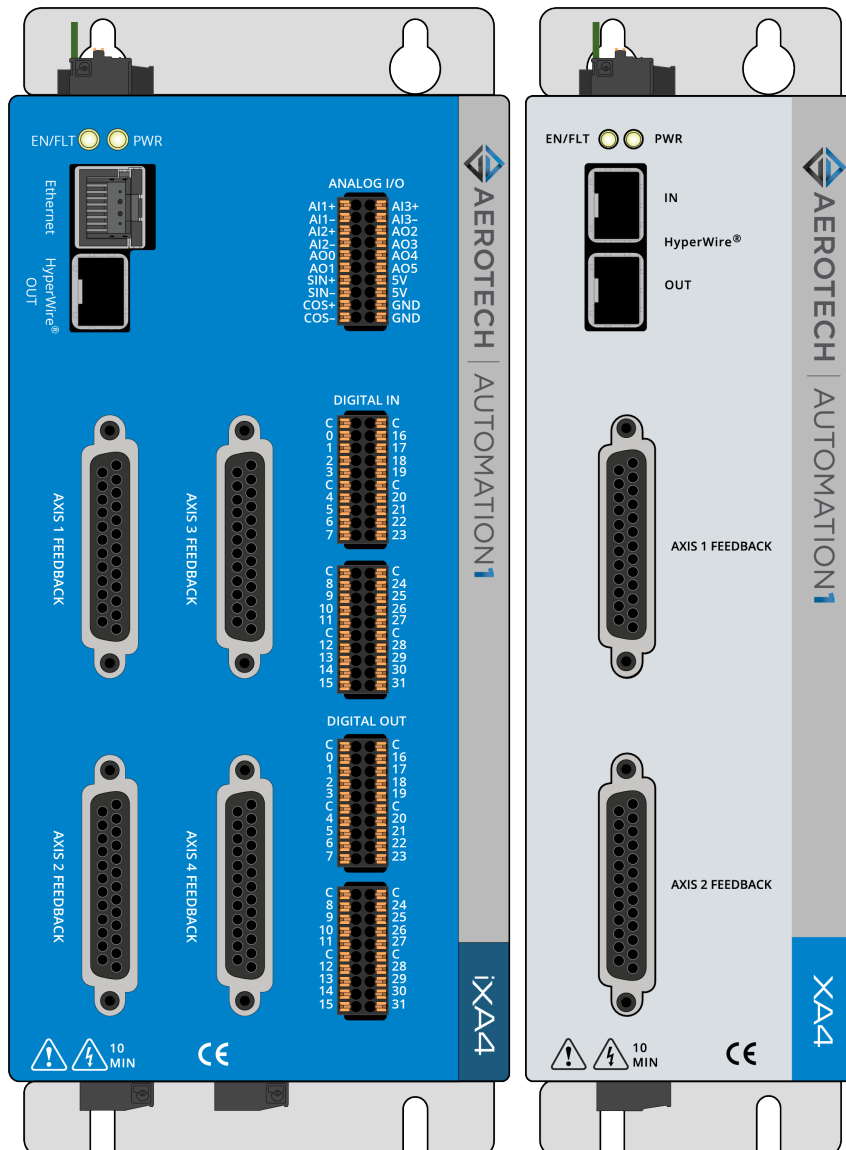


Automation1 iXA4 and XA4 PWM Digital Drives

HARDWARE MANUAL

Revision 1.04



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EU Declaration of Conformity

Manufacturer Aerotech, Inc.
Address 101 Zeta Drive
 Pittsburgh, PA 15238-2811
 USA
Product iXA4/XA4
Model/Types All



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

2014/30/EU	Electromagnetic Compatibility (EMC)
2014/35/EU	Low Voltage Directive
2006/42/EC	Machinery Directive
EU 2015/863	Directive, Restricted Substances (RoHS 3)

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

EN 61010-1:2010/AMD1:2016	Safety Requirements for Electrical Equipment
EN 61800-3:2004/A1:2011	EMC Requirements for Power Drives
IEC 61800-5-1:2016	Electrical Safety for Power Drive Systems
IEC 61800-5-2:2016	Functional Safety for Power Drive Systems
EN 55011:2000/A2:2003	Conducted and Radiated Emissions
EN 55022:1998	Conducted and Radiated Emissions

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 Pittsburgh, PA 15238-2811
 USA
 8/15/2024

Date

UKCA Declaration of Conformity

Manufacturer Aerotech, Inc.
Address 101 Zeta Drive
 Pittsburgh, PA 15238-2811
 USA
Product iXA4/XA4
Model/Types All



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

Electrical Equipment (Safety) Regulations 2016
 Electromagnetic Compatibility Regulations 2016
 Supply of Machinery (Safety) Regulations 2008
 Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

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

EN 61010-1:2010/AMD1:2016	Safety Requirements for Electrical Equipment
EN 61800-3:2004/A1:2011	EMC Requirements for Power Drives
IEC 61800-5-1:2016	Electrical Safety for Power Drive Systems
IEC 61800-5-2:2016	Functional Safety for Power Drive Systems
EN 55011:2000/A2:2003	Conducted and Radiated Emissions
EN 55022:1998	Conducted and Radiated Emissions

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 Pittsburgh, PA 15238-2811
 USA
 8/15/2024

Date

Safety Procedures and Warnings



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

- Read all parts of this manual before you install or operate the drive or before you do maintenance to your system.
- To prevent injury to you and damage to the equipment, obey the precautions in this manual.
- All specifications and illustrations are for reference only and were complete and accurate as of the release of this manual. To find the newest information about this product, refer to www.aerotech.com.

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



IMPORTANT: This product has been designed for light industrial manufacturing or laboratory environments. If the product is used in a manner not specified by the manufacturer:

- The protection provided by the equipment could be impaired.
- The life expectancy of the product could be decreased.

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



The voltage can cause shock, burn, or death.



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



A surface can be hot enough to burn you.



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



Components are sensitive to electrostatic discharge.



Unsecured cables could cause you to:

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



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

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



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



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



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



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

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

Handling and Storage

Unpacking the drive



IMPORTANT: All electronic equipment and instrumentation is wrapped in antistatic material and packaged with desiccant. Ensure that the antistatic material is not damaged during unpacking.

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

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

The documentation for the drive is on the included installation device. The documents include manuals, interconnection drawings, and other documentation pertaining to the system. Save this information for future reference. Additional information about the system is provided on the Serial and Power labels that are placed on the chassis.

The system serial number label contains important information such as the:

- Customer order number (please provide this number when requesting product support)
- Drawing number
- System part number

Handling



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

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



WARNING: Electrostatic Discharge (ESD) Sensitive Components!

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

Storage

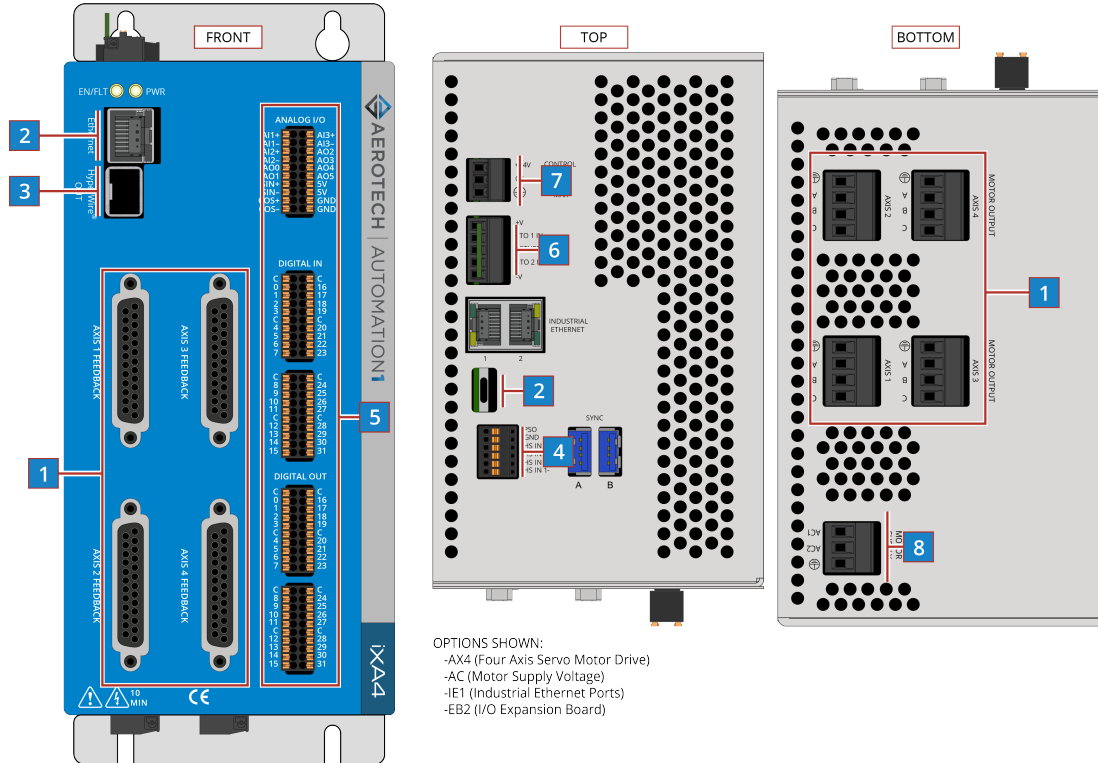
Store the drive in the original shipping container. If the original packaging included ESD protective packaging, make sure to store the drive in it. The storage location must be dry, free of dust, free of vibrations, and flat.

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

Installation Overview

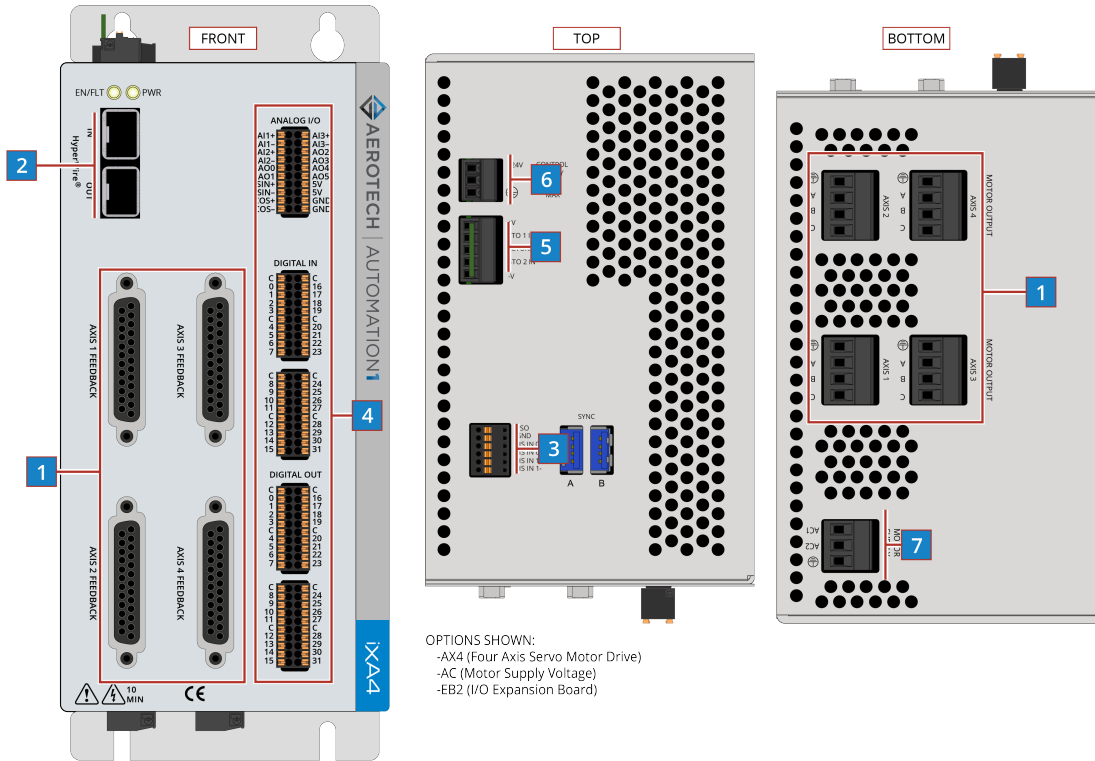
The images that follow show the order in which to make connections and settings that are typical to the iXA4/XA4. If a custom interconnect drawing was supplied with your system, that drawing is on your Storage Device and shows as a line item on your Sales Order in the Integration section.

Figure 1: Installation Connection Overview for the iXA4



1	Connect the motor(s) to the amplifier Motor Output connector(s).	Section 2.2.
	Connect the motor(s) to the amplifier Feedback connector(s).	Section 2.3.
2	Connect the PC to the USB or Ethernet port.	N/A
3	Connect the next drive in the system to the HyperWire Out port.	Section 2.7.
4	Connect additional I/O (PSO/HSIN) as required by your application.	Section 2.5. / Section 2.6.
5	With -EB1/-EB2: Connect additional I/O as required by your application.	Chapter 3
6	Connect the Safe Torque Off (STO).	Section 2.4.
7	Connect the power supply to the Control Supply connector.	Section 2.1.1.
8	Connect the motor power to the Motor Supply connector.	Section 2.1.2.

Figure 2: Installation Connection Overview for the XA4



1	Connect the motor(s) to the amplifier Motor Output connector(s).	Section 2.2.
	Connect the motor(s) to the amplifier Feedback connector(s).	Section 2.3.
2	Connect a PC or drive-based controller HyperWire port to the HyperWire In port.	Section 2.7.
3	Connect additional I/O (PSO/HSIN) as required by your application.	Section 2.5. /
		Section 2.6.
4	With -EB1/-EB2: Connect additional I/O as required by your application.	Chapter 3
5	Connect the Safe Torque Off (STO).	Section 2.4.
6	Connect the power supply to the Control Supply connector.	Section 2.1.1.
7	Connect the motor power to the Motor Supply connector.	Section 2.1.2.

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Chapter 1: iXA4/XA4 Overview

The iXA4 is a digital drive-based controller. It runs the Automation1-iSMC controller to generate commands for itself as well as for additional drives on the chain.

The XA4 is a digital drive. The XA4 is based on the HyperWire communication protocol and receives commands from a PC or drive-based controller.

Both drives provide deterministic behavior, auto-identification, and are fully software configurable. A double precision floating point DSP controls the digital PID and current loops. Both drives offer standard Safe Torque Off (STO) inputs and optional Position Synchronized Output (PSO) outputs. And both drives are offered with an optional encoder interpolation feature (-MX1), dedicated analog and high-speed digital inputs, and separate power connections for motor and control supply voltages.

Figure 1-1: iXA4 Digital Drive-Based Controller Labeled

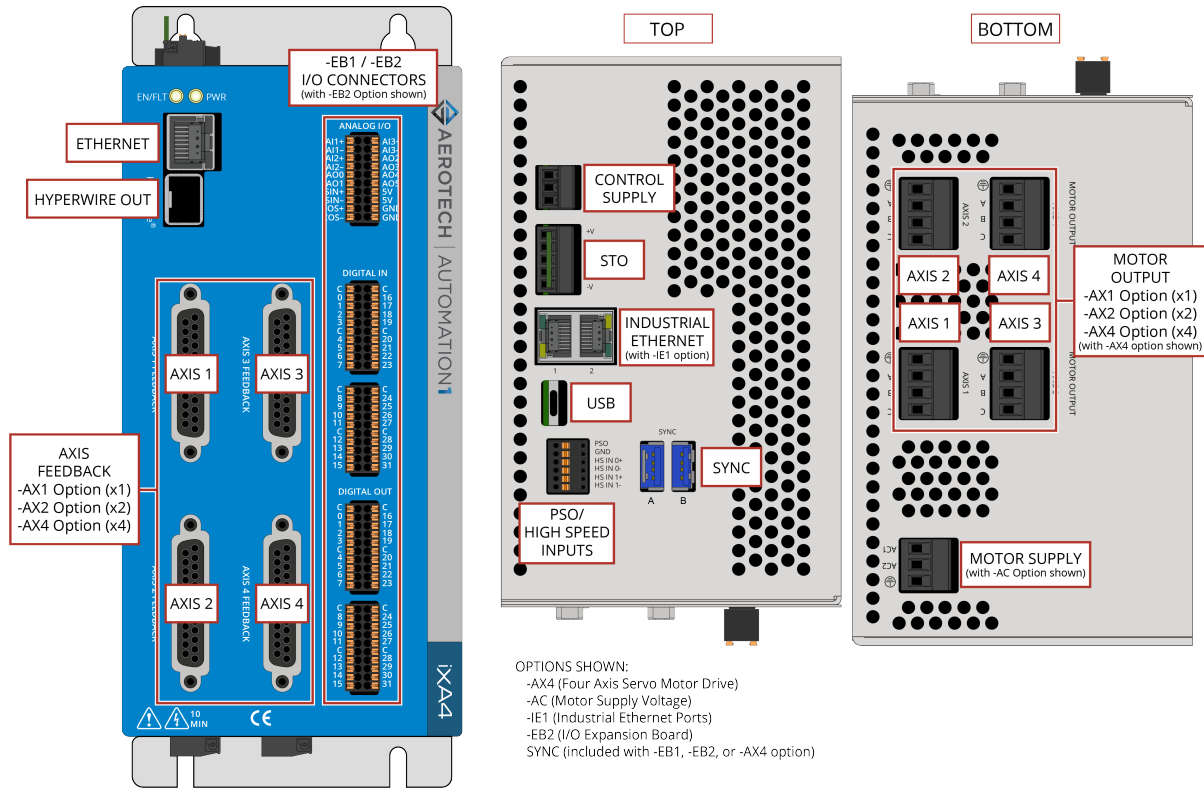
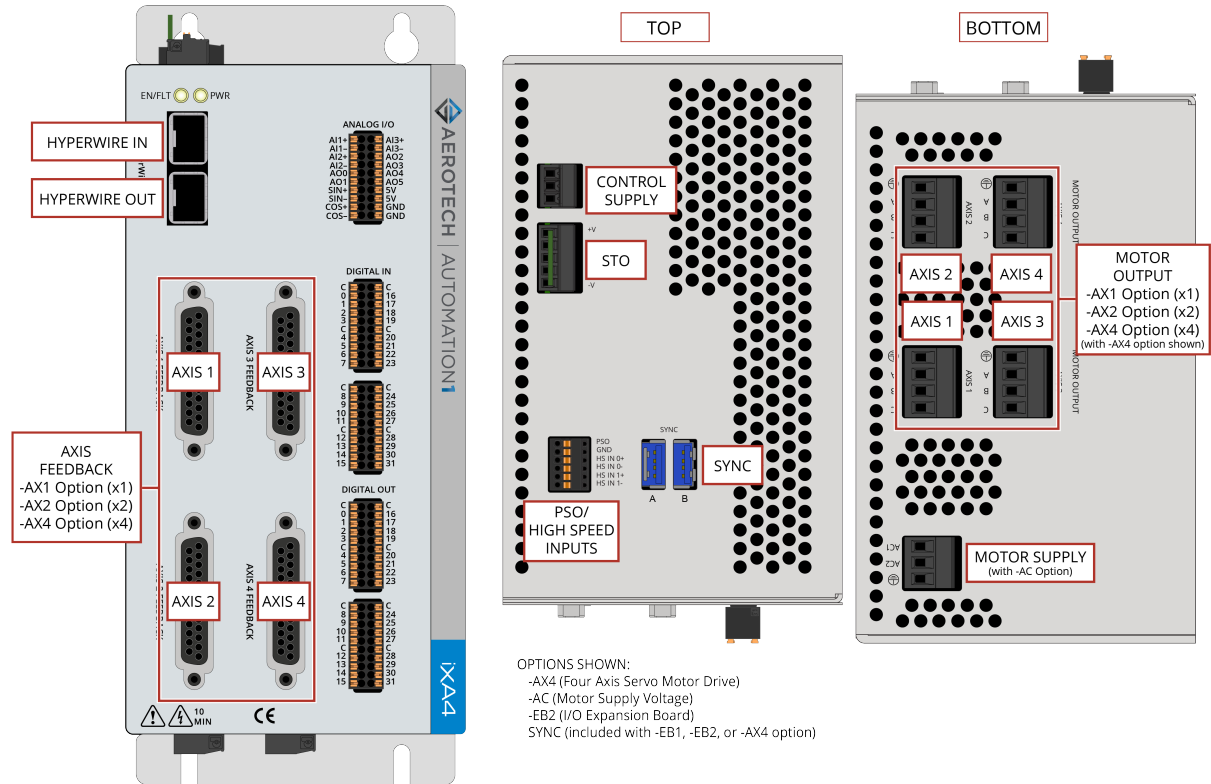


Figure 1-2: XA4 Digital Drive Labeled



1.1. Feature Summary

- 24 VDC control supply input ([Section 2.1.1.](#))
- 10 kHz Servo Loop Update Rate
- Line driver square wave quadrature encoder input for position and velocity feedback ([Section 2.3.1.](#))
- Absolute Encoder support on the Feedback connectors ([Section 2.3.1.2.](#))
- Fail-safe brake outputs ([Section 2.3.7.](#))
- Two STO sense inputs ([Section 2.4.](#))
- High-Speed Inputs ([Section 2.6.](#))
 - One High Speed Input (with the -AX1 axis option; only available on -AC voltage option drives)
 - Two High Speed Inputs (with the -AX2 or -AX4 axis options)
- One 16-bit differential analog input (± 10 V) per axis ([Section 2.3.3.](#))
- Position Synchronized Outputs (PSO):
 - Generate outputs synchronized to feedback positioning ([Section 2.5.](#))
 - Part-Speed PSO Firing:
 - One to three axes
 - Part-Speed PSO commands high-speed, low-latency output pulses based on the commanded vector velocity. Refer to the online help for more information.
 - Multi-Axis PSO Tracking: To track multiple axes...
 - with Aerotech drives, use the Sync Ports ([Section 2.8.](#))
 - with non-Aerotech drives and square wave encoder signals, use the Auxiliary Encoder connector ([Section 3.5.](#)) or use the Primary Feedback connector ([Section 2.3.](#))
- One HyperWire communication channel ([Section 2.7.](#))
- One 10/100/1000 BASE-T Ethernet Port (**iXA4 Only**)
- One USB 2.0 Type C Port (**iXA4 Only**)
- Two 100 BASE-T Industrial Ethernet Ports (**iXA4 Only**)

1.2. Ordering Options

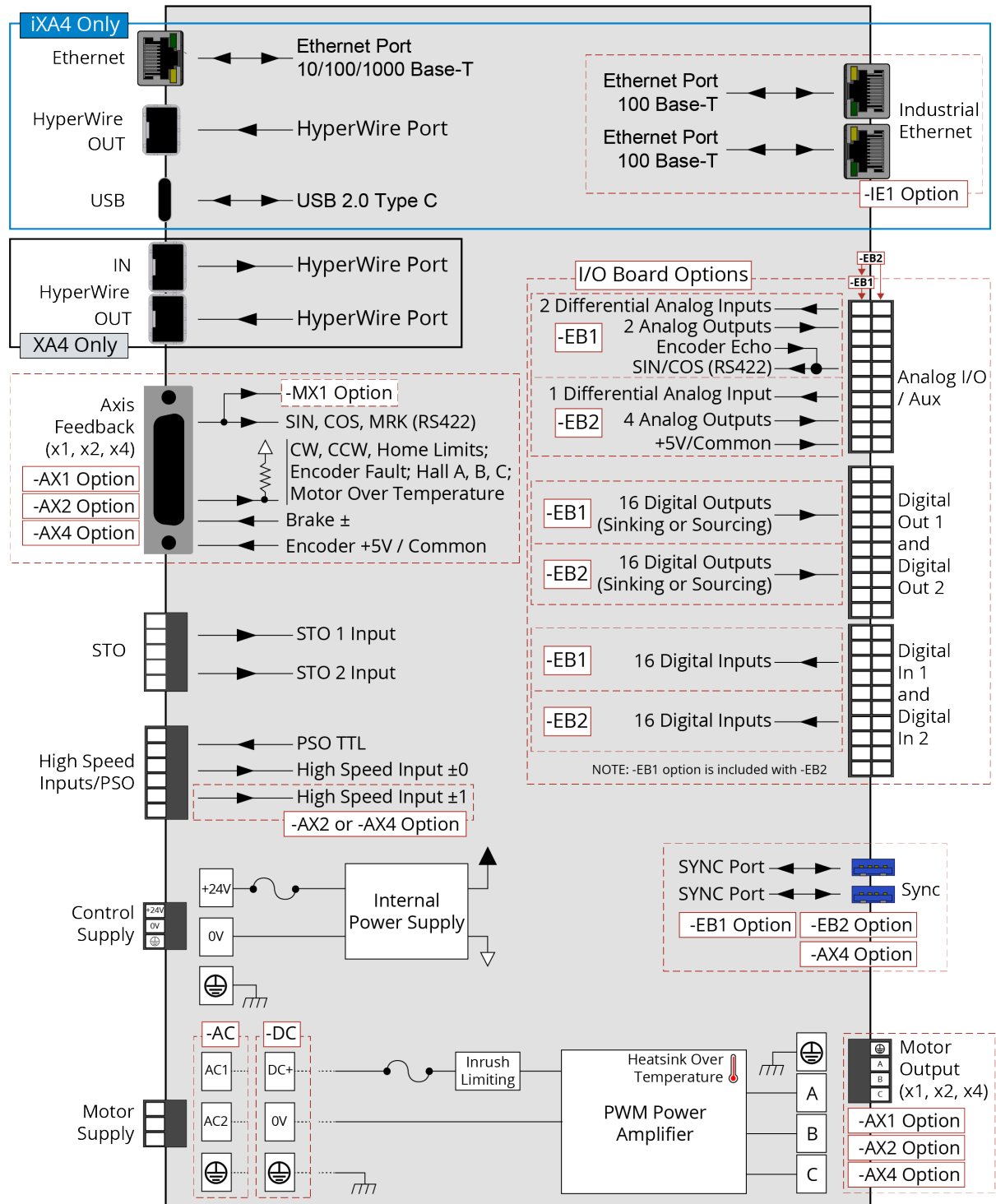
Table 1-1: Example Order and Ordering Options

Examples				
Two Axis: Automation1-iXA4-AC-AX2-20-MX1-IE1-EB0-PSO6				
Four Axis: Automation1-iXA4-AC-AX4-20-10-MX1-MX1-IE1-EB0-PSO6				
Options				
Automation1 Drive				
XA4	PWM Servo Drive			
iXA4	PWM Servo Drive with Motion Controller			
Motor Supply Voltage				
-AC	240 VAC rated motor supply (Peak Current Options: -10, -20)			
-DC	100 VDC rated motor supply (Peak Current Option: -10)			
Number of Axes				
-AX1	One-axis servo motor drive			
-AX2	Two-axis servo motor drive			
-AX4	Four-axis servo motor drive			
NOTE: The -AX1 Number of Axes option is only available with the -AC Motor Supply Voltage option.				
Peak Current (Section 1.4.)				
		-AX1/-AX2	-AX4	
-10	10 A Peak, 5 A Continuous Current		-10	10 A Peak, 5 A Continuous Current
-20	20 A Peak, 10 A Continuous Current		-20	20 A Peak, 10 A Continuous Current
NOTE: The -20 Peak Current option is only available with the -AC Motor Supply Voltage option.				
Multiplier (Section 2.3.1.3.)				
		-AX1/-AX2	-AX4	
-MX0	No encoder multiplier		-MX0	No encoder multiplier
-MX1	Interpolation circuit allowing for analog sine wave input on the primary encoder channel (4,096 interpolation factor).		-MX1	Interpolation circuit allowing for analog sine wave input on the primary encoder channel (4,096 interpolation factor).
Expansion Board (Chapter 3: -EB1/-EB2 Option Expansion Board)				
-EB0	No expansion board			
-EB1	Standard Density I/O Expansion Board <ul style="list-style-type: none"> Two 16-bit analog outputs (± 10 V) Two 16-bit analog inputs (± 10 V) 16 digital logic inputs (5 - 24 VDC); connect to current sourcing or sinking devices. 16 digital logic outputs (5 - 24 VDC); connect to current sourcing or sinking devices. Auxiliary square-wave encoder input channel 			
-EB2	High Density I/O Expansion Board <ul style="list-style-type: none"> Six 16-bit analog outputs (± 10 V) Three 16-bit analog inputs (± 10 V) 32 digital logic inputs (5 - 24 VDC); connect to current sourcing or sinking devices. 32 digital logic outputs (5 - 24 VDC); connect to current sourcing or sinking devices. Auxiliary square-wave encoder input channel 			
PSO (Section 2.5.)				
-PSO0	No PSO firing			
-PSO6	Three-axis Part-Speed PSO firing, which uses the PSO firing circuit based off of the commanded vector velocity of 3 or more axes (includes One-Axis PSO).			
Industrial Ethernet (iXA4 only) (Section 2.9.)				
-IE0	No industrial ethernet ports			
-IE1	Includes industrial ethernet ports			

1.3. Functional Block Diagram

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

Figure 1-3: Functional Diagram



1.4. Electrical Specifications

Table 1-2: Electrical Specifications (Common)

Description		Specification
Control Supply	Input Voltage	24 VDC
	Input Current	5 A maximum, 0.5 A typical without brake
SCCR		Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 240 volts maximum
Power Amplifier Bandwidth		2500 Hz maximum (software selectable)
PWM Switching Frequency		10 kHz
Minimum Load Inductance		0.5 mH
User Power Supply Output		5 VDC (@ 500 mA)
Motor Type		Brushless, Brush, Stepper
Protective Features		<ul style="list-style-type: none"> • Output short circuit • Peak over current • DC bus over voltage • Motor RMS over current • Motor over temperature • Heatsink over temperature • Control power supply under voltage • IGBT supply under voltage • Shunt resistor monitoring
Insulation		Over Voltage Category 3
Conductors		Copper Only, 75°C min

Table 1-3: Electrical Specifications (-AC Option)

Output Current Ordering Option	-10	-20
Motor Supply Input Current at full output power	5 A	10 A
Motor Supply Input Voltage Max ^(1,2) (Vrms AC1 to AC2, +10%)	240 VAC 50/60 Hz	
Output Current (peak, all axes together) (3,4,5, 6)	10 A	20 A
Output Current (continuous, single axis only) ^(3,4,5)	5 A	7 A
Output Current (continuous, two axes together) ^(3,4,5)	4.5 A	4.5 A
Output Current (continuous, four axes together) ^(3,4,5)	4 A	4 A
Internal time delay fuse (AC1 input only)	5 A	10 A
Peak Output Voltage ^(4,5)	340 V	
Maximum Motor Supply External Breaker	20 A maximum (Type-D)	
Internal Motor Supply Capacitance	-AX1/-AX2: 1200 µf -AX4: 2400 µf	
Capacitor Safe Discharge Time (to 50 V)	10 minutes	

- (1) The iXA4/XA4 uses a single phase motor supply power.
(2) A lower motor supply voltage can be used. This will result in a reduction of output power.
(3) There are three motor output phases from the drive.
(4) The maximum total power output is
-20 Peak Voltage Option: 1200 W
-10 Peak Voltage Option: 600 W
(5) These values are based on using the maximum motor supply input voltage.
(6) The drive can achieve the peak output current for each axis with all axes running.

