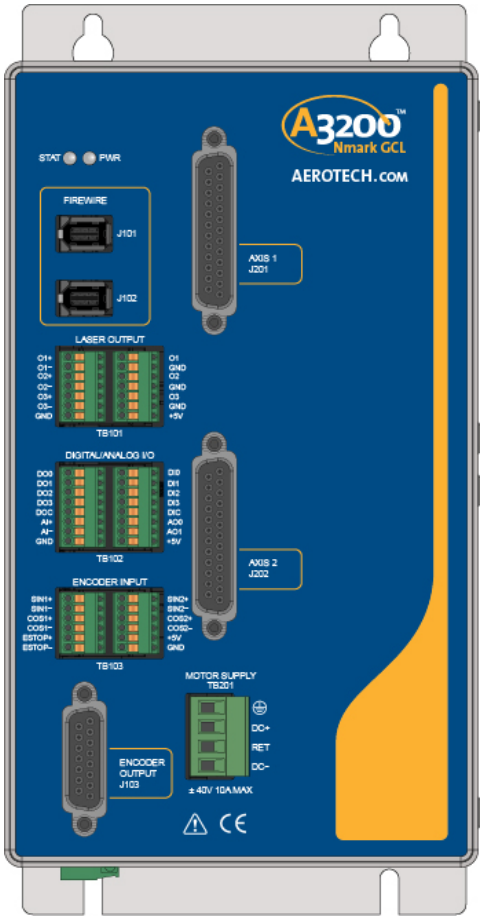
Nmark GCL Hardware Manual

Revision: 1.05.00



Patent Number: US 8,426,768 B2

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EU Declaration of Conformity

Manufacturer	Aerotech, Inc.
Address	101 Zeta Drive Pittsburgh, PA 15238-2811 USA
Product	Nmark GCL
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
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 61010-1:2010	Safety Requirements for Electrical Equipment

Authorized Representative:	Simon Smith, European Director
Address:	Aerotech Ltd The Old Brick Kiln, Ramsdell, Tadley Hampshire RG26 5PR UK
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Position	Engineer Verifying Compliance
Location	Pittsburgh, PA
Date	1/5/2021

CE

Agency Approvals

Aerotech, Inc. Model Nmark GCL drives have been tested and found to be in accordance to the following listed Agency Approvals:

Approval / Certification:	CUS NRTL
Approving Agency:	TUV SUD America Inc.
Certificate #:	U8 16 06 68995 021
Standards:	CAN/CSA-C22.2 No. 61010-1:2012; UL 61010-1:2012; EN 61010-1:2010

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

This manual tells you how to carefully and correctly use and operate the Nmark GCL.

- Read all parts of this manual before you install or operate the Nmark GCL or before you do maintenance to your system.
- To prevent injury to you and damage to the equipment, obey the precautions in this manual.
- Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to www.aerotech.com for the most up-to-date information.

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

This product has been designed for light industrial manufacturing or laboratory environments. The protection provided by the equipment could be impaired if the product is used in a manner not specified by the manufacturer.

DANGER: This product contains potentially lethal voltages. To reduce the possibility of electrical shock, bodily injury, or death the following precautions must be followed.

1. Disconnect electrical power before servicing equipment.
2. Disconnect electrical power before performing any wiring.
3. To minimize the possibility of electrical shock and bodily injury, extreme care must be exercised when any electrical circuits are in use. Suitable precautions and protection must be provided to warn and prevent persons from making contact with live circuits.
4. Refer to local electrical safety requirements to correctly size external system wires.
5. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
6. All components must be properly grounded in accordance with local electrical safety requirements.
7. Operator safeguarding requirements must be addressed during final integration of the product.

WARNING: To minimize the possibility of electrical shock, bodily injury or death the following precautions must be followed.

1. If the product is used in a manner not specified by the manufacturer, the protection provided by the product can be impaired and result in damage, shock, injury, or death.
2. Moving parts can cause crushing or shearing injuries. Access to all stage and motor parts must be restricted while connected to a power source.
3. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
4. Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
5. Operators must be trained before operating this equipment.
6. All service and maintenance must be performed by qualified personnel.

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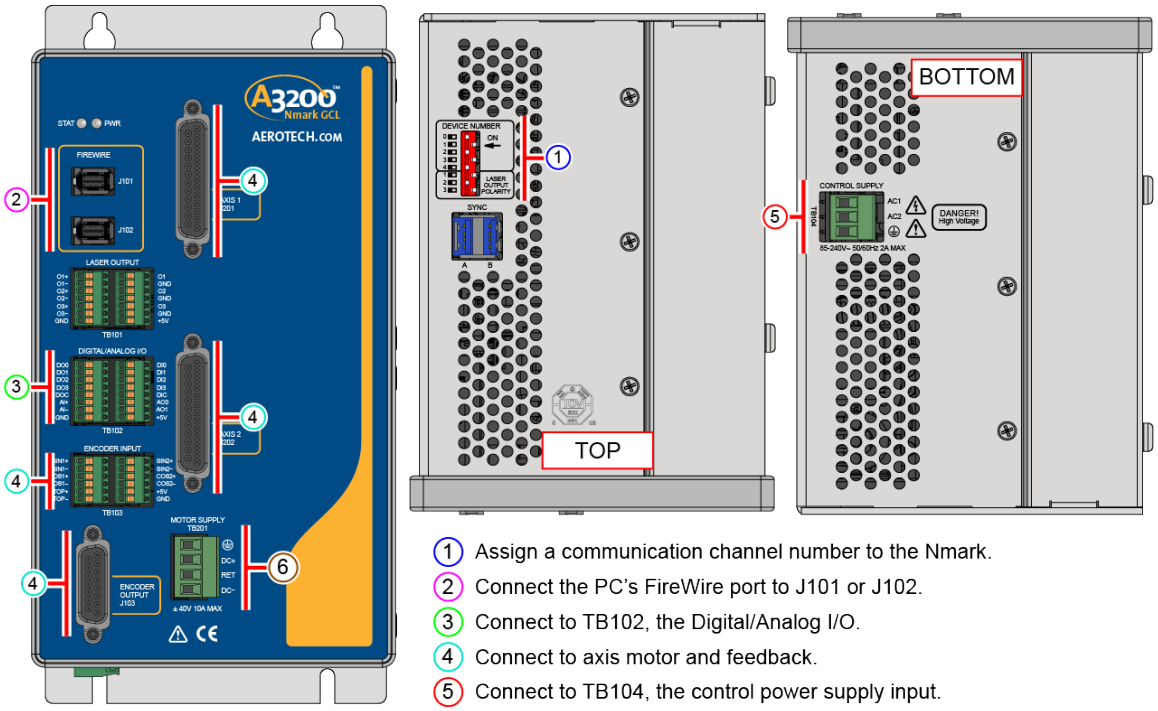
Quick Installation Guide

This chapter describes the order in which connections and settings should typically be made to the Nmark GCL. If a custom interconnection drawing was created for your system (look for a line item on your Sales Order under the heading “Integration”), that drawing can be found on your installation device.



1. Assign a communication channel number to the Nmark.
2. Connect the PC’s FireWire port to J101 or J102.
3. Connect to TB102, the Digital/Analog I/O.
4. Connect to axis motor and feedback.
5. Connect to TB104, the control power supply input.
6. Connect to TB201, the motor supply input.

Device Number	Section 2.1. Communication Channel Settings
FireWire	Section 2.3. FireWire Interface
Digital / Analog I/O	Section 2.7. Digital and Analog I/O (TB102 A/B)
Galvo Connections	Section 2.6. Galvo Connections (J201 and J202)
Control Supply	Section 2.2.1. Control Supply Connections (TB104)
Motor Supply	Section 2.2.2. Motor Supply Connections (TB201)

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Chapter 1: Introduction

Aerotech's Nmark GCL, part of the A3200 product family, is a closed-loop scanner module that allows direct control of galvo scanner servo motion for marking parts of unlimited size and complexity. The Nmark GCL has support for CO2 and YAG lasers and includes Position Synchronized Output (PSO) laser firing based on real-time scanner positional feedback. This allows the marking of large features with continuous motion of the servo axis and simultaneous marking by the scanner.

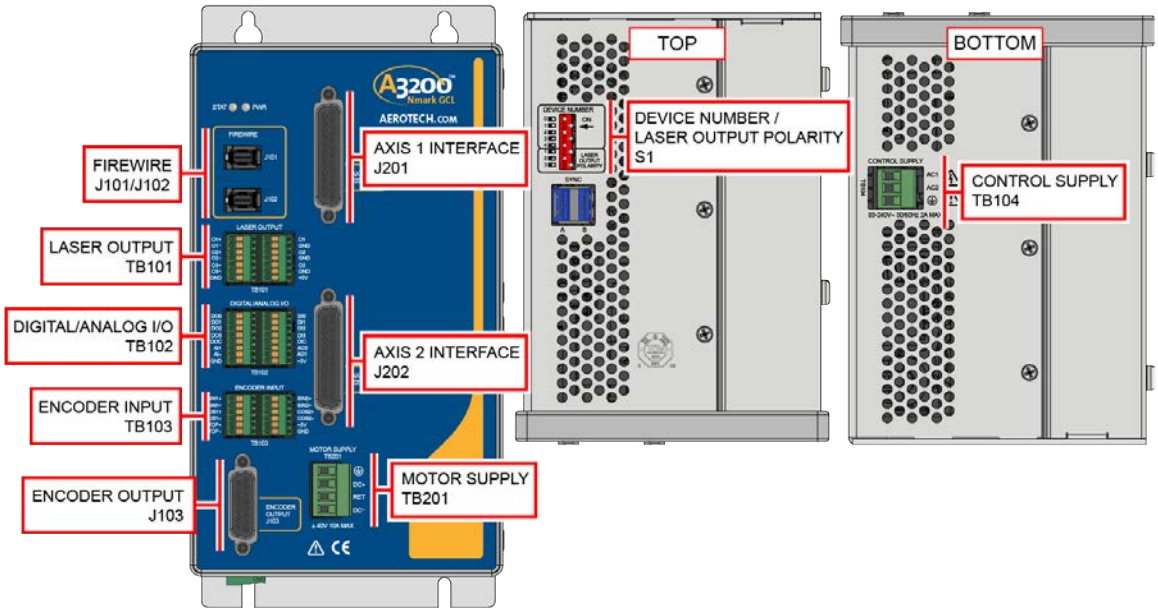


Figure 1-1: Nmark GCL Networked Digital Galvo Controller

Table 1-1: Feature Summary

Standard Features
• 85-240 VAC; 50-60 Hz control supply • ±40 VDC max motor supply • FireWire bus high-speed communications connection • Three TTL laser outputs • Three optically-isolated laser outputs • Dual-Axis PSO firing • Three-axis Part-Speed PSO firing that uses the PSO firing circuit based on the commanded vector velocity of up to three axes. • Two auxiliary channels of 40 MHz line driver quadrature encoder inputs • Four optically-isolated digital outputs; 5-24V • Four optically-isolated digital inputs; 5-24V • Two 16-bit single-ended analog outputs; ±10 V • One 16-bit differential analog input; ±10 V • Dedicated 5-24V Emergency Stop sense input

The following block diagram shows a connection summary (refer to Chapter 2 and Chapter 3 for more detailed connection information).

