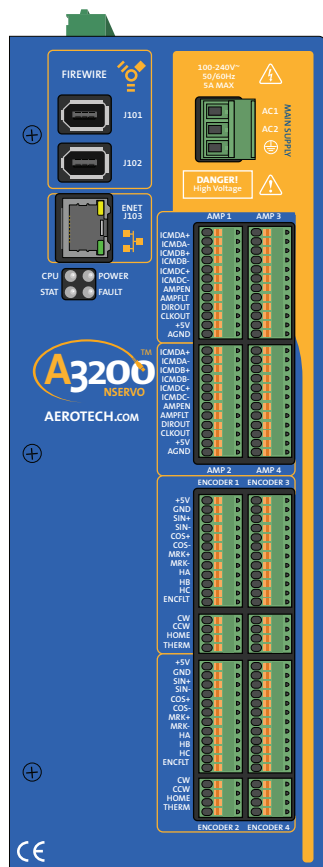


# Nservo Hardware Manual

Revision: 3.04.00



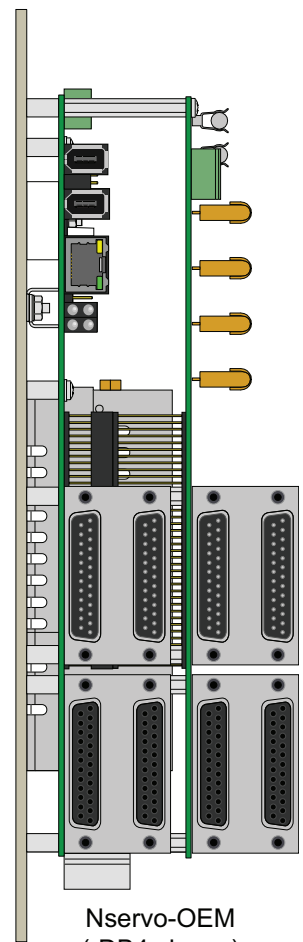
-DB4 4-axis option



-TB4 4-axis option



OP500 Interface  
(-OP option)



Nservo-OEM  
(-DB4 shown)

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# EC Declaration of Conformity

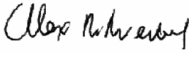
**Manufacturer** Aerotech, Inc.  
**Address** 101 Zeta Drive  
 Pittsburgh, PA 15238-2897  
 USA  
**Product** Nservo  
**Model/Types** All

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

2006/95/EC	Low Voltage Directive
2011/65/EU	RoHS 2 Directive

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

EN 61000-4-5	Surge Immunity
EN 61000-4-6	Conducted Immunity
EN 61000-4-11	Voltage Dips and Interruptions
EN 61010-1	Safety requirements for electrical equipment

**Name**  / Alex Weibel  
**Position** Engineer Verifying Compliance  
**Location** Pittsburgh, PA  
**Date** June 26, 2015

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# Safety Procedures and Warnings

Read this manual in its entirety before installing, operating, or servicing this product. If you do not understand the information contained herein, contact an Aerotech representative before proceeding. Strictly adhere to the statements given in this section and other handling, use, and operational information given throughout the manual to avoid injury to you and damage to the equipment.

The following statements apply wherever the Warning or Danger symbol appears within this manual. Failure to observe these precautions could result in serious injury to those individuals performing the procedures and/or damage to the equipment.

**NOTE:** 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.

**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. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
5. Make sure the Nservo and all components are properly grounded in accordance with local electrical safety requirements.
6. 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.

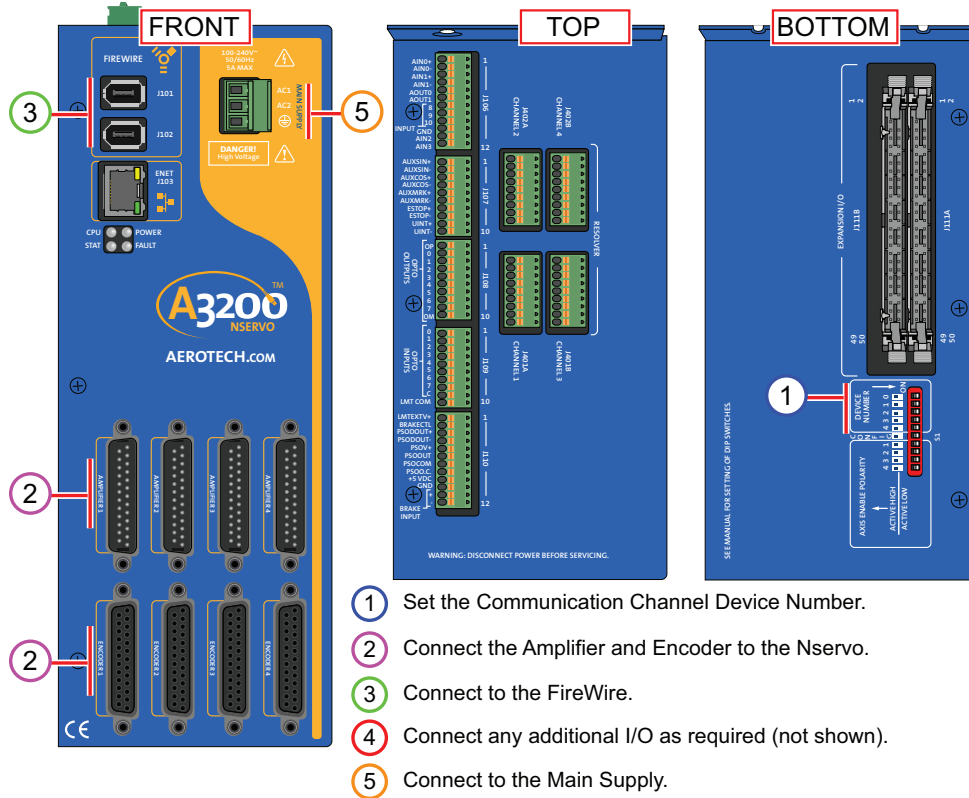
1. Use of this equipment in ways other than described by this manual can cause personal injury or equipment damage.
2. Moving parts can cause crushing or shearing injuries. Access to all stage and motor parts must be restricted while connected to a power source.
3. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
4. Do not expose the Nservo to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
5. If the Nservo is used in a manner not specified by the manufacturer, the protection provided by the Nservo can be impaired and result in damage, shock, injury, or death.
6. Operators must be trained before operating this equipment.
7. All service and maintenance must be performed by qualified personnel.
8. The Nservo is intended for light industrial manufacturing or laboratory use. Use of the Nservo for unintended applications can result in injury and damage to the equipment.



# Quick Installation Guide

This chapter describes the order in which connections and settings should typically be made to the Nservo. 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.

**NOTE:** If you purchased an Nservo-OEM, refer to [Section 2.6](#).



Step	Topic	Section
1	Set the Device Number	<a href="#">Section 2.1. Communication Channel Settings</a>
2	Connect the Axis and Encoder	For -DB: <a href="#">Section 2.3. Connections to the Nservo-DB</a> For -TB: <a href="#">Section 2.5. Connections to the Nservo-TB</a> For -OP: <a href="#">Section 2.4. Connections to the Nservo-OP</a>
3	Connect the FireWire	<a href="#">Section 2.8. FireWire Interface</a>
4	Additional I/O	User / Application dependent
5	Connect to the Main Supply	<a href="#">Section 2.2. Power Connections</a>

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# Chapter 1: Introduction

Aerotech's Nservo allows an industry standard analog transconductance amplifier (voltage command, current output) to interface to Aerotech's Automation 3200 digital drive network. The IEEE-1394 (FireWire®) communication bus provides deterministic behavior, auto-identification, and easy software setup.

The Nservo's high performance double precision floating point DSP controls the digital PID loop. All system configuration is done using software-settable parameters, including control loop gains settings and system safety functions.

The Nservo is offered with an optional resolver feature (-RDP), a secondary square wave encoder input for dual loop control, and dedicated analog and digital I/O.

**NOTE:** If you purchased an Nservo-OEM, refer to [Section 2.6](#).

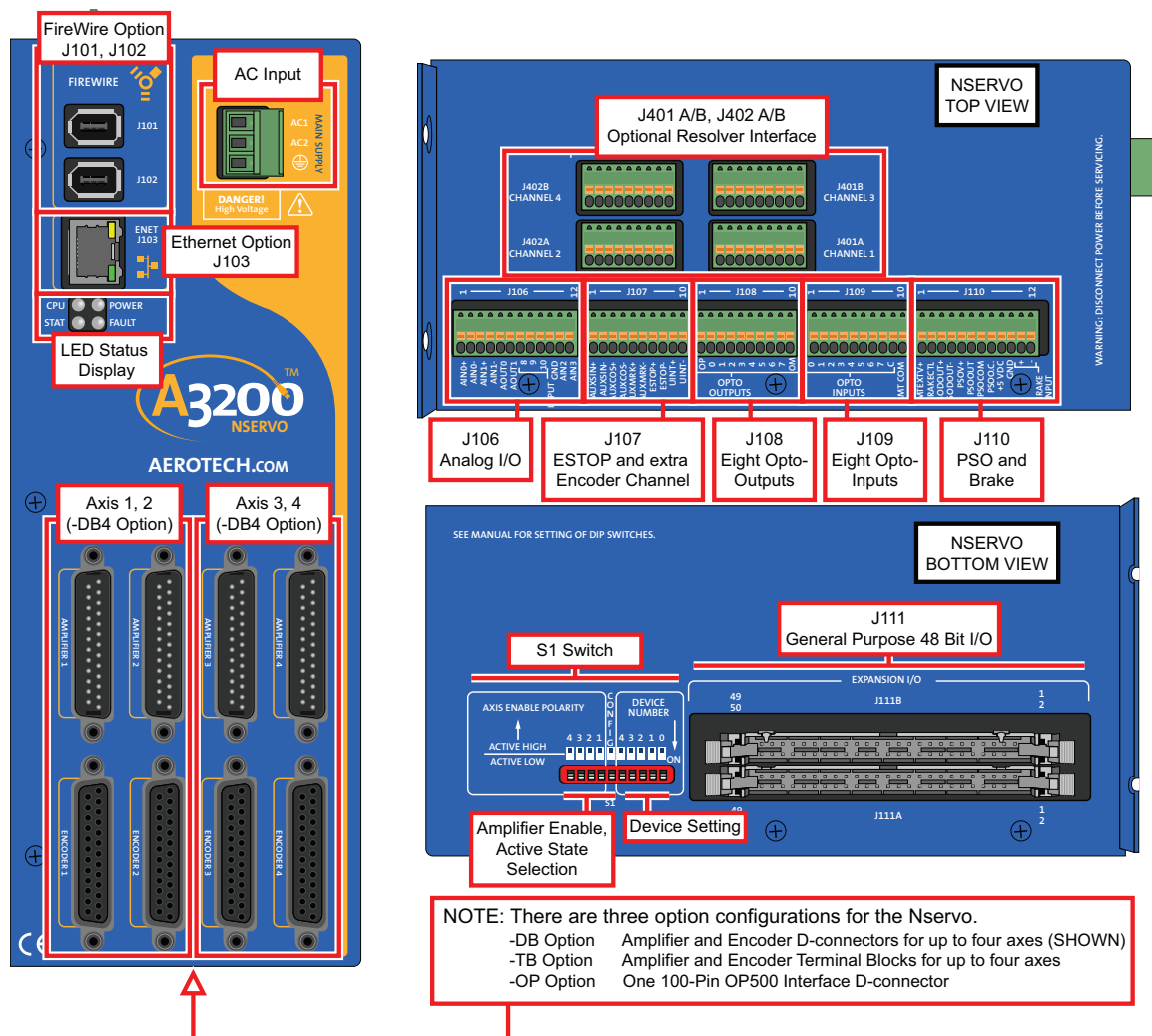


Figure 1-1: Nservo Drive Interface

**Table 1-1: Feature Summary**

Standard Features	
<ul style="list-style-type: none"> <li>• Supports 2 (standard) or 4 closed loop servo axes</li> <li>• Each axis has three <math>\pm 10</math> volt current command outputs</li> <li>• Up to 5 channels of 32 MHz line driver quadrature encoder inputs</li> <li>• Drive fault and 24-volt tolerant opto-isolated CW, CCW, Home inputs per axis powered by either an internal 5V or external power supply</li> <li>• 24-volt tolerant drive enable output per axis (open collector transistor; single ended; polarity selectable)</li> <li>• 11 digital inputs (8 optically isolated)</li> <li>• Eight opto-isolated digital outputs sinking or sourcing; 5-24V</li> <li>• Four 16-bit analog inputs, 2 are differential with x1, x2, x4, x10 input gains</li> <li>• Two 16 bit analog outputs</li> <li>• Opto-isolated PSO output (opto-coupled, open collector, differential)</li> <li>• All I/O connections via easily removable connectors</li> <li>• Two FireWire ports</li> <li>• Dedicated Emergency Stop sense input standard.</li> <li>• Internal power supply</li> <li>• Equivalent software functionality (less current loop support) to other drives in the A3200 family</li> <li>• Software configurable for brush, brushless and stepper motor operation</li> <li>• 5 VDC, 500 mA power output for encoder and limits, etc.</li> <li>• Fail safe brake control output (open collector)</li> <li>• Four auxiliary (U500/U600 compatible) open collector mode outputs</li> <li>• High-speed position latching input</li> <li>• 48 bits of programmable I/O, user definable as input/output by byte</li> </ul>	
Options	
-DB2	2 axis with D-Style Connectors for user interface
-DB4	4 axis with D-Style Connectors for user interface
-OP	OP500 legacy interface to DR500, BB500, etc. (4 axis)
-TB2	2 axis with terminal blocks for user interface
-TB4	4 axis with terminal blocks for user interface
-DPSO	Two axis PSO (laser firing), single axis PSO is standard
-TPSO	Three axis PSO (laser firing), single axis PSO is standard
-PSOOPTO1	Opto isolator for PSO (5V, high speed, high current, HCPL2601), standard.
-PSOOPTO2	Opto isolator for PSO (15VDC, high speed, low current, 6N136)
-PSOOPTO3	Opto isolator for PSO (30VDC, low speed, high current, 4N33)
-PSOOPTO4	Opto isolator for PSO (5-25VDC, 40kHz, 50mA, TIL117-M)
-RDP	Resolver to Digital Converter Input
-ENET	10/100 BASE-T Ethernet port
-LMT5V	Limit inputs configured for internal power, for -OP and -DB options
-NOLMT5V	For non-opto isolated inputs
-SE	Single ended (non-differential) analog inputs



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

**NOTE:** If you purchased an Nservo-OEM, refer to [Section 2.6](#).

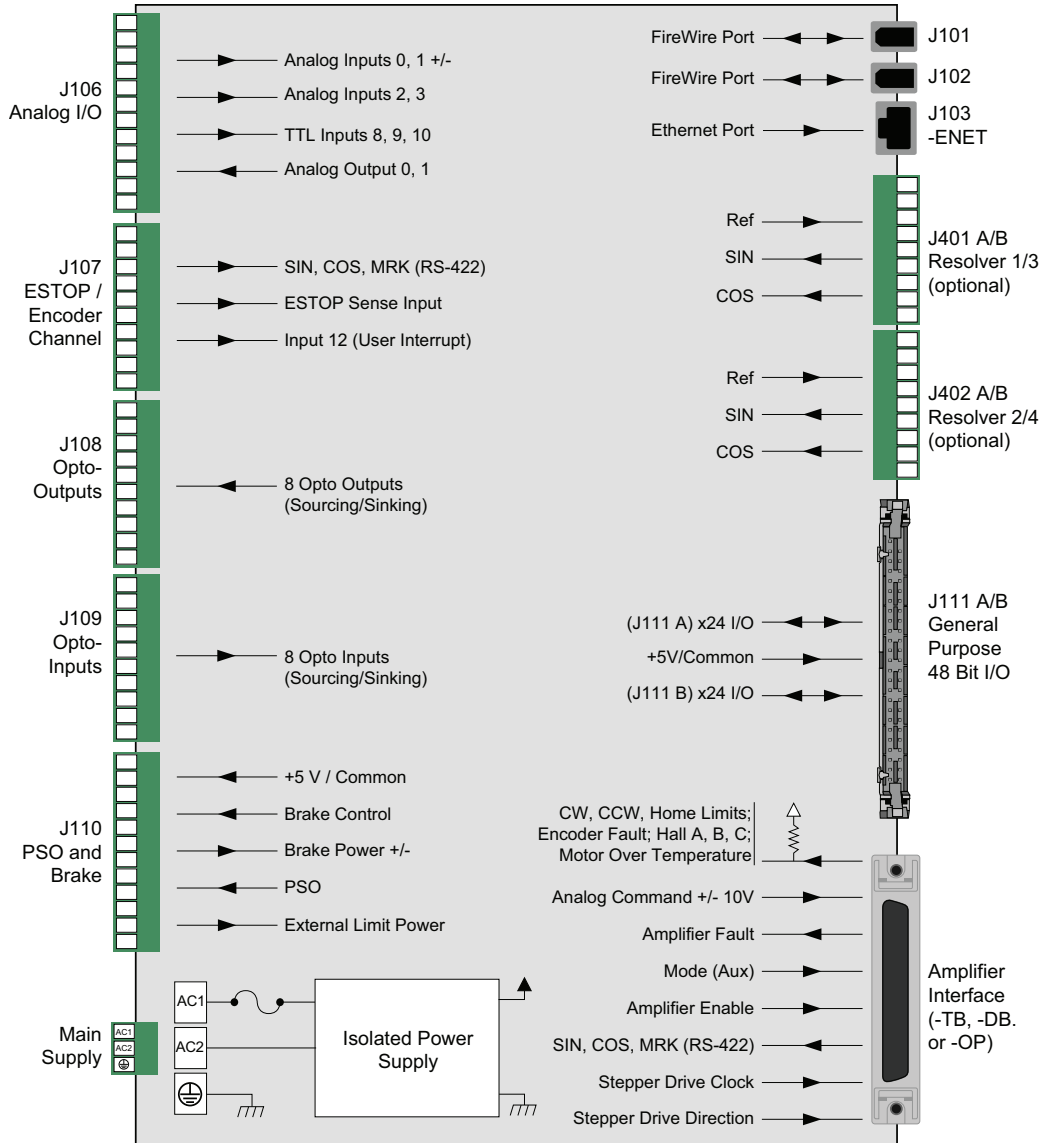


Figure 1-2: Functional Diagram

## 1.1. Electrical Specifications

The electrical specifications for the Nservo are listed below.

**Table 1-2: Electrical Specifications**

Description		Nservo
Main Supply	Input Volts	100-240 VAC
	Input Frequency	50-60 Hz
	Inrush Current	30 A (peak)
	Max Continuous Input Power	60.6 W
Modes of Operation	Brushless, Brush, Stepper	
Motor Protective Features	Over Temperature; Peak over current; RMS over current; Designed to EN61010 / UL3101	

## 1.2. Dimensions

Each unit should be separated from other drives and surrounded by 25 mm (1") of free air space. A space of 100 mm (4") should be allowed along the front of the unit for cable connections. Allow for connector access and cable bend radius on three sides.

**NOTE:** If you purchased an Nservo-OEM, refer to [Section 2.6](#).

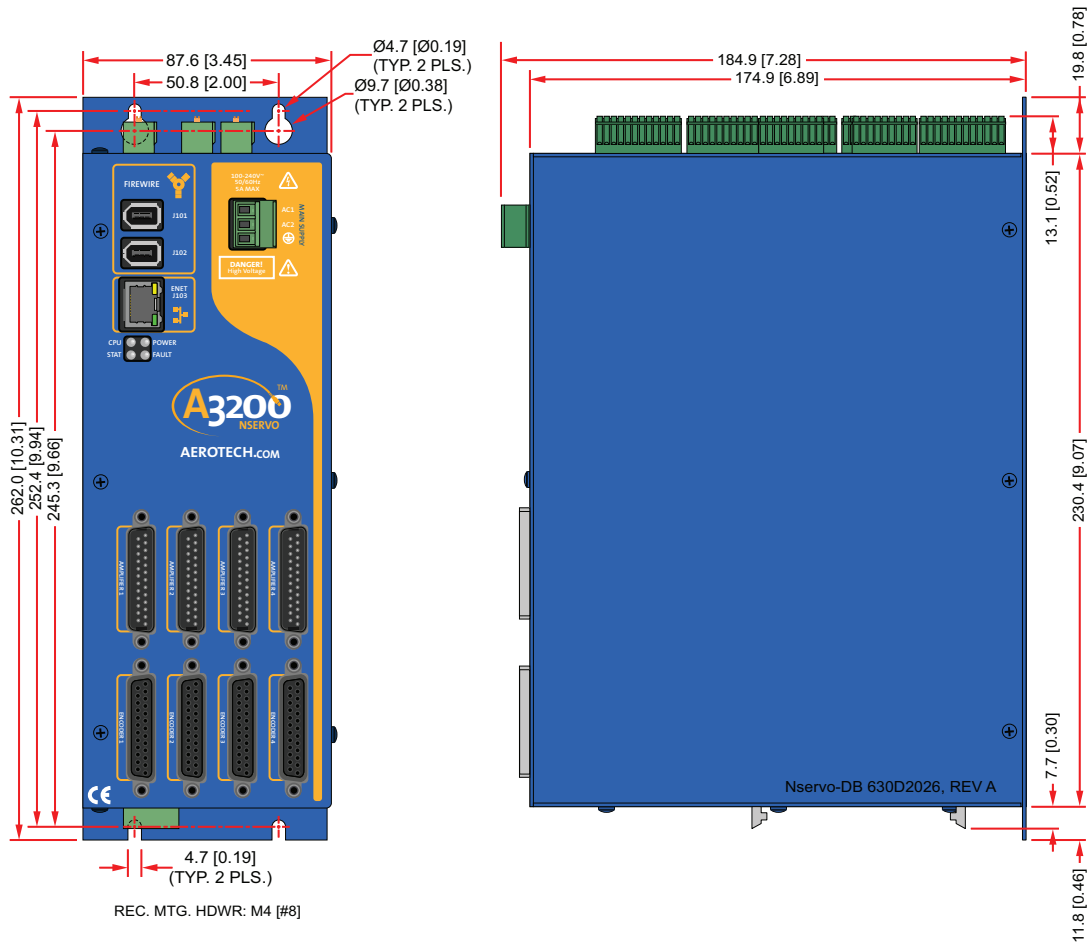


Figure 1-3: Nservo-DB Dimensions

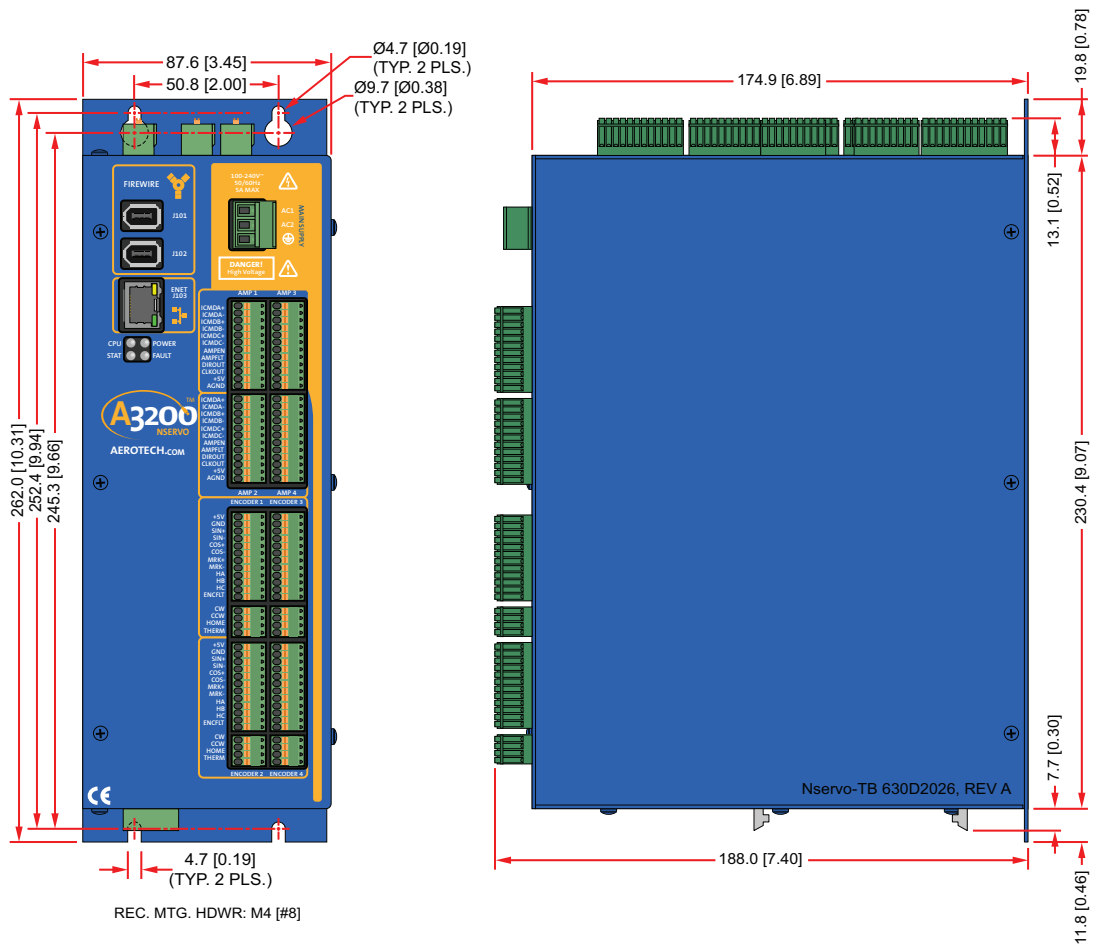


Figure 1-4: Nservo-TB Dimensions

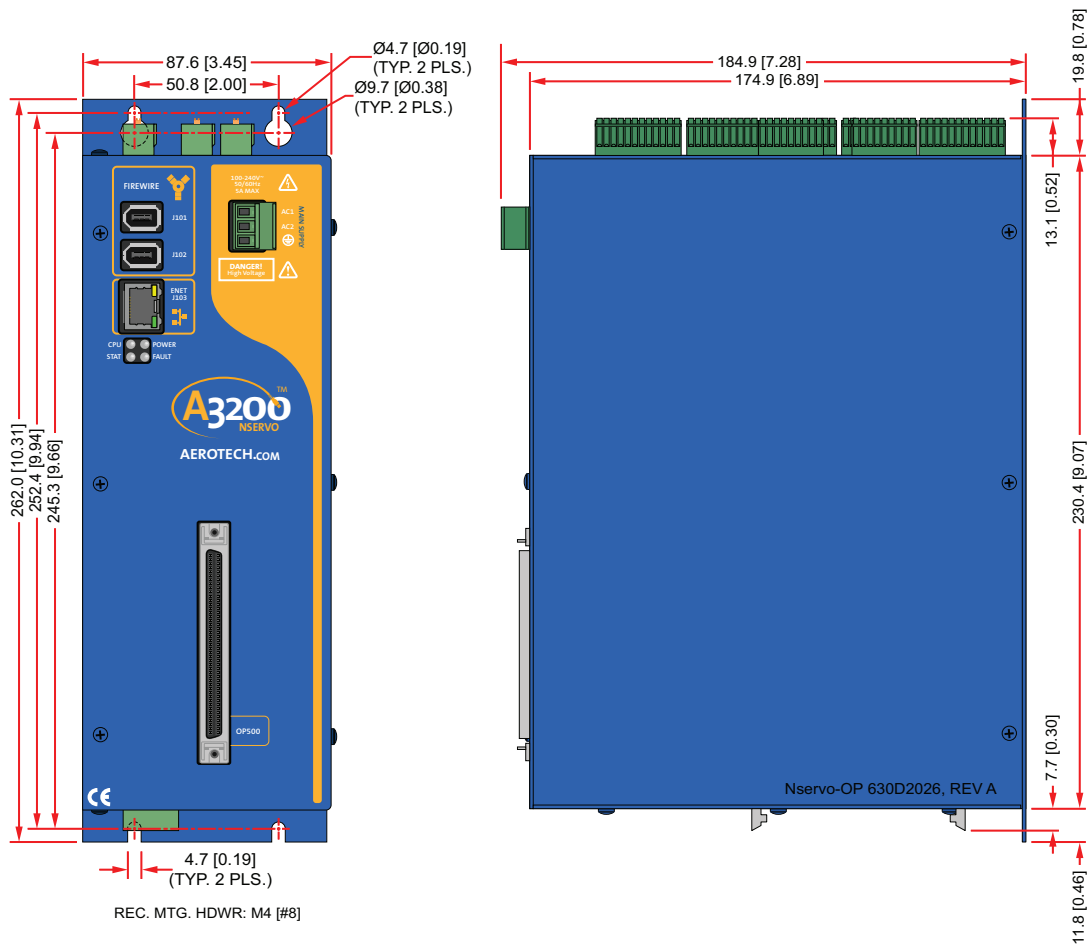


Figure 1-5: Nservo-OP Dimensions

Table 1-3: Weight Specifications

Model	Nservo
-DB2 (2 axis)	1.27 kg (2.8 lb)
-DB4 (4 axis)	1.36 kg (3.0 lb)
-TB2 (2 axis)	1.27 kg (2.8 lb)
-TB4 (4 axis)	1.36 kg (3.0 lb)
-OP (4 axis)	1.27 kg (2.8 lb)
Add for -RDP option	+0.18 kg (0.4 lb)

### 1.3. Environmental Specifications

The environmental specifications for the Nservo are listed below.

Ambient Temperature	Operating: 5° to 40°C (41° to 104° F)
	Storage: -20° to 70°C (-4° to 158° 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	Up to 2000 meters.
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 A3200 drives and which version of the A3200 software first provided support for a given 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: A3200 Drive and Software Compatibility**

Drive Type	Firmware Revision	First Software Version	Last Software Version
CL	-	2.18	Current
	A	2.55	Current
CP	-	2.03	2.55
	A	2.10	Current
	B	2.19	Current
FLS	-	4.03	Current
FLS	A	4.06.001	Current
HL	-	1.01	2.55
HLe	-	2.22	Current
HP	-	1.01	2.55
	A	1.08	2.55
HPe	-	2.22	Current
ML	-	3.00	Current
MP	-	2.14	Current
Nmark CLS	-	4.02	Current
Nmark CLS	A	4.06.001	Current
Nmark SSaM	-	2.21	Current
Nmark SSaM	A	4.06.001	Current
Npaq <sup>(1)</sup>	-	1.07	2.55
	A	2.09	Current
Nservo	-	2.08	Current
Nstep	-	2.14	Current
QL/QLe	-	5.01	Current

(1) This section does not apply to the Npaq MR. The Npaq MR contains multiple ML or MP drives. Refer to either the ML or MP drive type to determine the value for your Npaq MR.

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## Chapter 2: Installation and Configuration

This chapter describes the switches, jumpers, and connections when used with a DC brush, brushless, or stepper motor.

### 2.1. Communication Channel Settings

Use the Device Number switches of S1 to assign a communication channel number to the Nservo. If you are using multiple drives, each drive must be assigned a unique communication channel. Multiple drives are typically configured using sequential communication channels. The 32nd switch setting cannot be used for 2-axis units, and the 30th to 32nd switch settings cannot be used for 4 axis units (including Nservos with the -OP option).

**NOTE:** If you purchased an Nservo-OEM, refer to [Section 2.6](#).

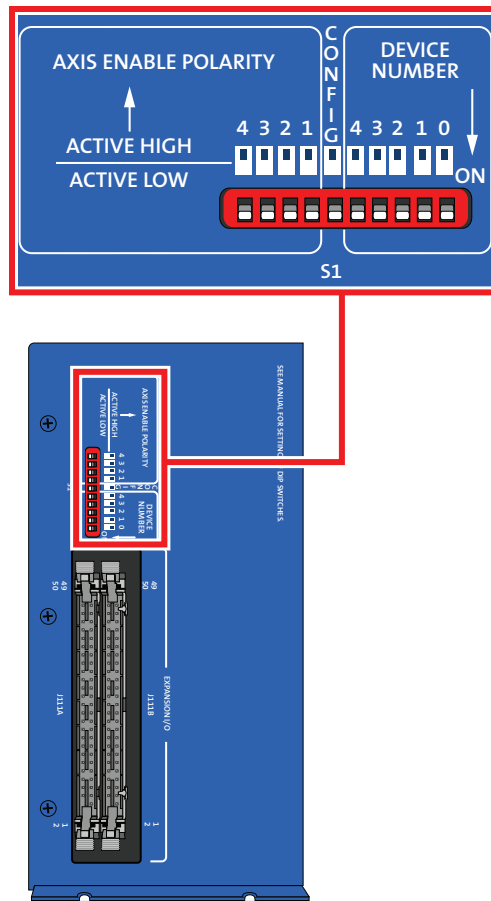


Figure 2-1: Device Number (S1) Location

**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 (S1)**

Device #	Switch Settings (Off is indicated by "-")				
	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

## 2.2. Power Connections

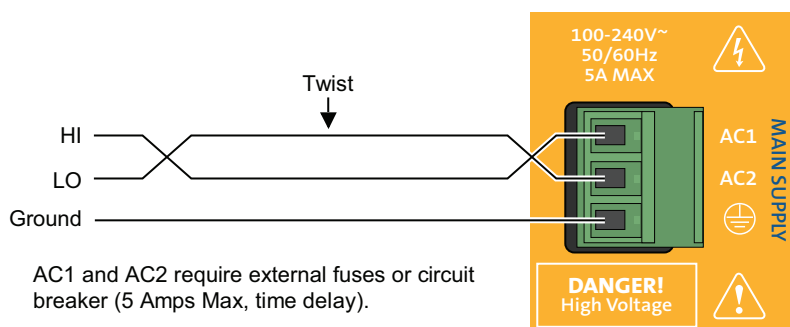
The Nservo is powered from a 100/115/208/230 VAC line. Input power is applied to the Nservo at three terminals of the Main Supply connector (refer to [Figure 2-2](#) for locations). For a complete list of electrical specifications, refer to [Section 1.1](#).

External fuses or a circuit breaker (5 A maximum, time delay type) are required for the AC1 and AC2 inputs for branch protection. The protective device should be located near the drive.



