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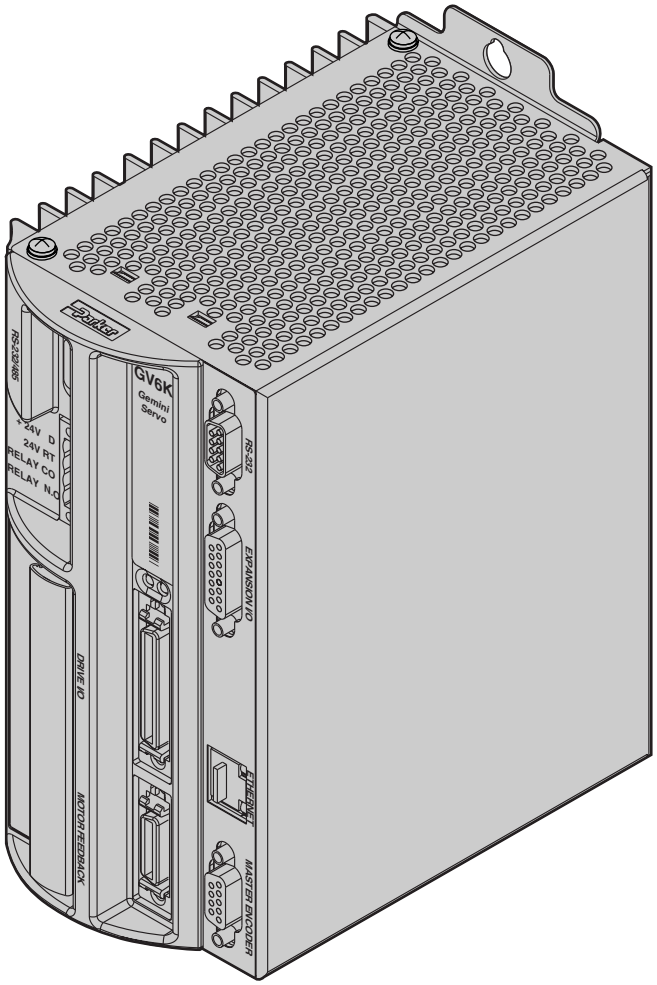
Find the *Parker / Compumotor GV-U3E / GV-U3E-NK* at our website: *Click HERE*

Parker
Automation

p/n 88-019932-01 A

Gemini GV6K and Gemini GT6K Hardware Installation Guide

Effective: October 15, 2001



GV6K-U3 Drive shown

Digital Controller/Drive

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IMPORTANT

User Information

⚠ WARNING ⚠

Gemini 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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Technical Assistance ⇨ *Contact your local automation technology center (ATC) or distributor,* ***or ...***

North America and Asia:
Compumotor Division of Parker Hannifin
5500 Business Park Drive
Rohnert Park, CA 94928
Telephone: (800) 358-9070 or (707) 584-7558
Fax: (707) 584-3793
FaxBack: (800) 936-6939 or (707) 586-8586
e-mail: tech_help@cmotor.com
Internet: http://www.compumotor.com

Europe *(non-German speaking)*:
Parker Digiplan
21 Balena Close
Poole, Dorset
England BH17 7DX
Telephone: +44 (0)1202 69 9000
Fax: +44 (0)1202 69 5750

Germany, Austria, Switzerland:
HAUSER Elektronik GmbH
Postfach: 77607-1720
Robert-Bosch-Str. 22
D-77656 Offenburg
Telephone: +49 (0)781 509-0
Fax: +49 (0)781 509-176

Parker
Automation

Technical Support Email
tech_help@cmotor.com

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CE

Product Type : Gemini GV6K and Gemini GT6K Family of Drives

Including, but not limited to :

GV6K-L3n, GV6K-U3n, GV6-U6n, GV6K-U12n,
GV6K-H20n, GV6K-H40n,
GT6K-L5, GT6K-L8,
GPDM

When installed in accordance with this installation guide, the above products have been demonstrated to be in compliance with the requirements of directives

- 89/336/EEC Electromagnetic Compatibility Directive
  as amended by Directive 92/31/EEC

These products are intended for use in Commercial, Light Industrial and Industrial Environments as defined in the relevant EMC standards.

These products are compliant with the Low Voltage Directive.

- 73/23/EEC Low Voltage Directive
- 93/68/EEC CE Marking Directive

Symbols:


Protective Earth Connection


Earth (Ground) Terminal


Shield, Frame, or Chassis Terminal


Caution, Risk of Electrical Shock


Caution, Refer to Accompanying Documentation

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CHAPTER ONE

1 Introduction

IN THIS CHAPTER

- Gemini Product Overview
- Compatible Compumotor Products

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Gemini Products—Overview

The Gemini Series is a *family* of high performance digital drives. The family contains drives for both stepper and servo motors. With many models and options available, the user can choose the precise level of power and control for the application's motion requirements.

Gemini Product Descriptions

Gemini GT and GV

Gemini GT Stepper Drives and GV Servo Drives are the basic Gemini products. They are controlled with standard command interfaces of step/direction or ±10V, and can be used with standard indexers or controllers.

The drives are configured over RS232/485 with either Motion Planner on a personal computer (PC), or Pocket Motion Planner on a palm PC. Many advanced features are standard in the drives, such as sensorless stall detect and ABS damping in the GT, and digital tuning and notch filters in the GV.

Gemini GT6 and GV6

The Gemini GT6 and GV6 are controller/drives available with several different programming modes. These drives have basic motion control and sequencing capabilities, and can be used in distributed control applications. By using optional plug-in cards, they can be equipped with interfaces for Profibus or DeviceNet.

The GT6 and GV6 are configured and programmed over RS232/485, either with Motion Planner on a PC, or Pocket Motion Planner on a palm PC.

Gemini GT6K and GV6K

The GT6K and GV6K are single axis packaged controller/drives in the Gemini family that offer full 6K Series controller functionality and programmability for complex distributed control applications. Key features include: complex program capabilities such as math, variables, and logic control; flexible and expandable serial I/O modules; and Ethernet compatibility for PC bus access. The user programs these devices over an RS232/485 communication port or Ethernet; a second port is available for use with a full-time operator interface.

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Gemini Product Names

The following table lists the meanings of letters and numbers in Gemini product names. Notice that "T" is associated with step motor products ("sTep"), and "V" is associated with servo motor products ("serVo").

Control Level:

Step Motor Drives and Controller/Drives		Servo Motor Drives and Controller/Drives	
GT	Step Motor Drive	GV	Servo Motor Drive
GT6	6000-based Step Motor Controller	GV6	6000-based Servo Controller
GT6K	6K-based Step Motor Controller	GV6K	6K-based Servo Controller

Power Level:

Step Motor Drives and Controller Drives

L5 120VAC, 5A at 170VDC

L8 120VAC, 8A at 170VDC

Servo Motor Drives and Controller/Drives

L3 120VAC, 3A continuous, 7.5A peak at 170VDC

U3 120/240VAC, single phase, 3A continuous, 7.5A peak at 170/340VDC

U6 120/240VAC, single phase, 6A continuous, 15A peak at 170/340VDC

U12 120/240VAC, single phase, 12A continuous, 30A peak at 170/340VDC

H20 208/240VAC, three phase, 20A continuous, 50A peak at 294/340VDC
(single phase: 16A continuous, 50A peak at 294/340VDC)

H40 208/240VAC, three phase, 40A continuous, 100A peak at 294/340VDC

Amperage values represent continuous current, peak of the sine wave.

"L" = "Low" voltage input (120VAC)

"U" = "Universal" voltage input (120/240VAC)

"H" = "High" voltage input (208/240VAC)

Options:

Data Bus (-db) Option (for GT6 and GV6 only):

DN DeviceNet

PB Profibus

Feedback (-fb) Option (for Servos only):

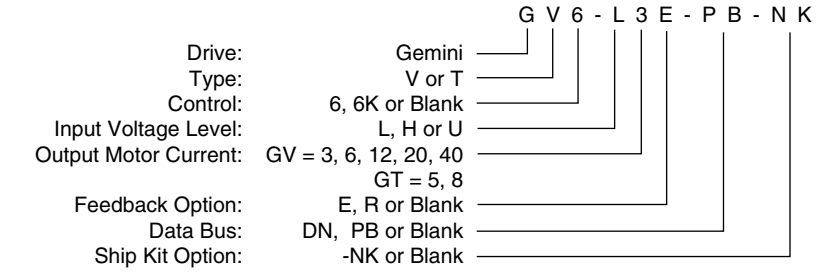
E Encoder/Hall

R Resolver

Ship Kit Options:

NK No Kit

Format:



Format Example

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Names in this Installation Guide: Gem6K = GV6K & GT6K

This *Hardware Installation Guide* describes two product families:

- Gemini GV6K Servo Controller/Drives
- Gemini GT6K Stepper Controller/Drives

In this *Hardware Installation Guide*, when we use the name Gem6K, it will apply to both products. Because most features are identical for the two products, this will usually be the case.

If we need to point out differences between the products, for features that are not identical, we will specifically call the product by its full name—GV6K or GT6K.

Compatible Compumotor Products

Software:	Motion Planner
EVM32-II, EVM32:	I/O Module
Cables, Motors, etc.:	See list at beginning of *Chapter 2 Installation*, in *Appendix A Specifications*, and in the separate *Gemini Motor Reference Manual*.

User Guides

The following items ship with the drive:

Gem6K Quick Start Guide
Gem6K Hardware Installation Guide
Gem6K Command Reference
Gem6K Programmer's Guide
Gemini Motor Reference Manual
Motion Planner CD-ROM

You can also order the drive only, with none of the above items. Specify the *-NK* option ("No Kit").

Motor Information

Information about Compumotor motors is in the separate *Gemini Motor Reference Manual*.

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CHAPTER TWO

2 Installation

IN THIS CHAPTER

- Checking Your Shipment
- Express Setup

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Checking Your Shipment

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

Gemini Drives

GV6K-L3n ("n" can be E or R)
GV6K-U3n
GV6K-U6n
GV6K-U12n
GV6K-H20n
GV6K-H40n

GT6K-L5
GT6K-L8

Ship Kit Items

The following ship with the drive:

Part	Part Number
Gem6K Quick Reference Guide	88-019930-01 (for GV6K); or 88-019931-01 (for GT6K)
Gem6K Hardware Installation Guide	88-019932-01
Gem6K Command Reference	88-019933-01
Gem6K Programmer's Guide	88-019934-01
Gemini Motor Reference Manual	88-017790-01
Motion Planner CD-ROM	95-017633-01

Options and Accessories

You may have ordered one or more of the following options or accessories.

Part	Part Number
EVM32-II or EVM32 Expansion I/O Module	EVM32-II or EVM32
GPDM Gemini Power Dissipation Module	GPDM
Drive Only (no accompanying manuals)	-NK

Cables: various cables, breakout modules, etc., are available. See *Appendix A Specifications* for cable and accessory information.

Cable clamps, EMC filters, ferrites, etc., are available. See *Appendix C Regulatory Compliance* for part numbers and more information.

Motors

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

Servo Motors:
SM Series BE Series NeoMetric Series J Series M Series Linear Series

Step Motors:
O Series T Series E Series*

*E Series motors are similar to S and ZETA Series motors. If you use one of these motors, during configuration select the same size E Series motor from the configuration software's menu.

"Express Setup" Overview

This chapter gives instructions for performing an *express setup*. The purpose of the express setup is to verify that the drive, cables, and motor work properly as a system. It will also verify serial communications.

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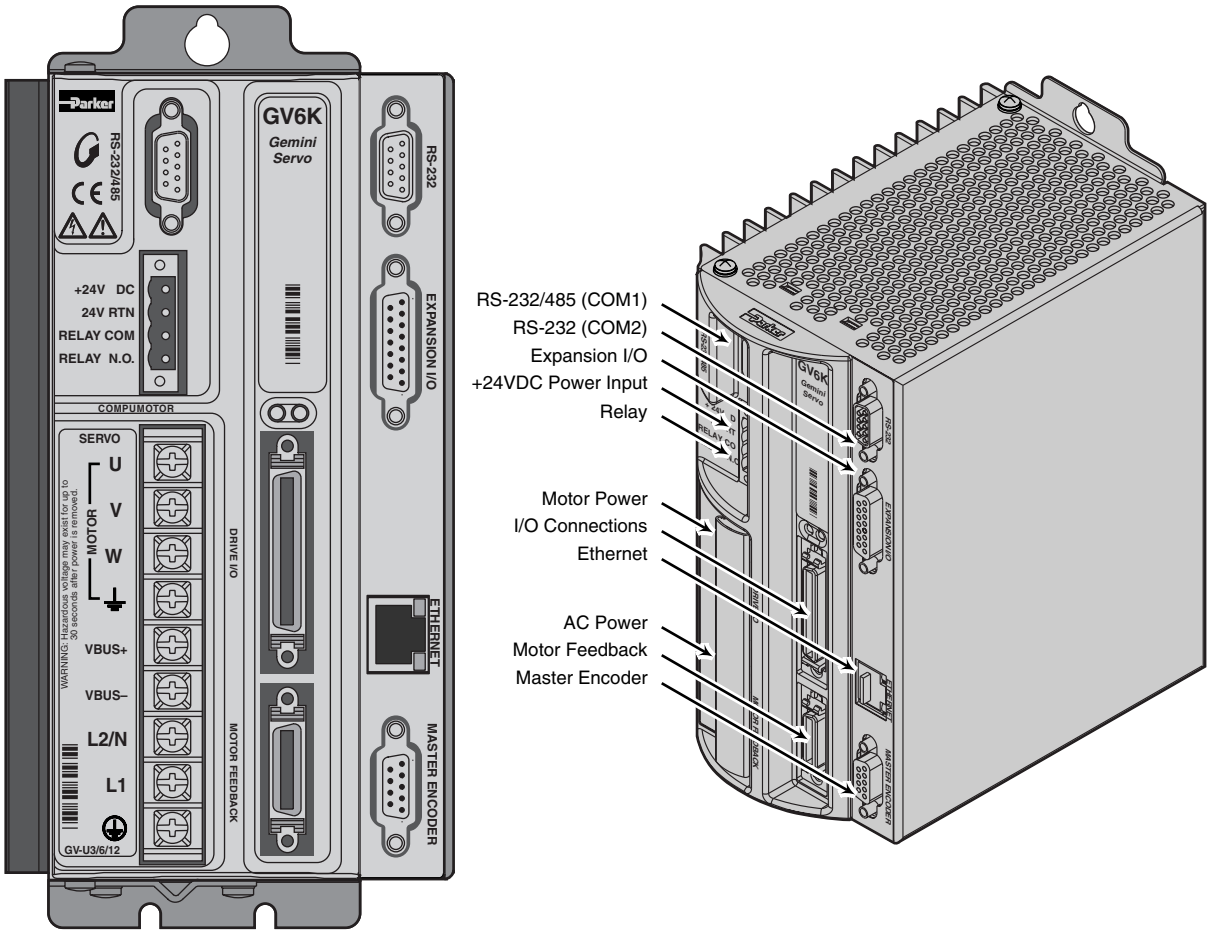
You will connect together only the components necessary to achieve basic motion—a drive, a motor (without a load connected), and cables. You will use a computer to communicate with the drive.

In the express setup, we will give procedures for the following steps:

1. Connecting the motor to the drive (with no load attached)
2. Connecting +24VDC power to the drive
3. Connecting AC power to the drive
4. Establishing communications and configuring the drive for autorun
5. Enabling the drive and observing the motor turn

Information you may need for final installation will be presented in *Chapter 3 Configuration*, in *Chapter 4 Special Features*, in *Appendix A Specifications*, and in the separate *Gemini Motor Reference Manual*.

The next drawing shows locations and names of the Gemini components that you will encounter during the installation procedure.



Component Locations

Illustrations in this Installation Guide

We will usually show the GV6K-U3n Drive in illustrations. Other Gem6K drives have similar features. In cases where we need to illustrate *differences* between drives, we will show relevant drawings for each drive.

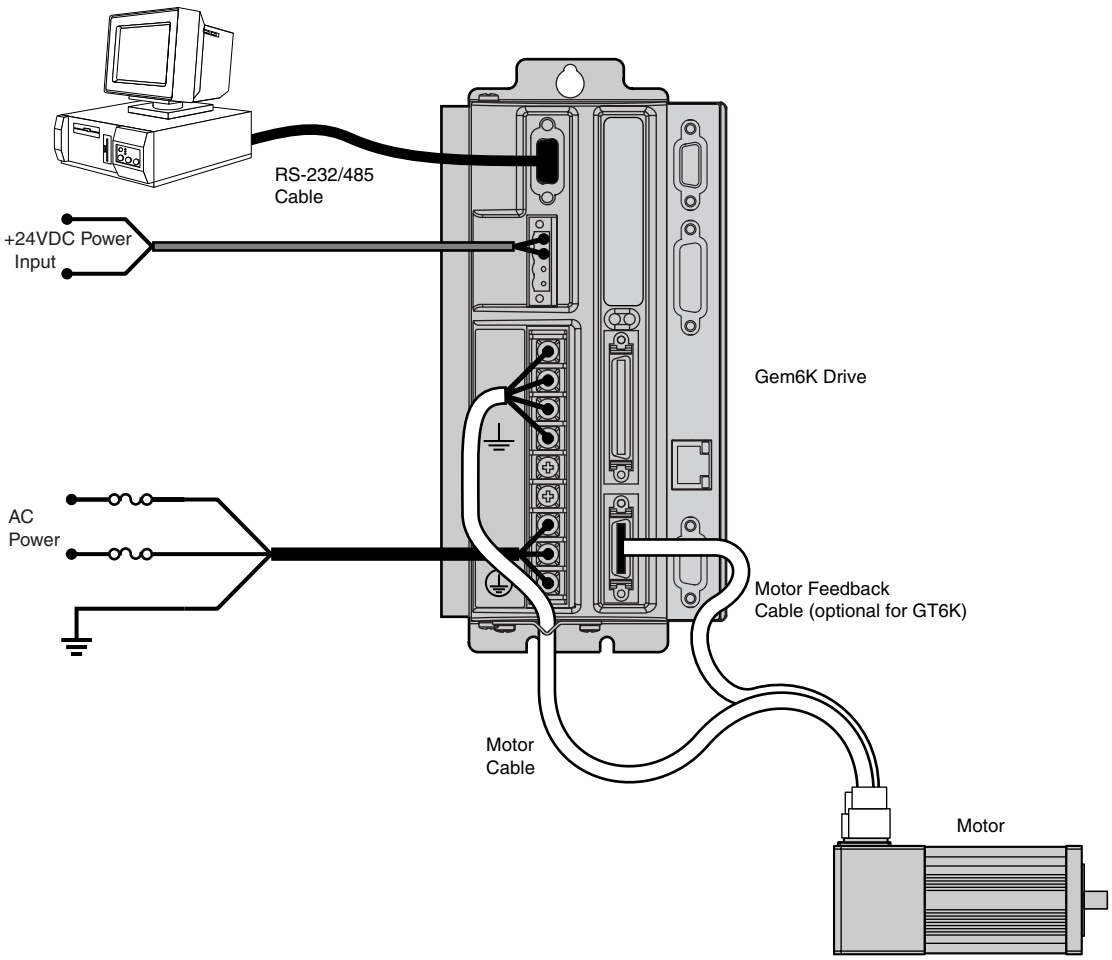
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System Overview

In this express setup procedure, we will give instructions for a Compumotor system—Gem6K drive with Compumotor motor, and Compumotor cables.

If you use non-Compumotor equipment, try to follow along and perform the steps in the Express Setup procedure; consult *Appendix A Specifications* for additional information you may need.

The next drawing shows the components of a Compumotor system.



Compumotor System

Step 1 – Connecting the Motor

GV6K Servos – Motor Connections

Compumotor's motor cable with the GS or GB option has an MS connector on one end. The other end has three black wires with identifying white numbers (1, 2, or 3), and one green/yellow wire. (See the separate *Gemini Motor Reference Manual* for motor specifications, dimensions, speed/torque curves, and wiring diagrams for your particular motor.)

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Connecting the Motor Cable

1. Connect the MS connector on the motor cable to the mating connector on the motor. (If you use a non-Compumotor motor, see *Appendix B* for information.)
2. Remove the clear plastic cover from the drive terminals. Connect the motor cable's green/yellow wire to the drive terminal with the ⏚ symbol. This connects the motor's protective conductor terminal to the drive's safety earth.
3. Connect your motor cable's phase wires 1, 2, and 3 to the drive's U, V, W terminals, respectively, as shown in the drawing below.

WARNING

The drive's barrier strip terminals are at hazardous voltages when power is applied to the drive, and up to 30 seconds after power is removed. Lower voltages may still be present for several minutes after power is removed. Reinstall the clear plastic terminal cover after you make connections.

4. Secure the cable to the drive by placing the exposed cable shield in the saddle clamp on the bottom of the drive (GV6K-H20n/H40n: R-Clamp on heatsink). Make the loop of cable between saddle clamp and drive terminals as short as possible.

Connecting the Motor Feedback Cable

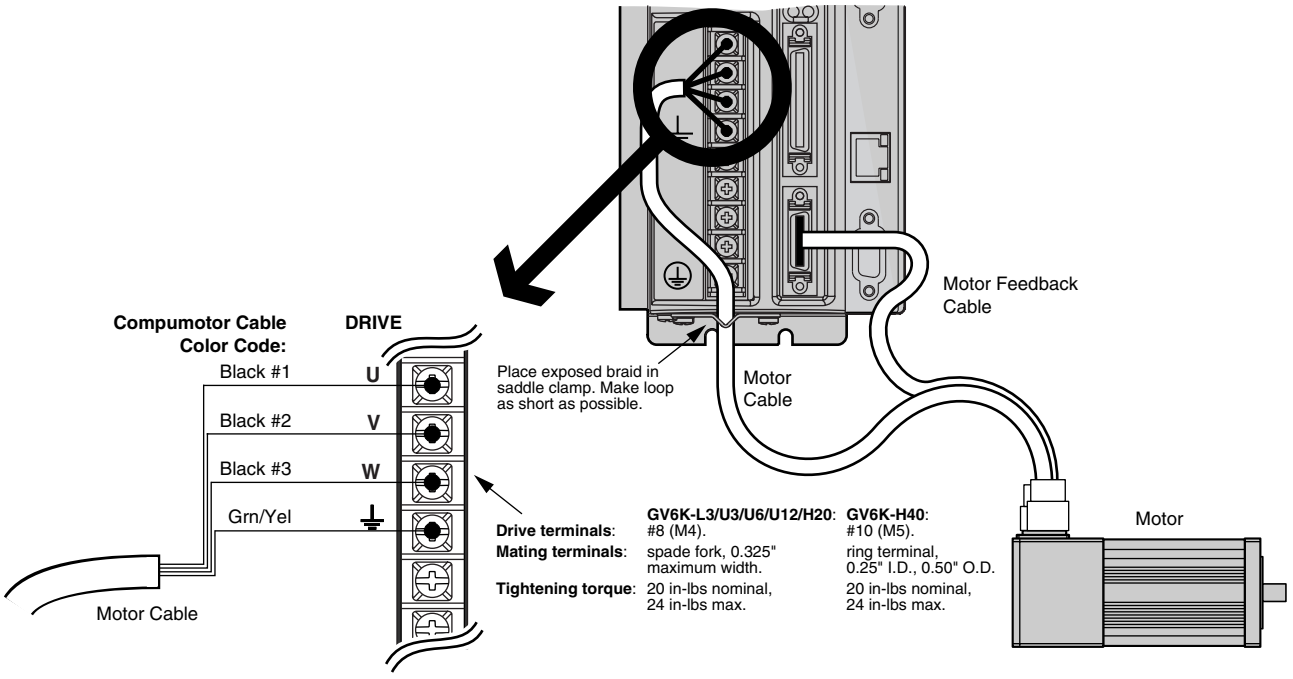
Compumotor's motor feedback cable with the GS or GB option has an MS connector on one end, and a 26 pin connector on the other end.

1. Connect the MS connector on the motor cable to the mating connector on the motor.
2. Connect the 26 pin connector on the motor cable to the drive's MOTOR FEEDBACK connector.
3. Tighten the jack screws on the connector housing to secure the connector to the drive.

Secure the Motor

1. If your motor is not permanently mounted, clamp it securely in place during this Express Setup procedure.

The next drawing illustrates these connections.



Motor Wiring with GV6K – Typical

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GT6K Steppers – Motor Connections

The GT6K drive is compatible with 4, 6, or 8 lead step motors designed for use with a bipolar drive.

Connecting the Motor

Make sure power is off before you connect the motor.

1. Wire your motor in series or parallel.

   For wiring diagrams, color codes, dimensions and speed/torque curves for Compumotor motors, consult the separate *Gemini Motor Reference Manual*.

   If you use a non-Compumotor motor, see *Appendix B Using Non-Compumotor Motors* for instructions on preparing your motor for connection to the GT6K.

2. Prepare four motor phase wires to connect to the GT6K drive, and identify them as A+, A-, B+, and B-.

3. Remove the clear plastic cover from the drive terminals. Connect the motor cable's earth wire to the drive terminal with the ⏚ symbol. This connects the motor's protective conductor terminal to the drive's safety earth.

4. Connect your motor cable's phase wires (A+, A-, B+, B-) to the drive's A+, A-, B+, and B- terminals, respectively, as shown in the drawing below.

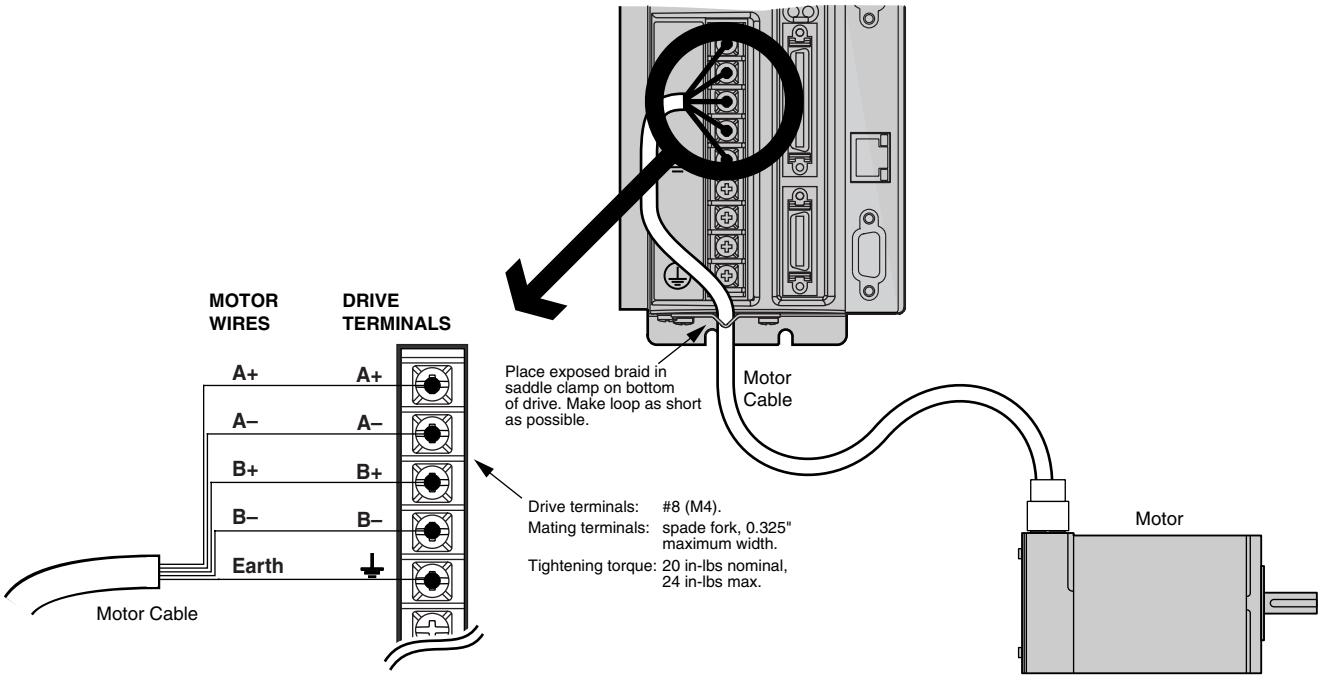
WARNING

The drive's barrier strip terminals are at hazardous voltages when power is applied to the drive, and up to 30 seconds after power is removed. Reinstall the clear plastic terminal cover after you make connections.

5. Secure the motor cable to the drive by placing the exposed cable shield in the saddle clamp on the bottom of the drive. Make the loop of cable between the saddle clamp and the drive terminals as short as possible.

6. Clamp the motor securely in place during this *Express Setup* procedure, if your motor is not permanently mounted.

The next drawing illustrates these connections.



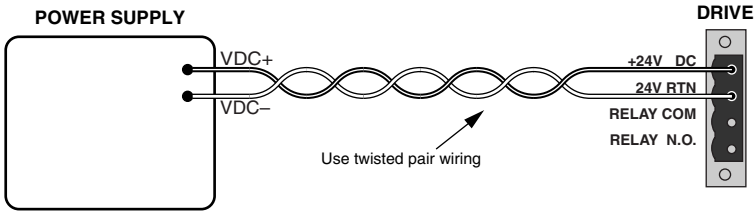
Motor Wiring with GT6K – Typical

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Step 2 – Connecting +24VDC Power

You must connect an external +24VDC power source to the Gem6K, as the next drawing shows. Use the removable terminal connector that is supplied with the drive.

With +24VDC applied, the drive's internal control board will remain powered when the primary AC power source is disconnected, and will maintain several important functions, including communication diagnostics, position feedback, and other logic functions.