Table 1-4: Electrical Specifications (-DC Option)

Output Current Ordering Option	-10
Motor Supply Input Current at full output power	5 A
Motor Supply Input Voltage Max ⁽¹⁾	100 VDC
Output Current (peak, two axes together) ^(2,5)	10 A
Output Current (continuous, single axis only) ^(2,3,4)	5 A
Output Current (continuous, both axes together) ^(2,3,4)	5 A
Output Current (continuous, four axes together) ^(2,3,4)	5 A
Internal time delay fuse (DC+ input only)	5 A
Peak Output Voltage ⁽³⁾ 100 VDC	100 VDC
Maximum Motor Supply External Breaker	10 A maximum (Type-D)
Internal Motor Supply Capacitance	1200 µf
Capacitor Safe Discharge Time (to 50V)	10 minutes
<p>(1) A lower motor supply voltage can be used. This will result in a reduction of output power.</p> <p>(2) There are three motor output phases from the drive.</p> <p>(3) DC input voltage and load dependent</p> <p>(4) The maximum total power output is 400 W.</p> <p>(5) The drive can achieve the peak output current for each axis with all axes running.</p>	

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.



WARNING: Electric Shock or Fire Hazard! A fault current interruption could be the result of an open branch-circuit protective device. To reduce the risk of fire or electric shock, examine the current-carrying parts and other controller components. Replace all damaged parts. If a burnout of the current element of an overload relay occurs, you must replace the complete overload relay.

AVERTISSEMENT : Risque d'électrocution ou d'incendie ! Une interruption du courant de défaut peut être provoqué par un dispositif de protection de circuit de dérivation ouvert. Pour réduire le risque d'incendie ou d'électrocution, examinez les pièces conductrices de courant et les autres composants du contrôleur. Remplacer toutes les parties endommagées. Si un grillage de l'élément de courant d'un relais de surcharge se produit, vous devez remplacer le relais de surcharge dans son ensemble.

1.4.1. System Power Requirements

The following equations can be used to determine total system power requirements. The actual power required from the mains supply will be the combination of actual motor power (work), motor resistance losses, and efficiency losses in the power electronics or power transformer. For 3-phase brushless motors:

Use an EfficiencyFactor of approximately 90% in the following equations.

PWM Amplifier Types

$$\begin{aligned} \text{Power Output [W]} &= \text{Torque [N}\cdot\text{m]} \cdot \text{Angular Velocity [rad/sec]} \quad ;\text{Rotary} \\ &= \text{Force [N]} \cdot \text{Linear Velocity [m/sec]} \quad ;\text{Linear} \\ &= B_{\text{emf}} [V_{\text{rms l-n}}] \cdot \text{MotorCurrent [A}_{\text{rms}}] \cdot 3 \quad ;\text{Rotary or Linear} \\ \text{Power Loss [W]} &= \text{MotorCurrent}^2 [\text{A}_{\text{rms}}^2] \cdot \text{MotorHotResistance } [\Omega \text{ l-l}] \cdot 3/2 \\ \text{Power Input [W]} &= (\text{Power Output [W]} + \text{Power Loss [W]}) / \text{EfficiencyFactor} \end{aligned}$$

NOTES

l-n = line to neutral
 l-l = line to line
 Vrms = Volt rms
 Arms = Ampere rms
 Apk = Ampere peak
 Vdc = Volt DC

1.4.2. Real-Time Clock Requirements (iXA4 Only)

The drive has an internal real-time clock that is used to time-stamp logged data. The clock is powered by an internal capacitor when the control supply is not connected to the drive. When the capacitor is fully charged, it will power the clock for 17.5 days.

If the capacitor is fully discharged, the time on the drive is not reliable. To reinitialize the real-time clock, you must:

- Connect the drive to the control supply. It will take 36 minutes to fully charge the capacitor.
- Connect the drive to the Automation1 Studio and reprogram the real-time clock.

The capacitor charges exponentially with a 7.2 minute time constant. Apply the control supply to charge the capacitor. To achieve the maximum 17.5 days of real-time clock operation in the absence of the control supply, the capacitor must be charged for 36 minutes. If the capacitor is not fully charged when the control supply is lost, the real-time clock will not last the entire 17.5 days on backup capacitor power.

1.5. Mechanical Specifications

1.5.1. Mounting and Cooling

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



IMPORTANT: The amount of airflow required to keep the drive temperature within a sufficient range is dependent on the operating conditions. You could be required to supply additional airflow to the drive.

Table 1-5: Mounting Specifications

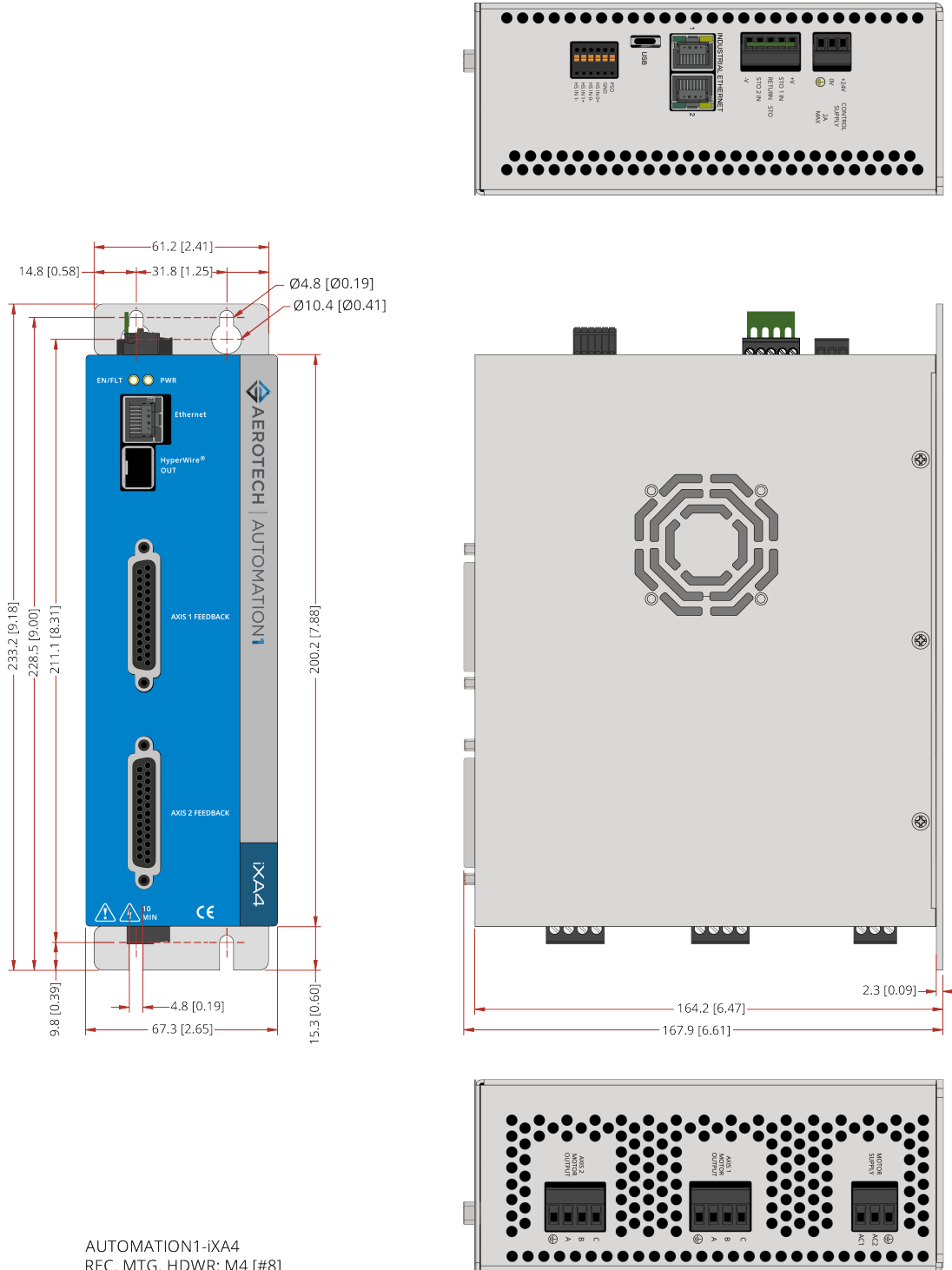
		XA4/iXA4
Customer-Supplied Enclosure		IP54 Compliant
Weight		-AX1/-AX2: 1 kg -AX4: 1.5 kg
Mounting Hardware		M4 [#8] screws (four locations, not included)
Mounting Orientation		Vertical (typical)
Dimensions		Refer to Section 1.5.2. Dimensions
Minimum Clearance	Airflow	~25 mm
	Connectors	~100 mm
Operating Temperature		Refer to Section 1.6. Environmental Specifications
Drive IP Rating		IP20
Mounting Panel Thickness (Recommended)		2.5 - 3.5 mm (.10 - .125 in)
UL Enclosure Type Rating of Drive		Open Type

1.5.2. Dimensions



IMPORTANT: iXA4 and XA4 with -AX1/-AX2 and -EB0 options have the same dimensions. iXA4-AX2-EB0 is shown.

Figure 1-4: Dimensions (Two Axis iXA4)

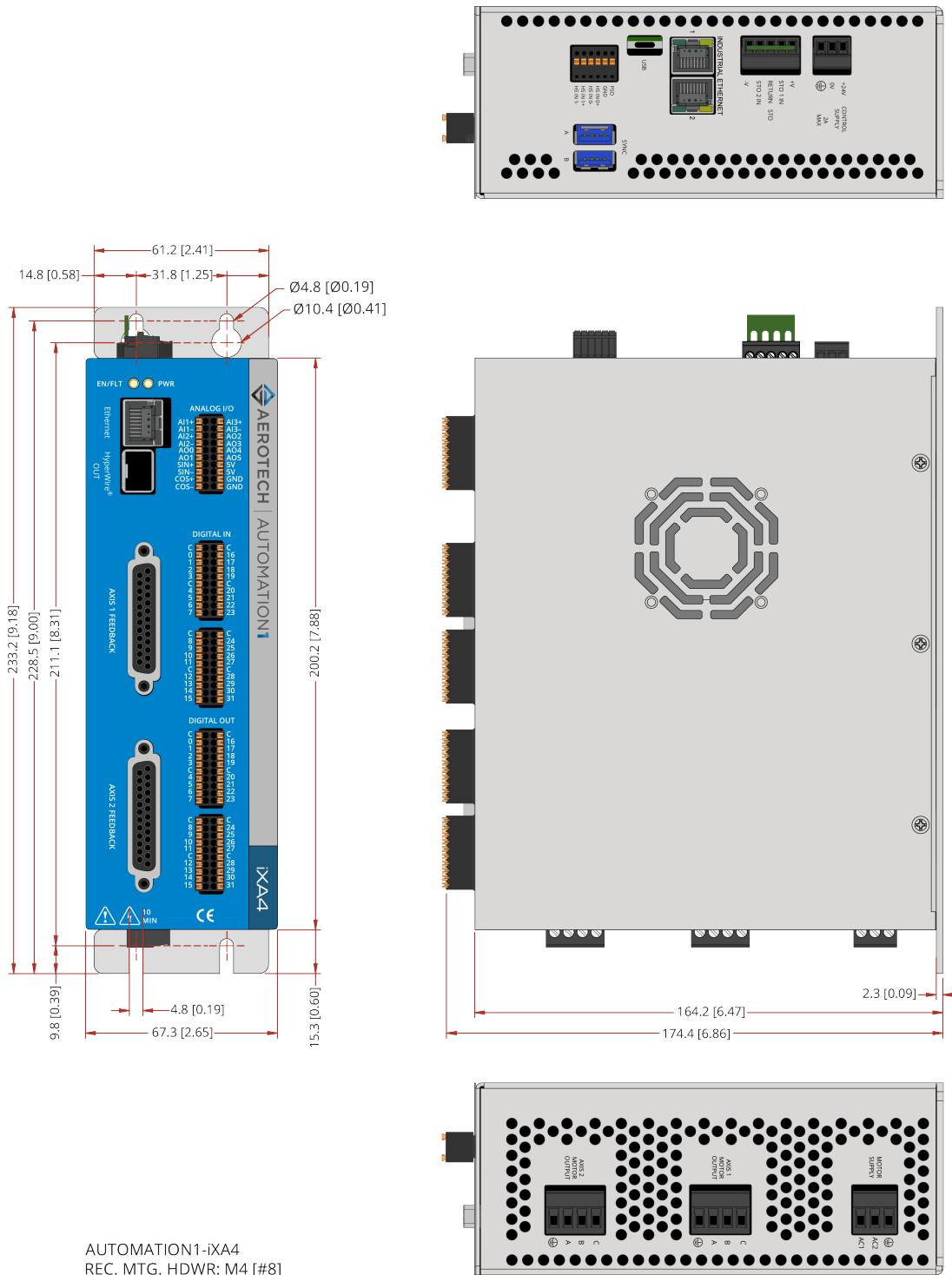


AUTOMATION1-iXA4
REC. MTG. HDWR: M4 [#8]



IMPORTANT: iXA4 and XA4 with -AX1/-AX2 and -EB1/-EB2 options have the same dimensions. iXA4-AX2-EB2 is shown.

Figure 1-5: Dimensions (Two Axis iXA4 with Expansion I/O Board)

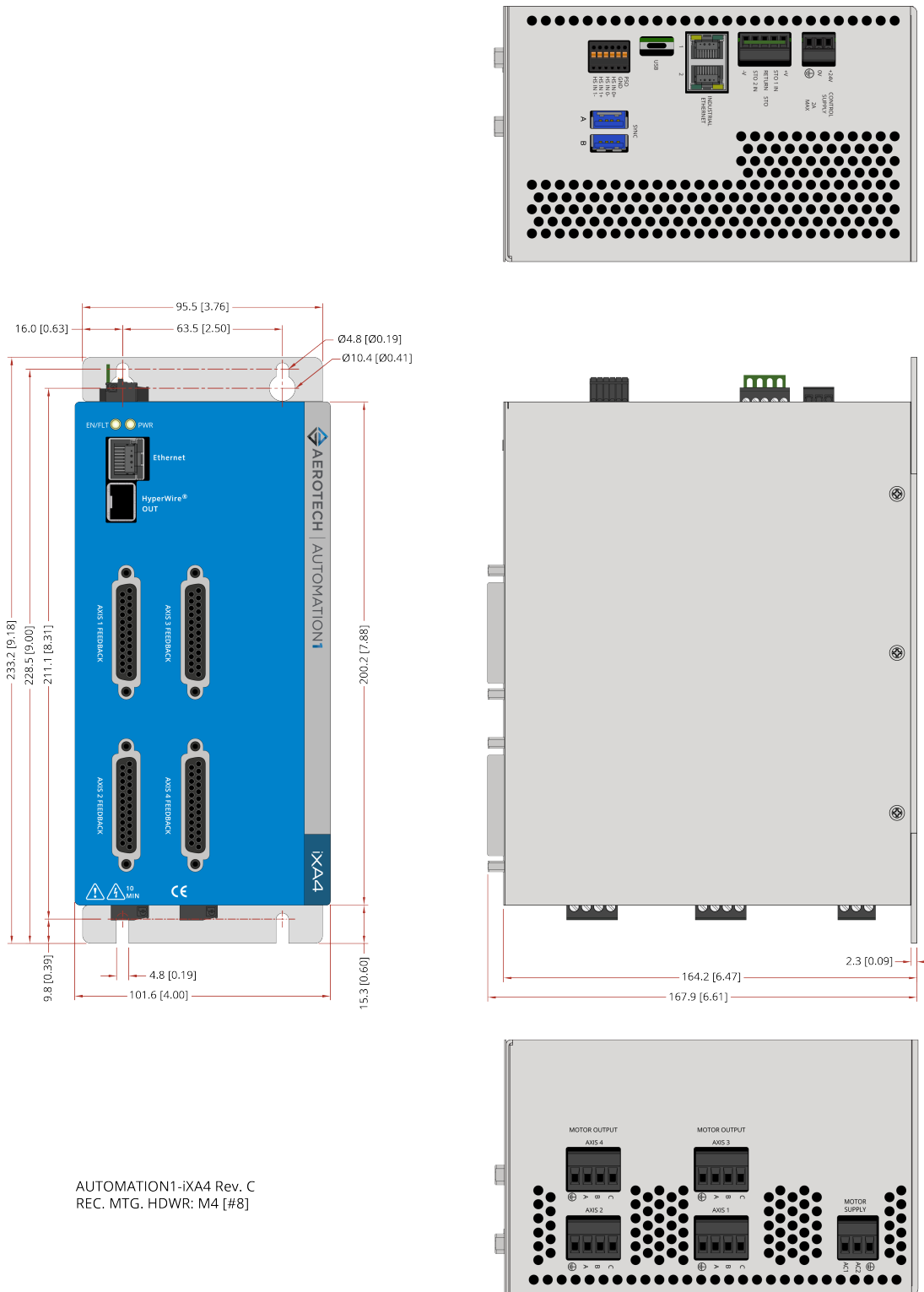


AUTOMATION1-iXA4
REC. MTG. HDWR: M4 [#8]



IMPORTANT: iXA4 and XA4 with -AX4 and -EB0 options have the same dimensions. iXA4-AX4 is shown.

Figure 1-6: Dimensions (Four Axis iXA4)

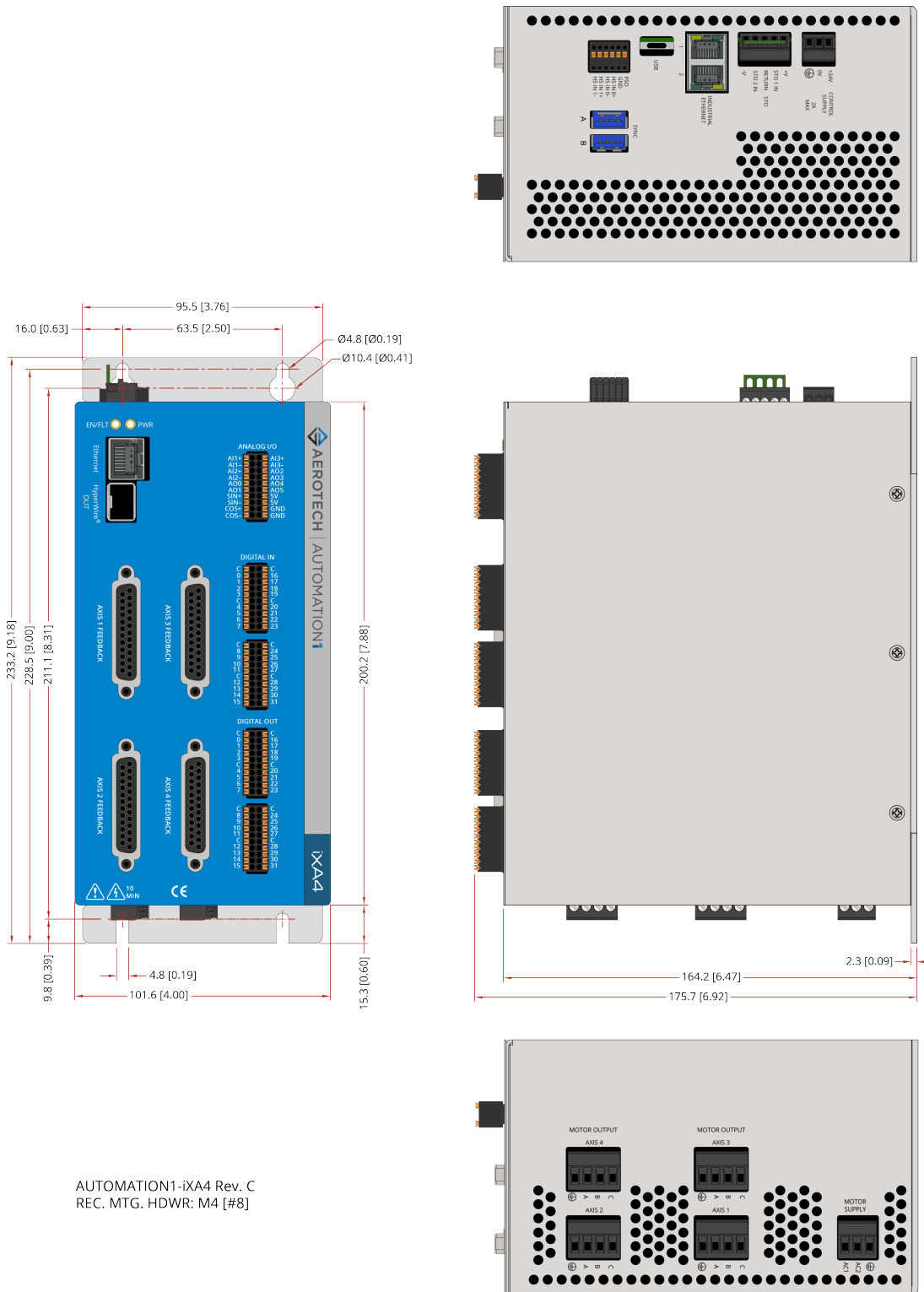


AUTOMATION1-iXA4 Rev. C
REC. MTG. HDWR: M4 [#8]



IMPORTANT: iXA4 and XA4 with -AX4 and -EB1/-EB2 options have the same dimensions. iXA4-AX4-EB2 is shown.

Figure 1-7: Dimensions (Four Axis iXA4 with I/O Expansion Board)



AUTOMATION1-iXA4 Rev. C
REC. MTG. HDWR: M4 [#8]

1.6. Environmental Specifications

The environmental specifications are listed below.

Table 1-6: Environmental Specifications

Temperature	Operating: 0 °C to 40 °C (32 °F to 104 °F)
	Maximum Surrounding Air: 40 °C (104 °F)
	Storage: -30 °C to 85 °C (-22 °C to 185 °F)
Humidity Non-condensing	The maximum relative humidity is 80% for temperatures that are less than 31 °C and decreases linearly to 50% relative humidity at 40 °C.
Operating Altitude	0 m to 2,000 m (0 ft to 6,562 ft) above sea level.
Pollution	Pollution Degree 2 Typically only nonconductive pollution occurs.
Operation	Use only indoors

1.7. Drive and Software Compatibility

This table shows the available drives and which version of the software first supported each drive. In the **Last Software Version** column, drives that show a specific version number are not supported after that version.

Table 1-7: Drive and Software Compatibility

Drive Type	Options	First Software Version	Last Software Version
iXA4/XA4	-AC; -AX1; -AX2; -EB0	2.7.0	Current
	-DC; -AX4; -EB1; -EB2	2.8.0	Current


Chapter 2: Installation and Configuration

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

2.1. Input Power Connections

The drive has one DC input power connection for control power. If it was ordered with the -AC motor supply option, it also has one AC input power connection for motor power. If it was ordered with the -DC motor supply option, it has a DC input power connection for motor power. Refer to [Section 2.10](#) for a System Interconnection Drawing.

2.1.1. Control Supply Connector



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

The Control Supply input supplies power to the communications and logic circuitry of the drive . The **+24V** input is connected to an internal fuse. Refer to [Table 4-4](#) for the internal fuse value and part number. For an isolated DC supply, connect **0V** to protective ground at the supply. Use twisted pair wiring to minimize radiated noise emissions (refer to [Figure 2-1](#)).

Use a control power supply that is dedicated only to the iXA4/XA4 drives to minimize noise. Do not use this supply to power other system components. Locate the power supply close to the drives.

Figure 2-1: Control Supply Connections

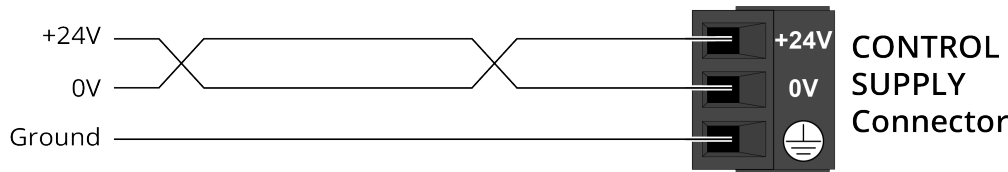


Table 2-1: Control Supply Connector Pinout


Pin	Description
+24 V	24 VDC (±10%) Control Power Input (5 A maximum, 0.5 A typical without brake)
0 V	Control Power Common Input
	Protective Ground

Table 2-2: Control Supply Mating Connector Ratings

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

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

2.1.2. Motor Supply Connector



DANGER: Shock and Fire Hazard!



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

If your drive has the -AC Motor Supply option, refer to [Section 2.1.2.1](#).

If your drive has the -DC Motor Supply option, refer to [Section 2.1.2.2](#).

If you have a combination of -AC and -DC Motor Supply option drives, Aerotech recommends that you key the Motor Supply connector and mating connectors. Refer to [Section 2.1.2.3. Motor Supply Keying](#) for more information.

2.1.2.1. Motor Supply Connector (-AC Option)

Motor power is applied to the **AC1** and **AC2** terminals of the Motor Supply connector.

Peak Current Option -10: The **AC1** input is internally connected to a 5 A fuse.

Peak Current Option -20: The **AC1** input is internally connected to a 10 A fuse.

Refer to [Section 5.2](#). for the internal fuse part numbers.

The **AC2** input is not internally fused. The system designer must provide external circuit breaker(s) in accordance with local electrical safety requirements. D-type breakers are required for proper branch protection (refer to [Section 1.4.](#)). Individual circuit breakers could be required for each drive in a system. The size of the breaker required is dependent upon the gauge of wire used between the drive and the motor.

For CE compliance, connect an AC line filter as close as possible to the drive (refer to [Section 2.1.4.](#)).



WARNING: Verify that all ground connections are installed correctly before you apply power to the iXA4/XA4.

Figure 2-2: Motor Supply Connections



Table 2-3: Motor Supply Connector Pinout

Pin	Description
AC1	AC Motor Power Input
AC2	AC Motor Power Input
	Protective Earthing Conductor - 2.5 mm ² / 14 AWG min conductor size

Table 2-4: Motor Supply Mating Connector Ratings

Specification		Description
Type		3-Pin Terminal Block
Part Numbers		Aerotech: ECK02388 Phoenix: 1756272
Conductor Cross Section	One conductor, stranded with ferrule and plastic sleeve	14...22 AWG (0.25...2.5 mm ²)
	Two conductors (same cross-section), stranded, twin ferrule with plastic sleeve	16...20 AWG (0.5...1.5 mm ²)
Tightening Torque		0.5...0.6 N·m
Conductor Insulation Strip Length		7 mm (0.25 in)
(1) Refer to the manufacturer website for additional information.		

Use these parameters to configure motor overload protection: AverageCurrentThreshold, AverageCurrentTime, and MaxCurrentClamp.

2.1.2.2. Motor Supply Connector (-DC Option)

Motor power is applied to the **DC+** and **0V** terminals of the Motor Supply connector.

The **DC+** input is internally connected to a 5 A fuse.

Use twisted pair wiring to minimize radiated noise emissions (refer to [Section 2.1.4.](#)). For inrush limiting, you must power up control and motor supply simultaneously.

Refer to [Section 5.2.](#) for the internal fuse part numbers.



WARNING: Verify that all ground connections are installed correctly before you apply power to the iXA4/XA4.

Figure 2-3: Motor Supply Connections

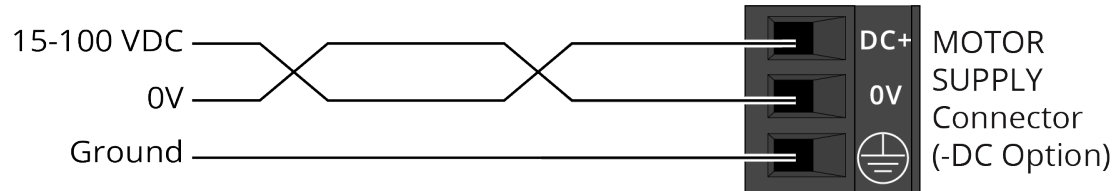


Table 2-5: -DC Option Motor Supply Connector Pinout

Pin	Description
DC+	Motor Power Input (15-100 VDC)
0V	Motor Power Input Common
	Protective Earthing Conductor - 0.75 mm ² / 18 AWG min conductor size

Table 2-6: Motor Supply Mating Connector Ratings

Specification		Description
Type		3-Pin Terminal Block
Part Numbers		Aerotech: ECK02388 Phoenix: 1756272
Conductor Cross Section	One conductor, stranded with ferrule and plastic sleeve	14...22 AWG (0.25...2.5 mm ²)
	Two conductors (same cross-section), stranded, twin ferrule with plastic sleeve	16...20 AWG (0.5...1.5 mm ²)
Tightening Torque		0.5...0.6 N·m
Conductor Insulation Strip Length		7 mm (0.25 in)
(1) Refer to the manufacturer website for additional information.		

Use these parameters to configure motor overload protection: AverageCurrentThreshold, AverageCurrentTime, and MaxCurrentClamp.

2.1.2.3. Motor Supply Keying

If you have a combination of -AC and -DC Option drives, Aerotech recommends that you key the Motor Supply Connector and mating connectors. You must use keys on both the drive and any mating cables in order for the keys to be effective.



IMPORTANT: If you insert a key with the cover on, you will accidentally break off the points adjacent to the point you are trying to use as a key. It would be easier to insert the key if you take the two points adjacent to the one you are trying to insert off the key star (refer to [Figure 2-4](#)).

