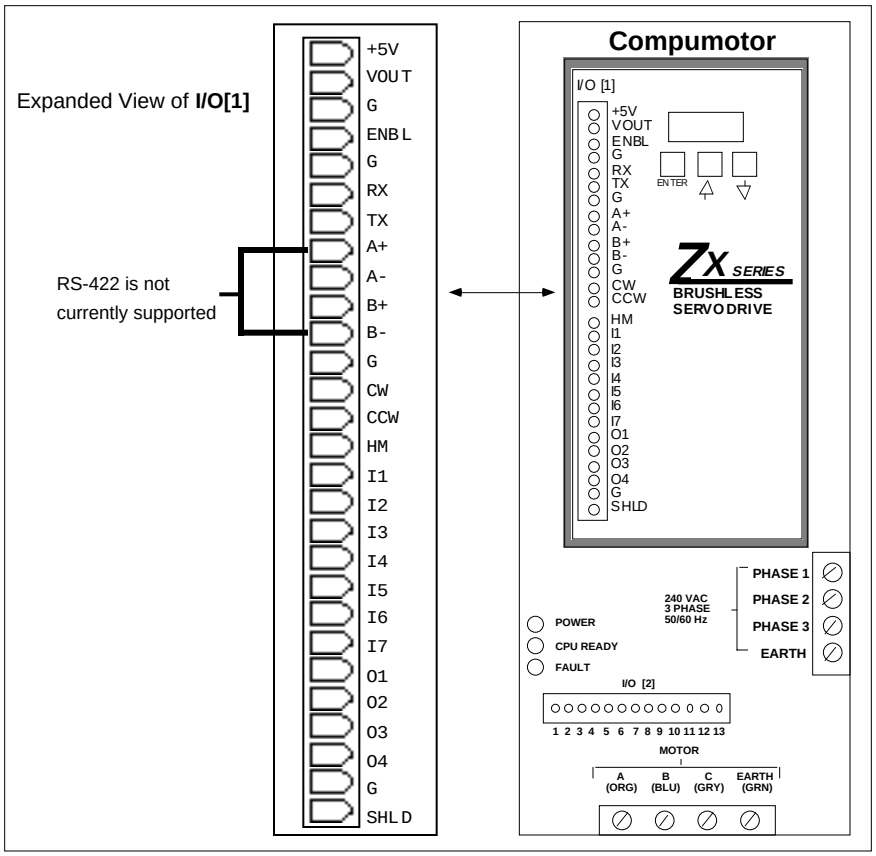
I/O[1] Connections

The ZX's **I/O[1]** connectors provides the following communication, input, and output connections.

- ❏ Communication
  - RS-232C
  - RS-422C (*not currently supported*)
- ❏ Inputs
  - VOUT
  - Seven programmable inputs
  - ENBL
  - Limits
  - Home
- ❏ Outputs
  - Four programmable outputs

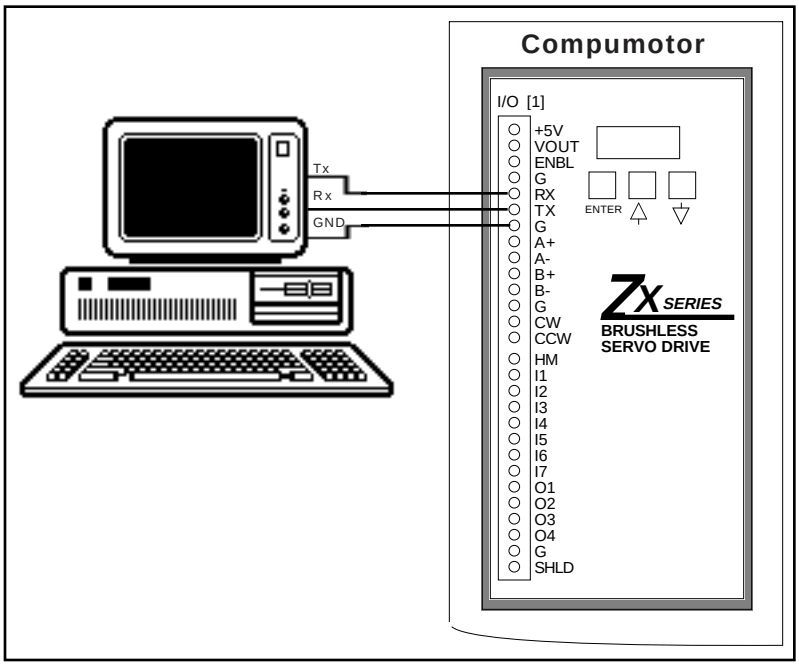


Screw Terminal I/O [1]

RS-232C Connections (RX, TX, GND) I/O[1]

The ZX can communicate to any terminal or host computer that can be configured for RS-232C. The ZX has a set of commands that can be used to set up the drive, program the drive, and report back drive information.

The ZX has a three-wire, optically isolated RS-232C interface that is compatible with RS-232C specifications. Receive Data (**Rx**), Transmit Data (**Tx**), and ground (**GND**) signals are connected on the screw terminal **I/O[1]**. Proper shielding of the RS-232C signal wires is required. The shield should be connected to an earth ground point on the terminal.



