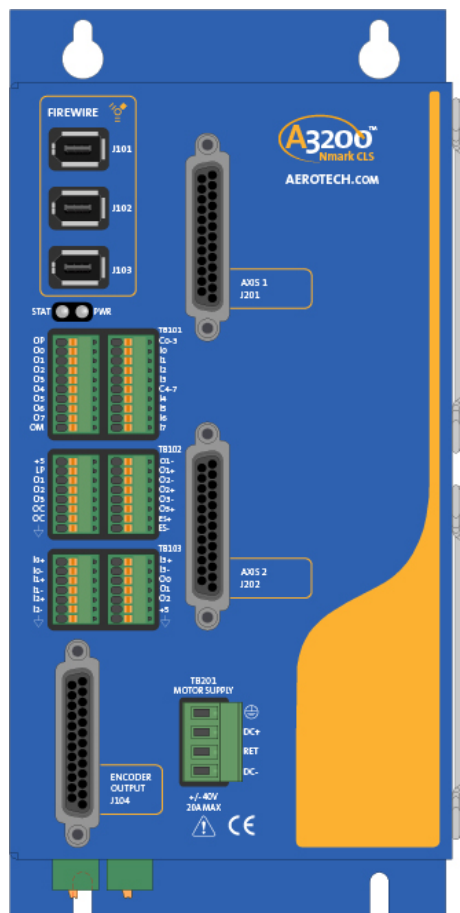




# Nmark CLS Hardware Manual

Revision: 1.04.00



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 CLS  
**Model/Types** All

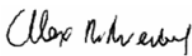
*This is to certify that the aforementioned product is in accordance with the applicable requirements of the following Directive(s):*

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

**Name**  / Alex Weibel  
**Position** Engineer Verifying Compliance  
**Location** Pittsburgh, PA  
**Date** 1/5/2021



## Agency Approvals

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

<b>Approval / Certification:</b>	CUS NRTL
<b>Approving Agency:</b>	TUV SUD America Inc.
<b>Certificate #:</b>	U8 16 06 68995 021
<b>Standards:</b>	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 CLS.

- Read all parts of this manual before you install or operate the Nmark CLS 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](http://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. Access to the Nmark CLS and component parts must be restricted while connected to a power source.
4. 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.
5. Install the Nmark CLS inside a rack or enclosure.
6. Refer to local electrical safety requirements to correctly size external system wires.
7. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
8. All components must be properly grounded in accordance with local electrical safety requirements.
9. Operator safeguarding requirements must be addressed during final integration of the product.



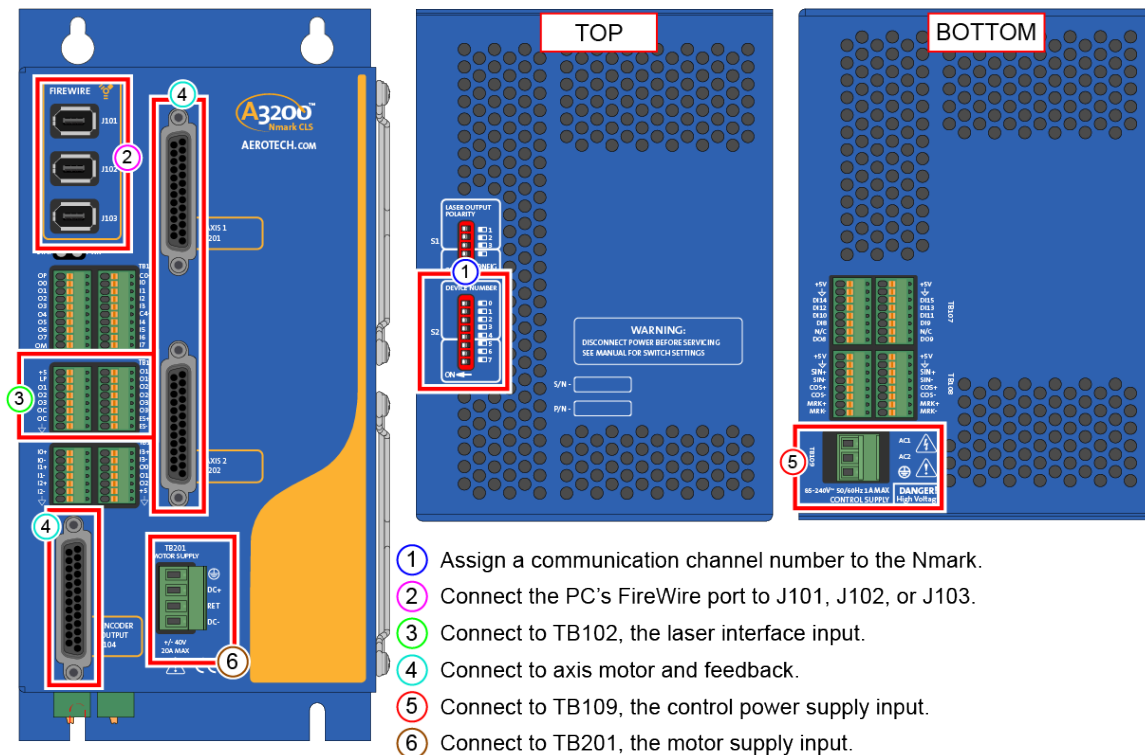
**WARNING:** To minimize the possibility of electrical shock, bodily injury or death the following precautions must be followed.

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 CLS. 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, J102, or J103.
- ③ Connect to TB102, the laser interface input.
- ④ Connect to axis motor and feedback.
- ⑤ Connect to TB109, the control power supply input.
- ⑥ Connect to TB201, the motor supply input.

Device Number	<a href="#">Section 2.1. Communication Channel Settings</a>
FireWire	<a href="#">Section 2.3. FireWire Interface</a>
Laser Interface Input	<a href="#">Section 2.4. Laser Interface (TB102)</a>
Galvo Connections	<a href="#">Section 2.6. Galvo Connections (J201 and J202)</a>
Control Supply	<a href="#">Section 2.2.1. Control Supply Connections (TB109)</a>
Motor Supply	<a href="#">Section 2.2.2. Motor Supply Connections (TB201)</a>

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## Chapter 1: Introduction

Aerotech's Nmark CLS, 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 CLS 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.

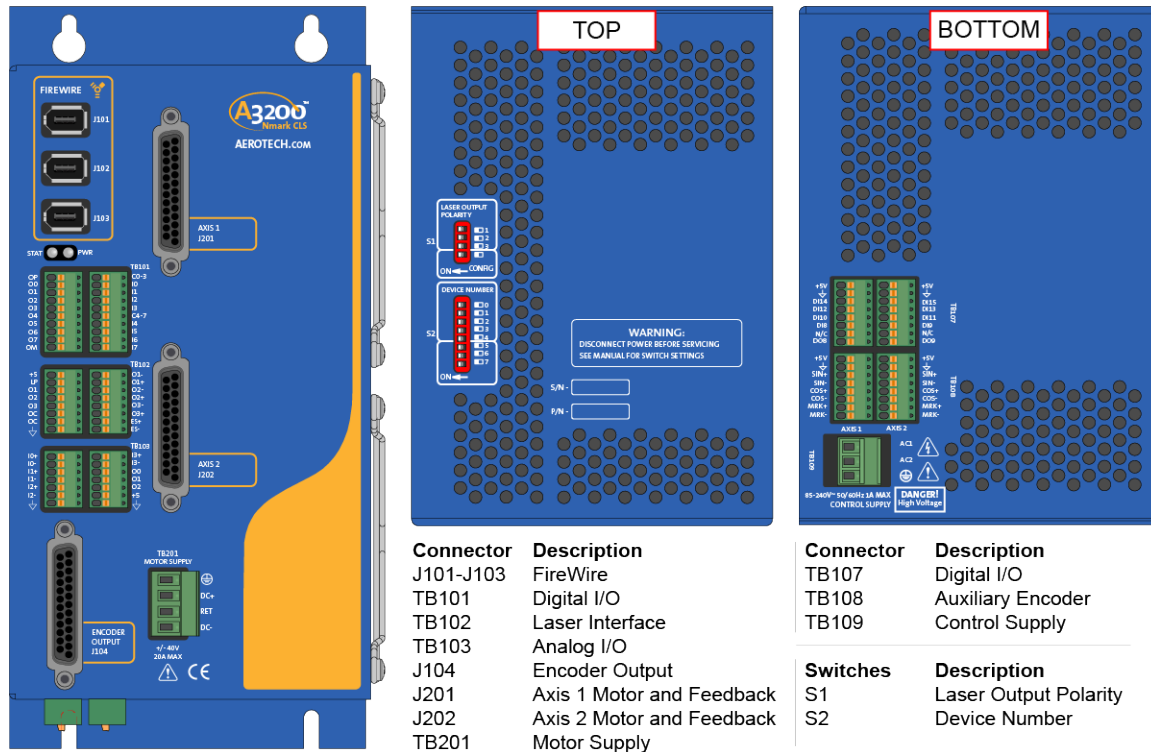


Figure 1-1: Nmark CLS Networked Digital Galvo Controller

**Table 1-1: Feature Summary**

Standard Features	
<ul style="list-style-type: none"><li>• Two auxiliary channels of 40 MHz line driver quadrature encoder inputs.</li><li>• Eight optically-isolated digital inputs; 5-24V</li><li>• Eight optically-isolated digital outputs sinking or sourcing; 5-24V</li><li>• Four 16-bit differential analog inputs</li><li>• Three 16-bit analog outputs</li><li>• Eight digital inputs</li><li>• Two digital outputs</li><li>• Three FireWire ports</li><li>• Three optically isolated Laser Outputs</li><li>• Three differential Laser Outputs</li><li>• Dedicated 5-24V Emergency Stop sense input</li><li>• Internal power supply</li><li>• 5 VDC, 500 mA user output power for encoder</li></ul>	
Options	
-SRC	Configure laser outputs as sourcing outputs (factory configuration, jumper settings cannot be changed in the field)
-SINK	Configure laser outputs as sinking outputs (factory configuration, jumper settings cannot be changed in the field)

