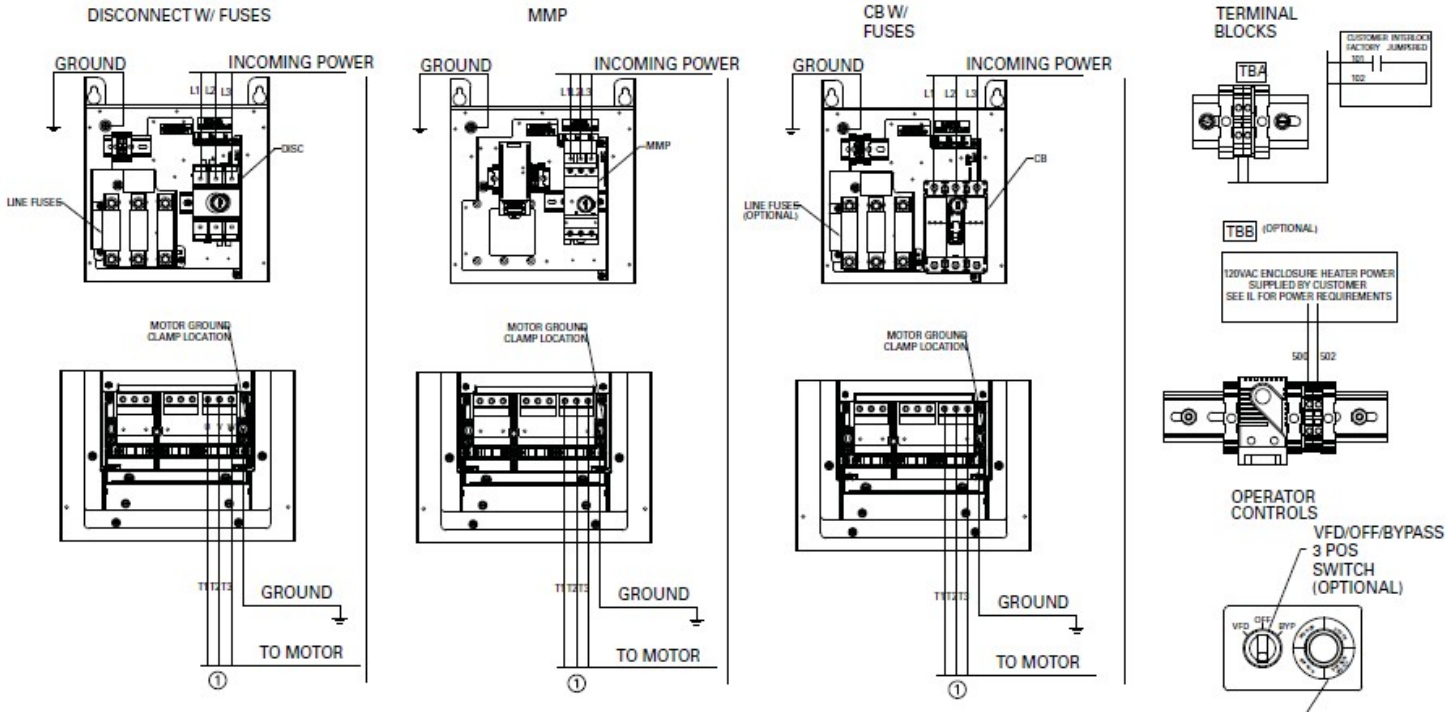


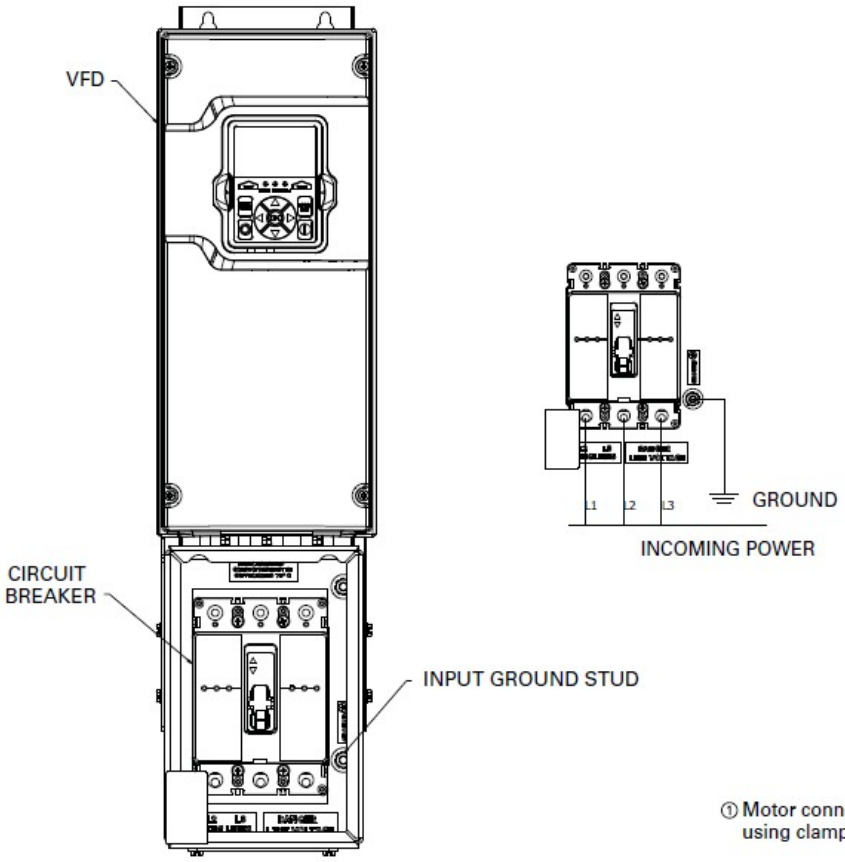
Input power wiring

Input power connection are made to the disconnect device. Connect the incoming power leads to terminals L1, L2 and L3. Input