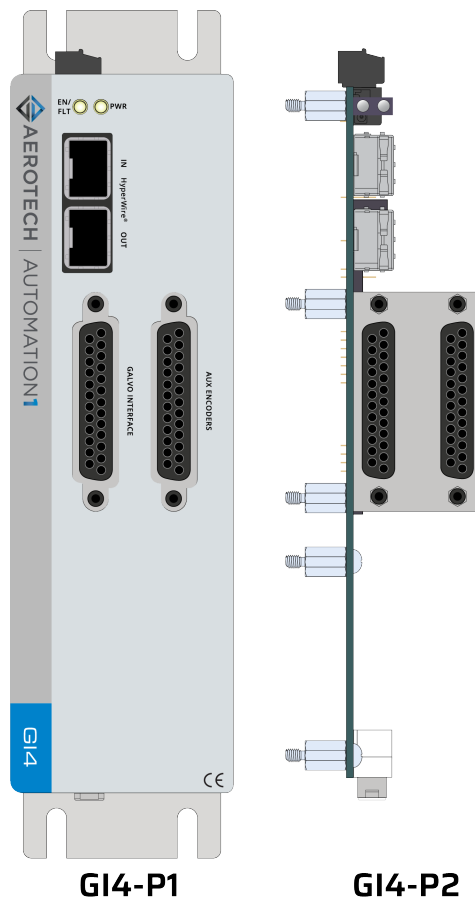




Automation1 GI4 Galvo Scanner Controller

HARDWARE MANUAL

Revision 1.09



GI4-P1

GI4-P2

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EU Declaration of Conformity

Manufacturer Aerotech, Inc.
Address 101 Zeta Drive
 Pittsburgh, PA 15238-2811
 USA
Product GI4
Model/Types All



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

2014/30/EU	Electromagnetic Compatibility (EMC)
EU 2015/863	Directive, Restricted Substances (RoHS 3)

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.

EN 55011:2000/A2:2003	Conducted and Radiated Emissions
EN 55022:1998	Conducted and Radiated Emissions

Authorized Representative:

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Engineer Verifying Compliance:

/ Alex Weibel

Aerotech, Inc.
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 Pittsburgh, PA 15238-2811
 USA
Date: 11/26/2024

UKCA Declaration of Conformity

Manufacturer Aerotech, Inc.
Address 101 Zeta Drive
Pittsburgh, PA 15238-2811
USA
Product GI4
Model/Types All



To which this declaration relates, meets the essential health and safety requirements and is in conformity with the relevant UK Legislation listed below:

Electromagnetic Compatibility Regulations 2016
Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

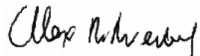
Using the relevant section of the following UK Designated Standards and other normative documents when installed in accordance with the installation instructions supplied by the manufacturer.

EN 55011:2000/A2:2003 Conducted and Radiated Emissions
EN 55022:1998 Conducted and Radiated Emissions

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USA

Date: 11/26/2024

Korean Certification



Registration of Broadcasting and Communication Equipments

It is verified that the foregoing equipment has been registered under the Clause 3, Article 58-2 of the radio Waves Act.

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.

Safety notes and symbols are placed throughout this manual to warn you of the potential risks at the moment of the safety note or if you fail to obey the safety note.



The voltage can cause shock, burn, or death.



You are at risk of physical injury.
You could damage the controller.



A surface can be hot enough to burn you.



Your actions, the temperature of the system, or the condition of the atmosphere that surround the system could start a fire.



Components are sensitive to electrostatic discharge.



Unsecured cables could cause you to:

- trip and fall
- drag the product off of its mounting location
- damage the cable connections.



A blue circle symbol is an action or tip that you should obey. Some examples include:



- General tip
- Read the manual/section
- Wear protective safety equipment (eye protection, ear protection, gloves)
- If applicable, do not lift unassisted

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.

Handling and Storage

Unpacking the controller



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

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

The documentation for the controller 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 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

Handling



IMPORTANT: It is the responsibility of the customer to safely and carefully lift and move the controller.

- Be careful when you move or transport the controller.
- Refer to [Section 1.5. Mechanical Specifications](#) for dimensions and weight specifications.
- Retain the shipping materials for future use.
- Transport or store the controller in its protective packaging.



WARNING: Electrostatic Discharge (ESD) Sensitive Components!

You could damage the power supply or drives if you fail to observe the correct ESD practices. Wear an ESD wrist strap when you handle, install, or do service to the system assembly.

Storage

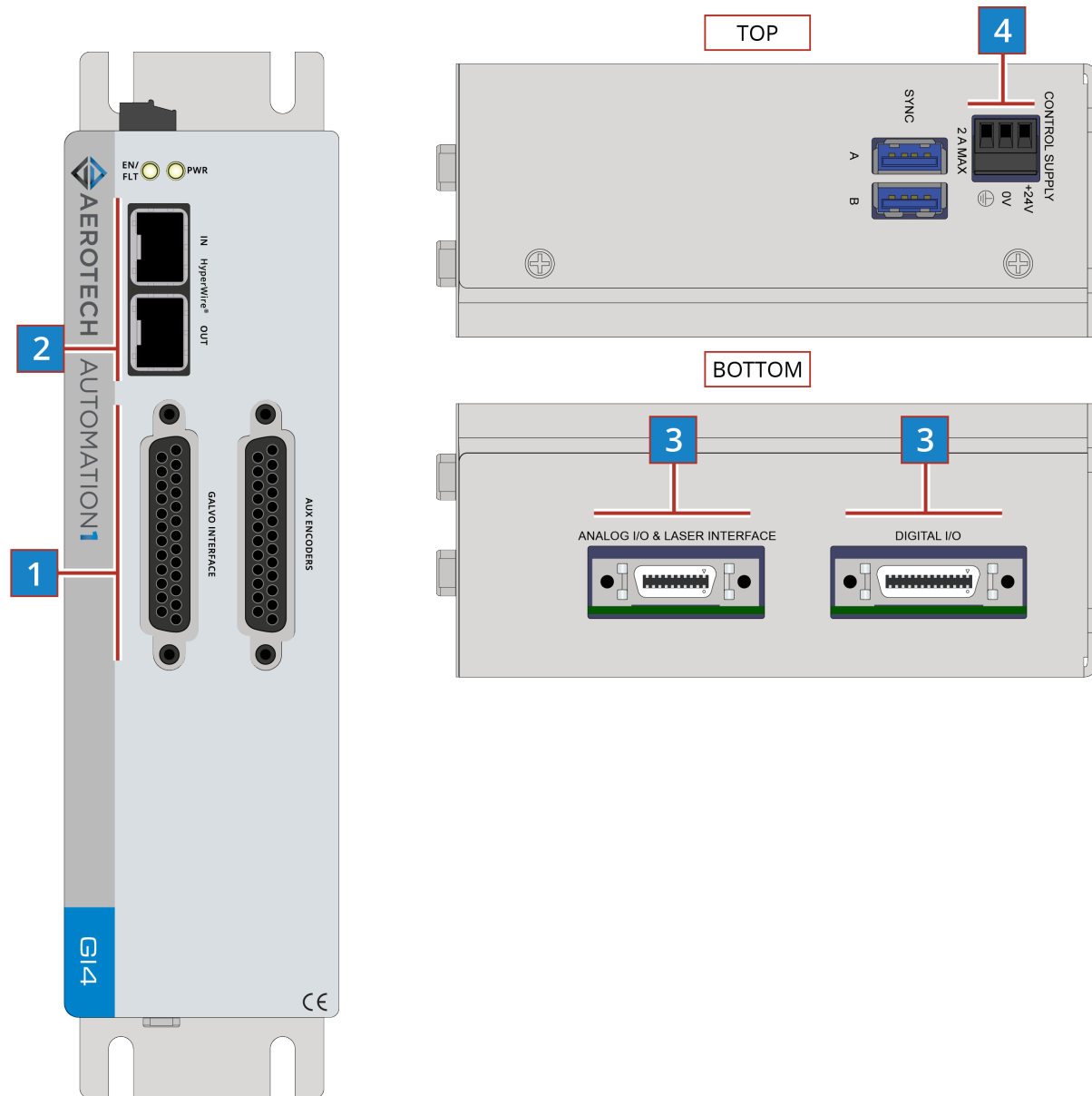
Store the controller in the original shipping container. If the original packaging included ESD protective packaging, make sure to store the controller in it. The storage location must be dry, free of dust, free of vibrations, and flat.

Refer to [Section 1.6. Environmental Specifications](#).