+24VDC Power Input

+24VDC Specifications:

Input voltage range:	19.2 – 28.8 VDC
Input current:	500 mA (maximum)
Functions available under +24VDC only:	position information (encoder or motor position counters in drive)
	communications
	diagnostics
	motor feedback
	program execution not involving motion (e.g., error programs, etc.)
Software status bit (see TASX command):	indicates "keep alive" is active: +24VDC power only (AC power is disconnected)

CAUTION

Do not exceed 28.8VDC input voltage

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Step 3 – Connecting AC Power

Power Requirements

Acceptable ranges of AC input voltage are listed below for each drive :

Drive	AC Input Range	
GT6K-L5/L8	95 – 132VAC	
GV6K-L3n	95 – 132VAC	
GV6K-U3n/U6n/U12n	95 – 264VAC	
GV6K-H20n	165 – 264VAC	[single phase (1∅) or three phase power (3∅)]
GV6K-H40n	165 – 264VAC	[three phase power (3∅) only]

WARNING

You must connect the drive's protective conductor terminal, marked with the ⏚ symbol, to a reliable system safety earth. Make the connection directly, by means of a low impedance path less than or equal to 0.1 ohm (no fuses, etc.). Under normal operation, no current should flow through the safety earth connection.

WARNING

The drive's barrier strip terminals are at hazardous voltages when power is applied to the drive, and up to 30 seconds after power is removed. Lower voltages may still be present for several minutes after power is removed. Reinstall the clear plastic terminal cover after you make connections.

Fuse Information

Gem6K drives have no internal fuses. For safety, you must provide a fuse in each of the AC input lines. Recommended fuse types and sizes are:

Drive Type	Fuse Style	Rating	Fuse Type
GT6K-L5/L8 (120VAC)	125VAC Time Delay	10 amp	Type RK5 or better
GV6K-L3n (120VAC)	125VAC Time Delay	10 amp	Type RK5 or better
GV6K-U3n/6n/12n (120VAC)	125VAC Time Delay	30 amp	Type RK5 or better
GV6K-U3n/6n/12n (240VAC)	250VAC Time Delay	30 amp	Type RK5 or better
GV6K-H20n (208/240VAC, 1∅/3∅)	250VAC Time Delay	30 amp	Type RK5 or better
GV6K-H40n (208/240VAC, 3∅)	250VAC Time Delay	60 amp	Type RK5 or better

The next table lists part numbers for suitable fuses, from several manufacturers:

Amps	Bussmann	Gould	Littelfuse	Grainger
10	FRN-R-10	TR10R	FLNR10	1A693
30	FRN-R-30	TR30R	FLNR30	1A698
60	FRN-R-60	TR60R	FLNR060	1A700

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AC Power Connections

GT6K-L5/L8 and GV6K-L3n: Connecting AC Power

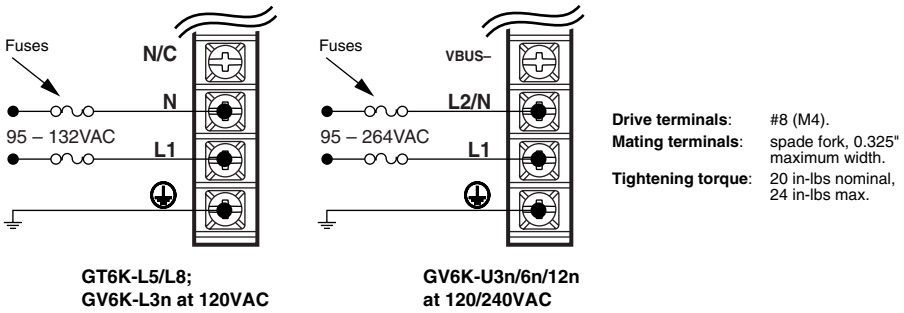
CAUTION

Do not operate GV6K-L3n above 132VAC, or the drive will be permanently damaged.

120VAC Operations:

1. Connect power system's safety earth to drive's protective conductor terminal, marked with the ⏚ symbol. Do not fuse the protective conductor terminal.
2. Connect 120VAC, 50/60 Hz, single phase power line to drive's L1 and N terminals.
3. **Reinstall the clear plastic terminal cover after you make connections**.

Connections are illustrated in the next drawing.



Power Connections – GT6K and GV6K-L3/U3/U6/U12

GV6K-U3n/6n/12n: Connecting AC Power

Connections are illustrated in the drawing above.

208/240VAC Operations:

1. Connect power system's safety earth to drive's protective conductor terminal, marked with the ⏚ symbol. Do not fuse the protective conductor terminal.
2. Connect 208/240VAC, 50/60 Hz, single phase power to drive's L1 and L2/N terminals.
3. **Reinstall the clear plastic terminal cover after you make connections.**

120VAC Operations:

1. Connect power system's safety earth to drive's protective conductor terminal, marked with the ⏚ symbol. Do not fuse the protective conductor terminal.
2. Connect 120VAC, 50/60 Hz, single phase power line to drive's L1 terminal.
3. Connect neutral to drive's L2/N terminal.
4. **Reinstall the clear plastic terminal cover after you make connections.**

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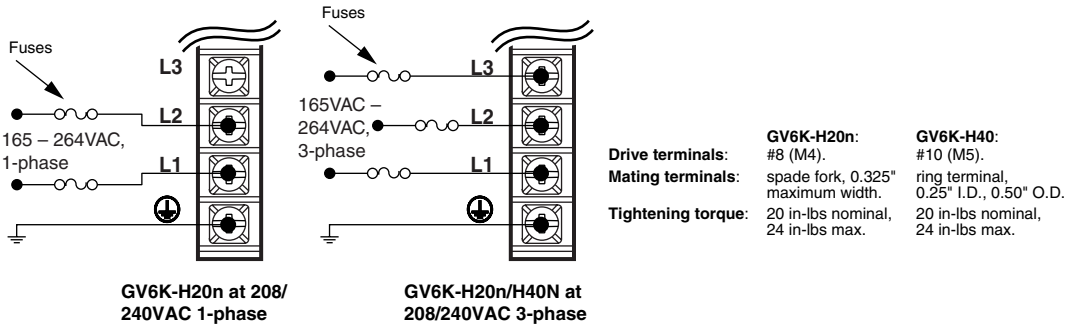
GV6K-H20n: Connecting Single Phase AC Power

Single Phase 208/240VAC Operations:

1. Connect power system's safety earth to drive's protective conductor terminal, marked with the ⏚ symbol. Do not fuse the protective conductor terminal.
2. Connect 208/240VAC, 1∅, 50/60 Hz power to drive's L1 and L2 terminals.
3. **Reinstall the clear plastic terminal cover after you make connections.**

NOTE: Default current settings are for three phase operation. For single phase, you must modify the current settings in *Step 4 – Configuring the Drive* on the next page.

Connections are illustrated in the next drawing.



	GV6K-H20n:	GV6K-H40:
Drive terminals:	#8 (M4).	#10 (M5).
Mating terminals:	spade fork, 0.325" maximum width.	ring terminal, 0.25" I.D., 0.50" O.D.
Tightening torque:	20 in-lbs nominal, 24 in-lbs max.	20 in-lbs nominal, 24 in-lbs max.

Power Connections – GV6K-H20n/H40n

GV6K-H20n/H40n: Connecting Three Phase AC Power

Connections are illustrated in the drawing above.

Three Phase 208/240VAC Operations:

1. Connect power system's safety earth to drive's protective conductor terminal, marked with the ⏚ symbol. Do not fuse the protective conductor terminal.
2. Connect 208/240VAC, 3∅, 50/60 Hz power to drive's L1, L2 and L3 terminals.
3. **Reinstall the clear plastic terminal cover after you make connections.**

Applying Power

1. Verify that the load is not connected to the motor, and that the motor is clamped securely in place.
2. Verify that a cable is not attached to the DRIVE I/O connector.
3. Apply power to the drive (both +24VDC and AC). After the power-up sequence, the LEDs should display the following state:

Left LED	Right LED	Indicated State:
red	off	Drive ready, not enabled

Proceed to *Step 4 – Configuring the Drive*.

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Step 4 – Configuring the Drive

Gem6K drives have no DIP switches or potentiometers for configuration. You will use *Motion Planner*, a software program, to communicate with the drive, configure drive settings, and load your application program.

Configuration Software

Motion Planner is located on the Motion Planner CD-ROM. This program is also available on the Compumotor web site at http://www.compumotor.com. Motion Planner runs on a personal computer (PC).

Information about installing and using Motion Planner can be found in the *Gem6K Programmer's Guide*.

Establishing Communications

We assume you have a Gem6K drive, and at least one serial port on your PC.

WARNING

This procedure causes the motor shaft to move. Do not connect a load to the shaft.

1. Verify that a load is not connected to the motor, and that the motor is clamped securely in place.
2. Verify that a cable is not attached to the DRIVE I/O connector.
3. Using a null modem cable, connect the drive's RS-232/485 connector to the serial port on your PC. (A null modem cable is available from Compumotor. See *Appendix A Specifications* for more information.) It is not necessary to turn off power before you plug in an RS-232 cable; however, connect RS-485 cables *before* applying power.

Proceed to *Configuring the Drive*. For more instructions on establishing communications, refer to the *Communications* section of *Chapter 4 – Special Features*.

Configuring the Drive

Use the following procedure to configure your drive.

1. Install and launch Motion Planner.
2. When the product selection dialog appears, select a Gem6K drive (GV6K or GT6K) and select the COM port to which the drive is connected.
3. To verify communications with the drive, click the "Terminal" tab on the bottom of the screen to enter terminal mode. Issue the following command to the drive:

   TREV (transfers the drive's revision level)

   Revision level information for your drive should appear on the screen.

   To solve communication problems: see *RS-232/485 Communications* in *Chapter 4 – Special Features*.

   NOTE: If this is not the first time the drive has been configured, issue an RFS command (Return to Factory Settings), before performing the following procedures.

   Click the "Editor" tab on the bottom of the screen to return to the Editor window.
4. In the Editor window, click on the Gemini button at the top of the window to launch the setup wizard.

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5. Select “Express Setup”, and select “Initialize wizard with factory defaults”. Click the “Next” button to proceed with the wizard.
6. Fill in the wizard dialogs as prompted, including choosing a motor series, frame size, and part number. At the end of the wizard, click the “finish” button; this creates the setup code and places it in the Editor window. (For GV6K-H20 using single phase power, see the *Note* at the end of this procedure.)
7. Select File/Save to save the setup code to a file (*.prg) on your hard drive.
8. Select Communications/Download to download the setup code (contents of the Editor window) to the Gem6K drive. When the download is complete, choose to “DRESET” the drive.

   Drive setup is complete. All of the setup parameters (command values) are stored in the Gem6K’s battery-backed RAM and are automatically recalled when you cycle power or reset the drive.
9. Click the “Terminal” tab on the bottom of the screen to enter terminal mode.
10. Issue a DMODE13 command. This configures the drive for autorun mode, in which the motor runs open loop in the clockwise direction at 1 rps. (The motor will not begin turning, though, because you have not yet enabled the drive.)

NOTE: GV6K-H20 – default current values are for three phase operation. If you use single phase power with the GV6K-H20, you must manually modify the current values as follows:

- Set continuous current (DMTIC) to 11.3 amps rms or less
- Set peak current (DMTIP) to 28.3 amps rms or less

Depending upon which motor you selected, your settings may already be lower than these limits.

Proceed to *Step 5 – Verifying Correct System Installation*.

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Step 5 – Verifying Correct System Installation

Commanding Motion in Autorun Mode

In this procedure you will enable the drive; the motor will then rotate in autorun mode. This will verify correct system wiring and drive configuration.

1. Connect a jumper wire between Pin 1 and Pin 2 on the 50 pin DRIVE I/O connector. (For connector diagrams, cable color codes, and breakout module information see *Appendix A Specifications*.)
2. Issue the following command to the drive:

   DRIVE1 (enables the drive)
3. Verify that the drive is enabled. (Left LED is illuminated green; right LED flashes yellow/green during autorun.)
4 Verify that the motor is rotating clockwise at approximately one revolution per second, as viewed from the shaft end of the motor. (The motor is turning because earlier you configured the drive for autorun.)

Proceed to *Commanding Motion Under Program Control*.

Commanding Motion Under Program Control

In this procedure you will use the Gem6K command language to make the motor turn. This will verify that your system is installed correctly.

1. Issue the following commands to change the drive mode:

   DRIVEØ (disables the drive and stops motion)

   DMODE12 (changes mode from autorun to controller/drive mode)

   DRIVE1 (enables the drive)
2. Issue the following commands to the drive to make the motor turn:

   LHØ (disables limits)

   MAØ (enables incremental positioning mode; disables absolute mode)

   MCØ (enables incremental positioning mode; disables continuous mode)

   A10 (sets acceleration to 10)

   V1 (sets velocity to 1)

   If you are using a GV6K, issue D4000. If you are using a GT6K, issue D25000:

   D4000 (GV6K: sets distance to 1 rev (if ERES = 4000))

   or

   D25000 (GT6K: sets distance to 1 rev (if DRES = 25000))

   GO (initiates motion)
3. Verify that the motor rotates one revolution and then stops.

This completes the *Express Setup* procedure.

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What's Next?

This chapter has given you information and instructions for performing an *Express Setup*. The following list explains the steps you should take to complete your installation, and indicates where to find additional information for each of those steps.

1. **Mount the drive**. For information on drive dimensions, environmental specifications, airflow and cooling, etc., see *Appendix A Specifications*.
2. **Mount the motor**. For information on motor dimensions, motor cables, encoders, speed/torque curves, etc., see the separate *Gemini Motor Reference Manual*.
3. **Make System Connections**. Information about Compumotor cables is in *Appendix A Specifications*. For information on cabling practices to reduce electrical noise, see *Appendix C Regulatory Compliance: UL and CE*.

   Connect any of the drive's optional features you may wish to use (see *Appendix A Specifications* for more information):

   - Reset Input
   - VINref – Voltage Input Reference
   - Digital Inputs (and CNTRL-P)
   - Digital Outputs
   - Analog Monitor
   - Encoder Output (GV6K only)
   - Step & Direction Output (GT6K only)

   Connect any of the drive's special features you may wish to use (see *Chapter 4 Special Features* for more information):

   - Relay, and how to control a Motor Brake
   - Aligning the Resolver (GV6K only)
   - RS-232 Daisy Chain
   - RS-485 Multi-Drop
   - Ethernet
   - Expansion I/O – EVM32-II and SIM modules
   - Multiple Drive Installations
   - Connecting drive power buses together (GV6K only)
   - Regeneration and the GPDM Power Dissipation Module (GV6K only)
4. **Connect the Load**.
5. **Configure Your Drive**. After completing your hardware installation in Steps 1 – 5 above, proceed to *Chapter 3 Configuration* for information about additional drive configuration options, including:

   - **Advanced Features Configuration** (GT6K only) – Configure settings for Active Damping, Electronic Viscosity, ABS Damping, and encoderless stall detect.
   - **Motor Matching** (GT6K only) – Match your drive to your particular motor.
6. **Tune Your System** (GV6K only) – Tune your system according to the instructions found at the end of *Chapter 3 Configuration*.

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CHAPTER THREE

3 Configuration

IN THIS CHAPTER

- Configuration
- Tuning Procedures (GV6K Only)
- Damping Configuration (GT6K Only)
- Stall Detect Configuration (GT6K Only)
- Motor Matching (GT6K Only)

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Configuration

You can configure the Gem6K's settings for optimum system performance. For most of these settings, configuration is optional—if you do nothing, the drive will use default values the very first time it powers up. If you change any settings, the new settings are saved automatically. Most changed settings are effective immediately, but some require that you issue a reset (software RESET or DRESET command, reset input, or cycle power) before the drive acts upon them.

This chapter will give an overview of all software commands that configure drive settings. For more in depth descriptions about these commands, see the separate *Gemini GV6K/GT6K Command Reference*.

GV6K: At the end of this chapter are procedures you can use to configure the GV6K's tuning settings.

GT6K: At the end of this chapter are procedures you can use to configure the GT6K's damping and stall detect settings, and to match the motor to the drive.

Software Programs for Configuration

Motion Planner , a software program, is located on the Motion Planner CD-ROM. It runs on a personal computer (PC). This program is also available on the Compumotor web site at http://www.compumotor.com.

Information about installing and using *Motion Planner* can be found in the *Gemini GV6K/GT6K Command Reference*.

Overview of Configuration Commands

The sections below present configuration commands in groups organized by function. (*Express Setup*, which was discussed in *Chapter 2 Installation*, gives you a smaller number of configuration commands.)

Motor Settings

If you select a Compumotor motor from the list of motors the software presents to you, the software will send settings to the drive for the motor you selected. No further configuration of motor settings is necessary on your part.

If you use a non-Compumotor motor, or choose to manually configure a Compumotor motor, use the following commands to configure motor settings. Also see *Appendix B – Using Non-Compumotor Motors* for additional instructions.

GV6K Commands	Description
ERES	feedback resolution (encoder or resolver)
DMTIC	continuous current
DMTICD	continuous current derating
DMTKE	motor constant
DMTRES	line-to-line resistance
DMTJ	rotor inertia

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DPOLE	number of pole pairs
DMTW	rated speed
DMTIP	peak current
DMTLMN	minimum line-to-line inductance
DMTLMX	maximum line-to-line inductance
DMTD	motor damping
DMTRWC	motor thermal resistance (winding to case)
DMTTCM	motor case (and heatsink) thermal time constant
DMTTCW	motor winding thermal time constant
DPWM	PWM switching frequency
DMTMAX	motor maximum temperature
SHALL	Hall sensor orientation

GT6K Commands	**Description**
DMTSTT	static torque
DMTIC	continuous current
DMTIND	inductance
DMTRES	phase resistance
DMTJ	rotor inertia
DPOLE	number of pole pairs
DIGNA	current loop gain
DIGNB	current loop gain
DIGNC	current loop gain
DIGND	current loop gain

System Settings

The system settings configure the drive's mode of operation, resolution, fault modes and inertia ratio.

Drive Settings – GV6K

Command	**Description**	**Options:**
DMODE	mode of operation:	alignment mode
		controller/drive mode
		autorun[1]
		torque/force tuning mode
		position tuning mode
DMEPIT	electrical pitch of magnets	you enter a number
ORES	encoder output resolution	you enter a number
DMTLIM	torque limit	you enter a number
DMTSCL	torque scale	you enter a number
DMVLIM	velocity limit	you enter a number

[1]Autorun mode commands motion with no program control. It is used during *Express Setup*, and for troubleshooting.

Drive Settings – GT6K

Command	**Description**	**Options:**
DMODE	mode of operation:	controller/drive mode
		autorun[1]
DMEPIT	electrical pitch of magnets	you enter a number

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DRES	motor step resolution	you enter a number
ORES	step/dir output resolution	you enter a number
DAUTOS	auto standby enable	you enter a number
DMVLIM	velocity limit	you enter a number

[1]Autorun mode commands motion with no program control. It is used during *Express Setup*, and for troubleshooting.

Load Settings – GV6K

Command	Description	Options:
LJRAT	load to rotor inertia ratio	you enter a number
LDAMP	load damping	you enter a number

Load Settings – GT6K

Command	Description	Options:
LJRAT	inertia ratio	you enter a number

Fault Settings – GV6K

Command	Description	Options:
FLTDSB	fault on disable	can be turned on or off
SMPER	maximum position error	you enter a number
SMVER	maximum velocity error	you enter a number
DIFOLD	enable current foldback	can be turned on or off
DMTAMB	motor ambient temperature	you enter a number
KDRIVE	disable drive on kill	can be turned on or off

Fault Settings – GT6K

Command	Description	Options:
FLTDSB	fault on disable	can be turned on or off
ESK	fault on stall	can be turned on or off
KDRIVE	disable drive on kill	can be turned on or off
DSTALL	encoderless stall detection	you enter a number
ESTALL	encoder-based stall detection	can be turned on or off

Input/Output (I/O) Settings

I/O settings configure the drive's digital inputs and outputs, and analog monitors.

Digital Inputs

Command	Description	Options:
LH	hard limit enable	both hard limits disabled
		negative limit only
		positive limit only
		both hard limits enabled
INDEB	input debounce time	can be set in milliseconds
LHAD	hard limit deceleration	you enter a number
LHADA	hard limit average decel.	you enter a number
Input Definition and Sense		configure up to 5 onboard inputs
Limit Definition and Sense		configure 2 onboard limit inputs and 1 home input

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Digital Outputs

Command	Description	Options:
Output Definition and Sense		configure up to 7 onboard outputs

Analog Monitors

Command	Description	Options:
DMONAV	analog monitor A variable	**GV6K Options:**
		unused/turn off output
		motor temperature
		drive temperature
		position error
		velocity setpoint
		actual velocity
		acceleration setpoint
		torque/force setpoint
		actual (electrical) torque
		velocity error
		phase A actual current
		phase B actual current
		d-axis commanded current
		d-axis actual current
		q-axis commanded current
		q-axis actual current
		position setpoint
		actual position
DMONAV	analog monitor A variable	**GT6K Options:**
		unused/turn off output
		drive temperature
		velocity setpoint
		acceleration setpoint
		phase A commanded current
		phase A actual current
		phase B commanded current
		phase B actual current
		phase A commanded voltage
		phase B commanded voltage
DMONAS	analog monitor A scaling[1]	you enter a percentage[1]
DMONBV	analog monitor B variable	same choices as DMONAV
DMONBS	analog monitor B scaling[1]	you enter a percentage[1]

[1]Monitor output is scalable from -2000% to +2000%, but is limited to ±10V peak to peak.

Communications Settings

The communication settings configure the drive for RS-232/485 communications.

RS-232/485

Command	Description	Options:
ERRLVL	error level	you enter a number
ECHO	echo enable	can be turned on or off

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Tuning Settings – GV6K

Tuning settings are divided into two groups: primary and advanced. Tuning can be done in torque, velocity, or position mode. Tuning procedures for each of these modes are presented later in this chapter. Relevant commands are:

Primary Tuning

Command	Description	Options:
DIBW	current loop bandwidth	you enter a number
DPBW	position loop bandwidth	you enter a number

Advanced Tuning

Command	Description	Options:
DIBW	current loop bandwidth	you enter a number
DPBW	position loop bandwidth	you enter a number
SGIRAT	current (torque) damping ratio	you enter a number
SGVRAT	velocity damping ratio	you enter a number
SGPRAT	position damping ratio	you enter a number
SGPSIG	position/velocity bandwidth ratio	you enter a number
SGINTE	integration selection	you enter a number
DNOTAF	notch filter A frequency	you enter a number
DNOTAD	notch filter A depth	you enter a number
DNOTAQ	notch filter A quality factor	you enter a number
DNOTBF	notch filter B frequency	you enter a number
DNOTBD	notch filter B depth	you enter a number
DNOTBQ	notch filter B quality factor	you enter a number
DNOTLD	notch lead filter frequency	you enter a number
DNOTLG	notch lag filter frequency	you enter a number

Motor Control Settings – GT6K

Motor control settings are divided into two groups: motor matching; and damping .

Motor Matching

Motor matching is used to match the drive to your specific motor. A procedure for performing motor matching is presented at the end of this chapter. Relevant commands are:

Command	Description	Options:
DWAVEF	% 3rd harmonic current waveform component	you enter a number
DPHBAL	phase B balance	you enter a percentage
DPHOFA	phase A current offset	you enter a percentage
DPHOFB	phase B current offset	you enter a percentage

Damping

These commands are used to configure the drive's settings for damping. A procedure for adjusting damping settings is presented later in this chapter. Relevant commands are:

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Command	Description	Options:
DACTDP	active damping gain	you enter a number
DDAMPA	damping during acceleration	can be turned on or off
DELVIS	electronic viscosity	can be turned on or off
DABSD	ABS damping	can be turned on or off

Tuning Procedures – GV6K Servo

During the *Express Setup* procedure in *Chapter 2 Installation*, the drive uses default values for tuning parameters, based upon the motor information you entered. That procedure assumes that the motor is ***unloaded***. In the following tuning procedures, you will enter system information that will characterize the load on the motor.

Entering Load Settings

The main load setting you will adjust is LJRAT, which is the load-to-rotor inertia value for your system. The more accurately you know this value, the closer your tuning bandwidth settings will correspond to the actual dynamic performance of your system. If you only know this value approximately, you can adjust this value until you achieve the system performance you desire. The total system inertia is given by the following formula:

$$\textit{Total system inertia} = \textit{motor rotor inertia}*(1 + \textit{LJRAT})$$

If your system has significant mechanical damping, you will also want to adjust the LDAMP setting which specifies system damping provided by the load. If you know that you have significant damping in your system from your load but do not know its exact value, you can adjust this value until you achieve the system performance that you desire.

Both the LJRAT and the LDAMP values can be set in the terminal mode of Motion Planner. During the tuning process you may want to use the terminal emulator to establish appropriate values for these parameters, and then save the drive's full configuration settings for use with other units.

Position Mode Tuning

For most applications, the default tuning parameters for position mode are set to provide good, stiff motor shaft performance for a given load setting. With the default tuning parameters set in the Express Setup procedure, you need only set the system load-to-rotor inertia ratio and your system will be tuned. If your system has significant mechanical damping, you may need to set the system damping as well. Should you wish to modify the default values and fine tune your system for position mode, use the following procedures

WARNING

This procedure causes the motor shaft to move. Make sure that shaft motion will not damage equipment or injure personnel.

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Position Mode Tuning Procedure

Primary Tuning Procedure

1. Disable the drive.
2. Configure the drive for *position tuning mode* (DMODE17). In this mode, the drive commands an alternating 1/4 revolution step change in position at a one second repetition rate.
3. Enable the drive and observe your system's response. (If necessary, you can connect an oscilloscope as described in *Advanced Tuning* below.)

   Ringing or an oscillating response indicates that the position loop bandwidth is too high. To eliminate oscillations:

   - decrease bandwidth using the DPBW command.

   A sluggish response indicates that position loop bandwidth is too low. To improve the response:

   - increase bandwidth by using the DPBW command.

   NOTE: Ringing, oscillations, or a sluggish response can also indicate inaccurate drive settings for LJRAT or LDAMP.
4. After you achieve a satisfactory system response, reconfigure the drive for controller/drive mode (DMODE12). This completes the primary tuning procedure.

   If you are unable to achieve a satisfactory response, proceed to the advanced tuning procedure below.

Advanced Tuning Procedure

1. Disable the drive.
2. Configure the drive for *position tuning mode* (DMODE17). In this mode, the drive commands an alternating 1/4 revolution step change in position at a one second repetition rate.

   (In some applications a different move profile may give better results. Choose a move similar to that required by your application, but using fast acceleration and deceleration rates. Be sure the maximum velocity of your move is well below the rated speed of your drive/motor combination.
3. Configure ANALOG MONITOR A to show position error (DMONAV3).
4. Connect one channel of your oscilloscope to the drive's ANALOG MONITOR A (pin 21). Connect your oscilloscope's ground to the drive's ANALOG GROUND (pin 25).
5. Adjust your oscilloscope to display position error. (The analog monitor can be scaled, in percent, with the DMONAS command.)
6. Enable the drive and observe your system's response. Position error will increase during acceleration, but should decay smoothly to near zero without significant ringing or instability.

   Ringing or an oscillating response indicates that the position loop bandwidth is too high, or the position loop damping is too low. To eliminate ringing or oscillations:

   - decrease bandwidth using the DPBW command; then, if necessary:
   - adjust damping by using the SGPRAT command. Use the value that gives the best performance.
   - in applications with backlash or high static friction, disabling the velocity integrator (SGINTE0) can help improve stability.
   - NOTE: In position mode, the velocity loop bandwidth tracks changes in position loop bandwidth by a ratio set by the SGPSIG command.

   A sluggish response indicates that position loop bandwidth is too low, or position loop damping is too high. To improve the response:

   - increase bandwidth by using the DPBW command; then, if necessary:
   - adjust damping by using the SGPRAT command. Use the value that gives the best performance.

   NOTE: Ringing or a sluggish response can also indicate inaccurate drive settings for LJRAT or LDAMP.
7. After you achieve a satisfactory system response, reconfigure the drive for controller/drive mode (DMODE12). This completes the advanced tuning procedure.

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If ringing or oscillations persist, and do not seem to be affected by the above adjustments, you may need to use notch filters or lead/lag filters. See the *Filter Adjustments* procedure below.

Filter Adjustments

If the previous tuning procedures did not eliminate ringing or oscillations, then mechanical resonances may be causing problems with your system's response.

Before trying the procedure below, we recommend that you check your mechanical system, especially the mechanical stiffness and mounting rigidity of your system. Use bellows or disk style couplers, not helical couplers. Once you have optimized your mechanical system, filters may allow increased performance, without causing system instability.

Filters can improve response by reducing system gain over the same frequencies that contain resonances. You can then increase the gain for frequencies outside this range, without exciting the resonance and causing instability.

The first procedure below describes how to set the drive's two notch filters, to reduce resonance and improve your system's response. The second and third procedures describe how to set the drive's lead and lag filters.

WARNING

These procedures cause the motor shaft to move. Make sure that shaft motion will not damage equipment or injure personnel.

Notch Filter Adjustment Procedure

1. Configure the analog monitor to show q-axis current (DMONAV19).
2. Configure the drive for position tuning mode (DMODE17).
3. Configure DMTLIM to approximately 1/3 of the default value for your Compumotor motor.
4. Connect one channel of your oscilloscope to the drive's ANALOG MONITOR A (pin 21). Connect your oscilloscope's ground to the drive's ANALOG GROUND (pin 25).
5. From the oscilloscope display, observe the system's response to the tuning mode's step input. Note the frequency of the oscillatory current waveform that is superimposed on the 1 Hz step command signal.
6. Using the DNOTAF command, set the notch filter to the frequency noted in Step 5.
7. Using the DNOTAD command, slowly increase the depth of the notch filter from 0.0 to 1.0 until the ringing decreases.
8. Continue to observe the response to the step command signal. Ringing should be reduced or eliminated.
9. Adjust the Q of the filter (DNOTAQ command). Use the following guidelines:
   - Set Q as low as possible. Resonances change with load; therefore, your system will be more robust with a lower Q value. (Default = 1)
   - If Q is too low, system stiffness will be reduced outside the resonant range.
   - If Q is too high, the response peak may shift in frequency.
10. After reducing the resonance, you may notice a second resonance. Use the second notch filter (DNOTBF, DNOTBD and DNOTBQ) to reduce the second resonance. Follow the same procedure as outlined in steps 1 – 9 above.
11. If you are done adjusting filters, reconfigure DMTLIM to its default value. Otherwise, proceed to the *Lag Filter Adjustment* procedure below.