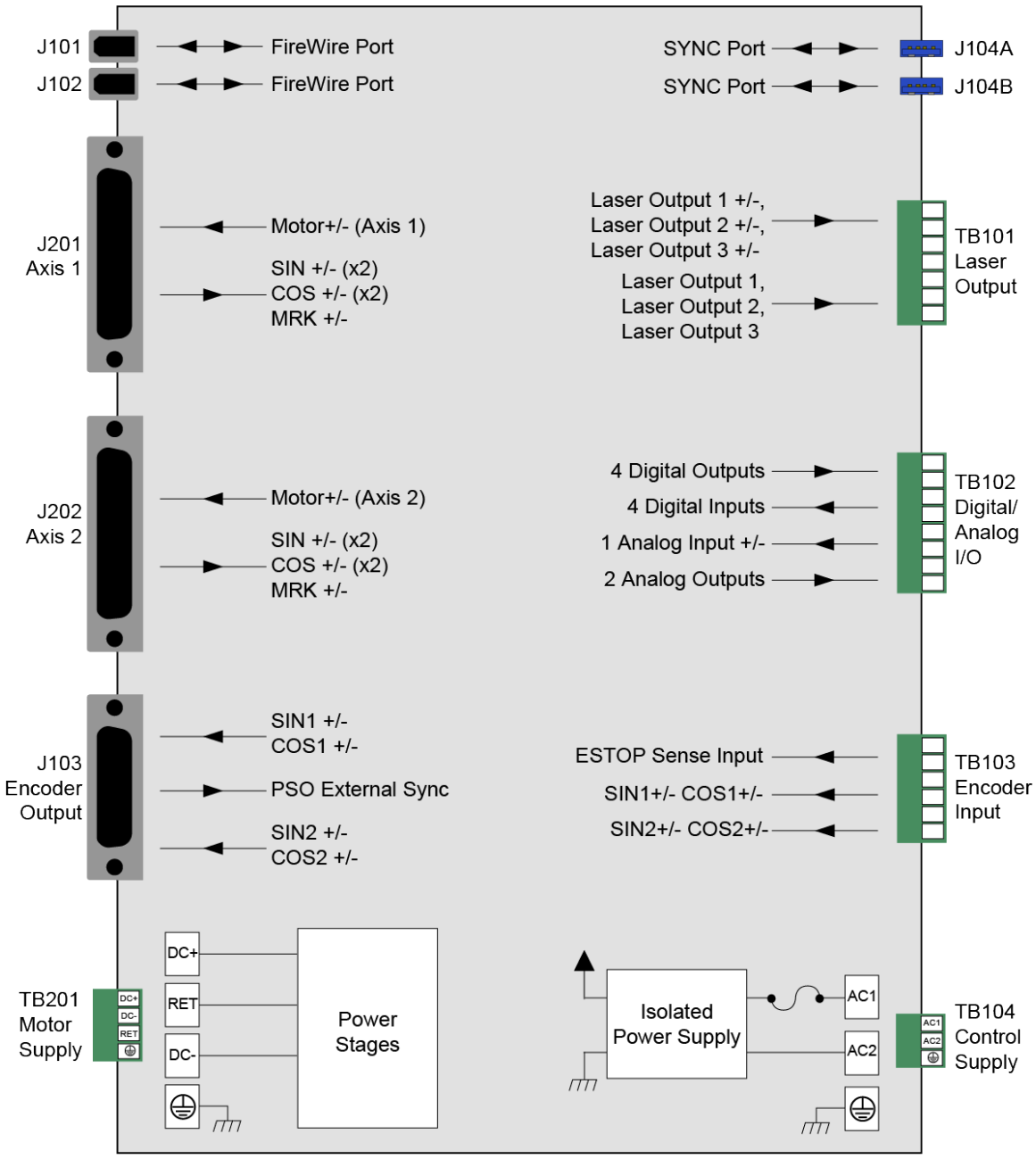


Figure 1-2: Functional Diagram

1.1. Electrical Specifications

The electrical specifications for the Nmark GCL are listed below.

Table 1-2: Electrical Specifications

Description		Nmark GCL
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 Design

The following figure shows the Nmark GCL package dimension as well as the typical mounting orientation.

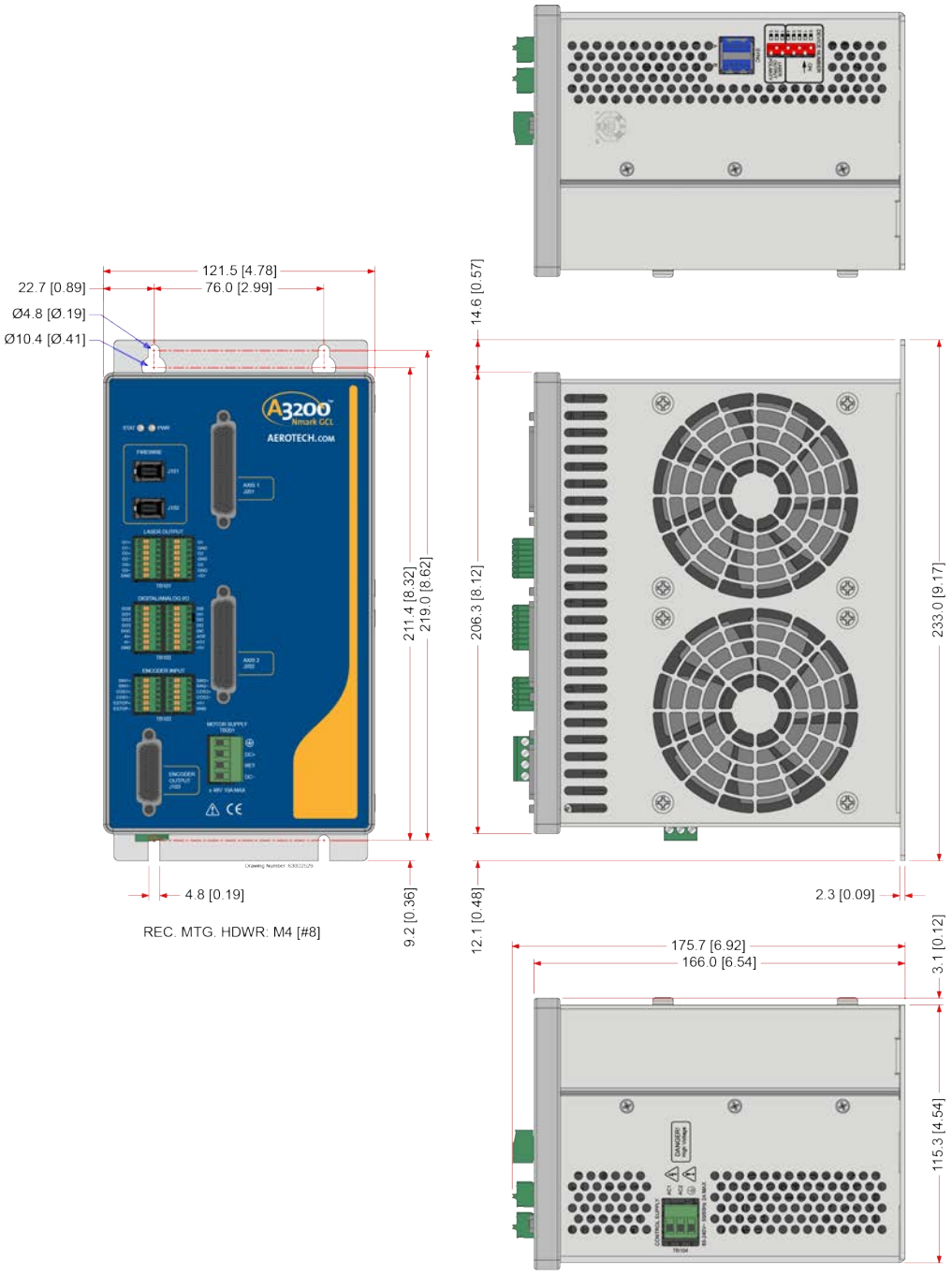


Figure 1-3: Dimensions

Table 1-3: Unit Weight

Weight
2.9 kg [6.4 lb]

1.3. Environmental Specifications

The environmental specifications for the Nmark GCL are listed below.

Ambient Temperature	Operating: 0° to 50°C (32° to 122° F)
	Storage: -30° to 85°C (-22° to 185° F)
Humidity	Maximum relative humidity is 80% for temperatures up to 31°C. Decreasing linearly to 50% relative humidity at 40°C. Non condensing.
Altitude	Operating: 0 m to 2,000 m (0 ft to 6,562 ft) above sea level Contact Aerotech if your specific application involves use above 2,000 m or below sea level.
Pollution	Pollution degree 2 (normally only non-conductive pollution).
Use	Indoor use only

1.4. Drive and Software Compatibility

The following table lists the available drives and which version of the software first supported the drive. Drives that list a specific version number in the **Last Software Version** column will not be supported after the listed version.

Table 1-4: Drive and Software Compatibility

Drive Type	Firmware Revision	First Software Version	Last Software Version
Nmark GCL	-	5.04	Current
	A	6.02	Current

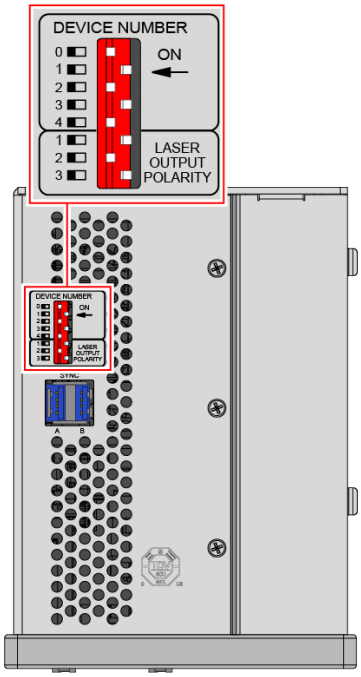
Chapter 2: Installation and Configuration

2.1. Communication Channel Settings

Use the Device Number switches to assign a communication channel number to the Nmark GCL. If you are using multiple drives, each drive must be assigned a unique, sequential communication channel. Since the Nmark GCL is a multi-axis device, the Nmark GCL will automatically claim the next sequential device number. If a two-axis Nmark GCL is set to Device #2, the next drive must be set to Device #4.

NOTE: The drive assigned to the first communication channel number (all switches set to ON) will be configured by the Axis 1 parameters defined in the software. The drive assigned to the second communication channel will be configured by the Axis 2 parameters, etc.

Table 2-1: Device Number Switch Settings

Device #	Switch Settings (Off is indicated by "-")					Switch Location
	4	3	2	1	0	
1	ON	ON	ON	ON	ON	
2	ON	ON	ON	ON	-	
3	ON	ON	ON	-	ON	
4	ON	ON	ON	-	-	
5	ON	ON	-	ON	ON	
6	ON	ON	-	ON	-	
7	ON	ON	-	-	ON	
8	ON	ON	-	-	-	
9	ON	-	ON	ON	ON	
10	ON	-	ON	ON	-	
11	ON	-	ON	-	ON	
12	ON	-	ON	-	-	
13	ON	-	-	ON	ON	
14	ON	-	-	ON	-	
15	ON	-	-	-	ON	
16	ON	-	-	-	-	
17	-	ON	ON	ON	ON	
18	-	ON	ON	ON	-	
19	-	ON	ON	-	ON	
20	-	ON	ON	-	-	
21	-	ON	-	ON	ON	
22	-	ON	-	ON	-	
23	-	ON	-	-	ON	
24	-	ON	-	-	-	
25	-	-	ON	ON	ON	
26	-	-	ON	ON	-	
27	-	-	ON	-	ON	
28	-	-	ON	-	-	
29	-	-	-	ON	ON	
30	-	-	-	ON	-	
31	-	-	-	-	ON	
32	-	-	-	-	-	

2.2. Power Connections

The Nmark GCL has two input power connectors; one for control power (AC) and a second for motor power (DC). For a complete list of electrical specifications, refer to Section 1.1.

2.2.1. Control Supply Connections (TB104)

NOTE: This product requires two power supply connections. The Motor Supply and Control Supply must both be connected for proper operation.

The control power supply input supplies power to the Nmark GCL's communications and logic circuitry. Both AC1 and AC2 inputs are fused internally.

The control power supply contains an internal filter and does not require an external filter for CE compliance.

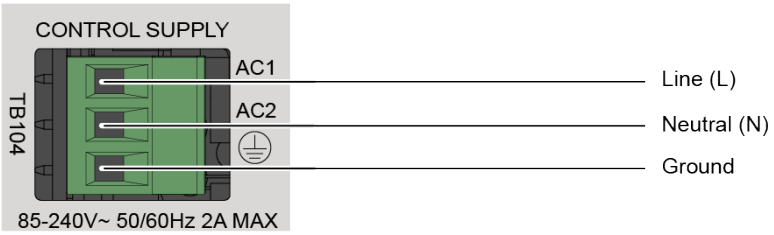


Figure 2-1: Control Supply Connections

Table 2-2: Control Supply Input Wiring (TB104)

Pin	Description	Recommended Wire Size
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 (Required for Safety)	1.3 mm^2 (#16 AWG)

NOTE: Wire insulation rated for 300 V.

Table 2-3: Control Supply Mating Connector (TB104)

Type	Aerotech P/N	Phoenix P/N	Screw Torque Value: Nm	Wire Size: mm^2 [AWG]
3-Pin Terminal Block	ECK00213	1754465	0.5 - 0.6	3.3 - 0.516 [12-30]

2.2.2. Motor Supply Connections (TB201)

NOTE: This product requires two power supply connections. The Motor Supply and Control Supply must both be connected for proper operation.

Motor power is applied to the Nmark GCL at the four terminals of the Motor Supply connector (TB201). The DC+ and DC- inputs are internally fused.

WARNING: Do not operate the Nmark GCL without the safety ground connection in place.

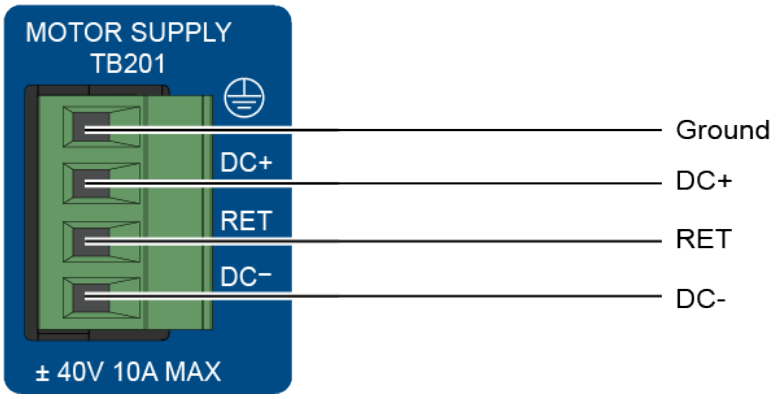


Figure 2-2: Motor Bus Input Connections

Table 2-4: Motor Supply Input Wiring

Pin	Description	Recommended Wire Size
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 (Required for Safety)	2.1 mm^2 (#14 AWG)

NOTE: Wire insulation rated for 300 V.