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

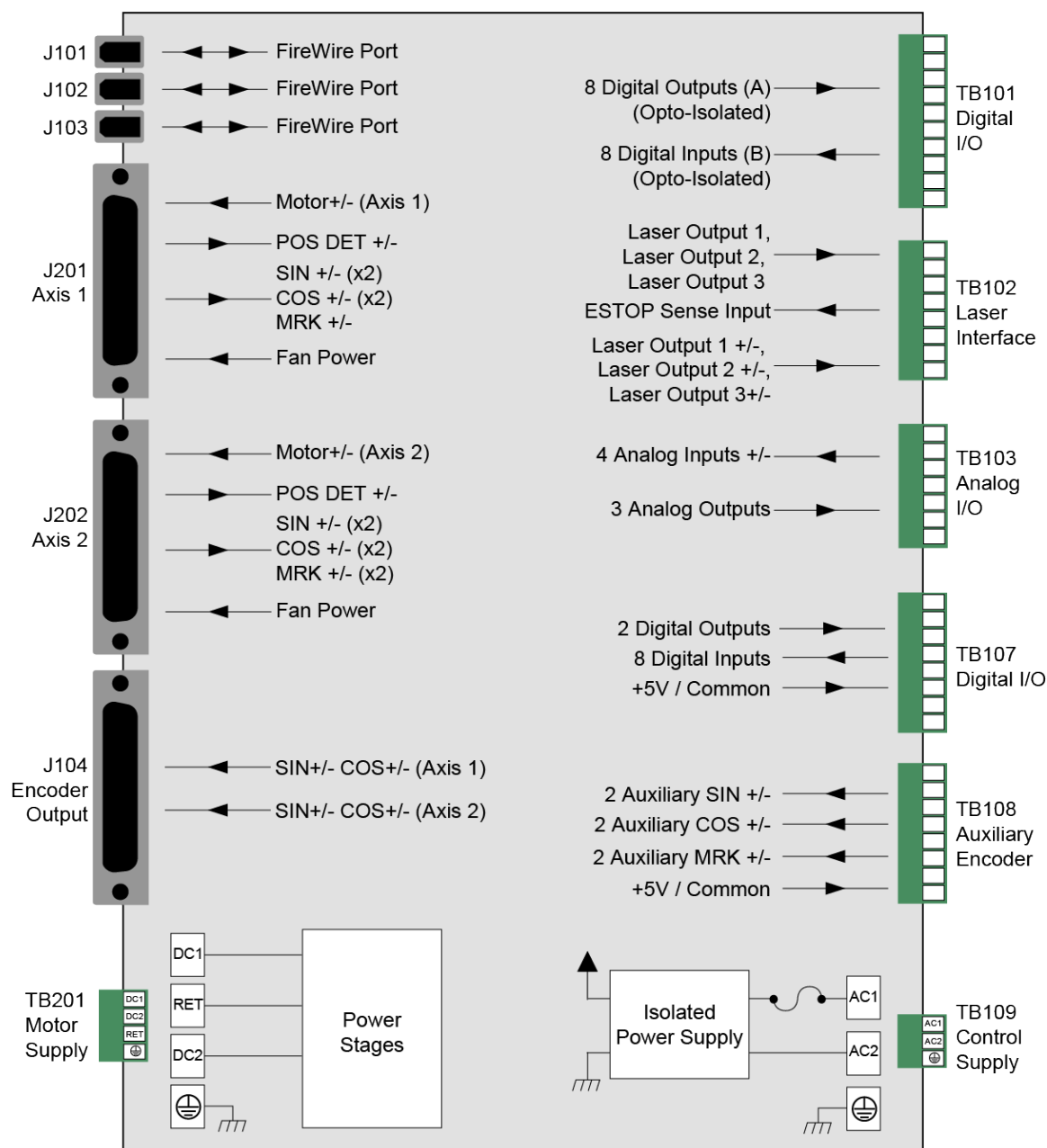


Figure 1-2: Functional Diagram

## 1.1. Electrical Specifications

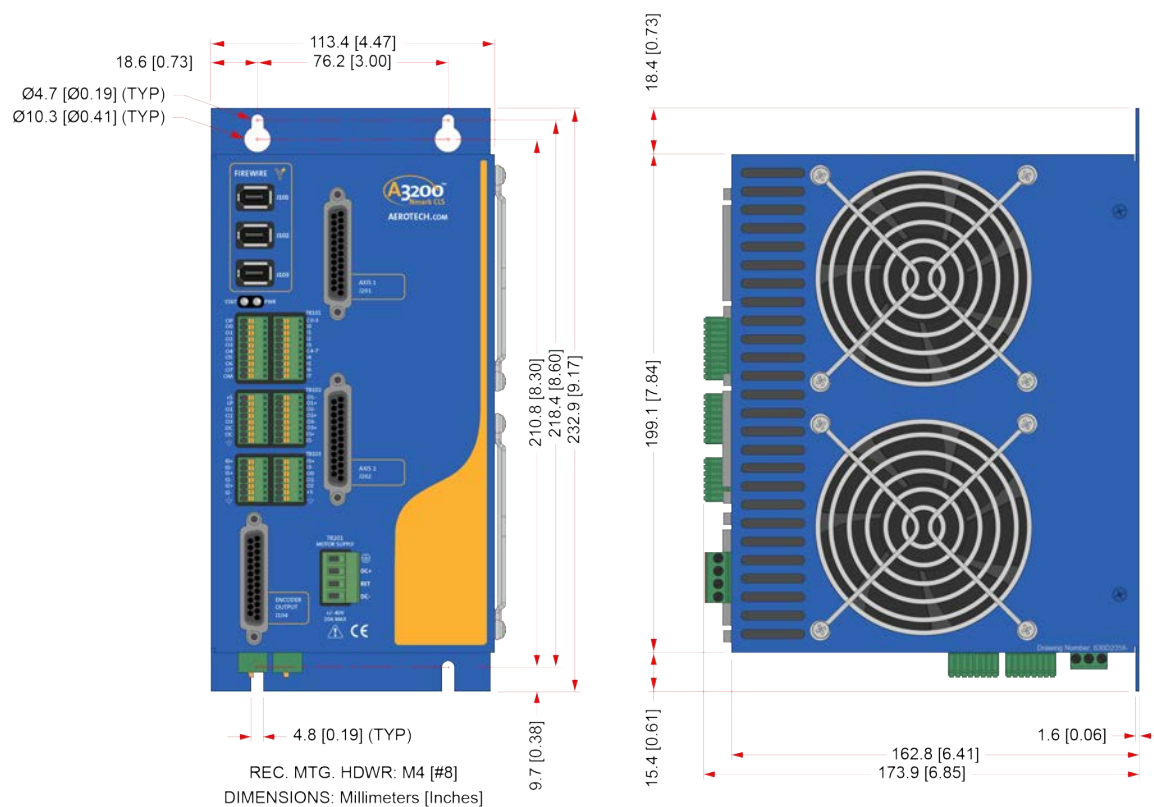
The electrical specifications for the Nmark CLS are listed below.

**Table 1-2: Electrical Specifications**

Description		Nmark CLS
Motor Supply	Input Voltage	$\pm 40$ 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	0.25 A (max)
Output Voltage <sup>(1)</sup>		$\pm 35$ V @ 20 A
Peak Output Current <sup>(1)</sup>		20 A
Continuous Output Current <sup>(1)</sup>		5 A
Minimum Load Resistance		0.5 $\Omega$
Output Impedance		0.25 $\Omega$
User Power Supply Output		5 VDC (@ 500 mA)
Mode of Operation		Galvo
(1) Load Dependent		

## 1.2. Mechanical Design

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



**Figure 1-3: Dimensions**

### 1.3. Environmental Specifications

The environmental specifications for the Nmark CLS 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 1-3: Drive and Software Compatibility**

Drive Type	Firmware Revision	First Software Version	Last Software Version
Nmark CLS	-	4.02	Current
	A	4.06.001	Current

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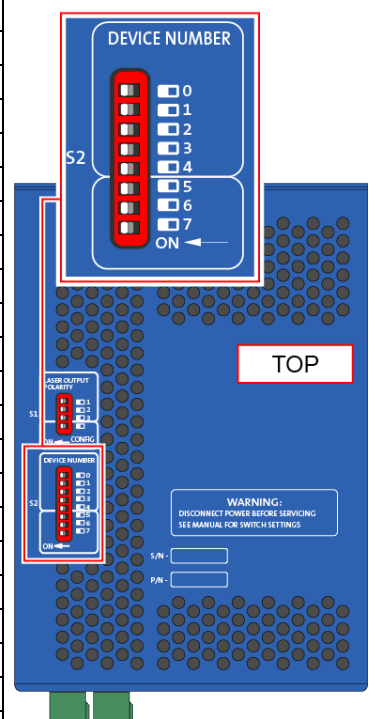
## Chapter 2: Installation and Configuration

### 2.1. Communication Channel Settings

Use the Device Number switches to assign a communication channel number to the Nmark CLS. If you are using multiple drives, each drive must be assigned a unique, sequential communication channel. Since the Nmark CLS is a multi-axis device, the Nmark CLS will automatically claim the next sequential device number. If a two-axis Nmark CLS 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 (S2)**

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

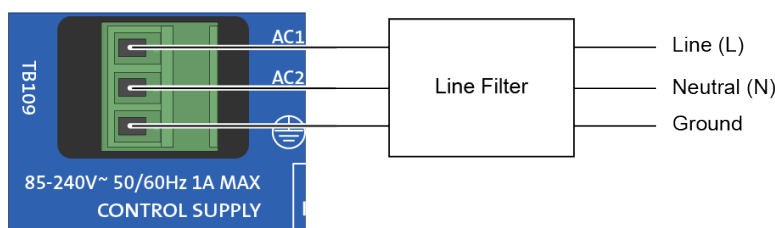
The Nmark CLS has two input power connectors; one for control power (AC) and a second for motor power (DC). For a complete list of electrical specifications, refer to [Section 1.1](#).

### 2.2.1. Control Supply Connections (TB109)

**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 allows the Nmark CLS to maintain communications if the motor power is removed, such as in an Emergency Stop condition. The control power supply requires a minimum of 85 VAC input to operate properly. The AC1 input is internally fused. The AC2 input is not internally fused but can be connected to a voltage source other than Neutral if an external 2 A time-delay fuse is used.

Although the control power supply contains an internal filter, an additional external filter located as close as possible to the Nmark CLS may be required for CE compliance (Aerotech recommends Schaffner FN2080).



**Figure 2-1: Control Supply Connections**

**Table 2-2: Control Supply Input Wiring (TB109)**

Pin	Description	Recommended Wire Size
AC1	Line Input: 85 - 240 Volt AC Input Range	1.3 mm <sup>2</sup> (#16 AWG)
AC2	Neutral (0V) or 85 - 240 Volt AC Input Range with external fuse	1.3 mm <sup>2</sup> (#16 AWG)
	Protective Ground (Required for Safety)	1.3 mm <sup>2</sup> (#16 AWG)

**NOTE:** Wire insulation rated for 300 V.

**Table 2-3: Control Supply Mating Connector (TB109)**

Type	Aerotech P/N	Phoenix P/N	Screw Torque Value: Nm	Wire Size: mm <sup>2</sup> [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 CLS at the four terminals of the Motor Supply connector (TB201). The DC+ and DC- inputs are internally fused.



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

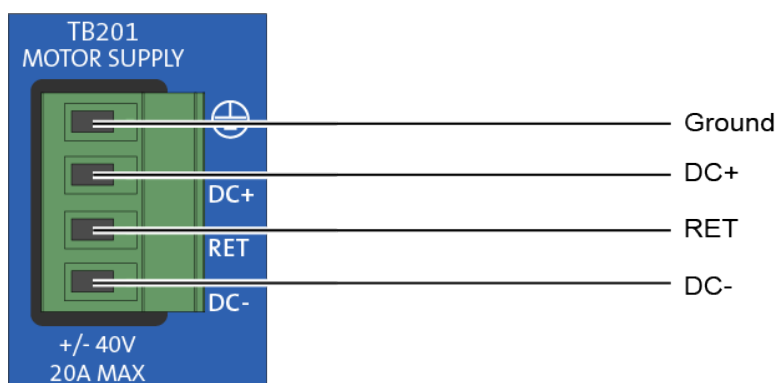


Figure 2-2: Motor Bus Input Connections

Table 2-4: Motor Supply Input Wiring

Pin	Description	Recommended Wire Size
DC+	0 to +40 Volt DC Input Range	2.1 mm <sup>2</sup> (#14 AWG)
RET	Return for DC Input	2.1 mm <sup>2</sup> (#14 AWG)
DC-	0 to -40 Volt DC Input Range	2.1 mm <sup>2</sup> (#14 AWG)
⊕	Protective Ground (Required for Safety)	2.1 mm <sup>2</sup> (#14 AWG)

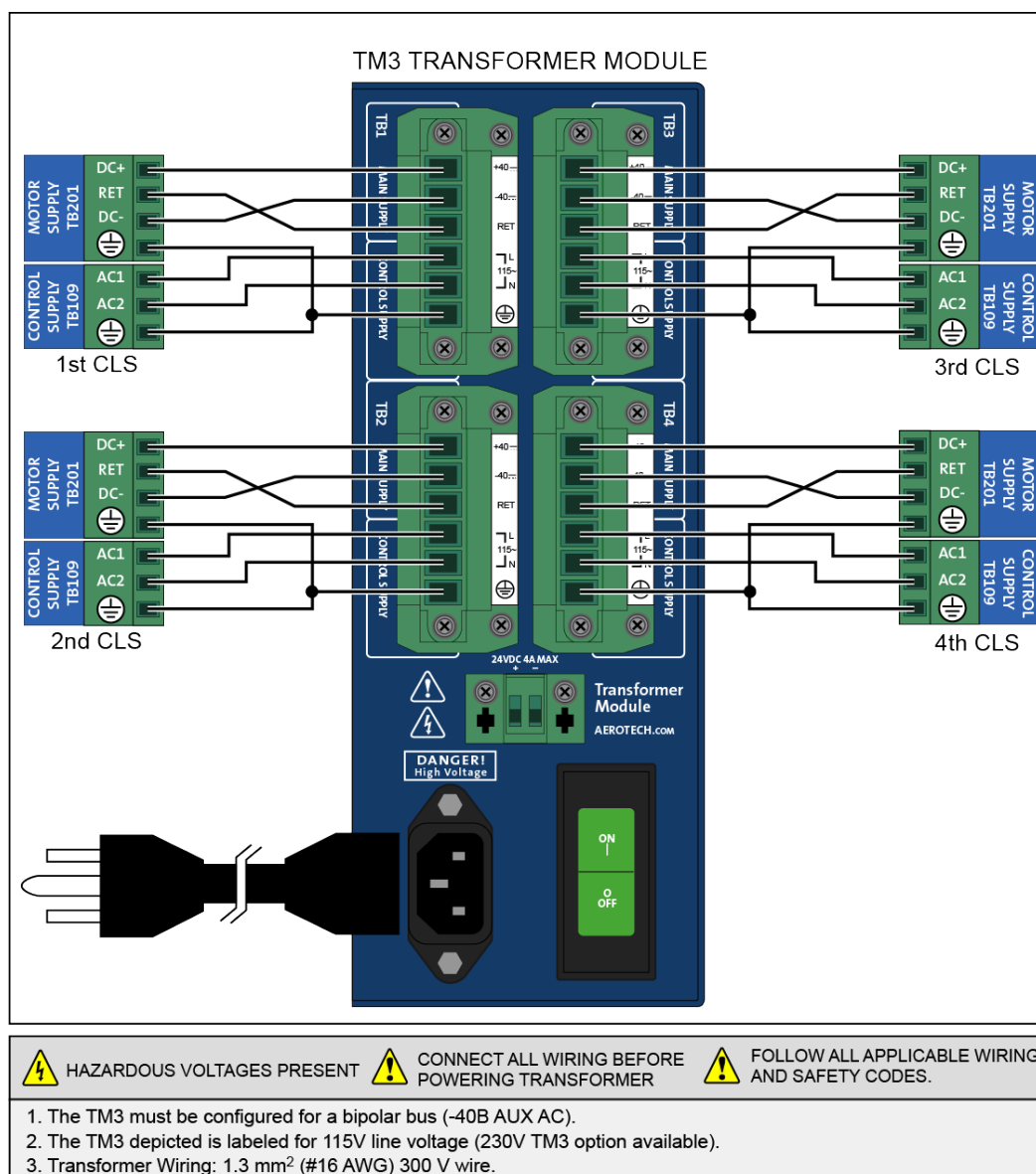
**NOTE:** Wire insulation rated for 300 V.

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

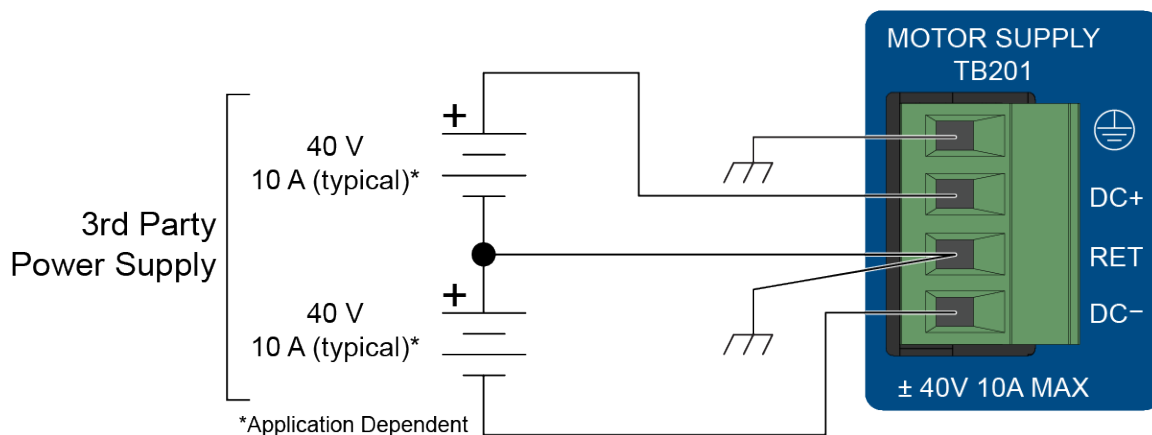
Type	Aerotech P/N	Phoenix P/N	Screw Torque Value: Nm	Wire Size: mm <sup>2</sup> [AWG]
4-Pin Terminal Block	ECK01581	1757035	0.5 - 0.6	3.3 - 0.0516 [12-30]

### 2.2.3. External Power Supply Options

The Nmark CLS 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 CLS 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 CLS 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 CLS 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 Interface (TB102)

The Laser Interface connector (two 8-pin, terminal block-style connectors) provides connections to the laser control outputs as well as the ESTOP sense input. There are three laser output signals and they are available in optically-isolated open drain/open source format or as RS-422 differential signals. The open drain / open source setting is a factory configured option.