Installation Overview

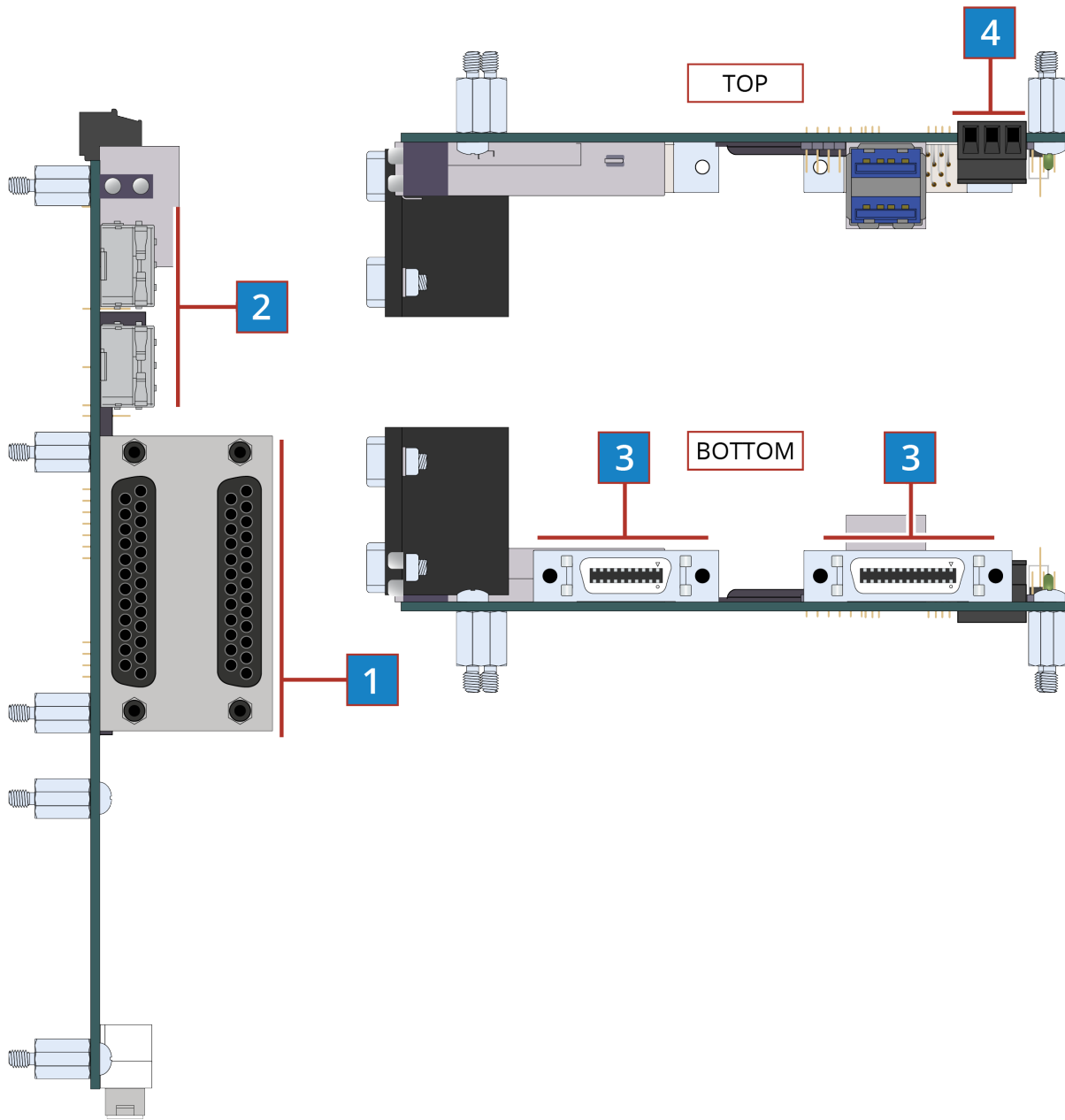
The images that follow show the order in which to make connections and settings that are typical to the GI4. If a custom interconnect drawing was supplied with your system, that drawing is on your Storage Device and shows as a line item on your Sales Order in the Integration section.

Figure 1: Installation Connection Overview (Standard)



1	Connect the galvo scanner to the Galvo Interface connector.	Section 2.2.
2	Connect the PC HyperWire to the HyperWire In port.	Section 2.7.
3	Connect the laser interface input and additional I/O as required by your application.	Section 2.4.
4	Connect the power supply to the Control Supply.	Section 2.1.1.

Figure 2: Installation Connection Overview (OEM)



1	Connect the galvo scanner to the Galvo Interface connector.	Section 2.2.
2	Connect the PC HyperWire to the HyperWire In port.	Section 2.7.
3	Connect the laser interface input and additional I/O as required by your application.	Section 2.4.
4	Connect the power supply to the Control Supply.	Section 2.1.1.

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Chapter 1: GI4 Overview

The GI4 is a digital drive based on the HyperWire communication protocol. The drive provides deterministic behavior, auto-identification, and is fully software configurable. The drive provides open-loop control of galvo scanners. It lets you synchronize galvo and servo motion to mark parts with no limit to size and complexity.

Figure 1-1: GI4 Galvo Scanner Controller

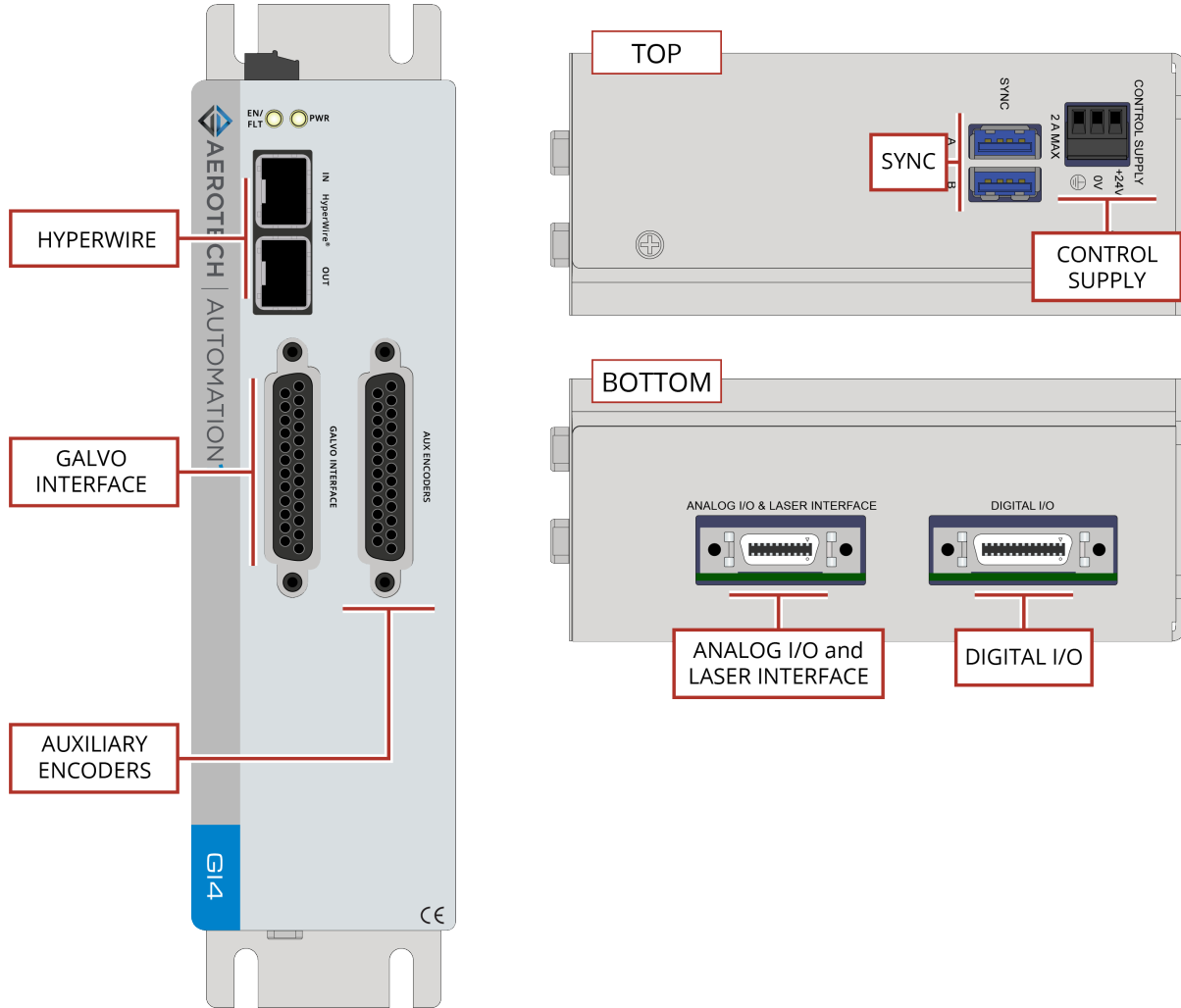
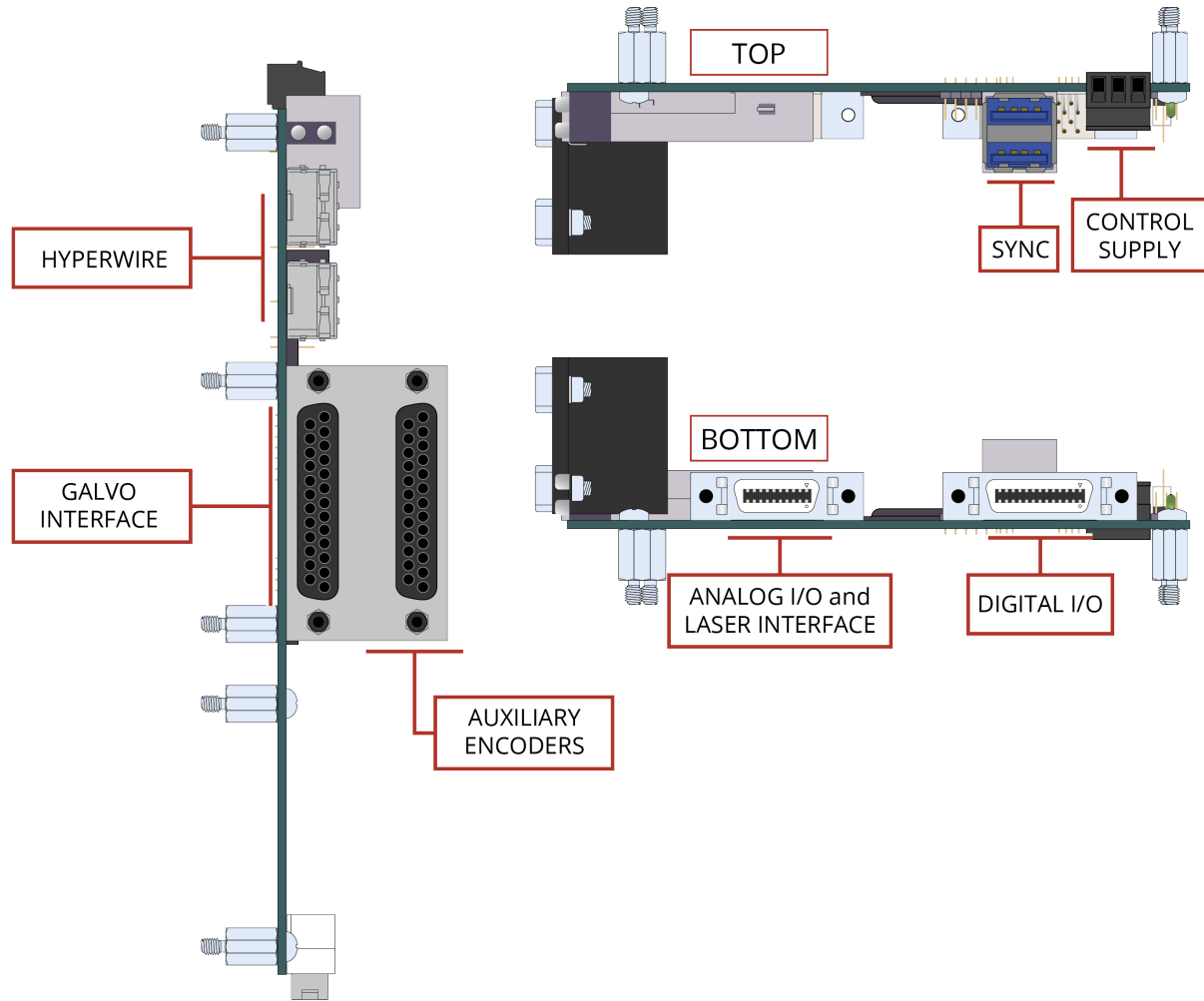