Table 2-5: Motor Supply Mating Connector (TB201)

Type	Aerotech P/N	Phoenix P/N	Screw Torque Value: Nm	Wire Size: mm^2 [AWG]
4-Pin Terminal Block	ECK01581	1757035	0.5 - 0.6	3.3 - 0.0516 [12-30]

2.2.3. External Power Supply Options

The Nmark GCL requires a bipolar power supply for the motor supply connector TB201. A TM3 can be used to power up to 4 drives as shown in Figure 2-3. Alternatively, two power supplies can be used as long as their output is not ground referenced and are specified to be used in either positive or negative polarity (refer to Figure 2-4). The Nmark GCL controller is capable of sourcing 10 A peak to each motor. This current must be supplied by the external power supply. Switching power supplies must be rated for the peak current requirement of the application since they will typically shut down if overloaded.

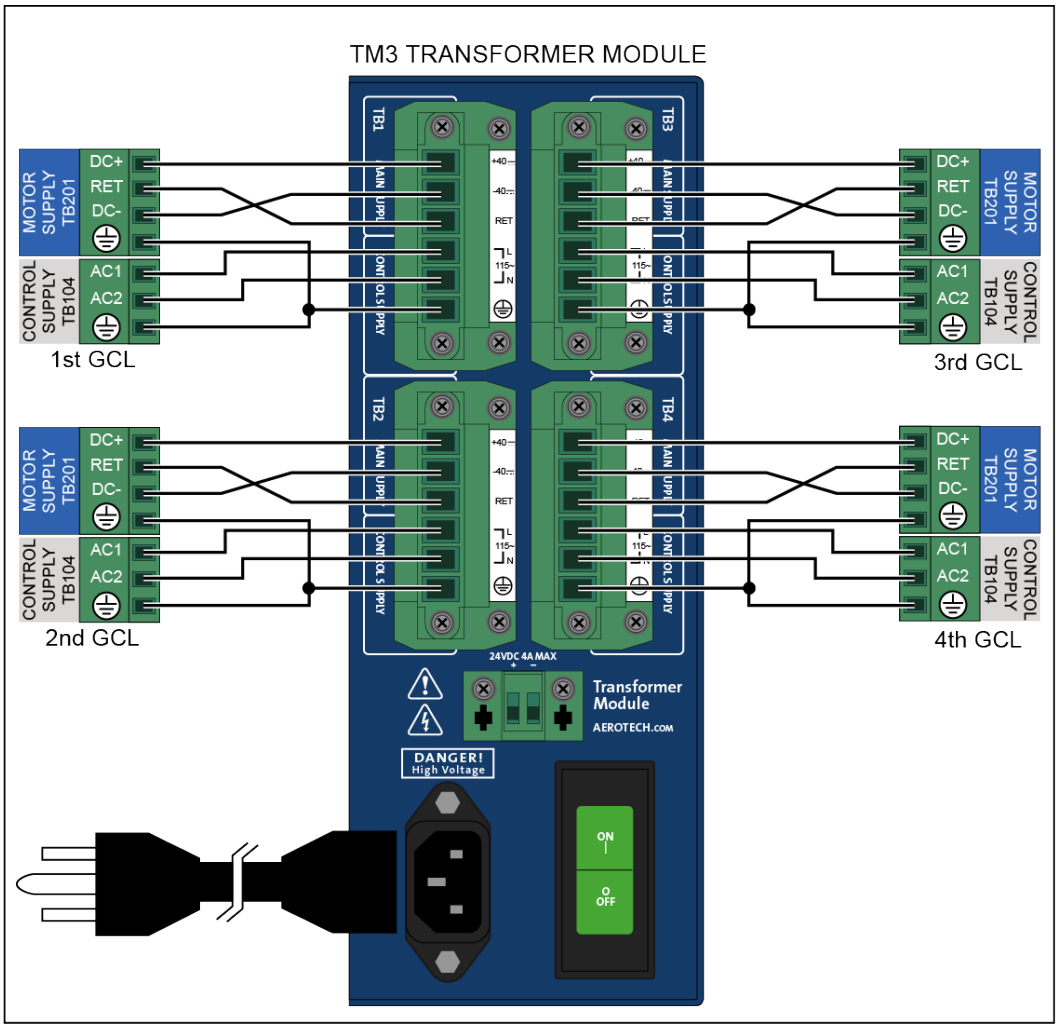


Figure 2-3: Control and Motor Power Wiring using a TM3 Transformer

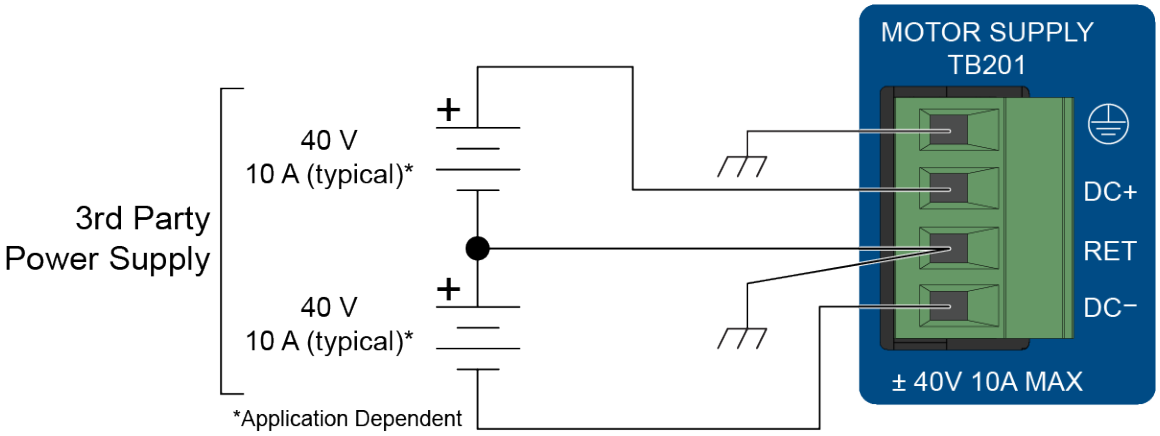


Figure 2-4: Third Party Power Supply Connection

2.2.4. Minimizing Conducted Radiated and System Noise

User connections to the product must be made using shielded cables with metal D-style connectors and back shells. The shield of the cables must be connected to the metal back shell in order for the product to conform to radiated emission standards.

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

2.3. FireWire Interface

The FireWire bus is the high-speed communications connection to the Nmark GCL operating at 400 megabits per second. All command and configuration information is sent via the FireWire port.

Table 2-6: FireWire Card Part Numbers

Part Number	Description
NFIRE-PCI	OHCI compliant FireWire PCI interface card, 3 port
NFIRE-PCIE	OHCI compliant FireWire PCIe x1 interface card, 2 port
NFIRE-PCI-TI-LP	Low Profile, OHCI compliant, PCI
NFIRE-PCIE-GOF	FireWire PCIE X1 Glass Optical Fiber Board

Table 2-7: FireWire Repeaters (for cables exceeding 4.5 m (15 ft) specification)

Part Number	Description
NFIRE-RPTR-1394A-1394A	Extender for copper cable lengths greater than 4.5 m (15 feet).
NFIRE-RPTR-1394A-GOF	Glass Optical Fiber FireWire Repeater, Qty. 1 (Fiber Cable not included)

Table 2-8: FireWire Cables (copper and glass fiber)

Part Number	Description
NCONNECT-60	6 m (20 ft) long, 6 pin to 6 pin
NCONNECT-45	4.5 m (15 ft) long, 6 pin to 6 pin
NCONNECT-30	3 m (10 ft) long, 6 pin to 6 pin
NCONNECT-15	1.5 m (5 ft) long, 6 pin to 6 pin
NCONNECT-9	0.9 m (3 ft) long, 6 pin to 6 pin
NCONNECT-10000-GOF	10 m (32.8 ft), glass fiber optical cable
NCONNECT-15000-GOF	15 m (49.2 ft), glass fiber optical cable
NCONNECT-20000-GOF	20 m (65.6 ft), glass fiber optical cable
NCONNECT-30000-GOF	30 m (101.7 ft), glass fiber optical cable

2.4. Laser / PSO Output (TB101)

The Laser Output connector (two 7-pin, terminal block-style connectors) provides connections to the laser control outputs. There are three laser output signals available as optically-isolated or as 5V TTL signals. The optically-isolated outputs can be wired in sourcing or sinking configuration.

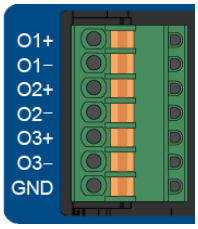
The active polarity of the laser output signals is set using the switches located on the top edge of the Nmark GCL (see Section 2.9.). In the switch “OFF” position, the output is turned on to activate the laser (this is the Normally-Open (N.O.) configuration). The output is considered "ON" when the optically-isolated output is conducting or when the TTL output is 5V.

The opposite polarity (Normally Closed (N.C.)) can be selected by moving the switch to the "ON" position. This state is not maintained while the Nmark is powered off and it is not considered fail-safe.

WARNING: The installer of this product is responsible for providing operator safeguarding measures. Please refer to your laser manual for additional information.

The connector pinout is shown below and the following figures show electrical connection options.

Table 2-9: Laser Output Interface Pinout (TB101 A)

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	--	

(1) Refer to Section 2.4.1. for more information

Table 2-10: Laser Output Interface Pinout (TB101 B)

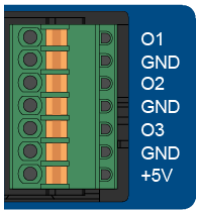
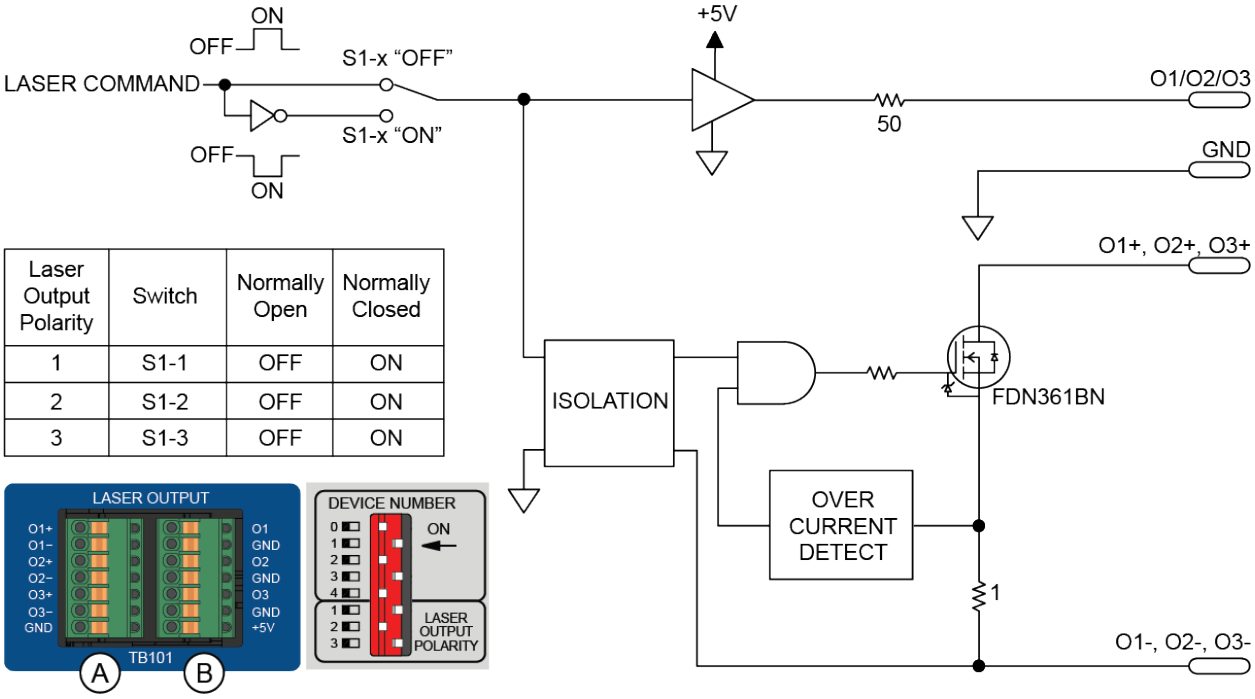
Pin #	Label	Description	In/Out/Bi	Connector
1	O1	Laser Output 1 (5V TTL)	Output	
2	GND	Ground	--	
3	O2	Laser Output 2 (5V TTL)	Output	
4	GND	Ground	--	
5	O3	Laser Output 3 (5V TTL)	Output	
6	GND	Ground	--	
7	+5V	5 Volt Power Supply (500 mA)	Output	

