



p/n 88-020292-01 A

E-AC Drive Hardware Installation Guide

Effective: April 9, 2002



IMPORTANT

User Information



WARNING



E Series products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

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CHAPTER ONE

Introduction

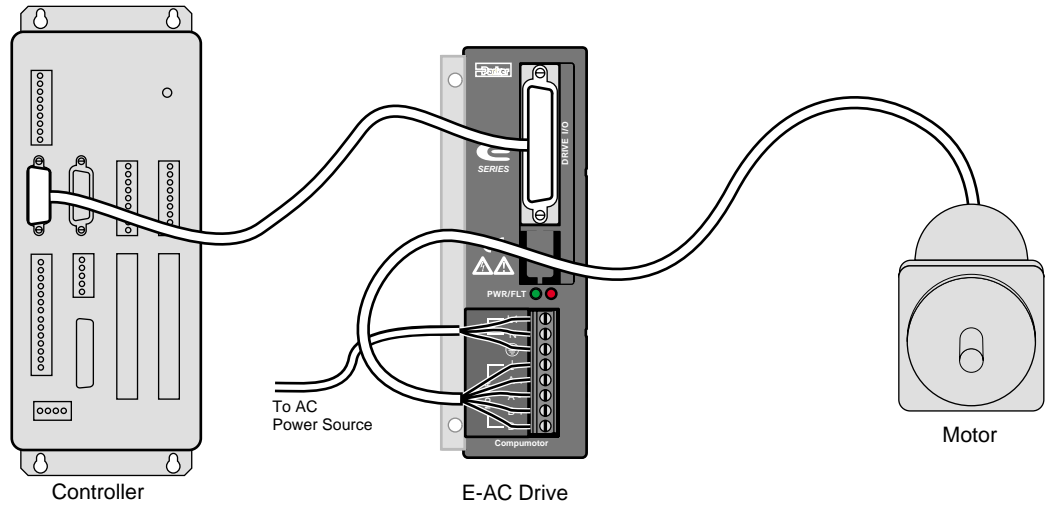
IN THIS CHAPTER

- E-AC Drive Description
 - Compumotor Products
-

E-AC DRIVE – DESCRIPTION

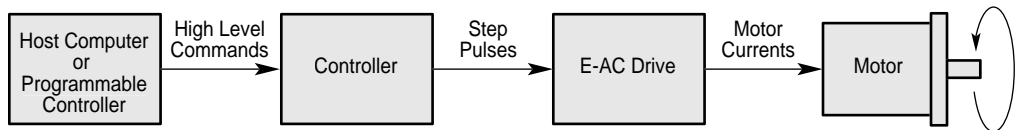
The E-AC Drive is a microstepping drive that runs two-phase step motors. It operates directly from 120VAC power; no separate DC power supply or transformer is required.

A typical system is shown below.



System Components

The controller sends step and direction signals to the drive. For each step pulse it receives, the drive will commutate the motor to increment rotor position. This is shown in the next drawing.



Block Diagram of E-AC Drive System

The host computer or programmable controller may or may not be necessary, depending upon the controller's capabilities.

The motor can be wired in series or parallel; the amount of current the drive sends to the motor is set by DIP switches.

DIP SWITCHES

DIP switches are located on top of the E-AC Drive, accessible through an opening in the top of the cover. During the installation procedure, the user sets these DIP switches to configure the drive for motor current, resolution, waveform, and other functions.

⚠ **CAUTION** ⚠
Remove power before changing DIP switches

INPUTS & OUTPUTS

All communications with the controller take place through the E-AC Drive's 25-pin D-connector. Available inputs and outputs are:

- Step Input
- Direction Input
- Shutdown Input
- Fault Output
- Reset Input

ANTI-RESONANCE

All step motors are subject to resonance, and to ringing after quick transient moves. The E-AC Drive has an anti-resonance circuit. This is a general purpose damping circuit that provides aggressive and effective damping. Anti-resonance can be disabled with a DIP switch.

E-AC DRIVE – COMPATIBLE MOTORS

Compumotor offers a wide range of motors that are compatible with the E-AC Drive. See *Chapter 2 – Installation* for recommended motors.

COMPUMOTOR FAMILY OF PRODUCTS

The E-AC Drive is compatible with Compumotor's broad range of microstepper controllers (single-axis and multi-axis) and motion control products.

CHAPTER TWO

Installation

IN THIS CHAPTER

- Product Ship Kit
 - Quick Test
 - Motor Selection and Wiring
 - Drive Configuration – DIP Switches and I/O
 - Mounting the Drive and Motor; Attaching the Load
 - Connecting AC Power
 - Testing the Installation
-

WHAT YOU SHOULD HAVE (*SHIP KIT*)

Inspect your shipment carefully. You should have received one or more of the following:

| Part | Part Number |
|----------------------------------|--------------|
| E-AC Drive | E-AC |
| E-AC Drive Quick Reference Guide | 88-020290-01 |

You may have ordered a motor from one of the following families of Compumotor motors:

- OS Motors
- VS Motors

PRECAUTIONS

To prevent injuries to personnel and damage to equipment, observe the following guidelines:

- Never probe the drive. Hazardous voltages are present within the drive.
- Never open the drive. Opening the drive will void the warranty.
- Never increase the current setting to a value greater than that specified for the motor you are using. Excessive current may cause motor overheating and failure.
- Always remove AC power before changing or reconfiguring DIP switches.

INSTALLATION OVERVIEW

Topics in this chapter are arranged to lead you through the installation process in a step-by-step manner. Complete each step before proceeding to the next.

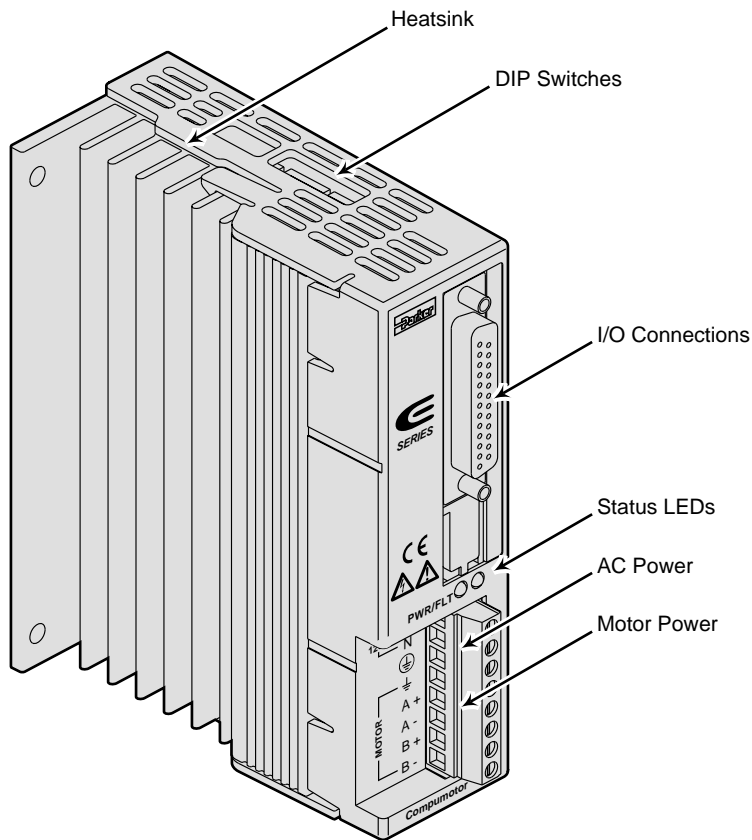
The order of topics in the installation procedure is:

- Quick Test
- Motor selection: specifications, speed/torque curves and dimensions
- Motor wiring—series vs. parallel
- DIP switch configuration
- Controller connections and 25 pin D-connector input/output schematic
- Drive mounting
- Motor mounting
- Connecting the load
- Connecting AC power
- Testing the installation

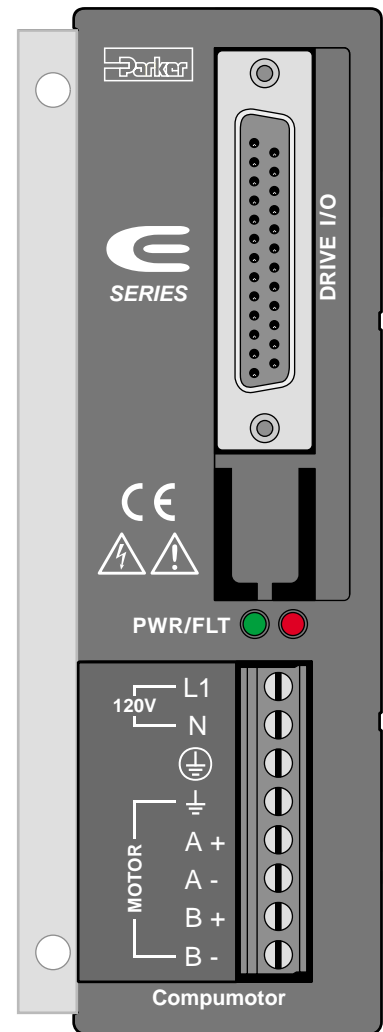
INSTALLATION PROCEDURE

In the following installation procedure, we assume you are using a Compumotor motor with your E-AC Drive. If you are using a non-Compumotor motor, consult *Appendix A – Using Non-Compumotor Motors* for information you may need during the following installation steps.

The next drawing shows locations and names of the various connectors, switches and LEDs that you will encounter during the installation procedure.

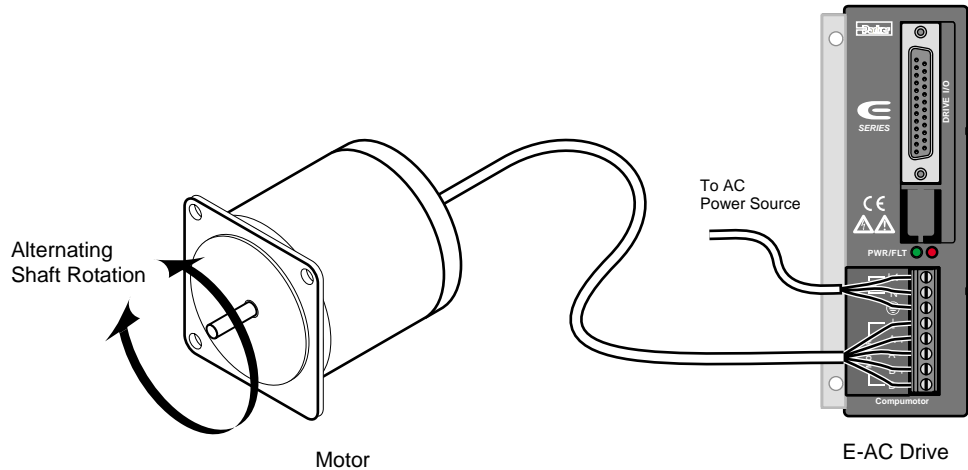


Component Locations



AUTOMATIC TEST

Follow this procedure to have your E-AC Drive perform its *automatic test* function. Once you set DIP switches, connect the motor, and connect AC power, the automatic test will begin—the motor shaft will turn at one revolution per second in an alternating mode until you remove power. This will verify that the drive, motor, and motor cable work properly as a system.



Automatic Test Setup

This is a *bench top* procedure—as the drawing shows, you can perform it before you connect a controller, mount the drive, or mount the motor. Full installation instructions follow this *Automatic Test* section.

1. SET DIP SWITCHES FOR Motor Current

Two 8-position DIP switches are located on top of the E-AC Drive.
NOTE: if you are testing a drive that has already been configured for an application, make note of the original DIP switch settings.



Set DIP switches SW2-#4 — SW2-#8 for the current for your motor, according to the table. (For non-Compumotor motors, see *Appendix A*.)



2. SET DIP SWITCHES FOR THE **Automatic Test** Function

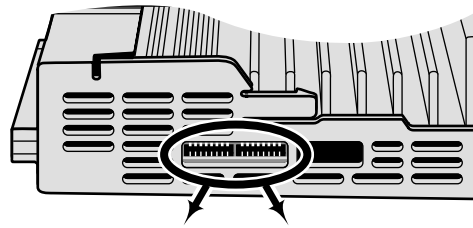
Set DIP switch SW1-#1 to the *on* position. This selects the automatic test function.

