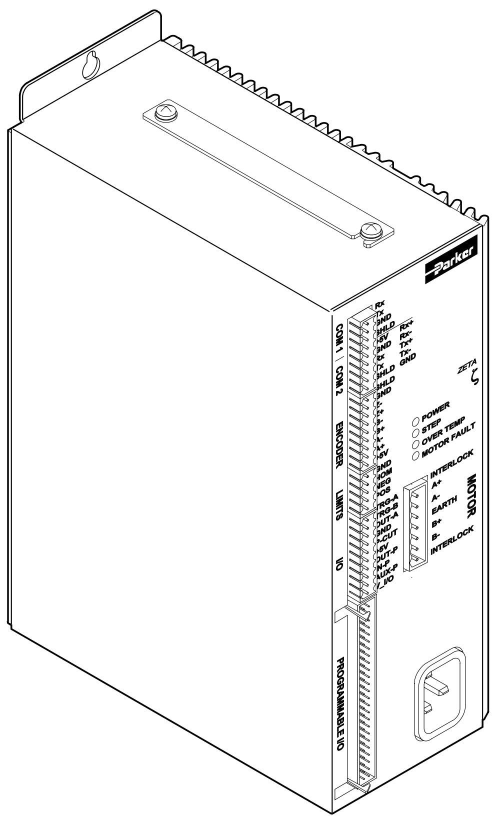
Compumotor

ZETA6xxx Indexer/Drive

Installation Guide



Compumotor Division
Parker Hannifin Corporation
p/n 88-017277-01B January 2010

IMPORTANT

User Information

⚠ WARNING ⚠

6000 Series products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

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

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ABOUT THIS GUIDE

Purpose of This Guide

This document is designed to help you install and troubleshoot your ZETA6xxx hardware system. Programming related issues are covered in the *6000 Series Programmer's Guide* and the *6000 Series Software Reference*.

"ZETA6xxx" Nomenclature
The nomenclature "ZETA6xxx" is used in this documentation to indicate the higher power versions of the ZETA6000 Indexer Drive, the ZETA6104-240, the ZETA6108 and the ZETA6112. Any information that refers to the ZETA6xxx is applicable to all three higher power versions.
In older versions of the 6000 Software & Programmers Guides as well as the older versions of the Motion Architect software, references are made to the ZETA6104 or "6104". These references are equally applicable to the higher power versions of the ZETA6xxx series.

What You Should Know

To install and troubleshoot the ZETA6xxx, 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*, 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
- Current *Parker Compumotor Motion Control Catalog*
- Schram, Peter (editor). *The National Electric Code Handbook* (Third Edition). Quincy, MA: National Fire Protection Association

Online Manuals This manual (in Acrobat PDF format) is available from our web site: `http://www.compumotor.com`

LVD and EMC Installation Guidelines

The ZETA6xxx is in compliance with the Low Voltage Directive (72/23/EEC) and the CE Marking Directive (93/68/EEC) of the European Community.

When installed according to the procedures in the main body of this installation guide, the ZETA6xxx may not necessarily comply with the Low Voltage Directive (LVD). To install the ZETA6xxx so that it is LVD compliant, refer to supplemental installation instructions provided in Appendix C. If you do not follow these instructions, the protection of the ZETA6xxx may be impaired.

The ZETA6xxx is sold as a complex component to professional assemblers. As a component, it is not required to be compliant with Electromagnetic Compatibility Directive 89/336/EEC. However, Appendix D provides guidelines on how to install the ZETA6xxx in a manner most likely to minimize the ZETA6xxx's emissions and to maximize the ZETA6xxx's immunity to externally generated electromagnetic interference.

CHAPTER ONE

Installation

IN THIS CHAPTER
• Product ship kit list • Things to consider before you install the ZETA6xxx • General specifications table • Optional pre-installation alterations   - DIP switch settings – motor current, device address, autobaud feature   - Changing the COM 2 port from RS-232C to RS-485 • Mounting the ZETA6xxx • Connecting all electrical components (includes specifications) • Testing the installation • Matching the motor to the ZETA6xxx • Motor mounting and coupling guidelines • Using the damping features to optimize performance • Preparing for what to do next
CE — To install the ZETA6xxx so that it is LVD compliant, refer to the supplemental instructions in Appendix C. Appendix D provides guidelines on how to install the ZETA6xxx in a manner most likely to minimize the ZETA6xxx's emissions and to maximize the ZETA6xxx's immunity to externally generated electromagnetic interference.

What You Should Have (ship kit)

Part	Part Number
ZETA6108 standard product (with ship kit)	ZETA6108
OR	
ZETA6112 standard product (with ship kit)	ZETA6112
OR	
ZETA6104-240 standard product (with ship kit)	ZETA6104-240
Ship kit:	
This user guide (ZETA6xxx Indexer/Drive Installation Guide)	88-017277-01
6000 Series Software Reference	88-012966-01
6000 Series Programmer's Guide	88-014540-01
Motion Architect disks: Disk 1	95-013070-01
Disk 2	95-013070-02
Driver & Samples	95-016324-01
Wire jumpers: Qty 3	44-015142-01
Qty 1	44-015741-01
Quick-reference magnet (located on the side of the ZETA6xxx chassis)	87-017473-01
Motor connector	43-008755-01
120VAC power cord (ZETA6108 and ZETA6112 versions only)	44-030083-01
240 VAC power connector (ZETA6104-240 version only)	43-011905-01

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

You may have also ordered some of the following accessories:

Part	Part Number
* O Series Motor (CE/LVD Marked) (170 VDC winding)	OS2HB-*nnnnn* OS21B-*nnnnn* OS22B-*nnnnn*
* R Series Motor (CE/LVD Marked) (170 VDC winding)	RS31B-*nnnnn* RS32B-*nnnnn* RS33B-*nnnnn* RS42B-*nnnnn* RE42B-*nnnnn*
* T Series Motor (CE/LVD Marked) (170 VDC winding)	TS31B-*nnnnn* TS32B-*nnnnn* TS33B-*nnnnn* TS41B-*nnnnn* TS42B-*nnnnn* TS43B-*nnnnn*
** R Series Motor (CE/LVD Marked) (340 VDC winding)	RS31C-*nnnnn* RS32C-*nnnnn* RS33C-*nnnnn* RS42C-*nnnnn* RE42C-*nnnnn* RS43C-*nnnnn*
Cable Kit for LVD/EMC Motor Installation (10') (compatible with R & T series motors)	C10 C10H***
EMC Kit for LVD/EMC Installation	ZETA EMC SHIPKIT
24V input/output module	VM24
50-pin header-to-screw terminal breakout board	VM50
Operator interface	RP240
Operator interface (NEMA 4 rated)	RP240-NEMA 4
DDE server for 6000 series	DDE 6000
LabVIEW library of VI's for Motion Control	Motion Toolbox
Graphical icon-based programming software	Motion Builder

** These motors are recommended for use with the ZETA6108, ZETA6112 and the ZETA6104-240 operating at 120 VAC.*
*** These motors are recommended for use with the ZETA6104-240 operating at 240 VAC.*
****The C10H (to be released soon) is recommended for use with applications rated for more than 10 amps of current in the motor.*
NOTE: See the Compumotor catalog for more information on accessories.

Before You Begin

> ⚠ **WARNINGS** ⚠
>
> The ZETA6xxx 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 ZETA6xxx 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 ZETA6xxx
4. Connect all electrical system components
5. Test the installation
6. Match the motor to the ZETA6xxx — *optional*
7. Mount the motor and couple the load
8. Optimize performance (using the ZETA6xxx'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 Series Programmer's Guide* and the *6000 Series Software Reference*. 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 26.
- Appendix D (page 63) provides guidelines on how to install the ZETA6xxx in a manner most likely to minimize the ZETA6xxx's emissions and to maximize the ZETA6xxx's immunity to externally generated electromagnetic interference.

General Specifications

Parameter	Specification
Power	
AC input	95-132VAC, 50/60Hz, single-phase (95-264VAC for ZETA6104-240) (refer to page 25 for peak power requirements, based on the motor you are using)
Status LEDs/fault detection	Refer to *Diagnostic LEDs* on page 46
Environmental	
Operating Temperature	32 to 113°F (0 to 45°C)
Storage Temperature	-22 to 185°F (-30 to 85°C)
Humidity	0 to 95% non-condensing
Performance	
Position Range & Stepping Accuracy	Position range: ±2,147,483,648 steps; Stepping accuracy: ±0 steps from preset total
Velocity Range, Accuracy, & Repeatability	Range: 1-2,000,000 steps/sec; Accuracy: ±0.02% of maximum rate; Repeatability: ±0.02% of set rate
Acceleration Range	1-24,999,975 steps/sec^2
Motion Algorithm Update Rate	2 ms
Serial Communication	*RS-485 requires internal jumper and DIP switch configuration (see page 8).*
Connection Options	RS-232C, 3-wire; RS-485 (default is 4-wire; for 2-wire move JU7 to position 1); Change internal jumpers JU1-JU6 to position 1 to select RS-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 7), 8 data bits, 1 stop bit, no parity; RS-232: Full duplex; RS-485: Half duplex (change jumper JU6 to position 1)
Inputs	*All inputs are optically isolated from the microprocessor (not from the other inputs).*
HOM, **POS**, **NEG**, **TRG-A**, **TRG-B**, **P-CUT**	Powered by voltage applied to **V_I/O** terminal (switching levels: ≤1/3 of **V_I/O** voltage = low, ≥2/3 of **V_I/O** voltage = high). **V_I/O** can handle 5-24V with max. current of 100mA. Internal 6.8 KΩ pull-ups to **AUX-P** terminal—connect **AUX-P** to power source (**+5V** terminal or an external 5-24V supply) to source current or connect **AUX-P** to **GND** to sink current; **AUX-P** can handle 0-24V with max. current of 50mA. Voltage range for these inputs 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 power source (**+5V** pin #49 or an external 5-24V supply) to source current or connect **IN-P** to **GND** to sink current; **IN-P** can handle 0-24V with max. current of 100 mA. Voltage range = 0-24V.
Outputs	*All outputs are optically isolated from the microprocessor (not from the other outputs).*
9 Programmable (includes **OUT-A**)	Open collector output with 4.7 KΩ pull-ups. Can be pulled up by connecting **OUT-P** to power source (**+5V** terminal or an external 5-24V supply); **OUT-P** can handle 0-24V with max. current of 50mA. Outputs will sink up to 300mA or source up to 5mA at 5-24VDC. 8 general-purpose outputs on the **Programmable I/O** connector, **OUT-A** on the **I/O** connector.
+5V Output	Internally supplied +5VDC. **+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 Parameters		Size 23 O Motors (170 VDC winding)			Size 34 R Motors (170 VDC winding)			Size 42 R Motors (170 VDC winding)	
		OS2HB	**OS21B**	**OS22B**	**RS31B**	**RS32B**	**RS33B**	**RS42B**	**RE42B**
Static Torque**	oz-in (N-m)	43 (0.30)	82 (0.58)	155 (1.09)	133 (0.93)	267 (1.87)	392 (2.74)	985 (6.90)	1907 (13.35)
Rotor Inertia	$oz\text{-}in^2$ ($kg\text{-}cm^2$)	0.39 (0.07)	0.66 (0.12)	1.39 (0.25)	3.02 (0.55)	6.56 (1.20)	9.65 (1.77)	61.76 (11.30)	61.76 (11.30)
Drive Current (Apk)(Arms)**									
Series		1.5 (1.0)	1.8 (1.3)	2.2 (1.5)	2.3 (1.6)	2.8 (2.0)	3.4 (2.4)	6.1 (4.3)	3.4 (2.4)
Parallel		3.0 (2.1)	4.0 (2.8)	4.0 (2.8)	4.6 (3.3)	5.6 (4.0)	6.9 (4.9)	12.0 (8.5)	7.2 (5.1)
Phase Inductance (mH)***									
Series		8.6	12	16.6	9.4	11.6	9.6	8.2	42.6
Parallel		2.2	3	4.2	2.4	2.9	2.4	2.1	10.7
Drive Bus Voltage (VDC)		170	170	170	170	170	170	170	170
Detent Torque	oz-in (Nm)	2.5 (0.02)	4.0 (0.03)	7.0 (0.05)	8.8 (0.06)	18.0 (0.13)	27.0 (0.19)	41.7 (0.35)	81.0 (0.57)
Bearings Information									
Thrust load	lb (kg)	13 (5.9)	13 (5.9)	13 (5.9)	180 (81.6)	180 (81.6)	180 (81.6)	400 (182)	400 (182)
Radial load	lb (kg)	20 (9.1)	20 (9.1)	20 (9.1)	35 (15.9)	35 (15.9)	35 (15.9)	140 (63.6)	140 (63.6)
End play *(Reversing load equal to 1 lb)*	in (mm)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)
Radial play *(Per 0.5 lb load)*	in (mm)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)	0.0008 (0.02)
Motor Weight *(Motor+Cable+Connector)*	lb (kg)	1 (0.5)	1.5 (0.7)	2.5 (1.1)	3.2 (1.5)	5.3 (2.4)	7.6 (3.5)	18.2 (8.3)	18.2 (8.3)
Certifications	UL Rec.	Pending	Pending	Pending	Yes	Yes	Yes	Yes	Yes
	CE (LVD)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CE (LVD & EMC)*	No	No	No	*	*	*	*	*
Speed/Torque Curves		------ Refer to page 15 ------			------ Refer to page 15 ------			-- Refer to page 15 ------	
Dimensions		------ Refer to page 33 ------			------ Refer to page 34 ------			-- Refer to page 34 ------	

*EMC is a system compliance. To comply with EMC and low-noise (C15PR22/EN55022 Class B or FCC Class B emissions) standards, the following items are required:

- ZETA4-240, ZETA8, or ZETA12 Drive
- CE(LVD) motor for LVD. Compumotor recommends a terminal board (NPS) motor construction for easier EMC installation
- C10 motor accessory (LVD/EMC cable kit)
- ZETA EMC Kit

**Values shown in speed-torque curves

***Small signal values

Motor Specifications Parameters		Size 34 T Series (170 VDC winding)			Size 42 T Series (170 VDC winding)			Size 34 R Series (340 VDC winding)			Size 42 R Series (340 VDC winding)		
		TS31B	**TS32B**	**TS33B**	**TS41B**	**TS42B**	**TS43B**	**RS31C**	**RS32C**	**RS33C**	**RS42C**	**RE42C**	**RS43C**
Static Torque**	oz-in	455	647	1525	1332	2515	3479	171	292	532	1,266	1,959	1,671
	(N-m)	(3.19)	(4.53)	(10.68)	(9.32)	(17.61)	(24.35)	(1.21)	(2.06)	(3.76)	(8.94)	(13.8)	(11.8)
Rotor Inertia	oz-in^2	7.80	14.67	21.89	30.22	59.68	88.51	3.20	6.56	9.65	61.76	61.76	92.64
	(kg-cm^2)	(1.43)	(2.68)	(4.01)	(5.53)	(10.92)	(16.20)	(0.59)	(1.20)	(1.77)	(11.30)	(11.30)	(16.95)
Drive Current (Apk)(Arms)**													
Series		3.3 (2.3)	3.1 (2.2)	5.6 (4.0)	6.4 (4.5)	6.7 (4.7)	6.9 (4.9)	2.2 (1.6)	2.8 (2.0)	3.5 (2.5)	3.2 (2.3)	3.4 (2.4)	4.0 (2.8)
Parallel		6.7 (4.7)	6.2 (4.4)	12.0 (8.5)	12.0 (8.5)	12.0 (8.5)	12.0 (8.5)	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)
Phase Inductance (mH)***													
Series		10.3	10.3	13.6	15.8	22.0	30.7	17.4	26.2	23.3	65.4	55.6	42.9
Parallel		2.6	2.6	3.4	3.9	5.5	7.7	4.4	6.6	5.8	16.4	13.9	10.7
Drive Bus Voltage (VDC)		170	170	170	170	170	170	340	340	340	340	340	340
Detent Torque													
oz-in		18	36	54	42	84	106	8.8	18.0	27.0	50.0	81.0	71.0
(Nm)		(0.13)	(0.25)	(0.38)	(0.30)	(0.59)	(0.75)	0.062	0.130	0.190	(0.350)	(0.570)	(0.500)
Bearings Information													
Thrust load	lb	305	305	305	404	404	404	180	180	180	400	400	400
	(kg)	(139)	(139)	(139)	(184)	(184)	(184)	(81.6)	(81.6)	(81.6)	(182)	(182)	(182)
Radial load	lb	65	65	110	125	110	110	35	35	35	140	140	140
	(kg)	(30)	(30)	(50)	(57)	(50)	(50)	(15.9)	(15.9)	(15.9)	(63.6)	(63.6)	(63.6)
End play *(Reversing load equal to 1 lb)*	in	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(mm)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Radial play *(Per 0.5 lb load)*	in	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008
	(mm)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Motor Weight *(Motor+Cable+Connector)*	lb	5.0	8.4	11.9	11.0	18.4	25.7	3.2	5.3	7.6	18.2	18.2	25.7
	(kg)	(2.3)	(3.8)	(5.4)	(5.0)	(8.4)	(11.7)	(1.5)	(2.4)	(3.5)	(8.3)	(8.3)	(11.7)
Certifications	UL Rec.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CE (LVD)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CE (LVD & EMC)*	*	*	*	*	*	*	*	*	*	*	*	*
Speed/Torque Curves		------ Refer to page 15 ------			------ Refer to page 15 ------			------ Refer to page 16 ------			------ Refer to page 16 ------		
Dimensions		------ Refer to page 34 ------			------ Refer to page 35 ------			------ Refer to page 34 ------			------ Refer to page 34 ------		

*EMC is a system compliance. To comply with EMC and low-noise (C15PR22/EN55022 Class B or FCC Class B emissions) standards, the following items are required:

- ZETA4-240, ZETA8, or ZETA12 Drive
- CE(LVD) motor for LVD. Compumotor recommends a terminal board (NPS) motor construction for easier EMC installation
- C10 motor accessory (LVD/EMC cable kit)
- ZETA EMC Kit

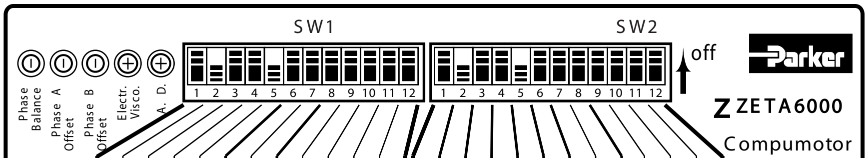
**Values shown in speed-torque curves

***Small signal values

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

- Device address is set to zero (if daisy-chaining you can automatically establish with the ADDR command).
- Serial communication method is RS-232C.

DIP Switch Settings



Current (amps pk) — SW1

Z-240	Z-8	Z-12	1	2	3	4	5
0.14	0.12	0.12	off	off	off	off	off
0.26	0.26	0.39	off	off	off	off	on
0.39	0.52	0.77	off	off	off	on	off
0.51	0.77	1.16	off	off	off	on	on
0.64	1.03	1.55	off	off	on	off	off
0.76	1.29	1.94	off	off	on	off	on
0.89	1.55	2.32	off	off	on	on	off
1.01	1.81	2.71	off	off	on	on	on
1.14	2.06	3.10	off	on	off	off	off
1.26	2.32	3.48	off	on	off	off	on
1.38	2.58	3.87	off	on	off	on	off
1.51	2.84	4.26	off	on	off	on	on
1.63	3.10	4.65	off	on	on	off	off
1.76	3.35	5.03	off	on	on	off	on
1.88	3.61	5.42	off	on	on	on	off
2.01	3.87	5.81	off	on	on	on	on
2.14	4.13	6.19	on	off	off	off	off
2.26	4.39	6.58	on	off	off	off	on
2.38	4.65	6.97	on	off	off	on	off
2.51	4.90	7.35	on	off	off	on	on
2.63	5.16	7.74	on	off	on	off	off
2.76	5.42	8.13	on	off	on	off	on
2.88	5.68	8.52	on	off	on	on	off
3.01	5.94	8.90	on	off	on	on	on
3.13	6.19	9.29	on	on	off	off	off
3.26	6.45	9.68	on	on	off	off	on
3.38	6.71	10.06	on	on	off	on	off
3.50	6.97	10.45	on	on	off	on	on
3.63	7.23	10.84	on	on	on	off	off
3.75	7.48	11.23	on	on	on	off	on
3.88	7.74	11.61	on	on	on	on	off
4.00	8.00	12.00	on	on	on	on	on

AUTOBAUD

	6	7
enabled	on	off
default Ð disabled	off	off

ADDRESS

TIP: The ADDR command allows you to automatically establish addresses for multiple units in a chain or multidrop (ADDR address overrides the DIP switch setting)

	8	9	10	11	12
default Ð 0	off	off	off	off	off
1	off	off	off	off	on
2	off	off	off	on	off
3	off	off	off	on	on
4	off	off	on	off	off
5	off	off	on	off	on
6	off	off	on	on	off
7	off	off	on	on	on
(Binary Weighted)					
31	on	on	on	on	on

LED functions:

POWER	120VAC power is applied.
STEP	Flashes green with each step pulse.
OVER TEMP	Max. drive temp limit exceeded.
MOTOR FAULT	Short circuit in motor or cable, or INTERLOCK jumper is disconnected or too long.

