ABOUT THIS GUIDE

Purpose of This Guide

This document is designed to help you install and troubleshoot your ZETA6104 hardware system. Programming related issues are covered in the *6000 Series Programmer's Guide* and the *6000 Series Software Reference Guide*.

> **"ZETA6104" Synonymous with "6104"**
> The ZETA6104 product is often referred to the as the "6104" because it is part of the 6000 family of products. The ZETA6104's software and the 6000 Series software documentation (e.g., *6000 Series Software Reference Guide*) refer to this product as the "6104."

What You Should Know

To install and troubleshoot the ZETA6104, you should have a fundamental understanding of:

- Electronics concepts, such as voltage, current, switches.
- Mechanical motion control concepts, such as inertia, torque, velocity, distance, force.
- Serial communication and terminal emulator experience: RS-232C and/or RS-485

Related Publications

- *6000 Series Software Reference Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-012966-01
- *6000 Series Programmer's Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-014540-01
- *6000 Series Following User Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-014217-01
- *Motion Architect User Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-013056-01
- Current *Parker Compumotor Motion Control Catalog*
- Schram, Peter (editor). *The National Electric Code Handbook (Third Edition).* Quincy, MA: National Fire Protection Association

User Guide Feedback	Please send your comments to our email address: `6000user@cmotor.com`

CHAPTER ONE

1 Installation

IN THIS CHAPTER

- Product ship kit list
- Things to consider before you install the ZETA6104
- General specifications table
- Optional pre-installation alterations
  - Selecting series or parallel motor wiring
  - DIP switch settings – motor current, device address, autobaud feature
  - Changing the COM 2 port from RS-232C to RS-422/485
- Mounting the ZETA6104
- Connecting all electrical components (includes specifications)
- Testing the installation
- Matching the motor to the ZETA6104
- Motor mounting and coupling guidelines
- Using the damping features to optimize performance
- Preparing for what to do next

What You Should Have *(ship kit)*

If an item is missing, call the factory (see phone numbers on inside front cover).

Part Name			Part Number
One of the following line items:			
	ZETA6104 standard product (with ship kit)		**ZETA6104**
	ZETA6104 with expanded memory (with ship kit)		**ZETA6104-M**
Ship kit:	120VAC power cord		44-014768-01
	Motor connector (Zeta motors are factory wired with a motor connector)		43-008755-01
	Quick-reference magnet (see side of ZETA6104 chassis)		87-014873-01
	This user guide (*ZETA6104 Installation Guide*)		88-014782-01
	6000 Series Software Reference Guide		88-012966-01
	6000 Series Programmer's Guide		88-014540-01
	Motion Architect User Guide		88-013056-01
	Motion Architect diskettes:	Disk 1	95-013070-01
		Disk 2	95-013070-02
	6000 DOS Support Disk		95-102266-01
	Warranty registration card		88-013468-01

Motor: (If you ordered a ZETA6104 *system* (controller/drive and motor), you will receive one of the Zeta motors listed below.)

ZETA57-51	ZETA83-62
ZETA57-83	ZETA83-93
ZETA57-102	ZETA83-135

Before You Begin

⚠ WARNINGS ⚠

The ZETA6104 is used to control your system's electrical and mechanical components. Therefore, you should test your system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

Always remove power to the ZETA6104 before:

- Connecting any electrical device (e.g., motor, encoder, inputs, outputs, etc.)
- Adjusting the DIP switches, jumpers, or other internal components

Recommended Installation Process

This chapter is organized sequentially to best approximate a typical installation process.

1. Review the general specifications
2. Perform configuration/adjustments (if necessary)
3. Mount the ZETA6104
4. Connect all electrical system components
5. Test the installation
6. Match the motor to the ZETA6104 — *optional*
7. Mount the motor and couple the load
8. Optimize performance (using the ZETA6104's damping features) — *optional*
9. Record the system configuration (record on the information label and/or in a set-up program)
10. Program your motion control functions. Programming instructions are provided in the *6000 Programmer's Guide* and the *6000 Software Reference Guide*. We recommend using the programming tools provided in Motion Architect for Windows (found in your ship kit). You can also benefit from an optional iconic programming interface called Motion Builder (sold separately).

Electrical Noise Guidelines

- Do not route high-voltage wires and low-level signals in the same conduit.
- Ensure that all components are properly grounded.
- Ensure that all wiring is properly shielded.
- Noise suppression guidelines for I/O cables are provided on page 19.

General Specifications

Parameter	Specification
Power	
AC input	95-132VAC, 50/60Hz, single-phase (refer to page 18 for peak power requirements, based on the motor you are using)
Status LEDs/fault detection	Refer to *Status LEDs* in Chapter 2
Environmental	
Operating Temperature	32 to 122°F (0 to 50°C) — over-temperature shutdown fault at 131°F (55°C)
Storage Temperature	-22 to 185°F (-30 to 85°C)
Humidity	0 to 95% non-condensing
Performance	
Position Range	±2,147,483,648 steps
Velocity Range	1-2,000,000 steps/sec
Acceleration Range	1-24,999,975 steps/sec^2
Stepping Accuracy	±0 steps from preset total
Velocity Accuracy	±0.02% of maximum rate
Velocity Repeatability	±0.02% of set rate
Motion Algorithm Update Rate	2 ms
Serial Communication	*RS-422/485 requires internal jumper and DIP switch configuration (see page 6).*
Connection Options	RS-232C (3-wire); RS-422/485 (4-wire); Change internal jumpers JU1-JU5 to position 1 to select RS-422/485 communication
Maximum units in daisy-chain or multi-drop	99 (use DIP switch or ADDR command to set individual addresses for each unit)
Communication Parameters	9600 baud (range is 19200-1200—see *AutoBaud*, page 5), 8 data bits, 1 stop bit, no parity; RS-232 & RS-422: Full duplex; RS-485: Half duplex (change jumper JU6 to position 1)
Inputs	***ALL INPUTS ARE OPTICALLY ISOLATED***
HOM, POS, NEG, TRG-A, TRG-B, P-CUT	HCMOS compatible*; internal 6.8 KΩ pull-ups to **AUX-P** terminal (connect **AUX-P** to **+5V** to source current or connect **AUX-P** to **GND** to sink current); voltage range is 0-24V.
Encoder	Differential comparator accepts two-phase quadrature incremental encoders with differential (recommended) or single-ended outputs. Maximum voltage = 5VDC. Switching levels (TTL-compatible): Low ≤ 0.4V, High ≥ 2.4V. Maximum frequency = 1.6 MHz. Minimum time between transitions = 625 ns.
16 General-Purpose Programmable	HCMOS compatible* with internal 6.8 KΩ pull-ups to **IN-P** terminal (connect **IN-P** to **+5V** to source current or connect **IN-P** to **GND** to sink current). Voltage range = 0-24V.
Outputs	***ALL OUTPUTS ARE OPTICALLY ISOLATED***
9 Programmable (includes **OUT-A**)	Open collector output with 4.7 KΩ pull-ups. Can be pulled up by connecting **OUT-P** to **+5V**, or to user-supplied voltage of up to 24V. Max. voltage in the OFF state (not sinking current) = 24V, max. current in the ON state (sinking) = 30mA. Includes the 8 general-purpose outputs on the **Programmable I/O** connector, and the **OUT-A** terminal on the **I/O** connector.
+5V Output	+5V terminals are available on the **COM2**, **ENCODER** and **I/O** connectors. Load limit (total load for all I/O connections) is 0.5A.

* HCMOS-compatible switching voltage levels: Low ≤ 1.00V, High ≥ 3.25V.
TTL-compatible switching voltage levels: Low ≤ 0.4V, High ≥ 2.4V.

Motor Specifications

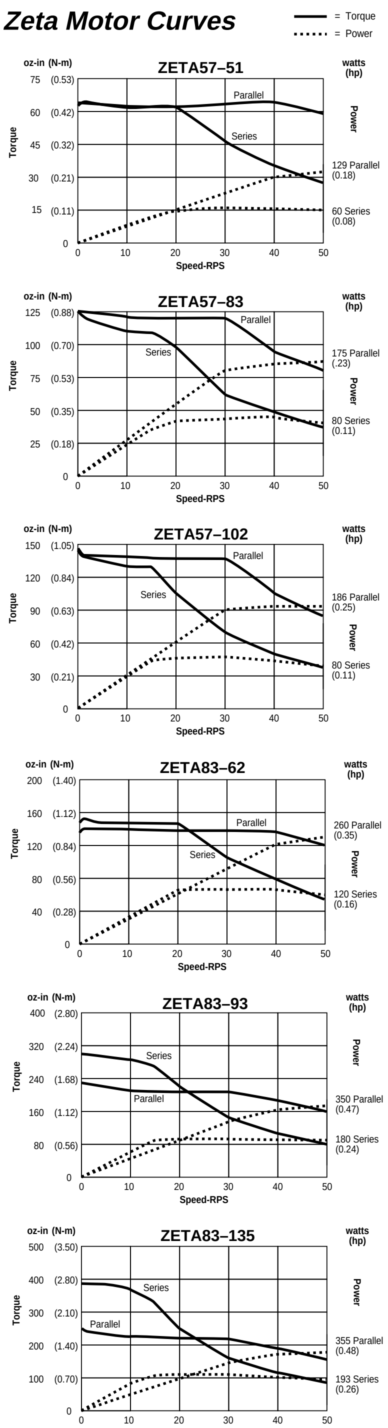
		Size 23			Size 34		
		ZETA57-51	**ZETA57-83**	**ZETA57-102**	**ZETA83-62**	**ZETA83-93**	**ZETA83-135**
Static Torque							
oz-in		65	100	125	160	300	400
(N-m)		(0.46)	(0.71)	(0.89)	(1.14)	(2.14)	(2.80)
Rotor Inertia							
oz-in^2		0.546	1.1	1.69	3.47	6.76	10.47
(kg-m^2 x 10^{-6})		(9.998)	(20.1)	(30.9)	(63.4)	(124)	(191)
Bearings							
Thrust load	lb	25	25	25	50	50	50
	(kg)	(11.3)	(11.3)	(11.3)	(22.6)	(22.6)	(22.6)
Radial load	lb	15	15	15	25	25	25
	(kg)	(6.8)	(6.8)	(6.8)	(11.3)	(11.3)	(11.3)
End play *(Reversing load equal to 1 lb)*	in	0.005	0.005	0.005	0.005	0.005	0.005
	(cm)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Radial play *(Per 0.5 lb load)*	in	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
	(cm)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Weight *(Motor+Cable+Connector)*							
	lb	1.6	2.4	3.2	3.8	5.1	8.3
	(kg)	(0.7)	(1.1)	(1.5)	(1.7)	(2.3)	(3.8)
Speed/Torque Curves		-------- Refer to page 4 --------			-------- Refer to page 4 --------		
Dimensions		-------- Refer to page 24 --------			-------- Refer to page 24 --------		

Factory Settings May Be Sufficient (if so, skip this section)

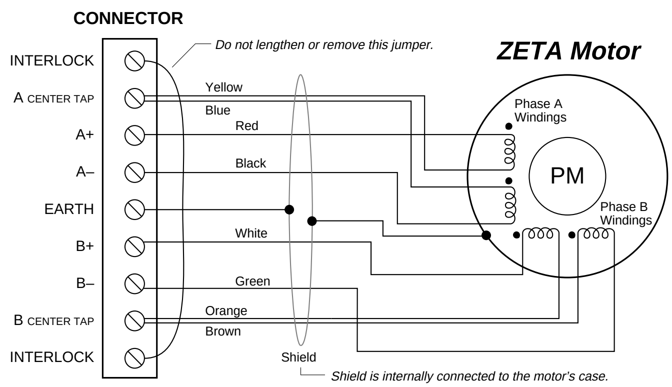
- Zeta motors are pre-configured for series operation
- Motor current is factory set for the Zeta motor if it was ordered with the ZETA6104
- Device address is set to zero (if daisy-chaining you can automatically establish with the `ADDR` command)
- Serial communication method is RS-232C

Selecting Series or Parallel Motor Wiring

Zeta Motor Curves

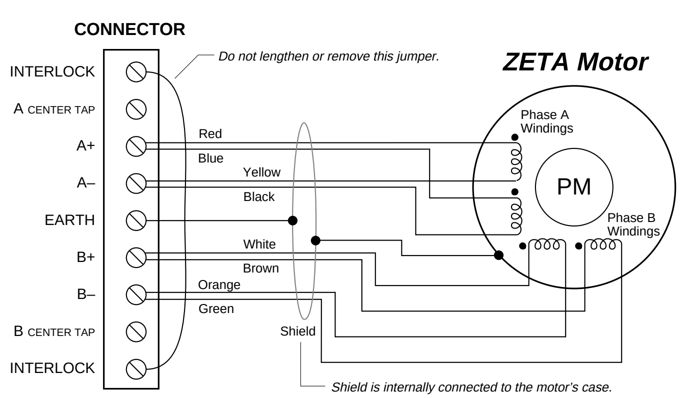


Use series wiring if your application permits. The ZETA motor comes from the factory with a permanently attached motor cable. The connector on the cable is prewired for series motor current (see drawing below). The operating temperature of a motor connected in series will be lower than that of a motor connected in parallel. Typically, series connections work well in high torque/low speed applications.



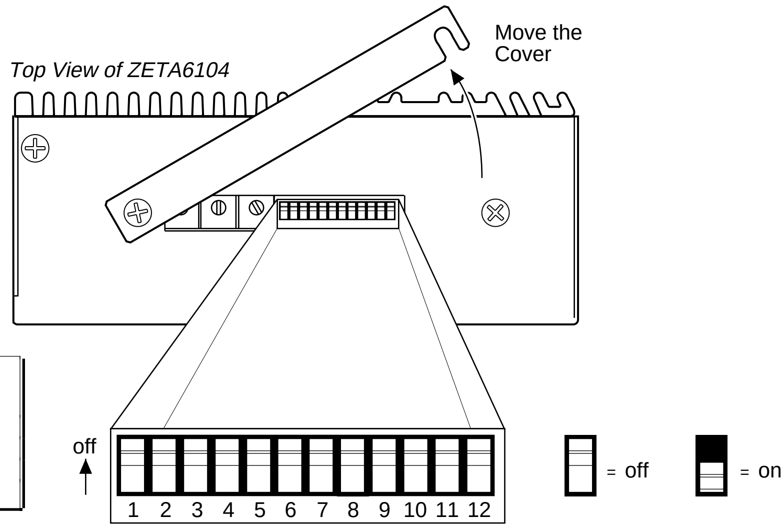
When to use parallel wiring. At higher speeds, a motor connected in parallel will produce more torque than the same motor connected in series. Use **caution**, however, because the operating temperature of the motor in parallel will be much hotter. If you operate your motor in parallel, measure motor temperature under actual operating conditions. If the motor exceeds its maximum case temperature, reduce the duty cycle to limit motor heating. ZETA motors have maximum case temperatures of 212°F (100°C).

To rewire the motor connector for parallel motor current, pull back the rubber boot that covers the connector and attach wires from the motor cable as shown below.



Non-Compumotor Motors: If you are using a non-Compumotor motor, refer to Appendix B for connection instructions and current-select DIP switch settings.

DIP Switch Settings – Motor Current, Address, Autobaud



> ⚠ **CAUTION**
>
> Do not set switches 6-11 to ON at the same time. This invokes a factory test mode in which the ZETA6104 executes a motion sequence upon power up.

Motor Current (Amps)

Motor	Wiring	Amps	1	2	3	4	5
		0.14	off	off	off	off	off
		0.26	off	off	off	off	on
		0.39	off	off	off	on	off
		0.51	off	off	off	on	on
		0.64	off	off	on	off	off
		0.76	off	off	on	off	on
		0.89	off	off	on	on	off
		1.01	off	off	on	on	on
		1.14	off	on	off	off	off
Zeta57-51	*Series*	1.26	off	on	off	off	on
		1.38	off	on	off	on	off
Zeta57-83	*Series*	1.51	off	on	off	on	on
		1.63	off	on	on	off	off
Zeta57-102	*Series*	1.76	off	on	on	off	on
		1.88	off	on	on	on	off
		2.01	off	on	on	on	on
		2.14	on	off	off	off	off
Zeta83-62	*Series*	2.26	on	off	off	off	on
Zeta57-51	*Parallel*	2.38	on	off	off	on	off
		2.51	on	off	off	on	on
		2.63	on	off	on	off	off
		2.76	on	off	on	off	on
Zeta83-93	*Series*	2.88	on	off	on	on	off
		3.01	on	off	on	on	on
Zeta57-83	*Parallel*	3.13	on	on	off	off	off
		3.26	on	on	off	off	on
		3.38	on	on	off	on	off
Zeta57-102 Zeta83-135	*Parallel* *Series*	3.50	on	on	off	on	on
		3.63	on	on	on	off	off
		3.75	on	on	on	off	on
		3.88	on	on	on	on	off
Zeta83-xx	*Parallel*	4.00	on	on	on	on	on

Address

8	9	10	11	12	Address
off	off	off	off	off	0 (default)
off	off	off	off	on	1
off	off	off	on	off	2
off	off	off	on	on	3
off	off	on	off	off	4
off	off	on	off	on	5
off	off	on	on	off	6
off	off	on	on	on	7
off	on	off	off	off	8
off	on	off	off	on	9
off	on	off	on	off	10
off	on	off	on	on	11
off	on	on	off	off	12
off	on	on	off	on	13
off	on	on	on	off	14
off	on	on	on	on	15
on	off	off	off	off	16
on	off	off	off	on	17
on	off	off	on	off	18
on	off	off	on	on	19
on	off	on	off	off	20
on	off	on	off	on	21
on	off	on	on	off	22
on	off	on	on	on	23
on	on	off	off	off	24
on	on	off	off	on	25
on	on	off	on	off	26
on	on	off	on	on	27
on	on	on	off	off	28
on	on	on	off	on	29
on	on	on	on	off	30
on	on	on	on	on	31

Automatic Addressing: If you are connecting multiple units (see page 9), you can use the ADDR command to establish a unique address for each unit. The ADDR command overrides the DIP switch setting. For details, refer to the *6000 Series Software Reference Guide* or the *6000 Series Programmer's Guide*.

Factory Settings: If you ordered the Zeta motor as part of your ZETA6104 system (e.g., ZETA6104-83-62), then the DIP switches will be factory-configured to operate your motor in a series wiring configuration.

If you ordered the ZETA6104 without a motor, all DIP switches are factory-set to the OFF position.

AutoBaud

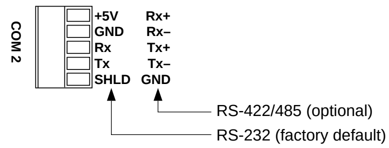
6	7
on	off

If your terminal is not capable of 9600 baud, use this procedure to automatically match your terminal's speed of 1200, 2400, or 4800 baud.

1. Set switch 6 to on and switch 7 to off.
2. Connect the ZETA6104 to the terminal.
3. Power up the terminal.
4. Cycle power to the ZETA6104 and immediately press the space bar several times.
5. The ZETA6104 should send a message with the baud rate on the first line of the response. If no baud rate message is displayed, verify steps 1-3 and repeat step 4.
6. Change switches 6 & 7 to off.
7. Cycle power to the ZETA6104. This stores the baud rate in non-volatile memory.

NOTE: Autobaud works only on the **COM 1** serial port.

