

ZX900 Electrical Specifications

Electrical specifications for the ZX900 series drive's input and output power are provided in this section.

Input Power

Voltage (Nominal)	240VAC (1-phase or 3-phase)
Voltage (Range)	205-252 VAC (1 or 3-phase)
Frequency (Range)	47-66 Hz
Current (Max. cont.)	30A (rms) 3-phase
Power (Max. cont.)	12.4 KVA
Fuses	40A slow blow—User accessible
Isolation transformer	Not required

The actual input power and current is a function of the operating point of the motor (speed and torque) and the duty cycle. You can de-rate the fuse and the isolation transformer by scaling the above numbers by your actual requirements. The data above reflects the servo motor and drive operating at rated speed and at rated torque at 100% duty.

Output Power

Voltage	405 VDC (maximum)
Frequency	0 - 400Hz fundamental (7 kHz PWM)
Current	40A continuous per phase sinusoidal (28.28 Arms) 80A per phase peak (56.56 Arms)
Regen/power dump	Optional accessory

Motor/Drive Configuration

The ZX900's hardware is pre-configured to control ZX900 series motors. The ZX900 series drives only ZX900 series motors, the ZX800 series drives only Z800 motors, and ZX600 series drives only ZX600 motors. *Be sure that your drive type matches your motor type (Z600, Z800, or Z900).* If you have questions about the ZX Series motor/drive configuration, contact your local Automation Technology Center (ATC) or distributor.

Technical Data ZX900 Series

	Units	ZX-910	ZX-920	ZX-930	ZX-940
Continuous Stall Torque (*±10%)	oz-in	2407	4263	5990	9021
	lb-in	150	266	374	564
	lb-ft	12.5	22.2	31.2	47.0
	Nm	17.0	30.1	42.3	63.7
Peak Torque (*±10%)	oz-in	5205	8525	11980	18041
	lb-in	325	533	749	1128
	lb-ft	27	44	62	94
	Nm	37	60	85	127
Rated Torque (*±10%)	oz-in	1939	3341	4830	7480
	lb-in	121	209	302	467
	lb-ft	10.1	17.4	25.2	39.0
	Nm	13.7	23.6	34.1	52.8
Rated Power	hp	9.6	10.4	11.0	11.1
	kWatts	7.2	7.8	8.2	8.3
Rated Speed	rpm	5000	3150	2300	1500
	rps	83.3	52.5	38.3	25.0
Rated Current (line)	A (rms)	27.2	27.7	28.3	28.3
Peak Current (3.3 seconds max)	A (rms)	56.6	56.6	56.6	56.6
Max. Cont. AC input Current (3 phase 240VAC)	A (rms)	30	30	30	30
Rotor Inertia	oz-in ² (mass)	50.79	111.21	166.21	459.48
	oz-in-sec ²	0.132	0.288	0.431	1.190
	kg-m ² x 1E-6	92.9	2034	3040	8404
Motor Weight	lbs	32	57	65	112
	kg(f)	15	26	29	51
Shipping Weight	lbs	89	114	122	169
	kg(f)	40	52	55	77

ZX900 Indexer/Drive Performance Specifications

Positional Repeatability

Repeatability: ± 0.088 degrees, unloaded

Positional Accuracy

Resolver Accuracy: ± 7 arc minutes

Resolver-to-Digital Converter Accuracy: ± 8 arc minutes (For finer accuracies, contact Compumotor—800-358-9070.)

Motor/Drive Compatibility

Different motors can take different amounts of current and require different tuning parameters for typical loads. The **CMTR** (Configure Motor Type) command sets up a drive for a particular motor. By issuing **CMTR**, motor current levels and default parameters are recalled from memory. Do not exceed the current level specified for the motor, excessive current levels will damage the motor.

The following information is provided in case you must modify the motor/drive configuration. This command sequence will set up a drive for a particular motor size and perform the commutation (refer to the [ZX Indexer/Drive Software Reference Guide](#) for more on these commands).

WARNING

This commutation procedure causes violent motor motion. All loads should be removed from the motor shaft before you begin this procedure.

<u>Command</u>	<u>Description</u>
> 1OFF	Turns drive off
> 1CMTRxxx	Sets drive for the motor; xxx =910, 920, 930, or 940
> 10N	Enables the drive

Motor Brakes

These brakes are mounted directly behind the motor and come completely assembled from the factory. When ordering the brake option, please specify the motor type.

Brake Characteristics	Z910	Z920/930	Z940	Units
Supply voltage	24	24	24	VDC
Supply current	0.93	1.27	*	A
Static braking torque	1152	6720	*	oz-in

*Same as Z920/930 Characteristics
Z900 Motor Brake Characteristics

Motor Data

The following pages provide data on each of the four motor frame sizes of ZX900 series systems (ZX910, ZX920, ZX930, ZX940). The data reflecting motor torque does not assume operation from a ZX900 drive. The torque specifications reflect the motor's capabilities. In most cases, the motor windings match the drive's output power with an additional safety margin.

	Motor Size	Z910	Value	Units	Tolerance
1	Constant (s):	Torque	88.32	oz-in/A rms	± 10%
2		Voltage (Sinusoidal)	26.7	V rms/Krpm	± 10%
3		Electrical Time	24	milliseconds	nominal
4		Mechanical Time	0.672	milliseconds	nominal
5		Thermal	43	minutes	nominal
6	Torque (s):	Continuous, Stall	2544	oz-in	min. [1]
7		Continuous, Stall	2400	oz-in	min. [2]
8		Continuous, Rated	1939	oz-in	min. [2]
9		Peak, Max w/o Saturation	6835	oz-in	min. [1]
10		Static Friction	40.7	oz-in	max
11		Ripple (of Rated Torque)	4.5	percent	max [3]
12	Speed:	Rated	5000	rpm	reference
13		Maximum	5000	rpm	reference
14	Frequency:	Rated	166.6	Hz	max.
15	Current:	Rated	27.2	A rms	max. [1]
16		Peak	81.4	A rms	nominal
17	Voltage:	Rated	230	V rms	reference
18		Max	250	V rms	maximum
19	Output Power:	Rated	7.2 (9.6)	kWatts (hp)	min. [1]
20	Inductance:	Terminal (line-line)	4.8	mH	± 30%
21	DC Resistance	Terminal (line-line)	0.2	Ohms	± 10% [1]
22	Acceleration at Rated Torque		51971	rads/sec ²	Theoretical
23	Rotor Inertia		929	kgm ² * 1E-6	nominal
24	Damping		1.728	oz-in / krpm	nominal
25	Weight		32	lbs.	max.
26	Winding Temperature		170 [4]	°C (Celsius)	max.
27	Winding Temperature Rise (Above Ambient) [1]		145	°C (Celsius)	reference
28	Insulation Class		H	—	reference
29	Thermostat TRIP Temperature		135	°C (Celsius)	± 5°C
30	Thermostat RESET Temperature		135	°C (Celsius)	± 10°C
31	Dielectric Strength, (Winding-to-Frame)		1750	VAC	min.
32	Winding Capacitance to Frame		0.00205	µF	max.
33	IP Classification		65 (Shaft [8])	rated	standard
34	Shaft:	Radial-Play (front to back)	2E-5/7E-6	in/lb	reference
35		Material [3]	EC#30	—	reference
36		Magnet Type	NbFeB	—	—
37		Loading [4] 1000 rpm	160	lbs.	max.[7]
		2000 rpm	127.1	lbs.	max.[7]
		3000 rpm	110.9	lbs.	max.[7]
	4000 rpm	100.8	lbs.	max.[7]	
	5000 rpm	93.3	lbs.	max.[7]	
38	Bearing Class, Internal/External		1/Class 3	ABEC/AFBMA	reference
39	Bearing Grease		SRI#2	Manufacturer	reference
40	Shaft Seal Pressure		0.21 (3)	kg/cm ² (psi)	max.
41	Basic Motor Design		3 phase wye connected 2 (P/2)		
42	Stator Phase Sequence		A-B-C (CW viewed from front face plate)		
43	Resolver Type/Accuracy		oz-in/A rms ±7 arc min.		
44	Resolver Manufacturer/Model #		Facso #21-BRCX-334-J39		
45	Standard Resolver Cable Part Number		71-011776-xx		
46	Standard Motor Cable Part Number		71-011776-xx		
47	Options:	Brake—24VDC (1A)—1152 oz-in Holding Torque IP67 Classification Incremental Encoder Tachometer No Keyway			
[1]	25 °C ambient		[5]	Rotor steel is rated af fatigue proof	
[2]	40 °C ambient		[6]	Loads centered 1 inch from mounting flange	
[3]	Measured at 60 rpm (1 rps) in velocity mode		[7]	Loads may be radial and axial such that the sum of the radial and two times the axial does not exceed this figure.	
[4]	Rated for 20,000 hours or 40,000 hours @ 155°C		[8]	The motor shaft is IP30 rated.	