Figure 1-2: GI4-OEM Galvo Scanner Controller



1.1. Feature Summary

- 24 VDC control supply input ([Section 2.1.1.](#))
- 20 kHz Servo Loop Update Rate
- Three axis galvo controller interfaces ([Section 2.2.](#))
- Three TTL laser outputs ([Section 2.5.](#))
- Two line driver square wave auxiliary quadrature encoder inputs or outputs ([Section 2.3.1.](#))
- Eight digital user outputs ([Section 2.4.1.](#))
- Nine digital user inputs
 - Eight digital inputs ([Section 2.4.2.](#))
 - One high-speed user input ([Section 2.4.3.](#))
- Two 16-bit analog outputs ($\pm 10V$) ([Section 2.5.3.](#))
- Four 16-bit differential analog inputs ($\pm 10V$) ([Section 2.5.4.](#))
- Sync Ports ([Section 2.6.](#))
- Three HyperWire communication channels (one per axis) ([Section 2.7.](#))
- IFOV Capability

1.2. Ordering Options

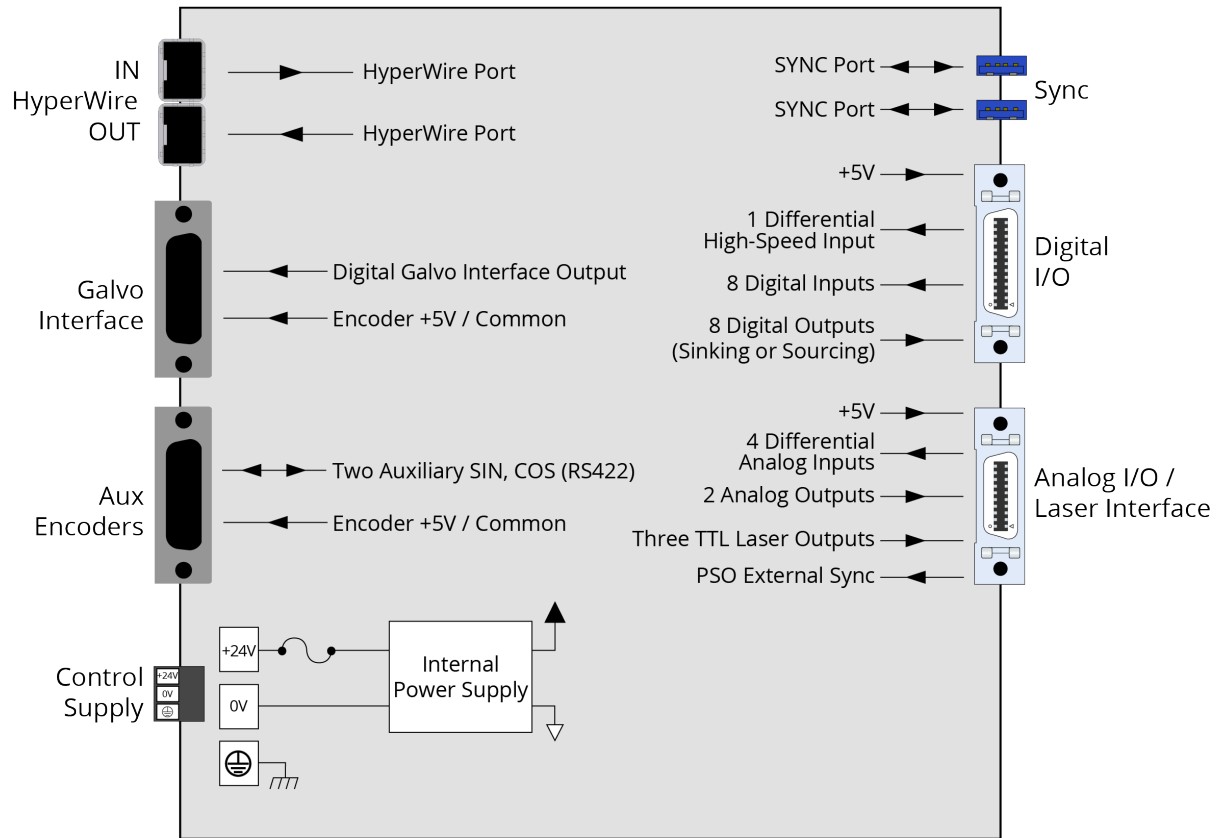
Table 1-1: Example Order and Ordering Options

Example	
Automation1-GI4-P1-PSO5	
Options	
Automation1 Controller	
-GI4	Laser Scan Head Controller
Packaging	
-P1	Standard Packaging
-P2	OEM Packaging
PSO (Section 2.5.2.)	
-PSO0	No PSO firing.
-PSO5	Two-axis Part-Speed PSO firing, which uses the PSO firing circuit based off of the commanded vector velocity of 2 or more axes.
-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.

1.3. Functional Block Diagram

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

Figure 1-3: Functional Diagram



1.4. Electrical Specifications

Table 1-2: Electrical Specifications

Description		GI4
Control Supply	Input Voltage	24 VDC
	Input Current	2 A max, 0.45 A typical
User Power Supply Output		5 VDC (@ 500 mA)
Modes of Operation		Open loop galvo
Protective Features		Control power supply under voltage

1.5. Mechanical Specifications

1.5.1. Mounting and Cooling

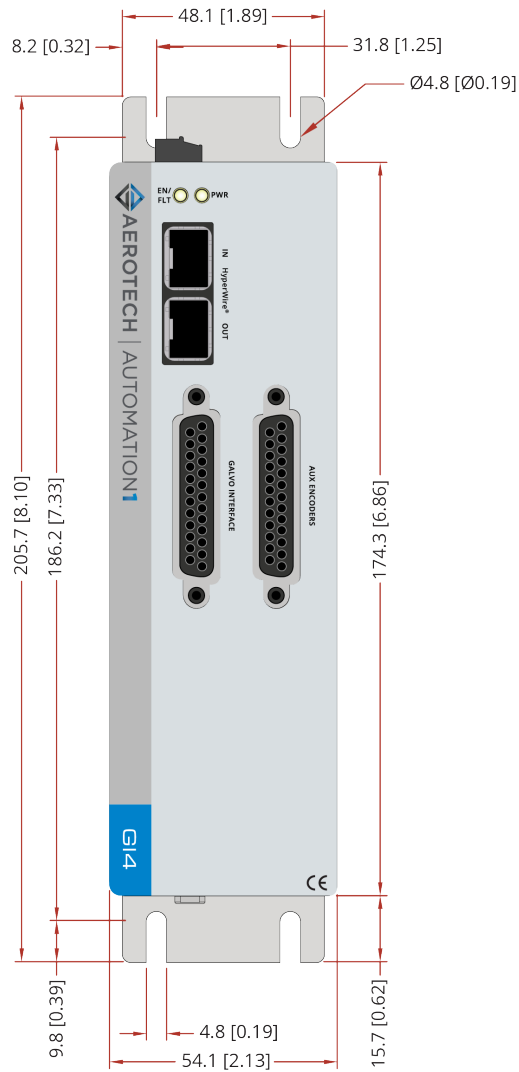
The controller must be installed in an enclosed control cabinet suitable for installation of power equipment. A minimum enclosure rating of IP54 is required to comply with safety standards. Make sure that there is sufficient clearance surrounding the controller for free airflow and for the routing of cables and connections. Consideration for items such as line reactors, line filters, and motor chokes or inductance should be made during the initial cabinet design phase.

Table 1-3: Mounting Specifications

		G14
Customer-Supplied Enclosure		IP54 Compliant
		For DIN Rail Mounting, refer to Section 1.5.3. DIN Rail Mounting
Weight	Standard	0.60 kg
	OEM	0.25 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 1.5.2. 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 1.6. Environmental Specifications
Drive IP Rating		IP20

1.5.2. Dimensions

Figure 1-4: Dimensions [-P1 Package]



Recommended Mounting Hardware: M4 [#8]
 Dimensions: MM [IN]

