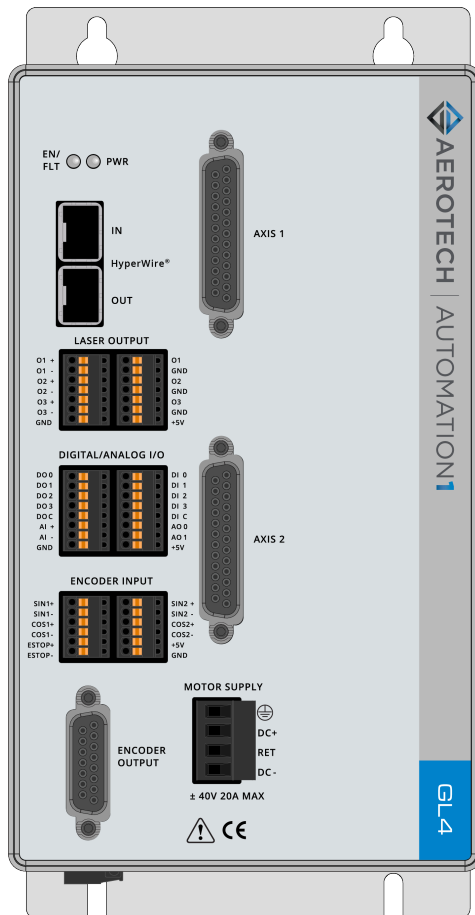


Automation1 GL4 Galvo Scan-Head Drive

HARDWARE MANUAL

Revision 2.02



Patent Number: US 8,426,768 B2

GLOBAL TECHNICAL SUPPORT

Go to the [Global Technical Support Portal](#) for information and support about your Aerotech, Inc. products. The website supplies software, product manuals, Help files, training schedules, and PC-to-PC remote technical support. If necessary, you can complete Product Return (RMA) forms and get information about repairs and spare or replacement parts. To get help immediately, contact a service office or your sales representative. Include your customer order number in your email or have it available before you call.

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Table of Contents

Automation1 GL4 Galvo Scan-Head Drive	1
Table of Contents	3
List of Figures	4
List of Tables	5
EU Declaration of Conformity	7
Agency Approvals	8
Safety Procedures and Warnings	9
Handling and Storage	11
Installation Overview	12
Chapter 1: GL4 Overview	13
1.1. Electrical Specifications	15
1.2. Mechanical Specifications	16
1.2.1. Mounting and Cooling	16
1.2.2. Dimensions	17
1.3. Environmental Specifications	18
1.4. Drive and Software Compatibility	18
Chapter 2: Installation and Configuration	19
2.1. Input Power Connections	19
2.1.1. Control Supply Connector	19
2.1.2. Motor Supply Connector	20
2.1.3. External Power Supply Options	21
2.1.4. Minimizing Noise for EMC/CE Compliance	22
2.2. HyperWire Interface	23
2.3. Laser Output Connectors	24
2.3.1. Position Synchronized Output (PSO)	29
2.4. Encoder Output Connector	30
2.5. Galvo Motor Connectors	32
2.5.1. Analog Encoder Inputs	33
2.5.2. End of Travel Limit Input Interface	33
2.5.2.1. End of Travel Limit Phasing	35
2.5.3. Thermistor Input	36
2.6. Digital and Analog I/O Connectors	37
2.6.1. Digital Outputs	38
2.6.2. Digital Inputs	40
2.6.3. Analog Outputs	41
2.6.4. Analog Inputs (Differential)	42
2.7. Encoder Input Connectors	43
2.7.1. Emergency Stop Sense Input	45
2.8. Laser Output Polarity Switches	46
2.9. Sync Port	47
2.10. PC Configuration and Operation Information	47
Chapter 3: Maintenance	49
3.1. Preventative Maintenance	50
3.2. Board Assembly	51
Appendix A: Warranty and Field Service	53
Appendix B: Revision History	55
Index	57

List of Figures

Figure 1-1:	GL4 Networked Digital Galvo Controller	13
Figure 1-2:	Functional Diagram	14
Figure 1-3:	Dimensions	17
Figure 2-1:	Control Supply Connections	19
Figure 2-2:	Motor Supply Connections	20
Figure 2-3:	Third-Party Power Supply Connection	21
Figure 2-4:	Control and Motor Power Wiring using a TM3 Transformer	22
Figure 2-5:	Laser Interface Outputs	25
Figure 2-6:	Current Sinking Configuration with Isolation	26
Figure 2-7:	Current Sinking Configuration without Isolation	26
Figure 2-8:	Current Sourcing Configuration with Isolation	27
Figure 2-9:	Current Sourcing Configuration without Isolation	27
Figure 2-10:	TTL Output	28
Figure 2-11:	Encoder Outputs	30
Figure 2-12:	PSO External Sync Input	31
Figure 2-13:	End of Travel Limit Input Connections	34
Figure 2-14:	End of Travel Limit Interface Input Schematic	34
Figure 2-15:	Limit Input Diagnostic Display	35
Figure 2-16:	Thermistor Input Input Schematic	36
Figure 2-17:	Digital Outputs Connected in Current Sourcing Mode	39
Figure 2-18:	Digital Outputs Connected in Current Sinking Mode	39
Figure 2-19:	Digital Inputs Connected to Current Sourcing Devices	40
Figure 2-20:	Digital Inputs Connected to Current Sinking Devices	40
Figure 2-21:	Analog Outputs Schematic	41
Figure 2-22:	Analog Inputs Schematic	42
Figure 2-23:	Encoder Input Connections Schematic	44
Figure 2-24:	ESTOP Sense Input Schematic	45
Figure 2-25:	Laser Output Polarity Switches	46
Figure 3-1:	Control Board Assembly	51
Figure 3-2:	Power Board Assembly	52

List of Tables

Table 1-1:	Feature Summary	13
Table 1-2:	Electrical Specifications	15
Table 1-3:	Mounting Specifications	16
Table 1-4:	Environmental Specifications	18
Table 1-5:	Drive and Software Compatibility	18
Table 2-1:	Control Supply Connector Wiring Specifications	19
Table 2-2:	Mating Connector Part Numbers for the Control Supply Connector	19
Table 2-3:	Motor Supply Wiring Specifications	20
Table 2-4:	Mating Connector Part Numbers for the Motor Supply Connector	20
Table 2-5:	HyperWire Card Part Number	23
Table 2-6:	HyperWire Cable Part Numbers	23
Table 2-7:	Laser Output Connector A Pinout	24
Table 2-8:	Laser Output Connector B Pinout	24
Table 2-9:	Mating Connector Part Numbers for the Laser Output Connectors	24
Table 2-10:	Laser Output Specifications	25
Table 2-11:	PSO Pins on the Laser Output A Connector	29
Table 2-12:	PSO Pins on the Laser Output B Connector	29
Table 2-13:	PSO Specifications	29
Table 2-14:	Encoder Output Connector Pinout	30
Table 2-15:	Mating Connector Part Numbers for the Encoder Output Connector	30
Table 2-16:	PSO External Sync Specifications	31
Table 2-17:	Galvo Motor Connector Pinout	32
Table 2-18:	Mating Connector Part Numbers for the Galvo Motor Connectors	32
Table 2-19:	Analog Encoder Specifications	33
Table 2-20:	End of Travel Limit Input Pins on the Galvo Motor Connectors	33
Table 2-21:	Thermistor Input Pins on the Galvo Motor Connectors	36
Table 2-22:	Digital and Analog I/O Connector A Pinout	37
Table 2-23:	Digital and Analog I/O Connector B Pinout	37
Table 2-24:	Mating Connector Part Numbers for the Digital / Analog I/O Connectors	37
Table 2-25:	Digital Output Specifications	38
Table 2-26:	Digital Output Pins on the Digital/Analog I/O A Connector	38
Table 2-27:	Digital Input Specifications	40
Table 2-28:	Digital Input Pins on the Digital/Analog I/O B Connector	40
Table 2-29:	Analog Output Specifications	41
Table 2-30:	Analog Output Pins on the Digital / Analog I/O B Connector	41
Table 2-31:	Analog Input Specifications	42
Table 2-32:	Analog Input Pins on the Digital / Analog I/O B Connector	42
Table 2-33:	Encoder Input Specifications	43
Table 2-34:	Axis 1 Encoder Input Pinout (Encoder Input Connector A)	43
Table 2-35:	Axis 2 Encoder Input Pinout (Encoder Input Connector B)	43
Table 2-36:	Mating Connector Part Numbers for the Encoder Input Connectors	43
Table 2-37:	GL4 to Drive Cable Part Numbers	43
Table 2-38:	ESTOP Pins on the Encoder Input Connector	45
Table 2-39:	Electrical Noise Suppression Devices	45
Table 2-40:	Sync-Related Functions	47
Table 2-41:	Sync Port Cables	47
Table 3-1:	LED Description	49
Table 3-2:	Troubleshooting	49

Table 3-3: Preventative Maintenance	50
Table 3-4: Control Board Fuse Specifications	51
Table 3-5: Power Board Fuse Specifications	52

EU Declaration of Conformity

Manufacturer Aerotech, Inc.
Address 101 Zeta Drive
Pittsburgh, PA 15238-2811
USA
Product GL4
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

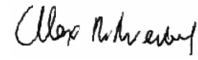
and has been designed to be in conformity with the applicable requirements of the following standard(s) when installed and used in accordance with the manufacturer's supplied installation instructions.

EN 61010-1:2010	Safety Requirements for Electrical Equipment
-----------------	--

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USA
1/10/2022

Date



Agency Approvals

Aerotech tested its GL4 drives and found that they obey the standards that follow:

Approval:	CUS NRTL
Approving Agency:	TUV SUD America Inc.
Certificate #:	U8 068995 0031 Rev. 00
Standards:	CAN/CSA-C22.2 No. 61010-1:2012 , EN 61010-1:2010, UL 61010-1:2012

Visit <https://www.tuev-sued.de/product-testing/certificates> to view Aerotech's TÜV SÜD certificates. Type the certificate number listed above in the search bar or type "Aerotech" for a list of all Aerotech certificates.

Safety Procedures and Warnings

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



- Read all parts of this manual before you install or operate the drive 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 drive.



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

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



1. Before you do maintenance to the equipment, disconnect the electrical power.
2. Restrict access to the drive when it is connected to a power source.
3. Do not connect or disconnect electrical components, wires, and cables while this product is connected to a power source.
4. Wait at least ten (10) minutes after removing the power supply before doing maintenance or an inspection. Otherwise, there is the danger of electric shock.
5. Supply each operator with the necessary protection from live electrical circuits.
6. Make sure that all components are grounded correctly and that they obey the local electrical safety requirements.
7. Install the necessary precautions to supply safety and protection to the operator.



DANGER: System travel can cause crush, shear, or pinch injuries. Restrict access to all motor and stage parts while your system is connected to a power source.



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

1. Make sure that all system cables are correctly attached and positioned.
2. Do not use the cables or the connectors to lift or move this product.
3. Use this product only in environments and operating conditions that are approved in this manual.
4. Only trained operators should operate this equipment.

Handling and Storage

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 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 drive 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 drive.

- Be careful when you move or transport the drive.
- Refer to [Section 1.2. Mechanical Specifications](#) for dimensions and weight specifications.
- Retain the shipping materials for future use.
- Transport or store the drive 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 drive in the original shipping container. If the original packaging included ESD protective packaging, make sure to store the drive in it. The storage location must be:

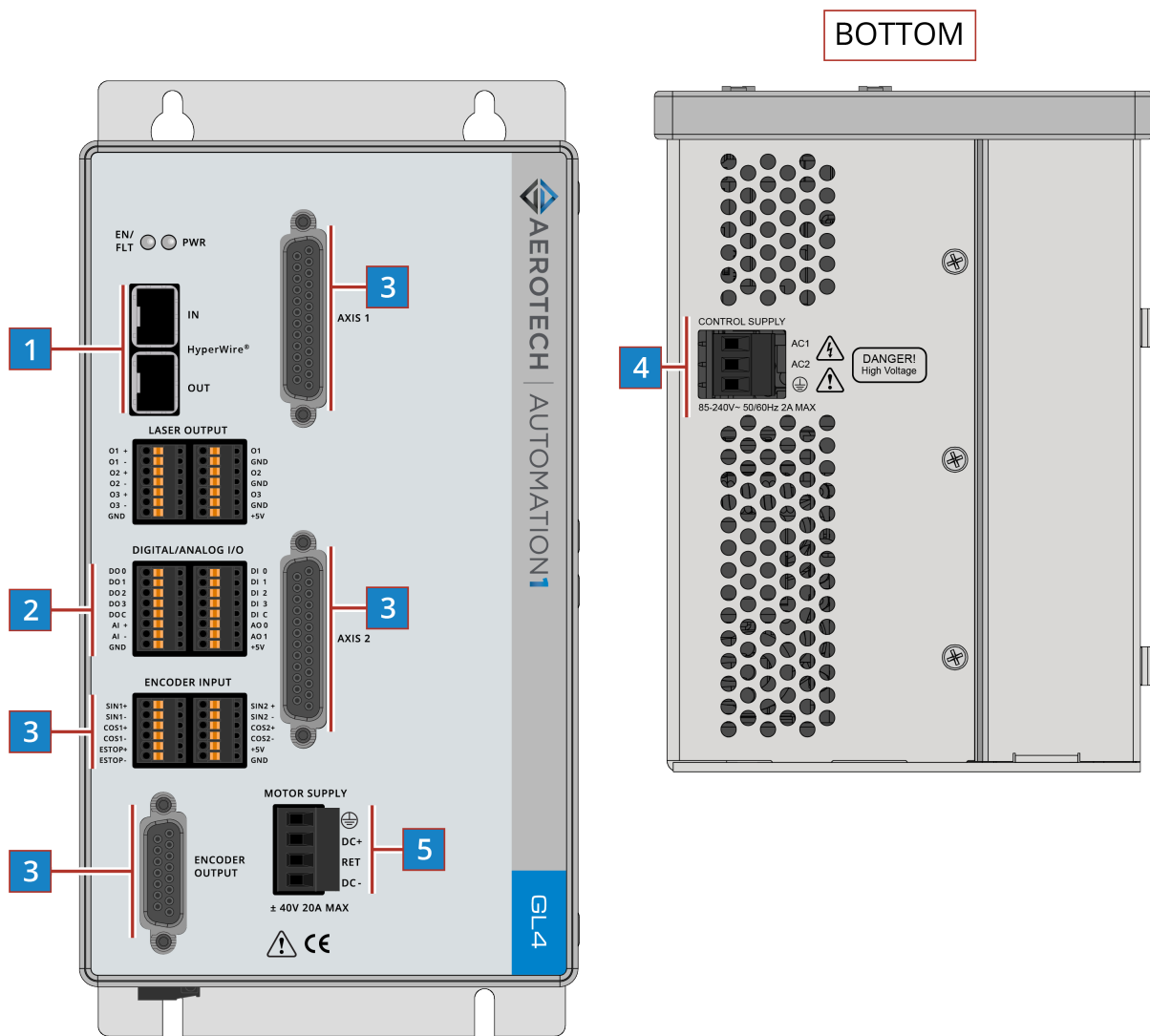
- dry
- free of dust
- free of vibrations
- flat

Refer to [Section 1.3. Environmental Specifications](#)

Installation Overview

This image shows the order in which to make connections and settings that are typical to the GL4. 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



1	Connect a PC HyperWire port to an amplifier HyperWire port.	Section 2.2.
2	Connect the Digital/Analog I/O.	Section 2.6.
3	Connect to Axis 1 and Axis 2 motor and feedback connectors.	Section 2.5.
4	Connect to the Control Supply connector.	Section 2.1.1.
5	Connect to the Motor Supply connector.	Section 2.1.2.