RS-232C Connections

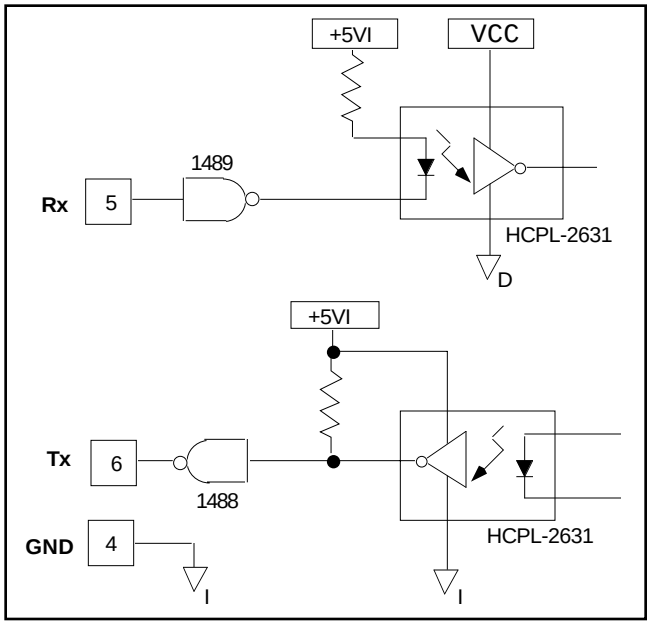
☞ ***Helpful Hint:***
The default communication parameters are:

- ❏ Baud Rate: 9600
- ❏ Data Bits: 8
- ❏ Stop Bit: 1
- ❏ Parity: None

Handshaking is not supported. The terminal should be set for Full Duplex mode.

You can change the baud rate with the front-panel pushbuttons (see *Chapter ④ Application Design* for more information). Baud rates of 300, 600, 1200, 2400, 4800, and 9600 are available. The RS-232C communication interface is optically isolated.

☞ ***Helpful Hint:***
Schematic of the RS-232C communication interface



RS-232C Input

ZX Daisy Chain Wiring

You may daisy chain up to 99 ZXs. Individual drive addresses are set with the ZX's push buttons. When daisy chained, the units may be addressed individually or simultaneously. You should establish a unique device address for each ZX. If you daisy chain more than 10 units, the baud rate should not exceed 2400.

Commands prefixed with a device address command only the unit specified. Commands

without a device address command all units on the daisy chain. The general rule is: ***Any command that causes the drive to transmit information from the RS-232C port (such as a status or report command), must be prefixed with a device address***. This prevents daisy chained units from all transmitting at the same time.

Attach device identifiers to the front of the command. The Go (**G**) command instructs all units on the daisy chain to go, while **1G** tells only unit one to go.

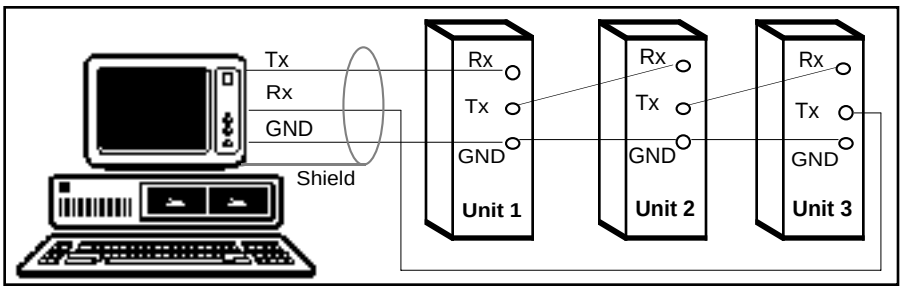
When you use a single communications port to control more than one ZX, all units in a daisy chain receive and echo the same commands. Each device executes these commands, unless this command is preceded with an address that differs from the units on the daisy chain. This becomes critical if you instruct any indexer to transmit information. To prevent all of the units on the line from responding to a command, you must precede the command with the device address of the designated unit.

No ZX executes a device-specific command unless the unit number specified with the command matches the ZX's unit number. Device-specific commands include both buffered and immediate commands.

You must use status-request commands in an orderly fashion. Commands should only be issued when the host is ready to read the response. You should not send new commands until you receive a response from the previous status-request command. In particular, you should not issue a immediate-status command until the host receives a buffered command status response. If this is not followed, the command responses will be intertwined, rendering the data useless.

If you enable the Interactive mode (**SSI1**), only the ZX that is set to Address 1 will respond with a prompt (>). This prevents all the ZXs from sending out > in a daisy chain. Typically, you should disable the Interactive mode when you use a host computer with the ZX.