**WARNING :** Never operate the Nservo without the safety ground connection in place.

**NOTE :** If you purchased an Nservo-OEM, refer to [Section 2.6](#).



**Figure 2-2: AC Power Input Connections**

**Table 2-2: Power Supply Input Wiring**

Pin	Description	Recommended Wire Size
AC1	100 - 240 Volt AC Input Range	1.3 mm <sup>2</sup> (#16 AWG)
AC2	100 - 240 Volt AC Input Range	1.3 mm <sup>2</sup> (#16 AWG)
⊕	Protective Ground (Required for Safety)	1.3 mm <sup>2</sup> (#16 AWG)

**Table 2-3: J201 Mating Connector**

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

### 2.3. Connections to the Nservo-DB

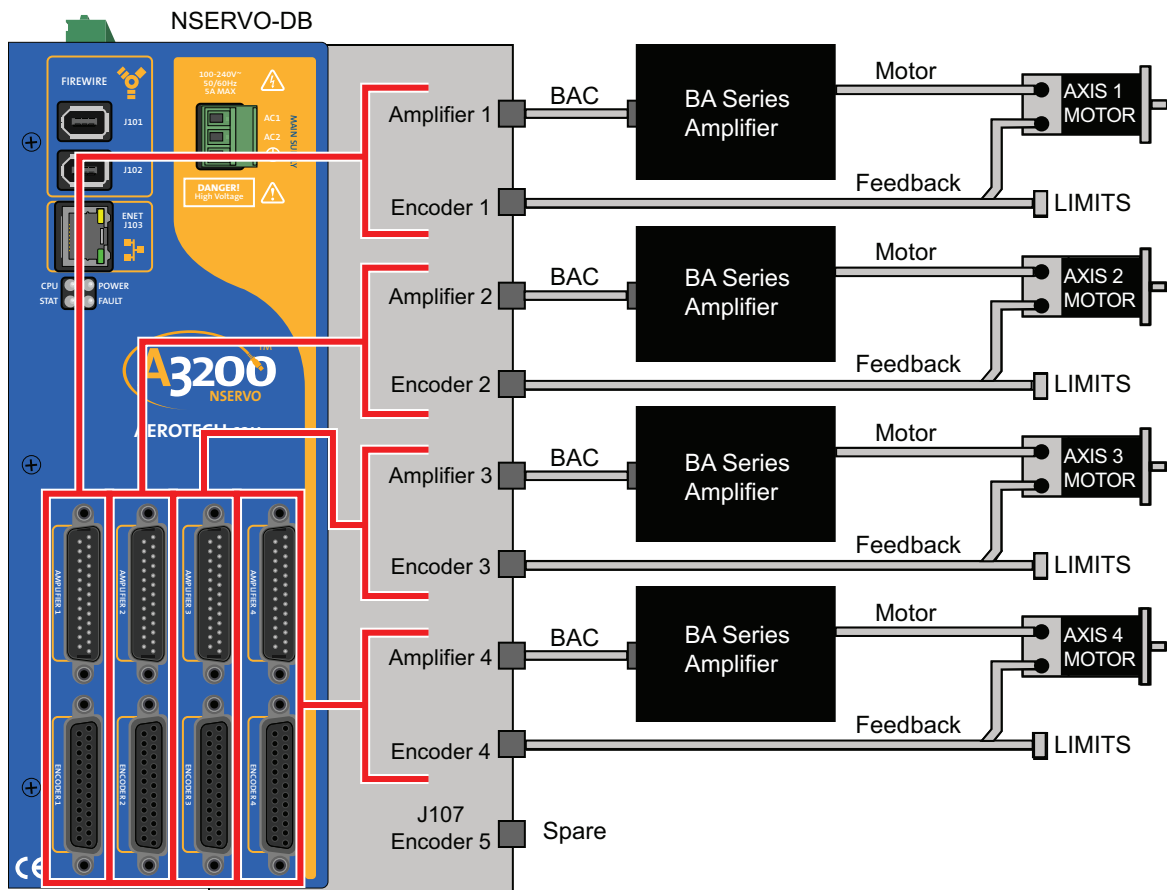
The Nservo -DB2 and -DB4 have D-Style connectors to interface to Aerotech BA series amplifiers via the BAC cables (Table 2-4) and Aerotech’s encoder feedback cables. The -DB option also interfaces to BB501 based systems, replacing the BB501 itself.

If the motor, encoder, or Hall-effect feedback devices require phasing, see Section 2.7.

Refer to Figure 2-3 for a system connection diagram.

**Table 2-4: BAC Cable Description**

Cable Name	Description
BAC2	Controller-Commutated Brushless Motor Cable
BAC3	Amplifier-Commutated Brushless Motor Cable
BAC4	DC Brush Motor in Current Command (Torque) Mode Cable



**Figure 2-3: Nservo-DB System Connection**

### 2.3.1. Amplifier Interface (Nservo-DB)

The amplifier 25-pin “D” style connectors each contain all of the required control signal outputs for control of one stepper or servo motor axis.

**Table 2-5: Amplifier Interface Connector Pin Assignment**

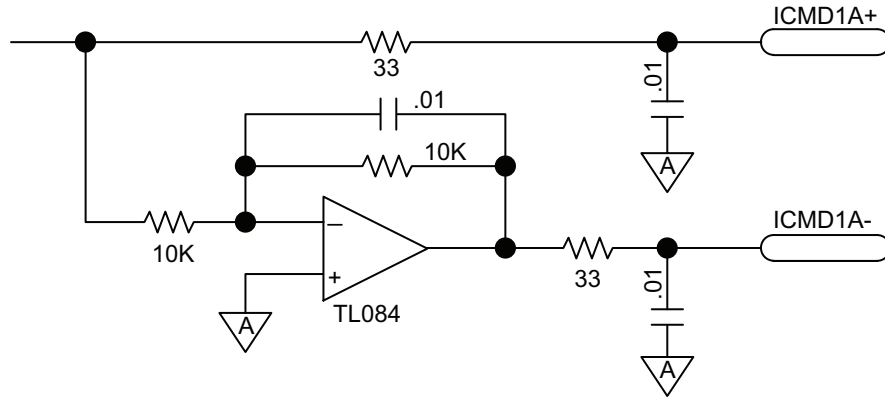
Pin	Label	Description	In/Out/Bi	Pin Location
1	SHIELD	Chassis Frame	Input	
2	N/A	Reserved for future use	--	
3	ICMD C+	Differential Current Command. Phase C +	Output	
4	--	Reserved for future use	--	
5	--	Reserved for future use	--	
6	--	Reserved for future use	--	
7	AGND	Analog Common	Input	
8	ICMD A- <sup>1</sup>	Differential Current Cmd Phase A-	Output	
9	ICMD A+	Differential Current Command Phase A+	Output	
10	AMP EN	Amplifier Enable	Output	
11	DIR OUT	Direction Output (Stepper mode)	Output	
12	--	Reserved for future use	--	
13	ICMD C-	Differential Current Command Phase C -	Output	
14	AGND	Analog Common	Input	
15	AGND	Analog Common	Input	
16	--	Reserved for future use	--	
17	--	Reserved for future use	--	
18	--	Reserved for future use	--	
19	--	Reserved for future use	--	
20	--	Reserved for future use	--	
21	ICMD B- <sup>2</sup>	Differential Current Cmd. Phase B-	Output	
22	ICMD B+	Differential Current Command Phase B+	Output	
23	AMP FLT	Amplifier Fault Input	Input	
24	CLK OUT	Clock Output (Stepper mode)	Output	
25	--	Reserved for future use	--	

1. Pin 8 to BA Amplifier Pin 8 (Input + Signal)  
 2. Pin 21 to BA Amplifier Pin 21 (Input - Signal)

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK00656	Amphenol 17-1726-2
Connector	ECK00300	Cinch DB-25S

**2.3.1.1. Current Command Output Signals**

The electrical specifications for the current command output signals are documented in [Table 2-6](#). These outputs are updated at an 8 kHz rate. The schematic of the current command output circuitry is shown in [Figure 2-4](#).



**Figure 2-4: Current Command Outputs**

**Table 2-6: ICMD Output Specification**

Description	Specification
Rated Output Current	10 mA
Output Impedance	36 Ohms @ DC
Output Voltage Range	±10 V
Reset State	0 V
Maximum Output Voltage Offset	10 mV
Maximum Output Voltage Error	< 1%

**2.3.1.2. Amplifier Enable Output Signals**

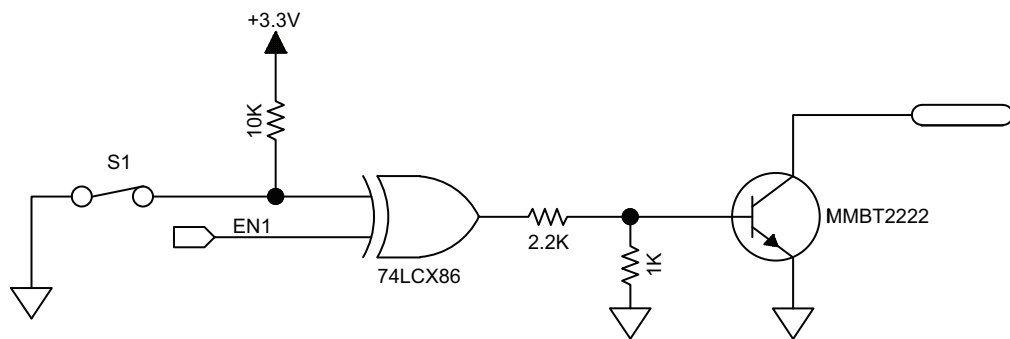
The specifications for the amplifier enable output are indicated in [Table 2-7](#), and the schematic of the circuitry is shown in [Figure 2-5](#).

**Table 2-7: Amplifier Enable Output Specifications**

Specification	Value
Maximum Power Supply Voltage	35 V
Maximum Current Sink	50 mA
Maximum Power Dissipation	350 mW

**Table 2-8: Amplifier Enable Switch Settings**

Switch #	Enable Active High	Enable Active Low
6 (Amp 1)	Open	Closed (Default)
7 (Amp 2)	Open	Closed (Default)
8 (Amp 3)	Open	Closed (Default)
9 (Amp 4)	Open	Closed (Default)



**Figure 2-5: Amplifier Enable Outputs**

2.3.1.3. Amplifier Fault Input Signals

The specifications for the amplifier fault input are indicated in Table 2-9, and the schematic of the circuitry is shown in Figure 2-6.

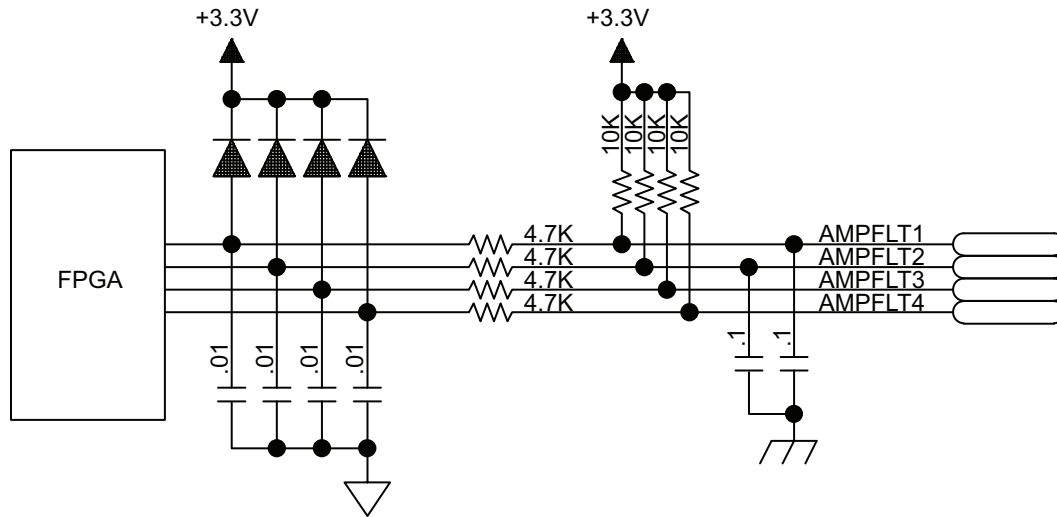


Figure 2-6: Amplifier Fault Inputs

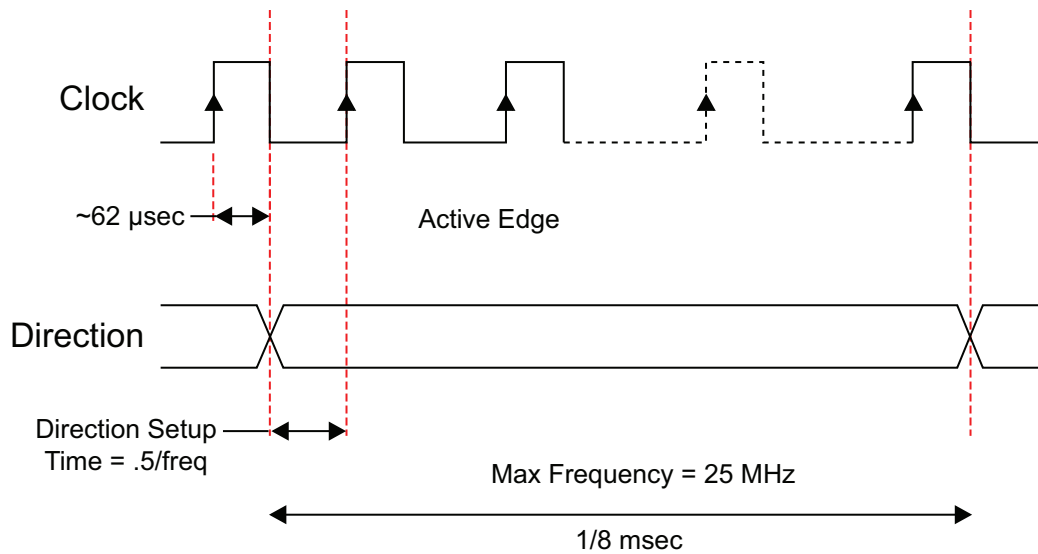
Table 2-9: Amplifier Fault Input Specifications

Specification	Value
Maximum Input Voltage	24 V



**2.3.1.4. Clock and Direction Output Signals**

The Clock and Direction outputs are used to interface to stepper motor drivers. These outputs are updated at an 8 kHz rate. The maximum output frequency is 25 MHz. The timing and electrical specifications of these signals is illustrated in Figure 2-7 and Table 2-10. The schematic of the output circuitry is shown in Figure 2-8.



**Figure 2-7: Clock and Direction Timing**

**Table 2-10: Clock and Direction Signal Output Specifications**

Specification	Value
Output Voltage	5V TTL
Maximum Source/Sink Current	±20 mA
Clock Reset State	Logic Low (0 Volts)
Direction Reset State	Logic High (5 Volts)

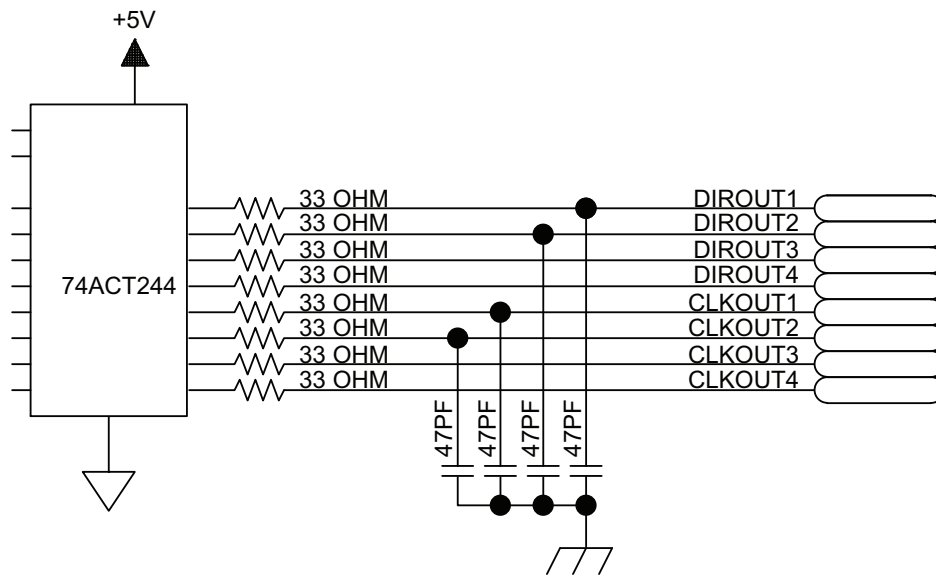


Figure 2-8: Clock and Direction Outputs

Table 2-11: Direction Signal Output Polarity

Direction of motion	Direction Output Voltage
Negative / CCW direction	Logic Low (0 Volts)
Positive / CW direction	Logic High (+5 Volts)

**NOTE:** If the stepper motor's direction of rotation is the opposite of what is desired, swap two motor connections to reverse the direction of rotation.

### 2.3.2. Encoder Interface (Nservo-DB)

The encoder feedback connector (a 25-pin, D-style connector) has inputs for an encoder, limit switches, Hall-effect devices, motor over-temperature device, 5 Volt encoder and limit power, and optional brake connections. The connector pin assignment is shown below with detailed connection information in the following sections.

See [Section 2.7.4](#). for information on interfacing non-Aerotech motors.

**Table 2-12: Encoder Feedback Connector Pin Assignment**

Pin#	Label	Description	In/Out/Bi	Pin Location
1	Frame Ground	Chassis Frame Ground	N/A	
2	THERM	Motor Over Temperature Thermistor	Input	
3	ENCODER PWR	+5V Power for Encoder <sup>(1)</sup>	Output	
4	Reserved	Reserved	N/A	
5	HB	Hall-Effect Sensor B <sup>(2)</sup>	Input	
6	MRK- IN	Encoder Marker Reference Pulse -	Input	
7	MRK+ IN	Encoder Marker Reference Pulse +	Input	
8	Reserved	Reserved	N/A	
9	Reserved	Reserved	N/A	
10	HA	Hall-Effect Sensor A <sup>(2)</sup>	Input	
11	HC	Hall-Effect Sensor C <sup>(2)</sup>	Input	
12	CW/+LIMIT	Clockwise End of Travel Limit	Input	
13	BRAKE -	Optional Brake - Output	Output	
14	COS+ IN	Encoder Cosine +	Input	
15	COS- IN	Encoder Cosine -	Input	
16	LIMIT PWR	+5V Power for Limit Switches <sup>(1)</sup>	Output	
17	SIN+ IN	Encoder Sine +	Input	
18	SIN- IN	Encoder Sine -	Input	
19	Reserved	Reserved	N/A	
20	LIMIT GND	Signal Common for Limit Switches	N/A	
21	ENCODER GND	Signal Common for Encoder	N/A	
22	HMLMT	Home Switch Input	Input	
23	ENC FAULT	Encoder Fault Input	Input	
24	CCW/-LIMIT	Counterclockwise End of Travel Limit	Input	
25	BRAKE +	Optional Brake + Output	Output	

(1) Total user +5 VDC power is limited to 3 A by an internal re-settable fuse. Should an over-current condition occur, the device will open to protect against the overload. To reset the device, remove the overload condition.  
 (2) Brushless motors only.

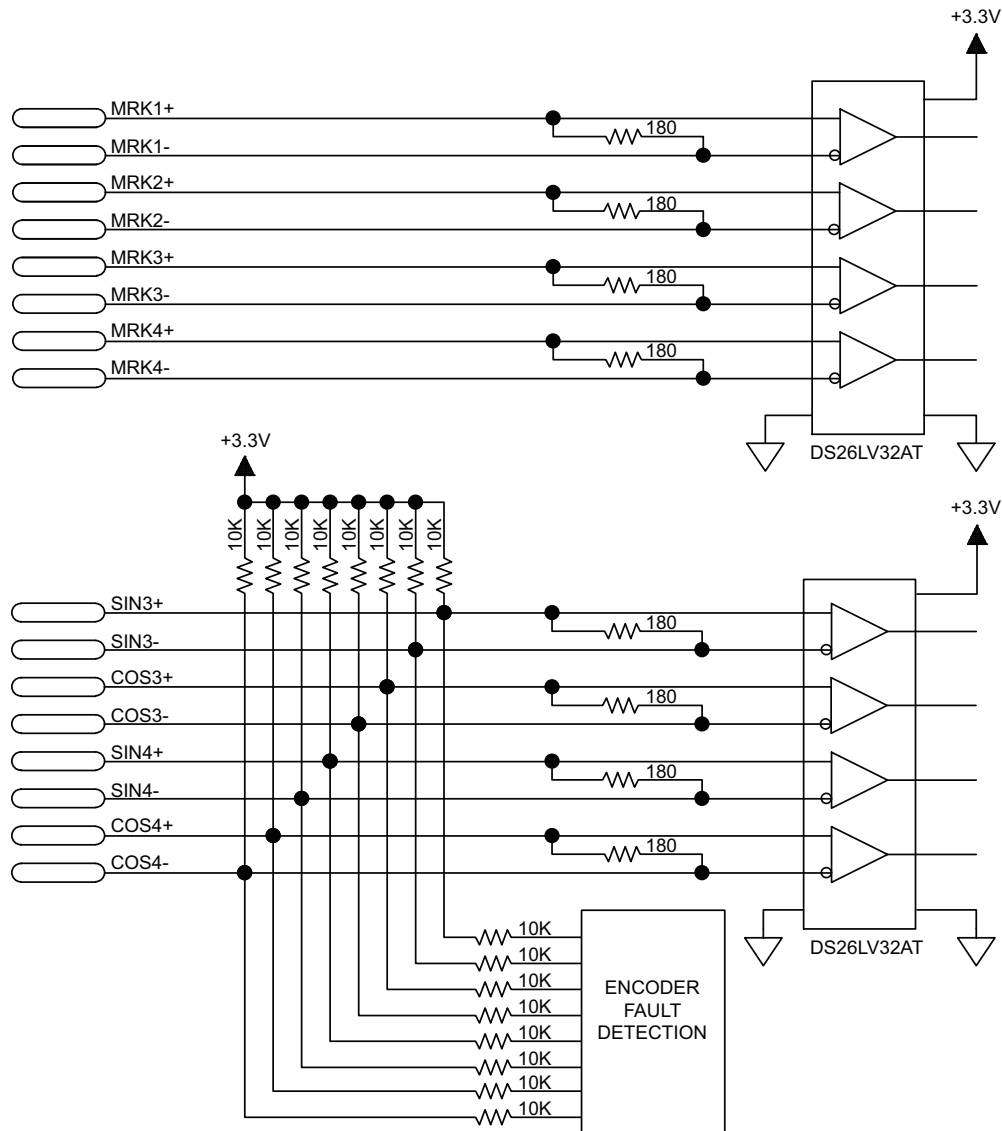
Mating Connector	Aerotech P/N	Third Party P/N
25-Pin D-Connector	ECK00101	FCI DB25P064TXLF
Backshell	ECK00656	Amphenol 17E-1726-2

**2.3.2.1. Encoder Input Signals**

The Nservo is equipped with primary and secondary encoder feedback channels which will accept an RS-422 differential line driver signal. The primary encoder input is configured for a differential line driver encoder, in the range of 0 to +5 volts. It allows up to an 10 MHz encoder signal (25 nsec minimum edge separation), producing 40 million counts per second, after times four (x4) quadrature decoding.

Refer to [Table 2-12](#) for the connector pin output assignment.

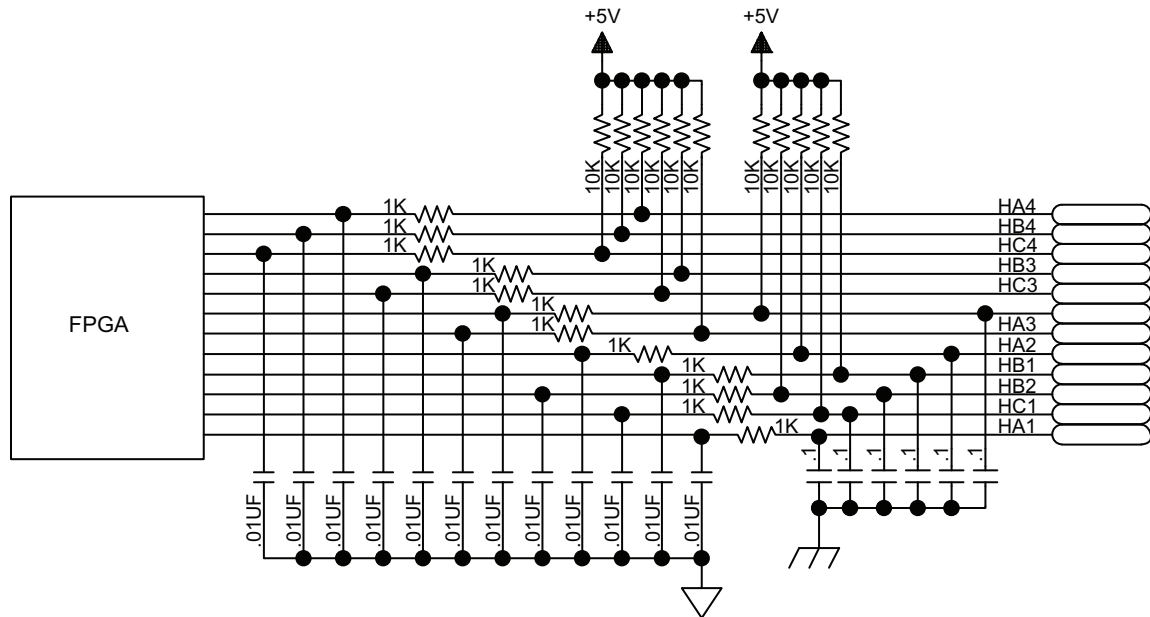
**NOTE:** Encoder wiring should be physically isolated from motor, AC power and all other power wiring.



**Figure 2-9: Encoder Inputs**

**2.3.2.2. Hall-Effect Input Signals**

The Hall-effect inputs accept 5V TTL signal levels and are not opto-isolated. The Hall-effect switch inputs are recommended for AC brushless motor commutation but not absolutely required. The Hall-effect inputs accept 5-24 VDC level signals.



**Figure 2-10: Hall-Effect Inputs**

2.3.2.3. Encoder Fault Input Signals

The Encoder Fault inputs accept 5V TTL signal levels and are not opto-isolated. The schematic of the input circuitry is shown in Figure 2-11.

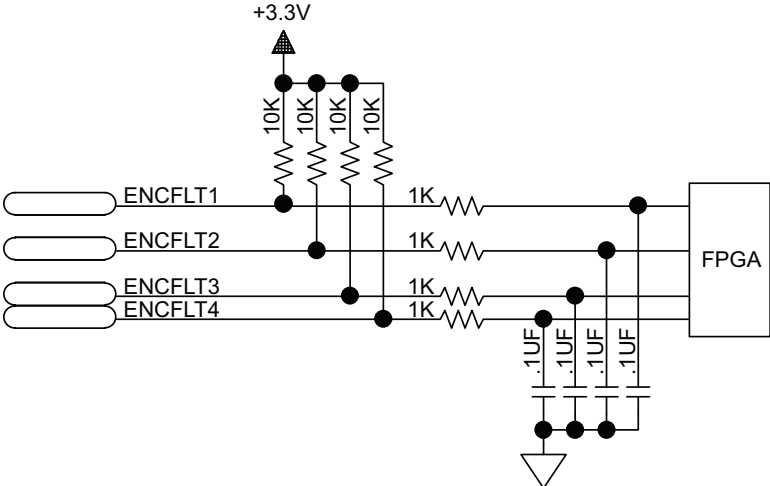


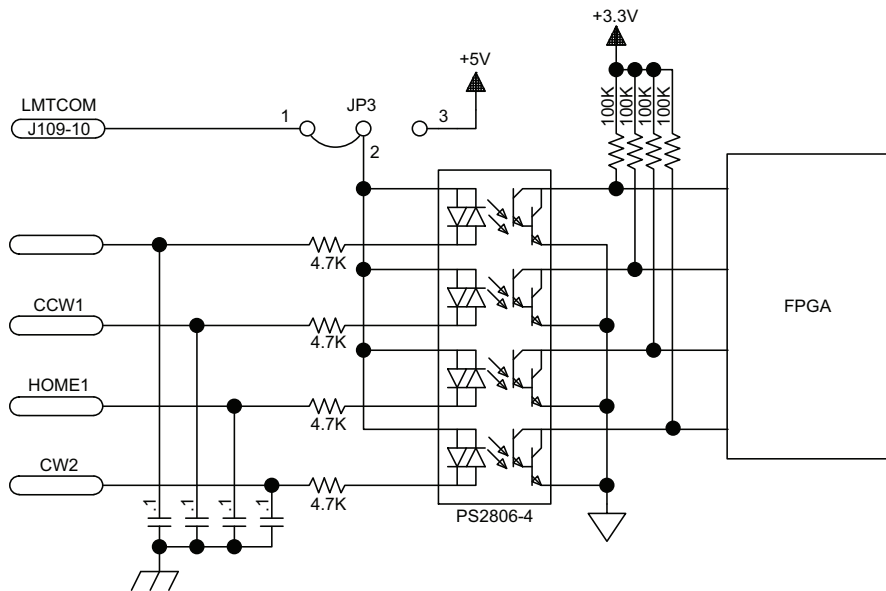
Figure 2-11: Encoder Fault Inputs

**2.3.2.4. Limit Input Signals**

End of Travel (EOT) limits are required to define the end of the physical travel on linear axes. Positive or clockwise motion is stopped by the clockwise (CW) end of travel limit input. Negative or counterclockwise motion is stopped by the counterclockwise (CCW) end of travel limit input. The Home Limit switch can be parameter configured for use during the home cycle, however, the CW or CCW EOT limit is typically used instead. All of the end-of-travel limit inputs accept 5-24 VDC level signals. Limit directions are relative to the encoder polarity as viewed in the Status Utility (refer to [Section 2.7.5.](#)).

The active state of the EOT limits is software selectable (by the EndOfTravelLimitSetup<sup>1</sup> axis parameter).

By default, all limit inputs share a common connection at J109 ([Section 2.12.](#)), allowing all limit inputs to be sourcing or sinking as shown in [Figure 2-62](#) (sinking) and [Figure 2-63](#) (sourcing).

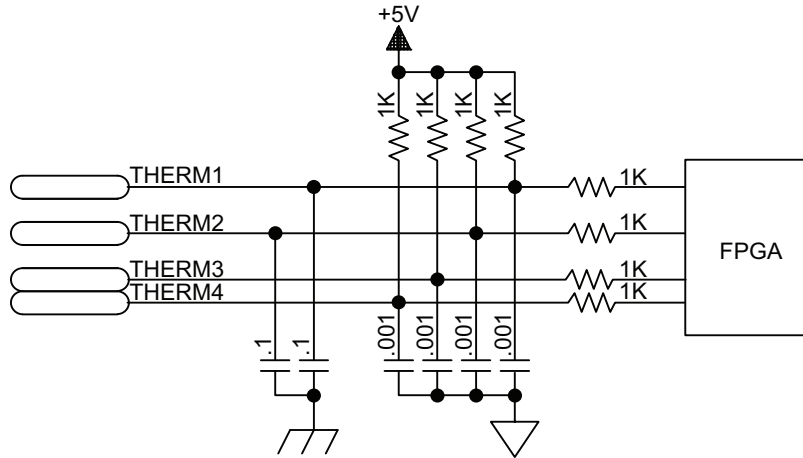


**Figure 2-12: End of Travel Limit Inputs**

<sup>1</sup>EndofTravelLimitSetup has replaced LimitLevelMask in software version 3.00.000.

**2.3.2.5. Thermistor Input Signals**

The thermistor input is used to detect an over temperature condition in a motor using a positive temperature coefficient sensor. As the temperature of the sensor increases, so does the resistance. Under normal operating conditions, the resistance of the thermistor is low (i.e., 100 ohms) which will result in a low input signal. If the increasing temperature causes the thermistor's resistance to increase, the signal will be seen as a logic high, triggering an over temperature fault.



**Figure 2-13: Thermistor Inputs**



## 2.4. Connections to the Nservo-OP

The Nservo-OP (OP500 option) allows legacy UNIDEX 600 and UNIDEX 500 systems to be upgraded to the A3200 platform. Its output interface has a connector which mates to an OP500 cable, which connects to a DR300, DR500, DR600, BB500 and BB501 based systems. It is only available in a 4-axis version.

**NOTE:** This version of the product does not permit opto-isolated limit switches to be used; the -LMT5V option must be present to configure the limit power properly.

The OP500 connector contains all of the required output signals and feedback inputs for 4 axes of servo loop control, as well as 2 axes of stepper motor control, including 4 sets of the following:

- A three-channel differential line driver encoder (Sine, Cosine, and Marker).
- Three end-of-travel limit inputs (CW, CCW, Home).
- Three Hall-effect inputs.
- Additional I/O, such as analog inputs, digital I/O, joystick interface, etc.

Optionally, it may be configured for the Hall-effect feedback signals to be connected to the J111 connector for compatibility with DR Series drive chassis, which does not allow Hall signals to be passed through the OP500 cable itself.

See [Section 2.7.4](#) for information on interfacing non-Aerotech motors.

The following three figures illustrate the typical connections to the Nservo-OP when interfacing to an existing UNIDEX 500 / UNIDEX 600 system, via a BB500 / BB501 or DR series drive chassis. Configure the jumpers as defined in [Section 5.5.1](#). If the motor, encoder, or Hall-effect feedback devices require phasing, see [Section 2.7.1](#) for more information.

**NOTE:** A DC Brush motor, stepper drive, or U500PCI system requires one less cable than the other configurations because it does not require Hall-effect feedback signals to the Nservo-OP, as shown in [Figure 2-14](#), [Figure 2-15](#), and [Figure 2-16](#).

**NOTE:** If J111A is used for feedback from the Hall-effect signals, set the FeedbackSetup<sup>1</sup> parameter (see the A3200 Help file for more information).

**NOTE:** If the 3rd phase option is required on systems using the BB500, be sure that the BB500 is not configured to drive the external DAC power input on a U500PCI (see the BB500 hardware manual), then set JP5 1-2 and JP7 1-2 on the Nservo.

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<sup>1</sup>FeedbackSetup has replaced DriveIOConfig in software version 3.00.000.

