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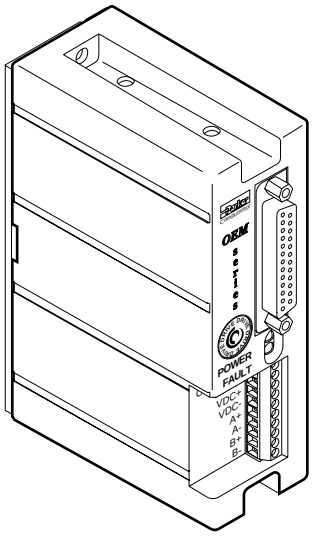
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Compumotor

OEM650/OEM650X
OEM350/OEM350X
Drive and Drive/Indexer
User Guide



Compumotor Division
Parker Hannifin Corporation
p/n 88-013157-02 A

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Important User Information

Installation & Operation of Compumotor Equipment

It is important that Compumotor motion control equipment is installed and operated in such a way that all applicable safety requirements are met. It is your responsibility as a user to ensure that you identify the relevant standards and comply with them. Failure to do so may result in damage to equipment and personal injury. In particular, you should review the contents of the user guide carefully before installing or operating the equipment.

Under no circumstances will the suppliers of the equipment be liable for any incidental, consequential, or special damages of any kind whatsoever, including but not limited to lost profits arising from or in any way associated with the use of the equipment or this user guide.

Safety Warning

High-performance motion control equipment is capable of producing rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. KEEP CLEAR of any machinery driven by stepper or servo motors and never touch them while they are in operation.

High voltages exist with in enclosed units, on rack system backplanes, and on transformer terminals. KEEP CLEAR of these areas when power is applied to the equipment.

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How To Use This User Guide

This user guide is designed to help you install, develop, and maintain your system. Each chapter begins with a list of specific objectives that should be met after you have read the chapter. This section will help you find and use the information in this user guide.

Assumptions

To use this product and its instructions effectively, you should have a fundamental understanding of the following information.

❏ Electronics concepts (voltage, switches, current, etc.)
❏ Motion control concepts (torque, velocity, distance, force, etc.)

User Guide Contents

Chapter 1: Introduction
This chapter provides a description of the product and a brief account of its specific features.

Chapter 2: Installation
This chapter contains a ship kit list of items you should have received with your OEM650 or OEM650X. Instructions to mount and connect the system properly are included. Upon completion of this chapter, your system should be completely installed and ready to perform basic operations.

Chapter 3: Tuning & Specifications
This chapter contains information on system performance specifications (speed/torque curves, environmental specifications, etc.). Tuning procedures that are designed to help you operate your system at peak performance are also provided.

Chapter 4: Troubleshooting
This chapter contains information on identifying and resolving system problems. Descriptions of LED signals, debugging tools, problems/solutions table are included.

Installation Process Overview

To ensure trouble-free operation, pay special attention to the environment in which the equipment will operate, the layout and mounting, and the recommended wiring and grounding. These recommendations will help you easily and safely integrate the OEM650/OEM650X into your manufacturing facility. If your environment contains conditions that may adversely affect solid-state equipment (electrical noise or atmospheric contamination), be sure to follow any special instruction to ensure the safety and long life of your equipment.

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Installation Preparation

Before you install this product, complete the following steps:

1. Review this user guide. Become familiar with the user guide's contents so that you can quickly find the information you need.
2. Develop a basic understanding of all system components, their functions, and interrelationships.
3. Complete the basic system configuration and wiring instructions (in a simulated environment, not a permanent installation) provided in *Chapter 2, Installation*.
4. Perform as many basic functions as you can with the preliminary configuration. Try to simulate the task(s) that you expect to perform when you permanently install your application (however, do not attach a load at this time). This will give you a realistic preview of what to expect from the complete configuration.
5. After you have tested the system's functions and become familiar with the system's basic features, carefully read Chapter *2*.
6. After you have read Chapter 2 and clearly understand what must be done to properly install the system, begin the installation process. Do not deviate from the instructions provided.
7. Before you customize your system, check all of the system functions and features to ensure that you have completed the installation process correctly.

The successful completion of these steps will prevent subsequent performance problems and allow you to isolate and resolve potential system difficulties before they affect your system's operation.

Software Reference Manual

A separate Software Reference Manual contains descriptions for all software commands applicable to the OEM650X and OEM350X.

Warnings & Cautions

Warning and caution notes alert you to problems that may occur if you do not follow the instructions correctly. Situations that may cause bodily injury are presented as warnings. Situations that may cause system damage are presented as cautions.

WARNING

Do not touch the motor immediately after it has been in use for an extended period of time. The motor may be hot.

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1 Introduction

Chapter Objective

The information in this chapter will enable you to:

❒ Understand the product's basic functions and features

OEM650 Description

The OEM650 Drive is intended to be a high-performance basic engine around which the original equipment manufacturer (OEM) designs his motion control system. Its single-power DC input makes it a convenient and cost effective motion control module. The drive offers a basic set of customer configurable features. These features are designed to meet the needs of most customers. The OEM650 is optimized to operate size 23 and 34 motors.

The OEM650 is a bipolar, recirculating, microstepping drive designed to drive two-phase permanent magnet hybrid step motors. The drive uses a custom ASIC, surface mount, and MOSFET technologies to give high performance in a small package while providing short circuit protection. The OEM650 is compatible with all Compumotor indexers.

The mechanical design is a fully enclosed product that uses a *heatplate* technique to provide a heat dissipation path. The user must attach the OEM650 module to a suitable mounting surface.

OEM650X Description

The OEM650X Drive/Indexer is the same drive product as the OEM650, but it includes an indexer (position controller). The OEM650X is the same size as the OEM650 and it incorporates the same design technologies (bipolar, recirculating, microstepping drive designed to drive two-phase permanent magnet hybrid step motors, custom ASIC, surface mount, and MOSFET technologies).

The indexer utilizes commands from Compumotor's popular and easy-to-use X Series Language. The indexer also provides additional I/O control and communication

OEM350/350X Description

The OEM350/OEM350X is a low power version of the OEM650 drive. It is designed for use with step motors that have lower current ratings and higher inductance (10 mH to 80 mH) than Compumotor

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step motors. Operation of the OEM350/OEM350X is identical to that of the OEM650/OEM650X. For clarity, instructions in this manual use only the name OEM650/OEM650X. Except where differences are specifically noted (resistor values for motor current settings, for example), OEM650 instructions also apply to the OEM350, and OEM650X instructions also apply to the OEM350X.

Features

The OEM650 requires an external power supply. It uses 24VDC - 75VDC for its power input. Compumotor's motors are two-phase hybrid motors (permanent magnet type). Four, six, or eight leaded motors may be used with the internal phases connected for either parallel or series operation. The motor's inductance cannot drop below 0.5 mH. *For best performance, motor inductance should be between 1 mH and 10 mH, but motors with inductance ratings as low as 0.5 mH may be used. Use the OEM350/OEM350X with motors whose inductance is in the 10 mH to 80 mH range.* The OEM650/OEM650X provides the following features:

- ❒ Microprocessor controlled microstepping provides smooth operation over a wide range of speeds
- ❒ Full short circuit protection for phase-to-phase and phase-to-ground short circuits
- ❒ Motor regeneration protection
- ❒ Over-temperature protection
- ❒ Uses low-inductance motors for improved high-speed performance (23, 34 frame size motors available with torques from 65 - 400 oz-in)
- ❒ Three-state current control for reduced motor/drive heating
- ❒ LED status indicators: **POWER** and **FAULT** (latched)
- ❒ Optically coupled step, direction, and shutdown inputs are compatible with all Compumotor indexers (25-pin D connector)
- ❒ A fault output to signal other equipment if a fault occurs
- ❒ 24VDC - 75VDC single power input
- ❒ 16 jumper selectable motor resolutions (200 - 50,800 steps/rev)
- ❒ 2 Mhz step input
- ❒ Waveform correction and phase offset for improved smoothness
- ❒ Built-in indexer (position controller)
- ❒ -M2 option allows users to store programmed sequences in nonvolatile memory
- ❒ I/O for motion and basic machine coordination

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2 Installation

Chapter Objectives

The information in this chapter will enable you to:

- ❒ Verify that each component of your system has been delivered safely and completely
- ❒ Become familiar with components and their interrelationships
- ❒ Ensure that each component functions properly by bench testing
- ❒ Mount unit within recommended thermal specifications

OEM650/OEM650X Ship kit

Inspect the OEM650 or OEM650X upon receipt for obvious damage to its shipping container. Report any such damage to the shipping company. Parker Compumotor cannot be held responsible for damage incurred in shipment. You should receive either a drive (OEM650) or drive/indexer (OEM650X). Compare your order with the units shipped.

Part	*Part Number*
OEM Microstepping Drive	OEM650
OEM Microstepping Drive/Indexer	OEM650X

Table 2-1. OEM650 Drive & OEM650X Drive/Indexer

The following options may be used with the OEM650X.

Option	*Description*
-M2	Nonvolatile Memory (2k BBRAM)

Table 2-2. OEM650X Options

The following motor(s) may be used with the OEM650 and OEM650X. Compare your order with the motors shipped.

Part	*Part Number*
Size 23—1/2 Stack Stepping Motor	OEM57-40-MO
Size 23—1 Stack Stepping Motor	OEM57-51-MO
Size 23—2 Stack Stepping Motor	OEM57-83-MO
Size 34—1 Stack Stepping Motor	OEM83-62-MO
Size 34—2 Stack Stepping Motor	OEM83-93-MO
Size 34—3 Stack Stepping Motor	OEM83-135-MO

Table 2-3. OEM650 & OEM650X Motors

The standard OEM650 Series motor is single-shafted. Motors can be purchased with a double-shaft option.

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Option	*Description*
-DS23	Double Shaft Size 23 Motors
-DS34	Double Shaft Size 34 Motors

Table 2-4. Double Motor Shaft Option

The following accessories are available.

Accessories	*Part Number*
OEM650/OEM650X User Guide	88-013157-02
OEM Series Software Ref. Guide	88-013785-01
Low Current Heatsink	OEM-HS1
High Current Heatsink	OEM-HS2

Table 2-5. OEM650/OEM650X Accessories

Evaluation kits

Evaluation kits include all items necessary to evaluate the OEM650 (OEM650-EK) and OEM650X (OEM650X-EK) in a simulated production environment. The kits are intended to be used to prototype a machine or operation before production units are purchased. The following items are included in an evaluation kit. Motors must be ordered separately—they are not included in the kit. If a component is missing, contact Compumotor's Customer Service Department.

Part	*Part Number*
Drive or Drive/Indexer	OEM650 ***or*** OEM650X
OEM650/OEM650X User Guide	88-013157-02
OEM Series Software Ref. Guide	88-013785-01
High Current Heatsink	OEM-HS2
Ship kit Items:	
❒ Resistors (for current selection—the following types are available)	
• 21.0KΩ 1% Resistor	12-008319-01
• 5.76KΩ 1% Resistor	12-008265-01
• 15.8KΩ 1% Resistor	12-008307-01
• 2.05KΩ 1% Resistor	12-008222-01
• 12.7KΩ 1% Resistor	12-008298-01
• 0.00KΩ 5% Resistor	12-003645-01
• 9.53KΩ 1% Resistor	12-008286-01
• 4.87KΩ 1% Resistor	12-008258-01
• 1.27KΩ 1% Resistor	12-008202-01
❒ Screwdriver	58-013155-01
❒ 25-Pin D Mating Connector	43-001989-01
❒ X-Ware Support Disk (OEM650X-EK Only)	
• 3 1/2" Disk	95-013066-01
• 5 1/4" Disk	95-013067-01

Table 2-6. OEM650 Series Evaluation kit Contents

Quick Test (OEM650/OEM650X)

Use the following steps to set the drive's jumpers, wire the unit, and test your system. You will need the following tools:

❒ Needle nose pliers or tweezers
❒ Flathead screw driver (1/10")

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WARNING

The drive and motor should be mounted to a heatsink. Drive mounting does not affect the following tests, but if you operate the OEM650/OEM650X for extended periods without proper mounting, it will damage the drive and/or motor. When you complete the quick tests, remove power to the drive.

Perform installation and test procedures in a properly grounded environment. Compumotor recommends the use of a grounding strap.