3. CONNECT THE MOTOR

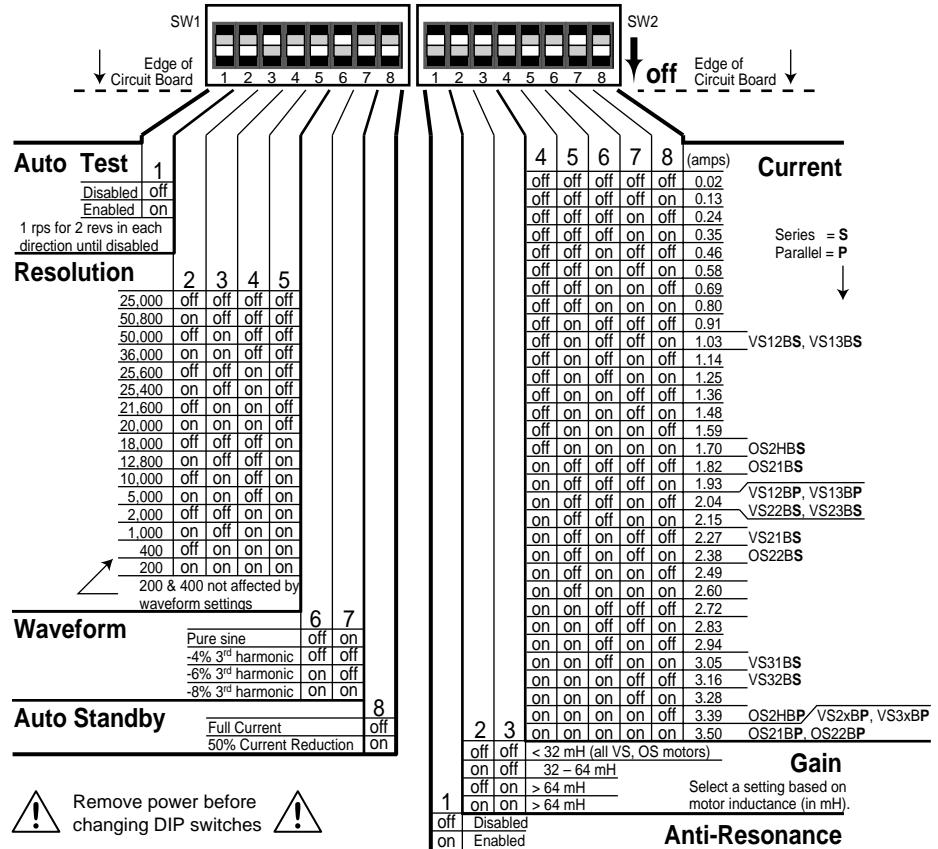
Connect your motor cable to the drive's **MOTOR** terminals. Motor wiring instructions are presented later in this chapter. (For non-Compumotor motors, see *Appendix A*.) Always observe the following two warnings:

 **WARNING** 
POWER MUST BE OFF when you connect or disconnect the motor connector. Lethal voltages are present on the screw terminals!

 **WARNING** 
You must ground the motor case. Large potentials can develop at the motor case that can create a lethal shock hazard if the motor case is not grounded.



Default Position:
Drive ships from factory with all DIP switches in the **OFF** position.



4. CONNECT AC POWER

The E-AC Drive does not have an ON/OFF switch. When you connect power, the automatic test will begin—the drive will turn on and the motor will start turning. Therefore, before you apply power to the E-AC Drive:

- Properly secure the motor.
- Do not attach a load to the motor shaft.

To apply power, connect one end of your power cable to the drive's 120V and \ominus terminals. Connect the other end to a grounded 120VAC power source. (Further instructions are presented later in this chapter.)

5. OBSERVE THE AUTOMATIC TEST

Your E-AC Drive should now be running in the automatic test mode.

- The motor shaft should rotate at approximately one revolution per second (1 rps) in an alternating mode, until you remove power.
- LED Operation – observe the LEDs on the front panel:
 - PWR LED (power; green) should illuminate
 - FLT LED (fault; red) should be off

6. STOP THE AUTOMATIC TEST

Disconnect power to stop the motor. Set DIP SW1-#1 to *off*. (Return DIP switches of previously configured drives to original settings, if desired.)

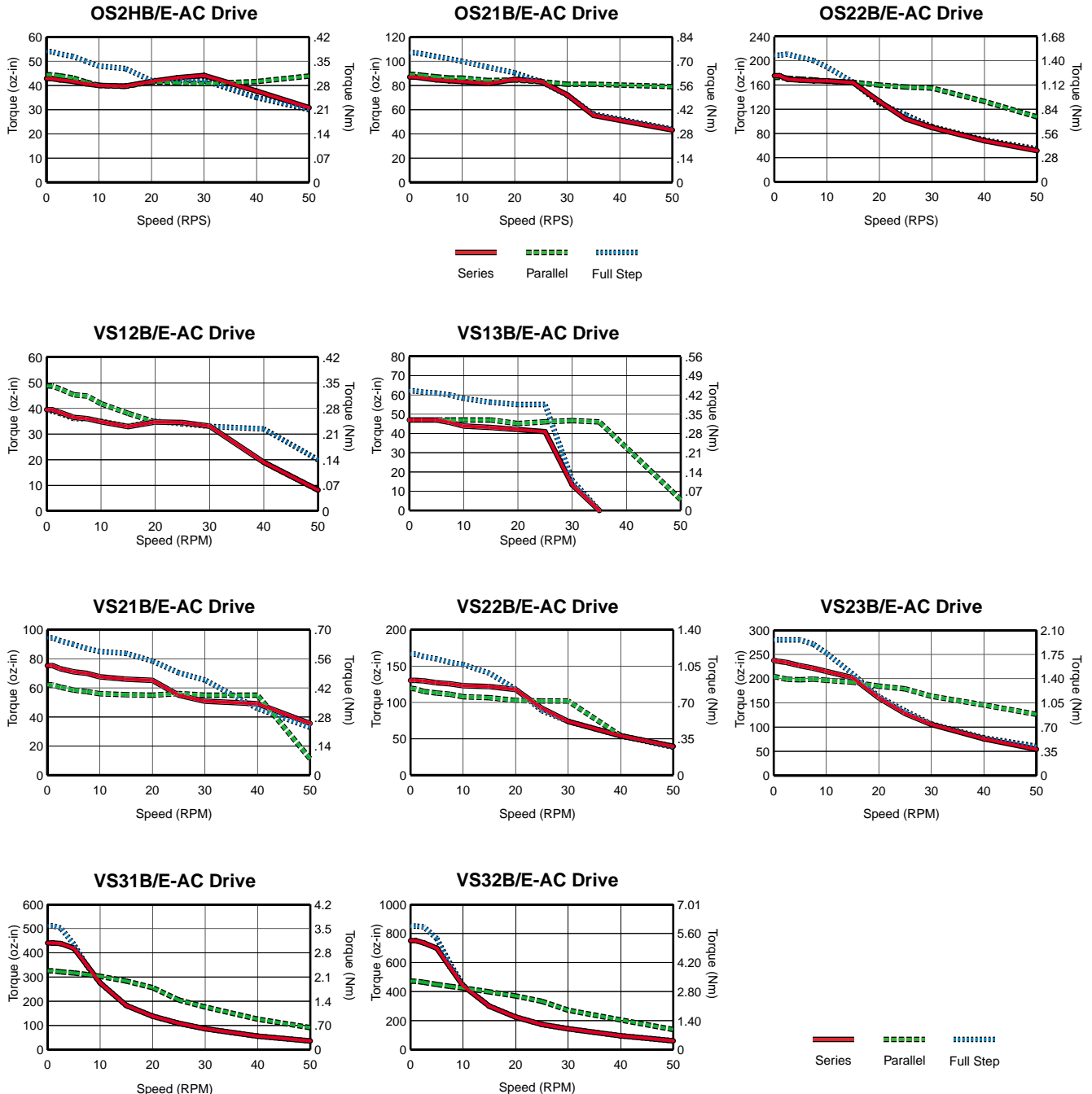
INSTALLATION

The procedures in the rest of this chapter will lead you through the steps required to permanently install your E-AC Drive and motor.

1 – SELECT A MOTOR

Speed/Torque curves, specifications, and motor dimensions for Compumotor motors are shown below.

SPEED/TORQUE CURVES



MOTOR SPECIFICATIONS

OS Motors

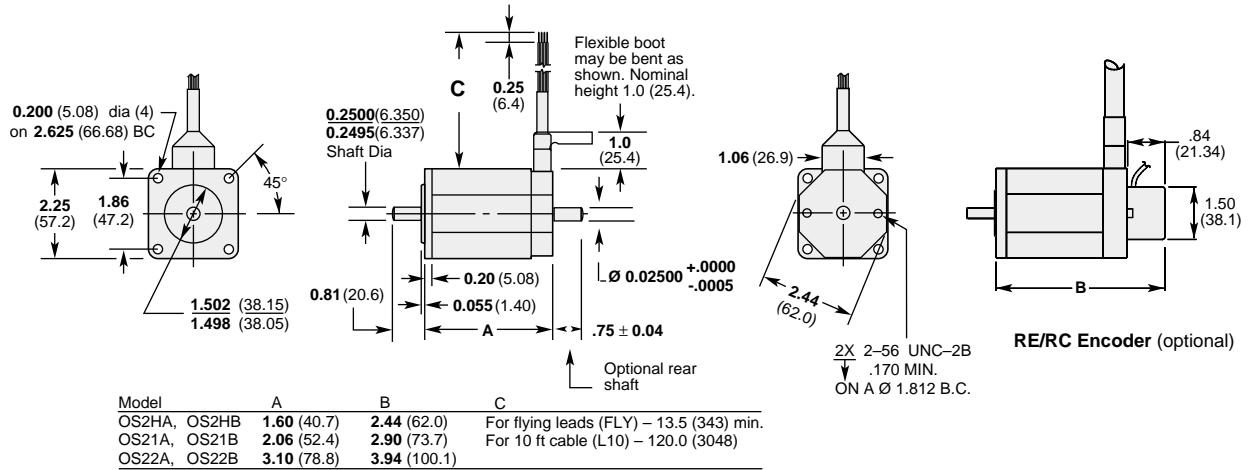
| | | Size 23 Frame | | |
|---|---|----------------------------|----------------------------|----------------------------|
| Parameters | Units | OS2HB | OS21B | OS22B |
| Static torque | oz-in (Nm) | 61.35 (0.43) | 126.5 (0.84) | 238 (1.68) |
| Rotor inertia | oz-in ² (kg-cm ²) | 0.39 (0.07) | 0.66 (0.12) | 1.39 (0.25) |
| Drive Current (Apk)(Arms) | Series Parallel | 1.76 (1.24) 3.25 (2.48) | 1.88 (1.33) 3.76 (2.66) | 2.38 (1.68) 4.76 (3.36) |
| Phase Inductance (mH) | Series Parallel | 8.6 2.2 | 12 3 | 16.6 4.2 |
| Detent Torque | oz-in (N-m) | 2.5 (0.02) | 4.0 (0.03) | 7.0 (0.05) |
| Bearings Information | | | | |
| Thrust Load | lb (kg) | 13 (5.9) | 13 (5.9) | 13 (5.9) |
| Radial Load | lb (kg) | 20 (9.1) | 20 (9.1) | 20 (9.1) |
| End Play (Reversing load equal to 1 lb) | in (mm) | 0.001 (0.025) | 0.001 (0.025) | 0.001 (0.025) |
| Radial Play (Per 0.5 lb load) | in (mm) | 0.0008 (0.02) | 0.0008 (0.02) | 0.0008 (0.02) |
| Motor Weight | lb (kg) | 1 (0.5) | 1.5 (0.7) | 2.5 (1.1) |
| Certifications | UL recognized CE (LVD) CE (EMC & LVD) | Pending Yes No | Pending Yes No | Pending Yes No |