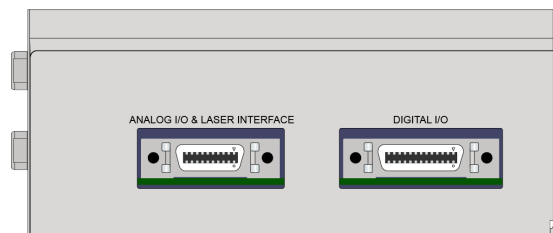
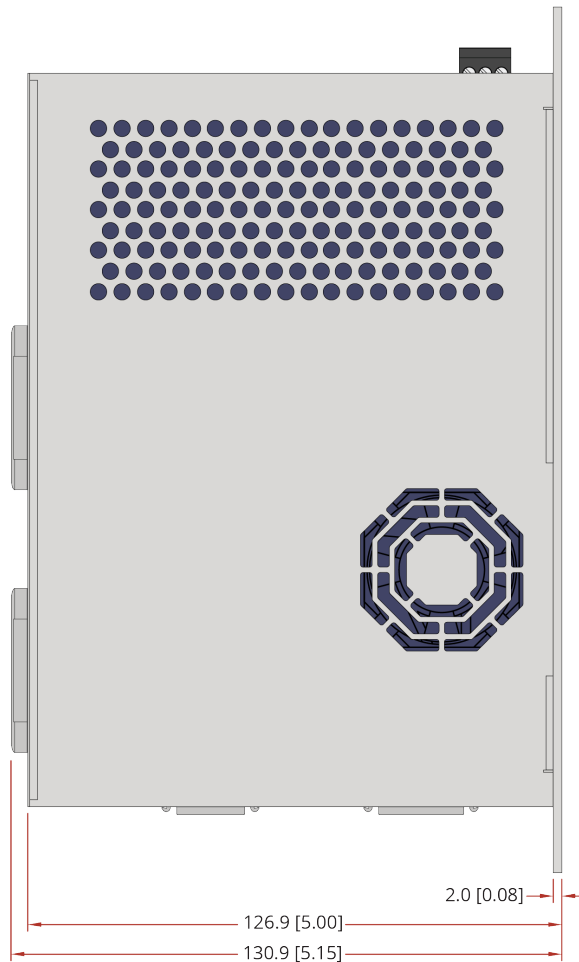
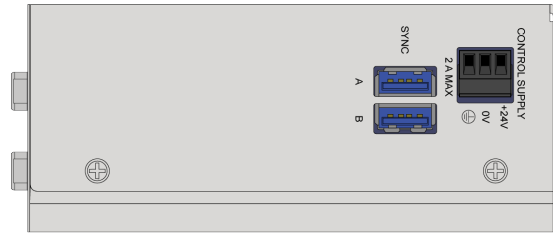
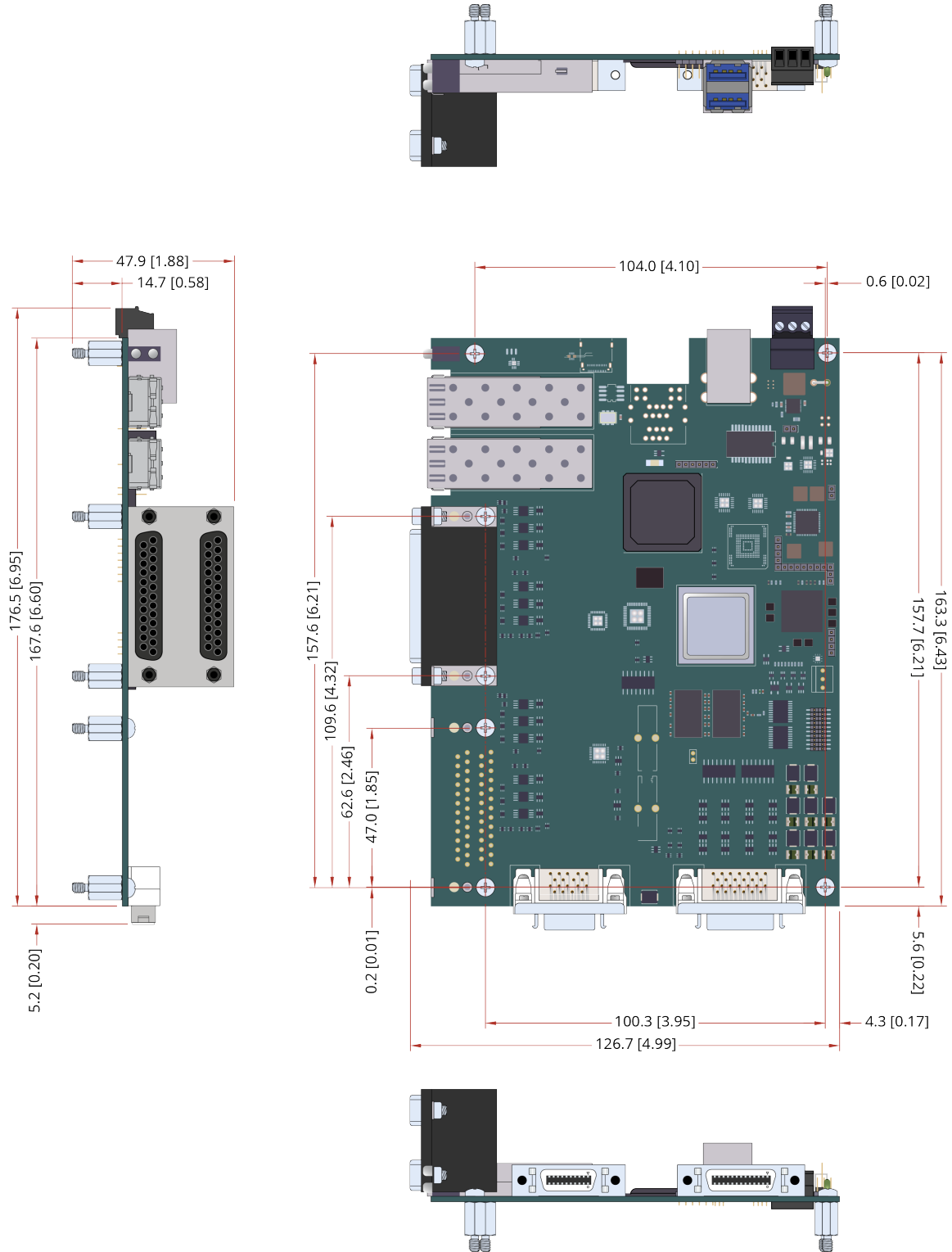


Figure 1-5: Dimensions [-P2 Package]



1.5.3. DIN Rail Mounting

A DIN rail can only be used with the -P1 option.

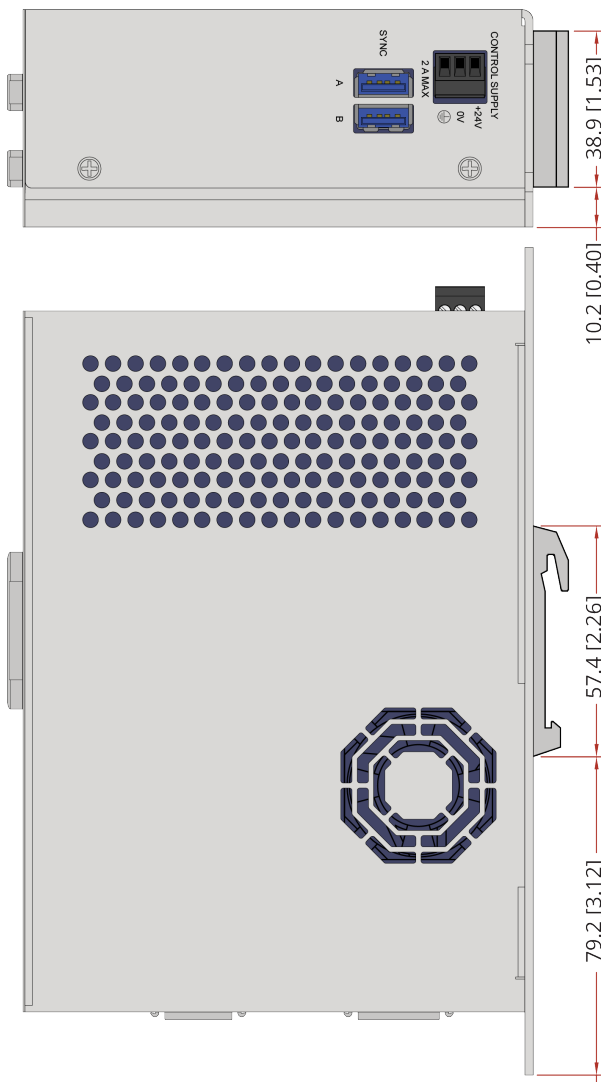
DIN Rail Mounting Procedure:

1. Mount the DIN rail clip to the GI4. 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	HyperWire-DIN

Figure 1-6: Din Rail Clip Dimensions



1.5.4. 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

1.6. Environmental Specifications

The environmental specifications are listed below.

Table 1-6: Environmental Specifications

Temperature	Operating: 0 °C to 40 °C (32 °F to 104 °F)
	Maximum Surrounding Air: 40 °C (104 °F)
	Storage: -30 °C to 85 °C (-22 °C 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.
Pollution	Pollution Degree 2 Typically only nonconductive pollution occurs.
Operation	Use only indoors

1.7. 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
GI4	2.1.0	Current

Chapter 2: Installation and Configuration

The sections in this chapter include details on how to set up the electrical and safety components of your system. Obey all safety warnings, including those in [Safety Procedures and Warnings \(Page 9\)](#).

2.1. Input Power Connections

The controller has one DC input power connector for control power. For a full list of electrical specifications, refer to [Section 1.4](#). Refer to [Section 2.8](#) for a System Interconnection Drawing.

2.1.1. Control Supply Connector



DANGER: Shock and Fire Hazard

Electrical wiring must be designed and installed in accordance with local electrical safety regulations to prevent the risk of fire and electrical shock.

The Control Supply input supplies power to the communications and logic circuitry of the drive. The **+24V** input is connected to an internal fuse. 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](#)).

Figure 2-1: Control Supply Connections

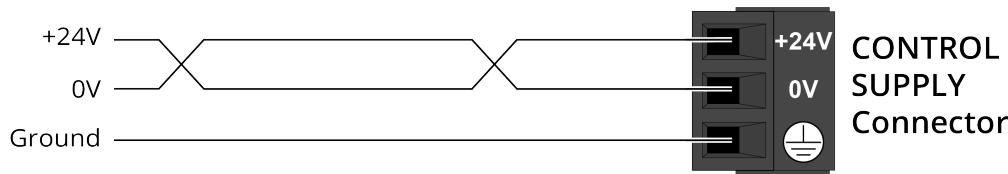


Table 2-1: Control Supply Connector Pinout

Pin	Description
+24 V	24 VDC ($\pm 10\%$) Control Power Input (2 A max, 0.45 A typical)
0 V	Control Power Common Input
	Protective Ground

Table 2-2: Control Supply Mating Connector Ratings

Specification		Description
Type		3-Pin Terminal Block
Part Numbers		Aerotech: ECK02456 Phoenix: 1839610
Conductor Cross Section	One conductor, stranded with ferrule and plastic sleeve	18...22 AWG (0.25...0.75 mm ²)
	Two conductors (same cross-section), stranded, twin ferrule with plastic sleeve	20 AWG (0.5 mm ²)
Tightening Torque		0.22...0.25 N·m
Conductor Insulation Strip Length		7 mm (0.25 in)
(1) Refer to the manufacturer website for additional information.		

2.1.2. Minimizing Noise for EMC/CE Compliance



IMPORTANT: The GI4 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 typical system interconnections, refer to [Section 2.8. System Interconnection](#).