1. Remove the cover by applying pressure to the 25-pin D connector.

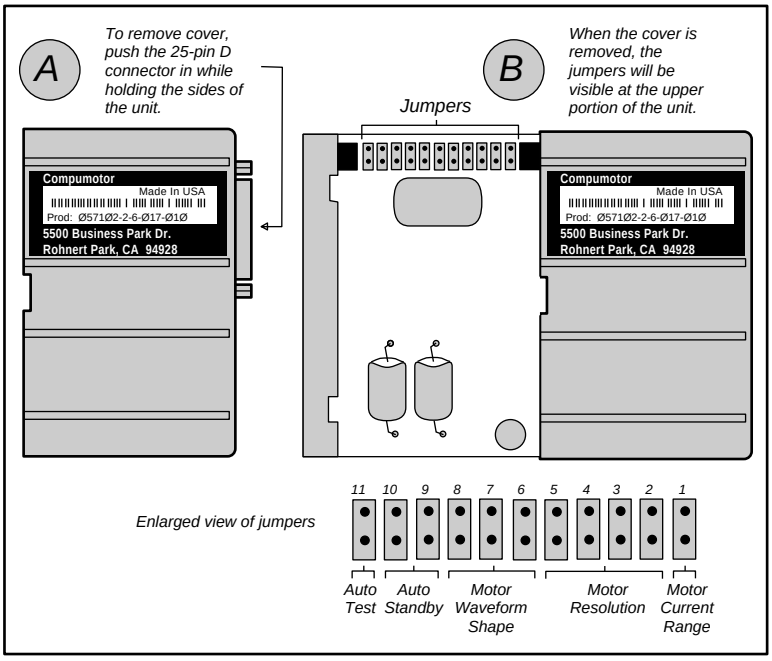


Figure 2-1. OEM650/OEM650X Jumpers

2. To test the system, you will use the Automatic Test function, jumper **11**. Remove jumper **11** to enable the function (save for later installation). ***Do not remove any other jumpers***. When power is applied to the drive with jumper **11** removed, the Automatic Test function will rotate the motor in an Alternating mode approximately 6 revolutions at 1 rps.

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3. Slide the drive cover back on.

4. Attach the motor (to A+, A-, B+, B-). Do not connect the motor to the load at this time (refer to Figure 2-2 for 23 size motors or Figure 2-3 for 34 size motors). OEM size 23 motors may be wired in a series or parallel configuration. *If you are using a 75VDC power supply (OEM300) with the drive or drive indexer, Compumotor recommends that you use a series configuration, however; a parallel configuration should be used when the power supply is 24VDC - 48VDC. Parallel configurations will cause the drive to dissipate slightly more heat than a serial configuration. This increase in drive temperature will not affect the unit's performance, but it may adversely affect heat-sensitive devices that are stored within the same enclosure.*

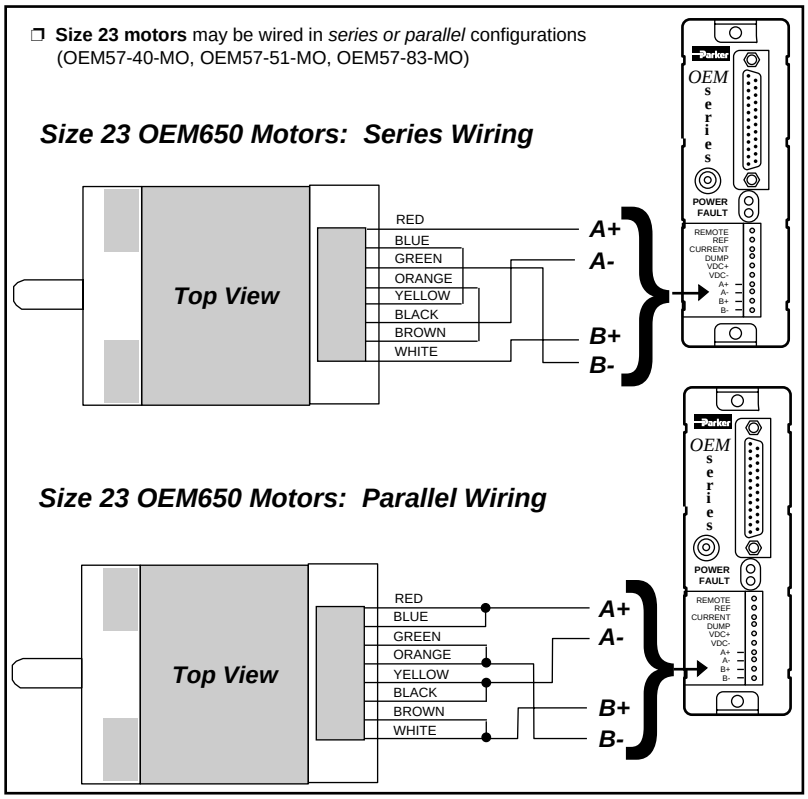


Figure 2-2. NEMA 23 Size OEM Motor Wiring—Series & Parallel

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OEM size 34 motors are internally wired in parallel. *A 75VDC power supply (OEM300) must be used to achieve maximum performance; however, lower voltage power supplies may be used (less than 75VDC but must be greater than 24VDC). The lower voltage power supply will not adversely affect the system's low-speed performance, but it will not yield the optimum high-speed performance achieved by using the 75VDC power supply.*

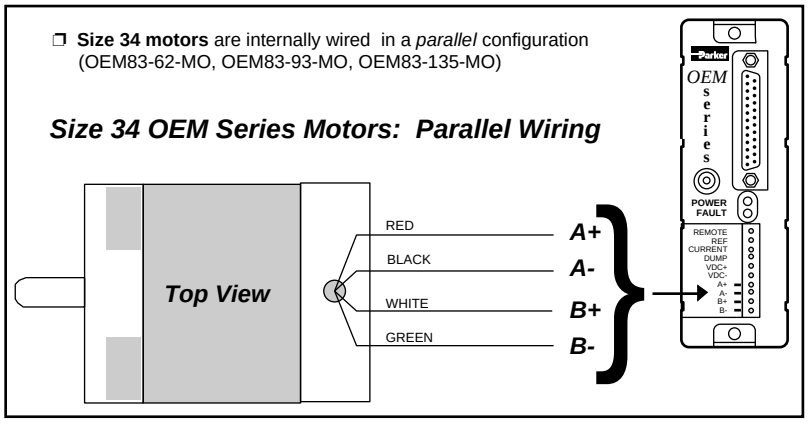


Figure 2-3. NEMA 34 Size OEM Motor Wiring—Series

5. Set motor current. Table 2-7 contains the proper motor current settings for Compumotor OEM motors. A 1/4 watt resistor connected between **REF** and **CURRENT** sets ***motor current***. Adjust the drive current to match the motor that you are using.

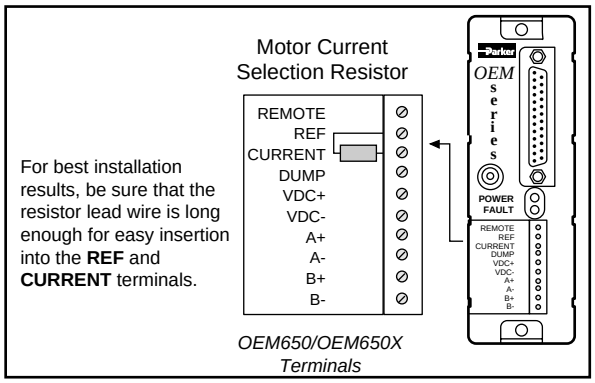


Figure 2-4. Motor Current Selection Resistor

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Motor Size	*Current*	*Resistor*	*Voltage*
OEM57-40-MO**S**	2.65A	21.0 kΩ	48 - 75VDC
OEM57-40-MO**P**	5.3A	5.76 kΩ	24 - 48VDC
OEM57-51-MO**S**	3.3A	15.8 kΩ	48 - 75VDC
OEM57-51-MO**P**	6.6A	2.05 kΩ	24 - 48VDC
OEM57-83-MO**S**	3.8A	12.7 kΩ	48 - 75VDC
OEM57-83-MO**P**	7.5A	0.00 kΩ	24 - 48VDC
OEM83-62-MO*	4.4A	9.53 kΩ	24 - 75VDC
OEM83-93-MO*	5.6A	4.87 kΩ	24 - 75VDC
OEM83-135-MO*	6.9A	1.27 kΩ	24 - 75VDC

S: Series Configuration P: Parallel Configuration

**34 size motors are internally wired in parallel*

Table 2-7. OEM Drive Motor Current (Compumotor Motors)

If you use a *non-Compumotor motor*, carefully follow the motor manufacturer's instructions regarding motor wiring and the proper operating current. Compumotor recommends a motor inductance of 2 mH measured in series or parallel (0.5 mH - 10 mH is acceptable). Table 2-8 shows resistor values that you must use to properly set motor current when using the **OEM650/ OEM650X** with a non-Compumotor motor. When the ***motor current range jumper*** (jumper 1—see Figure 2-1) is installed, the drive can generate 2.5 to 7.5 amps. When jumper 1 is removed, the drive can generate 0.83 to 2.5 amps. If you use the **OEM350/ OEM350X**, use Table 2-9 for resistor and current values to use with high-inductance (10 mH to 80 mH), low current motors.

Jumper #1 Installed				**Jumper #1 Removed**	
Current (Amps)	*Resistance (Ohms)*	*Current (Amps)*	*Resistance (Ohms)*	*Current (Amps)*	*Resistance (Ohms)*
7.5	0 Ω	4.9	7.32 kΩ	2.5	0 Ω
7.4	205 Ω	4.8	7.68 kΩ	2.4	619 Ω
7.3	412 Ω	4.7	8.06 kΩ	2.3	1.27 kΩ
7.2	619 Ω	4.6	8.45 kΩ	2.2	2.05 kΩ
7.1	825 Ω	4.5	8.87 kΩ	2.1	2.80 kΩ
7.0	1.02 kΩ	4.4	9.53 kΩ	2.0	3.57 kΩ
6.9	1.27 kΩ	4.3	10.0 kΩ	1.9	4.53 kΩ
6.8	1.54 kΩ	4.2	10.5 kΩ	1.8	5.49 kΩ
6.7	1.78 kΩ	4.1	10.0 kΩ	1.7	6.49 kΩ
6.6	2.05 kΩ	4.0	11.5 kΩ	1.6	7.68 kΩ
6.5	2.26 kΩ	3.9	12.1 kΩ	1.5	8.87 kΩ
6.4	2.55 kΩ	3.8	12.7 kΩ	1.4	10.5 kΩ
6.3	2.80 kΩ	3.7	13.3 kΩ	1.3	12.1 kΩ
6.2	3.09 kΩ	3.6	13.7 kΩ	1.2	13.7 kΩ
6.1	3.32 kΩ	3.5	14.3 kΩ	1.1	15.8 kΩ
6.0	3.57 kΩ	3.4	15.0 kΩ	1.0	18.2 kΩ
5.9	3.92 kΩ	3.3	15.8 kΩ	0.9	20.5 kΩ
5.8	4.22 kΩ	3.2	16.5 kΩ	0.83	22.6 kΩ
5.7	4.53 kΩ	3.1	17.4 kΩ		
5.6	4.87 kΩ	3.0	18.2 kΩ		
5.5	5.11 kΩ	2.9	19.1 kΩ		
5.4	5.49 kΩ	2.8	20.0 kΩ		
5.3	5.76 kΩ	2.7	20.5 kΩ		
5.2	6.19 kΩ	2.6	21.5 kΩ		
5.1	6.49 kΩ	2.5	22.6 kΩ		
5.0	6.81 kΩ				

Table 2-8. ***OEM650/650X*** *Resistor Selection for Motor Current*

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Jumper #1 Installed				Jumper #1 Removed	
Current (Amps)	*Resistance (Ohms)*	*Current (Amps)*	*Resistance (Ohms)*	*Current (Amps)*	*Resistance (Ohms)*
2.0	0 Ω	1.3	7.32 kΩ	0.7	0 Ω
1.9	787 Ω	1.2	8.87 kΩ	0.6	2.21 kΩ
1.8	1.62 kΩ	1.1	10.7 kΩ	0.5	5.36 kΩ
1.7	2.49 kΩ	1.0	13.0 kΩ	0.4	10.0 kΩ
1.6	3.57 kΩ	0.9	15.4 kΩ	0.3	16.2 kΩ
1.5	4.64 kΩ	0.8	18.2 kΩ	0.2	27.4 kΩ
1.4	5.90 kΩ	0.7	21.5 kΩ		

Table 2-9. ***OEM350/350X*** *Resistor Selection for Motor Current*

6. Connect a 24VDC - 75VDC power supply to **VDC+** and **VDC-**. Refer to Figure 2-5 for a diagram of this connection and the complete OEM650 test configuration.

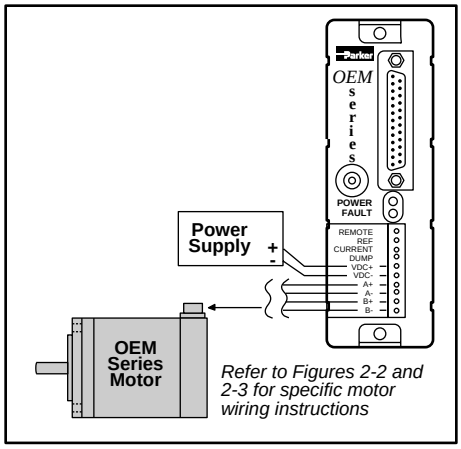


Figure 2-5. OEM650 Test Configuration

WARNING

Reversing VDC+ and VDC- can seriously damage the drive.

7. Apply power. The OEM's green power LED should be on. If the red **FAULT** LED is on, consult *Chapter 4, Troubleshooting*. After verifying that the motor moves CW and CCW, turn off power.

   - ❒ Disconnect cables and resistor.
   - ❒ Snap off cover.
   - ❒ Install jumper **11**.
   - ❒ Replace cover.