Chapter 1: GL4 Overview

The GL4 is a closed-loop scanner module that lets you control servo motion from the galvo scanner to mark parts with no limit to size and complexity. The GL4 supports CO2 and YAG lasers and includes Position Synchronized Output (PSO) laser firing that uses real-time scanner positional feedback.

Figure 1-1: GL4 Networked Digital Galvo Controller

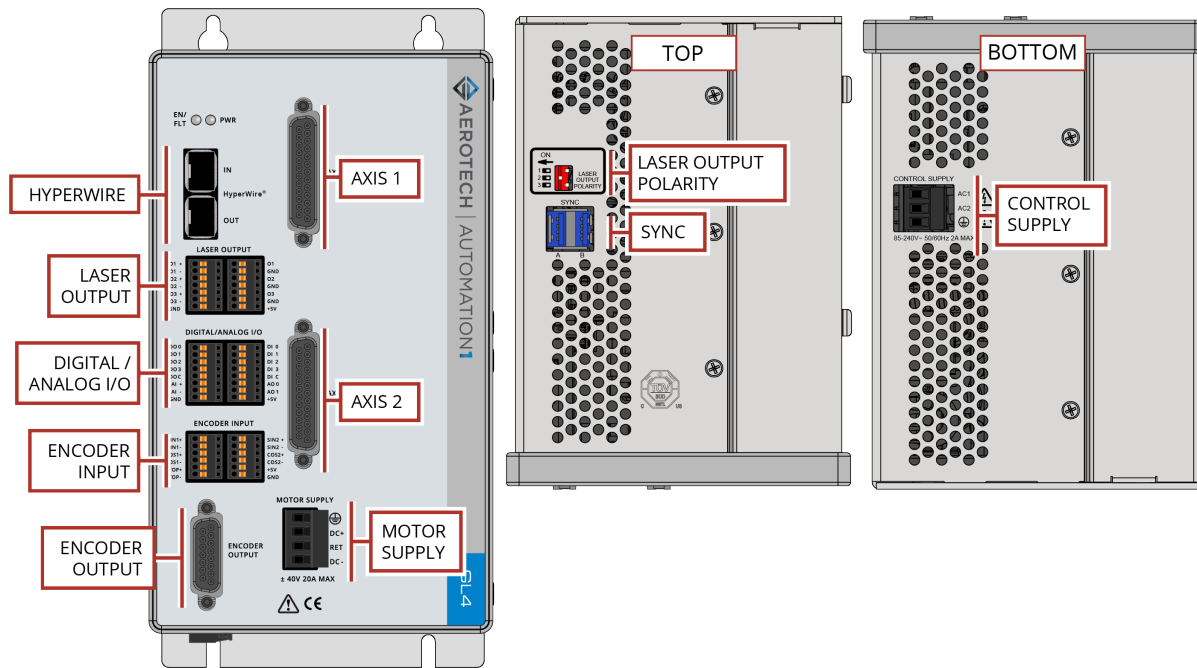
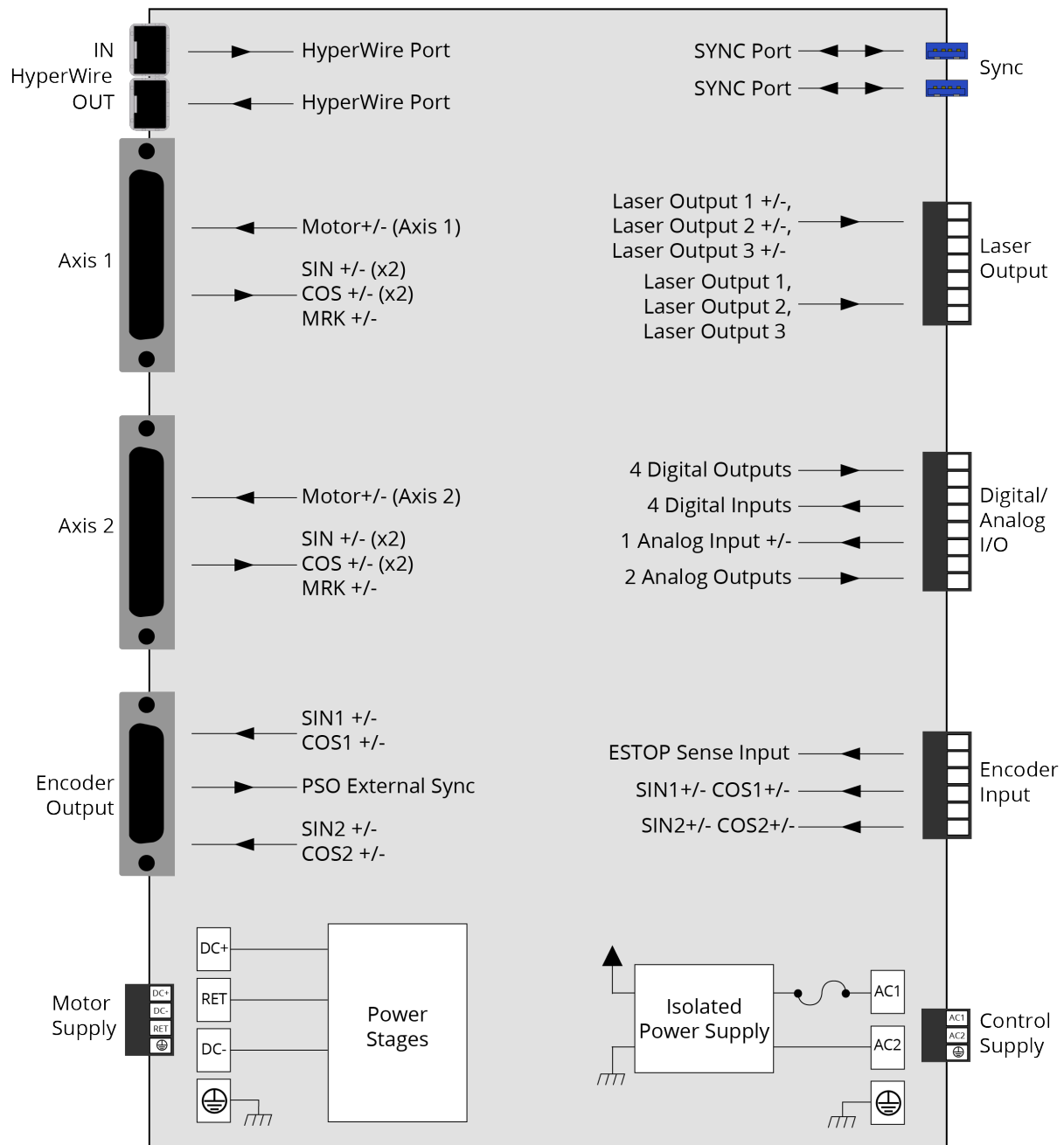


Table 1-1: Feature Summary

Standard Features
<ul style="list-style-type: none"> • 85-240 VAC; 50-60 Hz control supply (Section 2.1.1.) • ±40 VDC max motor supply (Section 2.1.2.) • Two HyperWire ports (Section 2.2.) • Three TTL laser outputs (Section 2.3.) • Three optically-isolated laser outputs (Section 2.3.) • Dual-Axis PSO firing (Section 2.3.1.) • Three-axis Part-Speed PSO firing that uses the PSO firing circuit based off of the commanded vector velocity of up to three axes (refer to the online Help) • Two auxiliary channels of 40 MHz line driver quadrature encoder inputs (Section 2.7.) • Four optically-isolated digital outputs; 5-24V (Section 2.6.1.) • Four optically-isolated digital inputs; 5-24V (Section 2.6.2.) • Two 16-bit single-ended analog outputs; ±10 V (Section 2.6.3.) • One 16-bit differential analog input; ±10 V (Section 2.6.4.) • Dedicated 5-24V Emergency Stop sense input (Section 2.7.1.) • Two Sync ports (Section 2.9.)

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

Figure 1-2: Functional Diagram



1.1. Electrical Specifications

Table 1-2: Electrical Specifications

Description		GL4
Motor Supply	Input Voltage	±40 VDC (max)
	Input Current (continuous)	10 A
Control Supply	Input Voltage	85-240 VAC
	Input Frequency	50-60 Hz
	Inrush Current	16 A
	Input Current	0.35 A (max)
Output Voltage		38 V
Peak Output Current		20 A
Continuous Output Current		5 A
Minimum Load Resistance		0.5 Ω
User Power Supply Output		5 VDC (@ 500 mA)

1.2. Mechanical Specifications

1.2.1. Mounting and Cooling

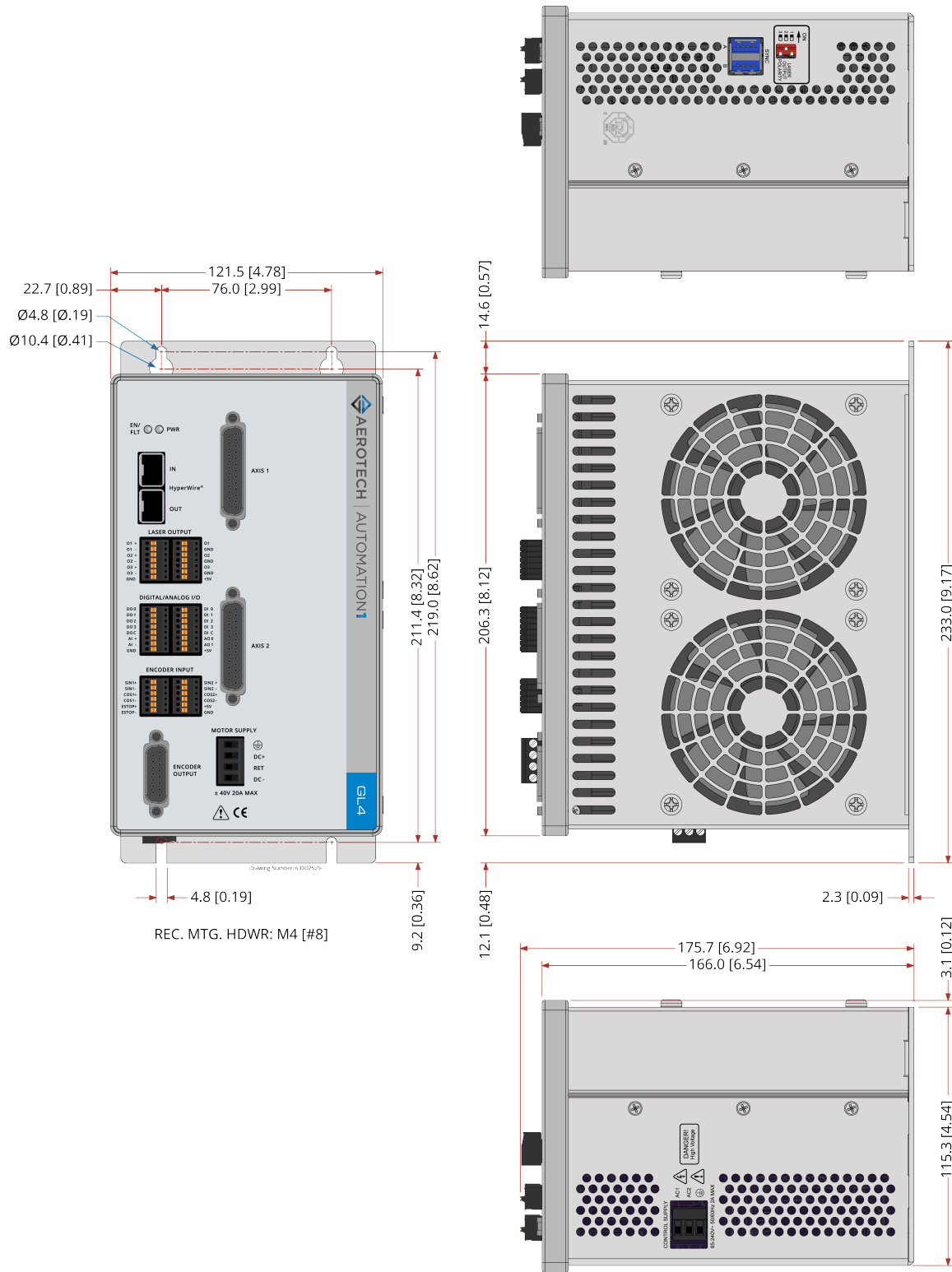
Install the drive in an IP54 compliant enclosure to comply with safety standards. Make sure that there is sufficient clearance surrounding the drive for free airflow and for the cables and connections.

Table 1-3: Mounting Specifications

		GL4
Customer-Supplied Enclosure		IP54 Compliant
Weight		~2.9 kg
Mounting Hardware		M4 [#8] screws (four locations, not included)
Mounting Orientation		Vertical (typical)
Dimensions		Refer to Section 1.2.2. Dimensions
Minimum Clearance	Airflow	~25 mm
	Connectors	~100 mm
Operating Temperature		Refer to Section 1.3. Environmental Specifications

1.2.2. Dimensions

Figure 1-3: Dimensions



1.3. Environmental Specifications

The environmental specifications are listed below.

Table 1-4: 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 1-5: Drive and Software Compatibility

Drive Type	Software	First Software Version	Last Software Version
GL4	Automation1	1.2.0	Current
	A3200	6.04	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](#).

2.1. Input Power Connections

The drive has two input power connectors. One connector is for AC control power and the other connector is for DC motor power. For a full list of electrical specifications, refer to [Section 1.1](#).