wiring points have labels to help locate.

Example of labels

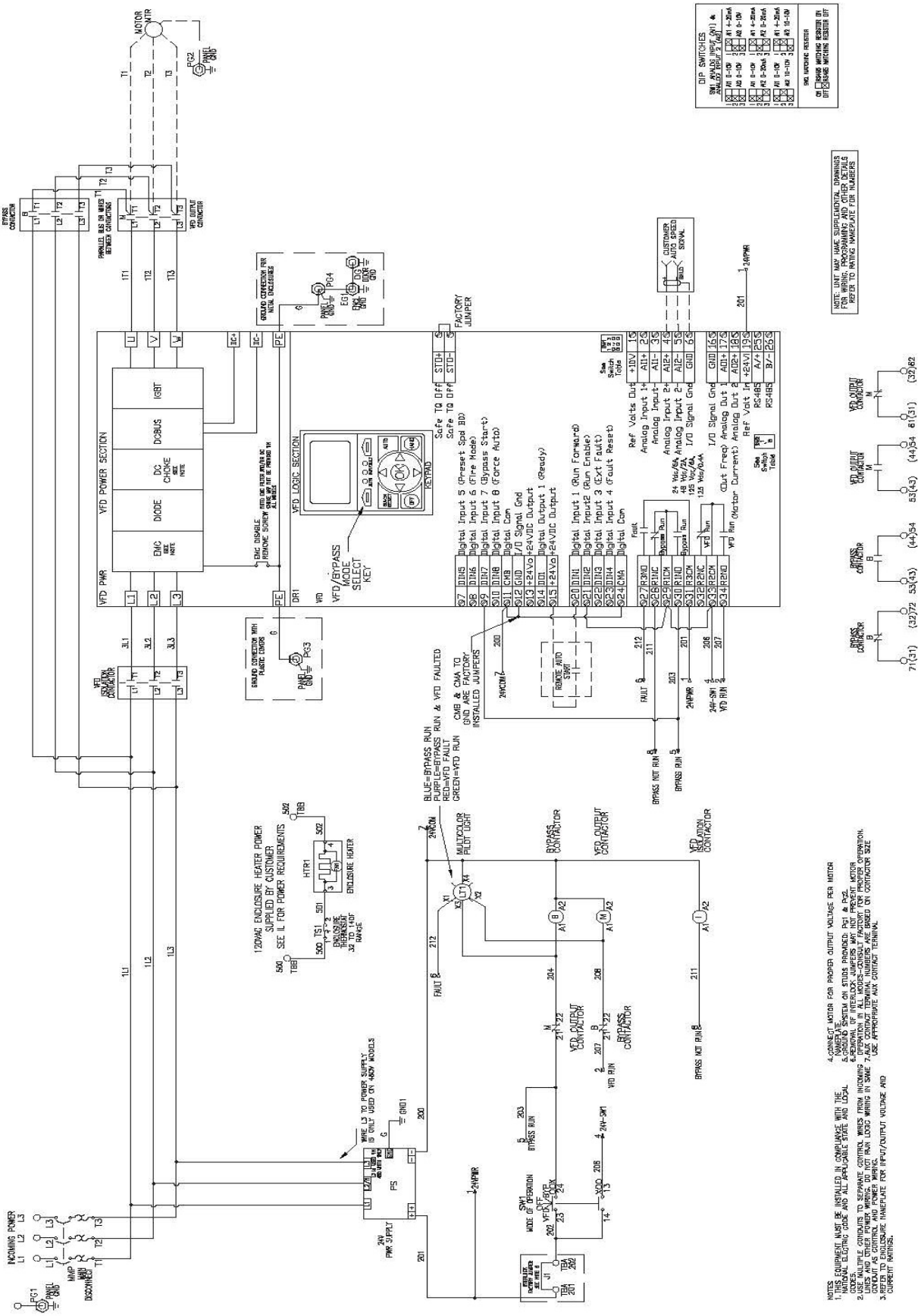
Some examples are shown below. Actual connection points are shown on the connection diagram provided with the unit.