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Quick Test: OEM650 with Separate Indexer

1. Complete steps 1- 6 from the OEM650 Quick Test, ***but do not remove jumper #11 (Auto Test Function)***.

2. To connect a ***Compumotor indexer*** to the OEM650's 25-pin D connector refer to Figure 2-6.

   To connect a ***non-Compumotor indexer*** to the OEM650's 25-pin D connector, refer to Figure 2-7.

3. Apply power. The OEM's green power LED should be on. If the red **FAULT** LED is on, consult *Chapter 5, Troubleshooting*.

This test assumes that your indexer's motor resolution is set to 25,000 steps/rev. This is the default motor resolution setting for the OEM650.

4. Using the indexer, send step pulses to the drive that will rotate the motor one **CW** revolution (25,000 step pulses) at 1 rps (25,000 steps per second).

5. Using the indexer, send step pulses to the drive that will rotate the motor one **CCW** revolution at 1 rps. The drive's default direction is CCW (i.e., if the the direction input is not activated, the motor will rotate CCW—if the direction input is activated, the motor will rotate CW). If the motor does not rotate in the desired direction, reverse the direction sense for your system by reversing the leads going to the A+ and A- terminals.

WARNING

Never connect or disconnect any component to or from the drive with power applied. System damage or personal injury may occur.

6. After verifying that the motor moves CW and CCW, turn off power.

   ❒ Disconnect cables and resistor.

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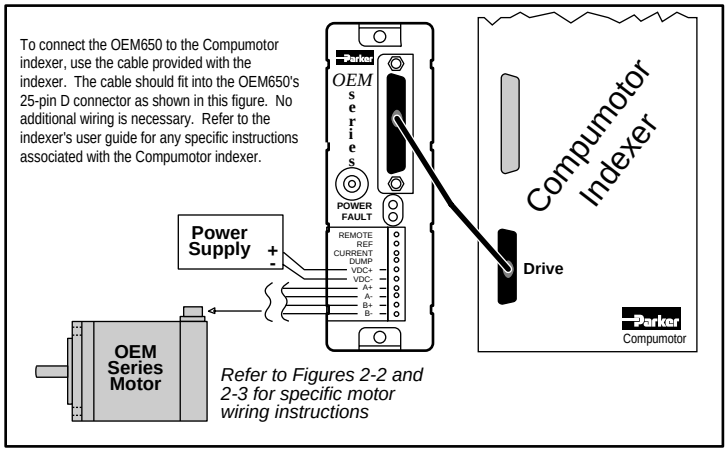


Figure 2-6. OEM650 with Compumotor Indexer Test Configuration

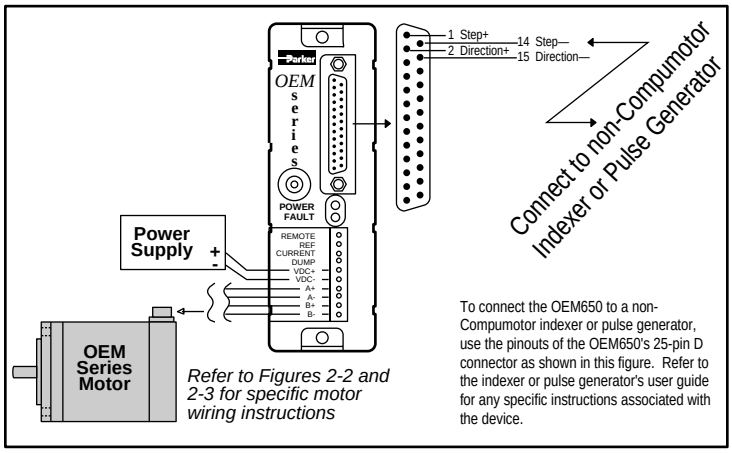


Figure 2-7. OEM650 with non-Compumotor Indexer or Pulse Generator Test Configuration

Quick Test: OEM650X

1. Complete steps 1- 6 from the OEM650 Quick Test. ***but do not remove jumper #11 (Auto Test Function)***

2. Connect the OEM650X to an RS-232C communications device (i.e., computer, PLC, etc.). The OEM650X's communication parameters are listed below:

   - ❏ Baud Rate: 9600
   - ❏ Data Bits: 8
   - ❏ Stop Bit: 1
   - ❏ Parity: None

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Handshaking is not supported. Terminals should be set for full duplex mode.

3. Apply power. The OEM's green power LED should be on. If the red **FAULT** LED is on, consult *Chapter 4, Maintenance & Trouble-shooting*.

This test assumes that your indexer's motor resolution is set to 25,000 steps/rev. This is the default motor resolution setting for the OEM650X.

4. Enter and run the following command sequence to test the system.

Command	Description
MN	Sets unit to Normal mode
LD3	Disables CW & CCW Limits
A1Ø	Set acceleration to 10 rps^2
V1Ø	Set velocity to 10 rps
D25ØØØ	Set move distance to 1 CW revolution
G	Initiate move (Go)
H	Reverse move direction (CCW)
G	Initiate move (Go)

5. After verifying that the motor moves CW and CCW, turn off power.

CAUTION

RS-232C signals are not on pins 2, 3, and 7 on the 25-pin D connector.

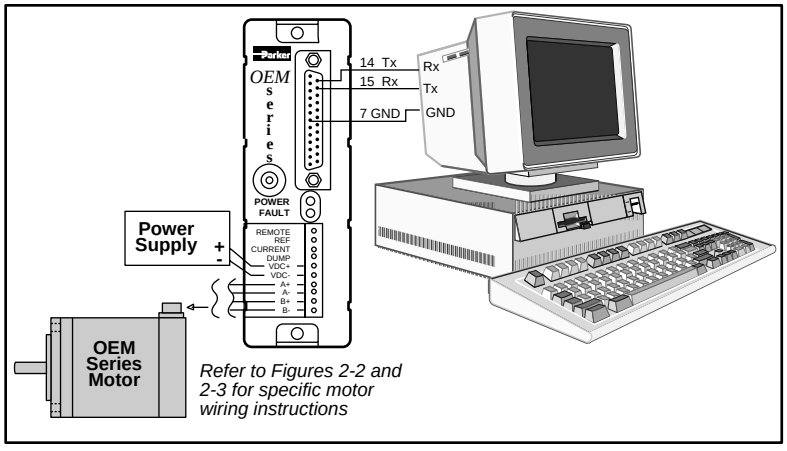


Figure 2-8. OEM650X Test Configuration

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OEM650/OEM650X Mounting

The OEM Drive mounting is designed to minimize panel area or footprint (refer to Figure 2-9). An optional heatsink can also be used to configure the drive for minimum depth.

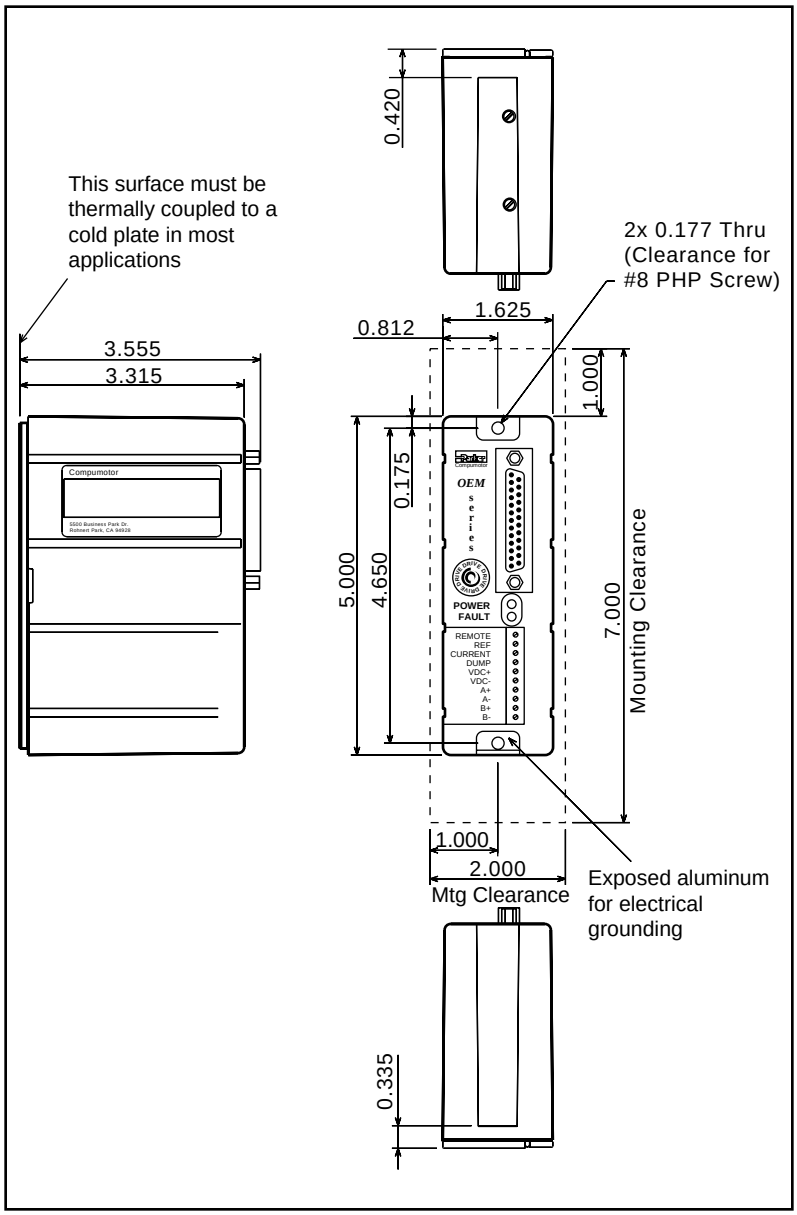


Figure 2-9. OEM650/OEM650X Dimensions

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Panel Layout

If you mount the OEM650/OEM650X in an enclosure, observe the following guidelines:

- ❑ Do not mount large, heat-producing equipment directly beneath the OEM650 or OEM650X.
- ❑ Do not mount the OEM650 directly below an indexer (the drive produces more heat than an indexer).
- ❑ Fan cooling may be necessary.

Refer to the subsequent instructions and diagrams in this section for specific mounting information about your configuration.

Mounting Without a Heatsink

If you are operating the OEM650/OEM650X without a heatsink, use the panel layout recommendations provided in Figure 2-10 to mount the unit(s) in an enclosure.

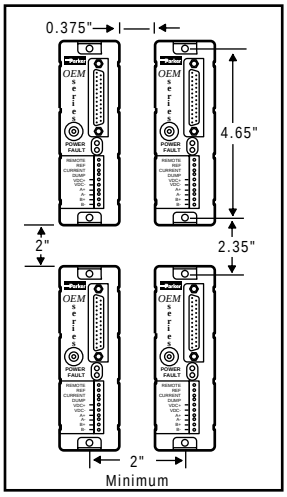


Figure 2-10. OEM650/OEM650X Without a Heatsink

Figure 2-11 shows the heat generated by the OEM650/OEM650X that needs to be dissipated by the mounting surface.

The OEM uses a heatplate design to dissipate heat. The drive should never be operated for more than a few minutes without properly mounting the drive to an adequate thermal heatsink.

The total thermal dissipation in the OEM650/OEM650X is almost constant, regardless of whether the motor is stationary or in motion. The motor current output jumper settings determine the motor phase currents that cause the power losses shown in Figure 2-11. The cabinet's thermal resistance is approximately 0.35°C/Watt in still air with the heatplate vertically oriented.

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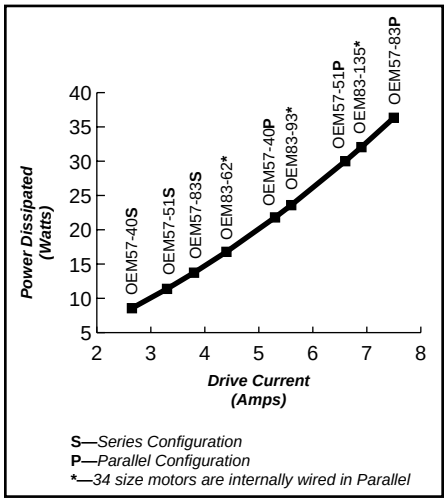


Figure 2-11. OEM650/OEM650X Power Dissipation

Over-Temperature Protection

The OEM650/OEM650X is over-temperature protected. The drive will shut down if its heatplate temperature exceeds 58°C (136°F). To measure drive temperature under operating conditions, position a thermal probe on the left edge of the heatplate, approximately 1.5" from the top of the drive, as shown in Figure 2-12.