**NOTE:** The three laser outputs are configured in the software; refer to the A3200 Help for more information.

The active polarity of the laser output signals is set using Switch S1 located on the top edge of the Nmark CLS (see [Section 2.12.](#)). In the “OFF” position, the output transistor is turned on to activate the laser (this is the Normally-Open (N.O.) configuration).

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.

Jumpers JP4-JP9 are set at the factory for sinking (-SINK) or sourcing (-SRC) operation and cannot be changed in the field.

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

**Table 2-9: Laser Interface Pinout (TB102 A)**

Pin #	Label	Description	In/Out/Bi	Connector
1	+5	5 Volt Power Supply (500 mA, max)	Output	
2	LP	Connect to laser power for sourcing mode	Input	
3	O1	Laser Output 1 / PSO Output	Output	
4	O2	Laser Output 2	Output	
5	O3	Laser Output 3	Output	
6	OC	Connect to laser common for sinking mode	Input	
7	OC	Connect to laser common for sinking mode	Input	
8	⏚	Power return for Pin 1 (+5V)	N/A	

**Table 2-10: Laser Interface Pinout (TB102 B)**

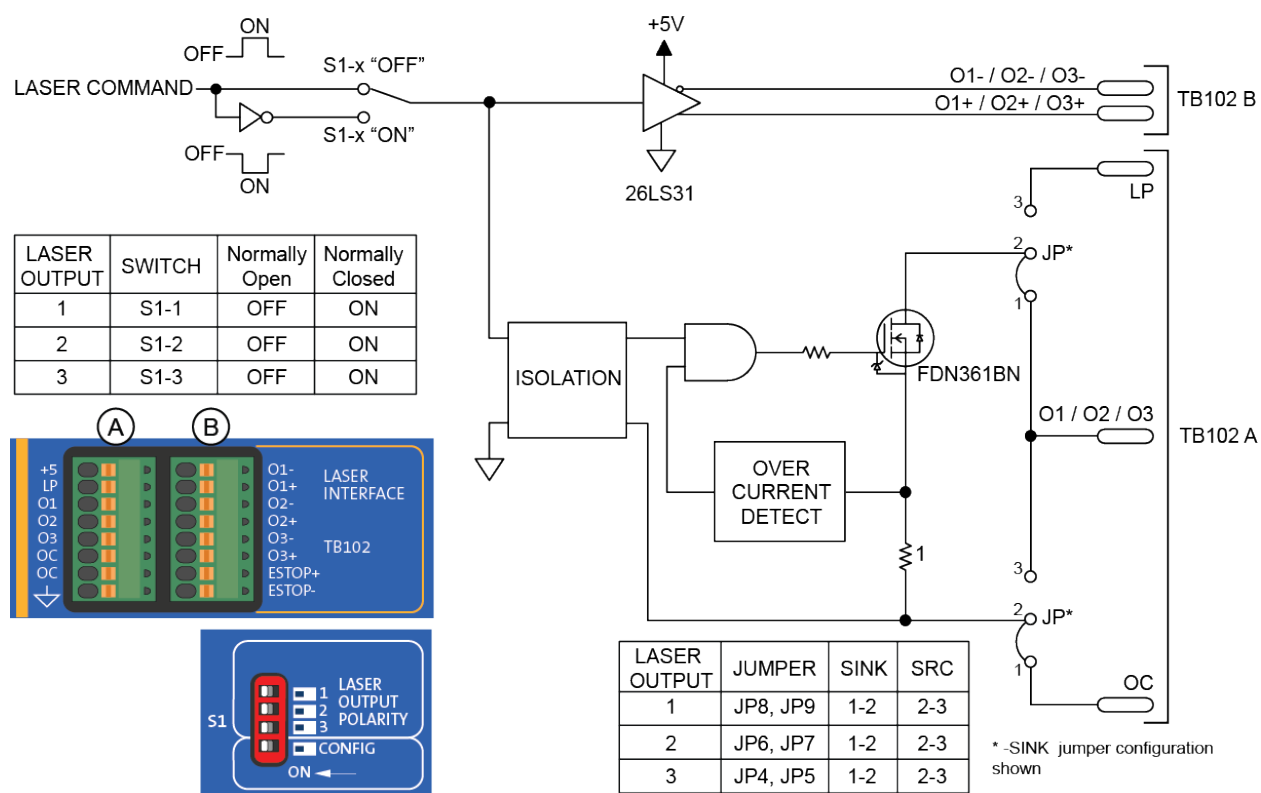
Pin #	Label	Description	In/Out/Bi	Connector
1	O1-	Laser Output 1- / PSO Output	Output	
2	O1+	Laser Output 1+ / PSO Output	Output	
3	O2-	Laser Output 2-	Output	
4	O2+	Laser Output 2+	Output	
5	O3-	Laser Output 3-	Output	
6	O3+	Laser Output 3+	Output	
7	ES+	Emergency Stop Digital Input +	Input	
8	ES-	Emergency Stop Digital Input -	Input	

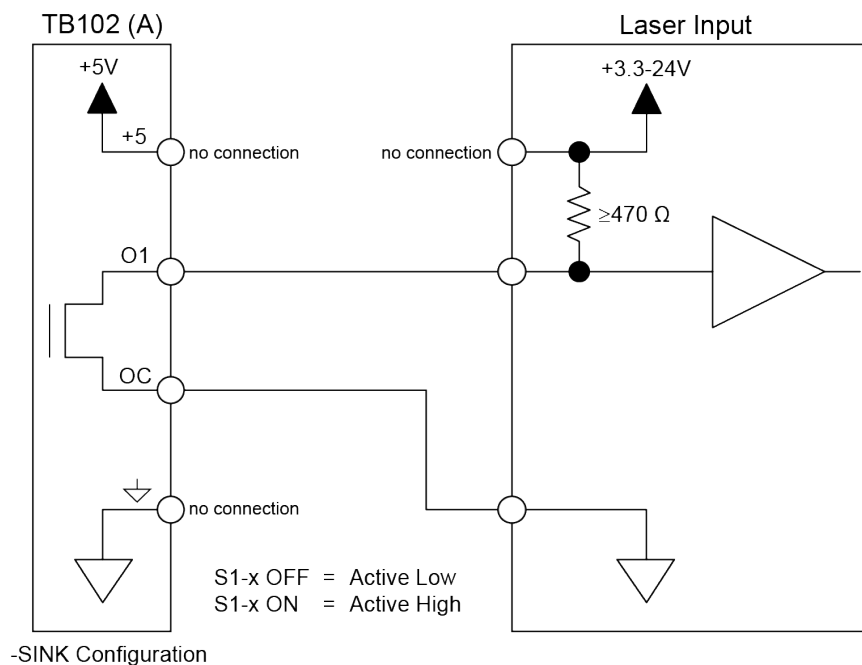
**Table 2-11: Mating Connector Part Numbers for the Laser Interface Connector (TB102)**

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

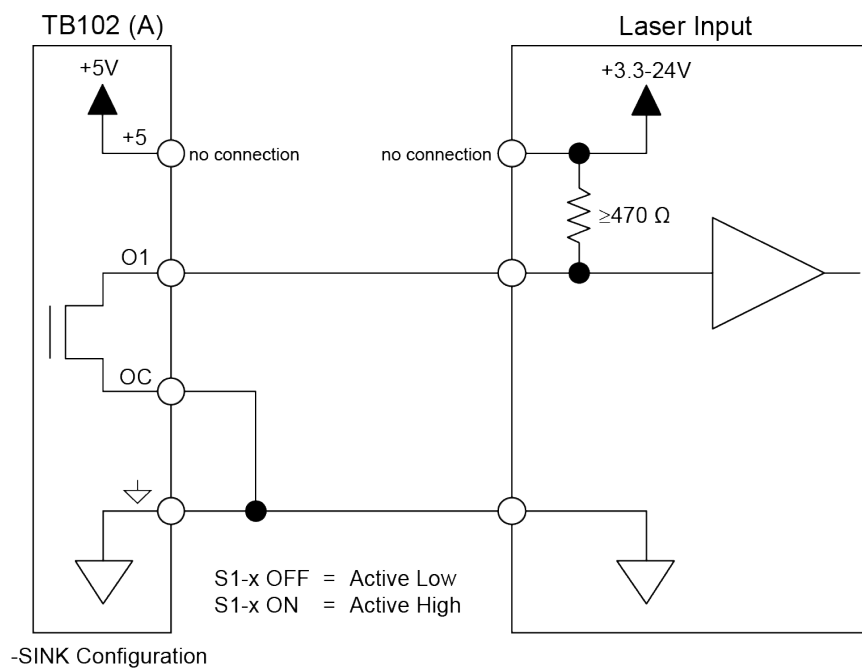
**Table 2-12: Output Specifications (TB102)**

Specification	Value
Maximum Frequency (Single-Ended)	12.5 MHz
Maximum Frequency (Differential)	5 MHz
Voltage	5 - 24 V
Output Current	≤ 50 mA

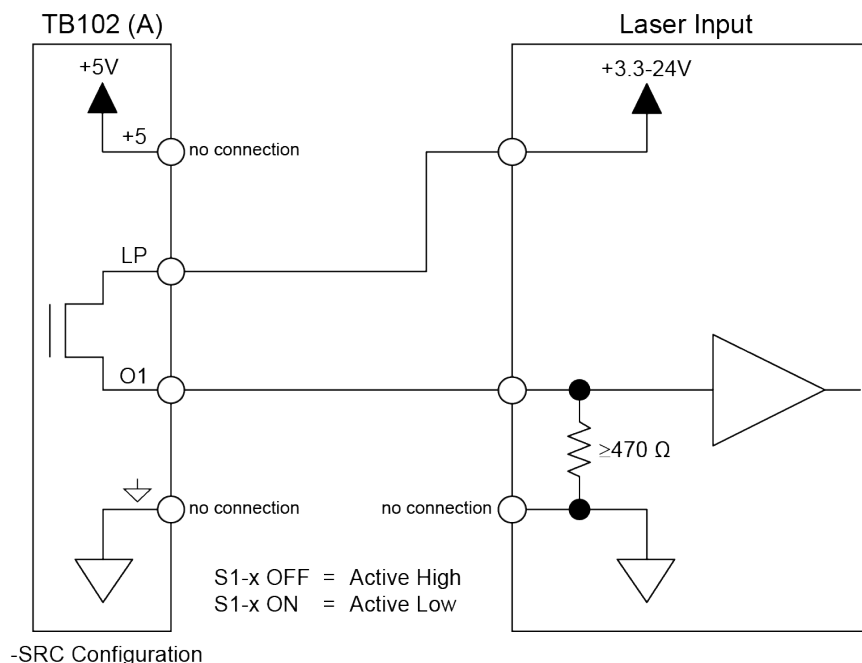
**Figure 2-5: Laser Interface Outputs (TB102)**



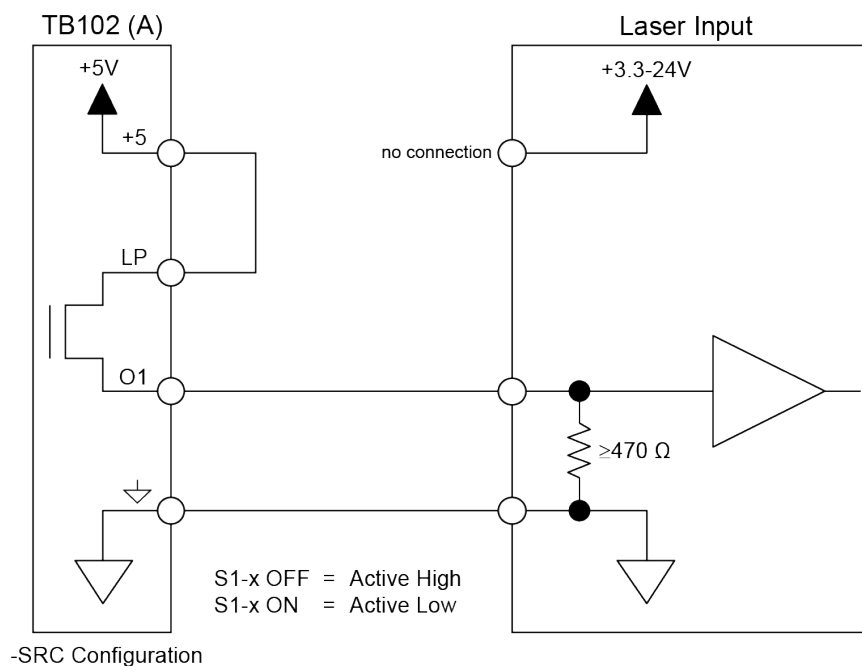
### Figure 2-6: Current Sinking Configuration (with Isolation)



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



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



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

### 2.4.1. Emergency Stop Sense Input (TB102)

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.