Changing the COM 2 Connector from RS-232 to RS-422/485

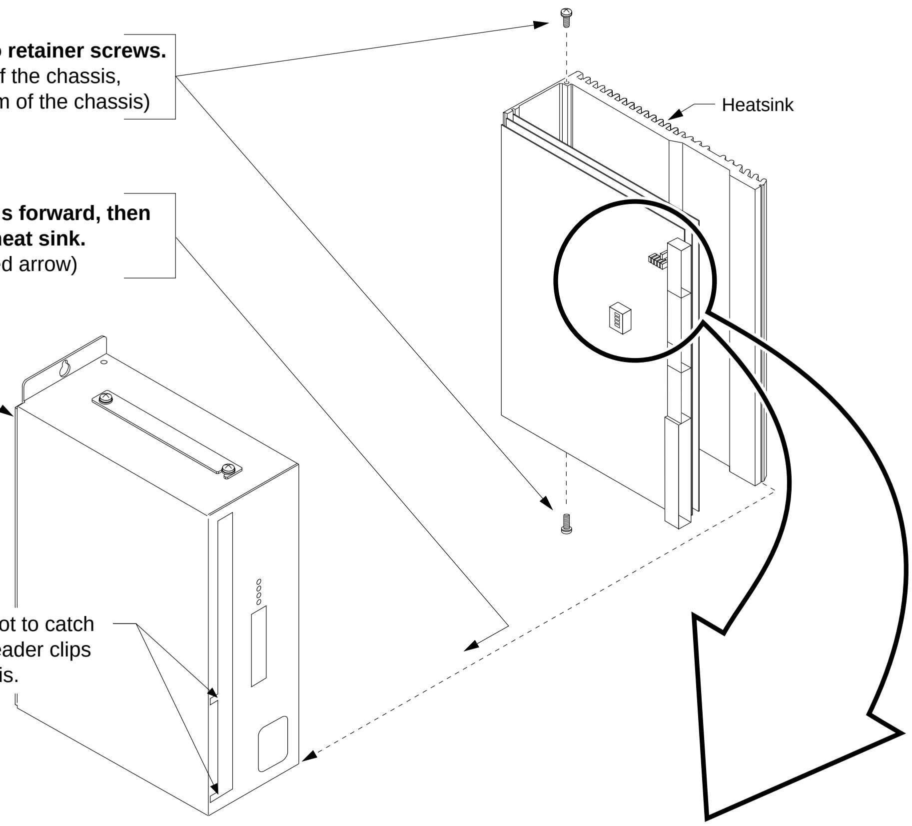


RS-232C Users

The ZETA6104's **COM 2** port is factory configured for RS-232C communication (use the left-hand pin descriptions). If you <u>do not</u> need to use RS-422/485 communication, you may ignore this section and proceed to the *Mounting* instructions.

① **Remove the two retainer screws.** (one on the top of the chassis, one on the bottom of the chassis)

② **Slide the chassis forward, then away from the heat sink.** (follow the dashed arrow)



Be careful not to catch the 50-pin header clips on the chassis.

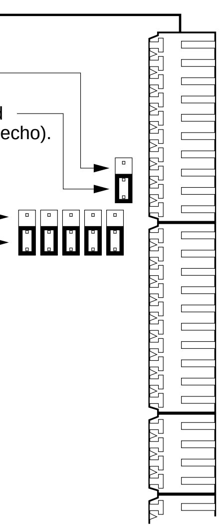
③ **Set the jumpers.**

RS-422 (or RS-232): Leave JU6 set to position 3.

RS-485 Multi-Drop: Set jumper JU6 to position 1 on all units, as illustrated (selects half duplex and disables power-up messages, error messages, & echo).

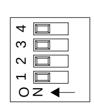
COM 2 port for RS-232, set JU1-JU5 to position 3 (factory default).

COM 2 port for RS-422/485, set JU1-JU5 to position 1 (as illustrated).



④ **Set the DIP switches.**

DIP switch #4: Rx Termination Resistor...........120 Ω
DIP switch #3: Tx+ Bias Resistor....................681 Ω
DIP switch #2: Tx Termination Resistor...........120 Ω
DIP switch #1: Tx– Bias Resistor....................681 Ω



NOTE: Set the switches to ON (as illustrated) to use the internal resistors. Do this for a single unit or for the last unit in a multi-drop only. If these resistor values are not appropriate for your application, set the switches to OFF and connect your own external resistors. See page 9 for resistor calculations and wiring instructions.

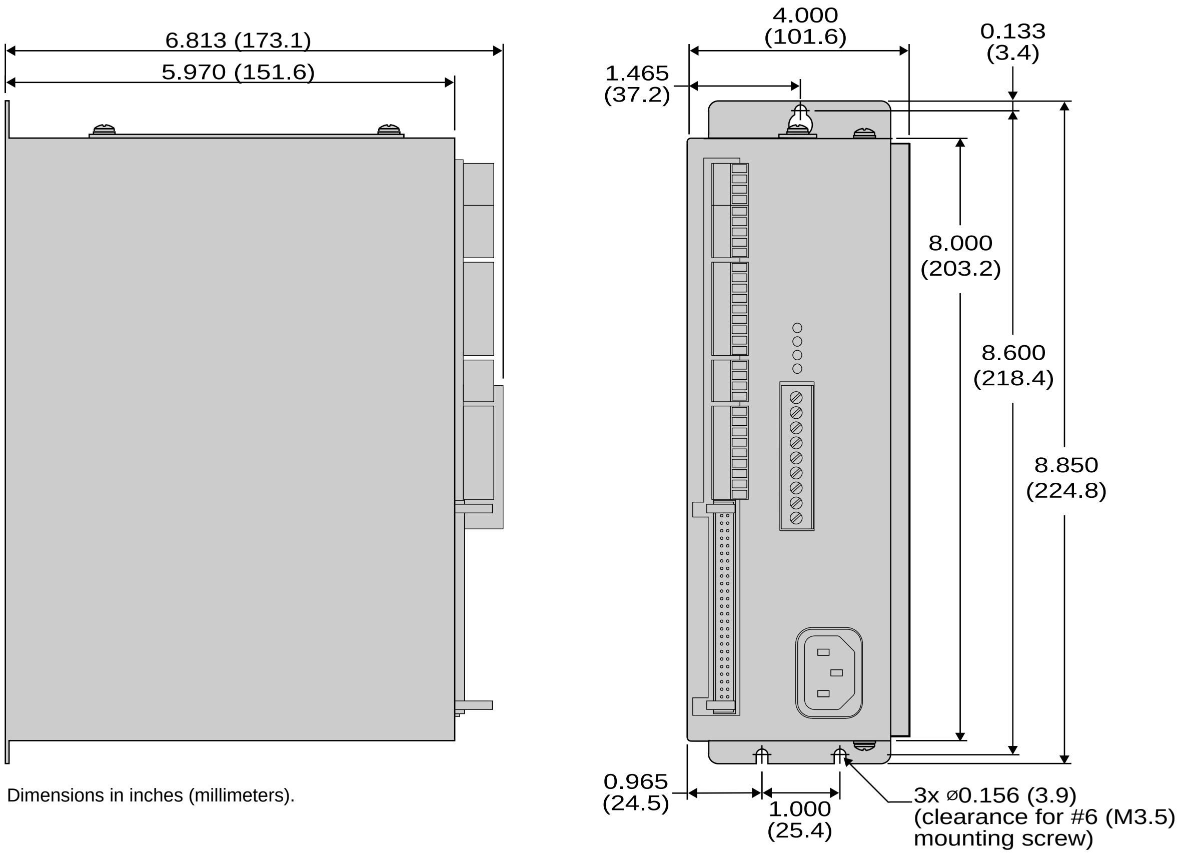
⑤ **Reattach the chassis and replace the two retainer screws.**

Mounting the ZETA6104

Before you mount the ZETA6104

Make sure you have performed all the necessary configuration tasks that require accessing internal components (DIP switches, potentiometers, and jumpers). You may be able to adjust DIP switches and pots after mounting, if you allow access to the top of the ZETA6104 chassis.

- **Select motor current (DIP switches)**. If you ordered a Zeta motor with your system and you intend to use series motor winding, use the factory setting. If you need to change this setting, refer to page 5 for instructions.
- **Select device address (DIP switches)**. If you are not connecting multiple ZETA6104 units in an RS-232C daisy chain or an RS-485 multi-drop, use the factory setting. If you need to change this setting, refer to page 5 for instructions.
- **Match the motor to the ZETA6104 (potentiometers)**. If you are content with the out-of-box performance of your motor, use the factory setting. If you wish to optimize your motor's performance, use the procedure on page 22.
- **Select serial communication method (jumpers & DIP switches)**. If you are using RS-232C to communicate with the ZETA6104, use the factory settings. If you need to change these settings (i.e., for RS-422/485), refer to page 6 for instructions.



Dimensions in inches (millimeters).

Environmental Considerations

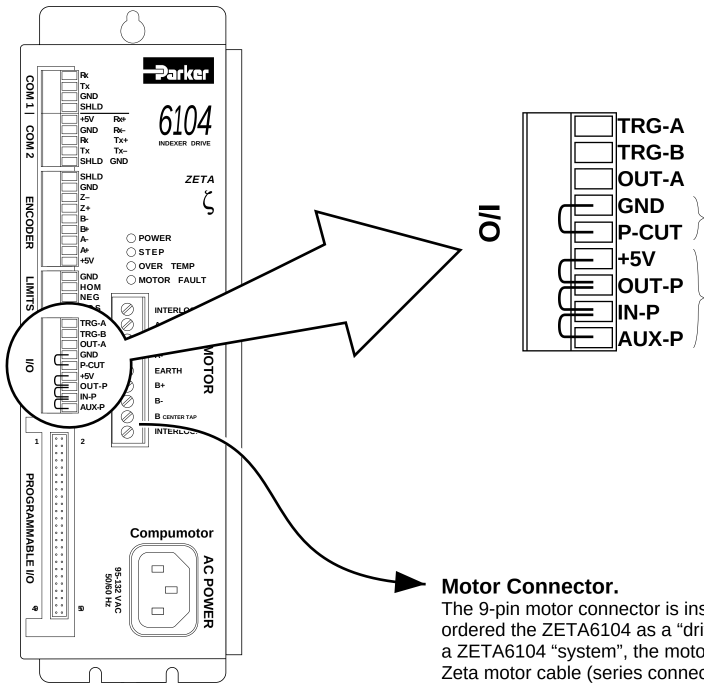
Temperature. Operate the ZETA6104 in ambient temperatures between 32°F (0°C) and 122°F (50°C). Provide a minimum of 1 inch of unrestricted air-flow space around the ZETA6104 chassis. The ZETA6104 will shut itself down if its internal sensor reaches 131°F (55°C).

Humidity. Keep below 95%, non-condensing.

Airborne Contaminants, Liquids. Particulate contaminants, especially electrically conductive material, such as metal shavings and grinding dust, can damage the ZETA6104 and the Zeta motor. Do not allow liquids or fluids to come in contact with the ZETA6104 or its cables.

Electrical Connections

Verify Factory-Wired Connections



P-CUT connected to GND.
If this connection is broken, step pulses to the motor are stopped (independent of the microprocessor).

+5V connected to OUT-P, IN-P & AUX-P.
Provides +5V power to the pull-up resistors for the general-purpose programmable outputs (OUT-P) & inputs (IN-P) on the 50-pin header, as well as the HOM, NEG, POS, TRG, and P-CUT inputs.

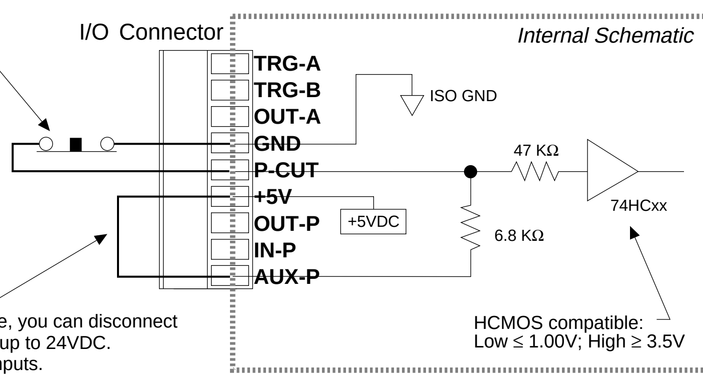
! If you intend to use your own external power supply, remove the +5V jumper first (failure to do so will damage the product).

Motor Connector.
The 9-pin motor connector is installed on the ZETA6104 if you ordered the ZETA6104 as a "drive only" (no motor). If you ordered a ZETA6104 "system", the motor connector is factory-wired to the Zeta motor cable (series connection) and is ready to plug in.

Pulse Cut-Off (P-CUT) — Emergency Stop Switch

P-CUT connected to GND (normally-closed switch).
If this connection is opened, step pulses to all axes are stopped (independent of the microprocessor).

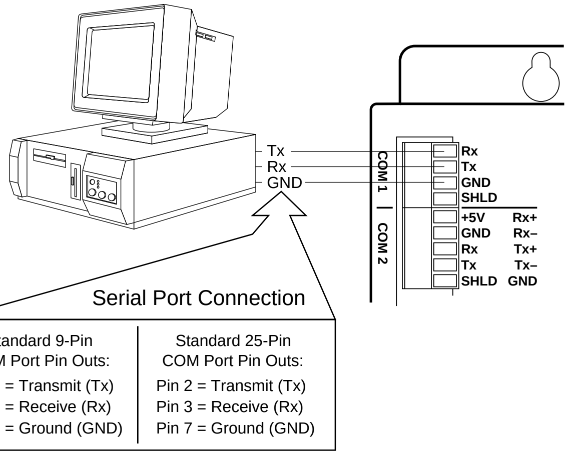
NOTE: If the P-CUT input is not grounded when motion is commanded, motion will not occur and the error message "WARNING: PULSE CUTOFF ACTIVE" will be displayed in the terminal emulator.



+5V connected to AUX-P (sourcing current).
Provides +5V power to the P-CUT pull-up resistor. As an alternative, you can disconnect the +5V jumper and connect AUX-P to an external power supply of up to 24VDC.
NOTE: AUX-P is also the pull-up for the HOM, NEG, POS & TRG inputs.
SINKING CURRENT: To make P-CUT (as well as HOM, NEG, POS & TRG) sink current, connect AUX-P to GND.

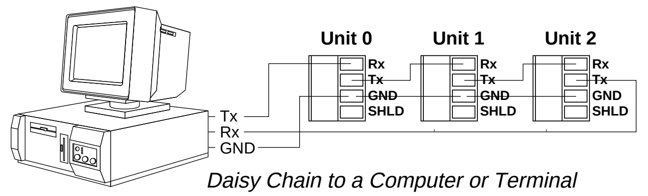
Serial Communication

RS-232C Connections

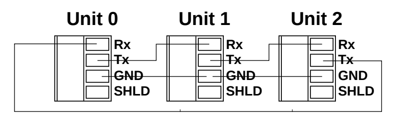


NOTE: Maximum RS-232C cable length is 50 feet (15.25 meters)

RS-232C Daisy-Chain Connections*



Daisy Chain to a Computer or Terminal



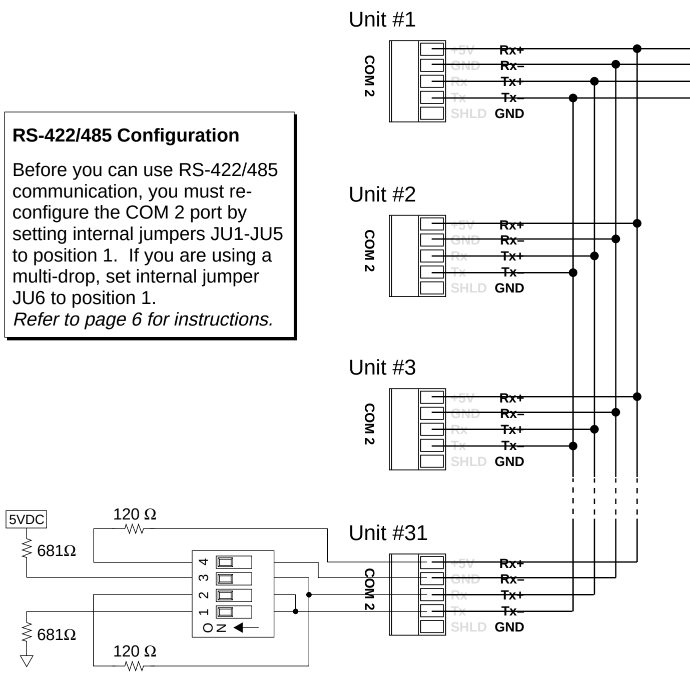
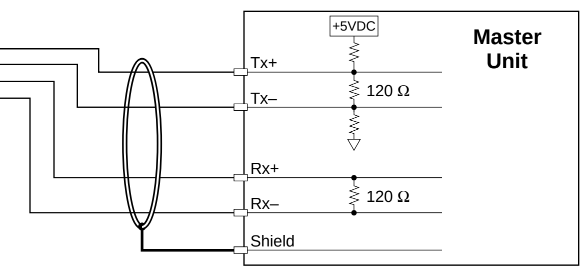
Stand-Alone Daisy Chain

* Be sure to set unique devices addresses for each unit. To set the address, use the DIP switch (see page 5), or use the ADDR command (see *6000 Series Software Reference*).

RS-422/485 Connections (4-wire interface)

RS-422/485 Configuration

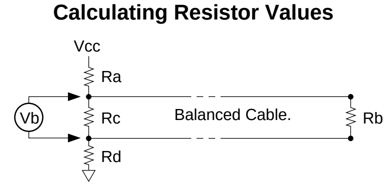
Before you can use RS-422/485 communication, you must re-configure the COM 2 port by setting internal jumpers JU1-JU5 to position 1. If you are using a multi-drop, set internal jumper JU6 to position 1.
Refer to page 6 for instructions.

DIP switch selects internal resistor values (ON selects the resistor).
Use these resistors only for the last unit (or for a single unit).

If your application requires terminating resistors other than 120Ω, and/or bias resistors other than 681Ω, then make sure the internal DIP switches are set to OFF and connect your own external resistors. To calculate resistor values: →

Calculating Resistor Values



Example Assumptions: The cable's characteristic impedance (Zo) = 120Ω. Rc and Rb are equal and are selected to match Zo (Rc = Rb = Zo = 120Ω).

Step 1 Calculate the equivalent resistance (Req)* of Rc / / Rb:
Rc / / Rb = 120Ω / / 120Ω = 60Ω

Step 2 Calculate the pull-up and pull-down resistor values knowing that the FAILSAFE bias is 200mV and Vcc = 5V:
Vb = Vcc (Req / (Ra + Req + Rd))
solving for R' (defined as Ra + Rd)
R' = ((Req) Vcc / Vb) - Req
R' = ((60Ω) 5V / 0.2V) - 60Ω = 1440Ω
Since Ra and Rd are equal, Ra = Rd = 1440Ω / 2 = 720Ω

Step 3 Recalculate the equivalent resistance of RC / / (Ra + Rd):
Rc / / (Ra + Rd) = 120Ω / / (720Ω + 720Ω) = 110.77Ω

Since the equivalent resistance is close (within 10%) to the characteristic impedance of the cable (Zo), no further adjustment of resistor values is required.