2.2. Galvo Interface Connector

The Galvo Interface connector supports two- and three-axis XY2-100 and XY3-100 galvo scanners. It outputs galvo clock, sync, and channel connections. You will need an interconnect cable to connect the GI4 to a galvo that supports these interfaces (refer to [Table 2-5](#) for standard Aerotech interconnect cables). Use shielded cables.

Many galvo scanner suppliers use the "no connection" pins on their interconnect cables to supply power to the scanner. Consult the hardware manual of the scanner to determine which pins are used to supply power and modify the interconnect cable accordingly.

Table 2-3: Galvo Interface Pinout

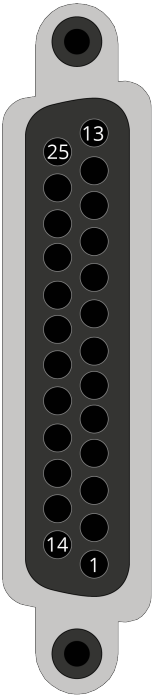
Pin #	Description	In/Out/Bi	Connector
1	Reserved	N/A	
2	Reserved	N/A	
3	Signal Common	Output	
4	Reserved	N/A	
5	Channel 3+	Output	
6	Sync+	Output	
7	Reserved	N/A	
8	+5 V Supply (500 mA)	Output	
9	Channel 1+	Output	
10	Channel 2+	Output	
11	Reserved	N/A	
12	Clock+	Output	
13	Reserved	N/A	
14	Reserved	N/A	
15	Reserved	N/A	
16	Reserved	N/A	
17	Reserved	N/A	
18	Channel 3-	Output	
19	Sync-	Output	
20	Reserved	N/A	
21	Signal Common	Output	
22	Channel 1-	Output	
23	Channel 2-	Output	
24	Reserved	N/A	
25	Clock-	Output	

Table 2-4: Galvo Interface Mating Connector Ratings

Specification	25-Pin Solder Cup	Backshell
Aerotech Part Number	ECK00101	ECK00656
Amphenol Part Number ⁽¹⁾	DB25P064TXLF	17E-1726-2
Maximum Wire Size	20 AWG (0.5 mm ²)	N/A

(1) Refer to the manufacturer website for additional information.

Table 2-5: Standard Galvo Interconnection Cables

Cable P/N	Description
C22281-XX	GI4 to XY2-100 Galvo with Power 25D-25D-MAX80DM
C23931-XX	GI4 to XY2-100 Galvo without Power 25D-25D-MAX100DM
C22282-XX	C22282 - GI4 to XY3-100 Galvo with Power 25D-25D-MAX80DM
C23932-XX	C23932 - GI4 to XY3-100 Galvo without Power 25D-25D-MAX100DM

2.3. Aux Encoders Connector

The GI4 has two auxiliary encoder channels. Each encoder interface accepts an RS-422 differential line driver. Use the auxiliary encoder input channels with the Infinite Field of View (IFOV) and the "Marking on the Fly" functionality of the controller. You cannot use the auxiliary encoder input channels to close the position loop.

Table 2-6: Aux Encoders Connector Pinout

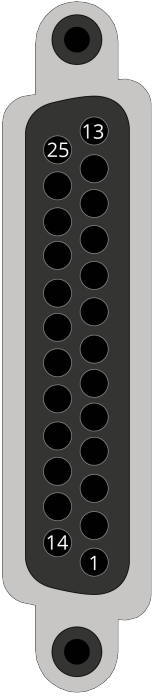
Pin #	Description	In/Out/Bi	Connector
1	Reserved	N/A	
2	Reserved	N/A	
3	Signal Common	Output	
4	Reserved	N/A	
5	Axis Sine 2+	Bidirectional	
6	Axis Cosine 2+	Bidirectional	
7	Reserved	N/A	
8	+5 V Supply (500 mA)	Output	
9	Axis Sine 1+	Bidirectional	
10	Axis Cosine 1+	Bidirectional	
11	Reserved	N/A	
12	Reserved	N/A	
13	Reserved	N/A	
14	Reserved	N/A	
15	Reserved	N/A	
16	Reserved	N/A	
17	Reserved	N/A	
18	Axis Sine 2-	Bidirectional	
19	Axis Cosine 2-	Bidirectional	
20	Reserved	N/A	
21	Signal Common	Output	
22	Axis Sine 1-	Bidirectional	
23	Axis Cosine 1-	Bidirectional	
24	Reserved	N/A	
25	Reserved	N/A	

Table 2-7: Aux Encoders Mating Connector Ratings

Specification	25-Pin Solder Cup	Backshell
Aerotech Part Number	ECK00101	ECK00656
Amphenol Part Number ⁽¹⁾	DB25P064TXLF	17E-1726-2
Maximum Wire Size	20 AWG (0.5 mm ²)	N/A
(1) Refer to the manufacturer website for additional information.		

2.3.1. Square Wave Encoder

The drive accepts RS-422 square wave encoder signals. Use twisted-pair wiring for the highest performance and noise immunity.

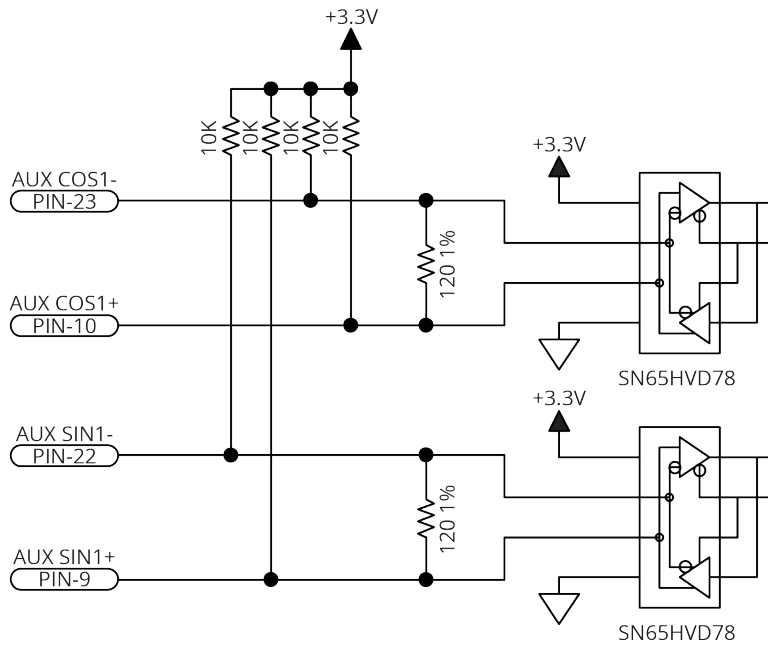
Table 2-8: Square Wave Encoder Specifications

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

Table 2-9: Aux Encoders Connector Pinout

Pin #	Description	In/Out/Bi
5	Axis Sine 2+	Bidirectional
6	Axis Cosine 2+	Bidirectional
9	Axis Sine 1+	Bidirectional
10	Axis Cosine 1+	Bidirectional
18	Axis Sine 2-	Bidirectional
19	Axis Cosine 2-	Bidirectional
22	Axis Sine 1-	Bidirectional
23	Axis Cosine 1-	Bidirectional

Figure 2-2: Square Wave Encoder Interface



2.4. 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 2-10: Digital I/O Connector Pinout

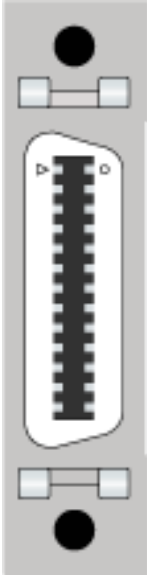
Pin #	Description	In/Out/Bi	Connector
14	Output Common for Digital Outputs 0-3	Output	
1	Opto-Isolated Digital Output 0	Output	
15	Opto-Isolated Digital Output 1	Output	
2	Opto-Isolated Digital Output 2	Output	
16	Opto-Isolated Digital Output 3	Output	
3	Output Common for Digital Outputs 4-7	Output	
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	Output	
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	Output	
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	Output	
13	Common	Output	
25	+5 V (500 mA max)	Output	

Table 2-11: Digital I/O Mating Connector Ratings [-EB1]

Specification	26-Pin Solder Cup	Backshell
Aerotech Part Number	ECK02514	ECK02517
3M Part Number ⁽¹⁾	10126-3000PE	10326-52F0-008
Maximum Wire Size	24 AWG (0.2 mm ²)	N/A
⁽¹⁾ Refer to the manufacturer website for additional information.		

2.4.1. 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 2-4](#) and [Figure 2-5](#).

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 2-4](#). To see an example of a current sinking output that has diode suppression, refer to [Figure 2-5](#).

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

Table 2-12: 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 μ s (2K pull up to 24V)
Reset State	Output Off (High Impedance State)

Table 2-13: Digital Output Pins on Digital I/O Connector

Pin #	Description	In/Out/BI
14	Output Common for Digital Outputs 0-3	Output
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	Output
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 2-3: Digital Outputs Schematic

