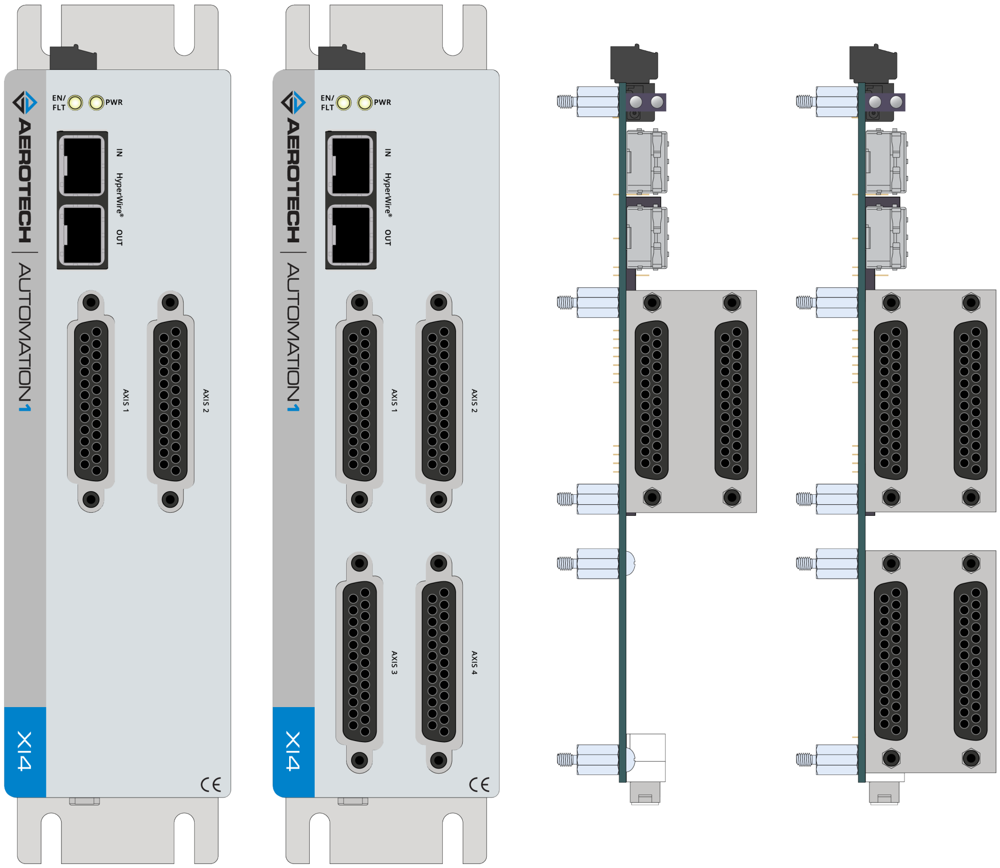
Automation1 XI4 Transconductance Amplifier Controller

HARDWARE MANUAL

Revision 1.00



XI4-2P1 XI4-4P1 XI4-2P2 XI4-4P2

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EU Declaration of Conformity

Manufacturer	Aerotech, Inc.
Address	101 Zeta Drive Pittsburgh, PA 15238-2811 USA
Product	XI4
Model/Types	All

This is to certify that the aforementioned product is in accordance with the applicable requirements of the following directive(s):

2014/35/EU	Low Voltage Directive
2011/65/EU	RoHS 2 Directive
EU 2015/863	Amendment RoHS 3 Directive

and has been designed to be in conformity with the applicable requirements of the following standard(s) when installed and used in accordance with the manufacturer’s supplied installation instructions.

IEC 61010-1:2010	Safety Requirements for Electrical Equipment

Authorized Representative	/ Simon Smith, European Director Aerotech Ltd The Old Brick Kiln, Ramsdell, Tadley Hampshire RG26 5PR UK
Engineer Verifying Compliance	/ Alex Weibel Aerotech, Inc. 101 Zeta Drive Pittsburgh, PA 15238-2811 USA
Date	6/30/2021

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Safety Procedures and Warnings

IMPORTANT: This manual tells you how to carefully and correctly use and operate the controller.

- Read all parts of this manual before you install or operate the controller or before you do maintenance to your system.
- To prevent injury to you and damage to the equipment, obey the precautions in this manual.
- All specifications and illustrations are for reference only and were complete and accurate as of the release of this manual. To find the newest information about this product, refer to www.aerotech.com.

If you do not understand the information in this manual, contact Aerotech Global Technical Support.

IMPORTANT: This product has been designed for light industrial manufacturing or laboratory environments. If the product is used in a manner not specified by the manufacturer:

- The protection provided by the equipment could be impaired.
- The life expectancy of the product could be decreased.

WARNING: To prevent damage to the equipment and decrease the risk of electrical shock and injury, obey the precautions that follow.

1. Supply each operator with the necessary protection from live electrical circuits.
2. Install the necessary precautions to supply safety and protection to the operator.
3. Do not connect or disconnect electrical components, wires, and cables while this product is connected to a power source.
4. Before you connect wires to this product, disconnect the electrical power.
5. Make sure that all components are grounded correctly and that they obey the local electrical safety requirements.
6. Before you do maintenance to the equipment, disconnect the electrical power.
7. Make sure that all system cables are correctly attached and positioned.
8. Do not use the cables or the connectors to lift or move this product.
9. Use this product only in environments and operating conditions that are approved in this manual.
10. Only trained operators should operate this equipment.

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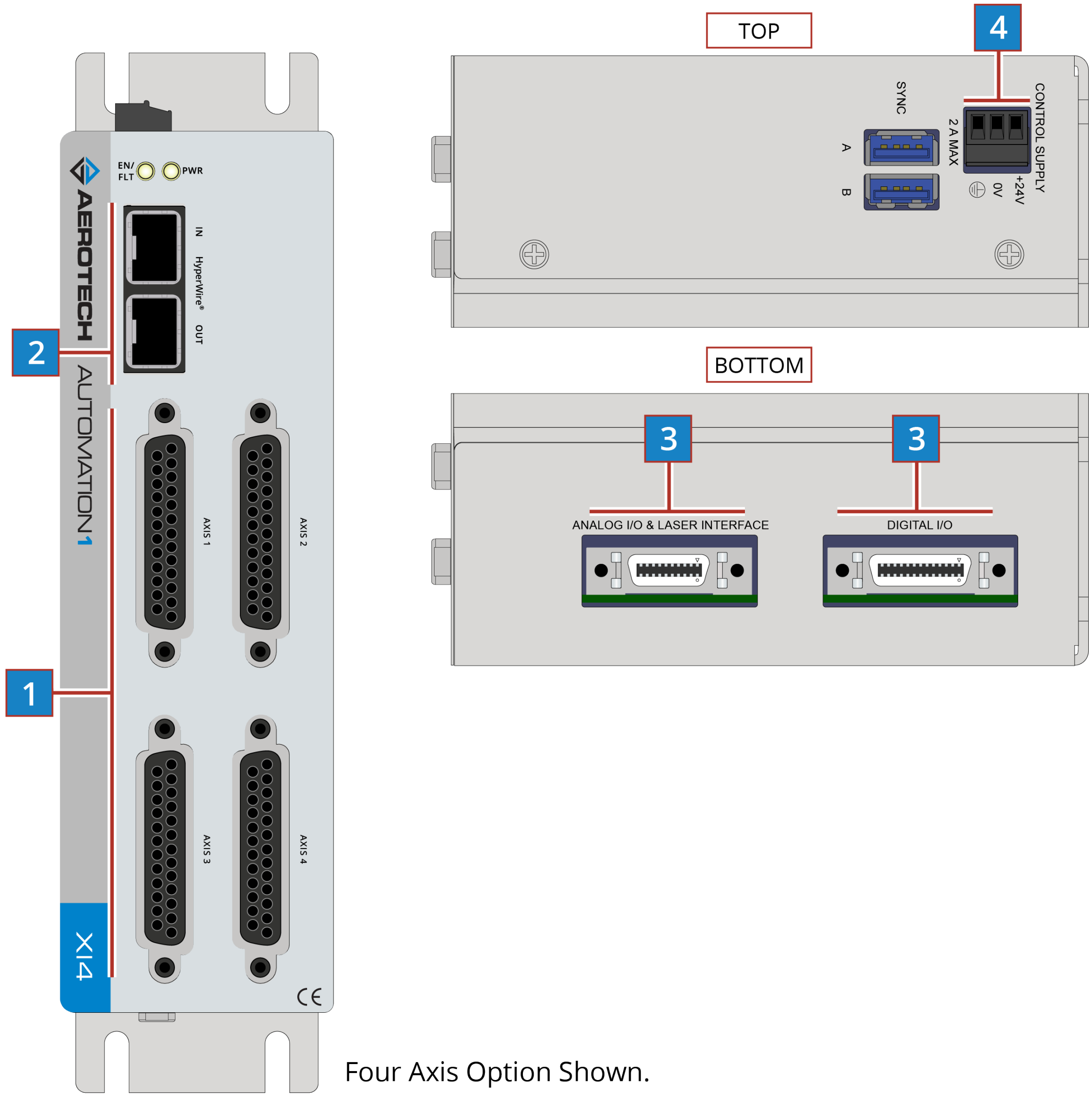
Installation Overview

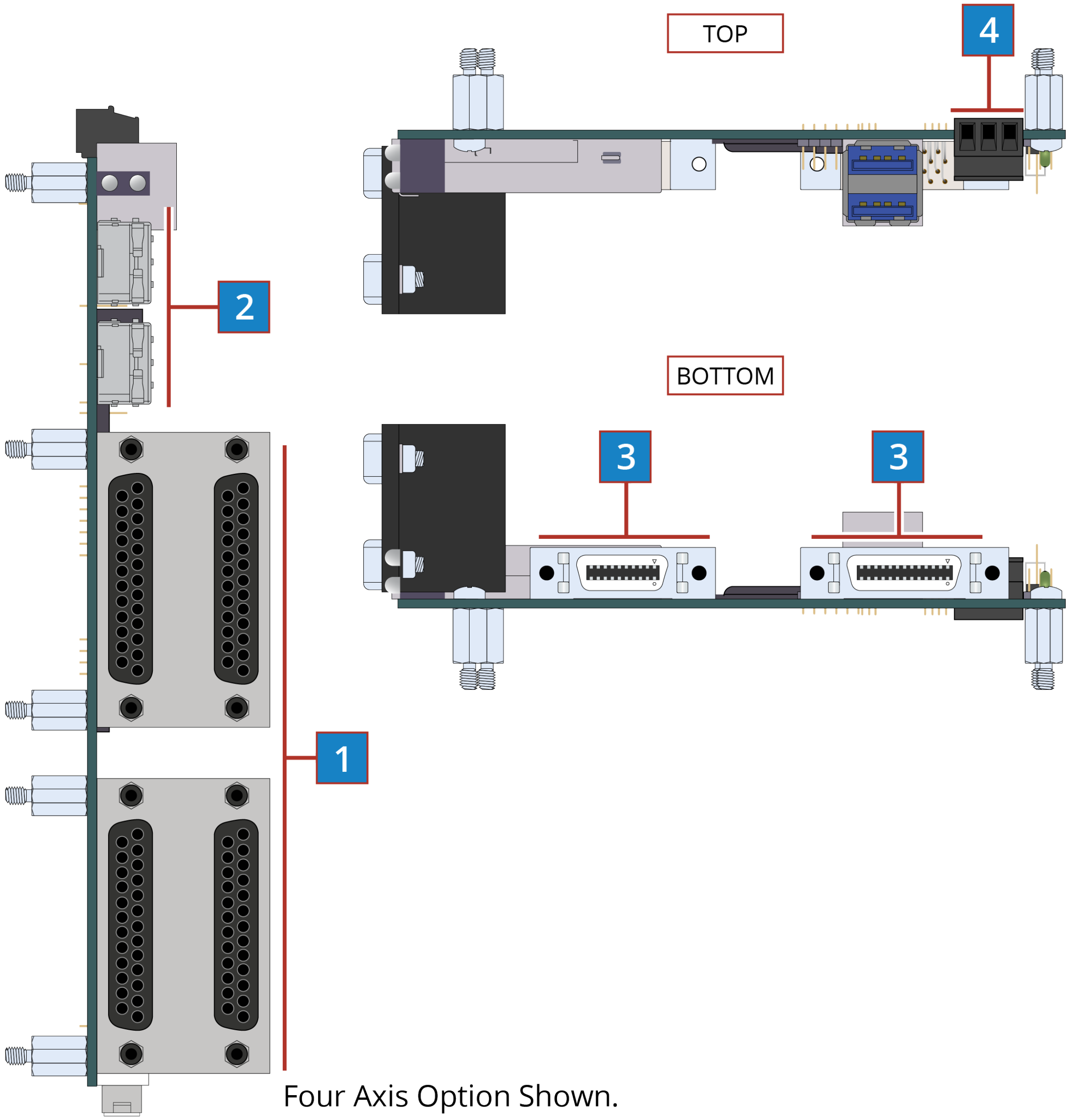
This image shows the order in which to make connections and settings that are typical to the XI4. If a custom interconnect drawing was supplied with your system, that drawing is on your Storage Device and shows as a line item on your Sales Order in the Integration section.



Four Axis Option Shown.

1	Connect the motor feedback and amplifier to the Axis Connectors.	Section 2.2.
2	Connect the PC HyperWire to the HyperWire In port.	Section 2.5.
3	Connect additional I/O as required by your application.	Section 2.3. / Section 2.4.
4	Connect the power supply to the Control Supply.	Section 2.1.1.

Figure 1: Installation Connection Overview (4 Axis Shown)



Four Axis Option Shown.

1	Connect the motor feedback and amplifier to the Axis Connectors.	Section 2.2.
2	Connect the PC HyperWire to the HyperWire In port.	Section 2.5.
3	Connect additional I/O as required by your application.	Section 2.3. / Section 2.4.
4	Connect the power supply to the Control Supply.	Section 2.1.1.

Figure 2: Installation Connection Overview (4 Axis OEM Shown)

Chapter 1: Introduction

The XI4 is a multi-axis digital drive based on the HyperWire communication protocol. The drive provides deterministic behavior, auto-identification, and is fully software configurable. The drive controls industry standard analog transconductance amplifiers which accept analog current commands. The drive also can also be used to control amplifiers which accept clock-and-direction commands.