Z805 Motor Specifications

	Motor Size	Z920	Value	Units	Tolerance	
1	Constant (s):	Torque	154.2	oz-in/A rms	± 10%	
2		Voltage (Sinusoidal)	46.6	V rms/Krpm	± 10%	
3		Electrical Time	26.9	milliseconds	nominal	
4		Mechanical Time	0.6	milliseconds	nominal	
5		Thermal	46	minutes	nominal	
6	Torque (s):	Continuous, Stall	4518	oz-in	min. [1]	
7		Continuous, Stall	4262	oz-in	min. [2]	
8		Continuous, Rated	3341	oz-in	min. [2]	
9		Peak, Max w/o Saturation	12422	oz-in	min. [1]	
10		Static Friction	65	oz-in	max	
11		Ripple (of Rated Torque)	4.5	percent	max [3]	
12	Speed:	Rated	3150	rpm	reference	
13		Maximum	3150	rpm	reference	
14	Frequency:	Rated	157.5	Hz	max.	
15	Current:	Rated	27.7	A rms	max. [1]	
16		Peak	84.8	A rms	nominal	
17	Voltage:	Rated	230	V rms	reference	
18		Max	250	V rms	maximum	
19	Output Power:	Rated	7.7 (10.4)	kWatts (hp)	min. [1]	
20	Inductance:	Terminal (line-line)	6.3	mH	± 30%	
21	DC Resistance	Terminal (line-line)	0.234	Ohms	± 10% [1]	
22	Acceleration at Rated Torque		43133	rads/sec ²	Theoretical	
23	Rotor Inertia		2034	kgm ² * 1E-6	nominal	
24	Damping		15.36	oz-in / krpm	nominal	
25	Weight		51	lbs.	max.	
26	Winding Temperature		170 [4]	°C (Celsius)	max.	
27	Winding Temperature Rise (Above Ambient) [1]		145	°C (Celsius)	reference	
28	Insulation Class		H	—	reference	
29	Thermostat TRIP Temperature		170	°C (Celsius)	± 5°C	
30	Thermostat RESET Temperature		135	°C (Celsius)	± 10°C	
31	Dielectric Strength, (Winding-to-Frame)		1750	VAC	min.	
32	Winding Capacitance to Frame		0.00034	µF	max.	
33	IP Classification		65 (Shaft [8])	rated	standard	
34	Shaft:	Radial-Play (front to back)	2E-5/7E-6	in/lb	reference	
35		Material [3]	RC#30	—	reference	
36		Magnet Type	NbFeB	—	—	
37		Loading [4]	1000 rpm	255.6	lbs.	max.[7]
		2000 rpm		202.9	lbs.	max.[7]
	3000 rpm		177.2	lbs.	max.[7]	
	4000 rpm		N/A	lbs.	max.[7]	
	5000 rpm		N/A	lbs.	max.[7]	
38	Bearing Class, Internal/External		1/Class 3	ABEC/AFBMA	reference	
39	Bearing Grease		SRI#2	Manufacturer	reference	
40	Shaft Seal Pressure		0.21 (3)	kg/cm ² (psi)	max.	
41	Basic Motor Design		3 phase wye connected 3 (P/2)			
42	Stator Phase Sequence		A-B-C (viewed from front face plate)			
43	Resolver Type/Accuracy		Single-Speed; Rotor-Excited; ±7 arc min.			
44	Resolver Manufacturer/Model #		Facso #21-BRCX-335-J39			
45	Standard Resolver Cable Part Number		71-011777-xx			
46	Standard Motor Cable Part Number		71-011777-xx			
47	Options:	Brake—24VDC (1.27A)—6720 oz-in Holding Torque IP67 Classification Incremental Encoder Tachometer No Keyway				
[1]	25 °C ambient		[5]	Rotor steel is rated af fatigue proof		
[2]	40 °C ambient		[6]	Loads centered 1 inch from mounting flange		
[3]	Measured at 60 rpm (1 rps) in velocity mode		[7]	Loads may be radial and axial such that the sum of the radial and two times the axial does not exceed this figure.		
[4]	Rated for 20,000 hours or 40,000 hours @ 155°C		[8]	The motor shaft is IP30 rated.		

Z805 Motor Specifications

	Motor Size	Z930	Value	Units	Tolerance	
1	Constant (s):	Torque	212	oz-in/A rms	± 10%	
2		Voltage ()	64	V rms/Krpm	± 10%	
3		Electrical Time	31.1	milliseconds	nominal	
4		Mechanical Time	0.53	milliseconds	nominal	
5		Thermal	50	minutes	nominal	
6	Torque (s):	Continuous, Stall	6513	oz-in	min. [1]	
7		Continuous, Stall	6144	oz-in	min. [2]	
8		Continuous, Rated	4954	oz-in	min. [1]	
9		Peak, Max w/o Saturation	17357	oz-in	min. [1]	
10		Static Friction	133.2	oz-in	max.	
11	Ripple (of Rated Torque)	4.5	percent	max.		
12	Speed:	Rated	2300	rpm	reference	
13		Maximum	2300	rpm	reference	
14	Frequency	Rated	115	Hz	max.	
15	Current:	Rated	29	A rms	max. [1]	
16		Peak	86.2	A rms	nominal	
17	Voltage:	Rated	230	V rms	reference	
18		Max	250	V rms	maximum	
19	Output Power:	Rated	8.4 (11.3)	kWatts (hp)	min. [1]	
20	Inductance:	Terminal (line-line)	8.1	mH	± 10%	
21	D.C. Resistance	Terminal (line-line)	0.26	Ohms	± 10% [1]	
22	Acceleration at Rated Torque		40357	rads/sec ²	Theoretical	
23	Rotor Inertia		3040	kgm ² * 1E-6	nominal	
24	Damping		2.88	oz-in/krpm	nominal	
25	Weight		65	lbs.	max.	
26	Winding Temperature		170 [4]	°C (Celsius)	max.	
27	Winding Temperature Rise (Above Ambient) [1]		145	°C (Celsius)	reference	
28	Insulation Class		H	—	reference	
29	Thermostat TRIP Temperature		170	°C (Celsius)	± 5 °C	
30	Thermostat RESET Temperature		135	°C (Celsius)	± 10 °C	
31	Dielectric Strength, (Winding-to-Frame)		1750	VAC	min.	
32	Winding Capacitance to Frame		0.0038	µF	max.	
33	IP Classification		65 (Shaft [8])	rated	standard	
34	Shaft:	Radial-Play (front to back)	2E-5/7E-6	in/lb	reference	
35		Material [3]	RC#30	—	reference	
36		Magnet Type	NbFeB	—	—	
37		Loading [4]	1000 rpm	263	lbs.	max.
			2000 rpm	208.8	lbs.	max.
3000 rpm	N/A		lbs.	max.		
4000 rpm	N/A		lbs.	max.		
5000 rpm	N/A		percent	max.		
38	Bearing Class, Internal/External		1/Class 3	ABEC/AFBMA	reference	
39	Bearing Grease		SRI#2	Manufacturer	reference	
40	Shaft Seal Pressure		0.21 (3)	kg/cm ² (psi)	max.	
41	Basic Motor Design		3 phase wye connected 2 (P/2)			
42	Stator Phase Sequence		A-B-C (CW viewed from front face plate)			
43	Resolver Type/Accuracy		Single-Speed; Rotor-Excited; ± 7 arc min.			
44	Resolver Manufacturer/Model #		Fasco #21-BRCX-335-J39			
45	Standard Resolver Cable Part Number		71-011777-01			
46	Standard Motor Cable Part Number		71-012979-01			
47	Options:	Brake—24VDC (1.27A)—6720 oz-in Holding Torque IP67 Classification Incremental Encoder Tachometer No Keypad				
[1]	25 °C ambient		[5]	Rotor steel is rated as fatigue proof		
[2]	40 °C ambient		[6]	Loads centered 1 inch from mounting flange		
[3]	Measured at 60 rpm (1 rps) in velocity mode		[7]	Loads may be radial and axial such that the sum of the radial and two times the axial does not exceed this figure.		
[4]	Rated for 20,000 hours or 40,000 hours @ 155°C		[8]	The motor shaft is IP30 rated.		