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Lag Filter Adjustment Procedure

The lag filter can act as a low pass filter, and reduce the effects of electrical noise on the commanded torque. (It can also reduce the effects of resonance at low frequencies—below 60 Hz—where the notch filters are not effective.)

1. As described in Steps 2 – 3 in the *Notch Filter Adjustment* procedure above, reduce DMTLIM and connect an oscilloscope.
2. Verify that the lead filter is turned off (DNOTLDØ).
3. Configure the drive for position tuning mode. Observe the system's response to the tuning mode's step input.
4. Choose a value for the lag filter (DNOTLG) that reduces low frequency resonance and provides satisfactory system performance.
5. If you are done adjusting filters, reconfigure DMTLIM to its default value. Otherwise, proceed to the *Lead /Lag Filter Adjustment* procedure below.

Lead/Lag Filter Adjustment Procedure

The lead filter can counteract the effects of the lag filter at higher frequencies. Do not use the lead filter by itself—if you use the lead filter, you must also use the lag filter.

1. As described in Steps 2 – 3 in the *Notch Filter Adjustment* procedure above, reduce DMTLIM and connect an oscilloscope.
2. Set the lag filter (DNOTLG) as described above.
3. Configure the drive for position tuning mode. Observe the system's response to the tuning mode's step input.
4. Choose a value for the lead filter (DNOTLD) that improves system performance. This value will typically be higher in frequency than the lag filter setting.
5. You must choose a value for the lead filter that is *higher* in frequency than the lag filter value. However, do not set the lead filter higher than four times the lag filter frequency, or a drive configuration warning will result, and the drive will use the previous filter settings.
6. If you are done adjusting filters, reconfigure DMTLIM to its default value.

Procedure for Configuring Advanced Features – GT6K

The GT6K has advanced motor control features that you can configure for increased damping, increased low speed smoothness, and increased disturbance rejection; and for detecting motor stalls.

Configuring Damping Settings

The GT6K's three damping modes reduce vibration, increase low speed smoothness, and decrease load settling time. These damping modes are independent of each other, and operate within specific velocity ranges.

ABS Damping

ABS damping provides load-invariant damping at extreme low speeds. It targets applications that require minimal zero-speed settling time (for example, pick-and-place applications with varying load).

Command	Function	Velocity Range	Default	Contributing Parameters
DABSD	ABS Damping	0 to 0.2 rps*	Disabled	DMTRES, DMTIND

*motor dependent

Electronic Viscosity

Electronic viscosity targets applications that require reduced low-speed velocity ripple and increased smoothness, as well as aggressive low-speed

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damping. NOTE: If ABS Damping is enabled, it overrides electronic viscosity in the 0 to 0.2 rps velocity range.

Command	Function	Velocity Range	Default	Contributing Parameters
DELVIS	Electronic Viscosity	0 to 3 rps**	Disabled	DMTJ, DMTSTT, DPOLE DMTIC, DMTIND, LJRAT

**motor and load dependent

Active Damping

Active damping targets applications that require high accelerations, fast settling at commanded speed, mechanical vibration disturbance rejection, and highly stable (non-resonant) motion.

Command	Function	Velocity Range	Default	Contributing Parameters
DACTDP	Active Damping	>3 rps	Enabled (DACTDP4)	DMTJ, DMTIND, DMTSTT, LJRAT

Note: You can use the DDAMPA command to disable ABS damping and electronic viscosity during acceleration rates greater than 50 rps^2. This allows full motor torque to be used during acceleration.

Use the following procedures to configure the damping settings. You can usually find the best setting by using touch or sound. If this is not adequate, use a tachometer attached directly to the motor by means of a stiff coupler.

Configuring ABS Damping (DABSD)

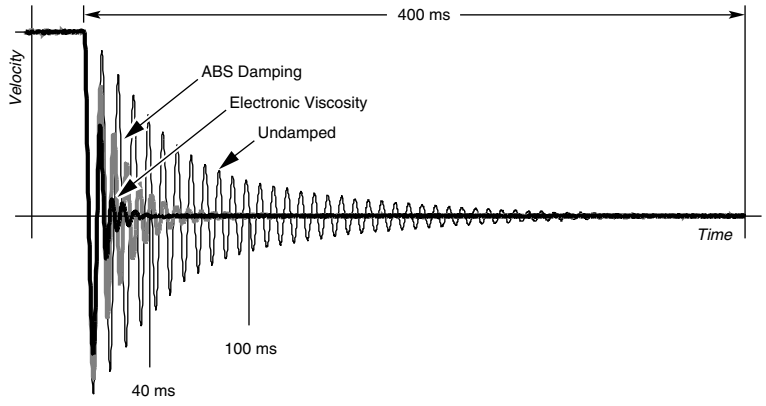
The default setting is *disabled*. (DABSD0)

1. To turn ABS damping *on*, use the DABSD command. (DABSD1)
2. If you use a Parker motor, the following parameters are automatically set when you use Motion Planner to select a motor. You do not need to enter values for them now.

   If you use a non-Parker motor, use the following commands to enter accurate values for the specified motor parameters:

Command:	Motor Parameter:
DMTRES	motor resistance
DMTIND	motor inductance

   The figure below shows performance with ABS Damping, with Electronic Viscosity, and without damping.



Damping Performance

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Configuring Electronic Viscosity (DELVIS)

1. Enter an accurate value for the load parameter, using the following command:

Command:	Parameter:
LJRAT	system load-to-rotor inertia ratio

2. If you use a Parker motor, the following parameters are automatically set when you use Motion Planner to select a motor. You do not need to enter values for them now.

   If you use a non-Parker motor, use the following commands to enter accurate values for the specified motor parameters:

Command:	Motor Parameter:
DMTJ	rotor inertia
DMTSTT	static torque
DPOLE	number of motor pole pairs
DMTIC	continuous current
DMTIND	inductance

3. Start with DELVIS set to 0, which is *disabled*. (This is the default setting.)
4. Increase DELVIS until your system performs as you require.
   - 1 - 7 is the full range
   - 5 provides optimal damping
   - 0 is *off*

   The figure above shows performance with Electronic Viscosity, with ABS Damping, and without damping.

Configuring Active Damping (DACTDP)

Using motor and load parameters, the drive calculates the optimum damping setting for your system, and scales this value to a setting of DACTDP20. However, the default setting is DACTDP4.

1. Enter an accurate value for the load parameter, using the following command:

Command:	Parameter:
LJRAT	system load-to-rotor inertia ratio

2. If you use a Parker motor, the following parameters are automatically set when you use Motion Planner to select a motor. You do not need to enter values for them now.

   If you use a non-Parker motor, use the following commands to enter accurate values for the specified motor parameters:

Command:	Motor Parameter:
DMTJ	rotor inertia
DMTSTT	static torque
DMTIND	inductance

3. Begin configuration with low values of DACTDP. Low values yield less aggressive damping.
4. Increase DACTDP until the system performs as you require. The optimum setting is DACTDP20. Note that higher values tend to cause overly aggressive damping, and generate jerk impulses that may result in machine vibration.

Configuring Encoderless Stall Detect Settings

You can use the GT6K's encoderless stall detect function to detect motor stalls. A stall occurs when the motor's rotor loses synchronism with the stator. An external feedback device is not required to detect stalls.

Some machine safety regulations require that external hardware feedback be used. Do not use the GT6K's stall detect function as a replacement for external feedback in such cases.

In order for the drive to detect a stall, the duration of the stall must be greater than 50 milliseconds. NOTE: if you use high values of active damping, extremely

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aggressive accelerations are possible during which the motor may skip poles (lose position). This loss of position can be less than 50 milliseconds; if so, it will not be recognized as a stall.

Because the command velocity must be in the 3 – 37 rps range for stall detect to be active, the drive will not recognize static loss of position as a stall. Therefore, do not use this function to detect loss of holding torque in vertical applications.

Settings are summarized below.

Stall Detect Settings:

Command:	DSTALL
Default:	Disabled (DSTALL0)
Velocity Range:	3 to 37 rps
Contributing Parameter:	LJRAT

Stall detect performance is based on motor parameters that you set up with Motion Planner. For optimum performance, accurate motor parameters are required.

If you select a Compumotor motor with Motion Planner, the motor parameters are set automatically, according to the motor you have chosen. If you use other motors, see *Appendix B – Using Non-Compumotor Motors*.

Use the following procedures to configure the stall detect settings.

Configuring Stall Detect

The DSTALL command sets the sensitivity for the stall detection circuitry. The default setting is *disabled*. (DSTALL0)

NOTE: Match the motor to the load (see the procedure on the following pages) *before* you configure stall detect settings.

1. Enter an accurate value for LJRAT.

   The LJRAT command sets the system's load-to-rotor inertia ratio. LJRAT must be set accurately in order for stall detect to function properly.

2. Begin configuration with low DSTALL values.

   - 1 - 50 is the full range
   - 0 is *off*

   The table below lists effective ranges of DSTALL values. Enter a value, based on your motor size:

Motor Frame Size:	**Size 23**	**Size 34**	**Size 42**
DSTALL Value Range:	1 – 15	10 – 40	30 – 50

3. Verify the DSTALL value you entered by forcing a stall as you monitor TASX. At the precise moment the stall occurs, TASX Bit #17 should be set. If Bit #17 is set before or after the stall occurs, modify the DSTALL value as follows:

   - If Bit #17 is set *before* the stall occurs, *decrease* the DSTALL value
   - If Bit #17 is set *after* the stall occurs, *increase* the DSTALL value

4. Run the system for an extended period of time to verify that no false stalls are detected.

Configuring Fault on Stall Mode

1. If you enable the Fault on Stall mode (ESK1), the occurrence of a stall will immediately stop pulses from being sent to the motor and will disable the drive (DRIVE0)
2. If Fault on Stall is enabled (ESK1), the stall is reported by the following commands:

   - TASX bit #17
   - TER bit #1

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Procedure for Motor Matching – GT6K

Due to slight manufacturing variations, each motor has its own particular characteristics. The drive has three settings—phase offset, balance and waveform—that can be adjusted to match the drive to a specific motor. The factory settings for these parameters will be acceptable in most applications. If you need increased smoothness or accuracy in your system, or if motor resonance causes vibration problems, perform the following procedure. You will match your drive to your motor by adjusting the drive settings, and selecting the best current waveform.

CAUTION

Verify correct series or parallel wiring. The label on the motor may be inaccurate if the motor has been rewired after it left the factory.

WARNING

The following procedure causes the motor shaft to rotate.

Setting Up Your System for the Motor Matching Procedure

Before beginning the *Motor Matching* procedure, set up your system as follows:

1. The *Motor Matching* procedure below is a *bench top* procedure—temporarily connect the drive, motor, and PC running Motion Planner, but do not permanently mount the components yet.
2. Properly secure the motor
3. Set the motor current at the value recommended for your motor.
4. Do not attach a load to the motor shaft, or anything else that affects or changes the inertia of the rotor. The characteristics you are matching are those only of the drive/motor combination.
5. Before beginning the *Motor Matching* procedure, you must use Motion Planner to configure the drive for your motor. See *Step 4* of *Chapter 2 Installation* for instructions.
6. Apply AC power when necessary to perform the steps below.

Motor Matching Procedure

1. Apply power to the drive, enable the drive, and allow the drive and motor to reach a stable operating temperature. This will take at least 5 minutes, and may take up to 30 minutes. For optimum results, perform the matching procedure at the same ambient temperature at which your application will operate.
2. Launch the *Interactive Motor Matching* procedure of Motion Planner.
3. Select the *PHASE A OFFSET* button. Note the recommended motor speed in the comment box.
4. Using the terminal emulator, set the motor speed to the recommended value for your motor.
5. Vary the motor speed about the recommended value, and find the most resonant operating speed. (Varying the speed makes resonance more noticeable.) You can find the *resonant speed* by touching the motor lightly with your fingertips as you vary the speed. When you notice the strongest vibrations and increased noise, the motor is running at a resonant speed. Note the actual speed; you will use it in the steps below. Return to *Interactive Motor Matching*.
6. Change the *PHASE A OFFSET* adjustment using the left and right arrow keys or by using the touch screen (if available). Adjust the offset for smoothest operation.
7. Select the *PHASE B OFFSET* button.
8. Change the offset adjustment using the left and right arrow keys or by using the touch screen (if available). Adjust the offset for smoothest operation.

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9. Select the *PHASE B BALANCE* button.
10. Using the terminal emulator, set the motor speed to one half the speed found in *Step 5*. Vary the motor speed about this setting, and find the most resonant operating speed. Return to *Interactive Motor Matching*.
11. Change the *PHASE B BALANCE* adjustment using the left and right arrow keys or by using the touch screen (if available). Adjust the balance for smoothest operation.
12. Repeat steps 3-10 if necessary.
13. Select the *WAVEFORM* button.
14. Using the terminal emulator, set the motor speed to one fourth the speed found in *Step 5*. Vary the motor speed about this setting, and find the most resonant operating speed. Return to *Interactive Motor Matching*.
15. Change the current waveform using the left and right arrow keys or by using the touch screen (if available). Adjust the current waveform for the smoothest operation.
16. Select the *OK* button when you are finished matching the drive to the motor. By selecting *OK*, you will be storing the adjusted values in the parameter configuration file. *Selecting the CANCEL button will return the adjusted values to the values previously stored in the configuration file.*

This completes the motor matching procedure.

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CHAPTER FOUR

4 Special Features

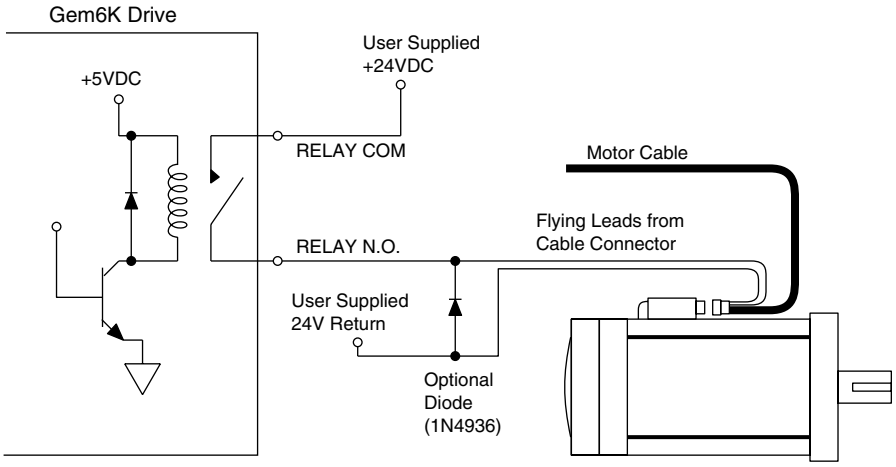
IN THIS CHAPTER

- Relay Connections
- Multiple Drive Installations
- V BUS± (GV6K Only)
- Regeneration and the GPDM (GV6K Only)
- Aligning the Resolver (GV6K Only)
- RS-232/485 and Ethernet Communications
- RP240, Master Encoder, and Expansion I/O
- Updating the Drive's Operating System

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Relay Connections (optional)

To use the Gem6K's internal relay, connect your external circuit to the RELAY COM and RELAY N.O. terminals. The next drawing shows a typical application—connecting a motor brake to the relay terminals.



Relay Connections

The relay is normally open. When the drive is enabled, it holds the relay closed. If the drive faults or is disabled, the relay will open.

Relay Operation:

Drive Condition:	**Relay State:**
Enabled	Closed
Faulted	Open
No AC power*, or not enabled	Open

* +24VDC power does not affect the relay. With +24VDC applied, the relay will be open if AC power is *not* applied.

Relay Specifications:

Relay Type:	Dry contact mechanical relay
	Normally open
Relay Rating:	5 amps at 24VDC or 120VAC

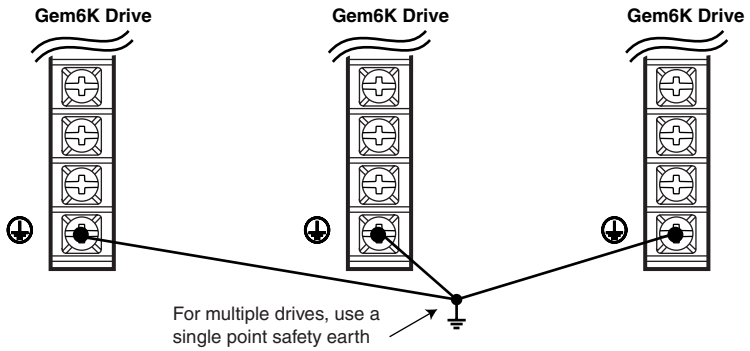
See the OUTFNC and OUTLVL commands in the *Gemini GV6K/GT6K Command Reference* for more information on configuring the relay.

Multiple Drive Installations (optional)

Safety Earth Connections

For multiple drive installations, we recommend a single point or "star" safety earth configuration, as shown in the next drawing.

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Multiple Drives: Single Point Safety Earth

Under normal operation, no current should flow through the safety earth connection.

Connecting V Bus±: Sharing the Power Bus (optional) (GV6K-U3n/6n/12n/H40n only)

You can connect the power buses of GV6K-U3n/6n/12n/H40n drives in parallel, through the V BUS+ and V BUS- terminals. With the buses connected in parallel, regenerated energy from one drive will be used by the other drives. (Do *not* connect GV6-H20n drives in parallel to each other or to other GemK or Gemini drives.)

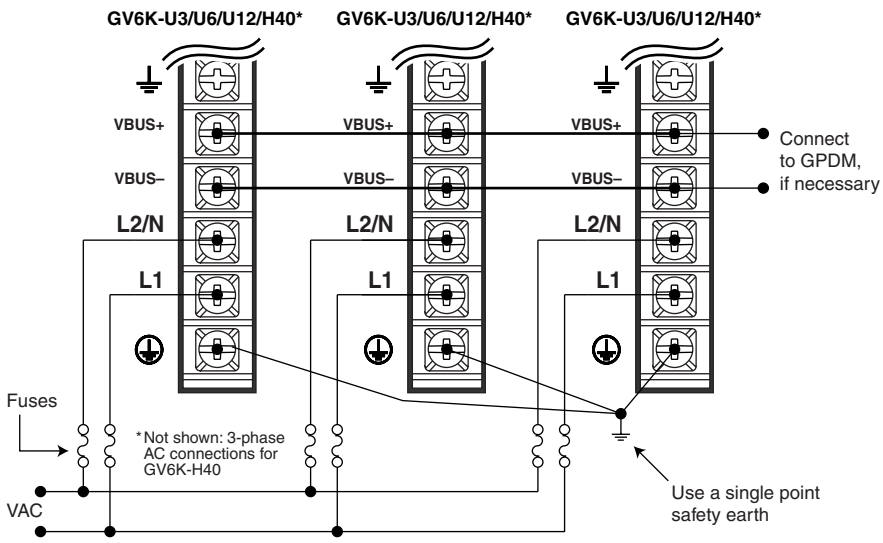
WARNING

V BUS+ and V BUS- terminals are at hazardous voltages when power is applied to the drive, and for up to 30 seconds after power is removed. Lower voltages may still be present for several minutes after power is removed. Reinstall the clear plastic terminal cover after you make connections.

CAUTION

Connect together only V BUS± terminals of drives that share the same fused AC power source, as shown in the next drawing.

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Sharing the Power Bus

If excess regenerated energy causes an overvoltage or regeneration fault, you can connect the Gemini Power Dissipation Module (GPDM) to the drive's V BUS± terminals. See *Regeneration Protection* below for connection instructions and more information about the GPDM.

NOTE: Because the GV6K has a current inrush limiter, we recommend that you do not add additional bus capacitance to V BUS+ and V BUS-.

Regeneration Protection

The following sections describe regeneration protection for GT6K and GV6K drives. The Gemini Power Dissipation Module is also described.

Regeneration with GV6K-L3n/H20n/H40n; GT6K-L5/L8

GV6K-L3n, GV6K-H20n, GV6K-H40n and all GT6K drives have internal circuitry to protect them from *regeneration*—energy from the load during deceleration. Excessive regeneration can cause:

- Regeneration Fault (if regeneration occurs for an extended period of time)
- Overvoltage Fault – GV6K Only (see *Overvoltage Protection* in *Appendix A Specifications*)

Specifications for regeneration protection are:

Drive	Dissipation (watts):	Maximum Pulse Energy	Activation Conditions Turn on:	Turn off:
GT6K-L5/L8	8W continuous 500W peak	1.3 KJ	218VDC	211VDC
GV6K-L3n	8W continuous 500W peak	1.3 KJ	200VDC	193VDC
GV6K-H20n	25W continuous (100W continuous at 40°C) 6KW peak	6 KJ	396VDC	385VDC
GV6K-H40n	150W continuous 9KW peak	9 KJ	396VDC	385VD
Results of Fault:	Latched fault; power to motor is turned OFF; fault output is activated LEDs: Left = illuminated RED; Right = off			

All temperatures in moving 50°C ambient air, unless otherwise noted.

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Regeneration with GV6K-U3n/U6n/U12n

GV6K-U3n/U6n/U12n drives do not have internal regeneration circuitry. Consequently, they cannot cause a regeneration fault. The drives can absorb the following amounts of regenerated energy in their internal capacitors:

Drive	Absorb (joules):	
GV6K-U3n	44 J	(from 340 – 410VDC: 1680 µF)
GV6K-U6n/12n	59 J	(from 340 – 410VDC: 2240 µF)

If excess regenerated energy causes overvoltage faults, you can connect the Gemini Power Dissipation Module (GPDM) to the V BUS± terminals of these drives. Regenerated energy from the drive will then be dissipated in the GPDM.

Gemini Power Dissipation Module (GPDM)

NOTE: The GPDM is designed for use with GV6K-U3n/U6n/U12n drives only. Do not use the GPDM with GV6K-L3n/H20n/H40n drives.

The GPDM dissipates excess regenerated energy in its internal resistors. If regenerated energy from the motor causes the drive's DC bus voltage to increase to 398VDC, the GPDM connects its resistors in shunt across the DC bus. Energy in the drive's capacitors is then dissipated as heat in the GPDM's resistors.

When the DC bus voltage decreases to 380VDC, the GPDM disconnects its resistors. If the motor continues to regenerate energy and the bus again rises to 398VDC, the process repeats until regeneration stops or a fault occurs.

The GPDM monitors three parameters, and generates a fault if any of the following are exceeded:

- maximum duty cycle
- maximum temperature
- maximum energy pulse

If the GPDM faults, it will disconnect itself from the DC bus and illuminate its red LED. Its internal fan will continue blowing. The GPDM will automatically clear the fault and reset itself within 10 seconds (an overtemperature fault may take longer to clear). When it resets itself, the GPDM will illuminate its green LED; the GPDM is then again ready to dissipate regenerated energy.

If regeneration continues while the GPDM is in a faulted state, the drive may experience an overvoltage fault. If you look for the cause of the drive overvoltage fault, be aware that it may have been caused by a prior GPDM fault—even though the left LED is now green.

If excessive regeneration continues to cause GPDM faults or drive faults, you can connect a second GPDM, as shown in the *GPDM Connections* drawing below.

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GPDM Specifications

Activation Conditions:	Turn on: 398VDC Turn off: 380VDC
Resistance:	Six 100 ohm resistors in parallel (16.7 ohm equivalent)
Continuous Dissipation:	300W in 25°C internal ambient
Maximum Dissipation:	9KW
Maximum Pulse Energy:	13KJ (pulse rating of resistors, repeatable, not to exceed continuous rating)
Weight:	3.1 pounds (1.4 kg)

GPDM LED Color Code:

Left:	Right:	Status:	
Green	Off	ready	
Green	Yellow*	active	
Red	Off	fault	(max. temperature, duty cycle, or pulse exceeded)

*Yellow LED may flash or be continuously illuminated until GPDM stops dissipating

GPDM Connection Instructions

WARNING

Sheet metal and exhaust air at the top of the enclosure are hot. Avoid contact.

WARNING

V BUS+ and V BUS- terminals are at hazardous voltages when power is applied, and for up to 30 seconds after power is removed. Lower voltages may still be present for several minutes after power is removed. Reinstall the clear plastic terminal cover after you make connections.

WARNING

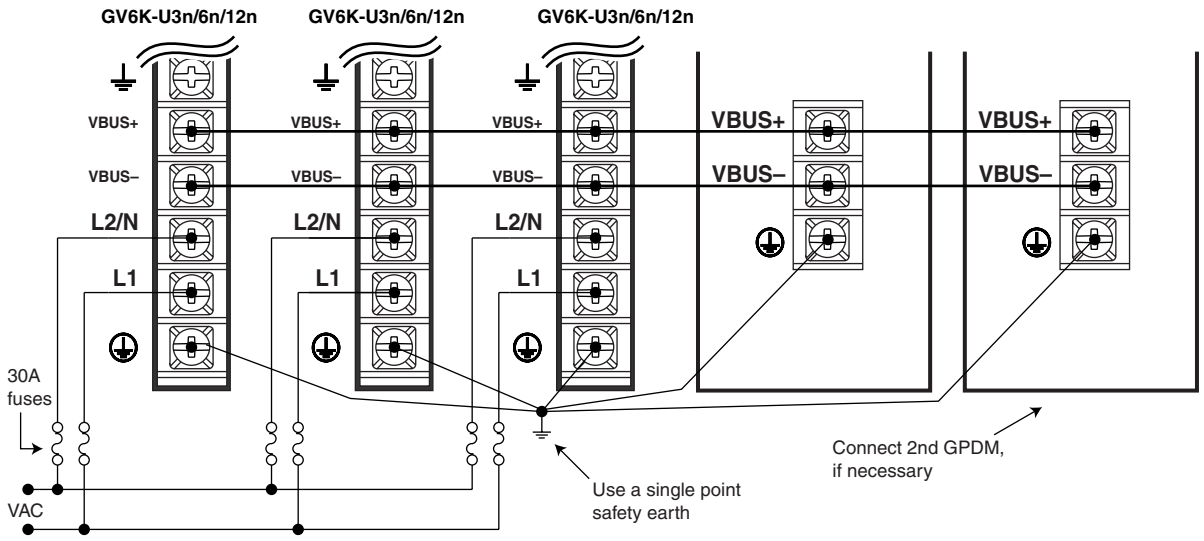
Only connect V BUS± terminals of drives that share the same fused AC power source, as shown in the next drawing.

Connecting the GPDM

1. Connect up to three GV, GV6 or GV6K Servo Drives to one GPDM. (Connect *only* GV(6)(K)-U3n/U6n/U12n drives; do not connect any other drives to the GPDM.)
2. Connect drive V BUS+ terminals to V BUS+ on the GPDM.
3. Connect drive V BUS– terminals to V BUS– on the GPDM.
4. For multiple drives, connect drive safety earth terminals to a single point ground.
5. Keep connections between drive and GPDM less than 12 inches (300 mm). Use 14 AWG (2.5 mm^2) or greater diameter wire.

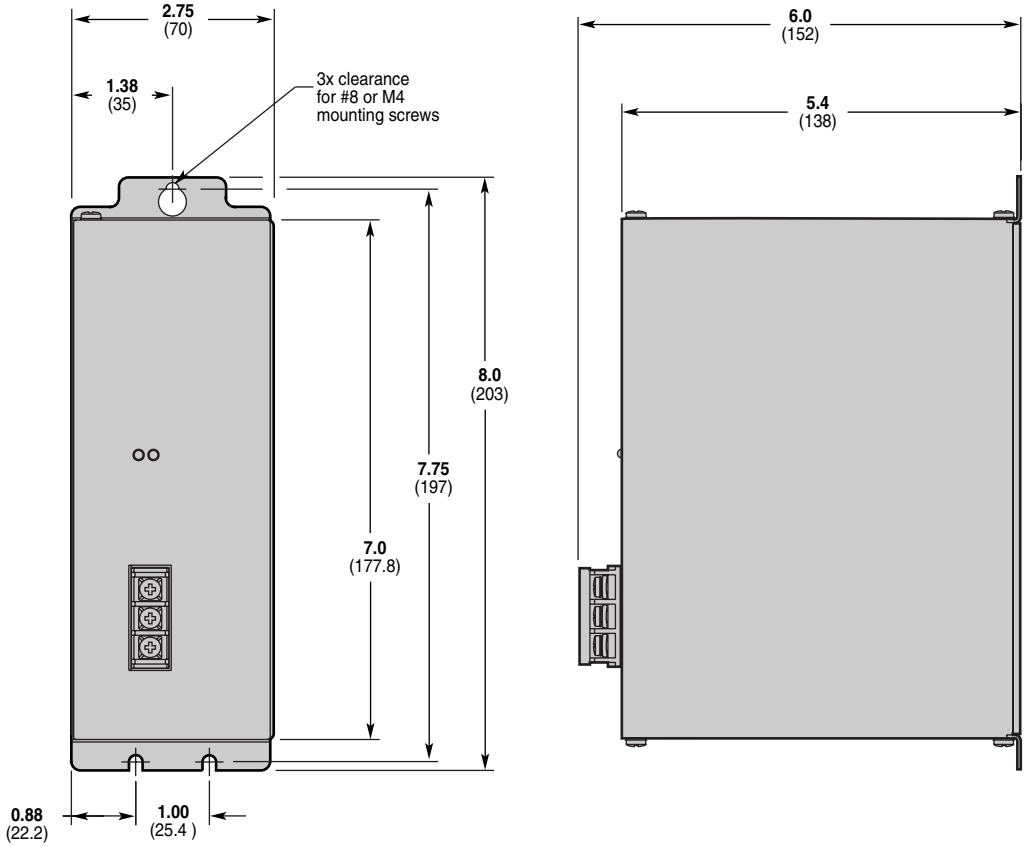
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The next figure shows a typical installation.



GPDM Connections

The next figure shows GPDM dimensions.



Dimensions – GPDM Power Dissipation Module

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Aligning the Resolver – GV6K Servos (optional)

Resolvers on Compumotor motors are aligned at the factory. Ordinarily, no further alignment is required. However, you may wish to align the resolver if you suspect the resolver is misaligned, or if you are using a non-Compumotor motor.