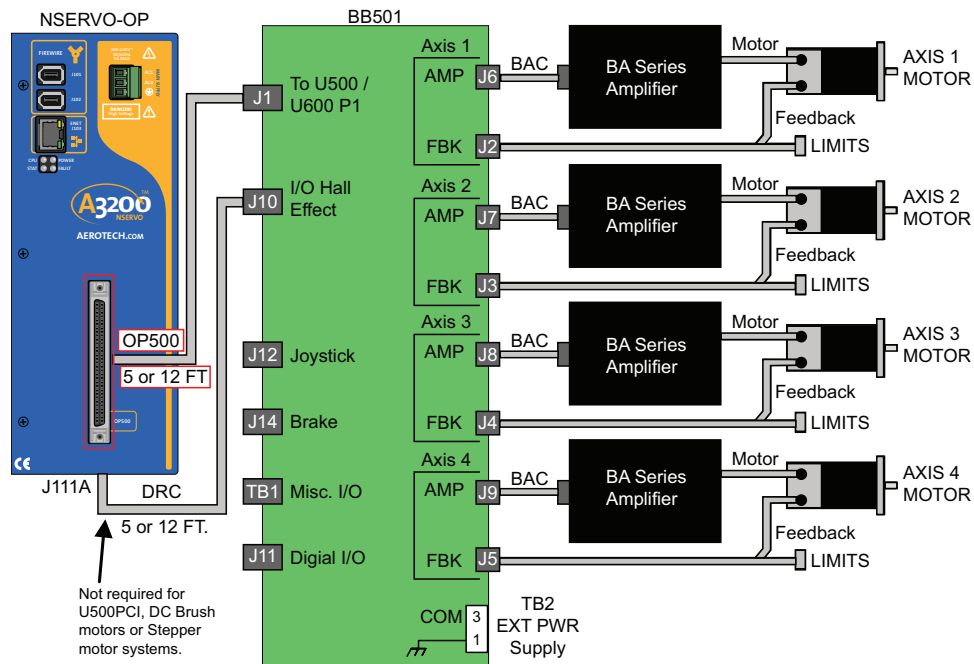


Figure 2-14: Connecting the Nservo-OP to a BB501 System

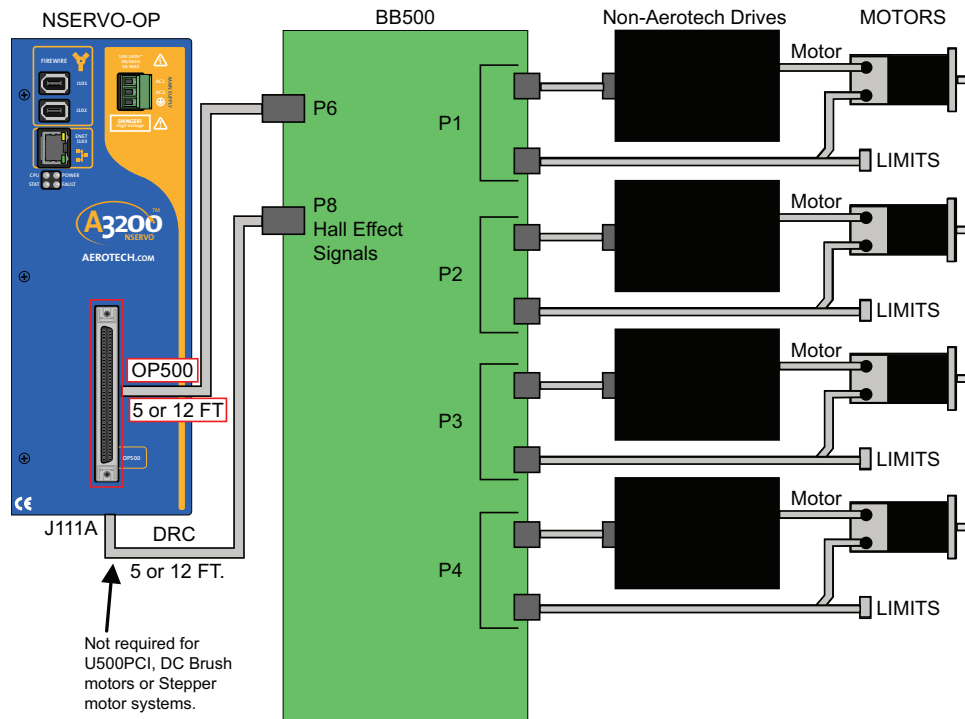


Figure 2-15: Connecting the Nservo-OP to a BB500 System

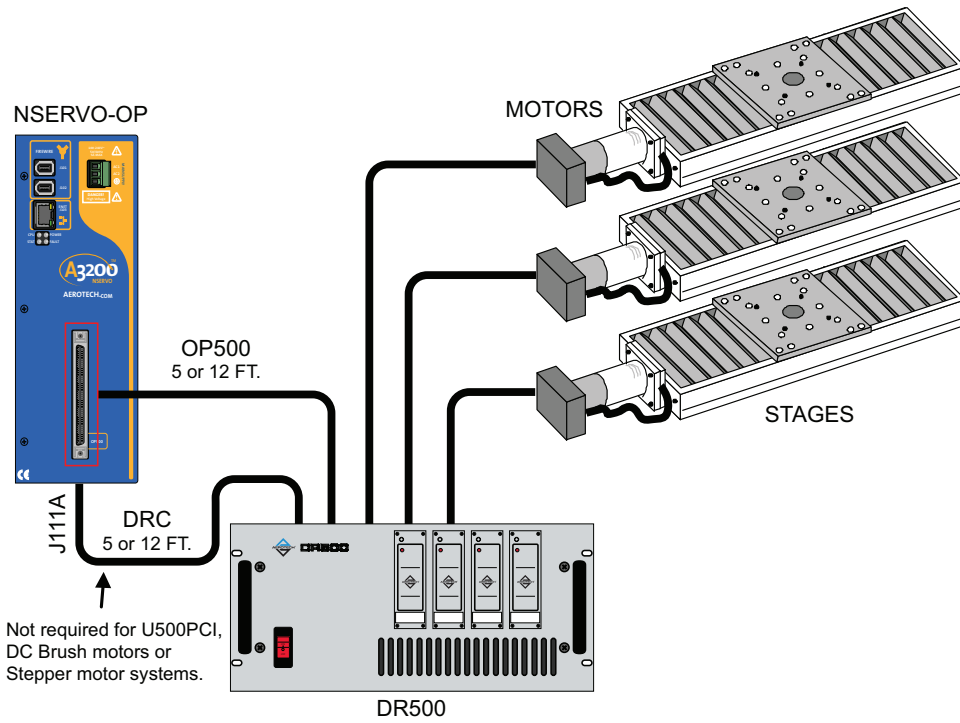
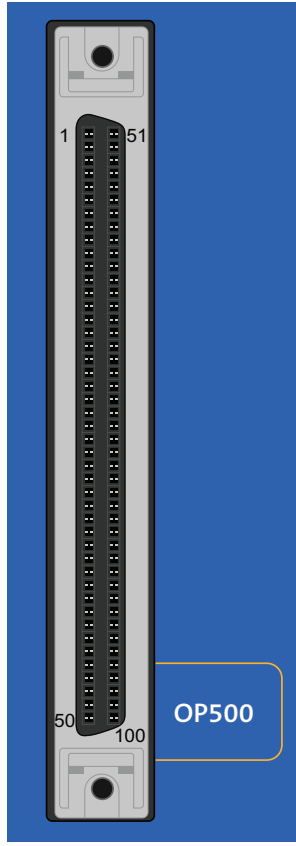


Figure 2-16: Connecting the Nservo-OP to a DR Series Drive Rack

### 2.4.1. Nservo-OP OP500 Interface

The pin assignment for the OP500 100-pin connector is shown in the following tables. See [Section 5.5.1](#) for -OP board jumper information.

**Table 2-13: OP500 Interface Pin Assignment**

Pin	Description	Pin	Description	Pin Location
1	Common	26	COS3- Input Axis 3	
2	Common	27	MRK3+ Input Axis 3	
3	+5 V	28	MRK3- Input Axis 3	
4	+5 V	29	Hall Effect A Input Axis 3	
5	Hall Effect B Input Axis 1	30	Hall Effect C Input Axis 3	
6	Hall Effect A Input Axis 1	31	SIN4+ Input Axis 4	
7	SIN+ Input Axis 1	32	SIN4- Input Axis 4	
8	SIN- Input Axis 1	33	COS4+ Input Axis 4	
9	COS+ Input Axis 1	34	COS4- Input Axis 4	
10	COS1- Input Axis 1	35	MRK4+ Input Axis 4	
11	MRK+ Input Axis 1	36	MRK4- Input Axis 4	
12	MRK1- Input Axis 1	37	Hall Effect B Input Axis 4	
13	Hall Effect B Input Axis 2	38	Hall Effect A Input Axis 4	
14	Hall Effect A Input Axis 2	39	CW Limit Input Axis 1	
15	SIN2+ Input Axis 2	40	CCW Limit Input Axis 1	
16	SIN2- Input Axis 2	41	CW Limit Input Axis 2	
17	COS2+ Input Axis 2	42	CCW Limit Input Axis 2	
18	COS- Input Axis 2	43	CW Limit Input Axis 3	
19	MRK2+ Input Axis 2	44	CCW Limit Input Axis 3	
20	MRK- Input Axis 2	45	CW Limit Input Axis 4	
21	Hall Effect C Input Axis 2	46	CCW Limit Input Axis 4	
22	MRK- Input Axis 2	47	Home Limit Input Axis 1	
23	SIN3+ Input Axis 3	48	Home Limit Input Axis 2	
24	SIN3- Input Axis 3	49	Home Limit Input Axis 3	
25	COS3+ Input Axis 3	50	Home Limit Input Axis 4	

\*Total user +5 VDC power is limited to 3 A by an internal re-settable fuse. Should an over-current condition occur, the device will open to protect against the overload. To reset the device, remove the overload condition.

**Table: OP500 Interface Pin Assignment (continued)**

Pin	Description	Pin	Description	Pin Location
51	Common	76	Amplifier Fault Input Axis 4	
52	Hall Effect C Input Axis 1	77	Common	
53	See JP7 (+12 VDC or N.C.)	78	Common	
54	See JP6 (+12 VDC or N.C.)	79	See JP10 (ICMD1B+ or CLK1)	
55	See JP5 (-12 VDC or N.C.)	80	See JP11 (ICMD1A+ or DIR1)	
56	See JP4 (-12 VDC or N.C.)	81	See JP20 (ICMD2B+ or CLK2)	
57	Mode Output Axis 1	82	See JP21 (ICMD2A+ or DIR2)	
58	Mode Output Axis 2	83	See JP30 (ICMD3B+ or CLK3)	
59	Opto-Isolated Input 0	84	See JP31 (ICMD3A+ or DIR3)	
60	Opto-Isolated Input 1	85	See JP40 (ICMD4B+ or CLK4)	
61	Opto-Isolated Input 2	86	See JP41 (ICMD4A+ or DIR4)	
62	Opto-Isolated Input 3	87	Common	
63	Opto-Isolated Output 0	88	Hall Effect C Input Axis 4	
64	Opto-Isolated Output 1	89	Analog Input 3	
65	Opto-Isolated Output 2	90	Analog Input 2	
66	Opto-Isolated Output 3	91	Joystick Button A Input	
67	Mode Output Axis 3	92	Joystick Button B Input	
68	Mode Output Axis 4	93	Joystick Interlock Input	
69	Amplifier Enable Output Axis 1	94	Brake Output	
70	Amplifier Enable Output Axis 2	95	Analog Input 0+	
71	Amplifier Enable Output Axis 3	96	Analog Input 1+	
72	Amplifier Enable Output Axis 4	97	ESTOP Input- (See pin 99)	
73	Amplifier Fault Input Axis 1	98	User Interrupt Input- (See pin 99)	
74	Amplifier Fault Input Axis 2	99	ESTOP+ / User Interrupt Input+	
75	Amplifier Fault Input Axis 3	100	Interlock Receive Input	

**Table 2-14: OP500 Connector Mating Cable**

Description	Aerotech P/N
100 Conductor Cable, 5 Feet	OP500-5
100 Conductor Cable, 12 Feet	OP500-12
100 Conductor Cable, 25 Feet	OP500-25
100 Conductor Cable, 30 Feet	OP500-30

## 2.5. Connections to the Nservo-TB

The Nservo with the -TB options can be integrated into a system using three basic configurations: brushless, DC Brush (Torque mode) and stepper motors. Each can have one or two feedback devices. The Nservo-TB option can also interface to a BB500 based system, replacing the BB500 itself.

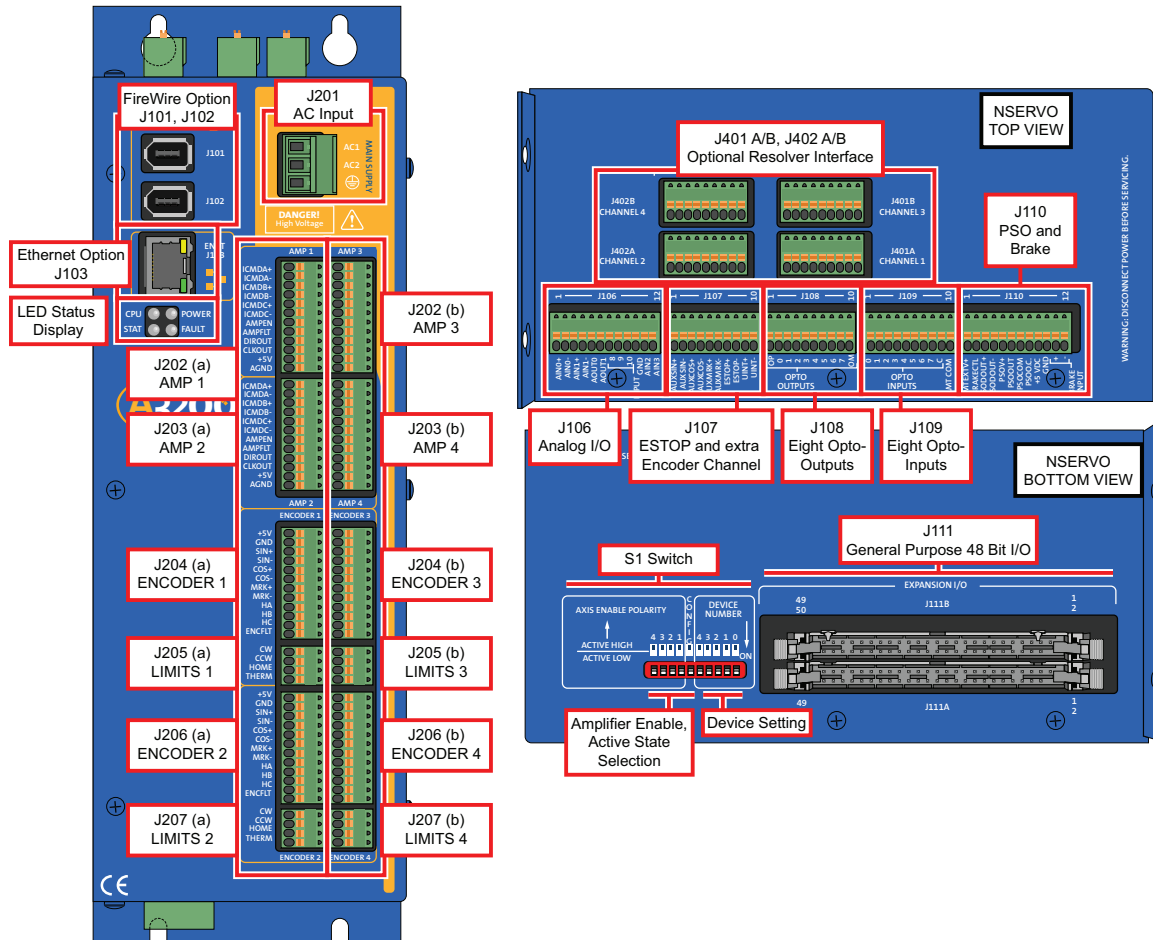


Figure 2-17: Nservo-TB

### 2.5.1. Amplifier Interface (Nservo-TB)

The axis 1 and axis 2 terminal blocks contain all of the required drive interface signals for two axes of servo loop control. The Nservo-TB4 will provide two more axes of closed loop control. These connectors have outputs for an analog current command in the range of  $\pm 10$  volts, an amplifier enable signal, and an amplifier fault input. There are also clock and direction outputs for stepper drives.

**Table 2-15: Drive Interface Pin Assignment for Axes 1 through 4**

Pin	Label	Description	In/Out/Bit
1	ICMDA+	Current Command A+ (Differential)	Output
2	ICMDA-	Current Command A- (Differential)	Output
3	ICMDB+	Current Command B+ (Differential)	Output
4	ICMDB-	Current Command B- (Differential)	Output
5	ICMDC+	Current Command C+ (Differential)	Output
6	ICMDC-	Current Command C- (Differential)	Output
7	AMP EN	Amplifier Enable	Output
8	AMP FLT	Amplifier Fault	Input
9	DIR OUT	Stepper Direction	Output
10	CLK OUT	Stepper Clock	Output
11	+5 VDC*	+5 Volts	Output
12	Common	Common	N/A

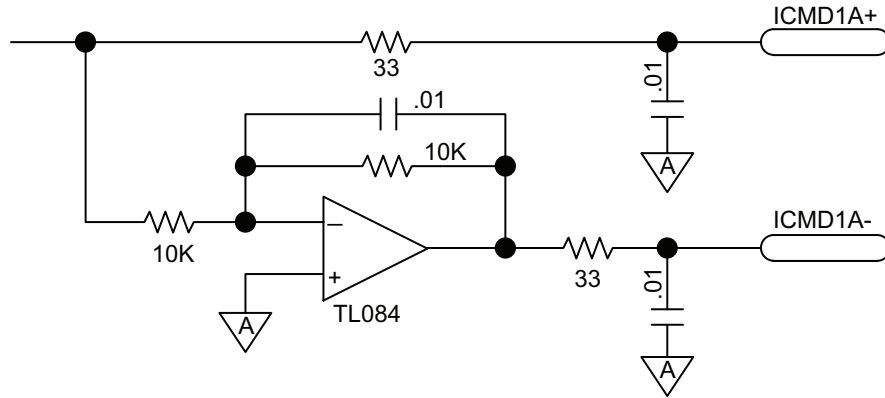
\* Total user +5 VDC power is limited to 3 A by an internal re-settable fuse. Should an over-current condition occur, the device will open to protect against the overload. To reset the device, remove the overload condition.

**Table 2-16: J202 A/B and J203 A/B Mating Connector**

Type	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm <sup>2</sup> ]
12-Pin Terminal Block	ECK01295	1881422	20-28 [0.5- 0.080]

**2.5.1.1. Current Command Output Signals**

The electrical specifications for the current command output signals are documented in [Table 2-17](#). These outputs are updated at an 8 kHz rate. The schematic of the current command output circuitry is shown in [Figure 2-18](#).



**Figure 2-18: Current Command Outputs**

**Table 2-17: ICMD Output Specification**

Description	Specification
Rated Output Current	10 mA
Output Impedance	36 Ohms @ DC
Output Voltage Range	±10 V
Reset State	0 V
Maximum Output Voltage Offset	10 mV
Maximum Output Voltage Error	< 1%



**2.5.1.2. Amplifier Enable Output Signals**

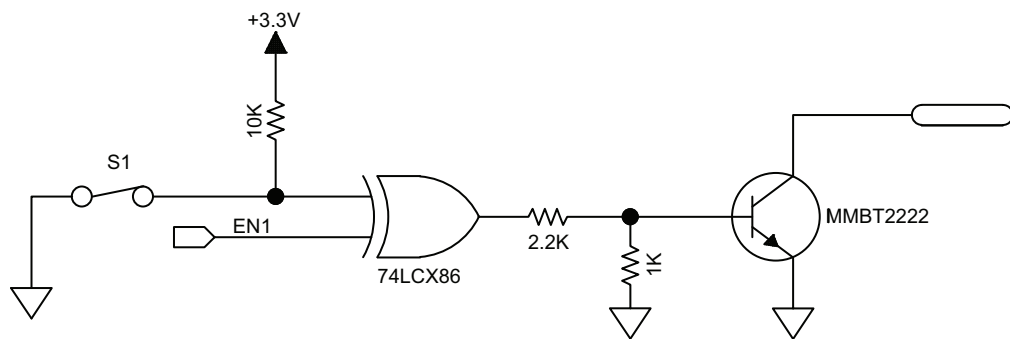
The specifications for the amplifier enable output are indicated in [Table 2-18](#), and the schematic of the circuitry is shown in [Figure 2-19](#).

**Table 2-18: Amplifier Enable Output Specifications**

Specification	Value
Maximum Power Supply Voltage	35 V
Maximum Current Sink	50 mA
Maximum Power Dissipation	350 mW

**Table 2-19: Amplifier Enable Switch Settings**

Switch #	Enable Active High	Enable Active Low
6 (Amp 1)	Open	Closed (Default)
7 (Amp 2)	Open	Closed (Default)
8 (Amp 3)	Open	Closed (Default)
9 (Amp 4)	Open	Closed (Default)



**Figure 2-19: Amplifier Enable Outputs**

2.5.1.3. Amplifier Fault Input Signals

The specifications for the amplifier fault input are indicated in Table 2-20, and the schematic of the circuitry is shown in Figure 2-20.

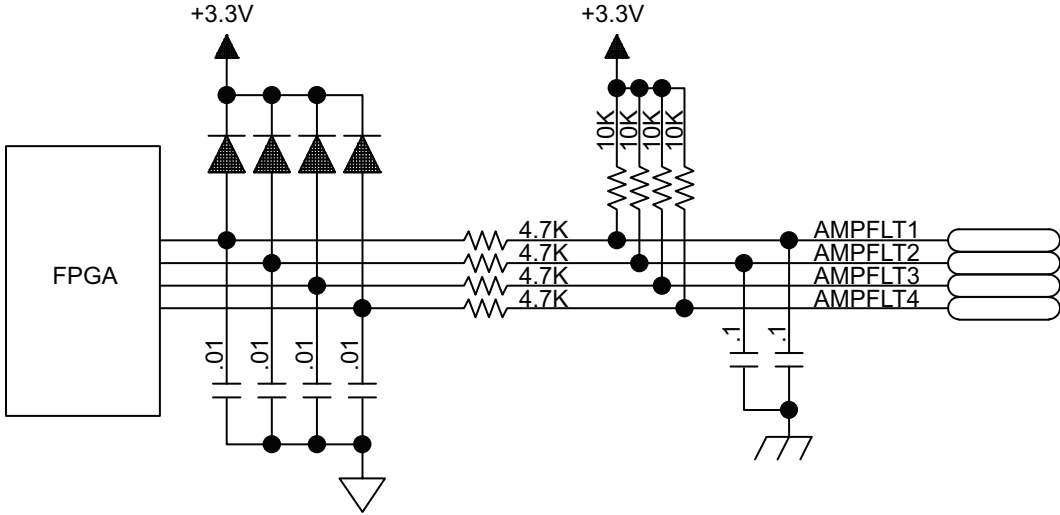


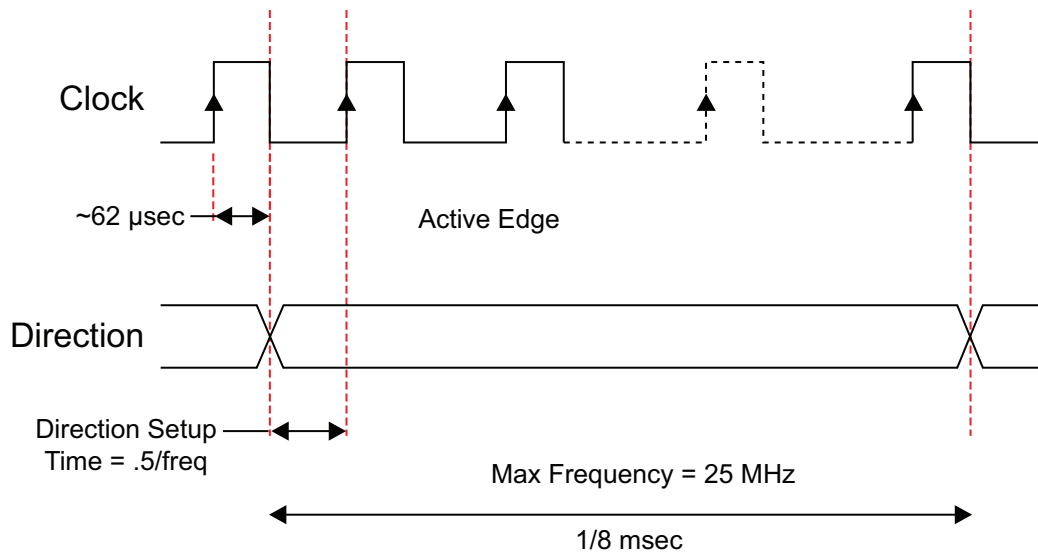
Figure 2-20: Amplifier Fault Inputs

Table 2-20: Amplifier Fault Input Specifications

Specification	Value
Maximum Input Voltage	24 V

**2.5.1.4. Clock and Direction Output Signals**

The Clock and Direction outputs are used to interface to stepper motor drivers. These outputs are updated at an 8 kHz rate. The maximum output frequency is 25 MHz. The timing and electrical specifications of these signals is illustrated in Figure 2-21 and Table 2-21. The schematic of the output circuitry is shown in Figure 2-22.



**Figure 2-21: Clock and Direction Timing**

**Table 2-21: Clock and Direction Signal Output Specifications**

Specification	Value
Output Voltage	5V TTL
Maximum Source/Sink Current	±20 mA
Clock Reset State	Logic Low (0 Volts)
Direction Reset State	Logic High (5 Volts)

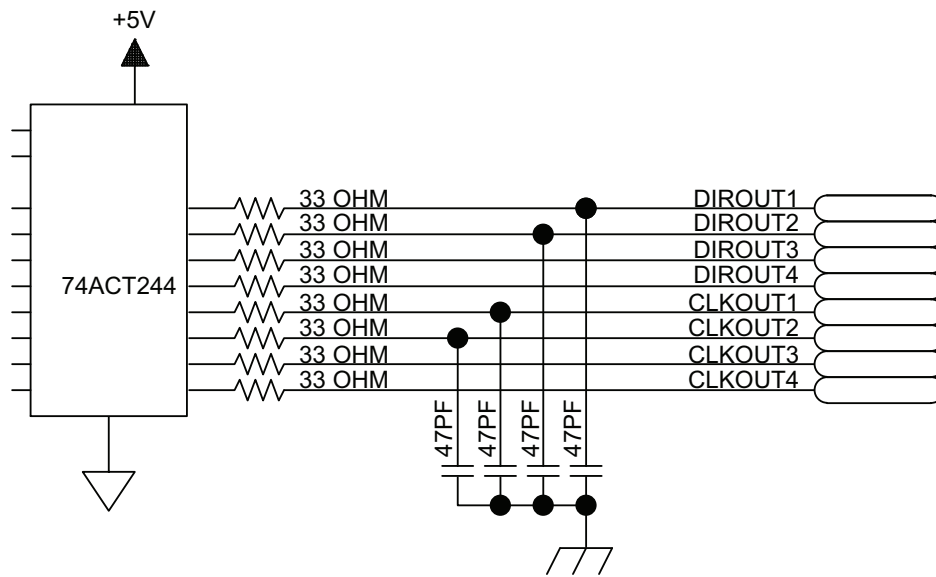


Figure 2-22: Clock and Direction Outputs

Table 2-22: Direction Signal Output Polarity

Direction of motion	Direction Output Voltage
Negative / CCW direction	Logic Low (0 Volts)
Positive / CW direction	Logic High (+5 Volts)

**NOTE:** If the stepper motor's direction of rotation is the opposite of what is desired, swap two motor connections to reverse the direction of rotation.

### 2.5.2. Motor Connections with the Nservo-TB

#### Brushless Motors with the Nservo-TB

If Aerotech’s standard cabling is not used, refer to [Section 2.7.1.](#) for information on correctly phasing the motor, encoder and Hall feedback devices.

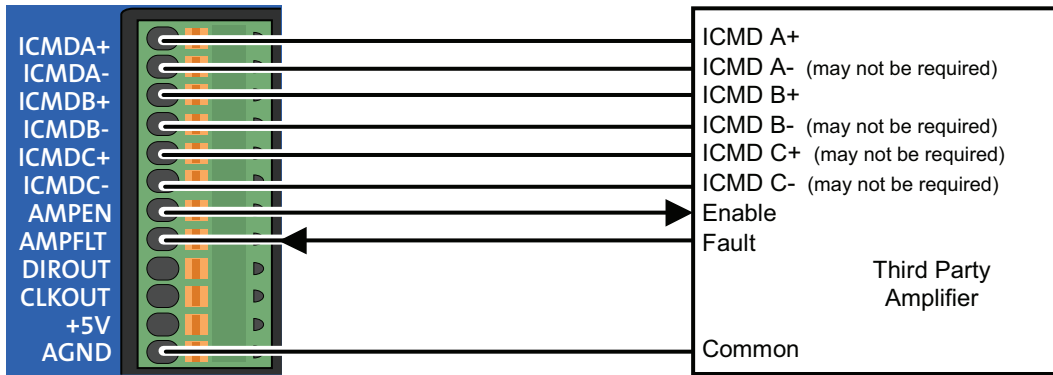


Figure 2-23: Brushless Motor Amplifier Connections

#### DC Brush Motors with the Nservo-TB

If Aerotech’s standard cabling is not used, refer to [Section 2.7.2.](#) for the correct encoder phasing information.

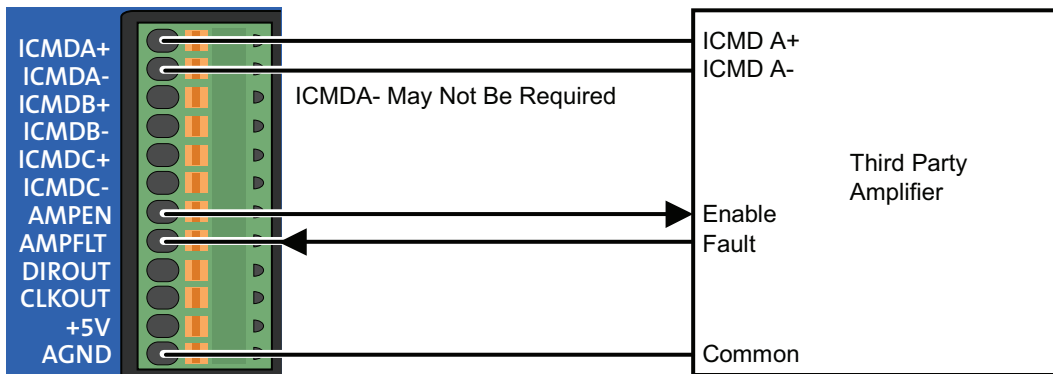
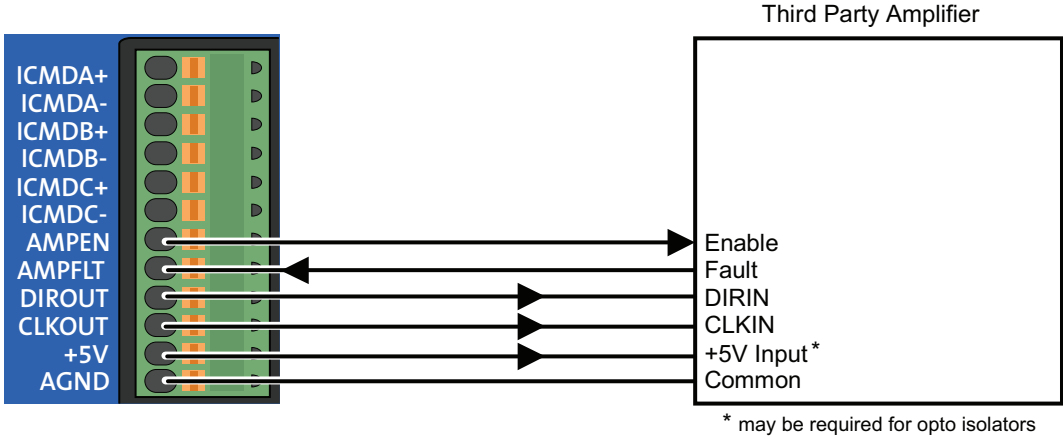


Figure 2-24: DC Brush Motor (Torque Mode) Amplifier Connections

**Stepper Motors with the Nservo-TB**

If Aerotech's standard cabling is not used, refer to [Section 2.7.3](#) for information on correctly phasing the motor feedback devices.



**Figure 2-25: Stepper Motor Amplifier Connections**

### 2.5.3. Encoder Interface (Nservo-TB)

Encoder 1 and Encoder 2 are quick release terminal blocks, and contain all of the required drive interface signals for two axes of servo loop control. The Nservo-TB4 has Encoder 3 and Encoder 4 connectors, providing two more axes of closed loop control. Each of these connectors have inputs for a differential line driver encoder, Hall feedback inputs, an encoder fault input and 5 VDC power for the encoder.

One encoder feedback device must always be used for DC brush and brushless motors. Each encoder channel accepts a differential line driver encoder. DC Brush and brushless motors may have a separate position and a velocity feedback device. An analog sine wave encoder may be used with Aerotech's MXH multiplier box to multiply the encoder resolution and simultaneously convert it to a differential line driver encoder signal.

See [Section 2.7.4.](#) for information on interfacing non-Aerotech motors.

**Table 2-23: Encoder Input Interface Pin Assignment**

Pin	Label	Description
1	+5 VDC*	Encoder and Limit Power
2	GND	Encoder and Limit Common
3	SIN+	Sine Encoder Feedback Signal
4	SIN-	Sine-N Encoder Feedback Signal
5	COS+	Cosine Encoder Feedback Signal
6	COS-	Cosine-N Encoder Feedback Signal
7	MRK+	Marker Encoder Feedback Signal
8	MRK-	Marker-N Encoder Feedback Signal
9	HA	Hall Effect A Feedback Signal (Brushless motors only)
10	HB	Hall Effect B Feedback Signal (Brushless motors only)
11	HC	Hall Effect C Feedback Signal (Brushless motors only)
12	ENCFLT	Encoder Fault Input

\*Total user +5 VDC power is limited to 3 A by an internal re-settable fuse. Should an over-current condition occur, the device will open to protect against the overload. To reset the device, remove the overload condition.

**Table 2-24: J204 A/B and J206 A/B Mating Connector**

Type	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm <sup>2</sup> ]
12-Pin Terminal Block	ECK01295	1881422	20-28 [0.5- 0.080]

**Table 2-25: Limit and Thermistor Input Interface Pin Assignment**

Pin	Label	Description
1	CW	Clockwise end of travel limit input
2	CCW	Counter-Clockwise end of travel limit input
3	HOME	Home Limit input
4	THERM	Thermistor input

**Table 2-26: J205 A/B and J207 A/B Mating Connector**

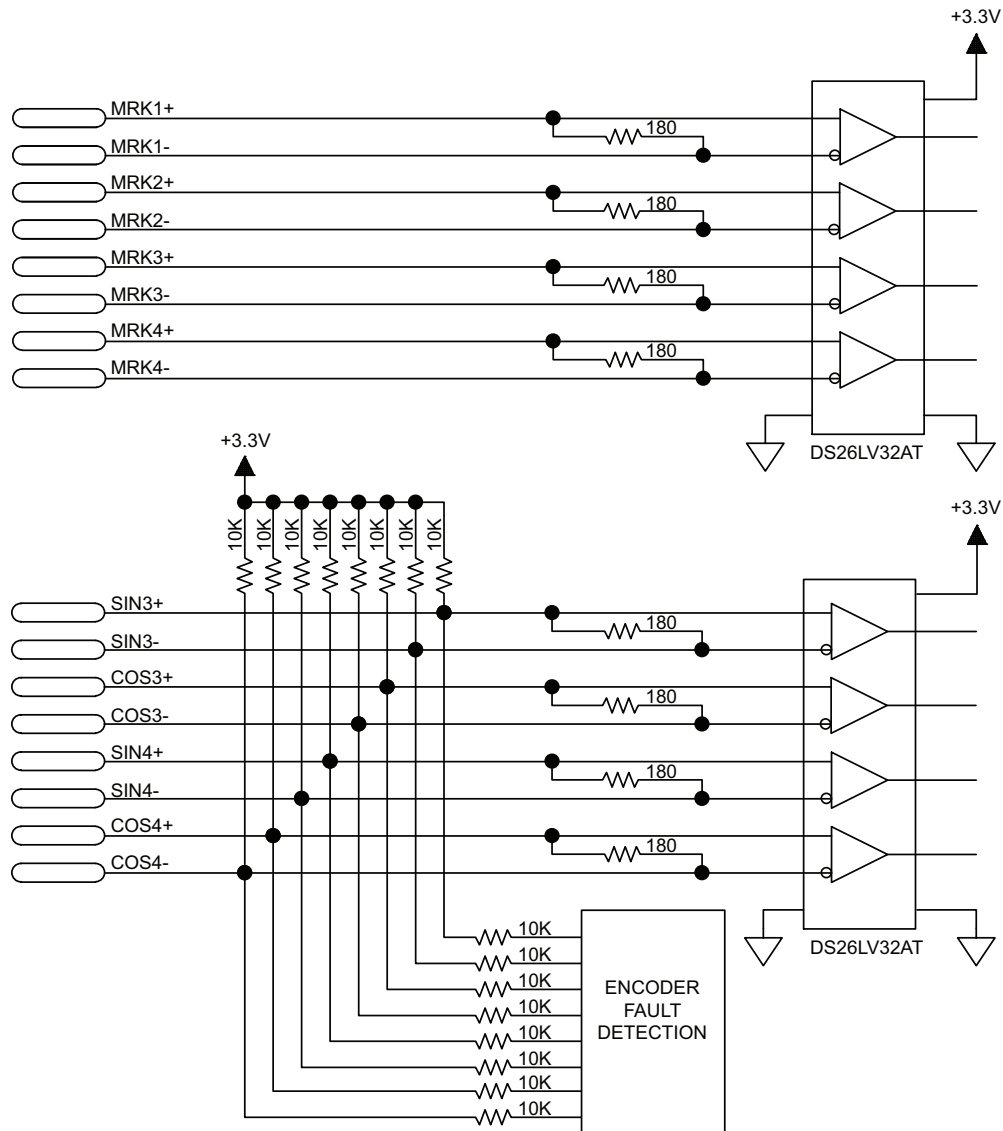
Type	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm <sup>2</sup> ]
4-Pin Terminal Block	ECK01293	1881341	20-28 [0.5- 0.080]

**2.5.3.1. Encoder Input Signals**

The Nservo is equipped with primary and secondary encoder feedback channels which will accept an RS-422 differential line driver signal. The primary encoder input is configured for a differential line driver encoder, in the range of 0 to +5 volts. It allows up to an 10 MHz encoder signal (25 nsec minimum edge separation), producing 40 million counts per second, after times four (x4) quadrature decoding.