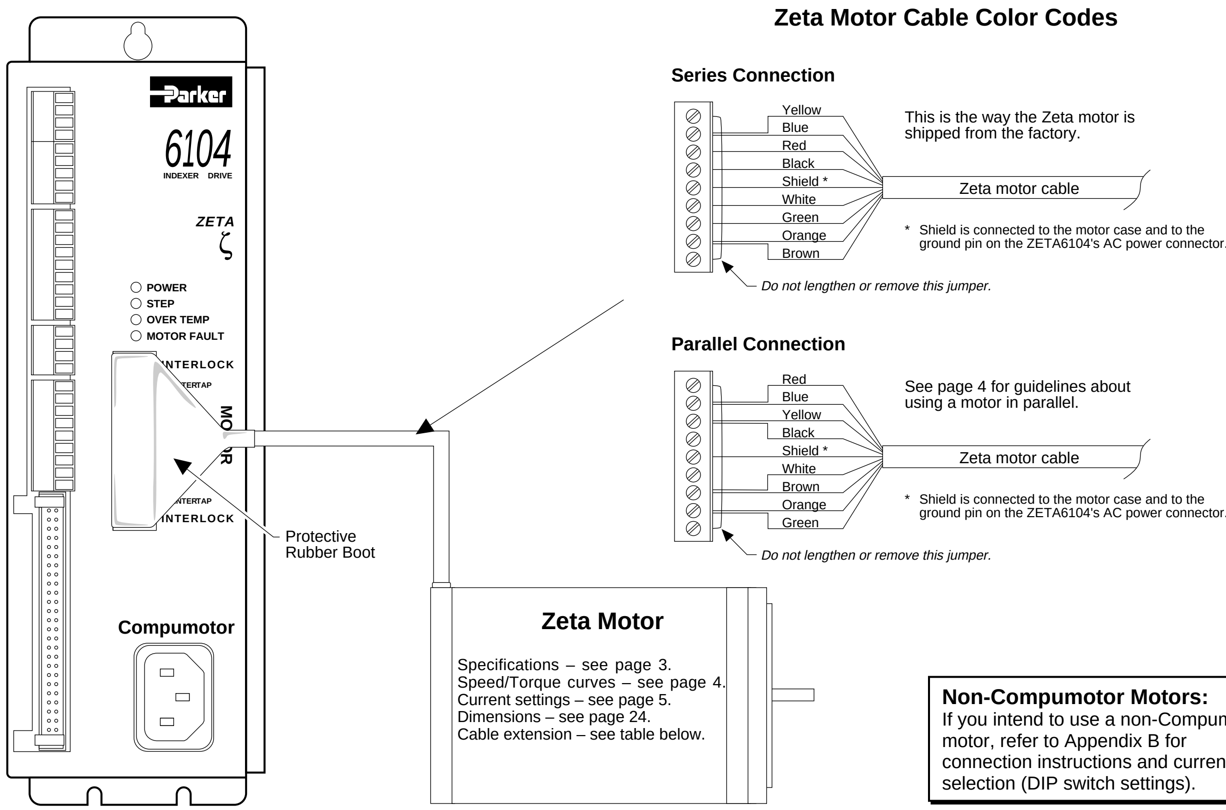
* Actual calculation for equivalent resistance (e.g., R_1 / / R_2): $\frac{R_1 R_2}{(R_1 + R_2)}$

For further information, consult a communications interface reference.

NOTE: Maximum RS-485 cable length is 4000 feet (1220 meters)

Motor (Zeta motors only)

> **WARNING**
>
> **REMOVE AC POWER FIRST** before connecting or disconnecting the motor. Lethal voltages are present on the screw terminals.



Non-Compumotor Motors:
If you intend to use a non-Compumotor motor, refer to Appendix B for connection instructions and current selection (DIP switch settings).

Auto Current Standby Mode: Reduces motor current by 50% when step pulses from the ZETA6104 have stopped for one second (**CAUTION: torque is also reduced**). Full current is restored upon the first step pulse. Enable with the `DAUTOS1` command; disable with the `DAUTOSØ` command (default is disabled). For more information, refer to the `DAUTOS` command in the *6000 Series Software Reference Guide*.

Extending Zeta Motor Cables

Standard length is 10 ft (3 m). Maximum extended length is 200 ft (61 m).
CAUTION: Cables longer than 50 feet (15 m) may degrade performance.

Motor Type	Max. Current (amps)	Less than 100 ft. (30 m) AWG	Less than 100 ft. (30 m) mm²	100 – 200 ft. (30 – 60 m) AWG	100 – 200 ft. (30 – 60 m) mm²
ZETA57-51S	1.26	22	0.34	20	0.50
ZETA57-51P	2.38	22	0.34	20	0.50
ZETA57-83S	1.51	22	0.34	20	0.50
ZETA57-83P	3.13	22	0.34	20	0.50
ZETA57-102S	1.76	22	0.34	20	0.50
ZETA57-102P	3.50	20	0.50	18	0.75
ZETA83-62S	2.26	22	0.34	20	0.50
ZETA83-62P	4.00	20	0.50	18	0.75
ZETA83-93S	2.88	22	0.34	20	0.50
ZETA83-93P	4.00	20	0.50	18	0.75
ZETA83-135S	3.50	20	0.50	18	0.75
ZETA83-135P	4.00	20	0.50	18	0.75

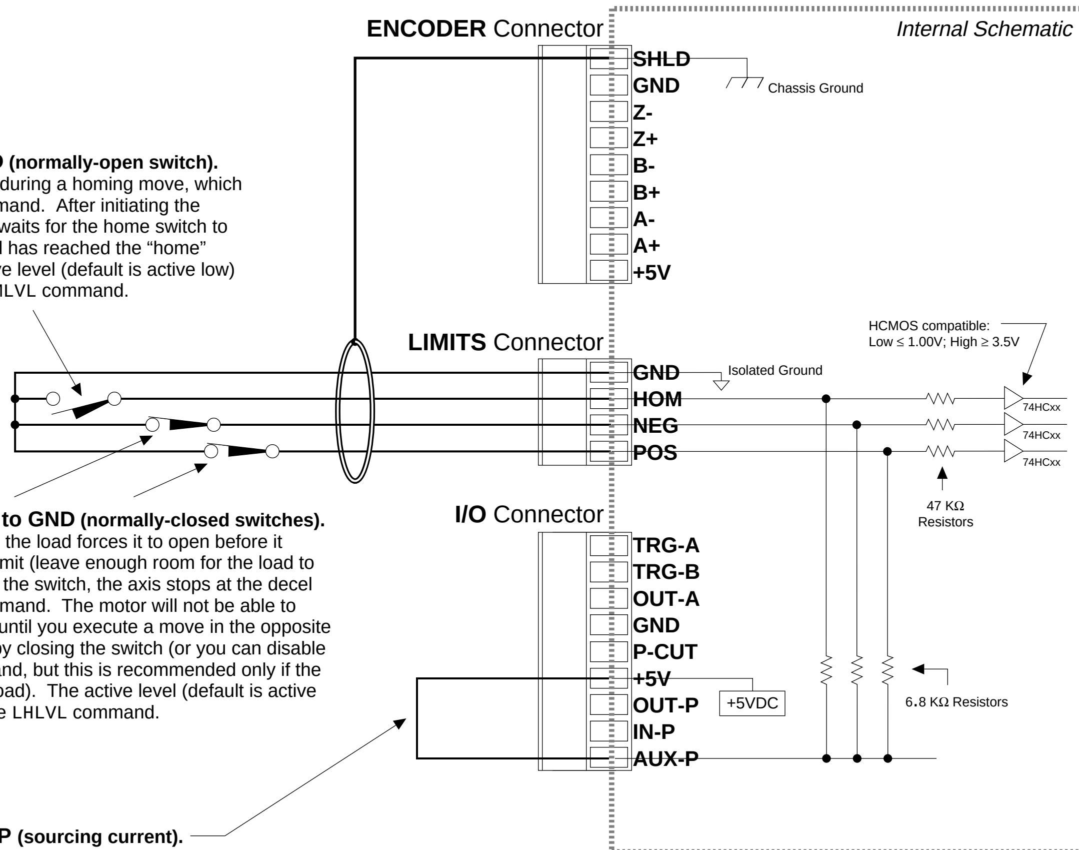
S = Series Configuration P = Parallel Configuration
Rated current in wire sizes shown may result in a maximum temperature rise of 18°F (10°C) above ambient.

End-of-Travel and Home Limit Inputs

> **NOTES**
>
> - Motion will not occur until you do one of the following:
>   - Install end-of-travel (**POS** & **NEG**) limit switches
>   - Disable the limits with the `LHØ` command (recommended only if load is not coupled)
>   - Change the active level of the limits with the `LHLVL` command
> - Refer to the *Basic Operations Setup* chapter in the *6000 Series Programmer's Guide* for in-depth discussions about using end-of-travel limits and homing.

CONNECTIONS & INTERNAL SCHEMATICS

HOM connected to GND (normally-open switch).
The home limit input is used during a homing move, which is initiated with the `HOM` command. After initiating the homing move, the controller waits for the home switch to close, indicating that the load has reached the "home" reference position. The active level (default is active low) can be changed with the `HOMLVL` command.



POS & NEG connected to GND (normally-closed switches).
Mount each switch such that the load forces it to open before it reaches the physical travel limit (leave enough room for the load to stop). When the load opens the switch, the axis stops at the decel value set with the `LHAD` command. The motor will not be able to move in that same direction until you execute a move in the opposite direction and clear the limit by closing the switch (or you can disable the limits with the `LH` command, but this is recommended only if the motor is not coupled to the load). The active level (default is active low) can be changed with the `LHLVL` command.

+5V connected to AUX-P (sourcing current).
Provides +5V power to the POS, NEG, and HOM input pull-up resistors. As an alternative, you can connect AUX-P to an external power supply of up to 24VDC (DISCONNECT THE +5V JUMPER FIRST).
NOTE: AUX-P is also the pull-up for the P-CUT & TRG inputs.
SINKING CURRENT: To make the limit inputs (as well as the P-CUT & TRG inputs) sink current, connect AUX-P to GND.

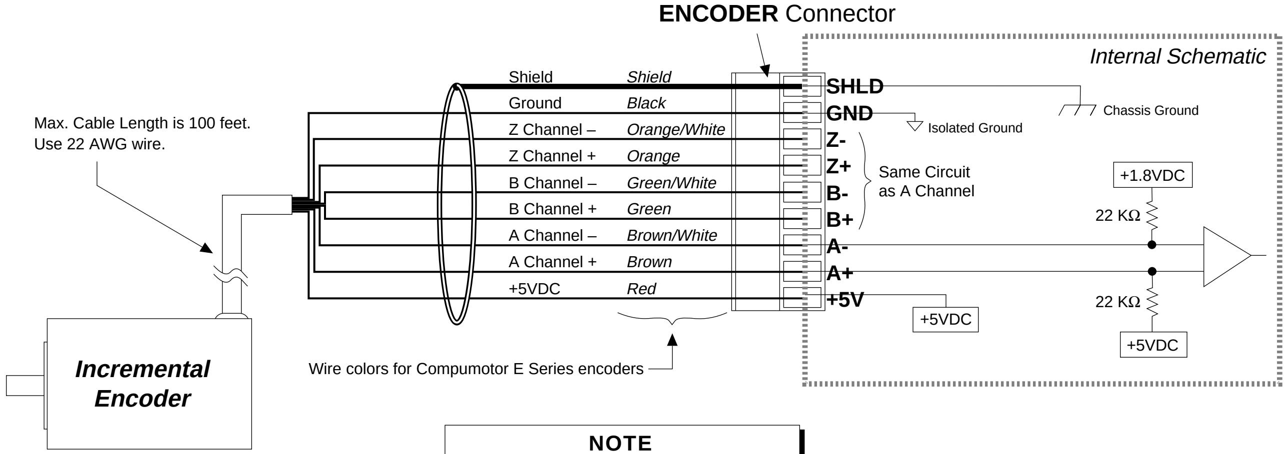
PIN OUTS & SPECIFICATIONS *(4-pin LIMITS Connector)*

Name	In/Out	Description
GND	—	Isolated ground.
HOM	IN	Home limit input.
NEG	IN	Negative-direction end-of-travel limit input.
POS	IN	Positive-direction end-of-travel limit input.

> **Specification for all limit inputs**
>
> HCMOS compatible (voltage levels: Low ≤ 1.00V, High ≥ 3.25V); internal 6.8 KΩ pull-ups to AUX-P terminal (AUX-P is wired at factory to +5V); voltage range is 0-24V.
>
> Active level for HOM is set with the `HOMLVL` command (default is active low, requiring normally-open switch).
>
> Active level for POS & NEG is set with the `LHLVL` command (default is active low, requiring normally-closed switch).

Encoder

CONNECTIONS & INTERNAL SCHEMATICS



NOTE

If you are using a single-ended encoder, leave the A-, B-, and Z- terminals on the ZETA6104 unconnected.

PIN OUTS & SPECIFICATIONS *(9-pin ENCODER Connector)*

Pin Name	In/Out	Description
SHLD	-----	*Shield*—Internally connected to chassis ground (earth).
GND	-----	Isolated logic ground.
Z–	IN	Z– Channel signal input.
Z+	IN	Z+ Channel signal input.
B–	IN	B– Channel quadrature signal input.
B+	IN	B+ Channel quadrature signal input.
A–	IN	A– Channel quadrature signal input.
A+	IN	A+ Channel quadrature signal input.
+5V	OUT	+5VDC output to power the encoder.

Specification for all encoder inputs

Differential comparator accepts two-phase quadrature incremental encoders with differential (recommended) or single-ended outputs. Max. frequency is 1.6 MHz. Minimum time between transitions is 625 ns. TTL-compatible voltage levels: Low ≤ 0.4V, High ≥ 2.4V. Maximum input voltage is 5VDC.

Requirements for Non-Compumotor Encoders

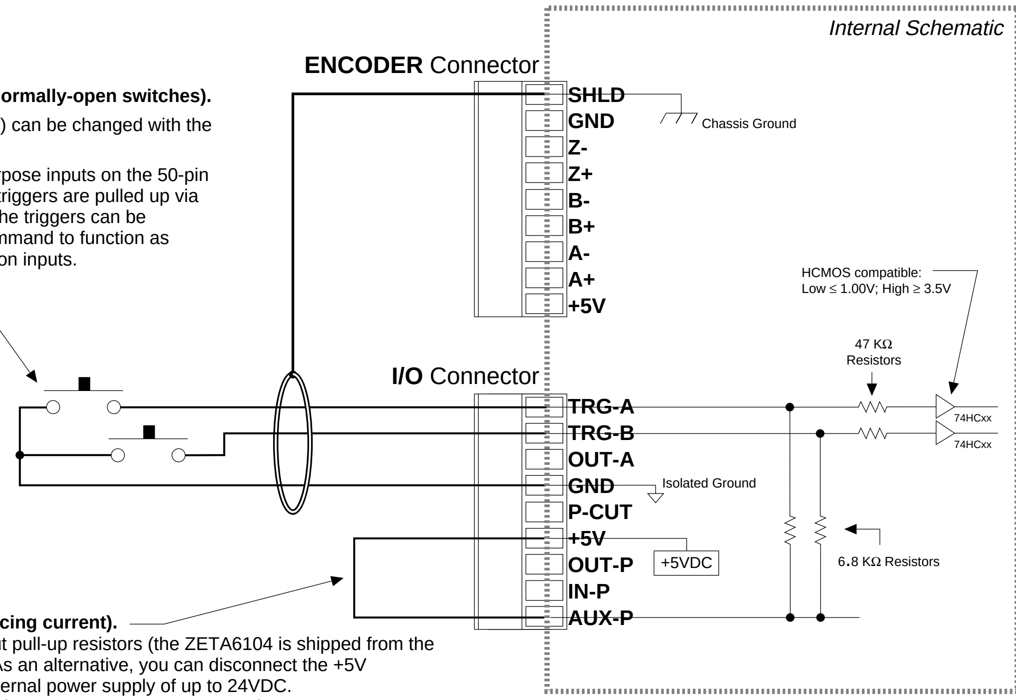
- Use incremental encoders with two-phase quadrature output. An index or *Z channel* output is optional. **Differential outputs are recommended.**
- It must be a 5V (< 200mA) encoder to use the ZETA6104's **+5V** output. Otherwise, it must be separately powered with TTL-compatible (low ≤ 0.4V, high ≥ 2.4V) or open-collector outputs.
- The decoded quadrature resolution should be less than the motor resolution by a factor of four to take advantage of the ZETA6104's position maintenance capability.

Trigger Inputs

TRG-A/B connected to GND (normally-open switches).

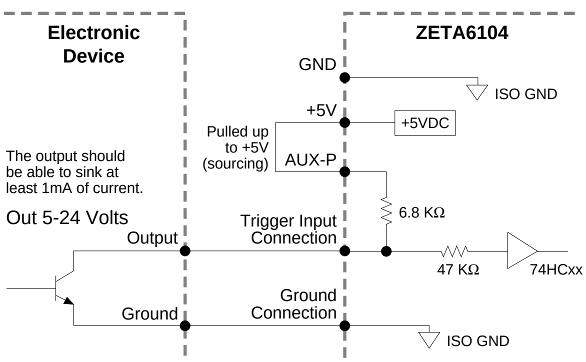
The active level (default is active low) can be changed with the INLVL command.

These inputs are like the general-purpose inputs on the 50-pin header. The differences are (1) the triggers are pulled up via the AUX-P pull-up terminal; and (2) the triggers can be programmed with the `INFNCi-H` command to function as position capture inputs and registration inputs.

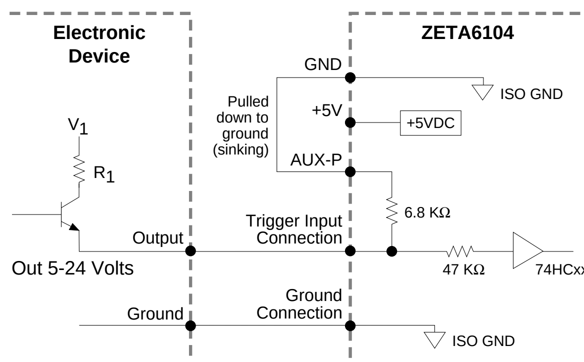


+5V connected to AUX-P (sourcing current).
Provides +5V power to the TRG input pull-up resistors (the ZETA6104 is shipped from the factory wired in this configuration). As an alternative, you can disconnect the +5V jumper and connect AUX-P to an external power supply of up to 24VDC.
NOTE: AUX-P is also the pull-up for the HOM, NEG, POS & P-CUT inputs.
SINKING CURRENT: To make the trigger inputs (and HOM, NEG, POS & P-CUT) sink current, connect AUX-P to GND.

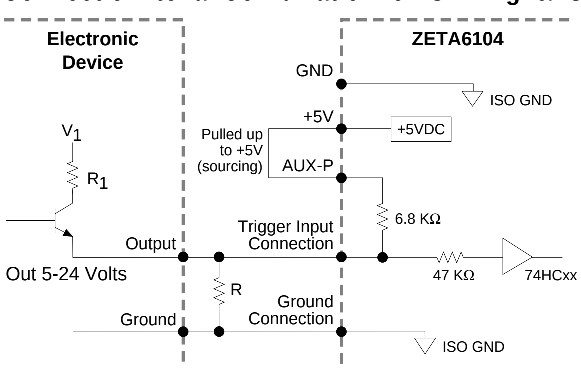
Connection to a Sinking Output Device



Connection to a Sourcing Output Device



Connection to a Combination of Sinking & Sourcing Outputs



Typical value for R = 450Ω (assuming R_1 = 0)
Note: The value of R may vary depending on the value of R_1 and V_1.