A Note About Resolver Speed

Resolver speed describes the relationship between resolver *electrical* revolutions and shaft *mechanical* revolutions. For example, if one resolver electrical revolution is equal to one shaft mechanical revolution, the resolver is a "single speed" or "one speed" resolver. If two electrical revolutions equal one mechanical revolution, the resolver is a "two speed" resolver.

The following alignment procedures assume you have configured the drive with an accurate resolver speed value. For Compumotor motors, resolver speed is loaded from the motor configuration file.

Resolver Alignment Procedures

There are three methods to align the resolver:

- Method 1 – Enter a known resolver offset angle.
- Method 2 – Find an unknown resolver offset angle, and store it in the drive's nonvolatile memory.
- Method 3 – Loosen the resolver cleats and rotate the housing while monitoring offset angle. Secure the housing when the angle is zero degrees.

Details for these methods are given below.

Method 1 – Entering a Known Offset Angle

1. Disconnect the load from the motor shaft. The shaft should be free to rotate.
2. Issue an SRSET command; include the desired offset angle. For example, entering SRSET10 automatically sets the offset angle to 10 resolver electrical degrees.

WARNING

The SRSET command takes effect immediately. If you set the offset angle incorrectly the system may become unstable.

3. Issue a DRESET command. The drive stores the value for the offset angle into nonvolatile memory. It uses this value for all future operations. You do not need to perform this procedure again.

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Method 2 – Finding an Unknown Offset Angle

Use this method if you do not know your resolver's offset angle.

1. Disconnect the load from the motor shaft. The shaft should be free to rotate.
2. Verify correct motor wiring. See the *Gemini Motor Reference Manual* for wiring information for Compumotor motors.
3. Configure the drive for your motor, as described in *Chapter 2 Installation*. If you use a non-Compumotor motor, create and download a motor configuration file for your motor.
4. Enable the drive.
5. Issue a DMODE13 command to put the drive into autorun mode. The motor should begin turning clockwise at approximately 1 rps, as viewed from the shaft end of the motor. If the motor turns in the wrong direction or at the wrong speed, check the motor wiring, and verify correct motor pole configuration (DPOLE command).
6. Issue a DMODE11 command to put the drive into alignment mode. The motor will stop turning.
7. Issue an SRSET command. The motor may turn as much as 1/2 revolution. It will stop when the motor magnetic poles align.
8. Disable the drive. Upon being disabled, the drive stores the value for the offset angle into nonvolatile memory. It uses this value for all future operations. You do not need to perform this procedure again.
9. Return the drive to the appropriate mode of operation (DMODE command).

Method 3 – Rotating the Resolver Housing

Use this method to manually rotate the resolver to a specific offset angle (usually zero degrees).

1. Disconnect the load from the motor shaft. The shaft should be free to rotate.
2. Verify correct motor wiring. See the *Gemini Motor Reference Manual* for wiring information for Compumotor motors.
3. Configure the drive for your motor, as described in *Chapter 2 Installation*. If you use a non-Compumotor motor, create and download a motor configuration file for your motor.
4. Enable the drive.
5. Issue a DMODE13 command to put the drive into autorun mode. The motor should begin turning clockwise at approximately 1 rps, as viewed from the shaft end of the motor. If the motor turns in the wrong direction or at the wrong speed, check the motor wiring, and verify correct motor pole configuration (DPOLE command).
6. Issue a DMODE11 command to put the drive into alignment mode. The motor will stop turning.
7. Issue an SRSET command. The motor may turn as much as 1/2 revolution. It will stop when the motor magnetic poles align.
8. Loosen the cleats that hold the resolver housing onto the motor.
9. Issue a TSROFF command repeatedly as you slowly turn the resolver housing. The TSROFF command indicates the present resolver offset angle.
10. Turn the resolver housing until the offset angle is zero degrees (or until you obtain your desired offset angle).
11. Tighten the cleats.
12. Disable the drive. Upon being disabled, the drive stores the value for the offset angle into nonvolatile memory. It uses this value for all future operations. You do not need to perform this procedure again.
13. Return the drive to the appropriate mode of operation (DMODE command).

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RS-232/485 Communications

The Gem6K uses an ASCII language for communication. Gem6K drives can be connected together in RS-232 Daisy Chains and RS-485 Multi-Drop configurations.

In this section:

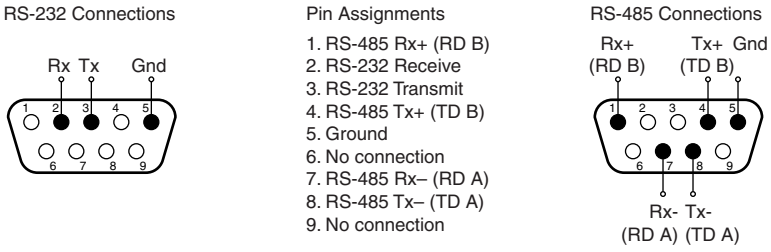
- Establishing Communications
- Configuring the Serial Ports
- RS-232 Communications
- RS-232 Daisy Chaining
- RS-485 Communications (COM1 only)
- RS-485 Multi-Drop (COM1 only)

Establishing Communications

The Gem6K has two serial ports located on the front of the drive. Both are 9 pin D-connectors. One is labeled "RS-232/485"; this port is referred to as COM1. The other is labeled "RS-232"; this port is referred to as COM2.

RS-232/485 Connector

You can use the RS-232/485 connector (COM1) for either RS-232 or four wire RS-485 communications, as shown below.

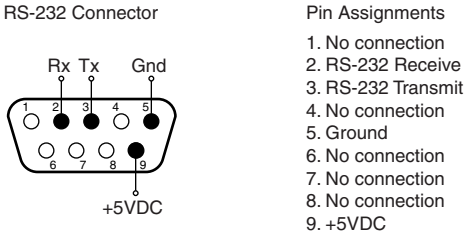


RS-232/485 Connector (COM1) – Connections

To communicate with the Gem6K, connect its RS-232/485 connector to a PC running Motion Planner, or other terminal emulation software. Verify your computer's connector pinout; you may need to use a "null modem" cable to connect your computer's transmit terminal to the Gem6K's receive terminal, your computer's receive terminal to the Gem6K's transmit terminal, and your computer's ground terminal to the Gem6K's ground terminal.

RS-232 Connector—and the RP240 Remote Operator Panel

You can use the RS-232 connector (COM2) for RS-232 communications (but ***not*** RS-485), or to connect an RP240. Its pinout is shown in the next drawing.



RS-232 Connector (COM2) – Connections

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Issue these commands to configure the RS-232 connector for use with an RP240:

```
PORT2      ; Select the RS-232 connector (COM2) as the port affected by
           ; the DRPCHK1 command.
DRPCHK1    ; On power up, check for RP240 on COM2.
```

NOTE: The +5VDC output on Pin 9 has short circuit protection/inrush current protection. If you plug in the RP240 while power is applied, the protection circuit may sense the inrush current and shut down the +5VDC output. To recover from this condition, you may need to cycle power or reset the drive.

Configuring the Serial Ports

To control the applicable port for setting up serial communication and transmitting ASCII text strings, use the PORT command:

```
PORT1      ; Selects the RS-232/485 connector (COM1)
PORT2      ; Selects the RS-232 connector (COM2)
```

The following commands can be used to configure the Gem6K serial ports and the terminals used by Motion Planner. Complete descriptions of these commands can be found in the *Gemini GV6K/GT6K Command Reference*.

DRPCHK	RP240 Check
E	Enable Serial Communication
ECHO	Enable Communication Echo
BOT	Beginning of Transmission Characters
BAUD	Serial Communication Baud Rate
EOT	End of Transmission Characters
EOL	End of Line Terminating Characters
ERRBAD	Error Prompt
ERRDEF	Program Definition Prompt
ERRLVL	Error Detection Level
ERROK	Good Prompt
XONOFF	Enable or disable XON/XOFF

- The default baud rate for the Gem6K is set at 9600. The RS-232/485 connector (COM1) only supports 9600 baud. The RS-232 connector (COM2) supports other baud rates; see the BAUD command for more information.
- The Gem6K'S RS-232/485 connector (COM1) contains connections for both RS-232 and RS-485 communication. The Gem6K will automatically switch between RS-232 and RS-485 mode depending on which connections in the port's 9 pin D-connector are active. See wiring diagrams. The RS-232 connector(COM2) only supports RS-232 communication.
- Some RS-232 cables use hardware handshake signals that are used by the RS-485 pins. The RS-485 interface will automatically disable itself if this is detected. If this occurs, you must reset the drive to re-enable the RS-485 interface.
- Enabling Ethernet communications (NTFEN1) will disable the RS-232/485 connector (COM1).

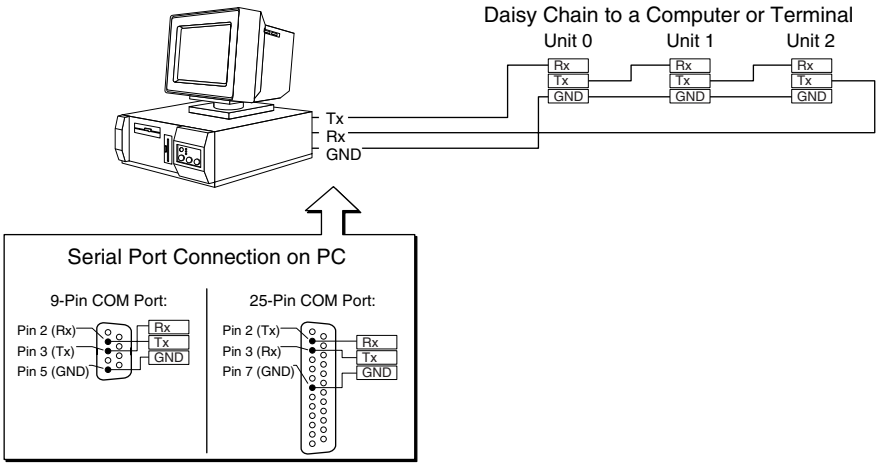
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RS-232 Communications

Pin Out for RS-232 Communication:

Pin	Description
2	Rx (receive). Connect to Tx on your computer.
3	Tx (transmit). Connect to Rx on your computer.
5	GND (logic ground). Connect to GND on your computer

- Maximum RS-232 cable length is 50 feet (15.25 meters)
- To establish unique addresses for daisy chained units, use the ADDR command.



RS-232 Daisy Chain Connections

RS-232 Daisy Chaining

Up to ninety-nine stand-alone Gem6K drives may be daisy chained. You can use either the RS-232/485 connector (COM1) or the RS-232 connector (COM2) for daisy chaining.

There are two methods of daisy chaining: one uses a computer or terminal as the master controller in the chain; the other uses a Gem6K as the master controller.

Follow the steps below to implement daisy chaining with a terminal as the master. (See the *Programmer's Guide* for details on using a Gem6K as master controller.)

Step 1

Connect the daisy chain with a terminal as the master. (See the previous drawing.)

To enable and disable communications on a particular drive unit in the chain, you must use the Daisy Chain Address (ADDR) command to establish a unique device address for each unit. The ADDR command automatically configures unit addresses for daisy chaining. This command allows up to 99 units on a daisy chain to be uniquely addressed, starting with Address 1.

Sending ADDRi to the first unit in the daisy chain sets its address to be (i). The first unit in turn transmits ADDR(i + 1) to the next unit to set its address to (i + 1). This continues down the daisy chain until the last unit of (n) daisy chained units has its address set to (i + n).

Note that only a drive with the device address of zero (0) will send an initial power-up start message. (ADDR0 is not normally used in a daisy chain.)

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Step 2

The error level must be set to 1 for all units on the daisy chain (ERRLVL1). When the error level is not set to 1, the unit sends ERROK or ERRBAD prompts after each command, which makes daisy chaining impossible. Send the ERRLVL1 command to each unit in the chain. (NOTE: To send the ERRLVL1 command to one specific unit on the chain, prefix the command with the appropriate unit's device address and an underline.)

Example Commands:

```
PORT1          ; Select the "RS-232/485" connector (COM1), as the port affected
               ; by the following commands.
1_ERRLVL1      ; Set error level to 1 for unit #1
2_ERRLVL1      ; Set error level to 1 for unit #2
3_ERRLVL1      ; Set error level to 1 for unit #3
```

After this has been accomplished, a carriage return sent from the terminal will not cause any unit to send a prompt. Verify this.

To send a command to all units on the daisy chain, send the command from the master terminal:

Example Commands:

```
OUT1111        ; Turn on onboard outputs 1 – 4 on all units
A50            ; Set acceleration to 50 for all units
```

To send a command to one particular unit on the daisy chain, prefix the command with the appropriate unit's device address and an underline:

Example Commands:

```
2_OUT0         ; Turn off onboard output 1 on unit #2
4_OUT0         ; Turn off onboard output 1 on unit #4
```

To receive data from one particular unit on the chain, prefix the command with the appropriate unit's device address and an underline:

Example Commands:

```
2_ERES         ; Request drive resolution from unit #2
*ERES4000      ; Response from unit #2
```

Use the E command to enable/disable RS-232 communications for an individual unit. If all drive units on the daisy chain are enabled, commands without a device address identifier will be executed by all units. Because of the daisy chain's serial nature, the commands will be executed approximately 1 millisecond per character later on each successive unit in the chain (assuming 9600 baud).

Units with RS-232 disabled (EØ) will not respond to any commands, except E1; however, characters are still echoed to the next device in the daisy chain.

Example Commands:

```
3_E0           ; Disable RS-232 on unit #3
ERES2000       ; Set encoder resolution to 2000 on all other units
3_E1           ; Enable RS-232 on unit #3
3_ERES4000     ; Set encoder resolution to 4000 on unit #3
```

Verify communication to all units by using the techniques described above.

Step 3

Now that you have verified that the daisy chain is set up properly, you can use the various Motion Planner tools to configure, program and monitor all units on the daisy chain. Alternatively, units can be programmed individually by connecting the master terminal to one unit at a time.

Additional Instructions

For more information, see *RS232-C Daisy Chaining* in the *Programmer's Guide*.

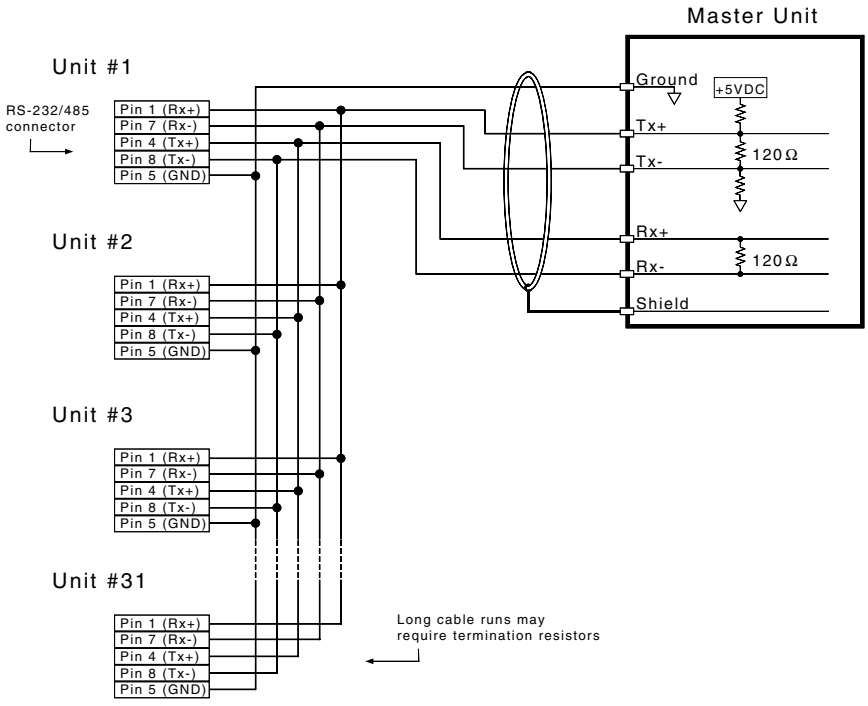
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RS-485 Communications (COM1 Only)

Pin Out for 4-Wire RS-485 Communications:

Pin	Description
1	Rx+ (also called RD B)
4	Tx+ (also called TD B)
5	GND (logic ground)
7	Rx- (also called RD A)
8	Tx- (also called TD A)

- Maximum RS-485 cable length is 4000 feet (1220 meters).
- To establish unique addresses for multi-drop units, use the ADDR command.
- Keep wires as short as possible. Termination resistors may be required on long cable runs.
- Connect RS-485 cables before applying power to the drive.
  (Reconnecting the cables with power applied may cause the drive to interpret intermittent connections as RS-232 hardware handshake signals; this may result in shutdown of the RS-485 interface. If this happens, reset the drive to re-enable the RS-485 interface.)
- Recommended cable: Belden 9842.
- Refer to the diagram below for connection information.



RS-485 Multi-drop Connections

RS-485 Multi-Drop (COM1 Only)

Up to 99 Gem6K drives may be multi-dropped. You ***must*** use the RS-232/485 connector (COM1) for multi-drop connections. (See the previous drawing.)

The ADDR command allows you to establish up to 99 unique addresses. To use the ADDR command, you must address each unit individually before it is connected on the multi drop. For example, given that each product is shipped configured with address zero, you could set up a 4-unit multi-drop with the commands below, and then connect them in a multi drop:

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1. Connect the unit that is to be unit #1 and transmit the Ø_ADDR1 command to it.
2. Connect the unit that is to be unit #2 and transmit the Ø_ADDR2 command to it.
3. Connect the unit that is to be unit #3 and transmit the Ø_ADDR3 command to it.
4. Connect the unit that is to be unit #4 and transmit the Ø_ADDR4 command to it.

If you need to replace a unit in the multi drop, send the Ø_ADDRi command to it, where "i" is the address you wish the new unit to have. For RS-485 multi-drop to work properly, each drive must have echo mode turned off (ECHOØ).

In order to prevent the collision of prompts being transmitted simultaneously from several drives in response to a global command, you must configure the drives for either error level 2 or error level 0 in multi-drop mode. This can be done as follows:

Commands:

```
1_ERRLVL2       ; Set error level to 2 for unit #1
2_ERRLVL2       ; Set error level to 2 for unit #2
3_ERRLVL2       ; Set error level to 2 for unit #3
```

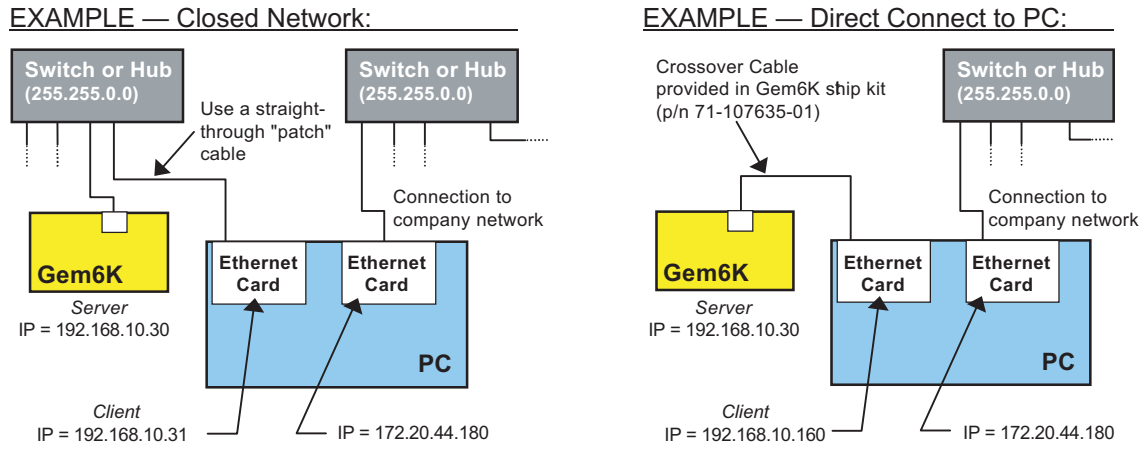
In general, to send a Gem6K command from the master unit to a specific unit in the multi-drop, prefix the command with the unit address and an underscore (e.g., 3_ERES4000 sets the encoder resolution to 4000 on unit #3). The master unit may receive data from a multi-drop unit. You should now verify that you can access each unit on the multi-drop.

Now that you have verified that the multi-drop is set up properly, you can use the various Motion Planner tools to configure and monitor all units on the multi-drop.

Ethernet

The Gem6K is equipped for Ethernet communication. It includes 10Base-T (10Mbps twisted pair) TCP/IP protocol. The default IP address is 192.168.10.30.

The Ethernet connector is an RJ-45 connector located on the Gem6K's front panel. The next drawing shows connections for a closed network, and for connecting the Gem6K directly to a PC.



Ethernet Connections

Status LEDs: Green LED is on when the Ethernet physical connection is OK.

Yellow LED is on when the Gem6K is transmitting over the Ethernet interface

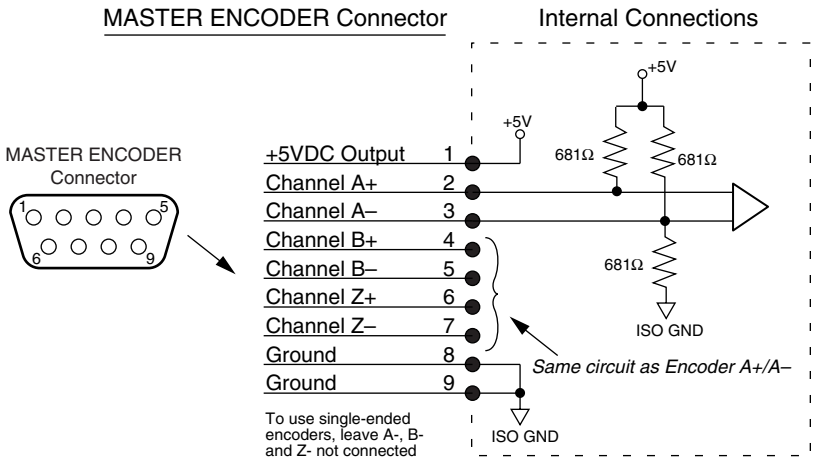
For complete information about using Ethernet with the Gem6K, see the *Ethernet* section of the *Programmer's Guide*.

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Master Encoder

The master encoder is used for Following only—*not* for servo feedback or stepper stall detect.

The pinout for the 9 pin D-connector is shown below.



Master Encoder Connections

Expansion I/O

EVM32-II I/O modules (or "bricks") are sold as accessories to the Gem6K. The EVM32-II provides more I/O than the Gem6K offers onboard. Up to eight DIN-rail mountable EVM32-II bricks can be connected in a serial chain to the Gem6K. Each EVM32-II brick can hold from one to four I/O SIM boards in any combination (each SIM board provides eight I/O points, for a total of 32 I/O points per I/O brick.)

NOTE: Instructions in this section also apply to the EVM32.

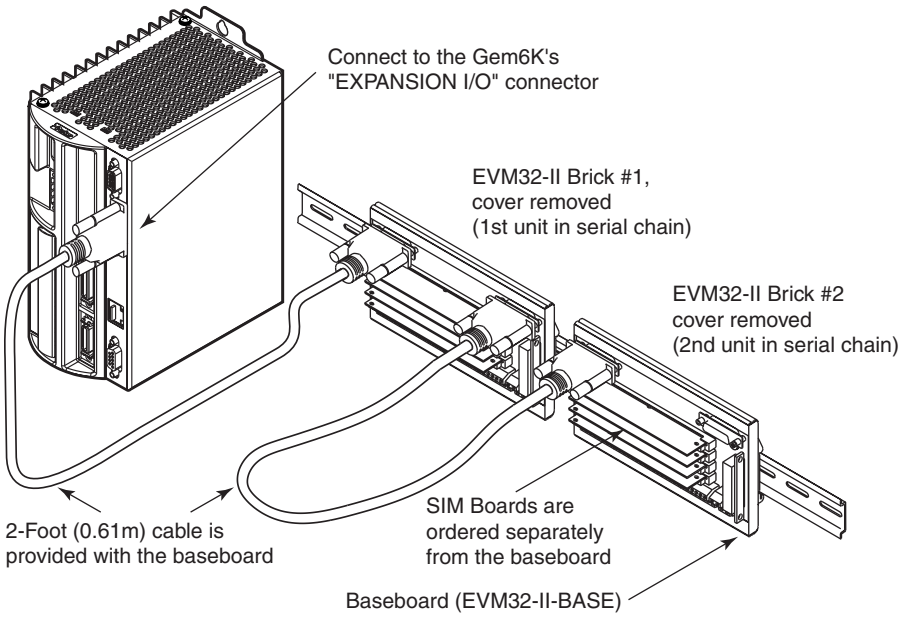
EVM32-II Connection Instructions

CAUTION

Remove power to the Gem6K and the EVM32-II baseboard before:
- Installing or removing SIM boards on the EVM32-II baseboard
- Connecting or disconnecting the EVM32-II baseboard to the Gem6K or to other EVM32-II units
- Connecting inputs and outputs to the EVM32-II

Connect EVM32-II modules to the Gem6K's EXPANSION I/O connector, as shown in the next diagram.

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EVM32-II Connections

For EVM32-II or SIM dimensions, power requirements, specifications, etc., see the documentation that accompanied your EVM32-II or SIM module.

Disconnecting EVM32-II I/O Bricks

If the EVM32-II I/O brick is disconnected (or if it loses power), the Gem6K will perform a kill (all motion and program execution on all tasks) and set error bit #18 (reported with the TER, TERF, and ER commands). The Gem6K will remember the brick configuration (volatile memory) in effect at the time the disconnection occurred. When you reconnect the I/O brick, the drive checks to see if anything changed (SIM by SIM) from the state when it was disconnected. If an existing SIM slot is changed (different SIM, vacant SIM slot, or jumper setting), the drive will set the digital input SIMs and digital output SIMs to factory default INEN and OUTLVL settings, respectively. If a new SIM is installed where there was none before, the new SIM is auto-configured to factory defaults.

To check the status of one or more EVM32-II I/O bricks, use the TIO command.

Updating the Drive's Operating System

The Gem6K runs under an internal software operating system (firmware). The operating system was loaded into your drive during the manufacturing process, and under ordinary circumstances you will not need to update your drive's operating system. However, because Compumotor continues to add enhancements, you may want to upgrade the operating system. You may obtain a new operating system file from the Compumotor web site, or from Technical Support (see phone numbers on the inside cover of this manual).

NOTE: To download the operating system to the drive, you must use the 9-pin connector labeled RS-232 (which is COM2). Do not use the connector labeled RS-232/485.

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Web Site Download

The operating system file is located in the software download section of the *Compumotor Online* web site (http://www.compumotor.com). For example, the operating system file for version 6.0 is called 6kos6p0.ops. Download the file to the Motion Planner directory on your hard drive.

Update Procedure

1. Using the Gem6K's RS-232 connector (COM2), connect to your computer's RS-232 serial communication port.

   NOTE: You can download the operating system to only one drive unit at a time and you must use RS-232 communication (no daisy chains).

   NOTE: You must use the Gem6K's RS-232 connector (COM2), not the RS-232/485 connector (COM1).
2. Launch Motion Planner
3. In the Default Communications Settings dialog box, select your Gem6K drive and select the PC's serial port to which the drive is connected, then click "OK".
4. Click on the Terminal tab to expose the terminal emulator.
5. From the Communications pull-down menu, select Download OS. When presented with the Locate Gem6K Operating System dialog, locate the operating system file and click the Open button. This initiates the download to the drive and displays the download status dialog.
6. When the download is completed successfully, Motion Planner displays a confirmation message. Also, the drive automatically resets itself and displays the power up message. Check the TREV report to verify that the proper operating system revision is now in the drive (e.g., the response:

   *TREV92-016740-01-6.0 GEM6K GV6K-L3E D1.74 F1.62

   indicates that the drive is using OS revision 1.74, denoted by "D1.74").

NOTE: If the download is interrupted or corrupted, the drive will flash the left LED (red) until a valid operating system is downloaded.

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CHAPTER FIVE

5 Troubleshooting

IN THIS CHAPTER

- LED Status
- Software Commands for Troubleshooting
- RS-232/485 Troubleshooting
- System Problems

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Troubleshooting Guidelines

If your system is not functioning properly, first try these steps.

First Troubleshooting Steps:

- Are the LEDs illuminated? If not, look for problems with AC and/or +24VDC power. Also see *System Problems* at the end of this chapter.
- Is the left LED illuminated RED? Try to enable drive by connecting pins 1 and 2 of the 50 pin DRIVE I/O connector, and issuing a DRIVE1 command.
- Cycle power to the drive. Cycling power clears most faults.
- Check wiring and feedback connections

If these steps do not solve your problem, follow the general troubleshooting procedure outlined below:

General Troubleshooting Procedure

- Check the LEDs (see the chart below)
- Launch Motion Planner
- Verify good RS-232/485 communications
- Use software commands for problem identification:

TERRLG	reports the last 10 error conditions
TAS	reports on axis status
TASX	extended reports on axis status and conditions
TCS	reports codes for specific faults and warnings

- Look for non-Drive problems (problems with other parts of the system)

Detailed procedures for each of these topics are given in the rest of this chapter.

LEDs

The drive has two LEDs. The LED on the left can be red or green. The LED on the right can be yellow or green. LED illumination states, and the conditions they indicate, are tabulated below.

Left LED (Green/Red)	Right LED (Yellow/Green)	Indicated Condition:
Red	Green	+24VDC only
Red	Yellow	AC only
Green	Green (flashing)	Motion in progress
Green	Yellow/Green (flashing)	Autorun mode
Red	Off	Drive not enabled; or, Drive faulted
Off	Yellow	Initializing
Green	Off	Drive ready

Establish Communications and Verify Drive Configuration

If you cannot enable the drive, and examining LED conditions has not solved your problem, then establish communications with the drive and launch Motion Planner. (See *Chapter 2 Installation* for detailed instructions on establishing communications. Information about installing and Motion Planner can be found in the *Gemini GV6K/GT6K Command Reference*.)