Figure 2-4: Key Star Tool

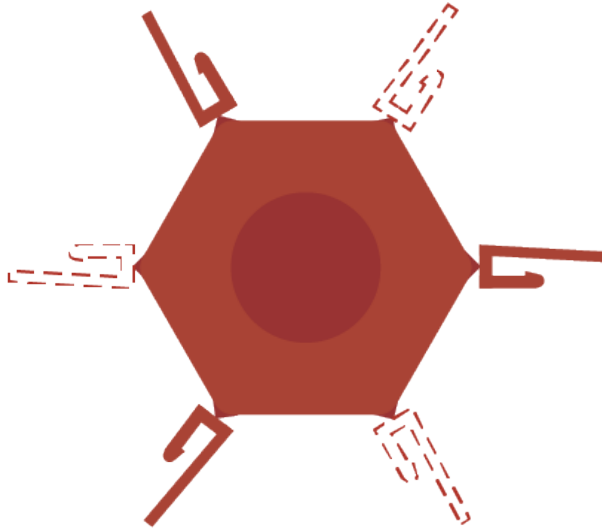


Table 2-7: Key Part Numbers

Location	Part Number
Cable Side	Aerotech P/N: EIK00501 Phoenix P/N: 1734634
Drive Side	Aerotech P/N: EIK00500 Phoenix P/N: 1734401

Table 2-8: Recommended Keying for -AC Options (Drive Connector)


Pin	Action
AC1	Do not key
AC2	Key
	Do not key

Table 2-9: Recommended Keying for -AC Options (AC Supply Cables)


Pin	Action
AC1	Key
AC2	Do not key
	Key

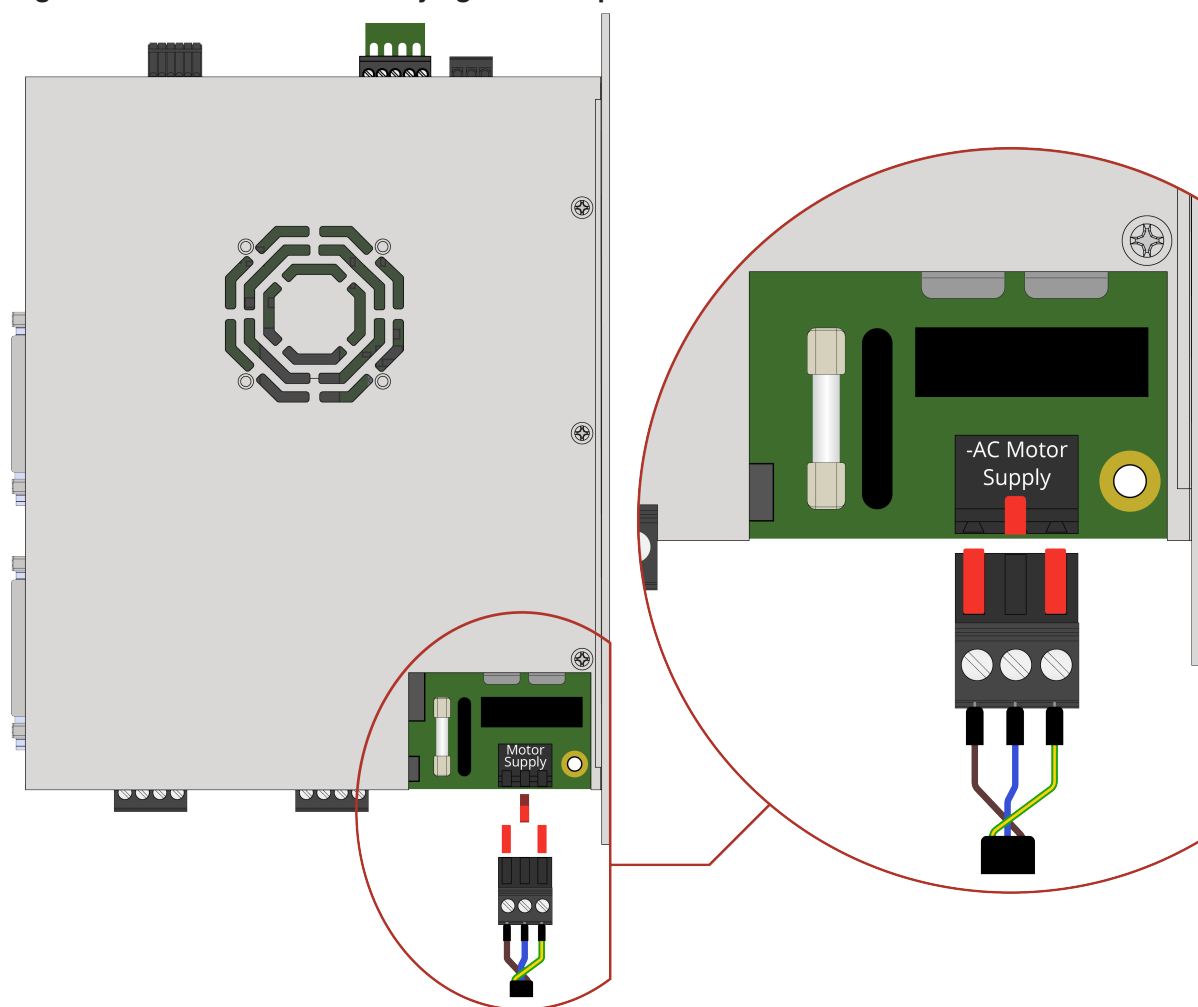
Figure 2-5: Recommended Keying for -AC Options

Table 2-10: Recommended Keying for -DC Options (Drive Connector)


Pin	Action
AC1	Key
AC2	Do not key
	Key

Table 2-11: Recommended Keying for -DC Options (DC Supply Cables)


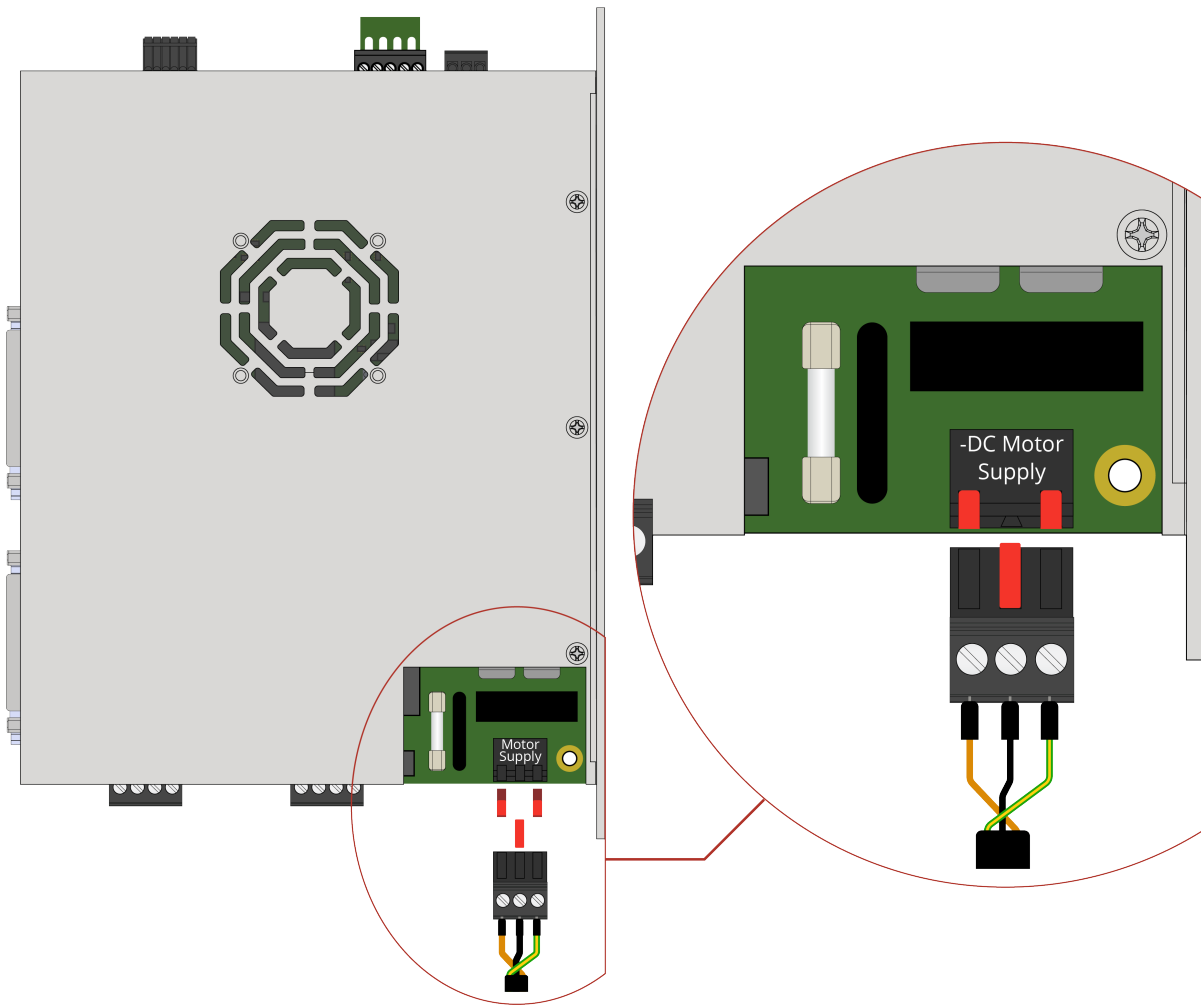
Pin	Action
AC1	Do not key
AC2	Key
	Do not key

Figure 2-6: Recommended Keying for -DC Options



2.1.3. Transformer Options (-AC Option)

You can connect an external isolation transformer to the Motor Supply AC Input to reduce the operating voltage of the motor. Using a transformer can also reduce electrical noise.

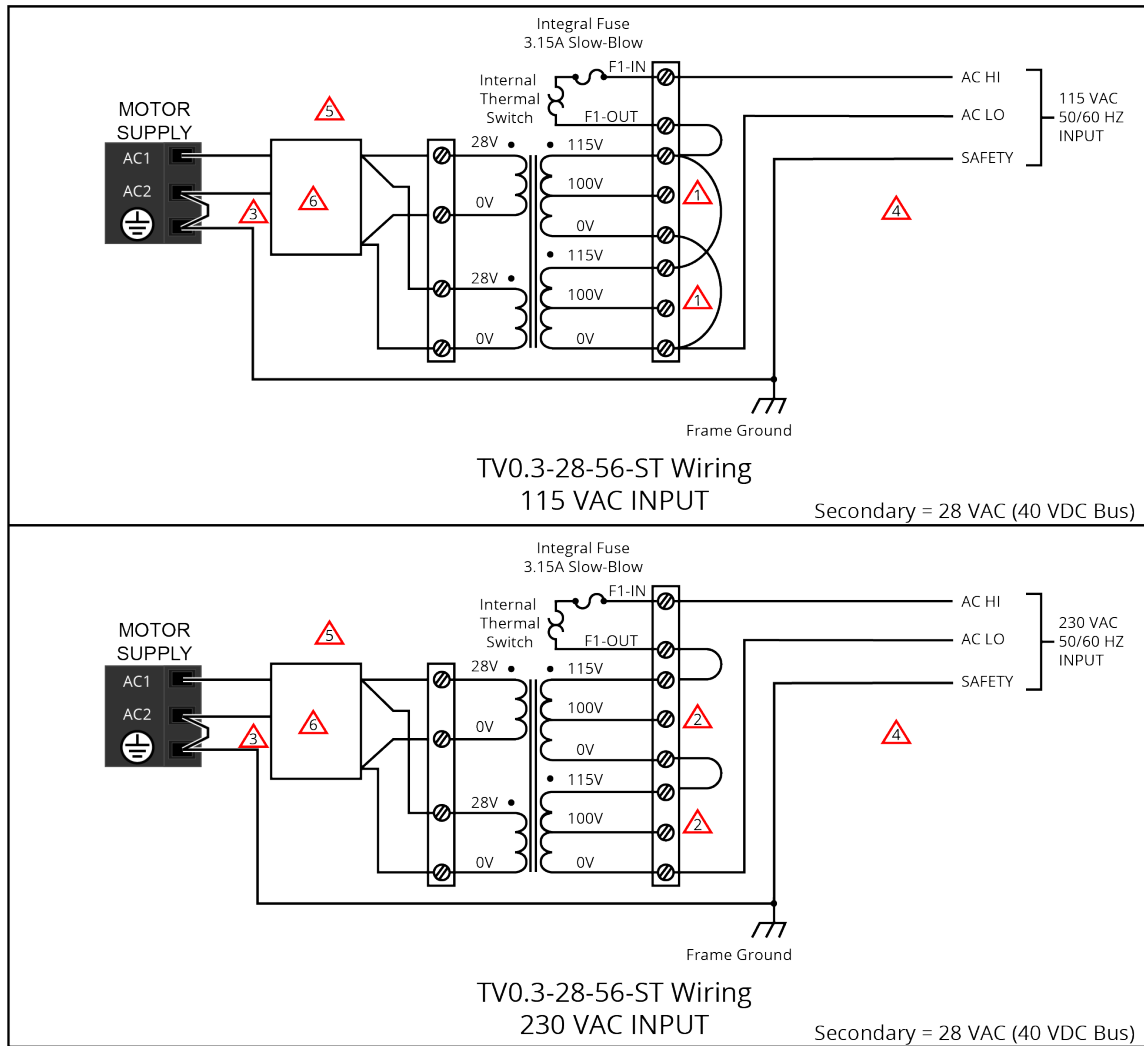
Table 2-12: Nominal Motor Operating Voltages / Required AC Voltages

AC Voltage	DC Voltage
28	40
56	80
115	160
230	320

Table 2-13: Transformer Options

Transformer	Description
TV0.3-28-56-ST	Generate 28 or 56 VAC from 115 VAC or 230 VAC input source voltage. When rectified by the drive, it produces a 40 or 80 VDC power bus.
TM3	Power up to 4 drives, providing 300 watts of power
TM5	Power up to 4 drives providing 500 watts of power
TV0.3-28	Generate 28 VAC from 115 VAC or 230 VAC input source voltage. When rectified by the drive, it produces a 40 VDC power bus.
TV0.3-56	Generate 56 VAC from 115 VAC or 230 VAC input source voltage. When rectified by the drive, it produces an 80 VDC power bus.
TV1.5, TV2.5, or TV5	1.5 kVA, 2.5 kVA, or 5 kVA isolation transformer; 115/230 VAC input; 28, 43, 56, 70, 115 VAC output

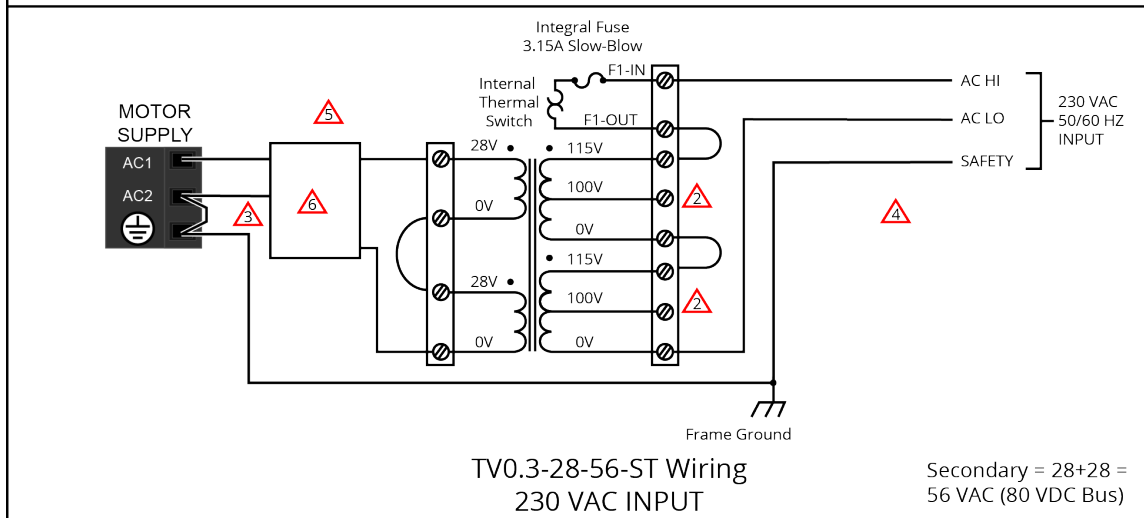
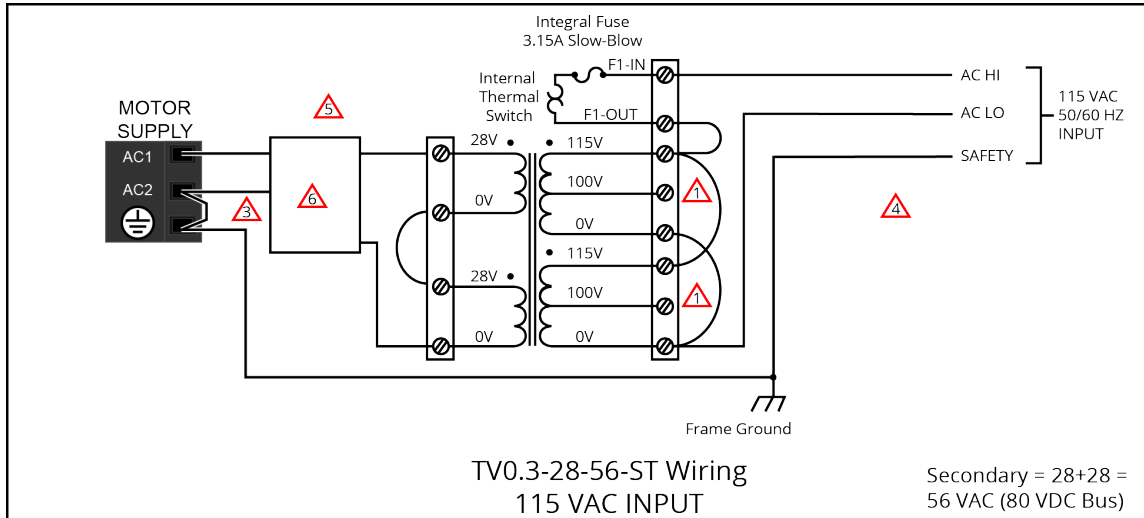
Figure 2-7: TV0.3-28-56-ST Transformer Motor Power Wiring (40 VDC Bus) [-AC Option]



HAZARDOUS VOLTAGES PRESENT **CONNECT ALL WIRING BEFORE POWERING TRANSFORMER** **FOLLOW ALL APPLICABLE WIRING AND SAFETY CODES.**

1. For 100 VAC primary input, parallel the 100 VAC taps and leave the 115 VAC taps unterminated.
2. For 200 VAC primary input, series the 100 VAC taps and leave the 115 VAC taps unterminated.
3. When using an isolation transformer, earth grounding of the AC2 input tap reduces electrical and audible noise emissions and provides increased servo performance.
4. Transformer Primary Wiring: 0.8 mm² (#18 AWG) 300 V wire.
5. Transformer Secondary Wiring: 1.3 mm² (#16 AWG) 300 V wire.
6. AC line filters are for CE compliance. Filters may also be located on the primary side of the transformer.

Figure 2-8: TV0.3-28-56-ST Transformer Motor Power Wiring (80 VDC Bus) [-AC Option]



HAZARDOUS VOLTAGES PRESENT



CONNECT ALL WIRING BEFORE
POWERING TRANSFORMER



FOLLOW ALL APPLICABLE WIRING
AND SAFETY CODES.

1. For 100 VAC primary input, parallel the 100 VAC taps and leave the 115 VAC taps unterminated.
2. For 200 VAC primary input, series the 100 VAC taps and leave the 115 VAC taps unterminated.
3. When using an isolation transformer, earth grounding of the AC2 input tap reduces electrical and audible noise emissions and provides increased servo performance.
4. Transformer Primary Wiring: 0.8 mm² (#18 AWG) 300 V wire.
5. Transformer Secondary Wiring: 1.3 mm² (#16 AWG) 300 V wire.
6. AC line filters are for CE compliance. Filters may also be located on the primary side of the transformer.

Figure 2-9: TV0.3-28-56-ST Transformer Motor Power Wiring (160 VDC Bus) [-AC Option]

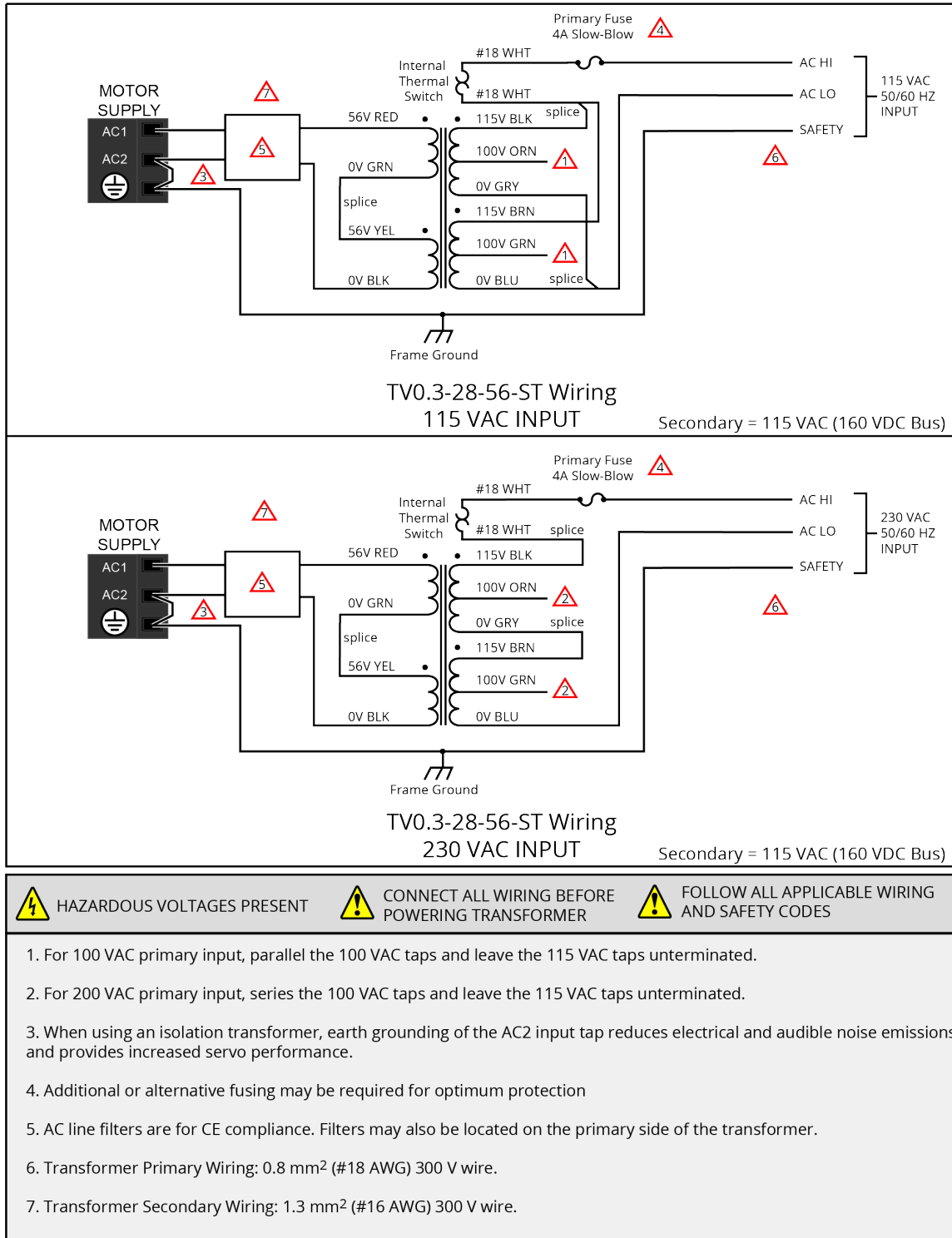
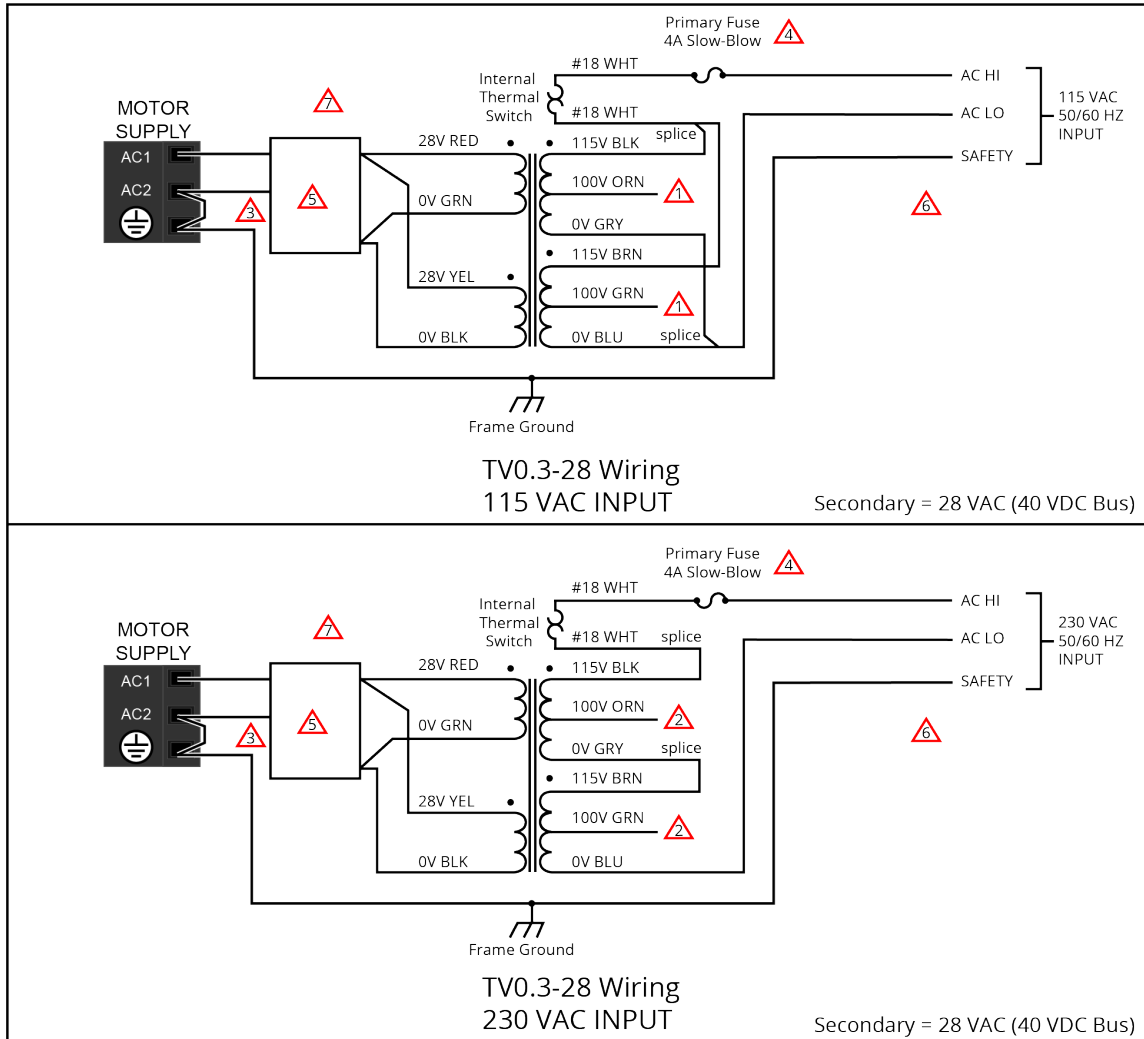


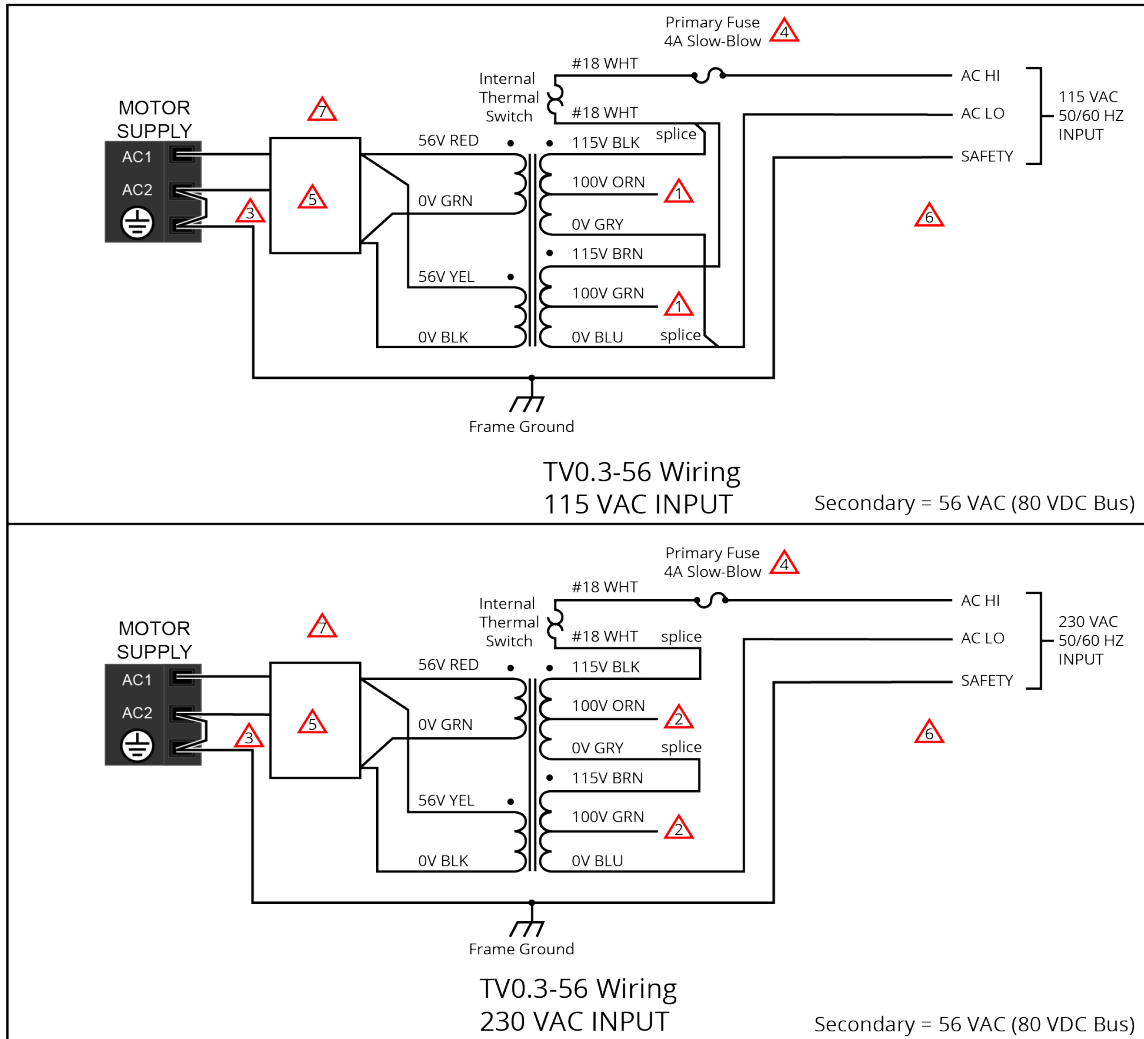
Figure 2-10: TV0.3-28 Transformer Motor Power Wiring (40 VDC Bus) [-AC Option]



- HAZARDOUS VOLTAGES PRESENT
- CONNECT ALL WIRING BEFORE POWERING TRANSFORMER
- FOLLOW ALL APPLICABLE WIRING AND SAFETY CODES.

1. For 100 VAC primary input, parallel the 100 VAC taps and leave the 115 VAC taps unterminated.
2. For 200 VAC primary input, series the 100 VAC taps and leave the 115 VAC taps unterminated.
3. When using an isolation transformer, earth grounding of the AC2 input tap reduces electrical and audible noise emissions and provides increased servo performance.
4. Additional or alternative fusing may be required for optimum protection
5. AC line filters are required for CE compliance. Filters may also be located on the primary side of the transformer.
6. Transformer Primary Wiring: 0.8 mm² (#18 AWG) 300 V wire.
7. Transformer Secondary Wiring: 1.3 mm² (#16 AWG) 300 V wire.