Refer to [Table 2-12](#) for the connector pin output assignment.

**NOTE:** Encoder wiring should be physically isolated from motor, AC power and all other power wiring.

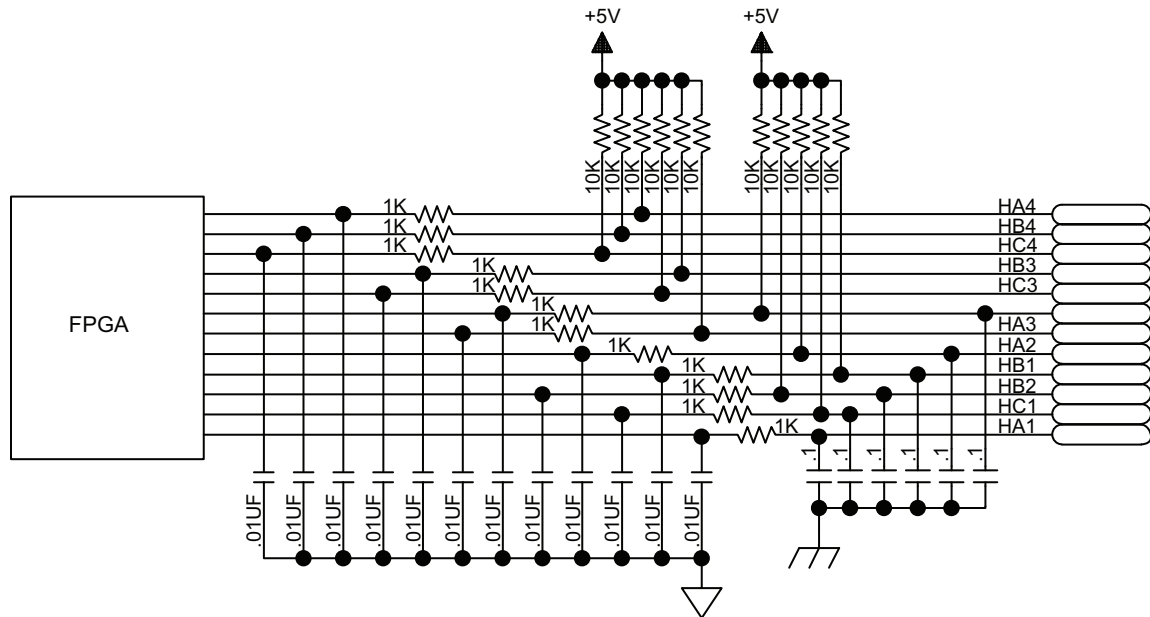


**Figure 2-26: Encoder Inputs**



**2.5.3.2. Hall-Effect Input Signals**

The Hall-effect inputs accept 5V TTL signal levels and are not opto-isolated. The Hall-effect switch inputs are recommended for AC brushless motor commutation but not absolutely required. The Hall-effect inputs accept 5-24 VDC level signals.



**Figure 2-27: Hall-Effect Inputs**

2.5.3.3. Encoder Fault Input Signals

The Encoder Fault inputs accept 5V TTL signal levels and are not opto-isolated. The schematic of the input circuitry is shown in Figure 2-28.

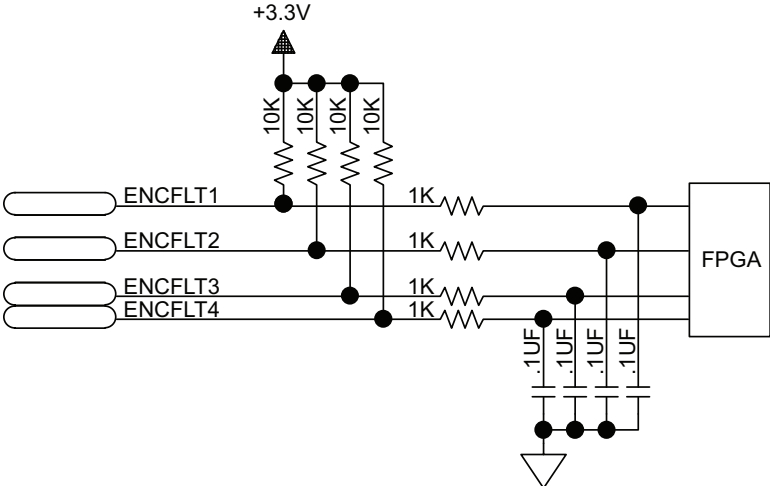


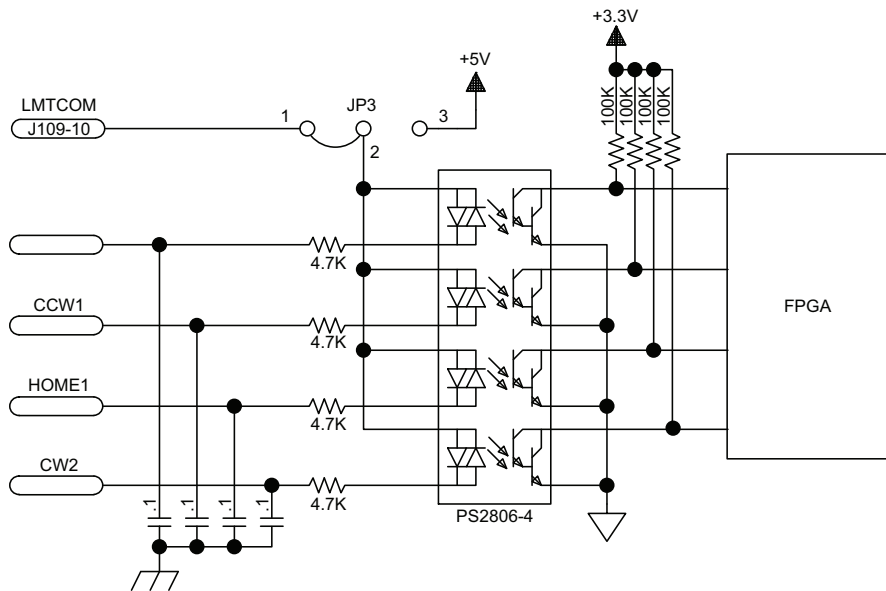
Figure 2-28: Encoder Fault Inputs

**2.5.3.4. Limit Input Signals**

End of Travel (EOT) limits are required to define the end of the physical travel on linear axes. Positive or clockwise motion is stopped by the clockwise (CW) end of travel limit input. Negative or counterclockwise motion is stopped by the counterclockwise (CCW) end of travel limit input. The Home Limit switch can be parameter configured for use during the home cycle, however, the CW or CCW EOT limit is typically used instead. All of the end-of-travel limit inputs accept 5-24 VDC level signals. Limit directions are relative to the encoder polarity as viewed in the Status Utility (refer to [Section 2.7.5.](#)).

The active state of the EOT limits is software selectable (by the EndOfTravelLimitSetup<sup>1</sup> axis parameter).

By default, all limit inputs share a common connection at J109 ([Section 2.12.](#)), allowing all limit inputs to be sourcing or sinking as shown in [Figure 2-62](#) (sinking) and [Figure 2-63](#) (sourcing).

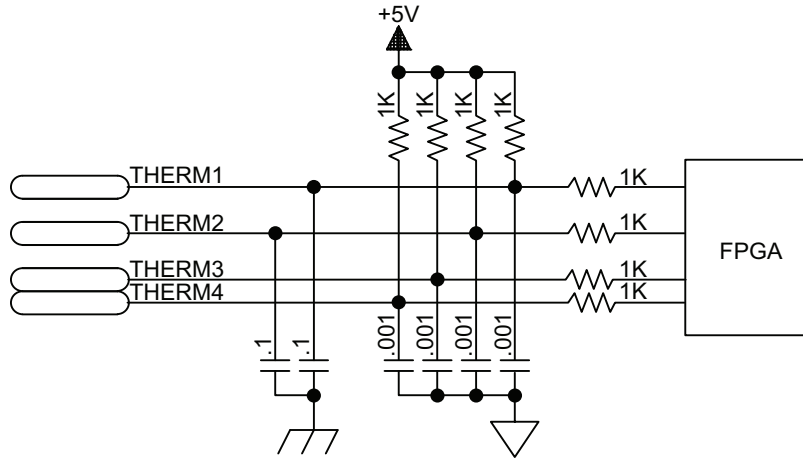


**Figure 2-29: End of Travel Limit Inputs**

<sup>1</sup>EndofTravelLimitSetup has replaced LimitLevelMask in software version 3.00.000.

**2.5.3.5. Thermistor Input Signals**

The thermistor input is used to detect an over temperature condition in a motor using a positive temperature coefficient sensor. As the temperature of the sensor increases, so does the resistance. Under normal operating conditions, the resistance of the thermistor is low (i.e., 100 ohms) which will result in a low input signal. If the increasing temperature causes the thermistor's resistance to increase, the signal will be seen as a logic high, triggering an over temperature fault.



**Figure 2-30: Thermistor Inputs**

## 2.6. Nservo-OEM

The Nservo-OEM is the internal board of the Nservo mounted on a sheet of metal.

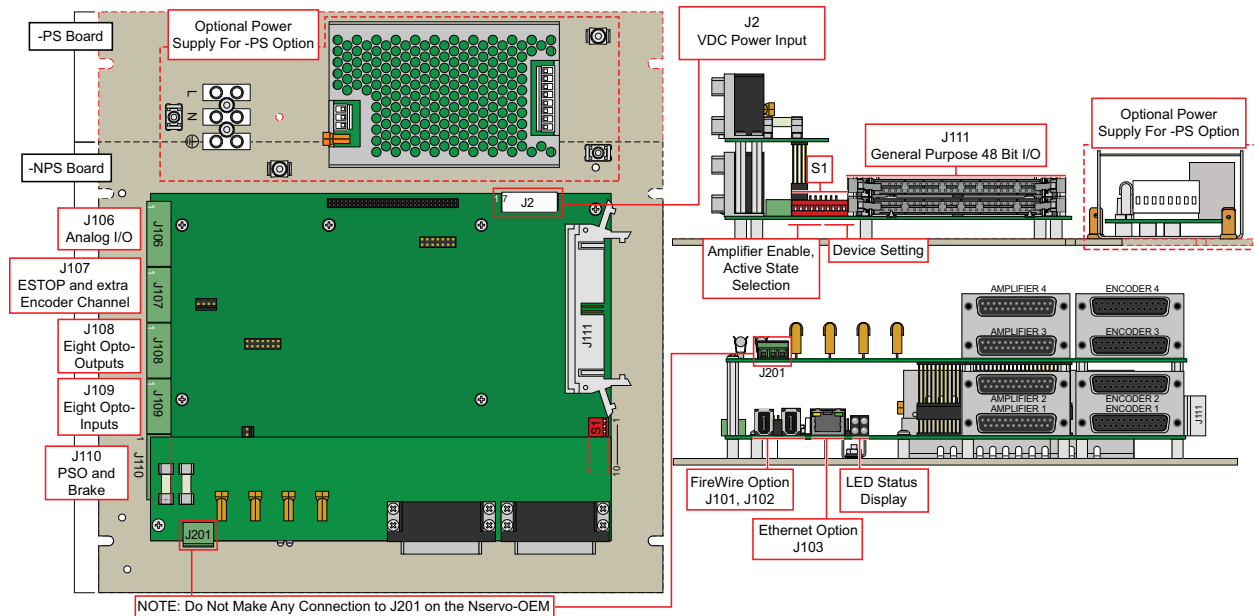


Figure 2-31: Nservo-OEM Connection Overview

Table 2-27: Nservo-OEM Configurations

Package	
-PS	Power Supply provided
-NPS	No Power Supply option
Base Model	
-DB2	2 axis with D-Style Connectors for user interface
-DB4	4 axis with D-Style Connectors for user interface
-ENET-DB2	2 axis with D-Style Connectors for user interface, with 10/100 BASE-T Ethernet port
-ENET-DB4	4 axis with D-Style Connectors for user interface, with 10/100 BASE-T Ethernet port
-TB2	2 axis with terminal blocks for user interface
-TB4	4 axis with terminal blocks for user interface
-ENET-TB2	2 axis with terminal blocks for user interface, with 10/100 BASE-T Ethernet port
-ENET-TB4	4 axis with terminal blocks for user interface, with 10/100 BASE-T Ethernet port
PSO Options	
-DPSO	Two axis PSO (laser firing), single axis PSO is standard
-TPSO	Three axis PSO (laser firing), single axis PSO is standard
-OPTO2	Opto isolator for PSO (15VDC, high speed, low current, 6N136)
-OPTO3	Opto isolator for PSO (30VDC, low speed, high current, 4N33)
-OPTO4	Opto isolator for PSO (5-25VDC, 40kHz, 50mA, TIL117-M)
Options	
-LMT5V	Limit inputs configured for internal power, for -OP and -DB options
-NOLMT5V	For non-opto isolated inputs
-SE	Single ended (non-differential) analog inputs

**Table 2-28: Feature Summary**

Standard Features
<ul style="list-style-type: none"> <li>• Supports 2 (standard) or 4 closed loop servo axes</li> <li>• Each axis has three <math>\pm 10</math> volt current command outputs</li> <li>• Up to 5 channels of 32 MHz line driver quadrature encoder inputs</li> <li>• Drive fault and 24-volt tolerant opto-isolated CW, CCW, Home inputs per axis powered by either an internal 5V or external power supply</li> <li>• 24-volt tolerant drive enable output per axis (open collector transistor; single ended; polarity selectable)</li> <li>• 11 digital inputs (8 optically isolated)</li> <li>• Eight opto-isolated digital outputs sinking or sourcing; 5-24V</li> <li>• Four 16-bit analog inputs, 2 are differential with x1, x2, x4, x10 input gains</li> <li>• Two 16 bit analog outputs</li> <li>• Opto-isolated PSO output (opto-coupled, open collector, differential)</li> <li>• All I/O connections via easily removable connectors</li> <li>• Two FireWire ports</li> <li>• Dedicated Emergency Stop sense input standard.</li> <li>• Internal power supply</li> <li>• Equivalent software functionality (less current loop support) to other drives in the A3200 family</li> <li>• Software configurable for brush, brushless and stepper motor operation</li> <li>• 5 VDC, 500 mA power output for encoder and limits, etc.</li> <li>• Fail safe brake control output (open collector)</li> <li>• Four auxiliary (U500/U600 compatible) open collector mode outputs</li> <li>• High-speed position latching input</li> <li>• 48 bits of programmable I/O, user definable as input/output by byte</li> </ul>

**Table 2-29: Nservo-OEM Connection Overview**

Connector	Refer To
-TB2 or -TB4 Amp and Encoder	<a href="#">Section 2.5. Connections to the Nservo-TB .</a>
-DB2 or -DB4 Amp and Encoder	<a href="#">Section 2.3. Connections to the Nservo-DB</a>
J101 and J102	<a href="#">Section 2.8. FireWire Interface</a>
J106	<a href="#">Section 2.9. Analog I/O and Non-Isolated Inputs/Joystick</a>
J107	<a href="#">Section 2.10. Auxiliary Encoder, ESTOP, and User Interrupt (J107)</a>
J108	<a href="#">Section 2.11. Opto-Isolated Digital Outputs (J108)</a>
J109	<a href="#">Section 2.12. Opto-Isolated Digital Inputs (J109)</a>
J110	<a href="#">Section 2.13. Brake, External Limit, and PSO Interface (J110)</a>
J111	<a href="#">Section 2.15. Hall Inputs and General Purpose I/O (J111A, J111B)</a>
PSO Options	<a href="#">Section 3.1. -DPSO and -TPSO Laser Firing Options; Section 2.13.3. PSO Outputs (J110)</a>
ENET Option	<a href="#">Section 3.2. -ENET Option (J103)</a>
RDP Option	The RDP option is not supported on the Nservo-OEM
J201	Do not make any connection to J201.

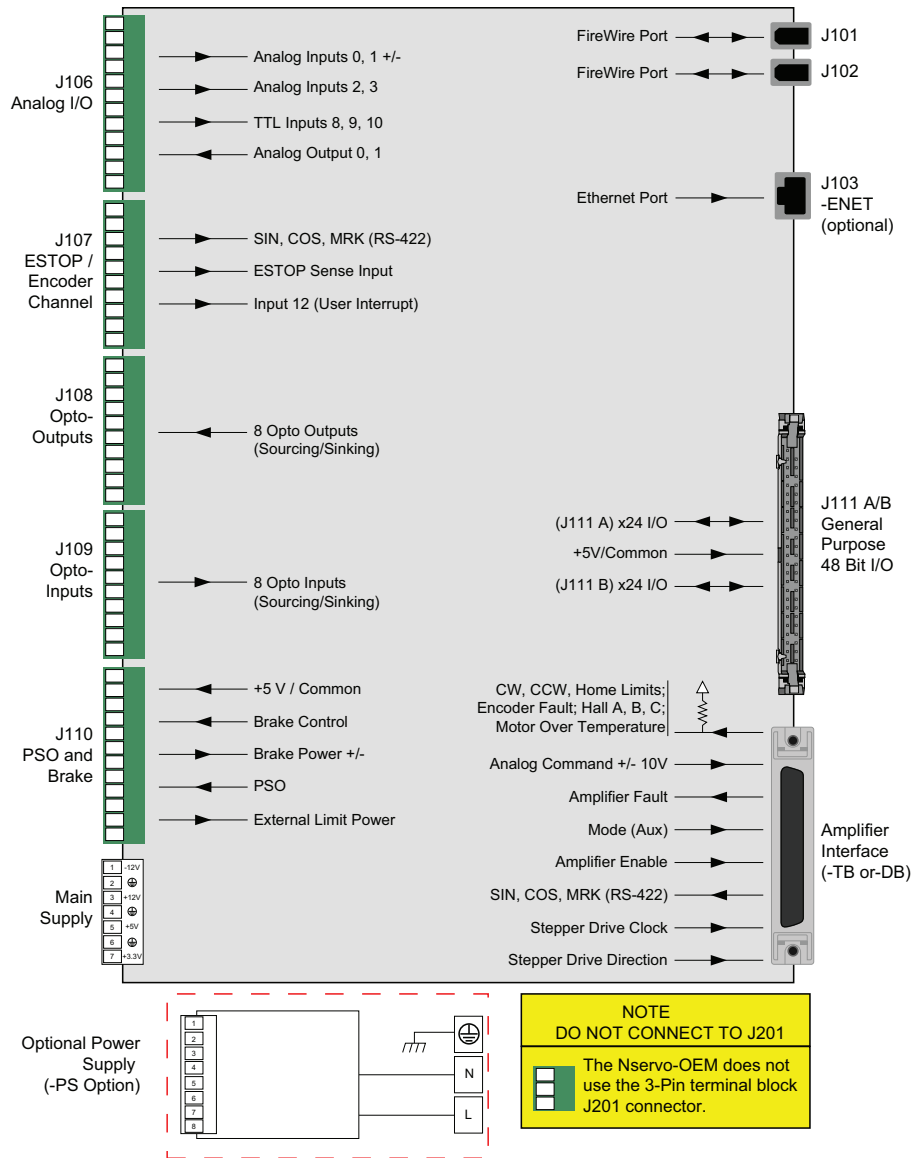


Figure 2-32: Functional Diagram

### 2.6.1. Nservo-OEM Communication Channel Setting

Use the Device Number switches of S1 to assign a communication channel number to the Nservo. If you are using multiple drives, each drive must be assigned a unique communication channel. Multiple drives are typically configured using sequential communication channels. The 32nd switch setting cannot be used for 2-axis units, and the 30th to 32nd switch settings cannot be used for 4 axis units.

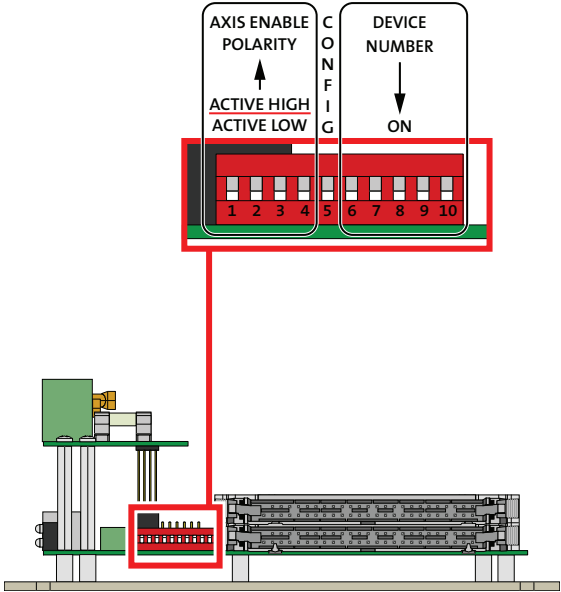


Figure 2-33: Nservo-OEM Device Number (S1) Location



**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 2-30: Device Number Switch Settings (S1)**

Device #	Switch Settings (Off is indicated by "-")				
	6	7	8	9	10
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

### 2.6.2. Nservo-OEM-PS

-PS refers to the "Power Supply" option.

This section has a connection overview, a power connection overview, and -PS dimensions.

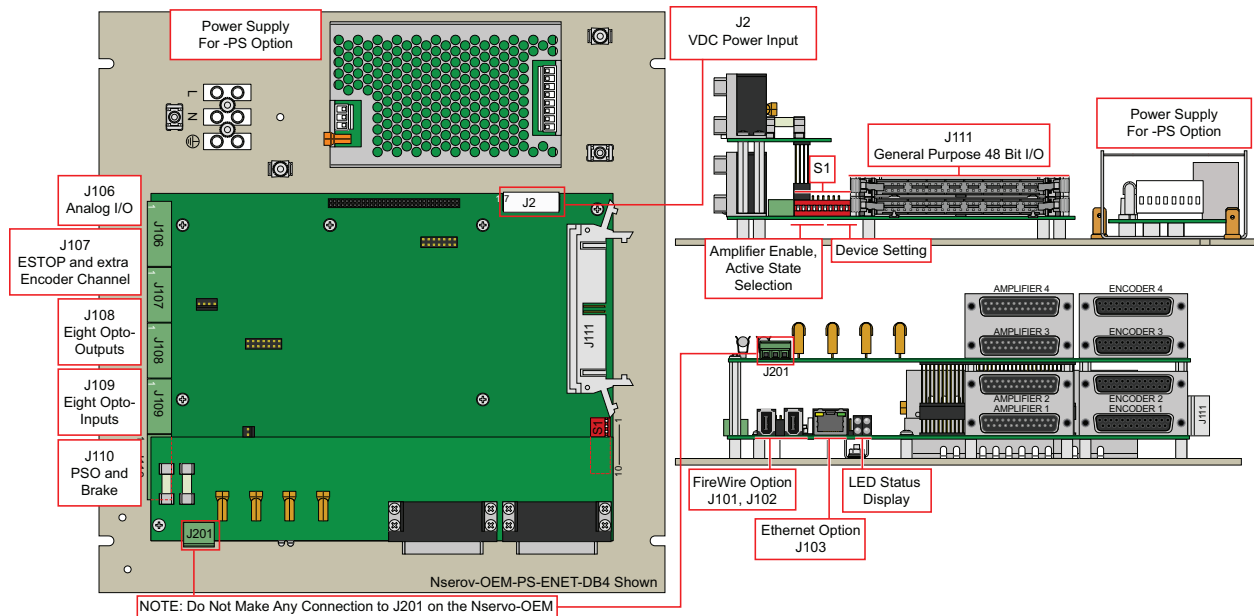


Figure 2-34: Nservo-OEM-PS Connection Overview

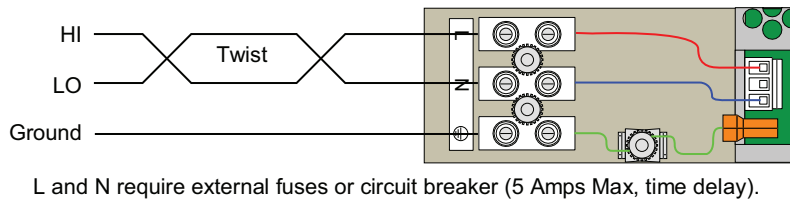
Connector	Refer To
-TB2 or -TB4 Amp and Encoder	<a href="#">Section 2.5. Connections to the Nservo-TB .</a>
-DB2 or -DB4 Amp and Encoder	<a href="#">Section 2.3. Connections to the Nservo-DB</a>
J101 and J102	<a href="#">Section 2.8. FireWire Interface</a>
J106	<a href="#">Section 2.9. Analog I/O and Non-Isolated Inputs/Joystick</a>
J107	<a href="#">Section 2.10. Auxiliary Encoder, ESTOP, and User Interrupt (J107)</a>
J108	<a href="#">Section 2.11. Opto-Isolated Digital Outputs (J108)</a>
J109	<a href="#">Section 2.12. Opto-Isolated Digital Inputs (J109)</a>
J110	<a href="#">Section 2.13. Brake, External Limit, and PSO Interface (J110)</a>
J111	<a href="#">Section 2.15. Hall Inputs and General Purpose I/O (J111A, J111B)</a>
PSO Options	<a href="#">Section 3.1. -DPSO and -TPSO Laser Firing Options; Section 2.13.3. PSO Outputs (J110)</a>
ENET Option	<a href="#">Section 3.2. -ENET Option (J103)</a>
RDP Option	The RDP option is not supported on the Nservo-OEM
J201	Do not make any connection to J201.

**2.6.2.1. Nservo-OEM-PS Power Connection**

The Nservo is powered from a 100/115/208/230 VAC line. Input power is applied to the Nservo at three terminals of the Main Supply connector (refer to [Figure 2-2](#) for locations). For a complete list of electrical specifications, refer to [Section 1.1](#).

External fuses or a circuit breaker (5 A maximum, time delay type) are required for the L and N inputs for branch protection. The protective device should be located near the drive.

**NOTE:** This is the only VAC connection required for the Nservo-OEM. Do not make any connection to J201.



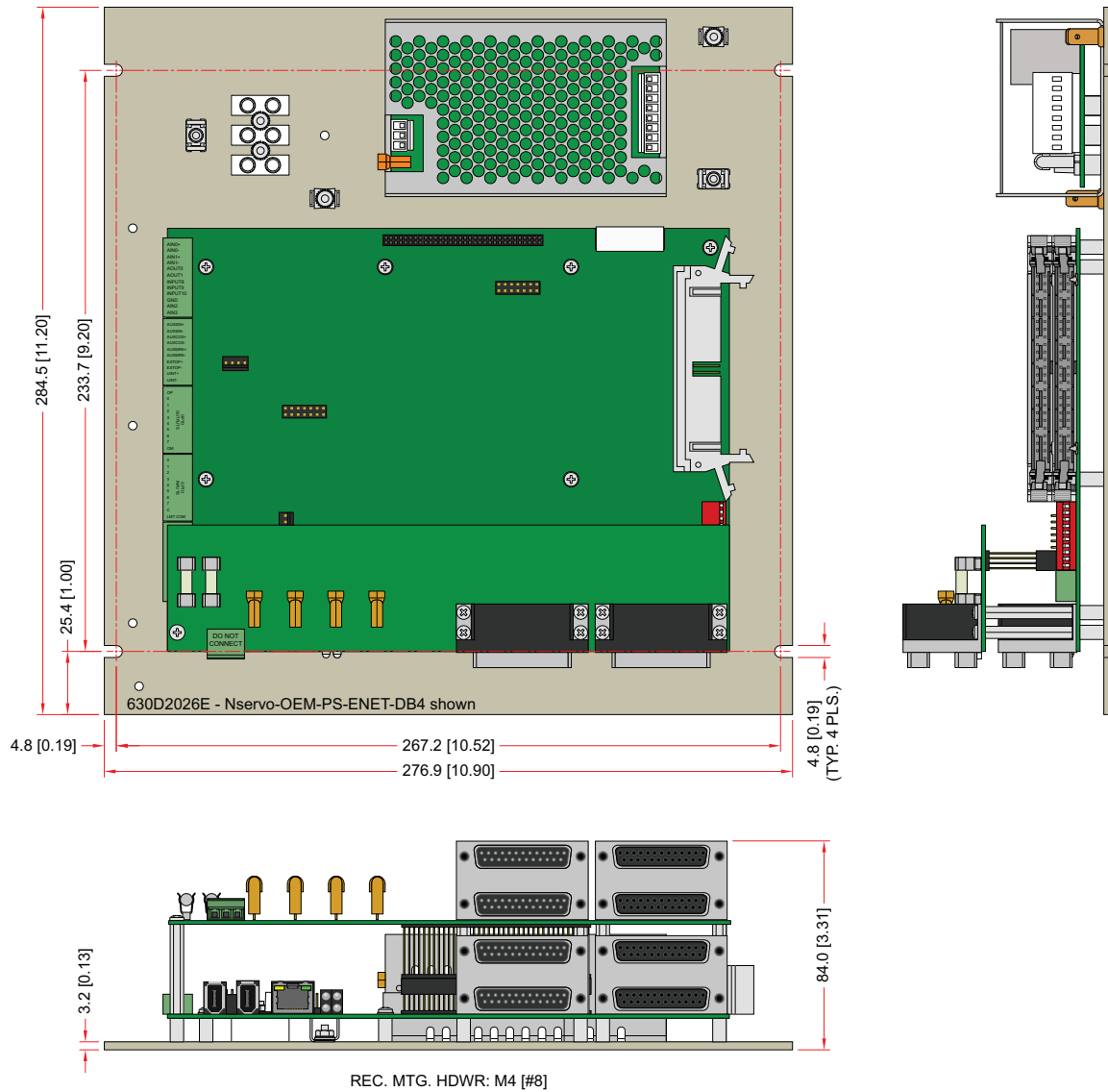
**Figure 2-35: Nservo-OEM-PS AC Power Input Connections**

**Table 2-31: Power Supply Input Wiring**

Pin	Description	Recommended Wire Size
L	100 - 240 Volt AC Input Range	1.3 mm <sup>2</sup> (#16 AWG)
N	100 - 240 Volt AC Input Range	1.3 mm <sup>2</sup> (#16 AWG)
⊕	Protective Ground (Required for Safety)	1.3 mm <sup>2</sup> (#16 AWG)

**2.6.2.2. Nservo-OEM-PS Dimensions**

Each unit should be separated from other drives and surrounded by 25 mm (1") of free air space. A space of 100 mm (4") should be allowed along the front of the unit for cable connections. Allow for connector access and cable bend radius on three sides.



**Figure 2-36: Nservo-OEM-PS-ENET-DB4 Dimensions**

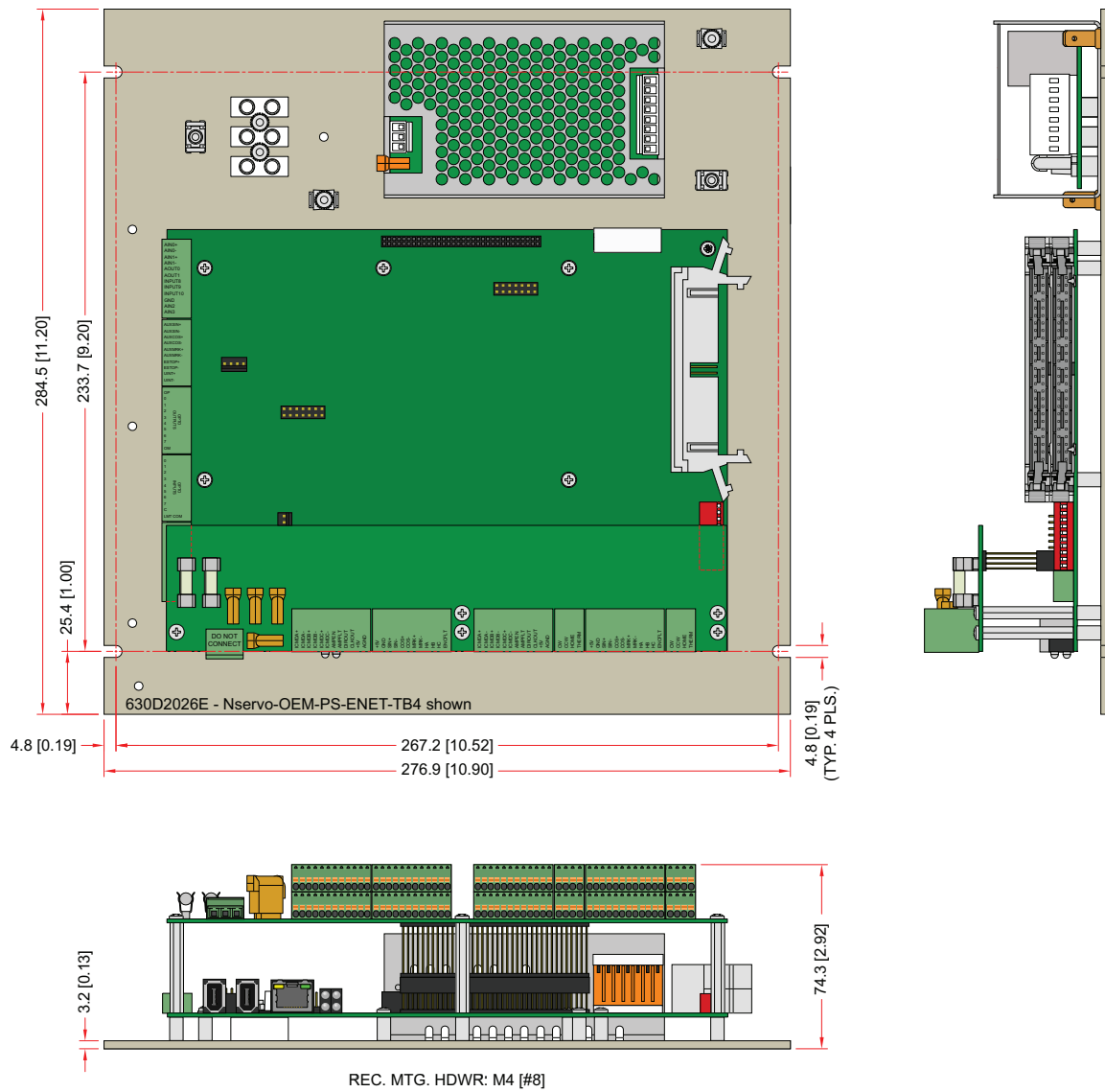


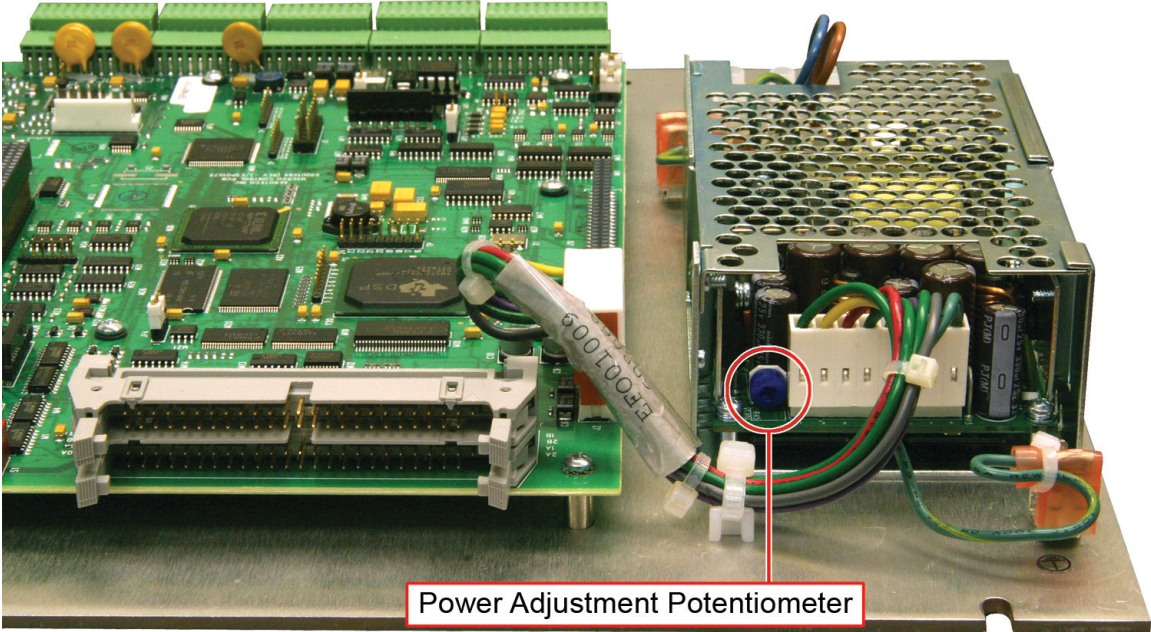
Figure 2-37: Nservo-OEM-PS-ENET-TB4 Dimensions

Table 2-32: Nservo-OEM-PS Weight Specifications

Model	Nservo-OEM-PS
-DB2 (2 axis)	1.5 kg (3.2 lb)
-DB4 (4 axis)	2.4 kg (3.4 lb)
-TB2 (2 axis)	1.5 kg (3.2 lb)
-TB4 (4 axis)	2.4 kg (3.4 lb)

**2.6.2.3. Nservo-OEM-PS 5-Volt Power Adjust**

The 5-volt power can be adjusted at the internal power supply as shown in the picture below. The solid green wire is common and the violet (purple) wire is +5 V.