2.1.1. Control Supply Connector



IMPORTANT: To operate correctly, this product must have a power supply connected to the Motor Supply and a power supply connected to the Control Supply.

The Control Supply input supplies power to the communications and logic circuitry of the drive. The AC1 input and the AC2 input are connected to fuses inside the drive. Refer to [Table 3-5](#) for fuse values and part numbers.

The Control Supply contains an internal filter. It is not necessary to use an external filter for CE compliance.



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



DANGER: Before you operate the GL4, install a ground connection for your safety and to prevent damage to the equipment.

Figure 2-1: Control Supply Connections

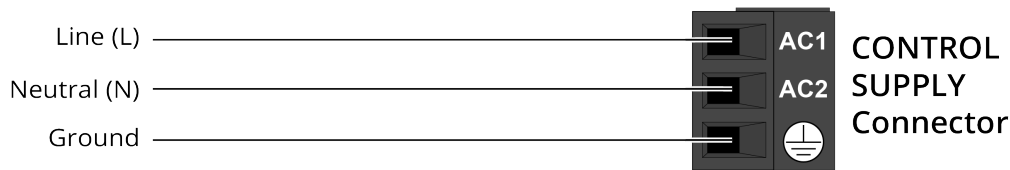


Table 2-1: Control Supply Connector Wiring Specifications

Pin	Description	Recommended Wire Size ⁽¹⁾
AC1	Line Input: 85 - 240 Volt AC Input Range	1.3 mm ² [#16 AWG]
AC2	Neutral (0V) or 85 - 240 Volt AC Input Range	1.3 mm ² [#16 AWG]
	Protective Ground	1.3 mm ² [#16 AWG]

(1) The wire insulation is rated for 300 V.

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	ECK02388	Phoenix 1756272	0.22 - 0.25	2.5 - 0.05 [14-30]

2.1.2. Motor Supply Connector



IMPORTANT: To operate correctly, this product must have a power supply connected to the Motor Supply and a power supply connected to the Control Supply.

Motor power is applied to the GL4 at the four terminals of the Motor Supply connector. The DC+ input and the DC- input are connected to fuses inside the drive. Refer to [Table 3-5](#) for fuse values and part numbers.



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



DANGER: To prevent the risk of electric shock, do not operate the GL4 without a ground connection.

Figure 2-2: Motor Supply Connections

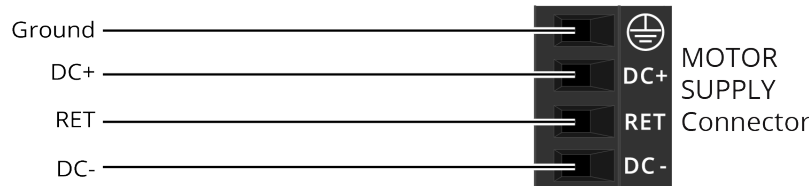



Table 2-3: Motor Supply Wiring Specifications

Pin	Description	Recommended Wire Size ⁽¹⁾
DC+	+40 VDC Input Range	2.1 mm ² (#14 AWG)
RET	Return for DC Input	2.1 mm ² (#14 AWG)
DC-	-40 VDC Input Range	2.1 mm ² (#14 AWG)
	Protective Ground	2.1 mm ² (#14 AWG)

(1)The wire insulation is rated for 300 V.

Table 2-4: Mating Connector Part Numbers for the Motor Supply Connector

Type	Aerotech P/N	Third Part P/N	Screw Torque: N·m	Wire Size: mm ² [AWG]
4-Pin Terminal Block	ECK002407	Phoenix 1758843	0.5 - 0.6	3.3 - 0.0516 [12-30]

2.1.3. External Power Supply Options

You must connect the Motor Supply to a bipolar power supply. Aerotech recommends that you use an Aerotech TM3 transformer which can supply power to a maximum of four controllers ([Figure 2-4](#)).

As an alternative to a bipolar power supply, you can use two third-party power supplies but they must obey these conditions ([Figure 2-3](#)).

- The output of each power supply must not be ground referenced.
- The output of each power supply must be specified to be used in positive or negative polarity.

The GL4 controller can source 10 A peak current to each motor. This current must be supplied by the external power supply. A switching power supply must be rated for the peak current requirement of the system because the switching power supply might shut down if it is overloaded.

Figure 2-3: Third-Party Power Supply Connection

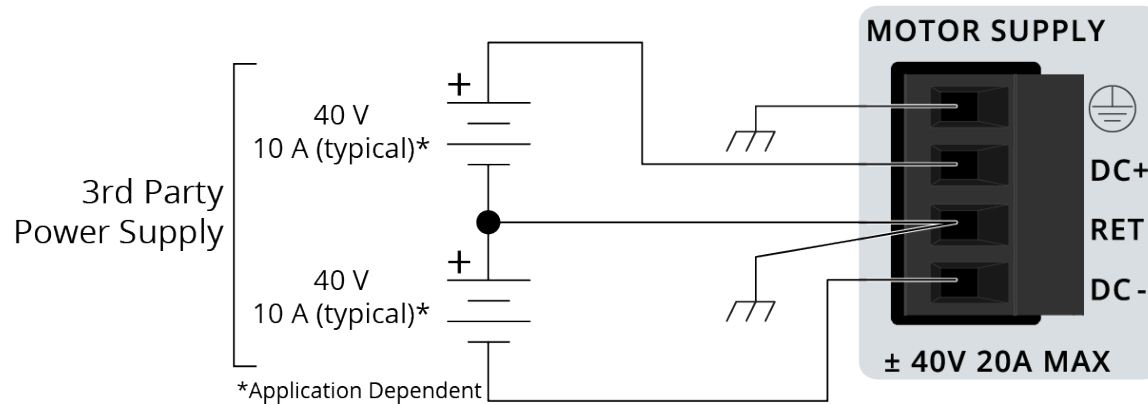
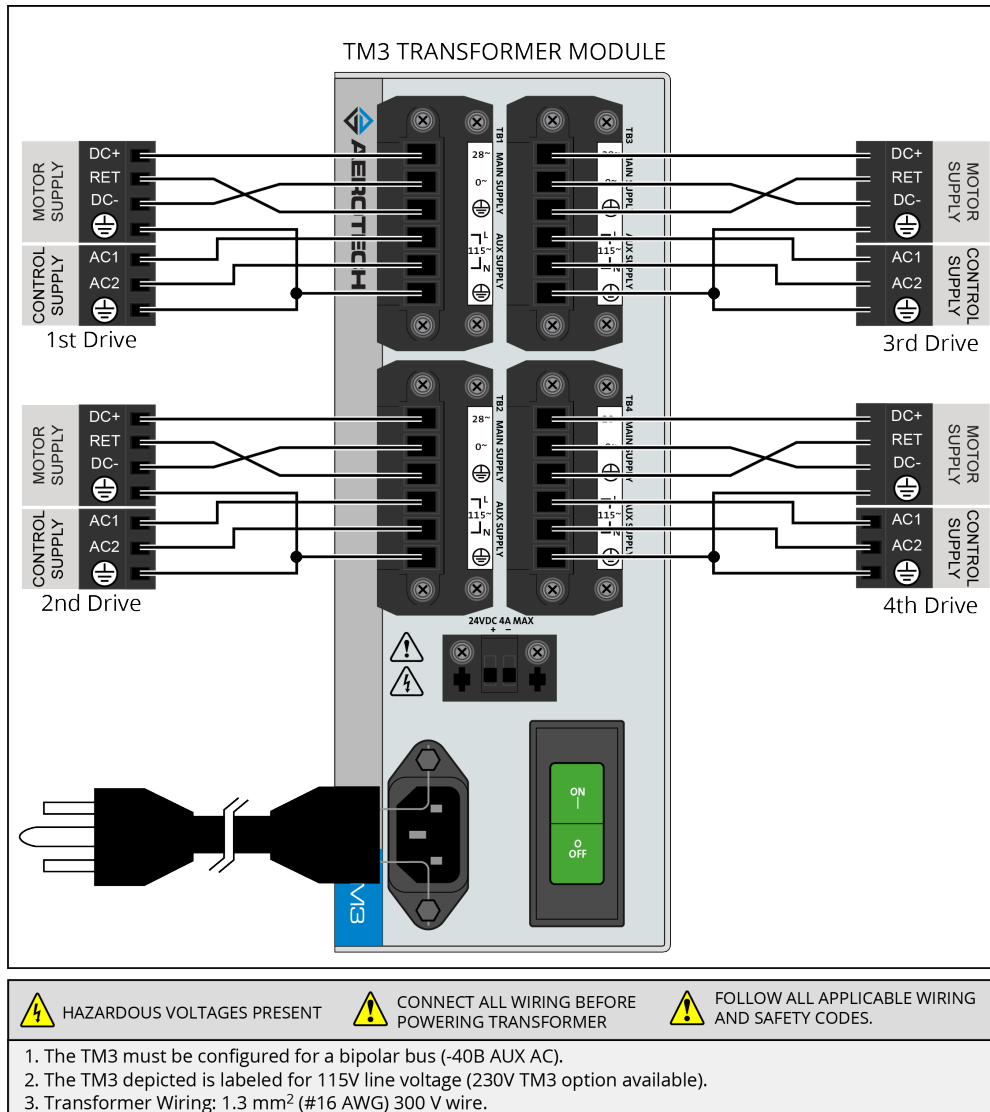


Figure 2-4: Control and Motor Power Wiring using a TM3 Transformer

2.1.4. Minimizing Noise for EMC/CE Compliance



IMPORTANT: The GL4 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. Separate motor and power wiring from encoder and I/O wiring.
2. Mount drives, power supplies, and filter components on a conductive panel. Mount line filters close to the drive to keep the wire length between the drive and filter to a minimum. Use a line filter, such as Aerotech's UFM-ST, on the Control Supply AC inputs.

The following additional changes could be required for EMC compliance and are recommended during initial EMC system evaluation.

1. Add a clamp-on ferrite to the motor feedback cable close to the drive.
[Aerotech PN ECZ02348, Fair-rite PN 0446167281]
2. Add a ferrite core to the UFM-ST AC input wires. Wrap the AC wires and ground wire around the core one time.
[Ferrite core: Aerotech PN ECZ02350, Fair-rite PN 2646102002]

2.2. 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 2-5: HyperWire Card Part Number

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

Table 2-6: 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

2.3. Laser Output Connectors

The Laser Output has two 7-pin terminal block-style connectors and supplies connections to the laser control outputs. Three laser output signals are available as optically-isolated or as 5V TTL signals. You can wire the optically-isolated outputs in a sourcing or sinking configuration.

To set the active polarity of the laser output signals, use the switches on the top of the GL4. Refer to [Section 2.8](#).

To turn on the output and activate the laser, move the switch to the **OFF** position. This is the Normally-Open configuration. The laser output is fully turned on when one of these conditions occurs.

- The optically-isolated output conducts current.
- The TTL output is 5 V.

To select the opposite polarity, move the switch to the **ON** position. This is the Normally-Closed configuration. When the GL4 is powered off, it does not continue to support this configuration. This configuration is not a fail-safe feature.



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 2-7: Laser Output Connector A Pinout

Pin #	Label	Description	In/Out/Bi	Connector
1	O1+	Laser Output 1+ / PSO Output ⁽¹⁾	Output	
2	O1-	Laser Output 1- / PSO Output ⁽¹⁾	Output	
3	O2+	Laser Output 2+	Output	
4	O2-	Laser Output 2-	Output	
5	O3+	Laser Output 3+	Output	
6	O3-	Laser Output 3-	Output	
7	GND	Ground	N/A	

(1) Refer to [Section 2.3.1](#), for more information

Table 2-8: Laser Output Connector B Pinout

Pin #	Label	Description	In/Out/Bi	Connector
1	O1	Laser Output 1 / PSO Output ⁽¹⁾ (5V TTL)	Output	
2	GND	Ground	N/A	
3	O2	Laser Output 2 (5V TTL)	Output	
4	GND	Ground	N/A	
5	O3	Laser Output 3 (5V TTL)	Output	
6	GND	Ground	N/A	
7	+5V	5 Volt Power Supply (500 mA)	Output	

(1) Refer to [Section 2.3.1](#), for more information

Table 2-9: Mating Connector Part Numbers for the Laser Output Connectors

Type	Aerotech P/N	Third Party P/N	Wire Size: mm ² [AWG]
7-Pin Terminal Block	ECK02403	Phoenix 1908114	0.5 - 0.080 [20-28]

Table 2-10: Laser Output Specifications

	Specification	Value
Isolated Output	Maximum Frequency	5 MHz
	Voltage	5 - 24 V
	Output Current	≤ 50 mA
5V TTL	Maximum Frequency	10 MHz
	Voltage	5 V
	Output Current	50 mA