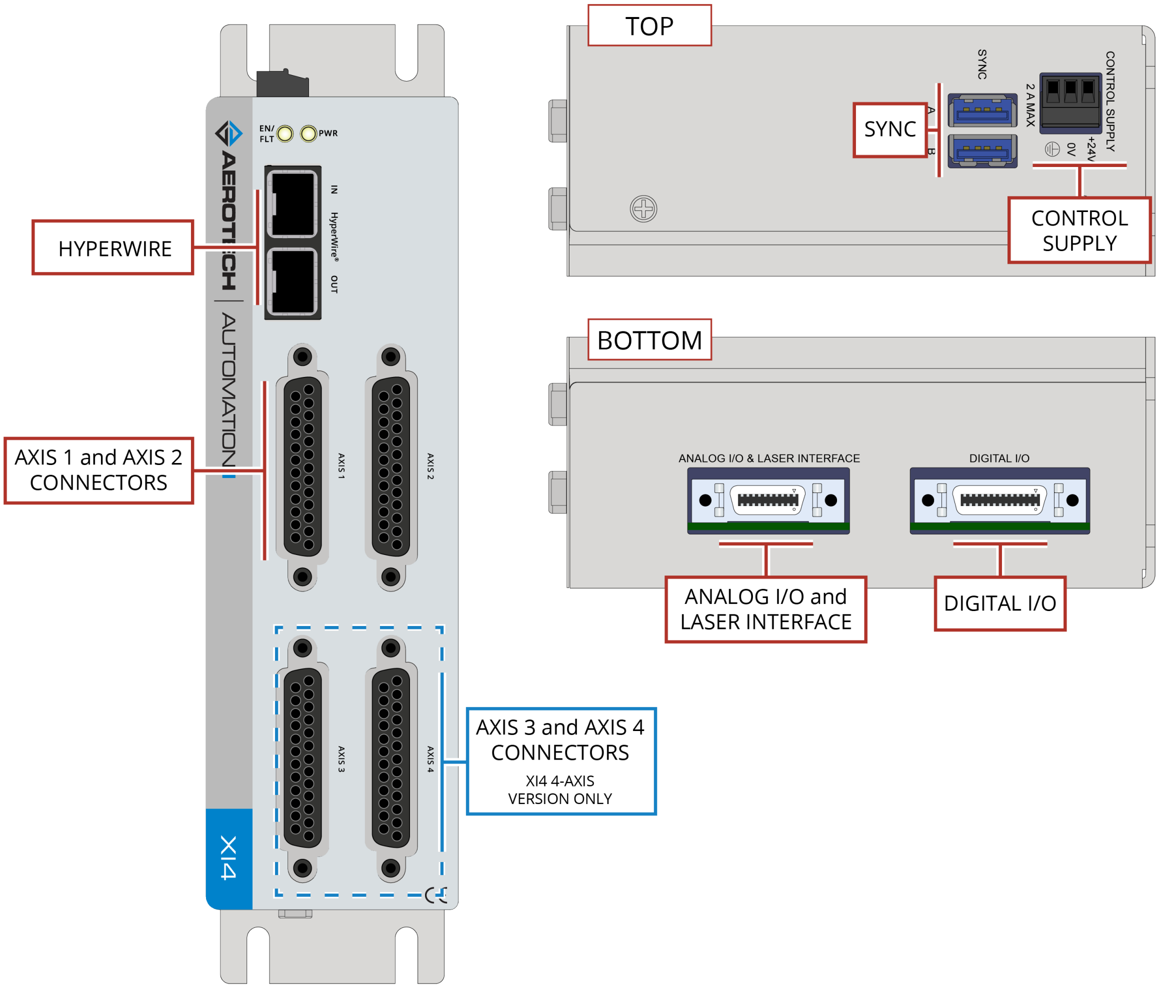


Figure 1-1: XI4 Transconductance Amplifier Controller

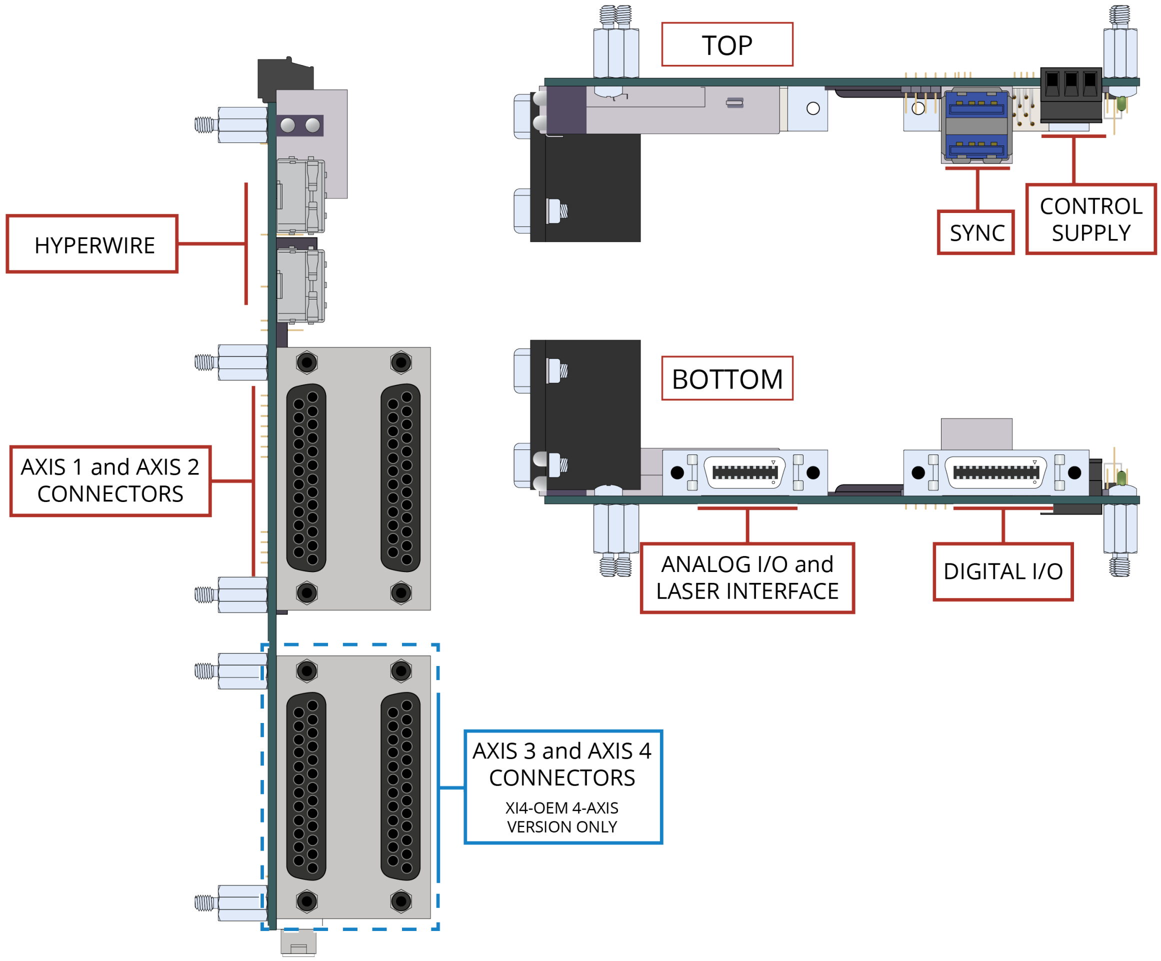


Figure 1-2: XI4-OEM Transconductance Amplifier Controller

Table 1-1: Feature Summary

Standard Features		
• 24 VDC control supply input		Section 2.1.1.
• Analog current command outputs (± 10V)		Section 2.2.1.
• Stepper clock and direction outputs		Section 2.2.2.
• Line driver square wave quadrature encoder input for position feedback		Section 2.2.7.
• Line driver square wave auxiliary quadrature encoder input or output for PSO		Section 2.2.8.1.
• Eight digital user outputs		Section 2.3.1.
• Nine digital user inputs		
■ Eight digital inputs		Section 2.3.2.
■ One high-speed input		Section 2.3.3.
• Two 16-bit analog outputs (± 10V)		Section 2.4.2.
• Four 16-bit differential analog inputs (± 10V)		Section 2.4.3.
Options		
Configuration		
-2P1	Two Axes of Control, Standard Packaging	
-2P2	Two Axes of Control, OEM Packaging	
-4P1	Four Axes of Control, Standard Packaging	
-4P2	Four Axes of Control, OEM Packaging	
Encoder		Section 2.2.7.2.
-A0	No Absolute Encoder support	
-A1	Absolute Encoder support	
Multiplier		Section 2.2.7.3.
-MX0	No encoder multiplier	
-MX1	Interpolation circuit allowing for analog sine wave input on the primary encoder channel with an interpolation factor of 16,384.	
PSO		Section 2.4.1.
-PSO1	One-axis PSO firing (includes One-axis Part-Speed PSO)	
-PSO2	Two-axis PSO firing (includes Two-axis Part-Speed PSO)	
-PSO3	Three-axis PSO firing (includes Three-axis Part-Speed PSO)	
-PSO6	Three-axis Part-Speed PSO firing, which uses the PSO firing circuit based off of the commanded vector velocity of 3 or more axes (includes One-Axis PSO).	
Version		
-DEFAULT	Firmware Matches Software Line	
-LEGACY	Legacy Firmware Version X.XX.XXX	

The block diagram that follows shows a summary of the connector signals.

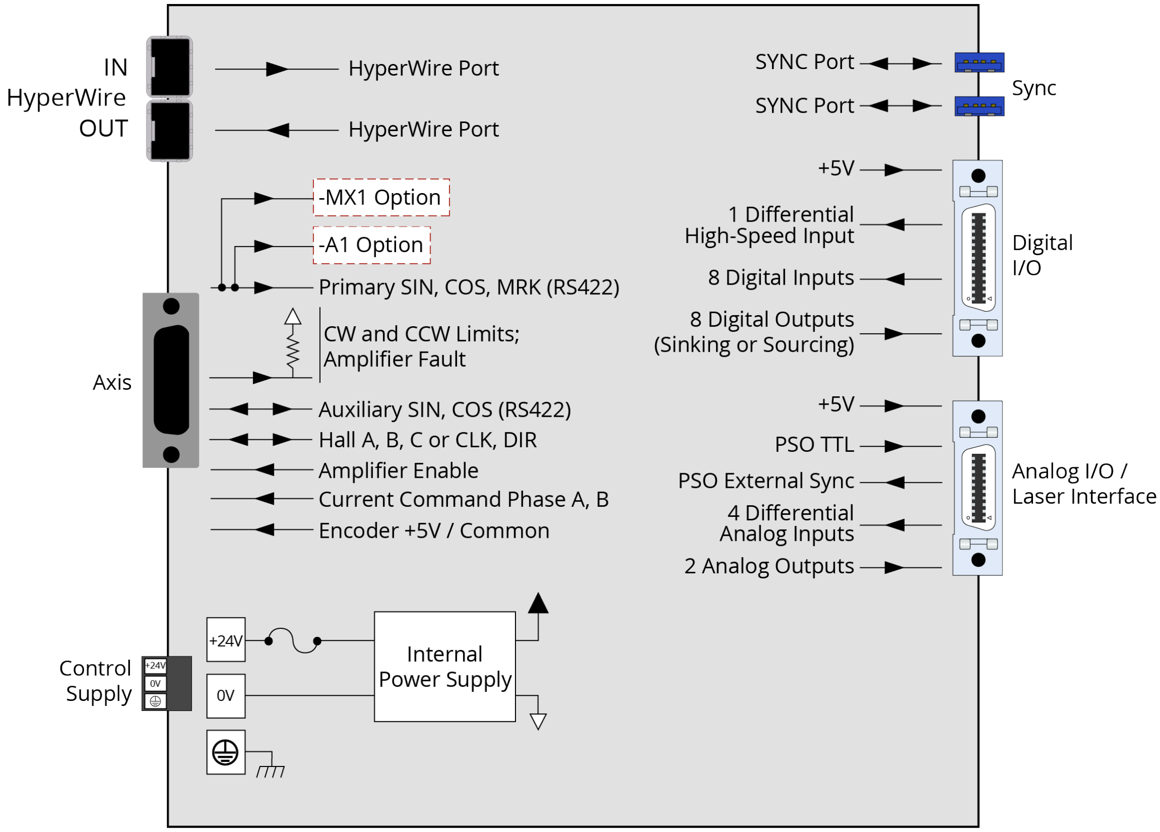


Figure 1-3: Functional Diagram

1.1. Electrical Specifications

Table 1-2: Electrical Specifications

Description		XI4
Control Supply	Input Voltage	24 VDC
Control Supply	Input Current	2-Axis: 2 A max, 0.45 A typical 4-Axis: 2 A max, 0.6 A typical
User Power Supply Output		5 VDC (@ 500 mA)
Modes of Operation		Brushless, Brush, Stepper
Protective Features		Control power supply under voltage

1.2. Mechanical Specifications

1.2.1. Mounting and Cooling

Install the XI4 in an IP54 compliant enclosure to comply with safety standards. Make sure that there is sufficient clearance surrounding the drive for free airflow and for the cables and connections.

Table 1-3: Mounting Specifications

		XI4
Customer-Supplied Enclosure		IP54 Compliant
		For DIN Rail Mounting, refer to Section 1.2.3. DIN Rail Mounting
Weight	Standard	~0.59 kg
	OEM	~0.23 kg
Mounting Hardware	Standard	M4 [#8] screws (four locations, not included)
	OEM	M3 screws and M3 standoffs (seven locations)
Mounting Orientation		Vertical (typical)
Dimensions		Refer to Section 1.2.2. Dimensions
Minimum Clearance	Airflow	~25 mm
	Connectors	~100 mm
Minimum Airflow (over the drive)	Standard	Provided by internal fan
	OEM	4.2 CMF (**NOTE**: Customer Supplied)
Operating Temperature		Refer to Section 1.3. Environmental Specifications

1.2.2. Dimensions

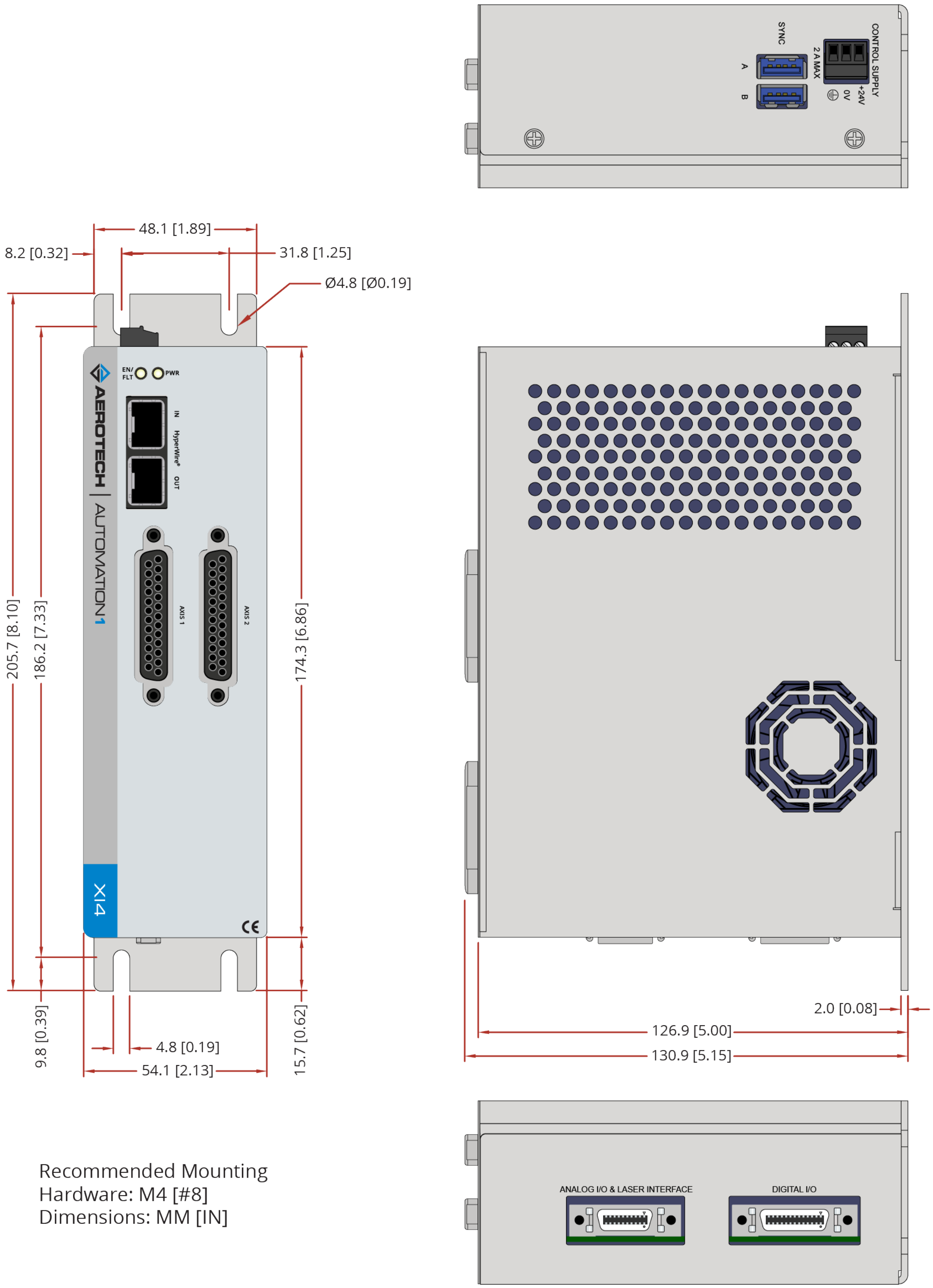


Figure 1-4: Dimensions [-2P1 (Standard 2-Axis)]

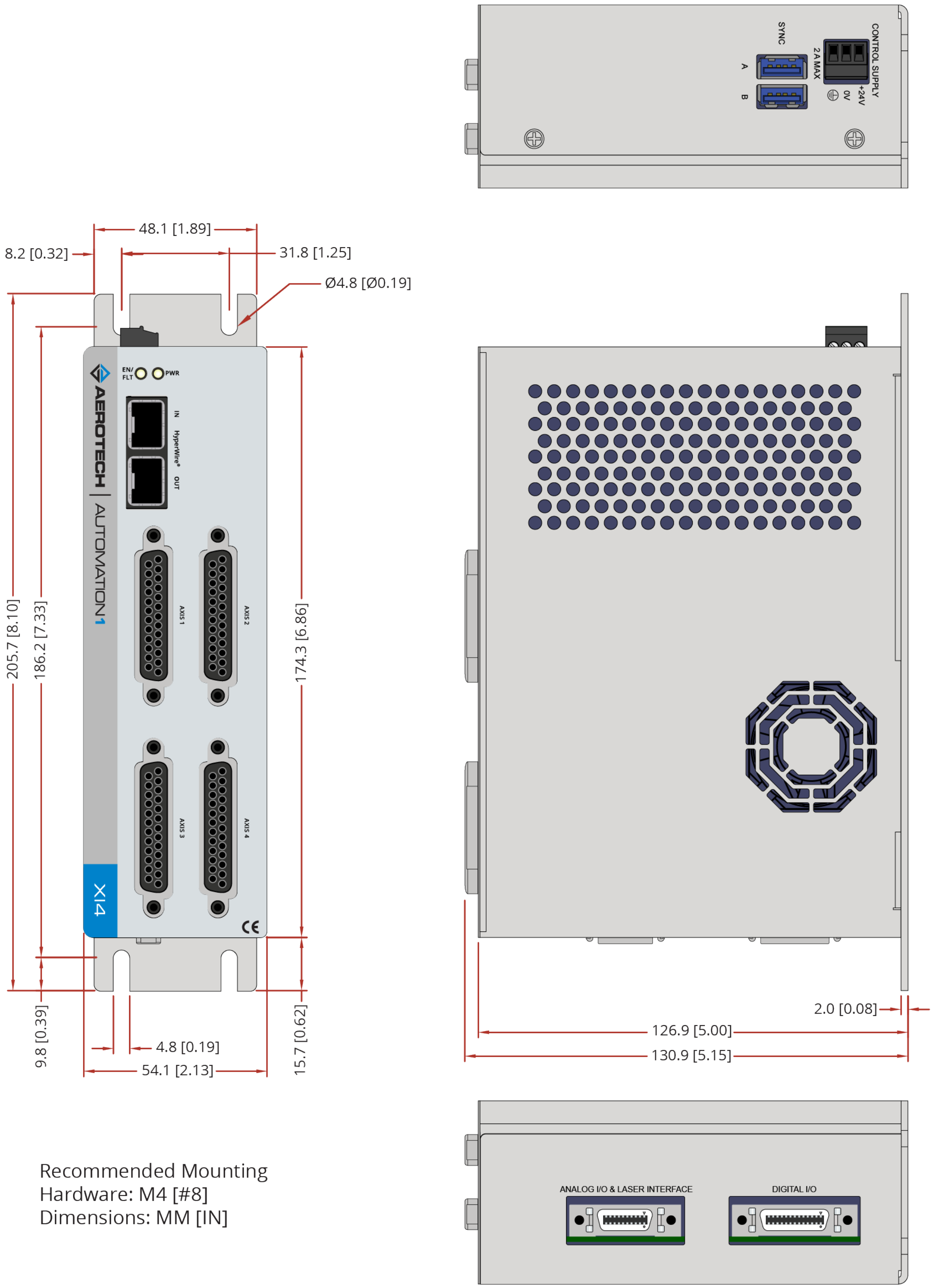


Figure 1-5: Dimensions [-4P1 (Standard 4-Axis)]