If you will be connecting to a combination of sourcing and sinking outputs, connect **AUX-P** to **+5V** to accommodate sinking output devices. Then for each individual input connected to a sourcing output, wire an external resistor between the ZETA6104's trigger input terminal and ground (see illustration). The resistor provides a path for current to flow from the device when the output is active.

PROGRAMMING TIP

Connecting to a sinking output? Set the trigger input's active level to low with the `INLVL` command (Ø = active low, *default setting*).

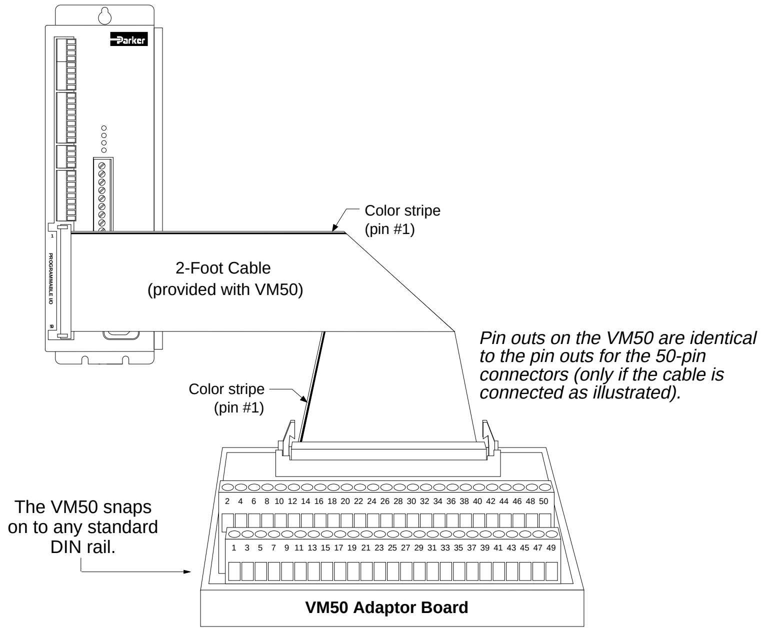
Connecting to a sourcing output? Set the trigger input's active level to high with the `INLVL` command (`1` = active high).

Thus, when the output is active, the `TIN` status command will report a "`1`" (indicates that the input is active), regardless of the type of output that is connected.

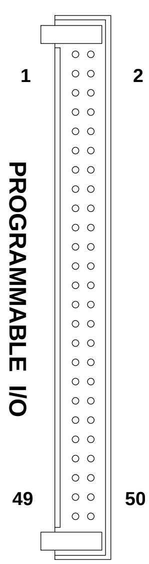
For details on setting the active level and checking the input status refer to the `INLVL` and `TIN` command descriptions in the *6000 Series Software Reference Guide*.

General-Purpose Programmable Inputs & Outputs

VM50 ADAPTOR — *for screw-terminal connections*



PIN OUTS & SPECIFICATIONS

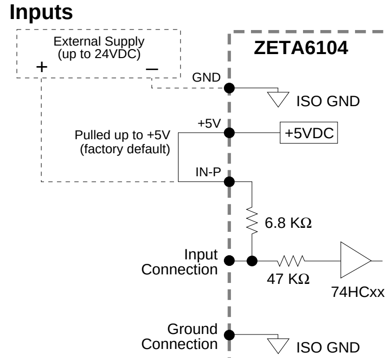


50-pin plug is compatible with OPTO-22™ signal conditioning equipment.

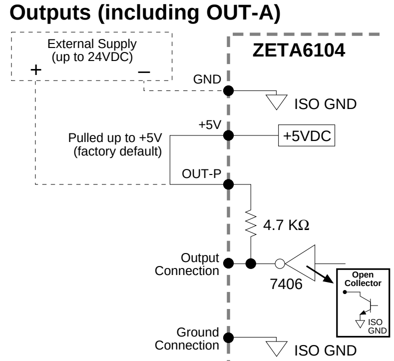
Pin #	Function
1	Input #16 (MSB of inputs)
3	Input #15
5	Input #14
7	Input #13
9	Input #12
11	Input #11
13	Input #10
15	Input #9
17	Output #8 (MSB of outputs)
19	Output #7
21	Output #6
23	Output #5
25	Input #8
27	Input #7
29	Input #6
31	Input #5
33	Output #4
35	Output #3
37	Output #2
39	Output #1 (LSB of outputs)
41	Input #4
43	Input #3
45	Input #2
47	Input #1 (LSB of inputs)
49	+5VDC

Internal Schematics

Inputs



Outputs (including OUT-A)



Specifications

Inputs

HCMOS-compatible voltage levels (low ≤ 1.00V, high ≥ 3.25V).

Voltage range = 0-24V.

Sourcing Current: On the **I/O** connector, connect **IN-P** to **+5V** or you can disconnect the +5V jumper and connect **IN-P** to your own power supply of up to 24VDC.

Sinking Current: On the **I/O** connector, connect **IN-P** to **GND**.

STATUS: Check with the `TIN` command.

Active level: Default is active low, but can be changed to active high with the `INLVL` command.

Outputs (including OUT-A)

Open collector output.

Pull-up connection on **I/O** connector: Connect **OUT-P** to **+5V**, or to an external supply of up to 24V.

Max. voltage in the OFF state (not sinking current) = 24V, max. current in the ON state (sinking) = 30mA.

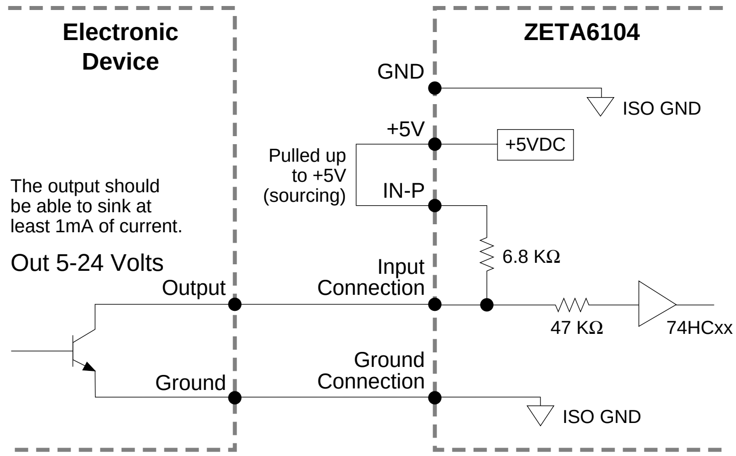
STATUS: Check with the `TOUT` status command.

Active level: Default is active low, but can be changed to active high with the `OUTLVL` command.

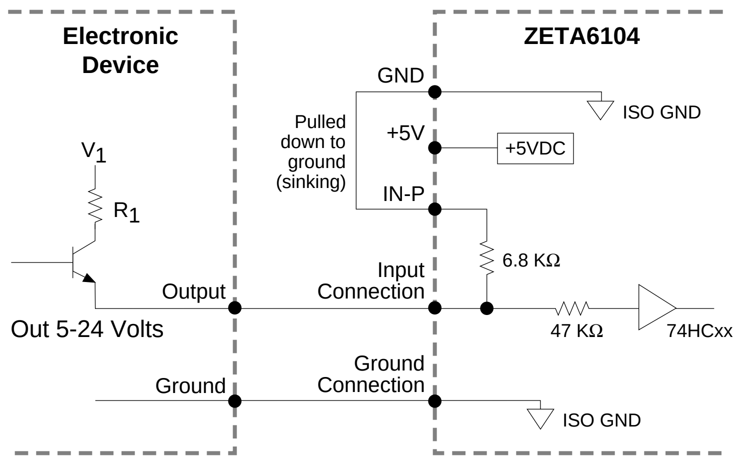
NOTE: All even-numbered pins are connected to a common logic ground (DC ground).
LSB = least significant bit; MSB = most significant bit

INPUT CONNECTIONS — *Connecting to electronic devices such as PLCs*

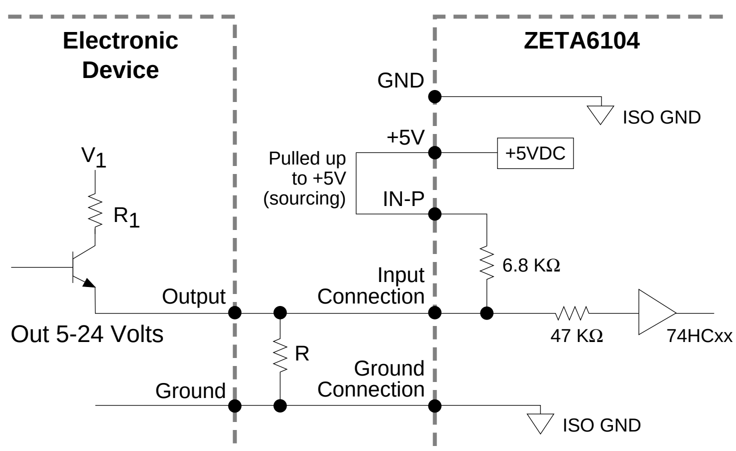
Connection to a Sinking Output Device



Connection to a Sourcing Output Device



Connection to a Combination of Sinking & Sourcing Outputs



Typical value for R = 450Ω (assuming R_1 = 0)

Note: The value of R may vary depending on the value of R_1 and V_1.

PROGRAMMING TIP

Connecting to a sinking output? Set the input's active level to low with the `INLVL` command (Ø = active low).

Connecting to a sourcing output? Set the input's active level to high with the `INLVL` command (`1` = active high).

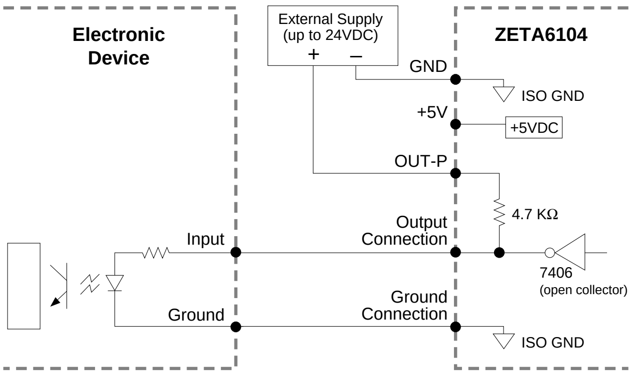
Thus, when the output is active, the `TIN` status command will report a "`1`" (indicates that the input is active), regardless of the type of output that is connected.

Details on setting the active level and checking the input status are provided in the *6000 Series Programmer's Guide*. Refer also to the `INLVL` and `TIN` command descriptions in the *6000 Series Software Reference Guide*.

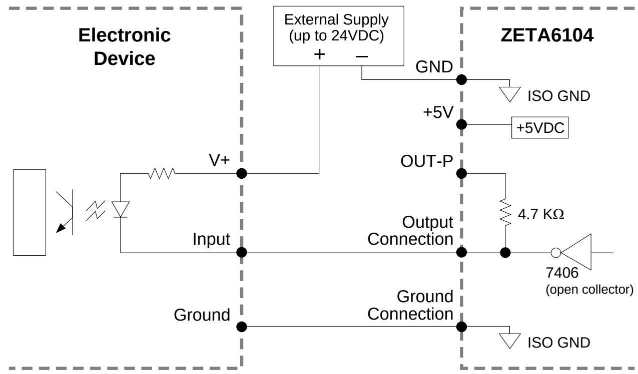
NOTE: If you will be connecting to a combination of sourcing and sinking outputs, connect **IN-P** to **+5V** to accommodate sinking output devices. Then for each individual input connected to a sourcing output, wire an external resistor between the ZETA6104's programmable input terminal and ground (see "R" in above drawing). The resistor provides a path for current to flow from the device when the output is active.

OUTPUT CONNECTIONS (includes OUT-A) — *for electronic devices such as PLCs*

Connection to a Sinking Input (active high)

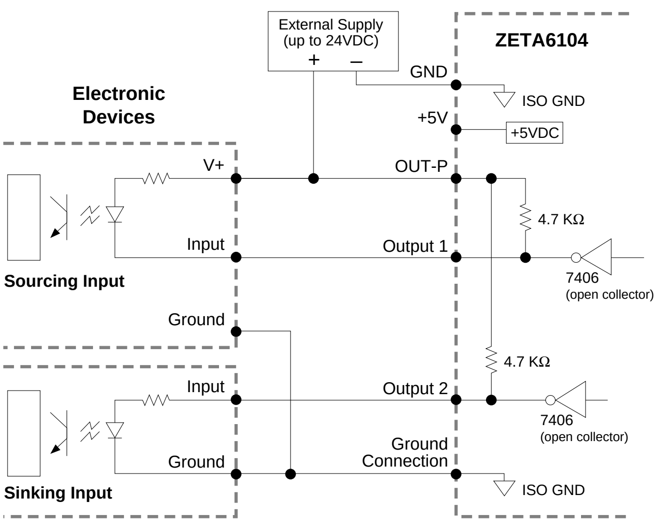


Connection to a Sourcing Input (active low)



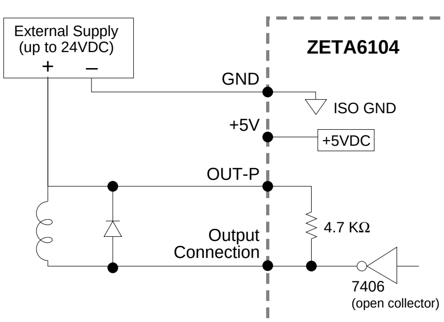
NOTE: It is not necessary to use the OUT-P pin for a sourcing input.

Connection to a Combination of Sinking & Sourcing Inputs



Combinations of sourcing and sinking inputs can be accommodated at the same voltage level. Be aware of the input impedance of the sourcing input module, and make sure that there is enough current flowing through the input module while in parallel with the OUT-P pull-up resistor.

Connection to an Inductive Load (active low)

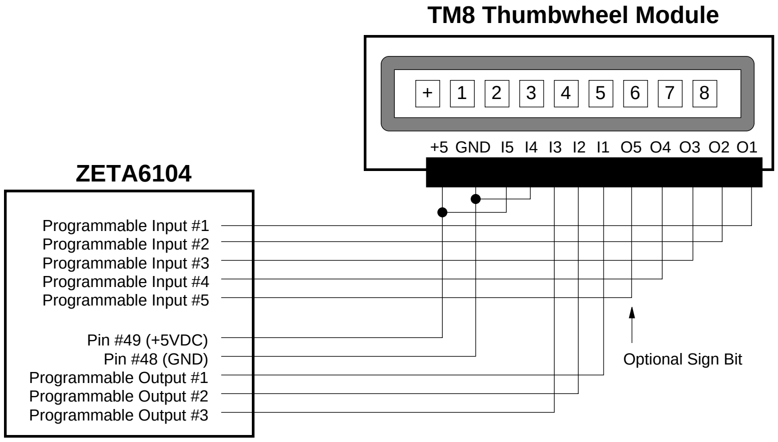


Use an external diode when driving inductive loads. Connect the diode in parallel to the inductive load, attaching the anode to the ZETA6104 output and the cathode to the supply voltage of the inductive load.

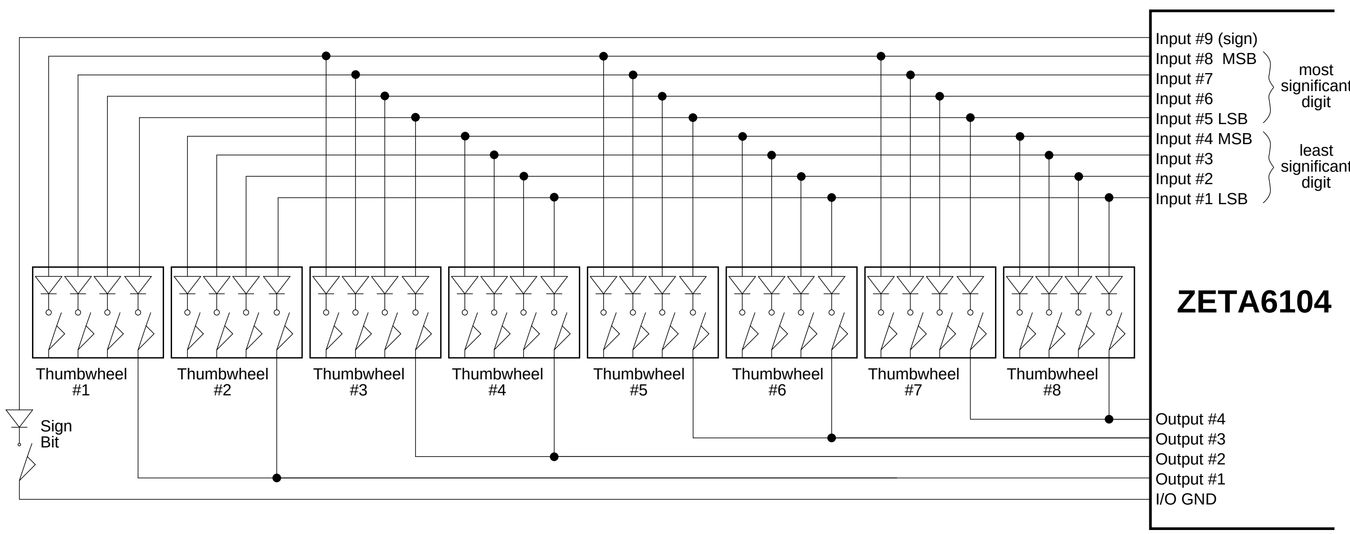
> **PROGRAMMING TIP**
>
> **Connecting to an active-high sinking input?** Set the output's active level to high with the `OUTLVL` command (1 = active high).
>
> **Connecting to an active-low sourcing input?** Set the output's active level to low with the `OUTLVL` command (Ø = active low).
>
> Thus, when the ZETA6104's output is activated, current will flow through the attached input and the `TOUT` status command will report a “1” (indicates that the output is active), regardless of the type of input that is connected.
>
> Details on setting the active level and checking the output status are provided in the *6000 Series Programmer's Guide*. Refer also to the `OUTLVL` and `TOUT` command descriptions in the *6000 Series Software Reference Guide*.