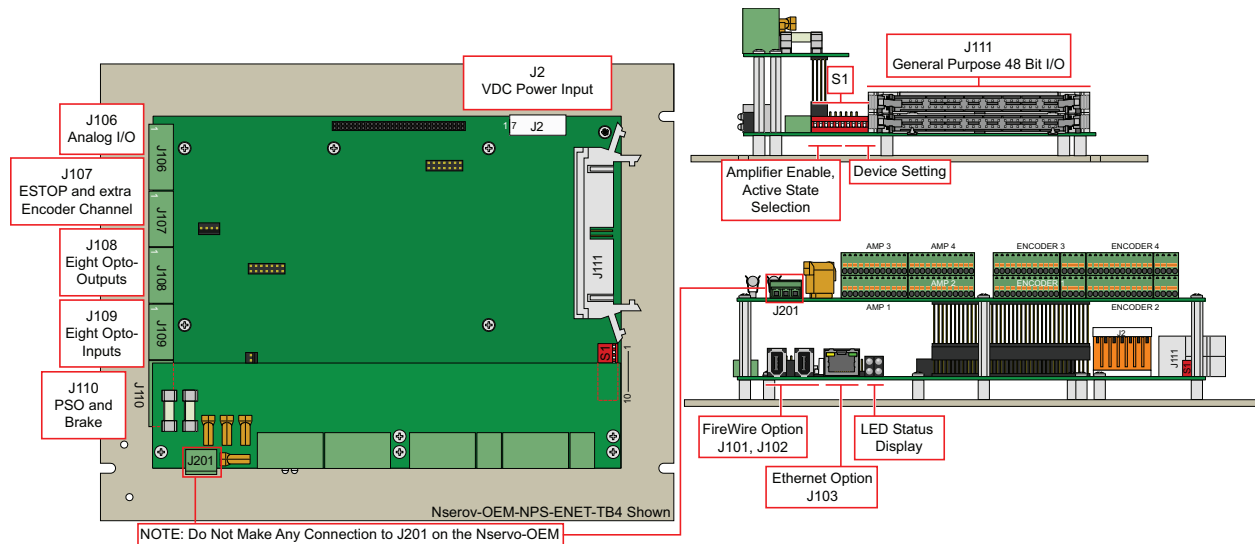


**Figure 2-38: 5-Volt Power Adjustment Location on the Nservo-OEM**

### 2.6.3. Nservo-OEM-NPS

-NPS refers to the "No Power Supply" option.

This section has a connection overview, a power connection overview, and -NPS dimensions.



**Figure 2-39: Nservo-OEM-NPS Connection Overview**

Connector	Refer To
-TB2 or -TB4 Amp and Encoder	<a href="#">Section 2.5. Connections to the Nservo-TB</a>
-DB2 or -DB4 Amp and Encoder	<a href="#">Section 2.3. Connections to the Nservo-DB</a>
J101 and J102	<a href="#">Section 2.8. FireWire Interface</a>
J106	<a href="#">Section 2.9. Analog I/O and Non-Isolated Inputs/Joystick</a>
J107	<a href="#">Section 2.10. Auxiliary Encoder, ESTOP, and User Interrupt (J107)</a>
J108	<a href="#">Section 2.11. Opto-Isolated Digital Outputs (J108)</a>
J109	<a href="#">Section 2.12. Opto-Isolated Digital Inputs (J109)</a>
J110	<a href="#">Section 2.13. Brake, External Limit, and PSO Interface (J110)</a>
J111	<a href="#">Section 2.15. Hall Inputs and General Purpose I/O (J111A, J111B)</a>
PSO Options	<a href="#">Section 3.1. -DPSO and -TPSO Laser Firing Options</a> ; <a href="#">Section 2.13.3. PSO Outputs (J110)</a>
ENET Option	<a href="#">Section 3.2. -ENET Option (J103)</a>
RDP Option	The RDP option is not supported on the Nservo-OEM
J201	Do not make any connection to J201.

2.6.3.1. Nservo-OEM-NPS Power Connection

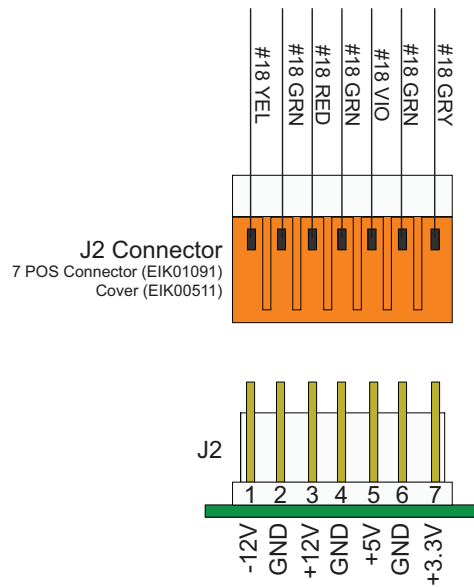


Figure 2-40: Nservo-OEM-NPS AC Power Input Connections

Table 2-33: J2 Wiring for the Nservo-OEM-NPS

Pin	Description	Recommended Wire Size
1	-12 V	0.8 mm <sup>2</sup> (#18 AWG)
2	Protective Ground (Required for Safety)	0.8 mm <sup>2</sup> (#18 AWG)
3	+12 V	0.8 mm <sup>2</sup> (#18 AWG)
4	Protective Ground (Required for Safety)	0.8 mm <sup>2</sup> (#18 AWG)
5	+5 V	0.8 mm <sup>2</sup> (#18 AWG)
6	Protective Ground (Required for Safety)	0.8 mm <sup>2</sup> (#18 AWG)
7	+3.3 V	0.8 mm <sup>2</sup> (#18 AWG)

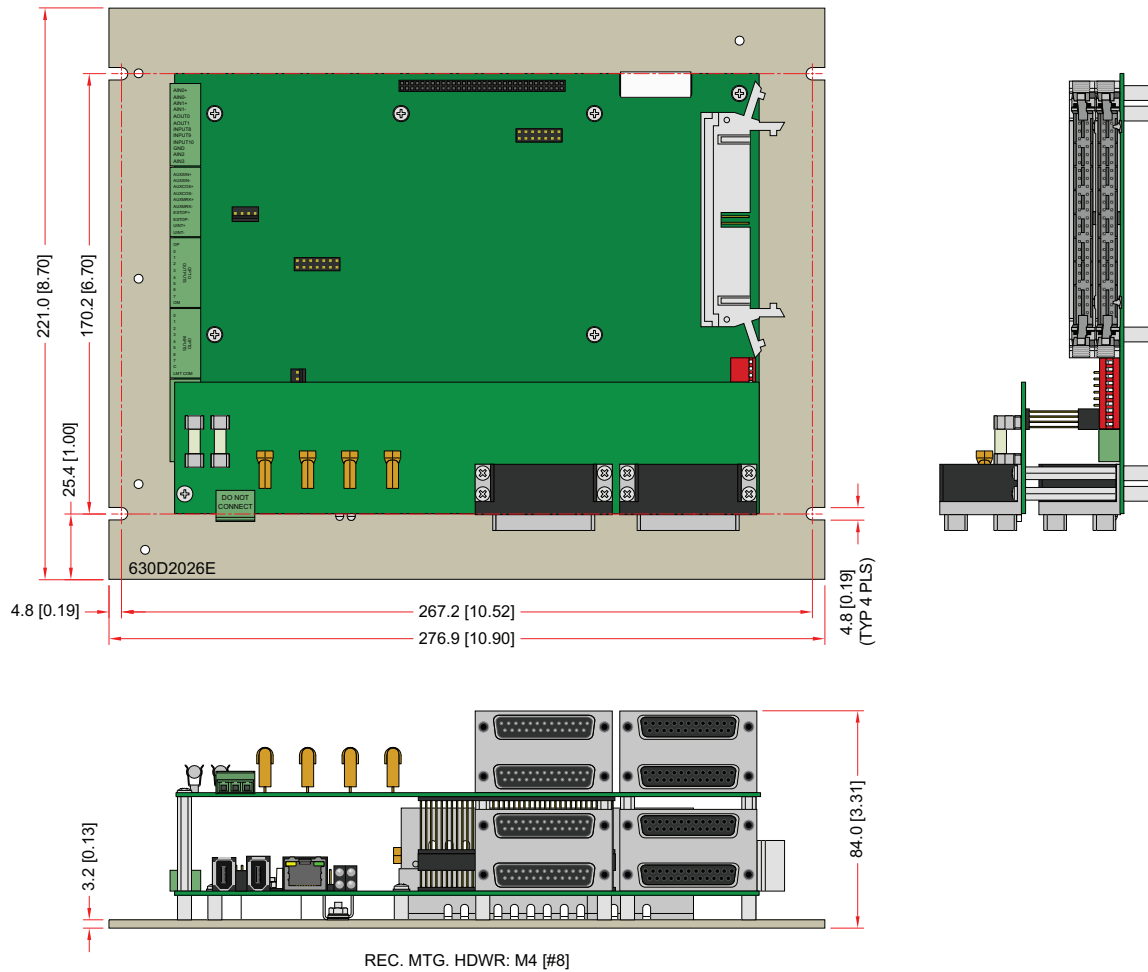
Table 2-34: Power Requirements

	Recommended Power Supply Capacity	Actual Current Consumption (Typical)
-12 V	0.7 A	0.26 A
+12 V	0.7 A	0.33 A
+5 V	3 A	0.11 A
+3.3 V	5 A	0.89 A



**2.6.3.2. Nservo-OEM-NPS Dimensions**

Each unit should be separated from other drives and surrounded by 25 mm (1") of free air space. A space of 100 mm (4") should be allowed along the front of the unit for cable connections. Allow for connector access and cable bend radius on three sides.



**Figure 2-41: Nservo-OEM-NPS-ENET-DB4 Dimensions**

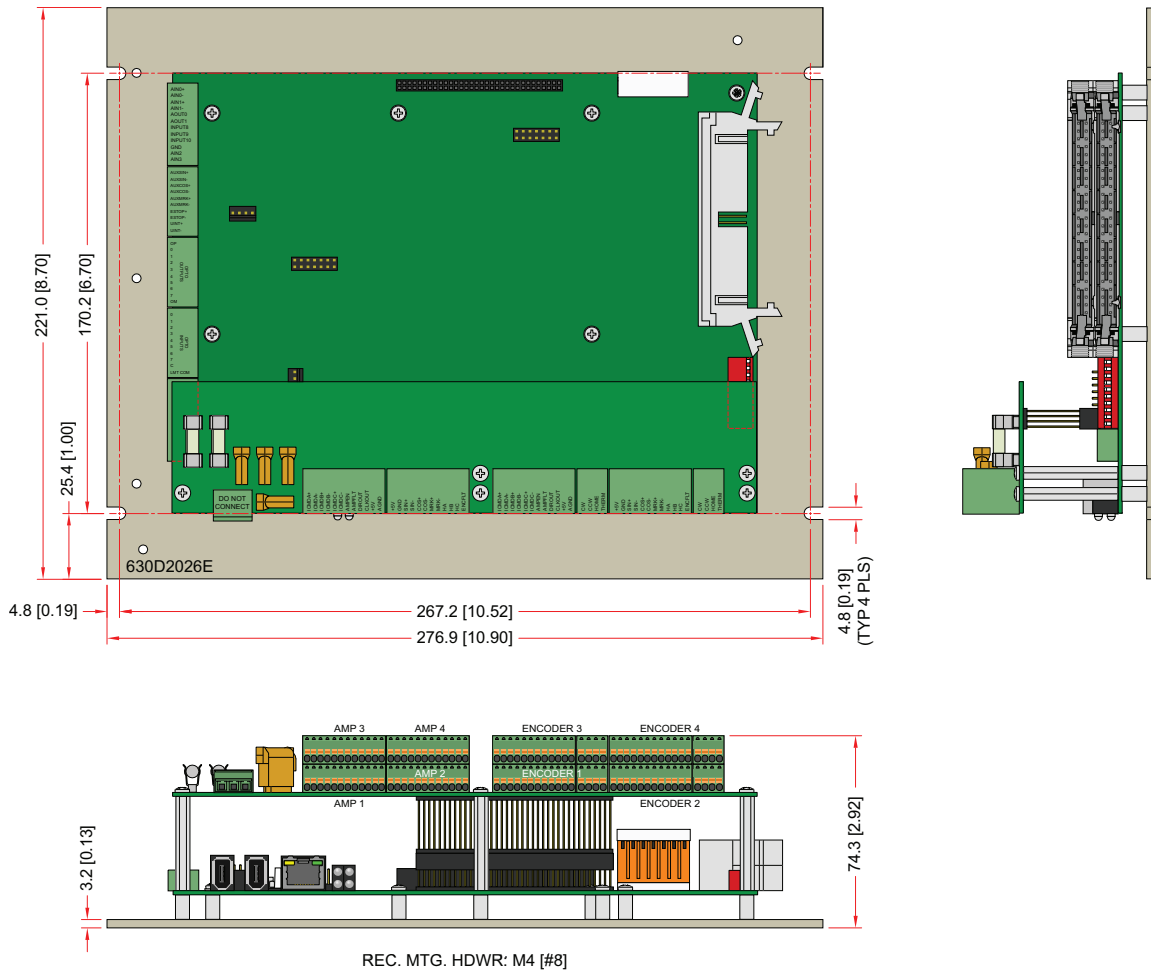


Figure 2-42: Nservo-OEM-NPS-ENET-TB4 Dimensions

Table 2-35: Nservo-OEM-NPS Weight Specifications

Model	Nservo-OEM-NPS
-TB2 (2 axis)	.265 kg (0.58 lb)
-TB4 (4 axis)	1.165 kg (2.57 lb)
-DB2 (2 axis)	.265 kg (0.58 lb)
-DB4 (4 axis)	1.165 kg (2.57 lb)

## 2.7. Motor and Encoder Phasing

**NOTE:** If using standard Aerotech motors and cables, motor and encoder connection adjustments are not required.

### 2.7.1. Brushless Motor Phasing

The Nservo requires that the Back-EMF of each motor phase be aligned with the corresponding Hall-effect signal. To ensure proper alignment, motor, Hall, and encoder connections should be verified.

There are two methods for verifying motor connections: powered (see [Section 2.7.1.1.](#)) through the use of a test program; and an unpowered method (see [Section 2.7.1.2.](#)) using an oscilloscope. Both methods will identify the A, B, and C Hall/motor lead sets and indicate the correct connections to the drive.

### 2.7.1.1. Powered Motor Phasing

To test the initial set of motor connections, run the MsetDebug.Pgm<sup>1</sup> test program.

The program will attempt to move the motor forward in a positive (CW) direction. Depending on the information that the program gathers during the test, you may be prompted to rearrange motor lead connections and run the test again.



**WARNING:** The MsetDebug.Pgm program moves the motor in “Open-Loop” mode, bypassing many of the standard safety faults.



**WARNING:** It is recommended that rotary motors be disconnected from the stage/load before running this test. Linear motor systems must be free from obstruction to prevent damage to other components. Operators must remain clear of all moving parts during the test.

### Hall Signal Phasing

With the information gathered while the program is running, the Hall signal wires may have to be swapped. After the Hall sequence is correct, the program will determine if a commutation offset is required (and calculate a value for the CommutationOffset<sup>2</sup> axis parameter that will have to be entered into the parameter editor).

### Encoder Phasing

The MsetDebug.Pgm program also determines if the feedback wiring is correct. Follow the program prompts to establish the correct feedback wiring.

### Feedback Monitoring:

The state of the encoder and Hall-effect device signals can be observed in the Status Utility.

A “L” for the given Hall input indicates zero voltage or logic low, where a “H” indicates 5V or logic high.

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<sup>1</sup>MotorVerification.pgm has replaced MSetDebug.pgm in software version 3.00.000.

<sup>2</sup>CommutationOffset has replaced CfgMotOffsetAng in software version 3.00.000.

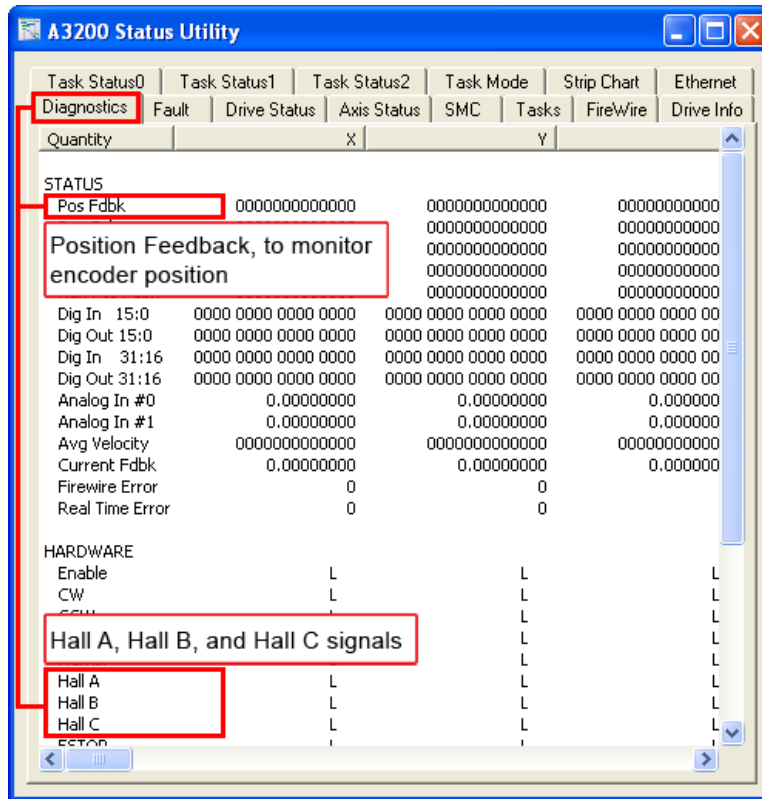


Figure 2-43: Encoder and Hall Signal Diagnostics

2.7.1.2. Unpowered Motor and Feedback Phasing

Disconnect the motor from the controller and connect the motor in the test configuration shown in Figure 2-44. This method will require a two-channel oscilloscope, a 5V power supply, and six resistors (10,000 ohm, 1/4 watt). All measurements should be made with the probe common of each channel of the oscilloscope connected to a neutral reference test point (TP4, shown in Figure 2-44).

To determine the relative phasing/order of the three motor lead signals in relation to each other, connect channel 1 of the oscilloscope to TP1. Connect channel 2 to TP2 and move the motor in the positive direction (CW) by hand. Note the peak of the sine wave signal of channel 1 in comparison to the peak of the sine wave signal of channel 2. Next, disconnect channel 2 from TP2 and reconnect it to TP3 and again move the motor in the positive direction. Note the peak of the sine wave signal of channel 3 in comparison to the peak of the sine wave signal of channel 1.

Aerotech phasing configuration expects ØC to be the lead signal (in time), ØB to follow it, and ØA to follow ØB. This means that whichever signal has its sine wave peak farthest to the left should be designated as the ØC signal.

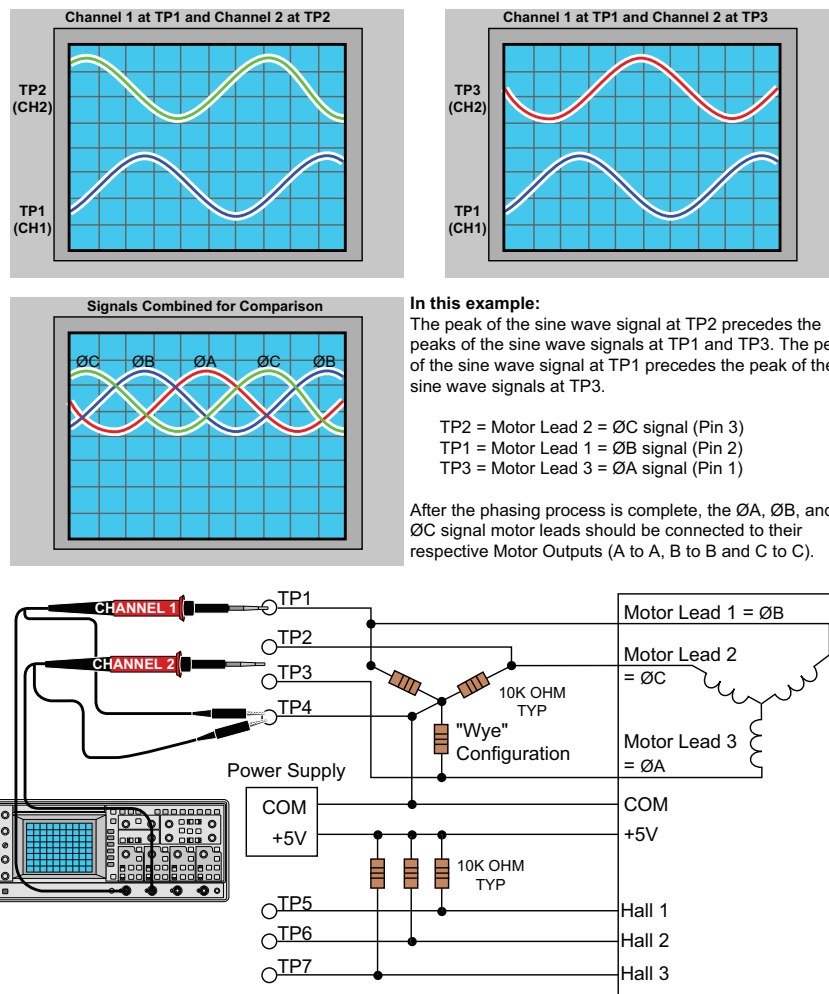


Figure 2-44: Motor Phasing Oscilloscope Example

After the motor leads have been tested, the next step is to determine the phase of the Hall signals. The required (by an Aerotech system) relationship between motor and Hall leads is that the peak of a motor lead signal should correspond to the low voltage phase of the Hall signal (the relationship is shown in Figure 2-45).

With channel 1 still connected to one of the motor leads, connect channel 2 of the oscilloscope to TP5, TP6, and then TP7, while advancing the motor in the positive direction after each connection. Note which of the three Hall signals has the complimentary phase relationship to the motor lead that channel 1 is connected to (as shown in Figure 2-45).

Move channel 1 of the oscilloscope to the second motor lead and repeat the steps from above. Note which Hall signal corresponds to the currently selected motor lead and repeat the process for the 3rd motor lead.

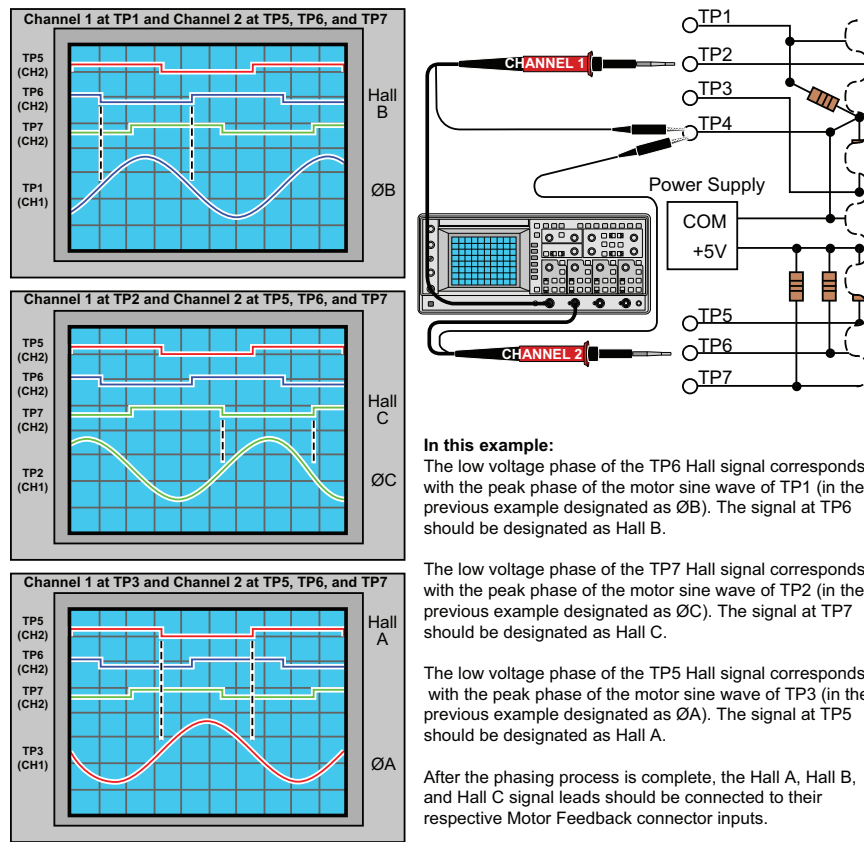


Figure 2-45: Hall Phasing with Oscilloscope

With the designations of the motor and Hall leads of a third party motor determined, the motor can now be connected to an Aerotech system. Connect motor lead A to motor connector A, motor lead B to motor connector B, and motor lead C to motor connector C. Connect Hall lead A to Pin 10 of the feedback connector. Hall lead B should be connected to Pin 5 and Hall lead C should connect to Pin 11 of the feedback connector.

The motor is correctly phased when the Hall states correspond to the states at each of the electrical angles. The Hall signal leads must be associated with its corresponding motor leads.

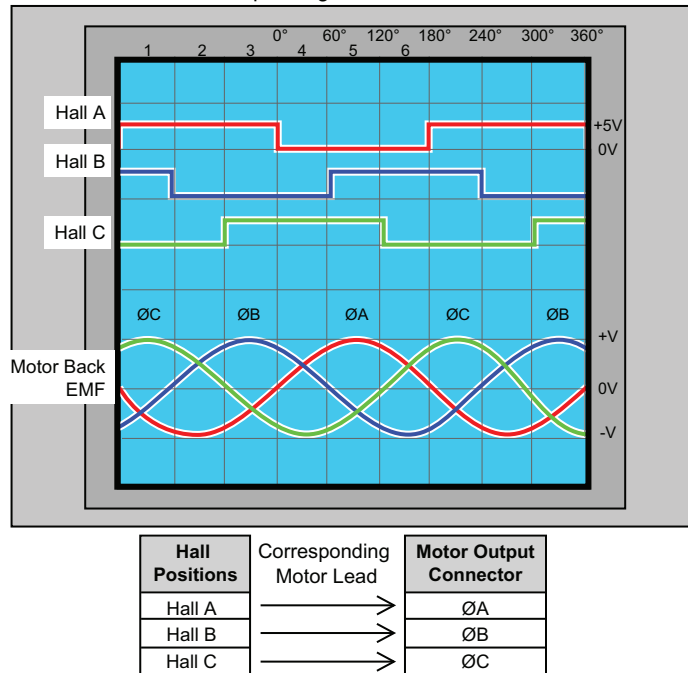


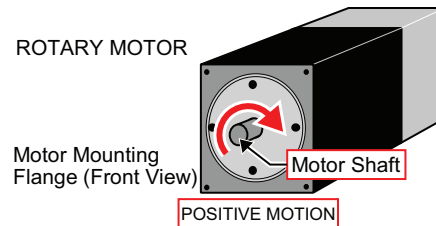
Figure 2-46: Brushless Motor Phasing Goal



### 2.7.2. DC Brush Motor Phasing

A properly phased motor means that the positive motor lead should be connected to the  $\emptyset A$  motor terminal and the negative motor lead should be connected to the  $\emptyset C$  motor terminal. To determine if the motor is properly phased, connect a voltmeter to the motor leads of an un-powered motor:

1. Connect the positive lead of the voltmeter to the one of the motor terminals.
2. Connect the negative lead of the voltmeter to the other motor terminal.
3. Rotate the motor clockwise (CW) by hand.



**Figure 2-47: Clockwise Motor Rotation**

4. If the voltmeter indicates a negative value, swap the motor leads and rotate the motor (CW, by hand) again. When the voltmeter indicates a positive value, the motor leads have been identified.
5. Connect the motor lead from the voltmeter to the  $\emptyset A$  motor terminal on the Nservo. Connect the motor lead from the negative lead of the voltmeter to the  $\emptyset C$  motor terminal on the Nservo.

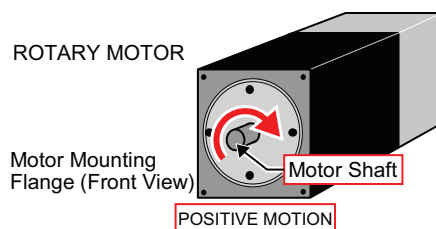
**NOTE:** If using standard Aerotech motors and cables, motor and encoder connection adjustments are not required.

### 2.7.3. Stepper Motor Phasing

A stepper motor can be run with or without an encoder. If an encoder is not being used, phasing is not necessary. With an encoder, test for proper motor phasing by running a positive motion command.

If there is a positive scaling factor (determined by the CountsPerUnit<sup>1</sup> parameters) and the motor moves in a clockwise direction, as viewed looking at the motor from the front mounting flange, the motor is phased correctly. If the motor moves in a counterclockwise direction, swap the motor leads and re-run the command.

Proper motor phasing is important because the end of travel (EOT) limit inputs are relative to motor rotation.



**Figure 2-48: Clockwise Motor Rotation**

**NOTE:** If using standard Aerotech motors and cables, motor and encoder connection adjustments are not required.

**NOTE:** After the motor has been phased, use the ReverseMotionDirection<sup>2</sup> parameter to change the direction of “positive” motion.

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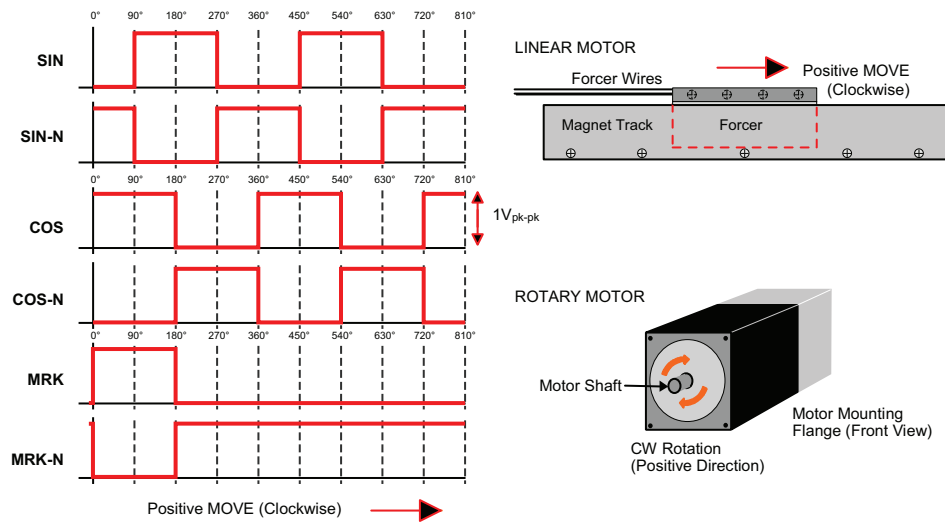
<sup>1</sup>CountsPerUnit has replaced CntsPerMetricUnit, CntsPerEnglishUnit, and CntsPerRotaryUnit in software version 3.00.000.

<sup>2</sup>ReverseMotionDirection has replaced the functionality of reversing the sign on the CntsPer\*Unit to change the direction of positive motion in software version 3.00.000.

### 2.7.4. Encoder Phasing

Incorrect encoder polarity will cause the system to fault when enabled or when a move command is issued. [Figure 2-49](#) illustrates the proper encoder phasing for clockwise motor rotation (or positive forcer movement for linear motors). To verify, move the motor by hand in the CW (positive) direction while observing the position of the encoder in the diagnostics display (see [Figure 2-50](#)). The MsetDebug.Pgm program can be used if the motor can not be moved by hand. If the program causes the Position Feedback to count more negative, swap the connections to the controllers SIN and the SIN-N encoder inputs.

For dual loop systems, the velocity feedback encoder is displayed in the diagnostic display ([Figure 2-50](#)).



**Figure 2-49: Encoder Phasing Reference Diagram (Standard)**

**NOTE:** Encoder manufacturers may refer to the encoder signals as A, B, and Z. The proper phase relationship between signals is shown in [Figure 2-49](#).