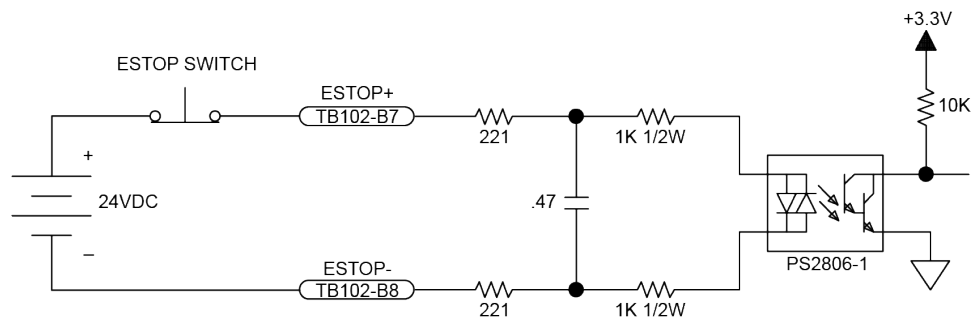


Figure 2-10: ESTOP Sense Input (TB102)

Table 2-13: TB102B ESTOP Pinout

Pin #	Label	Description	In/Out/Bit
7	ES+	Emergency Stop Digital Input +	Input
8	ES-	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 2-14. These devices are applied across the switched coil to suppress transient voltages.

Table 2-14: 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

### 2.4.2. 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 2-15: PSO Specifications**

Specification		Value
Maximum Input Tracking Rate <sup>(1)</sup>	Single-Axis Tracking	16.6 MHz
	Dual-Axis Tracking	8.33 MHz
Maximum Quadrature Encoder Output Frequency	-MXH Feedback	25 MHz
Maximum PSO Output (Fire) Frequency <sup>(2)</sup>	Isolated	5 MHz
	TTL	12.5 MHz
Firing Latency	Single-Axis Tracking	160 nsec
	Dual-Axis Tracking	220 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 2-16: PSO Output Pinout TB102 (A)**

Pin #	Label	Description	In/Out/BI
2	LP	Connect to laser power for sourcing mode	Input
3	O1	Laser Output 1 / PSO Output	Output
6	OC	Connect to laser common for sinking mode	Input
7	OC	Connect to laser common for sinking mode	Input

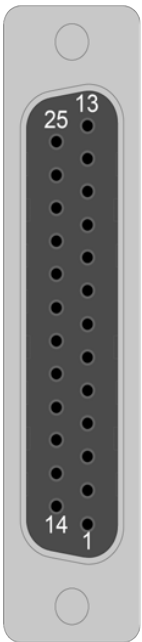
**Table 2-17: PSO Output Pinout TB102 (B)**

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 (J104)

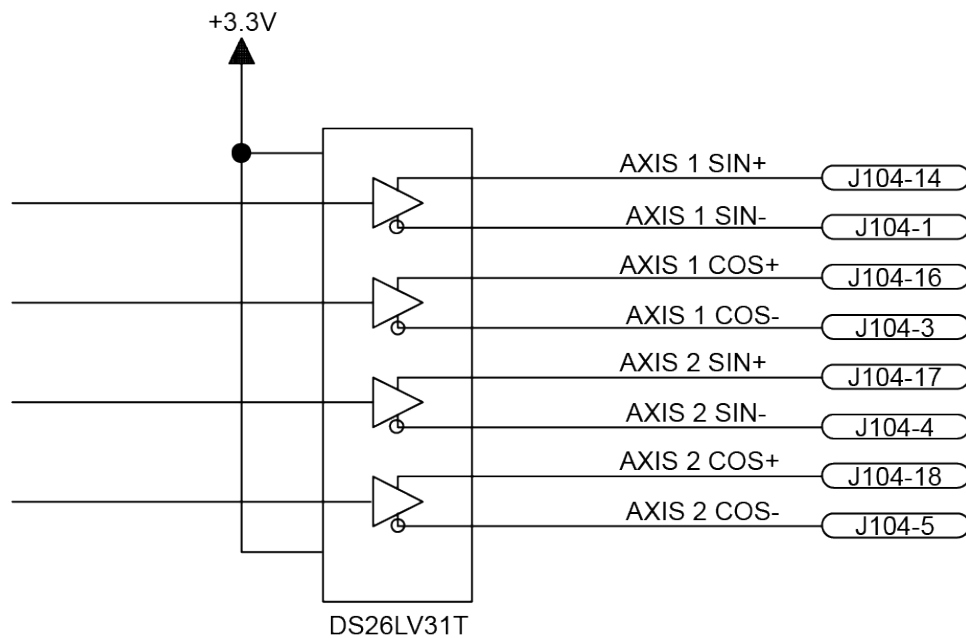
The Encoder Output interface is used to echo the encoder signals from both axes.

**Table 2-18: Encoder Output Connector Pinout (J104)**

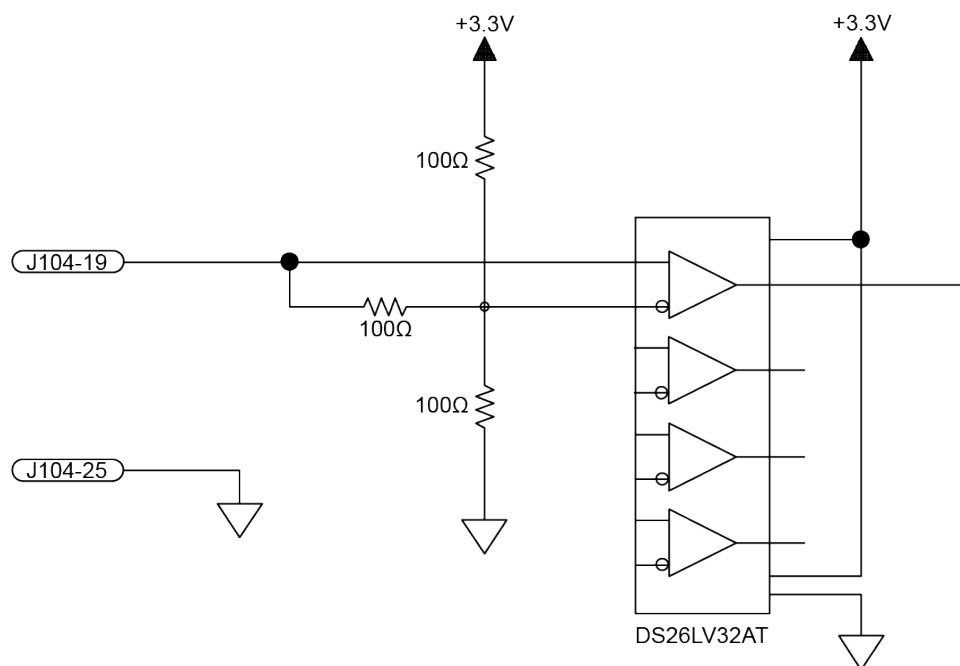
Pin	Description	In/Out/Bi	Connector
1	Axis 1 Sine -	Output	
2	No Connection	--	
3	Axis 1 Cosine -	Output	
4	Axis 2 Sine -	Output	
5	Axis 2 Cosine -	Output	
6	No Connection	--	
7	No Connection	--	
8	No Connection	--	
9	No Connection	--	
10	No Connection	--	
11	No Connection	--	
12	No Connection	--	
13	No Connection	--	
14	Axis 1 Sine +	Output	
15	No Connection	--	
16	Axis 1 Cosine +	Output	
17	Axis 2 Sine +	Output	
18	Axis 2 Cosine +	Output	
19	PSO External Sync	Input	
20	No Connection	--	
21	No Connection	--	
22	No Connection	--	
23	No Connection	--	
24	No Connection	--	
25	Signal Common	-	

**Table 2-19: Mating Connector Part Numbers for the Encoder Output Connector (J104)**

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



### Figure 2-11: Encoder Outputs

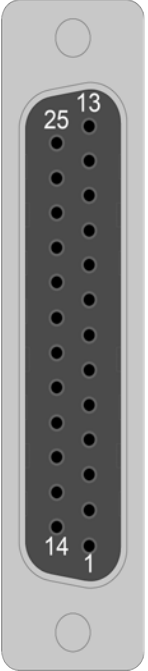


**Figure 2-12: PSO External Sync Input**

## 2.6. Galvo Connections (J201 and J202)

Each Galvo connector (a 25-pin, D-style connector) has 2 analog encoder inputs, 1 position detector input, 5 volt encoder power, 24 volt fan power, and galvo motor connections.

**Table 2-20: 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+ / Position Detector A+	Input	
5	Cosine 2+ / Position Detector B+	Input	
6	Reserved	--	
7	Marker 1+	Input	
8	Encoder Power (+5V, 500 mA)	Output	
9	Fan Power +	--	
10	Reserved	--	
11	Shield	--	
12	Motor +	Output	
13	Motor +	Output	
14	Sine 1-	Input	
15	Cosine 1-	Input	
16	Encoder Ground	--	
17	Sine 2- / Position Detector A-	Input	
18	Cosine 2- / Position Detector B-	Input	
19	Reserved	--	
20	Marker 1-	Input	
21	Encoder Ground	--	
22	Fan Power -	--	
23	Shield	--	
24	Motor -	Output	
25	Motor -	Output	

**Table 2-21: 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 CLS is equipped with two analog encoder input channels per Galvo connector that can be configured for position feedback via parameter settings. If using analog encoder for position feedback, the multiplication (interpolation) factor is determined by the EncoderMultiplicationFactor parameter.

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 2-22: Analog Encoder Specifications**

Specification	Value
Input Frequency (max)	500 kHz
Input Amplitude	0.6 to 2.25 Vpk-Vpk
Interpolation Factor (software selectable)	262,144

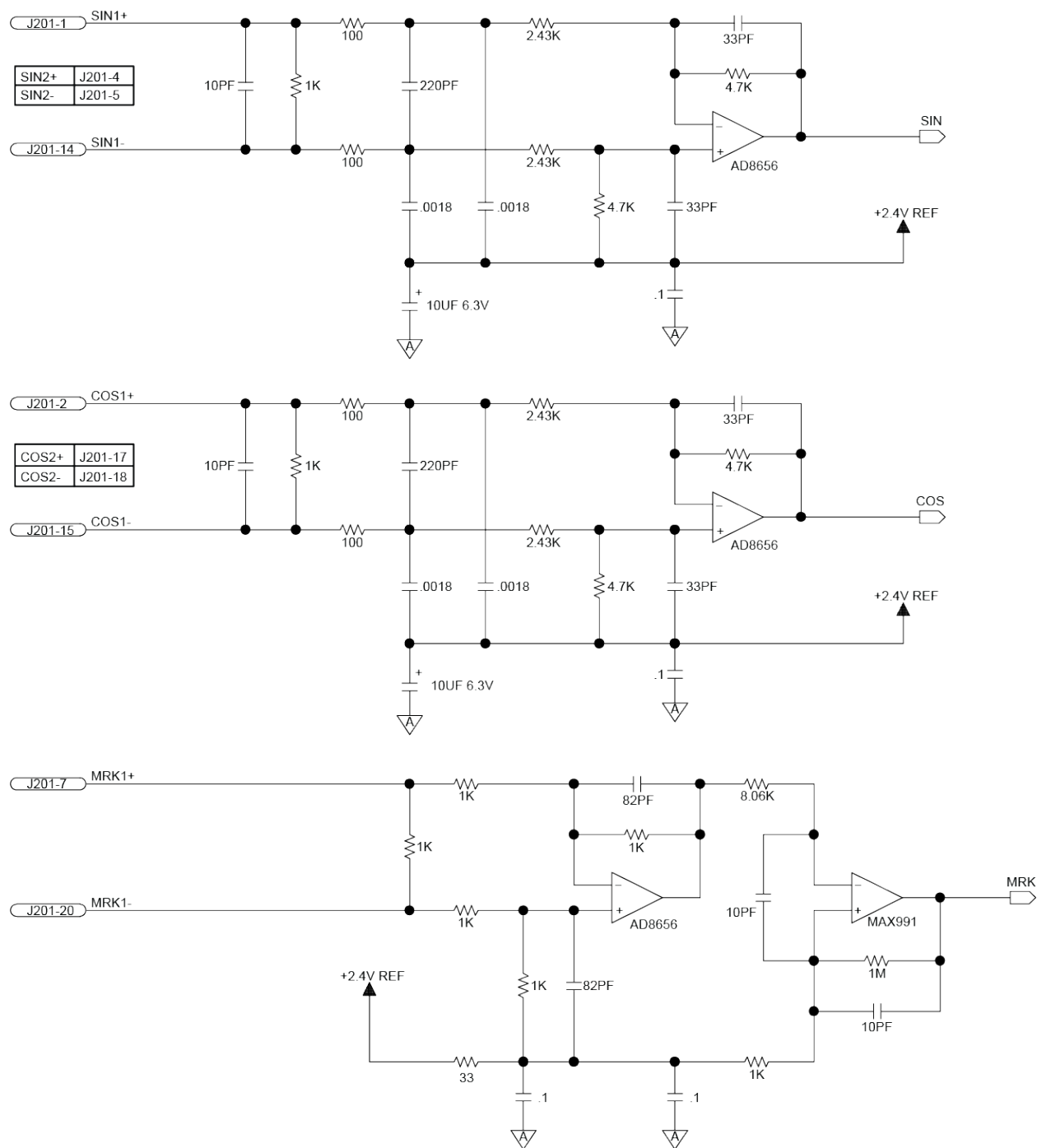


Figure 2-13: Analog Encoder Input Schematic

### 2.6.2. Position Detector Inputs (J201 and J202)

The Nmark CLS is equipped with one position detector input channel per Galvo connector that can be configured for position feedback via parameter settings.

The position detector interface circuitry expects two differential voltage signals, a positive sense and a negative sense, which are proportional to absolute position. The difference between the positive sense and the negative sense inputs determines the absolute position.

When interfacing to an Aerotech AGV Galvo, the feedback sensitivity is 5255.4888 counts / degree.