THUMBWHEEL CONNECTIONS — *for entering BCD data*

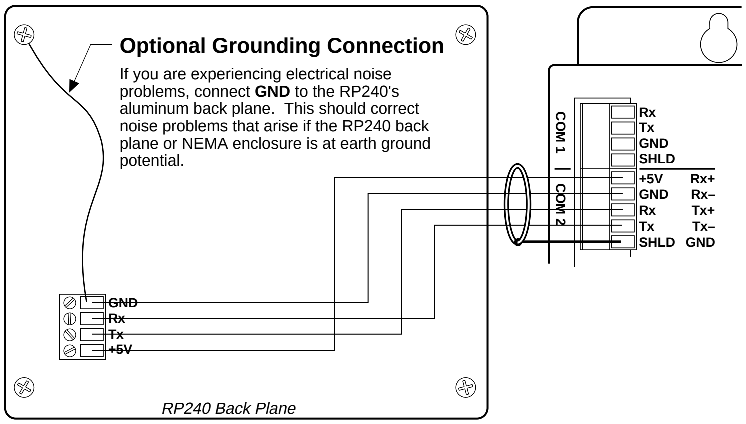
Connection to the Compumotor TM8 Module



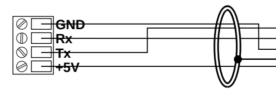
Connection to your own Thumbwheel Module

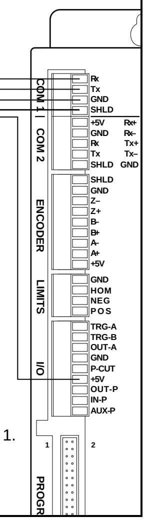


RP240 Remote Operator Panel



RP240 Connections when using RS-422/485



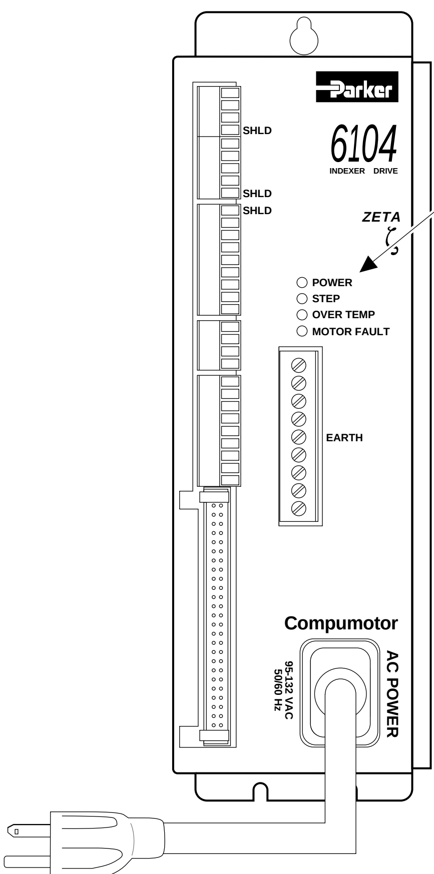


If you will use RS-422 or RS-485 serial communication, you must connect the RP240 to the **COM 1** connector (and connect the RP240's +5V lead to the **+5V** terminal on the **I/O** connector).

In addition, you will have to issue these commands to configure the ZETA6104 to communicate successfully with the RP240 connected to **COM 1** and with RS-422/485 connected to **COM 2**.

`PORT1`........Select COM 1 as the affected port.
`DRPCHK1`....On powerup, check for RP240 on COM 1.
`PORT2`........Select COM 2 as the affected port.
`DRPCHKØ`....On powerup, do not check for RP240 on COM 2.

Input Power



After Power Up (LEDs)

POWER...............On (green).
STEP..................Off. Or green if motion is commanded.
OVER TEMP.......Off. Or red if the internal sensor reaches 131°F (55°C).
MOTOR FAULT...Off. Or red if there is a short in the motor windings or motor cable, or if the INTERLOCK jumper on the connector is removed or extended.

Power Cable
Provided in ship kit (p/n 44-014768-01)
Length: 6.6 ft (2.0 m)

Power Input Specification
95-132VAC, 50/60Hz, single-phase
Peak Power requirements depend on the motor you use:

Motor Type	Current (Amps)	Cabinet Loss (W)	Peak Motor Loss (W)	Peak Shaft Power (W)	Peak Total Power (W)	Volt-Amp Rating (VA)
ZETA57-51S	1.26	11.9	25	60	97	145
ZETA57-51P	2.38	16.1	50	129	195	293
ZETA57-83S	1.51	12.7	27	80	120	180
ZETA57-83P	3.13	19.6	54	175	249	373
ZETA57-102S	1.76	13.6	30	80	124	185
ZETA57-102P	3.50	21.7	60	186	268	402
ZETA83-62S	2.26	15.5	50	120	186	278
ZETA83-62P	4.00	24.8	88	260	373	560
ZETA83-93S	2.88	18.4	52	180	250	376
ZETA83-93P	4.00	24.8	72	350	447	671
ZETA83-135S	3.50	21.7	57	193	272	408
ZETA83-135P	4.00	24.8	65	355	445	667

S: Series Configuration P: Parallel Configuration

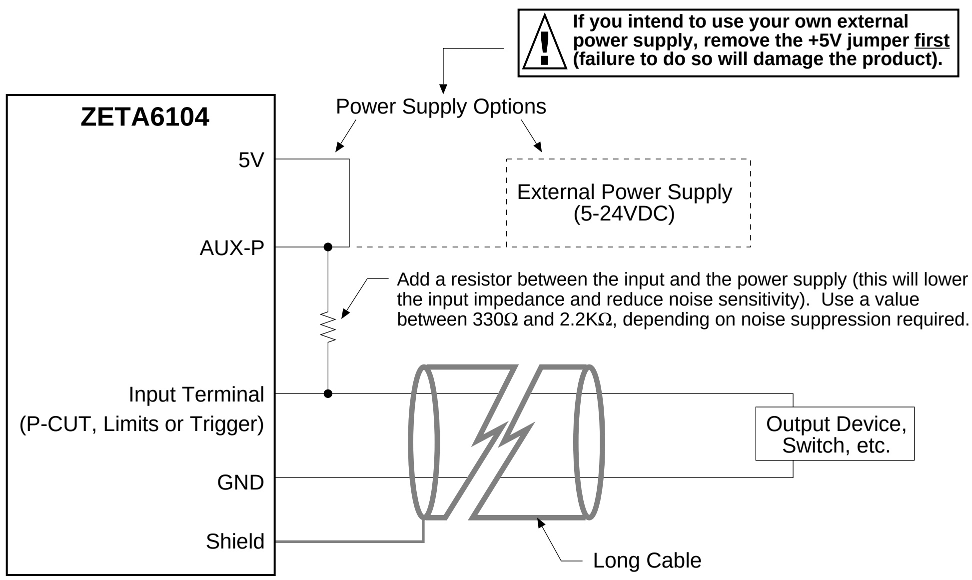
WARNING: The motor case (via the EARTH terminal) and the ZETA6104's SHLD terminals are grounded through the AC power connector ground pin. You must provide a proper AC power ground for safety purposes.

Lengthening I/O Cables

Bear in mind that lengthening cables increases noise sensitivity. (The maximum length of cables is ultimately determined by the environment in which the equipment will be used.) If you lengthen the cables, follow the precautions below to minimize noise problems.

- Use a minimum wire size of 22 AWG.
- Use twisted pair shielded cables and connect the shield to a **SHLD** terminal on the ZETA6104. Leave the other end of the shield disconnected.
- Do not route I/O signals in the same conduit or wiring trays as high-voltage AC wiring or motor cables.

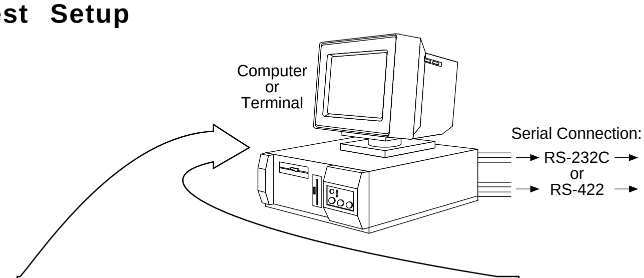
Reducing noise on limit, trigger, and P-CUT inputs. If you are experiencing noise problems, try adding resistors to reduce noise sensitivity (see illustration below).

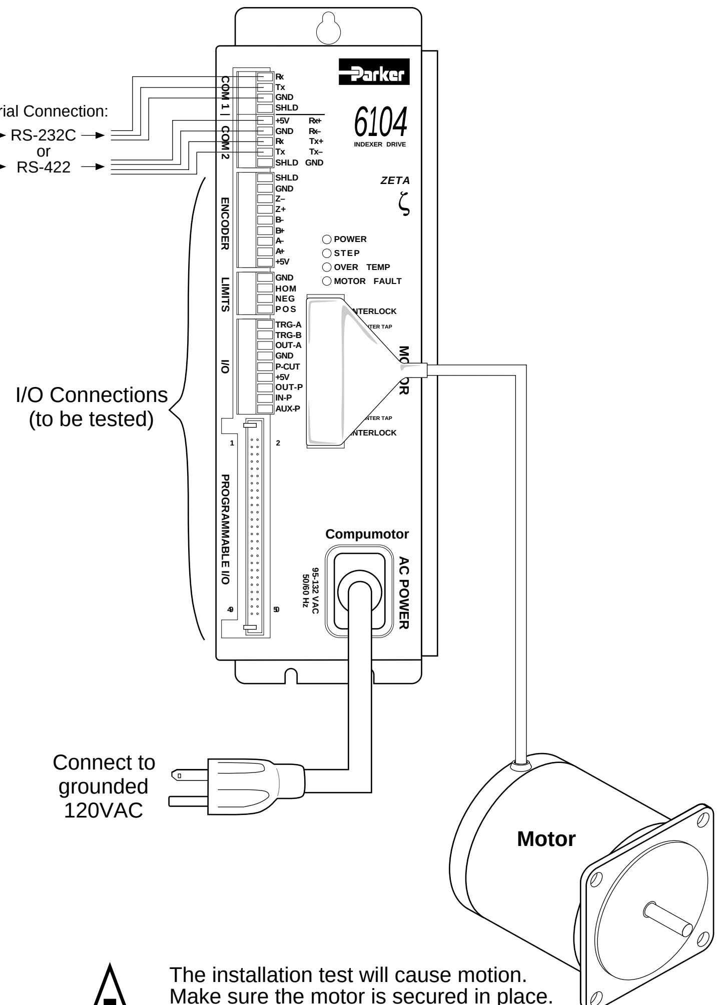


⚠ WARNING ⚠

This test procedure allows you to control I/O and produce motion. Make sure that exercising the I/O will not damage equipment or injure personnel. We recommend that you leave the motor uncoupled from the load, but if you have coupled the load to the motor, make sure that you can move the load without damaging equipment or injuring personnel.

Test Setup





Terminal Emulation for IBM/Compatibles

To communicate with the ZETA6104, you will need a terminal emulation program. We recommend you use Motion Architect for Windows or the DOS Support Software, which are provided in your ship kit. Both provide terminal emulation and program editor features. Motion Architect is more popular because of its graphical interface and its ensemble of programming tools.

Using Motion Architect:
1. To install, insert Disk 1 into your disk drive and run the Setup program (setup.exe).
2. After the Setup program is finished click on “Run Motion Architect”.
3. From the Product/Selection dialog box, select “ZETA6104” and click OK.
4. Click on “Terminal” from the main menu to run the terminal emulator.

Using the 6000 DOS Support Software:
1. Follow the installation/run instructions on the disk label.
2. Tab over to “Terminal Emulator” and press <enter> to run the terminal emulator.

If you use a different terminal emulation software package, make sure to configure it as follows:

9600 Baud
8 Data Bits
No Parity
1 Stop Bit
Full Duplex
Enable XON/XOFF

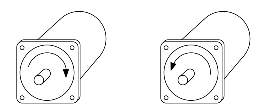
Having serial communication problems?
Refer to Chapter 2, *Troubleshooting*, for help.

⚠ The installation test will cause motion. Make sure the motor is secured in place. If you have coupled the load to the motor, make sure that the load can move without causing injury to equipment or personnel.

NOTE

The test procedures below are based on the factory-default active levels for the ZETA6104's inputs and outputs. Verify these settings with the following *status* commands:

Command Entered	Response Should Be
INLVL	*INLVLØØØØ_ØØØØ_ØØØØ_ØØØØ_ØØ
HOMLVL	*HOMLVLØ
LHLVL	*LHLVLØØ
OUTLVL	*OUTLVLØØØØ_ØØØØ_Ø

Connections	Test Procedure	Response Format (left to right)
End-of-travel and Home Limits	**NOTE**: If you are not using end-of-travel limits, issue the Disable Limits (LHØ) command and ignore the first two bits in each response field. 1. Enable the hardware end-of-travel limits with the LH3 command. 2. Close the end-of-travel switches and open the home switch. 3. Enter the TLIM command. The response should be *TLIM11Ø. 4. Open the end-of-travel switches and close the home switch. 5. Enter the TLIM command. The response should be *TLIMØØ1. 6. Close the end-of-travel switches and open the home switch (return to original config.). 7. Enter the TLIM command. The response should be *TLIM11Ø.	TLIM response: bit 1= POS (positive travel) limit bit 2= NEG (negative travel) limit bit 3 = HOM (home) limit
Motor and Encoder (motion)	1. Enter the ENCØ command to enable the motor step mode. Enter the PSETØ command to set the motor position to zero. Enter the TPM command to determine the motor position. The response should be *TPM+Ø (motor is at position zero) 2. **(Ignore this step if you are <u>not</u> using encoder feedback)** Enter the ENC1 command to enable the encoder step mode. Enter the PSETØ command to set the encoder position to zero. Enter the TPE command to determine the encoder position. The response should be *TPE+Ø (encoder is at position zero) 3. Enter the GO command. If you have not changed the default distance setting, the motor will move approximately one revolution in the clockwise direction (as viewed from the flange end). If the encoder is coupled to the motor, the encoder will also experience a one-rev clockwise move. **Encoder Not Coupled**: If the encoders are not coupled to the motor, manually rotate the encoder one revolution in the clockwise direction. 4. **(Ignore this step if you are <u>not</u> using encoder feedback)** Enter the TPE command to determine the encoder position. The response should be (approximately) *TPE+4ØØØ (encoder is at position +4000). 5. Enter the ENCØ command to enable the motor step mode. Issue the TPM command to determine the motor position. The response should be *TPM+25ØØØ (motors is at position +25000).	TPM response = motor counts TPE response = encoder counts Direction of rotation:  Clockwise (positive counts) Counter-clockwise (negative counts)
Programmable Inputs (incl. triggers)	1. Open the input switches or turn off the device driving the inputs. 2. Enter the TIN command. The response should be *TINØØØØ_ØØØØ_ØØØØ_ØØØØ_ØØ. 3. Close the input switches or turn on the device driving the inputs. 4. Enter the TIN command. The response should be *TIN1111_1111_1111_1111_11.	TIN response: bits 1-16 = prog. inputs 1-16 bits 17 & 18 = TRG-A & TRG-B
Programmable Outputs	1. Enter the OUTALL1,9,1 command to turn on (sink current on) all programmable outputs. Verify that the device(s) connected to the outputs activated properly. 2. Enter the TOUT command. The response should be *TOUT1111_1111_1. 3. Enter the OUTALL1,9,Ø command to turn off all programmable outputs. Verify that the device(s) connected to the outputs de-activated properly. 4. Enter the TOUT command. The response should be *TOUTØØØØ_ØØØØ_Ø.	TOUT response: bits 1-8 = prog. outputs 1-8 bit 9 = OUT-A

RP240	1. Cycle power to the ZETA6104.
	2. If the RP240 is connected properly, the RP240's status LED should be green and one of the lines on the computer or terminal display should read *RP24Ø CONNECTED.
	If the RP240's status LED is off, check to make sure the +5V connection is secure.
	If the RP240's status LED is green, but the message on the terminal reads *NO REMOTE PANEL, the RP240 Rx and Tx lines are probably switched. Remove power and correct.
	3. Assuming you have not written a program to manipulate the RP240 display, the RP240 screen should display the following:
	`COMPUMOTOR 6104 INDEXER/DRIVE`
	`RUN  JOG  STATUS   DRIVE  DISPLAY  ETC`
		ASSUMPTIONS
		• RP240 connected to **COM 2**
		• **COM 2** (PORT2) configured for RP240. To verify, type these commands:
		PORT2 <cr>
		DRPCHK<cr>
		The system response should report "*DRPCHK3".

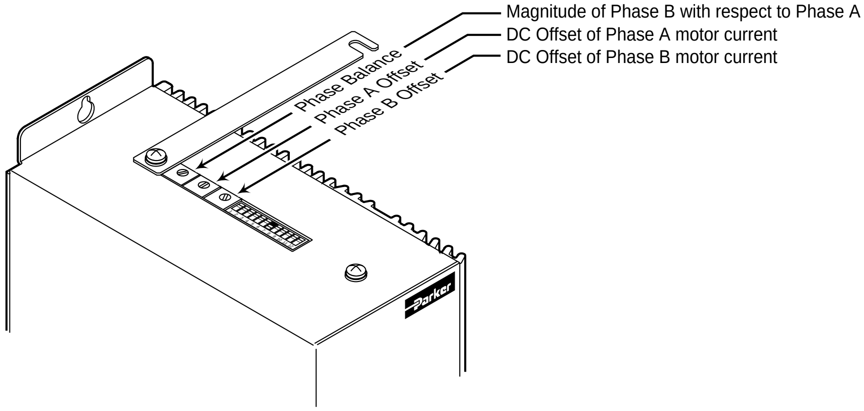
Pulse Cut	1. Open the P-CUT switch or turn off the device driving the P-CUT input. 2. Enter the TINO command (note the condition of the 6th bit from the left). The response should be *TINOØØØØ_ØØØØ. 3. Close the P-CUT switch or turn on the device driving the P-CUT input. 4. Enter the TINO command. The response should be *TINOØØØØ_Ø1ØØ.	TINO response: bit 6 = pulse cut input bits 1-5, 7 & 8 are not used

Matching the Motor to the ZETA6104 (OPTIONAL)

Due to slight manufacturing variations, each motor has its own particular characteristics. In the procedure below, you will adjust three potentiometers (*pots*), to match your ZETA6104 to your specific motor. You will also select the best current waveform to use with your motor.

If you purchased a ZETA6104 *system* (ZETA6104 and Zeta motor together), the ZETA6104 and the Zeta motor were matched to each other at the factory. However, you may still want to perform the matching procedure below, because your operating conditions may not be the same as factory conditions.

The ZETA6104's pots are located behind the removable metal cover on top of the chassis.



Before You Start

- Note that if you replace the ZETA6104 unit or the motor, you will have to redo this procedure.
- Set up a serial communication link and terminal emulator (see installation test on page 20).
- Connect the motor to the ZETA6104.
- Secure the motor in a location such that you can turn the pots and feel or hear the motor at the same time. (You should perform this procedure with the motor not coupled to the load, because the characteristics you are matching are those only of the drive/motor combination.)
- Apply AC power when necessary to perform the steps below.

Step 1 Apply power to the ZETA6104, and allow it to reach a stable operating temperature. This may take up to 30 minutes. For optimum results, perform the matching procedure at the same ambient temperature at which your application will operate.

Step 2 For each of the adjustments that follow, consult the table below to find the speed at which to run the motor. These are speeds that cause *resonance* in the unloaded motor. When the motor is running at a resonant speed, you will notice increased noise and vibration. To make resonance the most noticeable, you may need to vary the speed around the value given below for your motor. You can find the resonant speed by touching the motor lightly with your fingertips as you vary the speed. When you feel the strongest vibrations, the motor is running at resonant speed.

Motor	Offset Adjust (rps)	Balance Adjust (rps)	Waveform Adjust (rps)
ZETA57-51	4.72	2.36	1.18
ZETA57-83	4.66	2.33	1.17
ZETA57-102	4.12	2.06	1.03
ZETA83-62	2.96	1.48	0.74
ZETA83-93	2.96	1.48	0.74
ZETA83-135	2.89	1.45	0.73

Step 3 Run your motor at the resonant speed listed in the *Offset Adjust* column. Vary the speed slightly until you find the resonance point.