If you are unable to establish communications, see *RS-232/485 Communication Problems* later in this chapter.

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Reconfigure the Drive

To verify proper configuration, you may wish to reconfigure the drive. Pay particular attention to selecting proper configuration settings for the motor that you have installed, as motor configuration problems can cause a variety of errors. Download the new configuration to the drive; the changes will become effective after you issue a RESET, DRESET or cycle power. (A simplified configuration procedure was presented in *Chapter 2 Installation*. For full configuration information, see *Chapter 3 Configuration*.)

Software Commands for Troubleshooting

Four software commands are very useful for identifying problems. This section provides guidelines and tips for using these commands. For full command descriptions and tables of error codes, see the *Gemini GV6K/GT6K Command Reference*.

TERRLG – Transfer Error Log

The TERRLG command displays the last ten error conditions. It is updated every time an error occurs, if you have chosen that error to be included in the error log (see the ERRORL command). You may want to make a note of the errors listed the first time you issue the command, as this original information will be written over as subsequent errors occur.

You can use the CERRLG command to clear the contents of the error log. This allows you to start the diagnostic process when the error log is in a known state.

TAS – Transfer Axis Status

The TAS command returns the status of all axes, in the form of a 32 bit response (1 = Yes; Ø = No). Note the positions of bits that are "1" rather than "0"—they indicate problem areas, some of which are:

Status Condition:	Solution:
Drive shut down	If this is the only bit that is set, it indicates that the drive is waiting to be enabled. To enable the drive, connect pins 1 and 2 of the DRIVE I/O connector, and issue a DRIVE1 command.
Drive faults occurred	To identify which faults occurred, check the TASX command. (See following section.)
Hardware limit hit	The default is for limits to be disabled. If these bits are set, install or check limit switches; or disable limits with the LHØ command.
Position error exceeded	During tuning, you may want to disable position error by setting SMPER to zero. To help protect the motor from damage, restore SMPER to an appropriate value when you complete tuning.

See the *Gemini GV6K/GT6K Command Reference* for the complete list of status conditions.

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TASX – Transfer Extended Axis Status

The TASX command returns the axis status conditions. It reports more information than the TAS command, and is helpful for identifying which faults occurred. It returns a 32 bit response (1 = Yes; Ø = No). Note the positions of bits that are "1" rather than "0"—they indicate problem areas, some of which are:

Bit #:	Fault:	Solution:
1	Motor temperature fault	Thermal switch in motor is open; motor is hot
2	Low voltage fault	Check acceleration; AC power wiring and input level
3	Drive temperature fault	Check ventilation; ambient temperature
5	Resolver failed	Check resolver wiring.
7	Configuration error	Drive cannot operate as configured. See TCS command, below.
9	Velocity error limit exceeded	Check mechanics for jam; check tuning. Raise limit.
10	Bridge fault	Check motor wiring for short circuit. (See note below.)
11	Bridge I^2t fault	Current model indicates bridge is hot
12	Overvoltage (bus voltage)	Reduce deceleration (or install GPDM for regeneration on GV6K-U3n/U6n/U12n).
18	Override mode invoked	Velocity override (torque mode) or torque override (velocity mode) was invoked. Check mechanics. (Warning only: does not light LED or stop motion.)
19	Bridge foldback	Output current was reduced, to decrease dissipation. (Warning only: does not light LED or stop motion.)
20	Power Dissipation active	GT6K, GV6K-L3n, GV6K-H20n and GV6K-H40n only. Internal regeneration circuit was active. Check deceleration. (Warning only: does not light LED or stop motion.)
21	Bad Hall state	Bad state (111 or 000) was detected. Check Hall wiring.
22	Unrecognized hardware	Consult factory
23	User fault	Indicates user fault input was active.
24	Keep Alive active	Not a fault; indicates +24VDC power at input.
25	Power dissipation fault	Indicates excessive regeneration (GV6K-L3n, GV6K-H20n/H40n only). Check deceleration, load inertia.
28	Configuration warning	Drive altered a user entered value. See TCS command. (Warning only: does not light LED or stop motion.)
29	Encoder output failure	ORES is set too high for velocity commanded
30	Motor thermal model fault	Thermal model indicates motor is hot
31	Torque/force is at limit	Commanded torque/force has reached limit set by DMTLIM (TTRQ = DMTLIM). Not a fault condition.

(NOTE: Bridge fault can also indicate output bridge overheating (except in GV6K-L3n). To test, check drive heatsink temperature; allow drive to cool, then reset drive. If fault remains, it is due to a short circuit—check motor and motor wiring. If fault reoccurs after several minutes, it may be due to restricted airflow over the drive's heatsink.)

See the *Gemini GV6K/GT6K Command Reference* for the complete list of status conditions.

TCS – Transfer Configuration Status

If the TASX command indicates a configuration error or warning, use the TCS command to help ascertain the cause of the condition.

NOTE: TCS reports only one error code; errors will overwrite warnings. Therefore, if there is more than one error condition present:

1. Resolve the known error.
2. Cycle power to the drive, issue a RESET command, or activate the RESET input.
3. If another error condition presents itself (e.g., the drive will not enable), check for subsequent errors with the TCS command.

See the *Gemini GV6K/GT6K Command Reference* for the complete list of faults and warnings.

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RS-232/485 Communication Problems

If you cannot establish RS-232 or RS-485 communications, the next sections give instructions for procedures to help isolate problems.

Testing the COM Ports

Install and launch Motion Planner. See *Chapter 2 Installation* for information about using this software tool.

RS-232 communications require that you use a null modem cable. See *Chapter 2 Installation* for connection instructions. Pinout diagrams for the Gem6K's RS-232/485 and RS-232 connectors are in *Chapter 4 Special Features*.

Testing the COM Ports with Motion Planner

1. Install and launch Motion Planner.
2. When the product selection dialog appears, select a Gem6K drive and select the PC COM port to which the Gem6K is connected.
3. If you see the error message "unable to connect to com *n*", then the wrong PC COM port is selected, or the PC COM port is busy.
    - Check the PC COM port setting again. Your PC may have multiple COM ports. Try connecting to a different port.
    - Check to see if another application is busy using the COM port. Close all other applications.

If these steps do not solve your problem, see *Testing the Cable*, below.

Testing the Cable

Use the following two procedures to test your null modem cable, and to verify that it is working properly.

"Loop Back" Test

1. Connect one end of your RS-232 cable to your PC. Disconnect the other end of the cable from the drive.
2. Connect pin 2 to pin 3 on the drive end of the RS-232 cable.
3. Launch Motion Planner and click the "Terminal" tab on the bottom of the screen to enter terminal mode.
4. Type several characters on the keyboard. These characters should appear on the terminal screen as you type them.

If you are continuing to have trouble with communications, proceed to *Verifying a Null Modem Cable*.

Verifying a Null Modem Cable

1. Connect one end of your RS-232 cable to your PC. Disconnect the other end of the cable from the drive.
2. With no data being transmitted, measure the voltage on the RS-232 cable's transmit pin (should be pin 2). The voltage on the transmit pin should be in the range -3VDC to -12VDC.
3. Measure the voltage on the RS-232 cable's receive pin (should be pin 3). The voltage on the receive pin should be zero volts.
4. Verify that the cable's transmit pin connects to Pin 2 on the Gemini's RS-232/485 connector.

This completes the test.

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RS-232 Daisy Chain and RS-485 Multi-Drop Problems

For more information about RS-232 daisy chain and RS-485 multi-drop problems, see *RS-232/485 Communications* in *Chapter 4 – Special Features*.

System Problems

If your Gem6K drive is functioning properly, other parts of your system may be causing problems. It may be difficult to identify where the problem is coming from. To diagnose system problems, we recommend that you first have the drive perform its autorun function. Then check the other topics in this section.

Using Autorun Mode to Isolate Problems

In autorun mode, the motor runs open loop—the Gem6K drive generates its own internal control signal, and commands the motor to turn clockwise at 1 revolution per second.

NOTE: In autorun mode, the drive limits current to 90% of drive rating or continuous motor current rating, whichever is lower.

Follow these steps to put the drive in autorun mode, which will verify that the drive is functioning properly, and is not the source of the problem.

1. Disconnect the load from the motor.
2. Perform these procedures from *Chapter 2 Installation*:
   - Connect the Motor (power and feedback)
   - Connect AC and +24VDC Power
   - Configure the Drive

   The final step in “Configure the Drive” is issuing a DMODE13 command, which configures the drive for autorun.
3. Enable the drive by connecting Pin 1 to Pin 2 on the drive’s 50 pin DRIVE I/O connector. NOTE: connecting pin 1 to pin 2 may require that you use a breakout module, such as Compumotor’s GEM-VM50.
4. Apply AC and +24VDC power.
5. In Terminal Emulator mode, issue the following commands:

   DRIVE1 (enables the drive)

   DMODE13 (changes mode to autorun)
6. The motor should begin turning clockwise at one revolution per second.

Successful completion of the autorun test indicates that AC power and motor cables are connected correctly, and that the drive is functioning properly. Check the topics below for other sources of problems.

AC and DC Power

Verify that your AC power mains and +24VDC supply deliver adequate power to the respective drive power inputs.

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Motor Problems

Verify that the drive is configured properly for the motor you are using. The motor series, frame size, and part number information on a Compumotor motor's name plate should match the settings stored in the drive's memory.

Motor Brake

If you are using a motor with a brake, verify that the brake is connected properly, and that it is functioning as intended.

Motor Resolver

Resolvers on Compumotor motors are aligned at the factory. Ordinarily, no further alignment is necessary. However, if you suspect that the resolver has been altered and is out of alignment, you can follow the alignment procedure in *Aligning the Resolver*, located in *Chapter 4 Special Features*.

Mechanical System

Shaft Coupler

Verify that the shaft coupler is not slipping during acceleration or deceleration. We recommend bellows or disk style couplers for servo applications; helical couplers are inadequate, and are *not* recommended.

Mechanical Transmission

Verify that your mechanical system functions properly, and is not jammed.

Motion Problems

If problems occur during motion, check these possible causes:

- Motor Sizing (ensure that the motor has enough torque to perform the move)
- Excessive Acceleration or Deceleration
- Excessive Velocity

Electrical Noise

Electrical noise on input or output lines can cause stop or kill inputs to activate unexpectedly. See *Appendix C: Regulatory Compliance* for installation guidelines on reducing electrical noise.

Software/Motion Program Problems

Check to see that your motion programs are functioning properly, and are not causing unexpected problems.

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APPENDIX A

Specifications

IN THIS CHAPTER

- Gemini Drive Specifications
- Input/Output Specifications
- Dimensions
- Protective Circuits
- Cable Specifications

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Power Specifications

+24VDC Input Power

Input voltage range:	19.2 – 28.8 VDC
Input current:	500 mA (maximum)

AC Input Power

AC

Drive	AC Input Voltage
GT6K-L5	95VAC – 132VAC, 1-phase, 50/60 Hz
GT6K-L8	95VAC – 132VAC, 1-phase, 50/60 Hz
GV6K-L3n	95VAC – 132VAC, 1-phase, 50/60 Hz
GV6K-U3n	95VAC – 264VAC, 1-phase, 50/60 Hz
GV6K-U6n	95VAC – 264VAC, 1-phase, 50/60 Hz
GV6K-U12n	95VAC – 264VAC, 1-phase, 50/60 Hz
GV6K-H20n	165VAC – 264VAC, 1-phase or 3-phase, 50/60 Hz
GV6K-H40n	165VAC – 264VAC, 3-phase, 50/60 Hz

CAUTION

Do not operate GV6K-L3, GT6K-L5 or GT6K-L8 above 132VAC, or the drive will be permanently damaged.

Connector:	**GT6K-L5/L8; GV6K-L3/U3/U6/U12/H20:**	**GV6K-H40**
Drive terminals:	#8 (M4) screw terminals	#10 (M5) screw terminals
Mating terminals:	spade fork, 0.325” max. width	ring terminal, 0.25” I.D., 0.50” O.D.
Tightening torque:	20 in-lbs nom., 24 in-lbs max.	20 in-lbs nom., 24 in-lbs max.

Output Power

Drive	Output Current (amps, peak)	Output Voltage (motor bus) (DC, rms)
GT6K-L5	5.0	170
GT6K-L8	8.0	170

	Continuous Output:		Peak Output:	
Drive	**Current (amps, peak)**	**Power (watts, max)**	**Current (amps, peak)**	**Power (watts, max)**
GV6K-L3n	3A	440W	7.5A	1.1 kW
GV6K-U3n	3A	880W	7.5A	2.2 kW
GV6K-U6n	6A (at 8 kHz)	1.75 kW	15A (at 8 kHz)	4.4 kW
GV6K-U12n	12A (at 8 kHz)	3.5 kW	30A (at 8 kHz)	8.8 kW
GV6K-H20n	20A (3∅ input at 8 kHz)	5.8 kW	50A (3∅ input) at 8 kHz)	14.7 kW
GV6K-H40n	40A (3∅ input at 8 kHz)	11.8 kW	100A (3∅ input) at 8 kHz)	29.4 kW

Connector:	**GT6K-L5/L8; GV6K-L3/U3/U6/U12/H20:**	**GV6K-H40**
Drive terminals:	#8 (M4) screw terminals	#10 (M5) screw terminals
Mating terminals:	spade fork, 0.325” max. width	ring terminal, 0.25” I.D., 0.50” O.D.
Tightening torque:	20 in-lbs nom., 24 in-lbs max.	20 in-lbs nom., 24 in-lbs max.

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Amplifier

Type – GV6K Servos:	GV6K-L3n:	40 kHz PWM;	3 phases
	GV6K-U3n:	8 kHz PWM;	3 phases
	GV6K-U6n/U12n:	8, 16, 20 kHz PWM;	3 phases
	GV6K-H20n:	8, 16, 20 kHz PWM;	3 phases
	GV6K-H40n:	8, 16, 20 kHz PWM;	3 phases

Type – GT6K Steppers: 20 kHz fixed frequency, variable duty cycle PWM, current controlled, recirculating, bipolar type, MOSFET construction.

2 Phases: bipolar motor configuration only.

Auto Standby: When enabled, motor current reduces to a percentage of present value, when no step pulses are received for one second. (See DAUTOS command.)

Environmental Specifications

		GT6K-L5/L8; GV6K-L3n/U3/U6/U12n; GV6K-H20 (with < 25W regen); GV6K-H40	**GV6K-H20 (with <100W regen)**
Operating Temperature:	Still Air:	45°C (113°F)	35°C (95°F)
	Moving air:	50°C (122°F)	40°C (104°F)
	Minimum:	0°C (32°F)	0°C (32°F)
Storage Temperature:	-40°C – 85°C (-40°F – 185°F)		
Humidity:	0 – 95%, non-condensing		
Shock:	15g, 11msec half sine		
Vibration:	10 – 2000 Hz at 2g		

Performance

GV6K Servos – Performance:

Accuracy: ±1 encoder count; encoder dependent

GVTK Steppers – Performance:

Accuracy: ±5 arc min (0.0833°), typical unloaded bidirectional with Compumotor motors. Other motors may have different absolute accuracy.

±1 arc minute (0.0167°), loaded in addition to unloaded accuracy, per each frictional load equal to 1% rated torque.

Repeatability: ±5 arc sec (0.0014°), typical unloaded one revolution returning to starting point from same direction

Hysteresis: Less than 2 arc min (0.0334°) unloaded bidirectional

Resolution: User definable integer value between 200 and 128,000 steps per revolution

Waveform: -20% through 10%, 0.01% resolution, continuously variable, 3rd harmonic, (use DWAVEF command)

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Standards

UL, cUL	508C	
CE for LVD	72/23/EEC	
	BS EN61010-1:1993/A2:1995 (ie includes 1995 amendment AMD 8961) Safety requirements for electrical equipment for measurement, control, and laboratory use	Part 1. General requirements
CE for EMC	89/336/EEC	
	BS EN61800-3: 1997	Adjustable speed electric power drive systems Part 3. EMC product standard including specific test methods.
	IEC 61800-3: 1996	Adjustable speed electric power drive systems Part 3. EMC product standard including specific test methods.

Interface/Communication

Serial:

"RS-232/485" Connector (COM1):

RS-232: 3-wire connections (Rx, Tx, and GND). 8 data bits; 1 stop bit; no parity; full duplex; baud rate: 9600 (not adjustable). Drive connector: 9 pin D-subminiature plug.

RS-485*: 4-wire plus ground (Rx+, Rx-, Tx+, Tx-, Gnd). 8 data bits; 1 stop bit; no parity; full duplex; baud rate: 9600 (not adjustable). Drive connector: 9 pin D-subminiature plug.
*twisted pair cabling recommended (e.g. Belden 9842)

"RS-232" Connector (COM2):

RS-232: 3-wire connections (Rx, Tx, and GND), and +5VDC. 8 data bits; 1 stop bit; no parity; full duplex; baud rate: 9600 default (set with BAUD command; range: 1200-115200). Drive connector: 9 pin D-subminiature plug. The "RS-232" connector's default configuration is set for use with an RP240.

Ethernet:

"Ethernet Connector":

10Base-T (10Mbps twisted pair); TCP/IP protocol. RJ-45 connector. Default IP address is 192.168.10.30 (use NTADDR on RS-232 connector to change address).

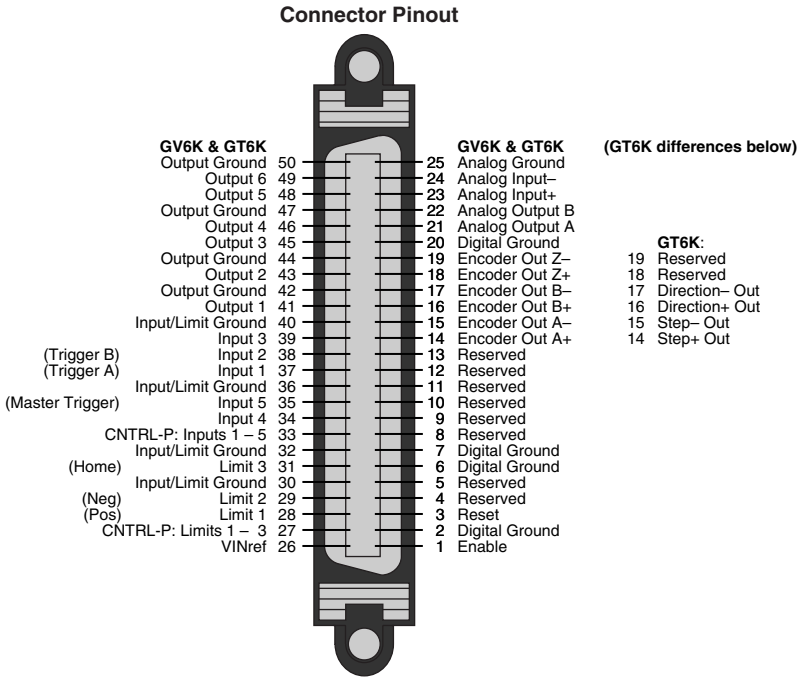
Weight

	Drive	**Weight** *pounds (kg)*
GV6K Servos:	GV6K-L3n:	4.8 (2.2)
	GV6K-U3n:	4.8 (2.2)
	GV6K-U6n:	5.5 (2.5)
	GV6K-U12n:	5.6 (2.6)
	GV6K-H20n:	9.6 (4.4)
	GV6K-H40n:	17.1 (7.7)
GT6K Steppers:	GT6K-L5:	4.8 (2.2)
	GV6K-U5:	6.4 (2.9)

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Inputs and Outputs

This section describes all inputs and outputs (I/O) located on the 50 pin DRIVE I/O connector. The connector pinout is shown in the next drawing.



Drive I/O Connector

Connector Specifications:

	Gem6K Drive:	Mating Connector* (not provided; see note):
Manufacturer:	AMP	AMP
Connector Type:	CHAMP .050 Series II	CHAMP .050 Series II
AMP Part Number:	2-178238-7	2-175677-7
Wire Gauge:	not applicable	use 28 AWG (0.08 mm^2)

* Note: Mating connectors are not provided with Gem6K drives; Compumotor cables are available with mating connectors attached. If you make your own cables, you must use a "jack screw" style fastener, not "spring clip" style.

Soldercup Connector

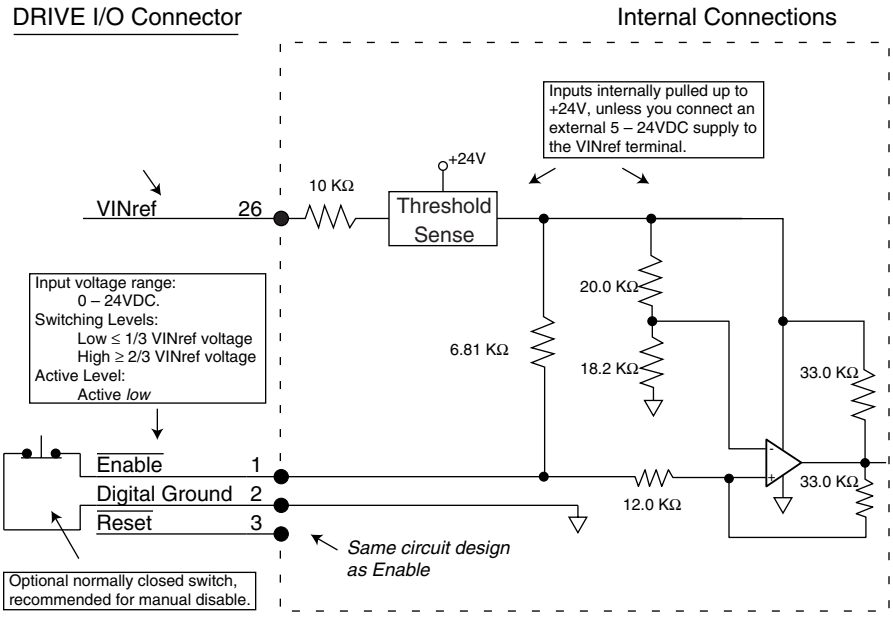
The soldercup connector and plastic screw lock backshell listed below will fit onto the Gem6K's DRIVE I/O connector. Because the backshell is plastic, it should not be used in CE applications.

Connector Type:	Soldercup Connector	Screw Lock Backshell
Manufacturer:	3M	3M
3M Part Number:	10150-3000VE	10350-52A0-008

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Enable Input (required)

To enable the drive and energize the motor, you must connect the enable input (pin 1) to digital ground (pin 2), and issue a DRIVE1 command. The next drawing shows the internal circuit.



Enable Input and Reset Input

Reset Input (optional)

The reset and enable inputs use the same circuit design, as the drawing above indicates.

To reset the drive, temporarily connect the reset input (pin 3) to digital ground (pin 2). Reset begins when pin 3 is grounded. The drive will begin its power up sequence upon disconnection of pin 3 from ground.

VINref – Voltage Input Reference (optional)

Use VINref (pin 26) to set the input reference voltage for the enable, reset, digital inputs and limit inputs.

Connections to VINref are optional. If you connect nothing, then the enable, reset, and inputs are internally pulled up to +24VDC. This is the factory default condition.

If you connect an external 5 – 24VDC power supply to VINref, then the input switching thresholds become:

Low ≤ 1/3 * VINref

High ≥ 2/3 * VINref

(Default, with VINref at internal +24VDC: Low < 8V, High > 16V)

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Digital Inputs (optional)

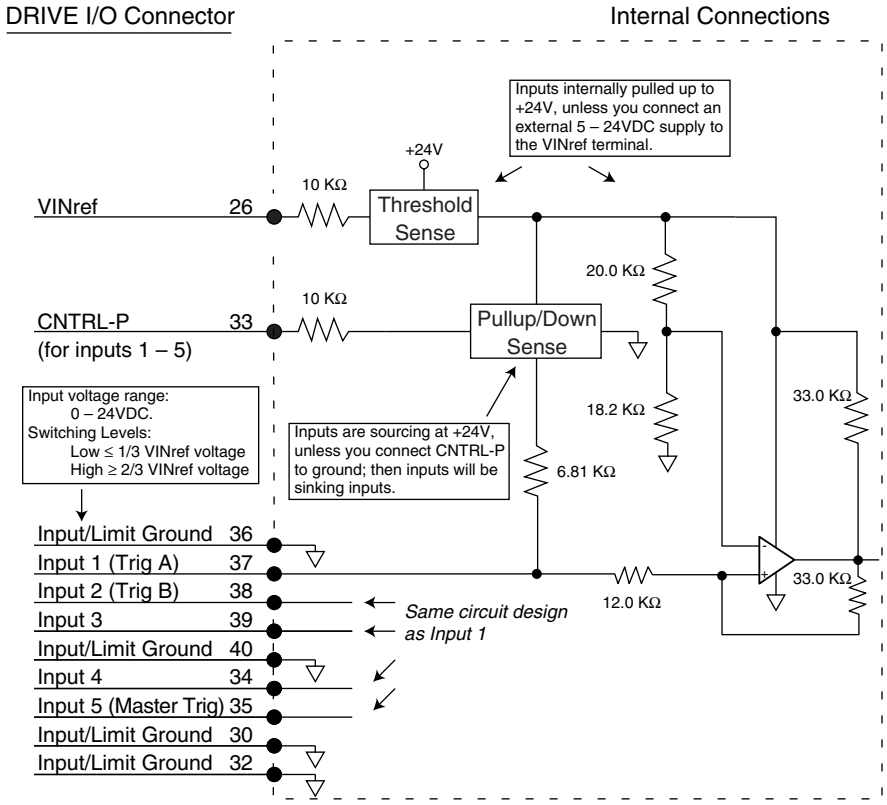
The Gem6K drive has five digital inputs. All connections are shown in the next drawing. By default, all inputs are configured as general purpose inputs. Use the INFNC command to redefine the function of any of the inputs. For more information, see the *Gemini GV6K/GT6K Command Reference*.

By default, these are +24VDC sourcing inputs. You can use VINref (pin 26) to change the switching voltage level. You can also use CNTRL-P (pin 33) to change the inputs from sourcing to sinking inputs.

Should you choose to use the Trigger A, Trigger B, or Master Trigger functions, you must assign them to specific inputs, as follows:

Trigger Function:	Must be assigned to:	Pin number:
Trigger A	Input 1	37
Trigger B	Input 2	38
Master Trigger	Input 5	35

Use the INFNC command to make these assignments.



Inputs

You can use the INLVL and INDEB commands to configure the inputs as active high or active low, and to set the debounce time, respectively.

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CNTRL-P – Reference for Digital Inputs (optional)

Make connections to one or both of the CNTRL-P pins to change the digital inputs or limit inputs from sourcing inputs to sinking inputs.

CNTRL-P (pin 27)	affects Limit Inputs	1 – 3
CNTRL-P (pin 33)	affects Digital Inputs	1 – 5

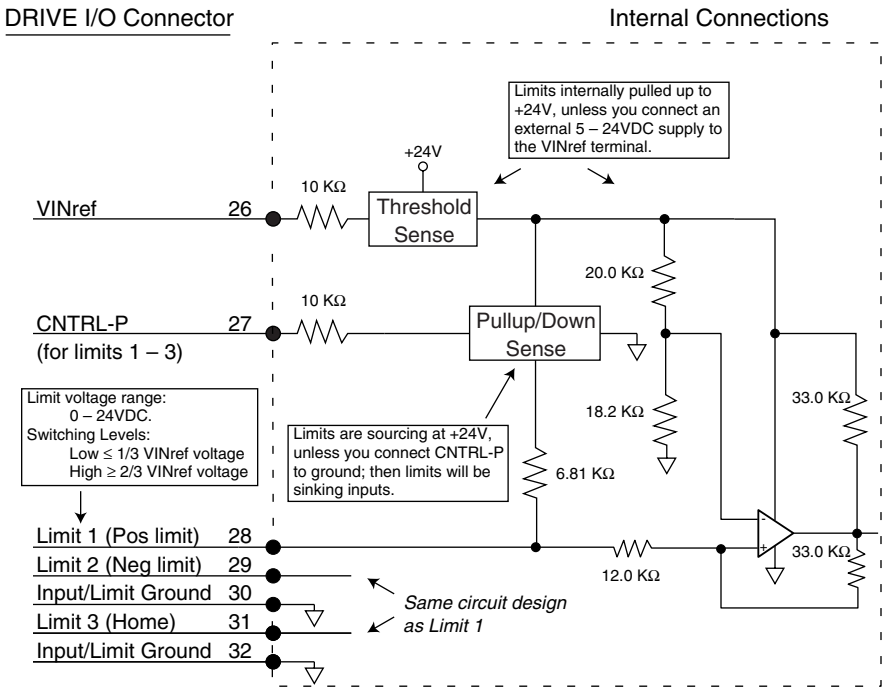
It is not necessary for you to make any connections to CNTRL-P. If you connect nothing, then the inputs are internally pulled up to VINref. If sourcing inputs are appropriate for your application, then make no connections to CNTRL-P.

If you connect a CNTRL-P pin to digital ground, then its associated inputs will become sinking inputs, and will sink current.

Limit Inputs (optional)

The Gem6K drive has three limit inputs. All connections are shown in the next drawing. Defaults are shown in parentheses, but you can use the LIMFNC command to redefine the function of any of the limits. See the *Gemini GV6K/ GT6K Command Reference* for more information.

By default, these are +24VDC sourcing inputs. You can use VINref (pin 26) to change the switching voltage level. You can also use CNTRL-P (pin 27) to change the inputs from sourcing to sinking inputs.



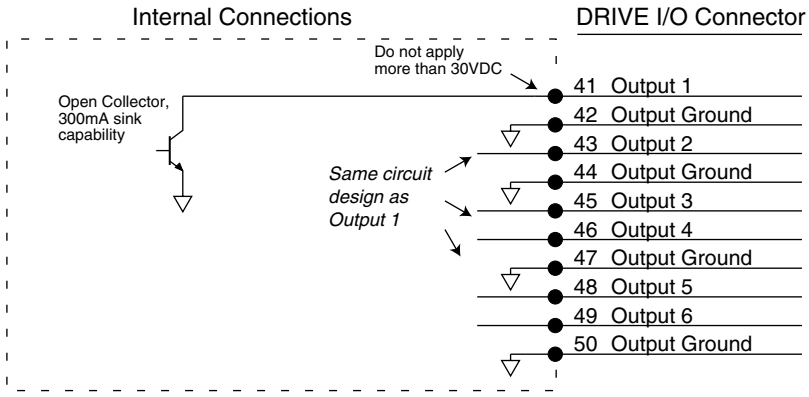
Limits

You can use the LIMLVL and INDEB commands to configure the limit inputs as active high or active low, and to set the debounce time, respectively.