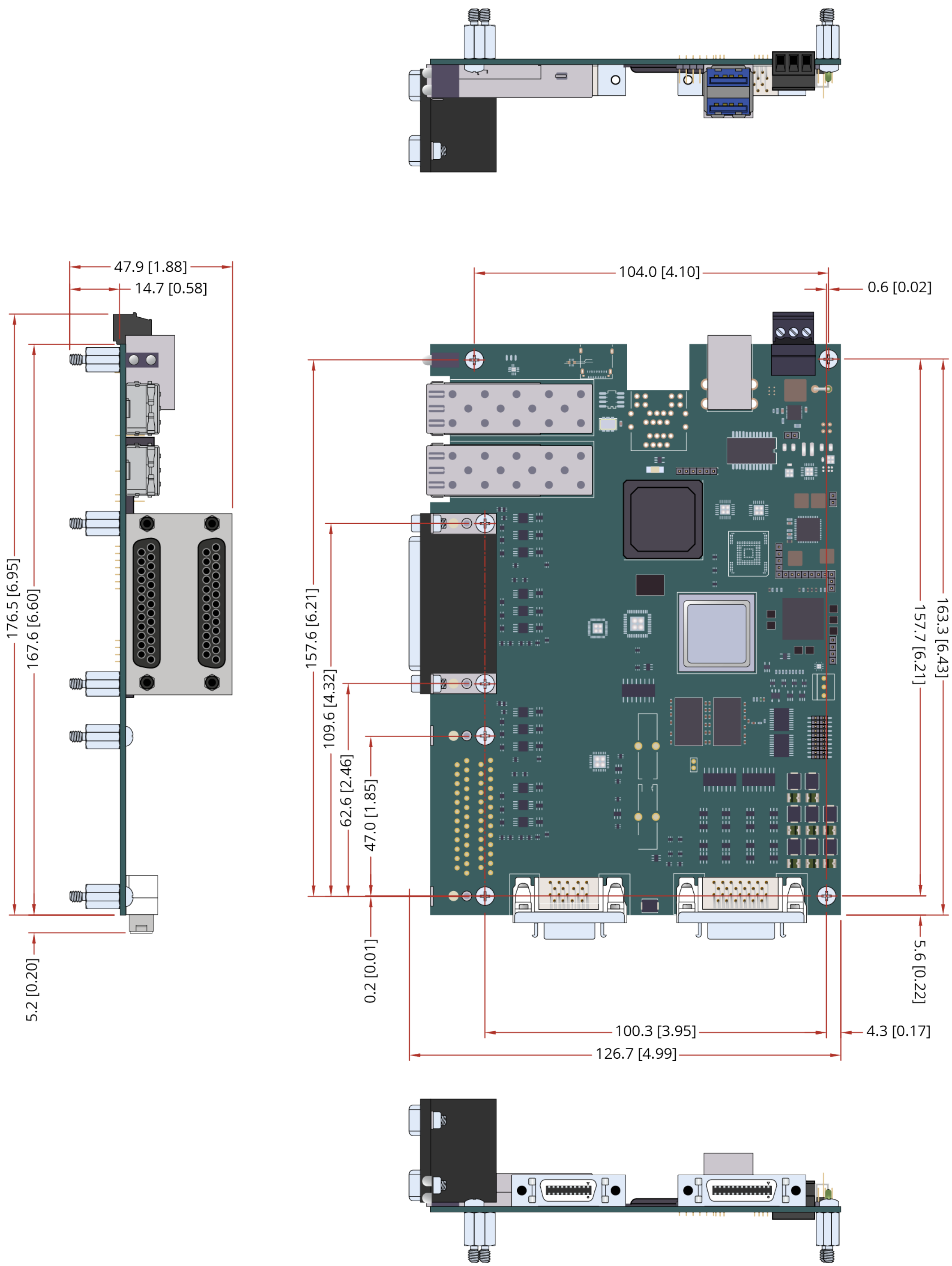


Figure 1-6: Dimensions [-2P2 (OEM 2-Axis)]

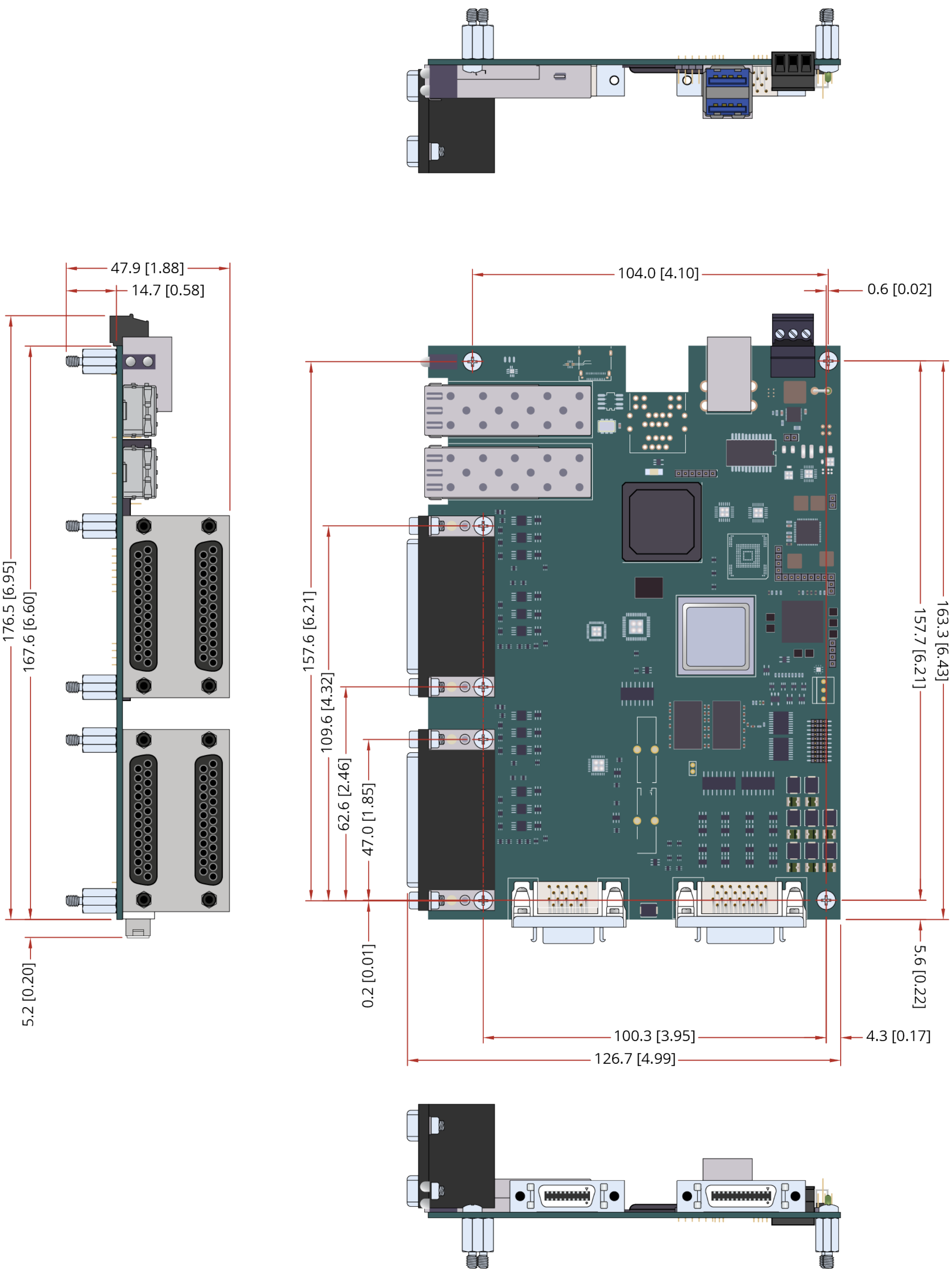


Figure 1-7: Dimensions [-4P2 (OEM 4-Axis)]

1.2.3. DIN Rail Mounting

A DIN rail can only be used with the -2P1 or -4P1 options.

DIN Rail Mounting Procedure:

1. Mount the DIN rail clip to the XI4. The clip and #6-32 x 1/4 flat head screws are included in the DIN rail clip kit.
2. Cut the DIN rail so one complete mounting hole extends beyond the last component at each end.
3. Secure the DIN Rail to the mounting surface with #10-32 screws spaced every six inches.
   NOTE: Do not install the DIN rail to the mounting surface with the components already attached.
4. Install all components on to the DIN rail.

Table 1-4: Mounting Parts

	Aerotech P/N
DIN Rail	EAM00914
DIN Rail Clip Kit	XC2-DIN

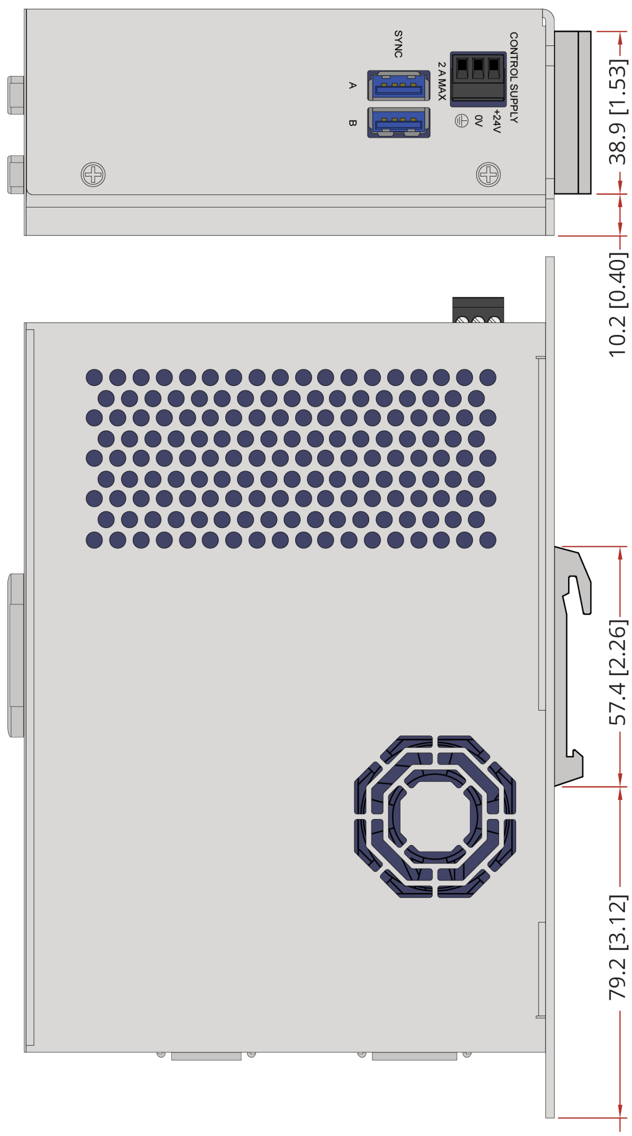


Figure 1-8: Din Rail Clip Dimensions

1.2.4. OEM Mounting

OEM Mounting Procedure:

1. Secure the seven M3 standoffs to the mounting surface with M3 hex nuts. These hex nuts are not included with the drive.
   NOTE: Do not install the standoffs to the mounting surface with the drive already attached.
2. Attach the drive to the standoffs with the M3 screws. These screws are included with the drive.

Table 1-5: OEM Mounting Parts

	Aerotech P/N
M3 Threaded Hex Standoff, 10 mm length	EIH01181
M3 Philips Pan Head Screw, 8 mm length	HCY0003008

1.3. Environmental Specifications

Table 1-6: Environmental Specifications

Ambient Temperature	Operating: 0° to 40°C (32° to 104° F)
	Storage: -30° to 85°C (-22° to 185° F)
Humidity Non-condensing	The maximum relative humidity is 80% for temperatures that are less than 31°C and decreases linearly to 50% relative humidity at 40°C.
Operating Altitude	0 m to 2,000 m (0 ft to 6,562 ft) above sea level. If you must operate this product above 2,000 m or below sea level, contact Aerotech, Inc.
Pollution	Pollution Degree 2 Typically only nonconductive pollution occurs.
Operation	Use only indoors

1.4. Drive and Software Compatibility

This table shows the available drives and which version of the software first supported each drive. In the **Last Software Version** column, drives that show a specific version number are not supported after that version.

Table 1-7: Drive and Software Compatibility

Drive Type	First Software Version	Last Software Version
Automation1 XI4	2.0.0	Current

Chapter 2: Installation and Configuration

Unpacking the Chassis

IMPORTANT: All electronic equipment and instrumentation is wrapped in antistatic material and packaged with desiccant. Ensure that the antistatic material is not damaged during unpacking.

Inspect the container of the XI4 for any evidence of shipping damage. If any damage exists, notify the shipping carrier immediately.

Remove the packing list from the XI4 container. Make sure that all the items specified on the packing list are contained within the package.

The documentation for the XI4 is on the included installation device. The documents include manuals, interconnection drawings, and other documentation pertaining to the system. Save this information for future reference. Additional information about the system is provided on the Serial and Power labels that are placed on the XI4 chassis.

The system serial number label contains important information such as the:

- Customer order number (please provide this number when requesting product support)
- Drawing number
- System part number

2.1. Input Power Connections

The XI4 has one DC input power connector for control power. For a full list of electrical specifications, refer to Section 1.1. Refer to Section 2.6. for a System Interconnection Drawing.

2.1.1. Control Supply Connector

The Control Supply input supplies power to the communications and logic circuitry of the drive . The **+24V** input is connected to an internal fuse. Refer to Table 1-4 for the internal fuse value and part number. For an isolated DC supply, connect **0V** to protective ground at the supply. Use twisted pair wiring to minimize radiated noise emissions (refer to Figure 2-1).

IMPORTANT: Refer to local electrical safety requirements to correctly size external system wires.

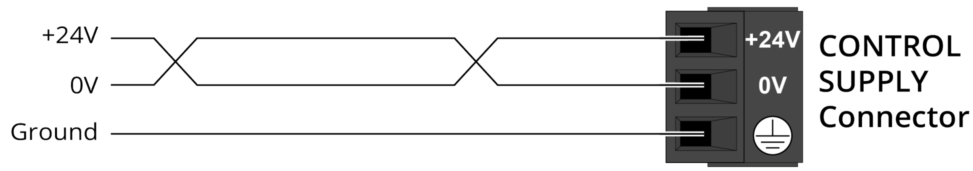


Figure 2-1: Control Supply Connections

Table 2-1: Control Supply Connector Wiring Specifications

Pin	Description	Recommended Wire Size
+24 V	24 VDC (±10%) Control Power Input (2-Axis: 2 A max, 0.45 A typical; 4-Axis: 2 A max, 0.6 A typical)	0.34 mm^2 (#22 AWG)
0 V	Control Power Common Input	0.34 mm^2 (#22 AWG)
⏚	Protective Ground	0.34 mm^2 (#22 AWG)

Table 2-2: Mating Connector Part Numbers for the Control Supply Connector

Type	Aerotech P/N	Third Party P/N	Screw Torque: N·m	Wire Size: mm^2 [AWG]
3-Pin Terminal Block	ECK02456	Phoenix 1839610	0.22 - 0.25	2.5 - 0.05 [14-30]

2.1.2. Minimizing Noise for EMC/CE Compliance

IMPORTANT: The XI4 is a component designed to be integrated with other electronics. EMC testing must be conducted on the final product configuration.

To reduce electrical noise, observe the following motor feedback and input power wiring techniques.

1. Use shielded cable for the feedback connector. Connect the shield to the backshell at each end of the cable.
2. Mount drives and power supplies on a conductive panel.Keep wire-run lengths to a minimum.
3. Use a separate wire for each ground connection to the drive.Use the shortest possible wire length.

For additional XI4 system interconnection information, refer to Section 2.6. System Interconnection.

2.2. Axis Connector

The connector pin assignment is shown in Table 2-3 with detailed connection information in the following sections.

Table 2-3: Axis Connector Pinout

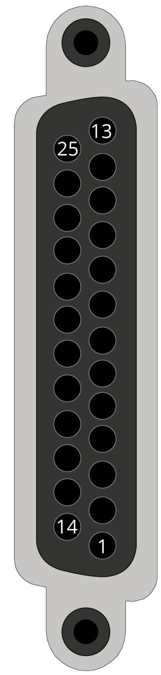
Pin #	Description	In/Out/Bi	Connector
1	Current Command A	Output	
2	Amplifier Enable	Output	
3	Signal Common	N/A	
4	Hall Effect Sensor A	Input	
5	Auxiliary Sine +	Bidirectional	
6	Auxiliary Cosine +	Bidirectional	
7	Clockwise End of Travel Limit	Input	
8	+5 V Supply (500 mA)	N/A	
9	Primary Sine +	Input	
10	Primary Cosine +	Input	
11	Primary Marker +	Input	
	Absolute Data +	Bidirectional	
12	Absolute Clock +	Output	
13	Reserved	N/A	
14	Current Command B	Output	
15	Amplifier Fault	Input	
16	Hall Effect Sensor B	Input	
	Stepper Clock	Output	
17	Hall Effect Sensor C	Input	
	Stepper Direction	Output	
18	Auxiliary Sine -	Bidirectional	
19	Auxiliary Cosine -	Bidirectional	
20	Counterclockwise End of Travel Limit	Input	
21	Signal Common	N/A	
22	Primary Sine -	Input	
23	Primary Cosine -	Input	
24	Primary Marker -	Input	
	Absolute Data -	Bidirectional	
25	Absolute Clock -	Output	

Table 2-4: Mating Connector Part Numbers for the Axis Connector

Mating Connector	Aerotech P/N	Third Party P/N
25-Pin D-Connector	ECK00101	FCI DB25P064TXLF
Backshell	ECK00656	Amphenol 17E-1726-2

2.2.1. Current Command Output Signals

The XI4 uses the Current Command A and B outputs to interface to an industry standard analog transconductance amplifier. These outputs are updated at a 20 kHz rate. Use the ServoLoopSetup parameter the configure this output type.