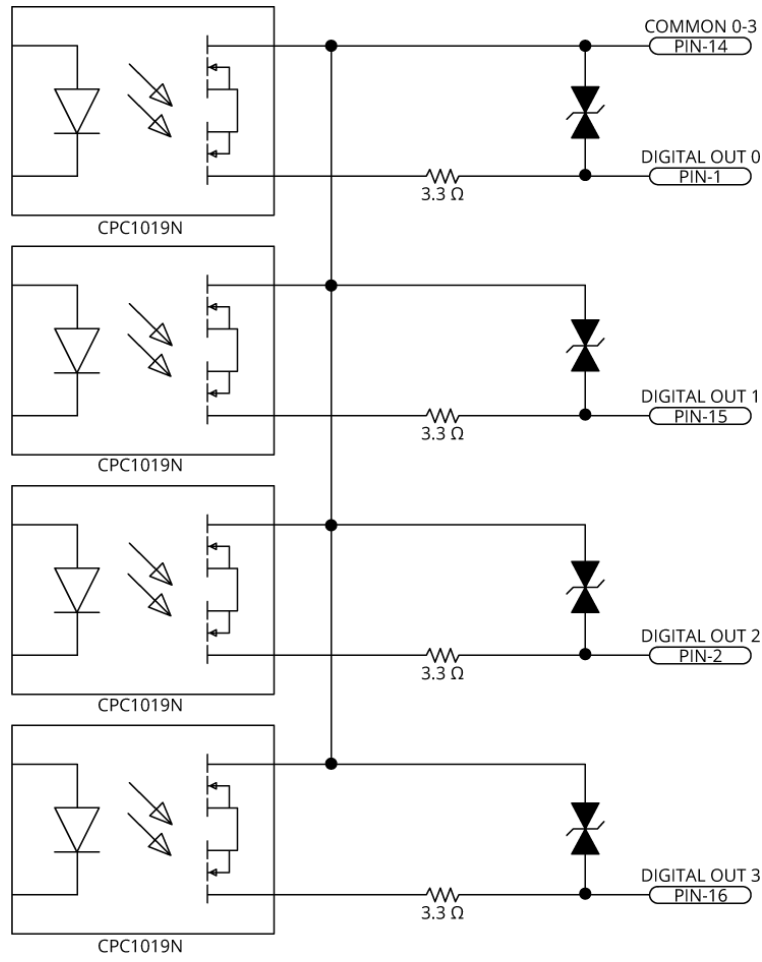
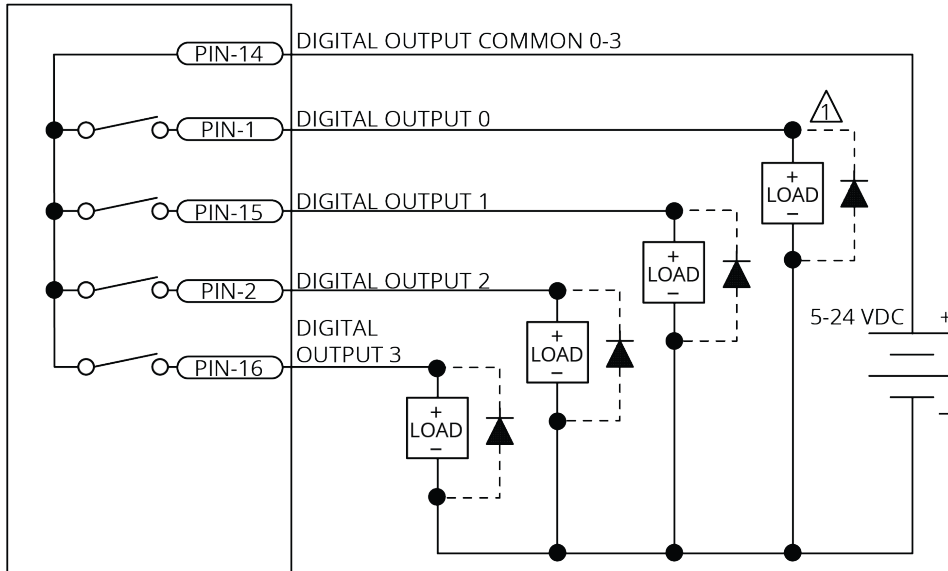
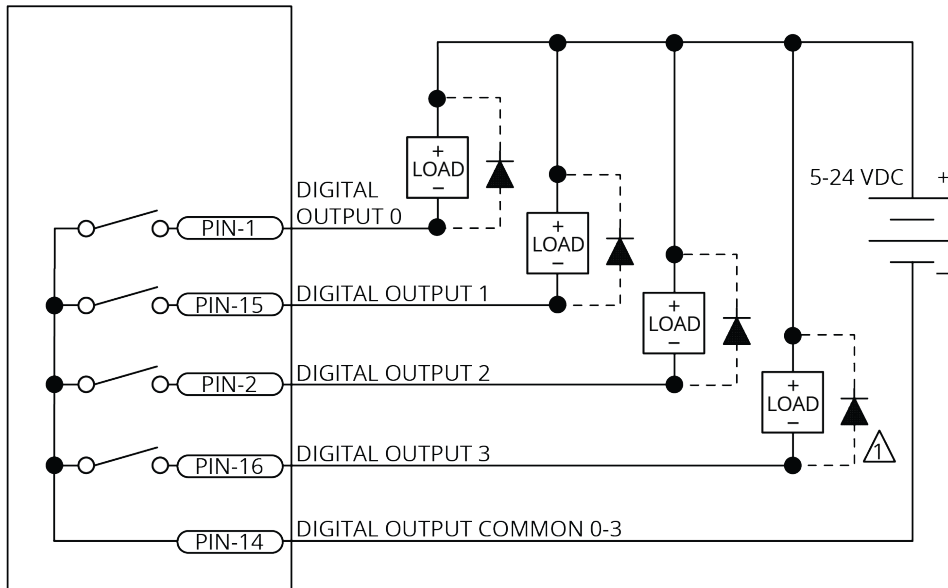


Figure 2-4: Digital Outputs Connected in Current Sourcing Mode



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

Figure 2-5: Digital Outputs Connected in Current Sinking Mode



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

2.4.2. 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 2-7](#).

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 2-8](#).

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

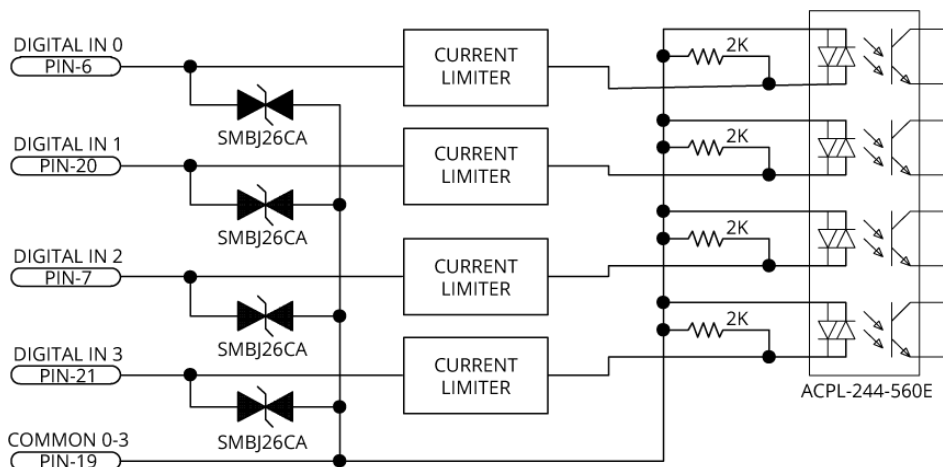
Table 2-14: Digital Input Specifications

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

Table 2-15: Digital Input Pins on the Digital I/O Connector

Pin #	Description	In/Out/Bi
19	Input Common for Digital Inputs 0-3	Output
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	Output
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 2-6: Digital Inputs Schematic



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

Figure 2-7: Digital Inputs Connected to Current Sourcing (PNP) Devices

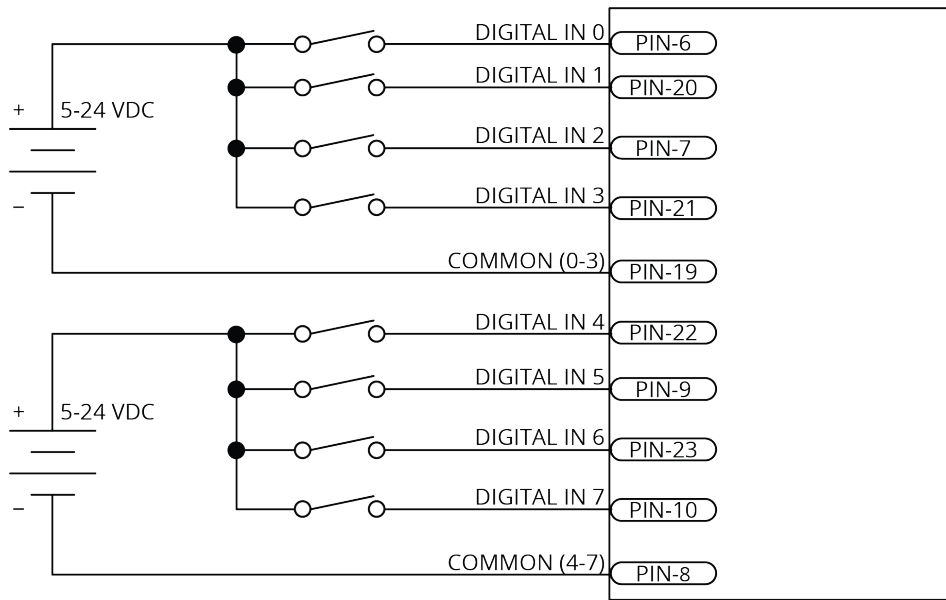
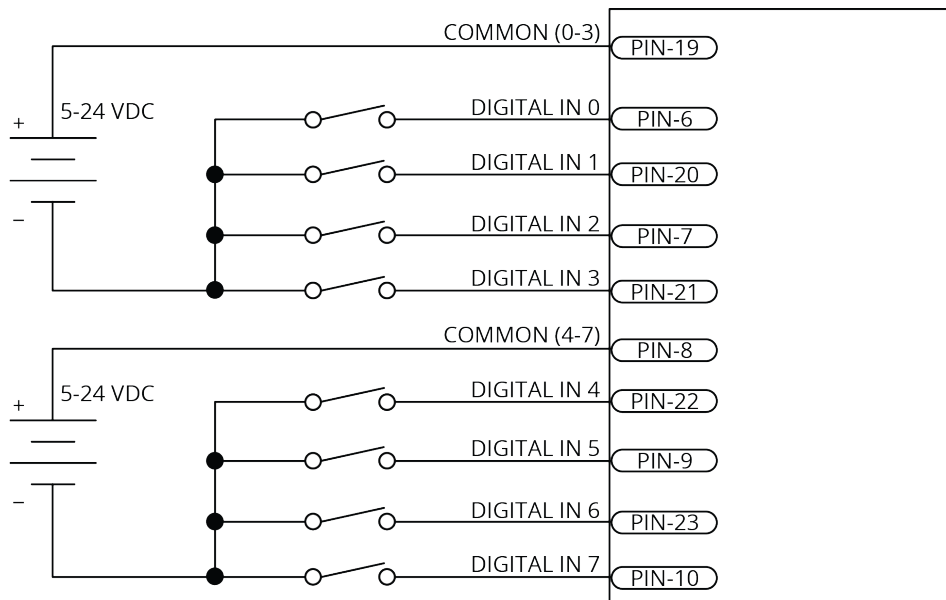


Figure 2-8: Digital Inputs Connected to Current Sinking (NPN) Devices



2.4.3. 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 Automation1 Help for more information.