Static Torque — SW2

9	10	11	12	Torque Range N-m	Torque Range oz-in
off	off	off	off	0.26Ð 0.72	36Ð100
off	off	off	on	0.73Ð 1.41	101Ð200
off	off	on	off	1.42Ð 2.33	201Ð330
off	off	on	on	2.34Ð 3.47	331Ð492
off	on	off	off	1.48Ð 2.12	210Ð300
off	on	off	on	2.13Ð 3.60	301Ð510
off	on	on	off	3.61Ð 7.06	511Ð1000
off	on	on	on	7.07Ð14.83	1001Ð2100
on	off	off	off	3.18Ð 4.94	450Ð700
on	off	off	on	4.95Ð 7.77	700Ð1100
on	off	on	off	7.78Ð16.24	1101Ð2300
on	off	on	on	16.25Ð35.31	2301Ð5000
on	on	off	off	5.65Ð 8.12	800Ð1150
on	on	off	on	8.13Ð14.12	1151Ð2000
on	on	on	off	14.13Ð28.95	2001Ð4100
on	on	on	on	28.96Ð60.02	4101Ð8500

Inductance

7	8	Inductance Range (mH)
off	off	20.08 & greater
off	on	10.31Ð20.07
on	off	5.03Ð10.30
on	on	less than 5.02

System Inertia

6	
off	less than 20 kg-cm2
on	greater than 20 kg-cm2

Current-Loop Gain

5	
off	Standard
on	Reduced

Anti-Resonance Gain

4	
off	Standard (system inertia < 20 kg-cm2)
on	Reduced (system inertia > 20 kg-cm2)

Anti-Res. Phase

3	
off	Resonant Freq. < 80 Hz
on	Resonant Freq. > 80 Hz

Anti-Res. Disable

2	
off	Anti-res. Enabled
on	Anti-res. Disabled

Automatic Standby

1	
off	Full Current
on	50% Current Standby

Axis Name [redacted] **Motor Size** [redacted] **S** [redacted] **P**

WF Setting (DWAVEF) [redacted]

EV Setting (DELVIS) [redacted]

AD Setting [redacted]

DIP Switch Settings

OFF

ON

1 2 3 4 5 6 7 8 9 10 11 12 — 1 2 3 4 5 6 7 8 9 10 11 12

⚠ CAUTION

Do not set switches SW1-6 thru SW1-11 to ON at the same time. This invokes a factory test mode in which the ZETA6xxx executes a motion sequence upon power up.executes

Automatic Addressing:
If you are connecting multiple units, 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 or the 6000 Series Programmer's Guide.

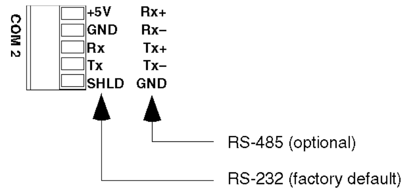
AutoBaud

The default baud rate os 9600. As an alternative, you can use this procedure to automatically match your terminal's speed of 1200, 2400, 4800, 9600 or 19200 baud.

1. Set switch 6 to on and switch 7 to off.
2. Connect the ZETA6xxx to the terminal.
3. Power up the terminal.
4. Cycle power to the ZETA6xxx and immediatly press the spacebar several times.
5. The ZETA6xxx 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 ZETA6xxx. This stores the baud rate in non-volatile memory.

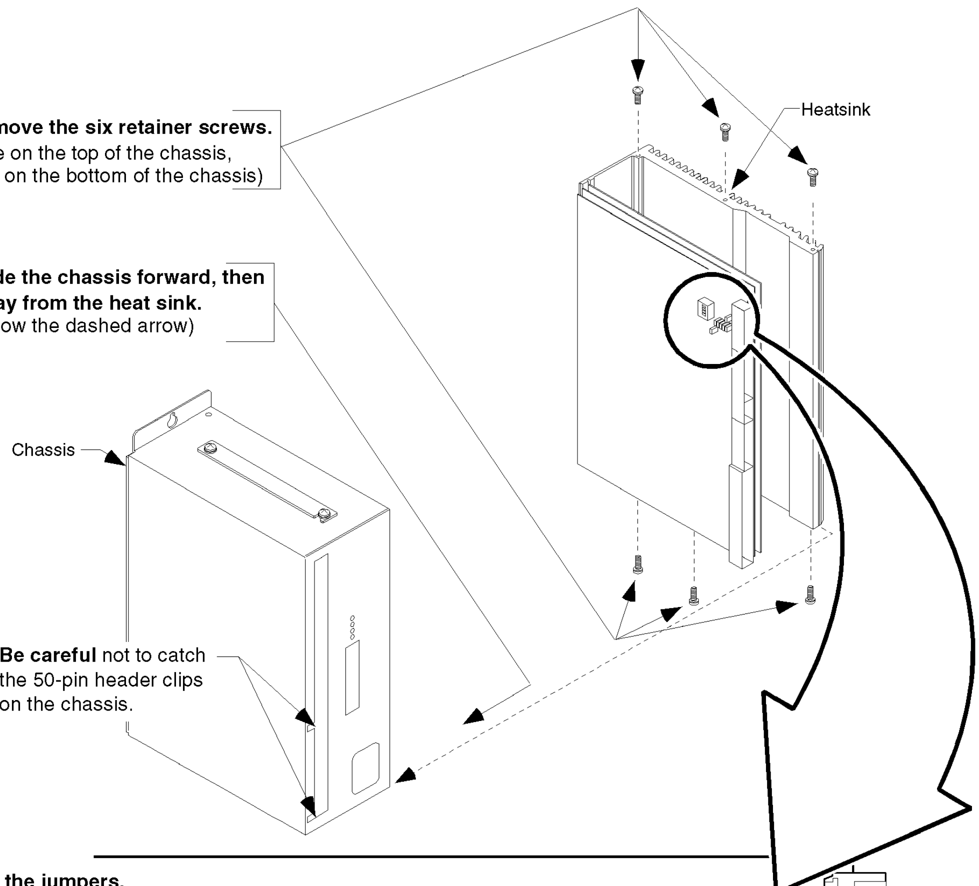
NOTE: Autobaud works only on the ZETA6xxx's COM 1 serial port.

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



RS-232C Users

The ZETA6xxx's **COM 2** port is factory configured for RS-232C communication (use the left-hand pin descriptions). If you do not need to use RS-485 communication, you may ignore this section and proceed to the *Mounting* instructions.



① **Remove the six 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-232: Leave JU6 set to position 3 (factory default).

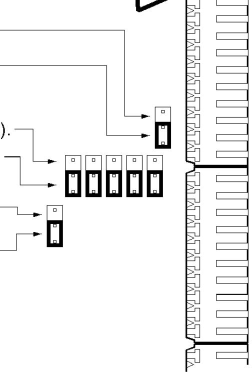
RS-485: Set jumper JU6 to position 1
(disables power-up messages, error messages, & echo).

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

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

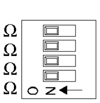
4-wire RS-485, set JU7 to position 3 (factory default).
(4-wire is full duplex: transmit and receive at the same time)

2-wire RS-485, set JU7 to position 1.
(2-wire is half duplex: transmit or receive at any time)



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 12 for resistor calculations and wiring instructions.

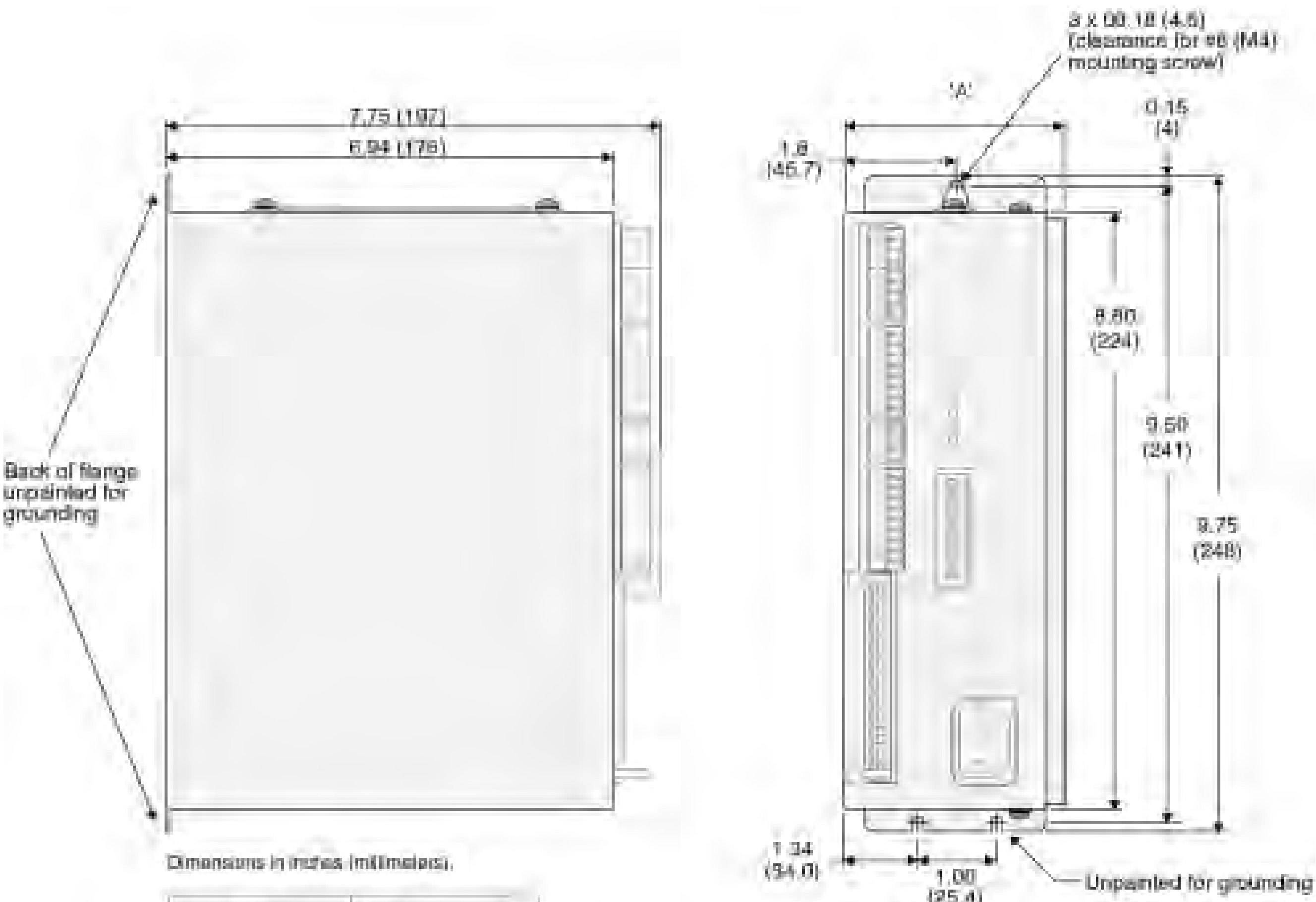
⑤ **Reattach the chassis and replace the six retainer screws.**

Mounting the ZETA6xxx

Before you mount the ZETA6xxx

Check the list below to make sure you have performed all the necessary configuration tasks that require accessing internal components (DIP switches, potentiometers, and jumpers). You may, however, be able to adjust DIP switches and pots after mounting, if you allow access to the top of the ZETA6xxx chassis.

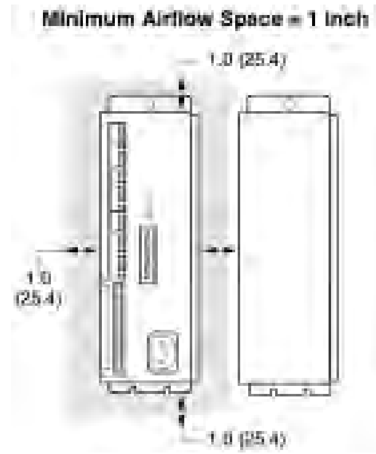
- **Select motor current (DIP switches)**. Set your motor current appropriately. See page 7 for current level DIP switch settings. If you ordered an O, R or T series motor, see pages 5 and 6 for the correct drive current rating for your particular motor.
- **Select device address (DIP switches)**. If you are not connecting multiple ZETA6xxx 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 7 for instructions.
- **Select serial communication method (jumpers & DIP switches)**. If you are using RS-232C to communicate with the ZETA6xxx, use the factory settings. If you need to change these settings (i.e., for RS-485), refer to page 8 for instructions.
- Be aware that if you exercise the motor matching procedures on page 30, you will need to access the potentiometers at the top of the ZETA6xxx chassis. (The motor matching procedures are placed after the Electrical Connections section of this manual because the process requires that you first understand how to connect the motor, serial communication, and AC power.)



Model	'A' Dimension
ZETA6104-240 ZETA6108	3.69 (93.7)
ZETA6112	4.69 (119.2)

Environmental Considerations

Temperature. Operate the ZETA6xxx in ambient temperatures between 32°F (0°C) and 113°F (45°C). Provide a minimum of 1 inch (25.4 mm) of unrestricted air-flow space around the ZETA6xxx chassis (see illustration). The ZETA6xxx will shut itself down if its internal sensor reaches 122°F (50°C).



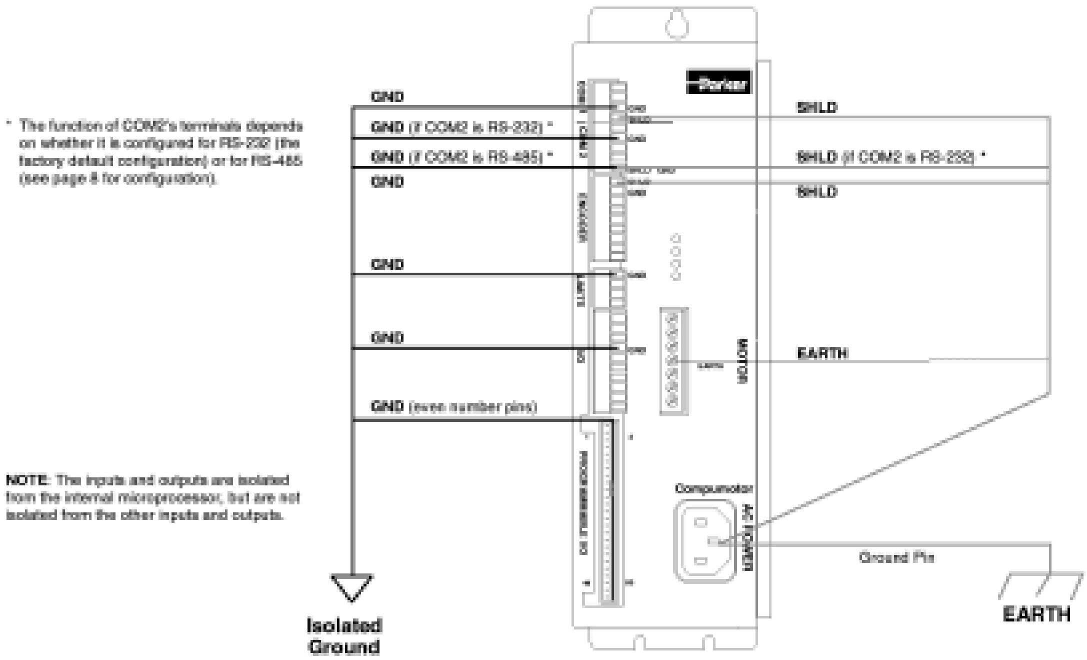
Humidity. Keep below 95%, non-condensing.

Airborne Contaminants, Liquids. Particulate contaminants, especially electrically conductive material, such as metal shavings and grinding dust, can damage the ZETA6xxx and the Zeta motor. Do not allow liquids or fluids to come in contact with the ZETA6xxx or its cables.

Electrical Connections

To install the ZETA6xxx so that it is LVD compliant, refer also to the supplemental instructions in Appendix C. Appendix D provides guidelines on how to install the ZETA6xxx in a manner most likely to minimize the ZETA6xxx's emissions and to maximize the ZETA6xxx's immunity to externally generated electromagnetic interference.

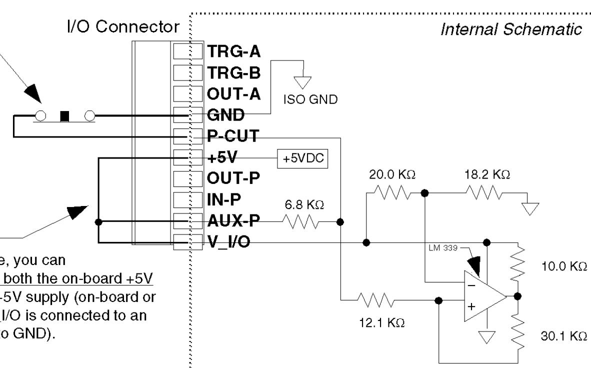
Grounding System



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

P-CUT connected to GND **(normally-closed switch).** If this connection is opened, motion is killed and the program in progress is terminated.

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 and V_I/O **(sourcing current).** Provides +5V power to the P-CUT pull-up resistor. As an alternative, you can connect AUX-P to an external supply of up to +24V (but do not use both the on-board +5V terminal and an external 5-24V supply). If V_I/O is connected to a +5V supply (on-board or external), AUX-P can be connected to a supply of up to +24V. If V_I/O is connected to an external +24V supply, AUX-P must also be connected to +24V (or to GND).

Switching levels depend on the voltage applied to V_I/O:
LOW ≤ 1/3 of V_I/O voltage; HIGH ≥ 2/3 of V_I/O voltage

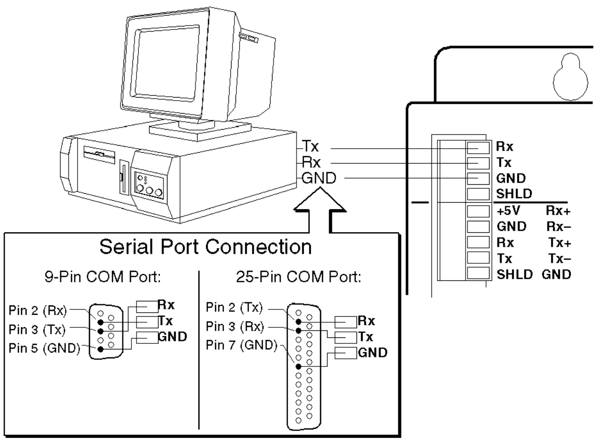
NOTE: AUX-P and V_I/O are also used by the HOM, NEG, POS & TRG inputs.

SINKING CURRENT: To make P-CUT (as well as HOM, NEG, POS & TRG) sink current, connect AUX-P to GND.

CAUTION: You must select either the on-board **+5V** terminal or an external power supply to power the **AUX-P** pull-up resistor (for the **P-CUT**, **HOM**, **NEG**, **POS**, **TRG-A**, and **TRG-B** inputs). Connecting **AUX-P** to the **+5V** terminal and an external supply will **damage the ZETA6xxx**. (The same rule applies to the **IN-P** and **OUT-P** terminals, see page 20.)

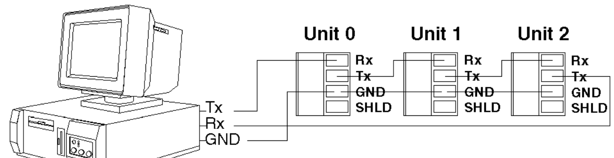
Serial Communications

RS-232C Connections

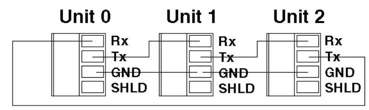


NOTE: Maximum RS-232C cable length is 50 feet (15.25 meters)

RS-232C Daisy-Chain Connections*



Daisy Chain to a Computer or Terminal



Stand-Alone Daisy Chain

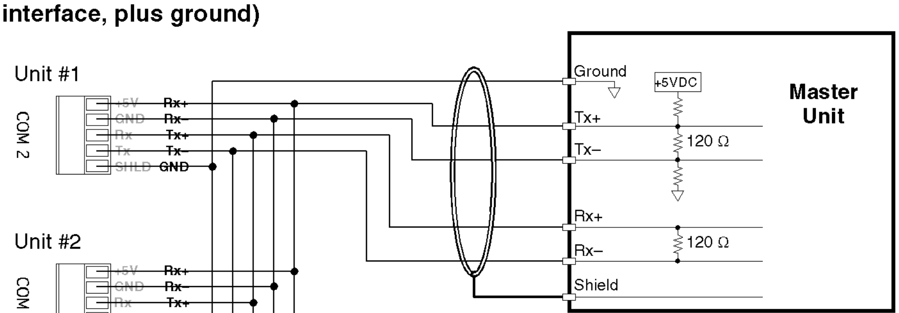
* Be sure to set unique devices addresses for each unit. To set the address, use the DIP switch (see page 7), or use the `ADDR` command (see *6000 Series Programmer's Guide*).

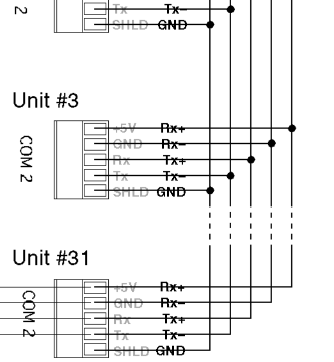
RS-485 Connections (4-wire interface, plus ground)

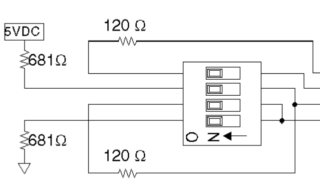
RS-485 Configuration

Before you can use RS-485 communication, you must re-configure the COM 2 port by setting internal jumpers JU1-JU6 to position 1. 4-wire is default (to use 2-wire, set JU7 to position 1).

Refer to page 8 for instructions.



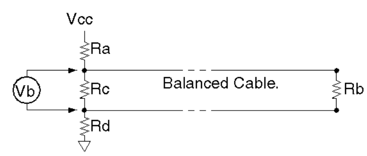




DIP switch selects internal resistor values (ON selects the resistor). *Use these resistors only for the last unit (or for a single unit).*

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

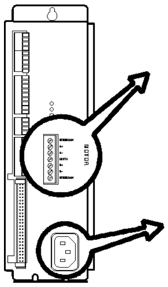
Since the equivalent resistance is close (within 10%) to the characteristic impedance of the cable (Zo), no further adjustment of resistor values is required.