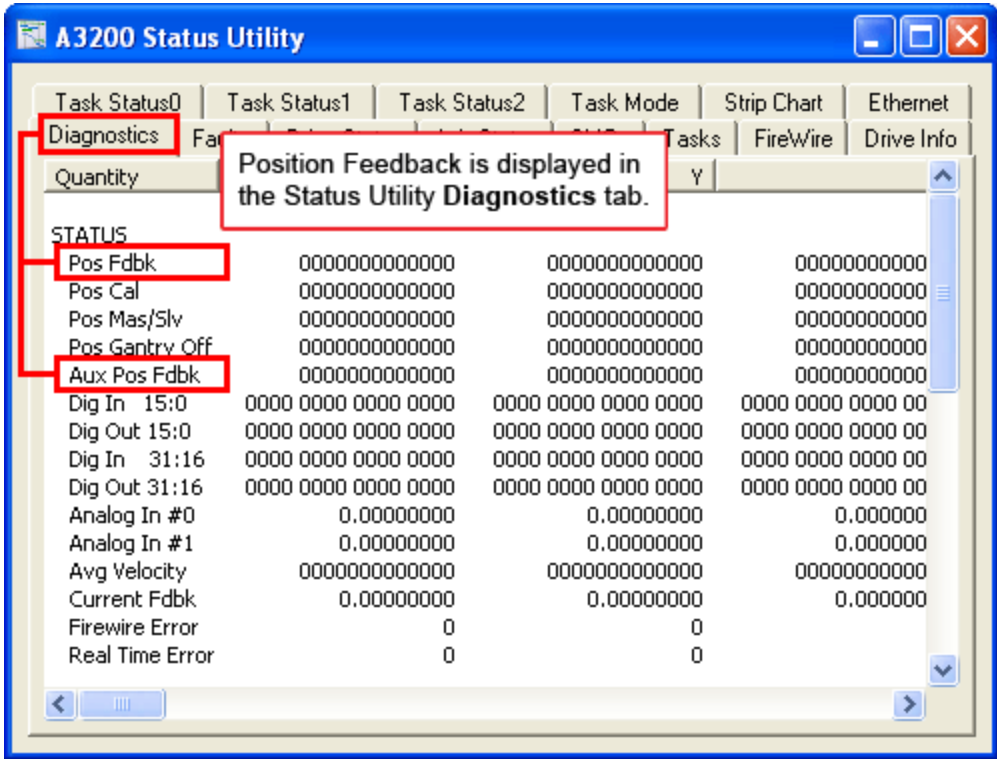


Figure 2-50: Position Feedback in the Diagnostic Display

### 2.7.5. 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. The logic level of the EOT limit inputs may be viewed in the diagnostic display (shown in [Figure 2-51](#)).

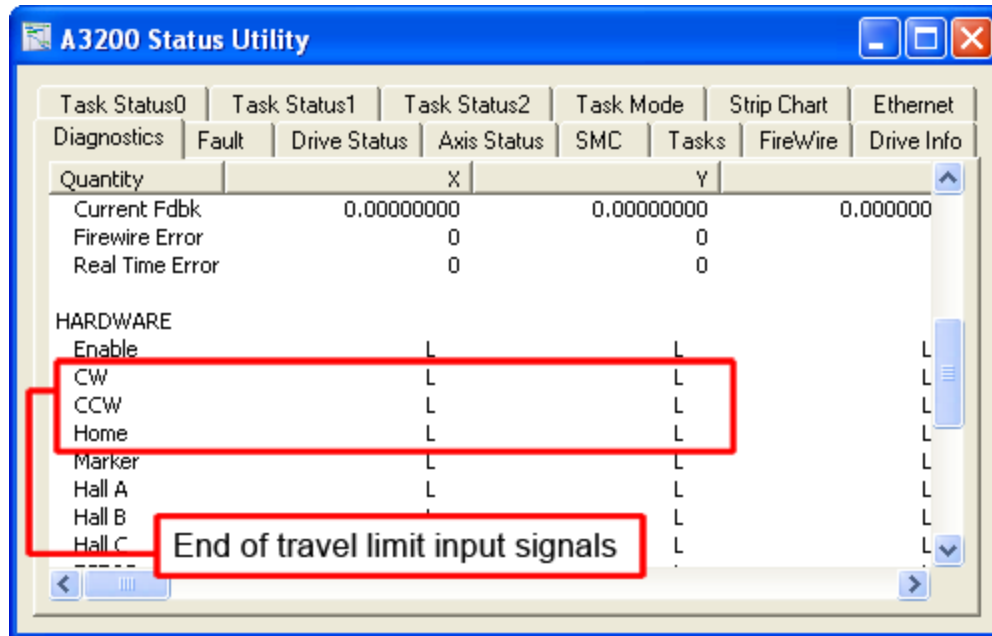


Figure 2-51: Limit Input Diagnostic Display

## 2.8. FireWire Interface

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

The following tables list compatible FireWire cards, repeaters, and cables available for use with the Nservo.

**Table 2-36: 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 2-37: FireWire Repeater (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 2-38: FireWire Cables (copper and glass fiber)**

Part Number	Description
NCONNECT-4500-66	4.5 m (15 ft) long, 6 pin to 6 pin
NCONNECT-3000-66	3 m (10 ft) long, 6 pin to 6 pin
NCONNECT-1800-66	1.8 m (6 ft) long, 6 pin to 6 pin
NCONNECT-900-66	900 mm (3 ft) long, 6 pin to 6 pin
NCONNECT-500-66	500 mm (19 in) long, 6 pin to 6 pin
NCONNECT-228-66	228 mm (9 in) 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

**NOTE:** Before connecting any device to the FireWire bus, the device should be powered up and tested independently to prevent damaging other drives on the FireWire bus.

## 2.9. Analog I/O and Non-Isolated Inputs/Joystick

The J106 connector provides the following 16-bit analog inputs and outputs and non-isolated digital inputs.

**Table 2-39: J106 Analog I/O and Inputs/Joystick Connector Assignment**

Pin	Label	Description	In/Out/BI
1	AIN0+	Analog input 0 differential + input *	Input
2	AIN0-	Analog input 0 differential - input *	Input
3	AIN1+	Analog input 1 differential + input *	Input
4	AIN1-	Analog input 1 differential - input *	Input
5	AOUT0	Analog output 0	Output
6	AOUT1	Analog output 1	Output
7	IN8	Input 8 (non-isolated) or Joystick input button	Input
8	IN9	Input 9 (non-isolated) or Joystick input button	Input
9	IN10	Input 10 (non-isolated) or Joystick input button	Input
10	AGND	Analog common	Input
11	AIN2	Analog input 2 (single ended)	Input
12	AIN3	Analog input 3 (single ended)	Input

\* The two differential analog inputs can scale the input voltage using the IOSetup<sup>1</sup> axis parameter; see the A3200 Help file for more information.

**Table 2-40: J106 Mating Connector**

Type	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm <sup>2</sup> ]
12-Pin Terminal Block	ECK01295	1881422	20-28 [0.5- 0.080]

<sup>1</sup>IOSetup has replaced DriveIOConfig in software version 3.00.000.

### 2.9.1. Analog Inputs (J106)

Analog Inputs 0 and 1 are differential inputs that accept a voltage in the range of  $\pm 10$  volts (maximum) with a resolution of 16 bits. Signals outside of this range may damage the input. To interface to a single-ended (non-differential) voltage source, connect the signal common of the source to the negative (-) input and connect your signal to the positive (+) input. A floating signal source should be referenced to the signal common (AGND) as shown in [Figure 2-52](#).

Analog Inputs 2 and 3 are single ended as shown in [Figure 2-53](#).

For improved noise immunity, a 1K-10K external load resistor can be connected between the AIN+/- differential inputs or between AIN and AGND for single-ended inputs.

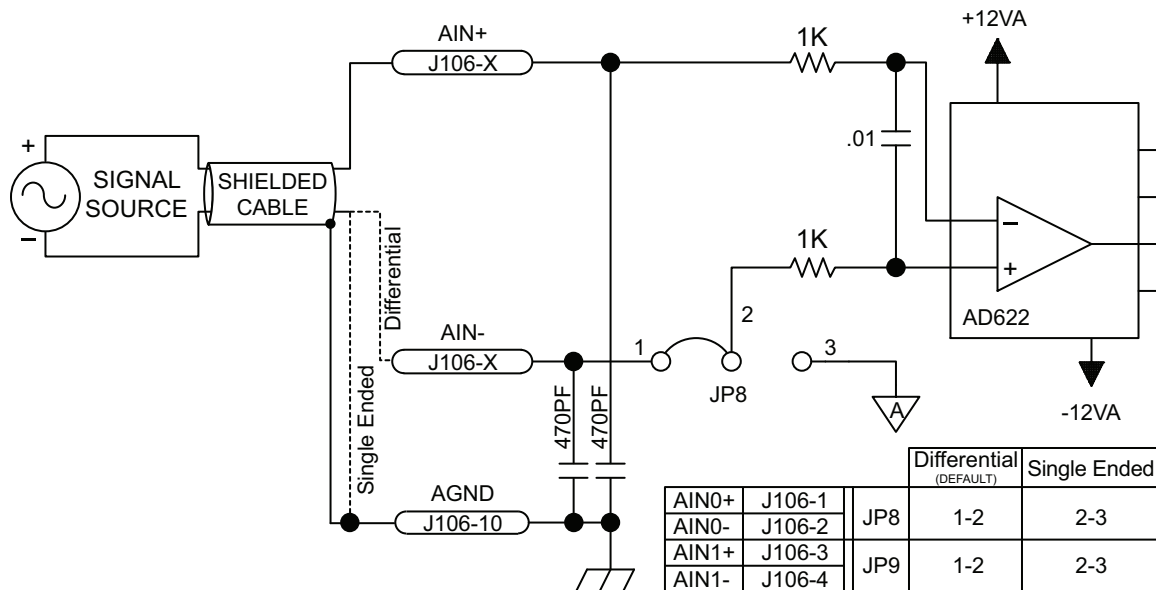


Figure 2-52: Analog Inputs (AIN0 and AIN1)

Table 2-41: Analog Input Specifications (AIN0 and AIN1)

Description	Specification
Input Impedance	10 GOhm
Differential Input Voltage Range	+/-10V
Input Voltage Range Per Pin	+/-10V
Input Voltage Range Adjustable	Yes (See the IOSetup <sup>1</sup> Parameter in the A3200 Help file)
Maximum Input Voltage Offset	10mV
Maximum Input Voltage Error	< 1%

<sup>1</sup>IOSetup has replaced DriveIOConfig in software version 3.00.000.



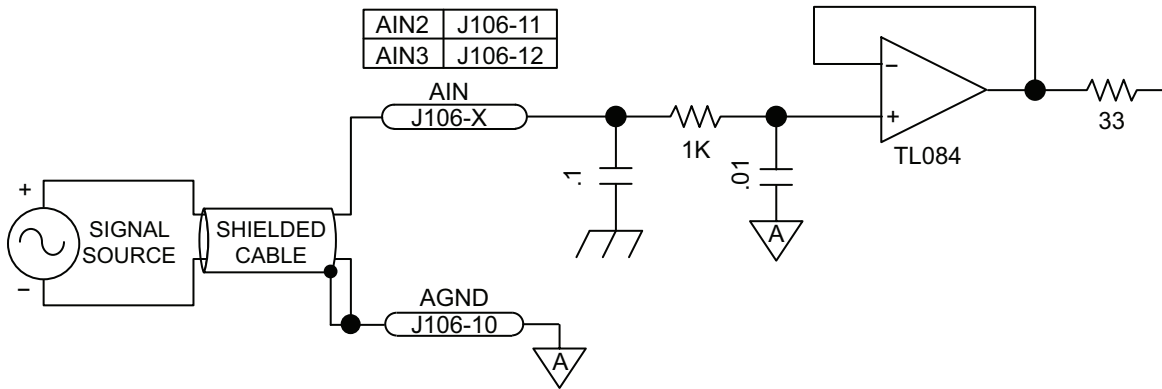


Figure 2-53: Analog Inputs (AIN2 and AIN3)

Table 2-42: Analog Input Specifications (AIN2 and AIN3)

Description	Specification
Input Impedance	10 TOhm
Input Voltage Range (single-ended only)	±10V
Input Voltage Range Adjustable	No
Maximum Input Voltage Offset	10mV
Maximum Input Voltage Error	< 1%

### 2.9.2. Analog Outputs (J106)

Analog Outputs 0 and 1 produce a single-ended output voltage in the range of  $\pm 10$  volts with a resolution of  $305 \mu\text{Volts}$ . The maximum output current recommended is 10 mA. The analog output is set to zero when the system is powered-up or during a system reset.

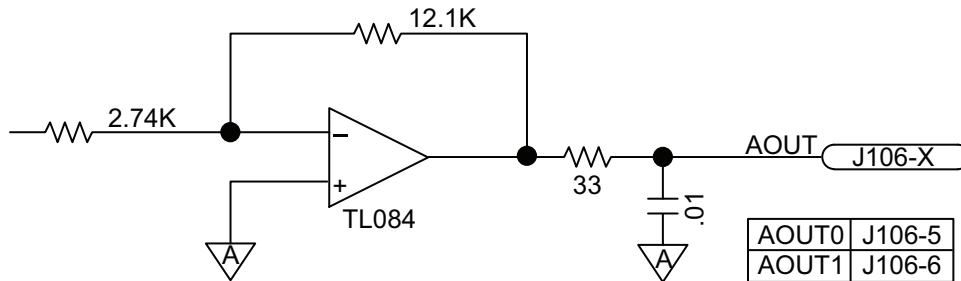


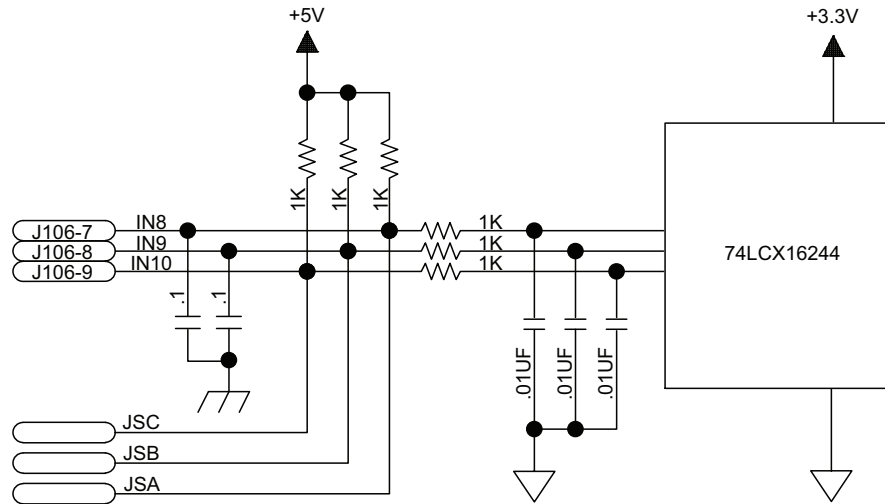
Figure 2-54: Analog Outputs (AOUT0 and AOUT1)

Table 2-43: Analog Output Specifications

Description	Specification
Rated Output Current	10 mA
Output Impedance	36 Ohm @ DC
Output Voltage Range	$\pm 10\text{V}$
Reset State	0V
Maximum Output Voltage Offset	10 mV
Maximum Output Voltage Error	<1%

### 2.9.3. Non-Isolated Inputs (J106)

The digital inputs are only available to the user if the optional joystick is not used. A relay or optical isolation device must be added by the user when the interface is not used for the joystick. These non-isolated digital inputs accept 5 volt TTL logic signals (refer to [Figure 2-55](#) for the typical input circuitry).



**Figure 2-55: Non-Isolated Inputs 8-10 / Joystick Buttons**

## 2.10. Auxiliary Encoder, ESTOP, and User Interrupt (J107)

The J107 connector provides additional encoder input channels, ESTOP inputs, and User Interrupt inputs.

**Table 2-44: Auxiliary Encoder (J107)**

Pin	Label	Description	In/Out/Bi
1	SINAUX+	Auxiliary Encoder Sine + input	Input
2	SINAUX-	Auxiliary Encoder Sine - input	Input
3	COSAUX+	Auxiliary Encoder Cosine + input	Input
4	COSAUX-	Auxiliary Encoder Cosine - input	Input
5	MRKAUX+	Auxiliary Encoder Marker + input	Input
6	MRKAUX-	Auxiliary Encoder Marker - input	Input
7	ESTOP+	Emergency Stop Opto-Isolated input	Input
8	ESTOP-	Emergency Stop Opto-Isolated input	Input
9	UINT+	User Interrupt Opto-Isolated input + (Input 12)	Input
10	UINT-	User Interrupt Opto-Isolated input - (Input 12)	Input

**Table 2-45: J107 Mating Connector**

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

### 2.10.1. Auxiliary Encoder (J107)

The auxiliary encoder interface accepts a 5 VDC RS-422 differential quadrature line driver signal. It accepts a 10 MHz (max) encoder signal frequency (25 nsec minimum edge separation), producing 40 million counts per second, after times four (x4) quadrature decoding.

This encoder channel can be used as an input for master/slave operation (handwheel) or for dual feedback systems.

An external Aerotech MXH multiplier can be used with analog encoders for resolution multiplication.

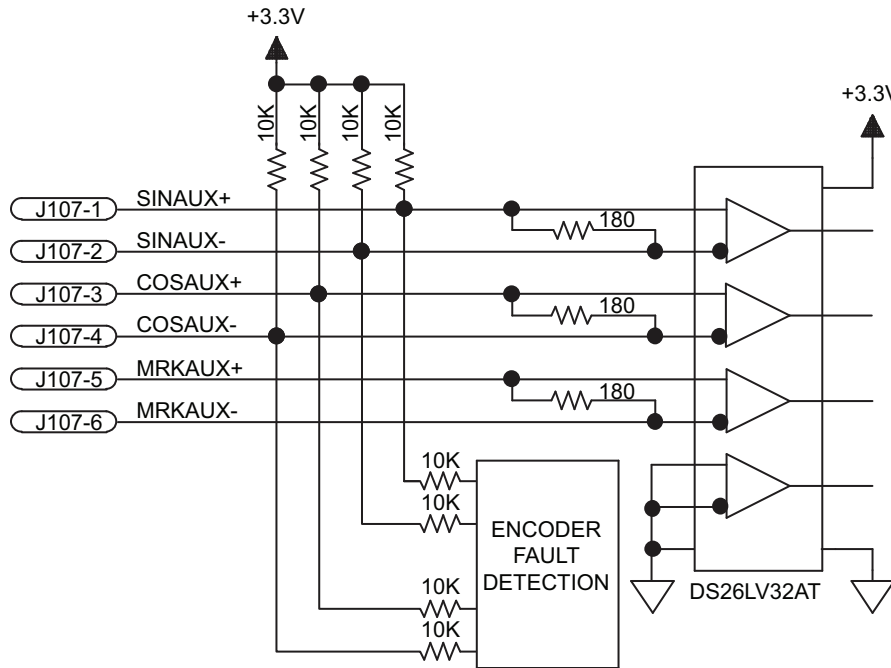


Figure 2-56: Auxiliary Encoder Channel (J107)

### 2.10.2. Emergency Stop Sense Input (J107)

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.

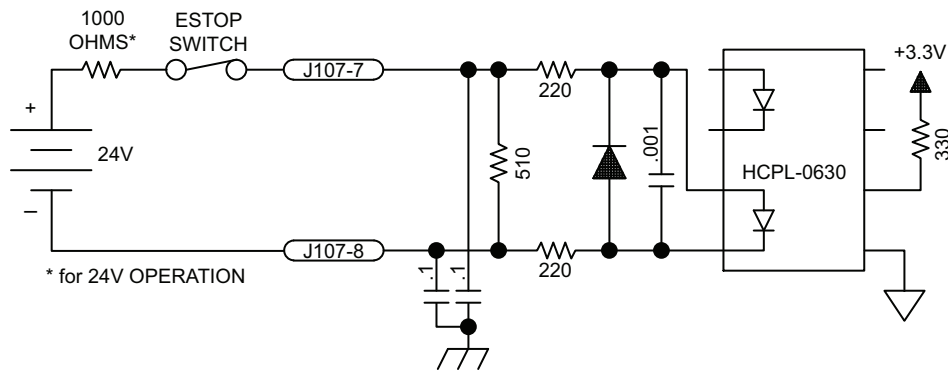


**WARNING:** The user is responsible for assessing operator risk levels and designing the external safety circuits appropriately.

The input is scaled for an input voltage of 5 VDC. Using a higher input voltage requires adding an external series resistor to limit the input current to 20 milliamps. The ESTOP input is isolated via an HCPL-0630 opto coupler and has a maximum delay of 100 nanoseconds.

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

Refer to [Figure 2-57](#) for a schematic and [Figure 2-58](#) for a typical ESTOP connection diagram.

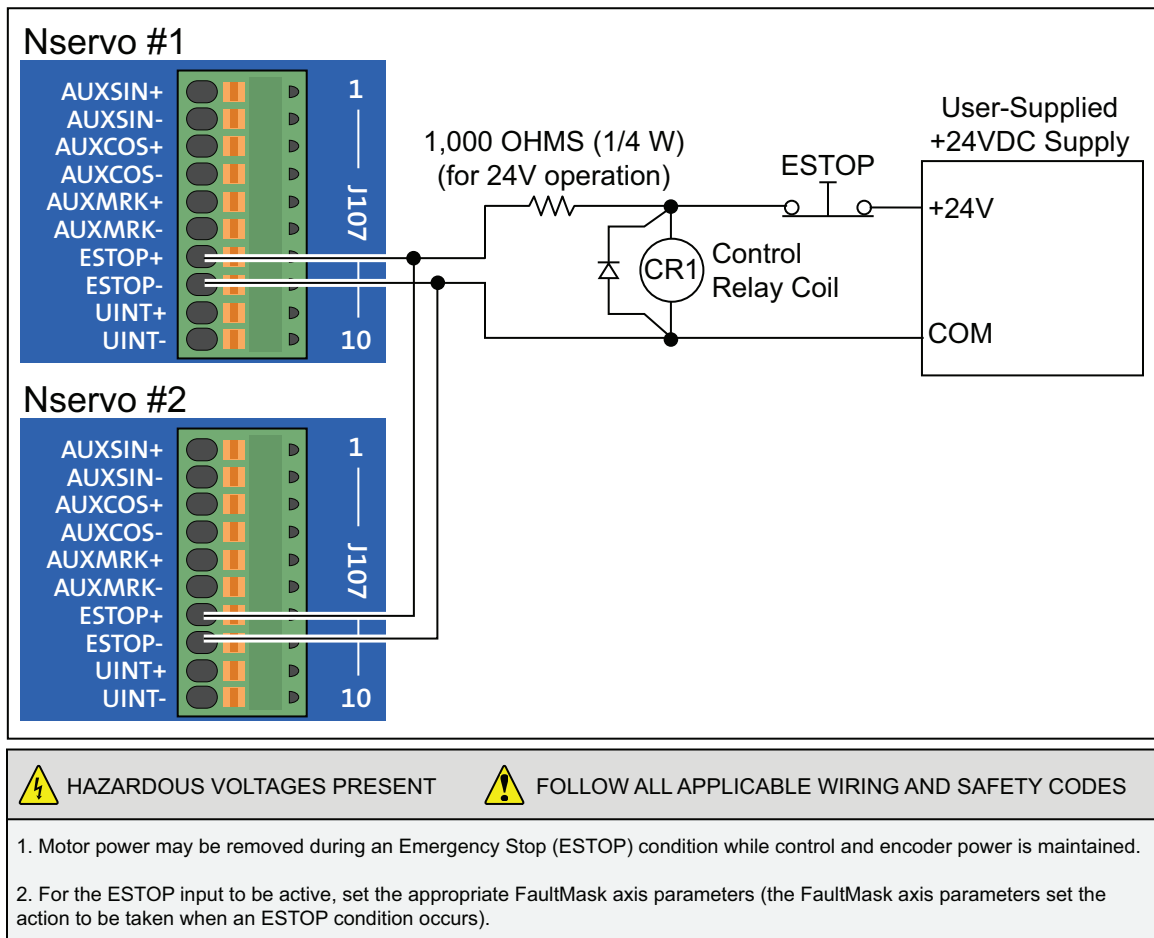


**Figure 2-57: ESTOP Sense Input (J107)**

Connecting the ESTOP input to a relay or other noise producing device requires the use of noise suppression devices such as those in [Table 2-46](#). These devices are applied across the switched coil to suppress transient voltages.

**Table 2-46: Electrical Noise Suppression Devices**

Device	Aerotech P/N	Third Party P/N
RC (.1 uf / 200 ohm) Network	EIC240	Electrocube RG1782-8
Varistor	EID160	Littelfuse V250LA40A



**Figure 2-58: Typical Emergency Stop Circuit**

### 2.10.3. User Interrupt (J107)

The User Interrupt input is isolated via an HCPL-0630 opto coupler and scaled for an input voltage of 5 VDC. A higher input voltage requires adding an external series resistor to limit the current to 20 milliamps (1 KOhm for 24 V).

The user interrupt opto-isolator has a maximum delay of 100 nanoseconds. The user interrupt is used primarily by the DATAACQ command. The user interrupt input may also be read with the \$DI command as input bit 12. See the A3200 Help file for more information.

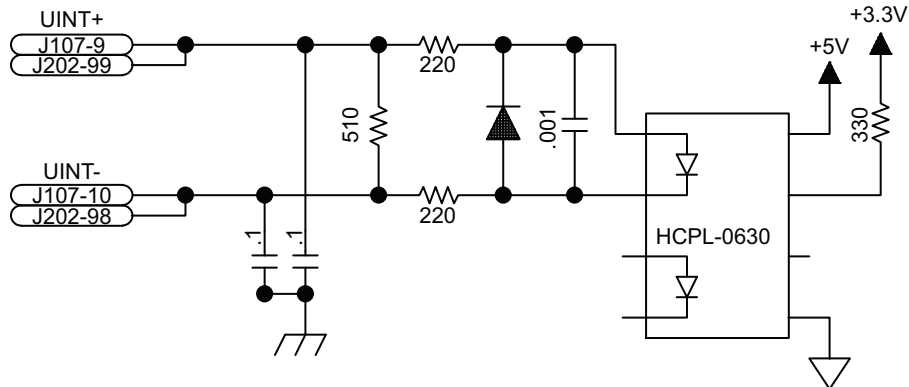


Figure 2-59: User Interrupt Input (J107)



## 2.11. Opto-Isolated Digital Outputs (J108)

The J108 connector provides eight optically isolated digital outputs. The outputs are software configurable through the IOSetup<sup>1</sup> axis parameter as sourcing or sinking. The outputs are driven by a PS2802-4 opto-isolator that is rated for 30 volts maximum and up to 80 mA/channel @ 20°C.

Outputs must be connected in either all sinking or all sourcing mode. [Figure 2-60](#) and [Figure 2-61](#) illustrate how to connect to an output in current sinking and current sourcing modes, respectively.

**Table 2-47: Digital Outputs (J108)**

Pin	Label	Description	In/Out/Bi
1	OPTO OUT V+	Opto positive voltage common	Input
2	OPTO OUT 0	Opto-isolated output 0	Output
3	OPTO OUT 1	Opto-isolated output 1	Output
4	OPTO OUT 2	Opto-isolated output 2	Output
5	OPTO OUT 3	Opto-isolated output 3	Output
6	OPTO OUT 4	Opto-isolated output 4	Output
7	OPTO OUT 5	Opto-isolated output 5	Output
8	OPTO OUT 6	Opto-isolated output 6	Output
9	OPTO OUT 7	Opto-isolated output 7	Output
10	OPTO OUT V-	Opto negative voltage common	Input

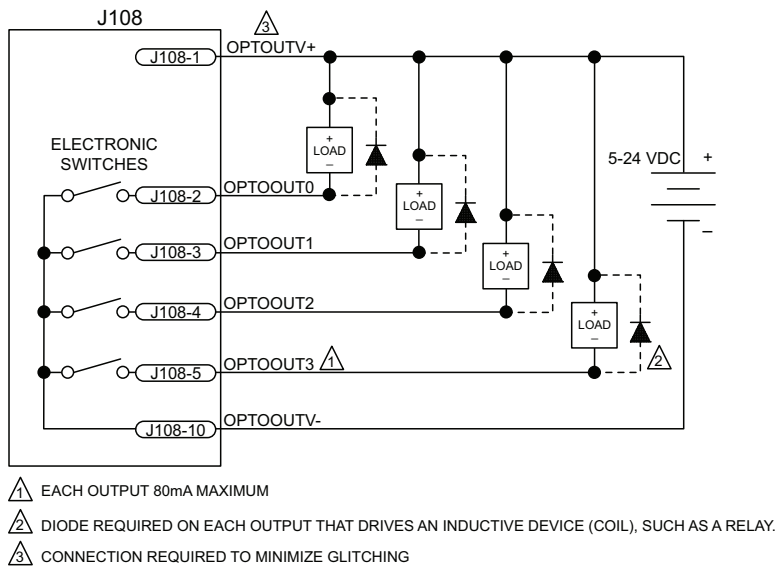
**Table 2-48: J108 Mating Connector**

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

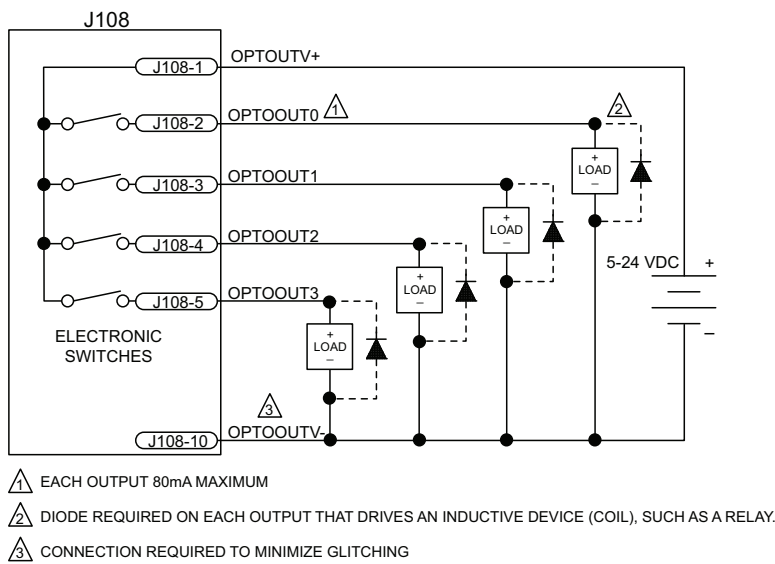
**Table 2-49: Output Specifications (J108)**

Specification	Value
Maximum Power Dissipation	90 mWatts / Channel
Maximum Voltage	30 Volt Maximum
Maximum Sink/Source Current	80 mA/Channel @ 20°C 60 mA/Channel @ 50°C
Output Saturation Voltage	~ 0.7 - 0.9 Volts
Rise / Fall Time	250 usec (typical)
Maximum Output Frequency	1 kHz
Reset State	Output off (high impedance state)

<sup>1</sup>IOSetup has replaced DriveIOConfig in software version 3.00.000.



**Figure 2-60: Outputs Connected in Current Sinking Mode**



**Figure 2-61: Outputs Connected in Current Sourcing Mode**

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). See [Figure 2-60](#) for an example of a current sinking output with diode suppression and [Figure 2-61](#) for an example of a current sourcing output with diode suppression.

## 2.12. Opto-Isolated Digital Inputs (J109)

The J109 connector provides eight optically isolated digital inputs. The inputs are scaled for 5-24 VDC and may be connected as sinking or sourcing by the user, and are driven into a PS2806-4 opto-isolator. [Figure 2-62](#) and [Figure 2-63](#) illustrate how to connect to the inputs in current sinking and current sourcing modes, respectively.

The J109 connector also provides the input common pin for the opto-isolated limit inputs on the encoder feedback connectors. The limit input common can be tied to an external 5V to 24V power supply (-NOLMT5V option) via J109 pin 10 or to the Nservo's internal 5V power supply (-LMT5V option). When the Nservo's internal 5V power supply is used, the opto-isolation for the limit inputs is bypassed and J109 pin 10 is disconnected from internal circuitry.

**Table 2-50: PS2806-4 Opto-Device 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 2-51: Digital Inputs (J109)**

Pin #	Label	Description	In/Out/Bi
1	Opto In 0	Opto-Isolated Input 0	Input
2	Opto In 1	Opto-Isolated Input 1	Input
3	Opto In 2	Opto-Isolated Input 2	Input
4	Opto In 3	Opto-Isolated Input 3	Input
5	Opto In 4	Opto-Isolated Input 4	Input
6	Opto In 5	Opto-Isolated Input 5	Input
7	Opto In 6	Opto-Isolated Input 6	Input
8	Opto In 7	Opto-Isolated Input 7	Input
9	Opto In Com	Opto-Isolated Input Common	Input
10	LMT COM	Opto-Isolated End of Travel Limit Common	Input

**Table 2-52: J109 Mating Connector**

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

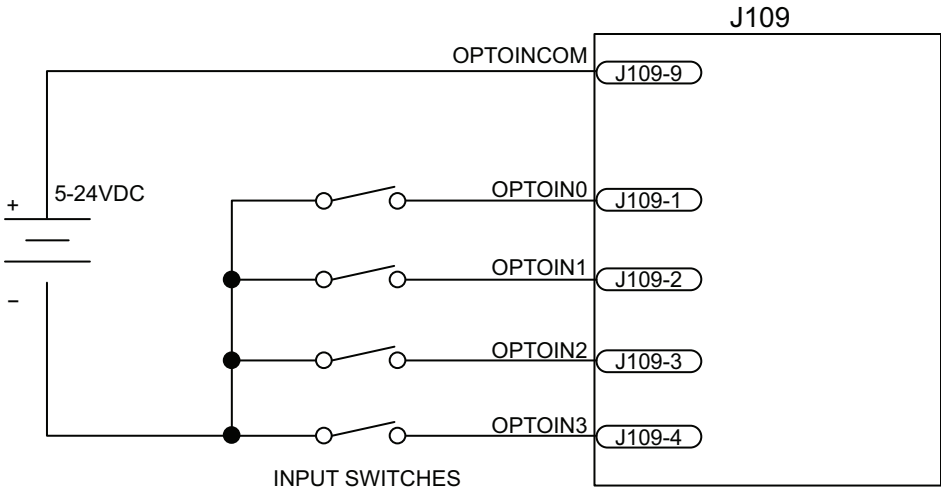


Figure 2-62: Inputs Connected to a Current Sinking Device (J109)

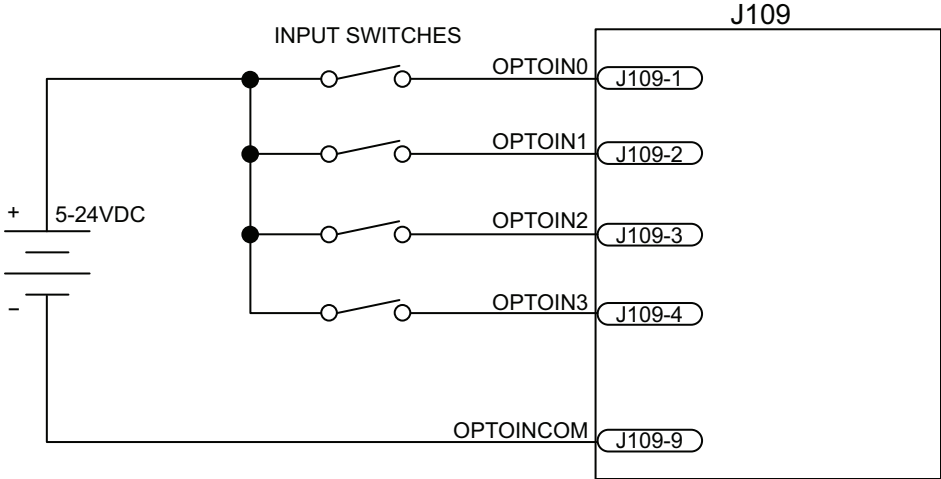


Figure 2-63: Inputs Connected to a Current Sourcing Device (J109)

## 2.13. Brake, External Limit, and PSO Interface (J110)

The J110 connector provides connections for the user to connect external limit power, brake input and output connections, and a Position Synchronized Output (PSO) option.