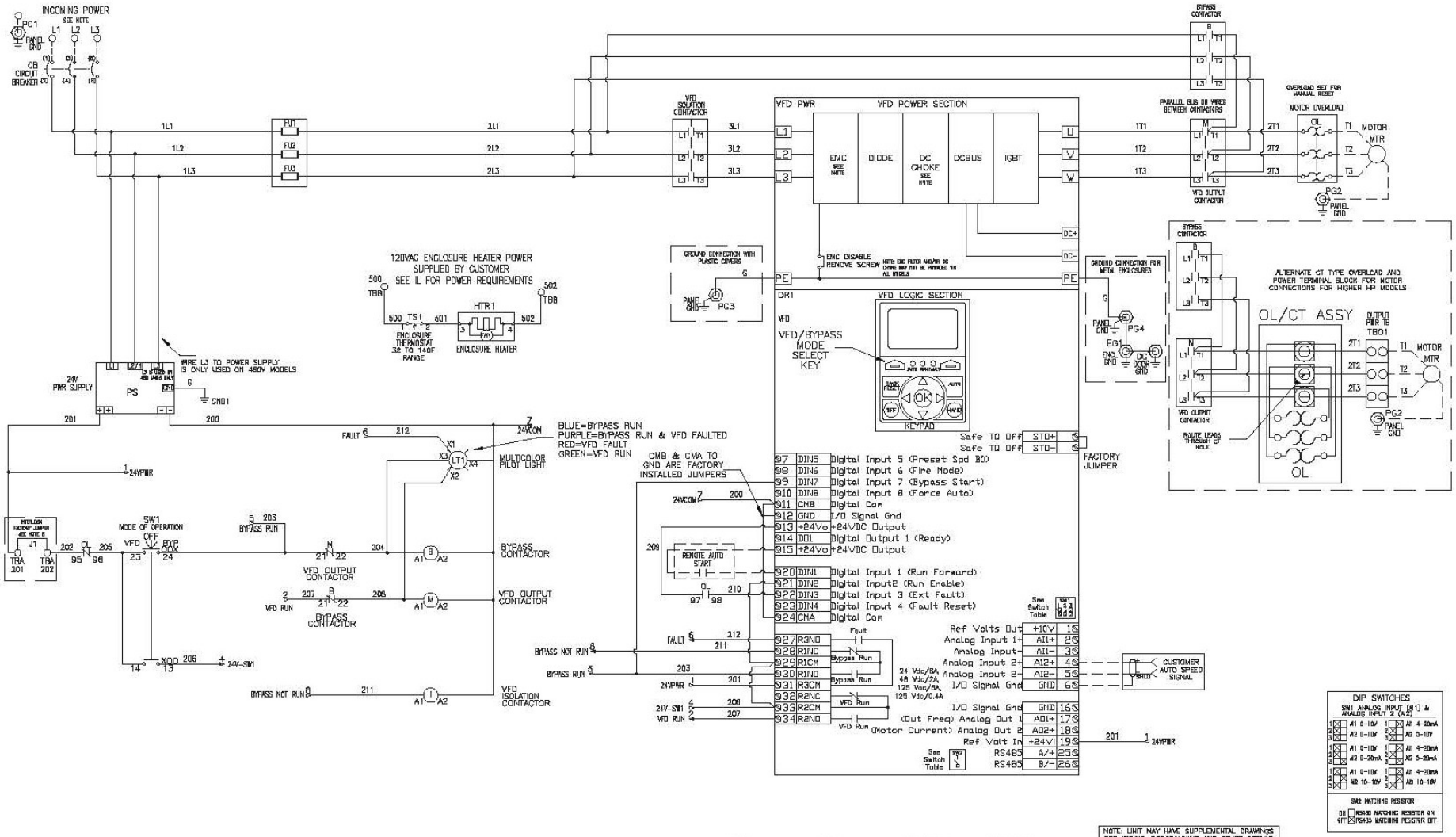




① Motor connections are made to VFD power terminals U,V & W, ground using clamp supplied. See VFD IL for more information.