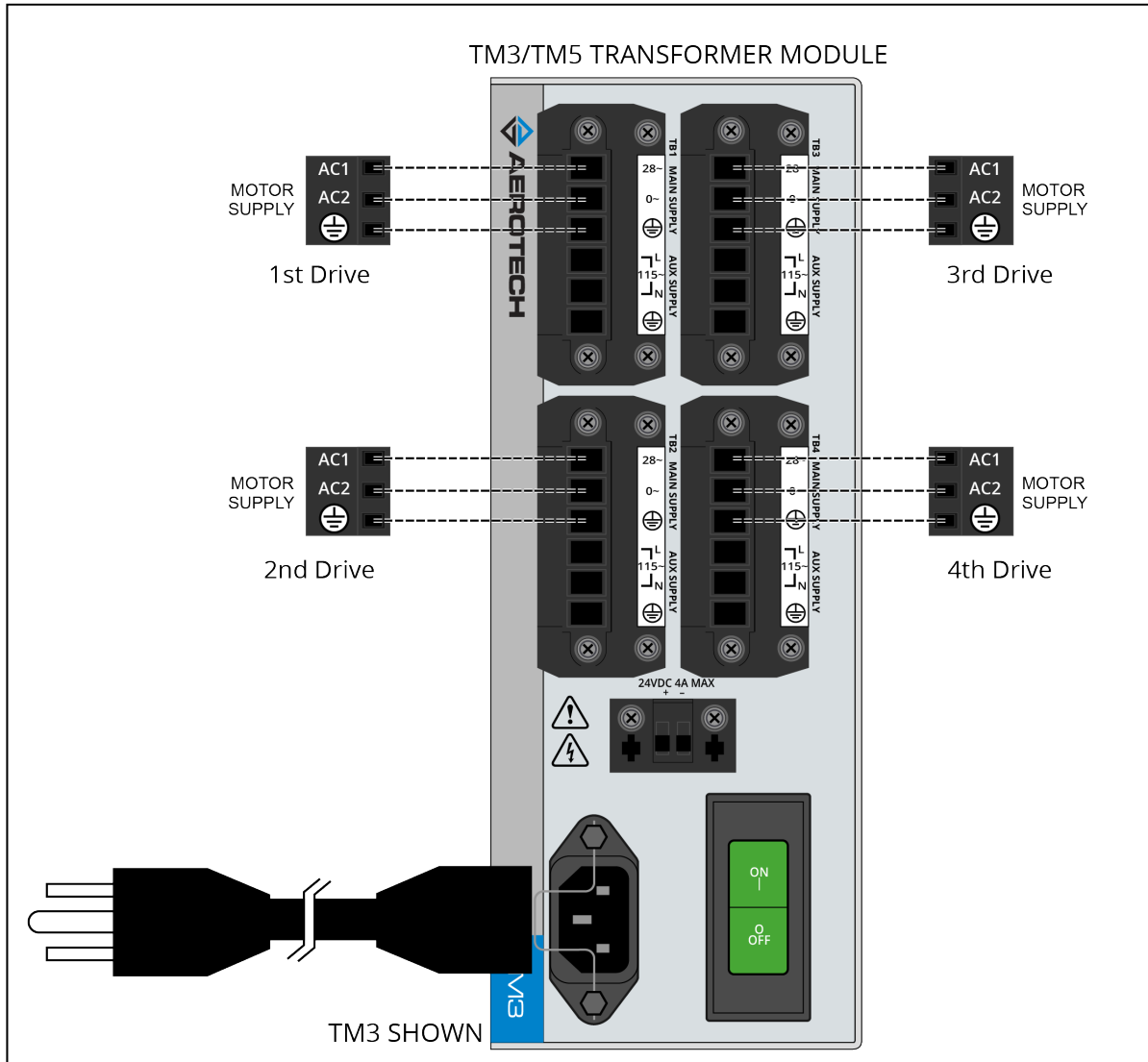
Figure 2-11: TV0.3-56 Transformer Motor Power Wiring (80 VDC Bus) [-AC Option]



- HAZARDOUS VOLTAGES PRESENT
- CONNECT ALL WIRING BEFORE POWERING TRANSFORMER
- FOLLOW ALL APPLICABLE WIRING AND SAFETY CODES

1. For 100 VAC primary input, parallel the 100 VAC taps and leave the 115 VAC taps unterminated.
2. For 200 VAC primary input, series the 100 VAC taps and leave the 115 VAC taps unterminated.
3. When using an isolation transformer, earth grounding of the AC2 input tap reduces electrical and audible noise emissions and provides increased servo performance.
4. Additional or alternative fusing may be required for optimum protection
5. AC line filters are required for CE compliance. Filters may also be located on the primary side of the transformer.
6. Transformer Primary Wiring: 0.8 mm² (#18 AWG) 300 V wire.
7. Transformer Secondary Wiring: 1.3 mm² (#16 AWG) 300 V wire.

Figure 2-12: TM3/TM5 Transformer Motor Power Wiring [-AC Option]



HAZARDOUS VOLTAGES PRESENT **CONNECT ALL WIRING BEFORE POWERING TRANSFORMER** **FOLLOW ALL APPLICABLE WIRING AND SAFETY CODES.**

1. See the TM3 or TM5 manual for input voltage configuration
2. Wiring Specifications: 1.3 mm² (#16 AWG) 300 V wire.
3. Control Supply output voltage (115 VAC in this example) is always the same as the AC Input Voltage to the unit.

2.1.4. Minimizing Noise for EMC/CE Compliance



IMPORTANT: The iXA4/XA4 is a component designed to be integrated with other electronics. EMC testing must be conducted on the final product configuration.

To reduce electrical noise, observe the following motor feedback and input power wiring techniques.

1. Use shielded cable for motor and feedback connectors. Connect the shield to the backshell.
2. Separate motor and power wiring from encoder and I/O wiring.
3. Mount drives, power supplies, and filter components on a conductive panel. Mount line filters close to the drive to keep the wire length between the drive and filter to a minimum. Use a line filter, such as Aerotech's UFM-ST, on the Motor Supply AC input.
4. Use the lowest motor voltage required by the application to reduce radiated emission.
5. Use an isolation transformer with grounded secondary to keep the effects of high frequency PWM amplifier currents to a minimum.
6. Use a separate wire for each ground connection to the drive. Use the shortest possible wire length.

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

1. Add a clamp-on ferrite to the feedback cable close to the drive.
[Aerotech PN ECZ02348, Fair-rite PN 0446167281]
2. Add a clamp-on ferrite to the Motor Supply and Control Supply wires, including the ground wire, close to the drive.
[Aerotech PN ECZ02347, Fair-rite PN 0446164281]
3. Add a ferrite core to the UFM-ST AC input wires. Wrap the AC wires and ground wire around the core one time.
[Ferrite core: Aerotech PN ECZ02350, Fair-rite PN 2646102002]
4. Add a ferrite core to the motor phase and ground wires close to the drive. Wrap all four wires around the ferrite core once. Remove ferrite beads from Aerotech supplied cables if installed.
[Ferrite core: Aerotech PN ECZ02349, Fair-rite PN 2646626402]
5. Install a motor filter module MFM10-1 close to the drive. The ferrite core that you added to the motor phase and ground wires should be located between the drive and the MFM10-1.

For typical system interconnections, refer to [Section 2.10. System Interconnection](#).

2.2. Motor Power Output Connectors



DANGER: Before you do maintenance to the equipment, disconnect the electrical power. Wait at least ten (10) minutes after removing the power supply before doing maintenance or an inspection. Otherwise, there is the danger of electric shock.

The drive can be used to drive the following motor types:

- Brushless (refer to [Section 2.2.1.](#))
- DC Brush (refer to [Section 2.2.2.](#))
- Stepper (refer to [Section 2.2.3.](#))

For a complete list of electrical specifications, refer to [Section 1.4.](#)



DANGER: Shock and Fire Hazard



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

Table 2-14: Motor Power Output Connector Pinout


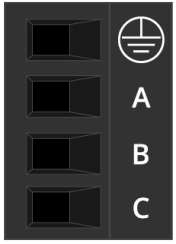
Pin	Description	Connector
	Motor Ground	
A	Motor Phase A Output	
B	Motor Phase B Output	
C	Motor Phase C Output	

Table 2-15: Motor Power Output Mating Connector Ratings

Specification		Description
Type		4-Pin Terminal Block
Part Numbers		Aerotech: ECK02593 Phoenix: 1756298
Conductor	One conductor, stranded with ferrule and plastic sleeve	14...22 AWG (0.25...2.5 mm ²)
Cross Section	Two conductors (same cross-section), stranded, twin ferrule with plastic sleeve	16...20 AWG (0.5...1.5 mm ²)
Tightening Torque		0.5...0.6 N·m
Conductor Insulation Strip Length		7 mm (0.25 in)
(1) Refer to the manufacturer website for additional information. (2) Motor wires should be sized based on the motor supply input fuse value. Upstream fusing and/or circuit breakers can be used for additional protection.		

2.2.1. Brushless Motor Connections

The configuration in [Figure 2-13](#) shows a typical brushless motor connection.

Figure 2-13: Brushless Motor Configuration

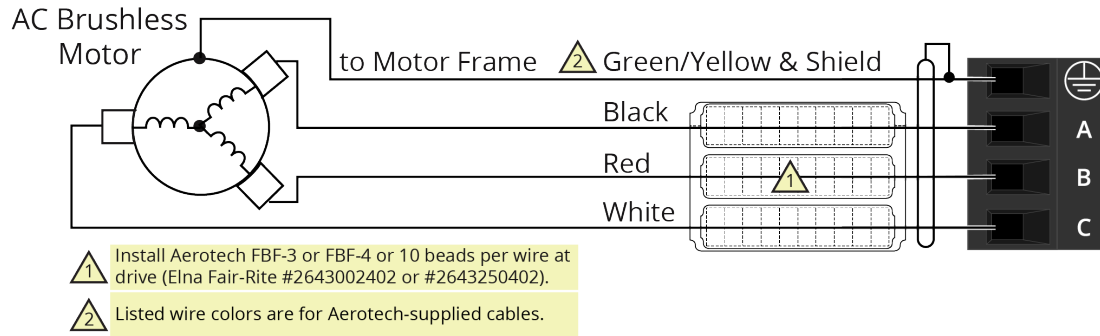


Table 2-16: Wire Colors for Aerotech-Supplied Brushless Motor Cables

Pin	Wire Color Set 1 ⁽¹⁾	Wire Color Set 2	Wire Color Set 3	Wire Color Set 4
	Green/Yellow & Shield ⁽²⁾	Green/Yellow & Shield	Green/Yellow & Shield	Green/Yellow & Shield
A	Black	Blue & Yellow	Black #1	Black & Brown
B	Red	Red & Orange	Black #2	Red & Orange
C	White	White & Brown	Black #3	Violet & Blue

(1) Wire Color Set #1 is the wire set typically used by Aerotech.
 (2) "&" indicates two wires (Red & Orange); "/" indicates a single wire (Green/White).

Brushless motors are commutated electronically by the controller. The use of Hall effect devices for commutation is recommended.

The controller 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 using one of the following methods: *powered*, through the use of a test program; or *unpowered* using an oscilloscope. Both methods will identify the A, B, and C Hall/motor lead sets and indicate the correct connections to the controller. Refer to [Section 2.2.1.1.](#) for powered motor phasing or [Section 2.2.1.2.](#) for unpowered motor and feedback phasing.

For Aerotech-supplied systems, the motor, encoder and Hall sensors are correctly configured and connection adjustments are not necessary.

A motor filter module such as the MFM10 can be installed between the drive and the motor, which will reduce the level of PWM amplifier related current spikes in the system.

2.2.1.1. Brushless Motor Powered Motor and Feedback Phasing

Observe the state of the encoder and Hall-effect device signals in the Diagnostics section of the Status Utility.

Table 2-17: Hall Signal Diagnostics

Hall-Signal Status	Definition
--	0 V or logic low
ON	5 V or logic high

Figure 2-14: Positive Motor Direction

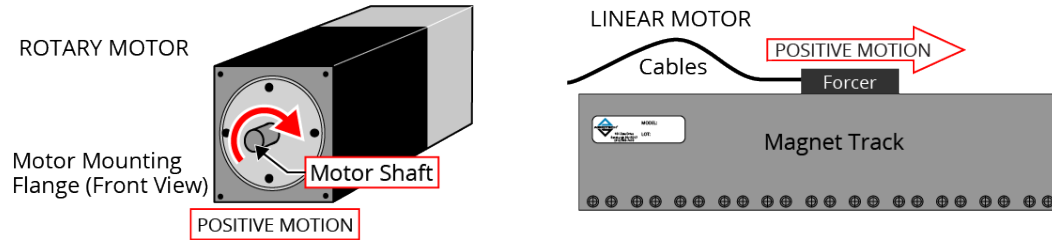


Figure 2-15: Encoder and Hall Signal Diagnostics

Polling rate: Medium

Diagnostics

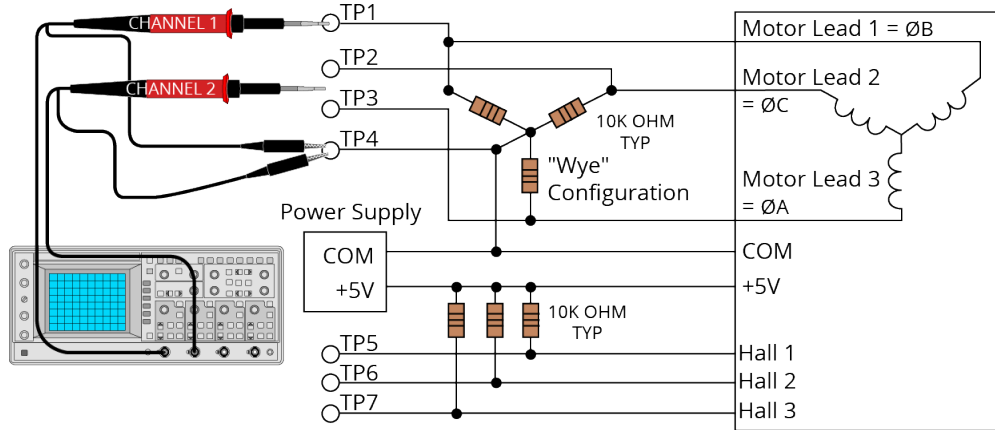
Data highlighted in blue has not been updated.

Item	X	Y	Z	U
Status				
Position Feedback	000000000000	000000000000	000000000000	000000000000
Position Calibration All	000000000000	000000000000	000000000000	000000000000
Position Camming/Gearing	000000000000	000000000000	000000000000	000000000000
Primary Feedback	000000000000	000000000000	000000000000	000000000000
Hardware				
Enable	--	--	--	--
CW	--	--	--	--
CCW	--	--	--	--
Home	--	--	--	--
Marker	--	--	--	--
Hall A	--	--	--	--
Hall B	--	--	--	--
Hall C	--	--	--	--
ESTOP	--	--	--	--
Brake	--	--	--	--

2.2.1.2. Brushless Motor Unpowered Motor and Feedback Phasing

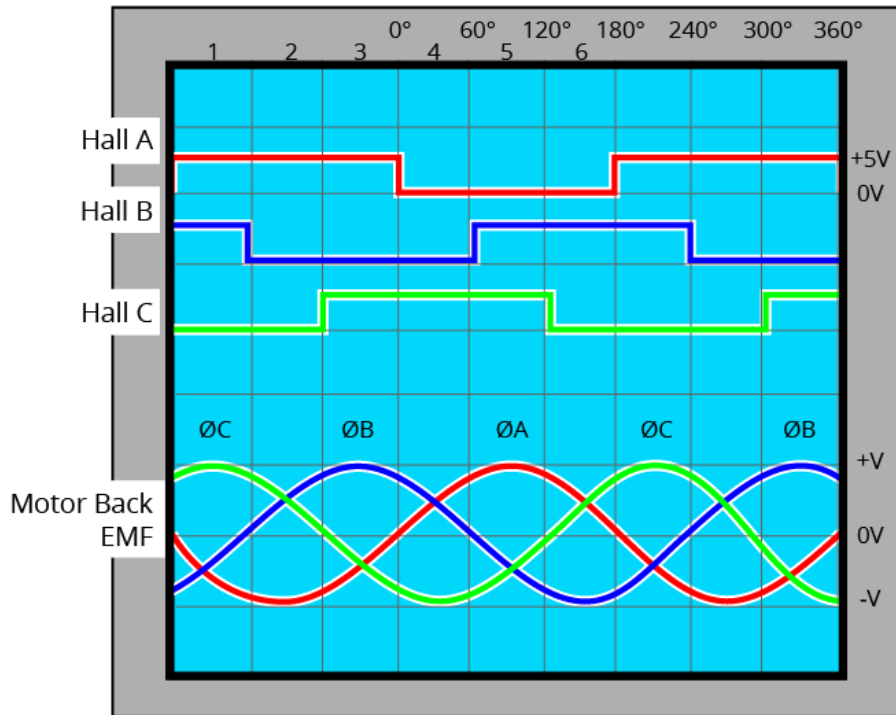
Disconnect the motor from the controller and connect the motor in the test configuration shown in Figure 2-16. This method will require a two-channel oscilloscope, a 5V power supply, and six resistors (10,000 ohm, 1/4 watt). All measurements should be made with the probe common of each channel of the oscilloscope connected to a neutral reference test point (TP4, shown in Figure 2-16). Wave forms are shown while moving the motor in the positive direction.

Figure 2-16: Brushless Motor Phasing Oscilloscope Example



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. Hall leads should also be connected to their respective feedback connector pins (Hall A lead to the Hall A feedback pin, Hall B to Hall B, and Hall C to Hall C). The motor is correctly phased when the Hall states align with the Back EMF as shown in Figure 2-17. Use the CommutationOffset parameter to correct for Hall signal misalignment.

Figure 2-17: Brushless Motor Phasing Goal



2.2.2. DC Brush Motor Connections

The configuration shown in [Figure 2-18](#) is an example of a typical DC brush motor connection. Refer to [Section 2.2.2.1](#) for information on motor phasing.

Figure 2-18: DC Brush Motor Configuration

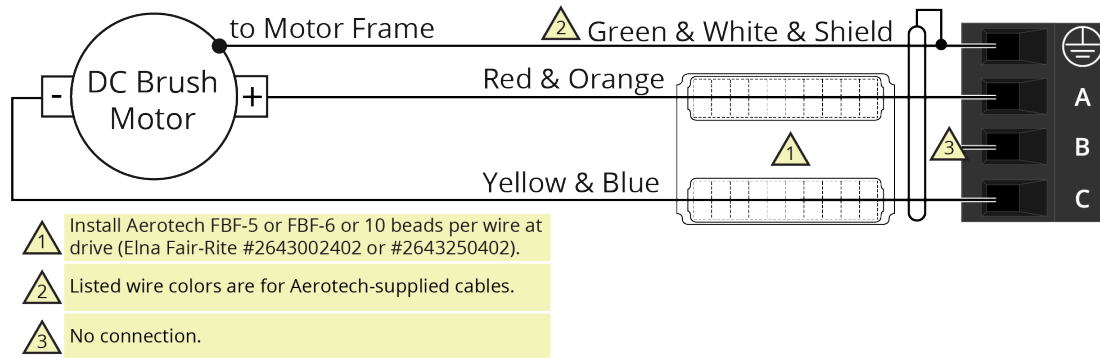


Table 2-18: Wire Colors for Aerotech-Supplied DC Brush Motor Cables

Pin	Wire Color Set 1 ⁽¹⁾	Wire Color Set 2	Wire Color Set 3
Ø	Green & White & Shield ⁽²⁾	Green/Yellow & Shield	Green/Yellow & Shield
A	Red & Orange	Red	Red & Orange
C	Yellow & Blue	Black	Yellow & Blue

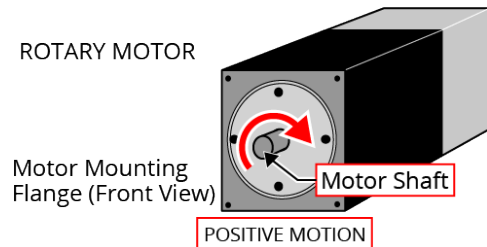
(1) Wire Color Set #1 is the typical wire set used by Aerotech.
 (2) “&” (Red & Orange) indicates two wires; “/” (Green/White) indicates a single wire.

2.2.2.1. DC Brush Motor Phasing

A properly phased motor means that the positive motor lead should be connected to the ØA motor terminal and the negative motor lead should be connected to the ØC 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. Move or rotate the motor in the positive or clockwise (CW) direction by hand.

Figure 2-19: Positive Motor Direction



4. If the voltmeter indicates a negative value, swap the motor leads and move the motor by hand in the positive direction, again. When the voltmeter indicates a positive value, the motor leads have been identified.
5. Connect the motor lead from the positive lead of the voltmeter to the ØA motor terminal on the drive. Connect the motor lead from the negative lead of the voltmeter to the ØC motor terminal on the drive.

For Aerotech-supplied systems, the motor, encoder and Hall sensors are correctly configured and connection adjustments are not necessary.

2.2.3. Stepper Motor Connections

The configuration shown in [Figure 2-20](#) is an example of a typical stepper motor connection. Refer to [Section 2.2.3.1.](#) for information on motor phasing.

In this case, the effective motor voltage is half of the applied bus voltage. For example, an 80 V motor bus supply is needed to get 40 V across the motor.

Figure 2-20: Stepper Motor Configuration

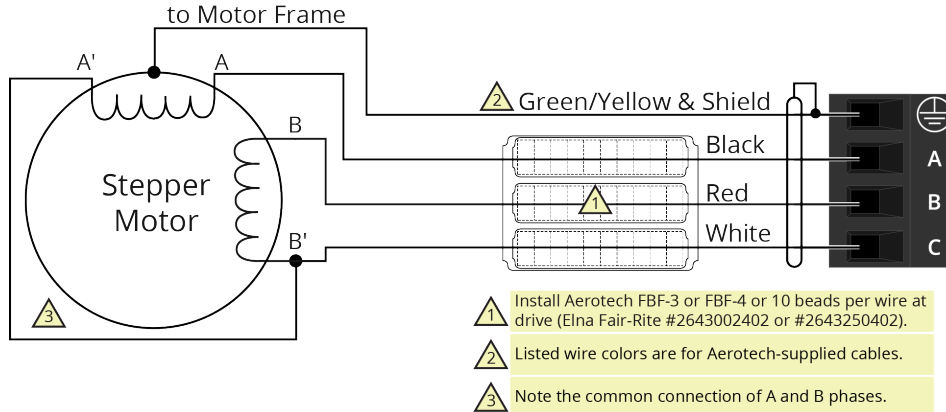


Table 2-19: Wire Colors for Aerotech-Supplied Stepper Motor Cables

Pin	Wire Color Set 1 ⁽¹⁾	Wire Color Set 2
⊕	Green/Yellow & Shield ⁽²⁾	Green/Yellow & Shield
A	Black	Brown
B	Red	Yellow
C	White	White & Red

(1) Wire Color Set #1 is the typical wire set used by Aerotech.
 (2) "&" (Red & Orange) indicates two wires; "/" (Green/White) indicates a single wire.

2.2.3.1. Stepper Motor Phasing

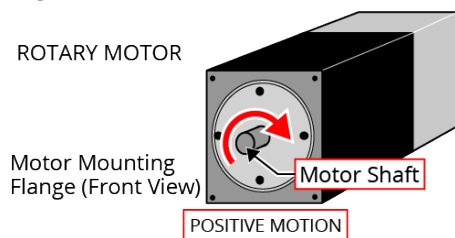
A stepper motor can be run with or without an encoder.

Without an Encoder: You do not need to phase the motor.

With an Encoder: Because the end of travel (EOT) limit inputs are relative to motor rotation, it is important to phase the motor.

Run a positive motion command. The motor is phased correctly if there is a positive scaling factor (determined by the ServoLoopSetup parameter) and the motor moves in a clockwise direction when you view the motor from the front mounting flange ([Figure 2-21](#)). If the motor moves in a counterclockwise direction, reverse the motor leads and re-run the command. After the motor has been phased, if you want to change the direction of positive motion, use the ReverseMotionDirection parameter.

Figure 2-21: Positive Motor Direction

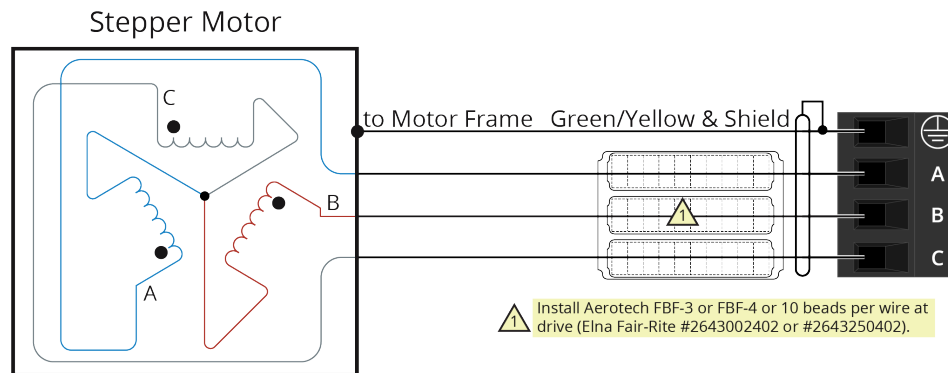


For Aerotech-supplied systems, the motor, encoder and Hall sensors are correctly configured and connection adjustments are not necessary.

2.2.4. Three Phase Stepper Motor Connections

The configuration shown in [Figure 2-22](#) is an example of a typical three phase stepper motor connection. Refer to [Section 2.2.4.1.](#) for information on motor phasing.

Figure 2-22: Three Phase Stepper Motor Configuration



2.2.4.1. Stepper Motor Phasing

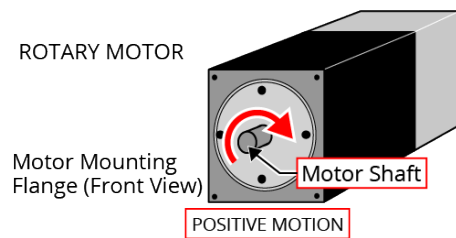
A three phase stepper motor can be run with or without an encoder.

Without an Encoder: You do not need to phase the motor.

With an Encoder: Because the end of travel (EOT) limit inputs are relative to motor rotation, it is important to phase the motor.

Run a positive motion command. The motor is phased correctly if there is a positive scaling factor (determined by the ServoLoopSetup parameter) and the motor moves in a clockwise direction when you view the motor from the front mounting flange ([Figure 2-23](#)). If the motor moves in a counterclockwise direction, reverse the motor leads and re-run the command. After the motor has been phased, if you want to change the direction of positive motion, use the ReverseMotionDirection parameter.

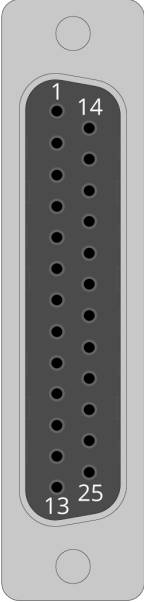
Figure 2-23: Positive Motor Direction



2.3. Feedback Connectors

The connector pin assignment is shown in [Table 2-20](#) with detailed connection information in the following sections.

Table 2-20: Feedback Connector Pinout

Pin #	Description	In/Out/Bi	Connector
1	Analog Input +	Input	
2	Motor Over Temperature Thermistor	Input	
3	+5V Power ⁽¹⁾	Output	
4	Plug and Play Serial Data (for Aerotech stages only)	Bidirectional	
5	Hall-Effect Sensor B (brushless motors only)	Input	
6	Encoder Marker Reference Pulse -	Input	
	Absolute Encoder Clock -	Output	
7	Encoder Marker Reference Pulse +	Input	
	Absolute Encoder Clock +	Output	
8	Absolute Encoder Data -	Bidirectional	
9	Analog Input -	Input	
10	Hall-Effect Sensor A (brushless motors only)	Input	
11	Hall-Effect Sensor C (brushless motors only)	Input	
12	Clockwise End of Travel Limit	Input	
13	Brake Output -	Output	
14	Encoder Cosine +	Input	
15	Encoder Cosine -	Input	
16	+5V Power ⁽¹⁾	Output	
17	Encoder Sine +	Input	
18	Encoder Sine -	Input	
19	Absolute Encoder Data+	Bidirectional	
20	Signal Common	Output	
21	Signal Common	Output	
22	Home Switch Input	Input	
23	Encoder Fault Input	Input	
24	Counterclockwise End of Travel Limit	Input	
25	Brake Output +	Output	

(1) The maximum combined current output is 500 mA.

Table 2-21: Feedback Mating Connector Ratings

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

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

2.3.1. Primary Encoder Inputs

The primary encoder inputs are accessible through the Feedback connector. Use the PrimaryFeedbackType parameter to configure the drive to accept an encoder signal type.

Square Wave encoder signals: [Section 2.3.1.1.](#)

Absolute encoder signals: [Section 2.3.1.2.](#)

Sine Wave encoder signals (as permitted by the multiplier option): [Section 2.3.1.3.](#)

You cannot use a sine wave encoder with the -MX1 multiplier option as an input to the PSO. The -MX1 option does not generate emulated quadrature signals.

Refer to [Section 2.3.1.4.](#) for encoder feedback phasing.

Table 2-22: Multiplier Options

Option	Primary Encoder Accepts...
-MX0	Square Wave or Absolute encoders
-MX1	Sine Wave, Square Wave, or Absolute encoders



IMPORTANT: Physically isolate the encoder wiring from motor, AC power, and all other power wiring

Table 2-23: Primary Encoder Pins on the Feedback Connector

Pin #	Description	In/Out/Bi
3	+5V Power ⁽¹⁾	Output
6	Encoder Marker Reference Pulse -	Input
	Absolute Encoder Clock -	Output
7	Encoder Marker Reference Pulse +	Input
	Absolute Encoder Clock +	Output
8	Absolute Encoder Data -	Bidirectional
14	Encoder Cosine +	Input
15	Encoder Cosine -	Input
16	+5V Power ⁽¹⁾	Output
17	Encoder Sine +	Input
18	Encoder Sine -	Input
19	Absolute Encoder Data+	Bidirectional
20	Signal Common	Output
21	Signal Common	Output

(1) The maximum combined current output is 500 mA.