* 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 (O, R and T motors only)

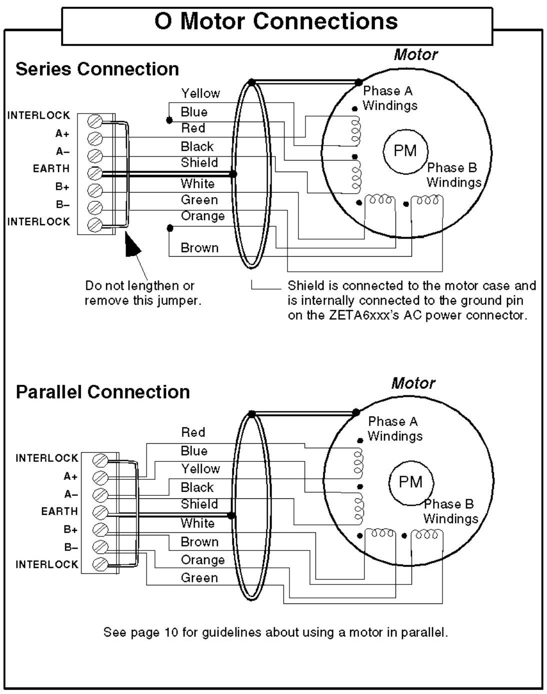


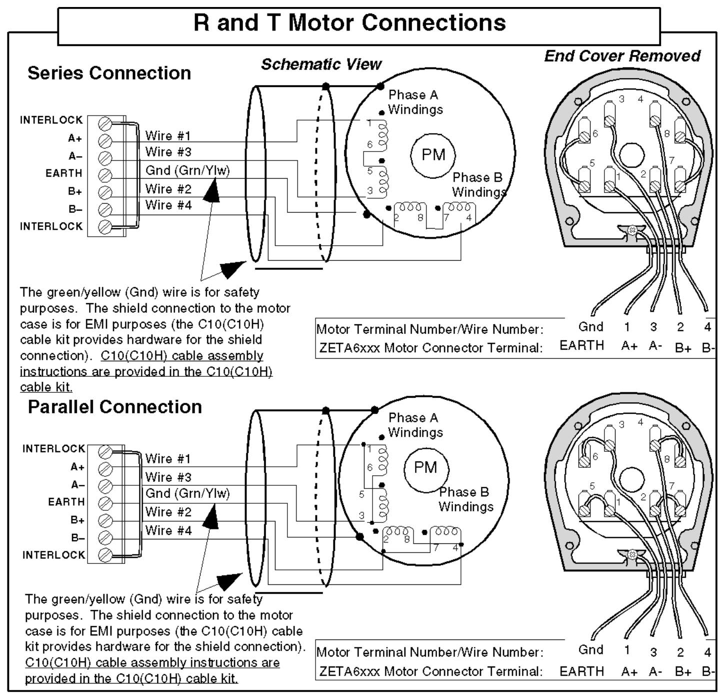
Motor Connector

WARNING: Remove AC power before connecting or disconnecting the motor. Lethal voltages are present on the screw terminals

OS, RS and TS Motors
Specifications – see page 5.
Speed/Torque curves – see pages 15-16.
Considerations for series & parallel wiring – see pages 15-16.
Current settings – see page 7. Dimensions – see pages 33-35.
Cable extension – see table on following page.

Non-Compumotor Motors
If you intend to use a non-Compumotor motor, refer to Appendix B for connection instructions and current selection.





Auto Current Standy Mode: Reduces motor current by 50% when step pulses from the ZETA6xxx have stopped for one second (**CAUTION**: torque is also reduced). Full current is restored upon the first step pulse. See page 11 for details.

Extending OS and RS Motor Cables

-L10, -S10 & -P10 motors are shipped with 10 ft (3 m) cables;
-FLY motor is shipped with 1 ft (0.3 m) flying leads.
-NPS motor does not include cable/leads; 10-foot: use 18 AWG (0.75 mm^2) wire for current levels below 10 amps and 16 AWG (1.5 $mm^{2)}$ for up to 12 amps..

LVD COMPLIANCE: Maximum DC resistance between the ZETA6xxx's "EARTH" terminal ("protective conductor terminal") and motor body must not exceed 0.1Ω. (This criteria must be taken into consideration when sizing cross-section (gage) for extended cable lengths.) See Appendix C for more LVD information.

NON-LVD: Maximum extended length is 200 ft (61 m), but cables longer than 50 feet (15 m) may degrade performance. See table below for guidelines:

Motor Type	Max. Current (amps)	< 100 ft (30 m) AWG	< 100 ft (30 m) mm^2	100-200 ft (30-60 m) AWG	100-200 ft (30-60 m) mm^2
OS2HB(S)	1.51	22	0.34	20	0.50
OS2HB(P)	3.01	22	0.34	20	0.50
OS21B(S)	1.88	22	0.34	20	0.50
OS21B(P)	3.75	20	0.50	18	0.75
OS22B(S)	2.14	22	0.34	20	0.50
OS22B(P)	4.00	20	0.50	18	0.75
RS31B(S)	2.32	20	0.50	18	0.75
RS31B(P)	4.65	18	0.75	16	1.50
RS32B(S)	3.10	20	0.50	18	0.75
RS32B(P)	5.81	18	0.75	14	2.50
RS33B(S)	3.48	18	0.75	16	1.50
RS33B(P)	6.97	16	1.50	14	2.50
RS42B(S)	6.19	16	1.50	14	2.50
RS42B(P)	12.00	14	2.50	12	4.00
RE42B(S)	3.48	18	0.75	16	1.50
RE42B(P)	7.35	16	1.50	14	2.50
TS31B(S)	3.48	18	0.75	16	1.50
TS31B(P)	6.97	16	1.50	14	2.50
TS32B(S)	3.10	20	0.50	18	0.75
TS32B(P)	6.19	16	1.50	14	2.50
TS33B(S)	5.81	18	0.75	14	2.50
TS33B(P)	12.00	14	2.50	12	4.00
TS41B(S)	6.58	16	1.50	14	2.50
TS41B(P)	12.00	14	2.50	12	4.00
TS42B(S)	6.97	16	1.50	14	2.50
TS42B(P)	12.00	14	2.50	12	4.00
TS43B(S)	6.97	16	1.50	14	2.50
TS43B(P)	12.00	14	2.50	12	4.00
RS31C(S)	2.26	20	0.50	18	0.75
RS31C(P)	4.00	18	0.75	16	1.50
RS32C(S)	2.88	20	0.50	18	0.75
RS32C(P)	4.00	18	0.75	16	1.50
RS33C(S)	3.50	18	0.75	16	1.50
RS33C(P)	4.00	18	0.75	16	1.50
RS42C(S)	3.26	20	0.50	18	0.75
RS42C(P)	4.00	18	0.75	16	1.50
RE42C(S)	3.38	20	0.50	18	0.75
RE42C(P)	4.00	18	0.75	16	1.50
RS43C(S)	4.00	18	0.75	16	1.50
RS43C(P)	4.00	18	0.75	16	1.50

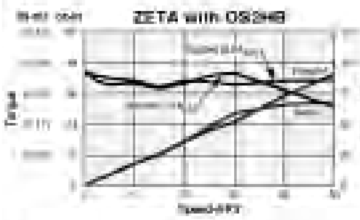
(S) = Series Configuration (P) = Parallel Configuration

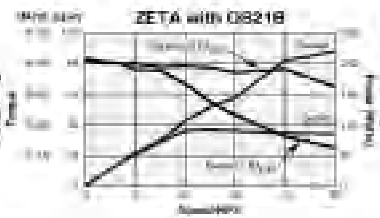
NOTE: Rated current in wire sizes shown may result in a maximum temperature rise of 18°F (10°C) above ambient.

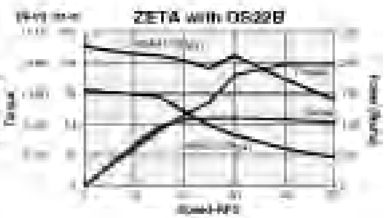
CAUTION: Cables longer than 50 feet (15m) may degrade performance.

Selecting Series or Parallel Motor Wiring

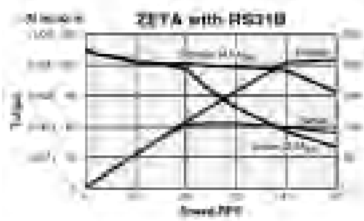
O Series Motors (170 VDC winding)
Size 23 Frame

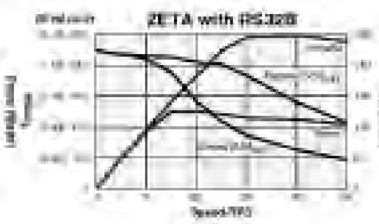


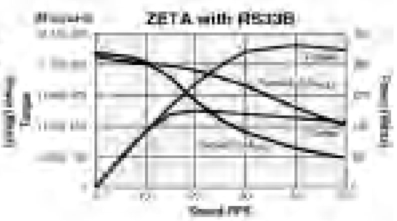




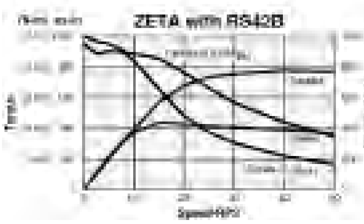
R Series Motors (170 VDC winding)
Size 34 Frame

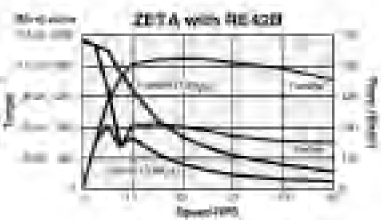




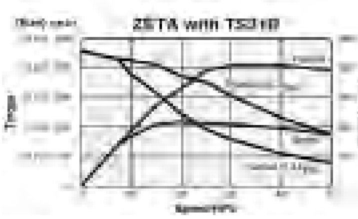


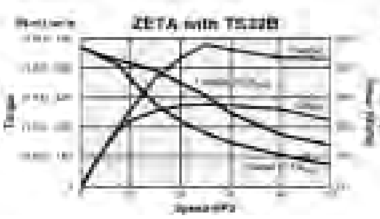
R Series Motors (170 VDC winding)
Size 42 Frame

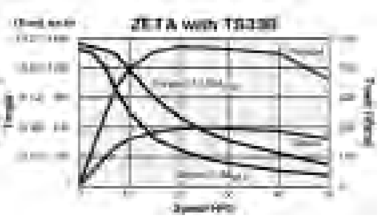




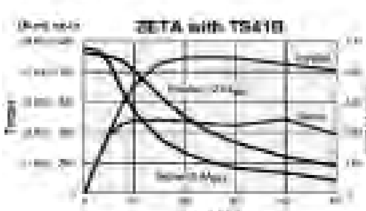
T Series Motors (170 VDC winding)
Size 34 Frame

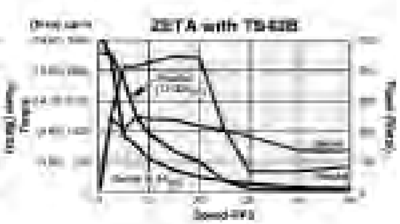




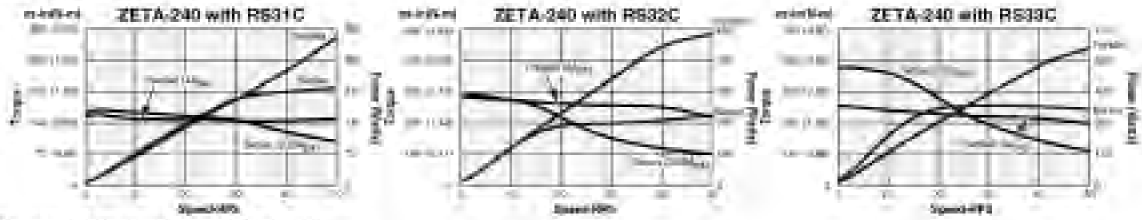


T Series Motors (170 VDC winding)
Size 42 Frame

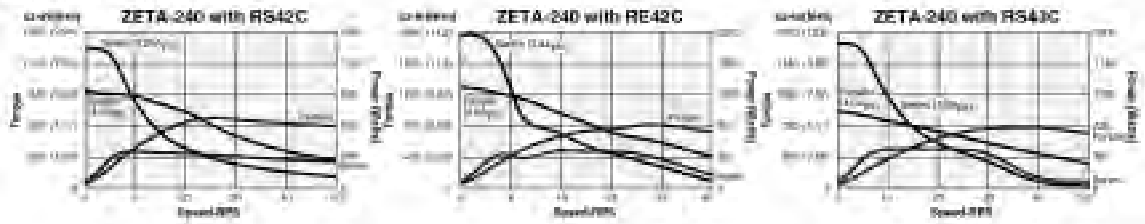




R Series Motors (340 winding)
Size 34 Frame



R Series Motors (340 winding)
Size 42 Frame



Drive's Peak Current Levels	
ZETA4, ZETA6104 ZETA4-240, ZETA6104-240	0-4Apk
ZETA6, ZETA6108	0-8Apk
ZETA12, ZETA6112	0-12Apk

Parallel connected motors are limited to 50% duty cycle when operated above 5rps. For greater than 50% duty cycle above 5rps you must connect the motor in series. Fan cooling the motor will increase duty cycles above 5rps.

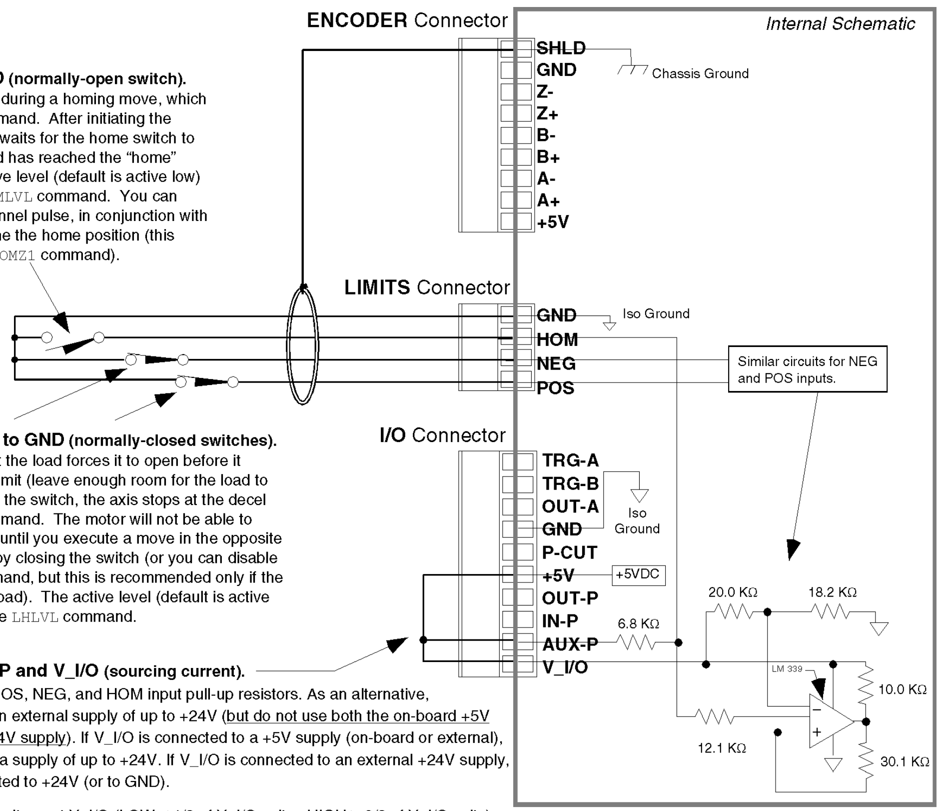
Viscous damper is not required to achieve speed-torque curves.

Note: ±10% torque variance due to motor tolerances.

End-of-Travel and Home Limit Inputs

NOTES
• **CAUTION**: Use <u>either</u> the on-board **+5V** terminal <u>or</u> an external power supply to power the **AUX-P** pull-up resistor (using both will damage the ZETA6xxx). • 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 Operation 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. You can also use an encoder's Z channel pulse, in conjunction with the home switch, to determine the home position (this feature is enabled with the `HOMZ1` 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 <u>and</u> clear the limit by closing the switch (or you can disable the limits with the `LHØ` 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 and V_I/O (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 supply of up to +24V (<u>but do not use both the on-board +5V terminal and an external 5-24V supply</u>). If V_I/O is connected to a +5V supply (on-board or external), AUX-P can be connected to a supply of up to +24V. If V_I/O is connected to an external +24V supply, AUX-P must also be connected to +24V (or to GND).

Switching levels depend on voltage at V_I/O (LOW ≤ 1/3 of V_I/O volts; HIGH ≥ 2/3 of V_I/O volts).

NOTE: AUX-P and V_I/O are also used by the P-CUT & TRG inputs.

SINKING CURRENT: To make the limit inputs (as well as P-CUT & TRG) sink current, connect AUX-P to GND.

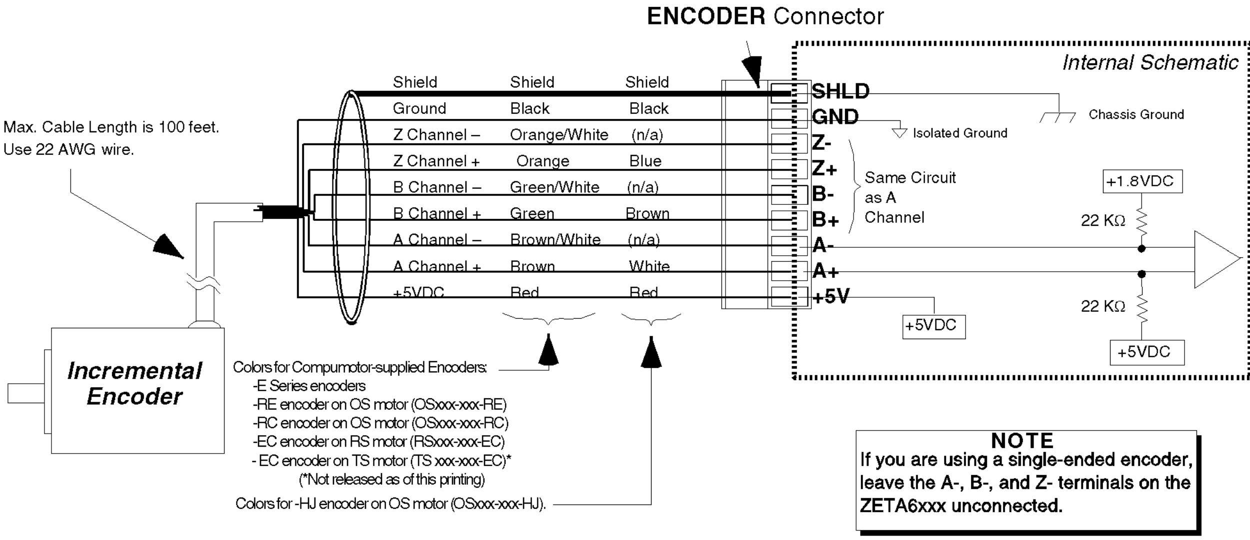
PIN OUTS & SPECIFICATIONS *(4-pin LIMITS Connector)*

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
• Powered by voltage applied to V_I/O terminal (switching levels: Low ≤1/3 of V_I/O voltage, High ≥2/3 of V_I/O voltage). V_I/O can handle 5-24V with max. current of 100mA. Internal 6.8 KΩ pull-ups to AUX-P terminal—connect AUX-P to power source (+5V terminal or an external 5-24V supply) to source current, or connect AUX-P to GND to sink current; AUX-P can handle 0-24V with max. current of 50mA. Voltage range for these inputs is 0-24V. • Active level for HOM is set with `HOMLVL` (default is active low, requires n.o. switch). • Active level for POS & NEG is set with `LHLVL` (default is active low, requires n.c. switch).

Encoder

CONNECTIONS & INTERNAL SCHEMATICS



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

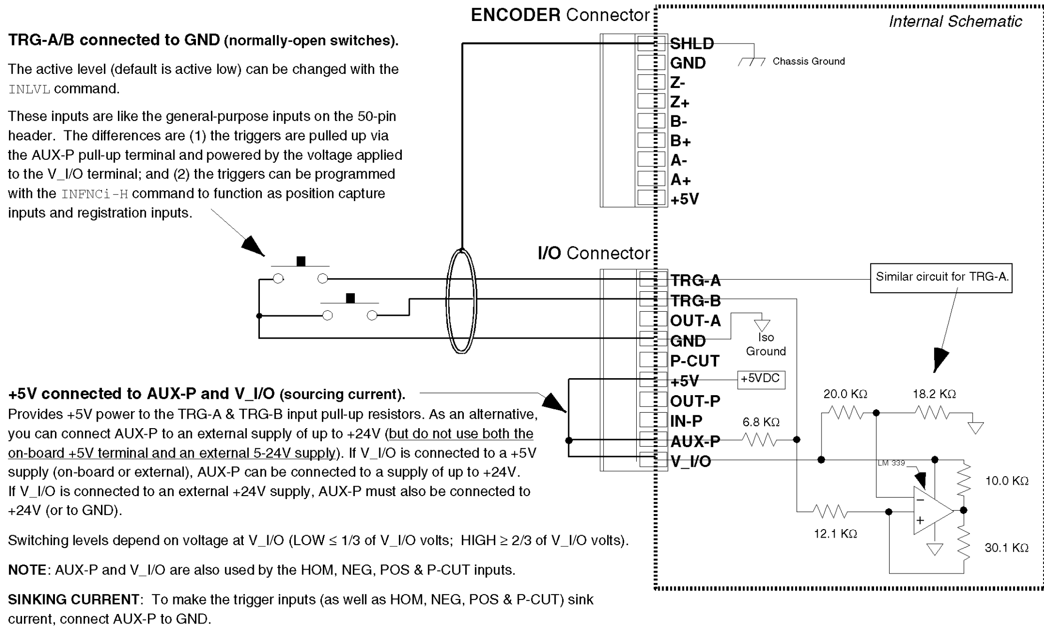
Differential comparator accepts two-phase quadrature incremental encoders with differential (recommended) or single-ended outputs. Max. frequency is 1.6 MHz. Minimum time between transitions is 625 ns.

TTL-compatible voltage levels: Low ≤ 0.4V, High ≥ 2.4V. Maximum input voltage is 5VDC.