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Digital Outputs (optional)

The Gem6K drive has six digital outputs. All connections are shown in the next drawing. Default function is general purpose, but you can use the OUTFNC command to redefine the function of any of the outputs. See the *Gemini GV6K/ GT6K Command Reference* for more information.



Outputs

You can use the OUTLVL command to configure each of the outputs as active high or active low. The default value is active low.

Encoder Output – GV6K Servos Only (optional)

Pins 14 – 19 are encoder outputs.

Encoder Output Specifications:

Default Resolution:	Quadrature outputs
	4000 counts per revolution, post quadrature
Clockwise Rotation:	Channel A leads Channel B
Counterclockwise Rotation:	Channel B leads Channel A

The encoder outputs operate in one of two modes:

Pseudo Encoder Mode:

Output Channels A and B are derived from position information from the load feedback device (e.g. encoder or resolver). The outputs are *not* based on calculated or commanded position. Pseudo encoder mode is the default mode, unless all conditions listed below are satisfied. There is no Channel Z output in pseudo encoder mode.

Pass Through Encoder Mode:

If the following conditions are satisfied, then Channels A, B, and Z are "passed through" the drive, from the feedback device (e.g. encoder or resolver) to the encoder outputs.

Required Conditions using an Encoder as Feedback Device

1. ERES and ORES values are equal.

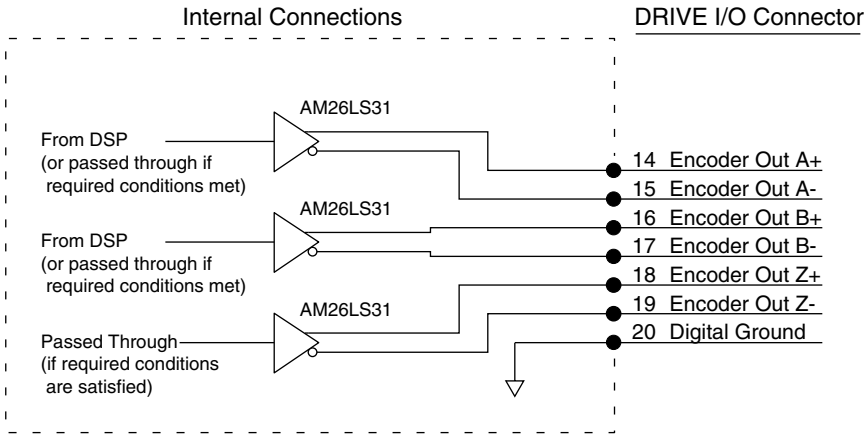
Required Conditions using a Resolver as Feedback Device

1. Resolver is selected as the feedback device (SFB command).
2. ERES is set to 4096.
3. ORES is set to 4096.

If any of these conditions is not satisfied, then the outputs will operate in pseudo encoder mode.

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The encoder output circuit is shown in the next drawing.



Encoder Outputs

You can use the ORES command to configure the encoder outputs.

Step & Direction Output – GT6K Steppers Only (optional)

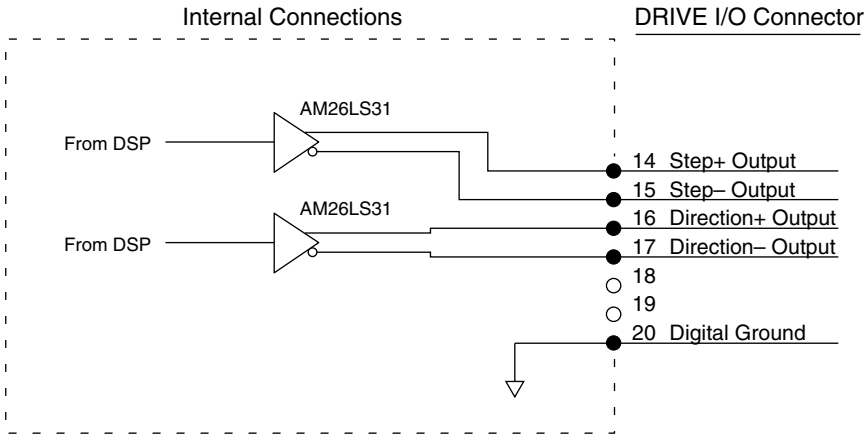
Pins 14 – 17 are step and direction outputs.

The outputs are based on calculated position.

Step & Direction Output Specifications:

Default Resolution:	25,000 steps per revolution
Clockwise Rotation:	Direction+ = High
Counterclockwise Rotation:	Direction+ = Low

The step and direction output circuit is shown in the next drawing.



Step & Direction Output

You can use the ORES command to configure the step and direction outputs.

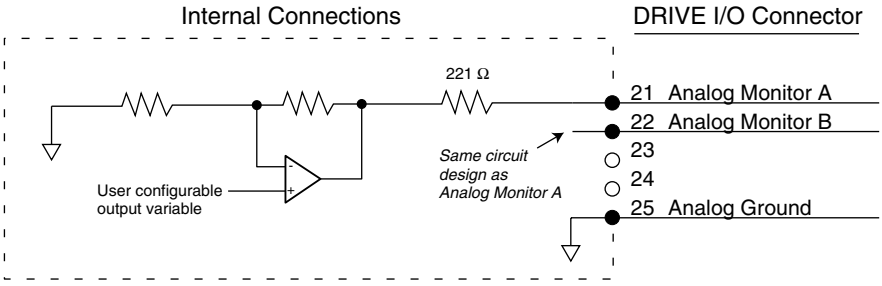
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Analog Monitor (optional)

Two analog monitor outputs are available on pins 21 and 22. Use pin 25 as a ground reference for these monitors.

Analog Monitor Specifications:

Maximum Output:	±10V (scalable; use DMON command)
Resolution:	8 bits peak to peak (for full scale signal)



Analog Monitors

You can configure the analog outputs to monitor many different variables, such as current, velocity, temperature, etc. You can also scale the outputs. See the DMON commands in *Chapter 3 Configuration* and the *Gemini GV6K/GT6K Command Reference* for more information.

WARNING

Do not use Analog Monitors as control signals. Because of offsets, limited resolution and accuracy, use the analog monitor outputs only for oscilloscope monitoring.

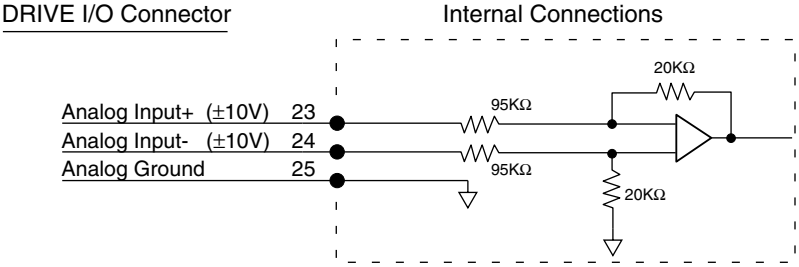
Analog Input (optional)

An analog input is available on pins 23 and 24. Use pin 25 as a ground reference for the analog input.

Connection Instructions for the Analog Input:

1. Connect Analog Input+ to pin 23.
2. Connect Analog Input- to pin 24.
3. Connect your analog source's ground reference to pin 25.

These connections are illustrated in the next drawing.



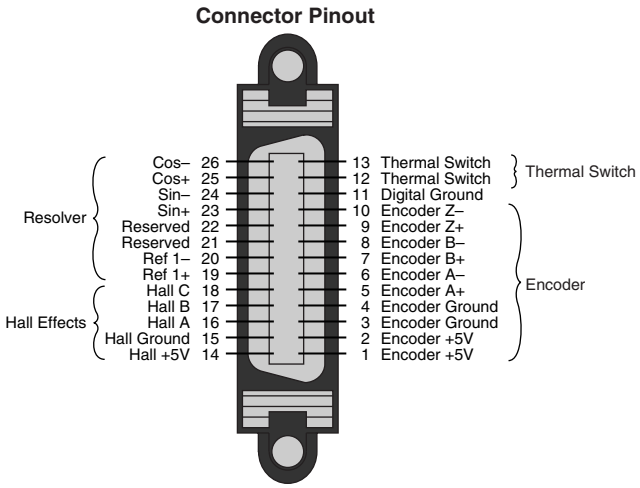
Analog Input

See the ANI, TANI and VARI commands in the *Gemini GV6K/GT6K Command Reference* for more information about using the analog input.

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Feedback Devices

This section describes inputs for encoder feedback, resolver feedback, motor thermal switch, and Hall effects located on the drive's 26 pin MOTOR FEEDBACK connector. The next drawing shows the pinout of the connector.



Motor Feedback Connector

Connector Specifications:

	Gem6K Drive:	Mating Connector* (not provided; see note):
Manufacturer:	AMP	AMP
Connector Model:	CHAMP .050 Series II	CHAMP .050 Series II
AMP Part Number:	2-178238-4	2-175677-4
Wire Gauge:	not applicable	use 28 AWG (0.08 mm^2)

* Note: Mating connectors are not provided with Gem6K drives; Compumotor cables are available with mating connectors attached. If you make your own cables, you must use a "jack screw" style fastener, not "spring clip" style.

Soldercup Connector

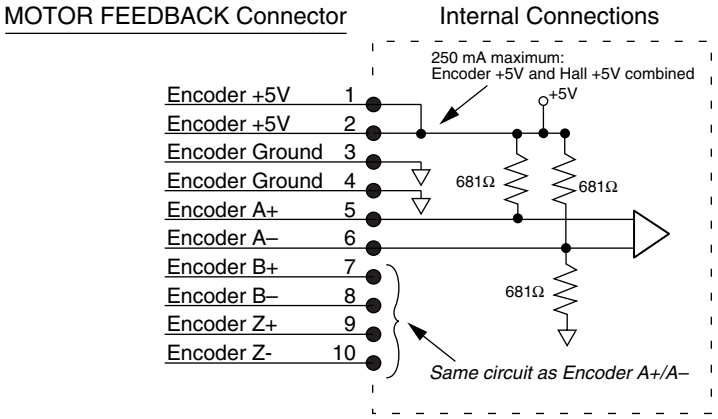
The soldercup connector and plastic screw lock backshell listed below will fit onto the Gem6K's MOTOR FEEDBACK connector. Because the backshell is plastic, it should not be used in CE applications.

Connector Type:	Soldercup Connector	Screw Lock Backshell
Manufacturer:	3M	3M
3M Part Number:	10126-3000VE	10326-52A0-008

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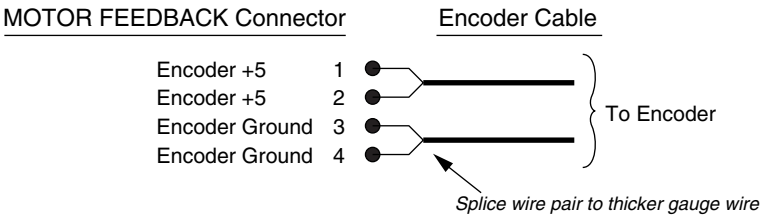
Encoder

If you use a motor with encoder feedback, connect your encoder to pins 1 – 10, as shown in the next figure. (NOTE: The MASTER ENCODER connector is used for Following. See *Chapter 4 Special Features* for master encoder connections.)



Encoder Input Connections

Because the wire used in many encoder cables is very thin, we provide two pins for encoder +5VDC (pins 1 and 2) and for encoder ground (pins 3 and 4). Connect two wires in your encoder cable to the +5VDC pins, and connect two wires to the encoder ground pins. We recommend that you splice each pair of wires to a larger diameter wire, as shown in the next drawing.

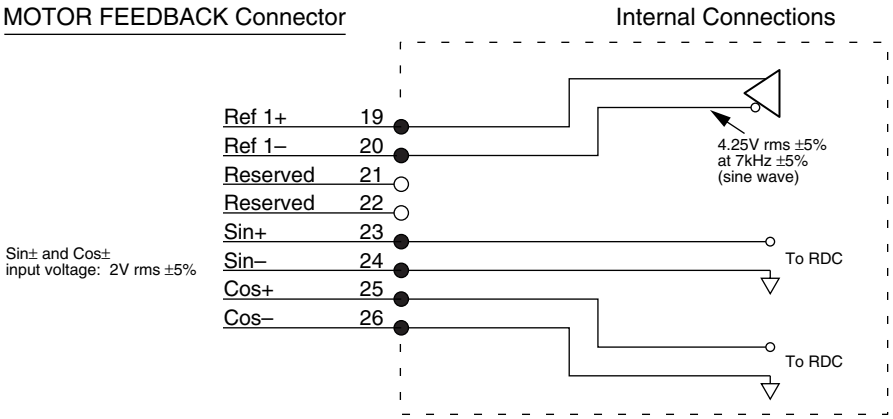


Splicing Wires Together

Splicing to a larger wire provides more wire for current conduction, minimizing voltage drop at the encoder. (Gemini motor feedback cables use this technique.)

Resolver – GV6K Servos Only

If you use a motor with resolver feedback, connect the resolver to pins 19 – 26, as shown in the figure below.



Resolver Input Connections

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Motor Thermal Switch – GV6K Servos Only (optional)

Connect your motor's thermal switch wires to pins 12 and 13 on the MOTOR FEEDBACK connector.

The drive checks for electrical continuity between pins 12 and 13. This continuity is usually provided by a normally-closed thermal switch mounted on the motor. If the motor overheats and the thermal switch opens, the loss of continuity triggers protection circuitry in the drive. The drive will turn off power output to the motor, illuminate the left LED red, and set the motor fault and drive fault bits. You can monitor the fault bits with the TAS and TASX commands.

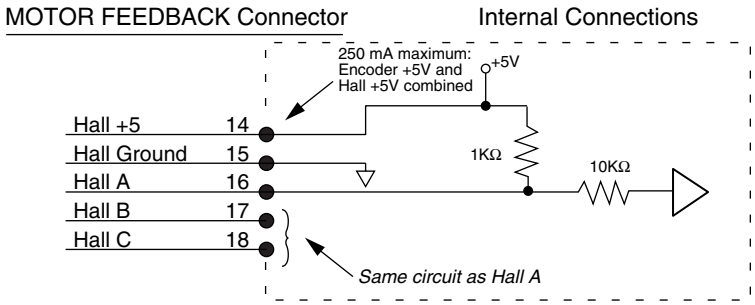
To resume operations after the motor cools and its thermal switch closes, cycle power or issue a DRIVE1 command.

If your servo motor does not have a thermal switch, short pins 12 and 13 together. The drive will experience a motor fault if neither a thermal switch nor a jumper wire is attached to pins 12 and 13.

Hall Effects – GV6K Servos Only

Connect your motor's Hall effect wires to pins 14 – 18 on the MOTOR FEEDBACK connector.

The GV6K drive is designed to be used with motors that have single-ended, open collector Hall outputs. Internally, the drive pulls these signals up to +5V. The Hall effect circuit is shown below.



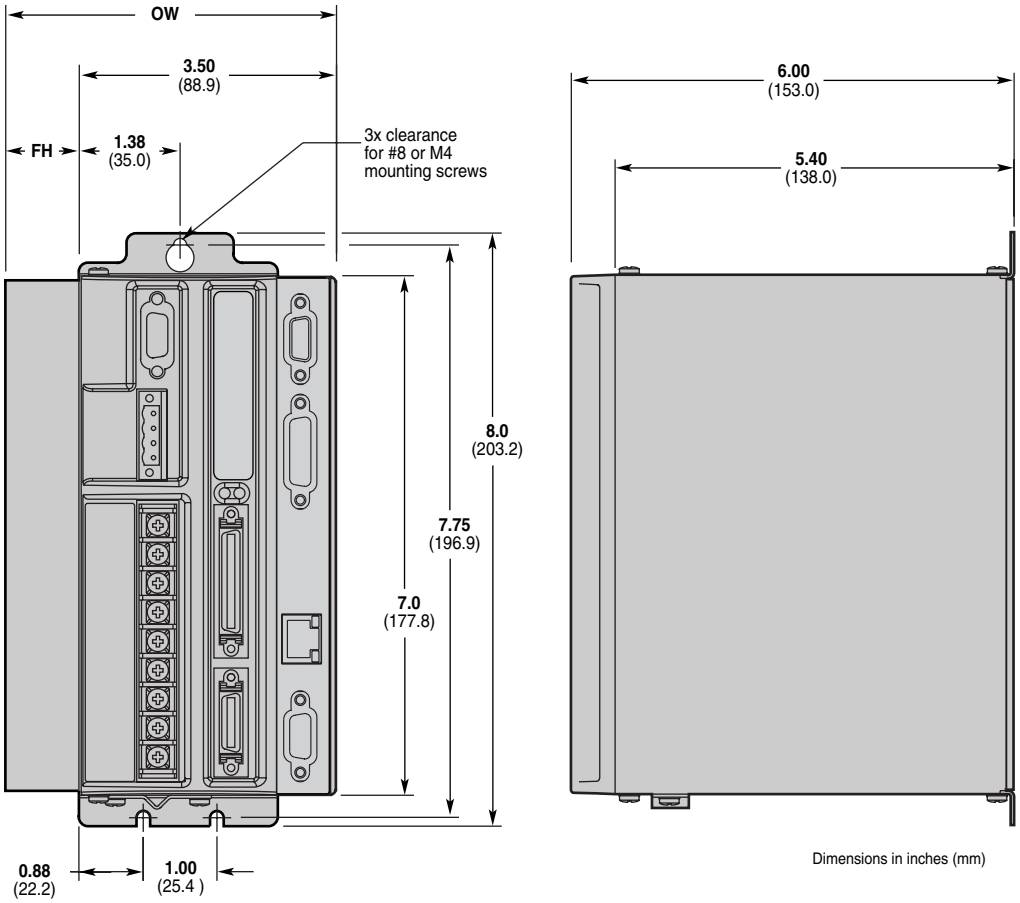
Hall Effect Connections

The GV6K uses the Hall effect inputs to synchronize the encoder with the motor's internal magnets at the start of motion. Initial commutation is trapezoidal; once the drive establishes synchronization it changes to sinusoidal commutation based on encoder position.

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Dimensions

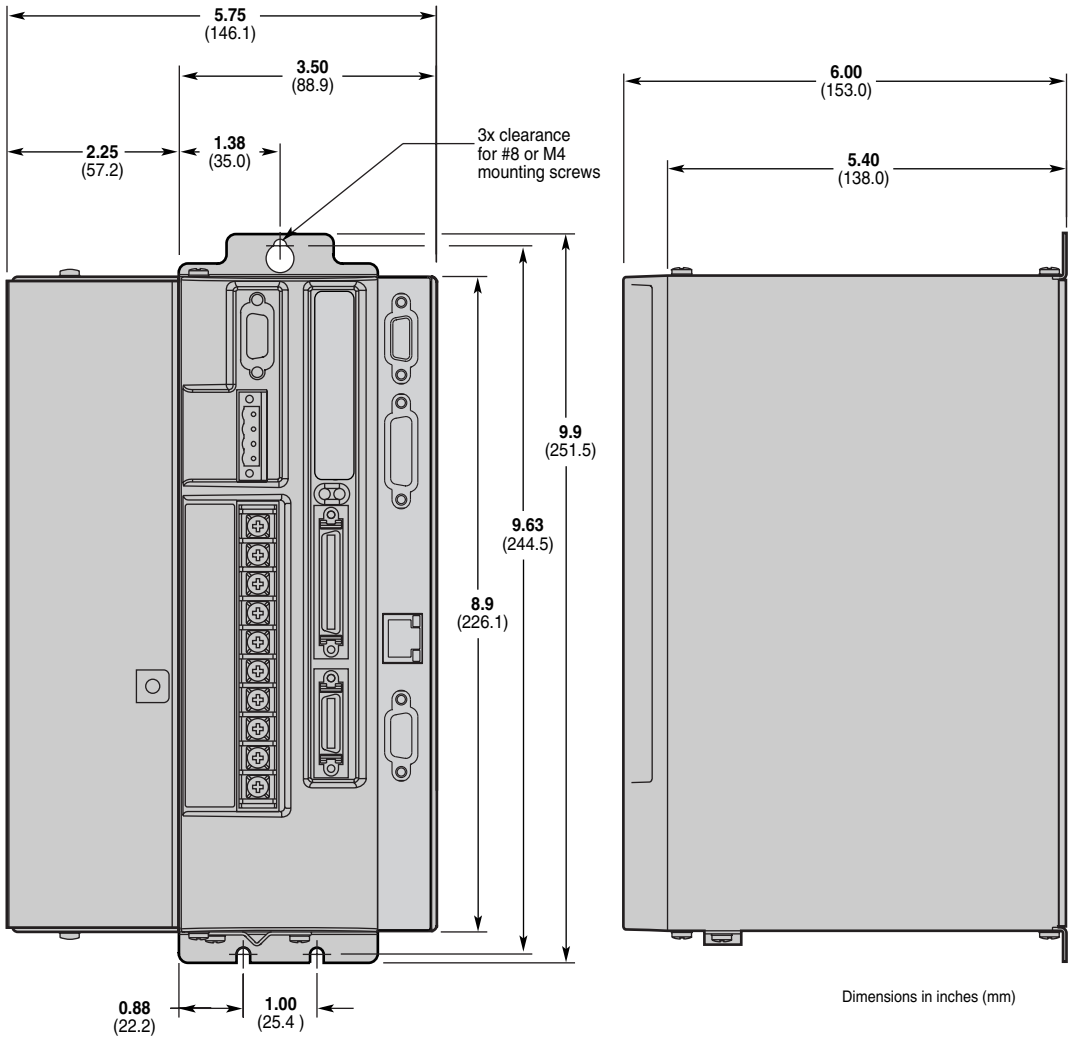
Drive Dimensions



Product	OW Overall Width inches (mm)	FH Fin Height inches (mm)
GV6K-L3n	**3.88** (98.6)	**0.38** (9.5)
GV6K-U3n	**3.88** (98.6)	**0.38** (9.5)
GV6K-U6n	**4.50** (114.3)	**1.00** (25.4)
GV6K-U12n	**4.50** (114.3)	**1.00** (25.4)
GT6K-L5	**3.88** (98.6)	**0.38** (9.5)
GT6K-L8	**4.50** (114.3)	**1.00** (25.4)

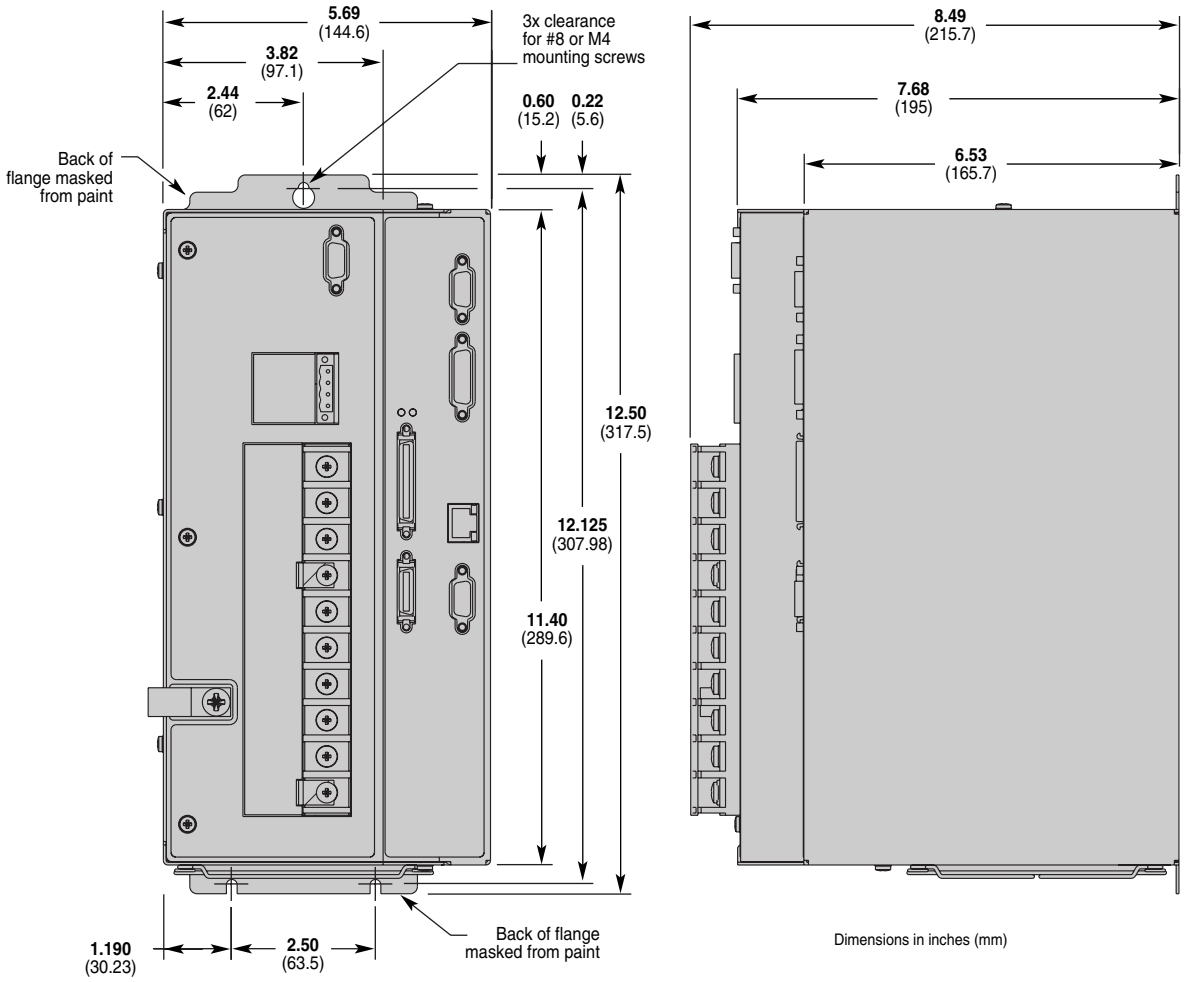
Dimensions (Shorter Enclosure)

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Dimensions – GV6K-H20

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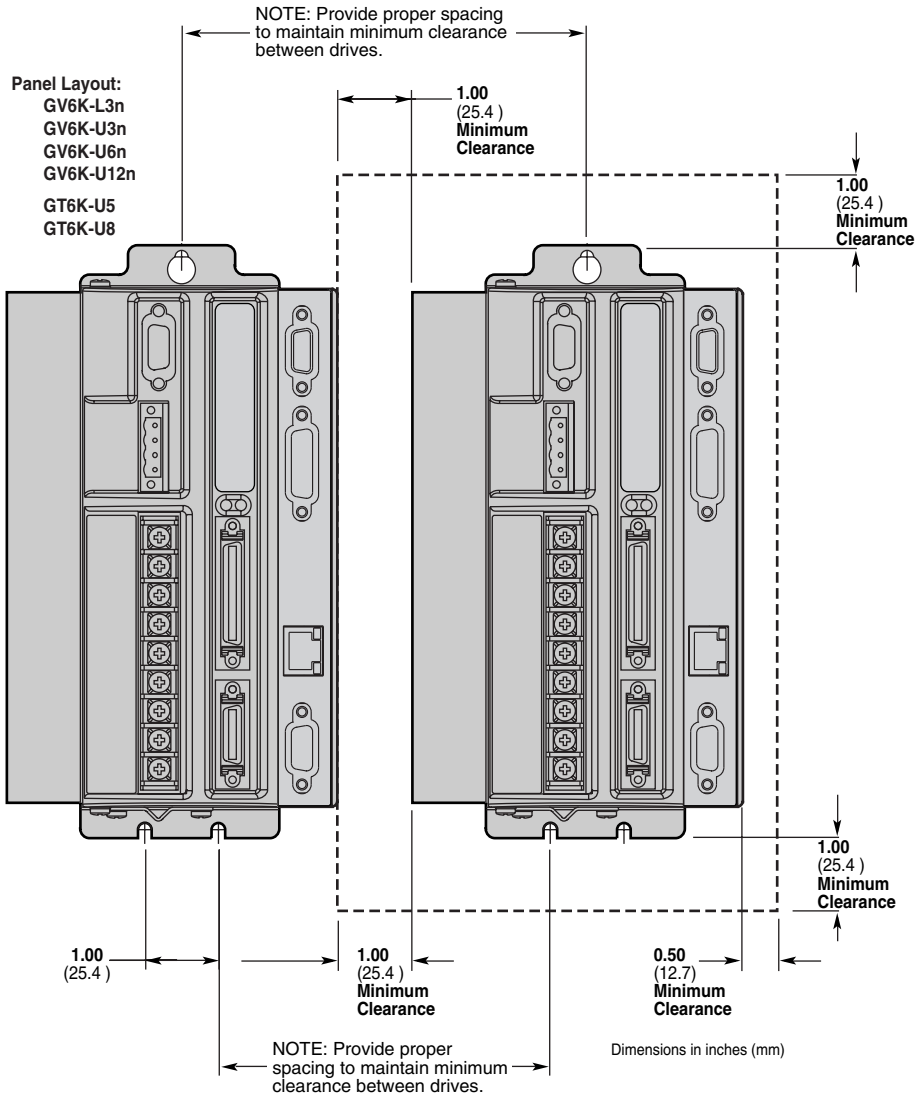
Dimensions – GV6K-G40

Drive Mounting

The Gem6K drive is a vented product. Mount it under an overhang to prevent material spilling into the drive.