To initiate motion, type these commands (followed by a carriage return) to the ZETA6104 from the terminal emulator:

- `MC1` (This command makes the motion run continuously until you issue a `!S` command.)
- `V`*n* (This command sets the velocity to *n* . For example, `V4.66` sets the velocity to 4.66 rps.)
- `GO` (This command initiate motion.)

To vary the speed while the motor is moving, type these *immediate* commands:

- `!V`*n* (This command selects the new velocity of *n*.)
- `!GO` (This command changes the motor's velocity to the new velocity value of *n*.)

NOTE: To stop the motor during this procedure, issue the `!S` command. Re-issue the `GO` command to resume motion.

Step 4 Adjust the Phase A Offset and Phase B Offset pots for minimum motor vibration and smoothest operation. Alternate between Phase A and Phase B to find the minimum vibration point.

Step 5 Run your motor at the resonant speed listed in the *Balance Adjust* column. Vary the speed slightly until you find the resonance point.

Step 6 Adjust the balance pot until you find the setting that provides minimum motor vibration and smoothest operation.

Step 7 Repeat steps 3–6.

Step 8 Run the motor at the resonant speed listed in the *Waveform Adjust* column. Vary the speed slightly until you find the resonance point.

Step 9 Choose the current waveform that provides minimum motor vibrations and smoothest operation at the speed you selected in step 8. To find the best waveform, compare motor performance as you select different waveforms using the `!DWAVEF` command.

Waveform	`DWAVEF` Setting	
-4% 3rd harmonic	`!DWAVEF1`	← Factory default
-10% 3rd harmonic	`!DWAVEF2`	
-6% 3rd harmonic	`!DWAVEF3`	
Pure sine	`!DWAVEF4`	← Do not use if drive resolution (DRES) is set to 200 steps/rev

NOTE: The `DWAVEF` command setting is NOT automatically saved in non-volatile memory; therefore, if `DWAVEF1` in not adequate, you have to place an alternative `DWAVEF` setting in a set-up (STARTP) program. Refer to page 31 for an example.

Step 10 Disconnect AC power to turn off the ZETA6104. Replace the cover over the pots. This completes the matching procedure.

Step 11 Proceed to the next section to mount and couple the motor.

⚠ WARNINGS ⚠

- Improper motor mounting and coupling can jeopardize personal safety, and compromise system performance.
- Never disassemble the motor; doing so will cause contamination, significant reduction in magnetization, and loss of torque.
- Improper shaft machining will destroy the motor's bearings, and void the warranty. Consult a factory Applications Engineer (see phone number on inside of front cover) before you machine the motor shaft.

Mounting the Motor

Use flange bolts to mount rotary step motors. The *pilot*, or centering flange on the motor's front face, can help you position the motor.

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

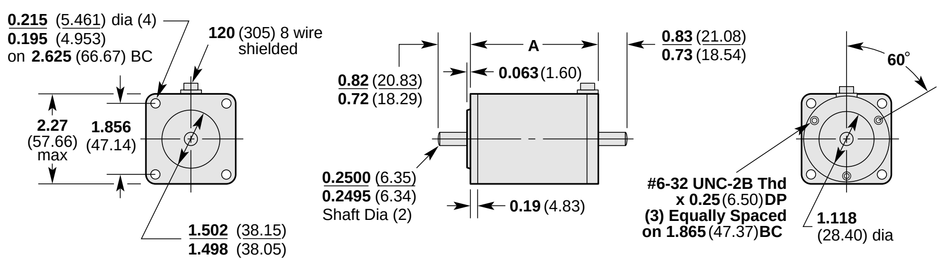
ZETA motors can produce very high torque and acceleration. If the mounting is inadequate, this combination of high torque/high acceleration can shear shafts and mounting hardware. Because of shock and vibration that high accelerations can produce, you may need heavier hardware than for static loads of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

Under certain move profiles, the motor can produce low-frequency vibrations in the mounting structure that can cause fatigue in structural members. A mechanical engineer should check the machine design to ensure that the mounting structure is adequate.

Zeta Motor Dimensions

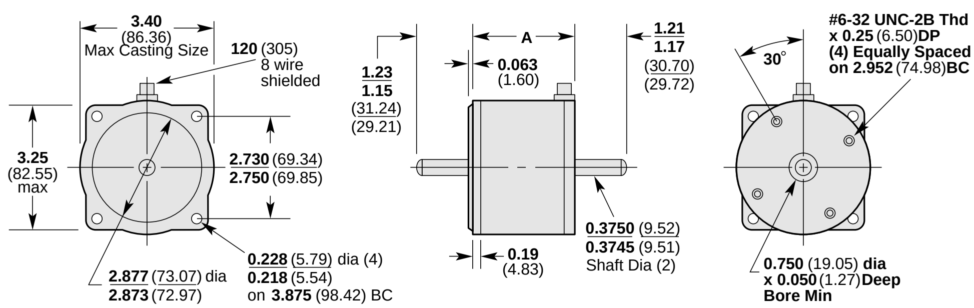
Size 23 Frame

Model	A
ZETA57-51	2.0 (50.23)
ZETA57-83	3.1 (75.23)
ZETA57-102	4.0 (101.6)



Size 34 Frame

Model	A
ZETA83-62	2.5 (62.0)
ZETA83-93	3.7 (93.98)
ZETA83-135	5.2 (129.0)



inches (millimeters)

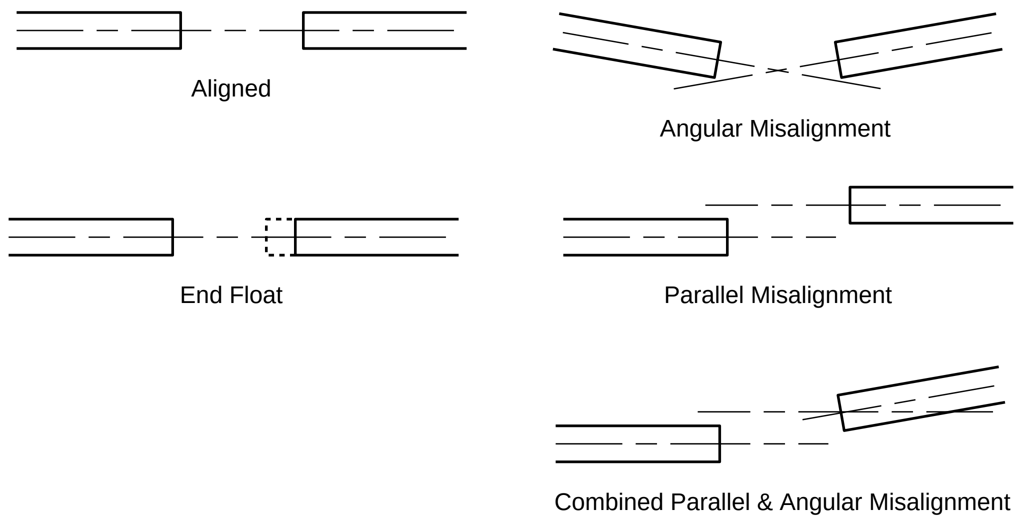
Motor Temperature & Cooling

The motor's face flange is used not only for mounting; it is also a *heatsink*. Mount the face flange to a large thermal mass, such as a thick steel plate. This is the best way to cool the motor. Heat will be conducted from inside the motor, through the face flange, and dissipated in the thermal mass. You can also use a fan to blow air across the motor for increased cooling, if you do not get enough cooling by conduction through the face flange.

In addition, the ZETA6104 has an automatic standby current feature that reduces motor current by 50% if no step pulses have been commanded for a period of 1 second or more. (**WARNING**: torque is also reduced.) Full current is restored upon the first step pulse. To enable this feature use, the `DAUTOS1` command (default is disabled, `DAUTOSØ`). The `DAUTOS` command setting is NOT automatically saved in non-volatile memory; therefore, if you intend to use this mode on power up, you have to place the `DAUTOS1` command in a set-up (`STARTP`) program—see example on page 31, or refer to the *6000 Series Programmer's Guide* for instructions.

Coupling the Motor

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



Single-Flex Coupling

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

Double-Flex Coupling

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

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

Rigid Coupling

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

Coupling Manufacturers

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

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

Optimizing System Performance (OPTIONAL)

The ZETA6104 automatically switches between the damping circuits, based upon the motor's speed.

The ZETA6104 is equipped with three damping circuits that minimize resonance and ringing, and thus enhance stepper performance:

- **Anti-Resonance** – General-purpose damping circuit. The ZETA6104 ships from the factory with anti-resonance enabled (see `DAREN` command). No configuration is necessary. Anti-resonance provides aggressive and effective damping at speeds greater than 3 revolutions per second (rps). If you are using a high-inductance motor (not applicable to Zeta motors), you should disable anti-resonance with the `DARENØ` command.
- **Active Damping** – Extremely powerful damping circuit at speeds greater than 3 rps. The ZETA6104 ships from the factory with active damping disabled. To enable active damping and optimize it for a specific motor size and load, refer to the *Configuring Active Damping* procedure below.
- **Electronic Viscosity** – Provides passive damping at lower speeds (from rest to 3 rps). The ZETA6104 ships with electronic viscosity disabled. To enable electronic viscosity and optimize it for a specific application, refer to the *Configuring Electronic Viscosity* procedure below.

For a theoretical discussion about these three circuits and how they minimize resonance and ringing, refer to Appendix A.

NOTE: You need to "match the motor to the ZETA6104" before you can configure active damping or electronic viscosity. Refer to the matching procedure on page 22.

Configuring Active Damping

Before You Start

- **Couple the motor to the load** (see pages 24-25 for details). Active damping must be configured under the normal mechanical operating conditions for your application.
- **Record the setup command settings.** The procedure below helps you identify the appropriate set-up commands (`DMTIND`, `DMTSTT`, and `DACTDP`) that will prepare your system for optimized performance. These commands are saved in non-volatile memory. However, you may still want to record these values so you can later place them in a set-up program (a set-up program executes user-specified commands that establish power-up operational defaults for your application). Page 31 shows an example of how to place these commands in a set-up (`STARTP`) program.

Step 1 **Verify correct motor-to-ZETA6104 matching.** See *Matching the Motor to the ZETA6104* on page 22. To be fully effective, the active damping circuit requires proper matching. If you are replacing a component (new ZETA6104 or motor in an existing application), you must rematch your system.

Step 2 **Establish appropriate inductance and static torque settings.** *If you ordered your ZETA6104 and Zeta motor together as a system, these setting were made at the factory (they are automatically saved in battery-backed RAM).* Use the `DMTIND` command to set the inductance, and use the `DMTSTT` command to set the static torque (see table below).

Zeta Motor	**--- INDUCTANCE ---**		**--- STATIC TORQUE ---**		
	Range MH	**`DMTIND` Setting**	**Range N-m**	**Oz-in**	**`DMTSTT` Setting**
ZETA57-51*S*	20.08 & greater	`DMTIND1` *	0.26 – 0.72	36 – 100	`DMTSTT1` *
ZETA57-83*S*	20.08 & greater	`DMTIND1` *	0.26 – 0.72	36 – 100	`DMTSTT1` *
ZETA57-102*S*	20.08 & greater	`DMTIND1` *	0.73 – 1.41	101 – 200	`DMTSTT2`
ZETA83-62*S*	10.31 – 20.07	`DMTIND2`	0.73 – 1.41	101 – 200	`DMTSTT2`
ZETA83-93*S*	10.31 – 20.07	`DMTIND2`	1.42 – 2.33	201 – 330	`DMTSTT3`
ZETA83-135*S*	10.31 – 20.07	`DMTIND2`	2.34 – 3.48	331 – 492	`DMTSTT4`
ZETA57-51*P*	5.03 – 10.30	`DMTIND3`	0.26 – 0.72	36 – 100	`DMTSTT1` *
ZETA57-83*P*	5.03 – 10.30	`DMTIND3`	0.26 – 0.72	36 – 100	`DMTSTT1` *
ZETA57-102*P*	5.03 – 10.30	`DMTIND3`	0.73 – 1.41	101 – 200	`DMTSTT2`
ZETA83-62*P*	less than 5.02	`DMTIND4`	0.73 – 1.41	101 – 200	`DMTSTT2`
ZETA83-93*P*	less than 5.02	`DMTIND4`	1.42 – 2.33	201 – 330	`DMTSTT3`
ZETA83-135*P*	less than 5.02	`DMTIND4`	1.42 – 2.33	201 – 330	`DMTSTT2`

S = Series Connection; *P* = Parallel Connection
* = Factory default setting (if you ordered the ZETA6104 without a Zeta motor)

Step 3 **Calculate the maximum Active Damping (`DACTDP`) setting.** To do this, first calculate your system's *total* inertia (include the motor's rotor inertia—see table on page 3). Then consult the table of inertia ranges below to find the `DACTDP` setting that corresponds to your system's total inertia. If you are on the boundary between two settings, pick the lower of the two numbers. This is the system's maximum setting. **In the rest of this procedure, *never set the* `DACTDP` *value higher than this maximum setting.***

`DACTDP` Setting	Total Inertia kg-cm^2			Total Inertia kg-m^2 x 10^{-6}			Total Inertia oz-in^2		
`DACTDP15`	0.088	to	0.205	8.8	to	20.5	0.481	to	1.121
`DACTDP14`	0.205	to	0.572	20.5	to	57.2	1.121	to	3.144
`DACTDP13`	0.572	to	1.069	57.2	to	106.9	3.127	to	5.845
`DACTDP12`	1.069	to	1.754	106.9	to	175.4	5.845	to	9.590
`DACTDP11`	1.754	to	2.727	175.4	to	272.7	9.590	to	14.910
`DACTDP1Ø`	2.727	to	3.715	272.7	to	371.5	14.910	to	20.312
`DACTDP9`	3.715	to	5.020	371.5	to	502.0	20.312	to	27.447
`DACTDP8`	5.020	to	6.275	502.0	to	627.5	27.447	to	34.308
`DACTDP7`	6.275	to	8.045	627.5	to	804.5	34.308	to	43.986
`DACTDP6`	8.045	to	9.595	804.5	to	959.5	43.986	to	52.460
`DACTDP5`	9.595	to	11.760	959.5	to	1176 .0	52.460	to	64.297
`DACTDP4`	11.760	to	14.250	1176.0	to	1425.0	64.297	to	77.884
`DACTDP3`	14.250	to	15.900	1425.0	to	1590.0	77.884	to	86.905
`DACTDP2`	15.900	to	17.770	1590.0	to	1777.0	86.905	to	97.129
`DACTDP1`	17.770	to	20.570	1777.0	to	2057.0	97.129	to	112.465
`DACTDPØ`	Active Damping Disabled (factory default)								

Step 4 **Make a *baseline* move with active damping disabled.** This is your baseline move. Notice the sound, amount of motor vibration, etc. This move shows how your system operates with anti-resonance enabled, and active damping disabled. Each time you adjust the DACTDP setting (in steps 5-7), you will compare results against this baseline move.

1. Issue the DACTDPØ command to disable active damping.
2. Make a move that is representative of your application, with similar velocity and acceleration. The velocity must be greater than 3 rps, in order for the ZETA6104 to activate anti-resonance or active damping.

WARNING

Make sure that causing motion will not damage equipment or injure personnel.

The following commands illustrate a simple incremental point-to-point move:

MCØ	(select the preset positioning mode)
MAØ	(select the incremental preset positioning mode)
A1Ø	(set the acceleration to 10 rps^2)
V8	(set the velocity to 8 rps)
D25ØØØØ	(set the distance to 250,000 steps, equal to 10 revs)
GO	(initiate the move)

NOTE: To stop a move in progress, issue the !S command.
To repeat the move, issue the GO command.
To reverse direction, issue the D~ command and the GO command.

Step 5 **Make a move with active damping enabled.** Compare the sound and vibration to the baseline move.

1. Issue the DACTDP1 command to enable active damping. This enables active damping at its lowest setting, and inhibits anti-resonance.
2. Make a move that is representative of your application. Use the same motion parameters that you set up in step 4. If you have not changed these settings, simply issue the GO command.

Step 6 **Increase the setting.** Issue the DACTDP2 command (unless DACTDP1 is your calculated maximum—see step 3). Make the move again. Compare the sound and vibration to the levels obtained at DACTDP1.

Step 7 **Find the ideal DACTDP setting.** Continue to increase the DACTDP setting by single increments. During a repetitive move, you can change the setting "on the fly" (while the move is in progress) if you precede the DACTDP command with a "!" (e.g., !DACTDP2). This allows you to immediately compare two different settings.

Increase the setting until you obtain optimum results for your move. This will be the setting that yields the lowest audible noise and smoothest motor operation. Write down this setting so that you can include it in your programming (perhaps in the set-up program).

Never exceed your maximum setting *(see step 3).* For many applications, you will not need to go as high as the maximum setting. If you do not see perceptible improvement from one switch setting to the next, use the lower switch setting.

Higher switch settings result in higher dynamic motor current during transients, which can cause increased motor heating. Higher current also increases motor torque, resulting in sharper accelerations that can jerk or stress the mechanics in your system. If you test each intermediate DACTDP setting, you can evaluate the effects on your mechanics as you gradually increase damping.

Configuring Electronic Viscosity (EV)

Before You Start

- If you configured active damping (see procedure above), leave the DACTDP setting set at the value you chose. You do not need to disable active damping while you configure EV.
- **Couple the motor to the load** (see pages 24-25 for details). EV must be configured under the normal mechanical operating conditions for your application.
- **Record the DELVIS command setting.** The procedure below helps you identify the appropriate set-up command (DELVIS) that will prepare your system for optimized performance. DELVIS is not saved in non-volatile memory. Therefore, you should write down this command as you qualify it in this procedure, then place it in a program. Page 31 shows an example of how to place DELVIS in a set-up (STARTP) program (a set-up program executes user-specified commands that establish power-up operational defaults for your application).

Step 1 **Verify correct motor-to-ZETA6104 matching.** See *Matching the Motor to the ZETA6104* on page 22. To be fully effective, the active damping circuit requires proper matching. If you are replacing a component (new ZETA6104 or motor) in an existing application, you must rematch your system.

Step 2 **Make a *baseline* move with EV disabled.** This is your baseline move. Notice the sound, amount of motor vibration, perceptible ringing, etc. This move shows how your system operates with EV disabled. Each time you adjust the DELVIS setting (in steps 3 & 4), you will compare results against this baseline move.

1. Issue the DELVISØ command to disable active damping.
2. Make a move that is representative of your application, with similar velocity and acceleration. The velocity must 3 rps or less, in order for the ZETA6104 to activate EV.

WARNING

Make sure that causing motion will not damage equipment or injure personnel.

The following commands illustrate a simple incremental point-to-point move:

MCØ	(select the preset positioning mode)
MAØ	(select the incremental preset positioning mode)
A1Ø	(set the acceleration to 10 rps^2)
V2	(set the velocity to 2 rps)
D25ØØØØ	(set the distance to 250,000 steps, equal to 10 revs)
GO	(initiate the move)

NOTE: To stop a move in progress, issue the !S command.
To repeat the move, issue the GO command.
To reverse direction, issue the D~ command and the GO command.