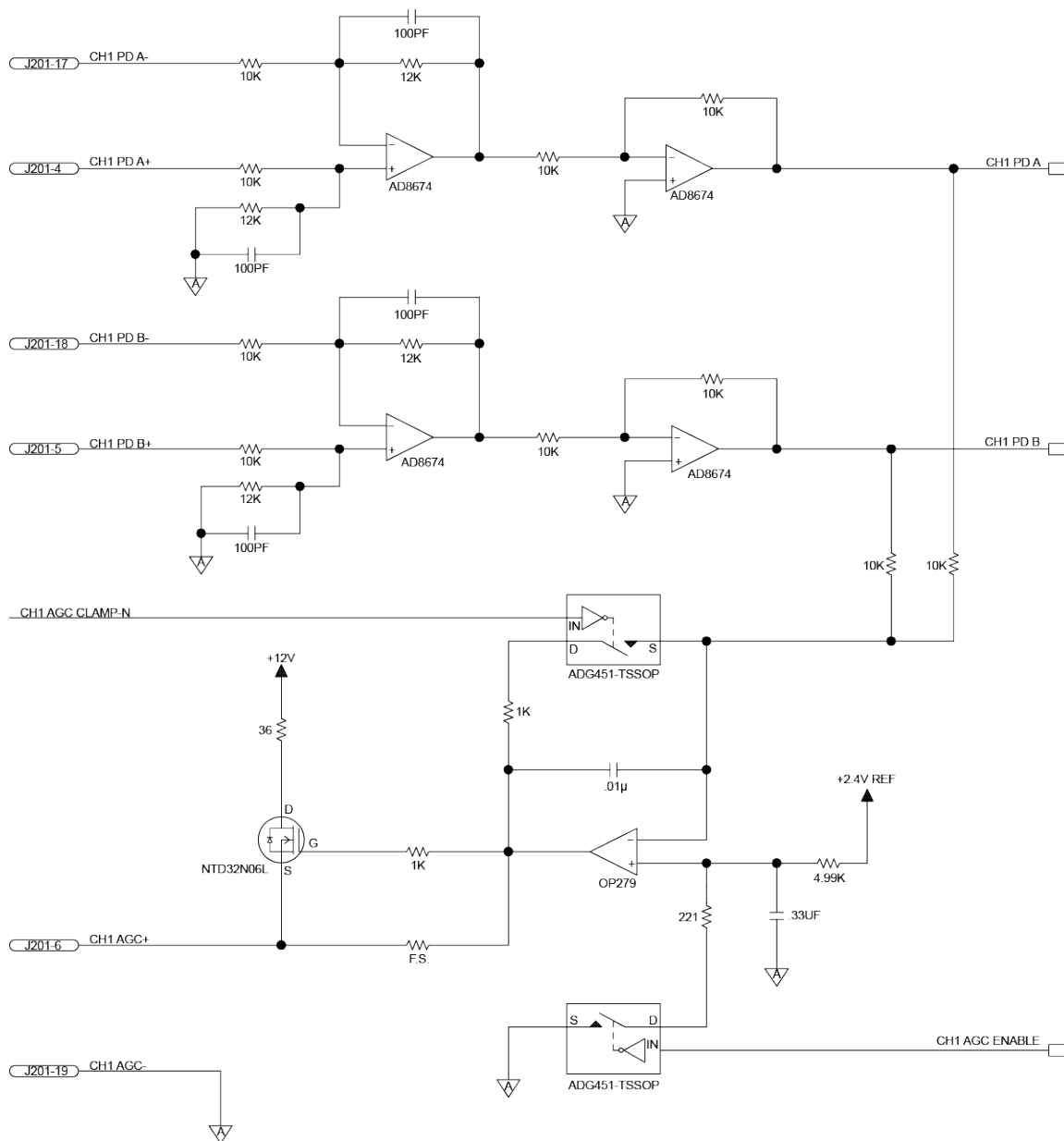


Figure 2-14: Position Detector Inputs Schematic

### **2.6.3. Fan Power Supply (J201 and J202)**

A user accessible power supply (+24V, 500mA) is available to provide power for a fan.

### **2.6.4. Galvo Motor Connection (J201 and J202)**

The Nmark CLS is capable of controlling a DC Brush motor only.

## 2.7. Digital Outputs (TB101 A)

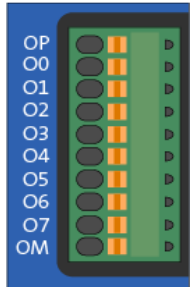
The digital outputs are optically-isolated and can be connected in sourcing or sinking configurations. The digital outputs are designed to connect to other ground referenced circuits and are not intended to provide high-voltage isolation.

Outputs must be connected in either all sinking or all sourcing mode. [Figure 2-16](#) and [Figure 2-17](#) 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:** Power supply connections must always be made to both the Output Common Plus (OP) and Output Common Minus (OM) pins as shown in [Figure 2-16](#) and [Figure 2-17](#).

**Table 2-23: Digital Outputs Pinout (TB101 A)**

Pin #	Label	Description	In/Out/Bi	Connector
1	OP	Output Common Plus	Input	
2	O0	Output 0 (Optically-Isolated)	Output	
3	O1	Output 1 (Optically-Isolated)	Output	
4	O2	Output 2 (Optically-Isolated)	Output	
5	O3	Output 3 (Optically-Isolated)	Output	
6	O4	Output 4 (Optically-Isolated)	Output	
7	O5	Output 5 (Optically-Isolated)	Output	
8	O6	Output 6 (Optically-Isolated)	Output	
9	O7	Output 7 (Optically-Isolated)	Output	
10	OM	Output Common Minus	Input	

**Table 2-24: Mating Connector Part Numbers for the Digital Output Connector (TB101 A/B)**

	Aerotech P/N	Phoenix P/N	Wire Size: mm <sup>2</sup> [AWG]
10-Pin Terminal Block	ECK01294	1881406	0.5-0.080 [20-28]

**Table 2-25: Digital Output Specifications (TB101)**

Opto Device Specifications	Value
Maximum Voltage	24 V maximum
Maximum Sink/Source Current	60 mA/channel @ 50°C
Output Saturation Voltage	2.75 V at maximum current
Output Resistance	33 Ω
Rise / Fall Time	250 usec (typical)
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 2-17](#) for an example of a current sinking output with diode suppression and [Figure 2-16](#) for an example of a current sourcing output with diode suppression.

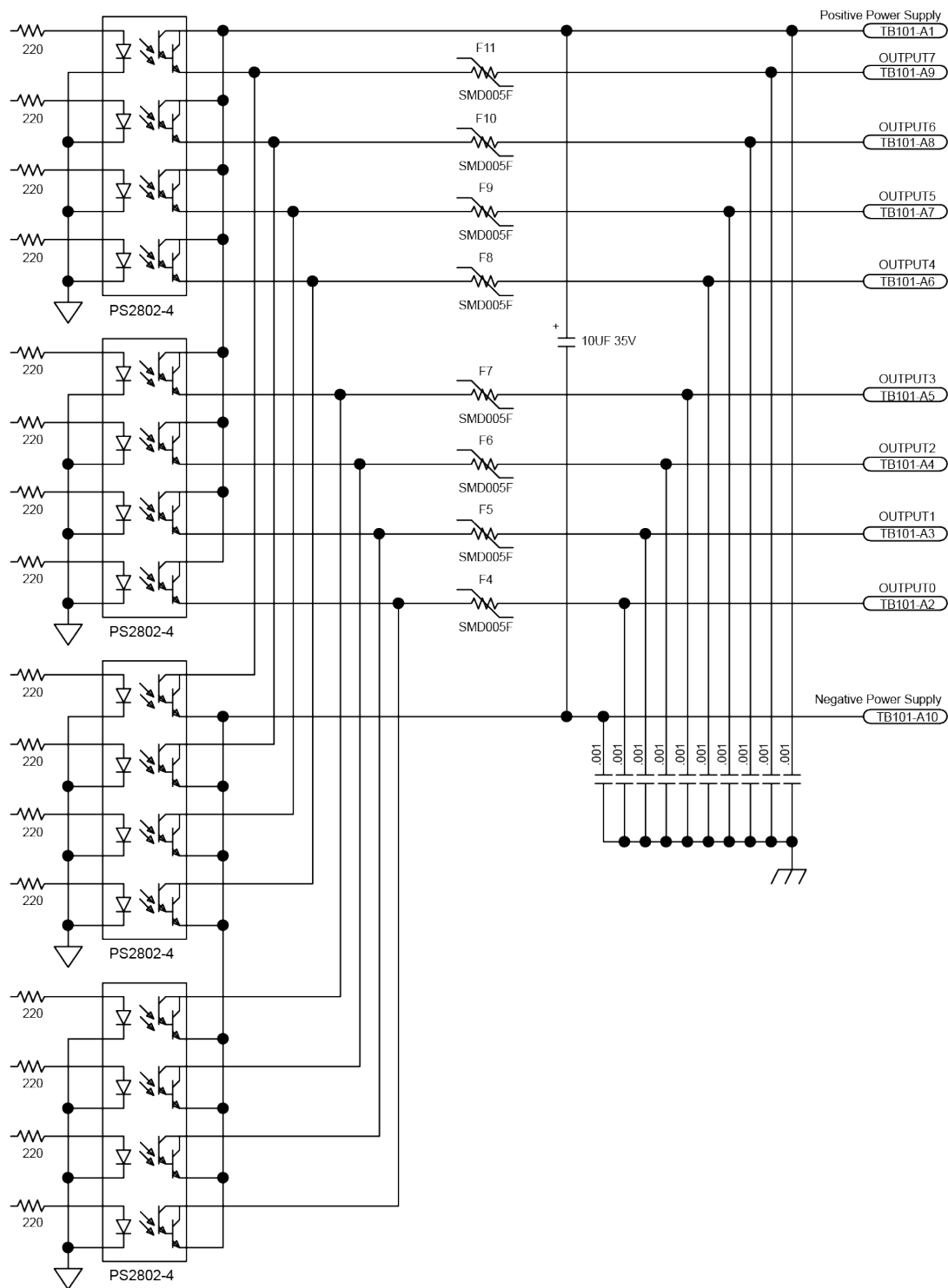
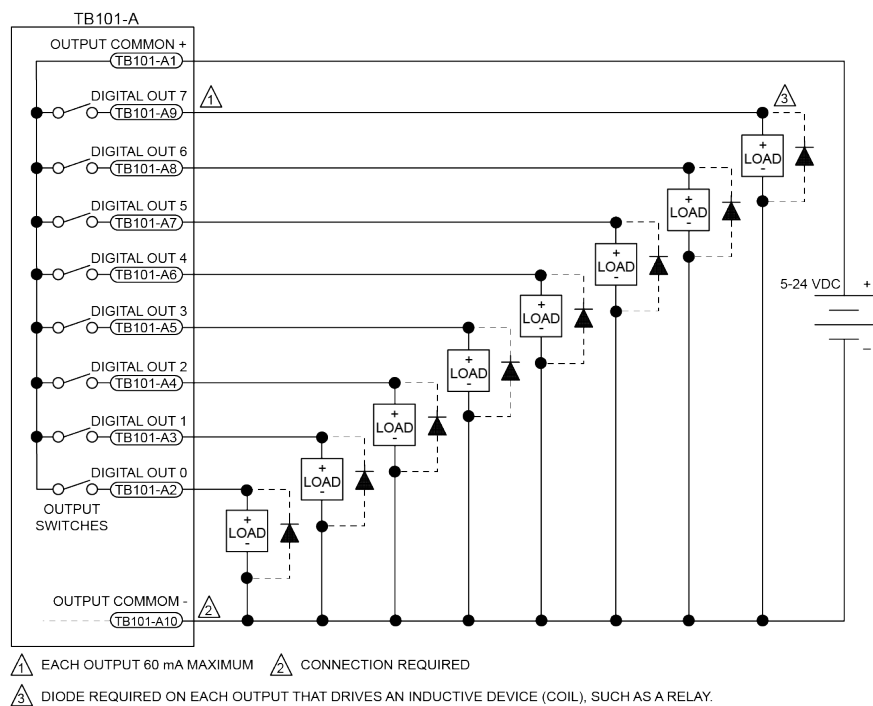
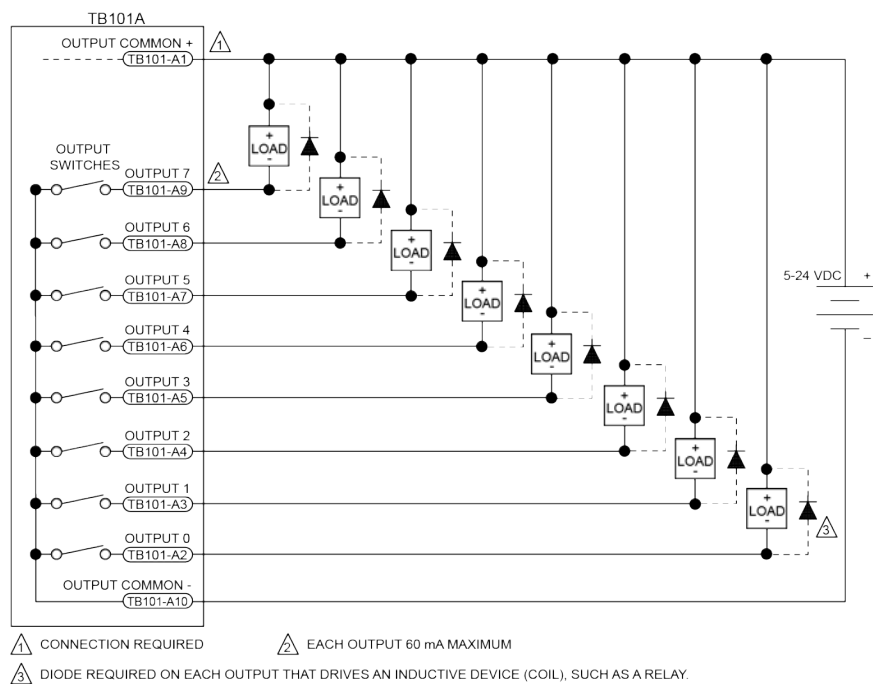


Figure 2-15: Digital Outputs (TB101 A)



**Figure 2-16: Outputs Connected in Current Sourcing Mode**



**Figure 2-17: Outputs Connected in Current Sinking Mode**

## 2.8. Digital Inputs (TB101 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.

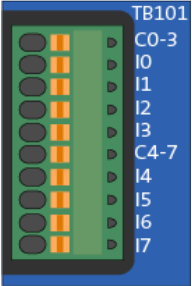
Inputs 0-3 and inputs 4-7 have separate common inputs (refer to [Table 2-27](#)). Each 4-bit bank of inputs must be connected in the same configuration (sinking or sourcing). Bank 1 can be connected differently from Bank 2, however.