Electrical schematic examples



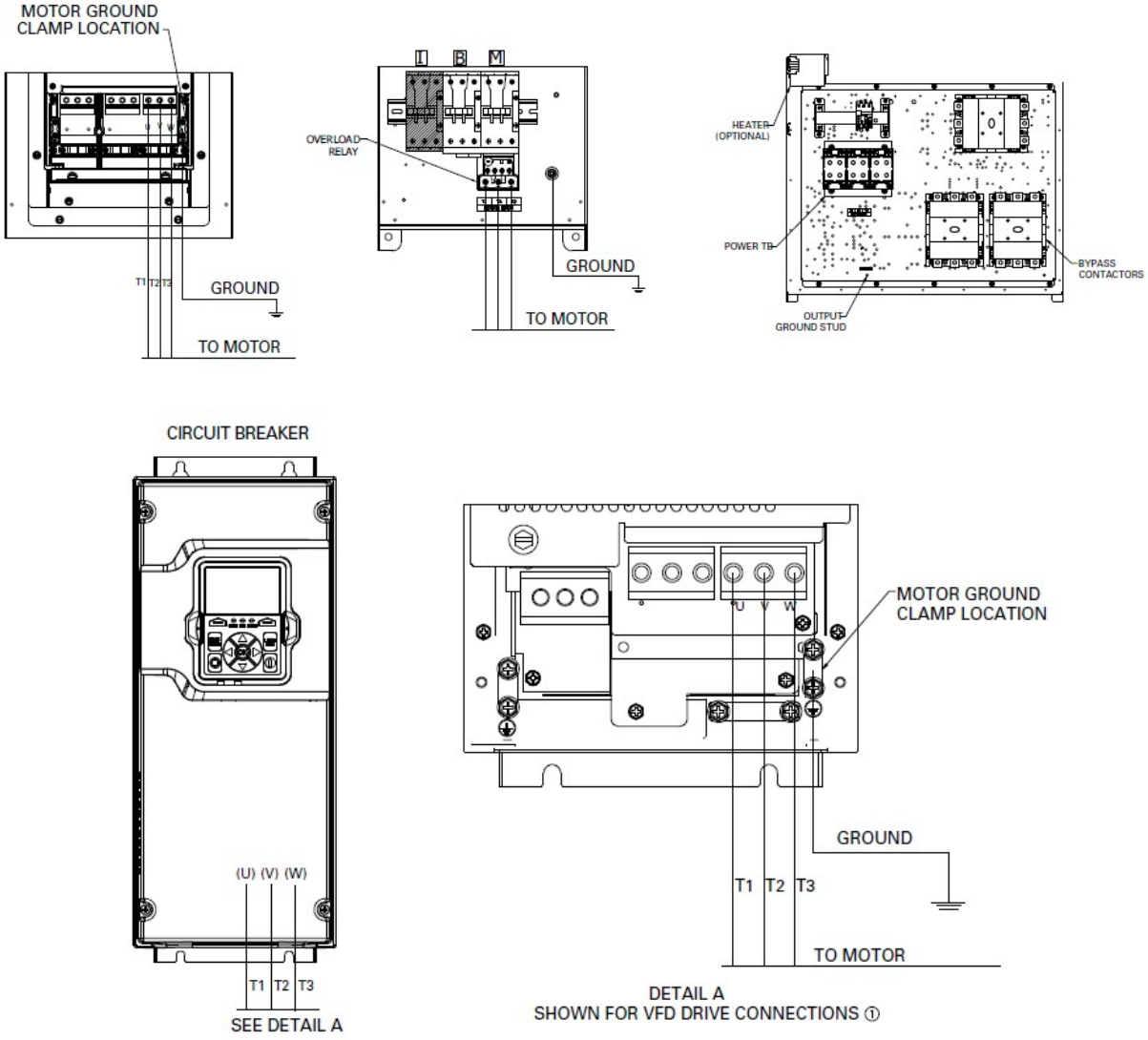


NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.
7. AUX CONTACT TERMINAL NUMBERS ARE BASED ON CONTACTOR SIZE USE APPROPRIATE AUX CONTACT TERMINAL

Motor wiring

For bypass units, wire motor leads directly to the output contactor M, overload OL or output power TB. All bypass models have labels to help locate.

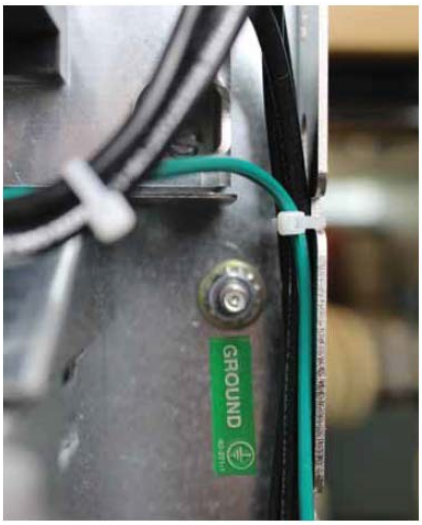