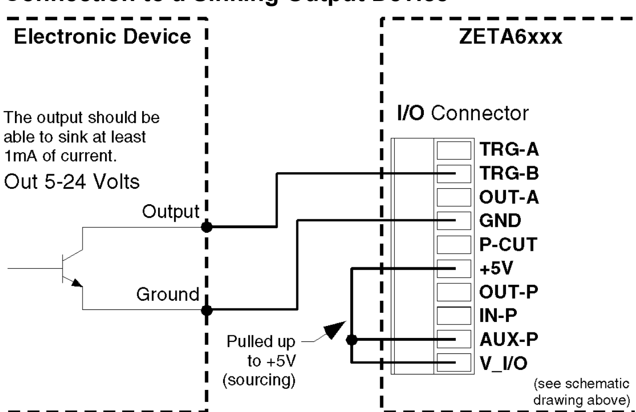
Requirements for Non-Compumotor Encoders

- 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 ZETA6xxx'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 ZETA6xxx's position maintenance capability.

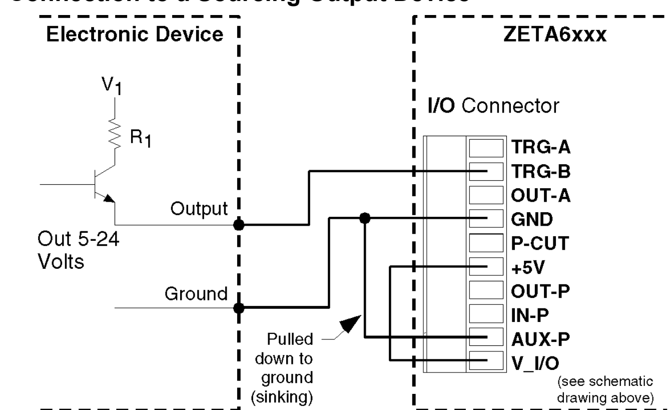
Trigger Inputs



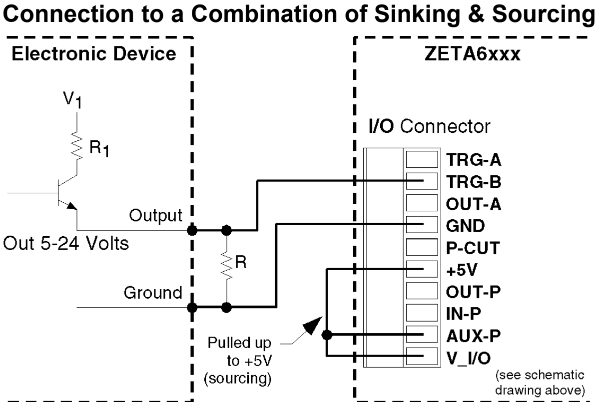
Connection to a Sinking Output Device



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 **+5-24V** to accommodate sinking output devices. Then for each individual input connected to a sourcing output, wire an external resistor between the ZETA6xxx'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*).

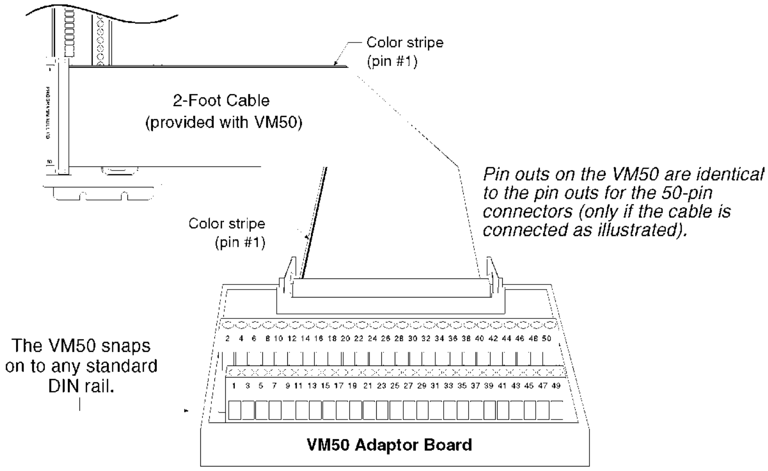
Connecting to a sourcing output? Set the trigger input's active level to high with the `INLVL` command (`1` = active high).

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.

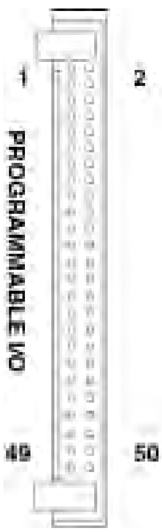
For details on setting the active level and checking the input status refer to the `INLVL` and `TIN` command descriptions in the *6000 Series Software Reference*.

General-Purpose Programmable Inputs & Outputs

VM50 ADAPTOR — for screw-terminal connections



PIN OUTS & SPECIFICATIONS

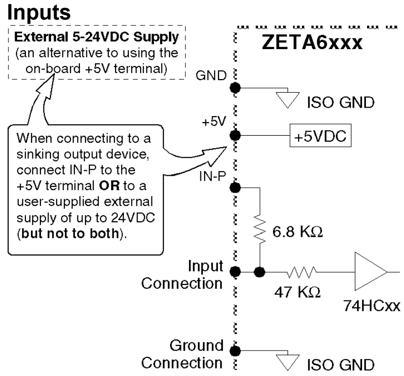


50-pin plug is compatible with OPTO-22™ signal conditioning equipment.

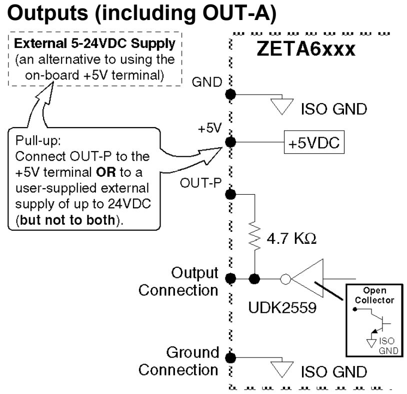
Pin	Function
1	Input #16 (MSB of inputs)
3	Input #15
5	Input #14
7	Input #13
9	Input #12
11	Input #11
13	Input #10
15	Input #9
17	Output #8 (MSB of outputs)
19	Output #7
21	Output #6
23	Output #5
25	Input #8
27	Input #7
29	Input #6
31	Input #5
33	Output #4
35	Output #3
37	Output #2
39	Output #1 (LSB 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 connect **IN-P** to an external 5-24VDC power supply (but not to both).

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

STATUS: Check with `TIN` or `INFNC`.

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 5-24VDC power supply (but not to both).

Outputs will sink up to 300mA or source up to 5mA at 5-24VDC.

STATUS: Check with `TOUT` or `OUTFNC`.

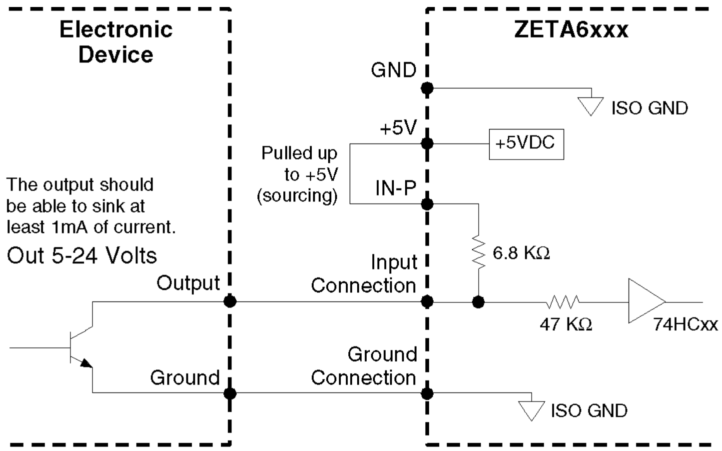
Active level: Default is active low, but can be changed to active high with the `OUTLVL` command.

NOTE: All even-numbered pins are connected to a common logic ground (DC ground) — see drawing on page 11.
LSB = least significant bit; MSB = most significant bit

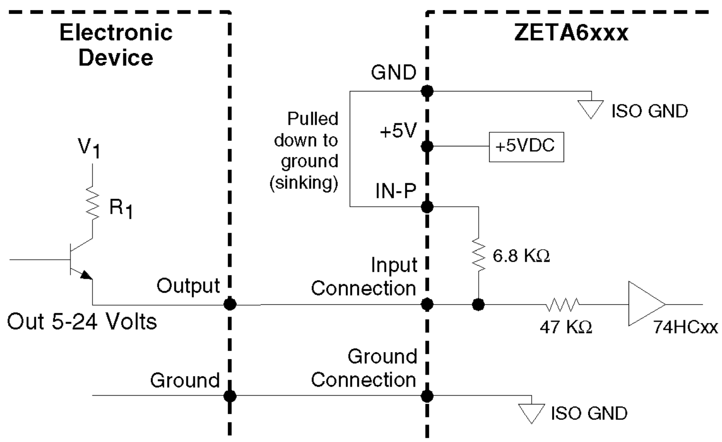
> **CAUTION**: You must select either the on-board **+5V** terminal or an external power supply to power the **IN-P** and **OUT-P** pull-up resistors. Connecting **IN-P** or **OUT-P** to the **+5V** terminal and an external supply will **damage the ZETA6xxx**. *(The same rule applies to the AUX-P terminal.)*

INPUT CONNECTIONS — Connecting to electronic devices such as PLCs

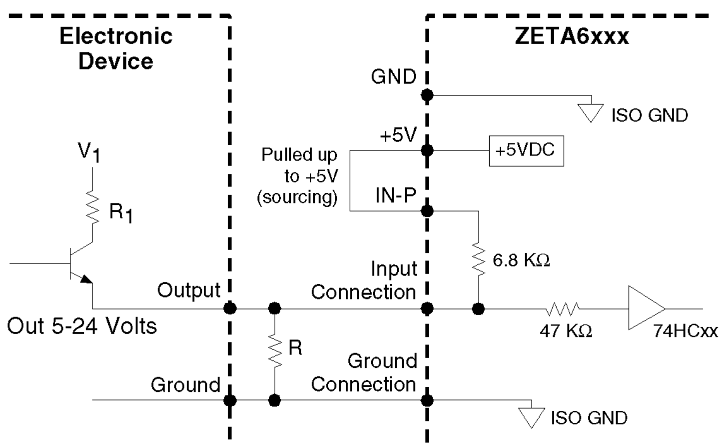
Connection to a Sinking Output Device



Connection to a Sourcing Output Device



Connection to a Combination of Sinking & Sourcing Outputs



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

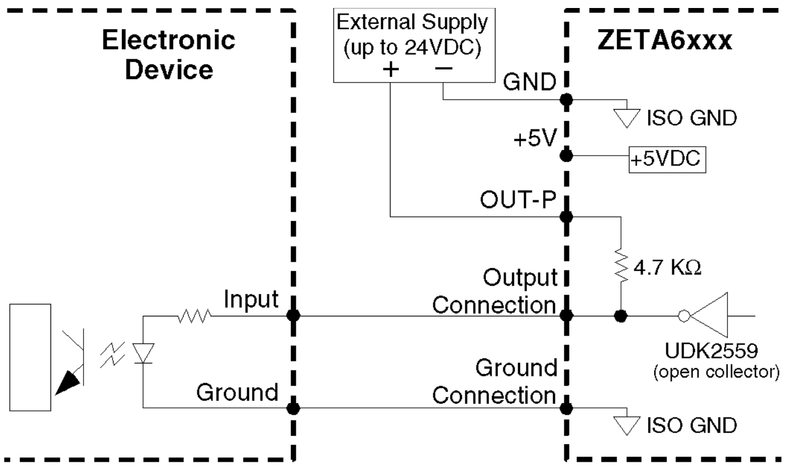
Note: The value of R may vary depending on the value of R_1 and V_1.

> **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*.

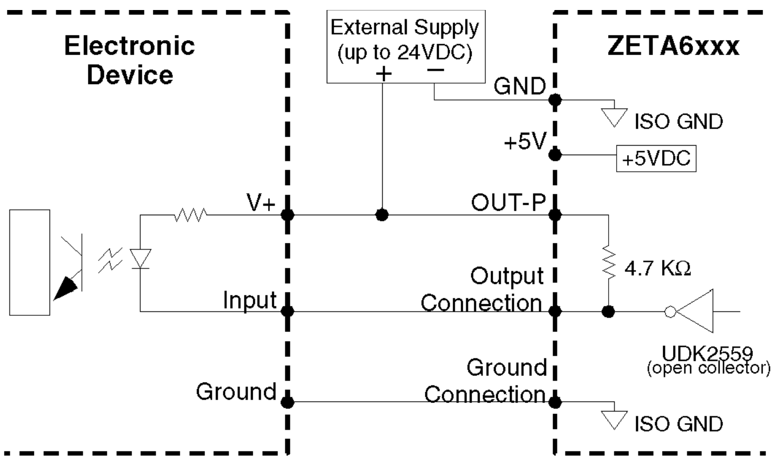
NOTE: If you will be connecting to a combination of sourcing and sinking outputs, connect **IN-P** to **+5V** (or to an external 5-24VDC supply) to accommodate sinking output devices. Then for each individual input connected to a sourcing output, wire an external resistor between the ZETA6xxx's programmable 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 <u>(includes OUT-A)</u> — for electronic devices such as PLCs

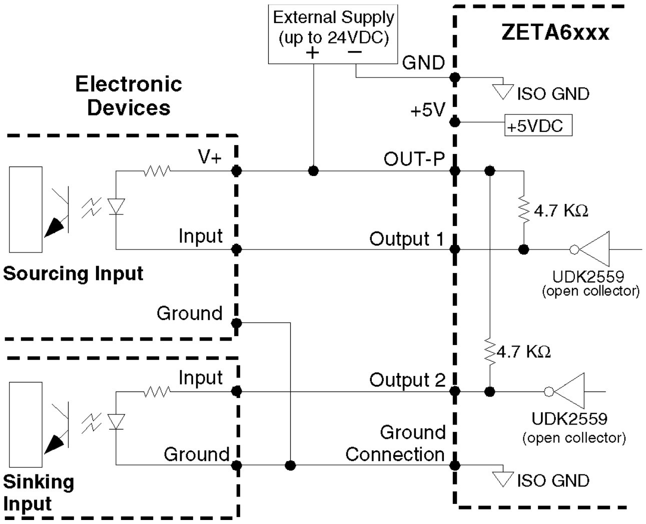
Connection to a Sinking Input (active high)



Connection to a Sourcing Input (active low)

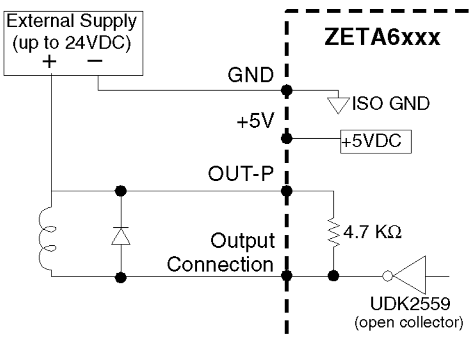


Connection to a Combination of Sinking & Sourcing Inputs



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 ZETA6xxx 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).

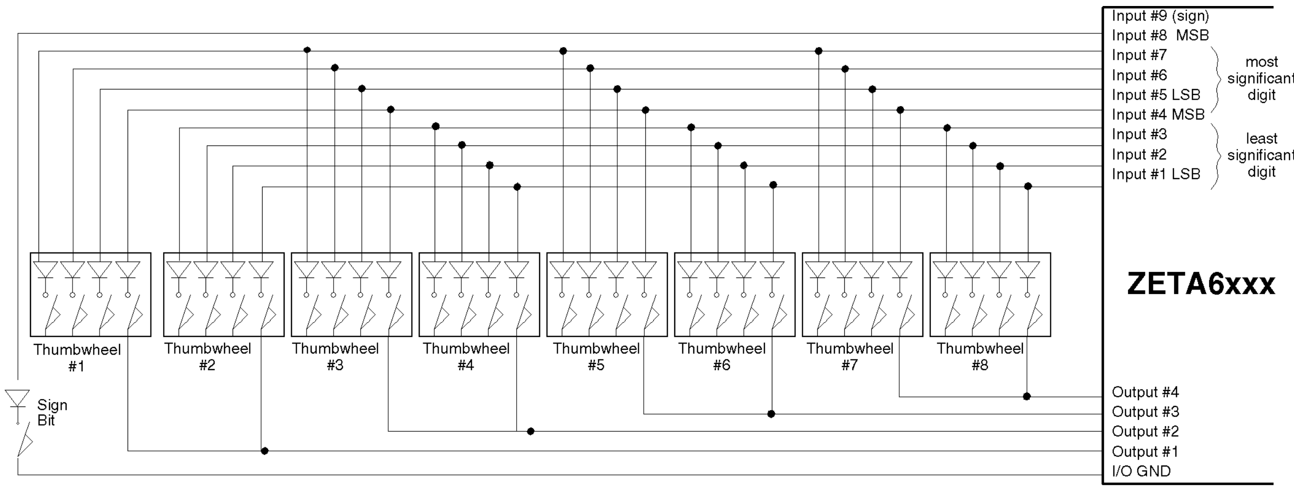
Connecting to an active-low sourcing input? Set the output's active level to low with the OUTLVL command (0 = active low).

Thus, when the ZETA6xxx'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.

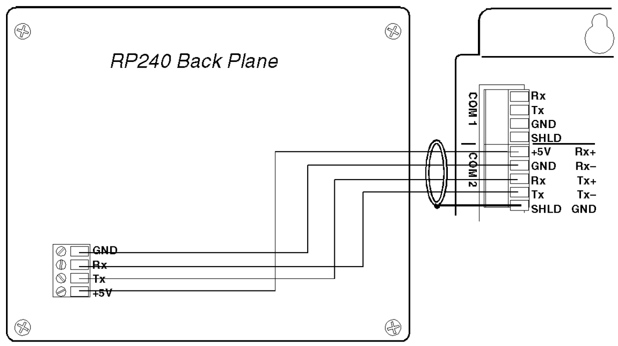
Details on setting the active level and checking the output status are provided in the 6000 Series Programmer's Guide. Refer also to the OUTLVL and TOUT command descriptions in the 6000 Series Software Reference.

THUMBWHEEL CONNECTIONS — for entering BCD data

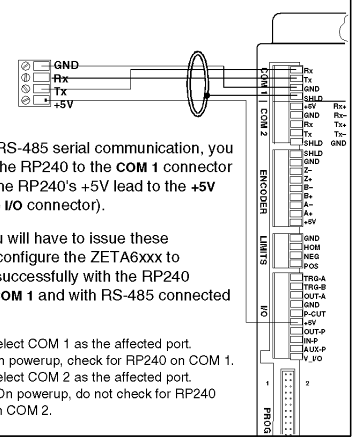
Connection to your own Thumbwheel Module



RP240 Remote Operator Panel



RP240 Connections when using RS-485



If you will use 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).

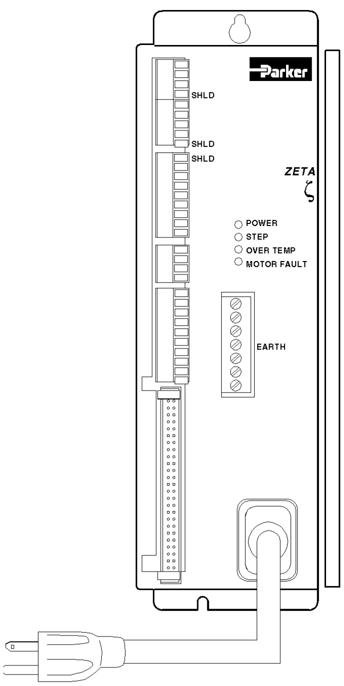
In addition, you will have to issue these commands to configure the ZETA6xxx to communicate successfully with the RP240 connected to **COM 1** and with RS-485 connected to **COM 2**.

`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

Peak Power Ratings

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



Power Cable

WARNING: The motor case (via the EARTH terminal) and the ZETA6xxx's SHLD terminals are grounded through the AC power connector ground pin. You must provide a proper AC power ground for safety purposes.