Table 2-5: Current Command Pins on the Axis Connector

Pin #	Description	In/Out/Bi
1	Current Command A	Output
14	Current Command B	Output

Table 2-6: Current Command Signal Output Specifications

Specification	Value
Rated Output Current	10 mA
Output Voltage Range	±10 V
Reset State	0 V

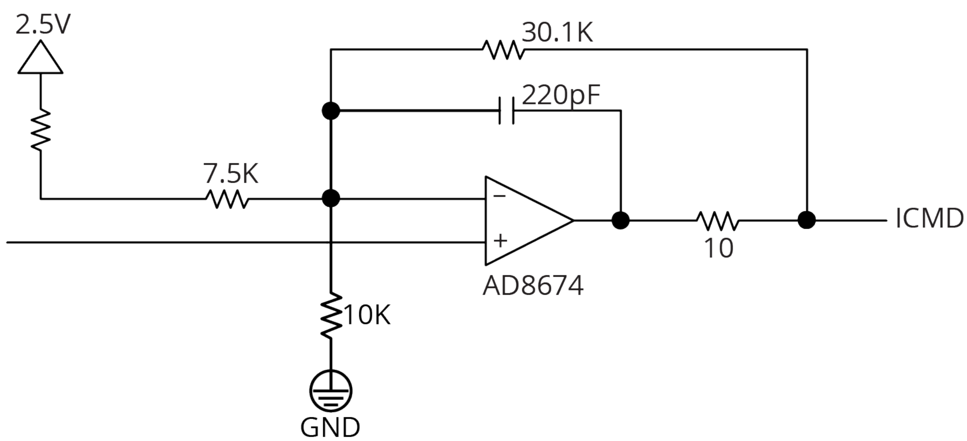


Figure 2-2: Current Command Output Schematic

2.2.2. Stepper Clock and Stepper Direction Signals

The XI4 uses the Stepper Clock and Stepper Direction outputs to interface to stepper motor drivers. Use the ServoLoopSetup parameter to configure this output type. The Hall-effect sensors are not available in this mode.

Table 2-7: Clock and Direction Pins on the Axis Connector

Pin #	Description	In/Out/Bi
16	Hall Effect Sensor B	Input
	Stepper Clock	Output
17	Hall Effect Sensor C	Input
	Stepper Direction	Output

Table 2-8: Stepper Clock and Stepper Direction Signal Output Specifications

Specification	Value
Output Voltage	5V TTL
Maximum Output Frequency	25 MHz
Maximum Source / Sink Current	±20 mA
Clock Default State	Logic Low (0 V)
Direction Default State	Logic Low (0 V)
Maximum Clock Pulse Width	25 µs
Minimum Clock Pulse Width	20 ns

To change the direction of the rotation of the motor, reverse the polarity of one of the phases. Reverse the A and A-N or B and B-N wires at the stepper motor driver.

Table 2-9: Stepper Direction Signal Output Polarity

Specification	Value
Negative / CCW Direction	Logic Low (0 V)
Positive / CW Direction	Logic High (+5 V)

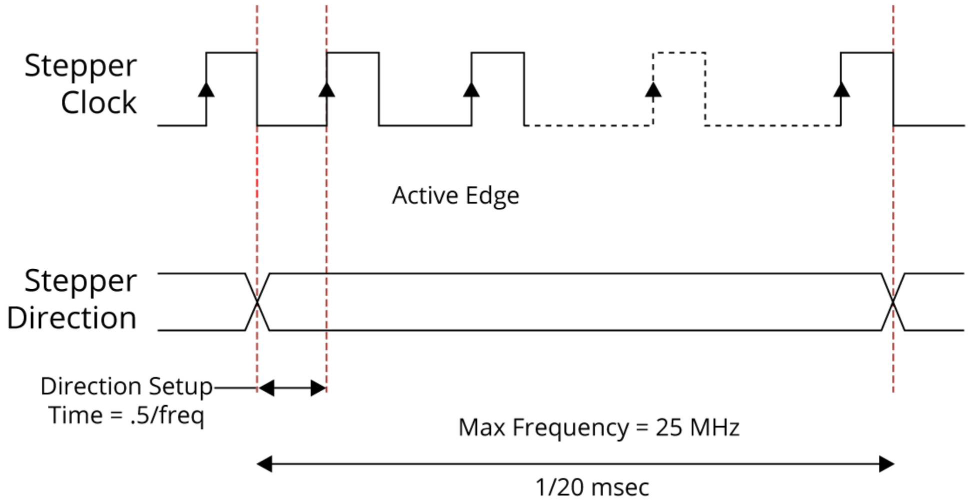


Figure 2-3: Stepper Clock and Stepper Direction Timing

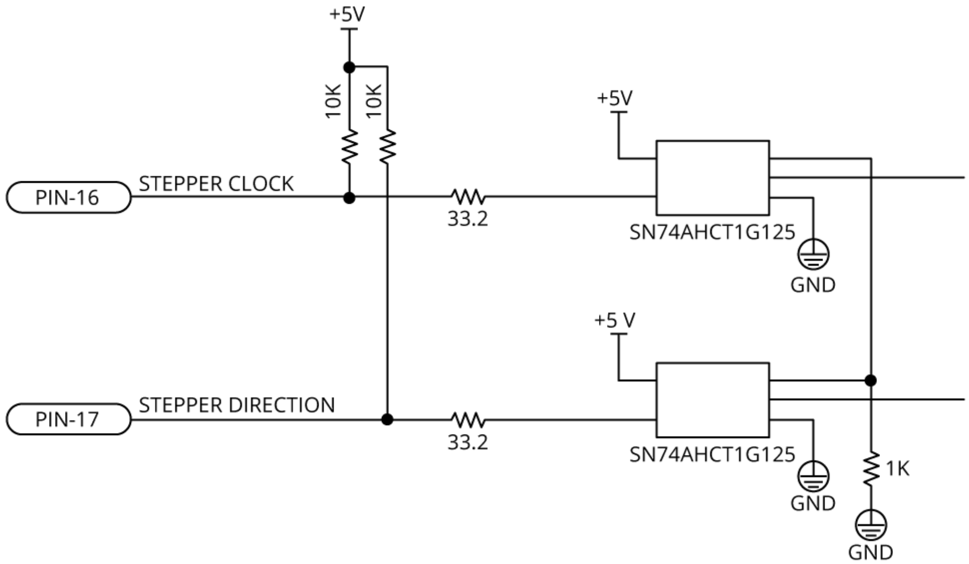


Figure 2-4: Stepper Clock and Stepper Direction Output Schematic

2.2.3. Hall-Effect Inputs

The Hall-effect switch inputs are recommended for AC brushless motor commutation but not absolutely required. The Hall-effect inputs accept 5 VDC level signals. Hall states (0,0,0) or (1,1,1) are invalid and will generate a "Hall Fault" axis fault.

Refer to Section 2.2.3.1. for Hall-effect device phasing.

The Hall-effect sensors are not available when the ServoLoopSetup parameter is configured for stepper clock and direction outputs.

Table 2-10: Hall-Effect Feedback Pins on the Axis Connector

Pin #	Description	In/Out/Bi
3	Signal Common	N/A
4	Hall Effect Sensor A	Input
8	+5 V Supply (500 mA)	N/A
16	Hall Effect Sensor B	Input
	Stepper Clock	Output
17	Hall Effect Sensor C	Input
	Stepper Direction	Output
21	Signal Common	N/A

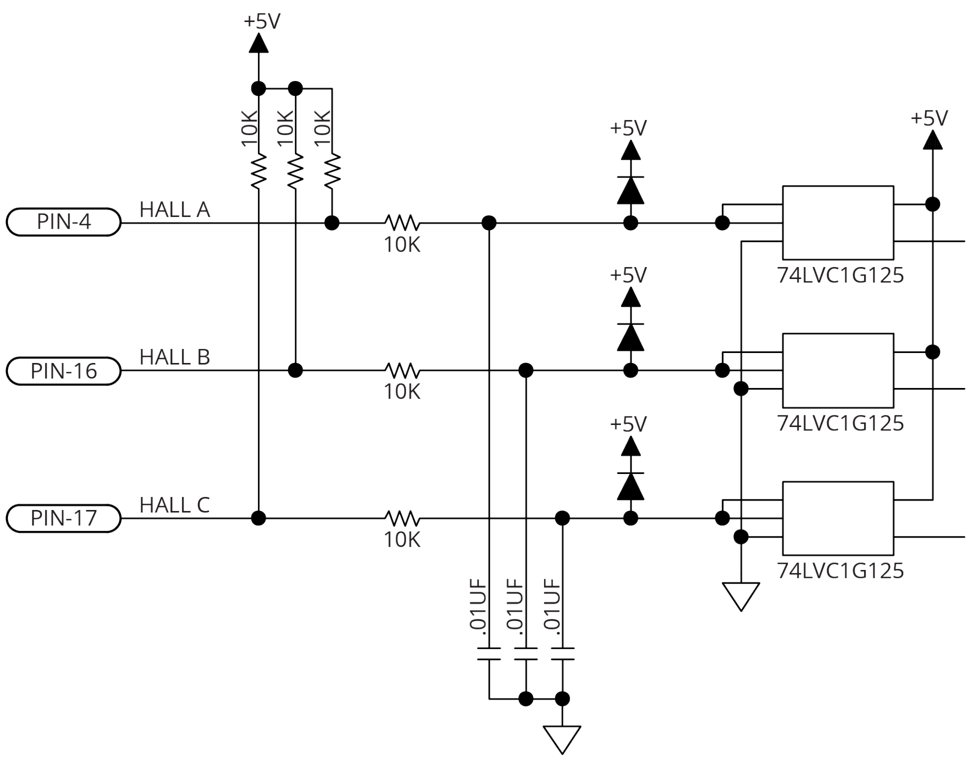


Figure 2-5: Hall-Effect Inputs Schematic

2.2.3.1. Brushless Motor Powered Motor and Feedback Phasing

Observe the state of the encoder and Hall-effect device signals in the Diagnostics section of the Status Utility.

Table 2-11: Hall Signal Diagnostics

Hall-Signal Status	Definition
--	0 V or logic low
ON	5 V or logic high

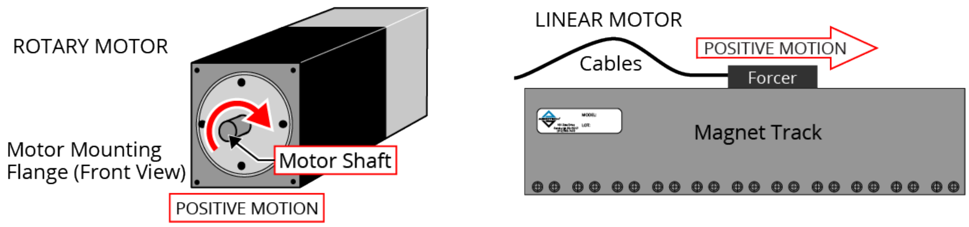


Figure 2-6: Positive Motor Direction

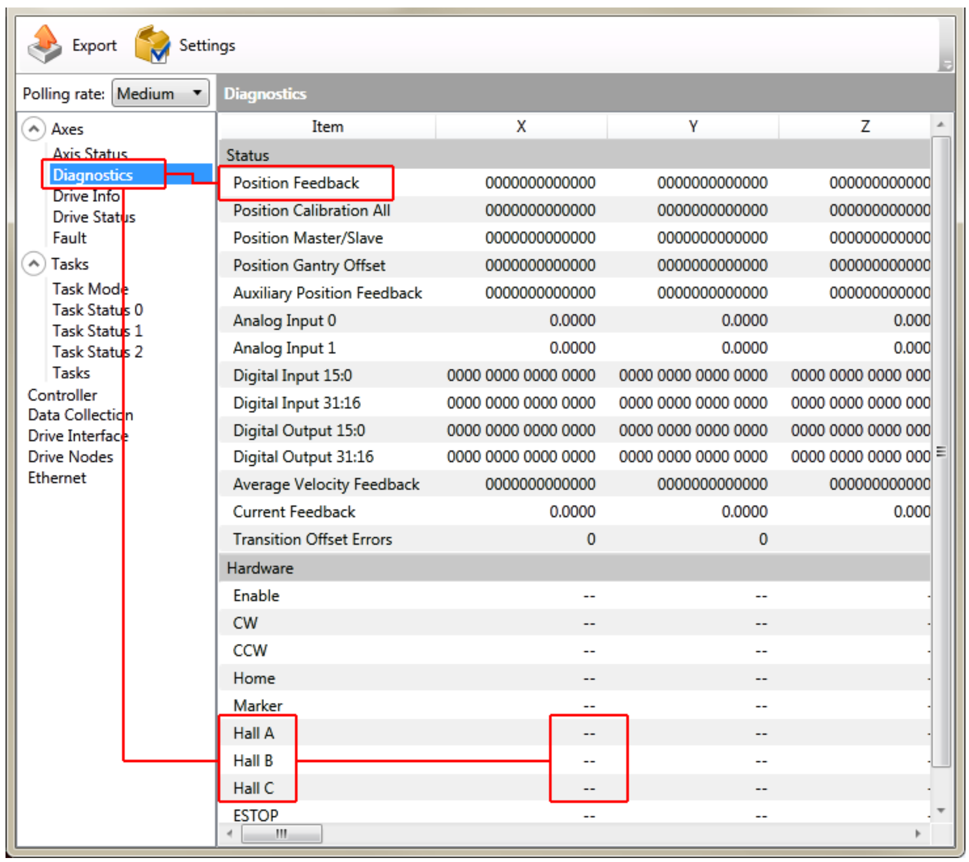


Figure 2-7: Encoder and Hall Signal Diagnostics

2.2.4. End of Travel Limits

End of Travel (EOT) limits are required to define the end of the physical travel on linear axes. Positive or clockwise motion is stopped by the clockwise (CW) end of travel limit input. Negative or counterclockwise motion is stopped by the counterclockwise (CCW) end of travel limit input. All of the end-of-travel limit inputs accept 0-5 VDC level signals. Limit directions are relative to the encoder polarity in the diagnostics display (refer to Figure 1-1).

Table 2-12: End of Travel Limit Pins on the Axis Connector

Pin #	Description	In/Out/Bi
3	Signal Common	N/A
7	Clockwise End of Travel Limit	Input
8	+5 V Supply (500 mA)	N/A
20	Counterclockwise End of Travel Limit	Input

The active state (High/Low) of the EOT limits is software selectable (by the EndOfTravelLimitSetup axis parameter). Figure 2-8 shows the possible wiring configurations for normally-open and normally-closed switches and the parameter setting to use for each configuration. Use NPN-type normally-closed limit switches (Active High) to provide fail-safe behavior in the event of an open circuit.

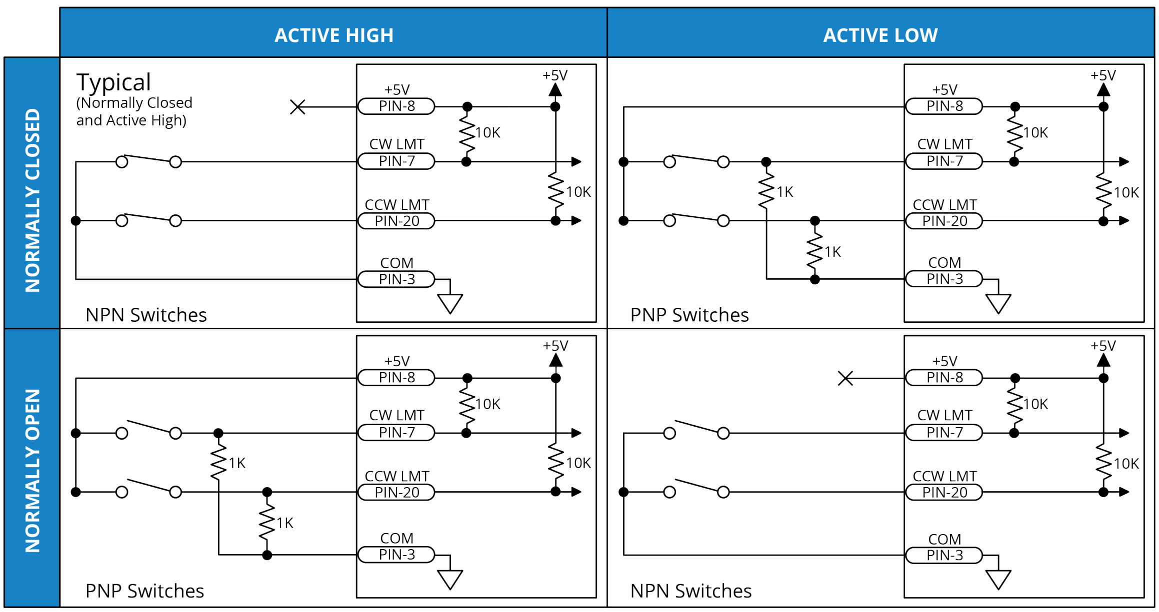


Figure 2-8: End of Travel Limit Input Connections

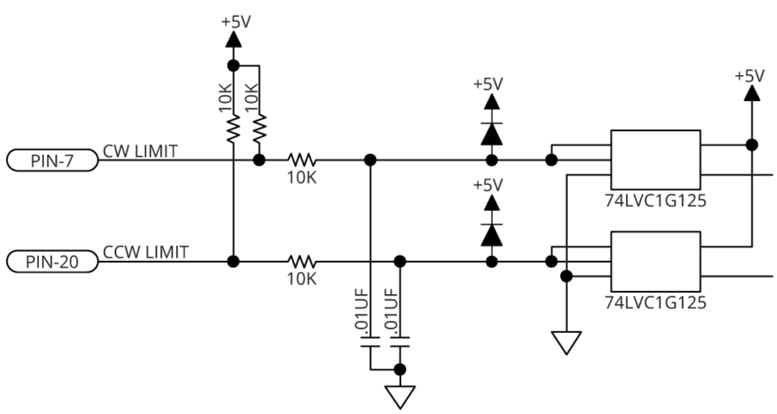


Figure 2-9: End of Travel Limit Input Schematic

2.2.4.1. End of Travel Limit Phasing

If the EOT limits are reversed, you will be able to move further into a limit but be unable to move out. To correct this, swap the connections to the CW and CCW inputs at the Feedback connector or swap the CW and CCW limit functionality in the software using the EndOfTravelLimitSetup parameter. View the logic level of the EOT limit inputs in the Diagnostics display (shown in Figure 2-10).