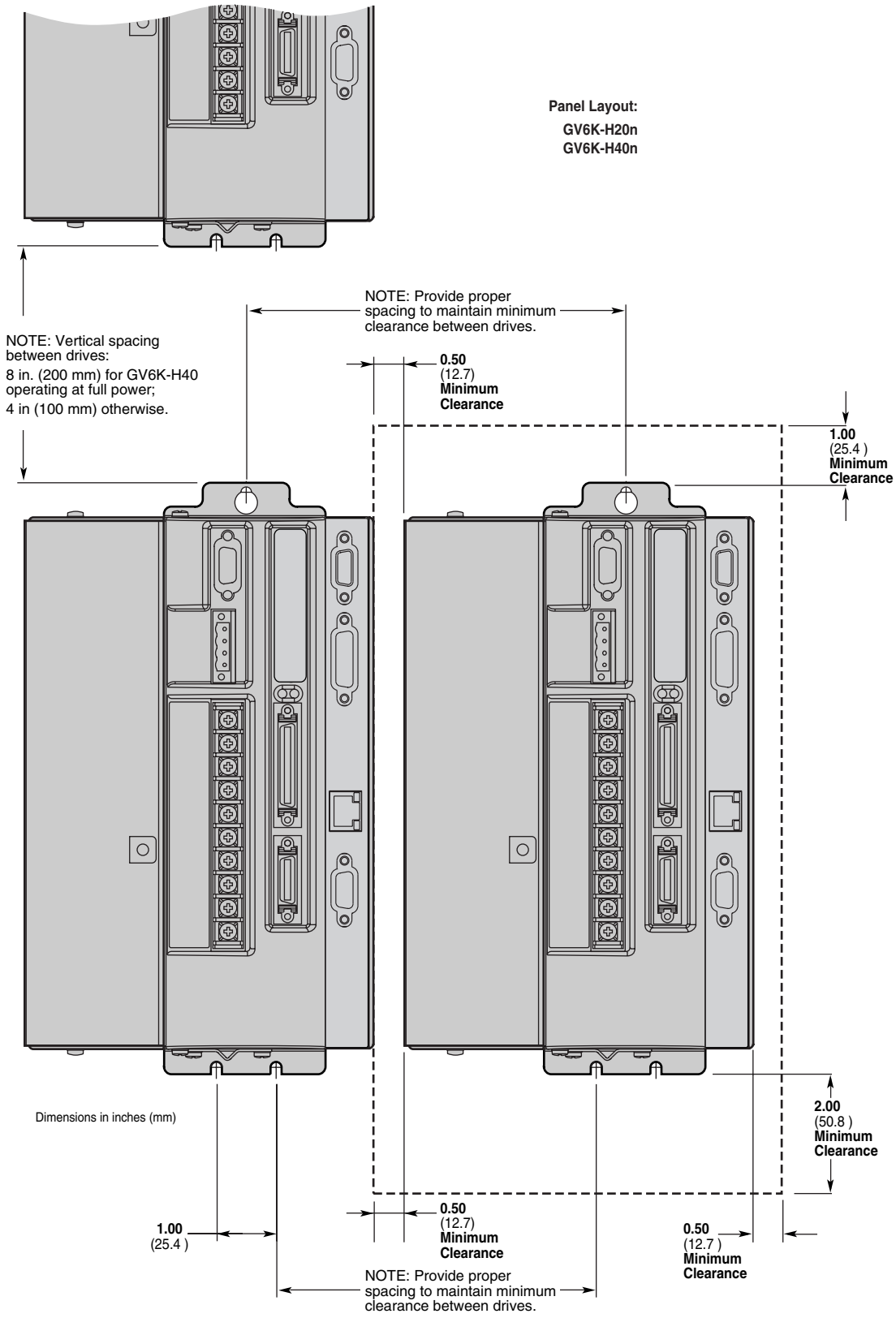
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Panel Layout Dimensions



Panel Layout Dimensions (Shorter Enclosure)

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Panel Layout Dimensions (Taller Enclosure)

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Protective Circuits

Short Circuit Protection

The Gem6K drive has an internal circuit that protects it from short circuits between one motor terminal to another (phase to phase), or from any motor terminal to earth. A short circuit fault is a latched fault.

Short circuit fault caused by:	Phase to phase short circuit Phase to earth short circuit
Results of Fault:	Power to motor is turned OFF LEDs: Left = illuminated RED; Right = off Fault output is activated Latched fault

Inrush Current Protection

The Gem6K drive has internal circuitry that protects it from high inrush current when power is initially applied to the drive. The circuitry works automatically.

Drive	Inrush Current Limiter (ohms):	Current limiter bypassed with shorting relay:
GV6K-L3n	5Ω	yes
GV6K-U3n	10Ω	yes
GV6K-U6n	10Ω	yes
GV6K-U12n	10Ω	yes
GV6K-H20n	10Ω	yes
GV6K-H40n	20Ω	yes
GT6K-L5	5Ω	yes
GT6K-L8	5Ω	yes

The shorting relay removes the inrush current limiter after drive startup. This allows maximum bus voltage during high acceleration/peak torque/maximum speed applications.

Inrush current is temperature dependent:

Ambient Temperature:	Inrush Current Limit:
25°C (77°F)	less than 35 amps
50°C (122°F)	less than 70 amps
50°C (122°F)	less than 70 amps

Drive Overtemperature Protection

The Gem6K drive's overtemperature circuit monitors the drive's internal temperature sensors. If the sensors exceed the threshold temperature, the drive issues an overtemperature fault.

Threshold Temperature:	All drives except GV6K-H20n: 80°C (176°F) GV6K-H20n: 90°C (194°F)
Results of Fault:	Power to motor is turned OFF LEDs: Left = illuminated RED; Right = off Fault output is activated Latched fault

Motor Overtemperature Protection – GV6K Servos Only

The GV6K drive has two motor overtemperature circuits:

Hardware Switch:	a thermal switch is embedded in Compumotor motor windings
I^2t Thermal Model:	the drive's internal operating software predicts motor winding temperature, based on motor current.

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Undervoltage Protection

The Gem6K drive's undervoltage protection circuit monitors AC input voltage. If the voltage falls below 75VAC while the drive is operating (85VAC for GV6K-H20), the drive issues an undervoltage fault and turns off power to the motor.

Undervoltage protection has the following features:

Threshold Voltage:	Voltage falling below 75VAC trips fault (85VAC for GV6K-H20n)
Results of Fault:	Power to motor is turned OFF LEDs: Left = illuminated RED; Right = off Fault output is activated Latched fault

Overvoltage Protection – GV6K Servos Only

The GV6K drive's overvoltage circuit protects the drive from excessive regeneration. If the voltage on the motor output terminals rises above the threshold voltage, the drive disables its output terminals, and the motor will freewheel.

Threshold Voltage:	GV6K-L3n: 212VDC GV6K-U3n/6n/12n/H20n/H40n: 410VDC
Results of Fault:	Power to motor is turned OFF LEDs: Left = illuminated RED; Right = off Fault output is activated Latched fault

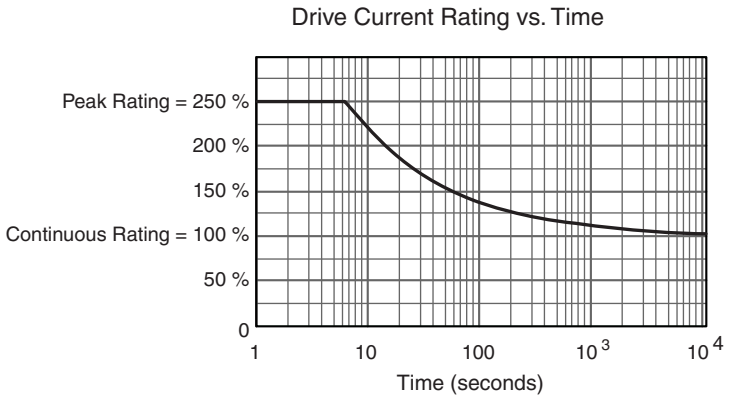
CAUTION

Overvoltage protection monitors only the motor output terminals (DC motor bus). It does not protect against an overvoltage on the AC input terminals.

Current Foldback – GV6K Servos Only

The GV6K drive's current foldback circuit helps to protect the motor from damage due to prolonged high currents.

If your drive is operating above its continuous rating, use the figure below to predict the number of seconds until foldback will occur. For example, the figure shows that at the drive's peak current rating (250% of continuous), foldback will occur after six seconds.



Time Until Foldback

See *Chapter 3 Configuration* for more information on how to configure the current foldback circuit to protect your motor.

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Cable Specifications

This section contains specifications for Compumotor cables and cabling accessories you can use with Gem6K drives.

CE Cables

Many Compumotor cables are *CE Cables*. If installed according to instructions in *Appendix C Regulatory Compliance: UL and CE*, these cables are designed to aid the user in gaining European Compliance, and are thus an integral part of a CE system solution. CE cables add RF screening and bonding to reduce emissions, and provide high integrity safety Earth bonding. They also help to reduce problems in high electrical noise environments.

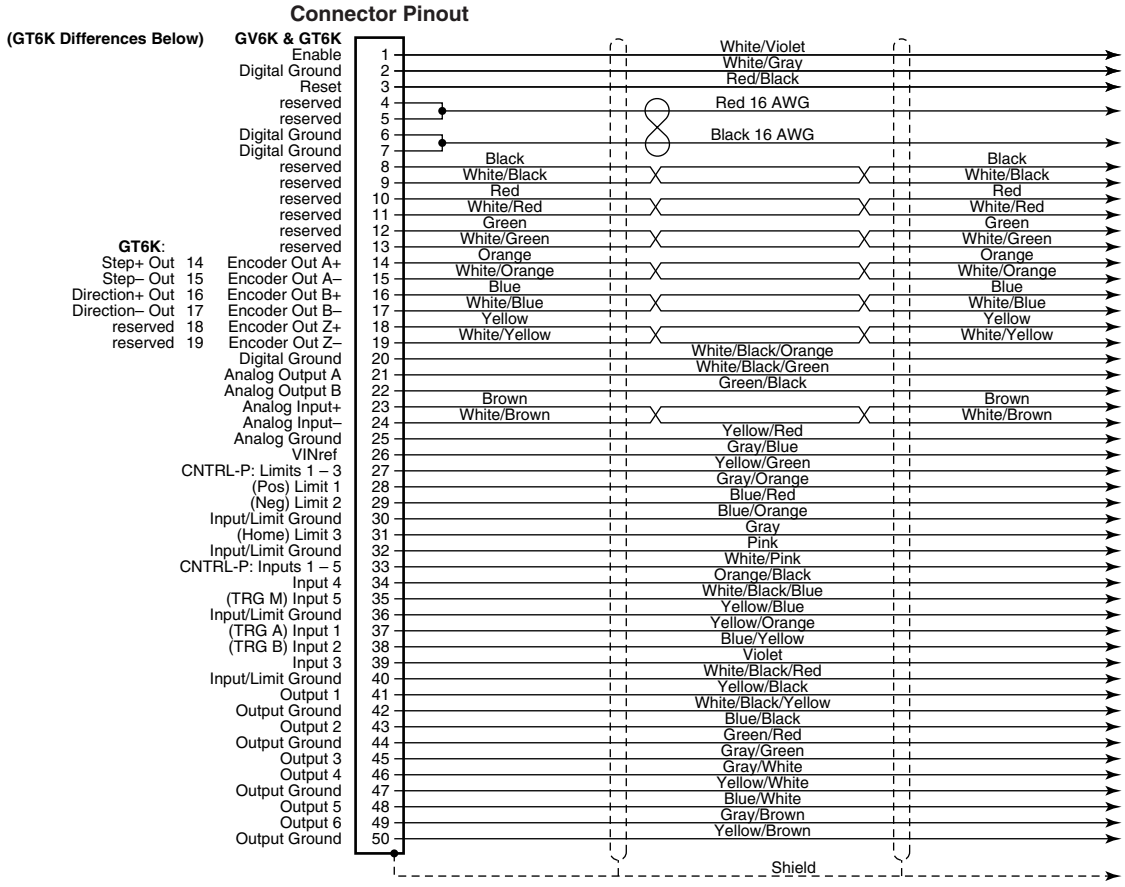
Gem6K 50 Pin Connector to Flying Leads Cable

Use this cable to connect an external device to the Gem6K drive's 50 pin DRIVE I/O connector.

Part Number: 71-016943-10

CE Cable: Yes, if installed according to instructions in *Appendix C*

The next drawing shows the color code for the cable.



Cable – Flying Leads

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Gem6K 50 Pin Connector to 50 Pin D-Connector Cable

Use this cable to connect the Gem6K's 50 pin DRIVE I/O connector to the 50 pin D-connector on the Gemini 50 pin breakout module (GEM-VM50).

Part Number:	71-016945-03
CE Cable:	Yes, if installed according to instructions in *Appendix C*

This cable has the same pinout and color code as the flying lead cable; instead of flying leads, it has a 50 pin D-connector on the end.

Gemini GEM-VM50 – 50 Pin Breakout Module

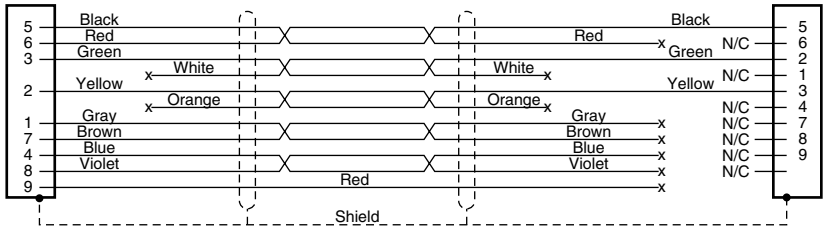
Use the 50 pin breakout module for access to individual terminals on the 50 pin connector. The GEM-VM50 includes the cable above.

Description:	**Part Number:**
50 pin Breakout Module (with Cable)	GEM-VM50
50 pin Breakout Module (without cable)	01-016986-01

Null Modem Cable – 9 Pin D-Connector to 9 Pin D-Connector

Use this cable for RS-232 communications between the Gem6K and a terminal. Note that this is not a "straight-through" cable; pins 2 and 3 are crossed, making it a "null-modem" cable.

Part Number:	71-016939-10
CE Cable:	Yes, if installed according to instructions in *Appendix C*
Connector:	9 pin female D-subminiature connector on each end



Cable – RS-232 Null Modem

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Gemini GC-26 and GC-50 Connectors

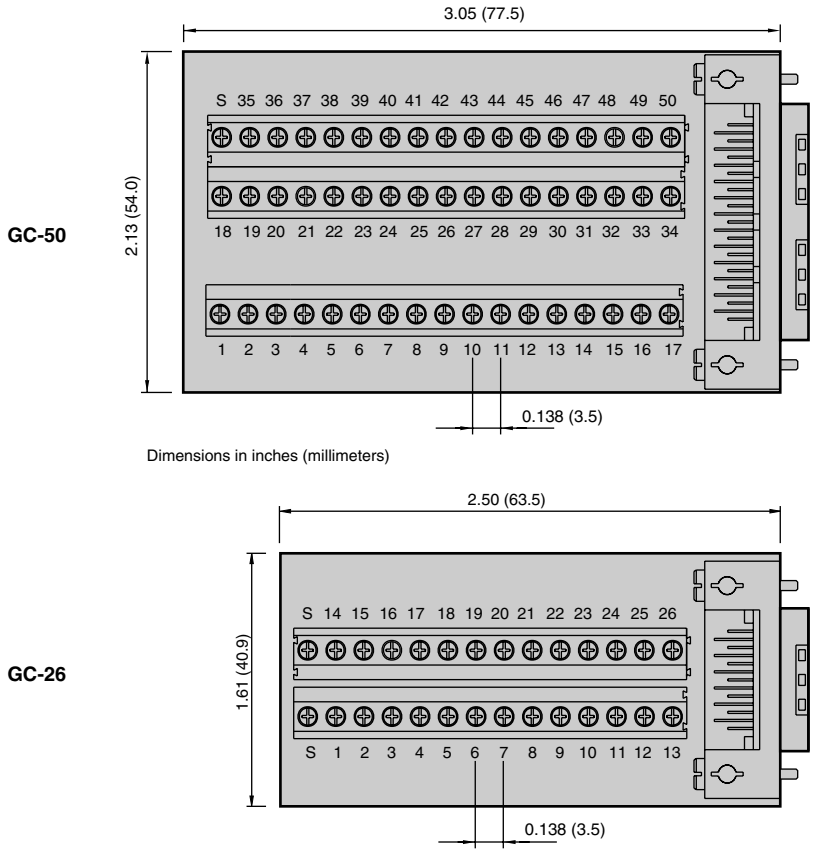
Two breakout modules are available that connect directly to the Gem6K's MOTOR FEEDBACK and DRIVE I/O connectors.

NOTE: These modules are recommended for system prototyping only—*not* for permanent installation.

Description:	Part Number:
50 pin Connector/Breakout Module	GC-50
26 pin Connector/Breakout Module	GC-26

CAUTION

Connect wires to the GC-26 and GC-50 *before* installing in the drive. This will avoid damage that may be caused by wiring the connector while attached to the drive.



GC-26 and GC-50 Dimensions

Gem6K 26 Pin Feedback Connector Kit

A cable connector backshell kit is available from Compumotor. The kit includes plug, cover, and all parts necessary to assemble the connector. It also includes spade lugs to install on the motor cable. The part number is:

GFB-KIT

The plug mates with the drive's 26 pin MOTOR FEEDBACK connector.

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APPENDIX B

Using Non-Compumotor Motors

IN THIS APPENDIX

- Commands for Motor Configuration
- Motor Requirements
- Hall Sensor Configuration and Troubleshooting – GV6K
- Wiring and Connections: 4-, 6-, and 8-lead motors – GT6K
- Setting Motor Current and Drive Gains – GT6K

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Commands for Configuration – GV6K Servos

If you use a non-Compumotor motor, you must configure the drive for your motor by setting values for all commands in the following table. Also see the *Motor Parameters* table on the *Motion Planner CD-ROM* for examples of recommended drive configuration settings for Compumotor motors.

Command:	Description:
ERES	encoder feedback resolution; counts per revolution, post-quadrature
DMTIC	continuous current; amps – rms, 40°C (104°F)
DMTICD	continuous current derating; percent
DMTKE	voltage constant; V/krpm
DMTRES	line-to-line resistance; at 25°C (77°F)
DMTJ	rotor inertia; kg-m^2*10^{-6}
DPOLE	number of pole pairs
DMTW	rated speed; revolutions per second
DMTIP	peak current; amps rms
DMTLMN	minimum line-to-line inductance; mH
DMTLMX	maximum line-to-line inductance; mH
DMTD	motor damping; nM/rad/sec
DMTRWC	winding to case thermal resistance; °C/watt
DMTTCM	motor case thermal time constant; minutes
DMTTCW	motor winding thermal time constant; minutes
DPWM	PWM switching frequency
DMTMAX	motor maximum temperature

Use Motion Planner to enter these command settings into the drive's memory. See the *Gemini GV6K/GT6K Command Reference* for more information on commands.

Servo Motor Requirements

If you have questions about using a non-Compumotor motor with a GV6K drive, call Technical Support (see phone numbers on the inside cover of this manual).

Hall Sensor Configuration/Troubleshooting – GV6K Servos

This section will assist you in resolving a Hall fault (TASX Bit 21). Several problems can cause a Hall fault. The following list will help identify these problems.

Troubleshooting Checklist:

1. Does THALL report back either 0 or 7?
   IF YES: see Problem #1 or #2, below.
2. Does THALL change if you move the motor by hand?
   IF NOT: see Problem #2, below.
3. Does THALL have six distinct Hall states from 1 to 6? (No numerical order is necessary.)
   IF NOT: see Problem #2, below.
4. As reported by THALL, are there *n* times 6 Hall states as the rotor turns one revolution, where *n* is equal to the number of pole-pairs. (Linear motors: *n* = pitch)
   IF NOT: see Problem #2 or #3, below.

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5. As reported by THALL, is the Hall state sequence [1, 5, 4, 6, 2, 3, 1 ...] as the motor turns clockwise? (Clockwise means TPE is increasing; it is also the direction the motor turns in DMODE13.)
   IF NOT: see Problem #4, below.
6. Does TASX report a Hall fault each time the drive is enabled (DRIVE1), even though the Hall state sequence is correct?
   IF YES: see Problem #4, below.
7. Is the Hall fault intermittent? (Intermittent means the fault does not occur every revolution.)
   IF YES: see Problem #5, below.

Possible Problems:

#1: No Hall states are seen by the drive.

#2: Cable is not connected, or is connected incorrectly (miswired).

#3: DPOLE or DMEPIT is not set correctly.

#4: Either the motor wires or the Hall wires are connected incorrectly.

- Use Procedure I to fix this problem by changing the motor wires.
- Use Procedure II to fix this problem by changing the Hall wires.

#5: The Hall wires or the encoder wires may have loose connections, causing intermittent faults.

Procedure I:

Use this procedure to connect your ***motor wires*** to the Gem6K.

1. Randomly connect two motor wires and slowly apply a positive voltage with respect to the third. See the next drawing.

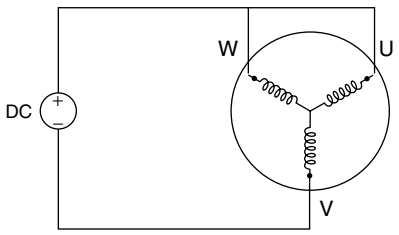
WARNING

This procedure could damage the motor. Slowly increase the voltage until the motor moves. Do not exceed the rated current.

2. If THALL reports back a 1, 2 or 4, change SHALL from either 0 to 1 or from 1 to 0. After you change SHALL, reset the drive.
3. Repeat step 1 until THALL reports a value of 6.
4. The wire which is on the negative voltage or ground is motor wire W. The two wires at the positive voltage are U and V.
5. Now there are two possibilities:

   5.1. Connect the motor wires to the terminals. Operate the drive in DMODE13. If the motor does not turn in the clockwise direction, exchange motor wires U and V.

   5.2. Put positive voltage on motor wire W together with either U or V and put negative voltage or ground on the remaining wire. If THALL reports a value of 3, the wire at the negative voltage is V. If THALL reports a value of 5, the wire at the negative voltage is U.



Connection Diagram

Procedure II:

Use this procedure to connect your ***Hall wires*** to the Gem6K.

1. First operate the drive in DMODE13 and verify that the motor turns clockwise. If not, swap any two motor wires.

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2. Connect motor wires U and V and slowly apply a positive voltage with respect to W. See the previous drawing.

WARNING

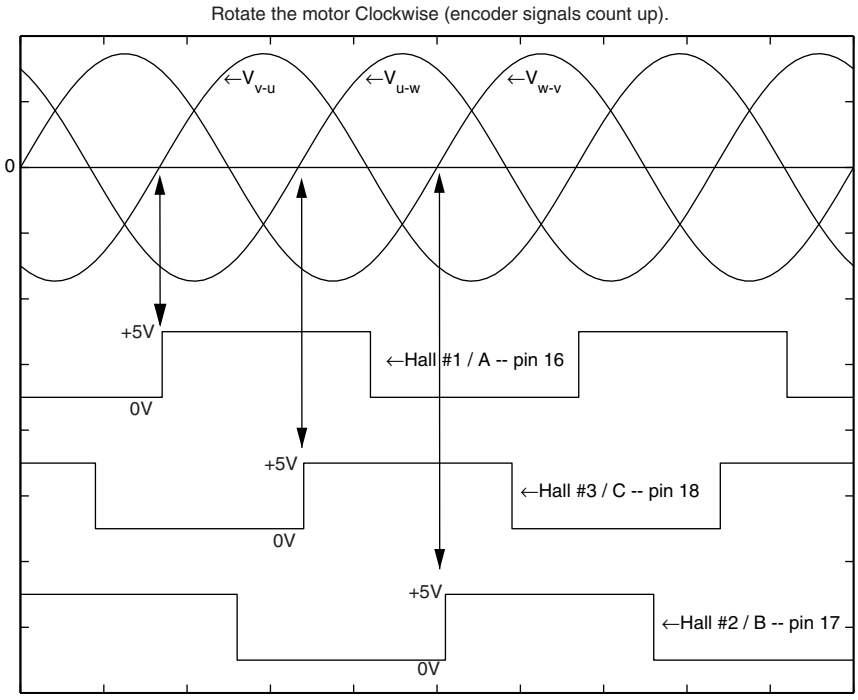
This procedure could damage the motor. Slowly increase the voltage until the motor moves. Do not exceed the rated current.

3. If THALL reports a value of 1, 2 or 4, change SHALL from either 0 to 1 or from 1 to 0. After you change SHALL, reset the drive.
4. Change the Hall wires until THALL reports a value of 6.
5. Connect motor wires U and W and slowly apply a positive voltage with respect to V.
6. If THALL does not report a value of 3, change Hall wires B and C.

   If THALL reports a value of 3, the wires are connected correctly.

The following table summarizes phase voltages and their corresponding Hall states. Starting with SHALL0 and the phase voltages as shown, the THALL command should report the Hall states that match the "Correct" column. If instead THALL reports Hall states that match the "Use SHALL1" column, enter SHALL1 and reset the drive. The Hall states should now match the "Correct" column.

Phase			Hall State	
U	**V**	**W**	**Correct**	**Use SHALL1**
-	-	+	1	6
-	+	+	5	2
-	+	-	4	3
+	+	-	6	1
+	-	-	2	5
+	-	+	3	4



Motor Terminal Voltages (back EMF) and Hall Sensor Signals

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GT6K Steppers – Commands for Configuration

If you use a non-Compumotor motor, you must configure the drive for your motor by setting values for all commands in the following table. Also see the *Motor Parameters* table on the *Motion Planner CD-ROM* for examples of recommended drive configuration settings for Compumotor motors.

Command	Description
DMTSTT	static torque
DMTIC	continuous current
DMTIND	inductance
DMTRES	phase resistance
DMTJ	rotor inertia
DPOLE	number of pole pairs
DIGNA*	current loop gain
DIGNB*	current loop gain
DIGNC*	current loop gain
DIGND*	current loop gain

*See the *Gemini GV6K/GT6K Command Reference* for instructions on calculating DIGN values

Use Motion Planner to enter these command settings into the drive's memory. See the *Gemini GV6K/GT6K Command Reference* for more information on commands.

Step Motor Requirements

We recommend that you use Compumotor step motors with the GT6K drive. If you use a non-Compumotor motor, it must meet the following requirements:

- Inductance: minimum: 0.5 mH
  recommended: 5.0 – 50.0 mH
  maximum: 100.0 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).
- The motor must not have riveted rotors or stators.
- Do not use solid rotor motors.
- 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.

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Step Motor Wiring Configurations – GT6K Steppers

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.

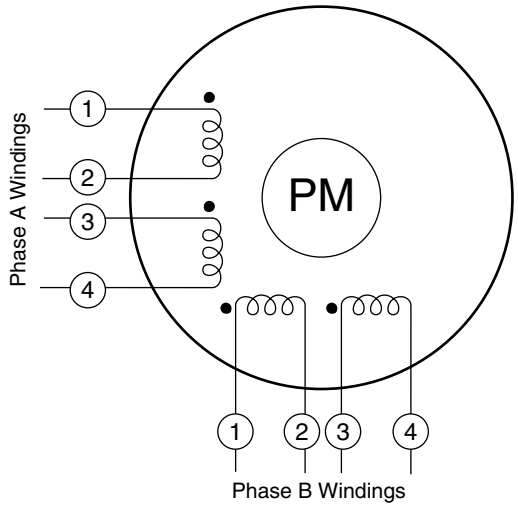
   Scenario #1 — The resistance measurements to the two remaining motor leads are virtually identical. Label the two remaining motor leads **A+** and **A–**. Label the motor lead connected to the negative lead of the ohmmeter **A CENTER TAP** (this is the center tap lead for Phase A of the motor).

   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.

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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.

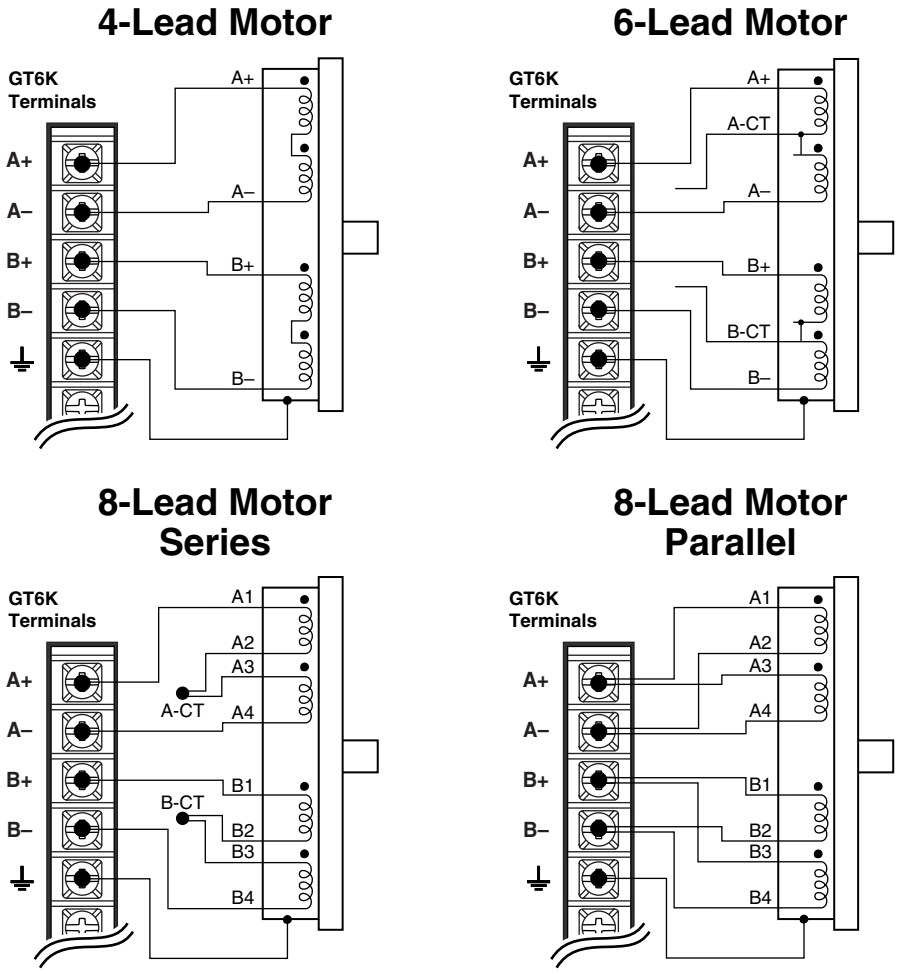
Parallel Configuration Use the following procedure for parallel configurations.