VS Motors

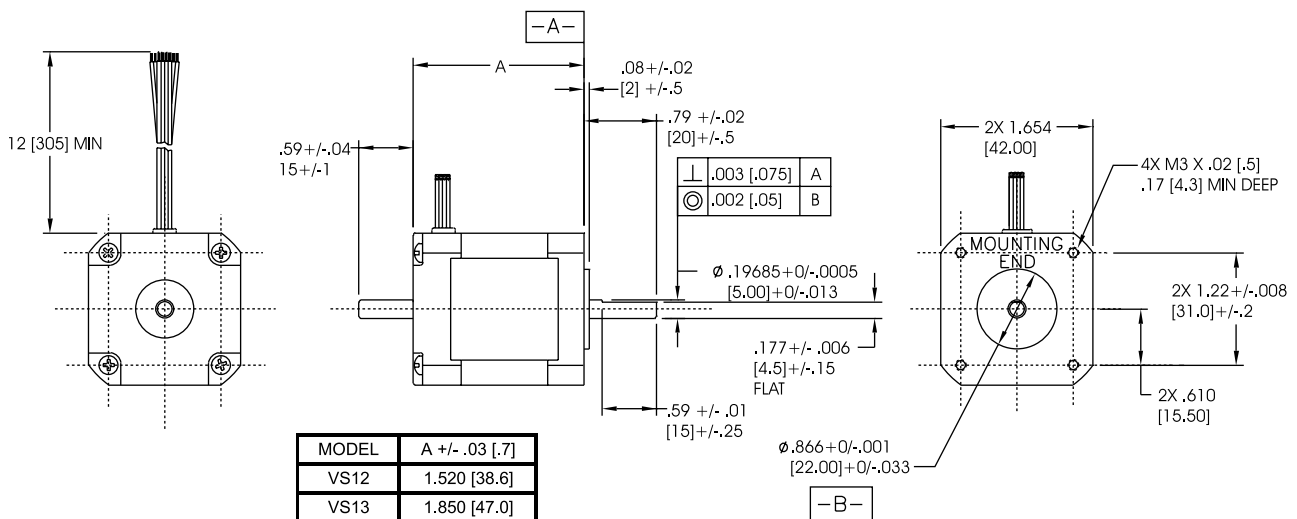
| | | Size 17 Frame | | Size 23 Frame | | | Size 34 Frame | |
|--|---|----------------------------|---------------------------|--------------------------|----------------------------|----------------------------|--------------------------|----------------------------|
| Parameters | Units | VS12B | VS13B | VS21B | VS22B | VS23B | VS31B | VS32B |
| Static torque | oz-in (Nm) | 55.27 (0.39) | 72.8 (0.51) | 115.5 (0.82) | 194.5 (1.37) | 334.5 (2.36) | 551.8 (3.90) | 1269.67 (8.97) |
| Rotor inertia | oz-in ² (kg-cm ²) | 0.3 (0.054) | 0.37 (0.068) | 0.66 (0.12) | 1.64 (0.3) | 2.62 (0.48) | 7.65 (1.4) | 4.8 (2.7) |
| Drive Current (Apk)(Arms) | Series Parallel | 1.00 (0.71) 2.00 (1.42) | 1.01(0.71) 2.02 (1.43) | 2.26 (1.6) 4.52 (3.2) | 2.01 (1.42) 4.02 (2.84) | 2.01 (1.42) 4.02 (2.84) | 3.0 (2.12) 6.0 (4.24) | 3.13 (2.21) 6.26 (4.42) |
| Phase Inductance (mH) | Series Parallel | 12.8 (3.2) | 11.2 (2.8) | 5.0 (1.2) | 12.0 (3.0) | 15.4 (3.8) | 15.8 4.0 | 25 6.25 |
| Detent Torque | oz-in (N-m) | 2.5 (0.02) | 4.0 (0.03) | 7.0 (0.05) | 8.8 (0.06) | 18.0 (0.13) | 27.0 (0.19) | 50 (0.35) |
| Bearings Information | | | | | | | | |
| Thrust Load | lb (kg) | 11.0 (5) | 11.0 (5) | 17.6 (8) | 17.6 (8) | 17.6 (8) | 35.3 (16) | 35.3 (16) |
| Radial Load | lb (kg) | 7.7 (3.5) | 7.7 (3.5) | 15.0 (6.8) | 15.0 (6.8) | 15.0 (6.8) | 30.9 (14) | 30.9 (14) |
| End Play (with 2.2 lbs axial load) | in (mm) | 0.003 (0.075) | 0.003 (0.075) | 0.003 (0.075) | 0.003 (0.075) | 0.003 (0.075) | 0.0032 (0.080) | 0.0032 (0.080) |
| Radial Play (with 1.1 lb radial load) | in (mm) | 0.001 (0.025) | 0.001 (0.025) | 0.001 (0.025) | 0.001 (0.025) | 0.001 (0.025) | 0.0008 (0.020) | 0.0008 (0.020) |
| Motor Weight | lb (kg) | 0.55 (0.25) | 0.77 (0.35) | 1.03 (0.47) | 1.54 (0.7) | 2.2 (1.0) | 3.86 (1.75) | 6.18 (2.8) |

MOTOR DIMENSIONS

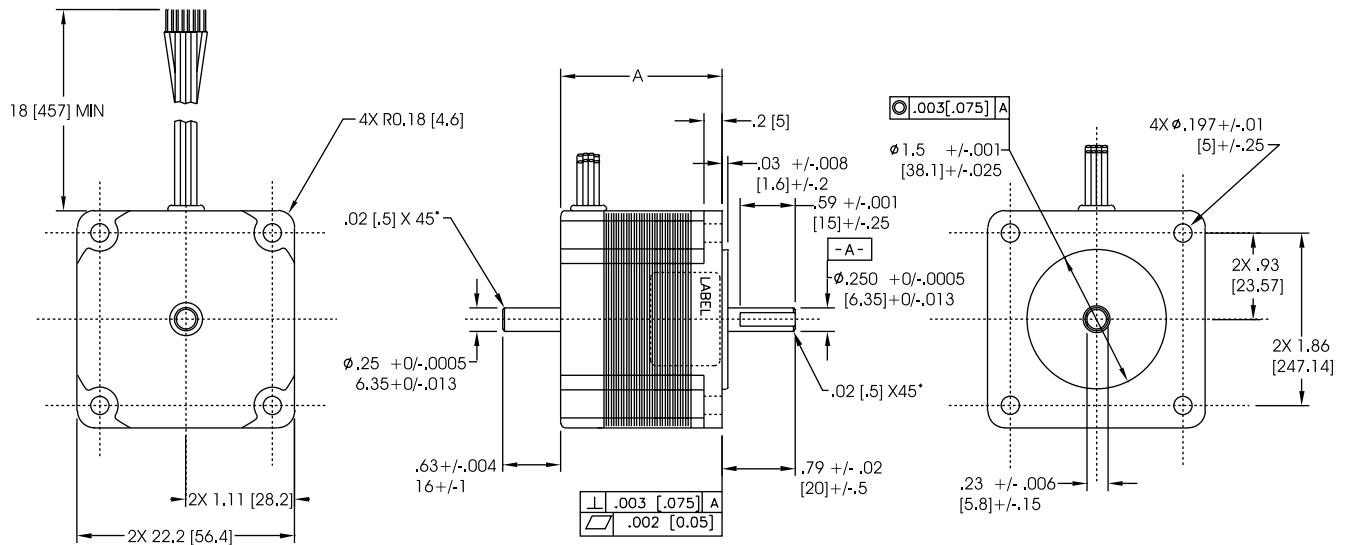
Dimensions in inches (mm)



OS Motors – Frame Size 23 – Dimensions

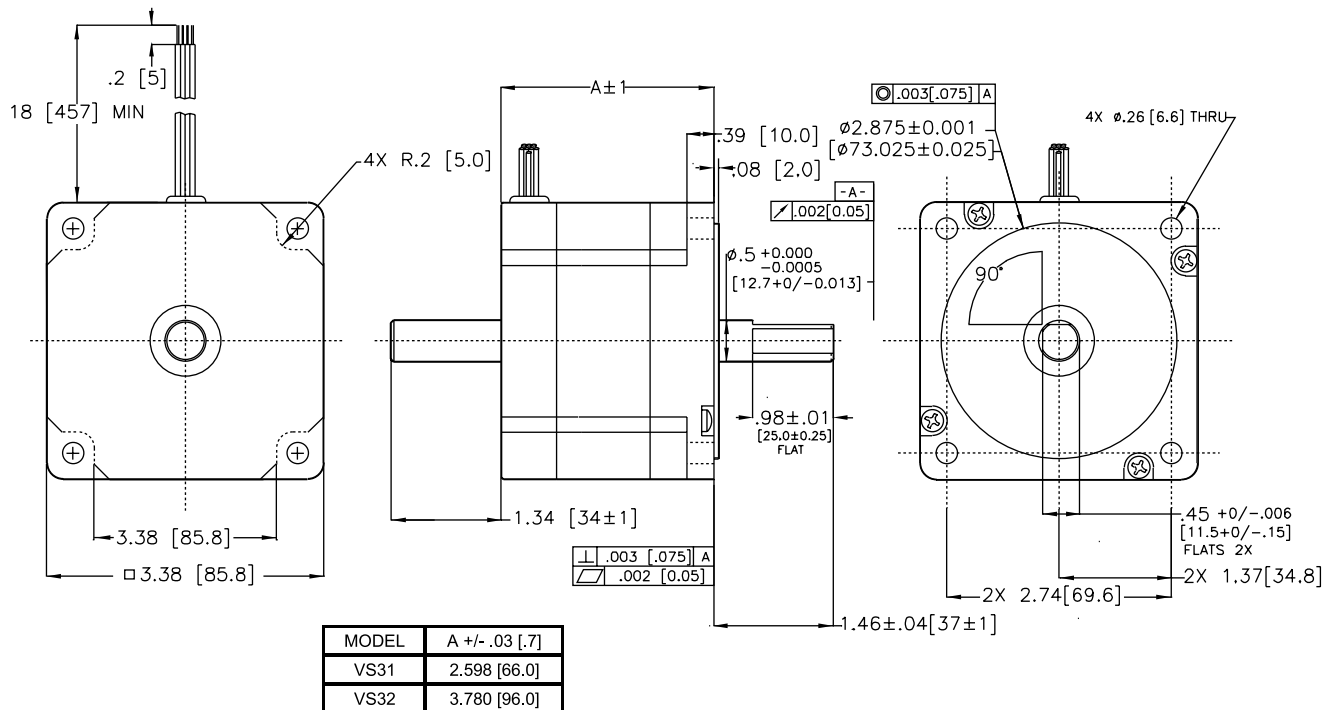


VS Motors – Frame Size 17 – Dimensions



| MODEL | A +/- .03 [.7] |
|-------|----------------|
| VS21 | 1.732 [44.0] |
| VS22 | 2.165 [55.0] |
| VS23 | 3.051 [77.5] |

VS Motors – Frame Size 23 – Dimensions



| MODEL | A +/- .03 [.7] |
|-------|----------------|
| VS31 | 2.598 [66.0] |
| VS32 | 3.780 [96.0] |

VS Motors – Frame Size 34 – Dimensions

2 – CONNECT THE MOTOR TO THE DRIVE – WIRING

Most Compumotor motor windings—phase A and phase B—are *bifilar* windings made from double-stranded copper wire. Each phase has two half-windings, which can be wired together in series or parallel.

These two alternatives—series and parallel—produce different speed/torque characteristics, affect the motor’s current rating, and alter the motor’s operating temperature. They are explained below.

GROUND THE MOTOR CASE

The motor case must be grounded, for safety purposes. On pre-cabled Compumotor motors, one end of the cable shield is permanently wired to the motor case; you should connect the other end to \perp on the drive’s motor connector. Inside the drive, \perp connects directly to the ground pin on the AC power terminals.

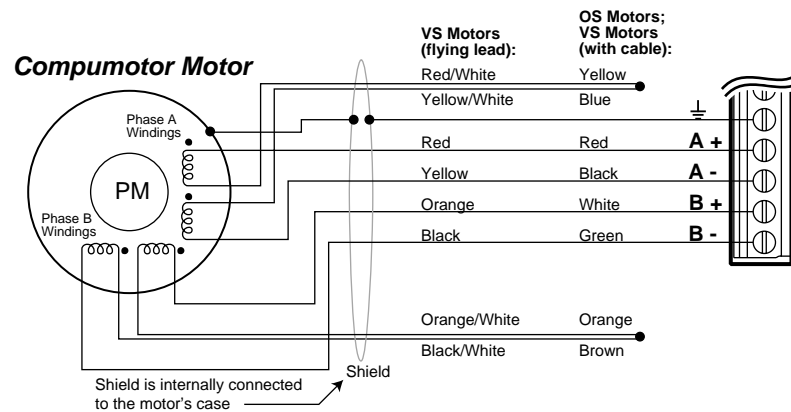
PRECAUTIONS

Follow these precautions when you wire the motor connector.