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 2-26: Digital Input Specifications**

Input Voltage	Approximate Input Current	Turn On Time	Turn Off Time
+5 V	1 mA	200 usec	2000 usec
+24 V	6 mA	4 usec	1500 usec

**Table 2-27: Digital Inputs Pinout (TB101 B)**

Pin #	Label	Description	In/Out/Bi	Connector
1	C0-3	Input Common for Inputs 0-3	Input	
2	I0	Input 0	Input	
3	I1	Input 1	Input	
4	I2	Input 2	Input	
5	I3	Input 3	Input	
6	C4-7	Input Common for Inputs 4-7	Input	
7	I4	Input 4	Input	
8	I5	Input 5	Input	
9	I6	Input 6	Input	
10	I7	Input 7	Input	

**Table 2-28: Mating Connector Part Numbers for the Digital I/O Connector (TB101 A/B)**

	Aerotech P/N	Phoenix P/N	Wire Size: mm <sup>2</sup> [AWG]
10-Pin Terminal Block	ECK01294	1881406	0.5-0.080 [20-28]

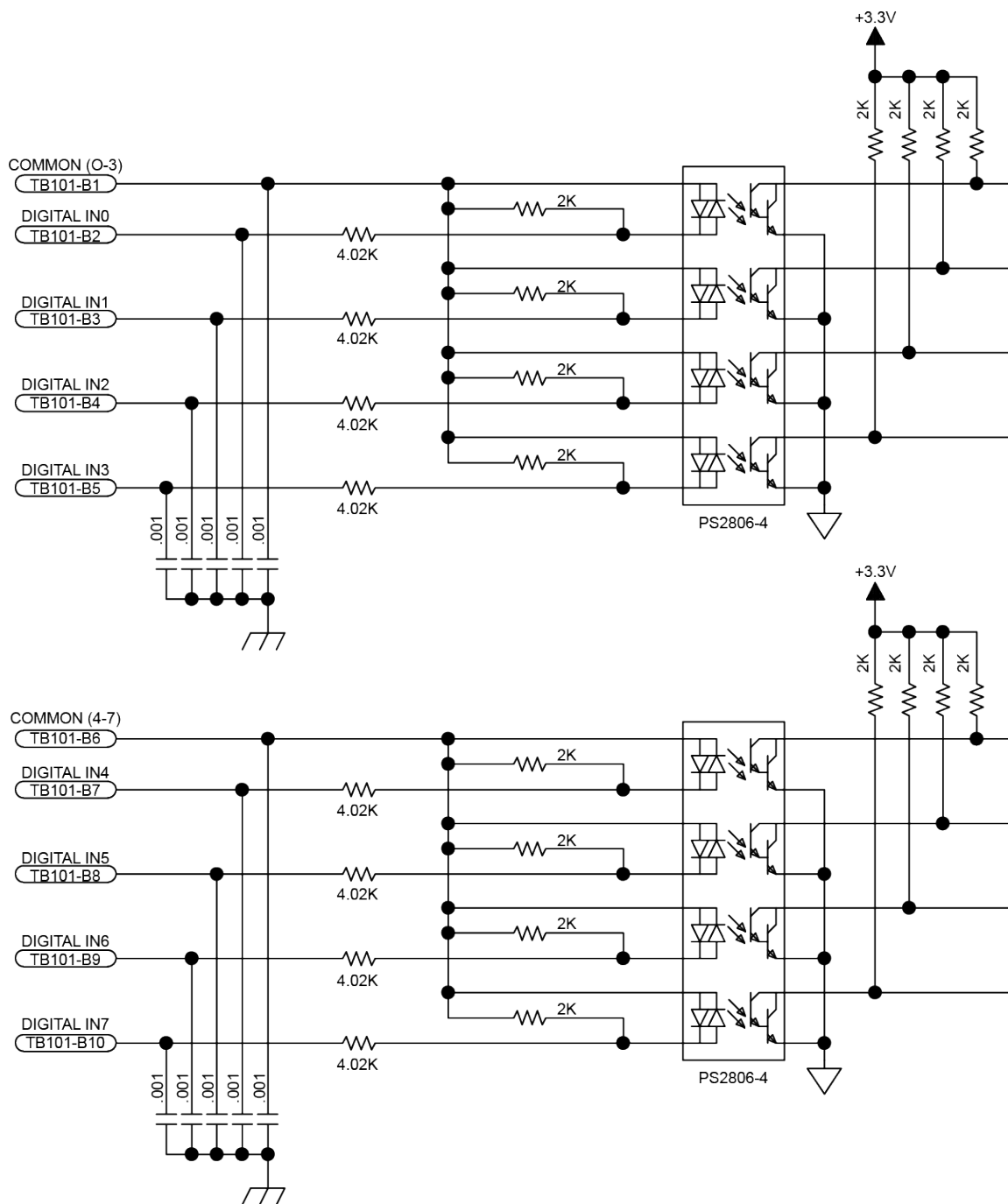
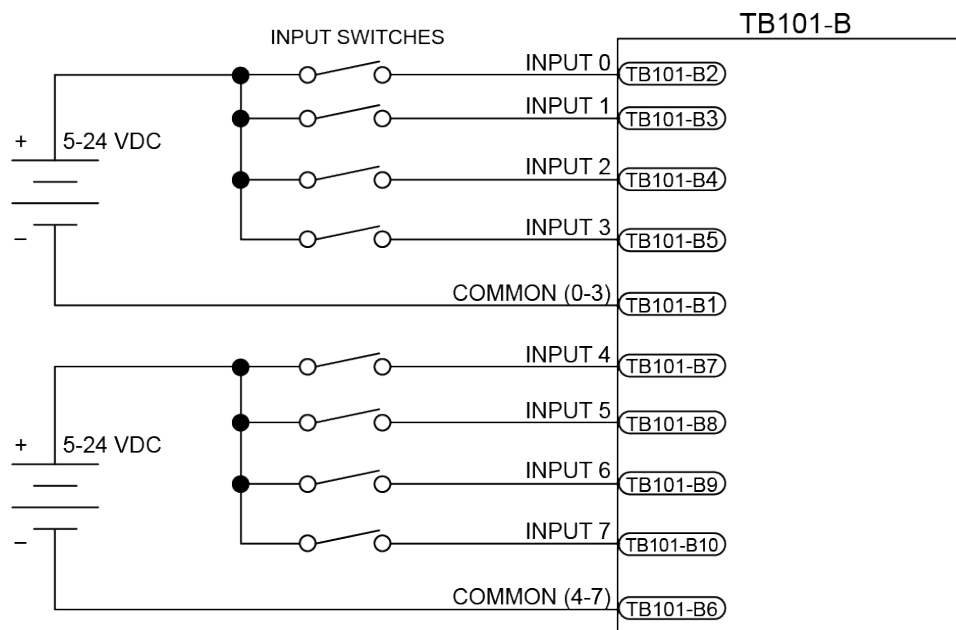
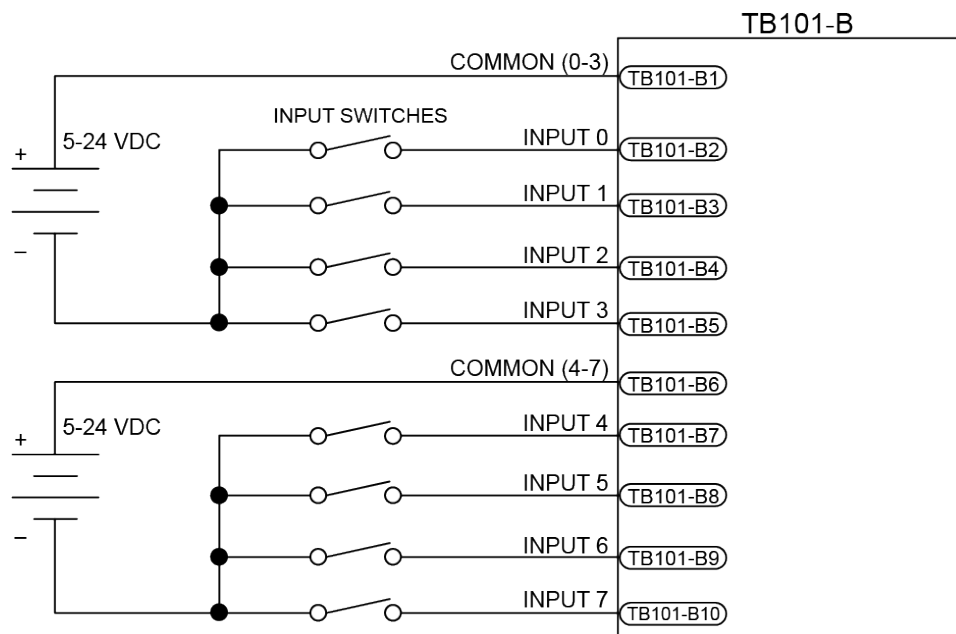


Figure 2-18: Digital Inputs (TB101 B)



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

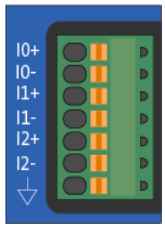


**Figure 2-20: Inputs Connected to a Current Sinking Device**

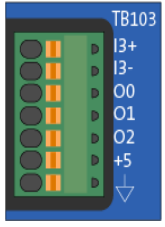
## 2.9. Analog I/O Interface (TB103 A/B)

This connector has four differential analog inputs and three analog outputs.

**Table 2-29: Analog I/O Pinout (TB103 A)**

Pin	Label	Description	In/Out/Bi	Connector
1	I0+	Analog Input 0+	Input	
2	I0-	Analog Input 0-	Input	
3	I1+	Analog Input 1+	Input	
4	I1-	Analog Input 1-	Input	
5	I2+	Analog Input 2+	Input	
6	I2-	Analog Input 2-	Input	
7	⏚	Analog Common	N/A	

**Table 2-30: Analog I/O Pinout (TB103 B)**

Pin	Label	Description	In/Out/Bi	Connector
1	I3+	Analog Input 3+	Input	
2	I3-	Analog Input 3-	Input	
3	O0	Analog Output 0	Output	
4	O1	Analog Output 1	Output	
5	O2	Analog Output 2	Output	
6	+5	+5V Output Power	Output	
7	⏚	Analog Common	N/A	

**Table 2-31: Mating Connector Part Numbers for the Analog I/O Connector (TB103 A/B)**

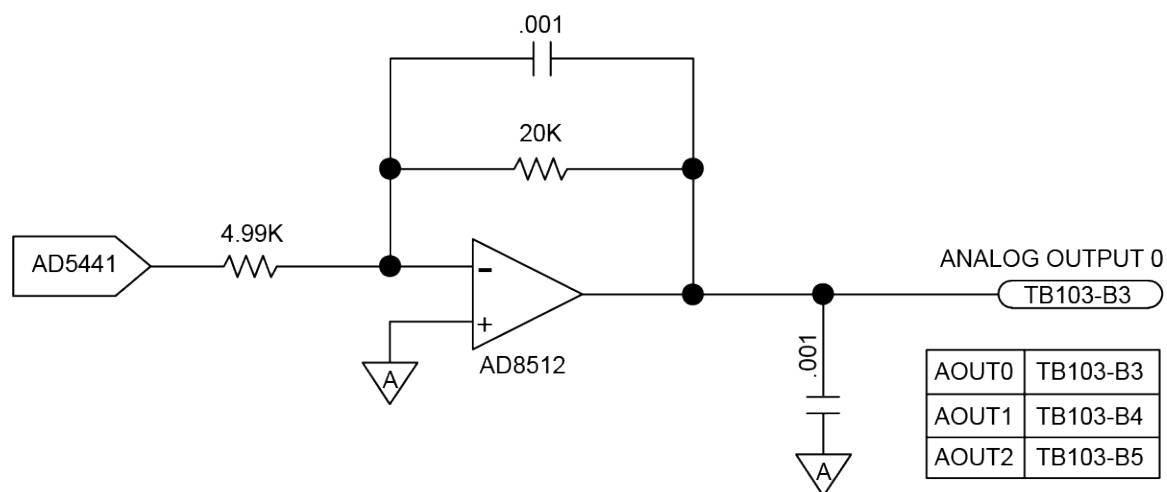
Type	Aerotech P/N	Phoenix P/N	Wire Size: mm <sup>2</sup> [AWG]
7-Pin Terminal Block	ECK01631	1881370	0.5 - 0.080 [20-28]