Actual connections points are shown on the connection diagram provided with the unit. Some examples are shown below:



① Motor connections are made to VFD power terminals U,V & W, ground using clamp supplied. See VFD IL for more information.

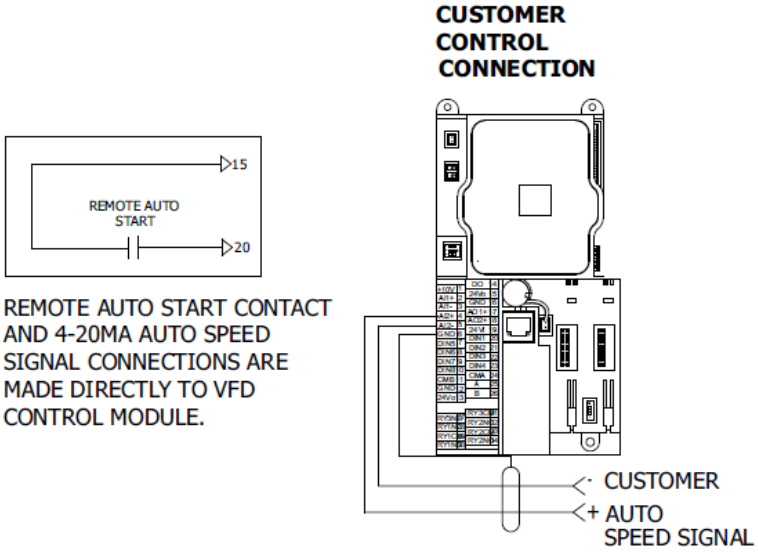
Grounding

Input and output ground points are provided, and hardware is also supplied. The locations are shown on the connection diagrams and differ based on design, enclosure type and size. In most designs, the grounds are also identified by a label.