Table 2-11: Laser Interface Connector Mating Connector (TB101)

Type	Aerotech P/N	Phoenix P/N	Wire Size: mm^2 [AWG]
7-Pin Terminal Block	ECK01631	1881370	0.5 - 0.080 [20-28]

Table 2-12: Output Specifications (TB101)

	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



Laser Output Polarity	Switch	Normally Open	Normally Closed
1	S1-1	OFF	ON
2	S1-2	OFF	ON
3	S1-3	OFF	ON

Figure 2-5: Laser Interface Outputs (TB101)

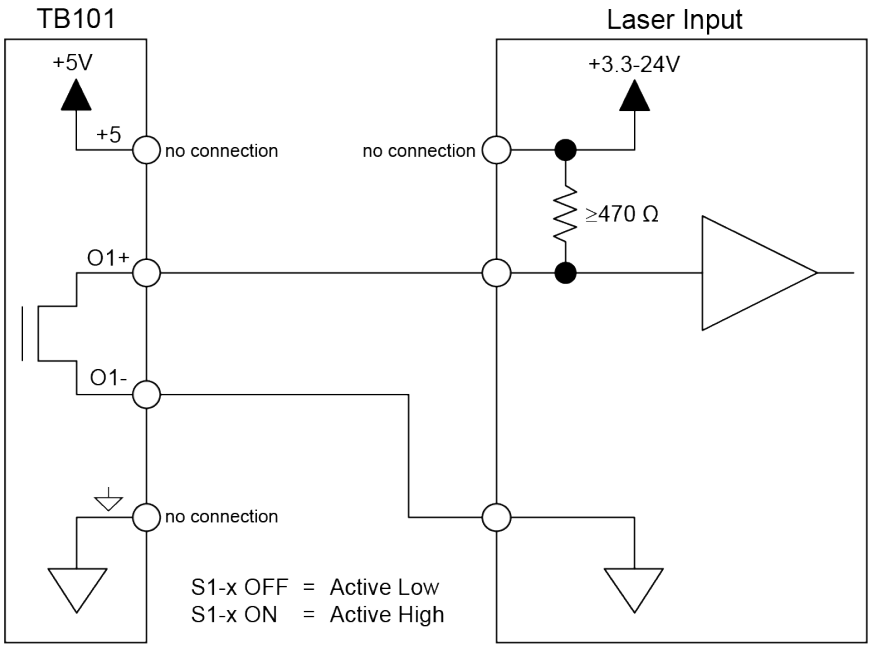


Figure 2-6: Current Sinking Configuration (with Isolation)

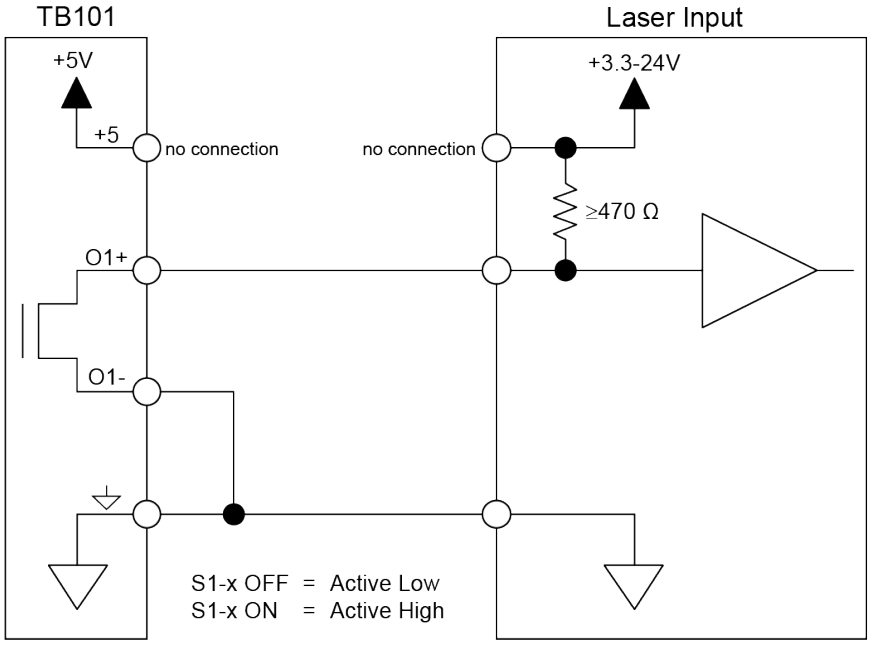


Figure 2-7: Current Sinking Configuration (without Isolation)

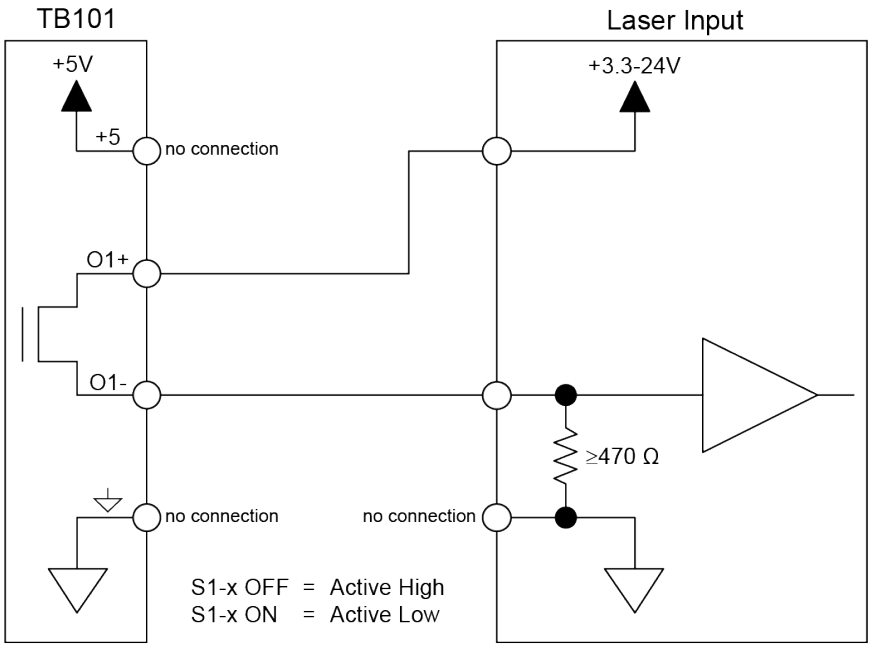


Figure 2-8: Current Sourcing Configuration (with Isolation)

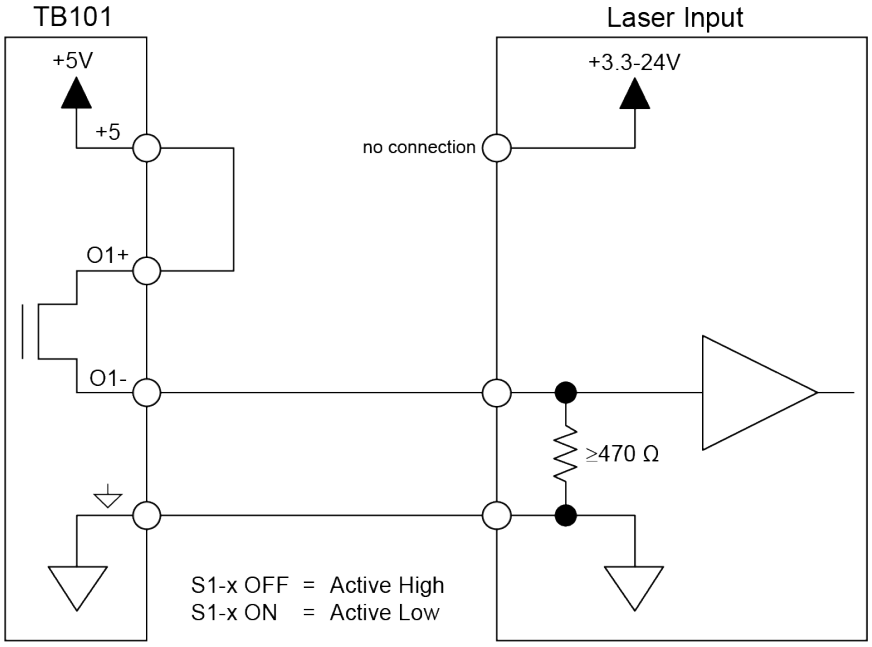


Figure 2-9: Current Sourcing Configuration (without Isolation)

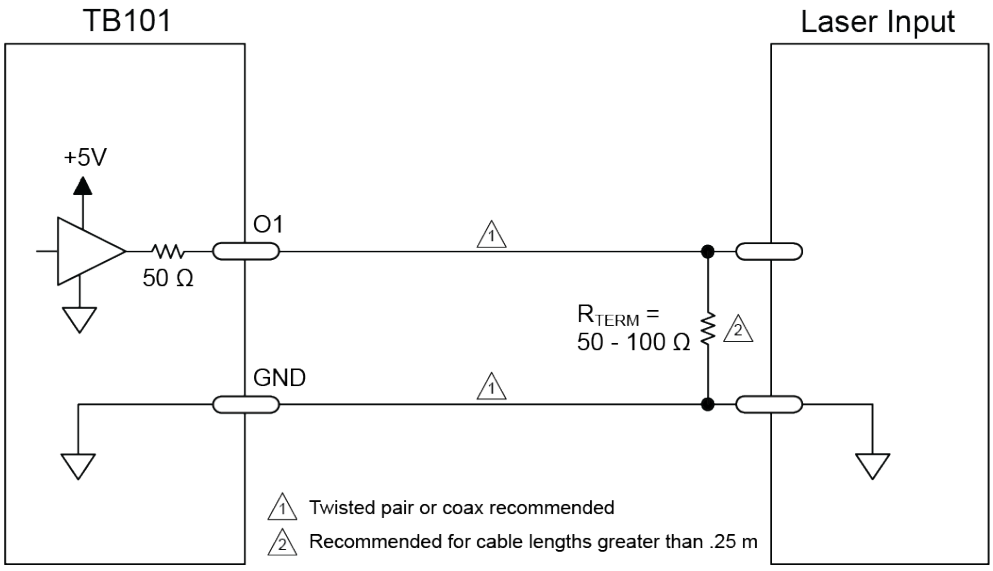


Figure 2-10: TTL Output

2.4.1. Position Synchronized Output (PSO)

The PSO can be programmed to generate an output synchronized to the feedback position and is typically used to fire a laser or sequence an external device. Trigger signals may be derived from a feedback channel or a software trigger. The position synchronized output pulse is generated using high-speed hardware, allowing minimal latency between the trigger condition and the output.

An RS-422 line receiver or opto-isolator is recommended, especially when using long cable lengths in noisy environments or when high frequency pulse transmission is required. It is best to locate the line receiver or opto-isolator close to the receiving electronics.

Table 2-13: PSO Specifications

Specification		Value
Maximum Input Tracking Rate (1)	Single-Axis Tracking	16.6 MHz
	Dual-Axis Tracking	15 MHz
Maximum Quadrature Encoder Output Frequency	-MXH Feedback	30 MHz
Maximum PSO Output (Fire) Frequency (2)	Isolated	5 MHz
	TTL	12.5 MHz
Firing Latency	Single-Axis Tracking	80 nsec
	Dual-Axis Tracking	110 nsec

1. Signals in excess of this rate will cause a loss of PSO accuracy.
2. The optocoupler that you use on the output might have an effect on this rate.

Table 2-14: PSO Output Pinout TB101 (A)

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

2.5. Encoder Output (J103)

The Encoder Output interface is used to echo the encoder signals from both axes.