Step 3 **Make a move with EV enabled.** Compare the results with the baseline move.

1. Issue the DELVIS1 command to enable EV.
2. Make a move that is representative of your application. Use the same motion parameters that you set up in step 1. If you have not changed these settings, simply issue the GO command.

Step 4 **Find the ideal EV setting.** Continue to increase the DELVIS setting by single increments (the maximum setting is DELVIS7), and executing a move. Repeat this step until you find the setting that gives the best performance. You can try all seven settings. Incorrect settings will not cause damage.

During a repetitive move, you can change the setting “on the fly” (while the move is in progress) if you precede the DELVIS command with a “!” (e.g., !DELVIS2). This allows you to immediately compare two different settings.

Record Your System's Configuration

You may wish to record your configuration information in the chart below.

Axis Name		
Motor Size	☐ S ☐ P	
Motor Inductance Setting (DMTIND)		
Motor Static Torque Setting (DMTSTT)		
Waveform Setting (DWAVEF)		
Electronic Viscosity Setting (DELVIS)		
Active Damping Setting (DACTDP)		
Anti-Resonance Enabled? (DAREN1)	☐ Yes ☐ No	
Current Standby Enabled? (DAUTOS1)	☐ Yes ☐ No	
COM 1 Serial Port Function	☐ RS-232 ☐ RP240	← COM port functions set with internal jumpers and the PORT and DRPCHK commands.
COM 2 Serial Port Function	☐ RS-232 ☐ RP240 ☐ RS-422/ RS-485	
RS-422/485 Resistor Values	☐ Terminate ☐ Bias	← RS-422/485 resistors are selected with internal DIP switches, or connected externally.
DIP Switch Settings	OFF / ON — 1 2 3 4 5 6 7 8 9 10 11 12	

This chart is repeated, along with other facts, on the *magnetic* information label located on the side of the ZETA6104 chassis. You can leave the label on the ZETA6104, or you can remove it and place it in a convenient location near the ZETA6104 (e.g., on an equipment cabinet door).

Use a marker or pen to write configuration information in the spaces at the bottom of the label. If you have multiple ZETA6104s, you can remove the labels and stack them on top of each other, with the bottom edge of each visible. This shows information about all axes at a glance.

Recommended Set-up Program Elements

NOTE
In most applications, the factory default settings are adequate.

Most of the software configuration commands (see table below) are not saved in non-volatile memory and therefore must be executed every time the ZETA6104 is powered up or reset. Therefore, you may wish to include the software configuration commands in the *set-up* program.

The set-up program is automatically executed when the ZETA6104 is powered up or reset; in it, you place the configuration commands that establish the operational readiness you require for your particular application. A sample set-up program is provided below. For more detailed information on creating a set-up program, refer to the *6000 Series Programmer's Guide*.

Command	Function	Factory Default Setting
DACTDP	Enable/disable active damping. Active damping is automatically inhibited at or below 3 rps. If active damping is enabled, anti-resonance is automatically inhibited. (See set-up procedure on page 26.)	**DACTDPØ** (disabled)
DAREN	Enable/disable anti-resonance. Anti-resonance is automatically inhibited at or below 3 rps, and it is inhibited if active damping is enabled.	**DAREN1** (enabled)
DAUTOS	Enable/disable automatic current standby mode in which current to the motor is reduced to 50% if no pulses are commanded for 1 second. Full current is restored upon the next pulse command.	**DAUTOSØ** (disabled)
DELVIS	Enable/disable electronic viscosity. Electronic viscosity is automatically inhibited above 3 rps. (See set-up procedure on page 29.)	**DELVISØ** (disabled)
DMTIND	Match the inductance of your motor (used only for active damping).	**DMTIND1** (≥ 20 MH) *
DMTSTT	Match the motor's static torque (used only for active damping).	**DMTSTT1** (0.26-0.72 N-m; 36-100 Oz-in) *
DRPCHK	Establish the type of check for an RP240. In general, this command is necessary only if you are using RS-422/485, which forces the RP240 to be connected to the **COM 1** connector, instead of being connected to the **COM 2** connector.	**DRPCHK3** *
DWAVEF	Match the motor waveform (required for matching the motor to the ZETA6104).	**DWAVEF1** (-4% 3rd harmonic)
PORT	Identify the COM port to be affected by subsequent serial communication set-up commands (DRPCHK, E, ECHO, EOT, BOT, EOL, ERROK, ERRBAD, ERRDEF, XONOFF, and ERRLVL).	**PORT1** (**COM 1** is affected)

* These commands are automatically saved in non-volatile memory.
If ordered as a system (with a motor), the ZETA6104 is shipped the DMTIND and DMTSTT commands set to match the motor.

Set-up Program Example *(as viewed in the terminal emulator)*

Assumptions:	The ZETA6104 is used with a Zeta83-93 motor wired in series. RS-232C is connected to the **COM 1** serial port. An RP240 is connected to the **COM 2** serial port.

```
> DEF SETUP          ;begin definition of the program called setup
- DWAVEF1            ;select -4% 3rd harmonic waveform
- DMTIND2            ;set motor inductance for ZETA83-93 motor in series
- DMTSTT3            ;set motor static torque for ZETA83-93 motor in series
- DACTDP7            ;enable active damping for total inertia of 40 oz-in
- DELVIS2            ;enable electronic viscosity with value of 2
- DAREN1             ;enable anti-resonance
- PORT1              ;subsequent serial communication setup affects COM1 port
- DRPCHKØ            ;COM1 to be used for 6000 language commands
- PORT2              ;subsequent serial communication setup affects COM2 port
- DRPCHK1            ;check COM2 for RP240 -- If no RP240, use for 6000 commands
- PORT1              ;subsequent serial-related commands will affect COM1 port
-
-
-
-
-
-
-
-
- END                ;end definition of program called setup
> STARTP SETUP       ;assign the program named setup as the program to be executed
                     ;on power up or reset
```

Insert other appropriate commands in the setup program — see *Programmer's Guide*, chapter 3 (e.g., custom power-up message, scaling factors, input function assignments, output function assignments, etc.)

What's Next?

By now, you should have completed the following tasks, as instructed earlier in this chapter:

1. Review the general specifications — see page 3
2. Perform configuration/adjustments, as necessary — see pages 4-6
3. Mount the ZETA6104 — see page 7
4. Connect all electrical system components — see pages 8-19
5. Test the installation — see pages 20-21
6. Match the motor to the ZETA6104 (OPTIONAL) — see pages 22-23
7. Mount the motor and couple the load — see pages 24-25
8. Optimize system performance (OPTIONAL)
   by implementing Active Damping and Electronic Viscosity — see pages 26-29
9. Record your system configuration information — see pages 30-31

Program Your Motion Control Functions

You should now be ready to program your ZETA6104 for your application. Knowing your system's motion control requirements, refer now to the *6000 Series Programmer's Guide* for descriptions of the ZETA6104's software features and instructions on how to implement them in your application. Be sure to keep the *6000 Series Software Reference Guide* at hand as a reference for the 6000 Series command descriptions.

For assistance with your programming effort, we recommend that you use the programming tools provided in Motion Architect for Windows (found in your ship kit). Additional powerful programming and product interface tools are available (see below).

Motion Architect

Motion Architect® is a Microsoft® Windows™ based 6000 product programming tool (included in your ship kit). Motion Architect provides these features (refer to the *Motion Architect User Guide* for detailed information):

- **System configurator and code generator**: Automatically generate controller code for basic system set-up parameters (I/O definitions, feedback device operations, etc.).
- **Program editor**: Create blocks or lines of 6000 controller code, or copy portions of code from previous files. You can save program editor files for later use in BASIC, C, etc., or in the terminal emulator or test panel.
- **Terminal emulator**: Communicating directly with the ZETA6104, you can type in and execute controller code, transfer code files to and from the ZETA6104.
- **Test panel and program tester**: You can create your own test panel to run your programs and check the activity of I/O, motion, system status, etc. This can be invaluable during start-ups and when fine tuning machine performance.
- **On-line context-sensitive help and technical references**: These on-line resources provide help information about Motion Architect, as well as interactive access to the contents of the *6000 Series Software Reference Guide* and the *6000 Following User Guide*.

Other Software Tools Available

Motion Builder™. A Windows-based iconic programming interface that removes the requirement to learn the 6000 programming language.

CompuCAM™. A CAD-to-Motion (CAM) program that allows you to easily translate DXF, HP-GL, and G-Code files into 6000 Series Language motion programs. Windows environment.

DDE6000™. Facilitates data exchange between the ZETA6104 and Windows™ applications that support the dynamic data exchange (DDE) protocol. NetDDE™ compatible.

Motion Toolbox™. A library of LabVIEW® virtual instruments (VIs) for programming and monitoring the ZETA6104. Available for Windows and Mac environments.

How To Order

To order these software packages, contact your local Automation Technology Center (ATC) or distributor.

CHAPTER TWO

Troubleshooting

IN THIS CHAPTER
• Troubleshooting basics: - Reducing electrical noise - Diagnostic LEDs - Test options - Technical support • Solutions to common problems • Resolving serial communication problems • Product return procedure

Troubleshooting Basics

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

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

Determine if the problem is mechanical, electrical, or software-related. Can you repeat or re-create the problem? Random events may appear to be related, but they are not necessarily contributing factors to your problem. You may be experiencing more than one problem. You must isolate and solve one problem at a time.

Log (document) all testing and problem isolation procedures. You may need to review and consult these notes later. This will also prevent you from duplicating your testing efforts.

Once you isolate the problem, refer to the problem solutions contained in this chapter. If the problem persists, contact your local technical support resource (see *Technical Support* below).

Reducing Electrical Noise

Refer to the guidelines on page 19. General information on reducing electrical noise can be found in the Engineering Reference section of the Parker Compumotor/Digiplan catalog.

Diagnostic LEDs

POWER ....On (green) if 120VAC connected. Off if no power.
STEP................Flashes on (green) with each pulse sent to the motor. Off if no pulses.
OVER TEMP........On (red) if internal sensor reaches 131°F (55°C). Off = O.K.
MOTOR FAULT....On (red) if there is a short in the motor windings, if the motor cable is disconnected or shorted, or if the INTERLOCK jumper on the MOTOR connector is removed or extended. Off = O.K.

Test Options

- **Test Panel**. Motion Architect's Panel Module allows you to set up displays for testing system I/O and operating parameters. Refer to the *Motion Architect User Guide* for details.
- **Hardware Test Procedure** (see pages 20-21).
- **Motion Test**. A test program is available to verify that the ZETA6104 is sending pulses to the motor and that the motor is functioning properly. The test program can be initiated by issuing the TEST command over the serial interface, or by accessing the RP240 TEST menu (see *6000 Series Programmer's Guide* for RP240 menu structure).

WARNING

The TEST program causes the end-of-travel limits to be ignored. If necessary, disconnect the load to ensure the test moves do not damage your equipment or injure personnel.

Technical Support

If you cannot solve your system problems using this documentation, contact your local Automation Technology Center (ATC) or distributor for assistance. If you need to talk to our in-house application engineers, please contact us at the numbers listed on the inside cover of this manual. (These numbers are also provided when you issue the HELP command.)
NOTE: Compumotor maintains a BBS that contains the latest software upgrades and late-breaking product documentation, a FaxBack system, and a tech support email address.

Common Problems & Solutions

NOTE
Some software-related causes are provided because it is sometimes difficult to identify a problem as either hardware or software related.

Problem	Cause	Solution
Communication (serial) not operative, or receive garbled characters	1. Improper interface connections or communication protocol 2. COM port disabled 3. In daisy chain, unit may not be set to proper address	1. See *Troubleshooting Serial Communication* section below. 2.a. Enable serial communication with the `E1` command. 2.b. If using RS-485, make sure the internal jumpers are set accordingly (see page 6). Make sure COM 2 port is enabled for sending 6000 language commands (execute the `PORT2` and `DRPCHKØ` commands). 3. Verify DIP switch settings (see page 5), verify proper application of the `ADDR` command.
Direction is reversed.	1. Phase of step motor reversed (motor does not move in the commanded direction). 2. Phase of encoder reversed (reported `TPE` direction is reversed).	1. Swap the A+ and A– connection at the MOTOR connector. 2. Swap the A+ and A– connection at the ENCODER connector. SOFTWARE ALTERNATIVE: If the motor (and the encoder if one is used) is reversed, you can use the `CMDDIR1` command to reverse the polarity of both the commanded direction and the polarity of the encoder feedback counts).
Distance, velocity, and accel are incorrect as programmed.	1. Incorrect resolution setting.	1.a. Set the drive resolution to 25,000 steps/rev (`DRES25ØØØ` command). 1.b. Set the encoder resolution (post-quadrature) for your encoder. If using Compumotor E series encoders, issue the `ERES4ØØØ` command.
Encoder counts missing.	1. Improper wiring. 2. Encoder slipping. 3. Encoder too hot. 4. Electrical noise. 5. Encoder frequency too high.	1. Check wiring. 2. Check and tighten encoder coupling. 3. Reduce encoder temperature with heatsink, thermal insulator, etc. 4.a. Shield wiring. 4.b. Use encoder with differential outputs. 5. Peak encoder frequency must be below 1.6MHz post-quadrature. Peak frequency must account for velocity ripple.
Erratic operation.	1. Electrical Noise. 2. Improper shielding. 3. Improper wiring.	1. Reduce electrical noise or move ZETA6104 away from noise source. 2. Refer to the Electrical Noise portion of the Technical Reference section in the Compumotor/Digiplan catalog. 3. Check wiring for opens, shorts, & mis-wired connections.
LEDs	See *Diagnostic LEDs* above	
Motion does not occur.	1. Check LEDs. 2. End-of-travel limits are active. 3. Improper wiring. 4. P-CUT (Pulse cut-off) not grounded. 5. Load is jammed. 6. No torque from motor.	1. See *Diagnostic LEDs* above. 2.a. Move load off of limits or disable limits with the `LHØ` command. 2.b. Set `LSPOS` to a value less than `LSNEG`. 3. Check motor and end-of-travel limit connections. 4. Ground the P-CUT connection. 5. Remove power and clear jam. 6. See problem: *Torque, loss of.*
Motor creeps at slow velocity in encoder mode.	1. Encoder direction opposite of motor direction. 2. Encoder connected to wrong axis.	1. Switch encoder connections A+ & A- with B+ & B-. 2. Check encoder wiring.
Programmable inputs not working.	1. IN-P (input pull-up) not connected to a power supply. 2. If external power supply is used, the grounds must be connected together. 3. Improper wiring.	1.a. When inputs will be pulled down to 0V by an external device, connect IN-P to +5V supplied or other positive supply. 1b. When inputs will be pulled to 5V or higher by an external device, connect IN-P to 0V. 2. Connect external power supply's ground to ZETA6104's ground (GND). 3. Check wiring for opens, shorts, and mis-wired connections.
Programmable outputs not working.	1. Output connected such that it must source current (pull to positive voltage). 2. OUT-P not connected to power source. 3. If external power supply is used, the grounds must be connected together. 4. Improper wiring.	1. Outputs are open-collector and can only sink current -- change wiring. 2. Connect OUT-P to the +5V terminal or to an external supply of up to 24V. 3. Connect the external power supply's ground to the ZETA6104's ground (GND). 4. Check wiring for opens, shorts, and mis-wired connections.
Torque, loss of.	1. Improper wiring. 2. No power(POWER LED off). 3. Overtemp, low voltage, or motor fault. 4. Drive shutdown. 5. Current standby mode enabled	1. Check wiring to the motor, as well as other system wiring. 2. Check power connection (POWER LED should be on. 3. Check LED status (see *Diagnostic LEDs* above). 4. Enable drive with the `DRIVE1` command. 5. If more torque is needed at rest, disable standby mode (`DAUTOSØ` command)
Trigger inputs not working.	1. If external power supply is used, the grounds must be connected together. 2. Improper wiring.	1. Connect external power supply's ground to ZETA6104's ground (GND). 2.a. Check wiring for opens, shorts, and mis-wired connections. 2.b. When inputs will be pulled down to 0V by an external device, connect AUX-P to +5V supplied or other positive supply. 2.c. When inputs will be pulled to 5V or higher by an external device, connect AUX-P to 0V.

Troubleshooting Serial Communication Problems

General Notes

- Power up your computer or terminal *BEFORE* you power up the ZETA6104.
- Make sure the serial interface is connected as instructed on page 9. Shield the cable to earth ground at one end only. The maximum RS-232 cable length is 50 feet (15.25 meters).
- RS-232: Handshaking must be disabled. Most software packages allow you to do this. You can also disable handshaking by jumpering some terminals on the computer's/ terminal's serial port: connect RTS to CTS (usually pins 4 and 5) and connect DSR to DTR (usually pins 6 and 20).
- RS-422/485: Make sure the internal DIP switches and jumpers are configured as instructed on page 6.

Test the Interface

1. Power up the computer or terminal and launch the terminal emulator.
2. Power up the ZETA6104. A power-up message (similar to the following) should be displayed, followed by a prompt (>):

```
*PARKER COMPUMOTOR 6104 – SINGLE AXIS INDEXER/DRIVE
*RP240 CONNECTED
*EXPANDED MEMORY OPTION INSTALLED

>
```

3. Type "TREV" and press the ENTER key. (The TREV command reports the software revision.) The screen should now look as follows (if not, see Problem/Remedy table below).

```
*PARKER COMPUMOTOR 6104 – SINGLE AXIS INDEXER/DRIVE
*RP240 CONNECTED
*EXPANDED MEMORY OPTION INSTALLED

>TREV
*TREV92-014630-01-4.0 6104
```

Problem	Remedy (based on the possible causes)
No Response	• COM port not enabled for 6000 language communication. If RS-232 connected to COM 1: issue "PORT1" and "DRPCHKØ" commands. If RS-232 connected to COM 2: issue "PORT2" and "DRPCHKØ" commands. If RS-422/485 connected to COM 2: issue "PORT2" and "DRPCHKØ" commands. • RS-232 & RS-422: Echo may be disabled; enable with the ECHO1 command. • Faulty wiring. See instructions on page 9. RS-422/485: verify internal DIP switch and jumper settings on page 6. Also check for shorts or opens. • Is the cable or computer/terminal bad? Here's a test: 1. Disconnect the serial cable from the ZETA6104 end only. 2. Connect the cable's Rx and Tx lines together (this echoes the characters back to the host). 3. Issue the TREV command. If nothing happens, the cable or computer/terminal may be faulty.
Garbled Characters	• Verify setup: 9600 baud (range is 19200-1200—see *AutoBaud*, page 5), 8 data bits, 1 stop bit, no parity; RS-232 & RS-422: Full duplex; RS-485: Half duplex (change internal jumper JU6 to position 1). • RS-422/485: Transmission line not properly terminated. See page 6 for internal DIP switch and jumper settings. See page 9 for connections and calculating termination resistors (if not using the internal resistors via internal DIP switches). • Faulty wiring. See instructions on page 9. RS-422/485: verify internal DIP switch and jumper settings on page 6. Also check for shorts or opens.
Double Characters	• Your terminal emulator is set to half-duplex; set it to full-duplex.

Product Return Procedure

Step 1 Obtain the serial number and the model number of the defective unit, and secure a purchase order number to cover repair costs in the event the unit is determined by the manufacturers to be out of warranty.