### 2.9.1. Analog Outputs (TB103 B)

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

**Table 2-32: Analog Output Specifications (TB103 B)**

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



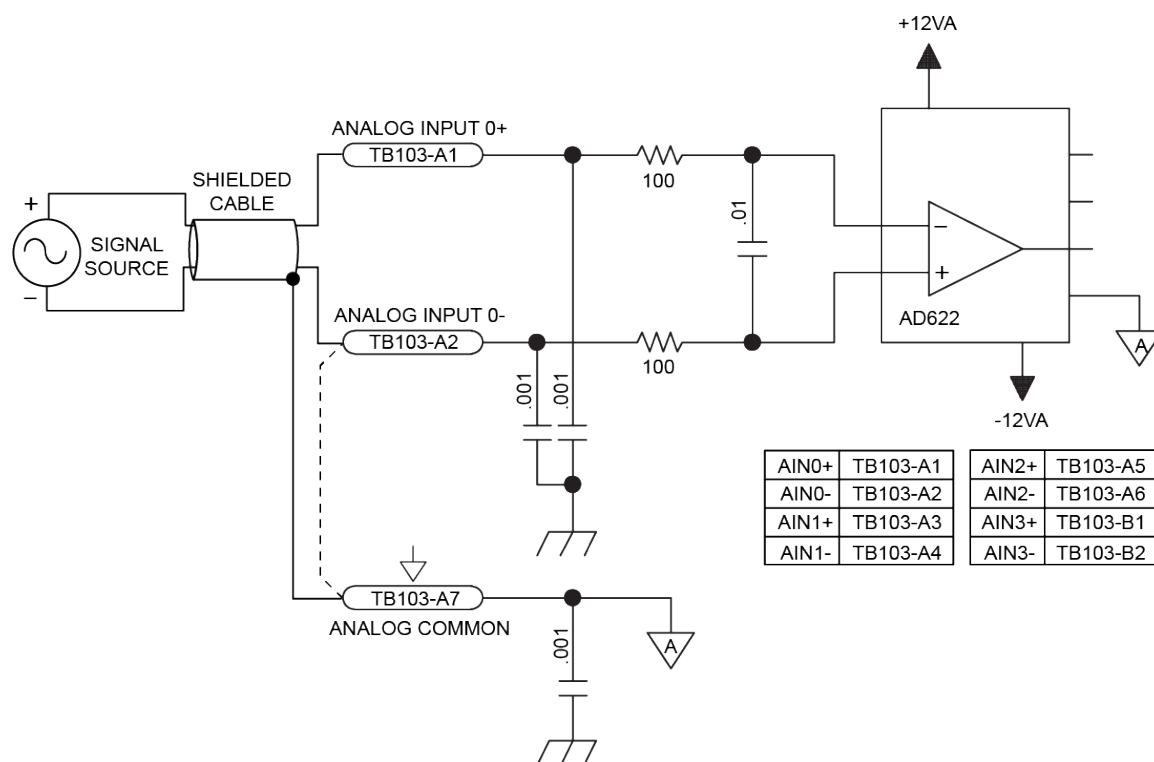
**Figure 2-21: Analog Outputs (TB103 B)**

### 2.9.2. Differential Analog Inputs (TB103 A/B)

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 2-33: Differential Analog Input Specifications (TB103 A/B)**

Specification	Value
(AI+) - (AI-)	+10 V to -10 V <sup>(1)</sup>
Resolution (bits)	16 bits
Resolution (volts)	305 $\mu$ V
1. Signals outside of this range may damage the input	



**Figure 2-22: Analog Inputs (TB103)**

## 2.10. Digital I/O Connector Interface (TB107 A/B)

The digital I/O connector provides eight non-isolated inputs and two non-isolated outputs. The inputs are filtered and connected to a 74LCX16244 (Figure 2-23). The two outputs are driven by 74AHCT1G14 inverters (Figure 2-24).

**Table 2-34: Digital Input Specifications (TB107)**

Specification	Value
Input Voltage	+5 VDC

**Table 2-35: Digital Output Specifications (TB107)**

Specification	Value
Output Voltage	+5 VDC
Output Current	24 mA

**Table 2-36: Digital I/O Pinout (TB107 A)**

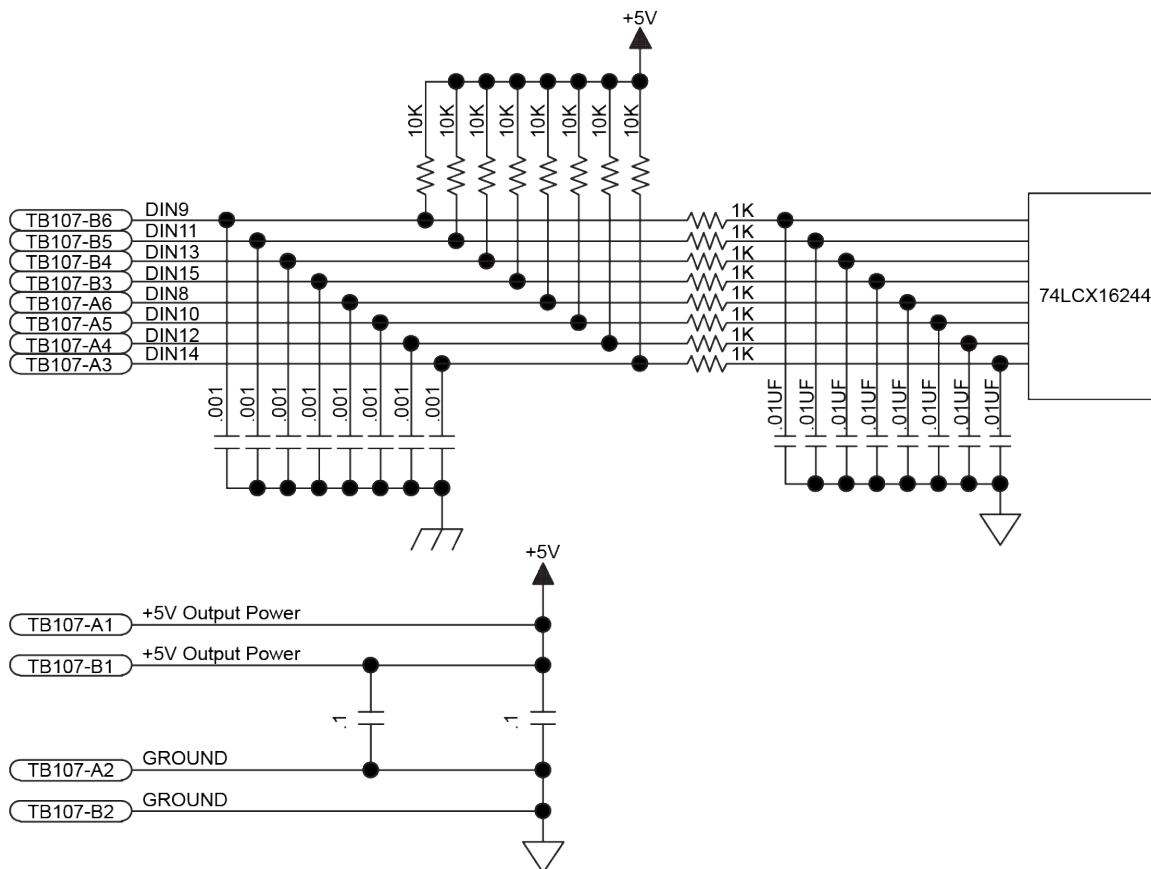
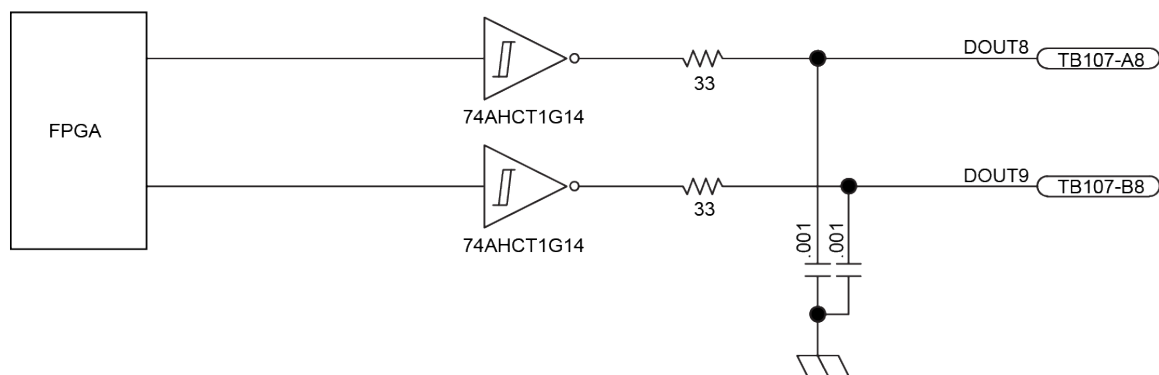
Pin	Label	Description	In/Out/Bi
1	+5V	+5V Output Power	Output
2	▽	Ground	N/A
3	DI14	Digital Input 14	Input
4	DI12	Digital Input 12	Input
5	DI10	Digital Input 10	Input
6	DI8	Digital Input 8	Input
7	N/C	No Connection	N/A
8	DO8	Digital Output 8	Output

**Table 2-37: Digital I/O Pinout (TB107 B)**

Pin	Label	Description	In/Out/Bi
1	+5V	+5V Output Power	Output
2	▽	Ground	N/A
3	DI15	Digital Input 15	Input
4	DI13	Digital Input 13	Input
5	DI11	Digital Input 11	Input
6	DI9	Digital Input 9	Input
7	N/C	No Connection	N/A
8	DO9	Digital Output 9	Output

**Table 2-38: Mating Connector Part Numbers for the Digital I/O Connector (TB107 A/B)**

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

**Figure 2-23: Digital Inputs (TB107)****Figure 2-24: Digital Outputs (TB107)**

## 2.11. Auxiliary Encoder Interface (TB108)

The Nmark CLS is equipped with two auxiliary encoder input channels that are accessible through TB108A/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 CLS.

**Table 2-39: Encoder Input Specifications (TB108)**

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

**Table 2-40: Axis 1 Auxiliary Encoder Interface Pinout (TB108A)**

Pin	Label	Description	In/Out/Bi
1	+5V	+5V Encoder Power	Output
2	▽	Ground	N/A
3	SIN+	Encoder SIN+ Input	Input
4	SIN-	Encoder SIN- Input	Input
5	COS+	Encoder COS+ Input	Input
6	COS-	Encoder COS- Input	Input
7	MRK+	Encoder MRK+ Input	Input
8	MRK-	Encoder MRK- Input	Input

**Table 2-41: Axis 2 Auxiliary Encoder Interface Pinout (TB108B)**

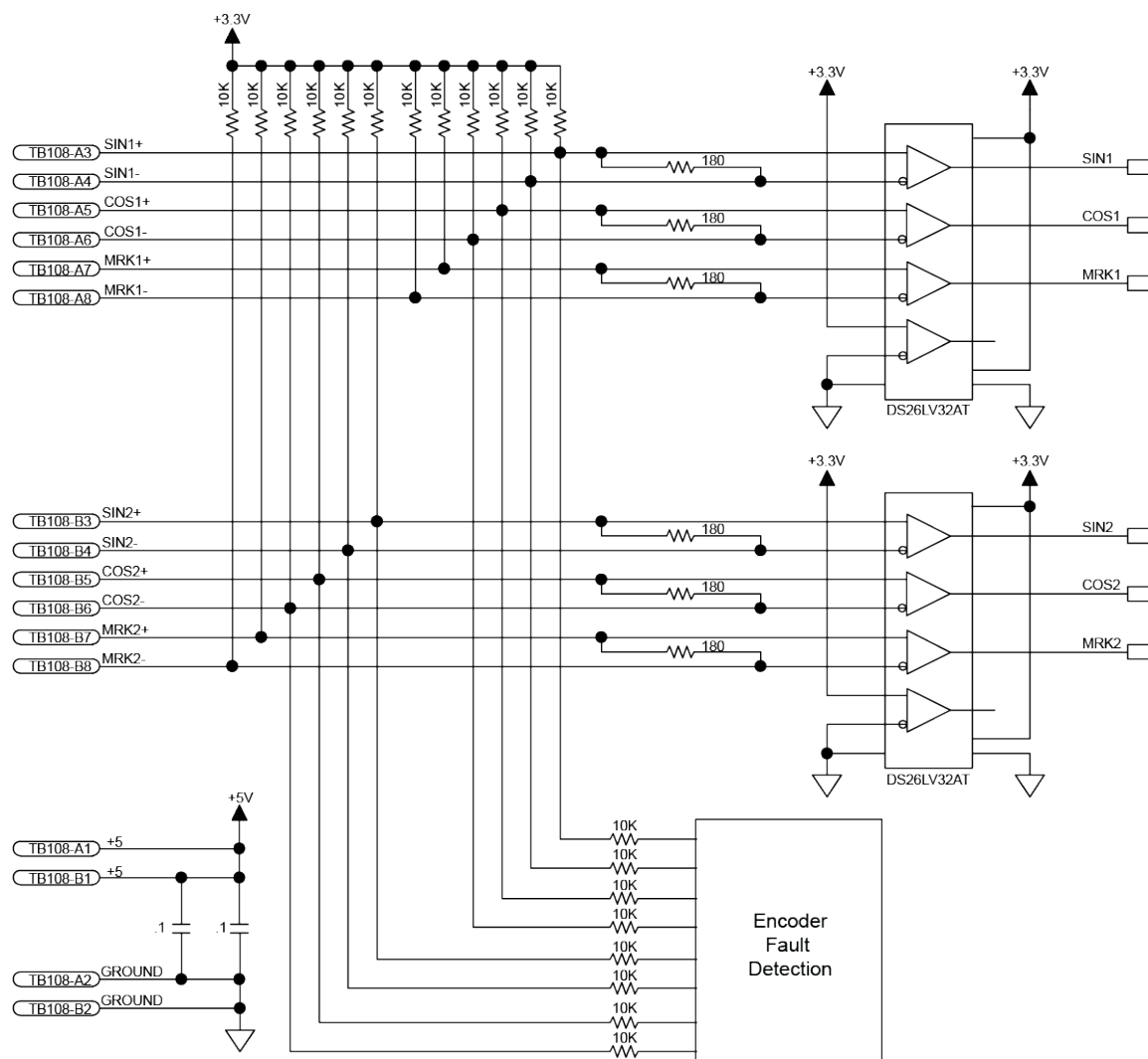
Pin	Label	Description	In/Out/Bi
1	+5V	+5V Encoder Power	Output
2	▽	Ground	N/A
3	SIN+	Encoder SIN+ Input	Input
4	SIN-	Encoder SIN- Input	Input
5	COS+	Encoder COS+ Input	Input
6	COS-	Encoder COS- Input	Input
7	MRK+	Encoder MRK+ Input	Input
8	MRK-	Encoder MRK- Input	Input