1. Turn off power to the drive before connecting or disconnecting the motor leads.
2. Verify that no wire whiskers short out motor connections.
3. Do not apply power to the drive when the motor is not connected.
4. Never connect anything other than the motor to the motor terminals.
5. After wiring the motor connector, perform the Automatic Test, to verify that the connector is wired correctly.

CONNECTING THE MOTOR: SERIES WIRING

For series motor current, connect a Compumotor motor as shown in the following diagram.



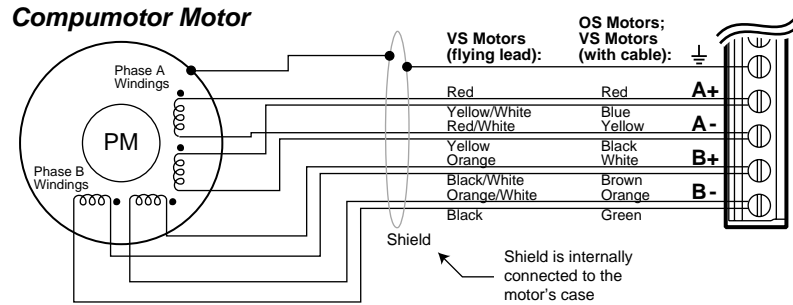
Motor Connector – Wired for **SERIES** Motor Current

Be sure to insulate the *center tap* connections; these are the wires shown joined together in the drawing above, but not connected to the drive.

The operating temperature of a motor connected in series will be lower than that of a motor connected in parallel. Therefore, you should operate your motor in series, if your application permits. Typically, series connections work well in high torque/low speed applications.

CONNECTING THE MOTOR: PARALLEL WIRING

For parallel motor current, connect a Compumotor motor as shown in the following diagram.



Motor Connector – Wired for **PARALLEL** Motor Current

At higher speeds, a motor connected in parallel will produce more torque than the same motor connected in series. However, the operating temperature of the motor in parallel will be much higher.

If you operate your motor in parallel, you must measure motor temperature under actual operating conditions. If the motor exceeds its maximum case temperature, reduce the duty cycle, or use automatic standby to reduce current at rest, or use forced air cooling to limit motor heating. Compumotor motors have maximum case temperature of 100°C (212°F).



CAUTION



High current in parallel connected motors may cause motor overheating. You may need to reduce the duty cycle to 50% to decrease motor temperature, or use automatic standby.

SERIES VERSUS PARALLEL – SUMMARY

The following list summarizes the points discussed above.

1. Examine the speed/torque curves for your motor.
2. Use series connection, if possible. (The motor will run cooler.)
3. Use parallel connection, if you need more torque than series connection provides. (Typically, at higher speeds.)
4. Parallel connection will cause the motor to run hotter, so measure motor temperature under operating conditions.
5. If necessary, reduce duty cycle, use automatic standby or use forced air cooling to keep motor temperature within acceptable limits.

3 – SET DIP SWITCHES

Two 8-position DIP switches are located on top of the E-AC Drive. Configure these DIP switches for your motor and application. The table below summarizes switch settings.

Default Position:
Drive ships from factory with all DIP switches in the **OFF** position.

| SW1 | | SW2 | | | | | | | | | | | | | | | | | | |
|---|------------------------------|----------|-----|-----|-----|---|---|---|---|-----------------------|-----|-----|-----------------------------|---|--------|----------------|------------------------|------|----------------|----------------|
| Edge of Circuit Board | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Edge of Circuit Board | | | | | | | | | | |
| Auto Test | 1 | | | | | | | | | 4 | 5 | 6 | 7 | 8 | (amps) | Current | | | | |
| | Disabled | off | | | | | | | | | off | off | off | off | off | | 0.02 | | | |
| | Enabled | on | | | | | | | | | off | off | off | on | off | 0.13 | | | | |
| 1 rps for 2 revs in each direction until disabled | | | | | | | | | | off | off | off | on | off | 0.24 | | | | | |
| Resolution | 2 | 3 | 4 | 5 | | | | | | | | | off | off | off | on | on | 0.35 | | |
| | 25,000 | off | off | off | off | | | | | | | | | off | off | on | off | off | 0.46 | |
| | 50,800 | on | off | off | off | | | | | | | | | off | off | on | off | on | 0.58 | |
| | 50,000 | off | on | off | off | | | | | | | | | off | off | on | off | on | 0.69 | |
| | 36,000 | on | on | on | off | | | | | | | | | off | off | on | on | off | 0.80 | |
| | 25,600 | off | off | on | off | | | | | | | | | off | on | off | off | off | 0.91 | |
| | 25,400 | on | off | on | off | | | | | | | | | off | on | off | off | off | 1.03 | VS12BS, VS13BS |
| | 21,600 | off | on | on | off | | | | | | | | | off | on | off | on | off | 1.14 | |
| | 20,000 | on | on | on | off | | | | | | | | | off | on | off | on | on | 1.25 | |
| | 18,000 | off | off | off | on | | | | | | | | | off | on | on | off | off | 1.36 | |
| | 12,800 | on | off | off | on | | | | | | | | | off | on | on | off | on | 1.48 | |
| | 10,000 | off | on | off | on | | | | | | | | | off | on | on | on | off | 1.59 | |
| | 5,000 | on | on | off | on | | | | | | | | | off | on | on | on | on | 1.70 | OS2HBS |
| | 2,000 | off | on | off | on | | | | | | | | | on | off | off | off | off | 1.82 | OS21BS |
| 1,000 | on | off | on | on | | | | | | | | | on | off | off | on | on | 1.93 | VS12BP, VS13BP | |
| 400 | off | on | on | on | | | | | | | | | on | off | off | on | off | 2.04 | VS22BS, VS23BS | |
| 200 | on | on | on | on | | | | | | | | | on | off | off | on | on | 2.15 | | |
| 200 & 400 not affected by waveform settings | | | | | | | | | | on | off | on | off | off | off | 2.27 | VS21BS | | | |
| Waveform | 6 | 7 | | | | | | | | | on | off | on | off | off | 2.38 | OS22BS | | | |
| | Pure sine | off | on | | | | | | | | | on | off | on | on | on | 2.49 | | | |
| | -4% 3 rd harmonic | off | off | | | | | | | | | on | off | on | on | on | 2.60 | | | |
| | -6% 3 rd harmonic | on | off | | | | | | | | | on | on | off | on | off | 2.72 | | | |
| | -8% 3 rd harmonic | on | on | | | | | | | | | on | on | off | off | on | 2.83 | | | |
| Auto Standby | 8 | | | | | | | | | on | on | on | on | off | 2.94 | | | | | |
| | Full Current | | | | | | | | | off | on | on | on | on | 3.05 | VS31BS | | | | |
| 50% Current Reduction | on | | | | | | | | | on | on | on | off | off | 3.16 | VS32BS | | | | |
| Gain | 2 | 3 | | | | | | | | | on | on | on | on | on | 3.28 | | | | |
| | off | off | | | | | | | | | on | on | on | on | off | 3.39 | OS2HBP, VS2xBP, VS3xBP | | | |
| | on | off | | | | | | | | | on | on | on | on | on | 3.50 | OS21BP, OS22BP | | | |
| | off | on | | | | | | | | | on | on | on | on | on | | | | | |
| Anti-Resonance | 1 | | | | | | | | | on | on | on | on | on | | | | | | |
| | off | Disabled | | | | | | | | | off | off | < 32 mH (all VS, OS motors) | | | | | | | |
| | on | Enabled | | | | | | | | | on | off | 32 – 64 mH | Select a setting based on motor inductance (in mH). | | | | | | |

Series = S
Parallel = P

Remove power before changing DIP switches

NOTE: This drawing is duplicated in *Quick Test*, earlier in this chapter.

DIP Switch Location and Settings

DEFAULT SETTINGS

The factory default position is *off* for all switches. For the drive to operate correctly, you must set the DIP switches for your application.

MOTOR CURRENT

Set DIP switches SW2-#4 — SW2-#8 for motor current. Verify that your connector wiring (series or parallel) and motor current rating match the current you set with these five switches.

DRIVE RESOLUTION

Set DIP switches SW1-#2 — SW1-#5 for drive resolution. There are sixteen settings, which range from 200 to 50,800 steps per revolution. The default setting is 25,000 steps per revolution.

Be sure to set your controller to the same resolution as your E-AC Drive. If the controller resolution and drive resolution do not match, commanded accelerations and velocities will not be properly scaled.

WAVEFORM

Set SW1-#6 and SW1-#7 to select a current waveform. There are four choices: one is a pure sine wave; the other three reduce the current waveform's 3rd harmonic by 4%, 6%, or 8%. In most applications, the default setting (*both switches off = -4% 3rd harmonic*) provides the best performance.

AUTOMATIC TEST

DIP switch SW1-#1 enables or disables the Automatic Test function. For more information, see the *Automatic Test* section earlier in this chapter.

AUTOMATIC STANDBY

SW1-#8 should be *off* if you do not use automatic standby. Turn this switch *on* to use automatic standby.

The *automatic standby* function allows the motor to cool when it is not moving. Automatic standby reduces motor current by 50% if the drive does not receive a step pulse for one second. Full current is restored upon the first step pulse that the drive receives. Be aware that reduced current results in reduced holding torque.

If you use the position maintenance feature of 6K or 6000 Series controllers, we recommend that you do not use automatic standby.

ANTI-RESONANCE DISABLE

SW1-#1 should be *on* for the anti-resonance circuit to be enabled. Normally, you will want anti-resonance enabled; therefore, this switch should be *on*. If you must disable anti-resonance, turn this switch *off*.

CURRENT LOOP GAIN

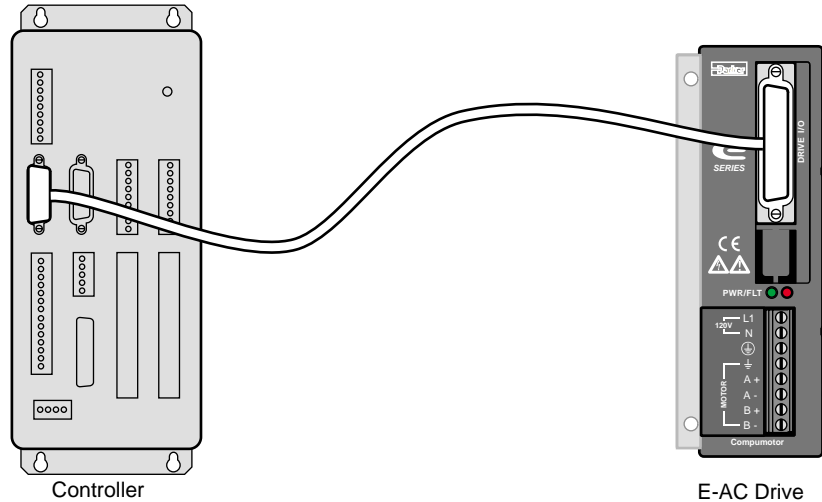
Set SW2-#2 and SW2-#3 according to your motor's *small-signal* inductance, in millihenries. The table shows the small-signal inductance range that corresponds to each of the four settings.

Small-signal inductance is the value read on an ordinary inductance bridge or meter.

NOTE: These two switches should be *off* for all Compumotor VS and OS motors, or for any motor whose inductance is less than 32 mH.