Control wiring

No additional control wiring is necessary for basic operation. See the example below. For ease of access, the control terminal blocks can be unplugged for wiring.

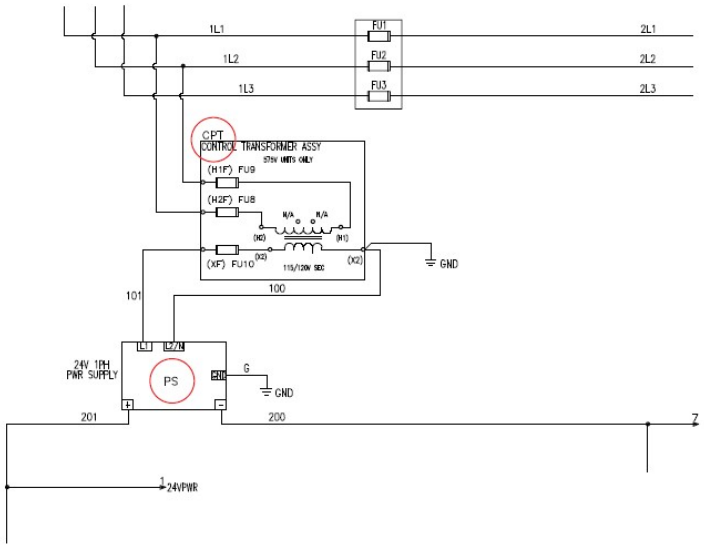


24 V power supply (PS) and control transformer CPT

All bypass units have a separate 24 V power supply that provides control circuit power as well as backup power to the VFD logic. This backup power feature allows the VFD logic and keypad to remain operational when the main input power has been removed when the Isolation Contactor or Switch option is provided.

For 208/230 and 480 V models, the power supply is powered directly from the main 3-phase power. The 24 V power supply has either a 3-phase or single-phase input.

575 V bypass models have an additional control transformer and fuses (FU8, 9 and 10) to step down the line voltage to 120 Vac. A single-phase 120 Vac input supply is used.



Bypass setup/operation

This section describes the basic operation allowing the unit to start/stop the motor in bypass and under VFD control. Refer to the Application Manual to become familiar with the VFD Keypad operation and VFD Menu Structures.

Bypass options

There are several bypass power and control options that are defined by the catalog number nomenclature: 2 Contactor Bypass, VFD Isolation Contactor and VFD Isolation Switch and Manual Bypass Switch. See options sections for description/operation.

VFD parameter settings

Bypass Designs have several parameters that were reset to operate the bypass controls correctly. If these parameters are changed either Manually or Automatically (using the “Load Parameter Set” function P13.1.3), the bypass control circuit may not operate properly!

The key bypass design parameters are:

P2.2.3	IO terminal 1 Start Signal 2 must be set to DigIN:NormallyOpen
P2.2.6	IO terminal 2 Start Signal 2 must be set to DigIN:NormallyOpen
P2.2.9	Ext Fault 1 NO must be set to DigIN 3
P2.2.19	Run Enable must be set to DigIN 2
P2.2.34	Bypass Start must be set to DigIN 7
P3.1.2	RO1 Function must be set to BYPASS Run
P3.1.5	RO2 Function must be set to RUN
P3.1.8	RO3 Function must be set to FAULT
P10.1.1	Bypass Enable is set to ENABLE
P10.1.2	Bypass Start Delay is set to 1 sec
P10.1.3	Auto Bypass Start is set to DISABLE

Bypass modes of operation

Bypass designs have three modes of operation: VFD, OFF or BYPASS.

VFD mode, the motor is powered by the VFD and motor speed is adjustable. The motor may or may not be running depending on the controls.

BYPASS mode, the motor connected across the line and motor speed is fixed at base speed.

The motor may or may not be running depending on the controls. OFF

mode, the motor is not powered and is not running.

Mode selection is dependent on the options provided. As standard, the three modes can always be selected from the VFD keypad. The BYPASS or VFD mode is selected by using the Left Soft key and the OFF mode by pressing the OFF/ Stop key.