**Table 2-42: Mating Connector Part Numbers for the Auxiliary Encoder Connector (TB108 A/B)**

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

**Table 2-43: Nmark CLS to Drive Cable Part Numbers**

Drive Type	Cable P/N
Ndrive CP, HPe, or HLe	C23161-xx
Ndrive MP, ML	C23940-xx
Npaq	C23320-xx

**Figure 2-25: Encoder Connections (TB108 A/B)**

## 2.12. Switch S1 (Laser Output Polarity/Configuration)

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

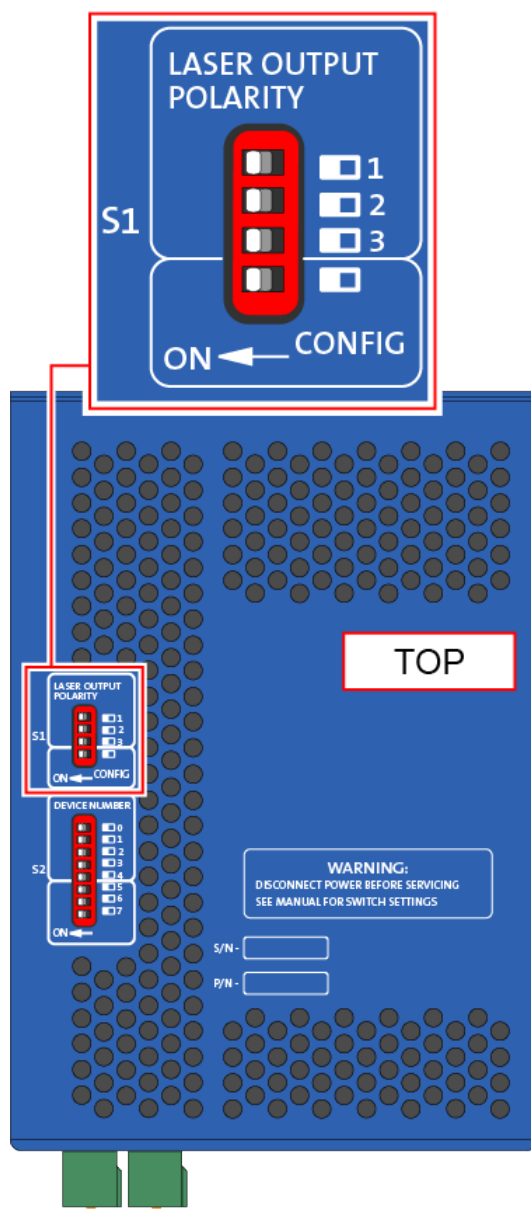


Figure 2-26: Switch S1 (Laser Output Polarity/Configuration)

### **2.13. 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

Except for S1 and S2, the Nmark CLS does not have any user-configurable switches or jumpers.



**DANGER:** Always disconnect the Mains power connection before opening the Nmark CLS 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.

**Table 3-1: LED Description**

LED	Description
PWR*	Turns green when power is applied.
STAT	Turns green to indicate the laser output is firing. Turns red to indicate a fault condition on any axis.
* If the power light flashes continuously and the unit does not operate, there is too much current draw from the 5V power supply or the control supply voltage level is low.	

### 3.1. Board Assembly

Figure 3-1 highlights the important components located on the control board. Table 3-2 lists the jumpers and the default configurations for the Nmark board. Refer to Figure 3-2 for Power Board fuse location and Table 3-4 for fuse information.



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

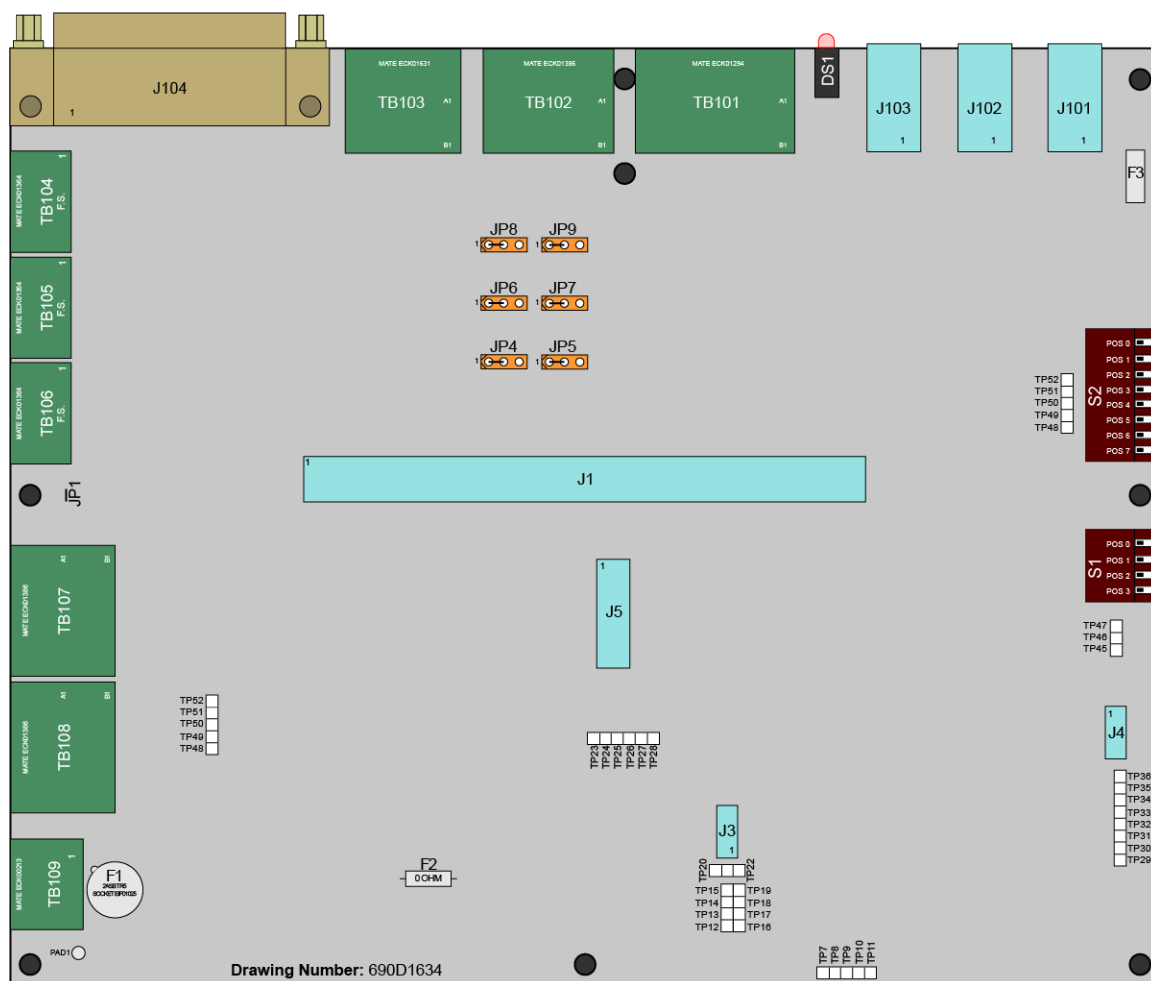


Figure 3-1: Control Board Assembly

**Table 3-2: Control Board Jumper Selections**

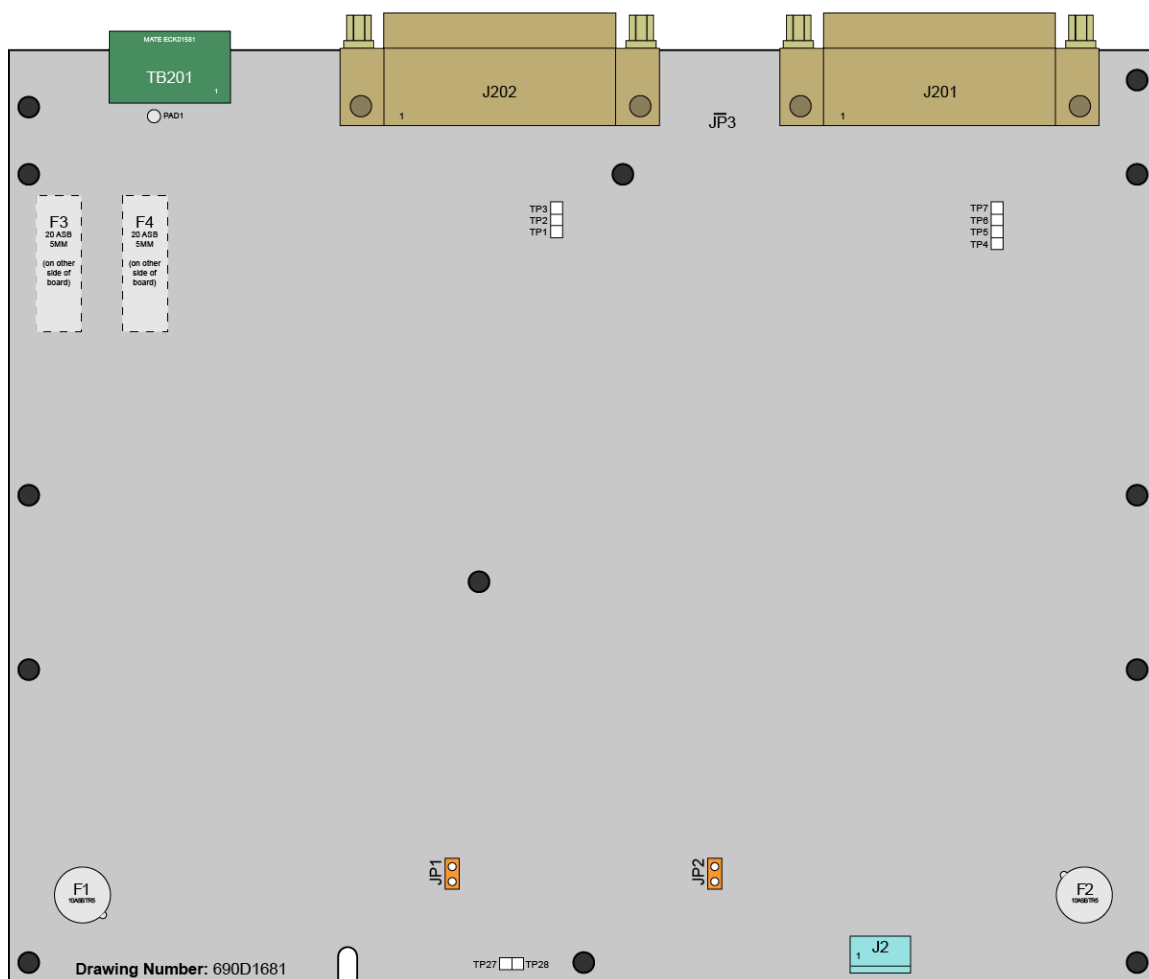
Jumpers	Positions	Function
JP4-JP5	1-2 <sup>(1)</sup>	Laser Output 3 (O3) Sinking
	2-3	Laser Output 3 (O3) Sourcing
JP6-JP7	1-2 <sup>(1)</sup>	Laser Output 2 (O2) Sinking
	2-3	Laser Output 2 (O2) Sourcing
JP8-JP9	1-2 <sup>(1)</sup>	Laser Output 1 (O1) Sinking
	2-3	Laser Output 1 (O1) Sourcing
(1) Default		

**Table 3-3: Control Board Fuse Specifications**

Fuse	Description	Size	Aerotech P/N	Manufacturer's P/N
F1	Control Power at TB109-1	2 A S.B.	EIF01029	Littelfuse 3721200041
F3	FireWire power at J101-103	3 A	EIF01001	Raychem RGE300
NOTE: F3 is a resettable fuse (turn off power and remove the short. F3 does not require replacement.				



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



**Figure 3-2: Power Board Assembly**

**Table 3-4: Power Board Fuses**

Fuse	Description	Size	Aerotech P/N	Manufacturer's P/N
F1	Motor Output (Channel 2)	10 A S.B.	EIF01035	Littelfuse 374210
F2	Motor Output (Channel 1)	10 A S.B.	EIF01035	Littelfuse 374210
F3	Motor Bus Supply (B-)	20 A S.B.	EIF01041	Littelfuse 215020.p
F4	Motor Bus Supply (B+)	20 A S.B.	EIF01041	Littelfuse 215020.p
NOTE: F3 and F4 can be located on the bottom of the board.				

## 3.2. Preventative Maintenance

The Nmark CLS 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 CLS chassis.

**Table 3-5: Preventative Maintenance**

Check	Action to be Taken
Visually Check chassis for loose or damaged parts / hardware. <b>Note:</b> 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 CLS.
Visually inspect all cables and connections.	Tighten or re-secure any loose connections. Replace worn or frayed cables. Replace broken connectors.

### Cleaning

The Nmark CLS 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 CLS 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 CLS while cleaning. Do not allow cleaning substances or other fluids to enter the Nmark CLS or to get on to any of the connectors. Avoid cleaning labels to prevent removing the label information.

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## Appendix A: Warranty and Field Service

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

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

### Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within thirty (30) days of shipment of incorrect material. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. A "Return Materials Authorization (RMA)" number must accompany any returned product(s). The RMA number may be obtained by calling an Aerotech service center or by submitting the appropriate request available on our website ([www.aerotech.com](http://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
1.04.00	<ul style="list-style-type: none"><li>Updated <a href="#">EU Declaration of Conformity</a></li><li>Added cable part numbers: <a href="#">Section 2.11</a>.</li></ul>
1.03.00	Declaration of Conformity updated: <a href="#">EU Declaration of Conformity</a>
1.02.00	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
1.01.00	
1.00.00	

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