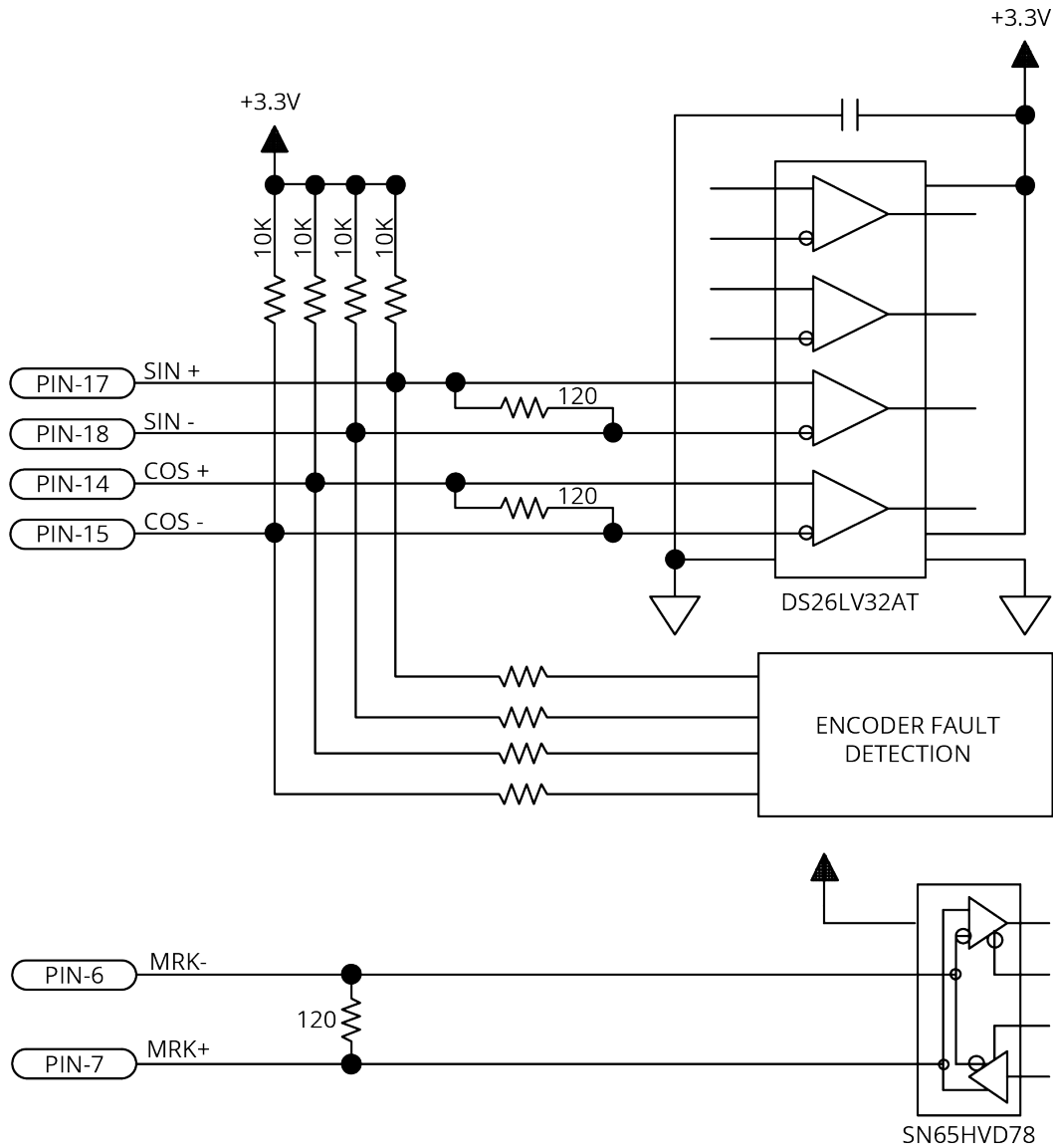
2.3.1.1. Square Wave Encoder (Primary)

The drive accepts RS-422 square wave encoder signals. The drive will generate a feedback fault if it detects an invalid signal state caused by an open or shorted signal connection. Use twisted-pair wiring for the highest performance and noise immunity.

Table 2-24: Square Wave Encoder Specifications

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

Figure 2-24: Square Wave Encoder Schematic (Feedback Connector)



2.3.1.2. Absolute Encoder (Primary)

The drive retrieves absolute position data along with encoder fault information through a serial data stream from the absolute encoder. Use twisted-pair wiring for the highest performance and noise immunity. You cannot echo an absolute encoder signal.

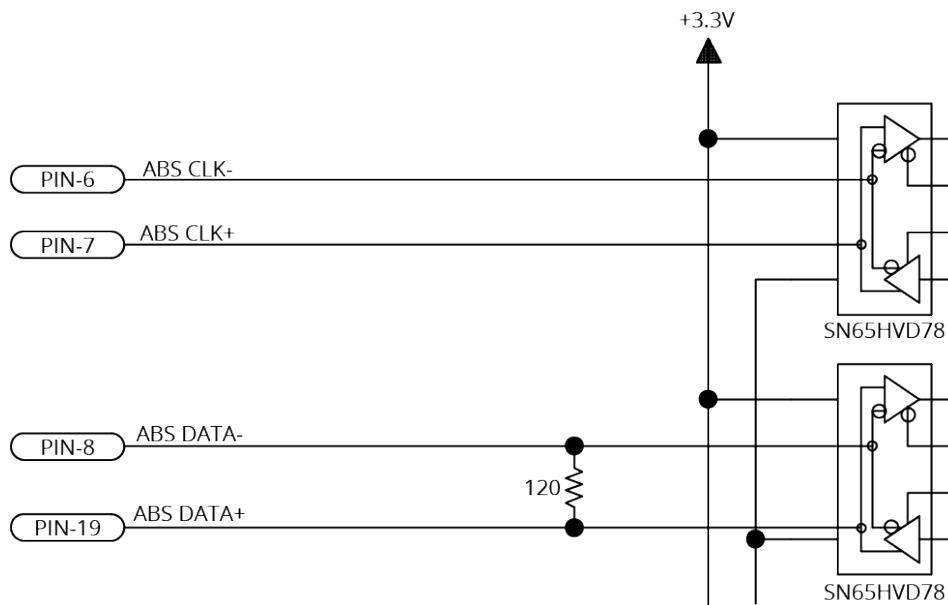
Refer to [Figure 2-25](#) for the serial data stream interface.

Refer to the Help file for information on how to set up your EnDat, BiSS, or SSI absolute encoder parameters.

Table 2-25: Absolute Encoder Specifications

Specification	Value
Sampling Frequency	10 kHz
Maximum Reading Speed	Refer to your encoder data sheet.

Figure 2-25: Absolute Encoder Schematic (Feedback Connector)



2.3.1.3. Sine Wave Encoder (Primary) [-MX1 Option]

The Sine Wave Encoder option provides higher positioning resolution by subdividing the fundamental output period of the encoder into smaller increments. The amount of subdivision is specified by the PrimaryEncoderMultiplicationFactor parameter. Use Encoder Tuning to adjust the value of the gain, offset, and phase balance controller parameters to get the best performance. For more information, refer to the Help file.

You cannot use a sine wave encoder with the -MX1 multiplier option as an input to the PSO. The -MX1 option does not generate emulated quadrature signals.

For the highest performance, use twisted pair double-shielded cable with the inner shield connected to signal common and the outer shield connected to frame ground. Do not join the inner and outer shields in the cable.

Table 2-26: Sine Wave Encoder Specifications

Specification	Value
Input Frequency (max)	450 kHz
Input Amplitude ⁽¹⁾	0.6 to 1.75 Vpk-pk
Interpolation Factor (max)	4,096
Input Common Mode	1.5 to 3.5 VDC

(1) Measured as SIN(+) - SIN(-) or COS(+) - COS(-)

Figure 2-26: Sine Wave Encoder Phasing Reference Diagram

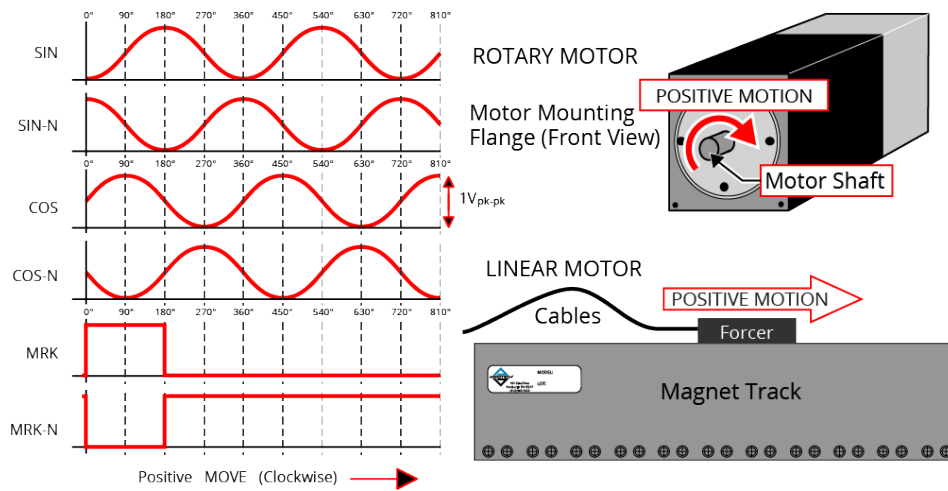
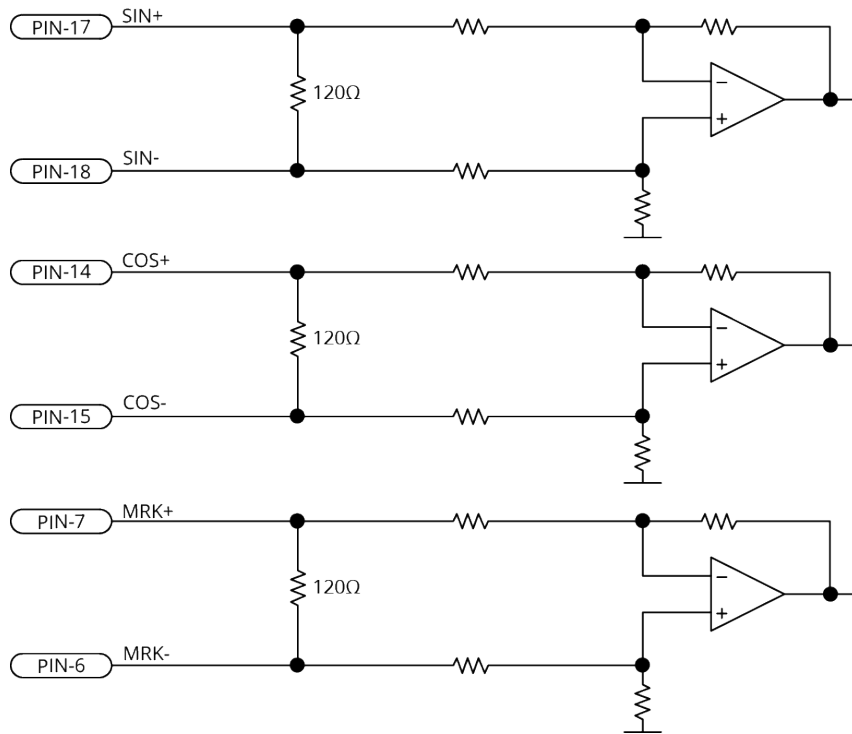


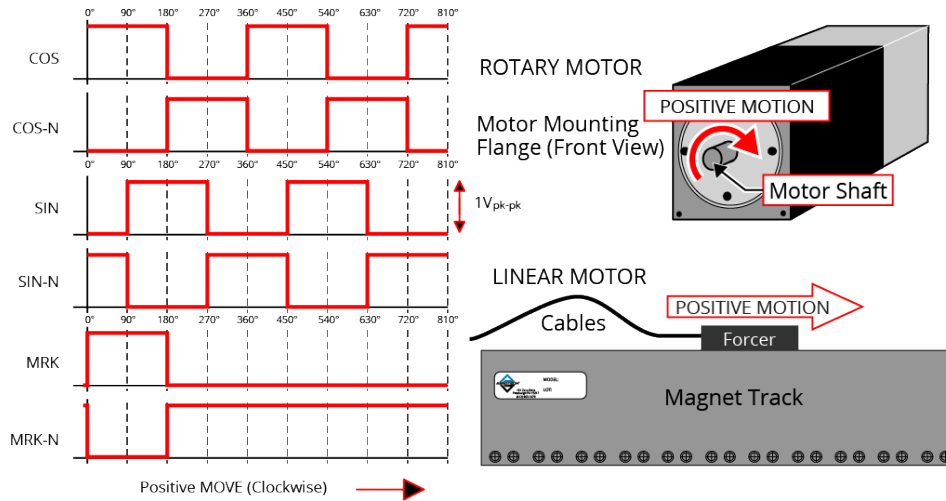
Figure 2-27: Sine Wave Encoder Schematic (Feedback Connector)

2.3.1.4. Encoder Phasing

Incorrect encoder polarity will cause the system to fault when enabled or when a move command is issued. Figure 2-28 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 2-29).

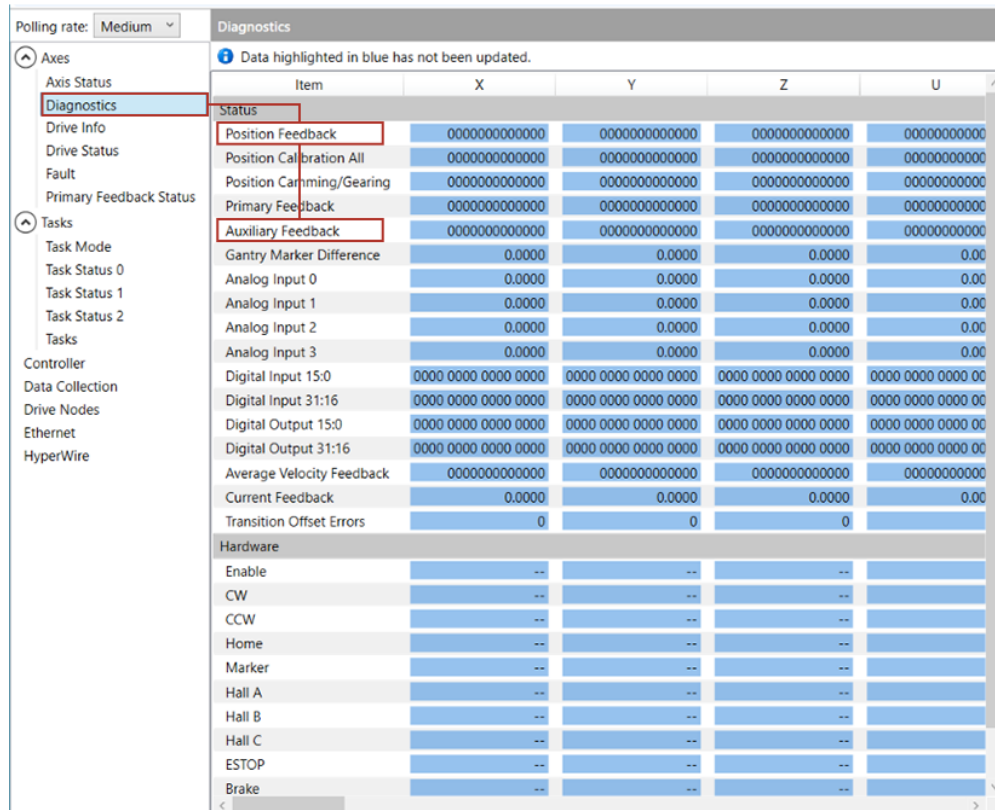
For dual loop systems, the velocity feedback encoder is displayed in the diagnostic display (Figure 2-29).

Figure 2-28: Encoder Phasing Reference Diagram (Standard)



IMPORTANT: Encoder manufacturers may refer to the encoder signals as A, B, and Z. The proper phase relationship between signals is shown in Figure 2-28.

Figure 2-29: Position Feedback in the Diagnostic Display



2.3.2. Hall-Effect Inputs

The Hall-effect switch inputs are recommended for AC brushless motor commutation but not absolutely required. The Hall-effect inputs accept 5 VDC level signals. Hall states (0,0,0) or (1,1,1) are invalid and will generate a "Hall Fault" axis fault.

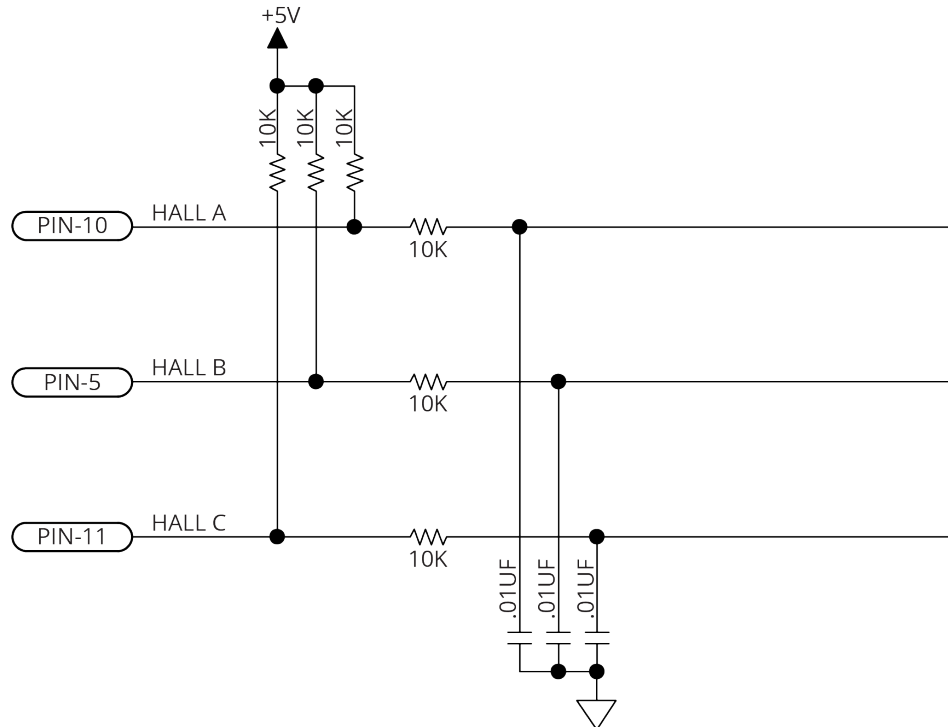
Refer to [Section 2.2.1.1](#) for Hall-effect device phasing.

Table 2-27: Hall-Effect Feedback Pins on the Feedback Connector

Pin #	Description	In/Out/BI
3	+5V Power ⁽¹⁾	Output
5	Hall-Effect Sensor B (brushless motors only)	Input
10	Hall-Effect Sensor A (brushless motors only)	Input
11	Hall-Effect Sensor C (brushless motors only)	Input
16	+5V Power ⁽¹⁾	Output
20	Signal Common	Output
21	Signal Common	Output

(1) The maximum combined current output is 500 mA.

Figure 2-30: Hall-Effect Inputs Schematic (Feedback Connector)



2.3.3. Analog Inputs (Differential)

To interface to a single-ended, non-differential voltage source, connect the signal common of the source to the negative input and connect the analog source signal to the positive input. A floating signal source must be referenced to the analog common. Refer to [Figure 2-31](#).

Table 2-28: Analog Input Specifications

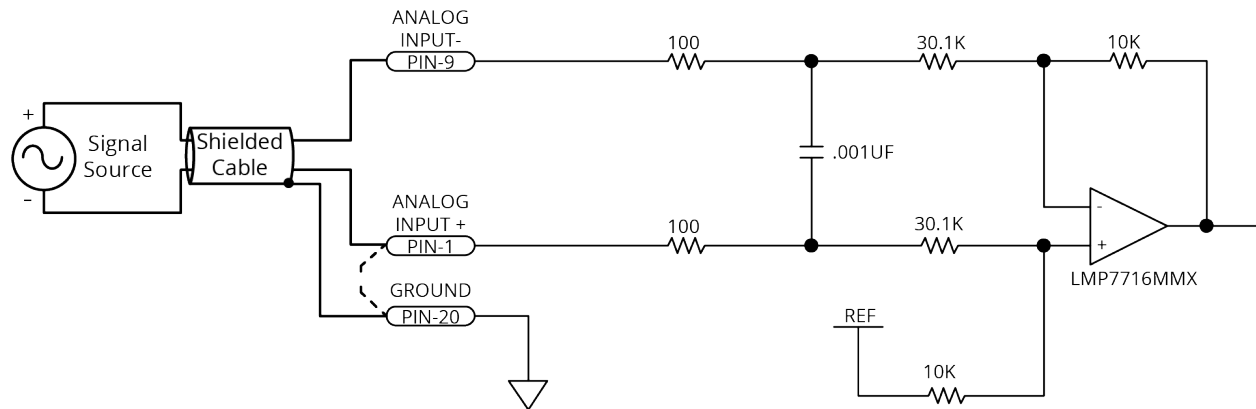
Specification	Value
(AI+) - (AI-)	+10 V to -10 V ⁽¹⁾
Resolution (bits)	16 bits
Input Impedance	1 MΩ

1. Signals outside of this range may damage the input

Table 2-29: Analog Input Pins on the Feedback Connector

Pin #	Description	In/Out/BI
1	Analog Input +	Input
9	Analog Input -	Input
20	Signal Common	Output
21	Signal Common	Output

Figure 2-31: Analog Inputs Schematic



2.3.4. Thermistor Input

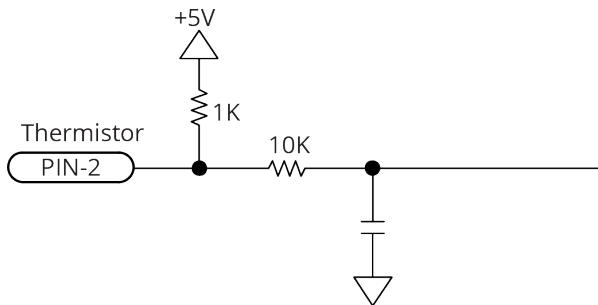
The thermistor input is used to detect a motor over temperature condition by using a positive temperature coefficient sensor. As the temperature of the sensor increases, so does the resistance. Under normal operating conditions, the resistance of the thermistor is low which will result in a low input signal. As the increasing temperature causes the resistance of the thermistor to increase, the sensor will trigger an over temperature fault.

The thermistor is connected between Pin 2 and Signal Common. The nominal trip value of the sensor is 1.385 k Ω . The circuit includes a 1 k Ω internal pull-up resistor which corresponds to a trip voltage of +1.5 V.

Table 2-30: Thermistor Input Pin on the Feedback Connector

Pin #	Description	In/Out/BI
2	Motor Over Temperature Thermistor	Input

Figure 2-32: Thermistor Input Schematic (Feedback Connector)



2.3.5. Encoder Fault Input

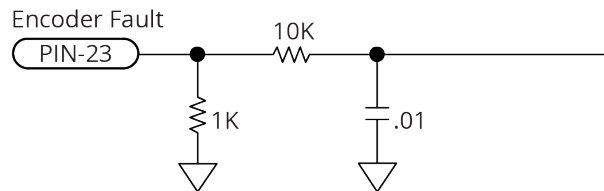
The encoder fault input is for use with encoders that have a fault output. This is provided by some manufacturers and indicates a loss of encoder function. The active state of this input is parameter configurable and the controller should be configured to disable the axis when the fault level is active.

The nominal trip voltage of the encoder fault input is +1.5 V.

Table 2-31: Encoder Fault Input Pin on the Feedback Connector

Pin #	Description	In/Out/Bi
23	Encoder Fault Input	Input

Figure 2-33: Encoder Fault Input Schematic (Feedback Connector)



2.3.6. End of Travel and Home Limit Inputs

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 0-24 VDC level signals. Limit directions are relative to the encoder polarity in the diagnostics display (refer to [Figure 2-36](#)).

Table 2-32: End of Travel and Home Limit Pins on the Feedback Connector

Pin #	Description	In/Out/Bi
12	Clockwise End of Travel Limit	Input
16	+5V Power ⁽¹⁾	Output
20	Signal Common	Output
21	Signal Common	Output
22	Home Switch Input	Input
24	Counterclockwise End of Travel Limit	Input

(1) The maximum combined current output is 500 mA.

The active state (High/Low) of the EOT limits is software selectable (by the EndOfTravelLimitSetup axis parameter). [Figure 2-34](#) shows the possible wiring configurations for normally-open and normally-closed switches and the parameter setting to use for each configuration.



IMPORTANT: Use NPN-type normally-closed limit switches (Active High) to provide fail-safe behavior in the event of an open circuit.

Figure 2-34: End of Travel and Home Limit Input Connections

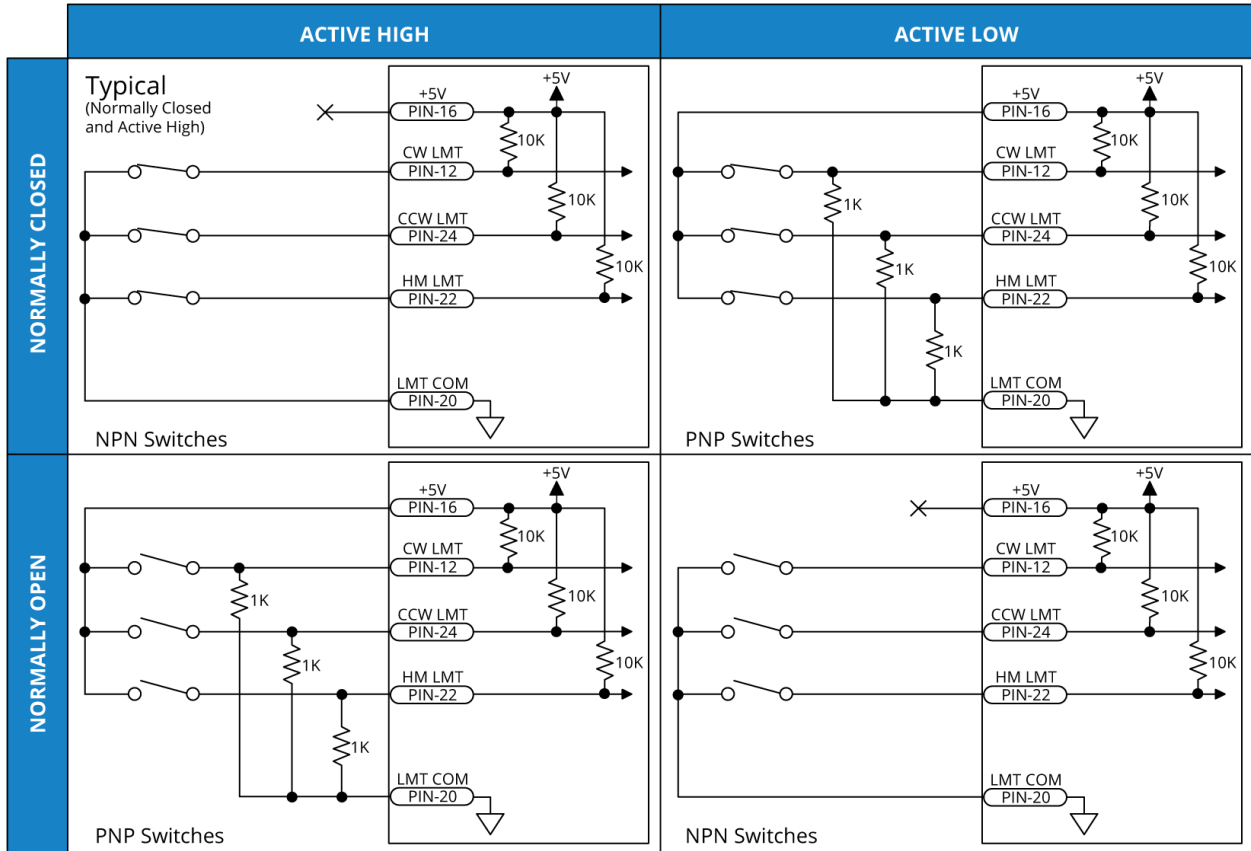
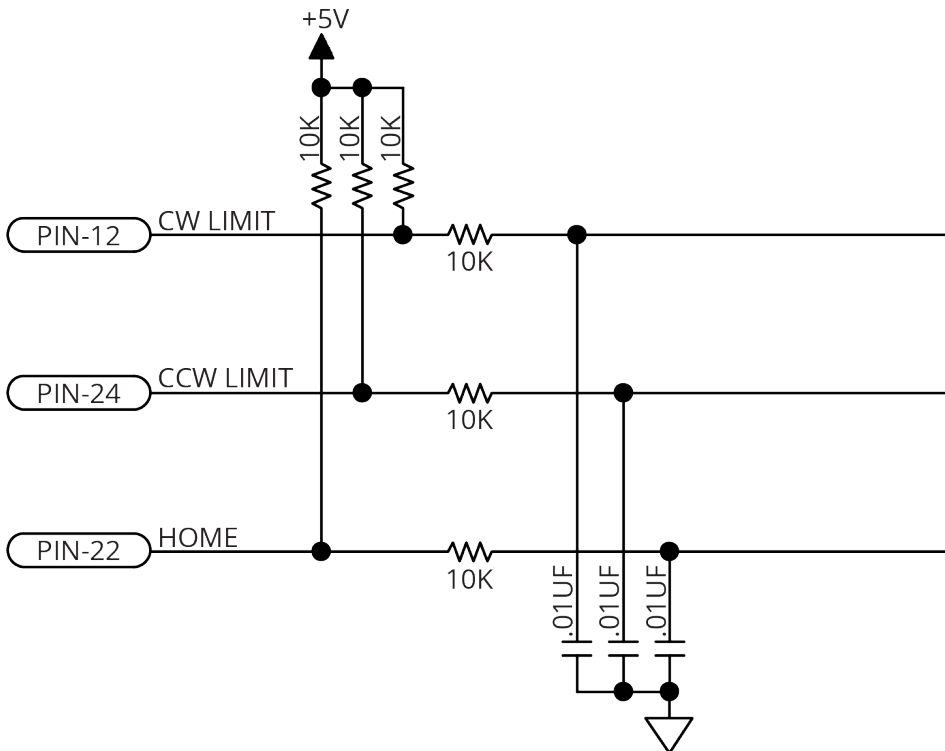


Figure 2-35: End of Travel and Home Limit Input Schematic (Feedback Connector)



2.3.6.1. End of Travel and Home 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 Feedback connector or swap the CW and CCW limit functionality in the software using the EndOfTravelLimitSetup parameter. View the logic level of the EOT limit inputs in the Diagnostics display (shown in [Figure 2-36](#)).

Figure 2-36: End of Travel and Home Limit Input Diagnostic Display

The screenshot shows a software interface with a left-hand navigation menu and a main data table. The navigation menu includes sections for Axes, Tasks, and Controller. The 'Diagnostics' section is selected. The main table displays data for axes X, Y, Z, and U across various status and hardware parameters. A red box highlights the 'Diagnostics' menu item and the 'Home' row in the hardware section of the table.

Item	X	Y	Z	U
Status				
Position Feedback	000000000000	000000000000	000000000000	000000000000
Position Calibration All	000000000000	000000000000	000000000000	000000000000
Position Camming/Gearing	000000000000	000000000000	000000000000	000000000000
Primary Feedback	000000000000	000000000000	000000000000	000000000000
Auxiliary Feedback	000000000000	000000000000	000000000000	000000000000
Gantry Marker Difference	0.0000	0.0000	0.0000	0.00
Analog Input 0	0.0000	0.0000	0.0000	0.00
Analog Input 1	0.0000	0.0000	0.0000	0.00
Analog Input 2	0.0000	0.0000	0.0000	0.00
Analog Input 3	0.0000	0.0000	0.0000	0.00
Digital Input 15:0	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 00
Digital Input 31:16	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 00
Digital Output 15:0	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 00
Digital Output 31:16	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 0000	0000 0000 0000 00
Average Velocity Feedback	000000000000	000000000000	000000000000	000000000000
Current Feedback	0.0000	0.0000	0.0000	0.00
Transition Offset Errors	0	0	0	
Hardware				
Enable	--	--	--	--
CW	--	--	--	--
CCW	--	--	--	--
Home	--	--	--	--
Marker	--	--	--	--
Hall A	--	--	--	--
Hall B	--	--	--	--
Hall C	--	--	--	--
ESTOP	--	--	--	--
Brake	--	--	--	--

2.3.7. Brake Outputs

The drive has a dedicated brake control circuit for each axis. Configure the brake with the BrakeSetup parameter for automatic control (typical). You can also use software commands to directly control the brake output.