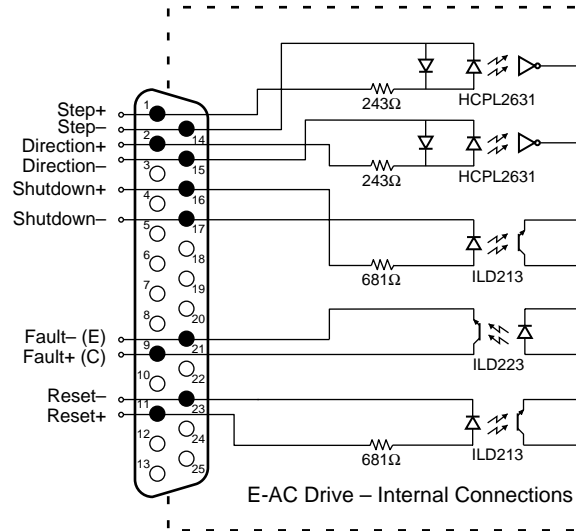
4 – CONNECT A CONTROLLER – INPUTS & OUTPUTS

Connect your controller cable to the **DRIVE I/O** connector, a 25 pin D-connector on the front of the drive. The cable that comes with Compu-motor controllers is prewired for compatibility with the E-AC Drive—you can plug the cable directly into the E-AC Drive's **DRIVE I/O** connector.



Connecting a Compumotor Controller

If you make your own cable, or use a non-Compumotor controller, consult the drawing below when you wire your cable and connector.



Drive I/O Connector

Descriptions of each function on the 25 pin D-connector follow.

STEP INPUT

For every step pulse it receives on its step input, the drive will commutate the motor to increment rotor position. To send a step pulse to the drive, apply a positive voltage to **STEP+** with respect to **STEP-**. The drive registers the pulse on the rising edge.

The input is optically isolated. You can drive the input differentially, or from a single-ended source.

Step input specifications are:

| | | |
|---------------------|------------------------------------|---|
| Input Current: | 6.5 mA minimum | |
| | 15 mA maximum | |
| Input Voltage: | 3.5V minimum | (min. required for <i>on</i> or <i>high</i> signal) |
| | 5.2V maximum* | |
| Step Pulse: | 200 nanosecond minimum pulse width | |
| | 200 nanosecond minimum off time | |
| | 2 MHz maximum pulse rate | |
| Optically Isolated: | Yes | |

*As a custom product, Compumotor can modify drive for higher input voltage

DIRECTION INPUT

While a positive voltage is applied to **DIRECTION+** with respect to **DIRECTION-**, the drive will commutate the motor in the clockwise (positive) direction as it receives step pulses on its step input.

While zero voltage (or a negative voltage) is applied to **DIRECTION+** with respect to **DIRECTION-**, the drive will commutate the motor in the counterclockwise (negative) direction as it receives step pulses.

The input is optically isolated. You can drive the input differentially, or from a single-ended source.

Direction input specifications are:

| | | |
|---------------------|---|---|
| Input Current: | 6.5 mA minimum | |
| | 15 mA maximum | |
| Input Voltage: | 3.5V minimum | (min. required for <i>on</i> or <i>high</i> signal) |
| | 5.2V maximum* | |
| Optically Isolated: | Yes | |
| Direction Change: | Direction input may change polarity coincident with first step pulse. | |

*As a custom product, Compumotor can modify drive for higher input voltage

SHUTDOWN INPUT

You can use the shutdown input to *shutdown*, or disable, the E-AC Drive. To activate shutdown, apply a positive voltage to **SHUTDOWN+** with respect to **SHUTDOWN-** when the motor is not moving. During shutdown, the drive turns off current to the motor. The current stays off as long as the voltage is maintained on the shutdown input.

When you remove the voltage on the input, shutdown ends. The drive restores current to the motor, in the same phase relationship that existed before shutdown was invoked.

The shutdown input may also be differentially driven. Specifications are:

| | | |
|---------------------|---|---|
| Input Current: | 2.5 mA minimum | |
| | 30 mA maximum | |
| Input Voltage: | 3.5V minimum | (min. required for <i>on</i> or <i>high</i> signal) |
| | 13V maximum | |
| | 5V maximum reverse voltage | |
| Active Level: | While voltage is applied, current to motor is shut down. When voltage is removed, normal operations resume. | |
| Time: | 250 nanosecond minimum width | |
| Optically Isolated: | Yes | |

FAULT OUTPUT

The E-AC Drive can signal, through its fault output, that it has detected a fault. Internally, the terminals **FAULT+ (C)** and **FAULT- (E)** connect to the open collector and open emitter, respectively, of an optically isolated transistor. The transistor acts like a switch: it conducts when the drive is functioning normally; it does not conduct when any of the following conditions exist.

- No power is applied to the drive
- AC line voltage is too low (less than 95VAC)
- Drive temperature is higher than 55°C (131°F)
- Drive detects a short circuit in motor or motor cable

Fault output specifications are:

| | |
|----------------------|---------------|
| V _{CE} : | 30VDC |
| V _{CESAT} : | 1 VDC |
| Collector Current: | 40 mA minimum |
| Dissipation: | 40 mW maximum |
| Optically Isolated: | Yes |

RESET INPUT

The reset input provides a means for you to reset the E-AC Drive, without actually cycling power. To activate the reset input, apply a positive voltage to **RESET+** with respect to **RESET-** when the motor is not moving. The reset will not be complete until 0.7 seconds after the voltage is removed. A reset has the same effect on the drive as cycling power:

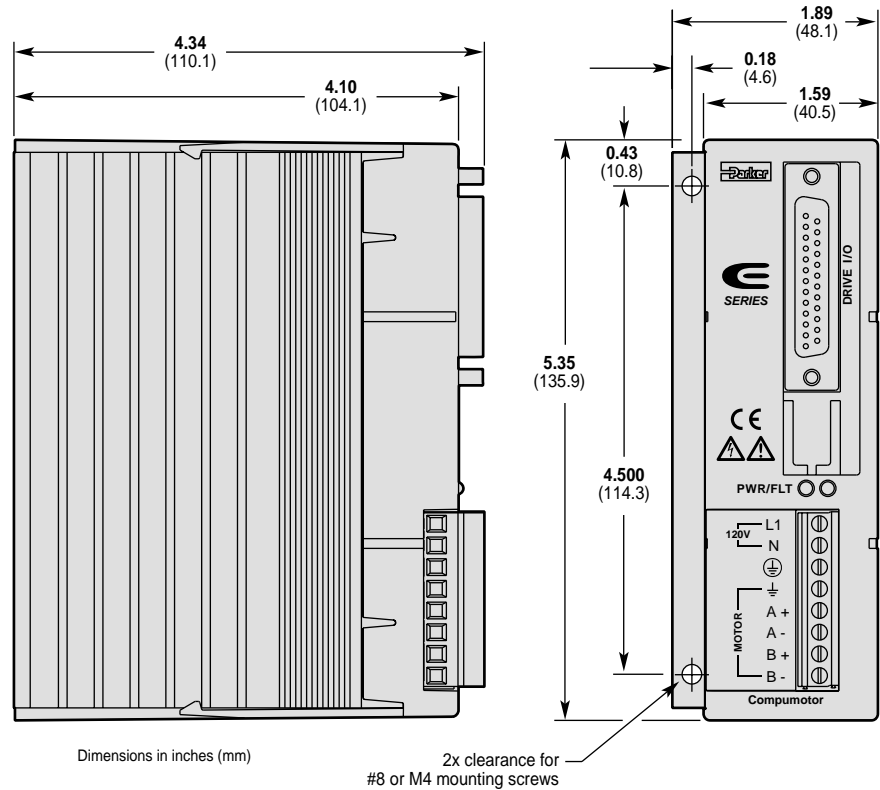
- DIP switch settings are loaded into the drive for configuration.
- Existing faults are cleared.
- Current to the motor is turned off while voltage is applied to the reset input.
- After voltage is removed from the reset input, the drive's soft start procedure will ramp current up to the startup state. The motor will move to the nearest pole position.
- After voltage is removed from the reset input, there will be a 0.7 second delay before reset is complete, and normal operations can continue.

Reset input specifications are:

| | | |
|----------------------|--|---|
| Input Current: | 2.5 mA minimum | |
| | 30 mA maximum | |
| Input Voltage: | 3.5V minimum | (min. required for <i>on</i> or <i>high</i> signal) |
| | 13V maximum | |
| | 5V maximum reverse voltage | |
| Reset Voltage Pulse: | 250 nanosecond minimum pulse width | |
| Active Level: | While voltage is applied, reset occurs. | |
| | When voltage is removed, normal operations resume. | |
| Reset Delay: | 0.7 second delay until reset is complete, after voltage is removed from input. | |
| Optically Isolated: | Yes | |

5 – MOUNT THE DRIVE

Dimensions of the E-AC Drive are shown below.



Dimensions – E-AC Drive

ENVIRONMENTAL CONSIDERATIONS

TEMPERATURE SPECIFICATIONS

Maximum Ambient Temperature: 50°C (122°F)

Minimum Ambient Temperature: 0°C (32°F)

Overtemperature Shutdown Fault: 55°C (131°F)

The E-AC Drive has an internal temperature sensor, located near the heatsink. If the sensor reaches 55°C (131°F), it will trigger an overtemperature fault, and the drive will shut down.

FAN COOLING

Operating the E-AC Drive in high ambient temperatures may require fan cooling to keep the drive from shutting down due to an overtemperature fault.

HUMIDITY

Keep the relative humidity below 95%, non-condensing.

LIQUIDS

Do not allow liquids or fluids to come into contact with the E-AC Drive or its cables.

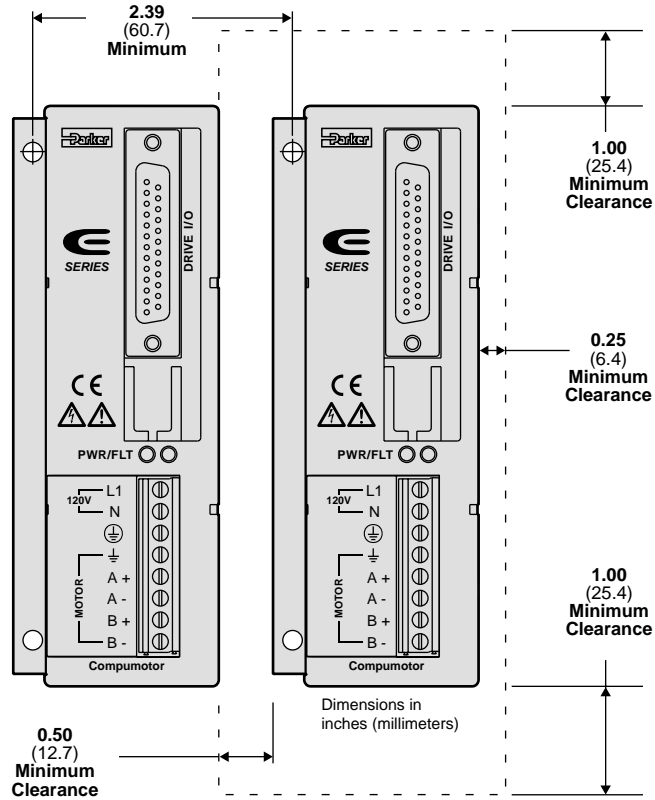
AIRBORNE CONTAMINANTS

Particulate contaminants, especially electrically conductive material such

as metal shavings or grinding dust, can damage the E-AC Drive and motor. Do not allow contaminants to come into contact with the drive or motor.

PANEL LAYOUT

Follow these minimum spacing and clearance requirements when you mount multiple E-AC Drives.



Panel Layout Dimensions

6 – MOUNT THE MOTOR

Use flange bolts to mount rotary step motors. The *pilot*, or centering flange on the motor's front face, should fit snugly in the pilot hole.

Do not use a foot-mount or cradle configuration, because the motor's torque is not evenly distributed around the motor case. When a foot mount is used, for example, any radial load on the motor shaft is multiplied by a much longer lever arm.

Step Motors can produce very high torques and accelerations. If the mounting is inadequate, this combination of high torque/high acceleration can shear shafts and mounting hardware. Because of shock and vibration that high accelerations can produce, you may need heavier hardware than for static loads of the same magnitude.

Under certain move profiles, the motor can produce low-frequency vibra-

tions in the mounting structure that can cause fatigue in structural members. A mechanical engineer should check the machine design to ensure that the mounting structure is adequate.



WARNING



Improper motor mounting can jeopardize personal safety, and compromise system performance.

For Compumotor motor dimensions, see *Select a Motor* earlier in this chapter.

MOTOR TEMPERATURE & COOLING

The motor’s face flange is used not only for mounting; it is also a *heatsink*. Mount the face flange to a large thermal mass, such as a thick steel or aluminum plate, which should be unpainted, clean, and flat. Heat will be conducted from inside the motor, through the face flange, and dissipated in the thermal mass. This is the best way to cool the motor. You can also use a fan to blow air across the motor for increased cooling, if conduction through the flange does not provide enough cooling.