Power Input Specification
95-132VAC, 50/60Hz, single-phase
(ZETA6108, ZETA6112, ZETA6104-240(@ 120 VAC))
Peak Power requirements depend on the motor you use:

Motor Type	Current (Amps)	Volt-Amp (Rating (VA)
OS2HB(S) OS2HB(P)	1.51 3.01	199 466
OS21B(S) OS21B(P)	1.88 3.75	240 509
OS22B(S) OS22B(P)	2.14 4.00	262 542
RS31B(S) RS31B(P)	2.32 4.65	440 830
RS32B(S) RS32B(P)	3.10 5.81	570 1030
RS33B(S) RS33B(P)	3.48 6.97	630 1220
RS42B(S) RS42B(P)	6.19 12.00	1090 2080
RE42B(S) RE42B(P)	3.48 7.35	630 1290
TS31B(S) TS31B(P)	3.48 6.97	630 1220
TS32B(S) TS32B(P)	3.10 6.19	570 1090
TS33B(S) TS33B(P)	5.81 12.00	1030 2080
TS41B(S) TS41B(P)	6.58 12.00	1160 2080
TS42B(S) TS42B(P)	6.97 12.00	1220 2080
TS43B(S) TS43B(P)	6.97 12.00	1220 2080

Power Input Specification
95-264VAC, 50/60Hz, single-phase
(ZETA6104-240)

Motor Type	Current (Amps)	Volt-Amp (Rating (VA)
RS31C(S) RS31C(P)	2.26 4.00	611 1337
RS32C(S) RS32C(P)	2.88 4.00	649 1312
RS33C(S) RS33C(P)	3.50 4.00	822 1401
RS42C(S) RS42C(P)	3.26 4.00	758 1258
RE42C(S) RE42C(P)	3.38 4.00	962 1384
RS43C(S) RS43C(P)	4.00 4.00	1016 1526

(S): Series Configuration (P): Parallel Configuration

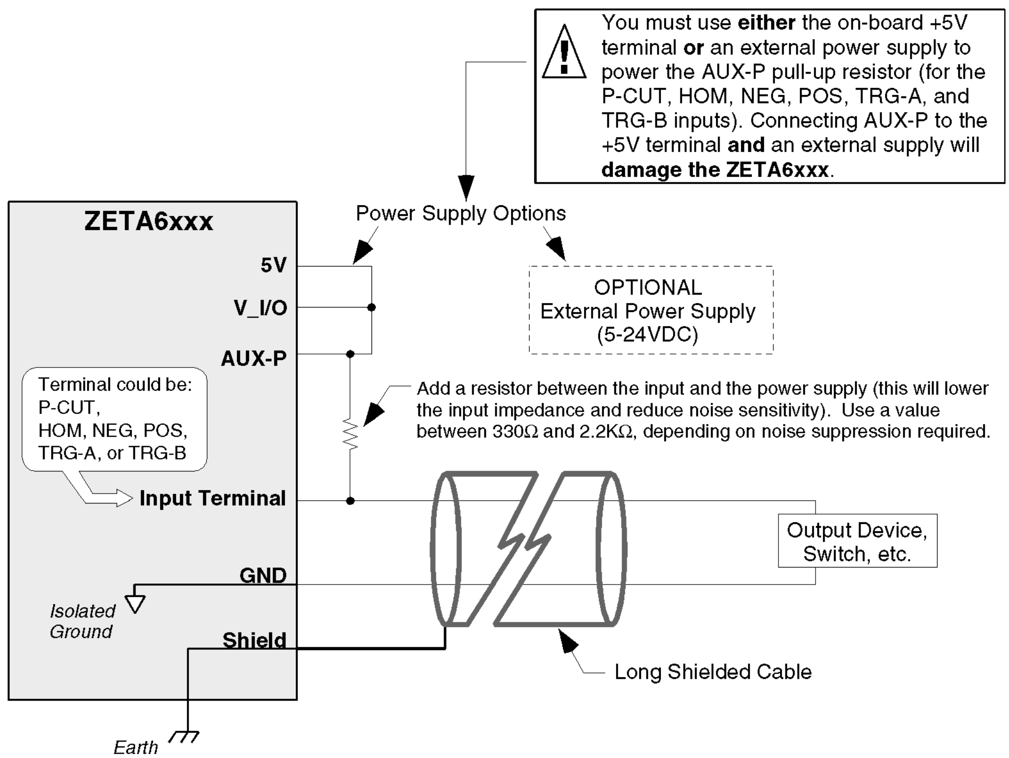
LEDs (after power is applied):
POWER .... On (green).
STEP .... Off. Or green if motion is commanded.
OVER TEMP .... Off. Or red if the internal sensor reaches 122°F (50°C).
MOTOR FAULT ...... Off. Or red if there is a short in the motor windings or motor cable, or if the INTERLOCK jumper on the motor connector is removed or extended.

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 ZETA6xxx. 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.

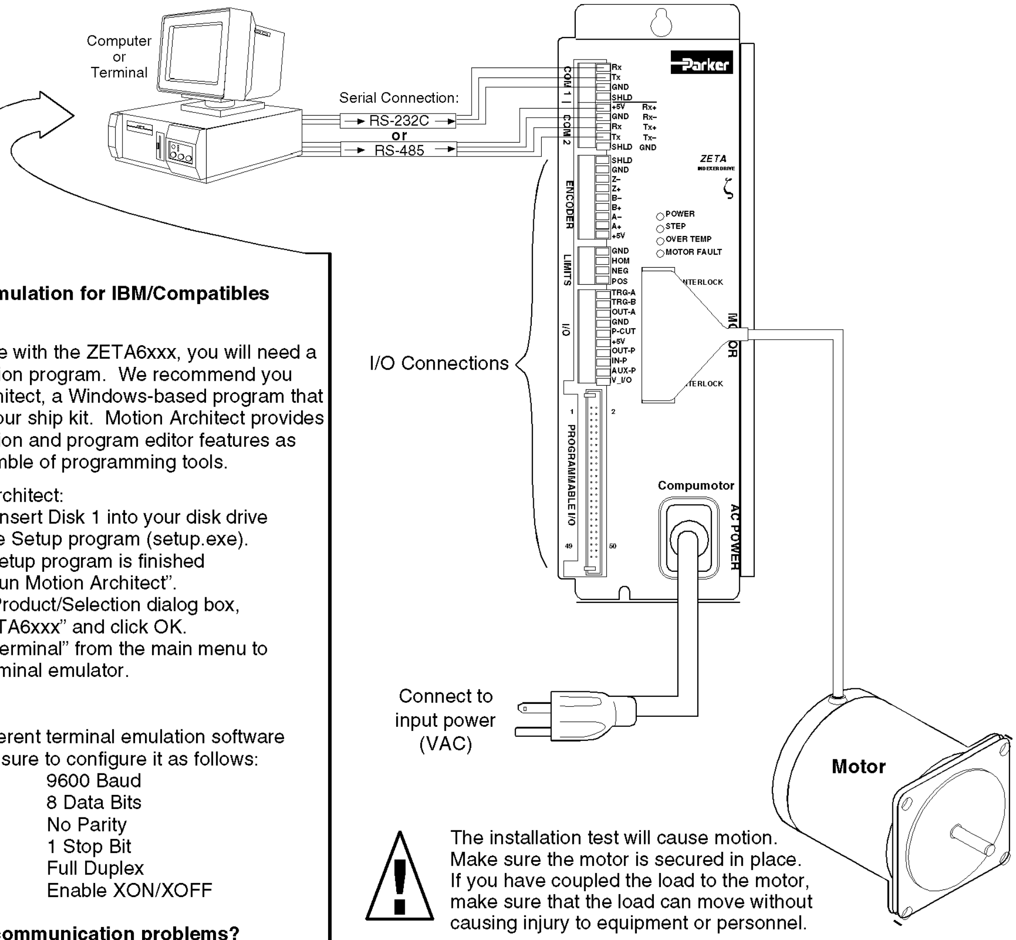
Reducing noise on limit, trigger, and P-CUT inputs. If you are experiencing noise problems, try adding resistors to reduce noise sensitivity (see illustration below).



Testing the Installation

> ⚠ **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 ZETA6xxx, you will need a terminal emulation program. We recommend you use Motion Architect, a Windows-based program that is provided in your ship kit. Motion Architect provides terminal emulation and program editor features as part of 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 "ZETA6xxx" and click OK.
4. Click on "Terminal" from the main menu to run the terminal emulator.

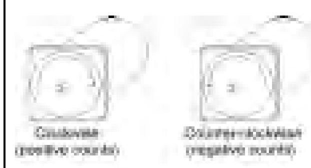
If you use a different terminal emulation software package, make sure to configure it as follows:

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

Having serial communication problems?
Refer to pages 48 through 51 for help.

> **NOTE**
>
> The test procedures below are based on the factory-default active levels for the ZETA6xxx'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

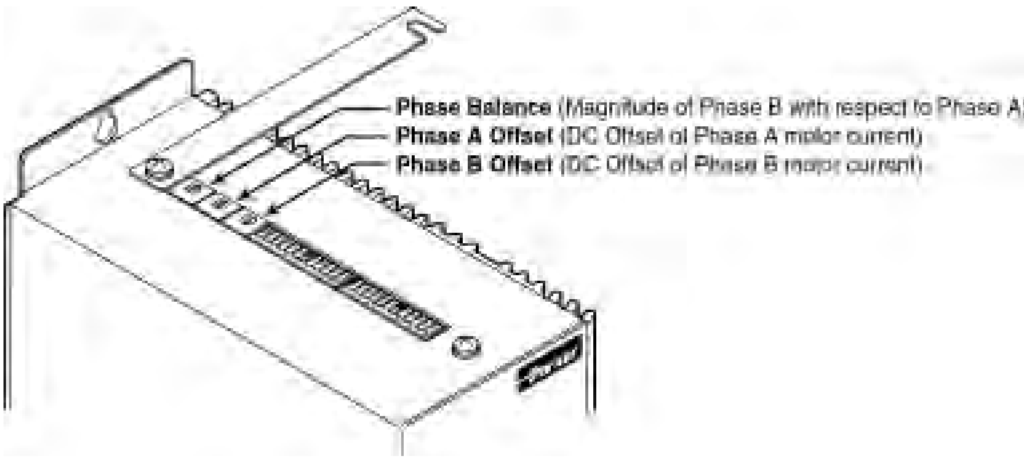
Connections	Test Procedure	Response Format (left to right)
End-of-travel and Home Limits	**NOTE**: If you are not using end-of-travel limits, issue the Disable Limits (`LHØ`) command and ignore the first two bits in each response field. 1. Enable the hardware end-of-travel limits with the `LH3` command. 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). Enter the `D25ØØØ` command, followed by the `GO` command. The motor will move one revolution (25000 steps) in the clockwise direction (viewed from the flange end). Enter the `TPM` command to determine the motor position. The response should be `*TPM+25ØØØ` (motor is at position 25000). 2. **NOTE:** Ignore this step if you are not using encoder feedback. This test assumes you are using a 1000-line encoder yielding a 4000 count/rev resolution. 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). **If the encoder is coupled to the motor shaft:** Enter the `D4ØØØ` command, followed by the `GO` command. The encoder (and motor) will move one revolution (4000 counts) in the clockwise direction (viewed from the flange end). **If the encoder is not coupled to the motor shaft:** Manually rotate the encoder shaft one revolution in the clockwise direction (viewed from the flange end). Enter the `TPE` command to determine the encoder position. The response should be `*TPE+4ØØØ` (encoder is at position 4000). Enter the `ENCØ` command to return the ZETA6xxx to the default motor step mode.	`TPM` response = motor counts `TPE` response = encoder counts Direction of rotation: 
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 ZETA6xxx. 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 6XXX 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 ZETA6xxx (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 ZETA6xxx to your specific motor. You will also select the best current waveform to use with your motor.

The ZETA6xxx's pots are located behind the removable metal cover on top of the chassis.



Before You Start

- Note that if you replace the ZETA6xxx 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 27).
- Connect the motor to the ZETA6xxx.
- 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 ZETA6xxx, 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 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.

These values are for use with ZETA6108, ZETA6112 or ZETA6104-240 at 120 VAC.

Motor	Offset Adjust (rps)	Balance Adjust (rps)	Waveform Adjust (rps)
OS2HB(S)	4.52	2.26	1.13
OS2HB(P)	4.52	2.26	1.13
OS21B(S)	4.49	2.24	1.12
OS21B(P)	4.49	2.24	1.12
OS22B(S)	4.51	2.26	1.13
OS22B(P)	4.51	2.26	1.13
RS31B(S)	2.58	1.29	0.65
RS31B(P)	2.58	1.29	0.65
RS32B(S)	2.48	1.24	0.62
RS32B(P)	2.48	1.24	0.62
RS33B(S)	2.63	1.32	0.66
RS33B(P)	2.63	1.32	0.66
RS42B(S)	1.72	0.86	0.43
RS42B(P)*	1.68 / 1.46	0.84 / 0.73	0.42 / 0.37
RE42B(S)	2.58	1.29	0.65
RE42B(P)	2.58	1.29	0.65
TS31B(S)	3.11	1.56	0.78
TS31B(P)	3.11	1.56	0.78
TS32B(S)	2.72	1.36	0.68
TS32B(P)	2.72	1.36	0.68
TS33B(S)	3.36	1.68	0.84
TS33B(P)*	3.40 / 2.92	1.70 / 1.46	0.85 / 0.73
TS41B(S)	2.82	1.41	0.71
TS41B(P)*	2.78 / 2.50	1.39 / 1.25	0.70 / 0.63
TS42B(S)	2.94	1.47	0.74
TS42B(P)*	2.57 / 2.35	1.29 / 1.18	0.64 / 0.59
TS43B(S)	2.74	1.37	0.69
TS43B(P)*	2.56 / 2.21	1.28 / 1.11	0.64 / 0.55

*Note: Use secondary value (after slash when being run with ZETA8 (only 8 amps)).

These values are for use with ZETA6104-240 at 240 VAC

Motor	Offset Adjust (rps)	Balance Adjust (rps)	Waveform Adjust (rps)
RS31C(S)	2.93	1.47	0.73
RS31C(P)	2.78	1.39	0.70
RS32C(S)	3.08	1.54	0.77
RS32C(P)	2.76	1.38	0.69
RS33C(S)	3.07	1.53	0.77
RS33C(P)	2.49	1.24	0.62
RS42C(S)	1.78	0.89	0.45
RS42C(P)	1.55	0.77	0.39
RE42C(S)	2.99	1.50	0.75
RE42C(P)	2.04	1.02	0.51
RS43C(S)	1.80	0.90	0.45
RS43C(P)	1.40	0.70	0.35

Note: Resonant speeds are shown for motors at full rated current. Operation of the motors at lower currents will shift the resonant speeds slightly.

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 ZETA6xxx 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 ZETA6xxx. Replace the cover over the pots. This completes the matching procedure.

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

Mounting & Coupling 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.

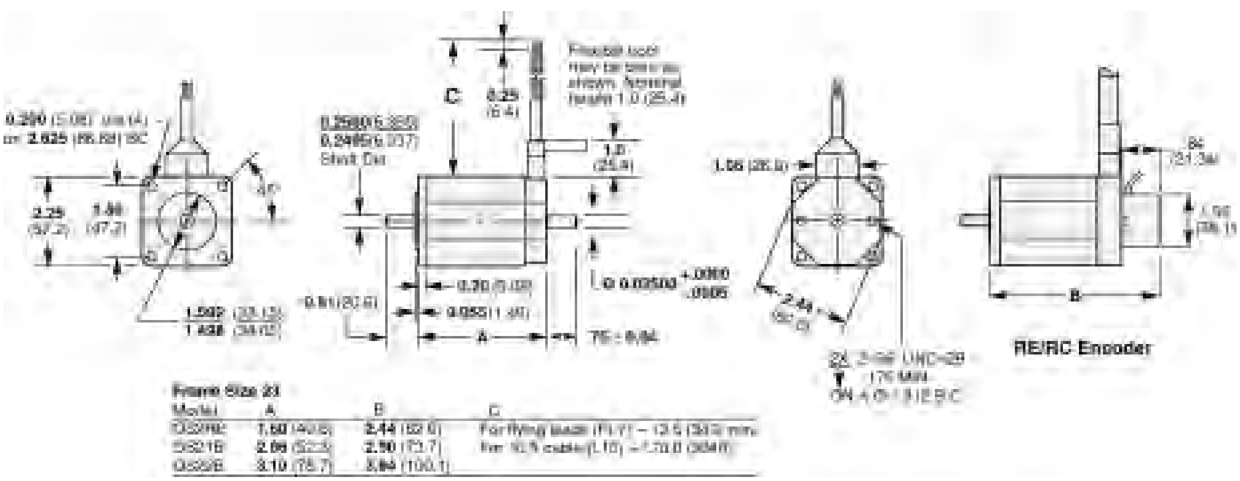
The motors can produce very high torque and acceleration. If the mounting is inadequate, this combination of high torque/high acceleration can shear shafts and mounting hardware. Because of shock and vibration that high accelerations can produce, you may need heavier hardware than for static loads of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

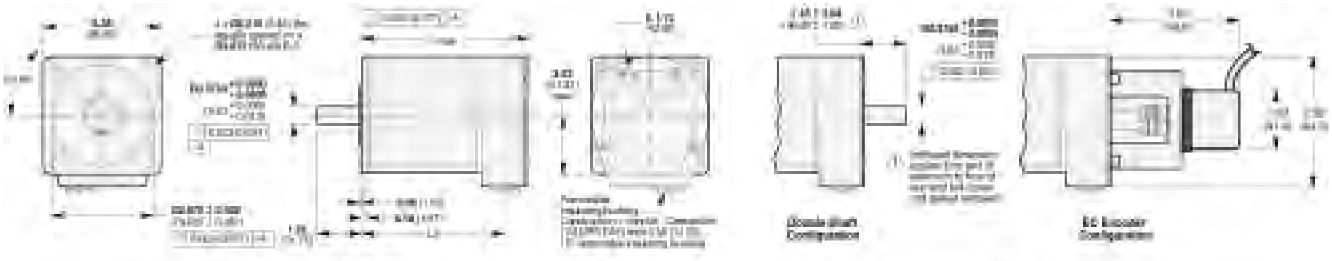
Zeta Series CE Motor Dimensions

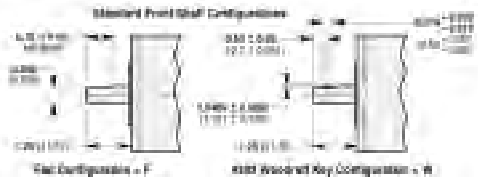
Dimensions in inches (mm)

Size 23 Frame, 0 Series



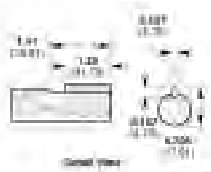
Size 34 Frame, R Series



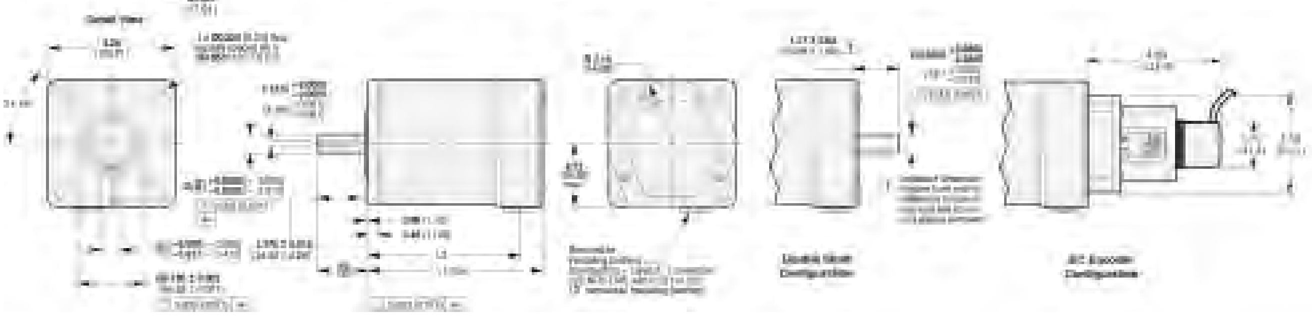


Model	Lmax	L2
RS31 - NPS	3.62 (91.95)	2.87 (72.9)
RS32 - NPS	4.77 (121.16)	4.02 (102.11)
RS33 - NPS	6.05 (153.67)	5.30 (134.62)

Size 42 Frame, R Series

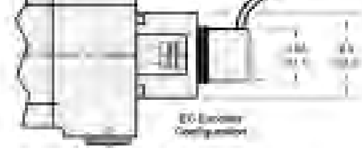


Model	Lmax	L2	A	B	C
RS42 - NPS	8.04 (204.22)	7.29 (185.17)	0.625 (15.87)	2.19 (55.63)	0.705 (17.91)
RE42 - NPS	8.04 (204.22)	7.29 (185.17)	0.625 (15.87)	2.19 (55.63)	0.705 (17.91)
RS43 - NPS	10.56 (268.23)	9.81 (249.18)	0.75 (19.05)	2.19 (55.63)	0.83 (21.08)

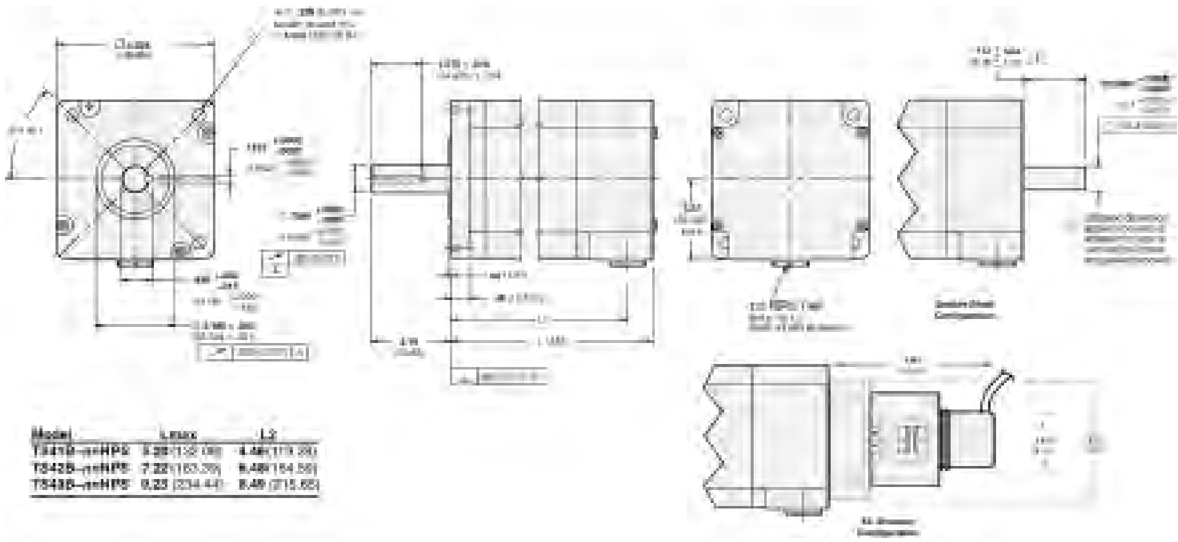


Size 34 Frame, T Series

Model	Lmax	L2	A	B	C
TS31B–nnNPS	4.44 (112.78)	3.70 (93.98)	0.5000 (12.70)	.555 (14.097)	.1250 (3.175)
TS32B–nnNPS	5.96 (151.38)	5.22 (132.59)	0.5000 (12.70)	.555 (14.097)	.1250 (3.175)
TS33B–nnNPS	7.48 (189.99)	6.74 (171.20)	0.6250 (15.88)	.705 (17.907)	.1875 (4.763)



Size 42 Frame, T Series



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 ZETA6xxx 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, change DIP switch SW2-1 (see page 8) to the ON position (enabled) (default is disabled, OFF).

Coupling the Motor

To ensure maximum performance, align the motor shaft and load as accurately as possible (although some misalignment may be unavoidable. The type of misalignment will affect your choice of coupler.