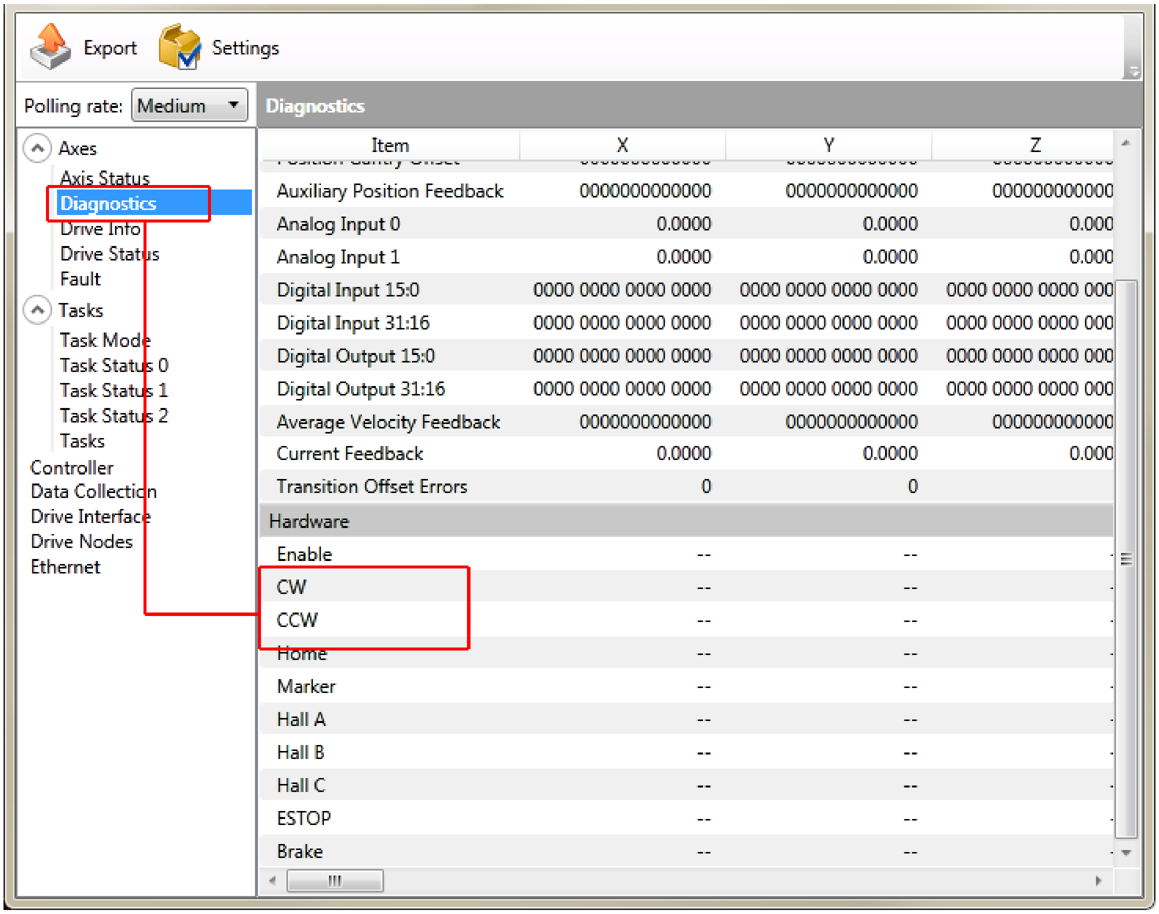


Figure 2-10: End of Travel Limit Input Diagnostic Display

2.2.5. Amplifier Fault Inputs

Use the amplifier fault input to monitor the stepper driver status. Use the FaultSetup parameter to configure the active polarity. The use of this input is optional.

Table 2-13: Amplifier Fault Input Specifications

Specification	Value
Maximum Input Voltage	5V

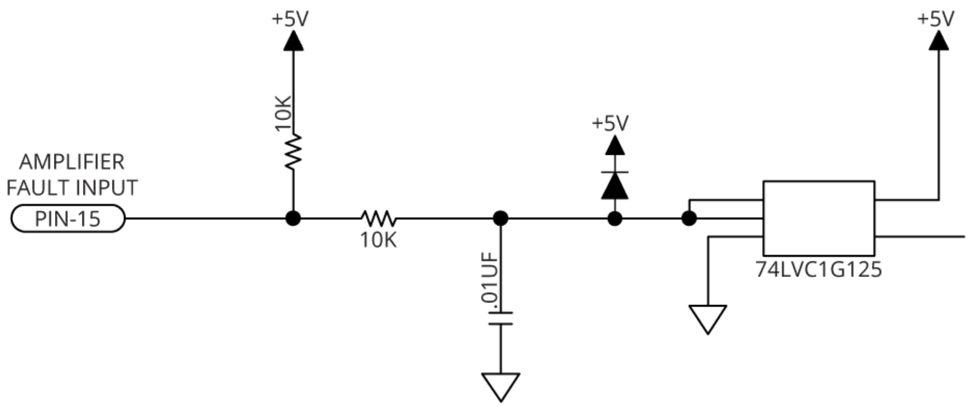


Figure 2-11: Fault Input Schematic

2.2.6. Amplifier Enable Output

Use the AmplifierEnableOutputMode parameter to set the enabled state of the amplifier enable output to sinking or sourcing. The default state is sourcing. However, during a drive reset and when the amplifier is disabled, the amplifier enable output is high-impedance. To ensure a fail-safe state, you must install external pull resistors on the output to pull it to a safe state when the amplifier is disabled.

Table 2-14: Amplifier Enable Connector Pin on the Axis Connector

Pin #	Description	In/Out/Bi
2	Amplifier Enable	Output

Table 2-15: Amplifier Enable Output Specifications

Specification	Value
High-Level Output Voltage	4.4 V
Output Current Source / Sink	10 mA

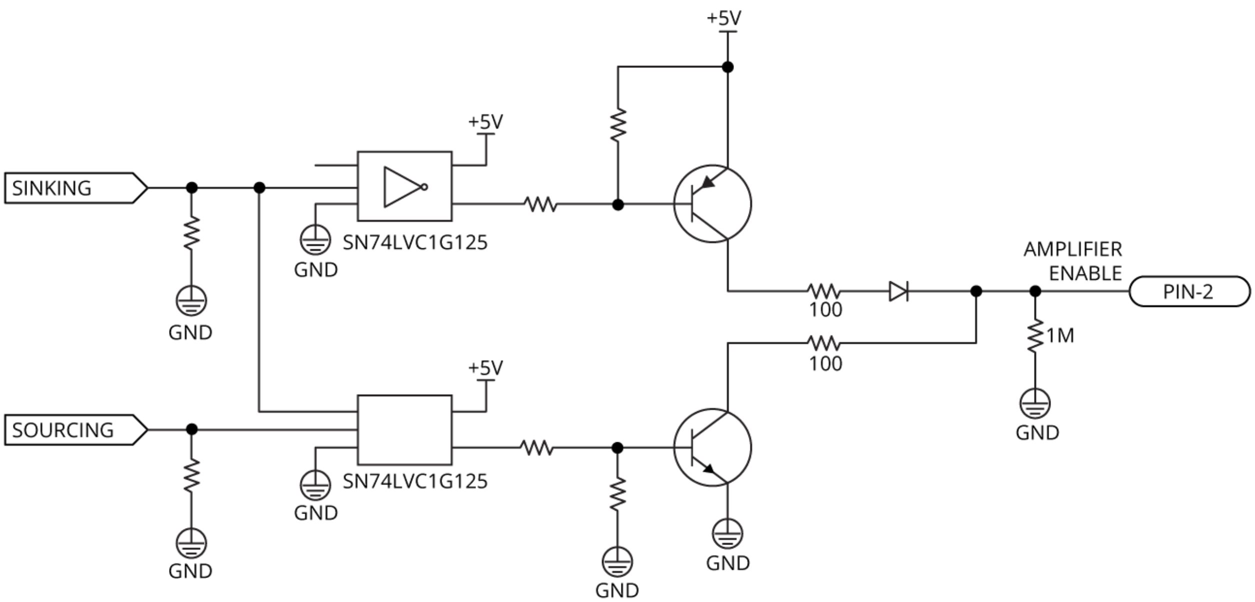


Figure 2-12: Amplifier Enable Output Schematic

2.2.7. Primary Encoder Inputs

The primary encoder inputs are accessible through the Axis connector. Use the PrimaryFeedbackType parameter to configure the XI4 to accept an encoder signal type.

Square Wave encoder signals: Section 2.2.7.1.

Absolute encoder signals: Section 2.2.7.2.

Sine Wave encoder signals (as permitted by the multiplier option): Section 2.2.7.3.

You cannot use a sine wave encoder with the -MX1 multiplier option as an input to the PSO. The -MX1 option does not generate emulated quadrature signals.

Refer to Section 2.2.7.4. for encoder feedback phasing.

Refer to Section 2.2.8. for the auxiliary encoder input on the Axis connector.

Table 2-16: Multiplier Options

Option	Primary Encoder Accepts...	Auxiliary Encoder Accepts...
-MX0	Square Wave or Absolute encoders	Square Wave encoders
-MX1	Sine Wave, Square Wave, or Absolute encoders	Square Wave encoders

IMPORTANT: Physically isolate the encoder wiring from motor, AC power, and all other power wiring

Table 2-17: Primary Encoder Input Pins on the Axis Connector

Pin #	Description	In/Out/Bi
8	+5 V Supply (500 mA)	N/A
9	Primary Sine +	Input
10	Primary Cosine +	Input
11	Primary Marker +	Input
	Absolute Data +	Bidirectional
12	Absolute Clock +	Output
21	Signal Common	N/A
22	Primary Sine -	Input
23	Primary Cosine -	Input
24	Primary Marker -	Input
	Absolute Data -	Bidirectional
25	Absolute Clock -	Output

2.2.7.1. Square Wave Encoder

The drive accepts RS-422 square wave encoder signals. The drive will generate a feedback fault if it detects an invalid signal state caused by an open or shorted signal connection. Use twisted-pair wiring for the highest performance and noise immunity.

Table 2-18: Square Wave Encoder Specifications

Specification	Value
Encoder Frequency	10 MHz maximum (25 ns minimum edge separation)
x4 Quadrature Decoding	40 million counts/sec

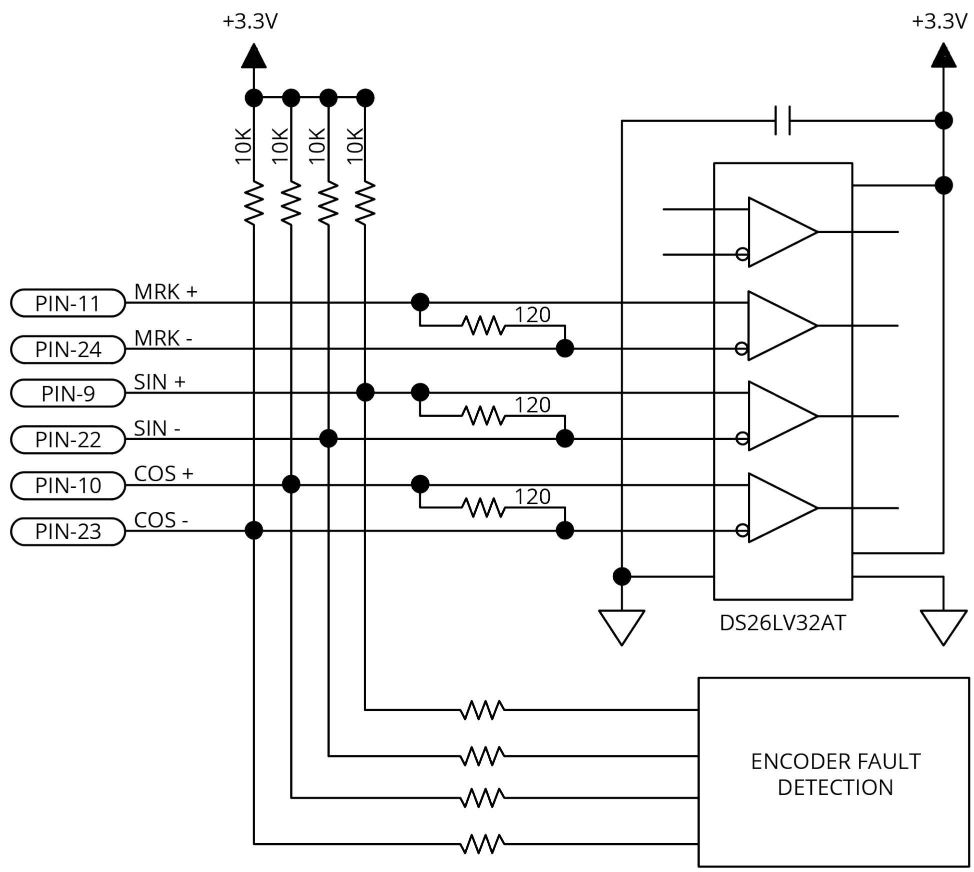


Figure 2-13: Square Wave Encoder Schematic (Axis Connector)

2.2.7.2. Absolute Encoder

The drive retrieves absolute position data along with encoder fault information through a serial data stream from the absolute encoder. Use twisted-pair wiring for the highest performance and noise immunity. You cannot echo an absolute encoder signal.

Refer to Figure 2-14 for the serial data stream interface.

Refer to the Help file for information on how to set up your EnDat or BiSS absolute encoder parameters.

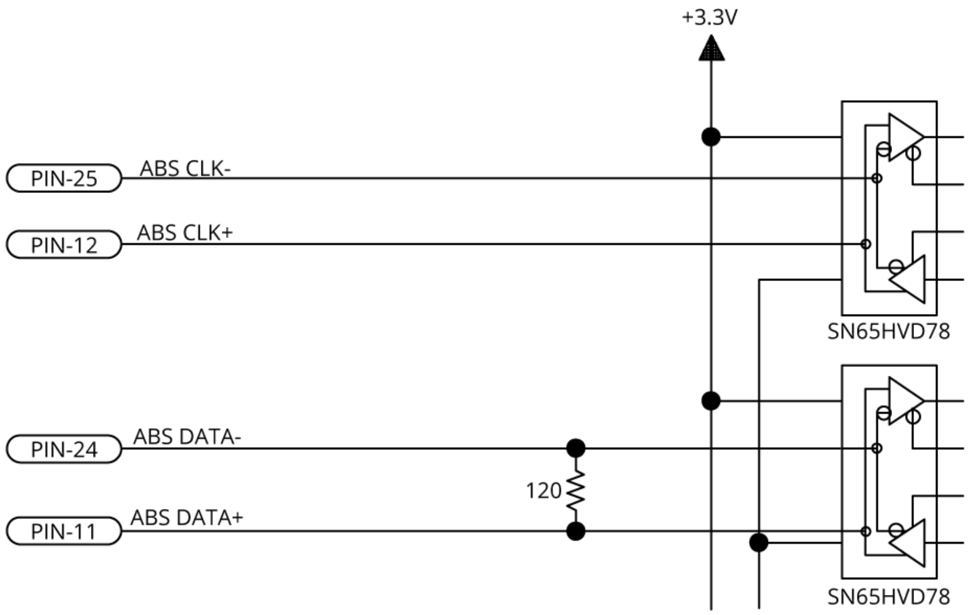


Figure 2-14: Absolute Encoder Schematic (Axis Connector)

2.2.7.3. Sine Wave Encoder

The Sine Wave Encoder option provides higher positioning resolution by subdividing the fundamental output period of the encoder into smaller increments. The amount of subdivision is specified by the PrimaryEncoderMultiplicationFactor parameter. Use Encoder Tuning to adjust the value of the gain, offset, and phase balance controller parameters to get the best performance. For more information, refer to the Help file.

High resolution or high-speed encoders can require increased bandwidth for correct operation. Use the High Speed Mode of the PrimaryEncoderMultiplierSetup parameter to enable the high bandwidth mode. Because this mode increases sensitivity to system noise, use it only if necessary.

You cannot use a sine wave encoder with the -MX1 multiplier option as an input to the PSO. The -MX1 option does not generate emulated quadrature signals.

For the highest performance, use twisted pair double-shielded cable with the inner shield connected to signal common and the outer shield connected to frame ground. Do not join the inner and outer shields in the cable.