Figure 2-5: Laser Interface Outputs

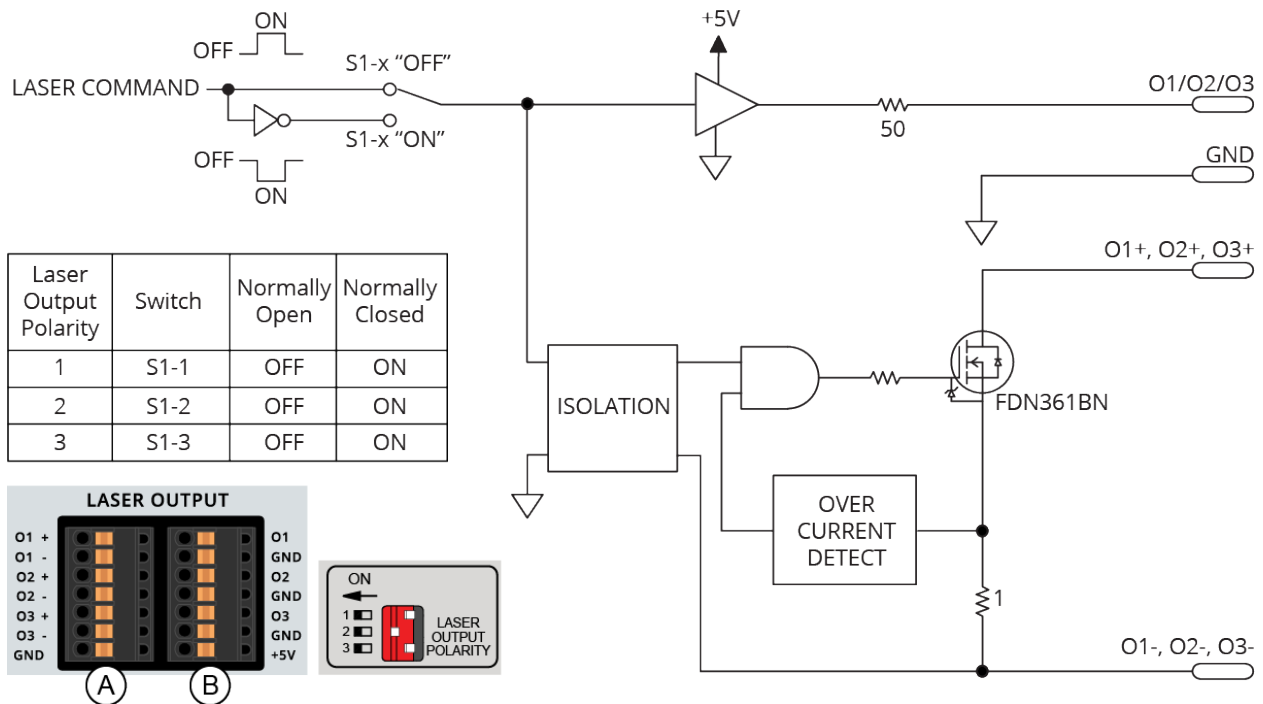


Figure 2-6: Current Sinking Configuration with Isolation

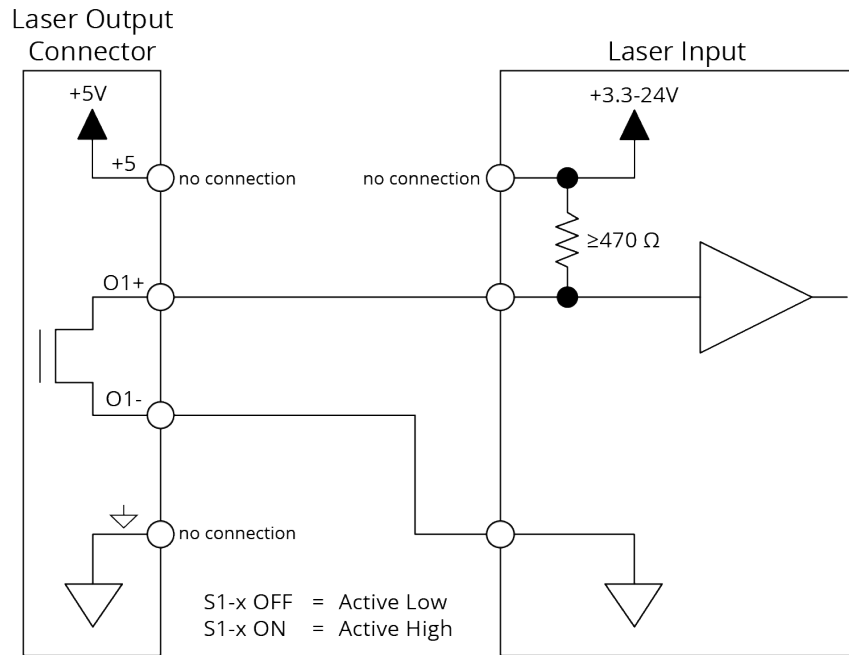


Figure 2-7: Current Sinking Configuration without Isolation

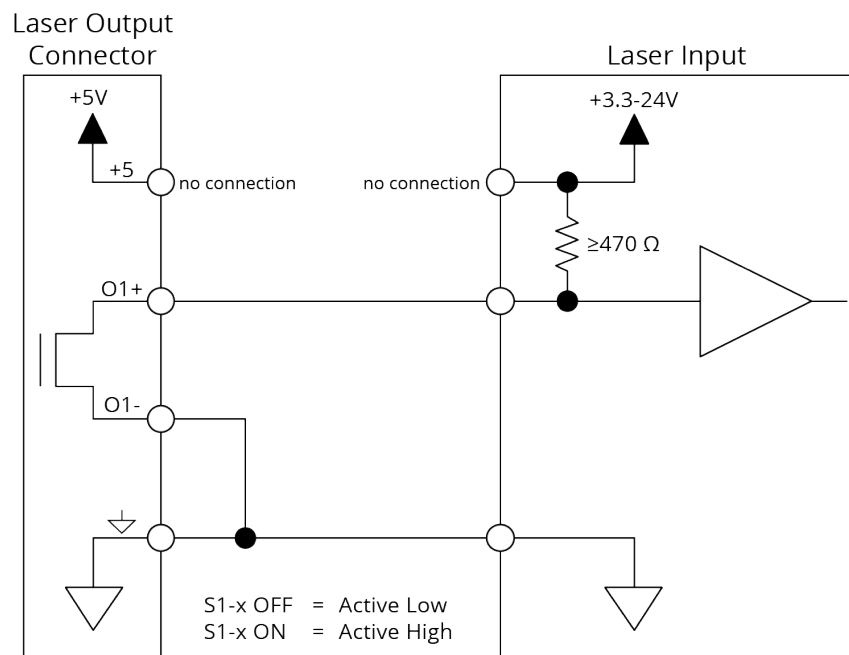


Figure 2-8: Current Sourcing Configuration with Isolation

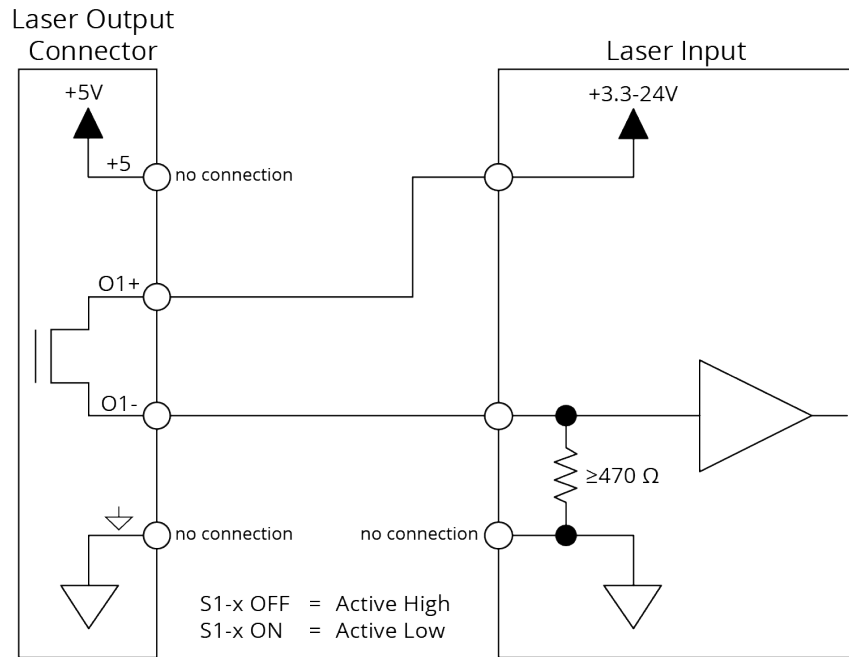


Figure 2-9: Current Sourcing Configuration without Isolation

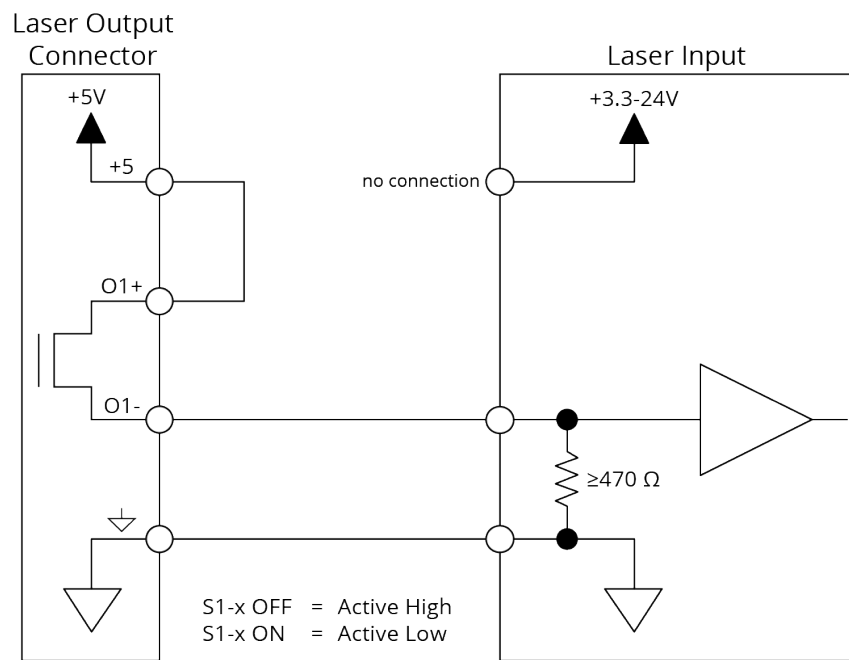
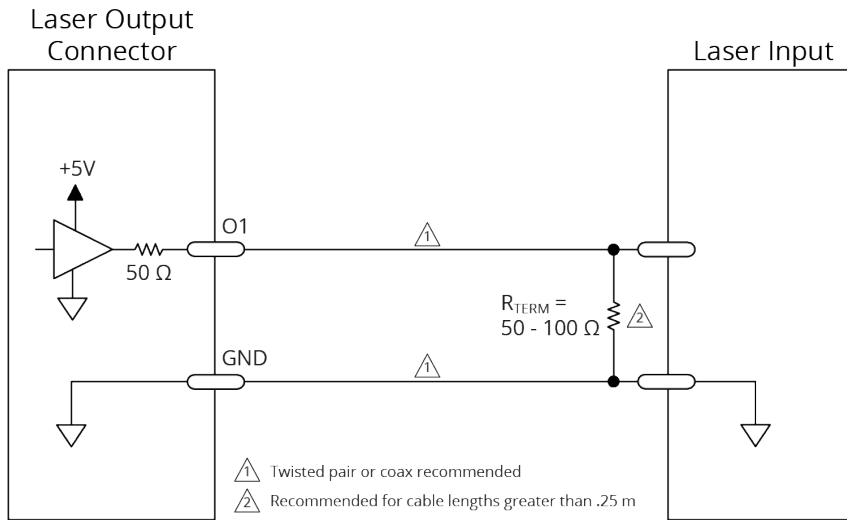


Figure 2-10: TTL Output



2.3.1. Position Synchronized Output (PSO)

Program the Position Synchronized Output (PSO) to generate an output that is synchronized to the feedback position of an axis. PSO is typically used to fire a laser or trigger an external hardware device.

A PSO firing event can be triggered from a feedback channel or from a software trigger. You can get quadrature signals from feedback channels and PSO firing event signals after a PSO firing event occurs. When the PSO generates pulses, minimum latency occurs between the trigger condition and the output.

Aerotech recommends that you use an RS-422 line receiver or an opto-isolator if your system:

- Uses cables with long lengths in work areas where a lot of electrical noise occurs.
- Uses high-frequency pulse transmission.

For best performance, put the RS-422 line receiver or the opto-isolator near the electronics that receive the PSO output pulse.

Table 2-11: PSO Pins on the Laser Output A Connector

Pin #	Label	Description	In/Out/Bi
1	O1+	Laser Output 1+ / PSO Output	Output
2	O1-	Laser Output 1- / PSO Output	Output

Table 2-12: PSO Pins on the Laser Output B Connector

Pin #	Label	Description	In/Out/Bi
1	O1	Laser Output 1 / PSO Output (5V TTL)	Output
2	GND	Ground	N/A

Table 2-13: PSO Specifications

Specification		Value
Maximum PSO Output (Fire) Frequency	TTL	12.5 MHz
	Isolated	5 MHz
Output Latency [Fire event to output change]	TTL	50 ns
	Isolated	150 ns
1. Signals in excess of this rate will cause a loss of PSO accuracy		

2.4. Encoder Output Connector

The Encoder Output interface echos the encoder signals out of the two axes.

Table 2-14: Encoder Output Connector Pinout

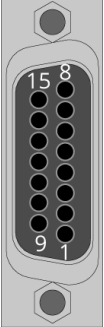
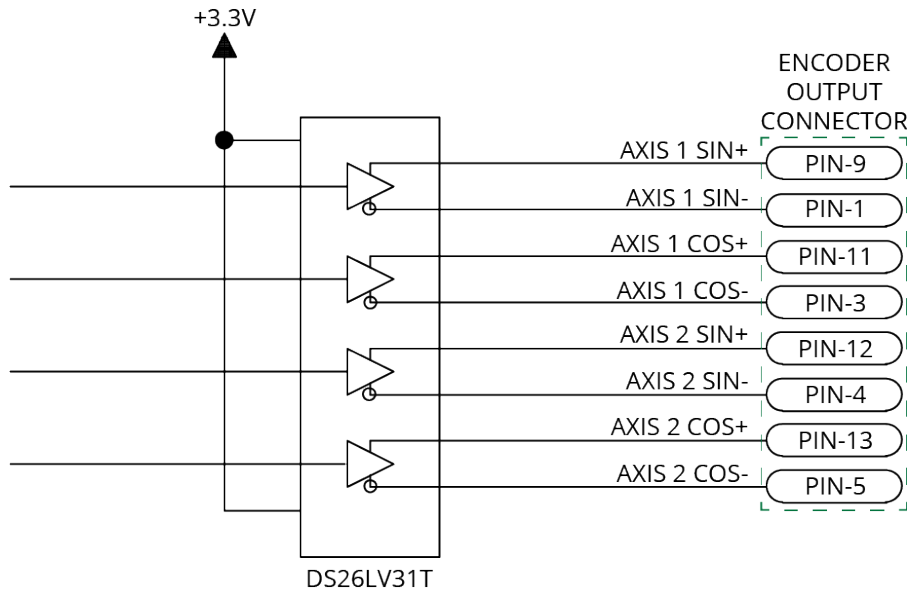
Pin	Description	In/Out/Bi	Connector
1	Axis 1 SIN-	Output	
2	Reserved	N/A	
3	Axis 1 COS-	Output	
4	Axis 2 SIN-	Output	
5	Axis 2 COS-	Output	
6	Reserved	N/A	
7	PSO External Sync	Input	
8	+5V	Output	
9	Axis 1 SIN+	Output	
10	Reserved	N/A	
11	Axis 1 COS+	Output	
12	Axis 2 SIN+	Output	
13	Axis 2 COS+	Output	
14	Reserved	N/A	
15	Ground	N/A	

Table 2-15: Mating Connector Part Numbers for the Encoder Output Connector

Mating Connector	Aerotech P/N	Third Party P/N
15-Pin D-Connector	ECK00100	Amphenol DA15P064TXLF
Backshell	ECK01022	Amphenol 17E-1725-2