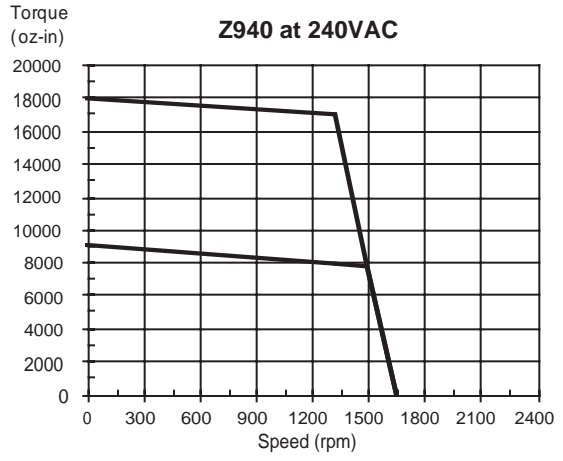
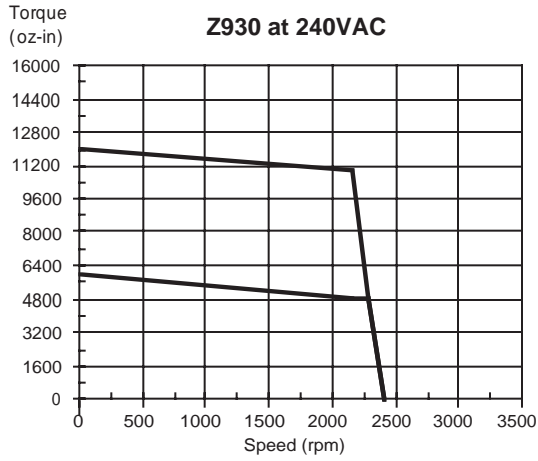
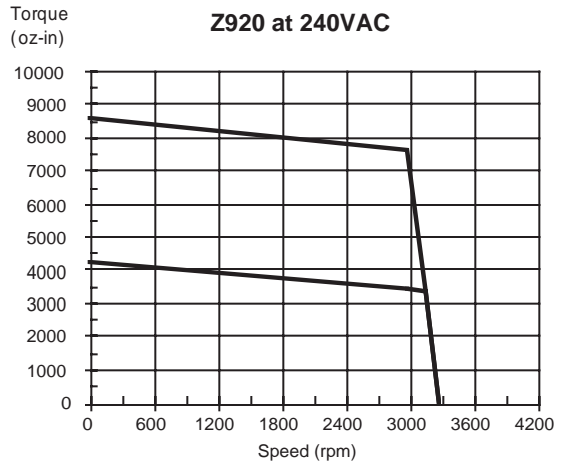
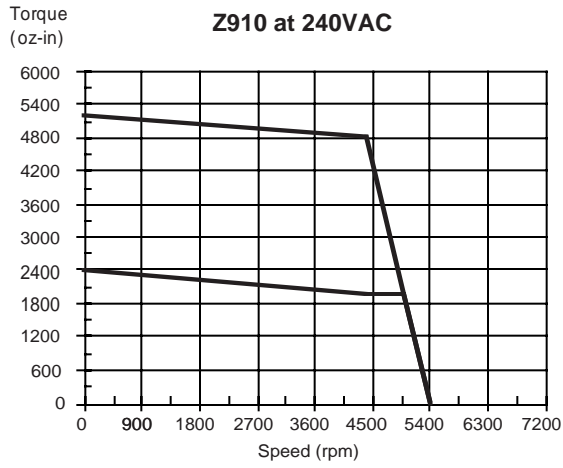
Z810 Motor Specifications

	Motor Size	Z940	Value	Units	Tolerance	
1	Constant (s):	Torque	319	oz-in/A rms	± 10%	
2		Voltage ()	96.3	V rms/Krpm	± 10%	
3		Electrical Time	56.5	milliseconds	nominal	
4		Mechanical Time	0.57	milliseconds	nominal	
5		Thermal	56	minutes	nominal	
6	Torque (s):	Continuous, Stall	12007	oz-in	min. [1]	
7		Continuous, Stall	11328	oz-in	min. [2]	
8		Continuous, Rated	9388	oz-in	min. [2]	
9		Peak, Max w/o Saturation	32870	oz-in	min. [1]	
10		Static Friction	128.6	oz-in	max.	
11		Ripple (of Rated Torque)	4.5	percent	max.[3]	
12	Speed:	Rated	1500	rpm	reference	
13		Maximum	1500	rpm	reference	
14	Frequency	Rated	75	Hz	max.	
15	Current:	Rated	35.5	A rms	max. [1]	
16		Peak	108.5	A rms	nominal	
17	Voltage:	Rated	230	V rms	reference	
18		Max	250	V rms	maximum	
19	Output Power:	Rated	10.4 (14.0)	kWatts (hp)	min. [1]	
20	Inductance:	Terminal (line-line)	13	mH	± 10%	
21	D.C. Resistance	Terminal (line-line)	0.23	Ohms	± 10% [1]	
22	Acceleration at Rated Torque		27613	rads/sec ²	Theoretical	
23	Rotor Inertia		8400	kgm ² * 1E-6	nominal	
24	Damping		15.36	oz-in / krpm	nominal	
25	Weight		112	lbs.	max.	
26	Winding Temperature		170 [4]	°C (Celsius)	max.	
27	Winding Temperature Rise (Above Ambient) [1]		145	°C (Celsius)	reference	
28	Insulation Class		H	—	reference	
29	Thermostat TRIP Temperature		170	°C (Celsius)	± 5 °C	
30	Thermostat RESET Temperature		135	°C (Celsius)	± 10 °C	
31	Dielectric Strength, (Winding-to-Frame)		1750	VAC	min.	
32	Winding Capacitance to Frame		0.0082	µF	max.	
33	IP Classification		65 (Shaft [8])	rated	standard	
34	Shaft:	Radial-Play (front to back)	1E-5/4E-6	in/lb	reference	
35		Material [3]	RC#3	—	reference	
36		Magnet Type	NbFeB	—	—	
37		Loading [4]	1000 rpm	365.9	lbs.	max.
			2000 rpm	N/A	lbs.	max.
		3000 rpm	N/A	lbs.	max.	
		4000 rpm	N/A	lbs.	max.	
		5000 rpm	N/A	lbs.	max.	
38	Bearing Class, Internal/External		1/Class 3	ABEC/AFBMA	reference	
39	Bearing Grease		SRI#2	Manufacturer	reference	
40	Shaft Seal Pressure		0.21 (3)	kg/cm ² (psi)	max.	
41	Basic Motor Design		3 phase wye connected 3 (P/2)			
42	Stator Phase Sequence		A-B-C (CW viewed from front face plate)			
43	Resolver Type/Accuracy		Single-Speed; Rotor-Excited; ± 7 arc min.			
44	Resolver Manufacturer/Model #		Faxco #21-BRCX-335-J39			
45	Standard Resolver Cable Part Number		71-011777-01			
46	Standard Motor Cable Part Number		71-012979-01			
47	Options:	Brake—24VDC (1.27A)—6816 oz-in Holding Torque IP65 Classification Incremental Encoder Tachometer No Keyway				
[1]	25 °C ambient		[5]	Rotor steel is rated af fatigue proof		
[2]	40 °C ambient		[6]	Loads centered 1 inch from mounting flange		
[3]	Measured at 60 rpm (1 rps) in velocity mode		[7]	Loads may be radial and axial such that the sum of the radial and two times the axial does not exceed this figure.		
[4]	Rated for 20,000 hours or 40,000 hours @ 155°C		[8]	The motor shaft is IP30 rated.		