Table 2-19: Sine Wave Encoder Specifications

Specification	Value
Input Frequency (max)	450 kHz, 2 MHz
Input Amplitude (1)	0.6 to 1.75 Vpk-pk
Interpolation Factor (max)	16,384
Input Common Mode	1.5 to 3.5 VDC
(1) Measured as SIN(+) - SIN(-) or COS(+) - COS(-)	

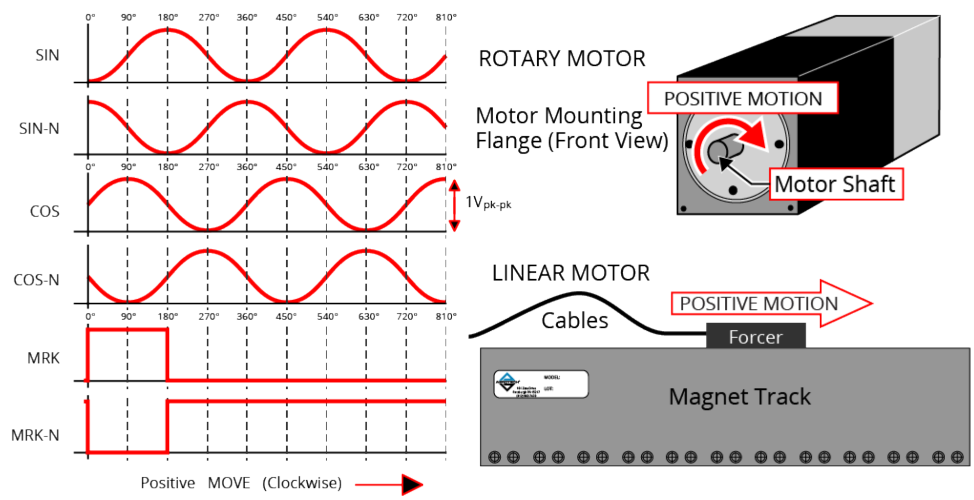


Figure 2-15: Sine Wave Encoder Phasing Reference Diagram

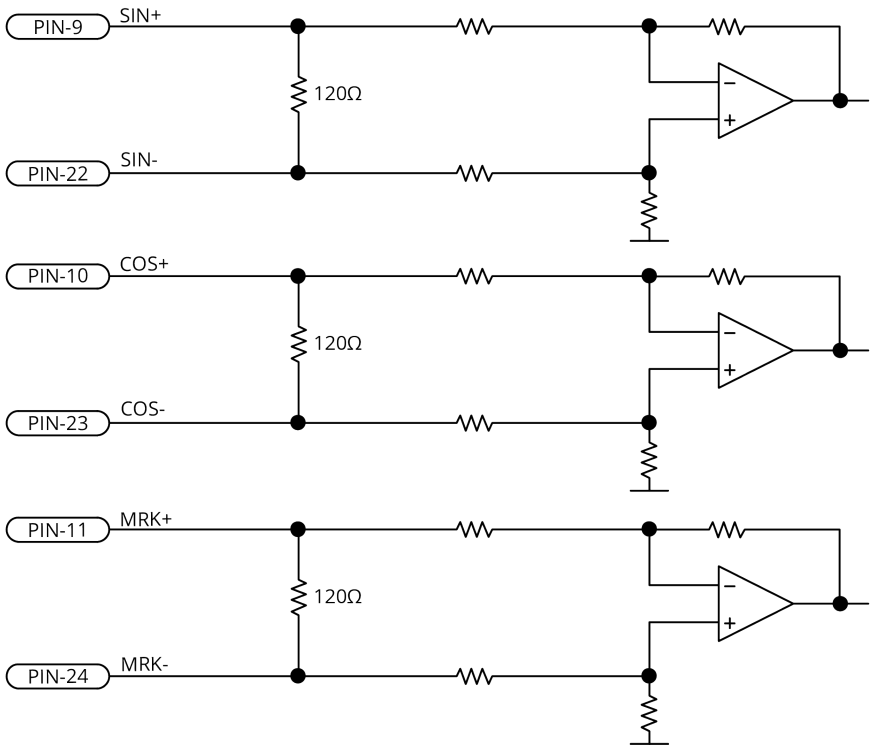


Figure 2-16: Sine Wave Encoder Schematic (Axis Connector)

2.2.7.4. Encoder Phasing

Incorrect encoder polarity will cause the system to fault when enabled or when a move command is issued. Figure 2-17 illustrates the proper encoder phasing for clockwise motor rotation (or positive forcer movement for linear motors). To verify, move the motor by hand in the CW (positive) direction while observing the position of the encoder in the diagnostics display (see Figure 2-18).

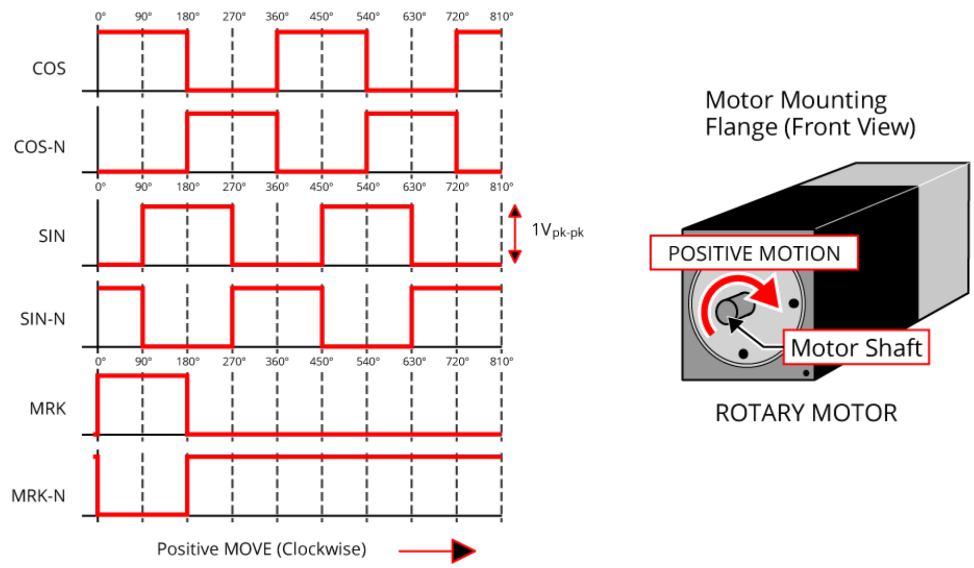


Figure 2-17: Encoder Phasing Reference Diagram (Standard)

IMPORTANT: Encoder manufacturers may refer to the encoder signals as A, B, and Z. The proper phase relationship between signals is shown in Figure 2-17.

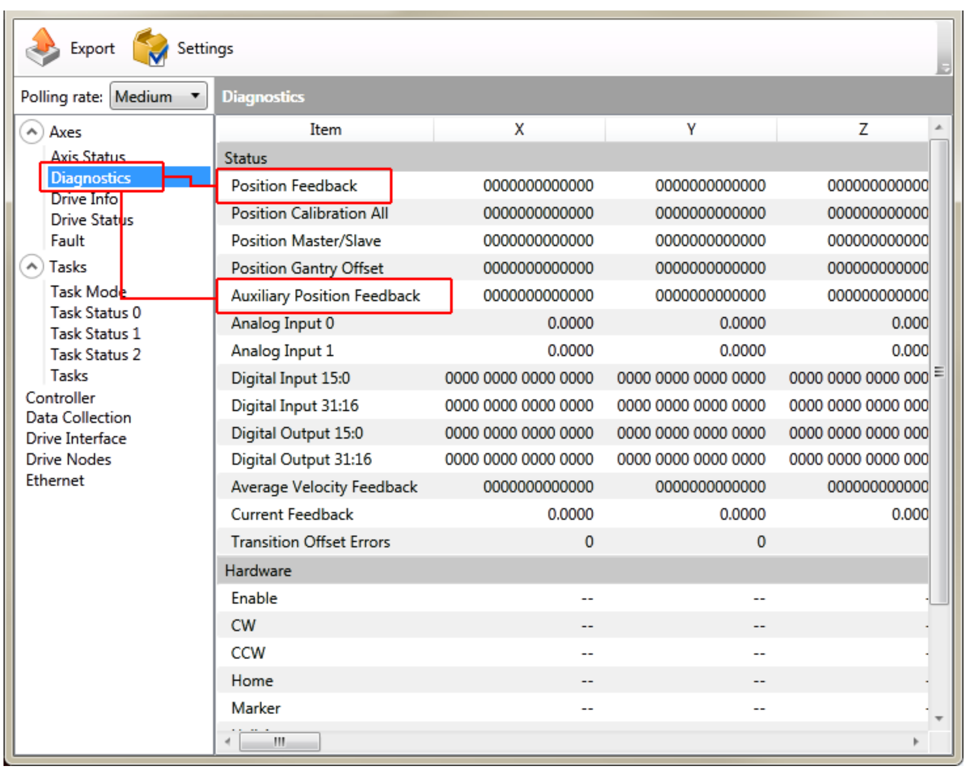


Figure 2-18: Position Feedback in the Diagnostic Display

2.2.7.5. Stepper Motor Phasing

A stepper motor can be run with or without an encoder.

Without an Encoder: You do not need to phase the motor.

With an Encoder: Because the end of travel (EOT) limit inputs are relative to motor rotation, it is important to phase the motor.

Run a positive motion command. The motor is phased correctly if there is a positive scaling factor (determined by the CountsPerUnit parameters) and the motor moves in a clockwise direction when you view the motor from the front mounting flange (Figure 2-19). If the motor moves in a counterclockwise direction, swap the motor leads and re-run the command. After the motor has been phased, if you want to change the direction of positive motion, use the ReverseMotionDirection parameter.

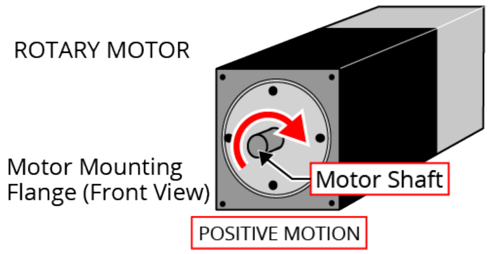


Figure 2-19: Positive Motor Direction

For Aerotech-supplied systems, the motor and encoder are correctly configured and connection adjustments are not necessary.

2.2.8. Auxiliary Encoder Input

The Axis connector gives you a second encoder input channel. This channel is typically used for dual loop applications.

Use the AuxiliaryFeedbackType parameter to configure the drive to accept an encoder signal type.

Square Wave encoder signals: Section 2.2.8.1.

You can configure the Auxiliary Encoder interface as an output that will transmit encoder signals for external use. Use the DriveEncoderOutputConfigureInput() function to configure the Sine ± and Cosine ± connector pins as RS-422 outputs. You can only echo incremental square wave primary encoder inputs.

Table 2-20: Auxiliary Encoder Pins on the Axis Connector

Pin #	Description	In/Out/Bi
5	Auxiliary Sine +	Bidirectional
6	Auxiliary Cosine +	Bidirectional
18	Auxiliary Sine -	Bidirectional
19	Auxiliary Cosine -	Bidirectional

2.2.8.1. Square Wave Encoder

The drive accepts RS-422 square wave encoder signals. The drive will generate a feedback fault if it detects an invalid signal state caused by an open or shorted signal connection. Use twisted-pair wiring for the highest performance and noise immunity.

Table 2-21: Square Wave Encoder Specifications

Specification	Value
Encoder Frequency	10 MHz maximum (25 ns minimum edge separation)
x4 Quadrature Decoding	40 million counts/sec

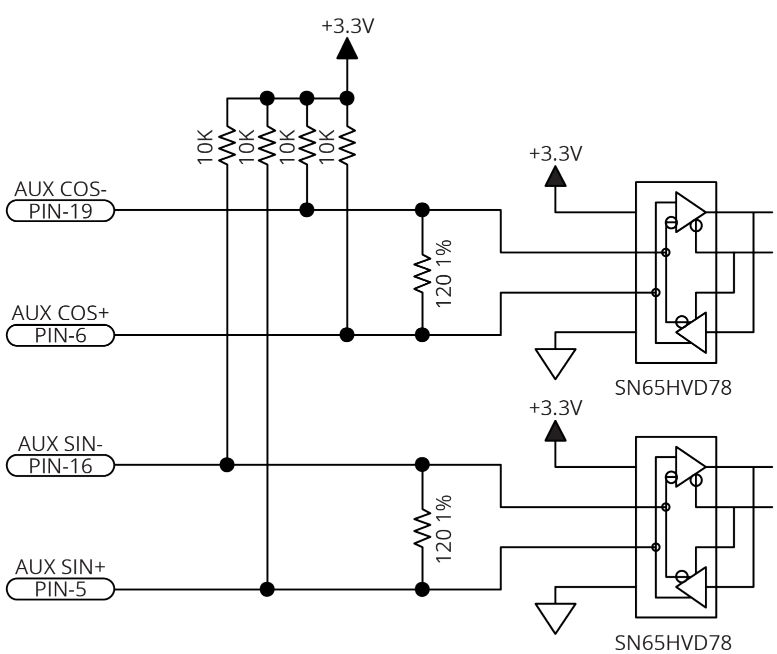


Figure 2-20: Square Wave Encoder Interface (Axis Connector)

2.3. Digital I/O Connector

This connector has two groups of four digital, optically-isolated outputs, two groups of four digital, optically-isolated inputs, and one differential high-speed user input.

Table 2-22: Digital I/O Connector Pinout

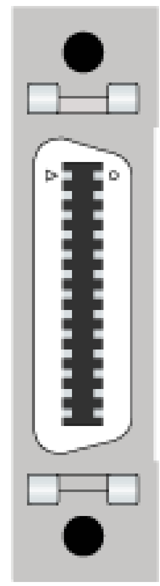
Pin #	Description	In/Out/Bi	Connector
14	Output Common for Digital Outputs 0-3	N/A	
1	Opto-Isolated Digital Output 0	Output	
15	Opto-Isolated Digital Output 1	Output	
2	Opto-Isolated Digital Output 2	Output	
16	Opto-Isolated Digital Output 3	Output	
3	Output Common for Digital Outputs 4-7	N/A	
17	Opto-Isolated Digital Output 4	Output	
4	Opto-Isolated Digital Output 5	Output	
18	Opto-Isolated Digital Output 6	Output	
5	Opto-Isolated Digital Output 7	Output	
19	Input Common for Digital Inputs 0-3	N/A	
6	Opto-Isolated Digital Input 0	Input	
20	Opto-Isolated Digital Input 1	Input	
7	Opto-Isolated Digital Input 2	Input	
21	Opto-Isolated Digital Input 3	Input	
8	Input Common for Digital Inputs 4-7	N/A	
22	Opto-Isolated Digital Input 4	Input	
9	Opto-Isolated Digital Input 5	Input	
23	Opto-Isolated Digital Input 6	Input	
10	Opto-Isolated Digital Input 7	Input	
11	High-Speed Differential Input 8-	Input	
24	High-Speed Differential Input 8+	Input	
26	Reserved	N/A	
12	Common	N/A	
13	Common	N/A	
25	+5 V	N/A	

Table 2-23: Mating Connector Part Numbers for the Digital I/O Connector

Mating Connector	Aerotech P/N	Third Party P/N
26-Pin Connector	ECK02514	10126-3000PE
Backshell	ECK02517	10326-52F0-008

2.3.1. Digital Outputs

Optically-isolated solid-state relays drive the digital outputs. You can connect the digital outputs in current sourcing or current sinking mode but you must connect all four outputs in a group in the same configuration. Refer to Figure 2-22 and Figure 2-23.

The digital outputs are not designed for high-voltage isolation applications and they should only be used with ground-referenced circuits.

You must install suppression diodes on digital outputs that drive relays or other inductive devices. To see an example of a current sourcing output that has diode suppression, refer to Figure 2-22. To see an example of a current sinking output that has diode suppression, refer to Figure 2-23

The digital outputs have overload protection. They will resume normal operation when the overload is removed.

Table 2-24: Digital Output Specifications

Digital Output Specifications	Value
Maximum Voltage	24 V (26 V Maximum)
Maximum Sink/Source Current	250 mA/output
Output Saturation Voltage	0.9 V at maximum current
Output Resistance	3.7 Ω
Rise / Fall Time	250 μs (2K pull up to 24V)
Reset State	Output Off (High Impedance State)

Table 2-25: Digital Output Pins on Digital I/O Connector

Pin #	Description	In/Out/Bi
14	Output Common for Digital Outputs 0-3	N/A
1	Opto-Isolated Digital Output 0	Output
15	Opto-Isolated Digital Output 1	Output
2	Opto-Isolated Digital Output 2	Output
16	Opto-Isolated Digital Output 3	Output
3	Output Common for Digital Outputs 4-7	N/A
17	Opto-Isolated Digital Output 4	Output
4	Opto-Isolated Digital Output 5	Output
18	Opto-Isolated Digital Output 6	Output
5	Opto-Isolated Digital Output 7	Output