Figure 2-11: Encoder Outputs

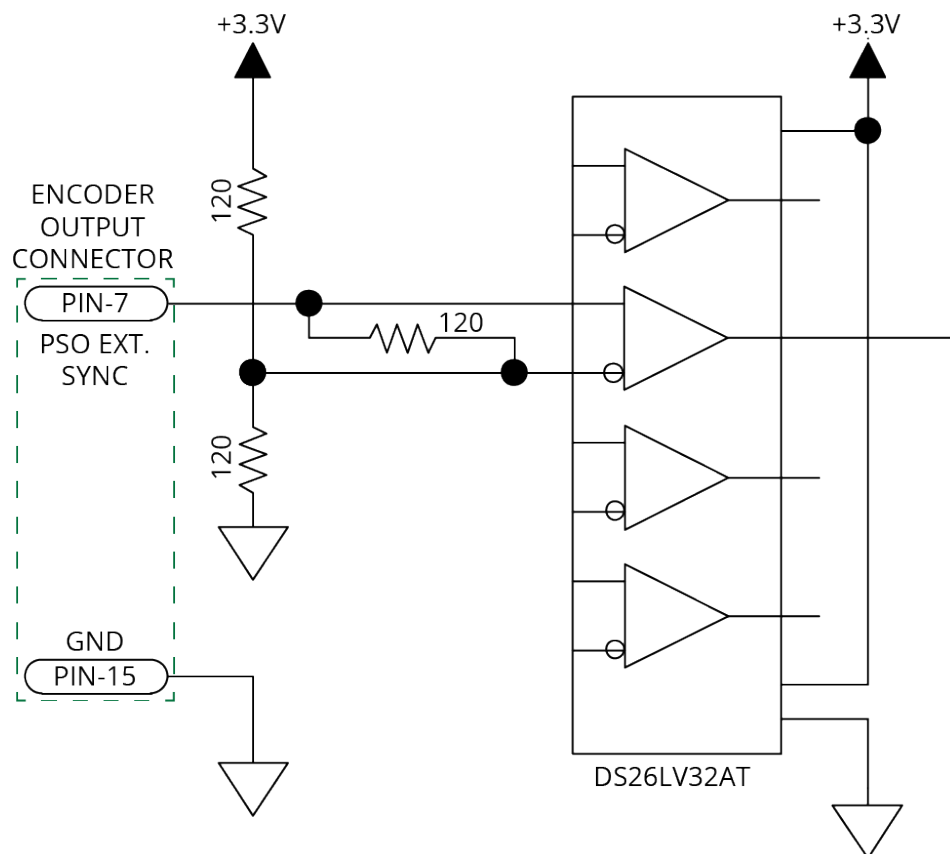


You can use the external [PSO synchronization functions](#) [A3200: PSOOUTPUT PULSE EXTSYNC command] to synchronize waveform generation with an external synchronization signal. When you activate this feature, the PSO Waveform module will not generate the configured waveform when an output event is received until the rising edge of the synchronization signal occurs.

Table 2-16: PSO External Sync Specifications

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

Figure 2-12: PSO External Sync Input



2.5. Galvo Motor Connectors

The GL4 is configured for AGV galvo motors at the factory. You cannot use the GL4 with other types of motors. AGV galvo motors operate as DC Brush motors over a limited travel.

Each galvo motor connector is a 25-pin, D-style connector that has two analog encoder inputs, 5 V encoder power, and galvo motor connections.

Table 2-17: Galvo Motor Connector Pinout

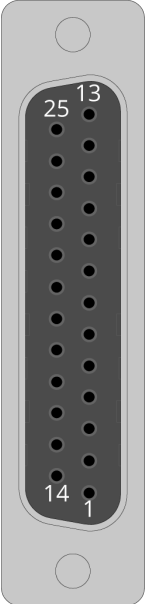
Pin	Description	In/Out/Bi	Pin Location
1	Sine 1+	Input	
2	Cosine 1+	Input	
3	Encoder Ground	N/A	
4	Sine 2+	Input	
5	Cosine 2+	Input	
6	Clockwise End of Travel Limit	Input	
7	Marker 1+	Input	
8	Encoder Power (+5V, 500 mA)	Output	
9	Motor Over Temperature Thermistor	Input	
10	Flash Configuration	Input	
11	Frame Ground	N/A	
12	Motor +	Output	
13	Motor +	Output	
14	Sine 1-	Input	
15	Cosine 1-	Input	
16	Encoder Ground	N/A	
17	Sine 2-	Input	
18	Cosine 2-	Input	
19	Counterclockwise End of Travel Limit	Input	
20	Marker 1-	Input	
21	Encoder Ground	N/A	
22	Encoder Ground	N/A	
23	Frame Ground	N/A	
24	Motor -	Output	
25	Motor -	Output	

Table 2-18: Mating Connector Part Numbers for the Galvo Motor Connectors

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

2.5.1. Analog Encoder Inputs

The GL4 has two analog encoder input channels for each galvo connector. The GL4 uses these input channels for position feedback.

Use Encoder Tuning [A3200: Feedback 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](#).

Table 2-19: Analog Encoder Specifications

Specification	Value
Input Frequency (max)	500 kHz
Input Amplitude ⁽¹⁾	0.6 to 1.2 Vpk-pk
Interpolation Factor (max)	262,144
Input Common Mode	1.5 to 3.5 VDC

(1) Any single-ended encoder signal measured with respect to ground.

2.5.2. End of Travel Limit Input Interface

Aerotech strongly recommends that you use End of Travel (EOT) limits to define the end of the physical travel. Current-based limits that are software-selectable through the EndOfTravelLimitSetup axis parameter can be used, but only if EOT limits are not available on your galvo motor. 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. The Home Limit switch can be parameter configured for use during the home cycle, however, the CW or CCW EOT limit is typically used instead. All of the end-of-travel limit inputs accept 0-24 VDC level signals. Limit directions are relative to the encoder polarity in the diagnostics display (refer to [Figure 1-1](#)).

Table 2-20: End of Travel Limit Input Pins on the Galvo Motor Connectors

Pin	Description	In/Out/Bi
6	Clockwise End of Travel Limit	Input
8	Encoder Power (+5V, 500 mA)	Output
16	Encoder Ground	N/A
19	Counterclockwise End of Travel Limit	Input

Aerotech recommends that you use a normally-closed limit switch and select Active High for this option. This configuration provides fail-safe limit behavior because the controller generates a fault if the external hardware is not connected or is not operating correctly. If you connect a normally-closed limit switch between the limit input and limit common and the switch is not activated, it stays closed and the limit inputs are pulled low by the limit switch. When the switch is activated, it opens and the limit input is pulled high by the circuit inside the drive.

The active state of the EOT limits is software selectable (by the EndOfTravelLimitSetup axis parameter). [Figure 2-13](#) shows the possible wiring configurations for normally-open and normally-closed switches and the parameter setting to use for each configuration.

Figure 2-13: End of Travel Limit Input Connections

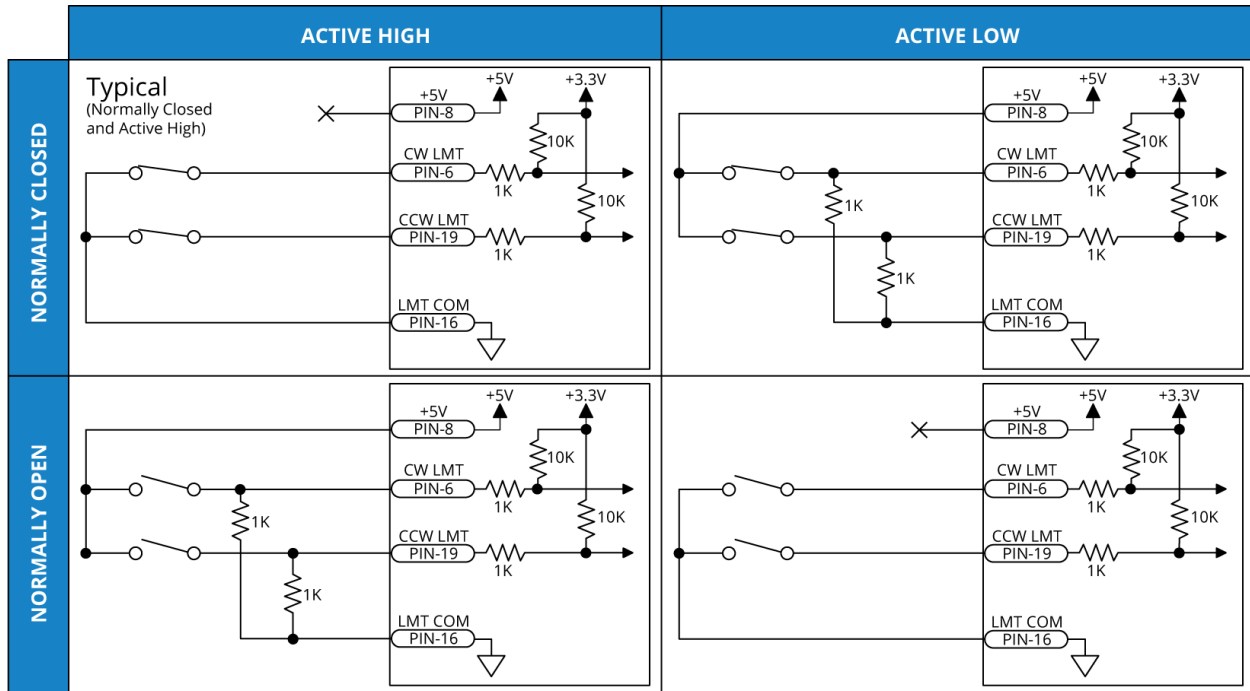
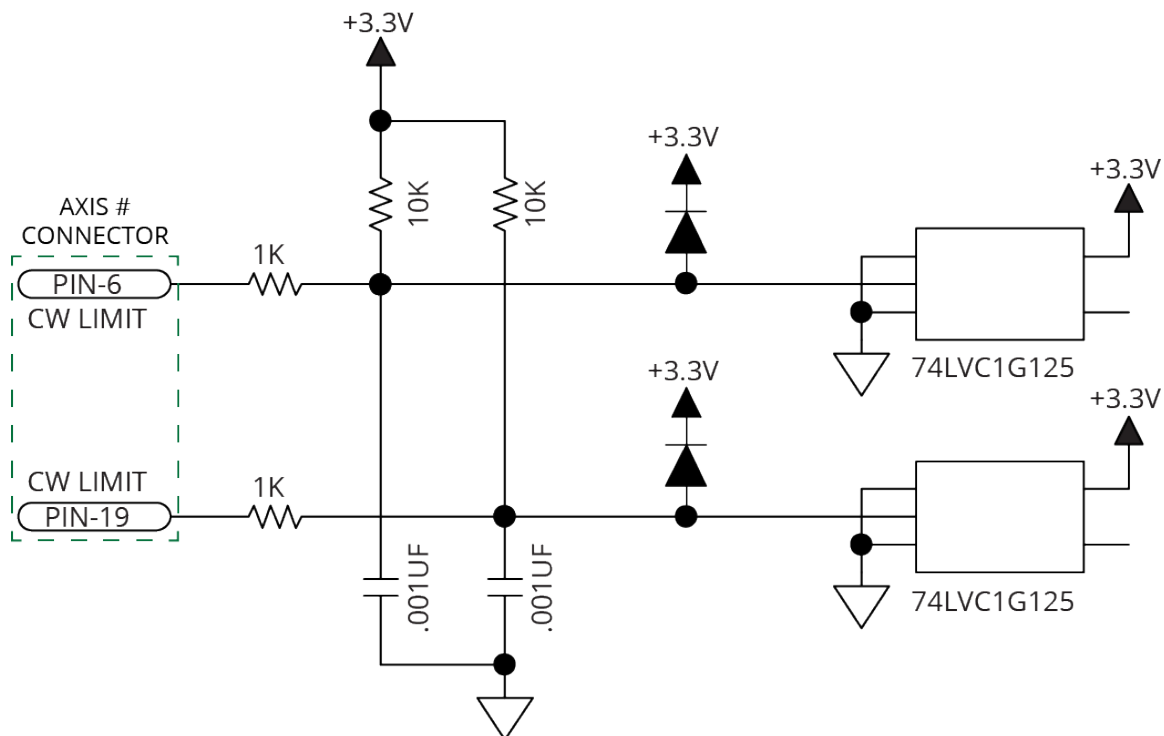


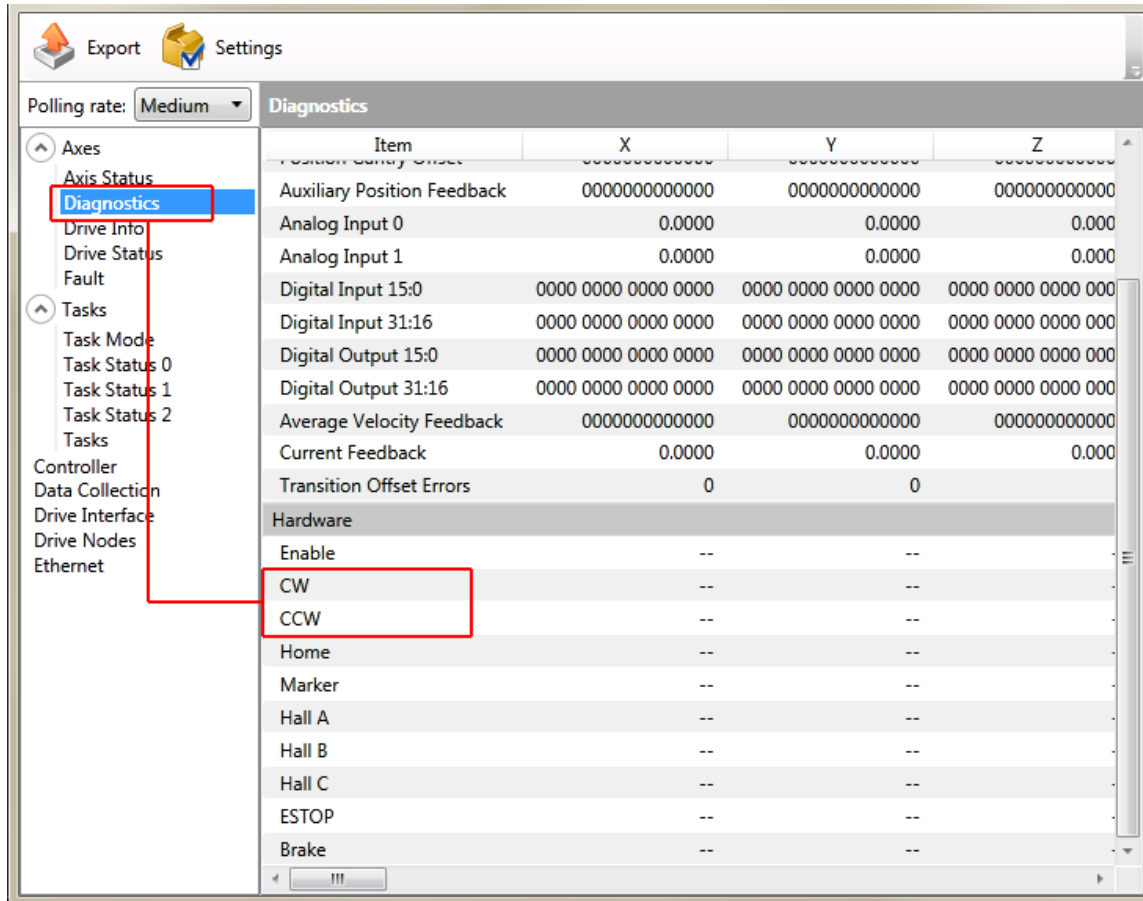
Figure 2-14: End of Travel Limit Interface Input Schematic



2.5.2.1. 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 motor 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 2-15](#)).