Z820 Motor Specifications

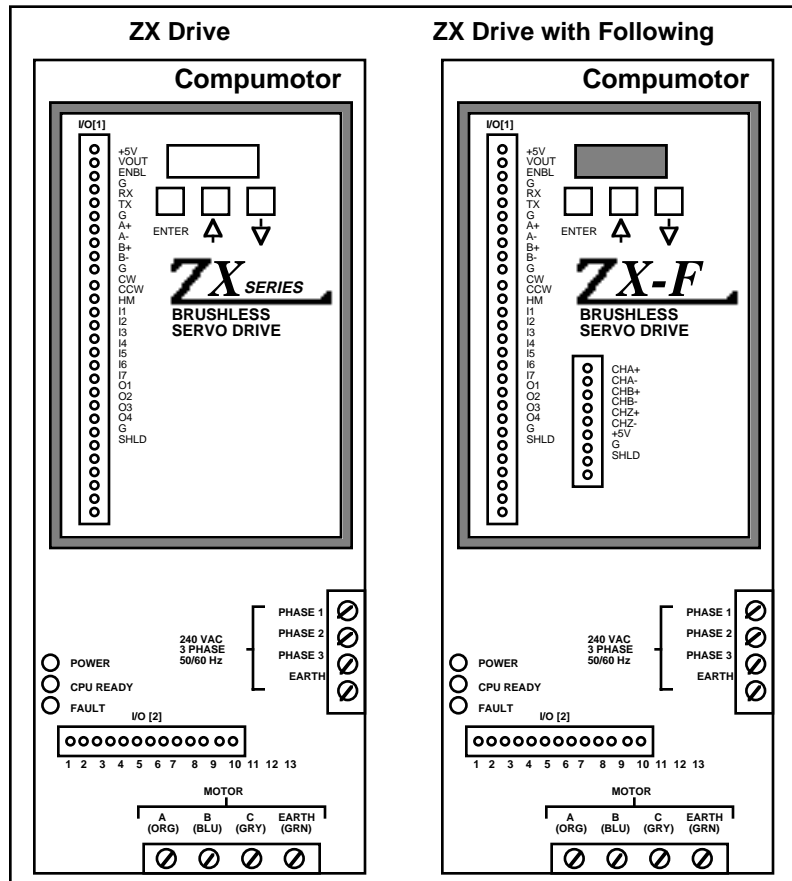
Speed/Torque Curves

The following speed/torque curves represent the available shaft torque at different operating speeds. Operation at 240VAC is shown for each motor size. Actual motor torque may vary $\pm 10\%$ due to motor manufacturing variances.



I/O Data & Descriptions

This section defines the inputs and outputs that are on the ZX's front panel. Refer to the figure below for the location of the inputs and outputs described in this section.



ZX & ZXF Front Panels

Pin #	Function	Color
1	Shield	—
2	Stator 1	Red
3	Stator 2	Black
4	Stator 3	Green
5	Stator 4	Blue
6	Rotor 1	Brown
7	Rotor 2	White
8	Motor Temp (+)	Yellow
9	Motor Temp (-)	Orange

Resolver Cable Pin-Out

Motor Connector	Pin	Color
A		Orange
B		Blue
C		Grey
D		Green

Motor Cable Pin-Out

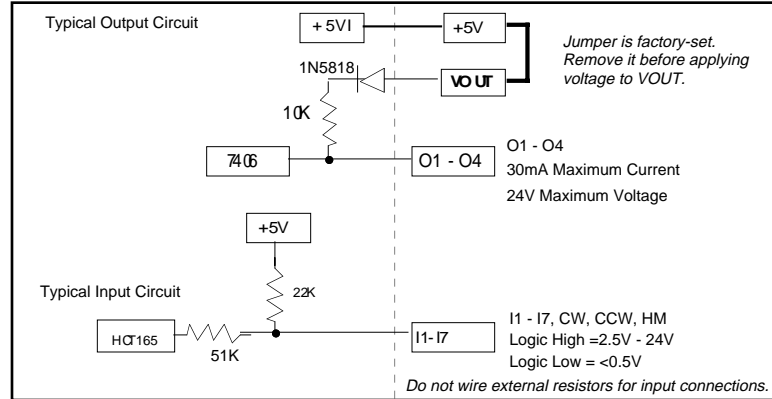
Programmable Inputs

There are 7 inputs, one I/O ground, and one earth ground pin associated with **PROG INPUTS**. The first three inputs are **CCW**, **CW**, and **HM**. These inputs are electronically identical to inputs **I1** - **I17**. The primary difference between these inputs is that **CCW**, **CW**, and **HM** are dedicated inputs, while **I1**-**I17** have programmable input functions. These inputs have an internal isolated 5V supply. The figure below represents a typical input circuit. *Input Voltage: 0 - 24VDC (Current limiting resistor not needed).*

Programmable Outputs

The ZX has four programmable outputs that are jumpered at the factory and pulled up to 5VDC through an internal 10K resistor. With the VOUT input, you can pull these outputs up to 24VDC and sink up to 30 mA (max).