MOTOR MODIFICATIONS

Modifying or machining the motor shaft will void the motor warranty. Contact a Compumotor Applications Engineer (800-358-9070) about shaft modifications as a custom product.

EXTENDING MOTOR CABLES

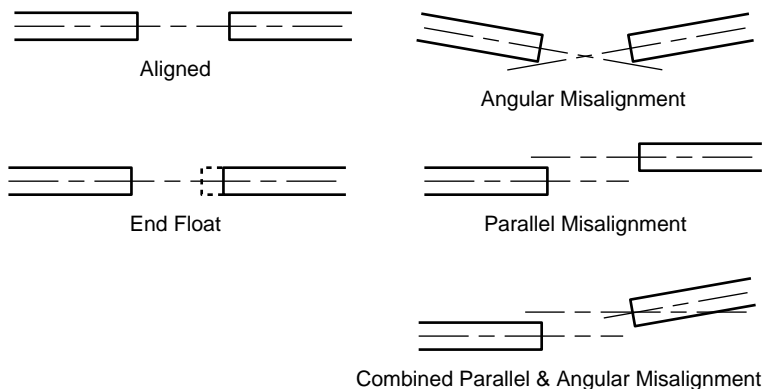
If you need to extend Compumotor motor cables beyond the standard 10 feet (3 m), consult the table below for recommended wire sizes. Cables longer than 50 feet (15 m) may degrade system performance. Do not extend cables beyond 200 feet (61 m).

| Motor Type | Max. Current (amps) | Less than 100 ft. (30 m) | | 100 – 200 ft. (30 – 60 m) | |
|------------|------------------------|--------------------------|-----------------|---------------------------|-----------------|
| | | Size: AWG | mm ² | AWG | mm ² |
| OS2HBS | 1.70 | 22 | 0.34 | 20 | 0.50 |
| OS2HBP | 3.39 | 20 | 0.50 | 18 | 0.75 |
| OS21BS | 1.82 | 22 | 0.34 | 20 | 0.50 |
| OS21BP | 3.50 | 20 | 0.50 | 18 | 0.75 |
| OS22BS | 2.38 | 22 | 0.34 | 20 | 0.50 |
| OS22BP | 3.50 | 20 | 0.50 | 18 | 0.75 |
| VS12BS | 1.03 | 22 | 0.34 | 20 | 0.50 |
| VS12BP | 2.04 | 22 | 0.34 | 20 | 0.50 |
| VS13BS | 1.03 | 22 | 0.34 | 20 | 0.50 |
| VS13BP | 2.04 | 22 | 0.34 | 20 | 0.50 |
| VS21BS | 2.27 | 22 | 0.34 | 20 | 0.50 |
| VS21BP | 3.50 | 20 | 0.50 | 18 | 0.75 |
| VS22BS | 2.04 | 22 | 0.34 | 20 | 0.50 |
| VS22BP | 3.50 | 20 | 0.50 | 18 | 0.75 |
| VS23BS | 2.04 | 22 | 0.34 | 20 | 0.50 |
| VS23BP | 3.50 | 20 | 0.50 | 18 | 0.75 |
| VS31BS | 3.05 | 22 | 0.34 | 20 | 0.50 |
| VS31BP | 3.50 | 20 | 0.50 | 18 | 0.75 |
| VS32BS | 3.16 | 22 | 0.34 | 20 | 0.50 |
| VS32BP | 3.50 | 20 | 0.50 | 18 | 0.75 |

S: Series Configuration P: Parallel Configuration Rated current in wire sizes shown may result in a maximum temperature rise of 10°C (18°F) above ambient.

7 – CONNECT THE MOTOR TO THE LOAD – COUPLERS

Align the motor shaft and load as accurately as possible. In most applications, some misalignment is unavoidable, due to tolerance buildups in components. However, excessive misalignment may degrade your system's performance. The three misalignment conditions, which can exist in any combination, are illustrated and described below.



Misalignment Condition

- Angular Misalignment: The center lines of two shafts intersect at an angle other than zero degrees.
- Parallel Misalignment: The offset of two mating shaft center lines, although the center lines remain parallel to each other.
- End Float: A change in the relative distance between the ends of two shafts.

The type of misalignment in your system will affect your choice of coupler.

SINGLE-FLEX COUPLING

Use a single-flex coupling when you have angular misalignment only. Because a single-flex coupling is like a hinge, one and only one of the shafts must be free to move in the radial direction without constraint. **Do not use a double-flex coupling in this situation:** it will allow too much freedom and the shaft will rotate eccentrically, which will cause large vibrations and catastrophic failure. **Do not use a single-flex coupling with a parallel misalignment:** this will bend the shafts, causing excessive bearing loads and premature failure.

DOUBLE-FLEX COUPLING

Use a double-flex coupling whenever two shafts are joined with parallel misalignment, or a combination of angular and parallel misalignment (the most common situation).

Single-flex and double-flex couplings may or may not accept end play, depending on their design.

RIGID COUPLING

Rigid couplings are generally not recommended, because they cannot compensate for *any* misalignment. They should be used only if the motor or load is on some form of floating mounts that allow for alignment compensation. Rigid couplings can also be used when the load is supported entirely by the motor's bearings. A small mirror connected to a motor shaft is an example of such an application.

COUPLING MANUFACTURERS

HUCO
70 Mitchell Blvd, Suite 201
San Rafael, CA 94903
(415) 492-0278

ROCOM CORP.
5957 Engineer Drive
Huntington Beach, CA 92649
(714) 891-9922

HELI-CAL
P.O. Box 1069
Santa Maria, CA 93456
(805) 928-3851

8 – CONNECT AC POWER

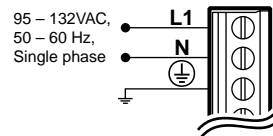
At this point in your installation procedure, you should have mounted your drive and motor, coupled the motor to the load, and connected the controller and motor cables to the drive.

The E-AC Drive does not have an *on/off* switch. When you apply power to the drive, the drive will turn on. Therefore, before you apply power, verify the following:

- Motor should be properly secured
- Motor cable should be connected to drive
- Drive should be properly mounted
- Controller cable should be connected to drive
- Controller cable should not be in close physical proximity to motor cable

APPLY POWER

To apply power, connect one end of your power cable to the drive's L1, N and \oplus terminals.

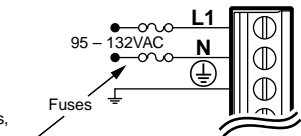


External Fuses:

Are not required for AC mains with Line and Neutral designations.

For AC mains without Line and Neutral designations:

1. Fuse both sides of the AC mains, as shown at right.
2. Use 125VAC Time Delay, 10 amp, type RK5 or better fuses.



AC Input Connections

Connect the other end of your power cable to a grounded 120VAC power source that meets the following specifications:

Specifications – AC Power Input

| | |
|-----------------|--|
| Input Power: | 120VAC nominal 95VAC minimum 132VAC maximum 50 – 60 Hz |
| Inrush Current: | 22.2 amps (peak) maximum |
| Fuses: | No user serviceable fuses |
| Grounding: | You must provide a proper AC power ground |
| Transformer: | Not required for 120VAC operation; to size step-down transformer, use Volt-Amp rating (<i>see the following table</i>) |



WARNING



The motor case and drive are grounded through the drive's \oplus terminal. You must provide a proper AC power ground for safety purposes.

PEAK POWER RATINGS

The amount of power the E-AC Drive requires from your AC power source depends upon the motor you use, whether you wire the motor in series or parallel, and upon your specific application. The next table shows *peak* power requirements. Power required for your application may be less.

| Motor Type | Current (Amps) | Cabinet Loss (W) | Peak Motor Loss (W) | Peak Shaft Power (W) | Peak Total Power (W) | Volt-Amp Rating (VA) |
|------------|----------------|------------------|---------------------|----------------------|----------------------|----------------------|
| OS2HBS | 1.70 | 22.0 | 22 | 39 | 83 | 151 |
| OS2HBP | 3.39 | 32.0 | 76 | 82 | 190 | 314 |
| OS21BS | 1.82 | 24.0 | 30 | 65 | 119 | 205 |
| OS21BP | 3.50 | 55.0 | 86 | 129 | 270 | 432 |
| OS22BS | 2.38 | 18.0 | 41 | 87 | 146 | 247 |
| OS22BP | 3.50 | 29.0 | 93 | 161 | 283 | 451 |
| VS12BS | 1.02 | 17.0 | 29 | 32 | 78 | 141 |
| VS12BP | 2.04 | 24.0 | 87 | 33 | 144 | 266 |
| VS13BS | 1.02 | 18.0 | 25 | 38 | 81 | 147 |
| VS13BP | 2.04 | 39.0 | 93 | 32 | 164 | 280 |
| VS21BS | 2.27 | 18.0 | 60 | 100 | 178 | 300 |
| VS21BP | 3.50 | 37.0 | 105 | 137 | 279 | 438 |
| VS22BS | 2.04 | 13.0 | 46 | 93 | 152 | 258 |
| VS22BP | 3.50 | 36.0 | 95 | 149 | 280 | 452 |
| VS23BS | 2.04 | 14.0 | 39 | 113 | 166 | 281 |
| VS23BP | 3.50 | 24.0 | 99 | 202 | 325 | 531 |
| VS31BS | 3.05 | 19.0 | 45 | 135 | 199 | 339 |
| VS32BS | 3.16 | 22.0 | 57 | 121 | 200 | 334 |

S: Series Configuration P: Parallel Configuration

9 – TEST THE INSTALLATION

System installation should be complete at this point. Perform the test procedure below to verify that your system is functioning properly.

In the test procedure, you will command single revolution moves in the clockwise and counterclockwise direction. If your mechanics do not permit such moves, choose a move that allows you to easily verify correct system response.

TEST PROCEDURE

1. Apply 120VAC power. The green LED labeled **PWR** should illuminate.
2. Command a slow move of one revolution in the clockwise direction. Verify that the motor turns as commanded.
3. Command a slow move of one revolution in the counterclockwise direction. Verify that the motor turns as commanded.
4. Test the shutdown input. With the motor stopped, activate the input. The motor will have no torque when shutdown is activated. You should be able to turn the motor manually (if your mechanics permit).

Successful completion of this procedure will verify that your controller and motor are correctly connected to the E-AC Drive, and that the drive is functioning properly.

If the test is unsuccessful, proceed to *Chapter 3 Troubleshooting* for problem identification and solution procedures.

CHAPTER THREE

Troubleshooting

IN THIS CHAPTER

- Troubleshooting Basics
 - Diagnostic LEDs
 - Protective Circuits
 - Automatic Test
 - Anti-Resonance Disable
 - Product Return Procedure
-

TROUBLESHOOTING BASICS

When your system does not function properly (or as you expect it to operate), the first thing that you must do is identify and isolate the problem. When you have accomplished this, you can effectively begin to resolve the problem.

The first step is to isolate each system component and ensure that each component functions properly when it is run independently. You may have to dismantle your system and put it back together piece by piece to detect the problem. If you have additional units available, you may want to exchange them with existing components in your system to help identify the source of the problem.

Determine if the problem is mechanical, electrical, or software-related. Can you repeat or re-create the problem? Random events may appear to be related, but they are not necessarily contributing factors to your problem.

You may be experiencing more than one problem. You must isolate and solve one problem at a time. Log (document) all testing and problem isolation procedures. You may need to review and consult these notes later. This will also prevent you from duplicating your testing efforts.

Once you have isolated a problem, take the necessary steps to resolve it. Refer to the problem solutions contained in this chapter.

DIAGNOSTIC LEDs

The E-AC Drive has two LEDs on its front panel. The following summary of LED functions may help you isolate problems.

| <u>LED Name</u> | <u>Color</u> | <u>Function</u> |
|--------------------|--------------|---|
| PWR (POWER) | Green | Illuminates when AC power is applied Off if AC power is under voltage (<95VAC) |
| FLT (FAULT) | Red | Indicates short circuit in motor or cabling; or Drive overtemperature |

PROTECTIVE CIRCUITS

The E-AC Drive has several protective circuits, some of which can indicate fault conditions by illuminating one of the above LEDs.