☞ ***Helpful Hint:*** Multiple-drive configuration (daisy-chain) of RS-232C ports from one controlling terminal or computer



RS-232C Daisy Chain Configuration

Sample Applications and Commands

Three ZXs are on an RS-232C daisy chain. Send the following commands:

Command	Description
> MN	Sets unit to Preset mode
> A5	Sets acceleration to 5 rps^2 for all three controllers
> V1Ø	Sets velocity to 5 rps for all three controllers
> LD3	Disables limits (if they are not connected)
> 1D25ØØØ	Sets Axis 1 distance to 25,000 steps
> 2D5ØØØØ	Sets Axis 2 distance to 50,000 steps
> 3D1ØØØØØ	Sets Axis 3 distance to 100,000 steps
> G	Moves all axes

Unit 1 moves 25,000 steps, unit 2 moves 50,000 steps, and unit 3 moves 100,000 steps. All three units use the same acceleration and velocity rates. Units 1, 2, and 3 move at approximately the same time.

VOUT Input I/O[1]

This input may be used to set the output voltage level of the programmable outputs (O1 - O4). The VOUT input, referenced to ground, should be no more than 24V. Refer to *Chapter ⑦ Hardware Reference* for the VOUT input's hardware specifications.

ENABLE Input I/O[1]

The ZX 's ENBL input can enable or disable the ZX servo amplifier.

- ❏ To disable the amplifier, open the connection from ground.
- ❏ To enable the amplifier, pull the input to ground, and reset the drive (or type **ON**). *This input must be pulled down to ground for the drive to be active.*

See *Chapter ⑦ Hardware Reference* for the ENBL input's hardware specifications.

Limits I/O[1]

The ZX has two dedicated hardware end-of-travel limits (CCW and CW on the front panel). When you power up the ZX, these inputs are enabled. If you want to test the ZX without connecting the CCW and CW switches, disable the limit inputs with the **LD3** command. If you disable a move without disabling the inputs, the ZX motor will not turn. You can use the **RA** (Limit Switch Status Report), **IS** (Input Status), and **IN** (Set Input Functions) commands to test the limits' status. Refer to *Chapter ⑦ Hardware Reference* for the limit inputs' hardware specifications.

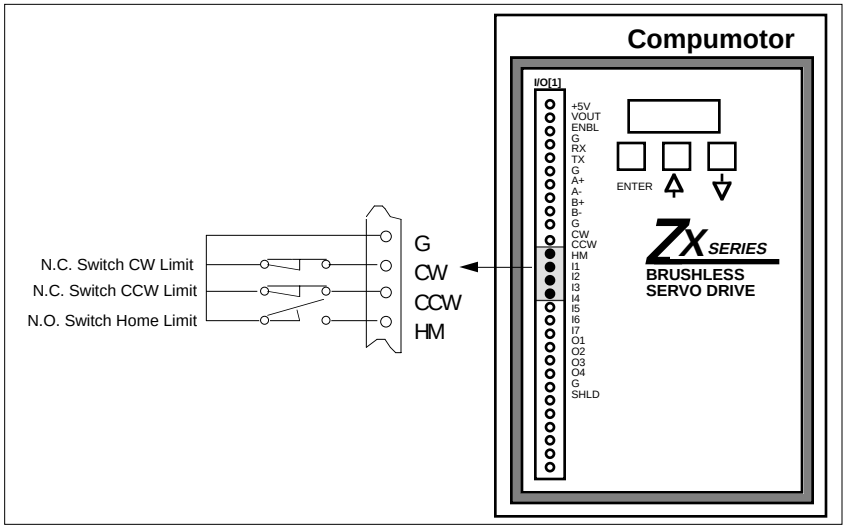
The ZX also has software limit capabilities. The software limits are disabled when you power up the system. If you need software limit capabilities, you can enable and define these software limits. Refer to the ***ZX Software Reference Guide***—Software Limits (**SL**) command.

Home Limit Input I/O[1]

The ZX's dedicated home HM input provides a reference for your application's motion. This input can command a machine to start an operation from a repeatable position. You may also use this input in conjunction with the Go Home (**GH**) command or the Go Home input with the Set Input Functions (**IN**) command. When the ZX executes a **GH** command, it scans the home limit input until the switch activates the home limit input.

Refer to *Chapter ⑦ Hardware Reference* for the home limit input's hardware specifications. *The homing function is discussed later in this chapter*.

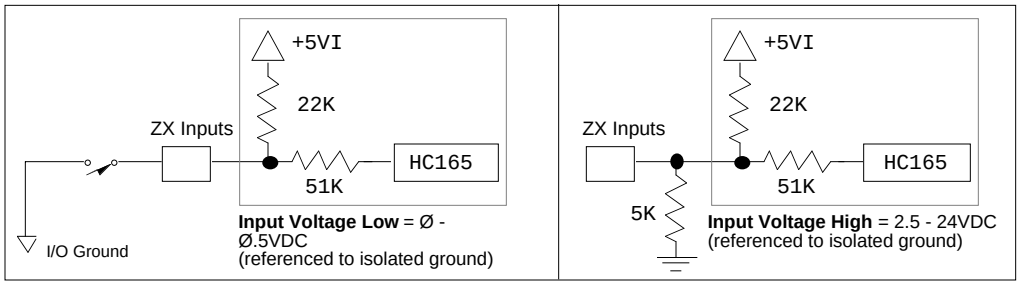
☛ You can activate the home limit input with the Define Active State of Home Switch (**OSC**) command.