Helpful Hint:
Output: 5 - 25V and can sink up to 30 mA

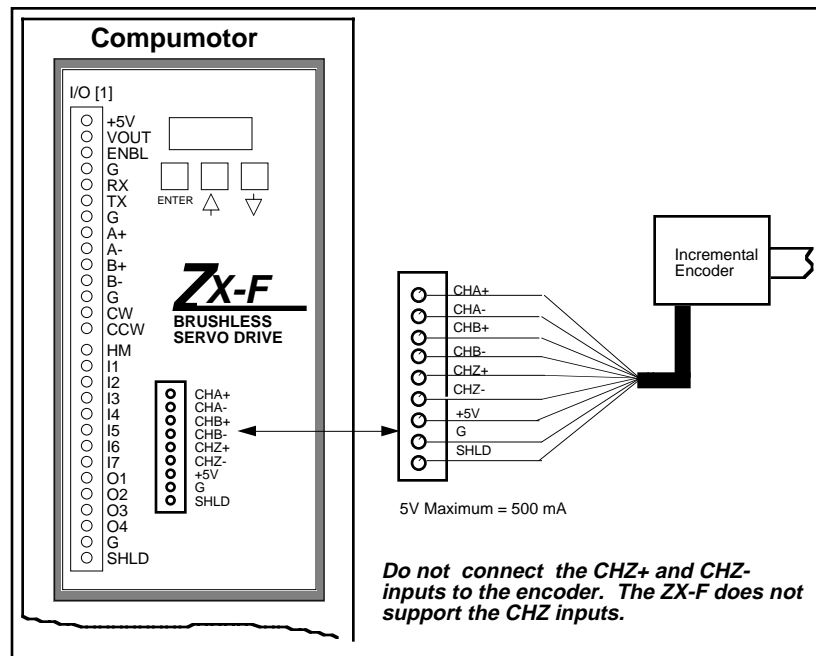


Typical Model Input & Output Circuit

INC Encoder

The ZXF's Incremental encoder connector is a 13-pin phoenix connector. The incremental encoder interface accepts two-phase quadrature incremental encoders with differential or single-ended outputs (+5V TTL-compatible). The ZX provides the 5VDC at 500 mA supply for the encoder. The maximum frequency per channel is 800Khz.

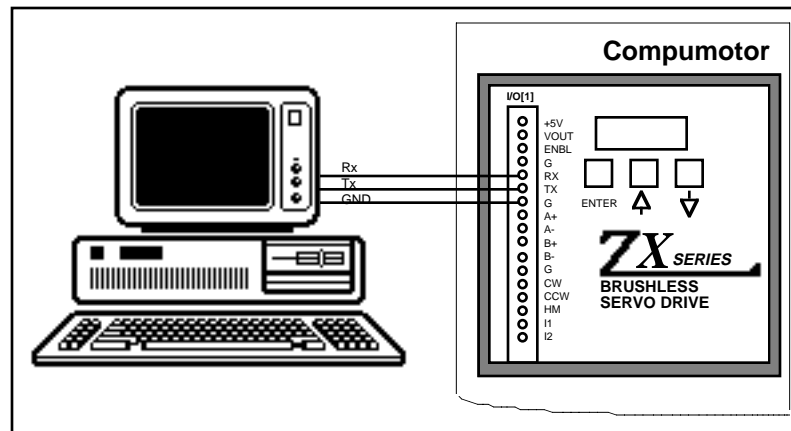
Helpful Hint:
The ZXF does not use the Z Channel



Incremental Encoder Connector Description

RS-232C

You can communicate with the ZX via a computer or terminal through RS-232C inputs. You must wire the Tx (Transmit), Rx (Receive), and GND (Logic Ground) inputs as shown in the figure below. The ZX accepts standard EIA RS-232C signals from +15VDC to -15VDC. You can change the baud rate, but the other parameters are fixed. You must configure your computer or terminal to the proper setting.



ZX RS-232C Interface

Factory Default Settings

This section contains the default settings for various ZX/ZXF functions. Your product will be shipped to you with these default settings.

RS-232C Communications

- Baud Rates: 9600 (default setting), 4800, 2400, 1200, 600, 300
- Data Bits: 8
- Parity: None
- Stop Bits: 1
- Full Duplex

ZX Device Address

The default address setting is **01**. Refer to *Chapter 2 Getting Started* for steps on displaying and modifying the address setting via pushbuttons.

Hardware Interfaces

- Front panel pushbuttons are enabled
- Sequence and Ratio Select are disabled
- RS-232C is enabled
- Inputs active low and configured as triggers, with dedicated home, CW, and CCW limits
- Outputs active low, configured as programmable outputs

Limits

- Hardware limits enabled
- Software limits disabled

Motion Parameters

- Acceleration = 10 rps²
- Deceleration = 10 rps²
- Velocity = 1 rps
- Motor Resolution = 5,000
- Distance = 25,000
- Encoder Resolution = 4,000
- Use the DR command to display the present configuration of the ZX

Maintenance & Troubleshooting

The information in this chapter will enable you to:

- Maintain the system's components to ensure smooth, efficient operation
- Isolate and resolve system hardware and software problems
- Use this chapter as a quick-reference for a description of system error codes

Motor Maintenance

Inspect the motor regularly to ensure that bolts and couplings have not loosened during operation. This will prevent minor problems from becoming major problems. The motor is brushless and the bearings are sealed. *No maintenance, other than regular visual inspection, is necessary.*

ZX Maintenance


The ZX requires minimal maintenance, but the NEMA cabinet should be inspected regularly to ensure that the air filters are kept clean. The ZX requires good air flow for proper cooling.

Spare Parts


Description	Function	Part Number
5-Pin Connector	I/O [1] Connectors	43-008128- 01
9-Pin Connector	I/O [1] Connectors	43-078755-01
Battery	Maintains RAM memory	47-007709-01

Spare Parts Table

Battery

 **Helpful Hint:**
The battery is located in the ZX's front module.

The ZX's nonvolatile memory is a battery-backed RAM (Random Access Memory). The lithium battery keeps the RAM powered at all times. *The life of this battery is approximately 10 years.* When the battery runs low, the ZX will be unable to hold a program in nonvolatile memory. *This error may also occur if the Sequence Termination (XT) command is not placed at the end of each sequence.* If the battery back up is not functioning, error code **30** (Check Sum Error) will be displayed when power is cycled. To verify that the battery is OK, type **1XC**, then cycle power to the ZX. If the battery is OK, error code **30** should be gone. If the message persists, replace the battery (part #47-007709-01). Call your local distributor to order the battery.

 **Helpful Hint:**
To change the battery, complete the following steps.

- ① You must remove the enclosure to reach the battery.
- ② Remove the four screws holding the visible circuit board.
- ③ Remove the visible circuit board to reach the *middle* circuit board.
- ④ The battery is labeled **BT1** and is the size of a quarter. Remove the battery from the ZX and *immediately replace it with the new battery.*

WARNING

Battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire.

Troubleshooting

If your system malfunctions, you must identify and isolate the problem. The first step is to isolate each component and ensure that each component functions properly when it is run independently. If you have additional units available, you may want to use them to replace existing components in your system to help identify the source of the problem.

Helpful Hint:
Refer to the problem solutions in this chapter. If the problem persists, contact Compumotor's Applications Engineering Department (800-358-9070).

Determine if the problem is mechanical, electrical, or software-related. Can you repeat or re-create the problem? Random events may appear to be related, but they may not be contributing factors to your problem. Carefully investigate and decipher the events that occurred before the subsequent system problem.

You may be experiencing more than one problem. 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.

CW, CCW, HM

If you are have problems using the Trigger (**TR**), Home (**HM**), CW, CCW, or Sequence Select inputs, check your wiring for proper installation. Use an ohmmeter to properly connect the switches and inputs.

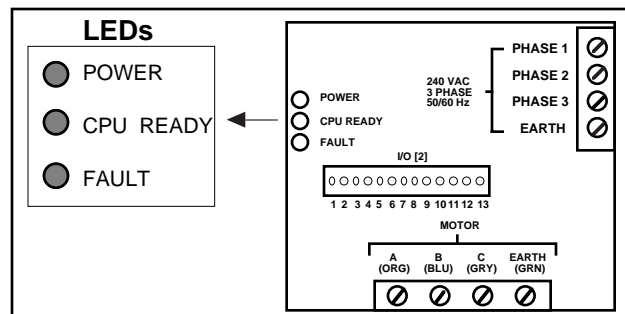
If the hardware connections are correct, use the **IS** command to check the hardware status of each input manually and determine if the ZX recognizes the input change. If the status does not change, check the hardware settings.