Step 2 Before you return the unit, have someone from your organization with a technical understanding of the ZETA6104 system and its application include answers to the following questions:

- What is the extent of the failure/reason for return?
- How long did it operate?
- Did any other items fail at the same time?
- What was happening when the unit failed (e.g., installing the unit, cycling power, starting other equipment, etc.)?
- How was the product configured (in detail)?
- Which, if any, cables were modified and how?
- With what equipment is the unit interfaced?
- What was the application?
- What was the system environment (temperature, enclosure, spacing, contaminants, etc.)?
- What upgrades, if any, are required (hardware, software, user guide)?

Step 3 Call for return authorization. Refer to the *Technical Assistance* phone numbers provided on the inside front cover of this document. The support personnel will also provide shipping guidelines.

Appendix A

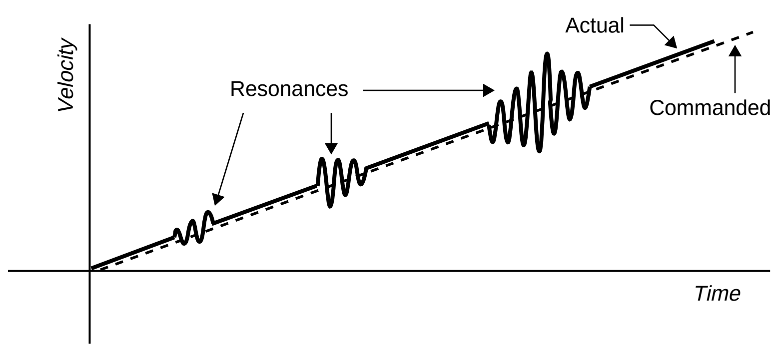
Resonance, Ringing & Damping—Discussion & Theory

In this appendix we will discuss resonance and ringing in step motors. This information will help you configure the ZETA6104's damping features—anti-resonance, active damping, and electronic viscosity.

All step motors have natural resonant frequencies, due to the nature of their mechanical construction. Internally, the rotor acts very similarly to a mass suspended on a spring—it can oscillate about its commanded position. Externally, the machine, mounting structure, and drive electronics can also be resonant, and interact with the motor. During a move, two types of problems can arise from these causes: resonance and ringing transients.

Resonance (Steady State Response)

Resonance is a *steady state* phenomenon—it occurs when the motor's natural resonant frequencies are excited at particular velocities. It is not caused by transient commands that we give the motor. If you slowly increase your motor's speed from zero to 20 rps, for example, you may notice "rough" spots at certain speeds. The roughness is resonance; it is depicted in the next drawing.



Instead of moving at the commanded velocity, the motor is oscillating between speeds faster and slower than commanded. This causes *error in rotor position.*

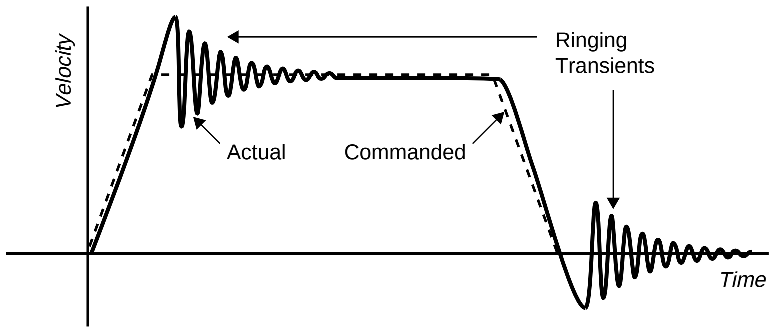
Resonance points can differ in intensity. The drawing shows a typical case—as motor speed increases, resonances of varying levels occur. Usually, the motor can accelerate through the resonance point, and run smoothly at a higher speed. However, if the resonance is extreme, the rotor can be so far out of position that it causes the motor to stall.

Resonance is affected by the load. Some loads are resonant, and can make motor resonance worse. Other loads can damp motor resonance. To solve resonance problems, system designers will sometimes attach a damping load, such as an inertial damper, to the back of the motor. However, such a load has the unwanted effect of decreasing overall performance, and increasing system cost.

The ZETA6104 has internal electronics that can damp resonance, and *increase* system performance. No external devices are necessary.

Ringing (Transient Response)

Inside a step motor, the rotor behaves like a mass on a spring, as mentioned above. When commanded to quickly accelerate to a given velocity, the rotor will "ring" about that velocity, oscillating back and forth. As shown in the next drawing, the ringing *decays*—grows smaller over time—and the rotor eventually settles at the commanded velocity.



Notice that ringing can be caused both by accelerating or decelerating to a commanded velocity, and decelerating to a stop. In any of these cases, ringing causes *error in rotor position*.

Ringing is a *transient* phenomenon (unlike resonance, which occurs during steady state operations). It is a response to a sudden change that we impose on the system, such as "Accelerate to Velocity" or "Stop."

Several problems are associated with ringing. It can cause audible noise; the motor must have a margin of extra torque to overcome the ringing; and longer settling times can decrease throughput.

To eliminate these problems, system designers use damping to force the ringing to decay quickly. Inertial dampers have been used as components in passive damping methods. Accelerometers, encoders, and tachometers have been used as components in active damping methods. These devices can have the unwanted effect of limiting performance, adding complexity, and increasing cost.

The ZETA6104 has internal electronics that can damp ringing transients, and cause them to decay quickly. No external devices are necessary.

Damping in the ZETA6104

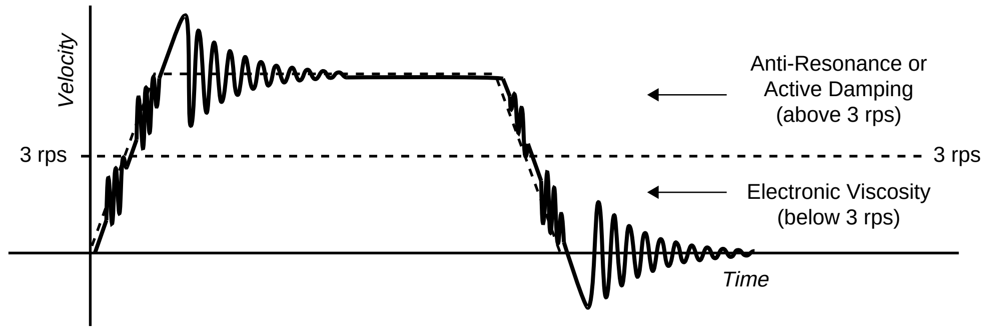
The ZETA6104 has three different circuits that can damp resonance and ringing.

Anti-Resonance – General-purpose damping circuit. The ZETA6104 ships from the factory with anti-resonance enabled. No configuration is necessary. Anti-resonance provides aggressive and effective damping.

Active Damping – Extremely powerful damping circuit. The ZETA6104 ships from the factory with active damping disabled. You must use the `DACTDP` command to enable active damping and optimize it for a specific motor size and load (see procedure on page 26).

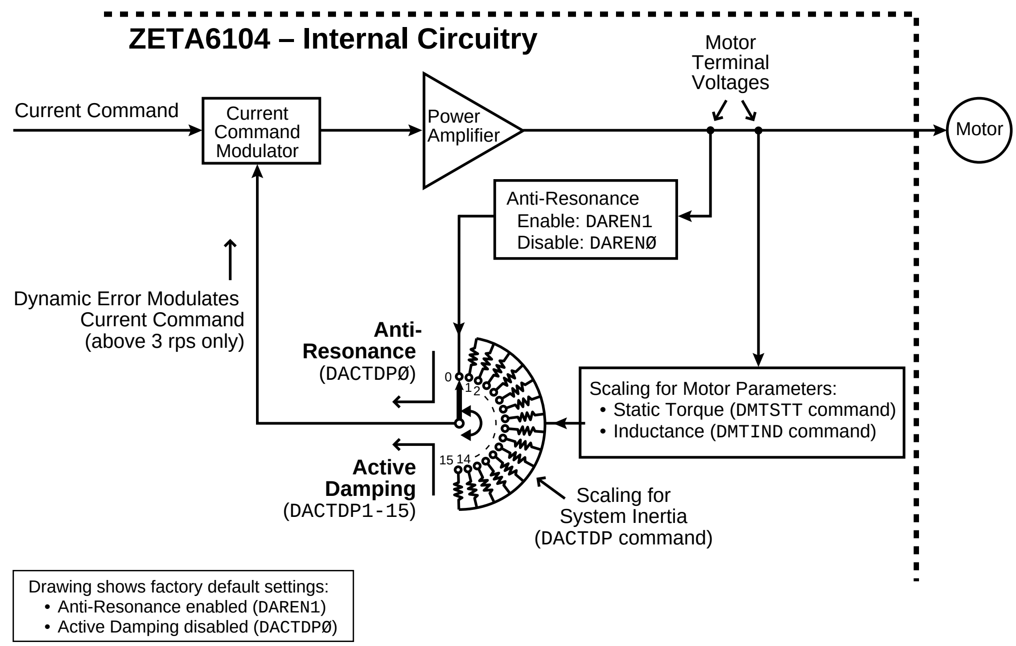
Electronic Viscosity – Provides passive damping at lower speeds. The ZETA6104 ships with electronic viscosity disabled. You must use the `DELVIS` command to enable electronic viscosity, and optimize it for a specific application (see procedure on page 29).

The first two damping circuits—anti-resonance and active damping—work at speeds greater than three revolutions per second (rps). Electronic viscosity works at speeds from rest up to three rps. The ZETA6104 will automatically switch between the damping circuits, based upon the motor's speed. The next drawing shows the effective range of each circuit.



Above 3 rps, the ZETA6104 automatically enables either anti-resonance or active damping—but not both at the same time. They are mutually exclusive.

If active damping is set to zero (`DACTDPØ`), the ZETA6104 enables anti-resonance. If the `DACTDP` command is set to any setting other than zero, the ZETA6104 enables active damping. This relationship is shown in the next drawing.



Notice in the drawing that anti-resonance can also be disabled with a command (`DARENØ`).

Differences between anti-resonance and active damping are described next; refer to the block diagram above.

Anti-Resonance

Anti-resonance monitors the ZETA6104's motor terminals, and looks at power exchange between the ZETA6104 and motor. From this, it extracts information about error in rotor position caused by resonance or ringing. It modifies the internal motor current command to correct for the error.

Anti-resonance is a general-purpose circuit. It corrects rotor position error, without knowledge about the system—whether the motor is large or small, or the system inertia is high or low. You cannot modify the circuit's gains, or customize it for a particular application—but, anti-resonance is easy to use. When enabled via the `DAREN1` command, it works automatically.

Active Damping

Active damping monitors the ZETA6104's motor terminals and, like anti-resonance, uses the same current command modulator to modify motor current.

Active damping uses a different method to extract information about rotor position error, however. The circuit's gains are adjustable—you can configure it for your particular system. The `DMTIND` and `DMTSTT` commands scale the circuit for motor inductance and static torque, respectively. The `DACTDP` command scales the circuit for system inertia.

The active damping circuit uses this information for two purposes:

1. It determines error in rotor position *very* accurately.
2. It adjusts the gains of its feedback loop, based upon how much inertia the system has, and how much torque the motor can produce.

If the rotor rings or vibrates, the active damping circuit will detect the corresponding error in rotor position. It will then modify the motor current command to damp the ringing.

DIP switches on top of the ZETA6104 set the amount of motor current during normal operations; this current is constant. To damp ringing, the active damping circuit can cause the ZETA6104 to produce up to twice as much current as is set by the DIP switches. The extra current is only applied during damping oscillations, and lasts a very brief time.

Electronic Viscosity (EV)

The ZETA6104 uses closed-loop current control to develop and maintain precise currents in the motor phases. When EV is off, the current loops have a bandwidth of approximately 1000 Hz. Because this bandwidth is well beyond the knee of step motor speed-torque curves, the current loop dynamics do not limit the response of the motor.

EV monitors motor velocity, and turns on below 3 rps. It "detunes" the current loop compensation values and brings the bandwidth down to 150 Hz. With this lower bandwidth, the drive electronics become "sluggish." Ordinarily, when the rotor oscillates, it generates current in the motor's coils; but with EV's lower bandwidth, the drive's electronics impede the flow of current caused by oscillations.

The effect on the motor is as if there were a viscous drag on the rotor. At the end of a move, oscillations are damped, and the rotor quickly comes to rest. After accelerating or decelerating to velocities below 3 rps, the rotor quickly settles at the commanded velocity. During moves below 3 rps, EV significantly reduces low speed velocity ripple.

EV is a "passive" circuit. It imposes viscosity on the system, but has no feedback loop to monitor the effect of the viscosity. EV keeps the amount of viscosity the same, regardless of the response of the system.

You can adjust the amount of viscosity by using the `DELVIS` command. This allows you to tailor the circuit for different motor sizes and system inertias, and adapt it to your application.

Recommendations

We recommend that you configure active damping and electronic viscosity. Even if you believe resonance and ringing will not cause problems in your system, you may find that the ZETA6104's damping circuits provide increased smoothness, reduced audible noise, and better performance. Refer to the configuration procedures beginning on page 26.

If you choose not to use active damping and electronic viscosity, at least use anti-resonance. The ZETA6104 is shipped from the factory with anti-resonance enabled (`DAREN1`).

Appendix B

Using Non-Compumotor Motors

We recommend that you use Compumotor ZETA Series motors with the ZETA6104. If you use a non-Compumotor motor, it must meet the following requirements:

- A minimum inductance of 2 mH, series or parallel, is required. (Compumotor recommends a minimum inductance of 5 mH.)
- A minimum of 500VDC high-pot insulation rating from phase-to-phase and phase-to-ground.
- The motor must be designed for use with a bipolar drive (no common center tap).
- 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. If you have questions regarding the use of a non-Compumotor motor with the ZETA6104, consult your local Automation Technology Center (ATC) or distributor, or refer to the numbers listed under *Technical Assistance* on the inside front cover of this document.

Wiring Configurations

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

4-Lead Motor

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

6-Lead Motor

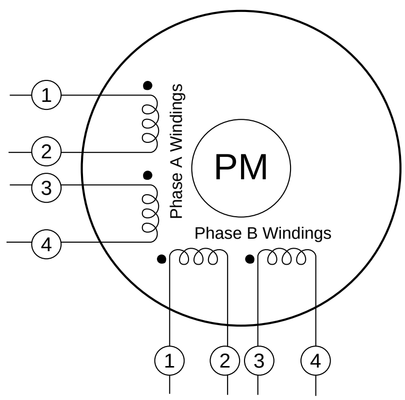
1. Determine, with an ohmmeter, which three of the six motor leads are common (one phase).
2. Label each one of these three motor leads **A**.
3. Using the ohmmeter, verify that the remaining three leads are common.
4. Label the remaining three leads **B**.
5. Set the ohmmeter range to the 100 ohm scale (approximately).
6. Connect the ohmmeter's negative lead to one of the motor leads labeled **A**. Alternately measure the resistance to the two remaining motor leads also labeled **A**. The resistance measurements will reflect one of the following two scenarios.

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

   Scenario #2 — The resistance measurement to the second of the three motor leads measures 50% of the resistance measurement to the third of the three motor leads. Label the second motor lead **A CENTER TAP** (this is the center tap lead for Phase A of the motor). Label the third motor lead **A–**. Label the motor lead connected to the ohmmeter **A+.**
7. Repeat the procedure as outlined in step 6 for the three leads labeled **B** (**B CENTER TAP** is the center tap lead for Phase B of the motor).
8. Proceed to the *Terminal Connections* section below.

8-Lead Motor

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



Series Configuration Procedure:

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.

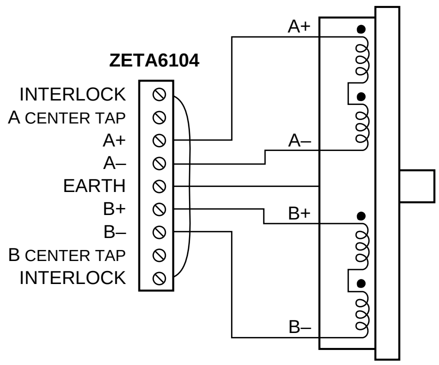
Parallel Configuration Procedure:

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

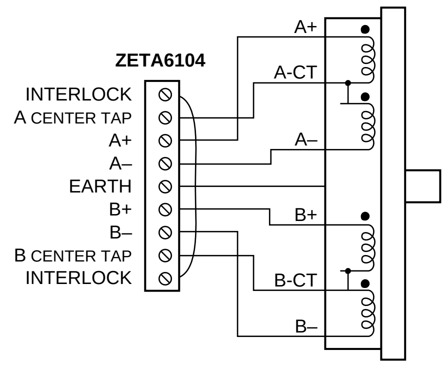
Terminal Connections

After you determine the motor's wiring configuration, connect the motor leads to the ZETA6104's 9-pin **MOTOR** connector according to the following figure.

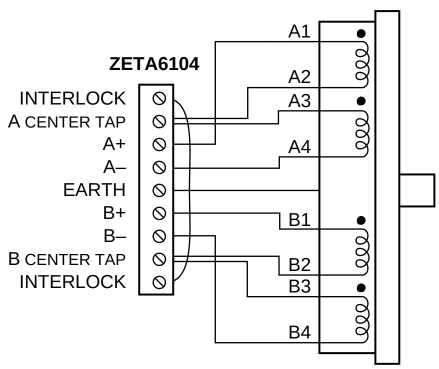
4-Lead Motor



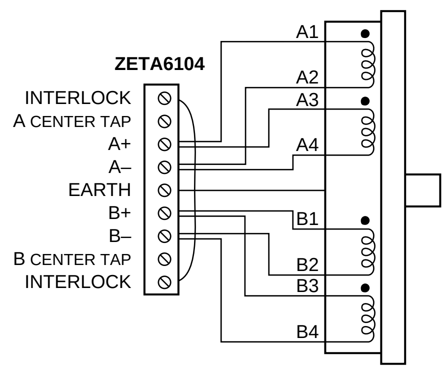
6-Lead Motor



8-Lead Motor
Series



8-Lead Motor
Parallel



Direction of Motor Rotation

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

CAUTION

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

Setting Motor Current – Non-Compumotor Motors

To set motor current for a non-Compumotor motor, refer to the formulas below that correspond to your motor (4-lead, 6-lead, 8-lead) and use the current settings shown on page 5 to set the motor's current.

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

4-Lead Motors

If you use a 4-lead motor, the manufacturer's current specification will translate directly to the values shown for current in the DIP switch table on page 5.

6-Lead Motors

If you use a 6-lead motor, and the manufacturer specifies the motor current as a bipolar rating, you can use the DIP switch table’s current settings directly (no conversion) to set motor current.

If the manufacturer specifies the motor current as a unipolar rating, use the following formula to convert the unipolar current rating to the correct bipolar rating:

Unipolar Current ∗ 0.707 = Bipolar Current

After you make the conversion, use the values shown for current in the DIP switch table to set the motor current.

8-Lead Motors

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

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

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

  Unipolar Current ∗ 0.707 = Bipolar Current
- If you wire the motor in **series**, use the DIP switch table’s current settings and the converted value to set the motor current.
- If you wire the motor in **parallel**, you must **double** the converted value and use the DIP switch table’s current settings to set the motor current.

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

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

If you have any questions about setting motor current, consult your local Automation Technology Center (ATC) or distributor, or refer to the numbers listed under *Technical Assistance* on the inside front cover of this document.

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