Home and Limit Input Wiring

Programmable Inputs I/O[1]

The ZX has seven programmable inputs. These inputs can be connected directly to 24VDC. Each input can be programmed to perform 24 different functions. The inputs can be used with PLCs and configured with the outputs to interface with thumbwheel switches. Refer to *Chapter ⑦ Hardware Reference* for the programmable inputs' hardware specifications.

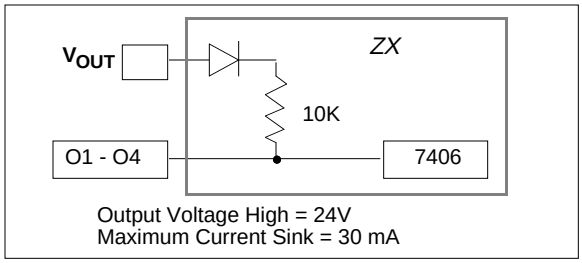


Enable, Home, Limits, and Programmable Inputs

Programmable Outputs I/O[1]

The ZX has four general programmable outputs. These outputs can sink up to 30 mA. You can program these outputs to perform 16 functions. They are open collector outputs, but they are pulled up internally with a 10K resistor. **V_{OUT}** is jumpered at the factory to 5V. To use a higher pull-up voltage, disconnect the jumper and apply an external power supply to **V_{OUT}**. The pull-up voltage will be equivalent to **V_{OUT}** - 0.3V. ***Remember that 5V < V_{OUT} < 24V***.

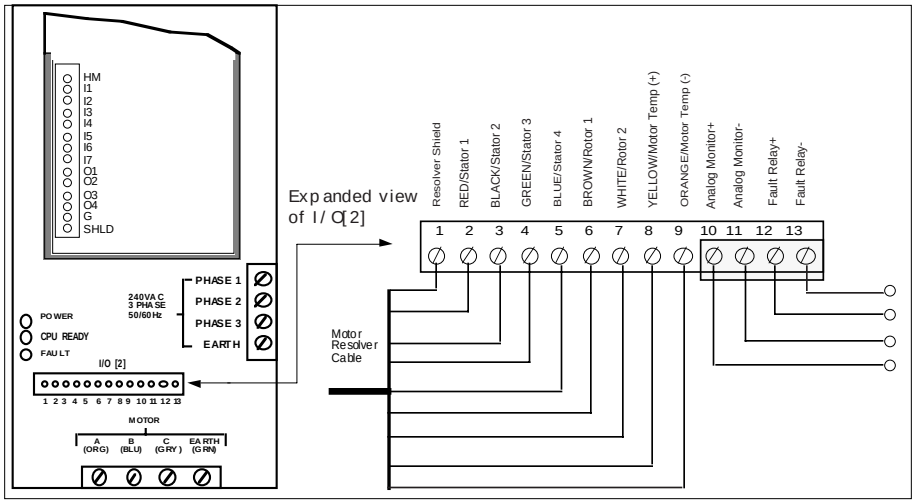
Refer to *Chapter ⑦ Hardware Reference* for the programmable output's hardware specifications.



V_{OUT} Input and Programmable Outputs 1 - 4

I/O[2] Connections

In addition to resolver signals and motor thermal signals, the **I/O[2]** screw terminal connector also has two outputs. Resolver cables on all ZX Indexers are the same.



Screw Terminal I/O (2) Outputs

Analog Monitor Output I/O[2]

This output provides an analog voltage (±10V) proportional to the velocity of the motor shaft.

- ❏ **MONITOR+** (pin #10) labeled **MON+**
- ❏ **MONITOR-** (pin #11) labeled **MON-**

You can connect these pins to an oscilloscope to facilitate tuning.

Drive Fault Relay Output I/O[2]

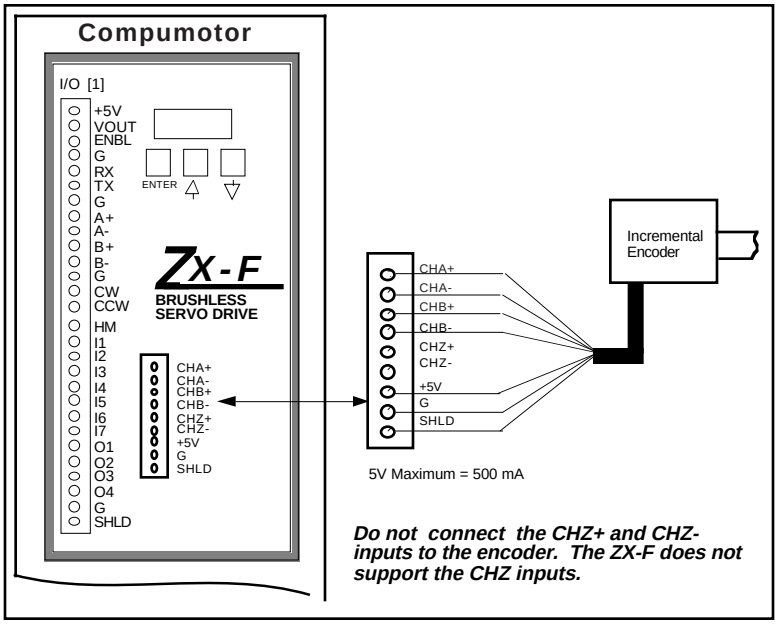
This isolated output is active during normal operation.