Remote Sequencing (Binary Weighted)

If you want to run sequences from binary weighted interfaces, verify that the hardware interface is wired properly. Use an ohmmeter to verify proper wiring. Enter the **IS** command to read the status of the inputs. Change the input setting and check the input status (**IS**) again to ensure that the ZX recognizes the change in the sequence select input. Ensure that the binary weighted input is calling the proper sequences. Check *Chapter 4 Application Design* for the Sequence Select Table. If you have a problem running a sequence from the remote input, run the sequence using the **XR** command before attempting to run it using BCD input.

Diagnostic LEDs

The ZX has three diagnostic LEDs on its front panel.



ZX LEDs

- POWER Indicates that the drive is powered-up (normally green).
- CPU READY Indicates that the processor is properly functioning (normally green).
- FAULT Indicates a drive fault or error (red when a fault exists; normally off).

In addition to these LED indicators, the ZX has a front panel display that scrolls fault messages when a fault occurs. *Chapter 4 Application Design* describes all operations and capabilities of the front panel display.

ZX Warning Codes

The following warning codes will be displayed on the alphanumeric display before an overvoltage fault occurs.

Code	Warning	Description
03	Over Voltage	The internal bus voltage has passed the warning threshold. This warning will not fault the drive; the error threshold (Error 04) will fault the drive. The warning message will remain present until an ON command or a system reset is executed.
60	Commanded Shutdown	The ZX has been commanded off by the OFF command.

ZX Warning Codes

ZX Fault Codes

The following fault codes and messages will be displayed on the alphanumeric display when the respective faults occur. The Report Servo Errors (**RSE**) command also reports faults and warnings. Except where noted, the drive can be re-enabled after a fault has occurred by correcting the fault (if applicable) and typing **ON**.

Code	Fault	Description
04	Overvoltage	The internal bus voltage has exceeded its limit. Verify the input power voltage. This error may also be caused by rapid decelerations. This error overrides the over voltage warning.
18	Low Voltage	The input power to the drive is either not present, or at a lower voltage than 92V. Verify the input power voltage and make sure that the power is correctly connected.
19	over-current (Short Circuit)	A short circuit between motor phases, or between any phase and ground will cause the drive to fault. This may be due to improper motor wiring to the drive or due to a bad motor. In some cases an extremely high acceleration may cause this error. Power down the complete ZX, correct the wiring, and power-up the system. This fault cannot be removed by typing the ON command.
20	Position Error Exceeded	The user defined position error limit has been exceeded. The CPE (Configure Position Error) command can alter the error limit. The factory default is one revolution (5,000 motor steps). A position error may be caused by a rapid acceleration rate or possibly bad servo tuning. The user must decide whether to increase the position error limit or to change his motion profile so that the drive no longer faults out.
21	Rolling Average Current Fault	The user specified average current limit has been exceeded. The CCA (Configure Current Average) command alters the average current limit. If the drive continues to fault out, you may have to reduce the acceleration rate of your move. The average current of the drive is calculated over a rolling 3-second time period.
22	Average Current Limit Exceeded	The drive's average current limit has been exceed. A hardware detect circuit has turned the drive off due to too much current.
23	Drive Enable Input Not Active	The drive enable input on the screw terminal connector I/O[1] has been deactivated. For drive operation, a normally closed switch or wire jumper is necessary from ENBL to ground. The ZX is shipped with a jumper installed.
27	Velocity Error Exceeded	The user-defined velocity error limit has been exceeded. The CVE (Configure Velocity Error) command can alter the error limit. A velocity error may be caused by a rapid acceleration rate or bad servo tuning.
30	Z RAM Failure	This error should occur only during factory initialization of the ZX/ZXF or <i>if the Sequence Termination (XT) command is not placed at the end of each sequence.</i> . Call Compumotor (800-358-9070) if it occurs at any other time.
41	CW Hardware Limit	The ZX has reached a CW hardware limit.
42	CCW Hardware Limit	The ZX has reached a CCW hardware limit.
43	CW Software Limit	The ZX has reached a CW software limit.
44	CCW Software Limit	The ZX has reached a CCW software limit.
55	Power Supply Failure	This error indicates that the isolated power supply for the ZX's amplifier has failed. Call Compumotor (800-358-9070).
61	Incoming Indexer Pulses	When the ZX is reset or commanded ON , no step pulses are accepted when the amplifier is first enabled (this would constitute infinite acceleration).
62	Current Integration Fault	Currently this fault is not enabled.
70	Resolver Disconnected	The resolver feedback signal from the motor to the drive is missing. This feedback is required to operate the drive. Make sure the resolver connection is secure.
77	Resolver Resolution Fault	For a given resolver resolution there is a maximum velocity at which the resolver-digital converter can operate. If the drive faults due to this error, the maximum velocity commanded to the drive exceeds the capabilities of the resolver-digital converter. See the CRR command.
91	Heatsink Overtemperature	The internal heatsink of the ZX has reached its temperature limit. Make sure the ambient temperature for the drive is within specifications.
92	Motor Overtemperature	The motor has reached its temperature limit. Make sure the motor's ambient temperature is within specifications. Be sure the drive is configured correctly for the motor used (CMTR command).
93	PCB Overtemperature	The Printed Circuit Board temperature limit has been reached. Make sure the ambient temperature for the drive is within specifications.

Drive Fault Codes

RS-232C Problems

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

- ① Be sure the host computer's transmit (**Tx**) wire is wired to the peripheral's receive (**Rx**) connection, and the host computer's receive (**Rx**) wire is wired to the peripheral's transmit (**Tx**) connection. Switch the receive and transmit wires on either the host or peripheral if the problem persists.
- ② Confirm that the host and peripheral are configured for the same baud rate, 8 data bits, 1 stop bit, and no parity.
- ③ If you receive double characters, for instance typing **A** and receiving **AA**, the computer is set for half duplex mode. Change the setup to full duplex mode.
- ④ Use DC common or signal ground as a reference, not earth ground.
- ⑤ Cable lengths should not exceed 50 ft. unless you are using some form of line driver, optical coupler, or shield. As with any control signal, be sure to shield the cable-to-earth ground at one end only.
- ⑥ To test the terminal or terminal emulation software and the RS-232C cable for proper three-wire communication, unhook the ZX and enter a character. You should not receive an echoed character. If you do, you are in half duplex mode. Connect the host's transmit and receive lines together and send another character. You should receive the echoed character. If not, consult the manufacturer of the host's serial interface for proper pin outs.

Software Debugging Tips

This section offers helpful tips for debugging your programs. The ZX has several tools that can be used to aide in the determination of a problem in the system design.

 **Helpful Hint:**
The software tools are listed below

XTR	Trace Mode
DIN , DOUT	I/O Simulation
XST	Single Step
XS	Sequence Execution Status
DF	Displays indexer Status
X	Displays state of the Indexer
DR	Displays Interface Option Status
FS	Displays Indexer Status Options
OS	Displays Homing/Jog Status
	Report backs

Trace Mode

Trace mode displays what is occurring as you execute your sequence. By running the Trace mode you can see what commands are being executed and if the program stops running, you can see what command was last executed. Trace mode and Interactive mode (**SSI**) will help you to find commands that the indexer may not recognize. The trace mode is enabled and disabled using the **XTR** command. When enabled you will execute sequences as you normally would using the **XR** command. As the sequence is running the commands are displayed on the screen. **XTR1** enables Trace mode, **XTR0** disables it. See *Chapter 4 Application Design*, for a thorough explanation of Trace mode.