Table 2-33: Brake Output Pins on the Feedback Connector

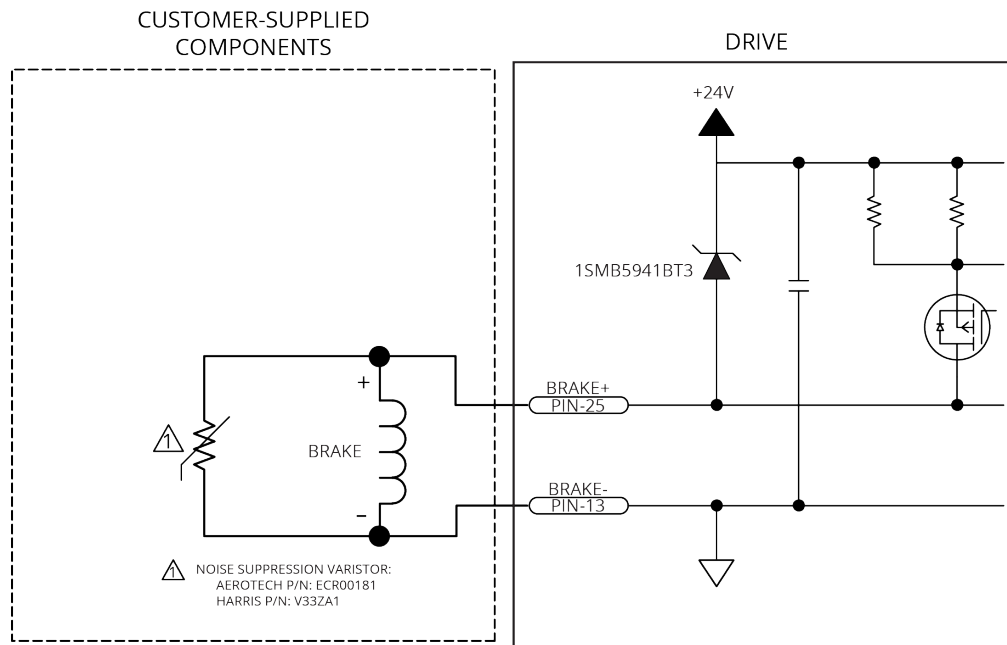
Pin #	Description	In/Out/Bi
13	Brake Output -	Output
25	Brake Output +	Output

Table 2-34: Brake Control Specifications

Specification	Value
Maximum Voltage	24 VDC
Maximum Current	1 A

A varistor must be connected across the brake to minimize voltage transients.

Figure 2-37: Brake Connected to the 25-Pin Feedback Connector (Typical)



2.4. Safe Torque Off Input (STO)

The STO circuit is comprised of two identical channels, each of which must be energized in order for the drive to produce motion. Each STO input is opto-isolated and accepts 24 V levels directly without the need for external current limiting resistors.



IMPORTANT: The drive might be equipped with an STO bypass circuit board. The bypass circuit board defeats the STO safety circuit and allows the system to run at all times. To use the STO safety functionality, remove the circuit board and make connections as outlined in this section. Refer to [Installation Overview](#) on [Page 14](#) for the location of the STO bypass plug.



IMPORTANT: The application circuit and its suitability for the desired safety level is the sole responsibility of the user of the drive.



WARNING: STO wires must be insulated to prevent short circuits between connector pins. The primary concern is a short circuit between STO 1 IN and STO 2 IN wire strands.

Table 2-35: STO Connector Pinout

Pin #	Signal	Description	In/Out/Bi	Connector
1	Power Supply +	Use only to defeat STO by connecting to STO 1 IN and STO 2 IN. Not for customer use.	Output	
2	STO 1 IN	STO Channel 1 Positive Input	Input	
3	RETURN	STO Negative Input	Input	
4	STO 2 IN	STO Channel 2 Positive Input	Input	
5	Power Supply -	Use only to defeat STO by connecting to RETURN. Not for customer use.	Output	

Table 2-36: STO Mating Connector Ratings

Specification		Description
Type		5-Pin Terminal Block
Part Numbers		Aerotech: ECK02393 Phoenix: 1827622
Conductor Cross Section	One conductor, stranded with ferrule and plastic sleeve	18...22 AWG (0.25...0.75 mm ²)
	Two conductors (same cross-section), stranded, twin ferrule with plastic sleeve	20 AWG (0.5 mm ²)
Tightening Torque		0.22...0.25 N·m
Conductor Insulation Strip Length		7 mm (0.25 in)

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

Table 2-37: STO Electrical Specifications

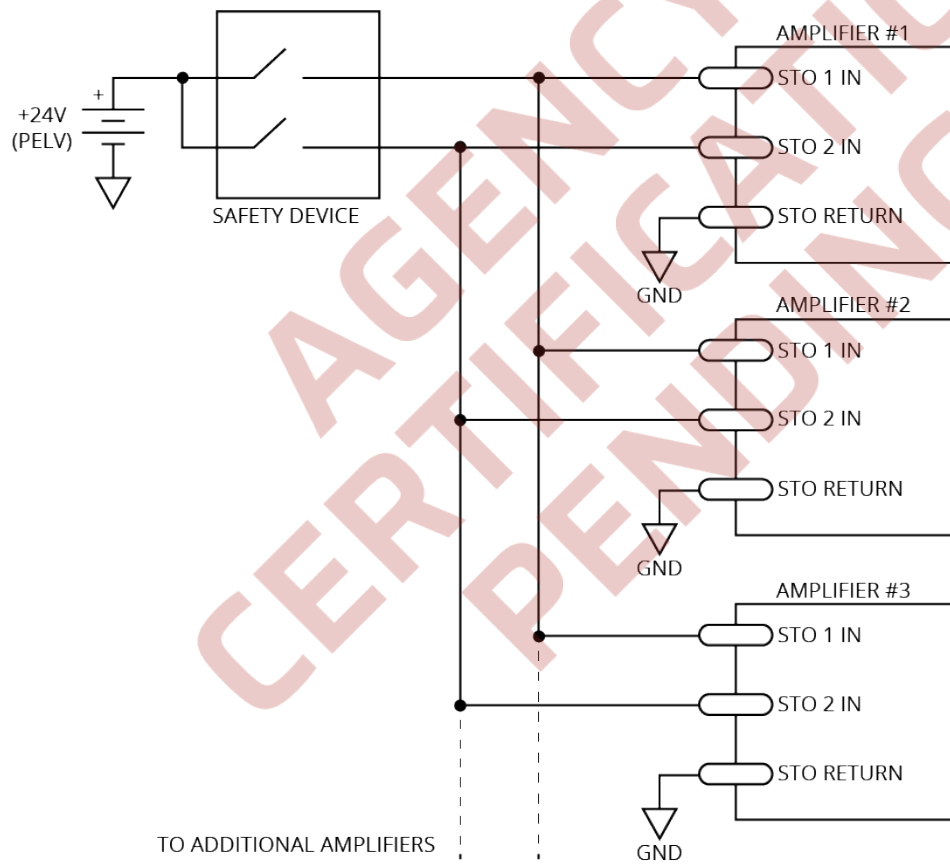
Status	Value
STO off (motion allowed)	18-24 V, 7 ma
STO on (safe state entered, no motion)	0-6 V
Recommended Wire Gauge	22-26 AWG (0.5 - 0.14 mm ²)
STO System Power Supply	PELV
STO Wire Length (maximum)	50 m

Figure 2-38 shows one safety device connected to multiple drives in parallel.



WARNING: The drive does not check for short circuits on the external STO wiring. If this is not done by the external safety device, short circuits on the wiring must be excluded. Refer to EN ISO 13849-2. For Category 4 systems, the exclusion of short circuits is mandatory.

Figure 2-38: Typical STO Configuration



2.4.1. STO Standards

Table 2-38 describes and specifies the safety requirements at the system level for the Safe Torque Off (STO) feature of the drive. This assumes that diagnostic testing is performed according to Section 2.4.4. and Table 2-39.

Table 2-38: STO Standards

Standard	Maximum Achievable Safety
EN/IEC 61800-5- 2:2016	SIL 3
EN/IEC 61508-1:2010	SIL 3
EN/IEC 61508-2:2010	SIL 3
EN ISO 13849-1:2015	Category 4, PL e
EN/IEC 62061:2005 with Amendments	SIL 3

Table 2-39: STO Standards Data

Standard	Value
EN ISO 13849-1:2015	MTTF _D > 1000 years, DC _{AVG} 99% Maximum PL e, Category 4
EN ISO 13849-1:2015 EN/IEC 61508	Lifetime = 20 years No proof test required Interval for manual STO test: <ul style="list-style-type: none"> • Once per year for SIL2/PL d/category 3 • Once per three months for SIL3/PL e/category 3 • Once per day for SIL3/PL e/category 4
EN/IEC 61508	SIL3 PFH < 3 FIT SFF > 99%

2.4.2. STO Functional Description

The motor can only be activated when voltage is applied to both STO 1 and STO 2 inputs. The STO state will be entered if power is removed from either the STO 1 or the STO 2 inputs. When the STO state is entered, the motor cannot generate torque or force and is therefore considered safe. Both STO channels must be driven at the same time. If they are not driven at the same time, a diagnostic test failure will occur (refer to [STO Diagnostics](#)).

The STO function is implemented with two redundant channels in order to meet stated performance and SIL levels. STO 1 disconnects the high side power amplifier transistors and STO 2 disconnects the low side power amplifier transistors. Disconnecting either set of transistors effectively prevents the drive from being able to produce motion.

The drive software monitors each STO channel and will generate an Emergency Stop software fault when either channel signals the stop state. Each STO channel contains a fixed delay which allows the drive to perform a controlled stop before the power amplifier transistors are turned off.

A typical configuration requiring a controlled stop has the Emergency Stop Fault mask bit set in the `FaultMask`, `FaultMaskDecel`, and `FaultMaskDisable` parameters. This stops the axis using the rate specified by the `AbortDecelRate` parameter. The software will disable the axis as soon as the deceleration ramp is complete. This is typically configured to occur before the STO channel turns off the power amplifier transistors.

The software-controlled stop functionality must be excluded when considering overall system safety. This is because the software is not safety rated and cannot be included as part of the safety function.

The software-controlled stop function can ignore short diagnostic pulses on the STO 1+ and STO 2+ inputs. The parameter "STOPulseFilter" specifies the maximum pulse width that the software will ignore. The filter parameter does not affect the operation of STO hardware channels.

To resume normal operation, apply power to both STO 1 and STO 2 inputs and use the *Acknowledge All* button or the `AcknowledgeAll()` or `FaultAcknowledge()` function to clear the Emergency Stop software fault. The recommended use of the Emergency Stop Fault fault mask bits prevent the system from automatically restarting.

You can achieve longer delay times through the use of an external delay timer, such as the Omron G9SA-321 Safety Relay Unit. Place this device between the system ESTOP wiring and the drive's STO inputs. Connect the ESTOP signal directly to a digital input, in addition to the external timer, to allow the drive to begin a software-controlled stop as soon as the ESTOP signal becomes active. Use the `EmergencyStopFaultInput` parameter to configure a digital input as an ESTOP input.

The STO feature can only be used with AC or stepper motor types. It is not certified to prevent hazardous motion when using DC brush motor types.

Non-standard STO delay times are provided by special factory order. In this case, the non-standard STO delay time is indicated by a label placed on the slice amplifier's main connector (STO DELAY = xx sec).

Table 2-40: STO Signal Delay

	Value
STO Time Delay	450-550 msec

Table 2-41: Motor Function Relative to STO Input State

STO 1	STO 2	Motor Function
Unpowered	Unpowered	No force/torque
Unpowered ⁽¹⁾	Powered ⁽¹⁾	No force/torque
Powered ⁽¹⁾	Unpowered ⁽¹⁾	No force/torque
Powered	Powered	Normal Operation

1. This is considered a Fault Condition since STO 1 and STO 2 do not match. Refer to [Section 2.4.4](#).

2.4.3. STO Startup Validation Testing

Verify the state of the STO 1 and STO 2 channels by manually activating the external STO hardware. Each STO channel must be tested separately in order to detect potential short circuits between the channels. The current state of the STO 1 and STO 2 inputs is shown in the Status Utility. A “-” indicates that the STO input is powered by a high voltage level (24 V). An “ON” indicates that the voltage source has been removed from the input (open circuit or 0 V), and that the STO channel is in the safe state.



DANGER: The STO circuit does not remove lethal voltage from the motor terminals. AC mains power must be removed before servicing.

2.4.4. STO Diagnostics

Activation of STO means removing power from the drive STO inputs. This is typically done by pressing the emergency stop switch. The drive initiates a diagnostic check every time the STO is activated after the Diagnostic Test Delay Time has elapsed. The diagnostic check verifies that each channel has entered the safe state. The drive is held in the safe state if it determines that one of the channels has not properly entered the safe state. An open circuit or short to 24 V in either STO channel will result in this condition (refer to [Section 2.4.3.](#)). The Status Utility screen can be used to verify the levels of the STO input signals while troubleshooting. The safe state is cleared when both STO channels are cycled with matching signal levels such that the diagnostic test completes successfully.

The drive is held in the safe state if it determines that one of the channels has not properly entered the safe state. In this case, the `stoCrossCheckFault` bit will be set and can be viewed in the **STO Status** status item. A **Position Error Fault** or **Emergency Stop Fault** will occur if motion is attempted while in this state. The drive will remain in the safe state until STO is reactivated with both channels in a safe state such that the diagnostics test completes successfully.

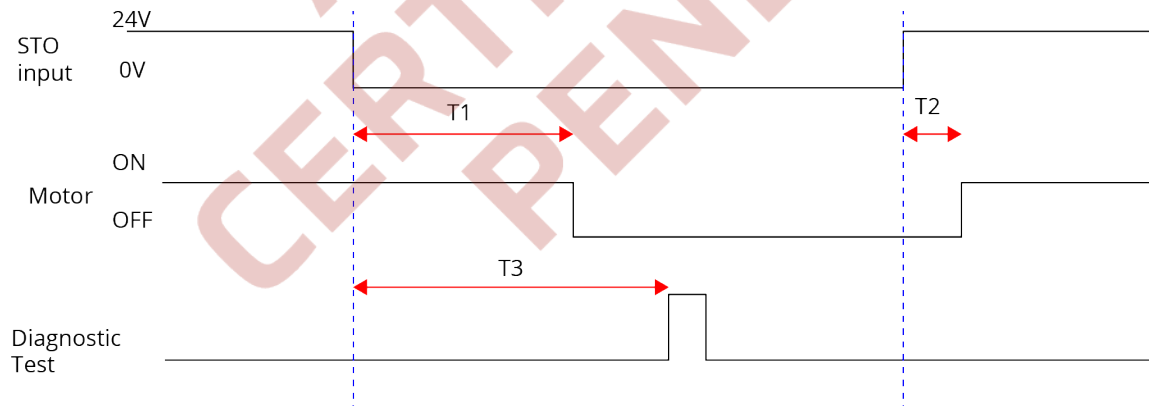
An open circuit or short to 24 V in either STO channel or a timing difference between the channels will result in a diagnostic test failure (refer to [STO Startup Validation Testing](#)). The Status Utility screen or **STO Status** status item can be used to verify the levels of the STO input signals while troubleshooting.

In order to pass internal testing, the STO circuit must be activated (power removed from both inputs) according to the interval specified in [Table 2-39](#).

Table 2-42: STO Timing

Time	Description	Value
T1	STO Delay Time (STO input active to motor power off)	450-550 msec
T2	STO deactivated to motor power on (the software is typically configured so that the motor does not automatically re-energize).	< 1 msec
T3	Diagnostic Test Delay Time	550-610 msec

Figure 2-39: STO Timing



The software is typically configured to execute a controlled stop when the STO state is first detected. If power is reapplied to the STO inputs before the STO Delay Time, an STO hardware shutdown will not occur but a software stop may, depending on the width of the STO pulse. The controller will ignore STO active pulses shorter in length than the `STOPulseFilter` parameter setting.

2.5. Position Synchronized Output (PSO)

You cannot use a sine wave encoder with the -MX1 multiplier option as an input to the PSO. The -MX1 option does not generate emulated quadrature signals.

This output signal is a 5V TTL signal which is used to drive an opto coupler or general purpose TTL input. This signal is active high and is driven to 5V when a PSO fire event occurs.

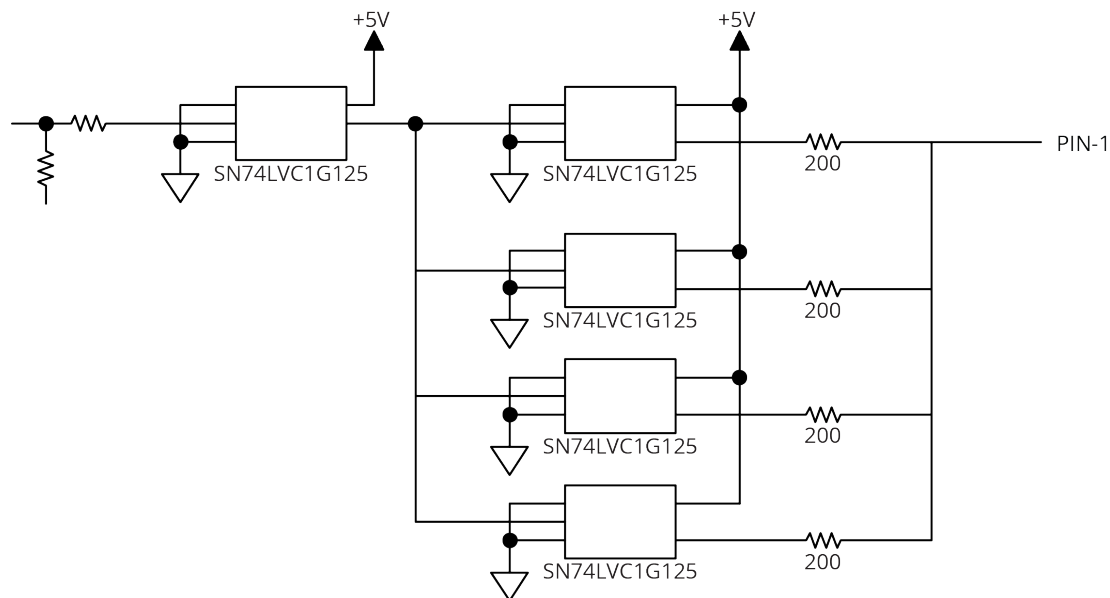
Table 2-43: PSO Specifications

Specification	Value
Output	5 V, 16 mA (max)
Maximum PSO Output (Fire) Frequency	12.5 MHz
Output Latency [Fire event to output change]	25 ns

Table 2-44: PSO/High-Speed Input Connector

Pin#	Description	In/Out/Bi	Connector
1	PSO	Output	
2	Ground	Output	
3	High-Speed Input 0+	Input	
4	High-Speed Input 0-	Input	
5	High-Speed Input 1+	Input	
6	High-Speed Input 1-	Input	

Figure 2-40: PSO Interface



2.6. High-Speed Inputs

High-speed inputs 0 and 1 can be used as general purpose inputs or as the trigger signal for high speed data collection. High-speed input 1 is only available with the -AX2 or -AX4 option. Refer to the DriveDataCaptureConfigureTrigger() function topic in the Help file for more information.

You can use the external PSO synchronization functions to synchronize waveform generation with an external synchronization signal. When you activate this feature, the PSO Waveform module will not generate the configured waveform when an output event is received until the rising edge of the synchronization signal occurs.

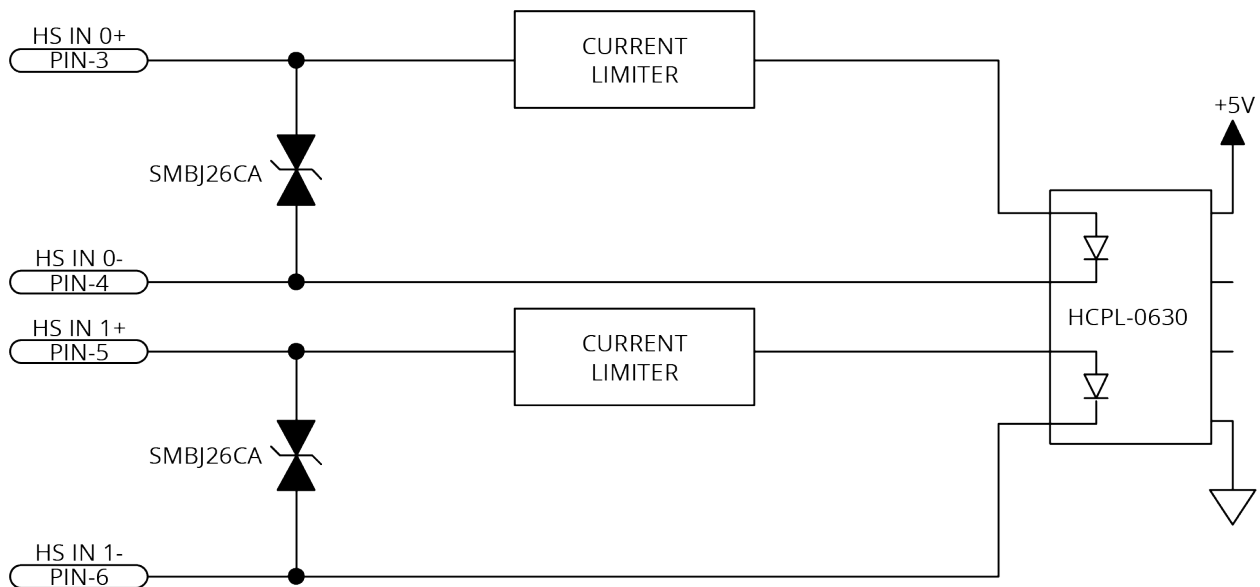
Table 2-45: High-Speed Input Specifications

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

Table 2-46: PSO/High-Speed Input Connector

Pin#	Description	In/Out/Bi	Connector
1	PSO	Output	
2	Ground	Output	
3	High-Speed Input 0+	Input	
4	High-Speed Input 0-	Input	
5	High-Speed Input 1+	Input	
6	High-Speed Input 1-	Input	

Figure 2-41: High-Speed Inputs



2.7. HyperWire Interface

The HyperWire bus is the high-speed communications connection from the controller. It operates at 2 gigabits per second. The controller sends all command and configuration information through the HyperWire bus. This device consumes one or more of the available axes of control on the HyperWire communication network depending on the number of axes ordered. Refer to your Automation1-iSMC license for the number of available HyperWire axes.

HyperWire cables can be safely connected to or disconnected from a HyperWire port while the PC and/or drive is powered on. However, any changes to the HyperWire network topology will disrupt communication and you must reset the controller to re-establish communication.



WARNING: Do not connect or disconnect HyperWire cables while you are loading firmware or damage to the drives may occur.

Table 2-47: HyperWire Card Part Number

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

Table 2-48: HyperWire Cable Part Numbers

Part Number	Description
HYPERWIRE-AO10-5	HyperWire cable, active optical, 0.5 m
HYPERWIRE-AO10-10	HyperWire cable, active optical, 1.0 m
HYPERWIRE-AO10-30	HyperWire cable, active optical, 3.0 m
HYPERWIRE-AO10-50	HyperWire cable, active optical, 5.0 m
HYPERWIRE-AO10-200	HyperWire cable, active optical, 20.0 m

2.8. Sync Port (-AX4, -EB1, or -EB2 Options Only)

The Sync port is a bi-directional high speed proprietary interface that lets you transmit encoder signals between drives. The drive contains two Sync ports, labeled A and B. To avoid signal contention, all Sync ports default to the input state during reset and immediately after power is applied to the drive.

This is typically used for multi-axis PSO applications where one or two drives send their encoder signals to a main drive that has the PSO logic and PSO output signal.

Table 2-49: Sync-Related Functions

Function	Description
DriveEncoderOutputConfigureDivider(), DriveEncoderOutputConfigureInput(), DriveEncoderOutputOn(), DriveEncoderOutputOff()	Configure each Sync port as an input or an output
PsoDistanceConfigureInputs()	Let the PSO track the SYNC A or SYNC B port.
PsoWindowConfigureInput()	

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

Table 2-50: Sync Port Cables

Part Number	Description
CBL-SYNC-3	Length 3 dm; Connectors: USB Type A to USB Type A
CBL-SYNC-5	Length 5 dm; Connectors: USB Type A to USB Type A
CBL-SYNC-7	Length 7 dm; Connectors: USB Type A to USB Type A
CBL-SYNC-10	Length 10 dm; Connectors: USB Type A to USB Type A

2.9. Industrial Ethernet (iXA4 -IE1 Option Only)

The controller is equipped with 100BASE-TX Industrial Ethernet ports.

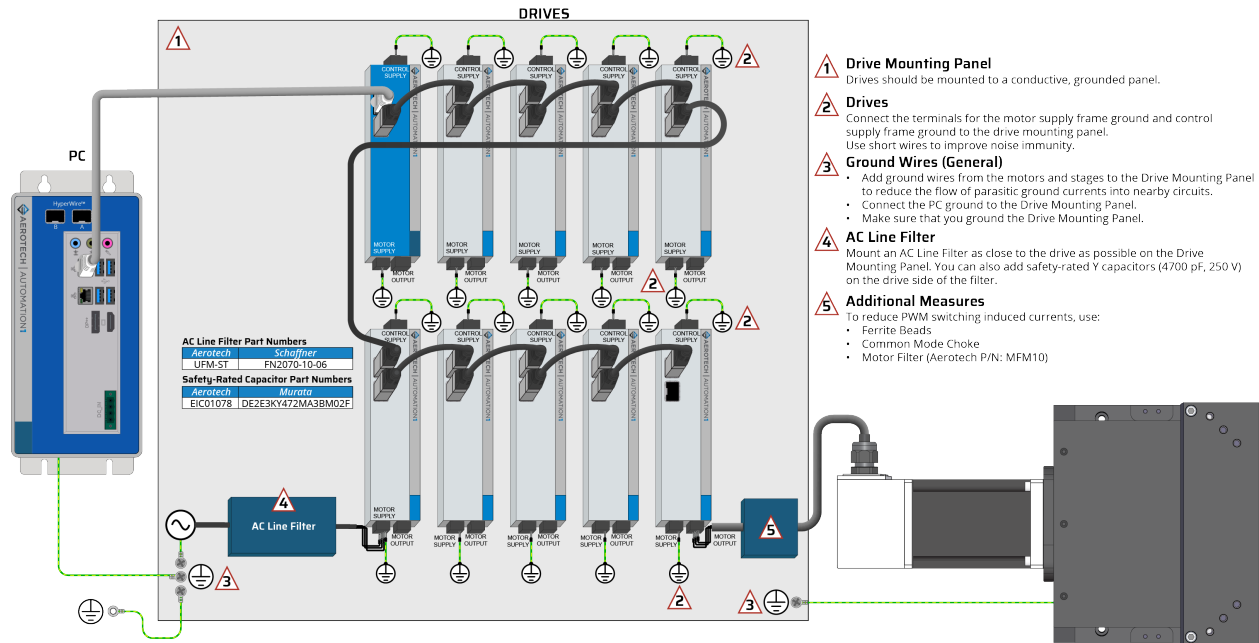


IMPORTANT: Industrial Ethernet is only available on the iXA4.

- For the location of the ports, refer to [Figure 1-1](#).
- For cable part numbers, refer to [Table 3-1](#).
- For more information, refer to the Help system.

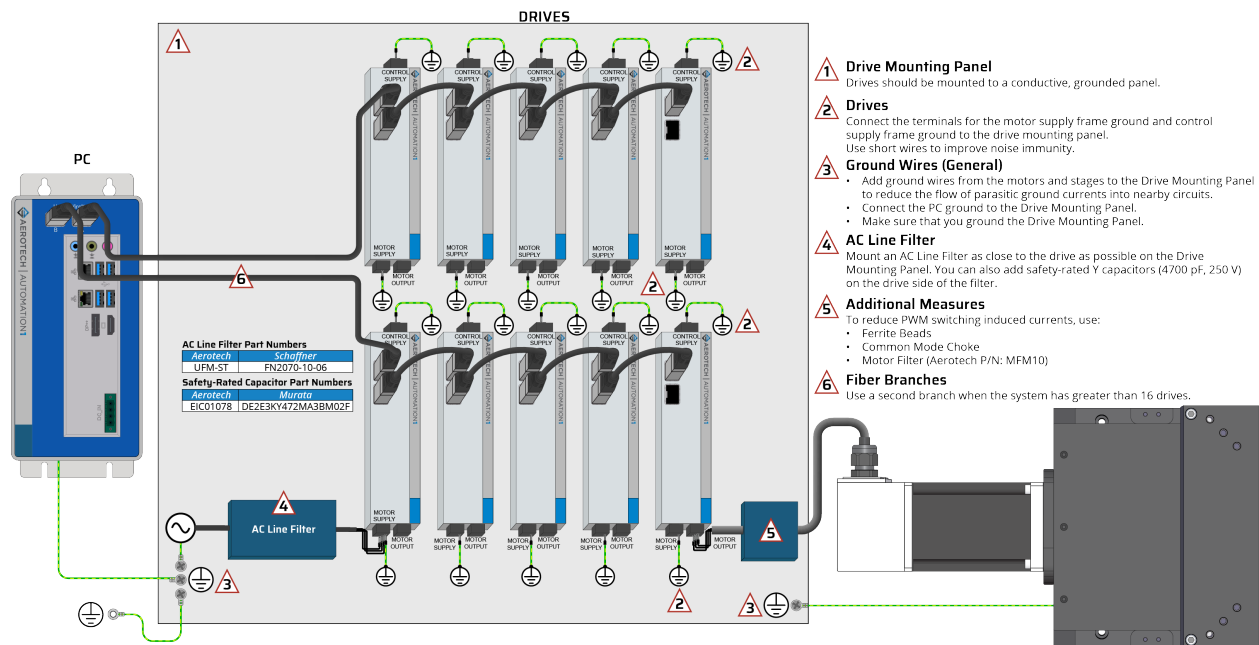
2.10. System Interconnection

Figure 2-42: iXA4-AC Drive-Based System Wiring Drawing (Best Practice)



- 1 Drive Mounting Panel**
Drives should be mounted to a conductive, grounded panel.
- 2 Drives**
Connect the terminals for the motor supply frame ground and control supply frame ground to the drive mounting panel. Use short wires to improve noise immunity.
- 3 Ground Wires (General)**
 - Add ground wires from the motors and stages to the Drive Mounting Panel to reduce the flow of parasitic ground currents into nearby circuits.
 - Connect the PC ground to the Drive Mounting Panel.
 - Make sure that you ground the Drive Mounting Panel.
- 4 AC Line Filter**
Mount an AC Line Filter as close to the drive as possible on the Drive Mounting Panel. You can also add safety-rated Y capacitors (4700 pF, 250 V) on the drive side of the filter.
- 5 Additional Measures**
To reduce PWM switching induced currents, use:
 - Ferrite Beads
 - Common Mode Choke
 - Motor Filter (Aerotech P/N: MFM10)

Figure 2-43: XA4-AC PC-Based System Wiring Drawing (Best Practice)



- 1 Drive Mounting Panel**
Drives should be mounted to a conductive, grounded panel.
- 2 Drives**
Connect the terminals for the motor supply frame ground and control supply frame ground to the drive mounting panel. Use short wires to improve noise immunity.
- 3 Ground Wires (General)**
 - Add ground wires from the motors and stages to the Drive Mounting Panel to reduce the flow of parasitic ground currents into nearby circuits.
 - Connect the PC ground to the Drive Mounting Panel.
 - Make sure that you ground the Drive Mounting Panel.
- 4 AC Line Filter**
Mount an AC Line Filter as close to the drive as possible on the Drive Mounting Panel. You can also add safety-rated Y capacitors (4700 pF, 250 V) on the drive side of the filter.
- 5 Additional Measures**
To reduce PWM switching induced currents, use:
 - Ferrite Beads
 - Common Mode Choke
 - Motor Filter (Aerotech P/N: MFM10)
- 6 Fiber Branches**
Use a second branch when the system has greater than 16 drives.