- ❏ **FAULT RELAY+** (pin #12) labeled **FTL+**
- ❏ **FAULT RELAY-** (pin #13) labeled **FTL-**

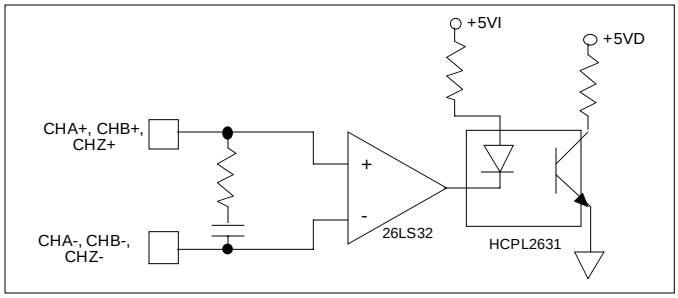
The relay will open during a fault condition or loss of power. This output is capable of 1A at 24VDC or 120VAC, resistive. The minimum current of 100mA at 12VDC is required to ensure contacts will not become contaminated.

ZXF Encoder Connection

The encoder connection is only applicable to the ZXF. ***If you are using a ZX, you may skip this procedure***.



Encoder Connection



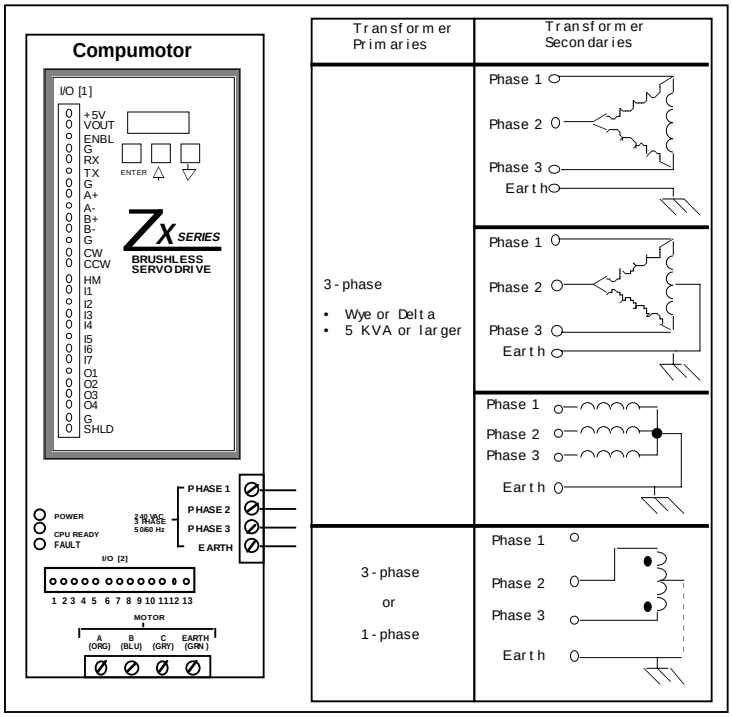
Encoder Inputs

Line Power Connections

The ZX600 and ZX800 are designed to be operated from a single or 3-phase 240VAC or single-phase 120VAC power source. The ZX900 is designed for single or 3-phase 240VAC operation. ***Only qualified personnel should install and service the equipment. Serious injury or death could result from miswiring***. The figures below illustrate the various ways to provide the main input power. The three input phase terminals feed a 3-phase rectifier that has current in-rush protection (each leg of the 3-phase input is fused separately). A 5KVA isolation transformer may be used for the ZX600 and ZX800 series, and a 10KVA isolation transformer may be used with the Z900 series, but transformers are generally not necessary if proper grounding procedures are followed and the proper line voltage is available.

> ***WARNING***
>
> Never disconnect the motor cable with the power on. The motor cable produces lethal voltages. This may cause a fatal injury. Be sure the drive is grounded properly to reduce the chance of electrical shock.

☞ ***Helpful Hint:***
Fuses: The ZX600 and ZX800 are fused for 240VAC 3-phase power (20A). If you suspect that a fuse has blown, call Compumotor (800-358-9070). ***Do not remove the outer chassis to access these fuses. Removing the chassis will void your warranty.***