OVERTEMPERATURE PROTECTION

To protect against damage from high temperatures, the E-AC Drive has an internal temperature sensor. If the sensor reaches 55°C (131°F) it will trigger an overtemperature fault. The red **FAULT** LED will illuminate, and the drive will shut down. This is a latched fault. To restart the drive, first allow it to cool, then cycle power or toggle the reset input.

SHORT CIRCUIT PROTECTION

The E-AC Drive has short circuit protection. When the drive detects a short circuit in the motor or motor cabling, it illuminates the **FAULT LED**, and stops producing motor current. This is a latched condition. To restart the drive, first remove power to the drive; fix the short in the motor or cable; then reapply power.

AUTOMATIC TEST

Often in diagnosing a problem, it is helpful to rule out possible causes. If you disconnect the load and controller from the drive, four components remain—the drive, motor, motor cable, and power cable.

You can then configure the drive to run the automatic test function. See instructions near the beginning of *Chapter 2 Installation*. If the motor turns as expected—in an alternating mode—then the drive, motor, and cables are probably *not* the cause of the problem. The cause may lie with the controller, software, mechanics, etc.

ANTI-RESONANCE DISABLE

If your mechanical system is highly resonant at precisely the *wrong* frequency, anti-resonance might interpret the mechanical vibrations as rotor position error. You would notice greater torque ripple, increased audible noise, and possibly even stalling. To solve these problems, try disabling anti-resonance (SW2-#1 *off*), and see if the problems improve.

TECHNICAL SUPPORT

If you cannot solve your system problems using this documentation, contact your local Automation Technology Center (ATC) or distributor for assistance. If you need to talk to our in-house application engineers, contact Parker Compumotor's Applications Department at (800) 358-9070.

PRODUCT RETURN PROCEDURE

If you must return your E-AC Drive for repairs, use the following steps:

1. Get the serial number and the model number of the defective unit, and a purchase order number to cover repair costs in the event the unit is determined to be out of warranty.
2. Before you return the unit, have someone from your organization with a technical understanding of the E-AC Drive and its application include answers to the following questions:
 - What is the extent of the failure/reason for return?
 - How long did the unit operate?
 - Did any other items fail at the same time?
 - What was happening when the unit failed (e.g., installing the unit, cycling power, starting other equipment, etc.)?
 - How was the unit configured (in detail)?
 - What, if any, cables were modified and how?
 - With what equipment is the unit interfaced?
 - What was the application?
 - What was the system environment (temperature, enclosure, spacing, unit orientation, contaminants, etc.)?
 - What upgrades, if any, are required (hardware, cables, etc.)?
3. In the USA, call your Automation Technology Center (ATC) for a Return Material Authorization (RMA) number. Returned products cannot be accepted without an RMA number. If you cannot obtain an RMA number from your ATC, call Parker Compumotor's Customer Service Department at (800) 722-2282.

Ship the unit to: Parker Hannifin Corporation
 Compumotor Division
 5500 Business Park Drive, Suite D
 Rohnert Park, CA 94928
 Attn: RMA # xxxxxxxx

4. In the UK, call Parker Digiplan for a GRA (Goods Returned Authorization) number. Returned products cannot be accepted without a GRA number. The phone number for Parker Digiplan Repair Department is 0202-690911. The phone number for Parker Digiplan Service/Applications Department is 0202-699000.

Ship the unit to: Parker Digiplan Ltd.,
 21, Balena Close,
 Poole, Dorset,
 England. BH17 7DX

5. Elsewhere: Contact the distributor who supplied the equipment.

A P P E N D I X A

Using Non-Compumotor Motors

IN THIS APPENDIX

- Wiring Configurations: 4-, 6- and 8-lead motors
 - Terminal Connections: 4-, 6- and 8-lead motors
 - Setting Motor Current: Series or Parallel
Unipolar or Bipolar
-

USING NON-COMPUMOTOR MOTORS

We recommend that you use Compumotor motors with the E-AC Drive. If you use a non-Compumotor motor, it must meet the following requirements:

- A minimum inductance of 2 mH, series or parallel, is required. (Compumotor recommends a minimum inductance of 5 mH.)
- A minimum of 500VDC high-pot insulation rating from phase-to-phase and phase-to-ground.
- The motor must be designed for use with a bipolar drive (no common center tap).
- Motors with riveted rotors or stators are not recommended.
- Motors with solid rotors are not recommended.
- Test all motors carefully. Verify that the motor temperature in your application is within the system limitations. *The motor manufacturer's maximum allowable motor case temperature must not be exceeded.* You should test the motor over a 2-to-3 hour period. Motors tend to have a long thermal time constant, but can still overheat, which results in motor damage.



CAUTION



Consult your motor vendor to verify that your motor meets the above specifications. Consult your Automation Technology Center (ATC) if you have questions regarding the use of a non-Compumotor motor with Compumotor equipment.

WIRING CONFIGURATIONS

Refer to the manufacturer's motor specification document to determine the motor's wiring configuration. You can also determine the wiring configuration with an ohmmeter using the procedures below (*4-Lead Motor, 6-Lead Motor, 8-Lead Motor*). Once you determine the correct motor wiring configuration, use the terminal connection diagram, shown at the end of this section, that applies to your configuration.

4-LEAD MOTOR

1. Label one motor lead **A+**.
2. Connect one lead of an ohmmeter to the **A+** lead and touch the other lead of the ohmmeter to the three remaining motor leads until you find the lead that creates continuity. Label this lead **A-**.
3. Label the two remaining leads **B+** and **B-**. *Verify that there is continuity between the **B+** and **B-** leads.*
4. Proceed to the *Terminal Connections* section below.

6-LEAD MOTOR

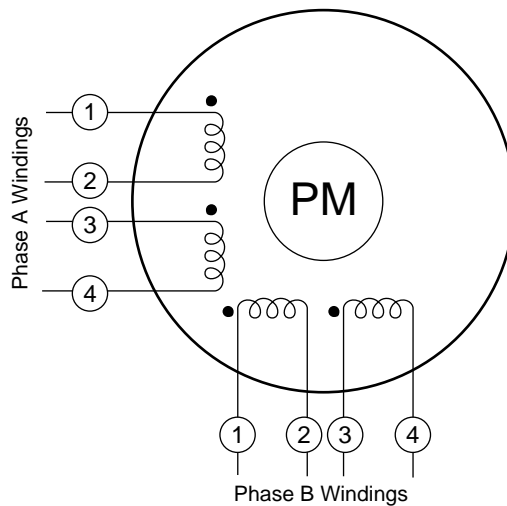
1. Determine, with an ohmmeter, which three of the six motor leads are common (one phase).
2. Label each one of these three motor leads **A**.
3. Using the ohmmeter, verify that the remaining three leads are common.
4. Label the remaining three leads **B**.
5. Set the ohmmeter range to the 100 ohm scale (approximately).
6. Connect the ohmmeter's negative lead to one of the motor leads labeled **A**. Alternately measure the resistance to the two remaining motor leads also labeled **A**. The resistance measurements will reflect one of the following two scenarios.
Scenario #1 — The resistance measurements to the two remaining motor leads are virtually identical. Label the two remaining motor leads **A+** and **A-**. Label the motor lead connected to the negative lead of the ohmmeter **A CENTER TAP** (this is the center tap lead for Phase A of the motor).

Scenario #2 — The resistance measurement to the second of the three motor leads measures 50% of the resistance measurement to the third of the three motor leads. Label the second motor lead **A CENTER TAP** (this is the center tap lead for Phase A of the motor). Label the third motor lead **A-**. Label the motor lead connected to the ohmmeter **A+**.

7. Repeat the procedure as outlined in step 6 for the three leads labeled **B** (**B CENTER TAP** is the center tap lead for Phase B of the motor).
8. Proceed to the *Terminal Connections* section below.

8-LEAD MOTOR

Because of the complexity involved in phasing an 8-lead motor, you must refer to the manufacturer's motor specification document. Using the manufacturer's specifications, label the motor leads as shown in the next drawing.



8-Lead Motor – Labeling the Leads

You can configure the 8-lead motor in series or parallel.

Series Configuration Use the following procedure for series configurations.

1. Connect A2 & A3 together and relabel this common point **A CENTER TAP**.
2. Connect B2 & B3 together and relabel this common point **B CENTER TAP**.
3. Relabel the A1 lead **A+**.
4. Relabel the A4 lead **A-**.
5. Relabel the B1 lead **B+**.
6. Relabel the B4 lead **B-**.
7. Proceed to the *Terminal Connections* section below.

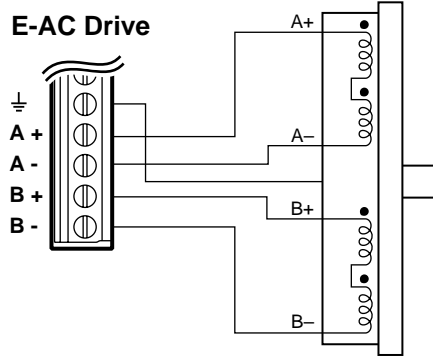
Parallel Configuration Use the following procedure for parallel configurations.

1. Connect motor leads A1 & A3 together and relabel this common point **A+**.
2. Connect motor leads A2 & A4 together and relabel this common point **A-**.
3. Connect motor leads B1 & B3 together and relabel this common point **B+**.
4. Connect motor leads B2 & B4 together and relabel this common point **B-**.
5. Proceed to the *Terminal Connections* section below.

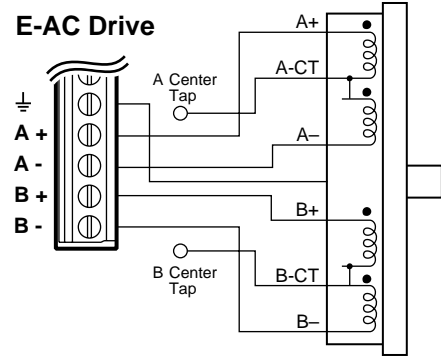
TERMINAL CONNECTIONS

After you determine the motor's wiring configuration, connect the motor leads to the E-AC Drive's **MOTOR** terminals according to the following figure.

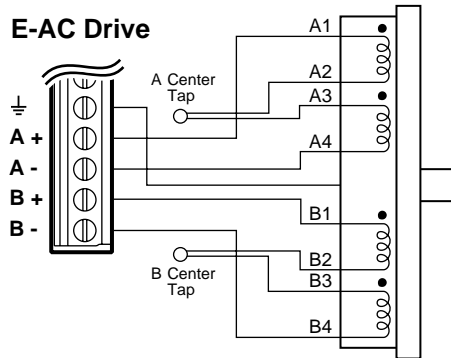
4-Lead Motor



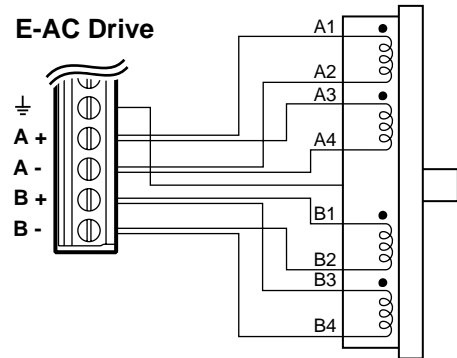
6-Lead Motor



8-Lead Motor Series



8-Lead Motor Parallel



Non-Compumotor Motor Connections



WARNING



The E-AC Drive has no *Center Tap* terminals. You must insulate and properly secure the ends of the motor's center tap wires.

DIRECTION OF MOTOR ROTATION

The procedures above do not determine the direction of motor shaft rotation. To find out which direction the shaft turns, you must power up your system and command motion. If the shaft turns in the opposite direction than you desire, exchange the motor leads connected to **A+** and **A-** to reverse the direction of rotation.



WARNING



Motor shaft rotation may be opposite than you expect. Do not connect a load to the shaft until you first determine the direction of shaft rotation.

SETTING MOTOR CURRENT – NON-COMPUMOTOR MOTORS

To set motor current for a non-Compumotor motor, refer to the formulas below that correspond to your motor (4-lead, 6-lead, 8-lead) and use the current settings shown in the DIP switch table (in *Chapter 2 Installation*) to set the motor's current.



WARNING



Do not connect or disconnect the motor with the power on. Doing so will damage the contacts of the motor connector and may cause personal injury.