Figure 2-44: iXA4-DC Drive-Based System Wiring Drawing (Best Practice)

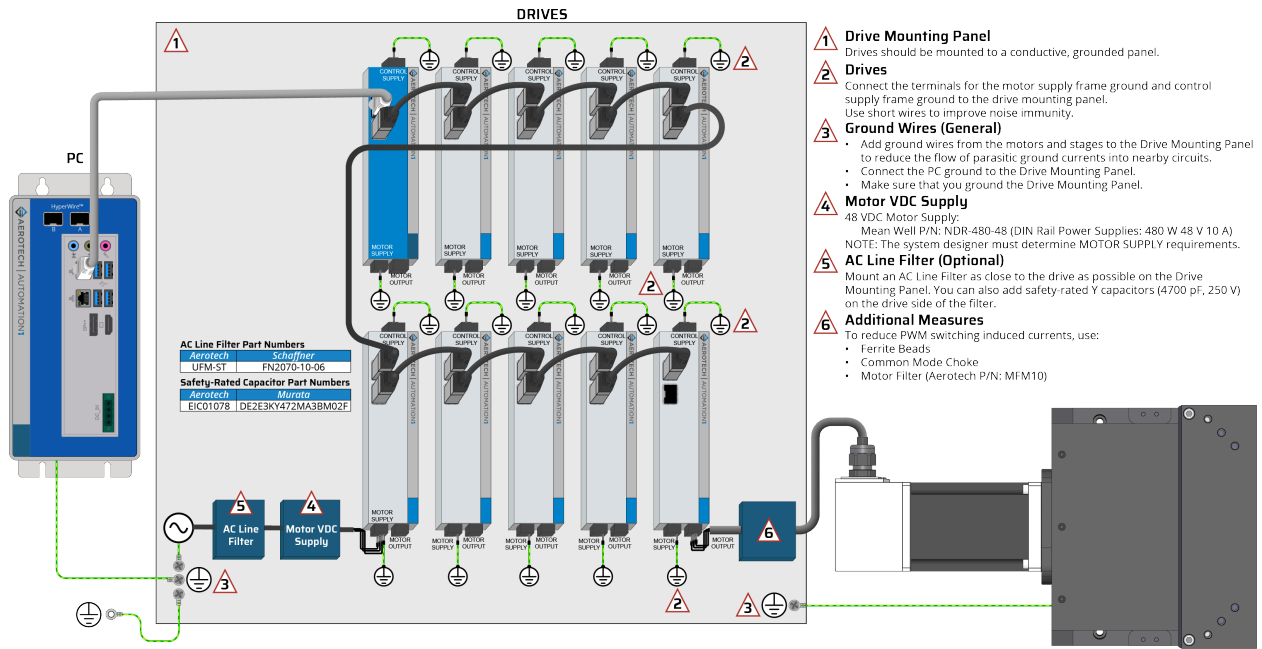


Figure 2-45: XA4-DC PC-Based System Wiring Drawing (Best Practice)

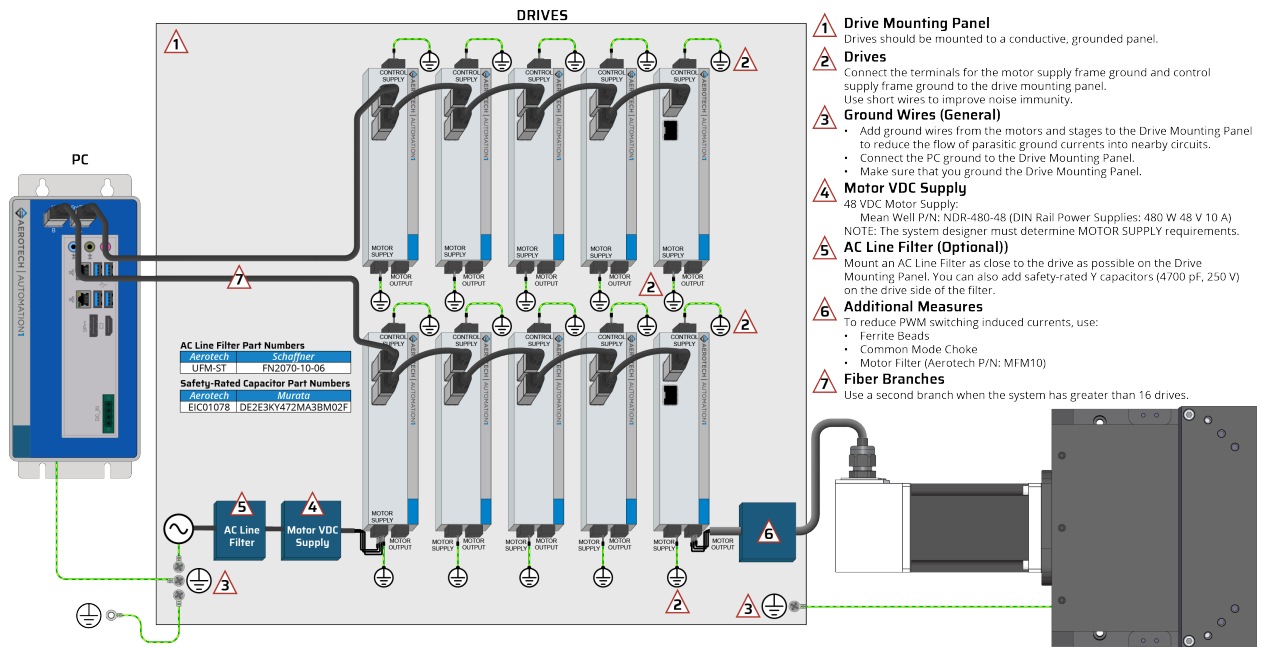
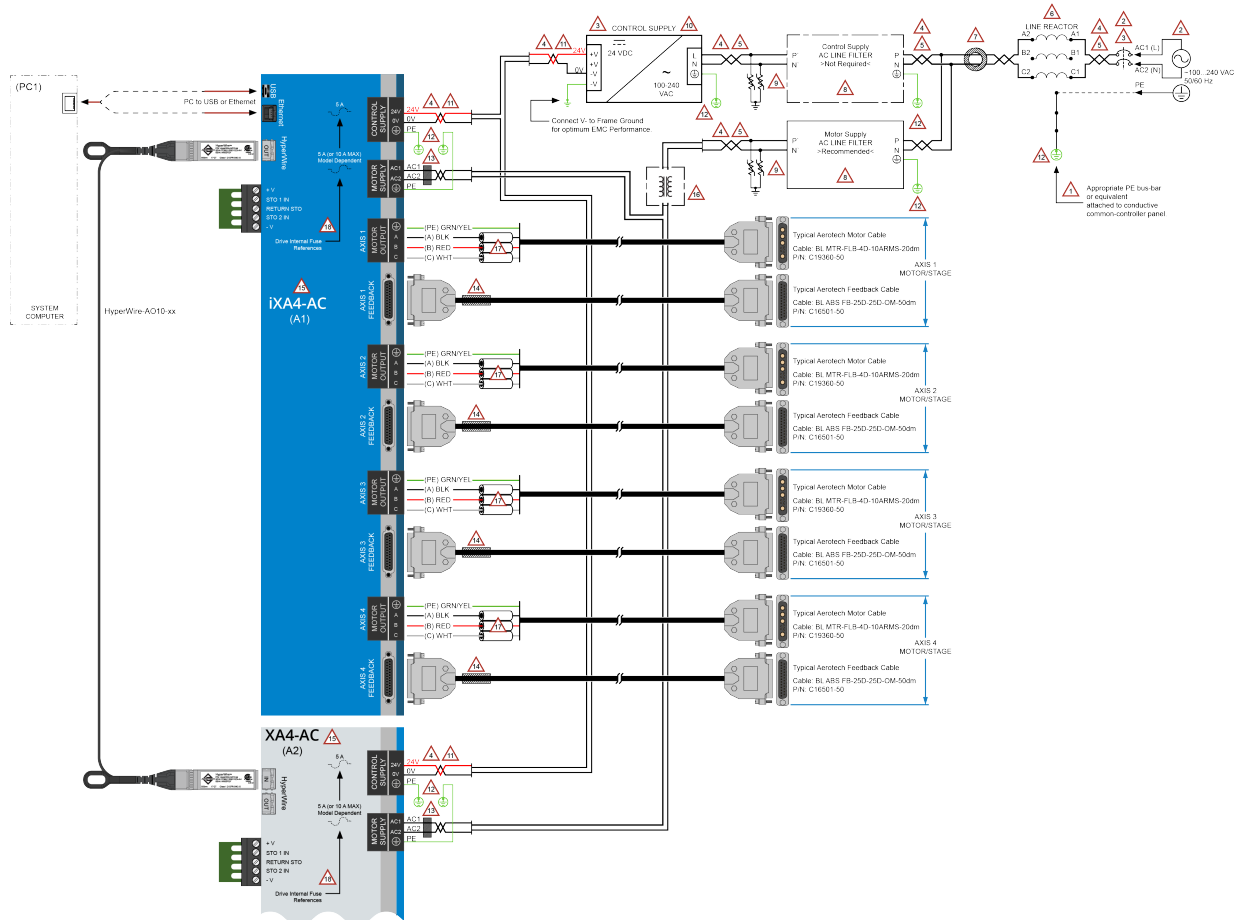
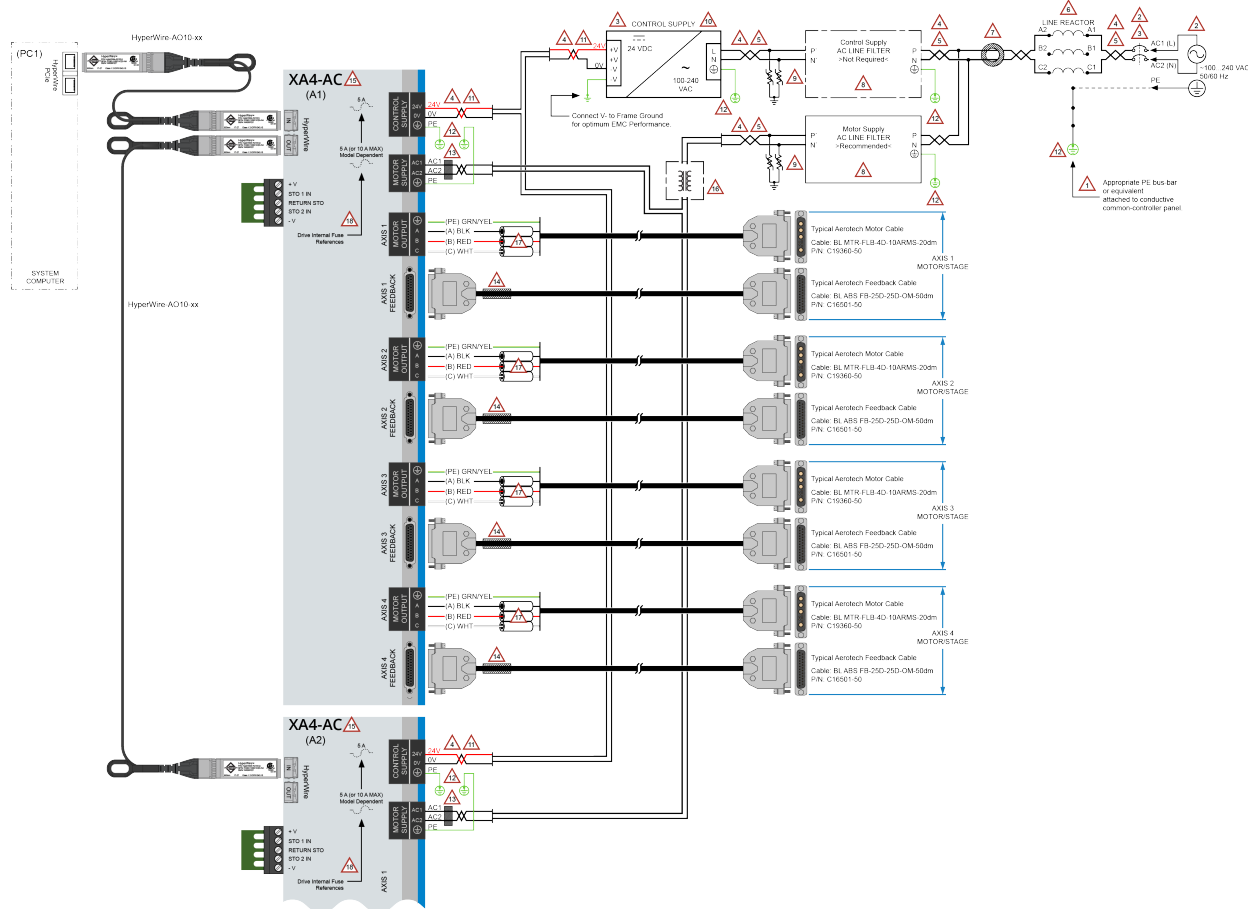


Figure 2-46: iXA4-AC Recommended System Connections for a Drive-Based Controller



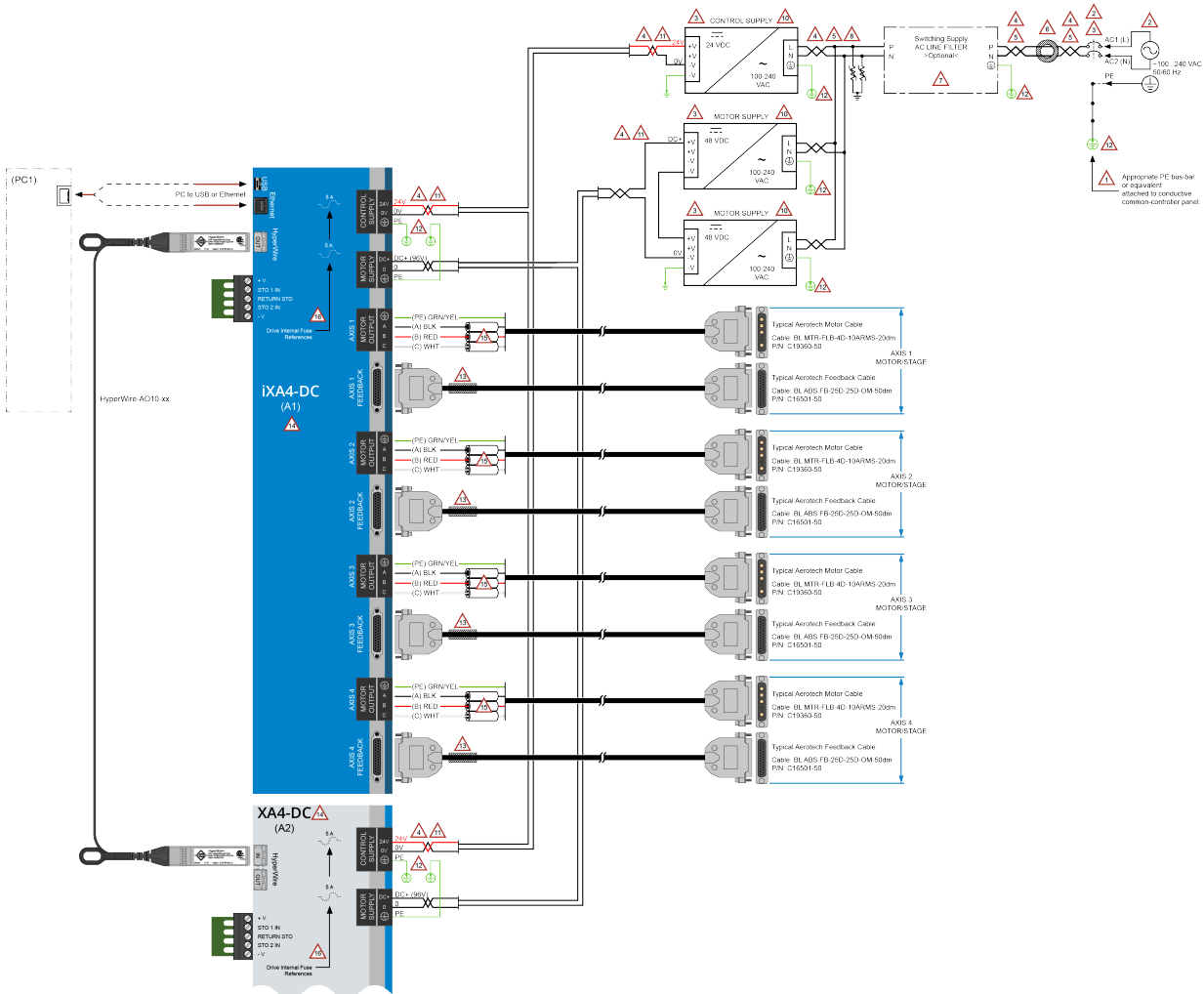
<p>! ATTENTION !</p> <p>The system integrator or end user is responsible for all safety compliance and technical requirements for the system wiring and power supply sizing.</p> <p>IMPORTANT: Read all parts of this manual before you install or operate the drive or before you do maintenance to your system.</p> <ul style="list-style-type: none"> To prevent injury to you and damage to the equipment, obey the precautions in this manual. If you do not understand the information in this manual, contact Aerotech Global Technical Support. For additional resources, refer to https://www.aerotech.com/resources/manuals-help-files/. <p>For EMC performance, mount all system components on a common conductive metal panel:</p> <ul style="list-style-type: none"> Do not use a panel that has a painted or non-conductive coat applied. You can use a panel with a conductive surface coat. <p>System AC Power:</p> <ul style="list-style-type: none"> Must have fuse or circuit breaker protection. Voltages and currents dependent on power supplies selected and system axis requirements (refer to 3.1). <p>UN Fuse:</p> <ul style="list-style-type: none"> If system components are DIN-Rail mounted, use Phoenix Pin NS 30 / 7.5 PERF 2000MM - 0801733 or equivalent. <p>SYSTEM WIRING - ROUTING:</p> <ul style="list-style-type: none"> Make sure that VDC and VDC wiring is separated. Make sure that Motor Supply Wiring is separated from Control Supply, Low Voltage I/O, and Feedback signal wiring. <p>AC SUPPLY: Recommended Wiring Specifications</p> <ul style="list-style-type: none"> Use labeled pair conductors with wire lengths as short as possible. Wire Size: As Required (determined by the system designer). Wire Color: North America: UL AWM I or UL I-ET-4483-ICE <p>The number of axes and motor power requirements dictate the architecture of the AC Power supply that could require design changes to the example illustrated. The System Designer must determine the requirements.</p> <p>LINE REACTOR (Automation Direct Model LR2-1P0 or equivalent)</p> <ul style="list-style-type: none"> Required for EMC "Surge Immunity" compliance. Recommended for protection from line transients. <p>AC SUPPLY SOURCE/FCB EMC Filter (Recommended)</p> <ul style="list-style-type: none"> Show for reference only. Not required for EMC compliance. Line-Ring Construction (Line P/N: LRS00200-300) Aerotech P/N: EC202399 Loop System AC1 and AC2 conductor pair two lines through the toroid. 	<p>SYSTEM AC SUPPLY/ EMC Filter</p> <ul style="list-style-type: none"> Required for EMC "Conducted Emissions" compliance. Required for EMC "Surge Immunity" compliance. P/N: Schaffner FN2070-10-06 (Aerotech EC202284) or equivalent. <p>Metal Oxide Varistor (MOV) for Surge Protection (Recommended)</p> <ul style="list-style-type: none"> Required for EMC "Surge Immunity" compliance. Install one (1) MOV to each AC1 and AC2 line as shown. P/N: Littelfuse V23L385F (Aerotech LBU0197) or equivalent. DIN Rail required surge protection devices (SPDs) can also be used. <p>CONTROL SUPPLY 24 VDC POWER SUPPLY</p> <ul style="list-style-type: none"> Minimum Requirements: Isolation Degree 2, Double Insulated, Short Circuit and Over-Voltage Protection, UL and CE Approvals. Recommended Power Supply: Mean Well P/N: NDR-240-24 (Aerotech P/N: EC202564) DIN Rail Power Supply, 10 W, 24 V, 10 A <p>NOTE: For installation details, refer to the Mean Well NDR Series installation manual. It is the responsibility of the system designer to determine the correct power supply requirements.</p> <p>VDC SUPPLY/ Wiring Specifications (Recommended)</p> <ul style="list-style-type: none"> Use twisted pair conductors with wire lengths as short as possible. Wire Size: 0.33 - 0.82 mm² (28 AWG) Wire Conformity: North America: UL AWM I (analog) EU: I-HAR-ICE <p>SYSTEM "Protective Earth" (PE) GROUNDS</p> <ul style="list-style-type: none"> PE wires should be as short as possible. Each PE wire should have a dedicated attachment point directly to the grounded component panel (refer to 3.1). <p>MOTOR SUPPLY Ferrite EMC Filter (Recommended)</p> <ul style="list-style-type: none"> Clamp-On Filter (Part P/N: 3440104201) Aerotech P/N: EC202347. Apply as close as possible to the power connector. Use non-metallic tie wraps to secure the filter. <p>AXIS FEEDBACK CABLE Ferrite EMC Filters (Recommended)</p> <ul style="list-style-type: none"> Clamp-On Filter (Part P/N: 344010701) Aerotech P/N: EC202348. Apply as close as possible to the FEEDBACK connector back shell as illustrated. <p>iXA4/XA4 CONTROL / ESD/SVDE</p> <ul style="list-style-type: none"> Assemblies A1 and A2. If the controllers were purchased as an Aerotech integrated system, refer to the "System Interconnections" drawing included with the system documentation. If you are implementing more than four axes, repeat axes 1 through 4 interconnections as needed. 	<p>Motor Supply Voltages: <math>\leq 100 \text{ VAC}</math></p> <ul style="list-style-type: none"> For the wiring example (as shown), the 24 VDC Control Supply requires a 100-240 VAC supply. <p>NOTE: If the system requires Motor Supply voltages below 100 VAC, you could use a step-down transformer. Transformer Example: 46 VAC to 80 VDC Bus - 50 VAC for 40 VDC Bus</p> <ul style="list-style-type: none"> Transformers must have applicable UL and/or CE conformance marks. We recommend that you use a grounded secondary for optimum servo and EMC performance. Additional Motor Supply Options are available. Contact Aerotech for more information. The system designer is responsible for determining the correct transformer requirements. <p>Axis Motor Cable Ferrite Filter (Recommended)</p> <ul style="list-style-type: none"> To keep servo EMC to a minimum, we recommend that you insert ferrite bead filters onto each of the motor phase wires. Apply 46 beads per phase. Use 1-in-100 P/N: 2673000001 (Aerotech P/N: LQZ1001) or an equivalent product. Keep the beads packed end-to-end closely together. Use non-metallic wire ties or stress tubing to keep the beads together. Aerotech standard factor motor cables have ferrite filters built into the cables. Axis motor cable "wing" beads, with ferrite bead filters. <p>iXA4/XA4 DRIVE SUPPLY INTERNAL FUSING</p> <ul style="list-style-type: none"> Control Supply is fused internally at 5 A. Motor Supply is fused internally at 5 A (10 A peak version). Motor Supply is fused internally at 10 A (20 A peak version). <p>The information on this page is for reference only and represents best practice applications.</p>
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Figure 2-47: XA4-AC Recommended System Connections for a PC-Based Controller



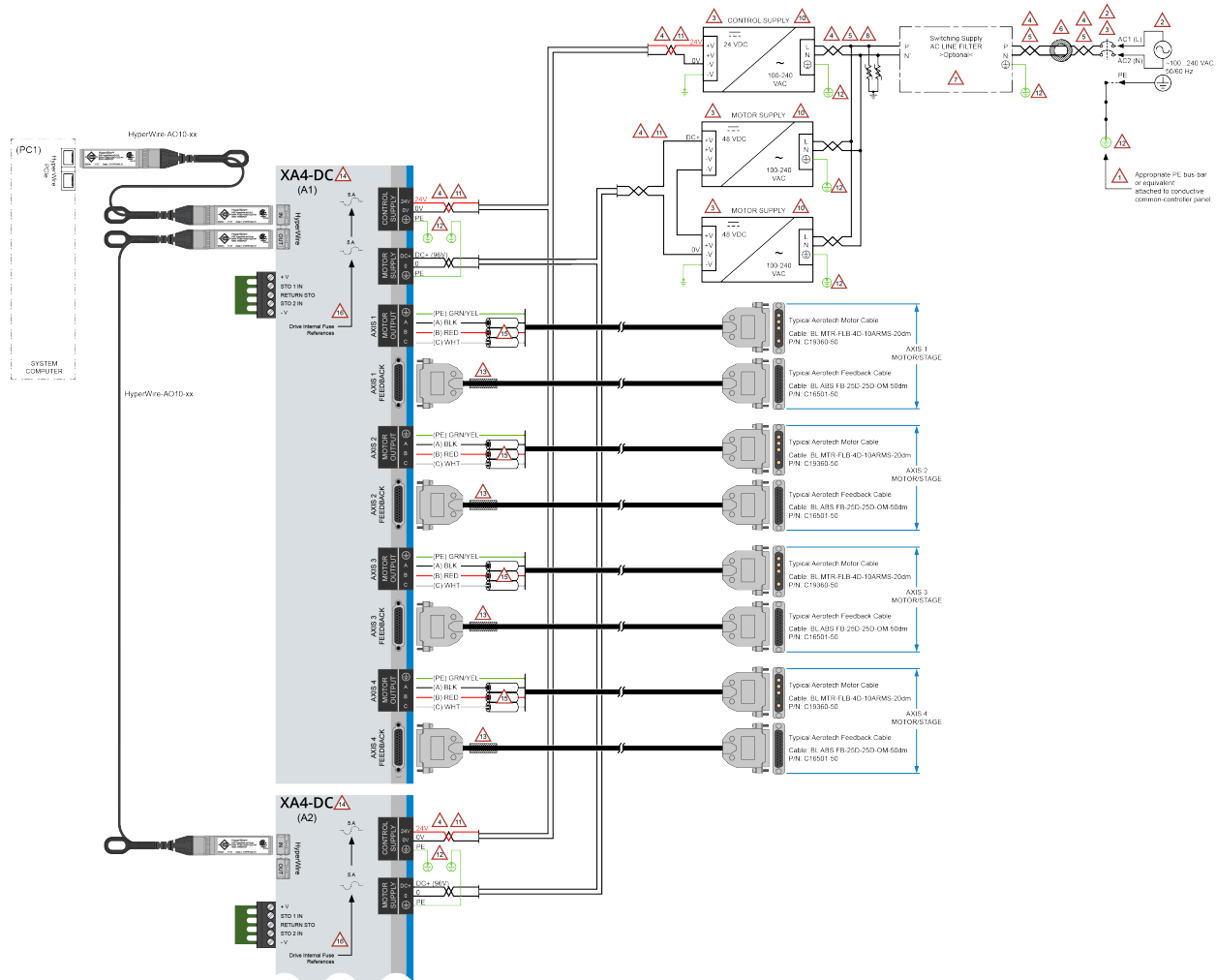
<p>! ATTENTION !</p> <p>The system integrator or end user is responsible for all safety compliance and technical requirements for the system wiring and power supply sizing.</p> <p>IMPORTANT: Read all parts of this manual before you install or operate the drive or before you do maintenance to your system.</p> <ul style="list-style-type: none"> To prevent injury to you and damage to the equipment, obey the precautions in this manual. If you do not understand the information in this manual, contact Aerotech Global Technical Support. For additional resources, refer to https://www.aerotech.com/resources-manuals-help-files/. <p>For EMC performance, mount all system components on to a common conductive metal panel.</p> <ul style="list-style-type: none"> Do not use a panel that has a painted or non-conductive coat applied. You can use a panel with a conductive surface coat. <p>System AC Power</p> <ul style="list-style-type: none"> Must have fuse or circuit breaker protection. Voltagess and currents depend on power supplies selected and system axis requirements (refer to 5.3). <p>DIN Rail</p> <p>If system components are DIN Rail mounted, use Phoenix P/N: NS 30/7.5 PE/RH 2000AM 0801733 or equivalent.</p> <p>SYSTEM WIRING: ROUTING</p> <ul style="list-style-type: none"> Make sure that VAC and VDC wiring is separated. Make sure that Motor Supply Wiring is separated from Control Supply, Low Voltage I/O, and Feedback signal wiring. <p>AC SUPPLY: Recommended Wiring Specifications</p> <ul style="list-style-type: none"> Use twisted pair conductors with wire lengths as short as possible. Wire Size: As Required (permitted by the system designer). Wire Conductor: (North America: 15 AWG) (and/or) EU: #18-#16-CE The number of axes and motor power requirements dictate the architecture of the AC Power supply that could require design changes to the example illustrated. The System Designer must determine the requirements. <p>LINE REACTOR (Automatic Direct Model (DZ) type or equivalent)</p> <ul style="list-style-type: none"> Required for EMC "Surge Immunity" compliance. Required for protection from line transients. <p>AC SUPPLY SOURCE: EMC Filter (Recommended)</p> <p>Shown for reference only, not required for EMC compliance.</p> <ul style="list-style-type: none"> Toroid Ring Construction: I and P/N: 1180210-300 Aerotech P/N: # C200398 Loop System AC1 and AC2 conductor pair two times through the toroid. 	<p>SYSTEM AC SUPPLY: EMC Filter</p> <ul style="list-style-type: none"> Required for EMC "Conducted Emissions" compliance. Required for EMC "Surge Immunity" compliance. P/N: Schottcher FN2075-10-50 (Aerotech EC202364) or equivalent. <p>Motor Oxide Varistor (MOV) for Surge Protection (Recommended)</p> <ul style="list-style-type: none"> Required for EMC "Surge Immunity" compliance. Install one (21V, 1) MOV to each AC1 and AC2 line as shown. P/N: Littelfuse V08L50SP (Aerotech EC201182) or equivalent. DIN-Rail mounted surge protection devices (SPDs) can also be used. <p>CONTROL SUPPLY 24 VDC POWER SUPPLY</p> <ul style="list-style-type: none"> Minimum Requirements: Pollution Degree 2; Double Insulated; Short Circuit and Over-Voltage Protection; UL and CE Approvals. Recommended Power Supply: Mean Well P/N: NDR-240-24 (Aerotech P/N: EC202364) DIN Rail Power Supply, 10 W, 24 V, 10 A NOTE: For installation details, refer to the Mean Well NDR Series installation manual. It is the responsibility of the system designer to determine the correct power supply requirements. <p>DC SUPPLY: Wiring Specifications (Recommended)</p> <ul style="list-style-type: none"> Use twisted pair conductors with wire lengths as short as possible. Wire Size: 0.33 - 0.82 mm (22 - 18 AWG). Wire Conductor: (North America: 15 AWG) (and/or) EU: #18-#16-CE <p>SYSTEM "Protective Earth" (PE) GROUNDS</p> <ul style="list-style-type: none"> PE wires should be as short as possible. Each PE wire should have a dedicated attach/termination point directly to the grounded component panel (refer to 1.3). <p>MOTOR SUPPLY Ferrite EMC Filter (Recommended)</p> <ul style="list-style-type: none"> Clamp-On Filter (Fair-Rite P/N: 544616231) Aerotech P/N: EC202347. Apply as close as possible to the power connector. Use non-metallic tie wraps to secure the filter. <p>AXIS FEEDBACK CABLE Ferrite EMC Filters (Recommended)</p> <ul style="list-style-type: none"> Clamp-On Filter (Fair-Rite P/N: 544616231) Aerotech P/N: EC202348. Apply as close as possible to the FEEDBACK connector base shell as illustrated. <p>AX4 CONNECTIONS</p> <ul style="list-style-type: none"> Assemblies A1 and A2. If the controllers were purchased as an Aerotech integrated system, refer to the "System Interconnections" drawing included with the system documentation. If you are implementing more than four axes, repeat axes 1 through 4 interconnections as needed. 	<p>Motor Supply Voltages: <math>\leq 100</math> VAC</p> <ul style="list-style-type: none"> For the wiring example (as shown), the 24 VDC Control Supply requires a 100.240 VAC supply. NOTE: If the system requires Motor Supply voltages below 100 VAC, you could use a step-down transformer. Transformer Examples: 50 VAC for 80 VDC Bus, 28 VAC for 40 VDC Bus Transformers must have applicable UL and/or CE conformance marks. We recommend that you use a grounded secondary for optimum servo and EMC performance. Additional Motor Supply Options are available. Contact Aerotech for more information. The system designer is responsible for determining the correct transformer requirements. <p>AC1 Line</p> <p>AC2 Line</p> <p>Axis Motor Cable Ferrite Filter (Recommended)</p> <ul style="list-style-type: none"> To keep servo EMC to a minimum, we recommend that you insert ferrite bead filters onto each of the motor phase wires. Apply ferrite beads per phase. Use Fair-Rite P/N: 261320801 (Aerotech P/N: EC214301) or an equivalent product. Keep the beads packed end-to-end closely together. Use non-metallic wire ties or wire tubing to keep the beads together. Aerotech standard factor motor cables have ferrite filters built into the cables. Axis motor cable "tying leads" with ferrite bead filters. <p>AX4/AX4 DRIVE SUPPLY: INTERNAL FUSING</p> <ul style="list-style-type: none"> Control Supply is fused internally at 5 A. Motor Supply is fused internally at 5 A (10 A peak version). Motor Supply is fused internally at 10 A (20 A peak version). <p>The information on this page is for reference only and represents best practice applications.</p>
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Figure 2-48: iXA4-DC Recommended System Connections for a Drive-Based Controller