Table 2-15: Encoder Output Connector Pinout (J103)

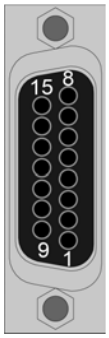
Pin	Description	In/Out/Bi	Connector
1	Axis 1 SIN-	Output	
2	Reserved	--	
3	Axis 1 COS-	Output	
4	Axis 2 SIN-	Output	
5	Axis 2 COS-	Output	
6	Reserved	--	
7	PSO External Sync	Input	
8	+5V	Output	
9	Axis 1 SIN+	Output	
10	Reserved	--	
11	Axis 1 COS+	Output	
12	Axis 2 SIN+	Output	
13	Axis 2 COS+	Output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

Table 2-16: Mating Connector Part Numbers for the Encoder Output Connector (J103)

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

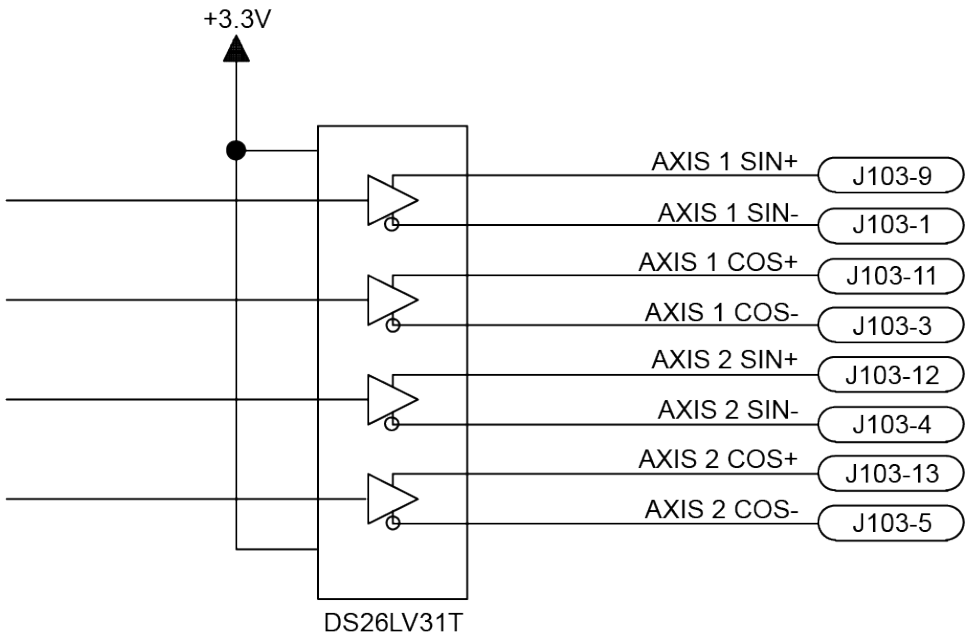


Figure 2-11: Encoder Outputs

Table 2-17: PSO External Sync Specifications

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

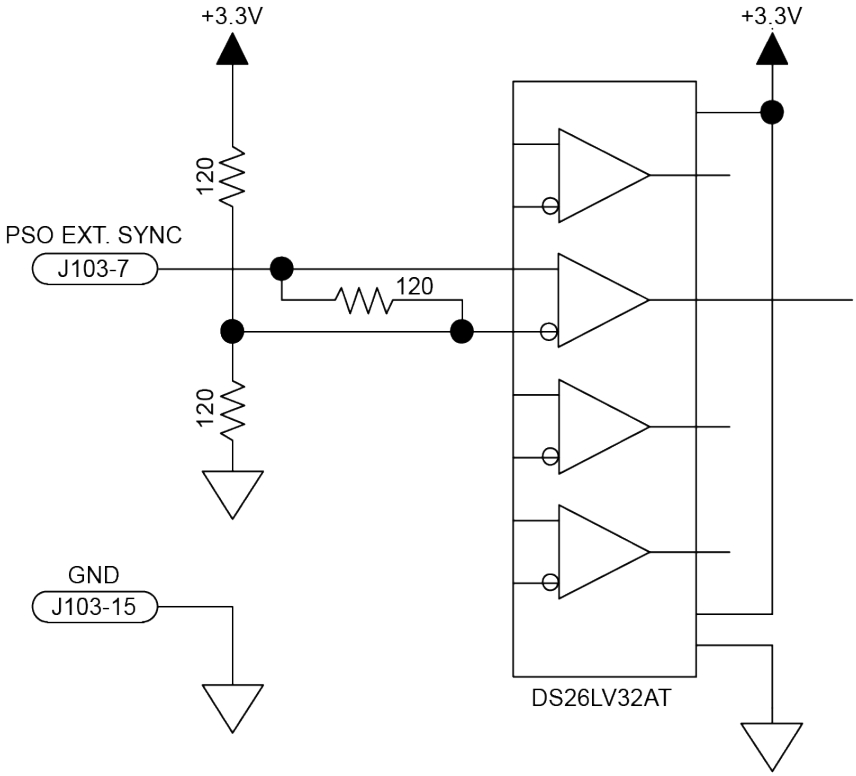


Figure 2-12: PSO External Sync Input

2.6. Galvo Connections (J201 and J202)

Each Galvo connector (a 25-pin, D-style connector) has 2 analog encoder inputs, 5 volt encoder power, and galvo motor connections.

Table 2-18: Galvo Connector Pinout (J201 and J202)

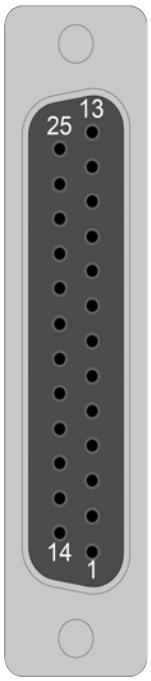
Pin	Description	In/Out/Bi	Pin Location
1	Sine 1+	Input	
2	Cosine 1+	Input	
3	Encoder Ground	--	
4	Sine 2+	Input	
5	Cosine 2+	Input	
6	Clockwise End of Travel Limit	Input	
7	Marker 1+	Input	
8	Encoder Power (+5V, 500 mA)	Output	
9	Motor Over Temperature Thermistor	Input	
10	Flash Configuration	Input	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

Table 2-19: Mating Connector Part Numbers for the Galvo Connector (J201 and J202)

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

2.6.1. Analog Encoder Inputs (J201 and J202)

The Nmark GCL is equipped with two analog encoder input channels per Galvo connector that are used for position feedback.

Each channel's gain, offset, and phase balance of the analog Sine and Cosine encoder input signals can be adjusted by controller parameters. Encoder signals for each channel should be adjusted using the Feedback Tuning tab of the Digital Scope utility, which will automatically adjust the encoder parameters for optimum performance (refer to the A3200 Help file for more information).

Table 2-20: Analog Encoder Specifications

Specification	Value
Input Frequency (max)	500 kHz
Input Amplitude(1)	0.6 to 1.2 Vpk-Vpk
Interpolation Factor (fixed)	262,144
1. Any single-ended encoder signal measured with respect to ground.	

2.6.2. Galvo Motor Connection (J201 and J202)

The Nmark GCL is designed to control the AGV Galvo motors which operate as DC Brush motors over a limited travel. The GCL must be factory-configured for the motor and cannot be used with any other motor types.

2.6.3. 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. All of the end-of-travel limit inputs accept 0-5 VDC level signals. Limit directions are relative to the encoder polarity in the diagnostics display (refer to Figure 1-1).

Table 2-21: End of Travel Limit Input Interface Pinout

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

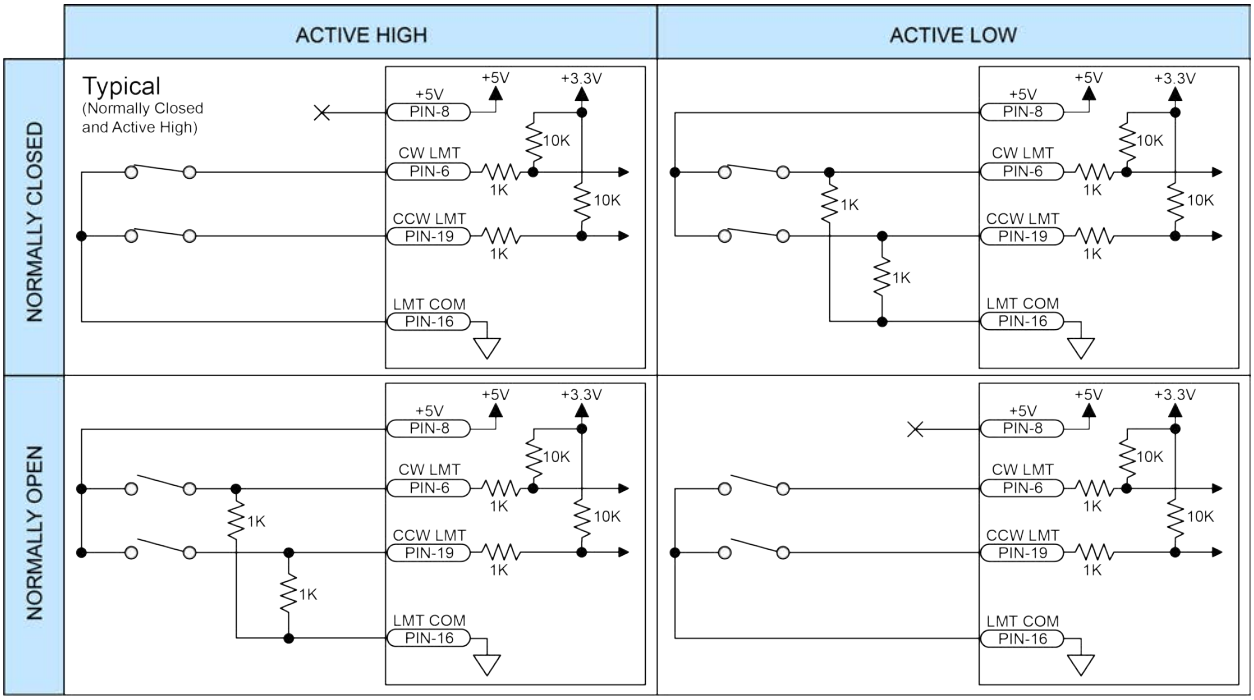


Figure 2-13: End of Travel Limit Input Connections

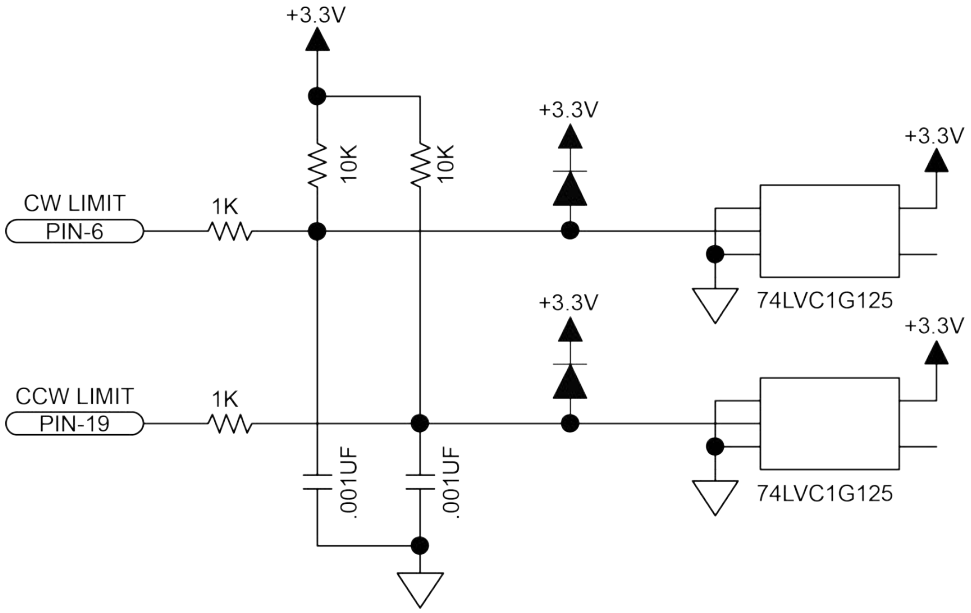


Figure 2-14: End of Travel Limit Interface Input

2.6.3.1. 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. The logic level of the EOT limit inputs may be viewed in the diagnostic display (shown in Figure 2-15).