Figure 2-15: Limit Input Diagnostic Display



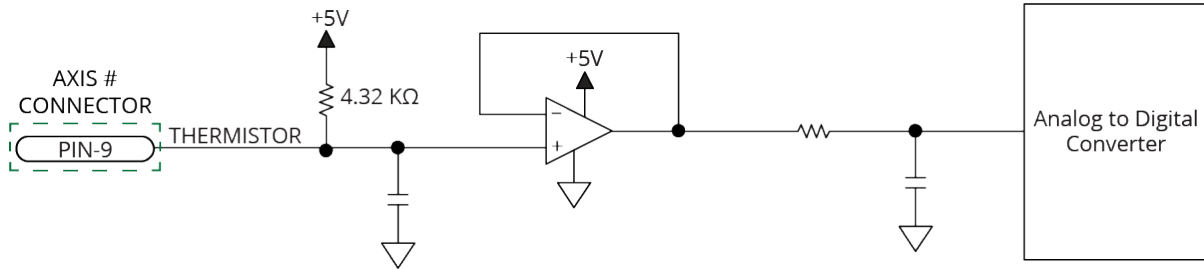
2.5.3. Thermistor Input

The thermistor input is used to detect a motor over temperature condition by using a negative temperature coefficient sensor. As the temperature of the sensor increases, the resistance decreases. Under normal operating conditions, the resistance of the thermistor is high (10 kΩ, for example) which will result in a high input signal. As the increasing temperature causes the thermistor’s resistance to decrease, the signal will be seen as a logic low triggering an over temperature fault. The nominal trip value of the sensor is 2.4 kΩ.

Table 2-21: Thermistor Input Pins on the Galvo Motor Connectors

Pin	Description	In/Out/Bi
9	Motor Over Temperature Thermistor	Input

Figure 2-16: Thermistor Input Input Schematic



2.6. Digital and Analog I/O Connectors

This connector has four digital, optically-isolated outputs, four digital, optically-isolated inputs, one differential analog input, and two analog outputs.

Table 2-22: Digital and Analog I/O Connector A Pinout

Pin #	Label	Description	In/Out/Bi	Connector
1	DO0	Digital Output 0 (Optically-Isolated)	Output	
2	DO1	Digital Output 1 (Optically-Isolated)	Output	
3	DO2	Digital Output 2 (Optically-Isolated)	Output	
4	DO3	Digital Output 3 (Optically-Isolated)	Output	
5	DOC	Digital Output Common	Output	
6	AI+	Analog Input +	Input	
7	AI-	Analog Input -	Input	
8	GND	Ground	N/A	

Table 2-23: Digital and Analog I/O Connector B Pinout

Pin #	Label	Description	In/Out/Bi	Connector
1	DI0	Digital Input 0 (Optically-Isolated)	Input	
2	DI1	Digital Input 1 (Optically-Isolated)	Input	
3	DI2	Digital Input 2 (Optically-Isolated)	Input	
4	DI3	Digital Input 3 (Optically-Isolated)	Input	
5	DIC	Digital Input Common	Input	
6	AO0	Analog Output 0	Output	
7	AO1	Analog Output 1	Output	
8	+5V	+5V	Output	

Table 2-24: Mating Connector Part Numbers for the Digital / Analog I/O Connectors

Mating Connector	Aerotech P/N	Third Party P/N	Wire Size: mm ² [AWG]
8-Pin Terminal Block	ECK02397	Phoenix 1908101	0.5 - 0.14 [20-26]

2.6.1. 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 the same configuration. Refer to [Figure 2-17](#) and [Figure 2-18](#).

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 2-17](#). To see an example of a current sinking output that has diode suppression, refer to [Figure 2-18](#).

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

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

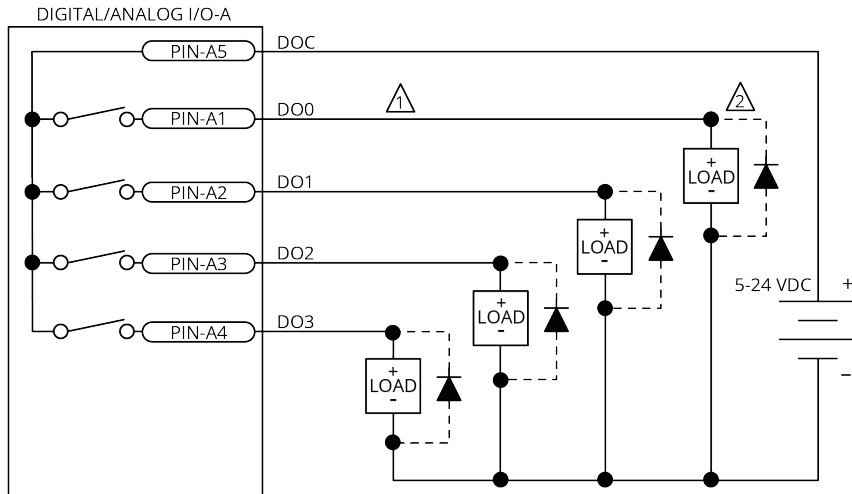
Table 2-25: Digital Output Specifications

Digital Output Specifications	Value
Maximum Voltage	24 V (26 V Maximum)
Maximum Sink/Source Current	50 mA/output
Output Saturation Voltage	0.2 V at maximum current
Output Resistance	4 Ω
Rise / Fall Time	250 μ s (2K pull up to 24V)
Reset State	Output Off (High Impedance State)

Table 2-26: Digital Output Pins on the Digital/Analog I/O A Connector

Pin #	Label	Description	In/Out/Bi
1	DO0	Digital Output 0 (Optically-Isolated)	Output
2	DO1	Digital Output 1 (Optically-Isolated)	Output
3	DO2	Digital Output 2 (Optically-Isolated)	Output
4	DO3	Digital Output 3 (Optically-Isolated)	Output
5	DOC	Digital Output Common	Output

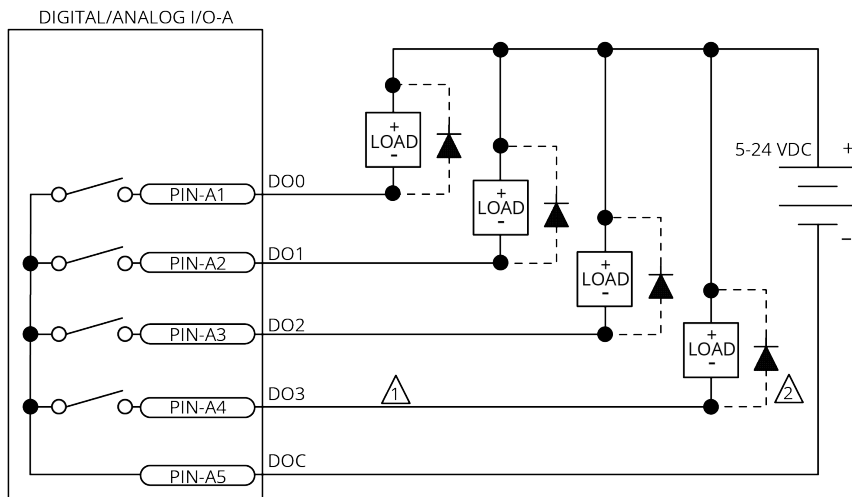
Figure 2-17: Digital Outputs Connected in Current Sourcing Mode



⚠ Each output 50 mA maximum

⚡ Diode required on each output that drives an inductive device (coil), such as a relay.

Figure 2-18: Digital Outputs Connected in Current Sinking Mode



⚠ Each output 50 mA maximum

⚡ Diode required on each output that drives an inductive device (coil), such as a relay.

2.6.2. Digital Inputs

You can connect the digital inputs to current sourcing or current sinking devices but you must connect all four inputs in the same configuration. Refer to [Figure 2-19](#) and [Figure 2-20](#). The digital inputs are not designed for high-voltage isolation applications. They should only be used with ground-referenced circuits.

Table 2-27: 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 2-28: Digital Input Pins on the Digital/Analog I/O B Connector

Pin #	Label	Description	In/Out/Bi
1	DI0	Digital Input 0 (Optically-Isolated)	Input
2	DI1	Digital Input 1 (Optically-Isolated)	Input
3	DI2	Digital Input 2 (Optically-Isolated)	Input
4	DI3	Digital Input 3 (Optically-Isolated)	Input
5	DIC	Digital Input Common	Input

Figure 2-19: Digital Inputs Connected to Current Sourcing Devices

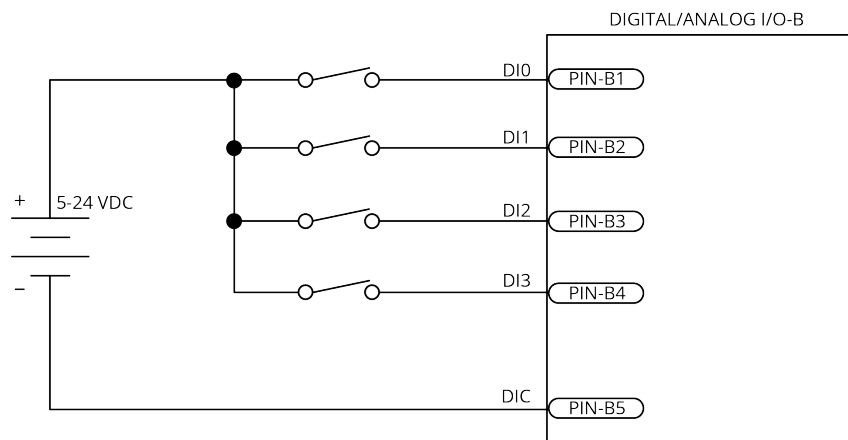
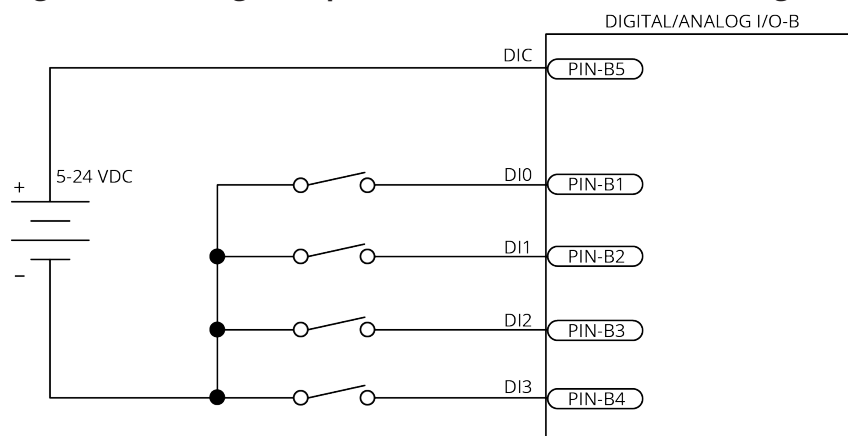


Figure 2-20: Digital Inputs Connected to Current Sinking Devices



2.6.3. 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.

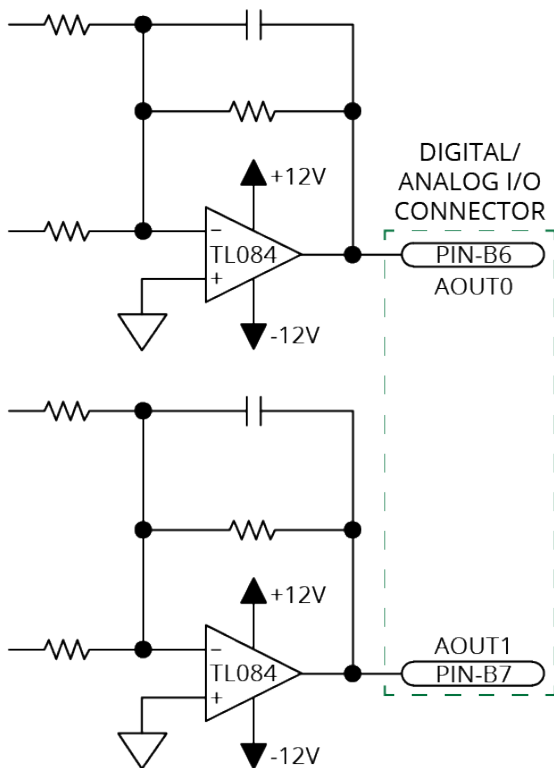
Table 2-29: Analog Output Specifications

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

Table 2-30: Analog Output Pins on the Digital / Analog I/O B Connector

Pin #	Label	Description	In/Out/Bi
6	AO0	Analog Output 0	Output
7	AO1	Analog Output 1	Output

Figure 2-21: Analog Outputs Schematic



2.6.4. 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 2-22](#).