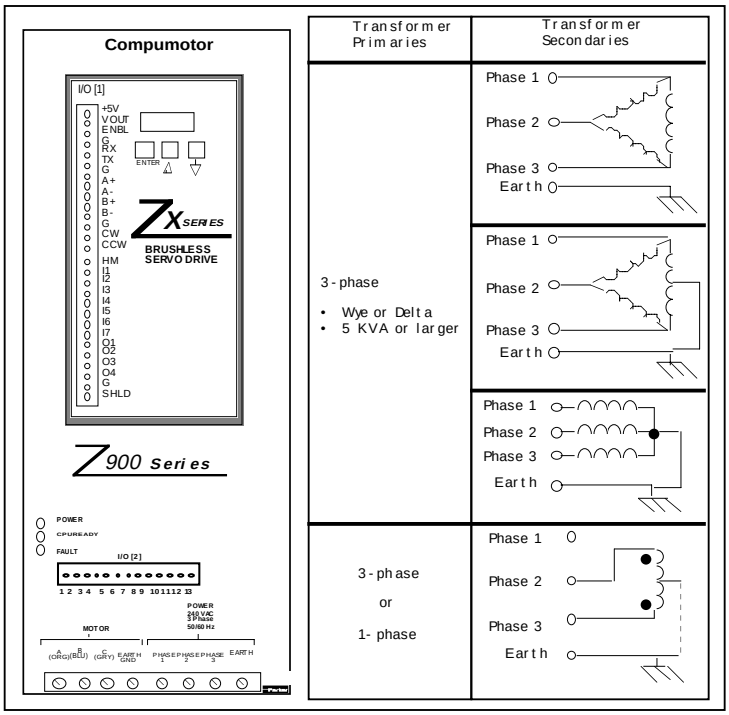


ZX600/800 Power Connections

Safety Interlock Switch

Put a 3-phase safety interlock switch between the drive and the power source to conveniently de-energize the drive in an emergency and/or service situation. A re-settable circuit breaker can also be used.

☞ ***Helpful Hint:***
Fuses: The ZX900 drives are fused for 240VAC 3-phase power (45A). The fuse block is located on the bottom of the drive beside the fan. These fuses may be replaced with Buss type SC45 fuses.



ZX900 Power Connections

Installation Verification

After you have completed all of the wiring instructions, you should complete the steps in this section to ensure that you have wired the motor, resolver, inputs, outputs, encoder (ZXF only), and power properly.

Programmable Input Functions

The input and output modes of the ZX offer flexibility and many function options for the input and output pins. You can program each input pin or designate them to correspond to a particular function. There are 24 functions that you can designate. To designate each input pin to a particular function, use the Set Input Functions (**IN**) command. (For a complete description of the **IN** command see the ***ZX Software Reference Guide***.) The input pins are numbered **I1** - **I7** on the front panel. The three remaining inputs are dedicated to **CW**, **CCW,** and **HM LIMIT** programmable inputs. Each function has been assigned a letter:

A: Trigger
B: Sequence Select
C: Kill
D: Stop
E: Drive Shutdown
F: Pause/Continue
G: Go
H: Direction
I: Synchronization
J: Jog+ (CW)
K: Jog- (CCW)
L: Jog Speed Select
M: Terminate Loop
N: Data
O: Reserved
P: Memory Lock
Q: Registration input (*can only be used with input #7)*
R: Reset
S: Go Home
T: Position Zero
U: User Fault
V: Data Valid
W: Data Sign
X: Increase Following Ratio
Y: Decrease Following Ratio
Z: Reserved

To program a particular input line to perform one of the designated functions, enter the **IN** command, followed by the pin number (1 - 7), followed by the letter of the function that you are designating the pin to perform. You may define the active input level with the Set Input Active Level (**INL**) command. The factory setting is **INLØ** (Active low).

Command	**Description**
> IN1A	Assigns input one to a trigger input

To display the present function assigned to each input type the following. To display one input at a time, type the number of the input following **1IN**.

Command	**Description**
> 1IN	Displays the input function assignments

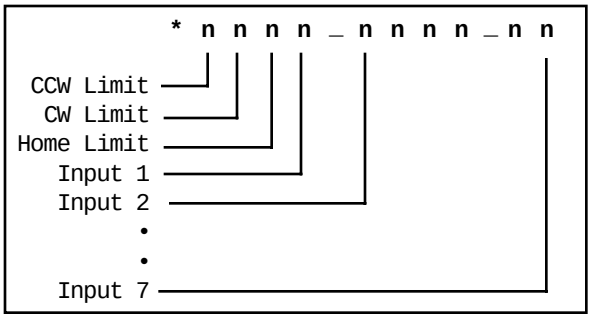
Verifying Proper Input Wiring

To verify that you have wired your inputs properly, enter the **IS** command. This command reports the active state of your inputs regardless of what function is assigned to them. Perform the following steps to verify proper wiring of your inputs.

Step ① Place the inputs in the active low state and display their current state.

Command	Description
> INLØ	Active level low
> 1IS	Response is ***ØØØØ_ØØØØ_ØØ**

Step ② Activate input #1 by shorting the input to ground and entering the status request **IS** again.



Command	**Response**
> 1IS	***ØØØ1_ØØØØ_ØØ**

This indicates that the ZX has recognized that the input number 1 has changed state. In this manner, you can verify that each input is changing state correctly.

Programmable Input Example

The following steps show how to configure input #1 (**IN1**) as a Remote Go input, and input #2 (**IN2**) as a stop input for control from your inputs.