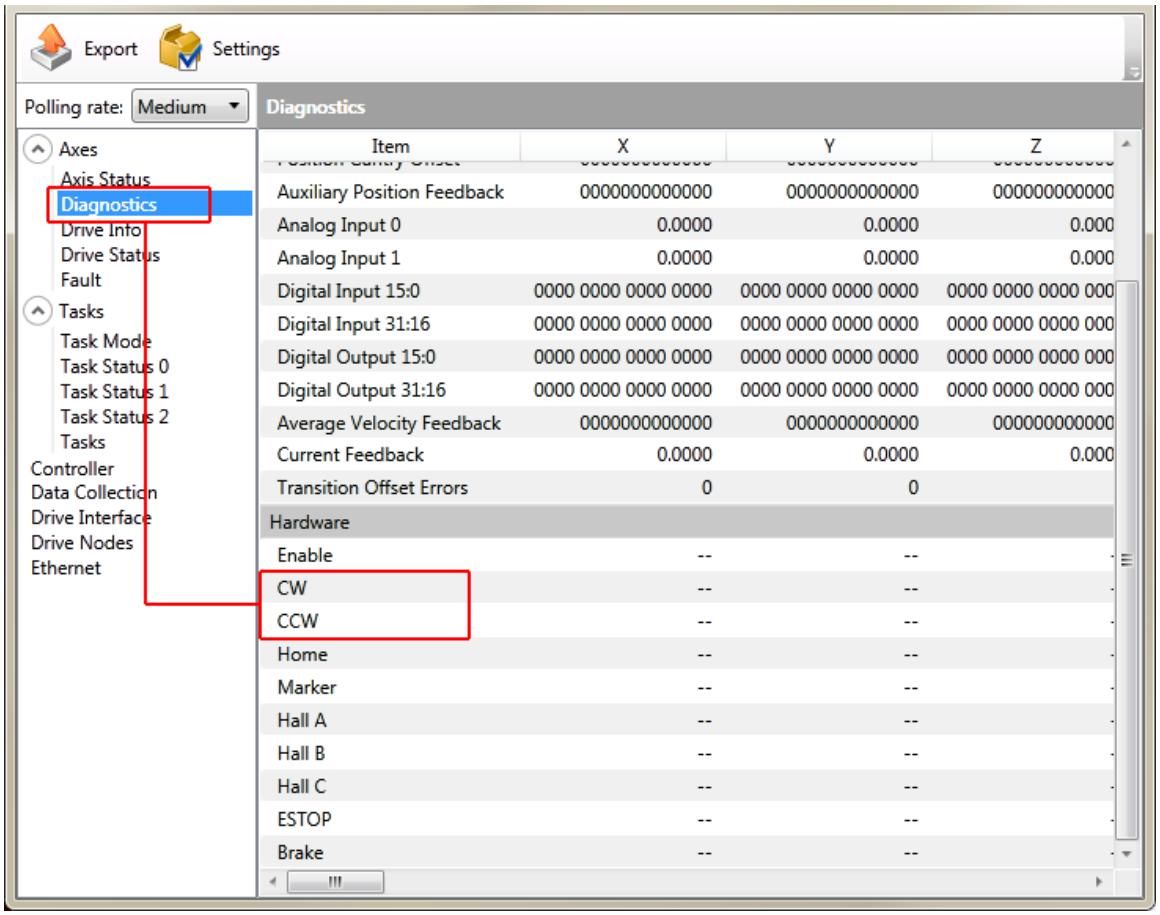


Figure 2-15: Limit Input Diagnostic Display

2.6.4. Thermistor Interface

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 (i.e., 10 kΩ) 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 2-22: Thermistor Interface Pinout

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

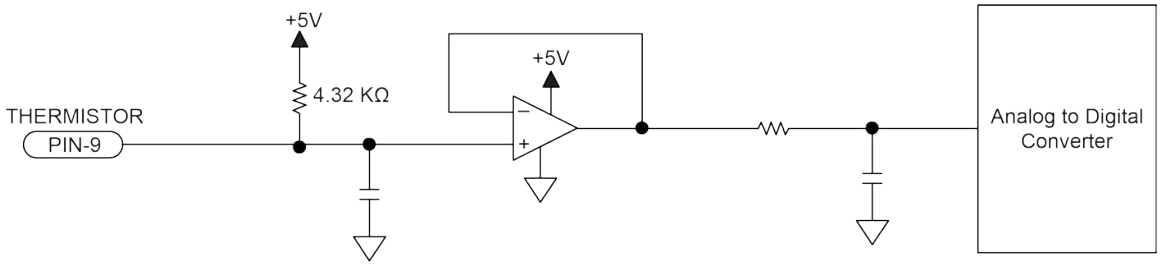


Figure 2-16: Thermistor Interface Input

2.7. Digital and Analog I/O (TB102 A/B)

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

Table 2-23: Digital Outputs and Differential Analog Input Pinout (TB102 A)

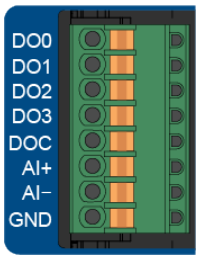
Pin #	Label	Description	In/Out/Bi	Connector
1	DO0	Digital Output 0 (Optically-Isolated)	Output	
2	DO1	Digital Output 1 (Optically-Isolated)	Output	
3	DO2	Digital Output 2 (Optically-Isolated)	Output	
4	DO3	Digital Output 3 (Optically-Isolated)	Output	
5	DOC	Digital Output Common	Input	
6	AI+	Analog Input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

Table 2-24: Digital Inputs and Analog Output Pinout (TB102 B)

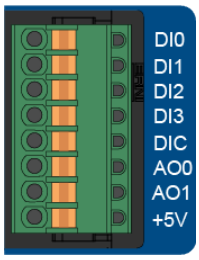
Pin #	Label	Description	In/Out/Bi	Connector
1	DI0	Digital Input 0 (Optically-Isolated)	Input	
2	DI1	Digital Input 1 (Optically-Isolated)	Input	
3	DI2	Digital Input 2 (Optically-Isolated)	Input	
4	DI3	Digital Input 3 (Optically-Isolated)	Input	
5	DIC	Digital Input Common	Input	
6	AO0	Analog Output 0	Output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

Table 2-25: Mating Connector Part Numbers for the Digital and Analog I/O (TB102 A/B)

Mating Connector	Aerotech P/N	Phoenix P/N	Wire Size: mm^2 [AWG]
8-Pin Terminal Block	ECK01386	1881383	0.5 - 0.080 [20-28]

2.7.1. Digital Outputs (TB102 A)

The digital outputs are optically-isolated and can be connected in sourcing or sinking configurations. The digital outputs are designed to connect to other ground referenced circuits and are not intended to provide high-voltage isolation.

Outputs must be connected in either all sinking or all sourcing mode. Figure 2-17 and Figure 2-18 illustrate how to connect to an output in current sinking and current sourcing mode, respectively.

The opto-isolator's common connections can be directly connected to the drive's power supply; however, doing so will effectively defeat the isolation and will reduce noise immunity.

NOTE: The outputs are protected by resettable thermal fuses. If there is an overload, removing the overload will reset the fuse.

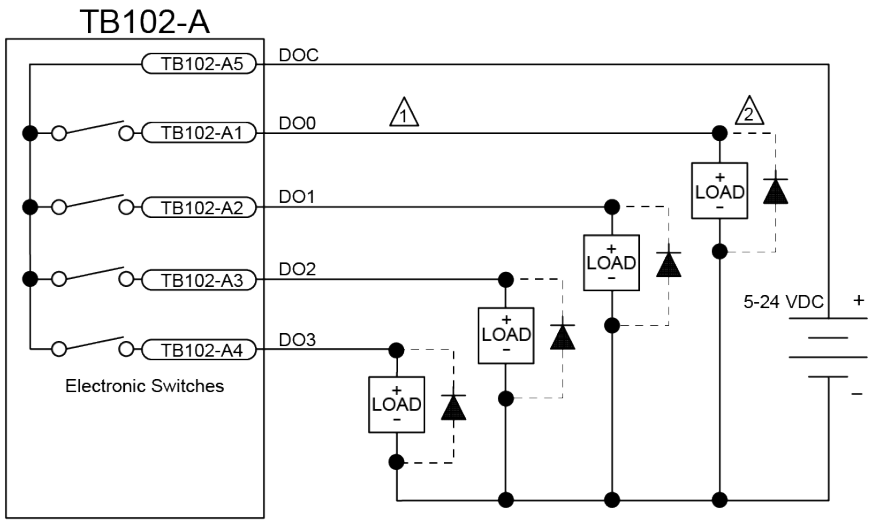
Table 2-26: Digital Outputs Pinout (TB102 A)

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	Input

Table 2-27: Digital Output Specifications (TB102)

Opto Device 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 usec (2K pull up to 24V)
Reset State	Output Off (High Impedance State)

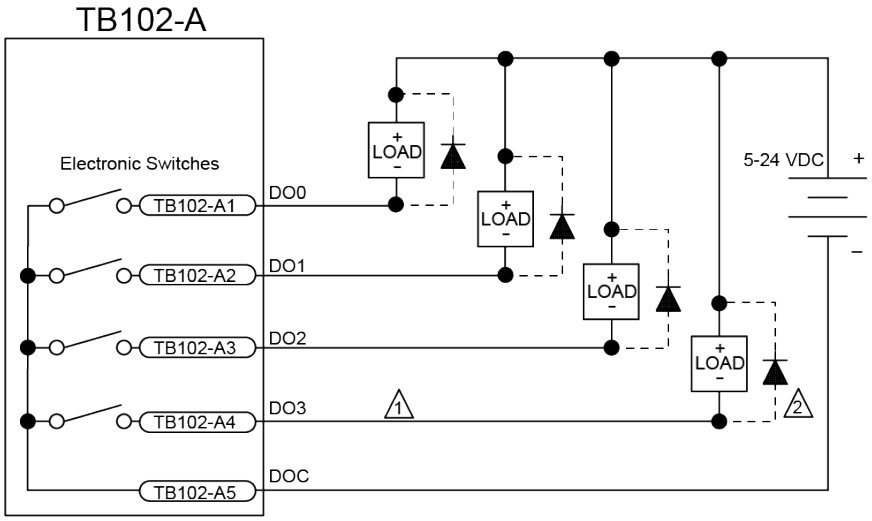
Suppression diodes must be installed on outputs driving relays or other inductive devices. This protects the outputs from damage caused by inductive spikes. Suppressor diodes, such as the 1N914, can be installed on all outputs to provide protection. It is important that the diode be installed correctly (normally reversed biased). Refer to Figure 2-18 for an example of a current sinking output with diode suppression and Figure 2-17 for an example of a current sourcing output with diode suppression.



1 Each output 50 mA maximum

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

Figure 2-17: Outputs Connected in Current Sourcing Mode



1 Each output 50 mA maximum

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

Figure 2-18: Outputs Connected in Current Sinking Mode

2.7.2. Digital Inputs (TB102 B)

The digital inputs are opto-isolated and may be connected to current sourcing or current sinking devices, as shown in Figure 2-19 and Figure 2-20. These inputs are designed to connect to other ground-referenced circuits and are not intended for high-voltage isolation.

The opto-isolator's common connections can be directly connected to the drive's power supply; however, doing so will effectively defeat the isolation and will reduce noise immunity.

Table 2-28: Digital Input Specifications

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

Table 2-29: Digital Inputs Pinout (TB102 B)

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

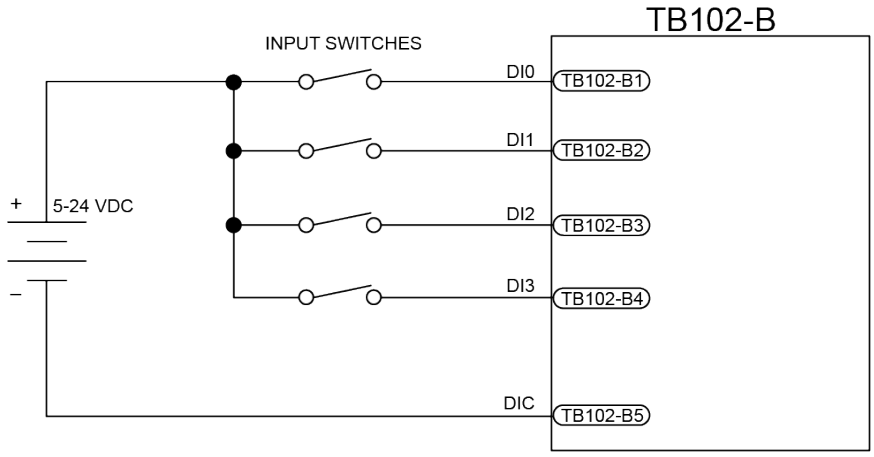


Figure 2-19: Inputs Connected to a Current Sourcing Device

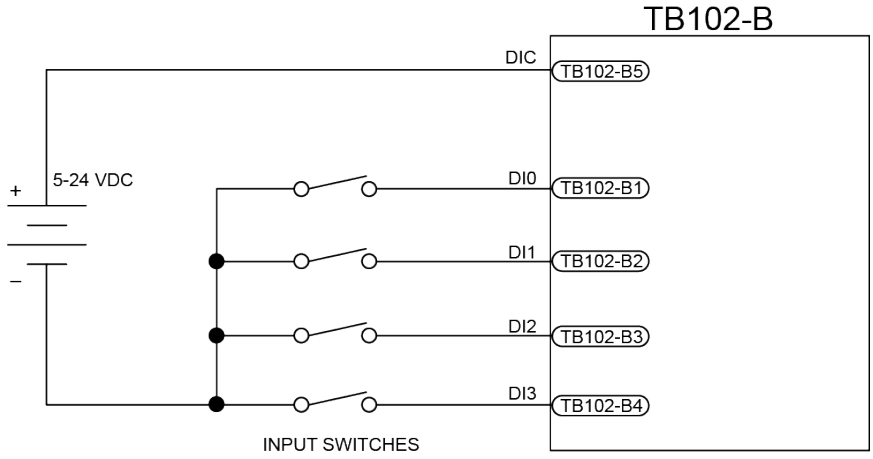


Figure 2-20: Inputs Connected to a Current Sinking Device

2.7.3. Analog Outputs (TB102 B)

The analog output is set to zero when power is first applied to the system or during a system reset.