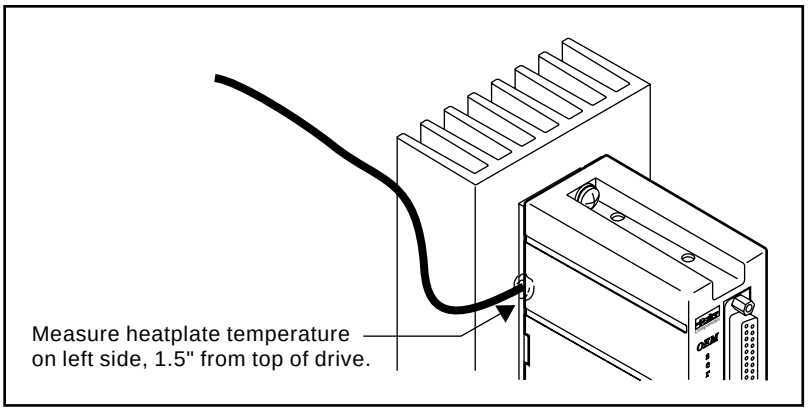


Figure 2-12. Heatplate Temperature Measurement

To keep the drive cool, and ensure that over-temperature protection does not unexpectedly shut down the drive, the temperature of the mounting surface adjacent to the drive should not exceed 55°C (131°F).

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Two types of optional heatsinks can be used for applications that do not have an adequate mounting surface.

Mounting With OEM-HS1

The small heatsink (OEM-HS1) is intended to be used with a current setting up to 5A in still, ambient (25°C) air. If the drive is to be mounted in an ambient environment hotter than 25°C, active cooling (forced air) will be required to maintain the heatsink temperature below 55°C. This heatsink may be purchased as an option.

Two #8-32 screws are needed to mount the OEM650/OEM650X to the OEM-HS1 heatsink. Use a *star washer* on the bottom screw to ensure proper electrical grounding. Two #8 screws should be used to mount the OEM-HS1 to the cabinet heatsink.

Do not use a star washer between the back of the OEM or heatplate and the mounting surface. The mounting surface must be flat. Use thermal grease or thermal pads to facilitate heat transfer from the drive's heatplate to your mounting surface.

A heatsink with holes tapped for metric screws is available. Its part number is OEM-HS1-M4. Consult your Compumotor sales guide for more information.

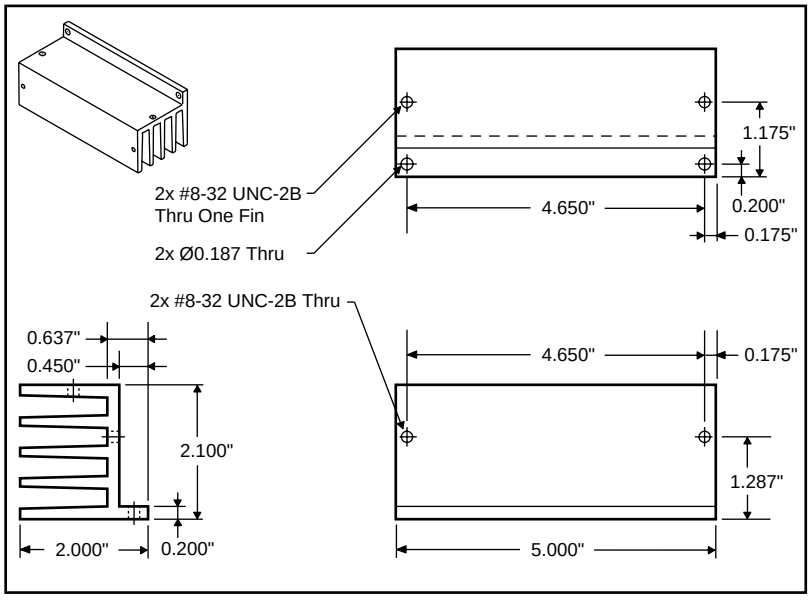


Figure 2-13. OEM-HS1 Dimensions

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With the OEM-HS1, the drive may be mounted in two different configurations (refer to Figures 2-14 and 2-15). One configuration provides the maximum amount of panel or mounting space (minimum area). The other configuration provides minimum depth.

Panel layout for minimum area is shown in Figure 2-14.

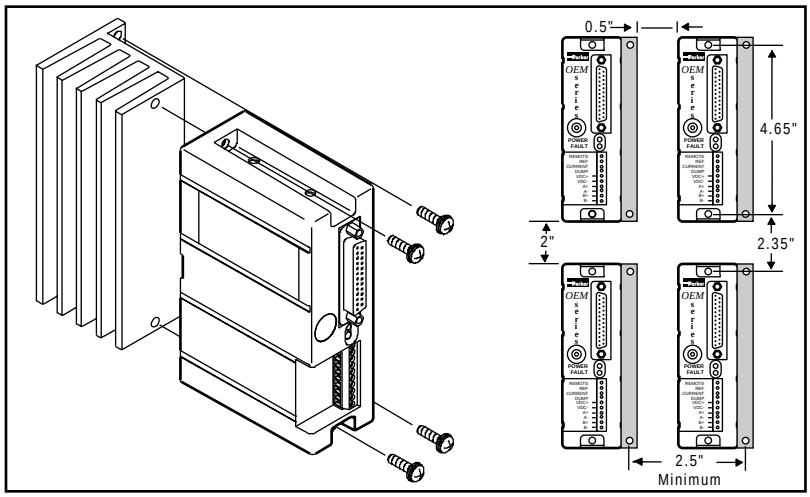


Figure 2-14. OEM650/OEM650X OEM-HS1 Minimum Area Panel Layout

Panel layout for minimum depth is shown in Figure 2-15.

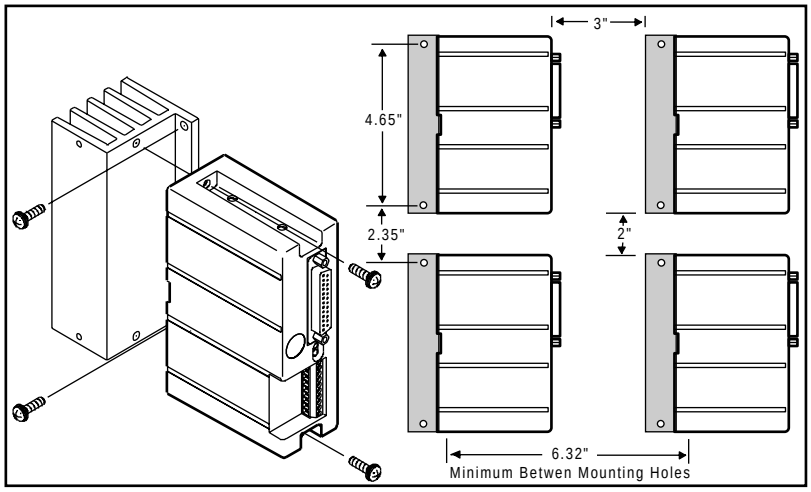


Figure 2-15. OEM650/OEM650X OEM-HS1 Minimum Depth Panel Layout

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Mounting With OEM-HS2

The large heatsink (OEM-HS2) is intended to be used with a current setting up to the drive maximum of 7.5A in still, ambient (25°C) air. If the drive is to be mounted in an ambient environment hotter than 25°C, active cooling (forced air) will be required to maintain the heatsink temperature below 55°C. This heatsink may be purchased as an option to provide adequate drive cooling when adequate cooling cannot otherwise be achieved (refer to Figures 2-16 and 2-17). Secure the drive or drive/indexer to the heatsink with #8 screws. Use thermal grease or a thermal pad between the unit and the heatsink to facilitate heat transfer. Secure the drive and heat-sink to your mounting surface with two #8 screws.

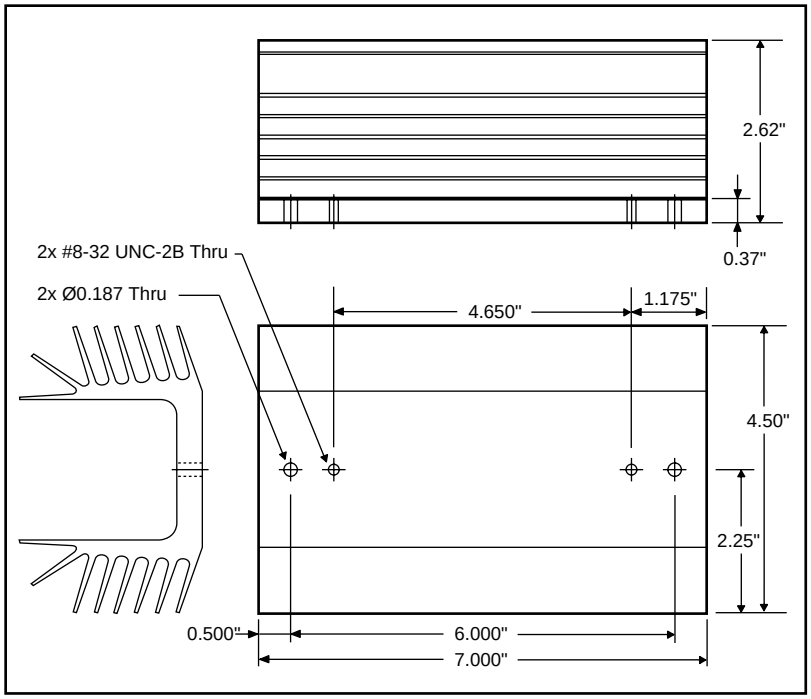


Figure 2-16. OEM-HS2 Dimensions

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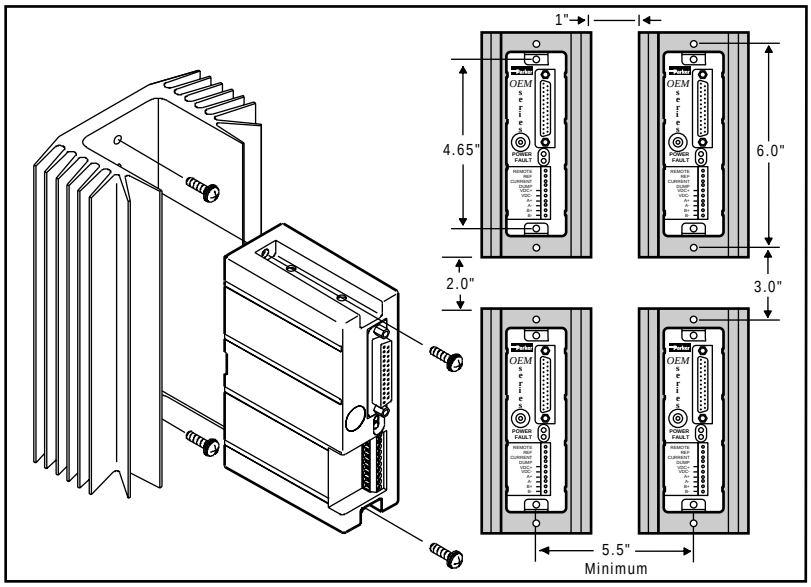


Figure 2-17. OEM650/OEM650X OEM-HS2 Minimum Area Panel Layout

Jumper Functions

Figure 2-1 shows the location and function of the 11 OEM650/ OEM650X jumpers. When the unit is shipped to you, all 11 jumpers are installed. Each jumper's function is defined in this section.

Jumper #1: Motor Current Range

This jumper sets the range of user configurable motor current settings. *Refer to Tables 2-8 and 2-9 for motor current values with jumper 1 installed and removed.*

Jumpers #2 - #5: Motor Resolution

These jumpers control motor resolution (how many steps are in one revolution). *Although higher resolutions typically result in finer positioning and improved low-speed smoothness, it does not necessarily result in improved accuracy.*

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Resolution	*JU2*	*JU3*	*JU4*	*JU5*
50,800 Steps/Rev	on	on	on	off
50,000 Steps/Rev	on	on	off	on
36,000 Steps/Rev	on	on	off	off
25,600 Steps/Rev	on	off	on	on
25,400 Steps/Rev	on	off	on	off
25,000 Steps/Rev *	on	on	on	on
21,600 Steps/Rev	on	off	off	on
20,000 Steps/Rev	on	off	off	off
18,000 Steps/Rev	off	on	on	on
12,800 Steps/Rev	off	on	on	off
10,000 Steps/Rev	off	on	off	on
5,000 Steps/Rev	off	on	off	off
2,000 Steps/Rev	off	off	on	on
1,000 Steps/Rev	off	off	on	off
400 Steps/Rev	off	off	off	on
200 Steps/Rev	off	off	off	off

** Default Setting*

Table 2-10. Motor Resolution Jumper Settings

Your indexer (if you are using an OEM650) and drive should be set to the same resolution. If the drive and indexer's motor resolution settings do not match, commanded accelerations and velocities will not be performed accurately.

Jumpers #6 - #8: Motor Waveform Shape

These jumpers control the shape or waveform of the commanded motor current. Motor waveforms can reduce resonance problems and allow the motor to run smoothly. This function will not operate when the 200-step or 400-step motor resolutions are used.

Motor Waveform	*JU6*	*JU7*	*JU8*
Pure sine	off	off	on
-2% 3rd Harmonic	off	on	off
-4% 3rd Harmonic*	on	on	on
-4% 3rd Harmonic	off	off	off
-4% 3rd Harmonic	off	on	on
-6% 3rd Harmonic	on	off	off
-8% 3rd Harmonic	on	off	on
-10% 3rd Harmonic	on	on	off

** Default Setting*

Table 2-11. Motor Waveform Jumper Settings

Jumpers #9 - #10: Auto Standby

The Automatic Standby function allows the motor to cool when it is not moving. This function reduces the current to the motor when the drive does not receive a step pulse for one second. Full current is restored upon the first step pulse that the drive receives. *Do not use this function in systems that use an indexer and an encoder for position maintenance. If used in this environment, the system will go in and out of the Auto Standby mode.*

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Standby Current	*JU9*	*JU10*
Full Current*	on	on
75% Current	off	on
50% Current	on	off
25% Current	off	off

** Default Setting*

Table 2-12. Auto Standby Jumper Settings

Jumper #11: Auto Test

The Automatic Test function turns the motor shaft slightly less than six revolutions in Alternating mode at 1 rps. The Automatic Standby function and motor resolution settings are disabled when you use the Automatic Test function.