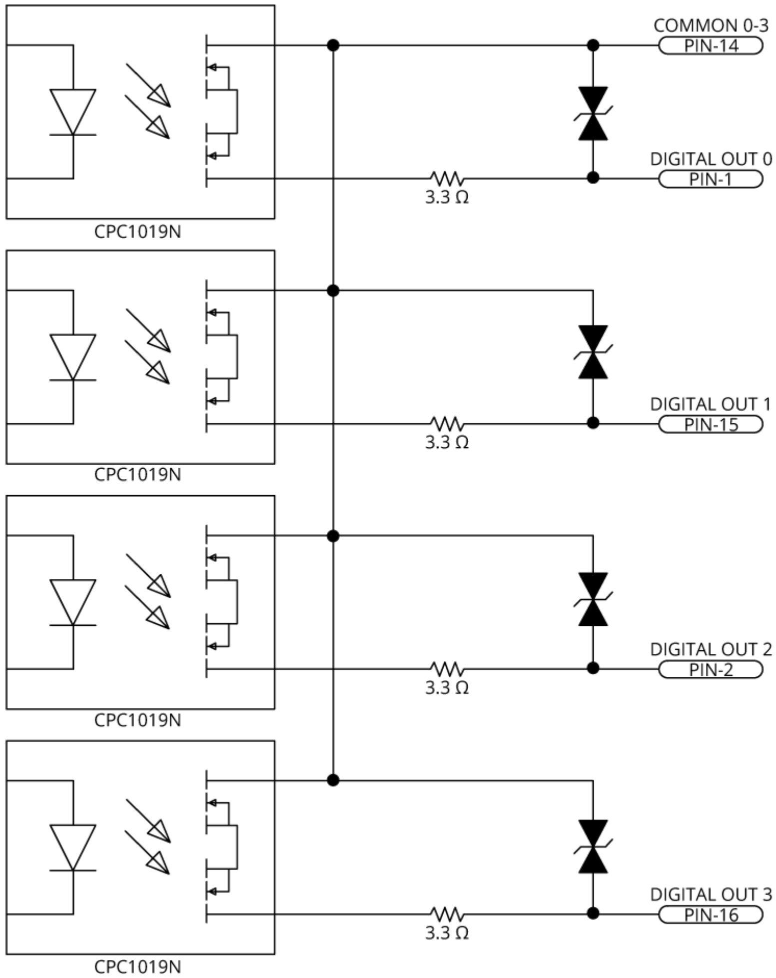
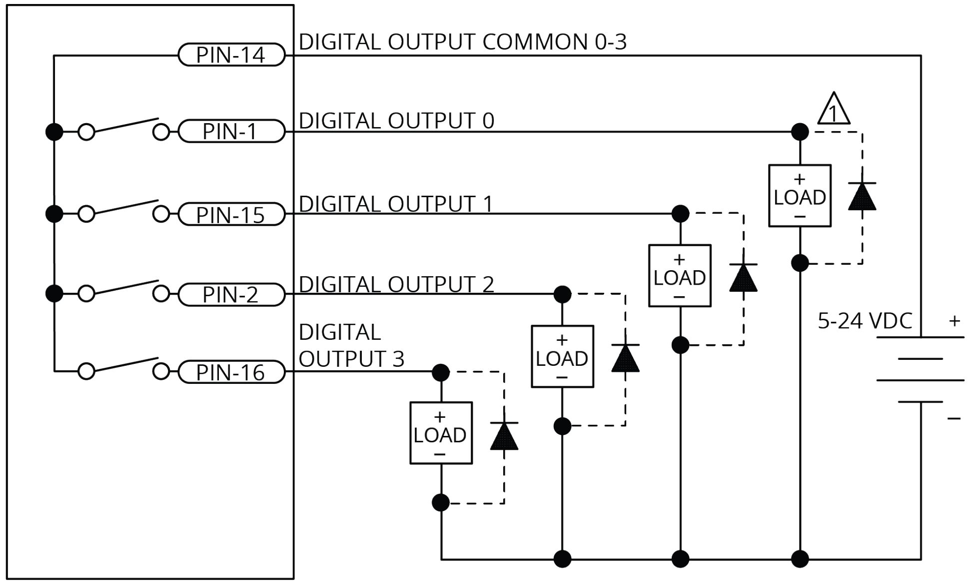
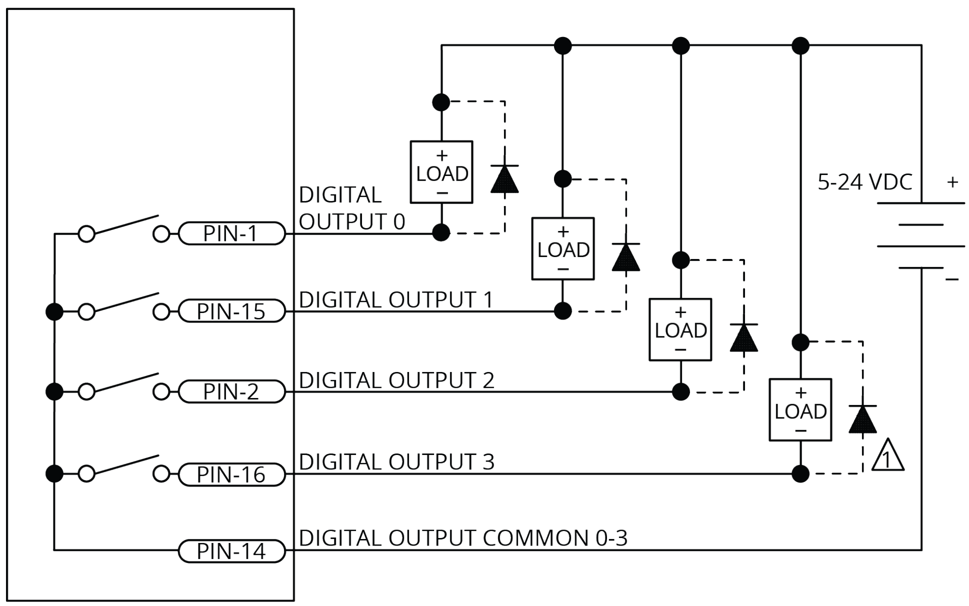


Figure 2-21: Digital Outputs Schematic



1 DIODE REQUIRED ON EACH OUTPUT THAT DRIVES AN INDUCTIVE DEVICE (COIL), SUCH AS A RELAY.

Figure 2-22: Digital Outputs Connected in Current Sourcing Mode



1 DIODE REQUIRED ON EACH OUTPUT THAT DRIVES AN INDUCTIVE DEVICE (COIL), SUCH AS A RELAY.

Figure 2-23: Digital Outputs Connected in Current Sinking Mode

2.3.2. Digital Inputs

Input bits are arranged in groups of 4 and each group shares a common pin. This lets a group be connected to current sourcing or current sinking devices, based on the connection of the common pin in that group.

To be able to connect an input group to current sourcing devices, connect the input group's common pin to the power supply return (-). Refer to Figure 2-25.

To be able to connect an input group to current sinking devices, connect the input group's common pin to the power supply source (+). Refer to Figure 2-26.

The digital inputs are not designed for high-voltage isolation applications. They should only be used with ground-referenced circuits.

Table 2-26: Digital Input Specifications

Input Voltage	Approximate Input Current	Turn On Time	Turn Off Time
+5 V to +24 V	6 mA	10 µs	43 µs

Table 2-27: Digital Input Pins on the Digital I/O Connector

Pin #	Description	In/Out/Bi
19	Input Common for Digital Inputs 0-3	N/A
6	Opto-Isolated Digital Input 0	Input
20	Opto-Isolated Digital Input 1	Input
7	Opto-Isolated Digital Input 2	Input
21	Opto-Isolated Digital Input 3	Input
8	Input Common for Digital Inputs 4-7	N/A
22	Opto-Isolated Digital Input 4	Input
9	Opto-Isolated Digital Input 5	Input
23	Opto-Isolated Digital Input 6	Input
10	Opto-Isolated Digital Input 7	Input

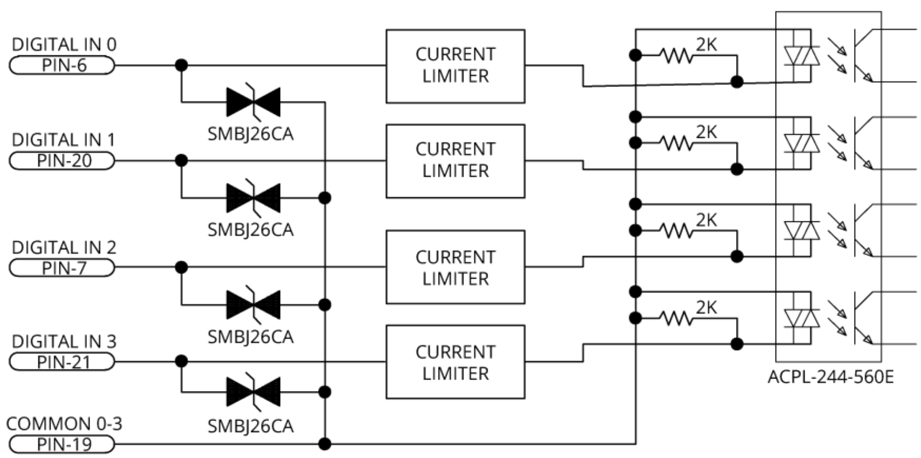


Figure 2-24: Digital Inputs Schematic

Each group of four inputs must be connected in an all sourcing or all sinking configuration.

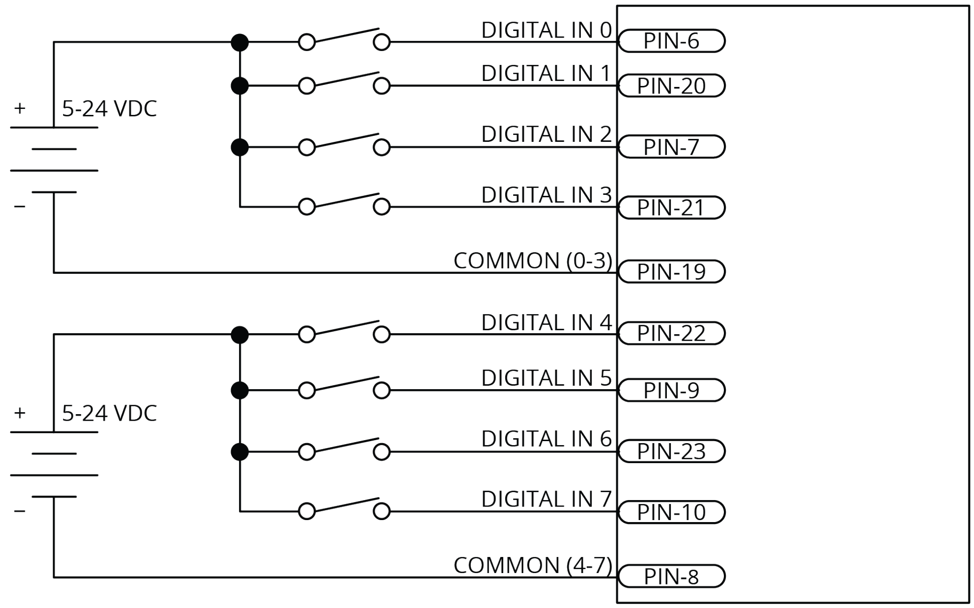


Figure 2-25: Digital Inputs Connected to Current Sourcing (PNP) Devices

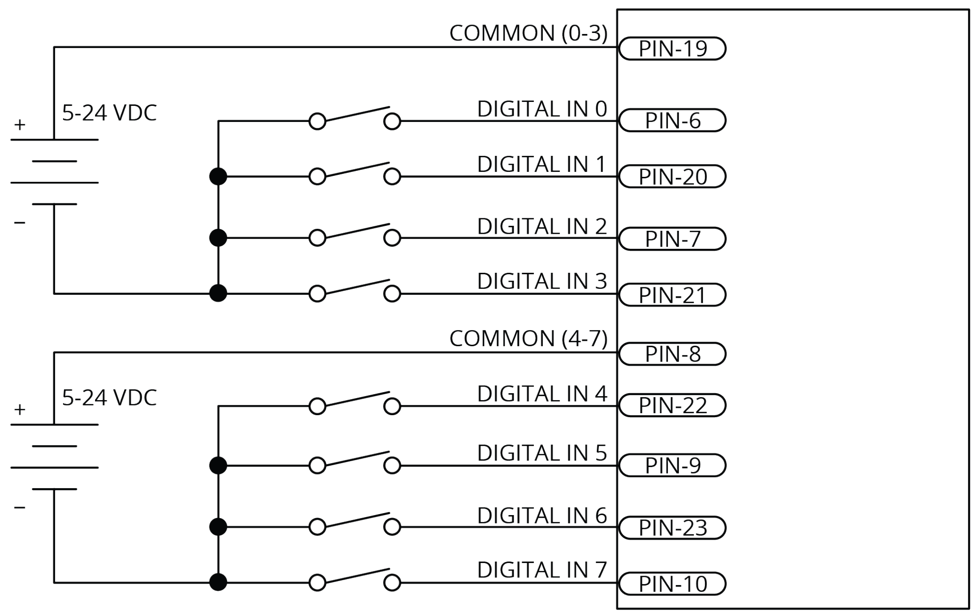


Figure 2-26: Digital Inputs Connected to Current Sinking (NPN) Devices

2.3.3. High-Speed User Input

High-speed input 8 can be used as a general purpose input or as the trigger signal for high speed data collection. Refer to the DriveDataCaptureConfigureTrigger() function topic in the Help file for more information.

Table 2-28: High-Speed Input Specifications

Specification	Value
Input Voltage	5V - 24 V input voltages
Input Current	10 mA
Input Device	HCPL-0630
Delay	50 nsec

Table 2-29: High-Speed Input Pins on the Digital I/O Connector

Pin #	Description	In/Out/Bi
11	High-Speed Differential Input 8-	Input
24	High-Speed Differential Input 8+	Input

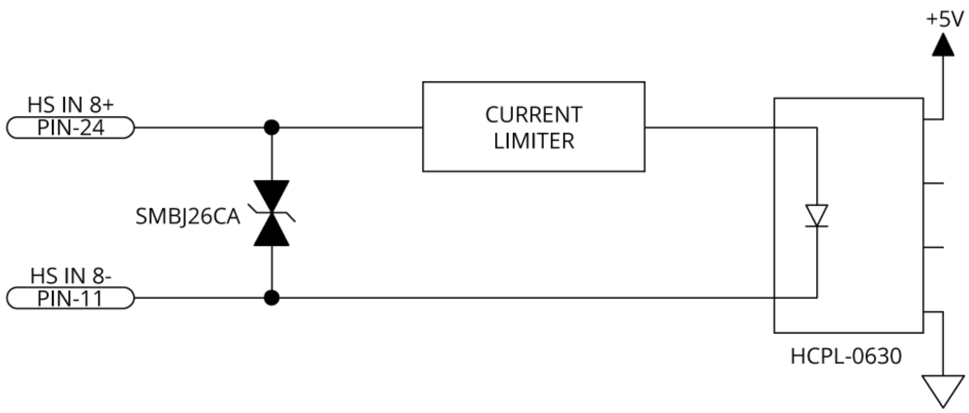


Figure 2-27: High-Speed Input

2.4. Analog I/O and Laser Interface Connector

This connector has four analog inputs, two analog outputs, one PSO output, and one PSO external sync input.

Table 2-30: Analog I/O and Laser Interface Connector Pinout

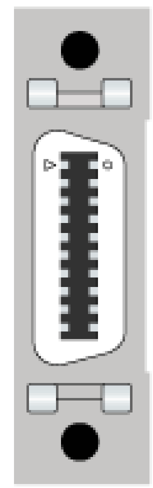
Pin #	Description	In/Out/Bi	Connector
4	+5 Volt (500 mA max)	N/A	
11	PSO Output (TTL)	Output	
1	Common	N/A	
12	Reserved	N/A	
2	Common	N/A	
13	Reserved	N/A	
3	Common	N/A	
14	PSO External Sync	Input	
15	Analog Output 0	Output	
5	Analog Common	N/A	
16	Analog Output 1	Output	
6	Analog Common	N/A	
7	Analog Input 0+ (Differential)	Input	
17	Analog Input 0- (Differential)	Input	
8	Analog Input 1+ (Differential)	Input	
18	Analog Input 1- (Differential)	Input	
9	Analog Input 2+ (Differential)	Input	
19	Analog Input 2- (Differential)	Input	
10	Analog Input 3+ (Differential)	Input	
20	Analog Input 3- (Differential)	Input	

Table 2-31: Mating Connector Part Numbers for the Analog I/O and Laser Interface Connector

Mating Connector	Aerotech P/N	Third Party P/N
20-Pin Connector	ECK02515	10120-3000PE
Backshell	ECK02518	10320-52F0-008

2.4.1. Position Synchronized Output (PSO) Interface

This output signal is a 5V TTL signal which is used to drive an opto coupler or general purpose TTL input. This signal is active high and is driven to 5V when a PSO fire event occurs.

You can use the external PSO synchronization functions to synchronize waveform generation with an external synchronization signal. When you activate this feature, the PSO Waveform module will not generate the configured waveform when an output event is received until the rising edge of the synchronization signal occurs.

Table 2-32: PSO Specifications

Specification	Value
Output	5 V, 50 mA (max)
Maximum PSO Output (Fire) Frequency	12.5 MHz
Output Latency [Fire event to output change]	5 ns

Table 2-33: PSO External Sync Specifications

Specification	Value
Voltage	3.3 VDC
Frequency	25 MHz Maximum
On Time	20 ns Minimum

Table 2-34: PSO Output Pins on the Analog I/O and Laser Interface Connector

Pin #	Description	In/Out/Bi
11	PSO Output (TTL)	Output
1	Common	N/A
14	PSO External Sync	Input

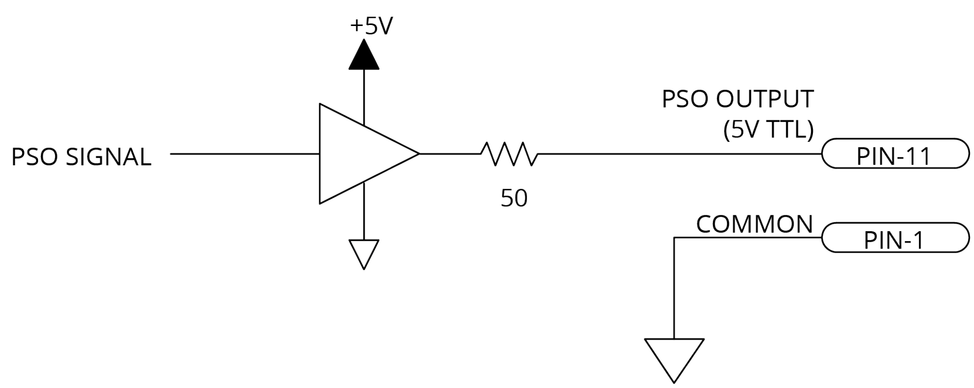


Figure 2-28: PSO TTL Outputs Schematic

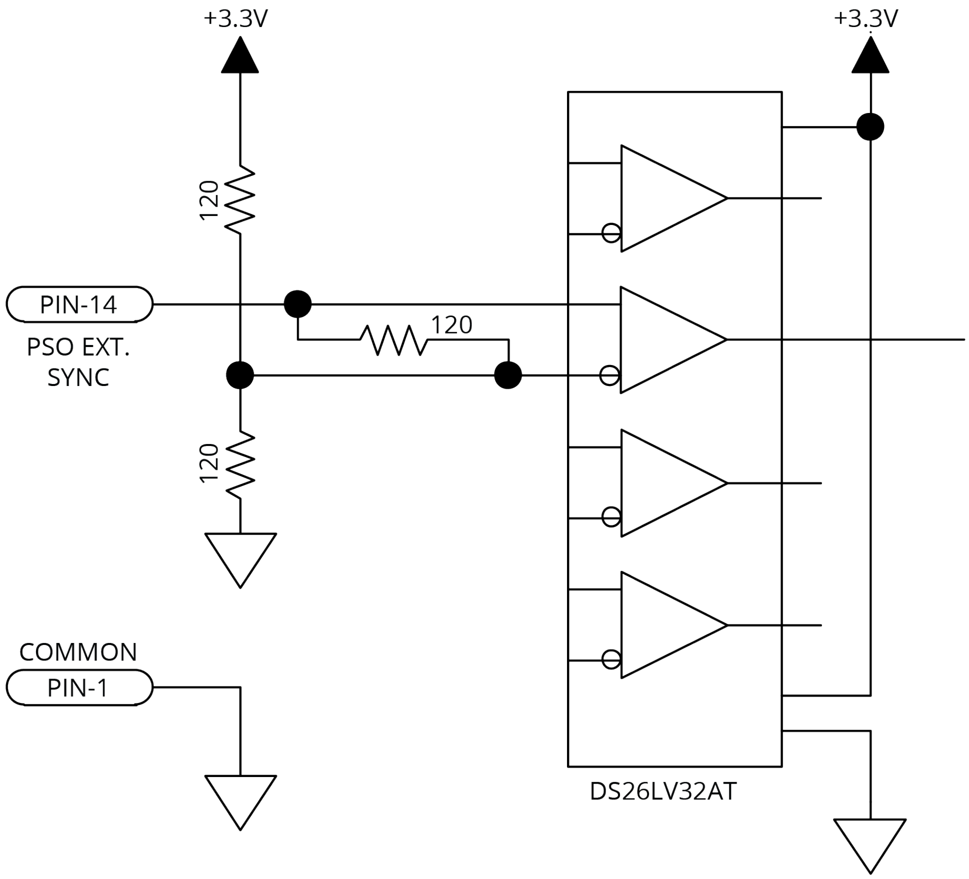


Figure 2-29: PSO External Sync Input Schematic

2.4.2. Analog Outputs

The analog outputs can be set from within a program or they can be configured to echo the state of select servo loop nodes.