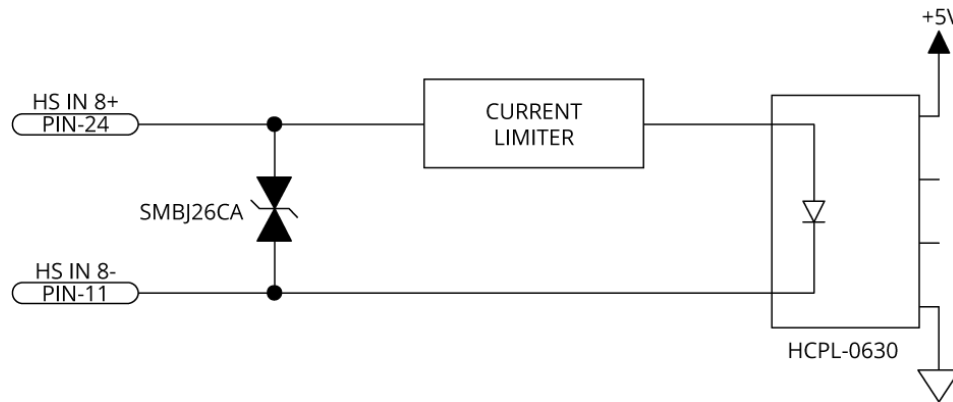
Table 2-16: High-Speed Input Specifications

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

Table 2-17: 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

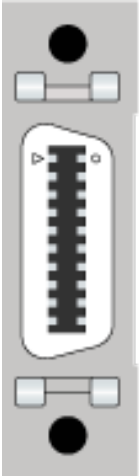
Figure 2-9: High-Speed Input



2.5. Analog I/O and Laser Interface Connector

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

Table 2-18: Analog I/O and Laser Interface Connector Pinout

Pin #	Description	In/Out/Bi	Connector
4	+5 Volt (500 mA max)	Output	
11	Laser Output 1 / PSO Output ⁽¹⁾ (TTL)	Output	
1	Common	Output	
12	Laser Output 2	Output	
2	Common	Output	
13	Laser Output 3	Output	
3	Common	Output	
14	PSO External Sync	Input	
15	Analog Output 0	Output	
5	Analog Common	Output	
16	Analog Output 1	Output	
6	Analog Common	Output	
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	

(1) Refer to [Section 2.5.2](#) for more information.

Table 2-19: Laser Interface Mating Connector Ratings

Specification	20-Pin Solder Cup	Backshell
Aerotech Part Number	ECK02515	ECK02518
3M Part Number ⁽¹⁾	10120-3000PE	10320-52F0-008
Maximum Wire Size	24 AWG (0.2 mm ²)	N/A

(1) Refer to the manufacturer website for additional information.

2.5.1. Laser Interface Outputs

Three laser output signals are available as 5V TTL signals. These signals are active high and are driven to 5V when the laser output is turned on.

The laser outputs can be configured for different laser modes. Refer to the [GalvoConfigureLaserMode\(\)](#) function topic in Automation1 Help for more information.



WARNING: After you install this product, you must tell the operator about all applicable safety conditions and safety information. Refer the operator to the laser manual for safety information about the laser.

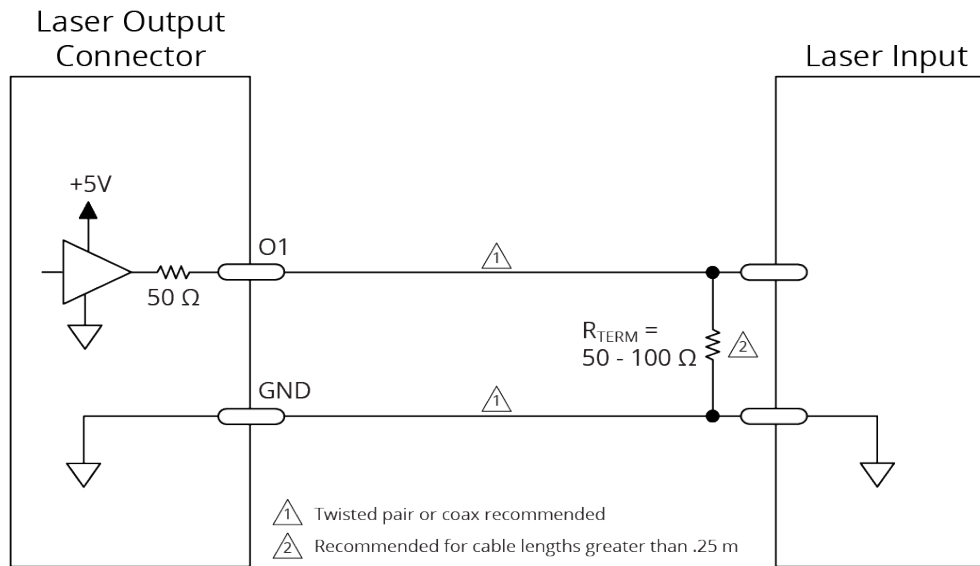
Table 2-20: Laser Output Pins on the Analog I/O and Laser Interface Connector

Pin #	Description	In/Out/Bi
11	Laser Output 1 / PSO Output (TTL)	Output
1	Common	Output
12	Laser Output 2	Output
2	Common	Output
13	Laser Output 3	Output
3	Common	Output

Table 2-21: Laser Output Specifications

Specification	Value
Output	5 V, 50 mA (max)
Maximum Frequency	12.5 MHz
Output Latency	5 ns

Figure 2-10: TTL Output



2.5.2. 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. Refer to the [PSO Waveform Functions](#) in Automation1 Help.

Table 2-22: 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]	15 ns

Table 2-23: PSO External Sync Specifications

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

Table 2-24: PSO Output Pins on the Analog I/O and Laser Interface Connector

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

Figure 2-11: PSO TTL Outputs Schematic

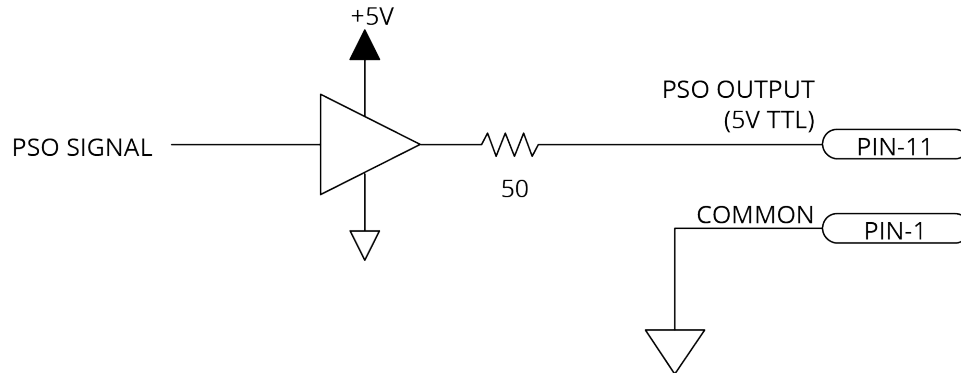
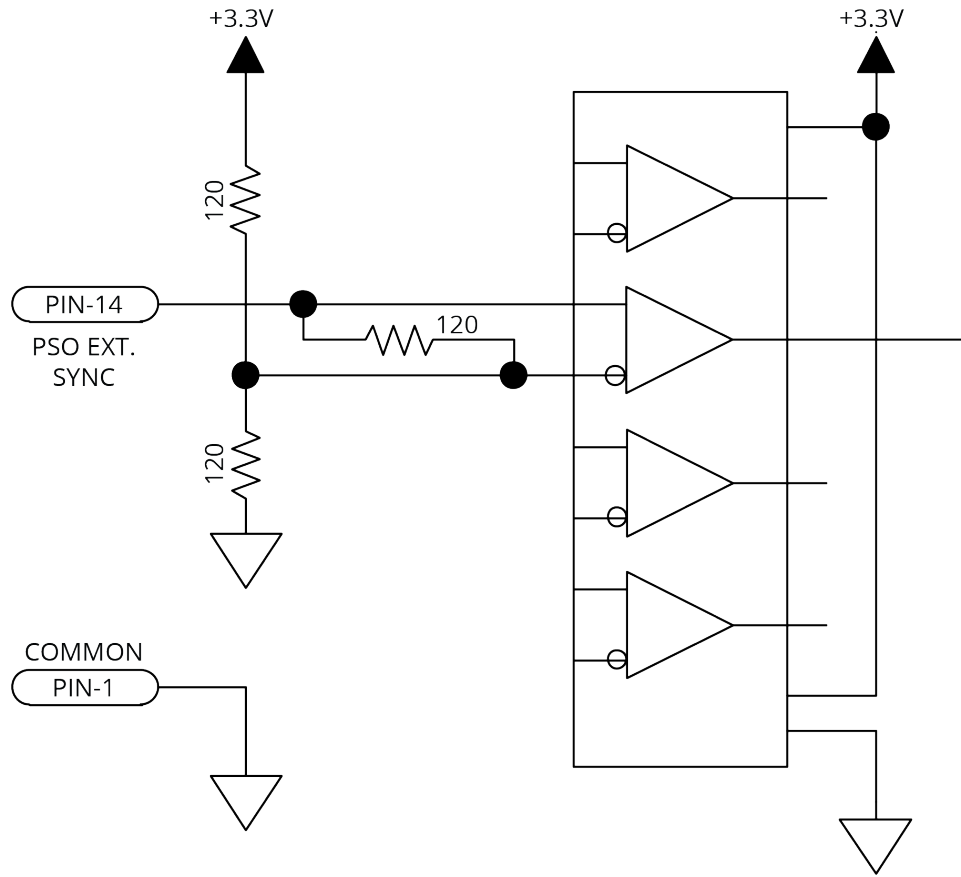


Figure 2-12: PSO External Sync Input Schematic



2.5.3. 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.