Auto Test	*JU11*
Enabled	off
Disabled*	on

** Default Setting*

Table 2-13. Auto Test Jumper Settings

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Motor Mounting

Rotary stepper motors should be mounted with flange bolts and positioned with the centering flange on the front face. Foot-mount or cradle configurations are not recommended because the motor's torque is not evenly distributed around the motor case and they offer poor registration. Any radial load on the motor shaft is multiplied by a much longer lever arm when a foot mount is used rather than a face flange.

WARNING

Improper mounting can reduce system performance & jeopardize personal safety.

The motors used with the OEM650/OEM650X can produce very large torques. These motors can also produce high accelerations. This combination can shear shafts and mounting hardware if the mounting is not adequate. High accelerations can produce shocks and vibrations that require much heavier hardware than would be expected for static loads of the same magnitude. The motor, under certain profiles, can produce low-frequency vibrations in the mounting structure. These vibrations can cause metal fatigue in structural members if harmonic resonances are induced by the move profiles you are using. A mechanical engineer should check the machine design to ensure that the mounting structure is adequate.

CAUTION

Consult a Compumotor Applications Engineer [800-358-9070] before you machine the motor shaft. Improper shaft machining can destroy the motor's bearings. *Never* disassemble the motor (it will cause a significant loss of torque).

Attaching the Load

This section discusses the main factors involved when attaching the load to the motor. The following three types of misalignments can exist in any combination.

Parallel Misalignment

The offset of two mating shaft center lines, although the center lines remain parallel to each other.

Angular Misalignment

When two shaft center lines intersect at an angle other than zero degrees.

End Float

A change in the relative distance between the ends of two shafts.

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Couplings

The motor and load should be aligned as accurately as possible. Any misalignment may degrade your system's performance. There are three types of shaft couplings: single-flex, double-flex, and rigid. Like a hinge, a single-flex coupling accepts angular misalignment only. A double-flex coupling accepts both angular and parallel misalignments. Both single-flex and double-flex, depending on their design, may or may not accept end-play. A rigid coupling cannot compensate for any misalignment.

Single-Flex Coupling

When a single-flex coupling is used, 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 immediate failure.***

Double-Flex Coupling

Use a double-flexed coupling whenever two shafts are joined that are fixed in the radial and angular direction (angular misalignment). ***Do not use a single-flex coupling with a parallel misalignment; this will bend the shafts, causing excessive bearing loads and premature failure.***

Rigid Coupling

Rigid couplings are generally not recommended. They should be used only if the motor is on some form of floating mounts, which allow for alignment compensation.

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OEM650 Inputs and Outputs

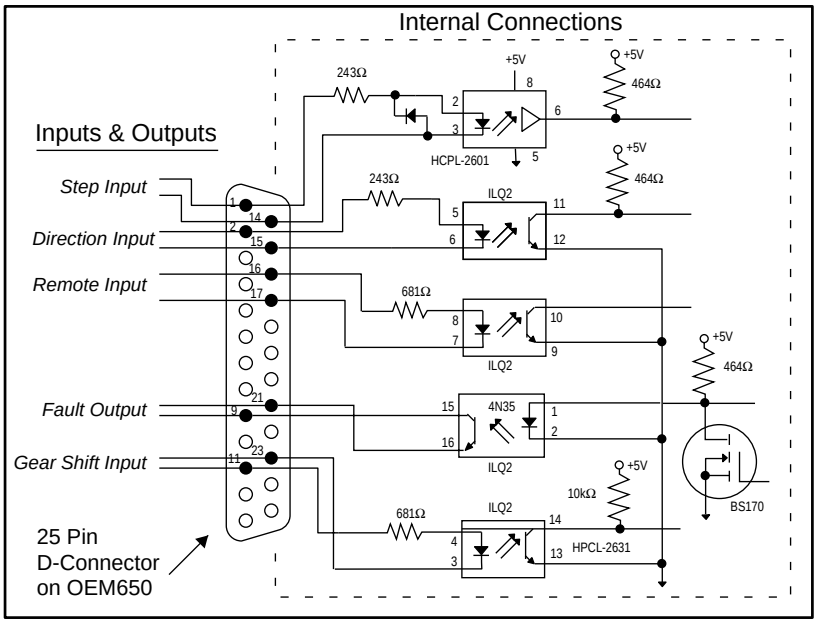


Figure 2-18. OEM650 Inputs & Output Schematic

Step Input Signal Specification

The OEM650's inputs are optically isolated and may be driven (activated) by providing a positive pulse to the plus input with respect to the minus input. This input may also be differentially driven. The input driver must provide a minimum of 6.5 mA—*approximately 3.5 VDC* (15 mA maximum).

Step Pulse Input

Operate the step pulse input within the following guidelines:

- ❏ 200 nanosecond-pulse minimum
- ❏ 40% - 60% duty cycle (2 MHz maximum pulse rate

Direction Input Signal Specification

The OEM650's inputs are optically isolated and may be driven (activated) by providing a positive pulse to the plus input with respect to the minus input. The input may also be differentially driven. The input driver must provide a minimum of 10 mA—*approximately 3.5 VDC*—to ensure adequate operation.

Direction Input

The direction may change polarity coincident with the last step pulse. The direction input must be stable for at least 120 µsec before the drive receives the first pulse.

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Remote Input

The Remote input is an optically isolated input that uses an ILQ2 quad OPTO isolator. The REMOTE+ terminal is connected to the anode of the OPTO lead via a 681Ω current limiting resistor. The REMOTE- terminal is connected to the cathode of the OPTO lead. The OPTO requires a minimum of 3.5 mA (≈3.5VDC) to ensure proper system operation.

This input allows you to reduce current to a motor from a remote location. This is accomplished by changing the current select resistor via the remote input. When the remote input is enabled, the open collector transistor connected to the REMOTE screw terminal will conduct to ground. If the CURRENT and REMOTE terminals are shorted together (with a wire) motor current will be reduced to zero.

Motor current can also be reduced by a percentage if CURRENT and REMOTE are shorted with the appropriate resistor. A remote motor current value must be selected (see Table 2-8) to set the operating current. Identify the current resistor associated with the operating current you select. Use the resistor values to determine the remote resistor that must be installed between the CURRENT and REMOTE terminals. Use the following equation to detemine R_{REMOTE}.

$$R_{REMOTE} = -13{,}300\ (3650 + R_C)\ /\ (R_C - R_S)$$

R_C = Resistor associated with the operating current
R_S = Resistor associated with the desired standby current

Fault Output

This output is an open-collector, open emitter output from a ILQ2 OPTO isolator. The output transistor will conduct when the drive is functioning properly. The transistor will not conduct properly when any of the following conditions exist.

- ❏ No power is applied to the drive
- ❏ There is insufficient voltage (<24VDC)
- ❏ The driver detects a motor fault
- ❏ The remote input is enabled

This output has the following electrical characteristics:

- ❏ V_{CE} = 35VDC
- ❏ V_{CESAT} = 0.3VDC
- ❏ Collector Current = 10 mA maximum
- ❏ Dissipation = 100 mW maximum

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Gear Shift Input

The Gear shift input is an optically isolated input that uses and ILQ2 quad OPTO isolator. The GS+ terminal is connected to the anode of the OPTO lead via a 681Ω current limiting resistor. The GS- terminal is connected to the cathode of the OPTO lead. The OPTO requires a minimum of 3.5 mA (approximately 3.5VDC) to ensure proper system operation.

This function allows a user with a limited frequency generator to achieve higher velocities while using high resolution settings. This is accomplished by the drive multiplying each step pulse that it receives by a factor of 8. This function may be invoked *on-the-fly*; however, to prevent stalling and to keep track of motor position, it should only be invoked when the motor is not moving.

OEM650X Inputs and Outputs

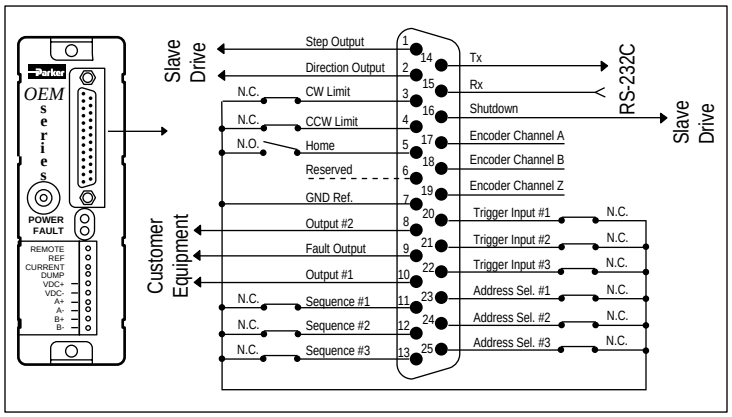
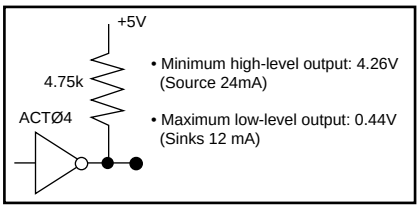


Figure 2-19. OEM650X Inputs & Output Schematic

CAUTION

I/O is not OPTO isolated, I/O GND is common to VDC-.

Step (Signal 1) & Direction (Signal 2) Outputs

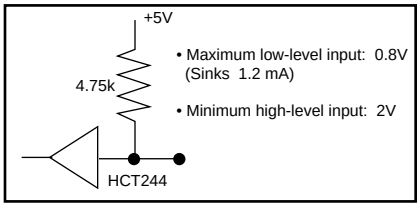


The OEM650X produces a step and direction output that is identical to the indexer's internal step and direction signals. These outputs can be used to slave to another drive or to monitor the OEM650X's position and velocity. The Direction output's default state is logic high. The Step output's default state is a high, pulsing low output. The figure represents a typical configuration of this output.

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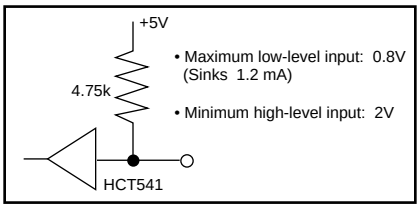
CW (Signal 3) & CCW (Signal 4) Limit Inputs

The OEM650X has two dedicated hardware end-of-travel limits (CCW and CW). When you power up the OEM650X, these inputs are enabled (high). To test the OEM650X without connecting the CCW and CW limits, you must disable the limits with the **LD3** command. You can use the Limit Switch Status Report (**RA**) and Input Status (**IS**) commands to monitor the limits' status. The figure represents a typical configuration of these inputs.



Home Position Input (Signal 5)

The OEM650X has one dedicated home input. The Home Limit input allows you to establish a home reference input. This input is not active during power-up. Refer to the Go Home command for more information on setting up and using this function. The figure represents a typical configuration of this input. (Refer to the **OS** and **GH** commands.)

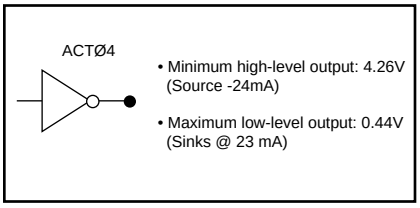


Reserved (Signal 6)

This signal cannot currently be used to perform any function in this release of the OEM650X. Additional functionality may be provided in future revisions.

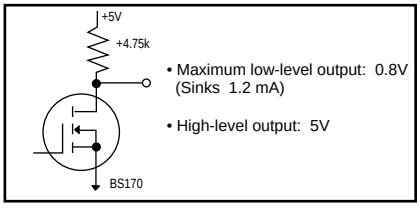
Output #1 (Signal 10) and Output #2 (Signal 8)

The OEM650X has two dedicated programmable outputs. They may be used to signal peripheral devices upon the start or completion of a move. The default state for Outputs #1 and #2 is logic low. The figure represents a typical configuration of these outputs. (Refer to the **O** command.)



Dedicated Fault Output (Signal 9)

The OEM650X has one dedicated fault output**.** This output may be used to signal peripheral devices if a unit failure occurs. The Fault output's default state is logic high. The figure represents a

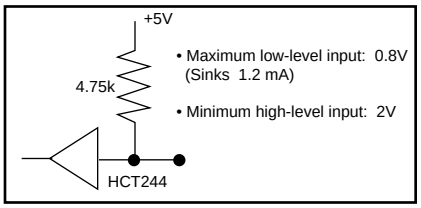


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typical configuration of this output.

Sequence Inputs #1 - #3 (Signals 11 - 13)

The OEM650X has three dedicated sequence inputs that allow you to control seven different sequences. Refer to the **X** commands for information on how to control these inputs. Sequence #Ø is not a valid sequence.