Under some circumstances there may be a delay in the actual start of the motor when in the bypass mode. Refer to application manual and parameters P10.1.2 Bypass delay start and P10.1.4 Auto Bypass Delay Start for more information about these delays.

An optional door or cover 3-position selector switch can be provided to override the VFD keypad mode selection and set the system to OFF or BYPASS.

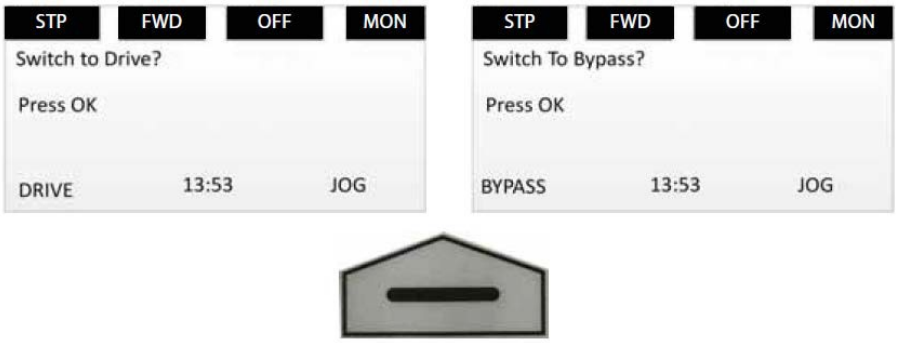
- If unit has SW1 option on cover or door, place in OFF position
- Apply power and close disconnect
- Keypad should power and display Startup Wizard
- The Keypad display should show “BYPASS” above the left keypad soft button. Pressing the button should give you the message “Switch to Bypass- Press OK”

Note: The BYPASS/VFD mode selection using the Soft Key on the keypad will only appear if the BYPASS mode has been enabled in software by using the startup wizard or direct entry using parameter P10.1.1

Using the keypad to select the mode

Mode selection is made from the VFD keypad using the Left soft key. The selection is shown above the key and the display will indicate the next mode to be selected by pressing the key and not the active mode.

Some bypass designs have an optional VFD-OFF-BYP switch located on the cover or door of the unit. The switch must be in the VFD position in order for the keypad to select the desired mode as described above.



Using the switch to select the mode

- Some bypass designs have an optional VFD-OFF-BYP switch located on the cover or door of the unit. The switch selects where the mode is determined.

In the OFF position, the VFD Keypad control is disabled and the motor cannot be started from any means. This position also removes the RUN ENABLE input to the VFD (DigIn2). In the Bypass position, the VFD Keypad control is disabled and the motor started immediately in Bypass. This position also removes the RUN ENABLE input to the VFD (DigIn2). In the VFD position, the VFD control is enabled and the motor can be started from keypad in either the Hand or Auto methods. This position applies the RUN ENABLE input to the VFD (DigIn2).

Motor overload protection types

For bypass designs, the motor overload protection is provided by different methods depending on the input disconnect type provided. It could be a Circuit Breaker/Disconnect or Type E CMC. Setting the Motor overload level and the OL trip/function is dependent on the type of overload protection that senses the overload.

Circuit Breaker or Disconnect

Motor protection is provided by the following depending on the mode:

A bimetallic overload relay provides the overload protection when in running in the bypass mode and the VFD logic provides the overload protection when the motor is running on the VFD.

Type E (CMC)

Motor protection is provided by the following depending on the mode:

The CMC input device provides the motor overload protection when in running in the bypass mode and the VFD logic provides the overload protection when the motor is running on the VFD.

Note: The VFD logic provides the overload protection when the motor is running on the VFD.

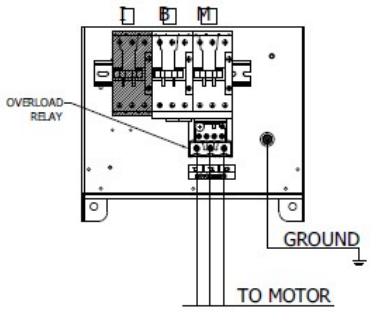
Note: For Type E Disconnect designs, CMC overload protection is also active when running on the VFD mode, but the VFD OL logic is more accurate and is the primary method of protection due to the nature of VFD output waveform.