Step ①

Command	Description
> MC	Sets to the continuous mode
> INLØ	Sets input level to be active low (off)
> LD3	Disables CW and CCW Limits
> IN1G	Sets up first input (**IN1**) as Go input.
> IN2D	Sets up second input (**IN2**) as a stop input
> A1ØØ	Sets acceleration to 100 rps^2
> AD1ØØ	Sets deceleration to 100 rps^2
> V5	Sets velocity to 5 rps
> D25ØØØ	Sets distance to 25,000 steps

Step ②

Command	Response
> 1IN1	*Ø1_G_GO_INPUT_(STATUS_OFF)
> 1IN2	*Ø2_D_STOP_INPUT_(STATUS_OFF)

These commands verify that inputs **IN1** and **IN2** have been configured properly. If not, go back and try step 1 again.

Step ③ To start motion, make sure that power is applied to the ZX and activate input #1 (**IN1**).

Step ④ To stop motion, activate input #2 (**IN2**).

This example shows how to use the inputs programmability Other **IN** features are discussed in *Chapter ④ Application Design.*

Programmable Output Functions

You can program the ZX outputs in the same way that you program the inputs. There are 16 possible functions that the outputs can perform (using the **OUT** command). Refer to the **OUT** command in the ***ZX Software Reference Guide*** for a detailed explanation. The possible output configurations are listed below:

A: Programmable Output
B: Moving/Not Moving
C: Sequence in Progress
D: At Limits
E: At Position Zero
F: Fault
H: Shutdown command indicator
J: Strobe (Outputs 1 - 3 only)
K: Command Error
L: Position Error Fault
N: CW Software Limit Reached
P: CCW Software Limit Reached
R: CW Hardware Limit Reached
S: CCW Hardware Limit Reached
T: Output Based on Position
U: Pulse output (Half axis)
V: Output When Within Deadband Range
W: Output When Within Deadband Range and Not Moving

The outputs are labeled on the front panel of the ZX as **O1** - **O4**. They are assigned in the same manner as the input pins. You can set the active level of the output with the Set Active Output Level (**OUTL**) command. The factory setting is **OUTLØ** (current flows when turned on). All of the outputs (**O1** - **O4**) are set up as programmable outputs as the factory default setting. The pull-up voltage is jumpered at the factory to 5V (through internal 10K resistors). If a higher pull-up voltage is desired, remove the jumper and apply the external power supply to **VOUT** (5V < **VOUT** < 24V). To increase the amount of current that the outputs can sink (30 mA maximum), you can add a resistor or apply voltage to the outputs (up to 24VDC).

Verify Proper Output Wiring

You can directly control each output by using the Output (**O**) command. Use the **O** command to turn on outputs 1 and 2 and turn off output 3. Use a voltmeter to verify that the output has changed state.

Command	Description
> O11Ø	Directly controls the outputs

Programmable Output Example

The following steps demonstrate how you can set up **O1** as a moving/not moving output and **O2** as a programmable output.

Step ① Make sure the outputs are properly wired.

Step ②

Command	Description
> MN	Sets unit to Normal mode
> OUT1B	Sets up **O1** as a moving/Not moving output
> OUT2A	Sets up **O2** as a programmable output
> A1ØØ	Sets acceleration to 100 rps^2
> AD1ØØ	Sets deceleration to 100 rps^2
> V5	Sets velocity to 5 rps
> D25ØØØ	Sets distance to 25,000 steps
> G	Executes the move
> T3	Waits 3 seconds
> O1	Turns on output 2 (**O2**)
> T3	Waits three seconds
> OØ	Turns off output 2 (**O2**)

While the motor is making the first move, **O1** should stay on. When the first move is finished, **O1** should go off. After 3 seconds, **O2** should come on and stay on for four seconds before turning off. Use the Output (**O**) command to display the current state of the outputs (type **1O**).

The successful completion of this test verifies that you can configure the ZX outputs to work as a programmable outputs and Moving/Not Moving outputs. In *Chapter ④ Application Design*, the use of other functions that you can program with the Configure Output (**OUT**) command are explained.

Limit Switches

Descriptions of the limits (**CW** & **CCW**) and a limit switch wiring example are provided earlier in this chapter. Before you test the limit switches, check the following:

- ❑ Ensure that the limit switches are wired properly.
- ❑ Ensure that the load is not attached to the motor.
- ❑ Ensure that you can manually open and close the limit switches.

To test the limit switches, complete the following steps:

Step ① Turn off (open) the CW and CCW limit switches.

Step ② Type **1IS**. Assuming that you have not turned on any other inputs, you should receive the following response:

***11ØØ_ØØØØ_ØØ**

This means that both CW and CCW limits are on (open).

Step ③ Turn on (close) the CW and CCW limit switches.

Step ④ To test the CW limit, enter the following commands:

Command	Description
> LDØ	Enables the CW and CCW limits
> INLØ	Normally closed limit inputs
> MC	Sets controller to Continuous mode

> A1ØØ	Sets acceleration to 100 rps^2
> AD1ØØ	Sets deceleration to 100 rps^2
> V3	Sets velocity to 3 rps
> H+	Changes the direction of the motor (CW)
> G	Executes the move (Go)

Step ⑤ Turn off (open) the CW limit switch. The motor should stop moving. Error **41** will scroll across the ZX's display. This verifies that the CW limit switch is working properly.