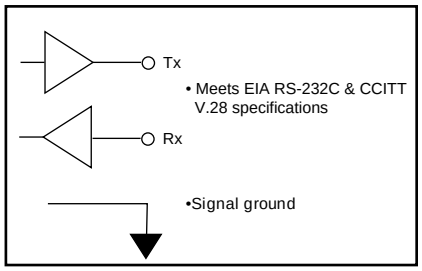
Sequences are executed remotely by using one of the following logic patterns. (1 represents a +5V signal, Ø represents a ØV signal.)

Sequence #	Ø	1	2	3	4	5	6	7
SEQ Input #1	Ø	1	Ø	1	Ø	1	Ø	1
SEQ Input #2	Ø	Ø	1	1	Ø	Ø	1	1
SEQ Input #3	Ø	Ø	Ø	Ø	1	1	1	1

The figure represents a typical configuration of these outputs.

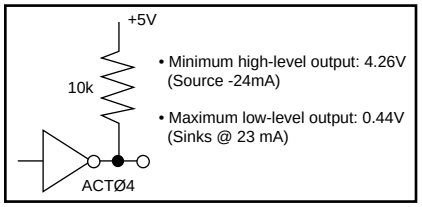
RS-232C—Tx (Signal 14), Rx (Signal 15), and Ground (Signal 7)

The OEM650X uses RS-232C as its communication medium. This indexer does not support handshaking. A typical three-wire (Rx, Tx, and Signal Ground) configuration is used). The figure represents a typical RS-232C configuration.



Shutdown Output (Signal 16)

The OEM produces a Shutdown output that is identical to the indexer's internal signal. This output may be used to slave to another drive or to monitor the OEM650X. The Shutdown output's default state is logic high. The figure represents a typical configuration of this output. (Refer to the **ST** command.)



Closed Loop Operation

Closed loop moves require an external encoder to provide position correction signals. Motor position may be adjusted to reach the desired position. To implement the closed loop functions, you must

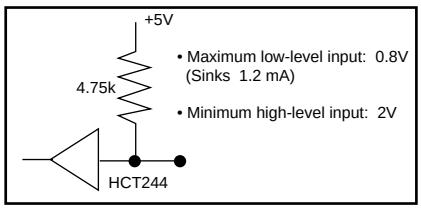
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connect a single-ended, incremental, optical encoder to the OEM650X. When an encoder is used, the following functions will be added to the system:

- ❏ Encoder referenced positioning
- ❏ Encoder position servoing
- ❏ Motor stall detection
- ❏ Higher accuracy homing function
- ❏ Multi-axis stop (also available without an encoder—see FSF in command reference)

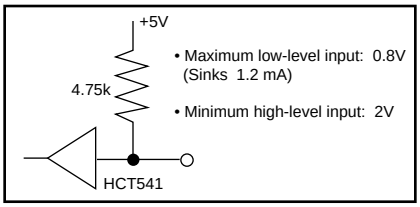
Encoder Inputs A, B, Z (Signals 17-19)

The OEM650X has three dedicated inputs for use with a single ended incremental encoder. These inputs in conjunction with the **FS** commands will determine the encoder functionality.



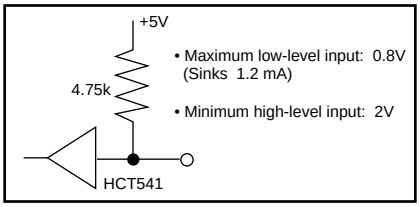
Trigger Inputs #1 - #3 (Signals 20 - 22)

The OEM650X has three dedicated Trigger inputs. These inputs are pulled up internally. These inputs are used with the Trigger (**TR**) command to control the OEM650X's trigger function. The figure represents a typical configuration of these inputs.



Address Signals #1 - #3 (Signals 23 - 25)

The OEM650X has three dedicated address inputs that allow you to specify a unique address for each OEM650X in your configuration. Units may be assigned a valid address from 1 to 8. Each unit in the configuration must have a unique address. The default address is 8 (all three inputs are internally pulled up. The address inputs are read only during power-up and when Restart (**Z**) commands are issued. Use the matrix below to assign unique address values. (Refer to the **#** command for more information.)



Address #	8	7	6	5	4	3	2	1
Address #1	Ø	1	Ø	1	Ø	1	Ø	1
Address #2	Ø	Ø	1	1	Ø	Ø	1	1
Address #3	Ø	Ø	Ø	Ø	1	1	1	1

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Daisy Chaining

You may daisy chain up to 8 OEM650Xs. Individual drive addresses are set with signals 23, 24, and 25 on the 25-pin D connector. When daisy chained, the units may be addressed individually or simultaneously. You should establish a unique device address for each OEM650X. Refer to Figure 2-20 for OEM650X daisy chain wiring.

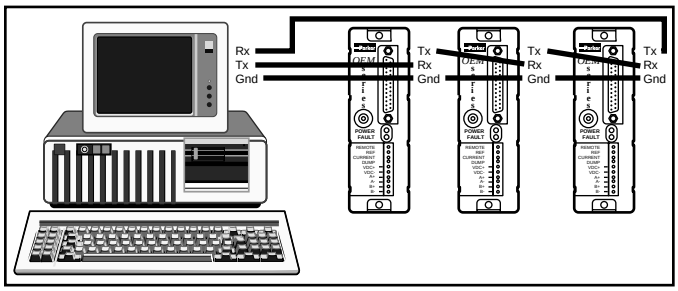


Figure 2-20. Daisy Chain Configuration

Commands prefixed with a device address control only the unit specified. Commands without a device address control all units on the daisy chain. The general rule is: *Any command that causes the drive to transmit information from the RS-232C port (such as a status or report command), must be prefixed with a device address.* This prevents daisy chained units from all transmitting at the same time.

Attach device identifiers to the front of the command. The Go (**G**) command instructs all units on the daisy chain to go, while **1G** tells only unit #1 to go.

When you use a single communications port to control more than one OEM650X, all units in a daisy chain receive and echo the same commands. Each device executes these commands, unless this command is preceded with an address that differs from the units on the daisy chain. This becomes critical if you instruct any indexer to transmit information. To prevent all of the units on the line from responding to a command, you must precede the command with the device address of the designated unit. No OEM650X executes a device-specific command unless the unit number specified with the command matches the OEM650's unit number. Device-specific commands include both buffered and immediate commands.

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Sizing Power Supply

Table 2-14 contains power ratings to help system designers size a power supply. Combinations of motors and current levels other than those shown may result in power values that are not recommended.

Connection

OEM57 motors may be configured in parallel or series. OEM83 motors must be wired in parallel. Refer to the OEM650 Quick Test.

Motor Size (@75VDC)	Motor Current	Motor Heat + Avg. Shaft Power	Drive Heat	Supply Total**
OEM57-40-MO**S**	2.65A	56 Watts	9 Watts	65 Watts
OEM57-40-MO**P**	5.3A	56 Watts	19 Watts	75 Watts
OEM57-51-MO**S**	3.3A	75 Watts	11 Watts	86 Watts
OEM57-51-MO**P**	6.6A	75 Watts	25 Watts	100 Watts
OEM57-83-MO**S**	3.8A	86 Watts	13 Watts	99 Watts
OEM57-83-MO**P**	7.5A	86 Watts	31 Watts	117 Watts
OEM83-62-MO*****	4.4A	113 Watts	15 Watts	128 Watts
OEM83-93-MO*****	5.6A	133 Watts	20 Watts	153 Watts
OEM83-135-MO*****	6.9A	155 Watts	27 Watts	182 Watts

S: Series Configuration P: Parallel Configuration

** 34 size motors are internal wired in Parallel ** User must supply this level of wattage*

Table 2-14. Power Sizing

Use the following equation to determine drive heat.

Drive Heat (Watts) = (0.31) (I_M^2) + (1.13 I_M) + 3 I_M = *Motor Current*

Calculations

- ❑ To convert watts to horsepower, **divide by 746**
- ❑ To convert watts to BTU/hour, **multiply by 3.413**
- ❑ To convert watts to BTU/minute, **multiply by 0.0569**

Motor Type

OEM650/OEM650X motors are custom-made for use with these drives and drive/indexers. They are not available as a standard model from any other manufacturer. These motors are designed for low loss at rest and at high speed. Motors in the same frame size from other manufacturers may sustain considerably higher iron losses than an OEM650/OEM650X motor. OEM motors are wound to render inductances within a range suitable for OEM Series products. If you do not use an OEM Series motor, you should consult Compumotor's Applications Engineering Department for assistance (800-358-9070). OEM650s/OEM650Xs are designed to run 2-phase PM step motors only. Do not use variable reluctance or DC motors.

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Current (Amps)

Compumotor has assigned the values shown in Table 2-14 for OEM Series motors to produce the highest possible torque, while maintaining smoothness. Higher currents will produce higher static torque; but, the motor will run roughly and may overheat. Do not run the parallel rated current into a motor that is wired in series—it will destroy the motor's windings.

Power Dump

This drive has built-in power dump circuitry to monitor power supply surges caused by a regenerative load. The power dump circuit is used in conjunction with an externally mounted power resistor. The circuitry effectively closes a switch to ground when the power supply voltage exceeds 85VDC. This switch terminal is at the screw terminal labeled **DUMP**. The power dump feature dissipates the energy created by a regenerative load (100 joules maximum). *The power dump is not designed to protect the unit from overvoltage caused by a poorly regulated or faulty power supply.* A 35Ω, 10 watt power resistor (such as a Dale RH-10) is the recommended power dump resistor. The resistor must be adequately heat sunk to meet its rated wattage. The power dump resistor must be connected between the **DUMP** and **VDC+** screw terminals.

CAUTION

Never allow the voltage supplies by the power supply to exceed 80VDC. Damage to the power dump resistor may result.

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3 Tuning & Specifications

Chapter Objectives

The information in this chapter will enable you to:

- ❏ Tune and operate your system at maximum efficiency.
- ❏ Use the information to compare system performance with different motor, power, and wiring configurations (speed/torque curves).

Short-Circuit Protection

The OEM Series is protected against phase-to-phase and phase-to-ground short circuits. The drive is designed to withstand short circuits during initial power up. Short circuits that occur while the motor is operating may damage the drive. Never short circuit the motor leads for motor braking.

Resonance

Resonance exists in all stepper motors and is a function of the motor's mechanical construction. It can cause the motor to stall at low speeds. Most full step motor controllers *jump* the motor to a set minimum starting speed that is greater than the resonance region. The OEM650X's microstepping capability allows you to operate a motor smoothly at low speeds.

Motors that will not accelerate past 1 rps may be stalling due to resonance. You can add inertia to the motor shaft by putting a drill chuck on the shaft. The drill chuck may provide enough inertia to test the motor when it is not loaded. In extreme cases, a viscous damper may also be needed.

Mid-Range Instability

All step motors are subject to mid-range instability, also referred to as parametric oscillations. These oscillations may stall the motor at speeds from 6 to 16 rps.

Tuning Procedures

You can tune the OEM650X to minimize resonance and optimize smoothness by adjusting the small potentiometers (pots) on the top of the unit. Figure 3-1 shows the location of the potentiometers and their functions.

- ❏ Phase A Offset: Adjusts DC offset of the phase current for Phase A.
- ❏ Phase B Offset: Adjusts DC offset of the phase current or Phase B.

Since tuning is affected by operating current, you may have to adjust these pots during the configuration or installation process. *For best*

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results, the drive and motor should be on, connected to the load, and warmed up for 30 minutes prior to tuning.

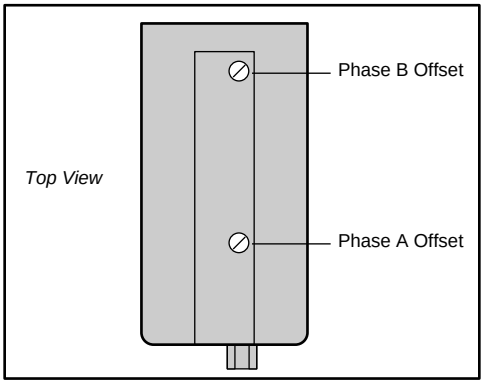


Figure 3-1. Tuning Potentiometers

Gauging Motor Resonance

There are several methods that you can use to determine the level of motor resonance in your system.

Tachometer Method

Use an oscilloscope to gauge the output of a tachometer attached to the motor shaft. The tachometer will output a DC voltage, proportional to speed. This voltage will oscillate around an average voltage when the motor is resonating. The amplitude of this oscillation will be at its maximum when you run the motor at its *resonance speed*. The goal of this tuning method is to tune the motor for its lowest oscillation amplitude.

Sounding Board Method

You can practice your tuning skills with an unloaded motor placed on a sounding board or table. When you command a velocity that is near the motor's *resonance speed*, the phenomenon will cause an audible vibration. The goal of this tuning method is to tune the motor for the least amount of vibration.

Stethoscope Method

When you tune your motor under loaded conditions, you can hear the audible vibration caused by the motor's natural frequency by placing the tip of a screw driver against the motor casing and placing the handle of the screw driver close to your ear (as you would a stethoscope). You will also be able to hear the different magnitudes of vibration caused by the motor's natural frequency. The goal of this tuning method is to tune the motor for the least amount of vibration.