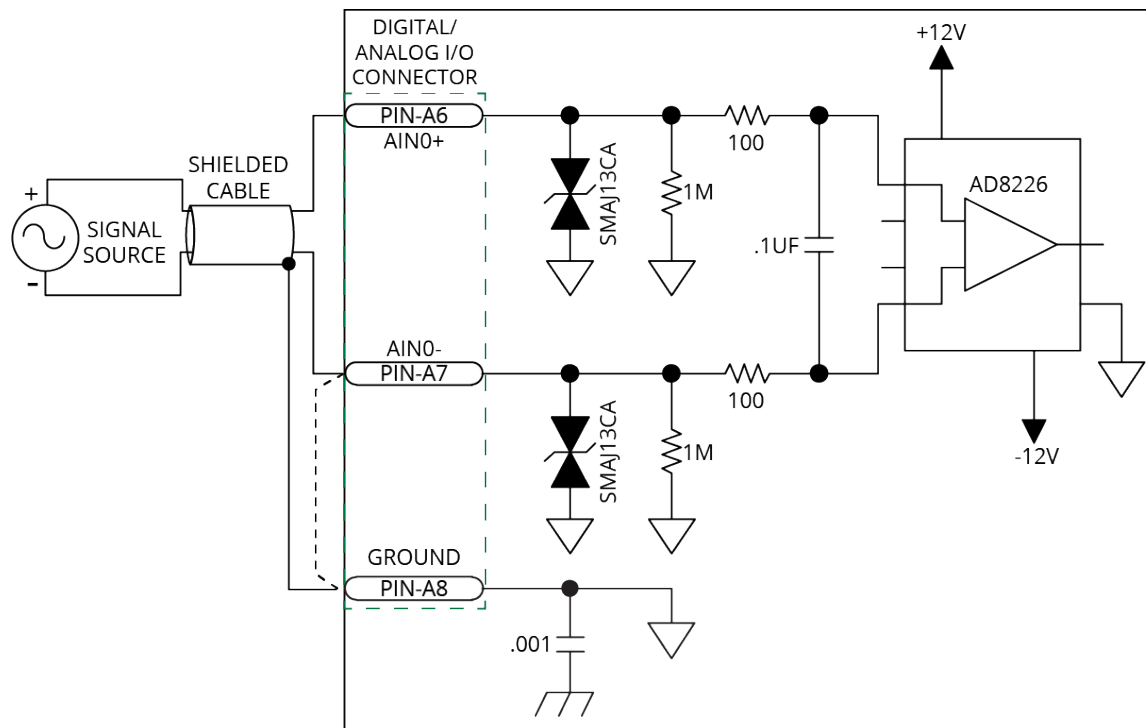
Table 2-31: Analog Input Specifications

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 2-32: Analog Input Pins on the Digital / Analog I/O B Connector

Pin #	Label	Description	In/Out/Bi
6	AI+	Analog Input +	Input
7	AI-	Analog Input -	Input
8	GND	Ground	N/A

Figure 2-22: Analog Inputs Schematic



2.7. Encoder Input Connectors

The GL4 has two auxiliary encoder input 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 drive. You cannot use the auxiliary encoder input channels to close the position loop.

Table 2-33: Encoder Input Specifications

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

Table 2-34: Axis 1 Encoder Input Pinout (Encoder Input Connector A)

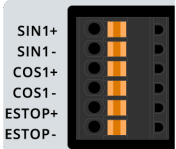
Pin	Label	Description	In/Out/Bi	Connector
1	SIN1+	Encoder SIN+ Input	Input	
2	SIN1-	Encoder SIN- Input	Input	
3	COS1+	Encoder COS+ Input	Input	
4	COS1-	Encoder COS- Input	Input	
5	ESTOP+	Emergency Stop Digital Input +	Input	
6	ESTOP-	Emergency Stop Digital Input -	Input	

Table 2-35: Axis 2 Encoder Input Pinout (Encoder Input Connector B)

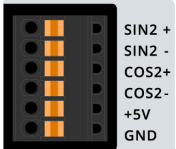
Pin	Label	Description	In/Out/Bi	Connector
1	SIN2+	Encoder SIN+ Input	Input	
2	SIN2-	Encoder SIN- Input	Input	
3	COS2+	Encoder COS+ Input	Input	
4	COS2-	Encoder COS- Input	Input	
5	+5V	+5V Encoder Power	Output	
6	GND	Ground	N/A	

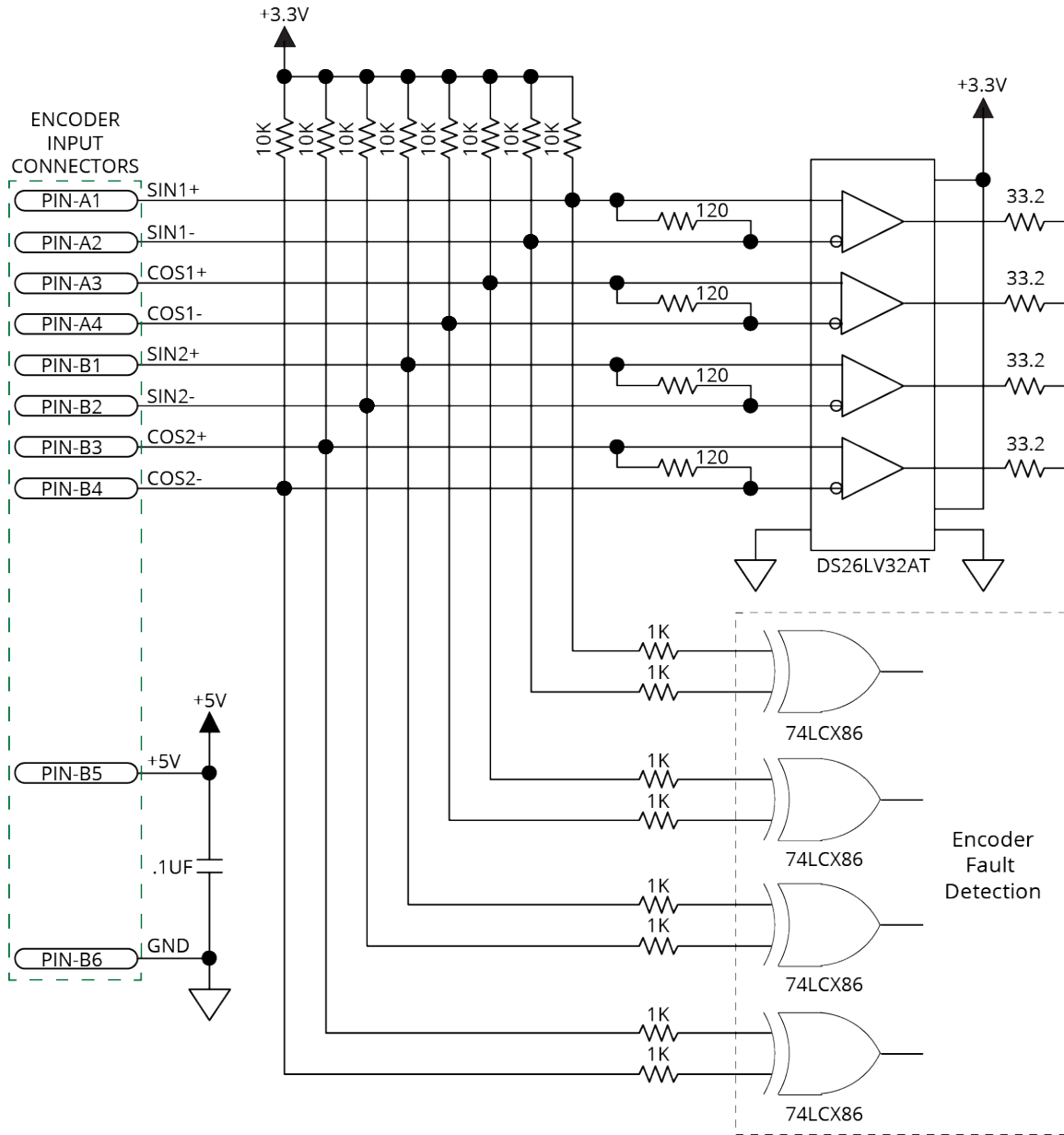
Table 2-36: Mating Connector Part Numbers for the Encoder Input Connectors

Type	Aerotech P/N	Third Party P/N	Wire Size: mm ² [AWG]
6-Pin Terminal Block	ECK02405	Phoenix 1704755	0.5 - 0.14 [20-26]

Table 2-37: GL4 to Drive Cable Part Numbers

Drive Type	Cable P/N
XR3	C26263-xx
XC2/XC2e	C25483-xx
Sync-Supported Drives (for example: XC4, XC4e)	Refer to Section 2.9. Sync Port

Figure 2-23: Encoder Input Connections Schematic



2.7.1. Emergency Stop Sense Input



WARNING: It is your responsibility to assemble the external safety circuits of your system to minimize the risk to the operator.



IMPORTANT: The ESTOP sense input is not a safety-rated system.

Use the ESTOP sense input to monitor the state of an external safety circuit only. The software identifies this state by using the **Emergency Stop Input Level** bit of the Drive Status. To get the software to generate an ESTOP fault when power is removed at the ESTOP input, set the ESTOP bit in the FaultMask parameter.

The ESTOP input is scaled for an input voltage of 5 - 24 volts.

Figure 2-24: ESTOP Sense Input Schematic

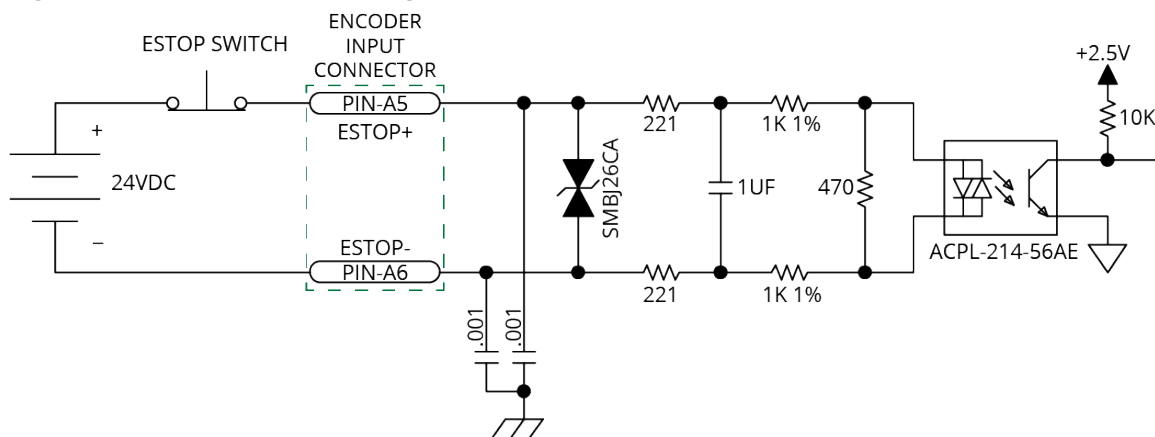


Table 2-38: ESTOP Pins on the Encoder Input Connector

Pin #	Label	Description	In/Out/Bi
5	ESTOP+	Emergency Stop Digital Input +	Input
6	ESTOP-	Emergency Stop Digital Input -	Input



IMPORTANT: If you connect the ESTOP input to a device that makes electrical noise, you must connect an electrical noise suppression device across the switched coil. Refer to [Table 2-39](#) to see the types of devices you can use.

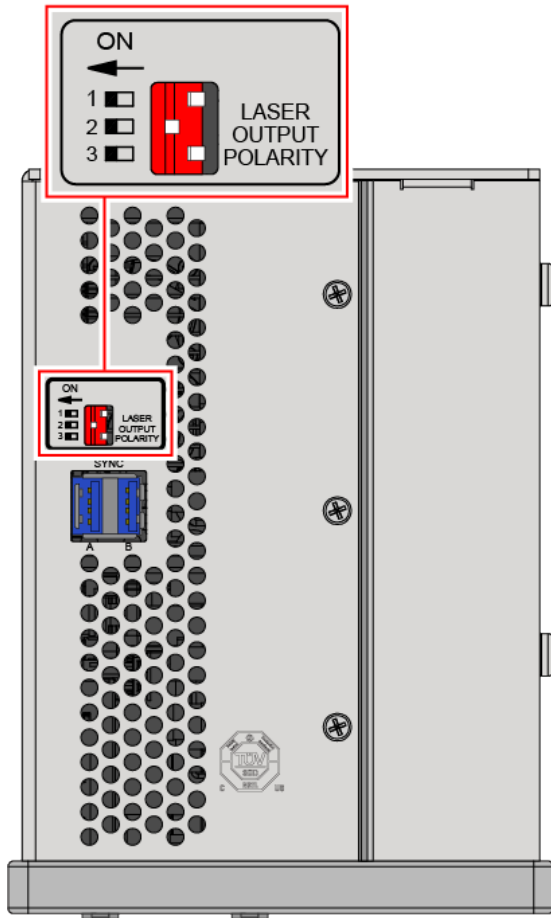
Table 2-39: Electrical Noise Suppression Devices

Device	Aerotech P/N	Third Party P/N
RC (.1uf / 200 ohm) Network	EIC00240	Electrocube RG1782-8
Varistor	EID00160	Littelfuse V250LA40A

2.8. Laser Output Polarity Switches

Use the Laser Output Polarity switches to specify the active laser output polarity. Refer to [Section 2.3](#).

Figure 2-25: Laser Output Polarity Switches



2.9. 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 drive 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 2-40: Sync-Related Functions

Function	Description
DriveEncoderOutputConfigureDivider(), DriveEncoderOutputConfigureInput(), DriveEncoderOutputOn(), DriveEncoderOutputOff() [A3200: ENCODER OUT command]	Configure each Sync port as an input or an output
PsoDistanceConfigureInputs() [A3200: PSOTRACK INPUT command]	Let the PSO to track the SYNC A or SYNC B port.
PsoWindowConfigureInput() [A3200: PSOWINDOW INPUT command]	

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

Table 2-41: 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

2.10. PC Configuration and Operation Information

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

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Chapter 3: Maintenance



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

- Do not remove the cover of the GL4.
- 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.



DANGER: If you must remove the covers and access any internal components be aware of the risk of electric shock.

1. Disconnect the Mains power connection.
2. Wait at least ten (10) minutes after removing the power supply before doing maintenance or an inspection. Otherwise, there is the danger of electric shock.
3. All tests must be done by an approved service technician. Voltages inside the controller and at the input and output power connections can kill you.

Table 3-1: LED Description

LED	Color	Description
PWR	GREEN	The light will illuminate and remain illuminated while power is applied.
EN/FLT	GREEN	The axis is Enabled.
	RED	The axis is in a Fault Condition.
	GREEN/RED (alternates)	The axis is 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 GL4 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 GL4, disconnect the electrical power from the drive.

Use a clean, dry, soft cloth to clean the GL4. 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 drive. 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.

3.2. Board Assembly

Figure 3-1 highlights the important components located on the control board.



DANGER: Before you open the GL4 chassis, you must disconnect the Mains power connection.