Table 2-30: Analog Output Pinout (TB102 B)

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

Table 2-31: Analog Output Specifications (TB102 B)

Specification	Value
Output Voltage	-10 V to +10 V
Output Current	5 mA
Resolution (bits)	16 bits
Resolution (volts)	305 µV

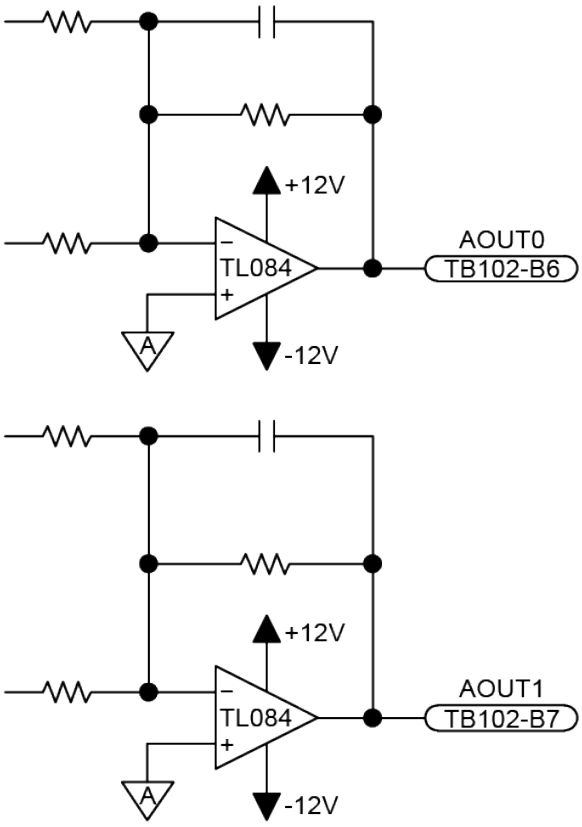


Figure 2-21: Analog Outputs (TB102 B)

2.7.4. Differential Analog Input (TB102 A)

To interface to a single-ended (non-differential) voltage source, connect the signal common of the source to the negative input and the analog source signal to the positive input. A floating signal source should be referenced to the analog common as shown in Figure 2-22.

Table 2-32: Analog Input Pinout (TB102 A)

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

Table 2-33: Differential Analog Input Specifications (TB102 A)

Specification	Value
(AI+) - (AI-)	+10 V to -10 V (1)
Resolution (bits)	16 bits
Resolution (volts)	305 µV
1. Signals outside of this range may damage the input	

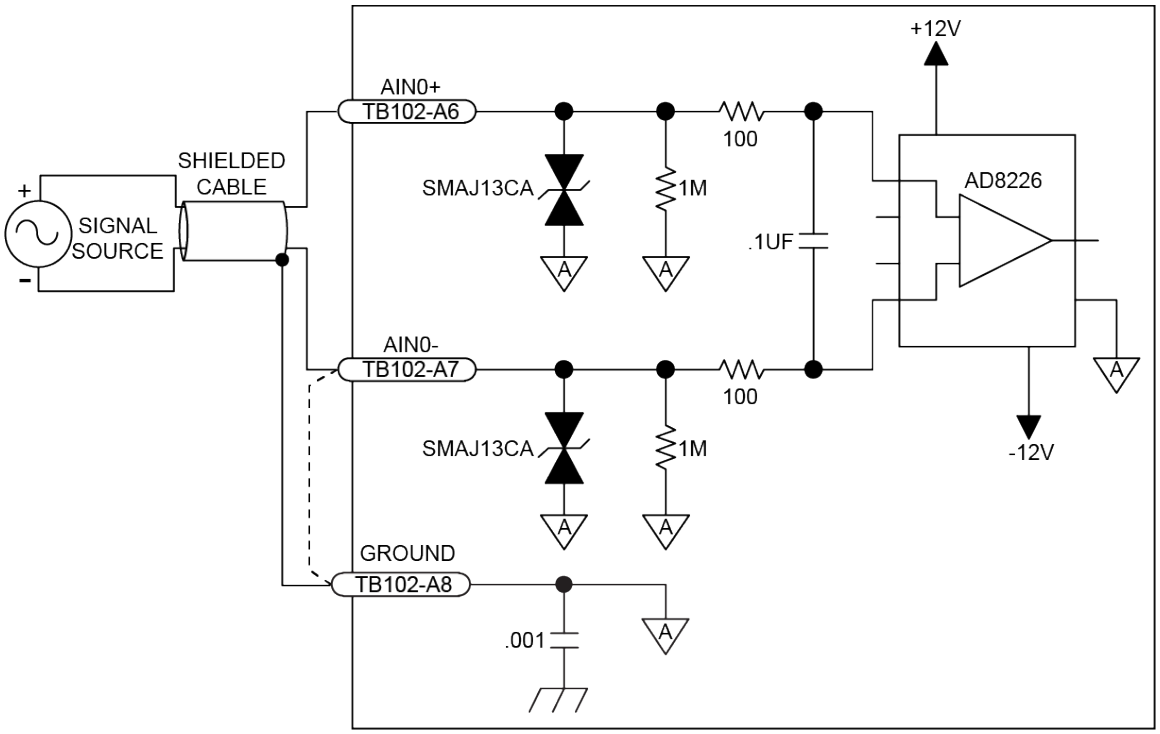


Figure 2-22: Analog Inputs (TB102)

2.8. Encoder Input (TB103)

The Nmark GCL is equipped with two auxiliary encoder input channels that are accessible through TB103A/B. The encoder interfaces accept an RS-422 differential line driver.

The auxiliary encoder input channels cannot be used for closing the position loop. They are intended to be used with the Infinite Field of View and the Marking on the Fly functionality of the Nmark GCL.

Table 2-34: Encoder Input Specifications (TB103)

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

Table 2-35: Axis 1 Encoder Input Pinout (TB103A)

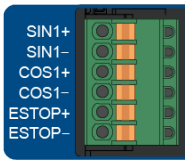
Pin	Label	Description	In/Out/Bi	Connector
1	SIN1+	Encoder SIN+ Input	Input	
2	SIN1-	Encoder SIN- Input	Input	
3	COS1+	Encoder COS+ Input	Input	
4	COS1-	Encoder COS- Input	Input	
5	ESTOP+	Emergency Stop Digital Input +	Input	
6	ESTOP-	Emergency Stop Digital Input -	Input	

Table 2-36: Axis 2 Encoder Input Pinout (TB103B)

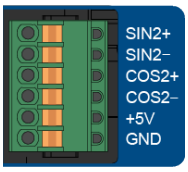
Pin	Label	Description	In/Out/Bi	Connector
1	SIN2+	Encoder SIN+ Input	Input	
2	SIN2-	Encoder SIN- Input	Input	
3	COS2+	Encoder COS+ Input	Input	
4	COS2-	Encoder COS- Input	Input	
5	+5V	+5V Encoder Power	Output	
6	GND	Ground	--	

Table 2-37: Mating Connector Part Numbers for the Encoder Interface Connector (TB103 A/B)

Type	Aerotech P/N	Phoenix P/N	Wire Size: mm^2 [AWG]
6-Pin Terminal Block	ECK02220	1881367	0.5 - 0.080 [20-28]

Table 2-38: Nmark GCL to Drive Cable Part Numbers

Drive Type	Cable P/N
Ndrive CP, HPe, or HLe	C25481-xx
Ndrive MP, ML	C25483-xx
Npaq	C25482-xx

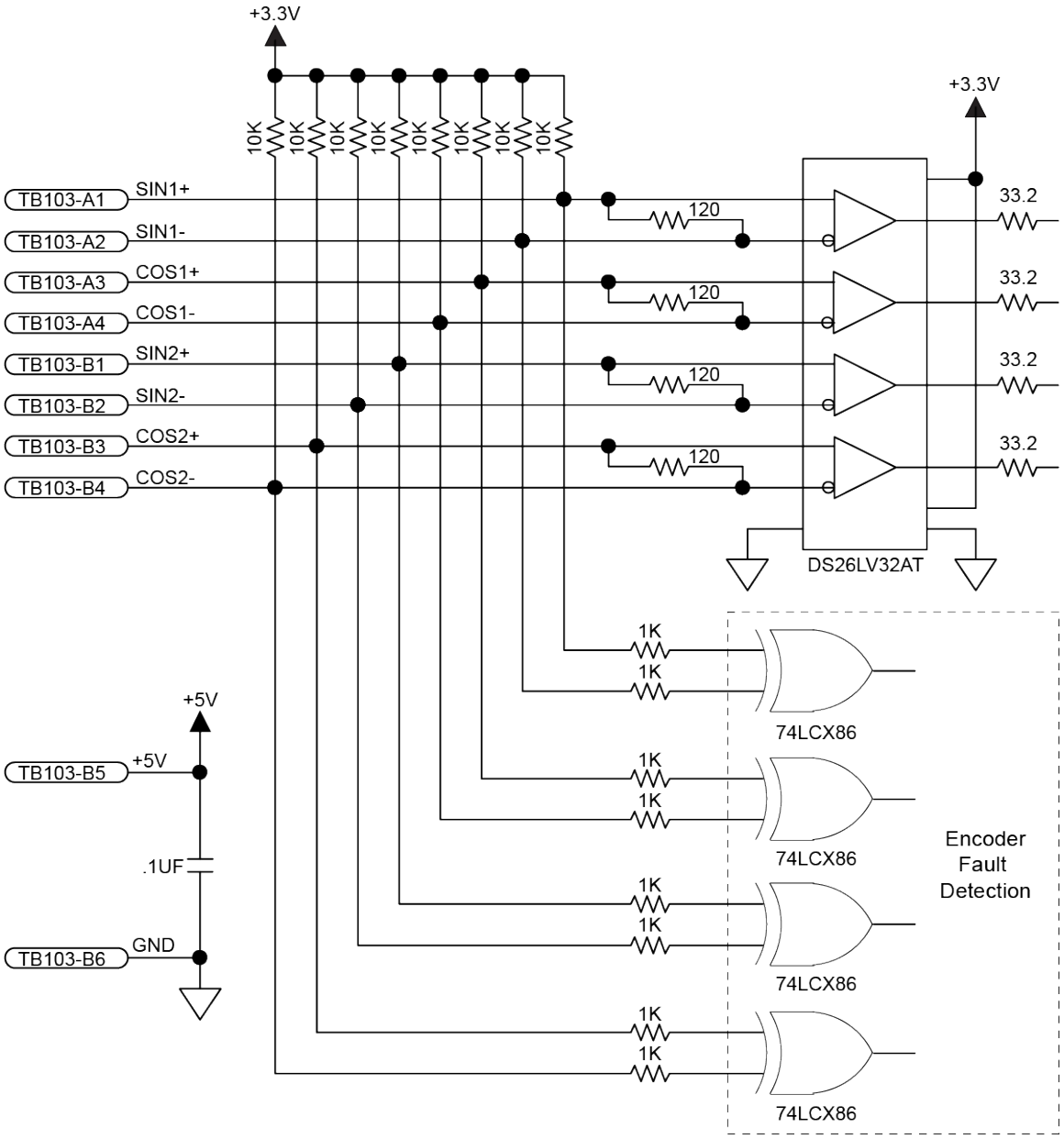


Figure 2-23: Encoder Connections (TB103 A/B)

2.8.1. Emergency Stop Sense Input (TB103)

The ESTOP sense input is used to monitor the state of an external safety circuit only. This state is indicated by the software and may be used to facilitate system restart. This ESTOP sense input is not intended to be a complete safety system.

WARNING: The user is responsible for assessing operator risk levels and designing the external safety circuits appropriately.

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

If the ESTOP bit is enabled in the FaultMask axis parameter, the ESTOP input must be driven to prevent the ESTOP fault condition.

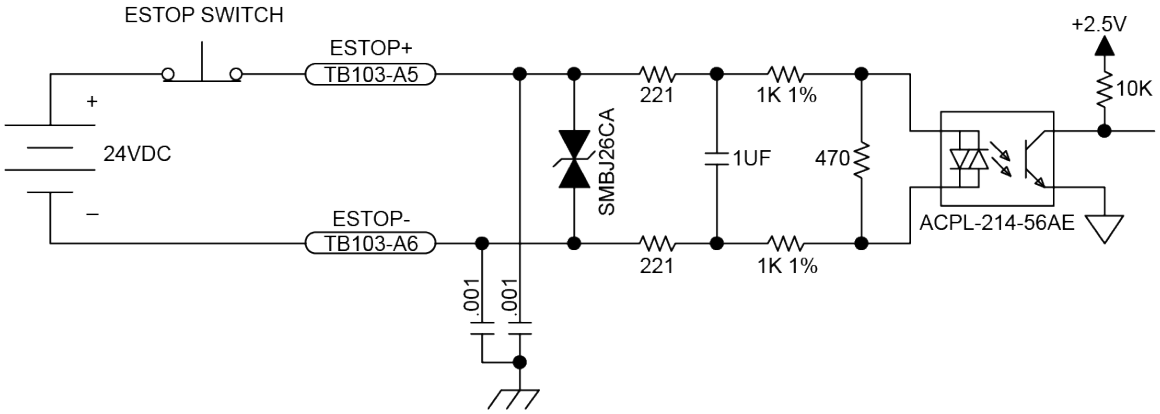


Figure 2-24: ESTOP Sense Input (TB103)

Table 2-39: TB103A ESTOP Pinout

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

NOTE: Connecting the ESTOP input to a relay or other noise producing device requires the use of noise suppression devices such as those in Table 2-40. These devices are applied across the switched coil to suppress transient voltages.