I/O Simulation

I/O simulation can be done without actually physically toggling the inputs or outputs using the **DIN** and **DOUT** commands. These commands can be used to simulate the input or output state you desire so that you can test portions of your sequences and program. See *Sequence Debugging Tools* in *Chapter 4 Application Design* for more details.

Displaying ZX Status

There are several commands that you can use to check the ZX's status. You can report back the value or setting of almost all of the ZX commands by typing the device address followed by the command then a carriage return or a space bar. In this way, you can find out what values you have entered in different commands. The **DR** command reports the current state of the ZX. Use this to verify that the unit is configured as you want it. You can use four other report back commands to determine the state of the unit. These commands report a binary number. Each bit of the report corresponds to possible ZX functions or modes.

DFX Command Report Back

The **DFX** command reports the ZX's current states and conditions.

```

32 31 30 29 23 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
*0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

```

Bit representations —25-32,13 reserved

Bit

- 24 Mode Profile: no = 0, yes = 1
- 23 Mode alternate: no = 0, yes = 1

- 21 Hit a software CCW limit no = 0; yes = 1
- 20 Hit a software CW limit no = 0; yes= 1
- 19 Home limit not found = 0; found = 1
- 18 Jogging no = 0; yes = 1
- 17 Queued for **RM** mode no = 0; yes = 1
- 16 Run sequence on power up no=0; yes=1
- 15 **U** command 0=not waiting; 1=waiting for continue
- 14 Waiting for a trigger no = 0; yes = 1
- 12 Back up to home limit 0 = no; 1 = yes
- 11 High-speed portion of home move no = 0; in process = 1
- 10 Execute a sequence no = 0; yes = 1
- 9 Wait on a timer no = 0; yes = 1
- 8 Hit a CCW limit no = 0; yes = 1
- 7 Hit a CW limit no = 0; yes = 1
- 6 **PS** command: 0 = not waiting; 1 = waiting for continue
- 5 Absolute move direction 0 = CW 1= CCW
- 4 Incremental/absolute 0 = **MPI**; 1 = **MPA**
- 3 Mode preset = 0; Continuous = 1
- 2 Commanded move direction: 0 = CW; 1 = CCW
- 1 Preset move in progress: 0 = not moving; 1 = moving
- 0 Continuous move: 0 = not moving; 1 = moving

The **FS** command reports a binary word that has various interface options associated with each bit. The **OS** command reports the homing options and the Jog enable option. The **SS** command reports various indexer software options. If **1** is in the bit location, the feature or mode is enabled. Refer to the example below.

	A	B	C	D	_	E	F	G	H	_I	J	K	L	M	N	O	P	_Q	R	S	T
SS	*0	0	0	0	_	0	0	0	0	_0	0	0	0	0	0	0	0	_0	0	0	0
FS	*0	0	0	0	_	0	0	0	0	_0	0	0	0	0	0	0	0	_0	0	0	0
OS	*0	0	0	0	_	0	0	0	0												

- SSA** RS232 Echo 0 = Echo on 1 = Echo off
- SSD** Alternate Mode Stop 0 = end of cycle 1 = immediately
- SSG** Clear/Save buffer on limit 0 = clear 1 = Save
- SSH** Clear/Save buffer on stop 0 = clear 1 = Save
- SSI** Enable/Disable Interactive Mode
- SSJ** Enable/Disable Continuous scan mode
- SSL** Resume execution enable
- SSN** Enable error message mode
- SSQ** Enable Drive Fault indicator

- FSD** Enable/Disable Stop on Stall
- FSI** Enable/Disable Following
- FSK** Enable following learn mode
- FSL** Enable following self correction mode
- FSN** Enable Pulse and Direction following
- FSP** Enable position tracking

- OSB** Enable back-up to home switch
- OSC** Define Active edge of Home switch 1=Active high signal
- OSD** Enable Encoder Z channel Input for Homing
- OSE** Enable Jogging
- OSG** Define Final Home approach direction 1=CCW
- OSH** Define Active edge of home switch to stop on 1=CCW

Error Code 30

Error code 30 indicates that a checksum that was calculated on a reset or from cycling power does not match the previously calculated checksum. Error code 30 will occur in the following situations:

- You are changing PROMs.
- If memory is corrupted during operation or when the ZX is off.
- If the battery fails (memory cannot be saved).

In most cases, you can use the Create Checksum (**XC**) command to clear error code 30. Select the proper motor size before you issue the **ON** command. **ON** clears error code 30 from the front panel display. If the error occurs each time you power up your unit, consult Compumotor's Application Engineering Department (800-358-9070).

Reducing Electrical Noise

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

Common Mistakes

Some common mistakes that have been made with Compumotor's X language and remedies for these mistakes are discussed below.

Problem A

A ZX move is commanded and no motion occurs.

Possible Errors

- Following mode may be enabled when you try to make a move as an indexer.
- A limit may be enabled and active.
- You may be in Absolute mode and are already at the position you are commanding the motor to move to.

Solution A

Check your configuration and motion settings.

Problem B

A following move is commanded and no motion occurs.

Possible Errors

- The unit may not be in Following mode (**FSI**).
- Limits are enabled, you may be in Absolute mode and are already at the position you are commanding the motor to move to.

Solution B

Set the ZX to Following mode. Check your configuration and motion settings.

Problem C

Motion is jittery in Following mode.

Solution C

Smooth motion by decreasing the sampling of the encoder interface (increase TF).

Problem D

The unit may appear to not be responding to commands.

Possible Error

- If you defined a sequence and never issued an **XT** command, the ZX still thinks you are defining a sequence.

Solution D

Issue an XT command at the end of the sequence to end sequence definition.

Returning The System

If your ZX Indexer/Drive system is faulty, you must return the drive and motor for replacement or repair. A failed drive can damage motors, and a faulty motor can damage subsequent drives. If you must return your ZX System to effect repairs or upgrades, use the following steps:

Step ①

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

Step ②

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

- What is the extent of the failure/reason for return?
- How long did it operate?
- How many units are still working?
- How many units failed?
- What was happening when the unit failed (i.e., installing the unit, cycling power, starting other equipment, etc)?

- How was the product configured (in detail)?
- What, if any, cables were modified and how?
- With what equipment is the unit interfaced?
- What was the application?
- What was the system sizing (speed, acceleration, duty cycle, inertia, torque, friction, etc.)?
- What was the system environment (temperature, enclosure, spacing, unit orientation, contaminants, etc.)?
- What upgrades, if any, are required (hardware, software, user guide)?

Step ③

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

Step ④

Ship the unit to: Parker Compumotor Corporation
 5500 Business Park Drive
 Suite D
 Rohnert Park, CA 94928
 Attn: RMA # xxxxxxxx

A P P E N D I X

Command Listing

"—Quote Command
;—Comment Field
#—Step Sequence

A—Acceleration
AD—Deceleration

B—Buffer Status Report
BCCA—Buffered Configure Current Average
BCCP—Buffered Configure Current Peak
BCDB—Buffered Configure Deadband
BCPD—Buffered Configure Position Derivative
BCPE—Buffered Configure Position Error
BCPI—Buffered Configure Position Integral
BCPP—Buffered Configure Position Proportional
BCPPM—Buffered Configure Pos Proportional Max.
BCRR—Buffered Configure Resolver Resolution
BCTC—Buffered Configure Time Constant
BCTG—Buffered Configure Tach Gain
BCTGM—Buffered Configure Tach Gain Maximum
BCVF—Buffered Configure Velocity Feed-Forward
BCVFM—Buffered Configure Vel Feed-Forward Max.
BCVI—Buffered Configure Velocity Integral
BCVIM—Buffered Configure Velocity Integral Maximum
BCVP—Buffered Configure Velocity Proportional
BCVPM—Buffered Configure Vel Proportional Max.