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Touch Method

After you have had some experience with tuning, you should be able to locate the motor's ***resonance speed*** by placing your fingertips on the motor shaft and adjusting the motor's velocity. Once the ***resonance speed*** is located, you can tune the motor for maximum smoothness in the same way.

Tuning the Drive to the Motor

To tune the OEM650X, follow the directions below:

1. Command the drive (via RS-232C or STEP & DIRECTION inputs) so that the motor is running at maximum roughness, as shown in Table 3-1 for the 1st speed motor resonance.

Motor Size	*1st Speed Resonance*	*2nd Speed Resonance*
OEM57-40-MO	1.8 rps	3.6 rps
OEM57-51-MO	1.8 rps	3.6 rps
OEM57-83-MO	1.8 rps	3.6 rps
OEM83-62-MO	1.4 rps	2.8 rps
OEM83-93-MO	1.4 rps	2.8 rps
OEM83-135-MO	1.4 rps	2.8 rps

Table 3-1. Motor Resonance for Unloaded Motors

2. Adjust Offsets A and B for best smoothness.
3. Double the motor speed (2nd speed resonance) until the motor runs rough again.
4. Adjust offsets A and B again for best smoothness.
5. Repeat above steps until no further improvement is noted.

Motor Waveforms

Step motor manufacturers make every effort to design step motors that work well with sinusoidal current waveforms. However, due to physical limitations, most motors operate best with a current waveform other than a pure sine wave.

The purpose of adjusting motor current waveforms is to cause the step motor to move with equal step sizes as the current waveforms are sequenced through the motor. This *waveform matching* will also help the motor run more smoothly. This can be changed with jumpers 6-8 (refer to Table 2-11).

Motor waveforms are usually adjusted after the drive has been tuned to its motor. If you do not have precision measurement equipment, you may select the correct motor waveform with one of the three methods described previously in this chapter (Tachometer Method, Sounding Board Method, Stethoscope Method, and Touch Method). These empirical methods generally yield acceptable results.

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Performance Specifications

Accuracy

±5 arcminutes typical (unloaded, bidirectional) with OEM Series motors.

Repeatability

±5 arcseconds typical (unloaded, bidirectional).

Hysteresis

Less than 2 arcminutes—0.0334° (unloaded, bidirectional).

Rotor Inertia

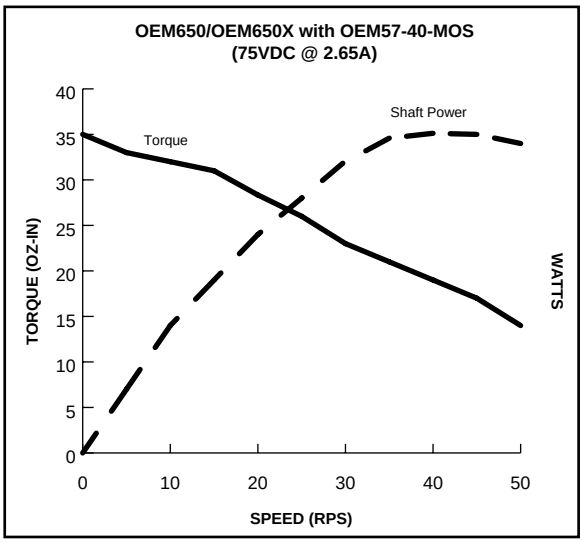
Motor Size	*Rotor Inertia oz-in²*	*Rotor Inertia Kg-cm²*
OEM57-40-MO	0.38	0.07
OEM57-51-MO	0.65	0.12
OEM57-83-MO	1.36	0.25
OEM83-62-MO	3.50	0.64
OEM83-93-MO	6.70	1.23
OEM83-135-MO	10.24	1.87

Table 3-2. Rotor Inertia—OEM Series Motors

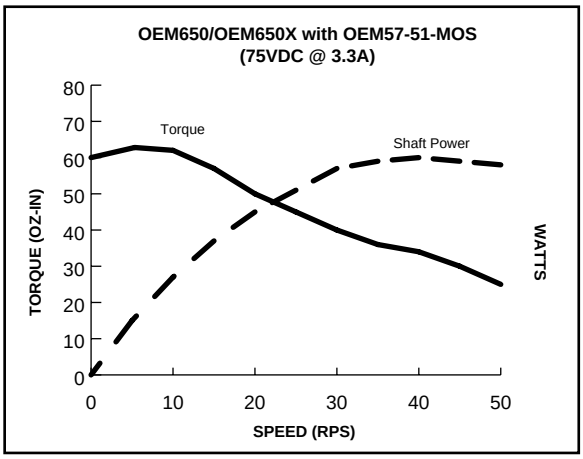
Motor Performance

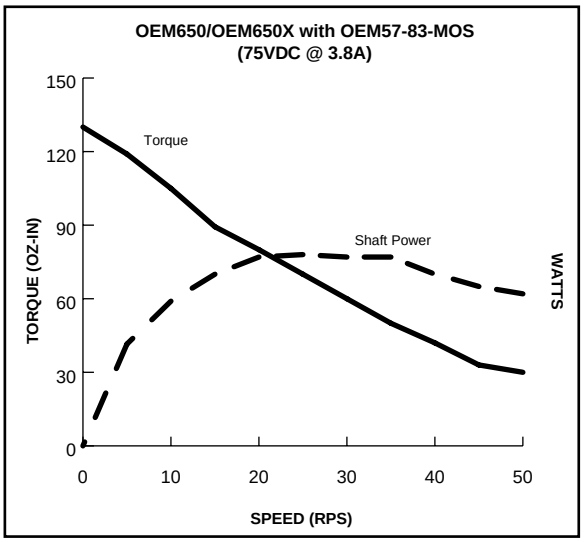
The performance (speed/torque) curves in this section show that different levels of performance can be achieved by wiring your motor in series or parallel and the power supply used to run the system. Size 34 motors are internally wired in parallel and can only be operated in this configuration.

OEM57 Motors (Series Configuration)



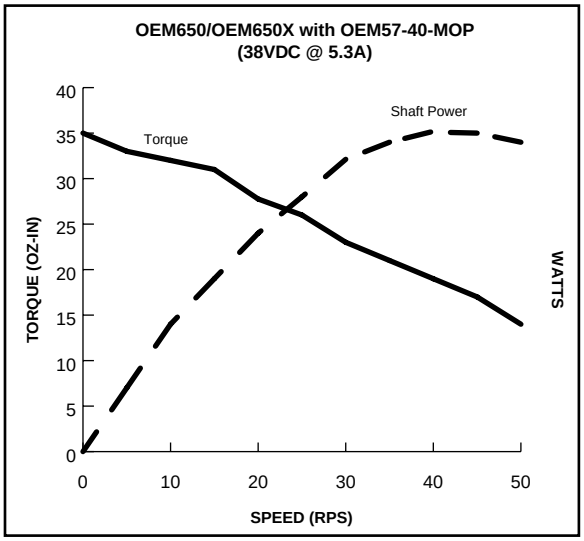
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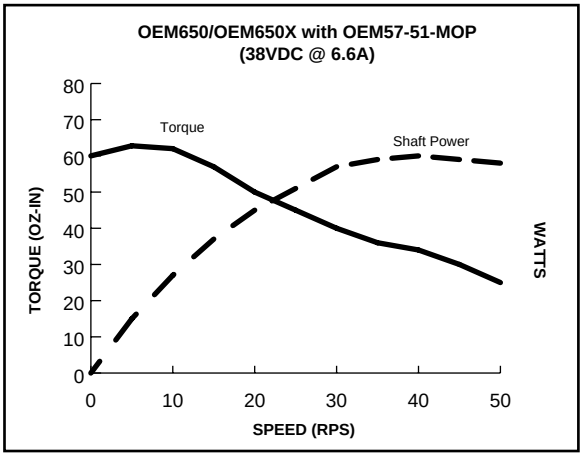




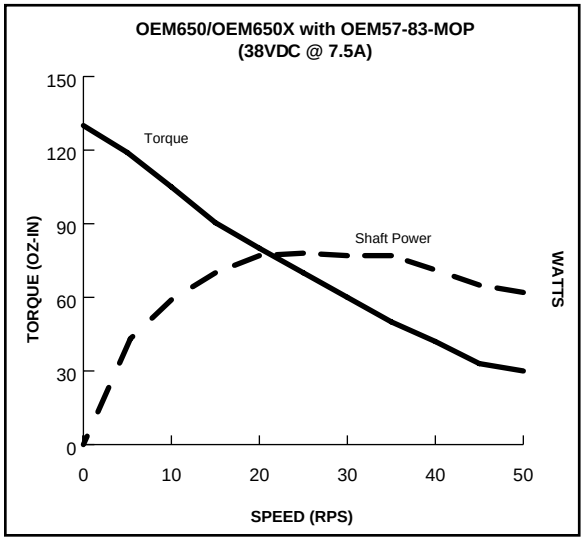
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OEM57 Motors (Parallel Configuration)

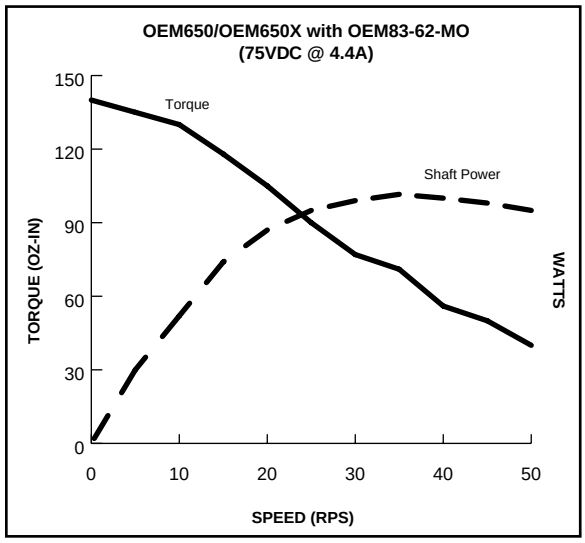




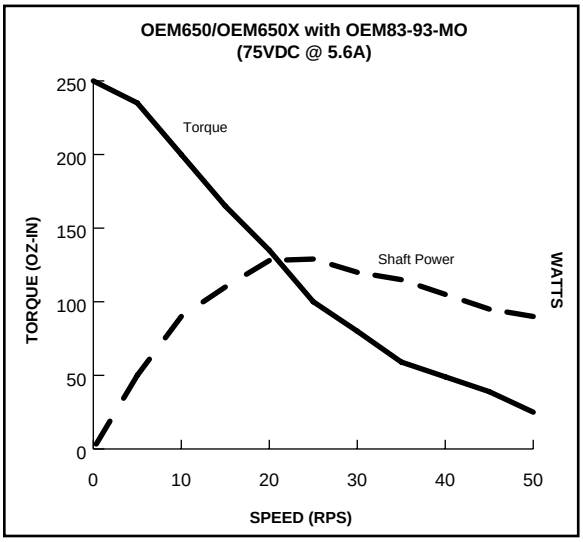
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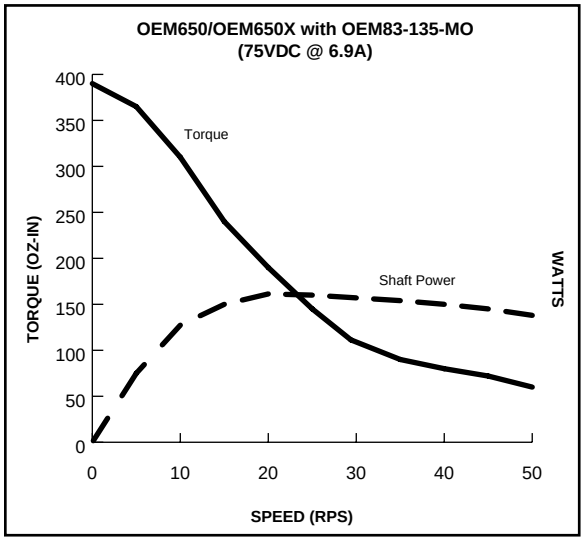


OEM83 Motors



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4 Troubleshooting

Chapter Objectives

The information in this chapter will enable you to:

❏ Maintain the system to ensure smooth, efficient operation
❏ Isolate and resolve system problems

Drive Maintenance

Ensure that the drive's heatplate has proper thermal contact with the mounting surface. Enclosures must be connected to earth ground through a grounding electrode conductor to provide a low-impedance path for ground-fault or noise-induced currents (use a star washer with the lower mounting screw on the drive). All earth ground connections must be continuous and permanent. Periodically check the mounting screws to ensure they are tight.

Motor Maintenance

Inspect the motor regularly to ensure that no bolts or couplings have become loose during normal operation. This will prevent minor problems from developing into more serious problems.

Inspect the motor cable periodically for signs of wear. This inspection interval is duty-cycle, environment, and travel-length dependent. The cable should not have excessive tensile force applied to it and should not be bent beyond a one-inch radius of curvature during normal operation. Tighten all cable connectors.

Reducing Electrical Noise

For detailed information on reducing electrical noise in your system, refer to the current Compumotor Catalog.