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.

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Terminal Connections – GT6K Steppers

After you determine the motor's wiring configuration, connect the motor leads to the GT6K drive's MOTOR connector according to the following figure.



Non-Compumotor Motor Connections

Direction of Motor Rotation – GT6K Steppers

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.

Autorun Mode, described in *Chapter 2 Installation*, provides a simple method of determining motor shaft rotation. Autorun causes the shaft to rotate in the clockwise (positive) direction, if the motor wires are properly connected.

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Setting Motor Current: GT6K with Non-Compumotor Motor

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 DMTIC command to set the motor's current.

NOTE: GT6K *drive* specifications for output current are in amps *peak*. Most motor current specifications are in amps *rms*. The DMTIC command uses amps rms; *do not use amps peak with the DMTIC command*.

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 value you should enter with the DMTIC command.

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 DMTIC command directly to set motor current—no conversion is required.

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

- Use the next formula to convert unipolar current rating to the correct bipolar rating:

  Unipolar Current * 0.707 = Bipolar Current

- Use the converted value and the DMTIC command 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 DMTIC command directly.
- If you wire the motor in **parallel**, you must double the manufacturer's rating and then use the DMTIC command to set the motor current.

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

- Use the next formula to convert 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 DMTIC command to set the motor current.
- If you wire the motor in **parallel**, you must **double** the converted value and use the DMTIC command to set the motor current.

If you have questions about setting motor current, call Compumotor's Applications Engineering Department at the number listed inside the front cover of this user guide.

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Setting Gains – Non-Compumotor Motors – GT6K Steppers

If you use a non-Compumotor motor, you must use the DIGN command to manually set the gain terms for the stepper current loop. Setting the gain terms correctly will optimize drive performance for your specific motor. See the description of the DIGN command in the *Gemini GV6K/GT6K Command Reference* for instructions.

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APPENDIX C

Regulatory Compliance: UL and CE

IN THIS CHAPTER

- Installation Instructions
- Installation Guidelines
- System Installation Techniques

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Regulatory Agencies

The Gem6K family of products is designed to meet the requirements of global regulatory agencies.

Gem6K products have shown compliance with the requirements of 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	Mains fuses
CE (LVD)	Mains fuses; 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 Gem6K drives are technically considered motion control components and are 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 Gem6K drives 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:

- Mains fuses
- Drive safety earth conductor
- Motor safety earth (for motor voltages greater than 75 volts)
- 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)
- Compumotor EMC cabling (requires no special cable preparation)
- 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.

Mains Fuses

Instructions for installing mains fuses were presented in *Connecting AC Power* in *Chapter 2 Installation*.

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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 Parker Compumotor CE cables.

NOTE: Parker Compumotor does not sell a cable for the Master Encoder connector. Use a high quality braided shield cable if you make connections to the Master Encoder connector.

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 V275LA2Ø or equivalent varistor from line to line, and from lines to earth before the mains filter, as shown in the *EMC Installation* drawings 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)	GV6K-L3 GV6K-U3	GV6K-U6 GT6K-L5	GT6K-L8	GV6K-U12	GV6K-H20	GV6K-H40
3EP1[1]	3	X					
6EP1[1]	9	X	X				
10EP1[1, 3]	10	X	X	X			
FN2070-10-06[2]	10	X	X	X	X		
FN2070-12-06[2]	12	X	X	X	X		
FN2070-16-06[2, 3]	16	X	X	X	X		
16FCD10[1]	16					X	
FN351-16/29[2]	16					X	
FN351-25/29[2]	25						X
25FCD10[1]	25						X
36FCD10[1]	36						X
FN351-36/29[2]	36						X

Product with applicable mains filter denoted by “X”

[1] Corcom; [2] Schaffner;
[3] Available from Compumotor: 10 amp filter – part number 47-016140-01
16 amp filter – part number 47-017900-01

+24VDC Power Supply

If you use the +24VDC power supply Parker Compumotor offers for sale (PS-60W), no additional filter is required on the +24VDC mains. If you use another manufacturer’s +24VDC power supply, it should be CE marked for safety and electromagnetic compatibility.

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Installation Guidelines

Gem6K drives are made available under “Restricted Distribution” for use in the “Second Environment” as described in BS EN 61800-3: 1996, page 9.

Cabinet Mounting

For Electromagnetic Compatibility, cabinet mounting is not required. However, Gem6K drives have high voltage terminals—for safety purposes, the drive must not be user accessible during normal operation.

Drive Mounting

The Gem6K 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. Compumotor CE cables are fully shielded and provide the required screening. When you install limit switches and other inputs/outputs, you must observe proper noise immunity standards. See the *EMC Installation* drawing at the end of this appendix.

Ethernet Cables

Install a ferrite ring core (toroid) on your Ethernet cable. Wrap the cable through the ferrite eight times, as shown in the installation drawings. Make the cable length between the ferrite and drive as short as possible.

A recommended toroid is listed below, along with its specifications.

Manufacturer:	Phillips; part number TL42/26/13-3C90 4330 030 35522 MU
Material:	3C90
A_L:	2690 ± 25% nH
μ_i:	≈2300

The ferrite you choose must meet or exceed the specifications above.

Ferrite Absorbers

To further increase product immunity and reduce product emissions, you must add clip-on or other ferrite absorbers to certain cables. (See the installation drawings at the end of this appendix for specific locations.) 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)

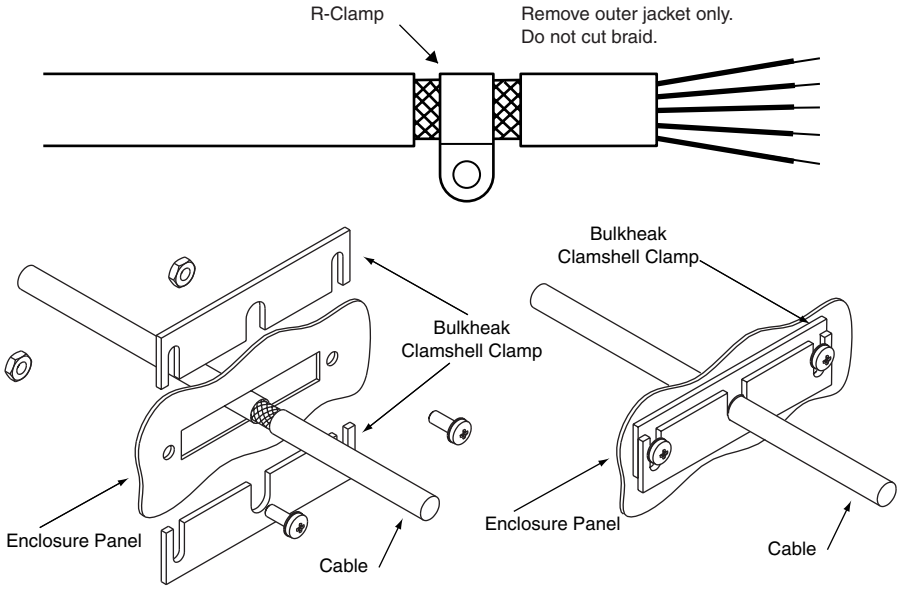
Expansion I/O

For EMC-sensitive applications requiring expansion I/O, or CE compliant installations, use Parker Compumotor’s EVM32-II.

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Enclosure Mounting the Gem6K 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 to the drive using the included saddle clamp or R-Clamp. 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
Saddle Clamp	53-017355-01

If you use the GEM-VM50 or other screw terminal cable breakout device, be sure to properly enclose all exposed conductors to avoid contamination and to reduce the risk of electrostatic discharge. Limit switches and other I/O must utilize high quality shielded cabling (85% braid coverage minimum), which must be RF earth bonded as shown above.

Panel Mounting the Gem6K Drive

The mounting panel must be properly earthed and paint must be removed from drive mounting locations. Gemini CE cables maintain proper RF bonding with the drive when you insert them in the correct location and tighten the headshell

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jackscrews. You must fasten the motor shield (braid) to the bottom of the drive, using the included saddle clamp. (GV6K-H20/H40: R-clamp on 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.

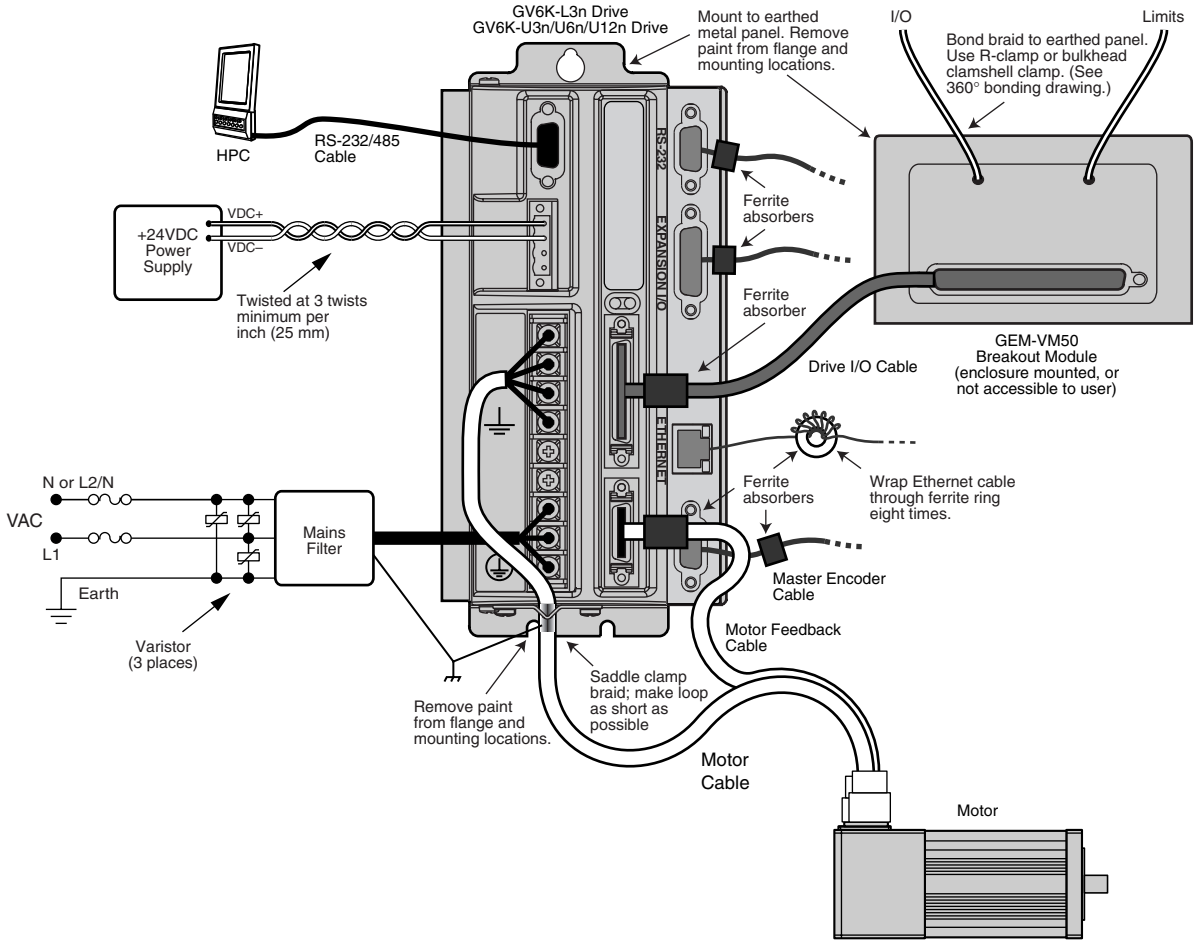
If you use the GEM-VM50 or other screw terminal cable breakout device, be sure to properly enclose all exposed conductors to avoid contamination and to reduce the risk of electrostatic discharge. Limit switches and other I/O must utilize high quality shielded cabling (85% braid coverage minimum), which must be RF earth bonded as shown in the *360° Bonding Techniques* drawing.

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System Installation

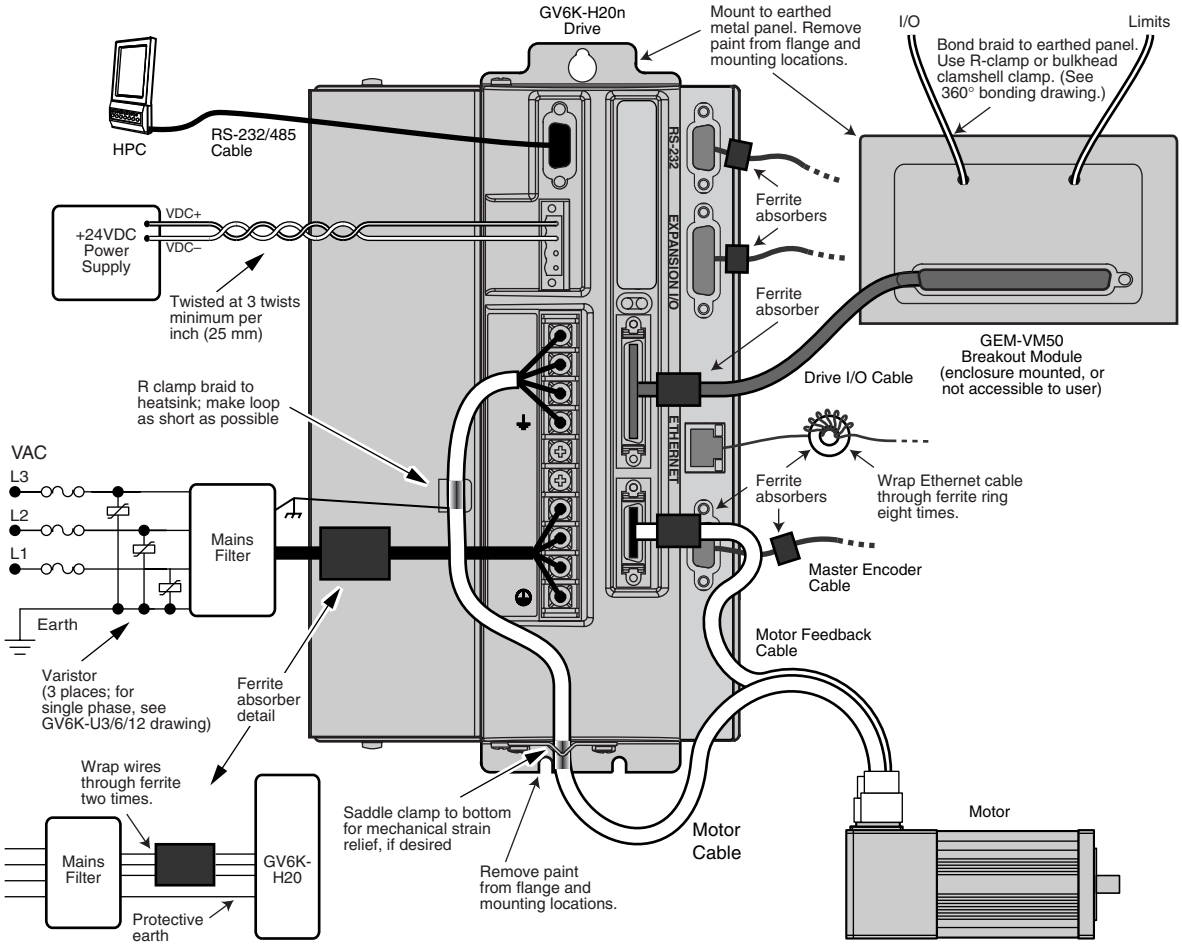
If you mount the Gem6K drive in an enclosure, terminate cable braids (screens) at the entrance of the enclosure. However, the motor braid *must* be returned to the drive's saddle clamp (GV6K-H20n/H40n: R-Clamp on heatsink), not any other location.

The next figures show typical EMC installations.



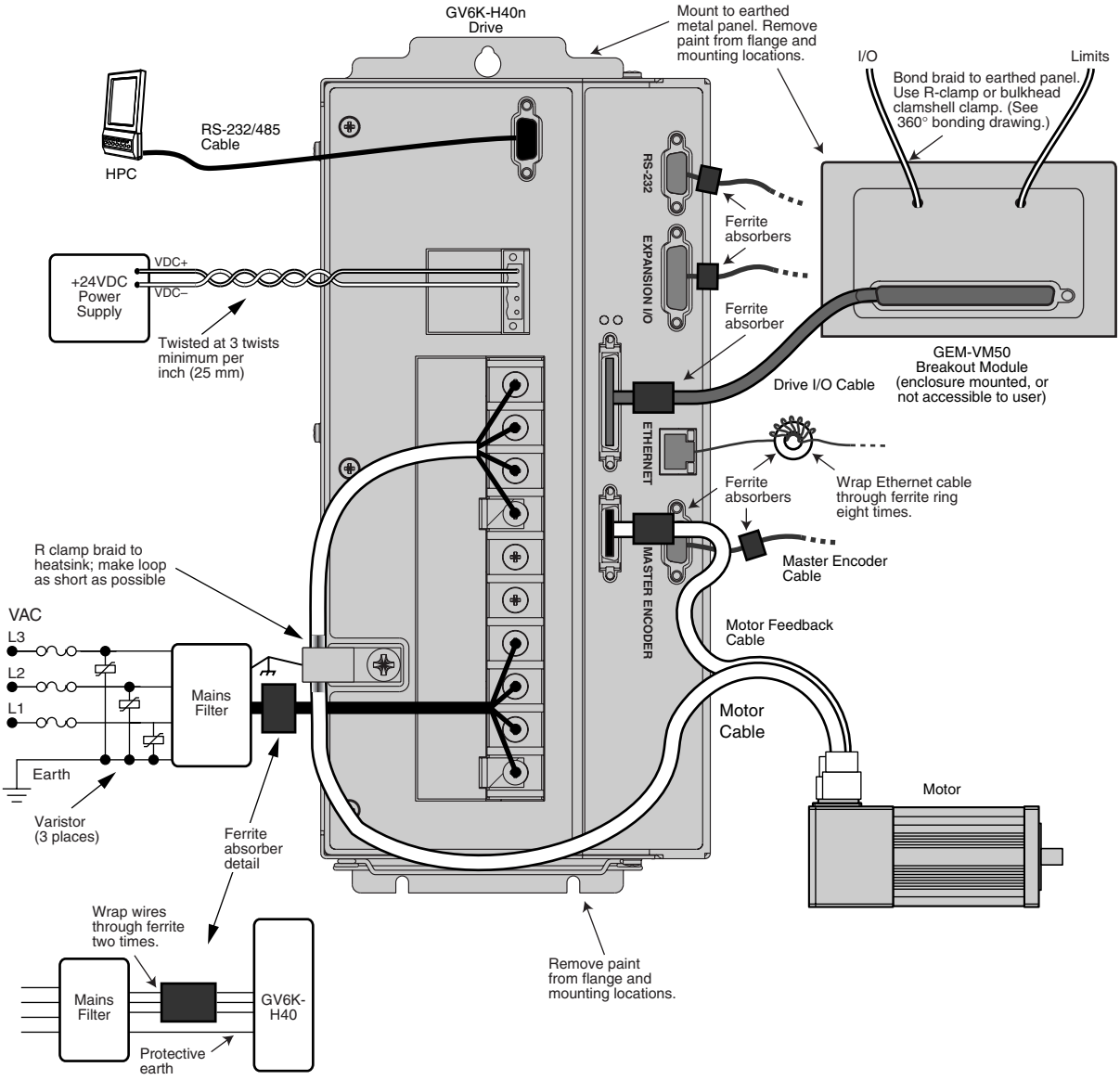
EMC Installation – GV6K-L3n; GV6K-U3n/U6n/U12n

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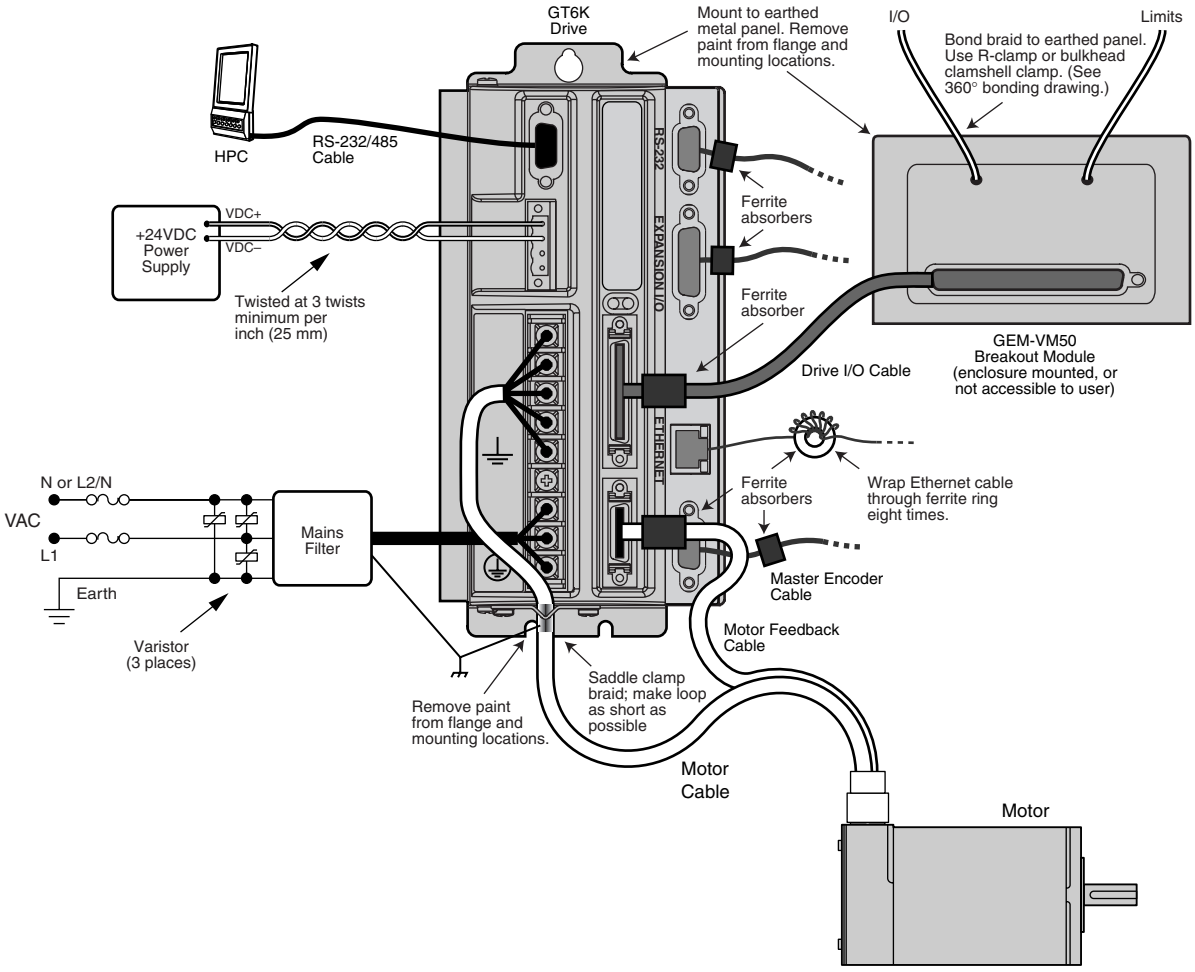
EMC Installation – GV6K-H20n

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EMC Installation – GV6K-H40n

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EMC Installation – GT6K

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Gem6K
Digital Controller/Drive

RS-232/485 Connector – COM1 – Port 1: see page 48

To configure drive parameters, connect a PC to this port.
Use Motion Planner for drive configuration.
Enabling Ethernet will disable the COM1 port.

RS-485 Connections
Rx+ (RD B) Tx+ (TD B) Gnd
Rx- (RD A) Tx- (TD A)

RS-232 Connections
Rx Tx Gnd

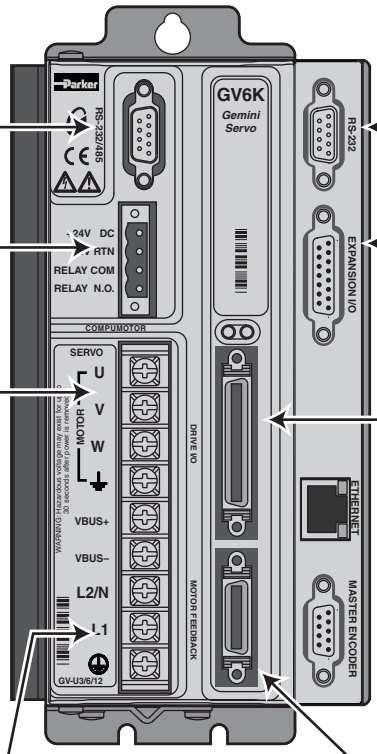
Male Pins

RS-232 Connector – COM2 – Port 2: see page 48

Connect an RP240, or use this port for RS-232.
Download OS through this port only.
Ethernet and COM2 can both be active at the same time.

RS-232 Connections
Rx Tx Gnd
+5VDC

Male Pins



+24VDC/Relay Connector – see page 15, 40

Required +24VDC input.
19.2 – 28.8 VDC,
500 mA maximum.

When drive is enabled, it holds relay closed.

Relay rating: 5A at 24VDC or 120VAC.

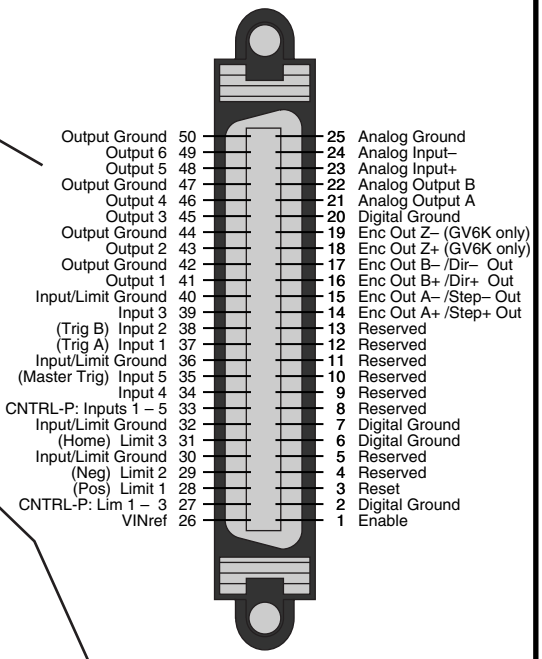
If drive is faulted or disabled, relay will open. (Typical use: control of motor brake.)

+24V DC
24V RTN
RELAY COM
RELAY N.O.

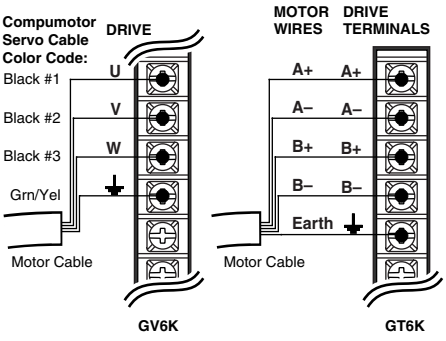
Expansion I/O Connector: see page 54

Connect as many as eight EVM32-II I/O modules in series, for up to 256 additional I/O points.

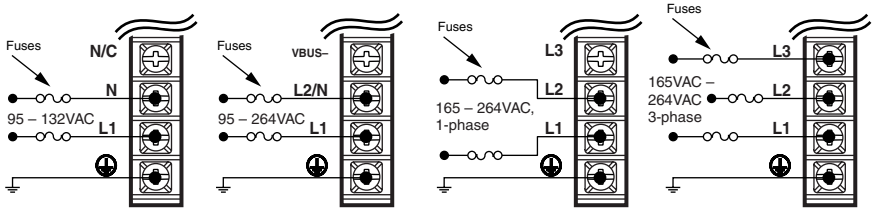
50 Pin DRIVE I/O Connector – see page 69



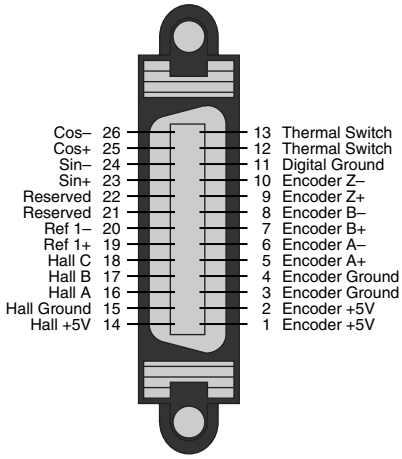
Motor Output Connections – see page 12



AC Input Connections– see page 16



26 Pin MOTOR FEEDBACK Connector – see page 76



Protective Circuits – see page 84

Short Circuit Protection
Inrush Current Protection
Drive Overtemperature Protection
Motor Overtemperature Protection
Undervoltage Protection
Overvoltage Protection
Current Foldback
Regeneration Protection

LEDs – see page 58

Green/Red Yellow/Green

LED Color:

Left	Right	Indicated State
Red	Grn	+24VDC only
Red	Yel	AC only
Grn	Grn (flash)	Motion in progress
Grn	Yel/Grn (flash)	Autorun mode
Red	Off	Drive not enabled; or Drive faulted
Off	Yel	Initializing
Grn	Off	Drive ready

Environmental Specifications – see page 67

Operating Temperature	Still Air: 45°C (113°F) Moving Air: 50°C (122°F)
Storage Temperature:	-40°C – 85°C (-40°F – 185°F)
Humidity:	0 – 95%, non-condensing

Troubleshooting – see page 57

Ethernet Connector: see page 53

RJ-45 connector for 10Base-T (10Mbps twisted pair) TCP/IP protocol. Default address is 192.168.10.30.
Green LED on = Connection OK; Red LED on = Transmitting

Master Encoder Connector: see page 54

Connect an encoder for Following. Not for servo feedback or stepper stall detect.

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