Motor overload operation

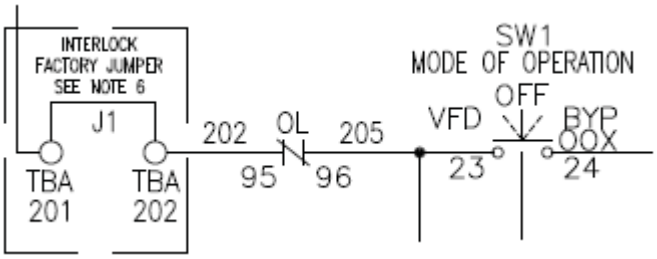
Depending the design and BCP, there are serval different ways a motor overload can be sensed.

Sensed by the bimetallic overload relay

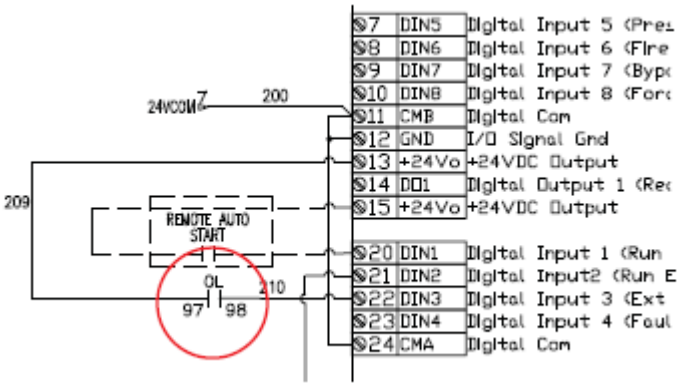
The OL trip level is set by the overload relay using the dial set to the motor FLA. The OL relay is designed to protect the motor at Class 10 protection. Some larger hp units may use CT base overloads, which provide Class 30.



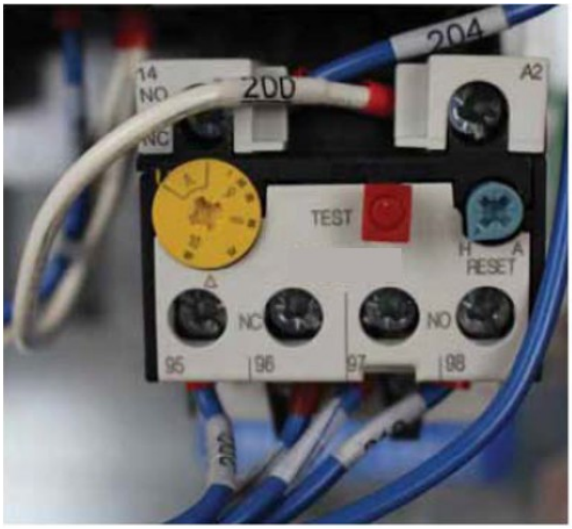
When an overload occurs, the 24 V control circuit power is removed via the NC overload relay contact (95-96) (see schematic). Both the VFD (M) and Bypass (B) contactors are disabled.



The VFD keypad display will also indicate an “External Fault”. VFD input 3 is closed via the NO overload relay contact (97-98) (see schematic). The VFD keypad fault LED will be on.



The overload can only be reset by removing main power and opening the enclosure door or removing the cover and then pressing the reset button on the OL relay. The overload relay is set for manual reset operation; Auto reset is not used or recommended.



NOTICE

THE BYPASS DESIGN HAVE AN OPTIONAL VFD-OFF-BYP SWITCH LOCATED ON THE COVER OR DOOR OF THE UNIT. IF THE SWITCH IS LEFT IN THE BYPASS POSITION, THE MOTOR WILL AUTOMATICALLY RESTART IN BYPASS AS SOON AS POWER IS REAPPLIED AFTER THE OVERLOAD RELAY HAS BEEN RESET. **IT IS RECOMMENDED THAT THE VFD-OFF-BYP SWITCH BE MOVED TO THE OFF POSITION BEFORE REAPPLYING POWER**

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