Problem Isolation

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 accomplish this, you can effectively begin to resolve and eradicate 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 use them to replace existing components in your system to help identify the source of the problem.

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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 may not be contributing factors to your problem. Investigate the events that occur before the subsequent system problem.

You may be experiencing more than one problem. You must solve one problem at a time. 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 isolate the problem, take the necessary steps to resolve it. Use the solutions in this chapter. If your system's problem persists, call Compumotor at 800-358-9070.

Front Panel LEDs

There are two LEDs on the front panel of the OEM650/OEM650X (refer to Figure 5-1).

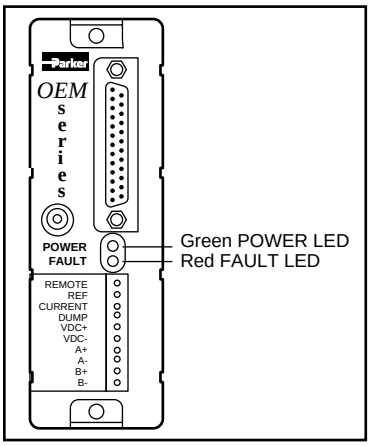


Figure 5-1. OEM650/OEM650X LEDs

The FAULT LED is red and turns on when the amplifier is disabled. This LED is activated when any of the following conditions occur:

- ❏ Motor short circuit detected
- ❏ Drive over-temperature
- ❏ Motor winding open
- ❏ Internal fault detected

The POWER LED is green and turns on when the internal bias supply is operating and providing +5V.

Common Problems and Solutions

The following table will help you eradicate most of the problems you might have with the OEM650/OEM650X.

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Power LED is not on (illuminated)	The drive is not receiving adequate DC voltage	Verify the VDC+ and VDC- connection Verify you power supply is producing adequate power Verify that there is DC voltage at the drive and at the VDC+ and VDC- connection
	Drive screw are terminals loose	Tighten screws—do not tin wires
Power LED is flashing	DC Line voltage is too low I/O incorrectly connected	Check DC line voltage (24VDC minimum)
	Internal damage to the drive	Remove 25-Pin D connector to isolate the problem Return drive to Compumotor for servicing
There is little or no holding torque; the power LED is on; the motor fault LED is off	The current select resistor is not installed or loose	Check for current select resistor, tighten screws, check wiring
	The incorrect current select resistor is being used	Verify the current selector resistor with the current table—measure the resistor with an ohmmeter
	Jumper #1 removed and you want between 7.5A - 2.5A	Install Jumper #1. Double check the desired resistor value
	Remote input activated	Remove 25-pin D connector to isolate the problem
	Auto standby function enabled	Check jumpers #9 and #10
The motor fault LED is on	The motor is not connected	Connect the motor
	A motor winding is open	Measure winding continuity—check the series connections for an 8-leaded motor
	The drive has detected a short circuit in the motor wiring	Check for miswiring—carefully check the motor wires for loose strands shorting the windings
	The drive is overheating	Verify that the drives heatsink does not exceed 55°C
	The drive may have internal damage	Return the drive to Compumotor for servicing
The motor moves erratically at low speeds	Motor current is set incorrectly	Check the current select resistor and verify that the current is set correctly
	Indexer pulses are being sent to the drive erratically	Verify, with an oscilloscope, that the indexer pulses are being sent at a constant rate and are not being frequency modulated
	Motor resolution is set for 200 or 400 steps per revolution	Full and half step modes will cause the motor to run roughly at low speeds

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The drive loses pulses at high speed	Indexer is overdriving step input	Verify that the step input current is not greater than 15 mA
	Indexer is underdriving step input	Verify that the step input current is greater than 6.25 mA
	Indexer is sending pulses too fast	Verify that the indexer is not exceeding the 2 MHz maximum pulse rate
	Motor is out of torque	Verify that the motor is sized correctly for your application
The motor stalls at high speeds	The velocity is too high	The drive can handle a maximum pulse rate of 2 MHz or 50 rps, whichever comes first—decrease the velocity
	Motor current is not set correctly	Check the current select resistor and verify that the current is set correctly
	Motor is undersized for application	Verify that the motor is sized correctly for your application
The motor stalls during acceleration	Motor current is not set correctly	Check the current select resistor and verify that the current is set correctly
	The acceleration is set too high	Decrease the acceleration
	There is insufficient rotor inertia	Add inertia to the motor shaft
	Motor is undersized for application	Verify that the motor is sized correctly for your application
The motor (unloaded) stalls at nominal speed	There is insufficient rotor inertia	Add inertia to the motor shaft
	Mid-frequency resonance	Add a damper to the shaft
Motor does not move commanded distance	Motor resolution is set incorrectly	Determine the resolution on your indexer and verify that the drive resolution setting is the same
Motor will not change direction as commanded	The direction input is not being enabled	Verify that the direction input is being enabled (6.4 mA to 15 mA)
Indexer moves motor in wrong direction	There is a direction conflict within the indexer	Change direction within your indexer or by swapping motor leads A+ and A- at the drive connector
When a move is commanded, no motion occurs	A limit may be enabled and active	Check hard limit or disable limits with the LD3 command
	You may be in Absolute mode and are already at the position you are commanding the motor to move to	Try another distance and issue Go (G) command
The unit may appear to not be responding to commands	If you defined a sequence and never issued XT, the OEM650/OEM650X still thinks you are defining a sequence	Issue an XT command at the end of the sequence to end sequence definition
	OEM650X may be off-line (F command)	Issue an E command to bring the unit on-line

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Testing the Motor

If the motor fails to move, you should test the motor with an *ohmmeter* to examine the resistance between the motor connections. If the motor is not malfunctioning, the source of the problem is probably within the drive. If you operate a faulty drive with a reliable motor, you may damage the motor. If you find that the motor is not faulty, remove power, and remove the motor from the drive. Use the following steps to test the motor.

1. Remove power from the system. Detach the motor from the drive.
2. With the motor detached from the system, use an ohmmeter to check the resistance across Phase A. It should be approximately 2 ohms**.**
3. Now use the ohmmeter to check the resistance across Phase B. It should be approximately 2 ohms too (*the resistance across Phase A and Phase B should be nearly identical*).
4. Use the ohmmeter to check the resistance between Phase A and Phase B. **It should be infinite** (∞).
5. Use the ohmmeter to check the resistance between Phase A and Earth (the motor case shaft). **It should be infinite** (∞).
6. Use the ohmmeter to check the resistance between Phase B and Earth (the motor case shaft). **It should be infinite** (∞).
7. Turn the shaft manually**.** There should not be any torque**.**

If the motor responds as described to each of these steps, it is functioning properly. The source of the problem is probably within the drive.

RS-232C Problems

Use the following procedure to troubleshoot communication problems that you may have with the OEM650X.

1. Be sure the host computer's transmit (Tx) wire is wired to the peripheral's receive (Rx) connection, and the host computer's receive (Rx) wire is wired to the peripheral's transmit (Tx) connection. Switch the receive and transmit wires on either the host or peripheral if the problem persists.

CAUTION

OEM650X Rx, Tx, and GND pin outs are not 2, 3, and 7 like most devices.

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2. Confirm that the host and peripheral are configured for the same baud rate, 8 data bits, 1 stop bit, and no parity.

3. Use DC common or signal ground as a reference, not earth ground.

4. Cable lengths should not exceed 50 ft. unless you are using some form of line driver, optical coupler, or shield. As with any control signal, be sure to shield the cable-to-earth ground at one end only.

5. To test the terminal or terminal emulation software and the RS-232C cable for proper three-wire communication, unhook the OEM650X and enter a character. You should not receive an echoed character. If you do, you are in half duplex mode. Connect the host's transmit and receive lines together and send another character. You should receive the echoed character. If not, consult the manufacturer of the host's serial interface for proper pin outs.

Software Debugging Tips

This section offers helpful tips for debugging programs and understanding errors and fault conditions. The OEM650/OEM650X has several tools that you can use to debug a problem in the system. The software tools are listed below:

RA—Limit Switch Status Report
R—Report Status
IS—Input Status Report
BS—Buffer Status Report
B—Buffer Status Report

Returning the System

If your OEM650/OEM650X system is faulty, you must return the drive and motor for replacement or repair. A failed drive can damage motors. If you must return your OEM650/OEM650X to effect repairs or upgrades, use the following steps:

1. Get the serial number and the model number of the defective unit(s), and a purchase order number to cover repair costs in the event the unit is determined by Parker Compumotor to be out of warranty.

2. Before you ship the drive to Parker Compumotor, have someone from your organization with a technical understanding of the OEM650/OEM650X and its application include answers to the following questions:

- What is the extent of the failure/reason for return?
- How long did it operate?
- How many units are still working?

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- How many units failed?
- What was happening when the unit failed (i.e., installing the unit, cycling power, starting other equipment, etc)?
- How was the product 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 sizing (speed, acceleration, duty cycle, inertia, torque, friction, etc.)?
- What was the system environment (temperature, enclosure, spacing, unit orientation, contaminants, etc.)?
- What upgrades are required (hardware, software, user guide)?

3. Call Parker Compumotor's Applications Engineering Department [(800) 358-9070] for a Return Material Authorization (RMA) number. Returned products cannot be accepted without an RMA number.

4. Ship the unit to: Parker Compumotor Corporation
   5500 Business Park Drive
   Rohnert Park, CA 94928
   Attn: RMA # xxxxxxx

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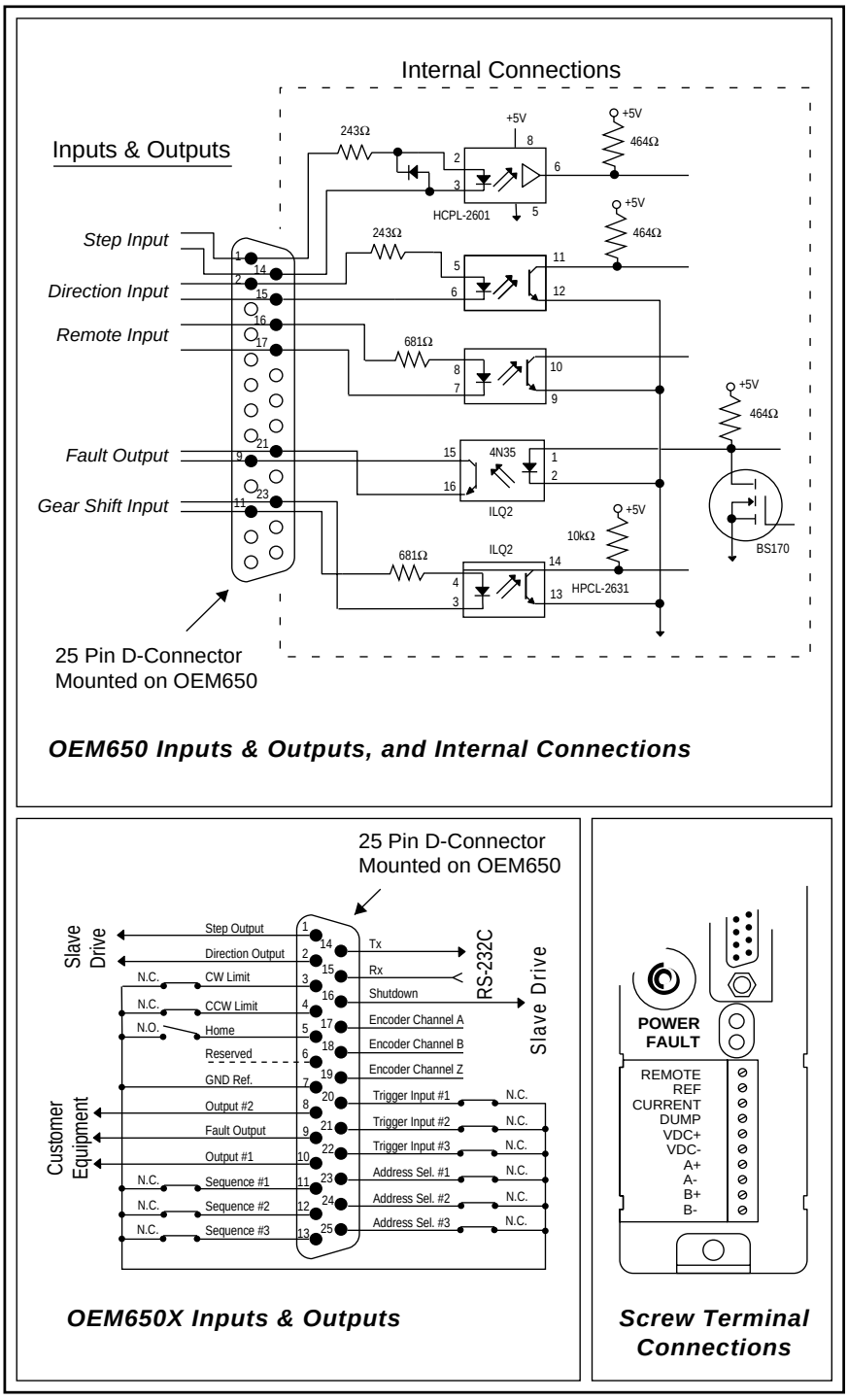
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