Single-Flex Coupling: Use for angular misalignment only. One (only) one of the shafts must be free to move in the radial direction without constraint. Do not use a single-flex coupling with parallel misalignment—this will bend the shafts, causing excessive bearing loads and premature failure.

Double-Flex Coupling: Use whenever two shafts are joined with parallel misalignment, or a combination of angular and parallel misalignment. Single-flex and double-flex couplings may or may not accept end pla, depending on their design.

Rigid Coupling: Not recommended, because they cannot compensate for *any* misalignment. Use 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 ZETA6xxx is equipped with three damping circuits that minimize resonance and ringing, and thus enhance stepper performance:

The ZETA6xxx automatically switches between the damping circuits, based upon the motor's speed.

- **Anti-Resonance –** General-purpose damping circuit. The ZETA6xxx ships from the factory with anti-resonance enabled (see page 7). 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 O, R or T motors), you should disable anti-resonance with the DIP switch SW2-2.
- **Active Damping** – Extremely powerful damping circuit at speeds greater than 3 rps. The ZETA6xxx 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 ZETA6xxx 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 ZETA6xxx" before you can configure active damping or electronic viscosity. Refer to the matching procedure on page 30.

Configuring Active Damping

Before You Start

- **Couple the motor to the load** (see pages 33-35 for details). Active damping must be configured under the normal mechanical operating conditions for your application.

Follow these steps to configure the active damping circuit.

1. **Verify Correct Drive/Motor Matching**
   See *Matching the Motor to the ZETA6xxx* earlier in this chapter. To be fully effective, the active damping circuit requires proper matching. If you are replacing a component (new drive or motor in an existing application), you must rematch your system.

2. **Verify Correct DIP Switch Settings**

Anti-Resonance	SW2-#2	switch in *OFF* position
Inductance	SW2-#7 - #8	set for your motor
Static Torque	SW2-#9 - #12	set for your motor

3. **Verify that the Active Damping Rotary Switch is at Zero**

4. **Calculate the Maximum Rotary Switch Setting**
   To do this, first calculate your system inertia. Be sure to include the motor's rotor inertia. Then consult the table of inertia ranges below. Find the switch setting that corresponds to your system inertia.

DIP SW2-#6 in *OFF* Position (Low Inertia Range)

Switch Position	Total Inertia ($kg\text{-}cm^2$)	Total Inertia ($kg\text{-}m^2 \times 10^{-6}$)	Total Inertia ($oz\text{-}in^2$)
15	0.088 - 0.205	8.8 - 20.5	0.481 - 1.121
14	0.205 - 0.572	20.5 - 57.2	1.121 - 3.127
13	0.572 - 1.069	57.2 - 106.9	3.127 - 5.845
12	1.069 - 1.754	106.9 - 175.4	5.845 - 9.590
11	1.754 - 2.727	175.4 - 272.7	9.590 - 14.910
10	2.727 - 3.715	272.7 - 371.5	14.910 - 20.312
9	3.715 - 5.020	371.5 - 502.0	20.312 - 27.447
8	5.020 - 6.275	502.0 - 627.5	27.447 - 34.308
7	6.275 - 8.045	627.5 - 804.5	34.308 - 43.986
6	8.045 - 9.595	804.5 - 959.5	43.986 - 52.460
5	9.595 - 11.760	959.5 - 1176.0	52.460 - 64.297
4	11.760 - 14.245	1176.0 - 1424.5	64.297 - 77.884
3	14.245 - 15.895	1424.5 - 1589.5	77.884 - 86.905
2	15.895 - 17.765	1589.5 - 1776.5	86.905 - 97.130
1	17.765 - 20.570	1776.5 - 2057.0	97.130 - 112.466
0	Active Damping Disabled		

DIP SW2-#6 in *ON* Position (High Inertia Range)

Switch Position	Total Inertia ($kg\text{-}cm^2$)	Total Inertia ($kg\text{-}m^2 \times 10^{-6}$)	Total Inertia ($oz\text{-}in^2$)
15	13 - 31	1324 - 3084	75 - 169
14	31 - 86	3084 - 8606	169 - 471
13	86 - 161	8606 - 16084	471 - 879
12	161 - 264	16084 - 26390	879 - 1443
11	264 - 410	26390 - 41029	1443 - 2243
10	410 - 559	41029 - 55894	2243 - 3056
9	559 - 755	55894 - 75528	3056 - 4129
8	755 - 944	75528 - 94411	4129 - 5162
7	944 - 1210	94411 - 121041	5162 - 6618
6	1210 - 1444	121041 - 144362	6618 - 7893
5	1444 - 1769	144362 - 176935	7893 - 9674
4	1769 - 2143	176935 - 214323	9674 - 11718
3	2143 - 2391	214323 - 239148	11718 - 13075
2	2391 - 2673	239148 - 267283	13075 - 14614
1	2673 - 3095	267283 - 309486	14614 - 16921
0	Active Damping Disabled		

Active Damping Rotary Switch Settings & Corresponding Inertia Ranges

This is your *Maximum* switch setting. If you are on the boundary between two switch settings, pick the lower of the two numbers. In the rest of this procedure ***never set the switch higher than this maximum setting.***

5. **Make a Move With Active Damping Turned *Off***
   (Rotary switch should be in the zero position.) 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 disables. Each time you adjust this switch, you will compare results with this baseline move.

   The move should be representative of your application, with similar velocity and acceleration. The speed must be faster than 3 rps, in order for the drive to activate anti-resonance or active damping.

6. **Turn On Active Damping**
   Turn the active damping rotary switch to position 1. This turns on active damping at its lowest setting, and disables anti-resonance.

   You can change the rotary switch setting "on the fly." You do not have to cycle power each time you change the switch setting. During a repetitive move, you can change the switch setting while the move is in progress. This allows you to immediately compare two different switch settings.

7. **Make a Move With Active Damping Turned *On***
   Compare the sound and vibration to the baseline move.

8. **Increase the Switch Setting**
   Turn the rotary switch to position 2 (unless position 1 is your calculated maximum). Make the move again. Compare the sound and vibration to the levels obtained at the lower setting.

9. **Find the Ideal Switch Setting**
   Continue to increase the switch setting by single increments. Each time you increase the setting, compare the results with the lower setting. 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.

Never exceed your maximum switch setting. 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 will result in higher dynamic motor current during transients, which can cause increased motor heating. Higher curent also increases motor torque, resulting in sharper accelerations than can jerk or stress the mechanics in your system. If you ramp up through each intermediate switch position, 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 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 33-35 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 41 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-ZETA6xxx matching.** See *Matching the Motor to the ZETA6xxx* on page 30. To be fully effective, the active damping circuit requires proper matching. If you are replacing a component (new ZETA6xxx 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 ZETA6xxx to activate EV.

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

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

```
MC0     ; select the preset positioning mode
MA0     ; select the incremental preset positioning mode
A10     ; set the acceleration to 10 revs/sec/sec
V2      ; set the velocity to 2 revs/sec/sec
D250000 ; 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.

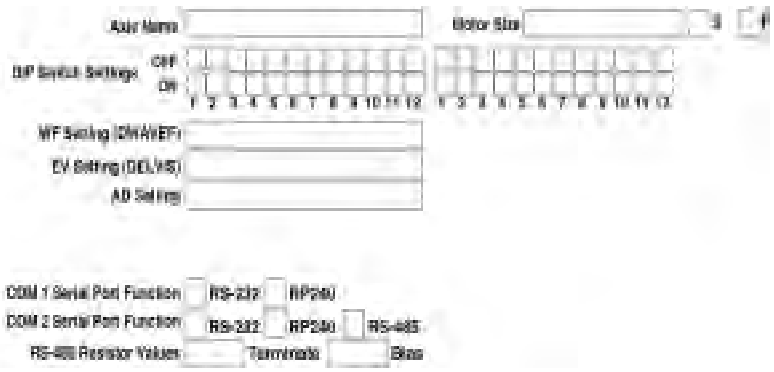
1. Issue the `DELVIS1` command to enable EV.
2. Make a move that is representative of your application. Use the same motion parameters that you set up in step 1. If you have not changed these settings, simply issue the `GO` command.

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 Systems Configuration

You may wish to record your configuration information in the chart



← COM port functions set with internal jumpers and the PORT and DRPCHK commands.

← RS-485 resistors are selected with internal DIP switches, or connected externally.

Much of this chart is repeated, along with other facts, on the *magnetic* information label located on the side of the ZETA6xxx chassis. You can leave the label on the ZETA6xxx, or you can remove it and place it in a convenient location near the ZETA6xxx (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 ZETA6xxxs, 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 Elements (software & hardware)

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 ZETA6xxx 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 ZETA6xxx 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
DELVIS	Enable/disable electronic viscosity. Electronic viscosity is automatically inhibited above 3 rps. (See set-up procedure on page 38.)	**DELVISØ** (disabled)
DRPCHK*	Establish the type of check for an RP240. In general, this command is necessary only if you are using RS-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 ZETA6xxx).	**DWAVEF1** (-4% 3rd harmonic)
ECHO	Enable/disable echoing of characters. If communicating over RS-232 to the master ZETA6xxx in an RS-485 multi-drop, see setup requirements on page 50.	**ECHO1** (enabled; but if using RS-485, **COM 2** is changed to ECHOØ by default)
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)
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 36.)	

`DAREN**`	Enable/disable anti-resonance. Anti-resonance is automatically inhibited at or below 3 rps, and it is inhibited if active damping is 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.
`DMTIND**`	Match the inductance of your motor (used only for active damping).
`DMTSTT**`	Match the motor's static torque (used only for active damping).

* These commands are automatically saved in non-volatile memory.
** These commands do exist, but are non-functional in the higher power ZETA6xxxs (ZETA6104-240, ZETA6108 and ZETA6112). Settings for these functions are made via DIP switch SW2 (see page 36) for the higher power ZETA versions.

Set-up Program Example

Assumptions:	The ZETA6108 is used with a an RS32B-DKS10 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
              ; Active damping value set to 9 for a total system inertia of 4
              ; SW2-6 set to OFF for lower inertia range
              ; Motor inductance set for 11.6 (SW2-7 = OFF, SW2-8 = ON)
              ; Motor static torque set for 267 (SW2-9 = OFF, SW2-10 = OFF,
                SW2-11 = ON, SW2-12 = OFF
              ;  Anti-resonance enabled (SW-2 = OFF)
DELVIS2       ; Enable electronic viscosity with value of 2
PORT1         ; Subsequent serial communication setup affects COM1 port
DRPCHK0       ; 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
; ************************************************************************
: * Insert other appropriate commands in the setup program (e.g., custom  *
; * power-up message, scaling factors, input function assignments, output *
; * function assignments, etc.).                                          *
; * See Programmer's Guide, chapter 3, for more information.              *
; ************************************************************************
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
```

Whats Next?

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

1. Review the general specifications — see page 4
2. Perform configuration/adjustments, as necessary — see pages 7-8
3. Mount the ZETA6xxx — see page 9
4. Connect all electrical system components — see pages 11-26
   Supplemental installation instructions for LVD-compliance are provided in Appendix C.
5. Test the installation — see pages 27-29
6. Match the motor to the ZETA6xxx (OPTIONAL) — see pages 30-32
7. Mount the motor and couple the load — see pages 33-35
8. Optimize system performance (OPTIONAL)
   by implementing Active Damping and Electronic Viscosity — see pages 36-39
9. Record your system configuration information — see pages 40-41

Program Your Motion Control Functions

You should now be ready to program your ZETA6xxx for your application. Knowing your system's motion control requirements, refer now to the *6000 Series Programmer's Guide* for descriptions of the ZETA6xxx's software features and instructions on how to implement them in your application. Be sure to keep the *6000 Series Software Reference* 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 ZETA6xxx, you can type in and execute controller code, transfer code files to and from the ZETA6xxx.
- **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 access to hypertext versions of the *6000 Series Software Reference* and the *6000 Series Programmer's Guide*.

Other Software Tools Available

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

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

DDE6000™. Facilitates data exchange between the ZETA6xxx 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 ZETA6xxx. Available for the Windows environment.

C H A P T E R T W O

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 26. General information on reducing electrical noise can be found in the Engineering Reference section of the Parker Compumotor/Digiplan catalog. Appendix D (page 63) provides guidelines on how to install the ZETA6xxx in a manner most likely to minimize the ZETA6xxx's emissions and to maximize the ZETA6xxx's immunity to externally generated electromagnetic interference.

Diagnostic LEDs

POWER................ On (green) if 120VAC (or 240 VAC for 240V versions) 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 122°F (50°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 27-29).
- **Motion Test**. A test program is available to verify that the ZETA6xxx 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 or multi-drop, the 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 8). 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 7), or proper use of `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 `ERES` command setting (default setting is 4,000 counts/rev) to match the post-quadrature resolution of the encoder. <u>Compumotor encoders</u>: E Series Encoders .... `ERES4000` OS motor with -HJ encoder (OSxxx-xxx-HJ) ...... `ERES2048` OS motor with -RE encoder (OSxxx-xxx-RE) ..... `ERES4000` OS motor with -RC encoder (OSxxx-xxx-RC) .... `ERES4000` RS motor with -EC encoder (RSxxx-xxx-EC) ..... `ERES4000` TS motor with -EC encoder (TSxxx-xxx-EC)*
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 and/or improper shielding. 2. Improper wiring.	1.a. Reduce electrical noise or move ZETA6xxx away from noise source. 1.b. Refer to *Reducing Electrical Noise* on page 46. 2. Check wiring for opens, shorts, & mis-wired connections.
LEDs	See *Diagnostic LEDs* above (page 46)	
Motion does not occur.	1. Check LEDs. 2. End-of-travel limits are active. 3. P-CUT (Pulse cut-off) not grounded. 4. Drive fault detected. 5. Undervoltage (AC supply < 95 VAC). 6. Improper wiring. 7. Load is jammed. 8. 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 greater than `LSNEG`. 3. Ground the P-CUT connection. 4. Check status with `TASXF` command (see bit #4). 5. Check status with `TASXF` command (see bit #2). Check AC supply. 6. Check motor and end-of-travel limit connections. 7. Remove power and clear jam. 8. See problem: *Torque, loss of*.
Motor creeps at slow velocity in encoder mode (`ENC1`).	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 <u>or</u> to an external 5-24V positive supply (<u>but not to both</u>). 1b. When inputs are pulled to 5-24V by an external device, connect IN-P to 0V. 2. Connect external power supply's ground to ZETA6xxx'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 <u>or</u> to an external supply of up to 24V. 3. Connect the external power supply's ground to the ZETA6xxx'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, home, end-of-travel, or P-CUT 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 ZETA6xxx's ground (GND). 2.a. Check wiring for opens, shorts, and mis-wired connections. 2.b. When inputs are pulled down to 0V by an external device, connect AUX-P to +5V supplied <u>or</u> to an external +5-24V supply (<u>but not to both</u>). 2.c. When inputs are pulled to 5-24V by external device, connect AUX-P to 0V. 2.d. Make sure a 5-24V power source is connected to the V_I/O terminal.

* Not released as of this printing.

Troubleshooting Serial Communication Problems

General Notes

- Power up your computer or terminal *BEFORE* you power up the ZETA6xxx.
- Make sure the serial interface is connected as instructed on page 12. 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-485: Make sure the internal DIP switches and jumpers are configured as instructed on page 8.

Test the Interface

1. Power up the computer or terminal and launch the terminal emulator.
2. Power up the ZETA6xxx. A power-up message (similar to the following) should be displayed, followed by a prompt (>):

```
*PARKER COMPUMOTOR 6000 Series – SINGLE AXIS INDEXER/DRIVE
*RP240 CONNECTED

>
```

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 6000 Series – SINGLE AXIS INDEXER/DRIVE
*RP240 CONNECTED