4-LEAD MOTORS

If you use a 4-lead motor, the manufacturer's current specification will translate directly to the values shown for current in the DIP switch table.

6-LEAD MOTORS

Manufacturers generally use either a bipolar rating or a unipolar rating for motor current in 6-lead motors.

Bipolar Rating: If the manufacturer specifies the motor current as a bipolar rating, you can use the DIP switch table's current settings directly to set motor current—no conversion is required.

Unipolar Rating: If the manufacturer specifies the motor current as a unipolar rating:

- Use the following formula to convert the unipolar current rating to the correct bipolar rating:
Unipolar Current * 0.707 = Bipolar Current
- Use the converted value and the DIP switch table's current settings to set the motor current.

8-LEAD MOTORS

Manufacturers generally use either a bipolar rating or a unipolar rating for motor current in 8-lead motors.

Bipolar Rating: If the manufacturer specifies the motor current as a bipolar series rating:

- If you wire the motor in **series**, use the DIP switch table's current settings directly.
- If you wire the motor in **parallel**, you must double the manufacturer's rating and then use the DIP switch table's current settings to set the motor current.

Unipolar Rating: If the manufacturer specifies the motor current as a unipolar rating:

- Use the following formula to convert the unipolar current rating to the correct bipolar rating:
Unipolar Current * 0.707 = Bipolar Current
- If you wire the motor in **series**, use the converted value and the DIP switch table's current settings to set the motor current.
- If you wire the motor in **parallel**, you must **double** the converted value and use the DIP switch table's current settings to set the motor current.

If you have questions about setting motor current, call Compumotor's Applications Engineering Department at the number shown inside the front cover.

APPENDIX B

Regulatory Compliance: UL and CE

IN THIS CHAPTER

- Installation Instructions
 - Installation Guidelines
 - System Installation Techniques
-

Regulatory Agencies

The E-AC Drive is designed to meet the requirements of global regulatory agencies.

The E-AC Drive has shown compliance with the regulatory agencies in the following list. The list also shows additional steps users must take to ensure compliance.

| Agency | Additional Steps User Must Take |
|----------|---|
| UL, cUL | No additional steps are required. (The E-AC Drive is UL recognized, as shipped from the factory.) |
| CE (LVD) | Earth connection for drive and motor (if applicable), proper installation |
| CE (EMC) | Varistors, mains filter, EMC cabling, EMC ready motor, proper installation |

Installation Instructions

Although the E-AC Drive is technically considered a motion control component and is therefore not within the scope of the European Union's CE (Conformité Européenne) directives, Compumotor has taken the initiative to provide its customers with easy to integrate motion control products that meet global requirements.

The following constitutes what is typically required to install the E-AC Drive into a CE compliant system. Additional installation measures may be required at some locations. The machine builder has ultimate responsibility for machine compliance.

Low Voltage Directive (LVD) Installation Requirements:

- Drive safety earth conductor
- Motor safety earth
- Drive must be installed such that the hazardous live terminals (barrier strip) are not accessible under normal operation

Electromagnetic Compatibility (EMC) Installation Requirements:

- Product does not need to be placed within an enclosure
- Mains filter (see filter recommendations)
- Transient suppressors (mains surge test)
- EMC cabling, braided and bonded as specified below
- EMC ready motor, or motor with EMC installation information
- Additional installation hardware as shown in drawings in this appendix

Additional Steps to Ensure Compliance

To meet the requirements of regulatory agencies, you *must* follow the installation guidelines presented below.

EMC – Electromagnetic Compatibility Directive – 89/336/EEC

In order to meet the requirements of the Electromagnetic Compatibility Directive 89/336/EEC, the entire system must comply: motor, drive, cabling, and peripherals. The installation of the product must include the following items.

EMC Cabling

For electromagnetic compatibility, you must use cables shown to be usable in EMC installations. Cables should have a minimum of 85% braid coverage, and be 360° bonded at both ends.

EMC Motor

For system CE compliance, you must use an EMC-ready motor, or a motor that has demonstrated acceptable EMC performance.

NOTE: Motors may bear the CE mark. This mark indicates the motor meets the requirements of construction and safety—*not EMC compliance*.

Motors with shielded cabling or pipe thread style cabling options allow the easiest integration into machines required to bear the CE mark for EMC.

Varistors

You must install varistors or other voltage surge limiting devices in order to meet the requirements of EN61000-4-5. Place a Littelfuse V140LA1Ø or equivalent varistor from line to line, and from lines to earth before the mains filter, as shown in the *EMC Installation* drawing later in this appendix. (Intersil, General Electric and Littelfuse manufacture equivalent varistors.)

Mains Filter

You must install a mains filter. The next table lists recommended filters.

| Filter: | Continuous Current (amps) |
|---------------------------|---------------------------|
| 6EP1 ¹ | 6 |
| 10EP1 ^{1,3} | 10 |
| FN2070-10-06 ² | 10 |

¹ Corcom; ² Schaffner;

³ Available from Compumotor: 10 amp filter – part number 47-016140-01

Installation Guidelines

The E-AC Drive is made available under “Restricted Distribution” for use in the “Second Environment” as described in EN 61800-3: 1996, page 9.

Cabinet Mounting

For Electromagnetic Compatibility, cabinet mounting is not required. However, the E-AC Drive has high voltage terminals—for safety purposes, the drive must not be user accessible during normal operation.

Drive Mounting

The E-AC Drive is designed to be mounted to an earthed metal panel. For EMC performance, mount the mains filter to the same panel, as close to the drive as possible. See the *EMC Installation* drawing at the end of this appendix.

Cable Routing

Route high power cables (motor and mains) at right angles to low power cables (communications and inputs/outputs). Never route high and low power cables parallel to each other.

Cable Shielding

All cables must maintain high integrity 360 degree shielding, and be constructed with at least 85% braid coverage. When you install inputs and outputs, you must observe proper noise immunity standards. See the *EMC Installation* drawing at the end of this appendix.

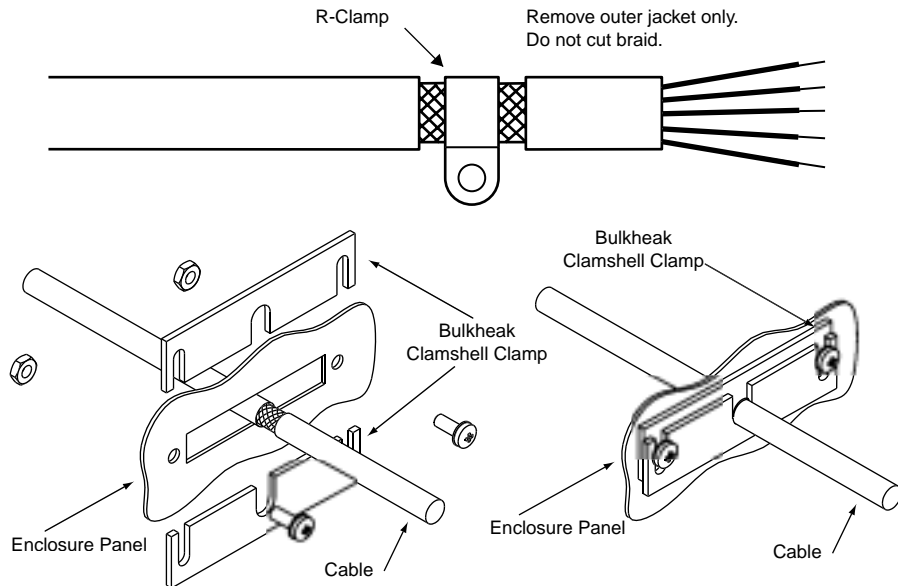
Ferrite Absorbers

To meet the requirements of the EMC directive, you must add clip-on ferrite absorbers to all cables. Compumotor recommends a ferrite with at least 200 ohm impedance at 100 MHz, such as:

Steward Ferrite part number 28A2024
Fair-Rite part number 0443164151
(These ferrites are available from Compumotor, part number 47-015956-01)

Enclosure Mounting the E-AC Drive

The enclosure must be properly earthed and paint must be removed from drive mounting and RF earth bonding locations. Proper shield termination of all cables entering and exiting the enclosure is required. The motor shield (braid) must be fastened close to the drive's heatsink. The shield must not make contact with other conductors, as this will cause common mode drive generated PWM current to flow where not expected. The shields of all other cables that enter or exit the enclosure must be RF bonded to the enclosure entrance point via R-Clamp, bulkhead clamshell clamp, or other 360° bonding technique. This ensures that no stray noise will enter or exit the enclosure. The next drawing illustrates 360° bonding techniques.



360° Bonding Techniques

The following clamps and clamp kits are available from Compumotor.

| Clamp Type: | Compumotor Part Number: |
|-----------------------------|-------------------------|
| R-Clamp | 58-016050-01 |
| R-Clamp Kit (10 per) | R CLAMP KIT |
| Bulkhead Clamshell Clamp | 53-016131-01 |
| Clamshell Clamp Kit (2 per) | CLAMSHELL KIT |

If you use a screw terminal cable breakout device, be sure to properly enclose all exposed conductors to avoid contamination and to reduce the risk of electrostatic discharge. I/O must utilize high quality shielded cabling (85% braid coverage minimum), which must be RF earth bonded as shown above.

Panel Mounting the E-AC Drive

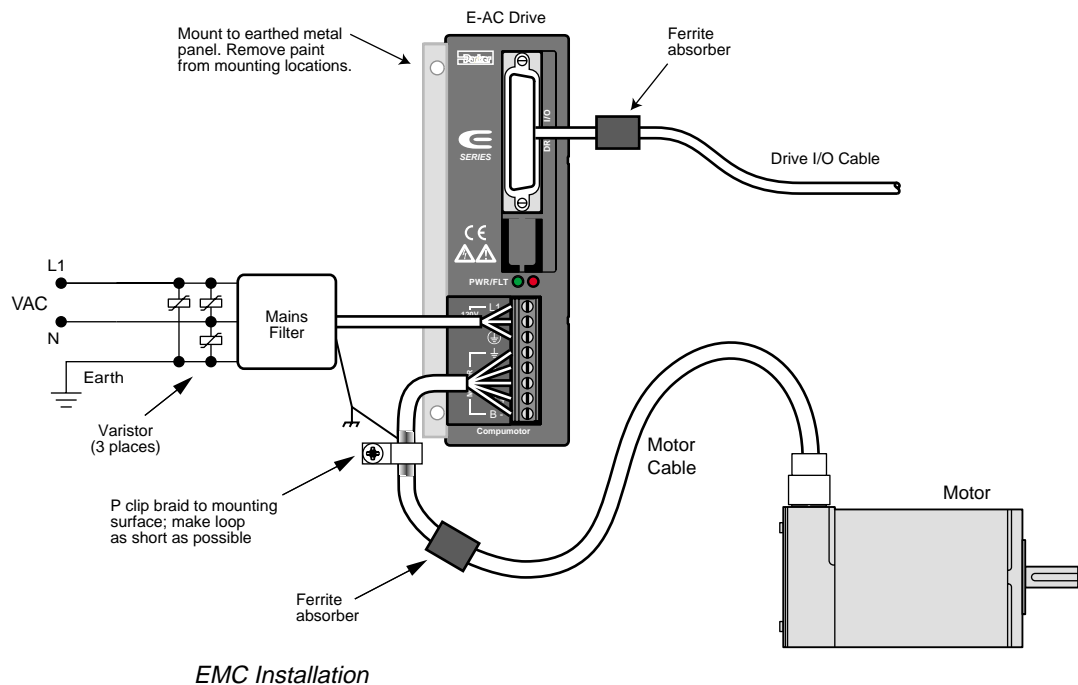
The mounting panel must be properly earthed and paint must be removed from drive mounting locations. You must fasten the motor shield (braid) close to the drive's heatsink.

If you use a screw terminal cable breakout device, be sure to properly enclose all exposed conductors to avoid contamination and to reduce the risk of electrostatic discharge. I/O must utilize high quality shielded cabling (85% braid coverage minimum), which must be RF earth bonded as shown above.

System Installation

If you mount the E-AC Drive in an enclosure, terminate cable braids (screens) at the entrance of the enclosure. However, the motor braid *must* be returned only to a location close to the drive's heatsink.

The next figure shows a typical EMC installation.



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