Figure 3-1: Control Board Assembly

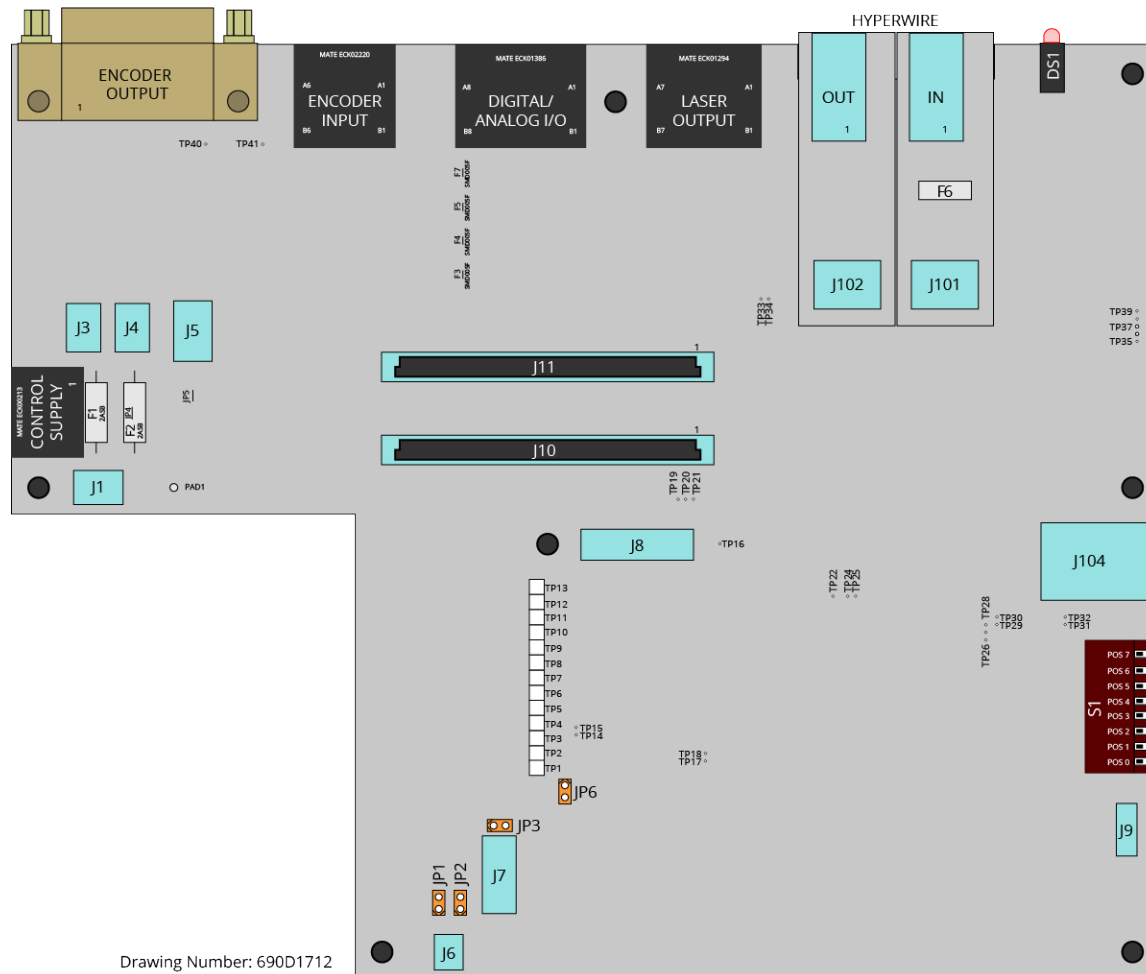


Table 3-4: Control Board Fuse Specifications

Fuse	Description	Size	Aerotech P/N	Third Party P/N
F1	Control Supply Power at Pin-1	2 A S.B.	EIF01048	Littelfuse 0875002.MXEP
F2	Control Supply Power at Pin-1	2 A S.B.	EIF01048	Littelfuse 0875002.MXEP
F6	HyperWire power	--	--	--

NOTE: F6 is a resettable fuse. It is not necessary to replace the fuse. Turn off the power and remove the short circuit.



DANGER: Before you open the GL4 chassis, you must disconnect the Mains power connection.

Figure 3-2: Power Board Assembly

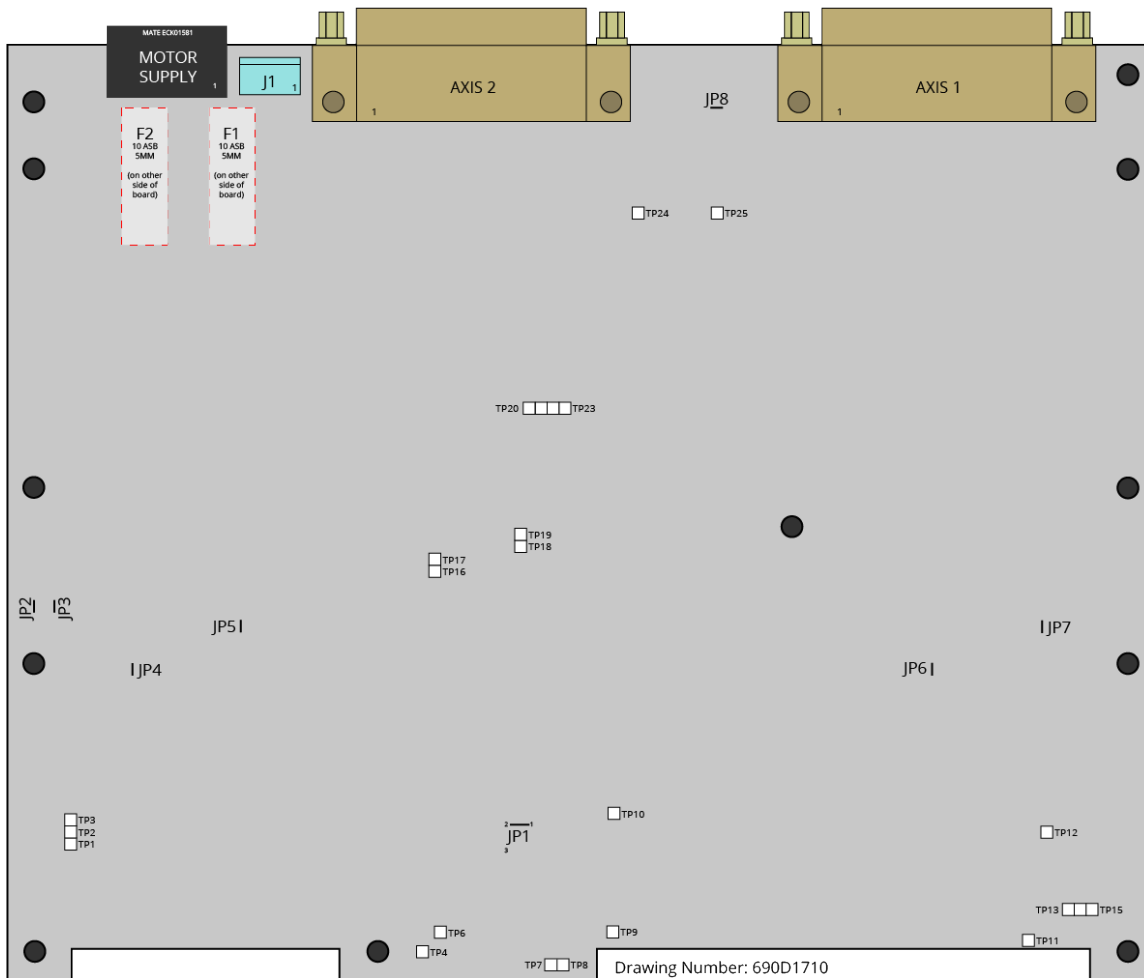


Table 3-5: Power Board Fuse Specifications

Fuse	Description	Size	Aerotech P/N	Third Party P/N
F1	Motor Bus Supply	10 A S.B.	EF01020	Littelfuse 215010.P
F2	Motor Bus Supply	10 A S.B.	EF01020	Littelfuse 215010.P

NOTE: F1 and F2 are on the bottom of the board.

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

Revision	Description
2.02	General update
2.01	The following sections have been updated: <ul style="list-style-type: none">• EU Declaration of Conformity• Agency Approvals
2.00	General update
1.05	Updated Section 1.2 .
1.04	Added cable part numbers: Table 2-37
1.03	Updated to AUTOMATION1 hardware
1.02	Added Table 2-16
1.01	The following sections have been updated: <ul style="list-style-type: none">• General product update• Section 2.1.4.
1.00	New Manual

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Index

	2		
2011/65/EU		7	
2014/35/EU		7	
	A		
Agency Approvals		8	
Altitude		18	
Ambient Temperature		18	
Analog Encoder Inputs (Galvo Motor Connectors)		33	
Analog Encoder Specifications (Galvo Motor Connectors)		33	
Analog Input Pins on the Digital / Analog I/O B Connector		42	
Analog Input Specifications (Digital / Analog I/O B Connector)		42	
Analog Inputs (Digital / Analog I/O B Connector)		42	
Analog Inputs Schematic		42	
Analog Output Pins on the Digital / Analog I/O B Connector		41	
Analog Output Specifications (Digital and Analog I/O Connector)		41	
Analog Outputs (Digital and Analog I/O Connector)		41	
Analog Outputs Schematic		41	
Axis 1 Encoder Input Pinout (Encoder Input Connector A)		43	
Axis 2 Encoder Input Pinout (Encoder Input Connector B)		43	
	B		
Board Assembly		51	
	C		
C25483		43	
C26263		43	
Cables			
HyperWire		23	
Sync Port		47	
cables, examining		50	
Check for fluids or electrically conductive material exposure		50	
Cleaning		50	
Commands			
Sync		47	
connections, examining		50	
Continuous Output Current		15	
			Control and Motor Power Wiring using a TM3 Transformer 22
			Control Board Assembly 51
			Control Board Fuse Specifications 51
			Control Supply 15
			Control Supply Connections 19
			Control Supply Connector 19
			Mating Connector Part Numbers 19
			Wiring Specifications 19
			cooling vents, inspecting 50
			Current Sinking Configuration with Isolation 26
			Current Sinking Configuration without Isolation 26
			Current Sourcing Configuration with Isolation 27
			Current Sourcing Configuration without Isolation 27
			Customer order number 11
			D
			Declaration of Conformity 7
			Digital / Analog I/O Connectors
			Analog Inputs (Differential) 42
			Mating Connector Part Numbers 37
			Digital and Analog I/O Connector
			Analog Outputs 41
			Digital Inputs 40
			Digital Outputs 38
			Digital and Analog I/O Connector A Pinout 37
			Digital and Analog I/O Connector B Pinout 37
			Digital and Analog I/O Connectors 37
			Digital Input Pins (Digital/Analog I/O B Connector) 40
			Digital Input Specifications 40
			Digital Inputs (Digital and Analog I/O Connector) 40
			Digital Inputs Connected to Current Sinking Devices 40
			Digital Inputs Connected to Current Sourcing Devices 40
			Digital Output Pins (Digital/Analog I/O A Connector) 38
			Digital Output Specifications 38
			Digital Outputs (Digital and Analog I/O Connector) 38
			Digital Outputs Connected in Current Sinking Mode 39
			Digital Outputs Connected in Current Sourcing Mode 39
			Dimensions 17
			Drawing number 11
			Drive and Software Compatibility 18
			E
			Electrical Noise Suppression Devices 45

Electrical Specifications	15	Dimensions	17
EMC/CE Compliance	22	Encoder Input Connections Schematic	44
Emergency Stop Sense Input	45	End of Travel Limit Input Connections	34
Enclosure	16	End of Travel Limit Input Schematic	34
Encoder Input Connections Schematic	44	ESTOP Sense Input Schematic	45
Encoder Input Connectors	43	Laser Interface Outputs	25
Mating Connector Part Numbers	43	Laser Output Polarity Switches	46
Encoder Input Specifications	43	Motor Supply Connections	20
Encoder Output Connector	30	Power Board Assembly	52
Mating Connector Part Numbers	30	Thermistor Interface Input Schematic	36
Pinout	30	Third-Party Power Supply Connection	21-22
End of Travel Limit Input Connections	34	TM3 Transformer Control and Power Wiring	22
End of Travel Limit Input Interface	33	TTL Output	28
End of Travel Limit Input Pins on the Galvo Motor Connectors	33	fluids, dangerous	50
End of Travel Limit Interface Input Schematic	34	Functional Diagram	14
End of Travel Limit Phasing	35		
Environmental Specifications	18	G	
ESTOP	45	Galvo Motor Connector	32
ESTOP Pins on the Encoder Input Connector	45	End of Travel Limit Input Interface	33
ESTOP Sense Input Schematic (Encoder Input Connector)	45	Galvo Motor Connectors	
EU 2015/863	7	Analog Encoder Inputs	33
examining parts		Mating Connector Part Numbers	32
cables	50	Pinout	32
connections	50	Thermistor Interface	36
examining, dangerous fluids	50		
examining, dangerous material	50	H	
External Power Supply Options	21	Handling	11
		Humidity	18
F		HyperWire	23
Feature Summary	13	Cable Part Numbers	23
Figure		Card Part Number	23
Analog Inputs Schematic	42		
Analog Outputs Schematic	41	I	
Control Board Assembly	51	IFOV Cable	43
Control Supply Connections	19	Input Power Connections	19
Current Sinking Configuration with Isolation	26	inspecting cooling vents	50
Current Sinking Configuration without Isolation	26	Inspection	50
Current Sourcing Configuration with Isolation	27	Installation and Configuration	19
Current Sourcing Configuration without Isolation	27	Installation Connection Overview	12
Digital Inputs Connected to Current Sinking Devices	40	Installation Overview	12
Digital Inputs Connected to Current Sourcing Devices	40	Introduction	13
Digital Outputs Connected in Current Sinking Mode	39	IP54 Compliant	16
Digital Outputs Connected in Current Sourcing Mode	39		

S

Safety Procedures and Warnings	9
serial number	11
Specifications	
Analog Encoder (Galvo Motor Connectors)	33
Analog Input (Digital / Analog I/O B Connector)	42
Analog Output (Digital and Analog I/O Connector)	41
Control Board Fuses	51
Control Supply Connector Wiring	19
Digital Inputs	40
Digital Outputs	38
Encoder Inputs	43
Laser Outputs	25
Motor Supply Wiring	20
Power Board Fuses	52
PSO	29
Unit Weight	16
Standard Features	13
Storage	11
Sync-Related Commands	47
Sync Port Cables	47
Sync Ports	47
System part number	11

T

Table of Contents	3
Thermistor Interface (Galvo Motor Connectors)	36
Thermistor Interface Input Schematic	36
Thermistor Interface Pins on the Galvo Motor Connectors	36
Third-Party Power Supply Connection	21
TM3 Transformer Control and Power Wiring	22
TTL Output	28

U

Unit Weight	16
Unpacking the Chassis	12
Use	18
User Power Supply Output	15

W

Warranty and Field Service	53
----------------------------	----