Step ⑥ Turn on (close) the CW limit switch. Error **41** will scroll across the ZX's display until a Go (**G**) command is executed in the opposite direction.

Step ⑦ To test the CCW limit, enter the following commands:

☞ ***Helpful Hint:*** The motor should move CCW

Command	Description
> H-	Changes the motor's direction (CCW)
> G	Executes the move (Go)

Step ⑧ Turn on (close) the CCW limit switch. The motor should stop moving and error **42** will scroll across the ZX's display. This verifies that the CCW limit switch is working properly.

Step ⑨ Turn on (close) the CCW limit switch. The motor should begin to move in the CCW direction. Error **42** will scroll across the ZX's display until a Go (**G**) command is executed.

If you are not able to stop the motor with the limit switches, reverse the CW and CCW limit input wiring. Perform this test again. If you are still unsuccessful, refer to *Chapter ⑧ Maintenance & Troubleshooting*.

Homing The Motor

Descriptions of the home limit (**HM**) and a home limit switch wiring example are provided earlier in this chapter. In this section, you will test your home limit switch and home the motor. You can initiate the Go Home function by entering the Go Home (**GH**) command over the RS-232C interface or by enabling the Go Home input using the Configure Input (**IN**) command. You must also define the Go Home Velocity (**GHV**), Go Home Acceleration (**GHA**), Go Home Deceleration (**GHAD**), and Final Go Home Velocity (**GHF**) to properly initiate the Go Home function. You can define the initial direction of the homing function with the Go Home Velocity (**GHV**) command. The **OS** commands set up the final go home approach and the edge of the switch to stop on.

When you command the motor to go home, it begins to move in the direction and at the velocity you specified. It performs this move at the acceleration rate specified with the **GHA** command, and looks for the **HM** input to go active. If the motor encounters an end-of-travel limit while it searches for home, it will reverse direction and look for the **HM** input to go active in the opposite direction. If the motor encounters the other limit before it detects the home signal, the Go Home move will be aborted and the motor will stop. To test the functionality of the **HM** limit switch, complete the following steps:

Step ① Manually open the **HM** limit switch and enter **1IS.** Assuming your end-of-limits and all other inputs are open (on), the system should respond with:

***11ØØ_ØØØØ_ØØ**

Step ② Close the **HM** limit switch and type **1IS.** The system should respond with ***111Ø_ØØØØ_ØØ**. This verifies that the home limit switch is functioning properly.

Step ③ Open the **HM** limit switch.

Step ④ To test the ZX's homing function, enter the following commands:

Command	Description
> IN1S	Sets up **IN1** (Input 1) as a remote Go Home input
> 1GHA1ØØ	Sets go home acceleration to 100 rps^2
> 1GHAD1ØØ	Sets go home deceleration to 100 rps^2
> 1GHF.5	Sets final go home speed to 0.5 rps.
> GHV+1	Sets the go home velocity to 1 rps (CW)
> 1OSB1	Enables the back up to home switch function
> 1OSGØ	The final approach direction is CW
> 1OSHØ	The CW edge is the edge the move stops on
> GH	Executes the Go Home function

Step ⑤ Ensure that the home limit input switch is open (on).

Step ⑥ Close **I1** (Input 1) and then open it. The motor will start to search for the **HM** limit switch again.

Step ⑦ Ground (turn off) the **HM** limit input. The motor decelerates to a stop. It then reverses

direction and moves off the switch at the final approach speed so that it can make its final approach to the home switch in the CW direction.

Step ⑧ Open the switch to simulate moving back off the home switch. Once it is off the switch, it begins its final approach in the CW direction.

Step ⑨ Activate the home switch again. The ZX will continue moving because it has reached only the CCW edge of the limit switch. Open the home limit switch again. This will be the CW edge and the motor will stop. This location will become the zero position. *Chapter ④ Application Design* explains the back-up to home limit function in detail. You will use the **OS** commands to set up the exact homing sequence that your application needs.

Verify Encoder Installation

This test is for ZXF users only. ***If you are using the ZX, you may skip this step***. To verify that your encoder is connected properly, enter the following series of commands.

Command	Description
> LD3	Disables the limits
> FSI1	Sets ZXF to Following mode
> 1PF	Reports the encoder count

Turn the encoder one CW revolution (move it in the positive direction). Check the encoder count again.

Command	Description
> 1PF	Reports the encoder count—it should have ***increased*** by the amount of your manual CW revolution

Turn the encoder one CCW revolution (move it in the negative direction). Check the encoder count again.

☞ ***Helpful Hint:***
If you pass this test, exit Following mode with the `FSIØ` *command.*

Command	**Description**
> 1PF	Reports the encoder count—it should have ***decreased*** by the amount of your manual CCW revolution

Command	**Description**
> S	Stops motion
> FSIØ	Exits Following mode, sets the ZXF to Indexer mode

You have now installed and tested your ZX system. *Chapter ④ Application Design* provides application information pertaining to motion, modes of operation, programming features, and other aspects of completing your application. Proceed to *Chapter ④ Application Design*.