**Table 2-53: J110 Connector Pin Assignment**

Pin	Label	Description	In/Out/Bi
1	LMTEXTV+	External Limit Power	Input
2	BRAKECTL	Brake Output (Low Current, Open Collector)	Output
3	PSODOUT+	PSO Non-Isolated RS-422 Output +	Output
4	PSODOUT-	PSO Non-Isolated RS-422 Output -	Output
5	PSOV+	PSO Opto-Isolator Power	Input
6	PSOOUT	PSO Opto-Isolator Output	Output
7	PSOCOM	PSO Opto-Isolator Common	Input
8	PSOOC.	PSO - Non-isolated Open Collector output	Output
9	+5VDC		
10	GND	Common	Input
11	BRAKE+	Connected to Encoder 1 thru 4 pin 25	Input
12	BRAKE+-	Connected to Encoder 1 thru 4 pin 13	Input

**Table 2-54: J110 Mating Connector**

Type	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm <sup>2</sup> ]
12-Pin Terminal Block	ECK01295	1881422	20-28 [0.5- 0.080]

### 2.13.1. Brake I/O Interface (J110)

The Brake Control Output is a logic level open collector output designed to drive an external fail-safe brake circuit on a vertical axis, via a relay or other high current device. The BRAKE INPUT+ and BRAKE INPUT- signals connect to the 25D encoder feedback cable on pins 13 and 25 to power a fail-safe brake. These two pins are connected to encoder connectors 1 through 4; however only one axis typically has a brake.

The brake control output signal is rated for 40 VDC, 50 mA, not to exceed 350 mW of power dissipation.

Refer to [Table 2-53](#) for the brake connector pin assignment.

See the EnableBrakeControl<sup>1</sup> axis parameter for information on activating the brake output automatically, or the BRAKE command for manually toggling the output, both in the A3200 Help file.

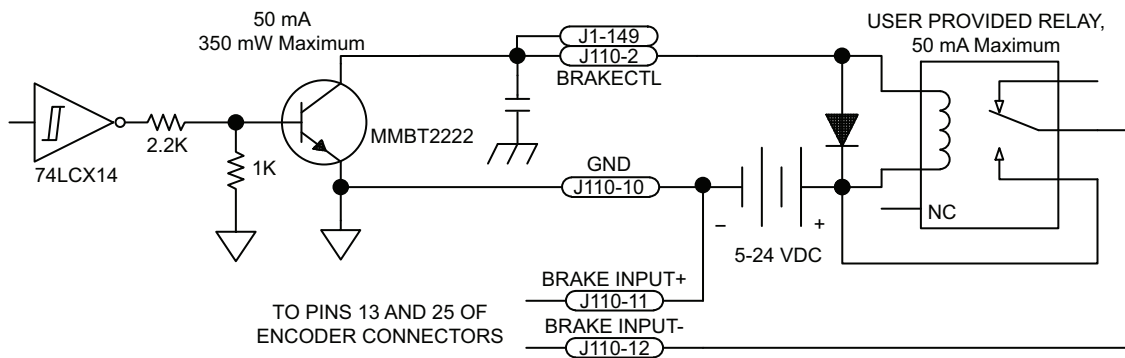


Figure 2-64: Brake Output

<sup>1</sup>EnableBrakeControl has replaced BrakeOnDriveDisable in software version 3.00.000.

### **2.13.2. External Limit Power (J110)**

The LMTEXTV+ input allows the user to provide external power for the end of travel limit switches connected to the Encoder feedback connectors of the Nservo-DB2, Nservo-DB4, and Nservo-OEM. This external power input can not be used with the Nservo-TB and Nservo-OP versions.

### 2.13.3. PSO Outputs (J110)

The Nservo includes a Position Synchronized Output (PSO). This feature can be programmed to generate an output synchronized to the encoder, typically used to fire a laser or sequence an external device. The output is provided in three formats, opto-isolated, differential RS-422, and non-isolated open collector logic output (see [Table 2-55](#)).

**Table 2-55: PSO Output Sources**

PSO Output Type	Maximum Frequency	Requires User Isolation
High Speed Opto-Isolator <sup>(1)</sup>	<a href="#">Table 2-56</a>	No
Differential RS-422 output	12.5 MHz	Yes
Open Collector Logic Output	12.5 MHz	Yes
<sup>(1)</sup> Recommended		

The PSO open collector signal is rated for 40 VDC, 50 mA (max). The active state is jumper configurable (JP5).

**Table 2-56: PSO Output Device Specifications**

M81 Device (Option #)	Nominal Frequency	Max Power Supply Voltage	Max Sink	Source/Sink
HCPL-2601 (-PSOOPTO1 option) <sup>(1)</sup>	5 MHz	5 VDC	10 mA	Sink Only
6N136 (-PSOOPTO2 option)	750 KHz	5-15 VDC	2 mA	Sink Only
4N33 (-PSOOPTO3 option)	10 KHz	5-25 VDC	50 mA	Source/Sink
TIL117-M (-PSOOPTO4 option)	40 KHz	5-25 VDC	50 mA	Source/Sink
MMBT2222 (PSO Out O.C.) <sup>(2)</sup>	1 MHz	35 VDC	50 mA	Sink Only
<sup>(1)</sup> Option not available on the Nservo-OEM				
<sup>(2)</sup> Standard				

See [Figure 2-65](#) and [Figure 2-66](#) for typical circuitry.

The PSO can track an encoder with a maximum data (count) rate of 16.7 MHz. Signals in excess of this rate will cause a loss of PSO accuracy. Multi-axis tracking is limited to a 8 MHz tracking rate.

The synchronized output pulse is generated using high-speed hardware allowing minimal latency of 200 nanoseconds for single axis and 275 ns for multi-axis.

For programming information, refer to the A3200 Help file.



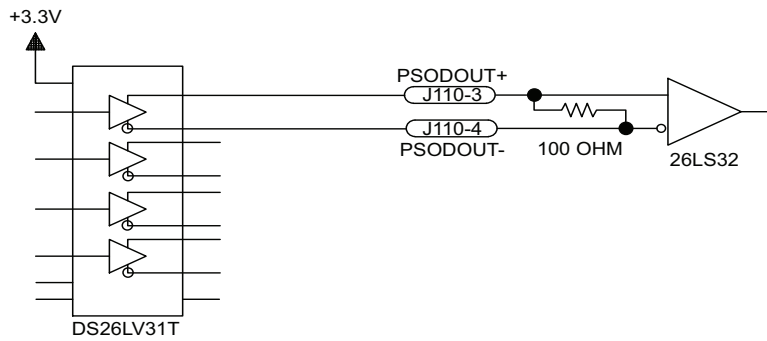


Figure 2-65: PSO (Laser Firing) Differential Output

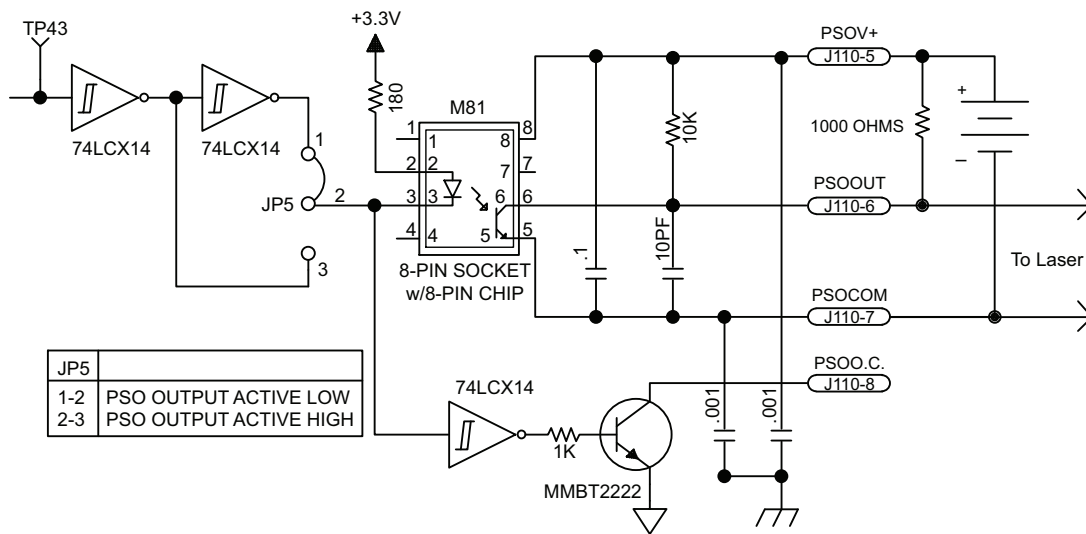


Figure 2-66: PSO (Laser Firing) Opto-Isolated Output (Sinking)

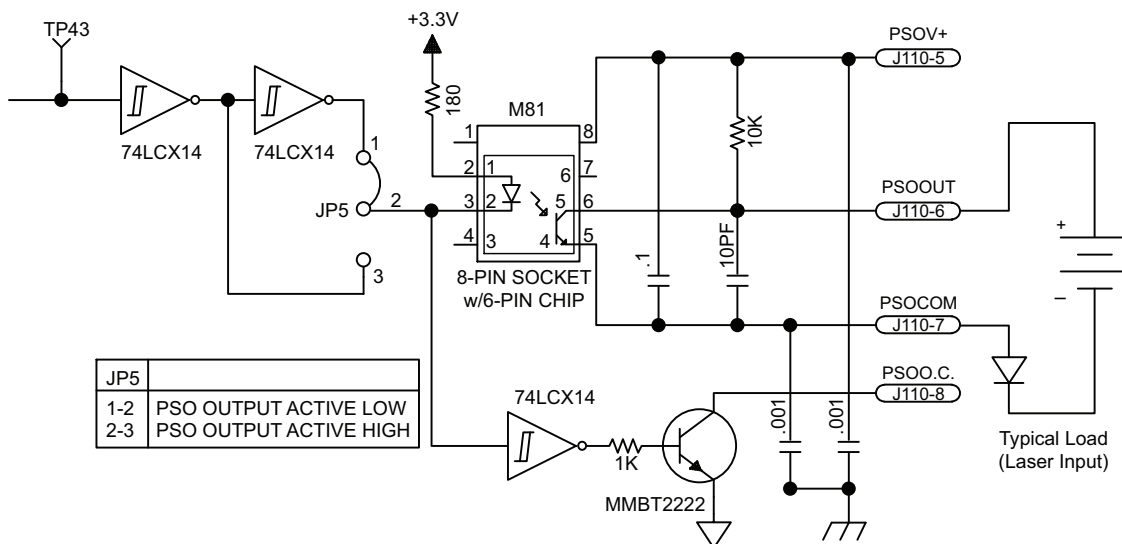
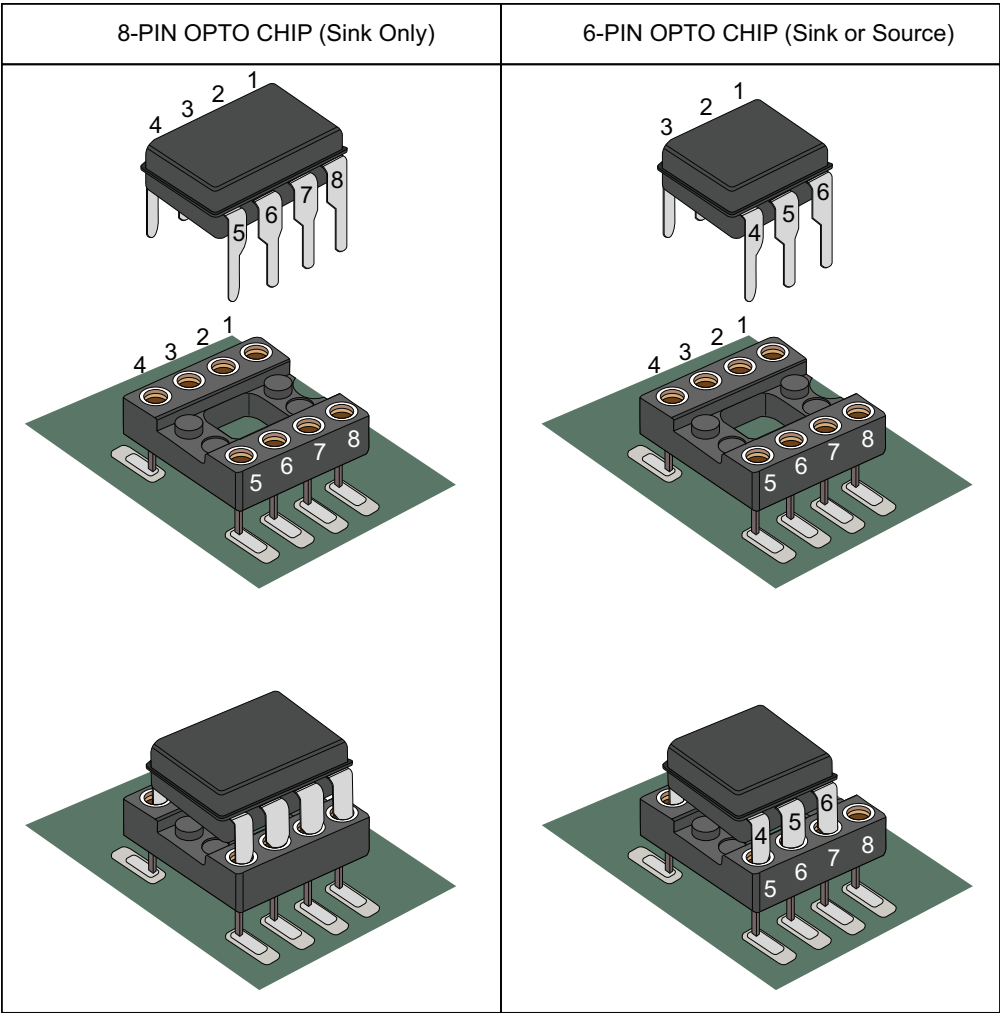


Figure 2-67: PSO (Laser Firing) Opto-Isolated Output (Sourcing)



NOTE: When installing the 6-pin opto-chip, Pin 1 on the chip matches to Pin 2 on the socket (Pin 1 and Pin 8 on the socket should be free).

Figure 2-68: PSO Opto-Chip Installation

### 2.14. Axis Enable Polarity (S1)

Define the axis enable output as active high (OFF) or active low (ON), using the Axis Enable Polarity switches of S1.

Refer to [Section 2.3.1](#) for electrical interface details (-DB option).

Refer to [Section 2.5.1](#) for electrical interface details (-TB option).

**NOTE:** Polarity switch settings are typically factory configured.

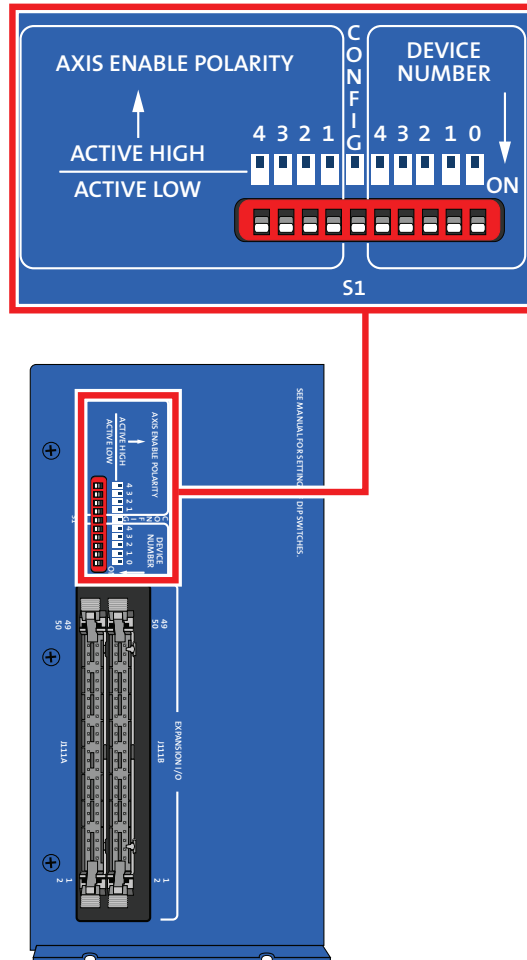


Figure 2-69: Axis Enable Polarity Detail (S1)

## 2.15. Hall Inputs and General Purpose I/O (J111A, J111B)

The J111 connector provides 48 bits of general purpose non-isolated I/O. Optionally, 12 bits may be used as inputs for the Hall-effect feedback signals for brushless motors, as required by UNIDEX 500 and UNIDEX 600 ISA based controllers. The U500 PCI controller allows the Hall effect signals to connect to the controller via the OP500 cable. In that mode all of these signals are available as user I/O signals. If this connector is used as Hall-effect inputs, the FeedbackSetup<sup>1</sup> parameter must be set. The J111A connector matches the pin assignment of the U600 P10 / U500 P5 connector and the J111B connector matches the pin assignment of the U600 P9 connector.

The 48 bits are comprised of two halves of the J111 connector, J111A and J111B. Each 50-pin half of J111 contains 24 bits of I/O, which may be configured by byte as an input or output byte. This allows six different bytes, each of which may be configured as an input or an output byte, using the PORT command. These I/O points may be written/read to/from as bytes via the \$PORT command, or as bits via the \$DO and \$DI commands, see the A3200 Help file for more information. Additionally, each half of the J111 connector follows the standard pin assignment to of industry standard OPTO-22 PB24 opto-isolation boards. See [Table 2-61](#) and [Table 2-62](#) for more information on the pin assignments to OPTO-22 PB24/G4PB24 products and the I/O bit number assignments used to reference the I/O bits by the \$DI and \$DO commands.

**Table 2-57: J111A Connector Pin Assignment**

Pin	Description	Pin	Description
1	Bit 23 / Axis 4 Hall C	26	Common
2	Reserved	27	Bit 26
3	Bit 22 / Axis 4 Hall A	28	Common
4	Common	29	Bit 25
5	Bit 21 / Axis 4 Hall B	30	Common
6	Common	31	Bit 24
7	Bit 20 / Axis 3 Hall C	32	Common
8	Common	33	Bit 39
9	Bit 19 / Axis 3 Hall A	34	Common
10	Common	35	Bit 38
11	Bit 18 / Axis 3 Hall B	36	Common
12	Common	37	Bit 37
13	Bit 17 / Axis 2 Hall C	38	Common
14	Common	39	Bit 36
15	Bit 16 / Axis 2 Hall A	40	Common
16	Common	41	Bit 35
17	Bit 31 / Axis 2 Hall B	42	Common
18	Common	43	Bit 34
19	Bit 30 / Axis 1 Hall C	44	Common
20	Common	45	Bit 33
21	Bit 29 / Axis 1 Hall A	46	Common
22	Common	47	Bit 32
23	Bit 28 / Axis 1 Hall B	48	Common
24	Common	49	+5 Volts*
25	Bit 27	50	Common

\* Total user +5 VDC power is limited to 3 A by an internal re-settable fuse. Should an over-current condition occur, the device will open to protect against the overload. To reset the device, remove the overload condition.

<sup>1</sup>FeedbackSetup has replaced DriveIOConfig in software version 3.00.000.

**Table 2-58: J111B Connector Pin Assignment**

Pin	Description	Pin	Description
1	Bit 47	26	Common
2	Reserved	27	Bit 50
3	Bit 46	28	Common
4	Common	29	Bit 49
5	Bit 45	30	Common
6	Common	31	Bit 48
7	Bit 44	32	Common
8	Common	33	Bit 63
9	Bit 43	34	Common
10	Common	35	Bit 62
11	Bit 42	36	Common
12	Common	37	Bit 61
13	Bit 41	38	Common
14	Common	39	Bit 60
15	Bit 40	40	Common
16	Common	41	Bit 59
17	Bit 55	42	Common
18	Common	43	Bit 58
19	Bit 54	44	Common
20	Common	45	Bit 57
21	Bit 53	46	Common
22	Common	47	Bit 56
23	Bit 52	48	Common
24	Common	49	+5 Volts *
25	Bit 51	50	Common

\* Total user +5 VDC power is limited to 3 A by an internal re-settable fuse. Should an over-current condition occur, the device will open to protect against the overload. To reset the device, remove the overload condition.

**Table 2-59: J111 Mating Connector**

Description	Aerotech P/N	Third Party P/N
50-Pin ribbon cable socket	ECK00332	3M 3425-6050

**Table 2-60: J111 Input Specifications**

Specification	Value
Sink/Source Current	30 mA
Input/Output Voltage	5 V TTL
Reset State	All signals default to inputs

**Table 2-61: J111A - Port 0, 1, and 2**

Opto 22 Board Type			Module #	Bit #	Port #	
G4 PB8	G4 PB16 or PB16A	G4 PB24 or PB24A	0	32	2	
			1	33		
			2	34		
			3	35		
			4	36		
			5	37		
			6	38		
			7	39		
			8	24	1	
			9	25		
			10	26		
			11	27		
			12	28		
			13	29		
			14	30		
				15	31	0
				16	16	
				17	17	
				18	18	
				19	19	
				20	20	
				21	21	
				22	22	
			23	23		

**Table 2-62: J111B - Port 3, 4, and 5**

Opto 22 Board Type			Module #	Bit #	Port #	
G4 PB8	G4 PB16 or PB16A	G4 PB24 or PB24A	0	56	5	
			1	57		
			2	58		
			3	59		
			4	60		
			5	61		
			6	62		
			7	63		
			8	48	4	
			9	49		
			10	50		
			11	51		
			12	52		
			13	53		
			14	54		
	15	55				
				16	40	3
				17	41	
				18	42	
				19	43	
				20	44	
				21	45	
				22	46	
23				47		

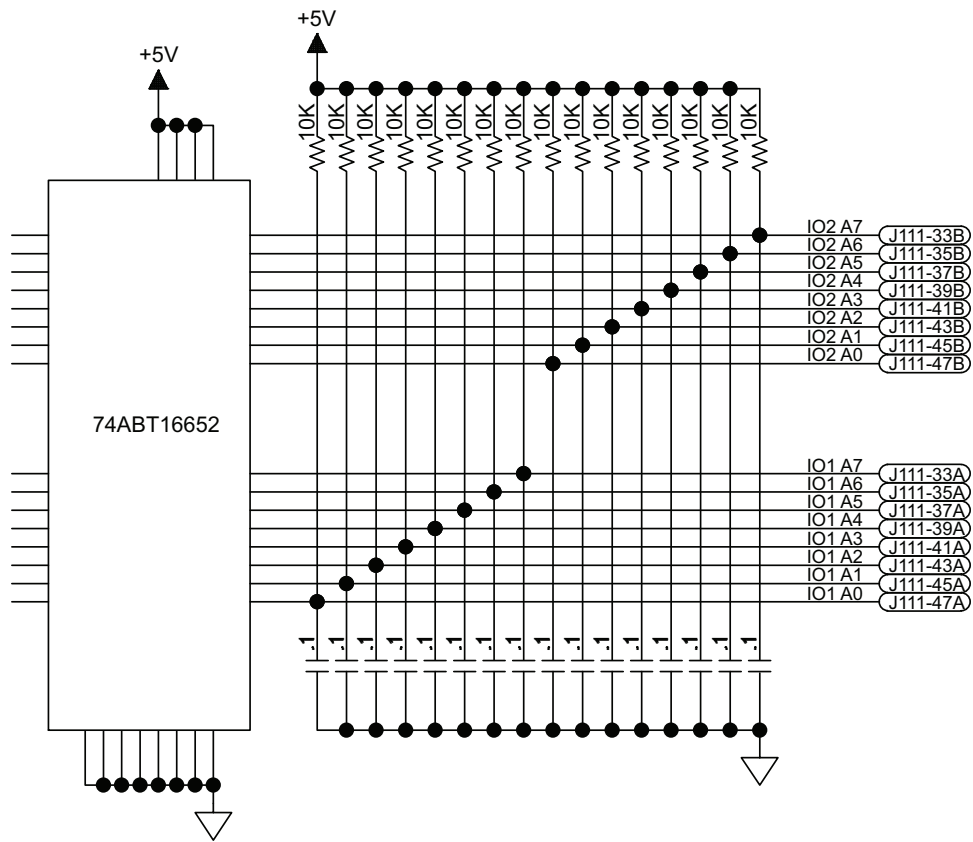


Figure 2-70: General Purpose I/O



## Chapter 3: Options

### 3.1. -DPSO and -TPSO Laser Firing Options

The Nservo allows two and three-axis laser firing via its -DPSO and -TPSO options. The PSO hardware provides pre-scalars, which may be required to limit each encoder being tracked to a 8 MHz data rate (which does not affect the servo feedback loop data rate).

See the A3200 Help file for more information on laser firing (PSO) parameter configurations.

### 3.2. -ENET Option (J103)

The optional Ethernet port provides connectivity to a 10/100 Base-T ModBus TCP network. This is typically used for adding analog and digital I/O to the Nservo. Expansion I/O is also supported from the PC's Ethernet port. For more information, refer to the A3200 Help file.

**Table 3-1: NConnect I/O Cable part Numbers**

Part Number	Description
NConnect-IO-900	Ethernet crossover cable 900 mm (3 ft.)
NConnect-IO-1500	Ethernet crossover cable 1500 mm (5 ft.)
NConnect-IO-3000	Ethernet crossover cable 3000 mm (10 ft.)
NConnect-IO-4500	Ethernet crossover cable 4500 mm (15 ft.)

### 3.3. -RDP Resolver Option (J401, J402)

Not available for the Nservo-OEM.

The optional resolver input has up to four industry standard resolver channels that can be used as a feedback device. The standard reference frequency output is 5 kHz, with factory options for either 7.5 kHz or 10.0 kHz. The amplitude of this signal can be adjusted on a per-channel basis using the ResolverReferenceGain<sup>1</sup> axis parameter. This value can be adjusted through the Digital Scope (see the A3200 Help file for more information).

For correct commutation of the motor, the alignment between the resolver and motor must be known and entered into the CommutationOffset<sup>2</sup> parameter. This alignment can be determined by using the MSET command. See the A3200 Help file for information on configuring the axis parameters for an axis with resolver feedback.

Channel 1 is on J401A, channel 2 is on J402A, channel 3 is on J401B and channel 4 is on J402B. The -RDP option can supply up to 7 VRMS reference voltage and requires 2 VRMS on the sine and cosine inputs.

**Table 3-2: J401A, J401B, J402A, J402B Connector Pin Assignment**

Pin	Description	Input/Output
1	COS- Input	Input
2	COS+ Input	Input
3	COS shield	Shield
4	SIN- Input	Input
5	SIN+ Input	Input
6	SIN shield	Shield
7	Reference Output +	Output
8	Reference Output -	Output
9	Reference shield	Shield

**Table 3-3: J401A/B and J402A/B Mating Connector**

Type	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm <sup>2</sup> ]
9-Pin Terminal Block	ECK01325	1881396	20-28 [0.5- 0.080]

<sup>1</sup>ResolverReferenceGain has replaced CfgFbkRDGain in software version 3.00.000.

<sup>2</sup>CommutationOffset has replaced CfgMotOffsetAng in software version 3.00.000.

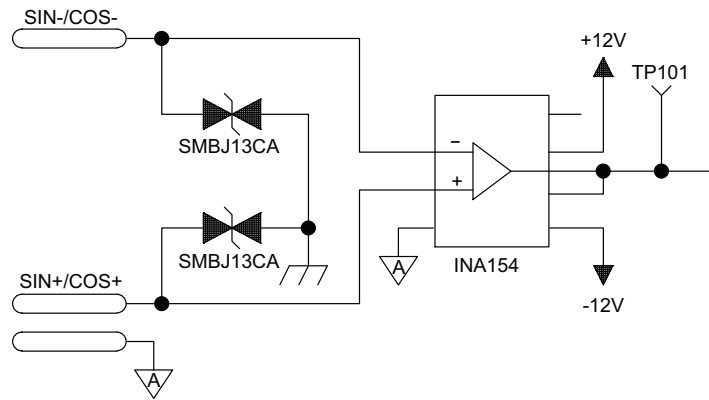


Figure 3-1: Sine and Cosine Input Circuitry

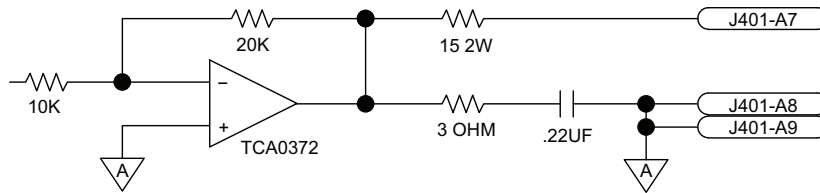


Figure 3-2: Reference Output Circuitry

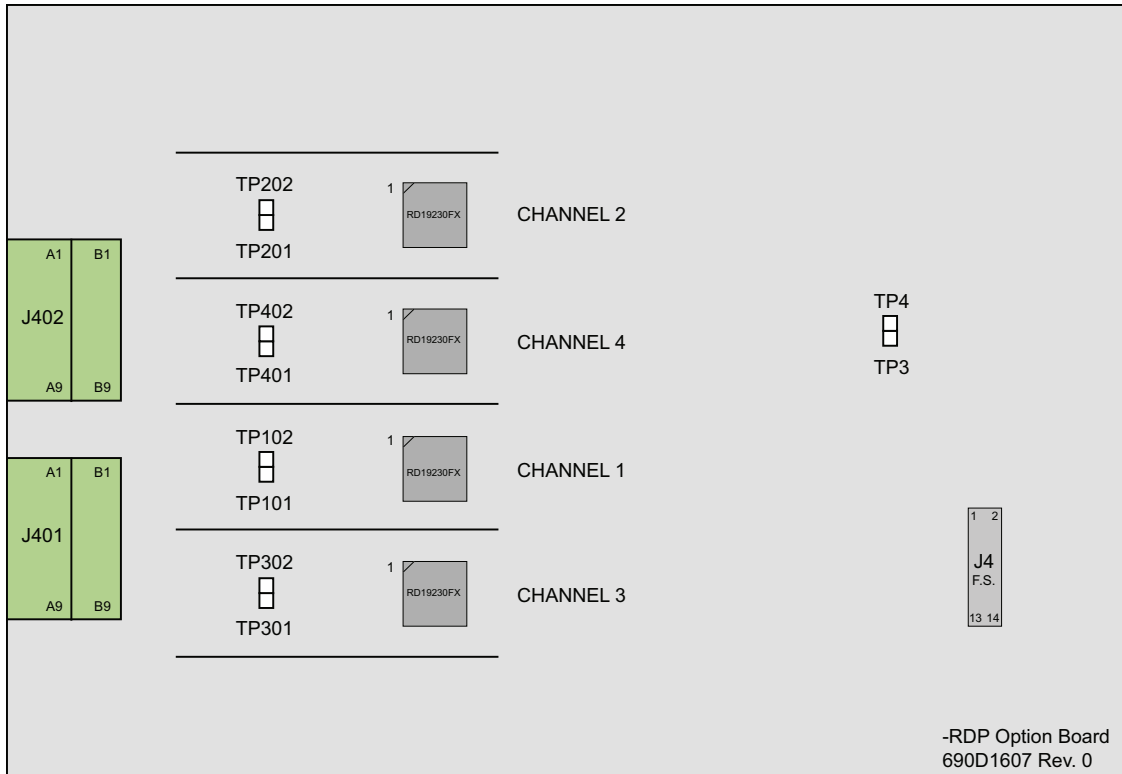


Figure 3-3: -RDP Option Board

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# Chapter 4: Accessories

## 4.1. Joystick Interface

Aerotech joysticks JI (NEMA12 (IP54) rated) and JBV are powered from 5V and have a nominal 2.5V output in the center detent position. Three buttons are used to select axis pairs and speed ranges. An optional interlock signal is used to indicate to the controller that the joystick is present. Joystick control will not activate unless the joystick is in the center location. Third party devices can be used provided they produce a symmetric output voltage within the range of 0V to +5V.

Refer to the A3200 Help file for programming information about how to change joystick parameters. The following drawings illustrate how to connect a single- or two-axis joystick.

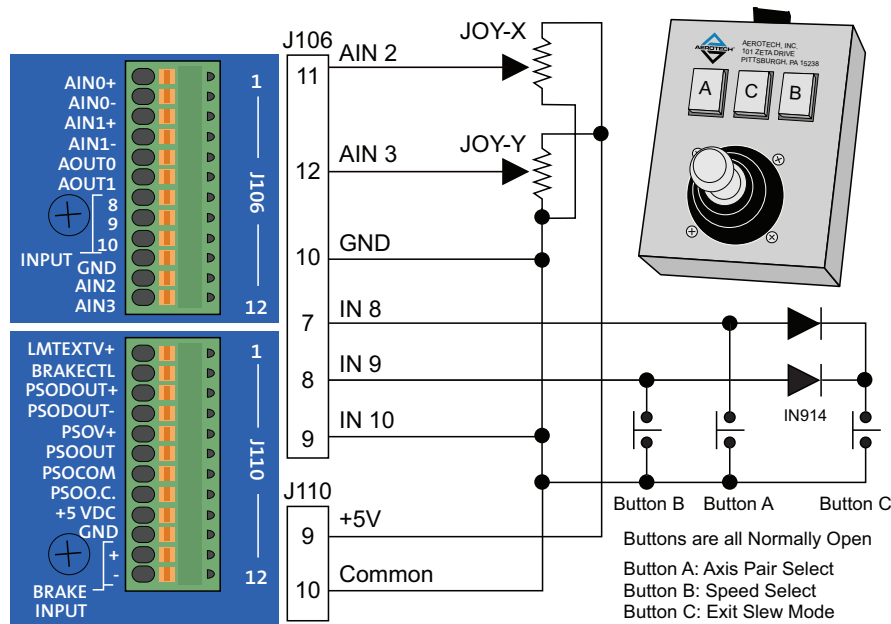


Figure 4-1: Joystick Interface

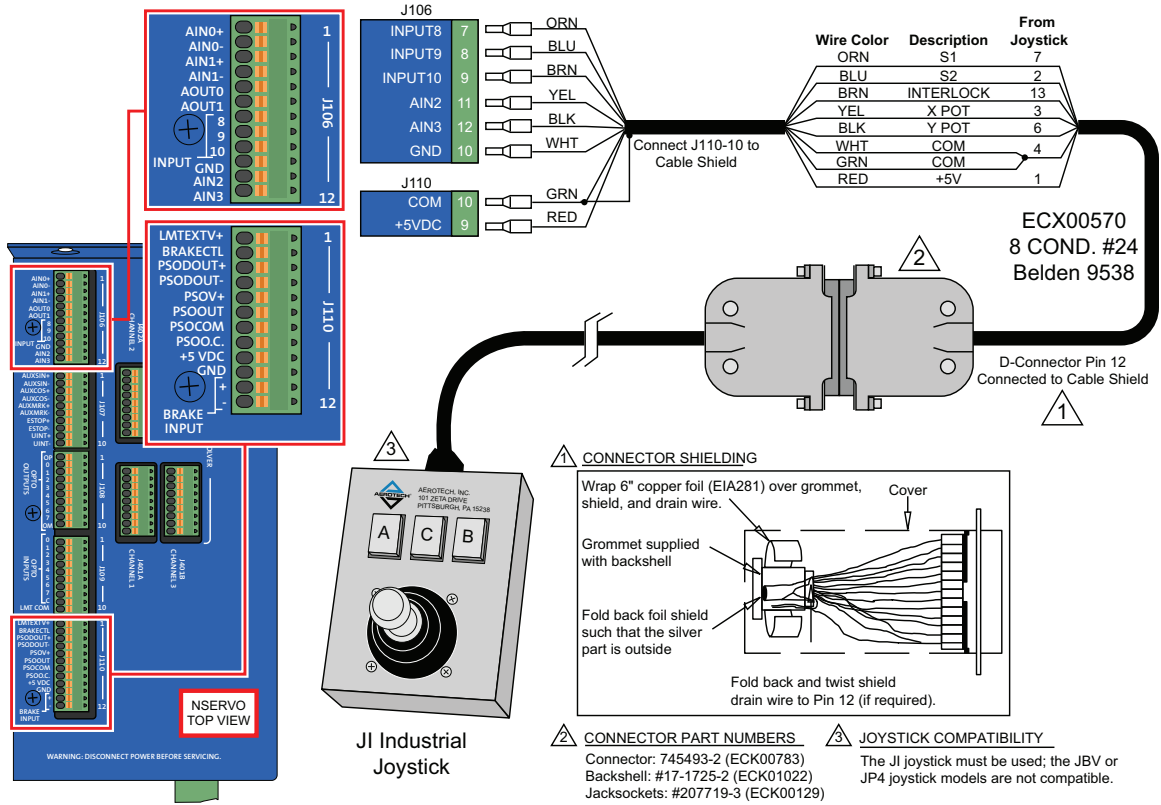


Figure 4-2: Joystick Wiring

### 4.2. Handwheel Interface

A handwheel (such as the Aerotech HW-xxx-xx) can be used to manually control axis position. The handwheel must provide 5V differential quadrature signals to the Nservo.