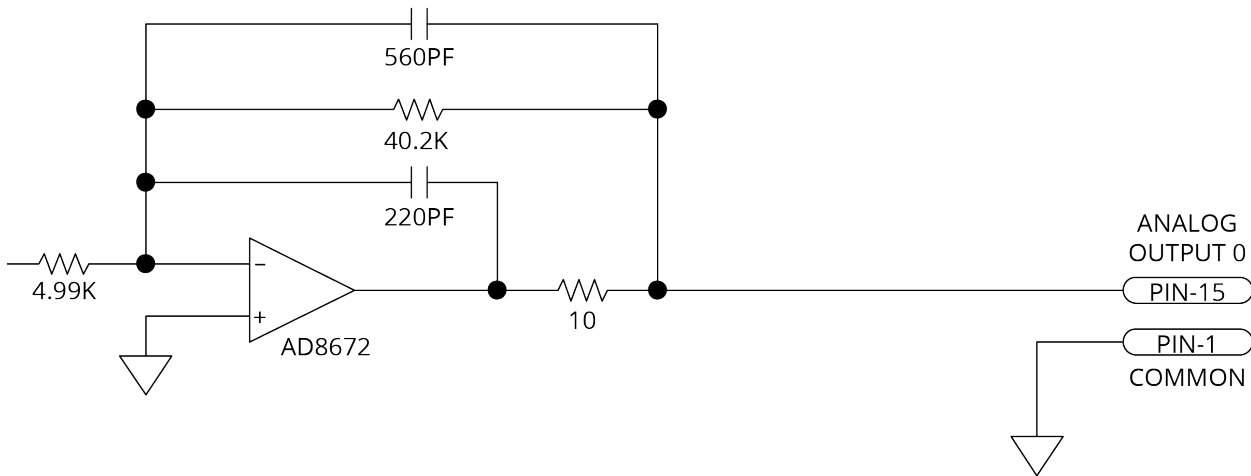
Table 2-25: Analog Output Specifications

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

Table 2-26: 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	Output
16	Analog Output 1	Output
6	Analog Common	Output

Figure 2-13: Analog Outputs Schematic



2.5.4. 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 2-14](#).

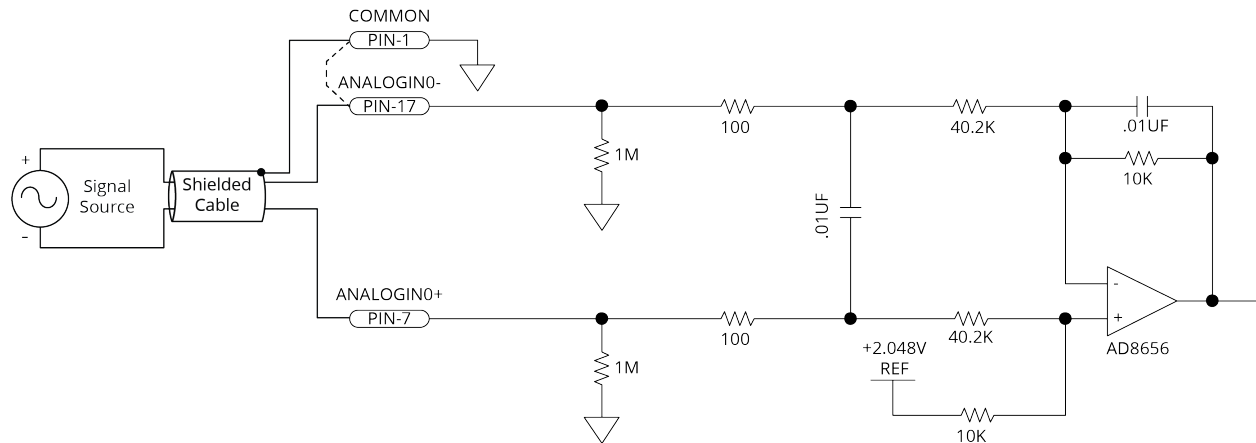
Table 2-27: Analog Input Specifications

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 2-28: Analog Input Pins on the Analog I/O and Laser Interface Connector

Pin #	Description	In/Out/Bi
6	Analog Common	Output
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 2-14: Analog Inputs Schematic



2.6. Sync Port

The GI4 contains two Sync ports, labeled A and B.

The Sync port is a bi-directional high speed proprietary interface that lets you transmit encoder signals between drives. This is typically used for IFOV to track the positions of your Automation1 servo axes in combination with your galvo scanner. You can use the [FeedbackSetup parameter](#) to configure the Sync ports as IFOV Inputs.

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

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

Table 2-29: Sync Port Cables

Part Number	Description
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

2.7. 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. This device consumes three of the available axes of control on the HyperWire communication network. Refer to your Automation1-iSMC license for the number of available HyperWire axes.

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 2-30: HyperWire Card Part Number

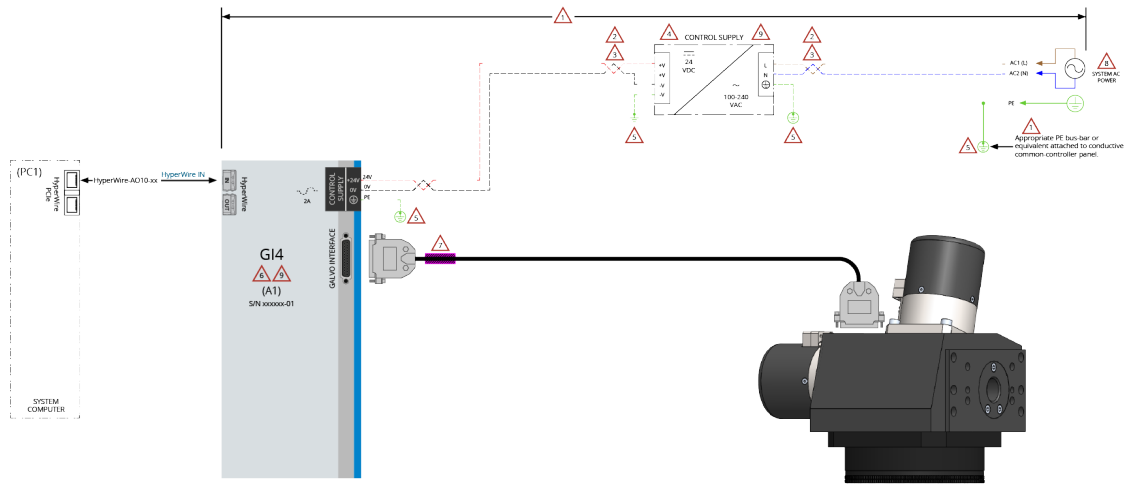
Part Number	Description
HYPERWIRE-PCIE	HyperWire adapter, PCIe x4 interface

Table 2-31: 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

2.8. System Interconnection

Figure 2-15: Recommended System Connections



<p>! ATTENTION !</p> <p>The system integrator or end user is responsible for all safety compliance and technical requirements for the system wiring.</p> <p>IMPORTANT: Read all parts of this manual before you install or operate the GI4 or before you do maintenance to your system.</p> <ul style="list-style-type: none"> 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. <p>For EMC performance, mount all system components on to a common conductive metal panel.</p> <ul style="list-style-type: none"> Do not use a panel that has a painted or non-conductive coat applied. You can use a panel with a conductive surface coat. <p>System Wiring: ROUTING</p> <ul style="list-style-type: none"> 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. 	<p>System Wiring: SPECIFICATIONS</p> <ul style="list-style-type: none"> Aerotech recommends that you use twisted pair conductors with wire lengths as short as possible. Wire Sizes: <ul style="list-style-type: none"> AC POWER: 1.3 mm² [16 AWG] CONTROL POWER: 0.34 mm² [22 AWG] Wire Conformity: <ul style="list-style-type: none"> North America: UL AWM EU: \leq HAR-ICE <p>System Control VDC Power Supply</p> <ul style="list-style-type: none"> Minimum Requirements: <ul style="list-style-type: none"> Pollution Degree 2 Double insulated Short-circuit and over-voltage protection UL and CE approvals Recommended Power Supply*: <ul style="list-style-type: none"> 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" <p>System Protective Earth (PE) grounds</p> <ul style="list-style-type: none"> Keep PE wires as short as possible Each PE wire must have a dedicated attachment point Terminate each PE directly to the grounded component panel (and that the component panel conform to NOTE 1). 	<p>GI4 Controller</p> <ul style="list-style-type: none"> Refer to assemblies (A1) If the controllers were purchased as an integrated system, refer to the System Interconnections drawing included with the system documentation. <p>Cable Interface Cable Ferrite EMC Filters</p> <ul style="list-style-type: none"> Use Aerotech P/N: EC-ZD2348 (Faw-Rise P/N: 0446167281) Clamp-On filters Attach the filter near to the interface connector back-shell as illustrated <p>System AC Power</p> <ul style="list-style-type: none"> 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). <p>DIN-Rail Mounted Components</p> <ul style="list-style-type: none"> Use DIN Rail from Phoenix P/N: NS 35/ 7,5 PERF 2000MM - 0801733 or equivalent <p>The information on this page is for reference only and represents best practice applications.</p>
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2.9. PC Configuration and Operation Information

For more information about hardware requirements, PC configuration, programming, system operation, and utilities, refer to [Automation1 Help](#).

Chapter 3: Maintenance



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

- Do not remove the cover of the GI4
- 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 3-1: 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 3-2: 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 GI4 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 3-3: 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 chassis.
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 GI4, disconnect the electrical power from the drive.

Use a clean, dry, soft cloth to clean the GI4. If necessary, 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 controller. Also make sure that it does not go onto the outer connectors and components. Internal contamination from the cleaning solution can cause corrosion and electrical short circuits.

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

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

<https://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

Revision	Description
1.09	Updated: <ul style="list-style-type: none">• EU Declaration of Conformity (Page 6)• Figure 2-14
1.08	<ul style="list-style-type: none">• Feature Summary updated (Section 1.1.)• Analog I/O Schematics updated (Section 2.5.3. and Section 2.5.4.)
1.07	New Section: Korean Certification
1.06	General update
1.05	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
1.04	
1.03	
1.02	
1.01	
1.00	

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			DIN Rail Clip Kit
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			HyperWire-DIN
			Drawing number
			Drive and Software Compatibility
			Drive IP Rating
			IP20
			E
			EAM00914 (DIN Rail Part Number)
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