>TREV
*TREV92-014630-01-4.72
```

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-485 connected to COM 2: issue "PORT2" and "DRPCHKØ" commands. • RS-232: Echo may be disabled; enable with the ECHO1 command. • If you are using an RS-232 connection between the host computer and the master ZETA6xxx connected to multiple ZETA6xxxs in an RS-485 multi-drop, make sure the master ZETA6xxx has these settings executed in the order given (you should place these settings in your power-up STARTP program): PORT1 (select RS-232 port, COM1, for configuration) ECHO3 (echo to both COM ports) PORT2 (select RS-485 port, COM2, for configuration) ECHO2 (echo to the other COM port, COM1) • Faulty wiring. See instructions on page 12. RS-485: verify internal DIP switch and jumper settings on page 8. Also check for shorts or opens. • Is the cable or computer/terminal bad? Here's a test: 1. Disconnect the serial cable from the ZETA6xxx 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. • The controller may be executing a program. Issue the !K command or the <ctrl>K command to kill the program.
Garbled Characters	• Verify setup: 9600 baud (range is 19200-1200—see *AutoBaud*, page 7), 8 data bits, 1 stop bit, no parity; RS-232: Full duplex; RS-485: Half duplex (change internal jumper JU6 to position 1). • RS-485: Transmission line not properly terminated. See page 8 for internal DIP switch and jumper settings. See page 12 for connections and calculating termination resistors (if not using the internal resistors via internal DIP switches). • Faulty wiring. See instructions on page 12. RS-485: verify internal DIP switch and jumper settings on page 8. 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 ZETA6xxx system and its application include answers to the following questions:

- Which version of the ZETAxxx do you have?
- 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

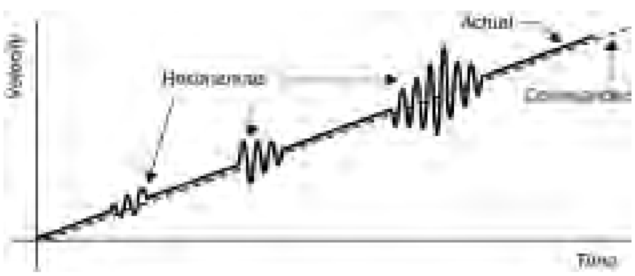
Resonance, Ringing & Damping— Discussion & Theory

In this appendix we will discuss resonance and ringing in step motors. This information will help you configure the ZETA6xxx'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.*

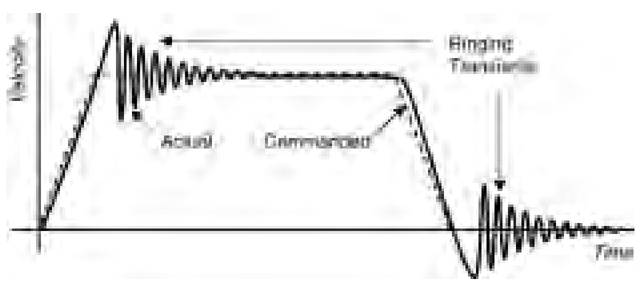
Resonance points can differ in intensity. The drawing shows a typical case—as motor speed increases, resonances of varying levels occur. Usually, the motor can accelerate through the resonance point, and run smoothly at a higher speed. However, if the resonance is extreme, the rotor can be so far out 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 ZETA6xxx 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 ZETA6xxx has internal electronics that can damp ringing transients, and cause them to decay quickly. No external devices are necessary.

Damping in the ZETA6xxx

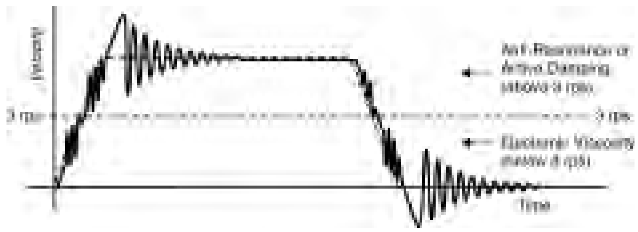
The ZETA6xxx has three different circuits that can damp resonance and ringing.

Anti-Resonance – General-purpose damping circuit. The ZETA6xxx 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 ZETA6xxx ships from the factory with active damping disabled. You must use the Active Damping rotary switch to enable active damping and optimize it for a specific motor size and load (see procedure on page 36).

Electronic Viscosity – Provides passive damping at lower speeds. The ZETA6xxx 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 pages 38-39).

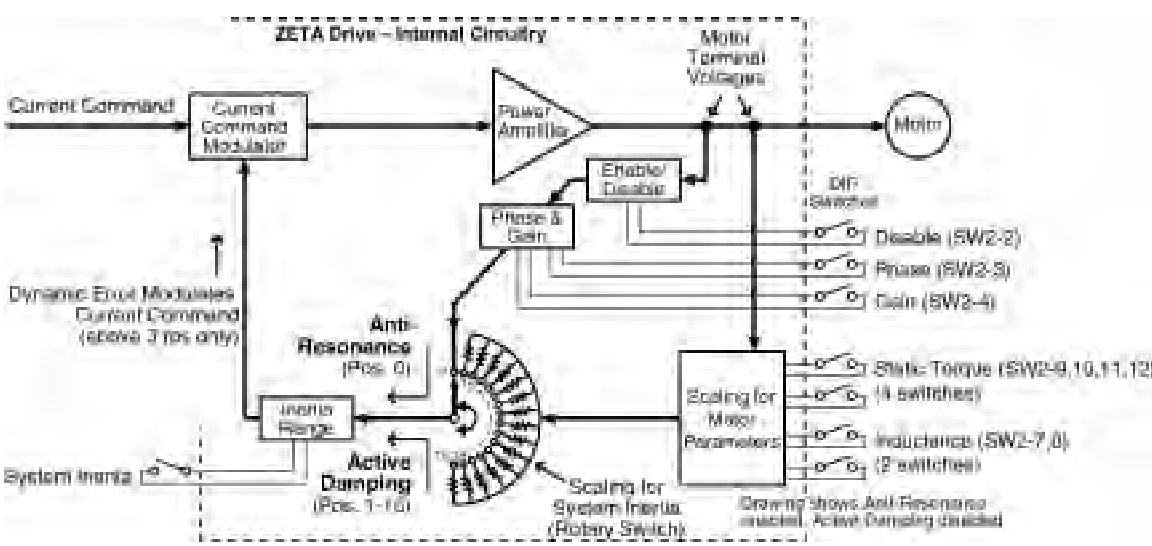
The first two damping circuits—anti-resonance and active damping—work at speeds greater than three revolutions per second (rps). Electronic viscosity works at speeds from rest up to three rps. The ZETA6xxx will automatically switch between the damping circuits, based upon the motor’s speed. The next drawing shows the effective range of each circuit.



Above 3 rps, the ZETA6xxx 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 (AD rotary switch), the ZETA6xxx enables anti-resonance. If the Active Damping rotary switch is set to any setting other than zero, the ZETA6xxx enables active damping. This relationship is shown in the next drawing—notice in the drawing that anti-resonance can also be disabled with a DIP switch setting (SW2-2).

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



Anti-Resonance (AR)

Anti-resonance monitors the ZETA6xxx's motor terminals, and looks at power exchange between the ZETA6xxx 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 DIP switch, SW2-2, it works automatically.

Anti-Resonance Gain

Large rotor motors, or motors driving large inertial loads, may require a reduction in anti-resonance gain. This will be evident if the load becomes too responsive and settles in an overly abrupt manner for your application. SW2-4 should be *off* if the system's inertia is 20 kg-cm^2 or less. SW2-4 should be *on* if system's inertia is greater than 20 kg-cm^2.

Anti-Resonance Phase

This switch allows a broad range of motors to benefit from the anti-resonance damping technique. SW2-3 should be *off* if your mechanical system's resonant frequency is 80 Hz or less. SW2-3 should be *on* if your mechanical system's resonant frequency is greater than 80 Hz, if your motor drives an extremely low inertia load, or if your system has an extremely high torque to inertia ratio.

Active Damping (AD)

Active damping monitors the ZETA6xxx'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. DIP switch SW2 allows you to scale the circuit for motor inductance and static torque. The AD rotary switch 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 ZETA6xxx set the amount of motor current during normal operations; this current is constant. To damp ringing, the active damping circuit can cause the ZETA6xxx 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 ZETA6xxx 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.

Current Loop Gain

SW2-5 should be *off* for normal current-loop gain. You can reduce the responsiveness of the current control loop by setting the SW2-5 to the *on* position. This may be necessary when connecting a motor with an extremely low inductance value, on the order of 2 mH. If you hear a high pitched (10kHz) oscillation from the motor, you can decrease or eliminate the oscillation by reducing loop gain. Excessive loop gain may cause motor faults at high loads; reduce loop gain to eliminate this problem.

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 ZETA6xxx's damping circuits provide increased smoothness, reduced audible noise, and better performance. Refer to the configuration procedures beginning on page 36.

If you choose not to use active damping and electronic viscosity, at least use anti-resonance. The ZETA6xxx is shipped from the factory with anti-resonance enabled (SW2-2 = OFF).

Appendix B

Using Non-Compumotor Motors

We recommend that you use Compumotor motors with the ZETA6xxx. If you use a non-Compumotor motor, it must meet the following requirements:

- Inductance: 2 mH minimum; 5.0 to 50.0 mH recommended range; 80.0 mH maximum.
- 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 ZETA6xxx, 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.

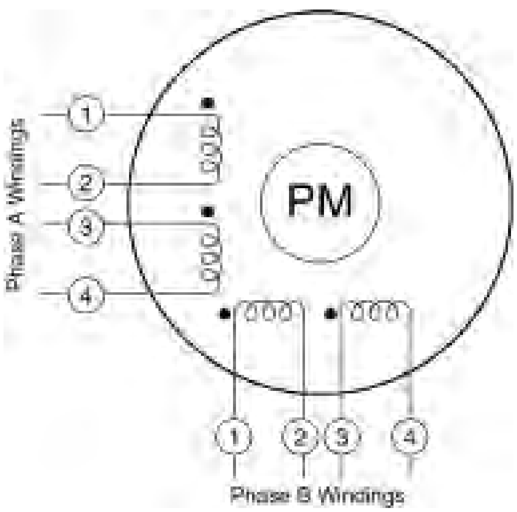
   Scenario #1 — The resistance measurements to the two remaining motor leads are virtually identical. Label the two remaining motor leads **A+** and **A–**. Label the motor lead connected to the negative lead of the ohmmeter **A CENTER TAP** (this is the center tap lead for Phase A of the motor).

   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:

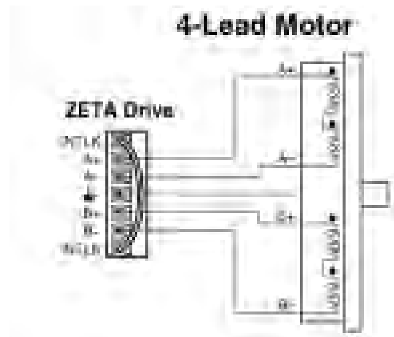
1. Connect A2 & A3 together and relabel this common point **A CENTER TAP**.
2. Connect B2 & B3 together and relabel this common point **B CENTER TAP**.
3. Relabel the A1 lead **A+**.
4. Relabel the A4 lead **A-**.
5. Relabel the B1 lead **B+**.
6. Relabel the B4 lead **B-**.
7. Proceed to the *Terminal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

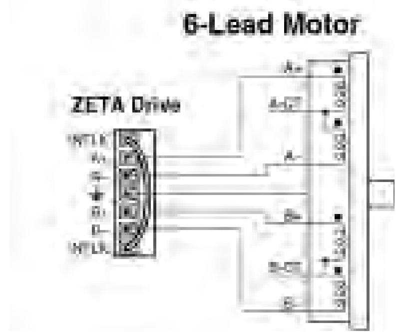
Parallel Configuration Procedure:

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.

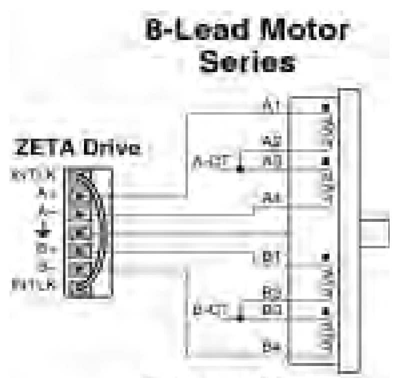
Terminal Connections

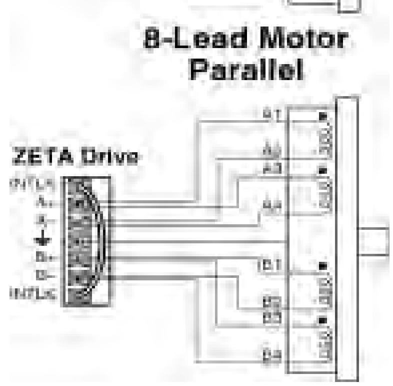
After you determine the motor's wiring configuration, connect the motor leads to the ZETA6xxx's 7-pin **MOTOR** connector according to the appropriate diagram below.





Note: the center top connections should be terminated properly, per local codes.





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

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 7 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 7.

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.

Appendix C

LVD Installation Instructions

For more information about the Low Voltage Directive (LVD), see 73/23/EEC and 93/68/EEC, published by the European Economic Community (EEC).

Environmental Conditions

Pollution Degree: The ZETA6xxx is designed for pollution degree 2.

Installation Category: The ZETA6xxx is designed for installation category II.

Electrical

Connecting & Disconnecting Power Mains

The ZETA6xxx's protective earth connection is provided through its make-first/break-last earth terminal on the power mains connector. You must reliably earth the ZETA6xxx's protective earth connection.

Using an Isolation Transformer

The ZETA6xxx's mains voltage is limited to 120 VAC (240VAC for ZETA6104-240) nominal. If your mains voltage is higher, use an isolation transformer located between the power mains and the ZETA6xxx. Your isolation transformer should be insulated to ~2300V rms.

Do not interrupt the protective earth conductor between the source mains and the isolation transformer's secondary. The core of the isolation transformer and the drive's protective conductor terminal must *both* be connected to the mains protective earth conductor.

CAUTION — Do not use an autotransformer.

Adding Line Fuses

Line fuses need to be added to protect the transformer and associated wiring. If the live wire cannot be readily identified, fuse both phase conductors. The value of fuse required is given by: (1.5 x VA)/(supply volts) [amps]

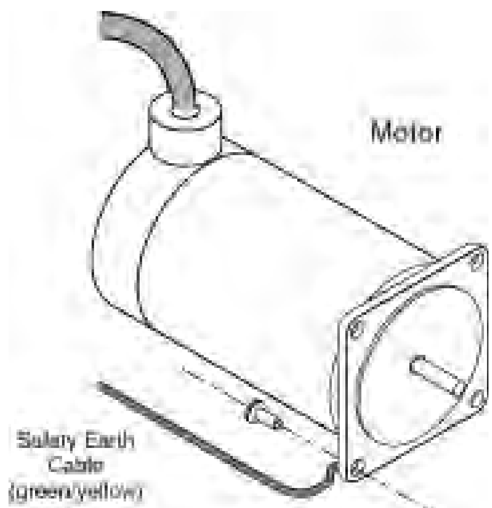
Fuse types should be anti-surge HBC.

⚠ **WARNING** — Safety Ground (Earth Ground) should **never** be fused.

Providing a Protective Earth Connection for Motors

You must provide a connection from the motor to a reliable protective earth contact point. This connection provides a protective earth for the motor, and is <u>in addition</u> to the earth connection provided by the drain wire in the motor's power cable. The motor's protective earth connection is important for safety reasons, and <u>must not be omitted</u>.

Make connections according to the diagram and instructions below:



1. Use a spade lug in combination with a star washer and mounting bolt to make good contact with the bare metal surface of the motor's mounting flange.
2. Use a green and yellow striped wire to make the connection between the motor and earth. Wire gauge must be no thinner than the current carrying wire in the motor's power cable.
3. Resistance between the motor and earth must be no greater than 0.1Ω. Use thicker gauge wire if the resistance is too high.

Mechanical

Installing in an Enclosure: The ZETA6xxx must be installed within an enclosure. The enclosure's interior must not be accessible to the operator. The enclosure should be opened only by skilled or trained service personnel.

Servicing the ZETA6xxx

Changing Firmware: Only skilled or trained personnel should change firmware.

Changing Batteries: The ZETA6xxx contains a replaceable lithium battery, of type Duracell DL2450, or Sanyo CR2450, or equivalent. Only skilled or trained personnel should change batteries. Dispose of batteries in accordance with local regulations.

Do Not Replace Fuses: The ZETA6xxx has no fuses designed to be replaced by the user. Fuse failure indicates that other components have also failed. Fuses and other components should only be replaced by Compumotor or its designated repair facilities.

Thermal Safety

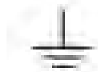
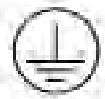
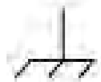
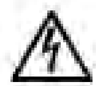
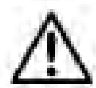
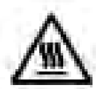
The Motor May Be HOT: The motor may reach high temperatures during normal operations, and may remain hot after power is removed.

Sonic Pressure

High Sound Level: The sound level from some large frame step motors (NEMA 34, NEMA 42, and larger) may exceed 85 dBA. Actual sound level is application dependent, and varies with motor loads and mounting conditions. Measure the sound level in your application; if it exceeds 85 dBA, install the motor in an enclosure to provide sound baffling, or provide ear protection for personnel.

Table of Graphic Symbols & Warnings

The following symbols may appear in this manual, and may be affixed to the products discussed in this manual.

Symbol	Description
	Earth Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	Caution, Risk of Electric Shock
	Caution, Refer to Accompanying Text
	Hot Surface
	Recycle Battery

Appendix D

EMC Installation Guidelines

General Product Philosophy

The ZETA6xxx was not designed originally for EMC compliance. Therefore, it will require specific measures to be taken during installation. The ultimate responsibility for ensuring that the EMC requirements are met rests with the systems builder.

It is important to remember that for specific installations, the full protection requirements of the EMC Directive 89/336/EEC need to be met before the system is put into service. This must be verified either by inspection or by testing. The following EMC installation instructions are intended to assist in ensuring that the requirements of the EMC directive are met. It may be necessary to take additional measures in certain circumstances and at specific locations.

It should be stressed that although these recommendations are based on expertise acquired during tests carried out on the ZETA6xxx, it is impossible for Compumotor to guarantee the compliance of any particular installation. This will be strongly influenced by the physical and electrical details of the installation and the performance of other system components. Nevertheless, it is important to follow ***all*** the installation instructions if an adequate level of compliance is to be achieved.

Safety Considerations

The ZETA6xxx is intended for installation according to the appropriate safety procedures including those laid down by the local supply authority regulations. The recommendations provided are based on the requirements of the Low Voltage Directive and specifically on EN60204. It should be remembered that safety must never be compromised for the purpose of achieving EMC compliance. Therefore in the event of a conflict occurring between the safety regulations and the following recommendations, ***the safety regulations always take precedence.***

Ferrite Absorbers and P-Clips

Ferrite Absorber Specifications

The absorbers described in these installation recommendations are made from a low-grade ferrite material which has high losses at radio frequencies. They therefore act like a high impedance in this waveband.

The recommended components are produced by Parker Chomerics (617-935-4850) and are suitable for use with cable having an outside diameter up to 10-13mm. The specification is as follows:

Chomerics part #	83-10-M248-1000	83-10-A637-1000
Outside diameter	17.5mm	28.5mm
Inside diameter	10.7mm	13.77mm
Length	28.5mm	28.57mm
Impedance at 25MHz	80Ω	135Ω
Impedance at 100MHz	120Ω	210Ω
Curie temperature	130°C	130°C

(*the device should not be operated near this temperature*)

Handling & Installing Ferrite Absorbers

Take care when handling the absorbers—they can shatter if dropped on a hard surface. For this reason the suggested method of installation is to use a short length of 19mm diameter heat-shrink sleeving (see Figure 1). This gives a degree of physical protection while the cable is being installed. The sleeving should have a shrink ratio of at least 2.5:1. Cable ties may be used as an alternative, however they give no physical protection to the absorber.

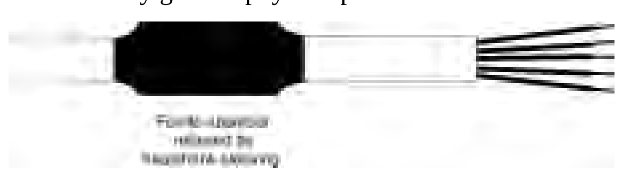


Figure 1. Ferrite Sleeve Installation

P-Clip Installation Details

The function of the P-clip is to provide a 360-degree metallic contact and thus a convenient means of ensuring a proper R.F. ground. When dealing with EMI issues, it is important to remember that continuity, a DC connection, does not at all speak to the integrity of an AC (high-frequency) connection. High-Frequency bonding typically involves wide, flat cabling to establish a suitable system ground. When applied properly, the P-clip has been shown to give an adequate high-frequency contact.

When installing a P-clip (see Figure 2), install as close to the cable end as possible, provided a suitable ground, backplane, earth stud or bus bar is accessible, (this may mean removing the paint from a cabinet or panel). Remove only the outer (vinyl) jacket of the braided screen cable (this allows the braid to continue to the cable connector), be careful not to damage the braid. Snap the P-clip over the exposed braid, and adjust for a tight fit. Secure the clip to the designated ground with a machine screw and lock washer. The use of brass or other inert conductive metal P-clip is recommended. Cover any exposed bare metal with petroleum jelly to resist corrosion.

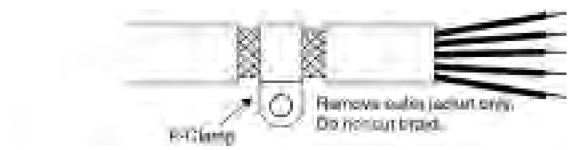


Figure 2. P-Clip Installation

Installation

External Enclosure

> ***Introduction***
>
> *The measures described in this section are primarily for the purpose of controlling conducted emissions. To control radiated emissions, all drive and control systems must be installed in a steel equipment cabinet which will give adequate screening against radiated emissions. This external enclosure is also required for safety reasons. There must be no user access while the equipment is operating. This is usually achieved by fitting an isolator switch to the door assembly.*
>
> *To achieve adequate screening of radiated emissions, all panels of the enclosure must be bonded to a central earth point. The enclosure may also contain other equipment and the EMC requirements of these must be considered during installation. Always ensure that drives and controllers are mounted in such a way that there is adequate ventilation.*

Preparing the ZETA6xxx: The ZETA6xxx must be mounted to a conductive panel. Notice that the mounting flanges have an area free of any paint. If necessary, remove the paint from the corresponding area on the rear panel of the enclosure (see Figure 3). This is to guarantee a good high-frequency connection between the drive case and the cabinet. After mounting the unit use petroleum jelly on the exposed metal to minimize the risk of future corrosion.

Filtering the AC Supply

> ***Introduction***
>
> *These recommendations are based on the use of proprietary screen filter units which are readily available. However, the full EMC test includes a simulated lightning strike which will damage the filter unless adequate surge suppression devices are fitted. These are not normally incorporated into commercial filters since the lightning strike test can be destructive. This test is normally carried out on the overall system and not on individual components; therefore, the surge protection should be provided at the system boundary.*

A filter must be installed between the incoming AC supply and the input to the drive. The manufacturer's part numbers for suitable filters are:

Corcom 10EP1	**Schaffner FN2070-10-06**
Corcom World Headquarters	Schaffner EMC Inc.