BL—Backlash
BS—Buffer Status Report

C—Continue
CCA—Configure Current Average
CCP—Configure Current Peak
CDB—Configure Deadband
CMR—Configure Motor Resolution
CMTR—Configure Motor
CPB—Configure Pushbuttons
CPD—Configure Position Derivative
CPDM—Configure Position Derivative Maximum
CPE—Configure Position Error
CPI—Configure Position Integral
CPIM—Configure Position Integral Maximum
CPP—Configure Position Proportional
CPPM—Configure Position Proportional Max.
CRR—Configure Resolver Resolution
CTG—Configure Tach Gain
CTGM—Configure Tach Gain Maximum
CVE—Configure Velocity Error
CVF—Configure Velocity Feed-Forward
CVFM—Configure Velocity Feed-Forward Max.
CVI—Configure Velocity Integral
CVIM—Configure Velocity Integral Maximum
CVP—Configure Velocity Proportional
CVPM—Configure Velocity Proportional Maximum
CR—Carriage Return

D—Distance
DCA—Display Current Average
DCI—Display Current Instantaneous
DCP—Display Current Peak
DFS—Display Flags for Servo Parameters
DFX—Display Flags for Indexer Status
DIN—Disable Inputs
DOUT—Disable Outputs
DP—Distance Point
DPA—Display Actual Position
DPE—Display Position Error
DPS—Display Setpoint Position
DR—Display Parameters
DRD—Read Distance Via Parallel I/O
DSP—Display Servo Picture
DVA—Display Actual Velocity
DVS—Display Velocity Setpoint

E—Enable RS-232C Communication Interface
ELSE—Else

F—Disable RS-232C Communication Interface
FAC—Set Following Synchronization Rate
FBS—Following Base
FC—Following Learn Count
FEN—Set Following Synchronization Count
FIN—Following Increment
FMCA—Find Motor Commutation Angle
FOL—Following Percent
FOR—Following Ratio
FP—Following Encoder Distance Point
FPA—Following Encoder Absolute Point
FRD—Read Following Via Parallel I/O
FS—Encoder Function Report
FSA—Enable Following Mimic Mode
FSF—Enable Following Synchronized Accel
FSI—Enable/Disable Following Mode
FSK—Enable/Disable Following Learn Mode
FSL—Enable/Disable Correction Mode
FSN—Enable/Disable Pulse Following Mode
FSP—Enable/Disable Tracking Mode

G—Go
GD—Go Predefined Move
GDEF—Move Definition
GH—Go Home
GHA—Go Home Acceleration
GHAD—Go Home Deceleration
GHF—Go Home Final Velocity
GHV—Go Home Velocity
GOSUB—GOSUB Sequence
GOTO—GOTO Sequence

^H—Backspace
H—Set Direction
HALT—Halt

ID—Immediate Distance
IF—If
IN—Set Input Functions
INL—Set Active Input Level
IO—Immediate Output
IS—Input Status Report
IV—Immediate Velocity

JA—Jog Acceleration
JAD—Jog Deceleration
JVH—Jog Velocity (High)
JVL—Jog Velocity (Low)

K—Kill

L—Loop
LAD—Limit Deceleration
LD—Limit Disable
LF—Line Feed
LRD—Read Loop Count via Parallel I/O

MA—Mode Alternate
MC—Mode Continuous
MN—Mode Normal
MPA—Mode Position Absolute
MPI—Mode Position Incremental
MPP—Mode Position Profile

N—End of Loop
NG—End Position Profile
NIF—End of IF Command
NWHILE—End of While

O—Output
OFF—Off
ON—On
OS—Function Set-Up Report
OSA—Set Limit Input Active Level
OSB—Backup to Home Switch
OSC—Define Active State of Home Switch
OSD—Enable Resolver Z Channel Input

OSE—Jog Enable
 OSF—Acknowledge STOP and KILL inputs on Power Up
 OSG—Final Homing Direction
 OSH—Reference Edge of Home Switch
 OSI—Save Sequence Scan Mode on Stop
 OUT—Set Output Functions
 OUTL—Set Active Output Level
 OUTP—Output on Position

 PF—Follower Position Report
 PFZ—Set Follower Position to Zero
 PR—Absolute Position Report
 PS—Pause
 PU—Configure Square Wave
 PUL—Activate Square Wave Output
 PZ—Set Absolute Counter to Zero

 R—Request ZX Status
 RA—Limit Switch Status Report
 RB—Loop, Pause, Shutdown, Trigger Status Report
 REG—Configure Registration Move
 REPEAT—Repeat
 RFS—Return Servo Parameters to Factory Settings
 RG—Go Home Status Report
 RIFS—Return to Factory Settings
 RS—Report Status of Sequence Execution
 RSE—Report Servo Errors
 RSIN—Set Variable Interactively
 RV—Revision Level Report

 S—Stop
 SFL—Set User Flag
 SL—Software Limits Enable
 SLD—Software Limits Disable
 SN—Scan Delay Time
 SP—Set Position Absolute
 SS—Function Set-Up Report
 SSA—RS-232 Echo Control
 SSD—Alternate Stop Mode
 SSG—Clear/Save the Command Buffer on Limit
 SSH—Clear/Save the Command Buffer on Stop
 SSI—Enable/Disable Interactive Mode
 SSJ—Enable/Disable Continuous Scan Mode
 SSL—Enable/Disable Resume Execution
 SSN—Enable/Disable Message Mode
 SSU—Enable/Disable Warning Display Mode
 ST—Shutdown
 STOP—Stop
 STR—Set Strobe Output Delay Time
 SV—Save

 T—Time
 TD—Set Input Debounce Time
 TDR—Set Registration Debounce
 TEST—System Test
 TF—Set Following Time
 TM—Move Time Report
 TR—Wait for Trigger
 TRD—Read Timer from Parallel I/O
 TS—Trigger Input Status
 TX—Transmit Variable and String

 U—Pause and Wait for Continue
 UNTIL—Until

 V—Velocity
 VAR—Variables
 VARD—Read Variables from Parallel I/O
 VRD—Read Velocity from Parallel I/O
 VS—Set Start/Stop Velocity

 W1—Signed Binary Position Report
 W2—Hexadecimal Position Report
 W3—Signed Hexadecimal (\pm) Position Report
 WHEN—Set WHEN Condition
 WHILE—While

 XBS—Report Sequence Memory Available
 XC—Sequence Checksum Report
 XD—Sequence Definition
 XDIR—Sequence Directory
 XE—Sequence Erase
 XEALL—Erase All Sequences
 XFK—Set Fault or Kill Sequence
 XG—GOTO Sequence
 XQ—Sequence Interrupted Run Mode
 XR—Run Sequence
 XRD—Read Sequence via Parallel I/O
 XRP—Sequence Run with Pause
 XS—Sequence Execution Status
 XSD—Sequence Status Definition Report
 XSR—Sequence Status Run Report
 XSS—Sequence Status Report
 XST—Sequence Step Mode
 XT—Sequence Termination
 XTR—Set Trace Mode
 XU—Upload Sequence
 XWHEN—When Sequence

 Y—Stop Loop
 Z—Reset

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