Table 2-40: 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

2.9. Switch S1 (Laser Output Polarity)

Define the active laser output polarity using the Laser Output Polarity switches of S1 (see Section 2.4.).

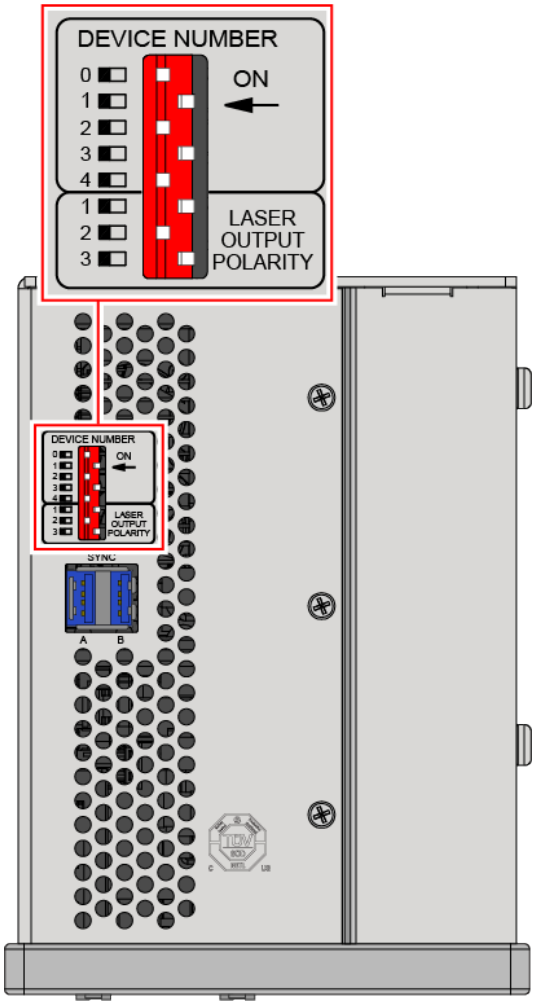


Figure 2-25: Switch S1 (Laser Output Polarity)

2.10. PC Configuration and Operation Information

For additional information about PC configuration, hardware requirements, programming, utilities, and system operation refer to the A3200 Help file.

Chapter 3: Maintenance

DANGER: Always disconnect the Mains power connection before opening the Nmark GCL chassis.

DANGER: Before performing any tests, be aware of lethal voltages inside the controller and at the input and output power connections. A qualified service technician or electrician should perform these tests.

3.1. Board Assembly

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

DANGER: Always disconnect the Mains power connection before opening the Nmark GCL chassis.

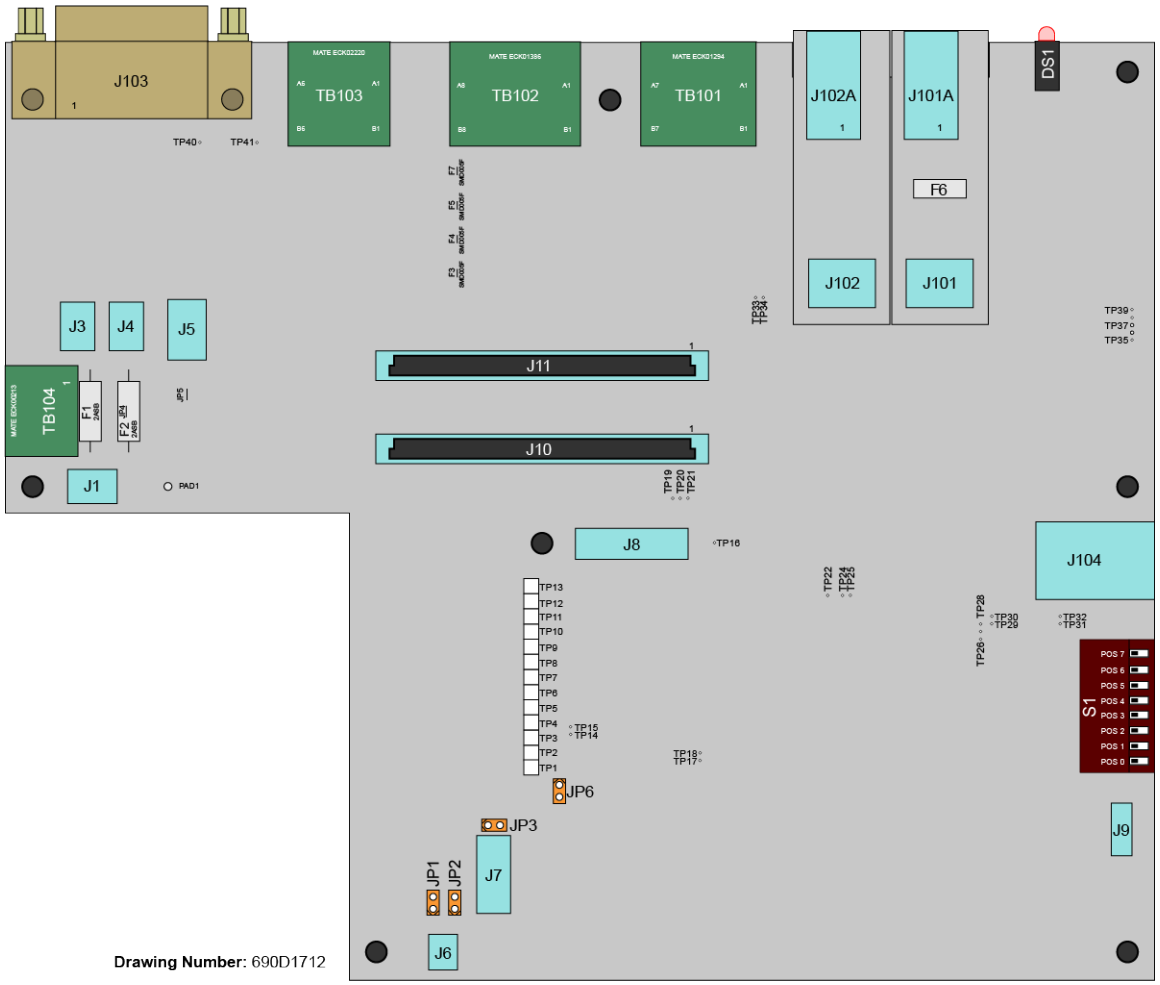


Figure 3-1: Control Board Assembly

Table 3-1: Control Board Fuse Specifications

Fuse	Description	Size	Aerotech P/N	Manufacturer's P/N
F1	Control Power at TB109-1	2 A S.B.	EIF01048	Littelfuse 0875002.MXEP
F2	Control Power at TB109-1	2 A S.B.	EIF01048	Littelfuse 0875002.MXEP
F6	FireWire power at J101-J102	--	--	-
NOTE: F6 is a resettable fuse (turn off power and remove the short. F6 does not require replacement.				

DANGER: Always disconnect the Mains power connection before opening the Nmark GCL chassis.

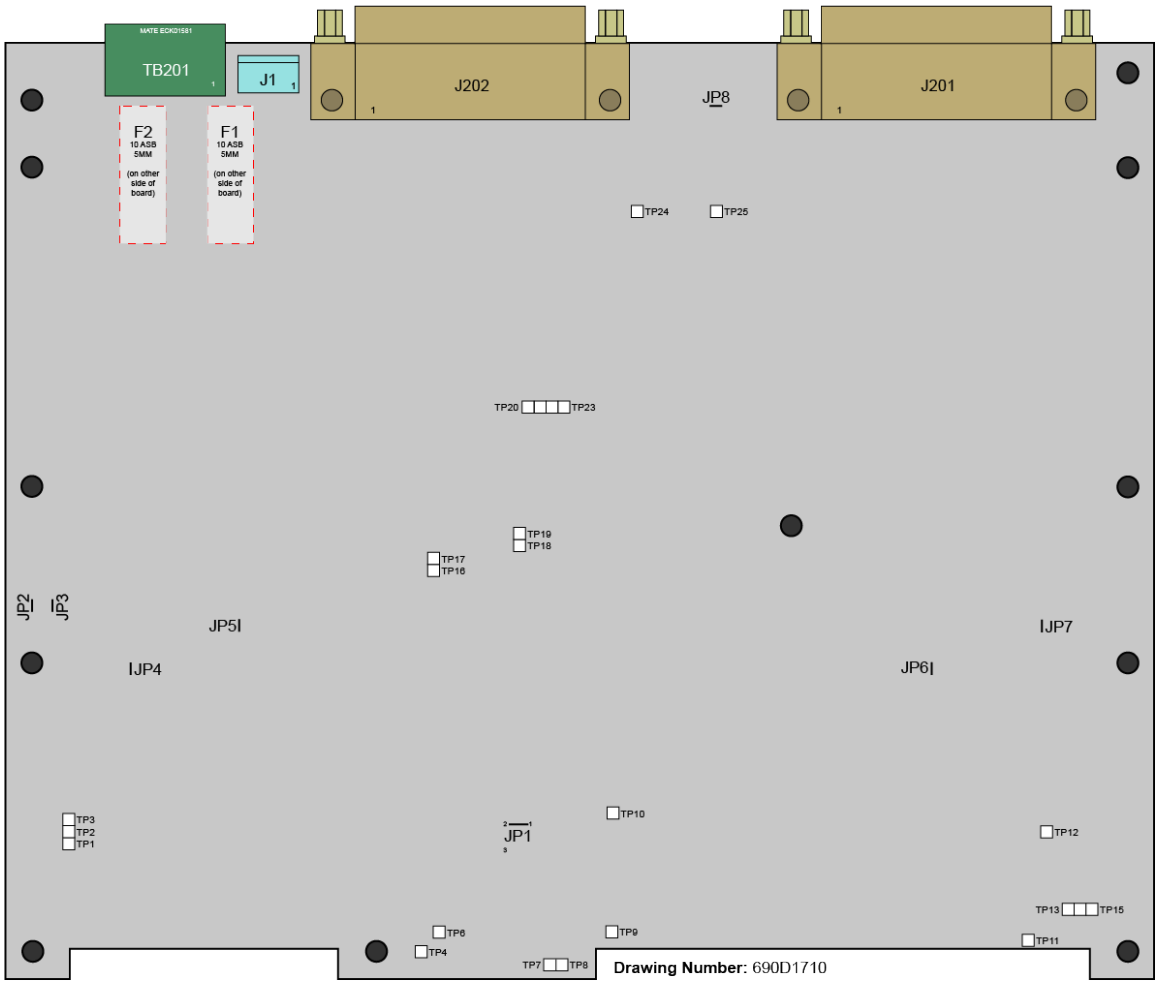


Figure 3-2: Power Board Assembly

Table 3-2: Power Board Fuses

Fuse	Description	Size	Aerotech P/N	Manufacturer's 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 located on the bottom of the board.				

3.2. Preventative Maintenance

The Nmark GCL and external wiring should be inspected monthly. Inspections may be required at more frequent intervals, depending on the environment and use of the system.

DANGER: Always disconnect the Mains power connection before opening the Nmark GCL chassis.

Table 3-3: Preventative Maintenance

Check	Action to be Taken
Visually Check chassis for loose or damaged parts / hardware. **Note**: Internal inspection is not required.	Parts should be repaired as required. If internal damage is suspected, these parts should be checked and repairs made if necessary.
Inspect cooling vents.	Remove any accumulated material from vents.
Check for fluids or electrically conductive material exposure.	Any fluids or electrically conductive material must not be permitted to enter the Nmark GCL.
Visually inspect all cables and connections.	Tighten or re-secure any loose connections. Replace worn or frayed cables. Replace broken connectors.

Cleaning

The Nmark GCL chassis can be wiped with a clean, dry, soft cloth. The cloth may be slightly moistened if required with water or isopropyl alcohol to aid in cleaning if necessary. In this case, be careful not to allow moisture to enter the Nmark GCL or onto exposed connectors / components. Fluids and sprays are not recommended because of the chance for internal contamination, which may result in electrical shorts and/or corrosion. The electrical power must be disconnected from the Nmark GCL while cleaning. Do not allow cleaning substances or other fluids to enter the Nmark GCL or to get on to any of the connectors. Avoid cleaning labels to prevent removing 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 https://www.aerotech.com/global-technical-support.aspx 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

Appendix B: Revision History

Revision	Description
1.05.00	• Updated EU Declaration of Conformity • Updated dimension drawing: Section 1.2.
1.04.00	Updated Table 2-38
1.03.00	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
1.02.00	
1.01.00	
1.00.00	
Beta	

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