Phone: 847-680-7400	Phone: 201-379-7778
Fax: 847-680-8169	Fax: 201-379-1151

For applications requiring the full 12 amps of current from the ZETA12, we recommend the SHAFFNER part number, **FN2070-12-06**. There is no comparable CORCOM 12 amp filter.

You will need one of these filters for each drive. Compumotor's EMC Kit includes a suitable AC mains filter.

Mount the filter within 2 inches (50mm) of the ZETA6xxx as shown in Figure 3. Ensure that there is no paint on the mounting panel under the filter mounting lugs—it is vital that there is good large-area contact between the filter and the panel.

Connect the incoming AC supply cable to the push-on terminals on the filter, with the earth lead connected to a local earth stud, bus bar or metal back-plane. Route the supply cable so that it runs close to the walls of the enclosure. Connect the earth terminal on the filter case to the earth stud.

Fit a ferrite absorber over the cable before wiring the filter output terminals to the AC input on the drive. Locate the absorber as close as possible to the drive using heat-shrink sleeving (see Figure 1 above). Take the ZETA6xxx earth connection from the same stud that retains the filter case earth, as shown in Figure 3.

Motor Connections

Motors in General

The Compumotor R & T Series motors should be used with the C10 (or C10H) cable kit (see page 67) for optimum performance in EMC installations. See Appendix E for installation instructions. This combination provides an appropriately shielded cable. However, many other step motor systems ship with motors that do not incorporate the use of a braided screen for the control of conducted emissions. Therefore, when used in installations where the motor cable is not within earthed conduit the entire length of travel, the standard motor cable should not be used.

At the drive end of the motor cable, fit a ferrite absorber over the cable before wiring to the motor connector (it may be necessary to remove the existing connector). Locate the absorber as close as possible to the connector using heat-shrink sleeving.

For motors with exposed cabling (not within earthed conduit), follow the guidelines below:

- Removable Cabling: Remove the motor cable from the standard motor, and replace with a suitable cable described below, see *Motor Cables.*
- Permanent Cabling: Cut off cable in excess of approximately 4 inches (10 cm). Configure the motor for series or parallel operation and attach a suitable braided screen cable to the motor, see *Motor Cables* below.

Termination of the braid shield at the motor must be made using a 360° bond to the motor body, and this may be achieved by using a suitable clamp. Many stepper motors are designed to accommodate an appropriate terminal gland which can be used for this purpose. If this is not the case, P-clip the braid to the rear end bell of the motor housing, as shown in Figure 4. This will not only provide a good high-frequency bond, but strain relief as well.

At the drive end, run the motor cable down to the mounting panel, expose a short length of braiding and anchor to the panel with a P-clip. The ZETA Series require a safety earth connection to the motor (see green and yellow striped wire in Figure 4) — take this from the stud or bus bar. Run the safety earth lead alongside the motor lead. Note that the motor cable should be kept away from I/O cables carrying control signals.

Motor Cables

For 10 foot (replacement) cable lengths, use 4-core 1mm^2 (AWG 18) (SWG 20) braided screen cable for the motor connections on the ZETA6xxx. At the drive end, fit a ferrite absorber over the cable before wiring to the motor connector. Locate the absorber as close as possible to the connector using heat-shrink sleeving (use AWG 16 cable for motors above 10 amperes).

All after-market motor connections must be made using a high quality braided-screen cable. Cables using a metallized plastic foil for an earth screen are unsuitable and provide very little screening. Terminating to the screen in a mechanically stable manner is difficult because the screen itself is comparatively fragile — bending it in a tight radius can seriously affect the screening performance.

There must be no break in the 360° coverage that the screen provides around the cable conductors. If a connector must be used it should retain the 360° coverage, possibly by the use of an additional metallic casing where it passes through the bulkhead of the enclosure. The cable screen must *not* be connected to the cabinet at the point of entry. Its function is to return high-frequency chopping current back to the drive or controller. This may require mounting the connector on a sub-panel insulated from the main cabinet, or using a connector having an internal screen which is insulated from the connector housing.

Within the cabinet itself, all the motor cables should lie in the same trunking as far as possible. They must be kept separate from any low-level control signal cables. This applies particularly where the control cables are unscreened and run close to the drive or other sources of electrical noise.

Motor Feedback Cables

Feedback devices such as encoders, tachometers and Hall effect sensors also require the use of high-quality braided screen cable. If it is necessary to replace the standard feedback cable, select a braided screen cable that matches the gage of the devices original cable and attach as close to the transducer as possible. Avoid complex and bulky connections that can cause degradation in feedback signal quality. If possible, use in-line cable splicing techniques, and cover the splice point with heat-shrink tubing. Remove a section of the braided shield cable's insulation to expose the braid, and tie the braid to earth using the same P-clip 360° bond as shown in Figure 2. Differential signals should use twisted pair cable to minimize magnetic coupling. At the receiving end, fit a ferrite absorber over the feedback cable before wiring the connector, then P-clip the braid to a suitable ground (metal back-plane of drive mounting panel, or earth point of device that receives the feedback)— see Figure 3.

Step Motors

It is preferable to use motors with screw terminations whenever possible. If flying-lead motors are used, it is important that the unscreened leads are converted into a braided-screen cable within 4 inches (10cm) of the motor body. A separate terminal box may be used for this purpose but the braided cable screen must be properly strapped to the motor body, as shown in Figure 4. Motors fitted with terminal boxes also allow local selection of series or parallel connection, reducing the cost of the cable running back to the drive.

Control Signal Connections

High-quality braided screen cable should be used for control connections. In the case of the ZETA6xxx, which has differential step-direction inputs, it is preferable to use a cable with twisted pairs to minimize magnetic coupling. No connection is made to the cable screen at the drive itself. Fit a ferrite absorber close to the I/O connector and run the cable down to the mounting panel as shown in Figure 3. Expose a short length of the braided screen and anchor to the panel with a P-clip.

The level at which the I/O operates means that the signals are unlikely to meet EMC immunity requirements if taken outside the enclosure without proper screening.

50-Pin Ribbon Cable: It is recommended when using the 50-Pin Ribbon Cable I/O found on the ZETA6xxx that a terminal break out box such as the VM50 be used (see Figure 3). Mount the VM50 close to the ZETA6xxx, keeping the ribbon cable as short as possible. Bundle any excess ribbon cable and secure close to a panel wall. Individual I/O points will require the use of individually shielded cable runs, with braids bonded to the panel (close to VM50) with a P-clip.

Communications: In applications that require serial communications with the ZETA6xxx, take special care to assure proper wiring practices are utilized. Good quality braided screen cable should be used for the communication cabling. In the specific case of differential mode (RS-485) protocol, twisted pair cable shall be used. No connection is made to the cable screen at the drive itself. Fit a ferrite absorber close to the communications connector and run the cable down to the mounting panel as shown in Figure 3. Expose a short length of the braided screen and anchor to the panel with a P-clip. Avoid routing communication cables near high power lines, and sources of high energy impulses.

Remember to route control signal connections well away (at least 8 inches) from relays and contactors. Control wiring should not be laid parallel to power or motor cables and should only cross the path of these cables at right angles. Bear in mind that control cables connected to other equipment within the enclosure may interfere with the controller, particularly if they have come from outside the cabinet. Take particular care when connecting external equipment with the cabinet door open, for instance a computer or terminal; static discharge may cause damage to unprotected inputs.

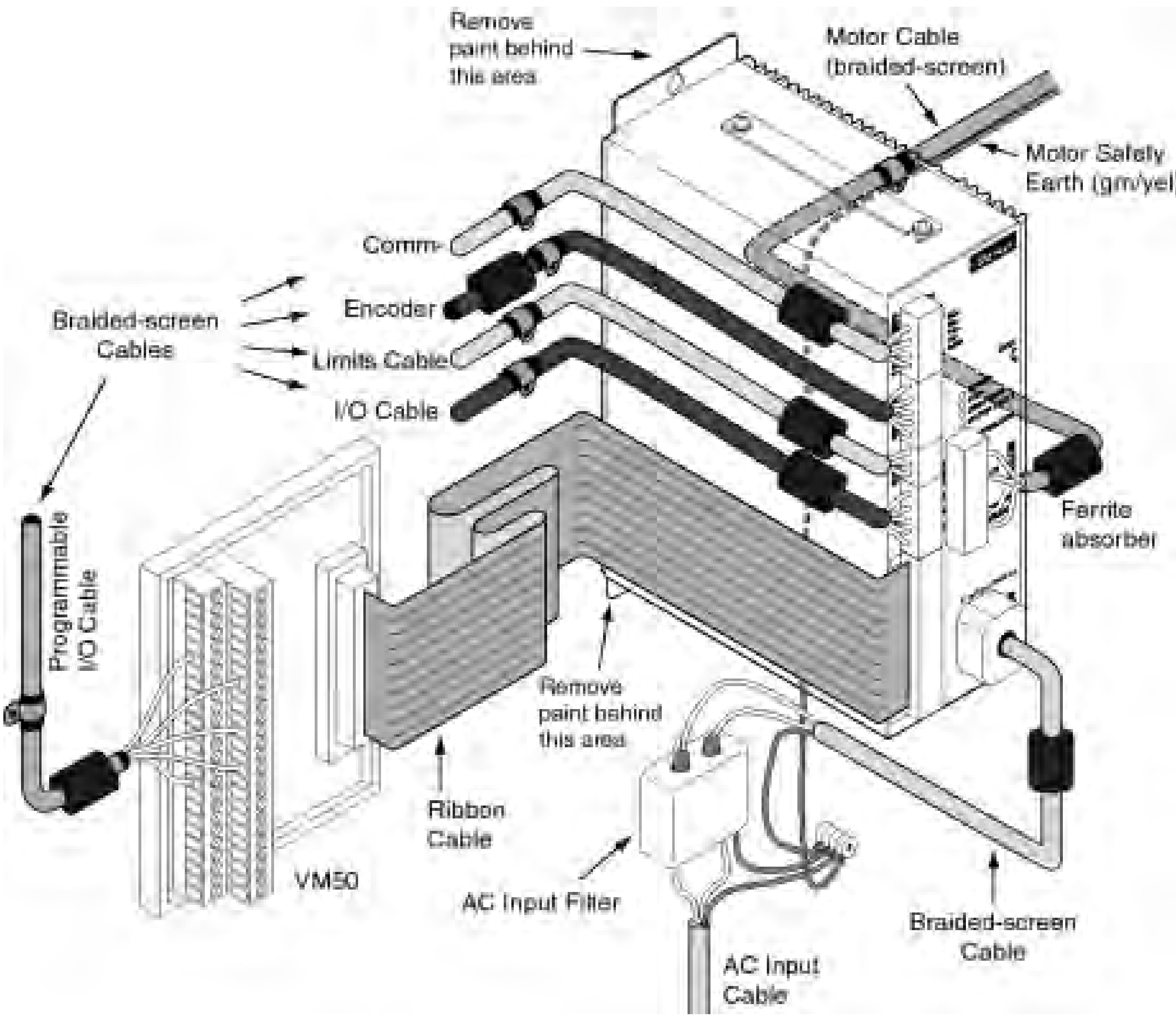


Figure 3. EMC Connections for ZETA6xxx (shown for non C10 motor installations)

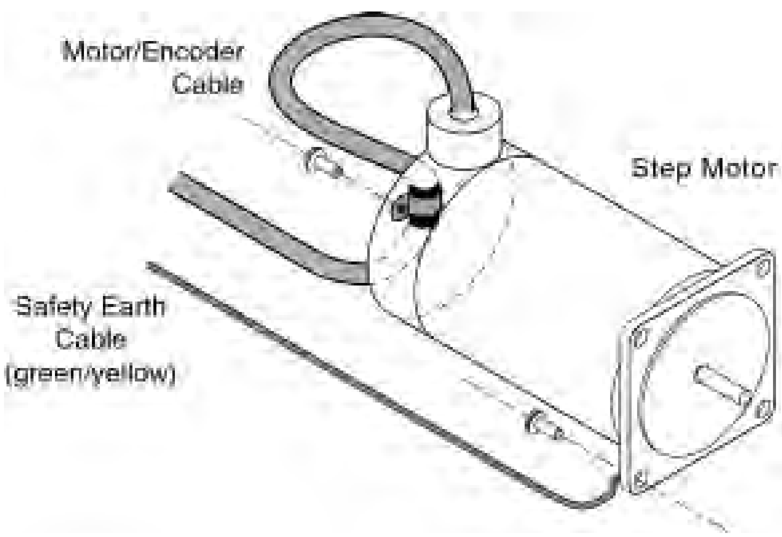
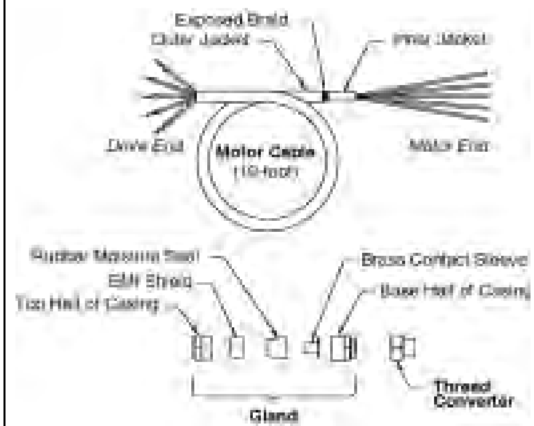


Figure 4. EMC Connections for Step Motor — P-Clip, Safety Earth (shown for non C10 motor installations)

LVD/EMC Compliance for RS and TS Motors

Compumotor's R and T Series motors may be used with the C10 (or C10H) cable kit for LVD/EMC compliance. The C10 cable kit is ordered separately (part number is **C10**)*. Instructions for assembling the cable are provided in the C10 cable kit.



*Note: we recommend the C10H for use with motors run above 10 amperes.

Appendix E

R or T Series Motor with C10 (C10H)

Motor Connections - R or T Series Motor with C10 Option (or C10H)

The C10 (C10H) option for Compumotor's R or T series motors includes a removable braided cable and all necessary hardware for making an EMC compliant installation. Instructions for attaching the cable follow.

The C10 (C10H) Motor cable is 10 feet (3 m) long. Longer cable lengths are not available from Compumotor. If you extend the motor cable, follow the appropriate guidelines in the LVD regulations published by the EEC.

CAUTION - At no time during the following procedure should the motor cable be allowed to twist within the gland assembly. This can damage the cable and greatly reduce its life.

Procedure for attaching C10 (C10H) Cable to R or T Series Motor and ZETA6xxx Indexer Drive.

1. **Inventory** (ship kit contents are listed below in next drawing).

   - Thread converter
   - Gland assembly (5 pieces)
   - Motor cable, 10 ft. (3 m)
   - R-Clamp with 6-32 x 1/2 inch screw

   Required Assembly Hardware:

   - Phillips screwdriver #2
   - Wire strippers
   - Standard slotted screwdriver, approximately 0.25 in (6mm)
   - Crimp-on ring terminals sized for 18AWG* (0.75 mm^2) wire:
     - 9 required for series wiring
     - 13 required for parallel wiring
   - 18AWG* (0.75 mm^2) wire jumpers 4 in (100 mm) long:
     - 2 required for series wiring
     - 4 required for parallel wiring
   - Crimp tool
   - Open end 15/16-inch wrench

   *Note: 16 AWG (1.50 mm^2) for motors operating above 10 amperes.

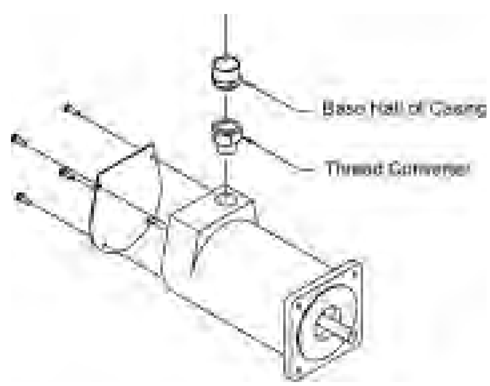
2. **Install Thread Converter and Casing Base.**

   A. Remove and discard the motor's plastic thread insert (CCW rotation).

   B. Remove endbell cover plate from the rear of the motor.

   C. Insert the thread converter into the motor rear endbell tighten. The NPT thread is designed for compression fit into the motor body and therefore will not bottom out.

   D. Insert the base half of the outer casing into the thread converter and tighten securely.



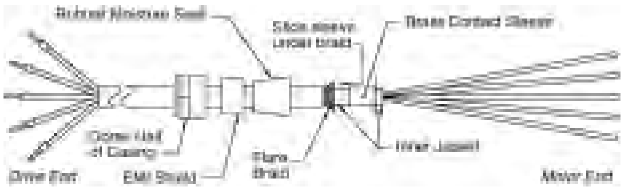
3. **Arrange Components on Cable.**

   A. From the motor end of the cable, first slide on the dome casing half, then the EMI shield, and finally, the rubber moisture seal. The EMI shield is installed blunt end first. The tapered end of the EMI shield fits over the tapered end of the rubber moisture seal.

   B. **The next step is critical and if not done properly will impair the EMC performance of the system:**

   With a finger tip, flare the braid away from the inner jacket of the cable (all the way around). This will allow the braid to relax, and eases insertion of the brass sleeve.

C. Carefully slide the brass sleeve as far under the exposed braid as possible. The sleeve must not cause the braid to bunch up or slide up under the outer jacket. The sleeve flange should butt up against the inner jacket of the cable.

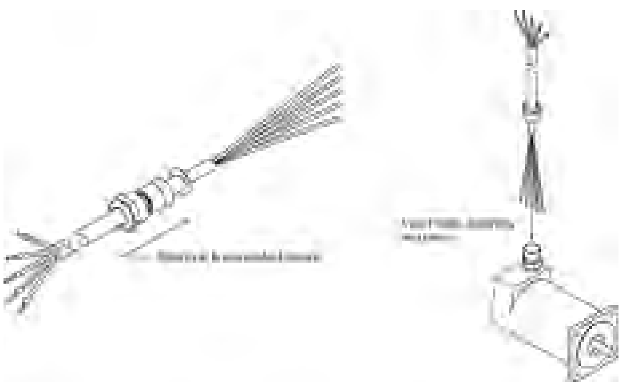


4. **Assemble Components on Cable.**

A. Slide the rubber moisture seal up to the flange of the brass sleeve.

B. Slide the EMI shield onto the rubber moisture seal.

C. Slide the dome half of the outer casing over the EMI shield.



5 **Insert Cable Assembly into Motor.**

Insert the assembly into the prepare motor and screw the dome half of the outer casing until snug. **Do not twist the cable.**

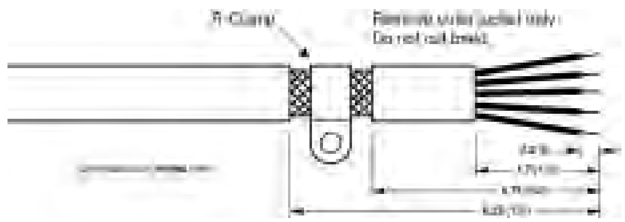
6. **Wire Motor for Series or Parallel Operation.**

See *Selecting Series or Parallel Motor Wiring* in Chapter 1 of this manual.

7. **Connect the Cable to the ZETA6xxx Indexer Drive.**

At the drive end of the motor cable, expose a short length of braiding and anchor the cable to ZETA6xxx Indexer Drive with an R-clamp and screw included in the C10 (C10H) Cable Kit. Avoid looping the motor cable. The motor cable should be kept away from I/O cables carrying control signals.

The next figure shows dimensions for your cable preparation.



INDEX

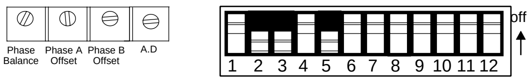
ZETA6xxx Indexer/Drive

Parker Automation

Setup

ADDRESS *(see also page 7)*

Access through the top of the ZETA6xxx chassis (loosen screws, move cover plate).



(S) = Series (P) = Parallel

Non-Compumotor motor current settings – see page 7.

AutoBaud (see page 7)

	6	7
enabled	on	off
default → disabled	off	off

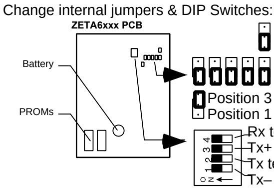
Address

	8	9	10	11	12
default → 0	off	off	off	off	off
1	off	off	off	off	on
2	off	off	off	on	off
3	off	off	off	on	on
4	off	off	on	off	off
5	off	off	on	off	on
(Binary Weighted)					
31	on	on	on	on	on

TIP: The ADDR command allows you to automatically establish addresses for multiple units in a daisy-chain or multi-drop (ADDR address overrides the DIP switch setting).

RS-485 CONFIGURATION *(see also pages 8 & 12)*

1. Change internal jumpers & DIP Switches:



- Position 3 = RS-232 (default)
- Position 1 = RS-485
- All in position 3 = RS-232 (default)
- All in position 1 = RS-485
- Position 3 = 4-wire RS-485 (default)
- Position 1 = 2-wire RS-485
- Rx termination resistor (120 Ω)
- Tx+ bias resistor (681 Ω)
- Tx termination resistor (120 Ω)
- Tx– bias resistor (681 Ω)

DIP switch: ON selects the resistor. Alternative: Set the switches to OFF and connect your own external resistors (see page 8 for calculations).

2. Execute the `PORT2` and `DRPCHKØ` commands to change the COM 2 port.

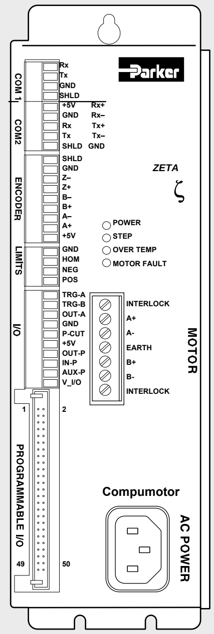
IMPORTANT SETTINGS *(see also page 40)*

Setting	Factory Default	Command
COM 1 Port Function	RS-232	`PORT & DRPCHK`
COM 2 Port Function	RP240	`PORT & DRPCHK`
Electronic Viscosity **	Disabled	`DELVIS`
Active Damping **	Disabled	`Rotary Switch`
Anti-Resonance	Enabled	`DIP SW2-2`
Auto Current Standby	Disabled	`DIP SW2-1`
Waveform	-4% 3rd harmonic	`DWAVEF`
Motor Inductance	≥ 20 mH	`DIP SW2-7,8`
Motor Static Torque	36-100 Oz-in (0.26-0.72 N-m)	`DIP SW2-9,10,11,12`

** These features work best if you "match the ZETA6xxx to the motor" (see matching procedure on page 30).
Active Damping configuration procedure – see page 36.
Electronic Viscosity configuration procedure – see page 38.

Connections

See also pages 11-26



PROGRAMMABLE I/O

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

Even numbered pins connected to common logic ground.

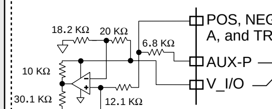
I/O SPECIFICATIONS & INTERNAL SCHEMATICS

AC Input ....95-132VAC (95-264 VAC for ZETA6104-240), 50/60Hz, single phase (peak power requirement - see page 25).

Serial Com ....RS-232C 3-wire; RS-485 4-wire (change jumpers JU1-JU6 to position 1, set JU7 to position 3 if you need 2-wire, select termination resistors).
Up to 99 units in a daisy chain or multi-drop.
9600 baud (or use AutoBaud feature – see page 7);
8 data bits; 1 stop bit; no parity;

Motors.................Compumotor motors (ZETA, OS, RS and TS motors):
Torque, inertia, bearings, weight – see pages 5-6;
Speed/torque curves – see pages 15-16.
Non-Compumotor motors – see page 57.

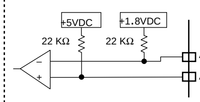
Limits, P-CUT, & Trigger Inputs



Connect AUX-P & V_I/O to the +5V terminal on the I/O connector, **or** to an external 5-24VDC supply. To sink current, connect AUX-P only to the GND terminal.

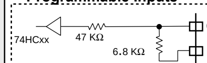
Specs: Low ≤ 1/3 of V_I/O voltage, High ≥ 2/3 of V_I/O voltage; Voltage range = 0-24VDC.

Encoder Inputs



Specs: Differential comparator. Use 2-phase quadrature encoders; max. frequency = 1.6 MHz; min. time between transitions = 625 ns. TTL levels (Low ≤ 0.4V, High ≥ 2.4V); range = 0-5VDC.

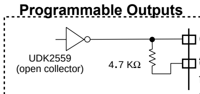
Programmable Inputs



IN-P (Connect to the +5V terminal on the I/O connector, **or** to an external supply of up to 24VDC. To sink current, connect to a GND terminal.) **

Specs: HCMOS-compatible*; voltage range = 0-24VDC.

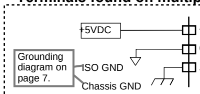
Programmable Outputs



OUT-P (connect to the +5V terminal on the I/O connector, **or** to an external supply of up to 24VDC) **

Specs: Open collector output. Outputs will sink up to 300mA, or source up to 5mA at 5-24VDC.

Terminals found on multiple connectors



5V terminal found on the COM 2, ENCODER, and I/O connectors. Total load limit for all connections is 0.5A.

* HCMOS-compatible levels: Low ≤ 1.00V, High ≥ 3.25V.
** Disconnect from +5V terminal BEFORE connecting an external 5-24VDC supply.

Troubleshooting

See also pages 45-52

- LEDs:
  - POWER......................120VAC power is applied
  - STEP......................... Flashes green with each step pulse.
  - OVER TEMP.............. Max. drive temp limit (122°F, 50°C) exceeded.
  - MOTOR FAULT..........Short circuit in motor windings, motor cable is disconnected or shorted, or INTERLOCK jumper is disconnected or extended.
- Status information (see command descriptions in *6000 Series Software Reference*):
  - General status information ....`TASF, TSSF, TSTAT`
  - Limits (end-of-travel, home) ....`TASF, TLIM`
  - P-CUT input ....`TINO` (bit #6)
  - Programmable inputs and TRG-A/B ....`TIN, INFNC`
  - Programmable outputs and OUT-A ....`TOUT, OUTFNC`
  - Motor fault ....`TASXF` (bit #1)
  - Low voltage fault ....`TASXF` (bit #2)
  - Over temperature fault ....`TASXF` (bit #3)
- P-CUT input must be grounded to GND terminal to allow motion.
- NEG & POS inputs must be grounded to GND terminal to allow motion (or disable with `LHØ` command).
- V_I/O must be connected to 5-24VDC for the P-CUT, HOM, NEG, POS, & TRG-A/B inputs to work.
- To help prevent electrical noise, shield all connections at one end only.
- Error messages while programming or executing programs – see *6000 Series Programmer's Guide*.
- Technical support – see phone numbers on inside of front cover, and the `HELP` command response.

We welcome your feedback on our products and user guides. Please send your responses to our email address: `6000user@cmotor.com`
Direct your technical questions to your local ATC or distributor, or to the numbers printed on the inside front cover of this document.

email