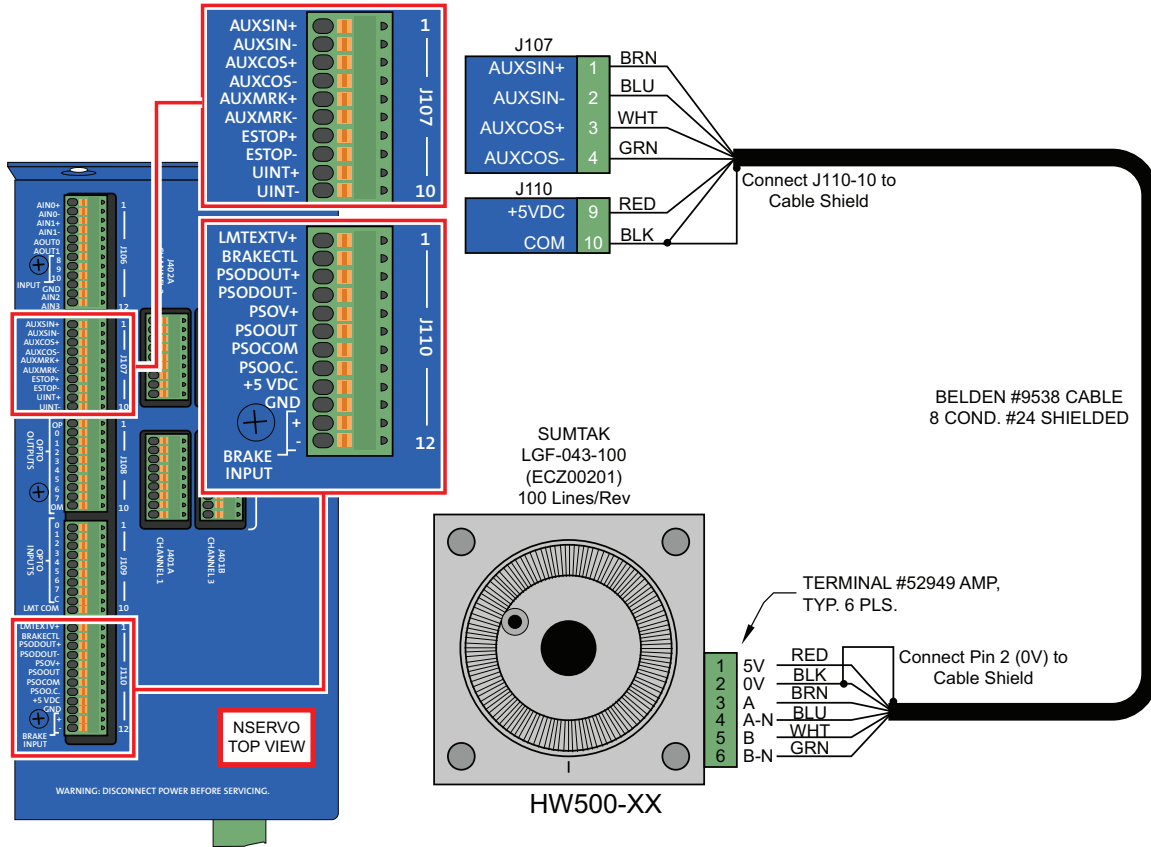


Figure 4-3: Handwheel Interconnection

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## Chapter 5: Maintenance

This section covers the internal boards, important board components, and how to clean the drive. Troubleshooting is covered in-depth in the A3200 Help file.



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



**DANGER:** To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.



**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.



**DANGER:** Motors must be mechanically secured before applying power.

**Table 5-1: Troubleshooting**

Symptom	Possible Cause/Solution
Motor rotates uncontrollably	Encoder (sine and cosine) signals are improperly connected. See <a href="#">Section 2.7</a> for motor and encoder phasing information.
Brushless motor will not rotate.	Motor phases A, B, and C connected incorrectly relative to Hall A, Hall B, and Hall C inputs. See <a href="#">Section 2.7</a> for motor and encoder phasing information.

The following LEDs are available on each Nservo. Full Nservo status is available via the Nmotion SMC and its utilities.

**Table 5-2: LED Indicators**

Label	Description
CPU	Turns green to indicate that the processor is active. This LED will blink off when the unit is reset.
STAT	Not used.
POWER	Turns green to indicate that power is being supplied to the unit.
FAULT	Turns red to indicate that a fault condition exists for one of the axes.

### 5.1. 5-Volt Power Adjust

The 5-volt power can be adjusted at the internal power supply as shown in the picture below. The solid green wire is common and the violet (purple) wire is +5 Volts.



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

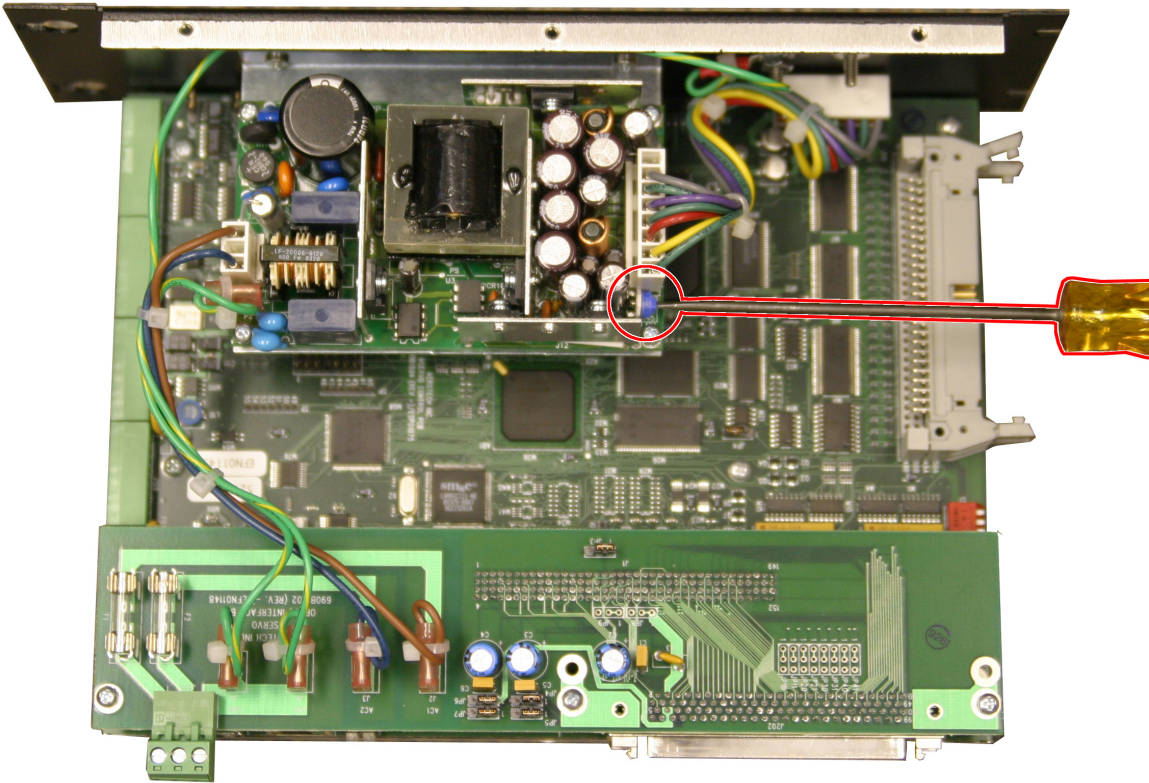


Figure 5-1: 5-Volt Power Adjustment Location (-DB, -TB, -OP)

## 5.2. Fuse Replacement

Table 5-3 lists the manufacturer and Aerotech’s part number for typical replacement fuses. Additional fuse information can be found on the system drawing supplied with the unit.



**DANGER:** To minimize the possibility of bodily injury and electrical shock, make certain that electrical power is disconnected (Mains disconnect) before performing system maintenance or wiring.



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



**DANGER:** Motors must be mechanically secured before applying power.

Table 5-3: Fuse Replacement Part Numbers (Power Board)

Fuse	Description	Aerotech P/N	Third Party P/N
F1	Supply Main Fusing for AC1 VAC Input; 5A S.B (5 mm)	EIF00118	Littelfuse 235002
F2	Supply Main Fusing for AC2 VAC Input; 5A S.B (5 mm)	EIF00195	Littelfuse 235002

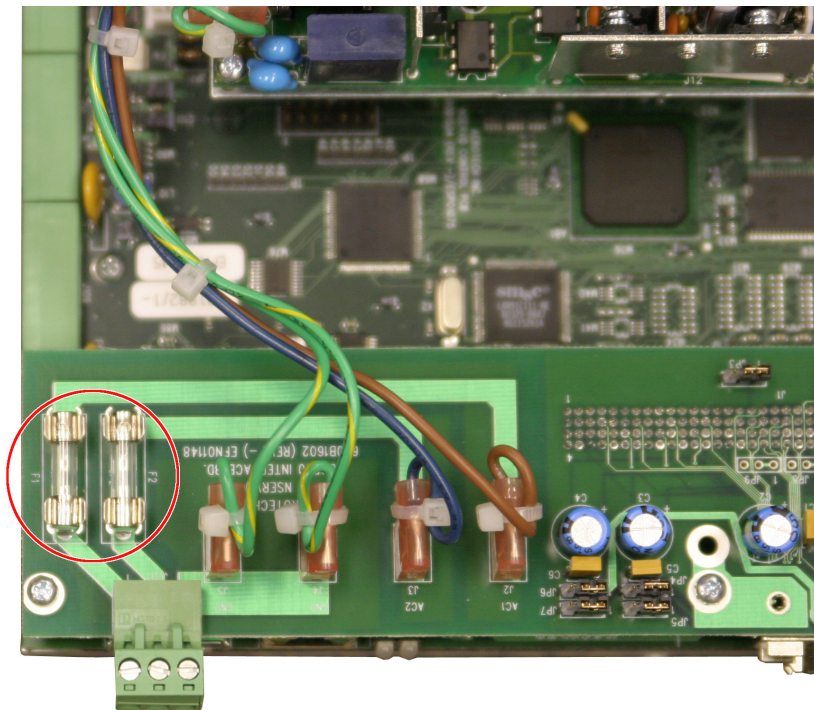


Figure 5-2: AC Input Power Fusing Location

### 5.3. Nservo-DB2, -DB4 Assembly

The Nservo-DB consists of the main control board and a smaller option board that can accommodate up to two extra axes (refer to Figure 5-3). Table 5-4 lists the jumpers for the main board and Table 5-5 lists the jumpers for the -DB4 daughter board.

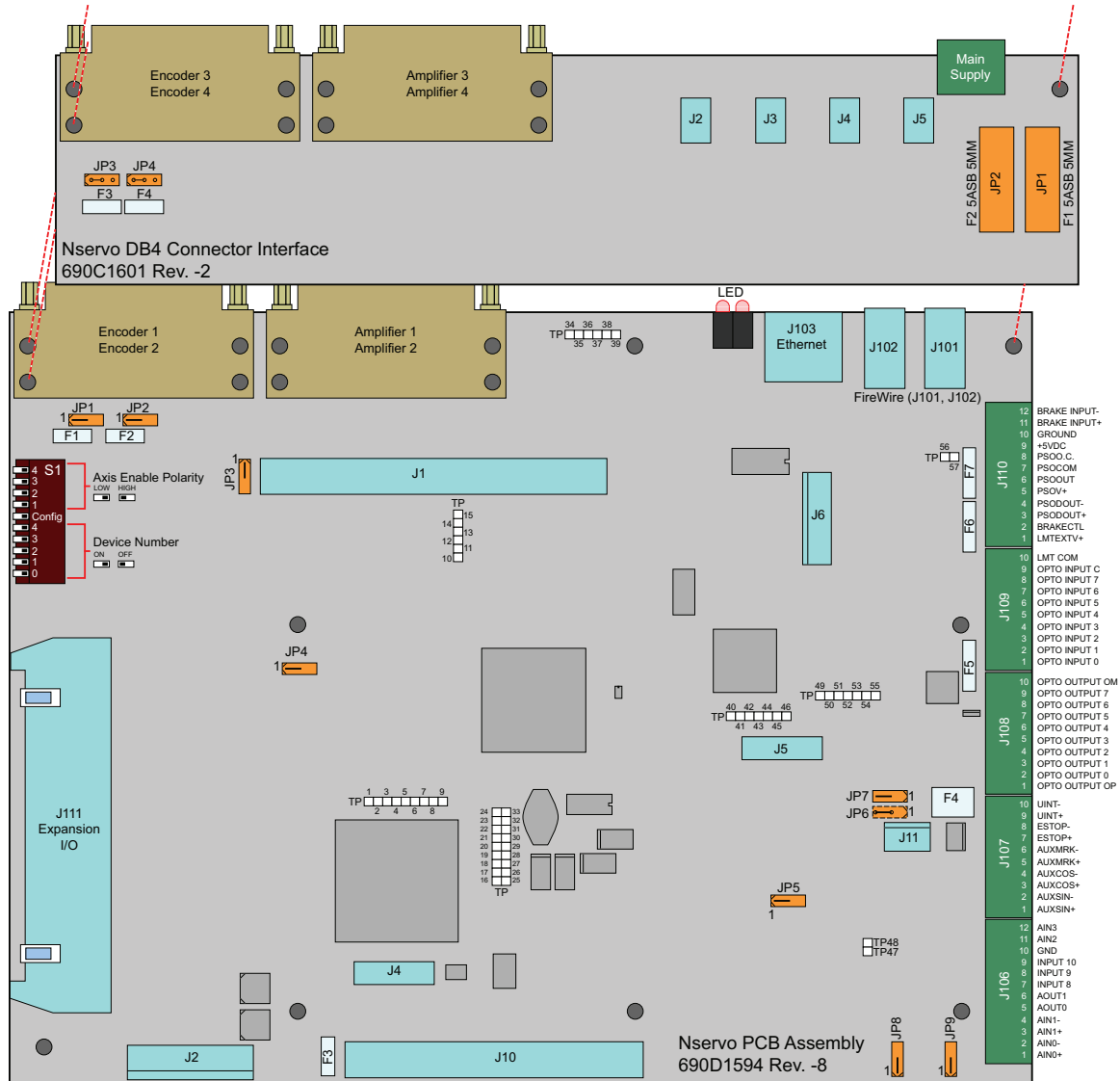


Figure 5-3: Nservo Control Board (simplified)

### 5.3.1. Jumper Settings for Nservo-DB2 and Nservo-DB4

Refer to [Figure 5-3](#) to see the jumper locations. JP3 on the Main Control Board must be set 2-3 for proper limit operation.

**NOTE:** Jumpers on the main control board may be hidden by the smaller stacked option circuit board. Setting JP3 on the main control board is not the same as setting JP3 on the option board.

**Table 5-4: Jumper Settings for the Main Control Board**

Jumper	Setting	Description
JP1 (1)	1-2 (2)	Encoder 2 Pin 16 Powered from Internal Supply
	2-3	Encoder 2 Pin 16 Powered from J110 Pin 1
JP2 (1)	1-2 (2)	Encoder 1 Pin 16 Powered from Internal Supply
	2-3	Encoder 1 Pin 16 Powered from J110 Pin 1
JP3	1-2 (2)	Opto Inputs at Encoder 1-4, powered from J109 Pin 10
	2-3 (3)	Opto Inputs at Encoder 1-4, powered from Internal 5 Volt Supply
JP4	1-2 (2)	Watchdog Timer Enabled
	2-3	Watchdog Timer Disabled
JP5	1-2 (2)	PSO (Laser Firing ) Output active Low
	2-3	PSO (Laser Firing ) Output active High
JP8	1-2 (2)	Analog Input 0 is a Differential Input at J106 Pins 1 and 2
	2-3	Analog Input 0 is a Single-Ended Input (set for Nservo-OP Option)
JP9	1-2 (2)	Analog Input 1 is a Differential Input at J106 Pins 3 and 4
	2-3	Analog Input 1 is a Single-Ended Input (set for Nservo-OP Option)
(1) JP1 and JP2 are present on all Nservo options but only affect -DB2 and -DB4 operation, including the Nservo-OEM.		
(2) Factory default jumper settings.		
(3) This setting can not be used with the Nservo-TB and Nservo-OP versions.		

The jumpers described in [Table 5-5](#) are for the 4-axis Nservo-DB4 option only, on the internally stacked circuit board.

**Table 5-5: Jumper Settings for the Nservo-DB4 Option Board**

Jumper	Setting	Description
JP3	1-2 (1)	Encoder 3 Pin 16 powered from internal +5 Volt Supply
	2-3	Encoder 3 Pin 16 powered from J110 Pin 1
JP4	1-2 (1)	Encoder 4 Pin 16 powered from internal +5 Volt Supply
	2-3	Encoder 4 Pin 16 powered from J110 Pin 1
(1) Factory default jumper settings.		

### 5.4. Nservo-TB2, -TB4 Assembly

Figure 5-4 highlights the important components located on the Nservo-TB2 and Nservo-TB4 component boards. The larger board is common to all Nservo versions; the smaller board contains the components specific to the Nservo-TB4 assembly.

The Nservo is jumper selectable to provide the user with quick operating mode reconfiguration capabilities. For jumper setting information, refer to Table 5-6.

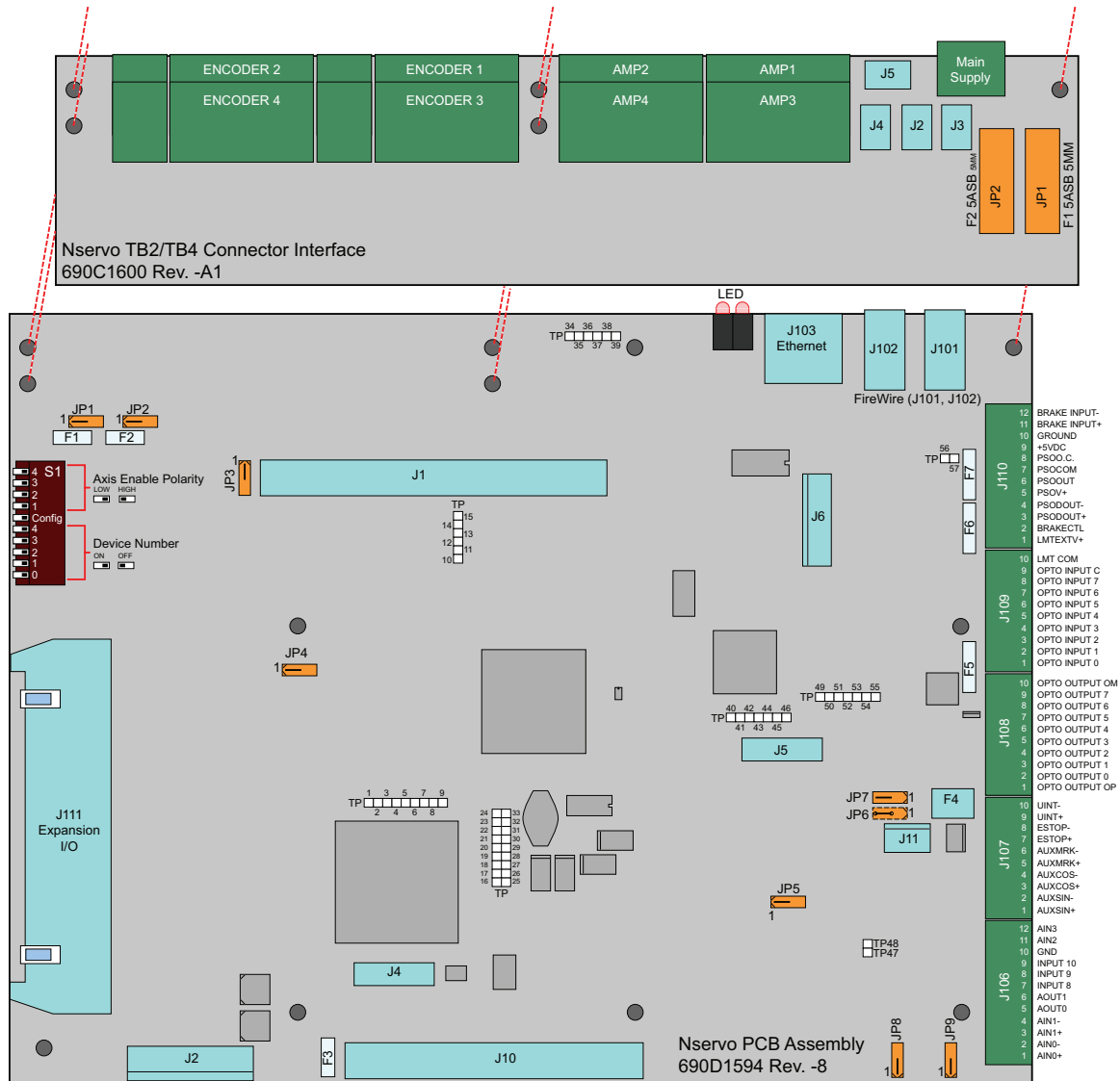


Figure 5-4: Nservo-TB2 and TB4 Control Board Assembly

### 5.4.1. Jumper Settings for Nservo-TB2 and Nservo-TB4

There are no jumpers on the -TB option board. For locations of the jumpers on the main control board refer to [Figure 5-4](#).

**Table 5-6: Jumper Settings for the Main Control Board**

Jumper	Setting	Description
JP1 (1)	1-2 (2)	Encoder 2 Pin 16 Powered from Internal Supply
	2-3	Encoder 2 Pin 16 Powered from J110 Pin 1
JP2 (1)	1-2 (2)	Encoder 1 Pin 16 Powered from Internal Supply
	2-3	Encoder 1 Pin 16 Powered from J110 Pin 1
JP3	1-2 (2)	Opto Inputs at Encoder 1-4, powered from J109 Pin 10
	2-3 (3)	Opto Inputs at Encoder 1-4, powered from Internal 5 Volt Supply
JP4	1-2 (2)	Watchdog Timer Enabled
	2-3	Watchdog Timer Disabled
JP5	1-2 (2)	PSO (Laser Firing ) Output active Low
	2-3	PSO (Laser Firing ) Output active High
JP8	1-2 (2)	Analog Input 0 is a Differential Input at J106 Pins 1 and 2
	2-3	Analog Input 0 is a Single-Ended Input (set for Nservo-OP Option)
JP9	1-2 (2)	Analog Input 1 is a Differential Input at J106 Pins 3 and 4
	2-3	Analog Input 1 is a Single-Ended Input (set for Nservo-OP Option)
(1) JP1 and JP2 are present on all Nservo options but only affect -DB2 and -DB4 operation, including the Nservo-OEM. (2) Factory default jumper settings. (3) This setting can not be used with the Nservo-TB and Nservo-OP versions.		

### 5.5. Nservo-OP Assembly

The Nservo-OP is composed of two circuit boards with the smaller board containing the components specific to the Nservo-OP assembly. Table 5-7 lists the jumpers and the default configurations for the smaller Nservo-OP Control board.

The Nservo is jumper selectable, providing the user with quick reconfiguration capability of operating modes.

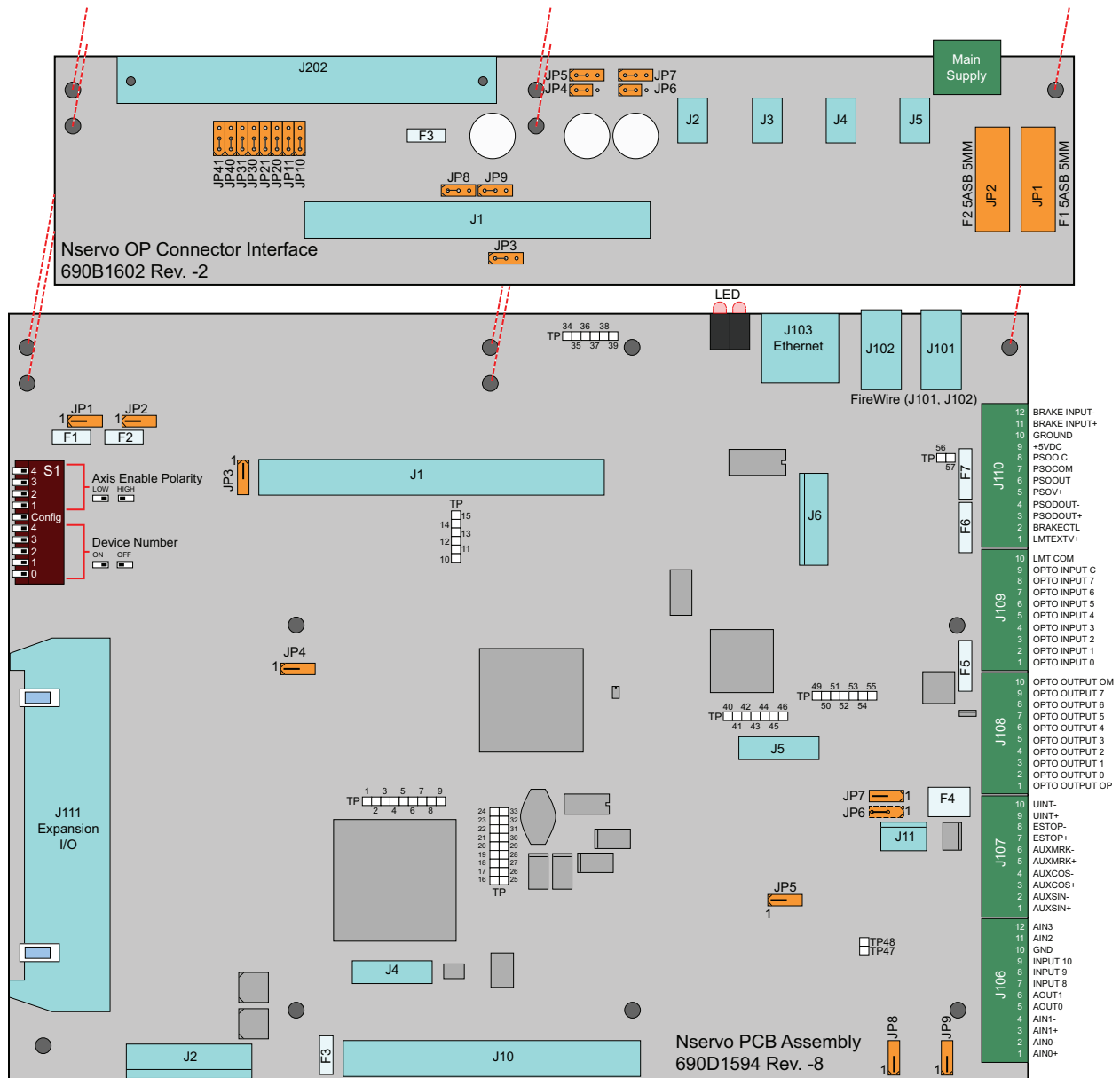


Figure 5-5: Nservo-OP Control Board Assembly



### 5.5.1. Nservo-OP Jumper Settings

The Nservo-OP is comprised of two circuit boards, the larger control board assembly and a smaller OP500 interface board, as shown in [Figure 5-5](#).

**NOTE:** Jumpers on the main control board may be hidden by the smaller stacked option circuit board. Setting JP3 on the main control board is not the same as setting JP3 on the option board.

**Table 5-7: Jumper Settings for the Main Control Board**

Jumper	Setting	Description
JP1 (1)	1-2 (2)	Encoder 2 Pin 16 Powered from Internal Supply
	2-3	Encoder 2 Pin 16 Powered from J110 Pin 1
JP2 (1)	1-2 (2)	Encoder 1 Pin 16 Powered from Internal Supply
	2-3	Encoder 1 Pin 16 Powered from J110 Pin 1
JP3	1-2 (2)	Opto Inputs at Encoder 1-4, powered from J109 Pin 10
	2-3 (3)	Opto Inputs at Encoder 1-4, powered from Internal 5 Volt Supply
JP4	1-2 (2)	Watchdog Timer Enabled
	2-3	Watchdog Timer Disabled
JP5	1-2 (2)	PSO (Laser Firing ) Output active Low
	2-3	PSO (Laser Firing ) Output active High
JP8	1-2 (2)	Analog Input 0 is a Differential Input at J106 Pins 1 and 2
	2-3	Analog Input 0 is a Single-Ended Input (set for Nservo-OP Option)
JP9	1-2 (2)	Analog Input 1 is a Differential Input at J106 Pins 3 and 4
	2-3	Analog Input 1 is a Single-Ended Input (set for Nservo-OP Option)

(1) JP1 and JP2 are present on all Nservo options but only affect -DB2 and -DB4 operation, including the Nservo-OEM.  
(2) Factory default jumper settings.  
(3) This setting can not be used with the Nservo-TB and Nservo-OP versions.

**Table 5-8: Jumper Settings for the OP500 Interface Board**

Jumper	Setting	Description
JP3	1-2 <sup>(2)</sup>	Analog Common connected to Signal Common
	2-3	Signal Common isolated from Analog Common
JP4	1-2 <sup>(2)</sup>	OP500 Pin 56 is -12 Volts
	2-3	OP500 Pin 56 is not driven
JP5	1-2 <sup>(2)</sup>	OP500 Pin 55 is -12 Volts
	2-3 <sup>(3)</sup>	No Connection
JP6	1-2 <sup>(2)</sup>	OP500 Pin 54 is +12 Volts
	2-3	OP500 Pin 56 is not driven
JP7	1-2 <sup>(2)</sup>	OP500 Pin 53 is +12 Volts
	2-3	No Connection
JP8 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Opto Input Common powered from internal +5 Volt Supply
	2-3	Opto Input Common not driven
JP9 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Opto Output V- connected to signal common
	2-3	Opto Output V- not driven
JP10 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 1 output at OP500 pin 79 is ICMD1B +
	2-3	Axis 1 output at OP500 pin 79 is Stepper Clock signal
JP11 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 1 output at OP500 pin 80 is ICMD1A +
	2-3	Axis 1 output at OP500 pin 80, is Stepper Direction signal
JP20 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 2 output at OP500 pin 81 is ICMD2B +
	2-3	Axis 2 output at OP500 pin 81 is Stepper Clock signal
JP21 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 2 output at OP500 pin 82 is ICMD2A +
	2-3	Axis 2 output at OP500 pin 82 is Stepper Direction signal
JP30 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 3 output at OP500 pin 83 is ICMD3B +
	2-3	Axis 3 output at OP500 pin 83 is Stepper Clock signal
JP31 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 3 output at OP500 pin 84 is ICMD3A +
	2-3	Axis 3 output at OP500 pin 84 is Stepper Direction signal
JP40 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 4 output at OP500 pin 85 is ICMD4B +
	2-3	Axis 4 output at OP500 pin 85 is Stepper Clock signal
JP41 <sup>(1)</sup>	1-2 <sup>(2)</sup>	Axis 4 output at OP500 pin 86 is ICMD4A +
	2-3	Axis 4 output at OP500 pin 86 is Stepper Direction signal

(1) Jumpers are traces etched onto the circuit board. Changing them requires the trace to be cut.  
(2) Factory default jumper settings.

## 5.6. Preventative Maintenance

The Nservo and external wiring should be inspected monthly. Inspections may be required at more frequent intervals, depending on the environment and use of the system. The table below lists the recommended checks that should be made during these inspections.



**DANGER:** To minimize the possibility of bodily injury or death, disconnect all electrical power prior to making any mechanical adjustments.



**DANGER:** To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.



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

**Table 5-9: 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 Nservo.
Visually inspect all cables and connections.	Tighten or re-secure any loose connections. Replace worn or frayed cables. Replace broken connectors.

### Cleaning

The Nservo 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 Nservo 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 Nservo while cleaning. Do not allow cleaning substances or other fluids to enter the Nservo 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 <http://www.aerotech.com/service-and-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>

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 3319 7715	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720
JAPAN	TAIWAN	UNITED KINGDOM
Aerotech Japan Full-Service Subsidiary Phone: +81 (0)50 5830 6814 Fax: +81 (0)43 306 3773	Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649

Have your customer order number ready before calling.

## Appendix B: Revision History

Rev	Date	Description
3.04.00	June 26, 2015	<ul style="list-style-type: none"> <li>Added RoHS statement to <a href="#">EC Declaration of Conformity</a></li> <li>Updated PSO Output specifications: <a href="#">Section 2.13.3</a>.</li> <li>Updated Nservo-OEM dimensions: <a href="#">Section 2.6.2.2.</a>, <a href="#">Section 2.6.3.2</a>.</li> <li>Added Tightening Torque specification (J201): <a href="#">Table 2-3</a></li> </ul>
3.03.00	November 15, 2012	<ul style="list-style-type: none"> <li>Added Drive and Software Compatibility chart: <a href="#">Section 1.4</a>.</li> <li>Updated section: <a href="#">Section 2.13.3</a>.</li> <li>Added JI NEMA information: <a href="#">Section 4.1</a>.</li> <li>Added and removed a FireWire cable: <a href="#">Section 2.8</a>.</li> </ul>
3.02.00	September 21, 2011	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
3.01.00	July 6, 2010	
3.00.00	April 15, 2010	
2.01.00	September 18, 2008	
2.00.00	January 9, 2008	
1.6	March 28, 2007	
1.5A	February 15, 2006	
1.5	January 13, 2006	
1.4	November 10, 2005	
1.3	April 27, 2005	
1.2	October 25, 2004	
1.1	May 26, 2004	
1.0	April 2, 2004	

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