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

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.

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.

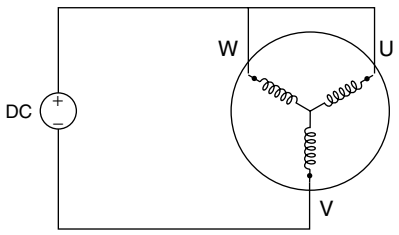
WARNING

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.

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

WARNING

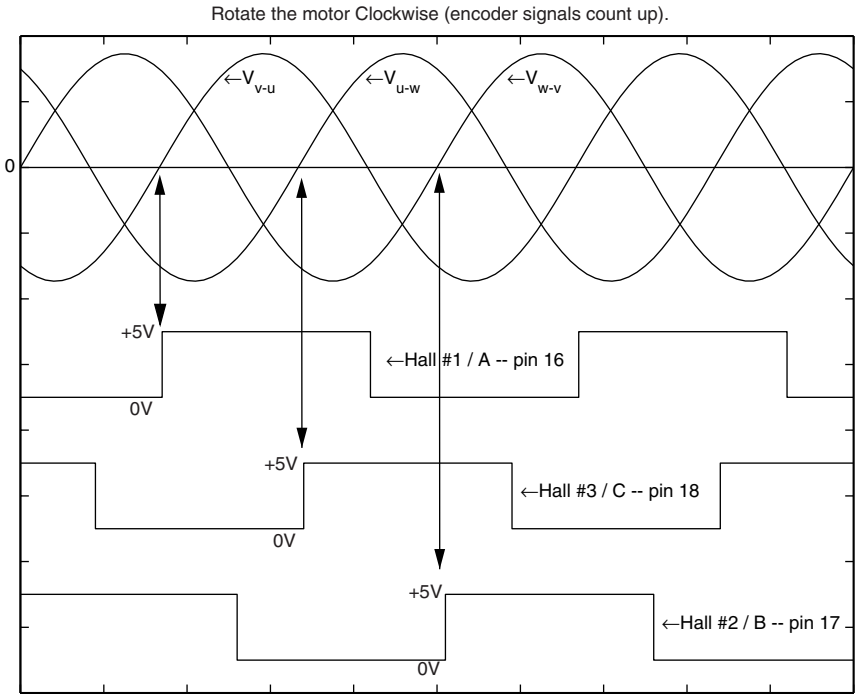
This procedure could damage the motor. Slowly increase the voltage until the motor moves. Do not exceed the rated current.

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

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.

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

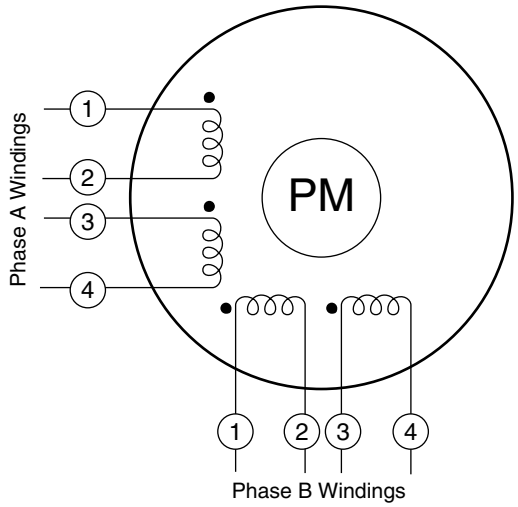
1. Determine, with an ohmmeter, which three of the six motor leads are common (one phase).
2. Label each one of these three motor leads **A**.
3. Using the ohmmeter, verify that the remaining three leads are common.
4. Label the remaining three leads **B**.
5. Set the ohmmeter range to the 100 ohm scale (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.



8-Lead Motor – Labeling the Leads

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

Series Configuration Use the following procedure for series configurations.

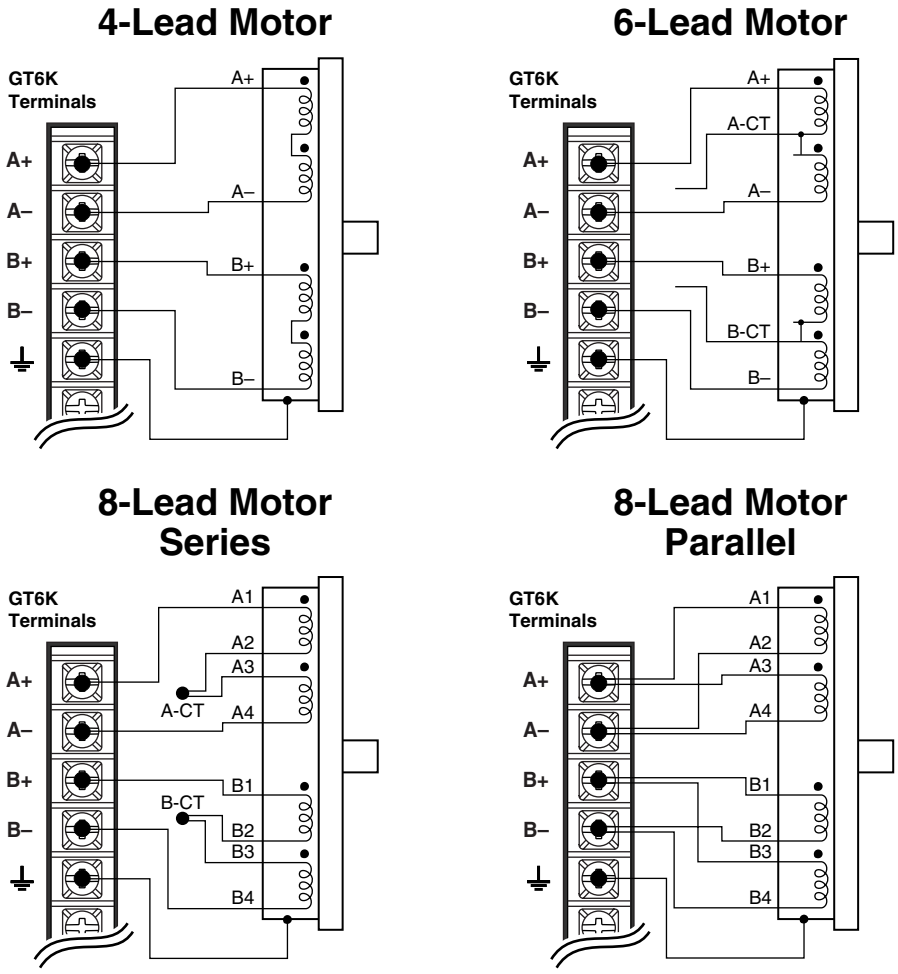
1. Connect A2 & A3 together and relabel this common point **A CENTER TAP.**
2. Connect B2 & B3 together and relabel this common point **B CENTER TAP.**
3. Relabel the A1 lead **A+**.
4. Relabel the A4 lead **A–**.
5. Relabel the B1 lead **B+**.
6. Relabel the B4 lead **B–**.
7. Proceed to the *Terminal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

Parallel Configuration Use the following procedure for parallel configurations.

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

Terminal Connections – 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.

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.

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.