The analog outputs are set to zero when you power on the system or reset the drive.

Table 2-35: Analog Output Specifications

Specification	Value
Output Voltage	-10 V to +10 V
Output Current	5 mA
Resolution (bits)	16 bits

Table 2-36: Analog Output Pins on the Analog I/O and Laser Interface Connector

Pin #	Description	In/Out/Bi
15	Analog Output 0	Output
5	Analog Common	N/A
16	Analog Output 1	Output
6	Analog Common	N/A

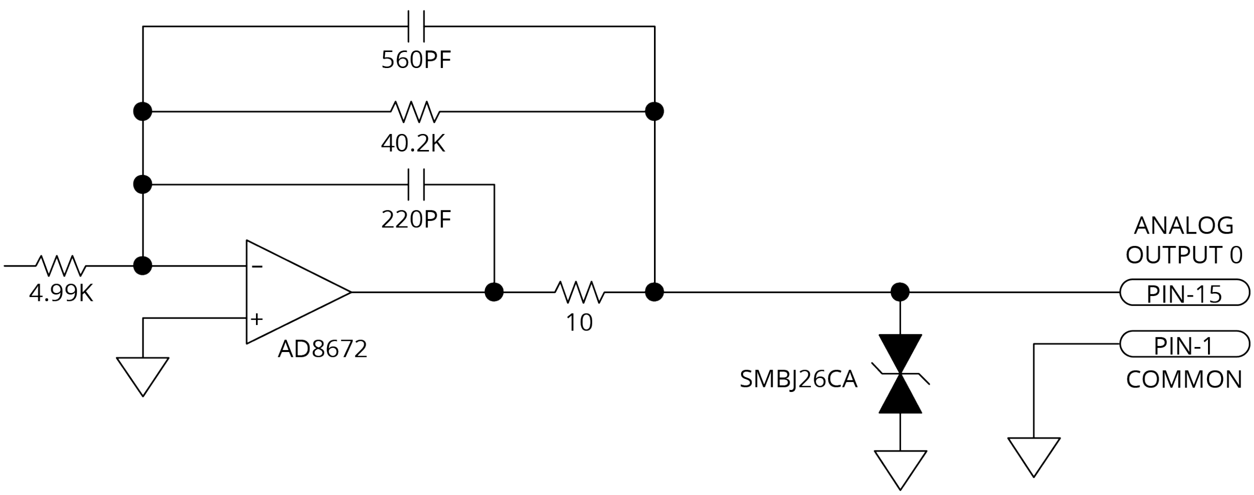


Figure 2-30: Analog Outputs Schematic

2.4.3. Analog Inputs (Differential)

To interface to a single-ended, non-differential voltage source, connect the signal common of the source to the negative input and connect the analog source signal to the positive input. A floating signal source must be referenced to the analog common. Refer to Figure 2-31.

Table 2-37: Analog Input Specifications

Specification	Value
(AI+) - (AI-)	+10 V to -10 V (1)
Resolution (bits)	16 bits
Input Impedance	1 MΩ

1. Signals outside of this range may damage the input

Table 2-38: Analog Input Pins on the Analog I/O and Laser Interface Connector

Pin #	Description	In/Out/Bi
6	Analog Common	N/A
7	Analog Input 0+ (Differential)	Input
17	Analog Input 0- (Differential)	Input
8	Analog Input 1+ (Differential)	Input
18	Analog Input 1- (Differential)	Input
9	Analog Input 2+ (Differential)	Input
19	Analog Input 2- (Differential)	Input
10	Analog Input 3+ (Differential)	Input
20	Analog Input 3- (Differential)	Input

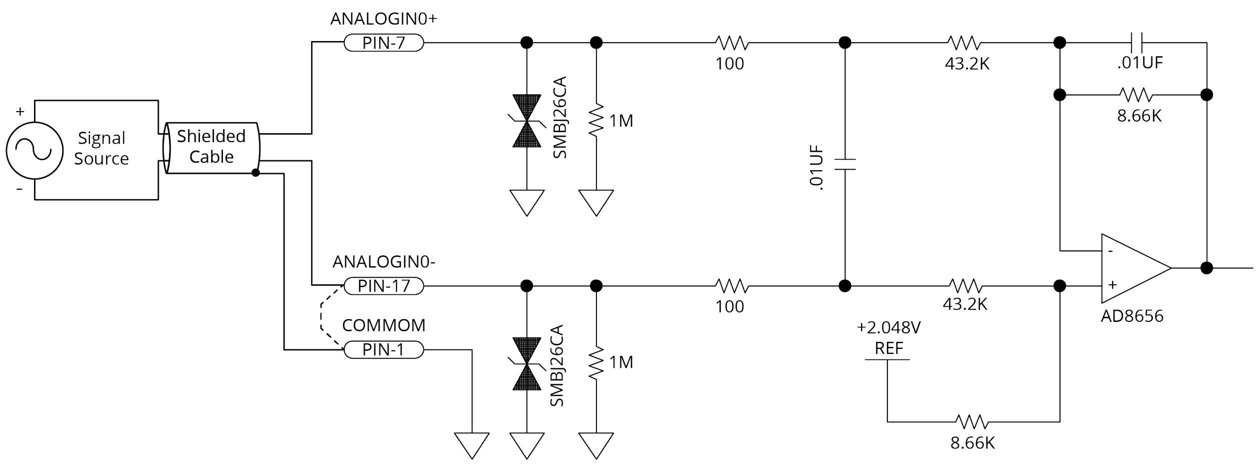


Figure 2-31: Analog Inputs Schematic

2.4.4. Sync Port

The Sync port is a bi-directional high speed proprietary interface that lets you transmit encoder signals between drives. This is typically used for multi-axis PSO applications where one or two drives send their encoder signals to a main drive that has the PSO logic and PSO output signal. The XI4 contains two Sync ports, labeled A and B.

To avoid signal contention, all Sync ports default to the input state during reset and immediately after power is applied to the drive.

Table 2-39: Sync-Related Functions

Function	Description
DriveEncoderOutputConfigureDivider(), DriveEncoderOutputConfigureInput(), DriveEncoderOutputOn(), DriveEncoderOutputOff()	Configure each Sync port as an input or an output
PsoDistanceConfigureInputs()	Let the PSO to track the SYNC A or SYNC B port.
PsoWindowConfigureInput()	

The Sync port uses low-voltage differential signaling (LVDS) and standard USB 3.0 type A (cross over) cables.

Table 2-40: Sync Port Cables

Part Number	Desciption
CBL-SYNC-3	Length 3 dm; Connectors: USB Type A to USB Type A
CBL-SYNC-5	Length 5 dm; Connectors: USB Type A to USB Type A
CBL-SYNC-7	Length 7 dm; Connectors: USB Type A to USB Type A
CBL-SYNC-10	Length 10 dm; Connectors: USB Type A to USB Type A

2.5. HyperWire Interface

The HyperWire bus is the high-speed communications connection from the controller. It operates at 2 gigabits per second. The controller sends all command and configuration information through the HyperWire bus.

HyperWire cables can be safely connected to or disconnected from a HyperWire port while the PC and/or drive is powered on. However, any changes to the HyperWire network topology will disrupt communication and you must reset the controller to re-establish communication.

WARNING: Do not connect or disconnect HyperWire cables while you are loading firmware or damage to the drives may occur.

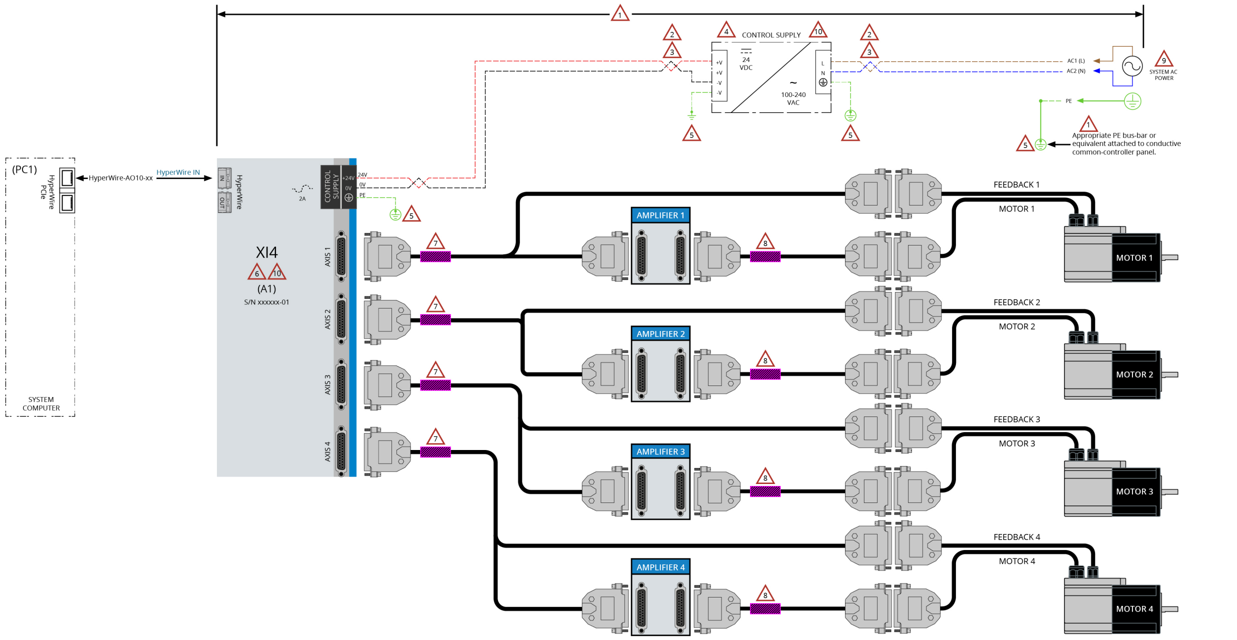
Table 2-41: HyperWire Card Part Number

Part Number	Description
HYPERWIRE-PCIE	HyperWire adapter, PCIe x4 interface

Table 2-42: HyperWire Cable Part Numbers

Part Number	Description
HYPERWIRE-AO10-5	HyperWire cable, active optical, 0.5 m
HYPERWIRE-AO10-10	HyperWire cable, active optical, 1.0 m
HYPERWIRE-AO10-30	HyperWire cable, active optical, 3.0 m
HYPERWIRE-AO10-50	HyperWire cable, active optical, 5.0 m
HYPERWIRE-AO10-200	HyperWire cable, active optical, 20.0 m

2.6. System Interconnection



! ATTENTION !

The system integrator or end user is responsible for all safety compliance and technical requirements for the system wiring.

IMPORTANT: Read all parts of this manual before you install or operate the SI4 or before you do maintenance to your system.
- To prevent injury to you and damage to the equipment, obey the precautions in this manual.
- If you do not understand the information in this manual, contact Aerotech Global Technical Support.

1 For EMC performance, mount all system components on to a common conductive metal panel.
- Do not use a panel that has a painted or non-conductive coat applied.
- You can use a panel with a conductive surface coat.

2 System Wiring: ROUTING
- Separate VAC and VDC wires
- Separate motor and cable wiring from Control Supply, Low-Voltage I/O, and Control and Feedback signal wires, and VAC/VDC supply wires.

3 System Wiring: SPECIFICATIONS
- Aerotech recommmends that you use twisted pair conductors with wire lengths as short as possible.
- Wire Sizes:
  - AC POWER: 1.3 mm² [16 AWG]
  - CONTROL POWER: 0.34 mm² [22 AWG]
- Wire Conformity:
  - North America: UL AWM
  - EU: <HAR>/CE

4 System Control VDC Power Supply
- Minimum Requirements:
  - Pollution Degree 2
  - Double insulated
  - Short-circuit and over-voltage protection
  - UL and CE approvals
- Recommended Power Supply*:
  - 24 VDC Control Supply
  Mean Well P/N: NDR-75-24 (DIN Rail power supply, 75W 24V 3.2A)
  * Refer to the Mean Well "NDR Series Installation Manual"

5 System Protective Earth (PE) grounds
- Keep PE wires as short as possible
- Each PE wire must have a dedicated attach/termination point
- Terminate each PE directly to the grounded component panel (and that the component panel conform to NOTE 1).

6 XI4 Controller
- Refer to assemblies (A1)
- If the controllers were purchased as an integrated system, refer to the System Interconnections drawing included with the system documentation.

7 Axis Feedback Cable Ferrite EMC Filters
- Use Aerotech P/N: ECZ02348 (Fair-Rite P/N: 0446167281) Clamp-On filters
- Attach the filter near to the feedback connector back-shell as illustrated

8 Axis Motor Cable Ferrite EMC Filters
- Use Aerotech P/N: ECZ02367 (Fair-Rite P/N: 2631626402) ferrite cores on motor-phase leads.
- Attach the filter near to the A+ and B+ motor output terminals on the amplifier.

9 System AC Power
- The system AC power must have a fuse or circuit breaker protection
- Voltages and currents are dependent on the selected power supplies and system axis requirements (refer to NOTE 4).

10 DIN-Rail Mounted Components
- Use DIN Rail from Phoenix P/N: NS 35/ 7,5 PERF 2000MM - 0801733 or equivalent

The information on this page is for reference only and represents best practice applications.

Figure 2-32: System Interconnection Drawing (Best Practice)

2.7. PC Configuration and Operation Information

For more information about hardware requirements, PC configuration, programming, system operation, and utilities, refer to the Help file.

Chapter 3: Maintenance

IMPORTANT: For your own safety and for the safety of the equipment:

- Do not remove the cover of the XI4
- Do not attempt to access the internal components.

A fuse that needs to be replaced indicates that there is a more serious problem with the system or setup. Contact Global Technical Support for assistance.

Table 2-43: LED Description

LED	Color	Description
PWR	GREEN	The light will illuminate and remain illuminated while power is applied.
ENB/FLT	GREEN	Any of the axes are Enabled.
	RED	Any of the axes are in a Fault Condition.
	GREEN/RED (alternates)	Any of the axes are Enabled in a Fault Condition. or The light is configured to blink for setup.

Table 2-44: Troubleshooting

Symptom	Possible Cause and Solution
No Communication	Make sure the power LED is illuminated (this indicates that power is present).
	Make sure that all communication cables (HyperWire, for example) are fully inserted in their ports.

3.1. Preventative Maintenance

Do an inspection of the XI4 and the external wiring one time each month. It might be necessary to do more frequent inspections based on:

- The operating conditions of the system.
- How you use the system.

Table 2-45: Preventative Maintenance

Check	Action to be Taken
Examine the chassis for hardware and parts that are damaged or loose. It is not necessary to do an internal inspection unless you think internal damage occurred.	Repair all damaged parts.
Do an inspection of the cooling vents.	Remove all material that collected in the vents.
Examine the work area to make sure there are no fluids and no electrically conductive materials.	Do not let fluids and electrically conductive material go into the drive.
Examine all cables and connections to make sure they are correct.	Make sure that all connections are correctly attached and not loose. Replace cables that are worn. Replace all broken connectors.

Cleaning

DANGER: Before you clean the XI4, disconnect the electrical power from the drive.

Use a clean, dry, soft cloth to clean the chassis of the drive. If necessary, you can use a cloth that is moist with water or isopropyl alcohol. If you use a moist cloth, make sure that moisture does not go into the drive. Also make sure that it does not go onto the outer connectors and components.

Do not use fluids and sprays to clean the drive because they can easily go into the chassis or onto the outer connectors and components. If a cleaning solution goes into the drive, internal contamination can cause corrosion and electrical short circuits.

Do not clean the labels with a cleaning solution because it might remove the label information.

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Appendix A: Warranty and Field Service

Aerotech, Inc. warrants its products to be free from harmful defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products that are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability on any claim for loss or damage arising out of the sale, resale, or use of any of its products shall in no event exceed the selling price of the unit.

THE EXPRESS WARRANTY SET FORTH HEREIN IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE. IN NO EVENT SHALL AEROTECH BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES.

Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within thirty (30) days of shipment of incorrect material. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. A "Return Materials Authorization (RMA)" number must accompany any returned product(s). The RMA number may be obtained by calling an Aerotech service center or by submitting the appropriate request available on our website (www.aerotech.com). Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than thirty (30) days after the issuance of a return authorization number will be subject to review.

Visit Global Technical Support Portal for the location of your nearest Aerotech Service center.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an expedited method of return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Fixed Fee Repairs - Products having fixed-fee pricing will require a valid purchase order or credit card particulars before any service work can begin.

All Other Repairs - After Aerotech's evaluation, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within thirty (30) days of notification will result in the product(s) being returned as is, at the buyer's expense.

Repair work is warranted for ninety (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

> Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special rates apply.
>
> If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following “On-Site Non-Warranty Repair” section apply.

On-site Non-Warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

> Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

Service Locations

http://www.aerotech.com/contact-sales.aspx?mapState=showMap

USA, CANADA, MEXICO
Aerotech, Inc.
Global Headquarters

CHINA
Aerotech China
Full-Service Subsidiary

GERMANY
Aerotech Germany
Full-Service Subsidiary

TAIWAN
Aerotech Taiwan
Full-Service Subsidiary

UNITED KINGDOM
Aerotech United Kingdom
Full-Service Subsidiary

Appendix B: Revision History

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1.00	New Manual

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