<p>! ATTENTION !</p> <p>The system integrator or end user is responsible for all safety compliance and technical requirements for the system wiring and power supply sizing.</p> <p>IMPORTANT: Read all parts of this manual before you install or operate the drive or before you do maintenance to your system.</p> <ul style="list-style-type: none"> To prevent injury to you and damage to the equipment, obey the precautions in this manual. If you do not understand the information in this manual, contact Aerotech Global Technical Support. For additional resources, refer to https://www.aerotech.com/resources-manuals-help-files/. <p>For EMC performance, mount all system components on a common conductive metal panel.</p> <ul style="list-style-type: none"> Do not use a panel that has a painted or non-conductive coat applied. You can use a panel with a conductive surface coat. <p>System AC Power</p> <ul style="list-style-type: none"> Mount fuses on a panel with a conductive surface coat. Mount fuses on a panel with a conductive surface coat. Mount fuses on a panel with a conductive surface coat. Mount fuses on a panel with a conductive surface coat. <p>DIN Rail</p> <ul style="list-style-type: none"> If system components are DIN-Rail mounted, use Phoenix P/N: NS 30/ 7.5 PERB 2000BM - 3821733 or equivalent. <p>SYSTEM WIRING - ROUTING</p> <ul style="list-style-type: none"> Make sure that VDC and VDC wiring is separated. Make sure that Motor Supply Wiring is separated from Control Supply, Low Voltage I/O, and Feedback signal wiring. <p>AC SUPPLY - Recommended Wiring Specifications</p> <ul style="list-style-type: none"> Use twisted pair conductors with wire lengths as short as possible. Wire Size: As Required (determined by the system designer). Wire Conformity: North America: UL 48W1 (and/or) IEC: IEC48W-ICE <p>The number of axes and motor power requirements dictate the architecture of the AC Power supply that could require design changes to the example illustrated. The System Designer must determine the requirements.</p>	<p>AC SUPPLY SOURCE: EMC Filter (Recommended)</p> <ul style="list-style-type: none"> Shown for reference only. Not required for EMC compliance. • Toroid Ring Construction (Lead P/N: LFR360228-300 Aerotech P/N: EC202366). • Loop System AC1 and AC2 conductor pair two times through the toroid. <p>SWITCHING SUPPLY: EMC Filter (Optional)</p> <ul style="list-style-type: none"> Shown for reference only. Not required for EMC compliance if proper switching supplies are used. • Split-Ring Construction (Lead P/N: LFR360228-300 Aerotech P/N: EC202366). <p>Metal Oxide Varistor (MOV) for Surge Protection (Recommended)</p> <ul style="list-style-type: none"> Required for EMC "Surge Immunity" compliance. • Install one (2V) MOV for each AC1 and AC2 line as shown. • P/N: Littelfuse V29E38SP (Aerotech EDD0187) or equivalent. • DIN-Rail mounted surge protection devices (SPDs) can also be used. <p>CONTROL SUPPLY 24 VDC POWER SUPPLY</p> <ul style="list-style-type: none"> Minimum Requirements: • Pollution Degree 2, Double Insulated, Short Circuit and Over-Voltage Protection, UL and CE Approvals. • Recommended Power Supply: Mean Well P/N: NDR-24C-24 (Aerotech P/N: EC202365) DIN Rail Power Supply, 480 W, 24 V, 10 A. NOTE: For installation details, refer to the Mean Well NDR Series installation manual. It is the responsibility of the system designer to determine the correct power supply requirements. <p>MOTOR SUPPLY (96 VDC Power Supply)</p> <ul style="list-style-type: none"> Minimum Requirements: • Pollution Degree 2, Double Insulated, Short Circuit and Over-Voltage Protection, UL and CE Approvals. • Recommended Power Supply: Mean Well P/N: NDR-48C-48 (Aerotech P/N: EC202365) DIN Rail Power Supply, 480 W, 48 V, 10 A. NOTE: For installation details, refer to the Mean Well NDR Series installation manual. It is the responsibility of the system designer to determine the correct power supply requirements. <p>VDC SUPPLY - Wiring Specifications (Recommended)</p> <ul style="list-style-type: none"> Use twisted pair conductors with wire lengths as short as possible. Wire Size: As Required (determined by the system designer). Wire Conformity: North America: UL 48W1 (and/or) IEC: IEC48W-ICE <p>SYSTEM - Protective Earth (PE) GROUNDS</p> <ul style="list-style-type: none"> PE wires should be as short as possible. Each PE wire should have a dedicated attachment point directly to the grounded component panel (refer to 1). 	<p>AXIS FEEDBACK CABLE Ferrite EMC Filters (Recommended)</p> <ul style="list-style-type: none"> • Clamp-On Filter (Ferrite P/N: 044616726 Aerotech P/N: EC202348) • Apply as close as possible to the FEEDBACK connector case shell as illustrated. <p>iXA4X44 CONTROLLER DRIVE</p> <ul style="list-style-type: none"> • Assemblies A1 and A2. • If the controllers were purchased as an Aerotech integrated system, refer to the "System Interconnections" drawing included with the system documentation. • If you are implementing more than four axes, repeat axes 1 through 4 interconnections as needed. <p>Axis Motor Cable Ferrite Filter (Recommended)</p> <ul style="list-style-type: none"> To keep servo EMC to a minimum, we recommend that you insert ferrite bead filters onto each of the motor power wires. • Apply 48 beads per phase. Use Ferrite P/N: 267300901 (Aerotech P/N: EC20107) or an equivalent product. • Keep the beads packed end-to-end closely together. Use non-metallic wire ties or straps being to keep the beads together. • Aerotech standard factor motor cables have ferrite filters built into the cables. • Axis motor cable: Tying leads with ferrite bead filters. <p>iXA4X44 DRIVE SUPPLY INTERNAL FUSING</p> <ul style="list-style-type: none"> • Control Supply is fused internally at 5 A. • Motor Supply is fused internally at 5 A (10 A peak version). <p>The information on this page is for reference only and represents best practice applications.</p>
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Figure 2-49: XA4-DC Recommended System Connections for a PC-Based Controller



<p>! ATTENTION !</p> <p>The system integrator or end user is responsible for all safety compliance and technical requirements for the system wiring and power supply sizing.</p> <p>IMPORTANT: Read all parts of this manual before you install or operate the drive or before you do maintenance to your system.</p> <p>To prevent injury to you and damage to the equipment, obey the precautions in this manual.</p> <p>If you do not understand the information in this manual, contact Aerotech Global Technical Support.</p> <p>For additional resources, refer to https://www.aerotech.com/resources/manuals-help-files/.</p> <p>For EMC performance, mount all system components on to a common conductive metal panel.</p> <ul style="list-style-type: none"> Do not use a panel that has a painted or non-conductive coat applied. You can use a panel with a conductive surface coat. <p>System AC Power</p> <ul style="list-style-type: none"> Must have fuse or circuit breaker protection. Voltages and currents dependent on power supplies selected and system axis requirements (refer to 3.3). <p>DN Rail</p> <ul style="list-style-type: none"> If system components are DIN-Rail mounted, use Phoenix P/N NS 35/7.5 PERF 2000MM - 0901733 or equivalent. <p>SYSTEM WIRING: ROUTING</p> <ul style="list-style-type: none"> Make sure that VAC and VDC wiring is separated. Make sure that Motor Supply Wiring is separated from Control Supply, Low Voltage I/O, and Feedback signal wiring. <p>AC SUPPLY: Recommended Wiring Specifications</p> <ul style="list-style-type: none"> Use twisted pair conductors with wire lengths as short as possible. Wire Size: As Required (determined by the system designer). Wire Conformity North America: UL AWM (and/or) IEC -1HAR-ICE <p>The number of axes and motor power requirements will determine the architecture of the AC Power supply that could require design changes to the example illustrated. The System Designer must determine the requirements.</p>	<p>AC SUPPLY SOURCE: EMC Filter (Recommended)</p> <p>Shown for reference only. Not required for EMC compliance.</p> <ul style="list-style-type: none"> Loop Ring Construction (Laser P/N: LFR30023-300) (Aerotech P/N: EC202398). Loop System AC1 and AC2 conductor pair two times through the toroid. <p>SWITCHING SUPPLY: EMC Filter (Optional)</p> <p>Shown for reference only. Not required for EMC compliance if proper switching supplies are used.</p> <ul style="list-style-type: none"> Schaffner P/N: FN2075-13-00 Aerotech P/N: EC200254 <p>Metal Oxide Varistor (MOV) for Surge Protection (Recommended)</p> <ul style="list-style-type: none"> Required for EMC "Surge Immunity" compliance. Install one (1) MOV for each AC1 and AC2 line as shown. P/N: Littelfuse V20E35P (Aerotech EDD00197) or equivalent. Only Rail mounted surge protection devices (SPDs) can also be used. <p>CONTROL SUPPLY 24 VDC POWER SUPPLY</p> <ul style="list-style-type: none"> Minimum Requirements: Position Degree 2: Double Insulated, Short Circuit and Over-Voltage Protection; UL and CE Approvals Recommended Power Supply: Mean Well P/N: NDR-24DC4 (Aerotech P/N: EC202954) DIN Rail Power Supply, 10 W, 24 V, 10 A NOTE: For installation details, refer to the Mean Well NDR Series installation manual. It is the responsibility of the system designer to determine the correct power supply requirements. <p>MOTOR SUPPLY (48 VDC Power Supply)</p> <ul style="list-style-type: none"> Minimum Requirements: Position Degree 2: Double Insulated, Short Circuit and Over-Voltage Protection; UL and CE Approvals. Recommended Power Supply: Mean Well P/N: NDR-48D-48 (Aerotech P/N: EC202965) DIN Rail Power Supply, 480 W, 48 V, 10 A NOTE: For installation details, refer to the Mean Well NDR Series installation manual. It is the responsibility of the system designer to determine the correct power supply requirements. <p>DC SUPPLY: Wiring Specifications (Recommended)</p> <ul style="list-style-type: none"> Use twisted pair conductors with wire lengths as short as possible. Wire Size: As Required (determined by the system designer). Wire Conformity North America: UL AWM (and/or) IEC -1HAR-ICE <p>SYSTEM "Protective Earth" (PE) GROUNDS</p> <ul style="list-style-type: none"> PE wires should be as short as possible. Each PE wire should have a dedicated attachment/terminal point directly to the grounded component panel (refer to 1.3). 	<p>AXIS FEEDBACK CABLE: Ferrite EMC Filters (Recommended)</p> <ul style="list-style-type: none"> Clamp-On Filter (for Rail P/N: 04610220) (Aerotech P/N: EC202348). Apply as close as possible to the FEEDBACK connector back shell as illustrated. <p>XA4 CONTROLLER/DRIVE</p> <ul style="list-style-type: none"> Assemblies A1 and A2. If the controllers were purchased as an Aerotech integrated system, refer to the "System Interconnectors" drawing included with the system documentation. If you are implementing more than four axes, repeat axes 1 through 4 interconnections as needed. <p>Axis Motor Cable: Ferrite Filter (Recommended)</p> <p>To keep noise (EMC) to a minimum, we recommend that you insert ferrite bead filters onto each of the motor phase wires.</p> <ul style="list-style-type: none"> Apply 45 beads per phase. Use Part P/N: 267300801 (Aerotech P/N: EC201001) or an equivalent product. Keep the beads packed and to-end closely together. Use non-metallic wire ties or strain tubing to keep the beads together. Aerotech standard factor motor cables have ferrite filters built into the cables. Axis motor cable "flying leads" with ferrite bead filters. <p>AXIS/AXIS DRIVE SUPPLY INTERNAL FUSING</p> <ul style="list-style-type: none"> Control Supply is fused internally at 5 A. Motor Supply is fused internally at 5 A (10 A peak version). <p>The information on this page is for reference only and represents best practice applications.</p>
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2.11. PC Configuration and Operation Information

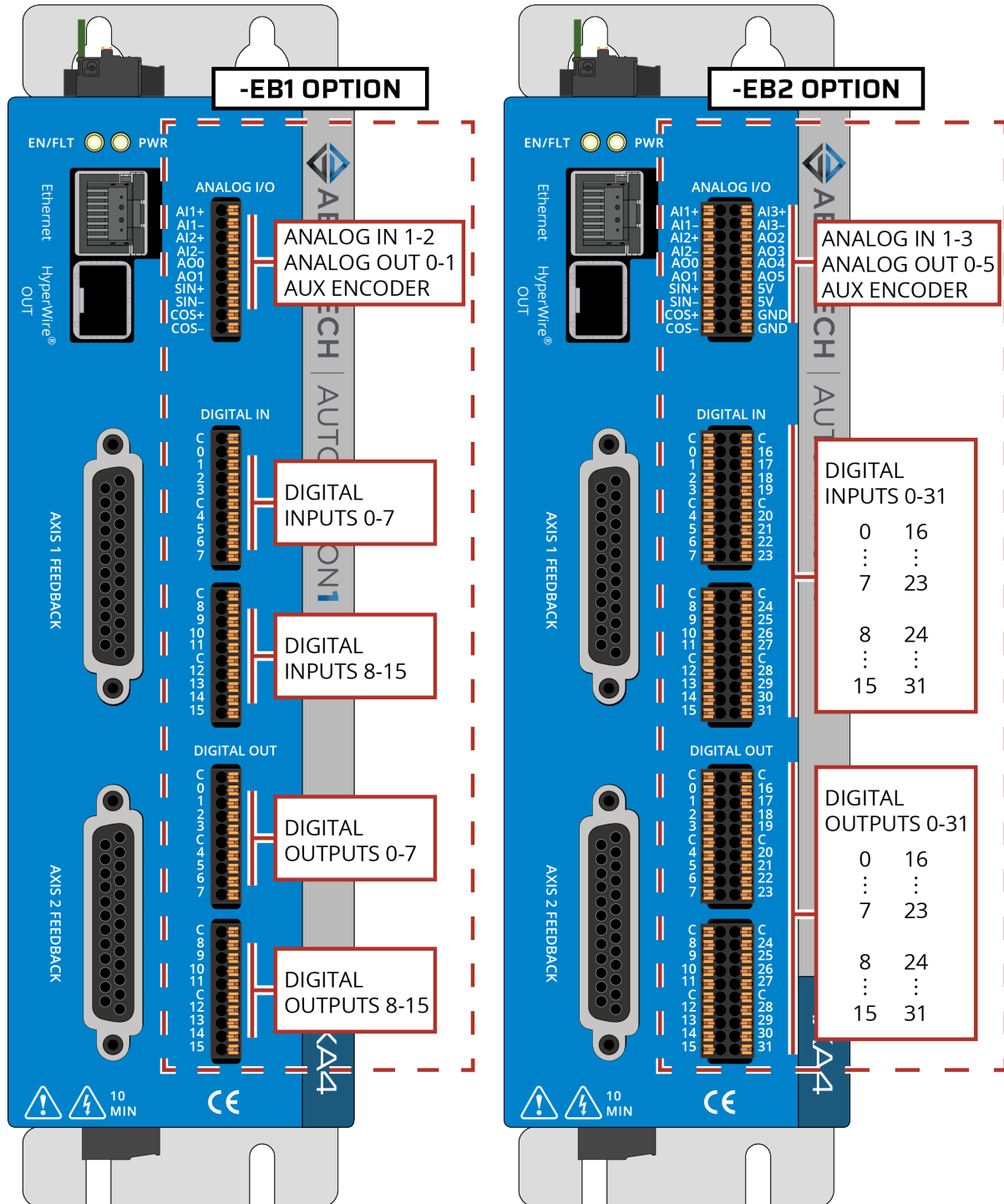
For more information about hardware requirements, PC configuration, programming, system operation, and utilities, refer to the Help file.

Chapter 3: -EB1/-EB2 Option Expansion Board

The drive supports two IO expansion boards: -EB1 is the standard-density option, and -EB2 is the high-density option.

- The -EB1 option board has 16 digital inputs, 16 digital outputs, 2 analog inputs, 2 analog outputs, and an auxiliary square-wave encoder input channel.
- The -EB2 option board has 32 digital inputs, 32 digital outputs, 3 analog inputs, 6 analog outputs, and an auxiliary square-wave encoder input channel.

Figure 3-1: -EB1 and -EB2 I/O Option Board Connectors



3.1. Digital Outputs [-EB1/-EB2]

Optically-isolated solid-state relays drive the digital outputs. You can connect the digital outputs in current sourcing or current sinking mode but you must connect all four outputs in a port in the same configuration. Refer to [Figure 3-3](#) and [Figure 3-4](#).

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

You must install suppression diodes on digital outputs that drive relays or other inductive devices. To see an example of a current sourcing output that has diode suppression, refer to [Figure 3-3](#). To see an example of a current sinking output that has diode suppression, refer to [Figure 3-4](#).

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

Table 3-1: Digital Output Specifications [-EB1/-EB2]

Digital Output Specifications	Value
Maximum Voltage	24 V (26 V Maximum)
Maximum Sink/Source Current	250 mA/output
Output Saturation Voltage	0.9 V at maximum current
Output Resistance	3.7 Ω
Rise / Fall Time	250 μ s (2K pull up to 24V)
Reset State	Output Off (High Impedance State)

Table 3-2: Digital Output Connectors Pinout [-EB1]

Pin#	Description	Connectors
1	Output Common for Outputs 0-3	
2	Output 0 (Optically-Isolated)	
3	Output 1 (Optically-Isolated)	
4	Output 2 (Optically-Isolated)	
5	Output 3 (Optically-Isolated)	
6	Output Common for Outputs 4-7	
7	Output 4 (Optically-Isolated)	
8	Output 5 (Optically-Isolated)	
9	Output 6 (Optically-Isolated)	
10	Output 7 (Optically-Isolated)	
1	Output Common for Outputs 8-11	
2	Output 8 (Optically-Isolated)	
3	Output 9 (Optically-Isolated)	
4	Output 10 (Optically-Isolated)	
5	Output 11 (Optically-Isolated)	
6	Output Common for Outputs 12-15	
7	Output 12 (Optically-Isolated)	
8	Output 13 (Optically-Isolated)	
9	Output 14 (Optically-Isolated)	
10	Output 15 (Optically-Isolated)	

Table 3-3: Digital Output Mating Connector Ratings [-EB1]

Specification		Description
Type		10-Pin Terminal Block
Part Numbers		Aerotech: ECK02750
		Phoenix: 1821177
Conductor Cross Section	Solid or stranded	20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve	22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length		7 mm
(1) Refer to the manufacturer website for additional information.		

Table 3-4: Digital Output Connectors Pinout [-EB2]

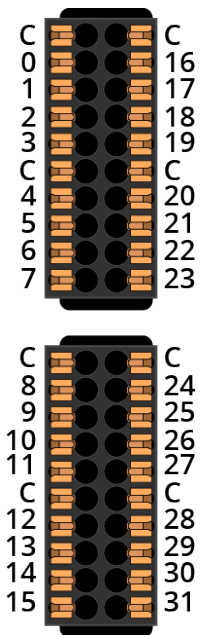
Pin#	Description	Pin#	Description	Connectors
11	Output Common for Outputs 0-3	1	Output Common for Outputs 16-19	
12	Output 0 (Optically-Isolated)	2	Output 16 (Optically-Isolated)	
13	Output 1 (Optically-Isolated)	3	Output 17 (Optically-Isolated)	
14	Output 2 (Optically-Isolated)	4	Output 18 (Optically-Isolated)	
15	Output 3 (Optically-Isolated)	5	Output 19 (Optically-Isolated)	
16	Output Common for Outputs 4-7	6	Output Common for Outputs 20-23	
17	Output 4 (Optically-Isolated)	7	Output 20 (Optically-Isolated)	
18	Output 5 (Optically-Isolated)	8	Output 21 (Optically-Isolated)	
19	Output 6 (Optically-Isolated)	9	Output 22 (Optically-Isolated)	
20	Output 7 (Optically-Isolated)	10	Output 23 (Optically-Isolated)	
11	Output Common for Outputs 8-11	1	Output Common for Outputs 24-27	
12	Output 8 (Optically-Isolated)	2	Output 24 (Optically-Isolated)	
13	Output 9 (Optically-Isolated)	3	Output 25 (Optically-Isolated)	
14	Output 10 (Optically-Isolated)	4	Output 26 (Optically-Isolated)	
15	Output 11 (Optically-Isolated)	5	Output 27 (Optically-Isolated)	
16	Output Common for Outputs 12-15	6	Output Common for Outputs 28-31	
17	Output 12 (Optically-Isolated)	7	Output 28 (Optically-Isolated)	
18	Output 13 (Optically-Isolated)	8	Output 29 (Optically-Isolated)	
19	Output 14 (Optically-Isolated)	9	Output 30 (Optically-Isolated)	
20	Output 15 (Optically-Isolated)	10	Output 31 (Optically-Isolated)	

Table 3-5: Digital Output Mating Connector Ratings [-EB2]

Specification		Description
Type		20-Pin Terminal Block
Part Numbers		Aerotech: ECK02751
		Phoenix: 1844659
Conductor Cross Section	Solid or stranded	20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve	22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length		7 mm
(1) Refer to the manufacturer website for additional information.		

Figure 3-2: Digital Outputs Schematic [-EB1/-EB2]

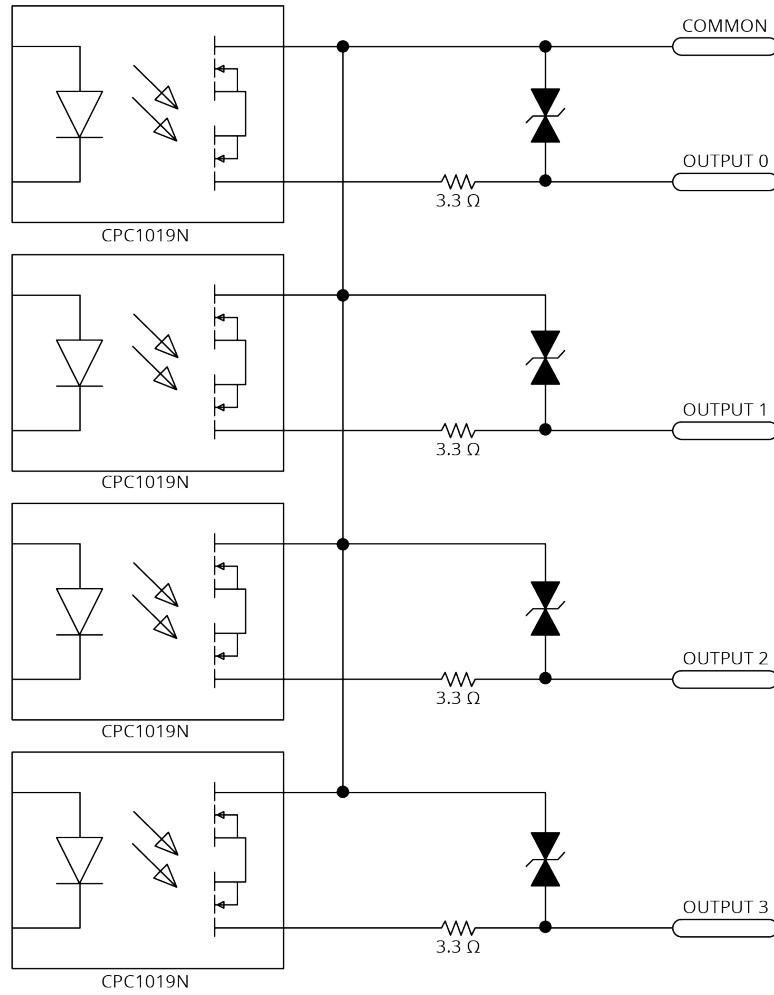
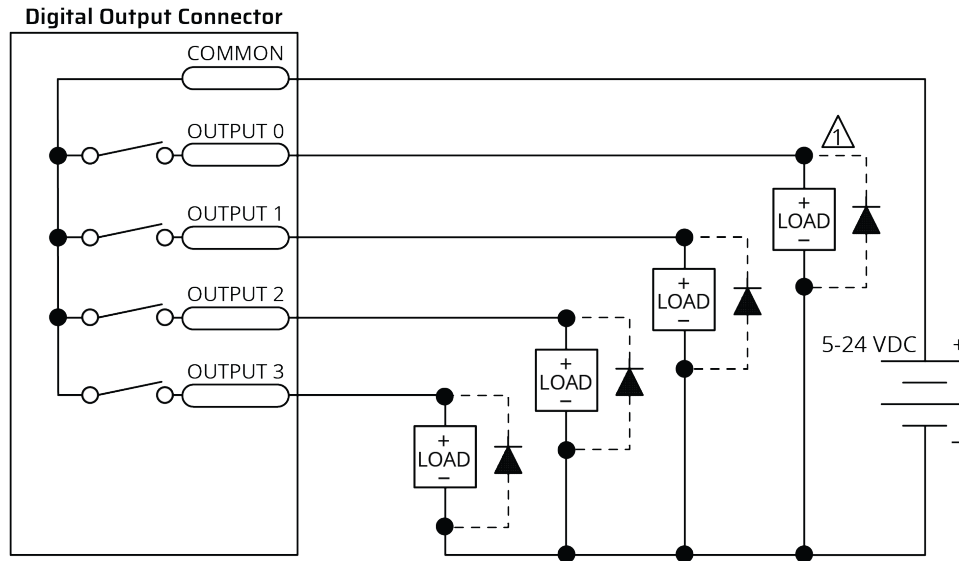
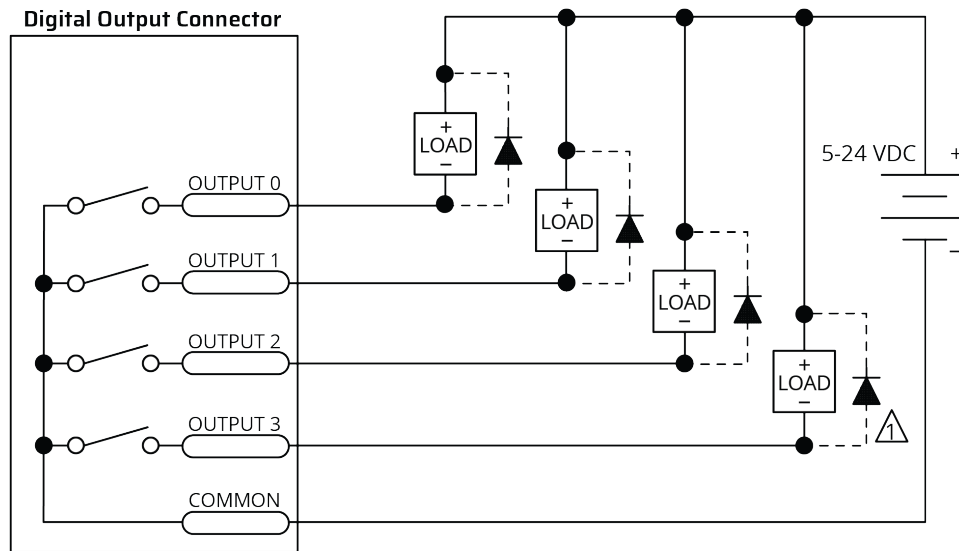


Figure 3-3: Digital Outputs Connected in Current Sourcing Mode [-EB1/-EB2]



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

Figure 3-4: Digital Outputs Connected in Current Sinking Mode [-EB1/-EB2]



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

3.2. Digital Inputs [-EB1/-EB2]

Input bits are arranged in groups of 4 and each group shares a common pin. This lets a group be connected to current sourcing or current sinking devices, based on the connection of the common pin in that group.

To be able to connect an input group to current sourcing devices, connect the input group's common pin to the power supply return (-). Refer to [Figure 3-6](#).

To be able to connect an input group to current sinking devices, connect the input group's common pin to the power supply source (+). Refer to [Figure 3-7](#).

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

Table 3-6: Digital Input Specifications [-EB1/-EB2]

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

Table 3-7: Digital Input Connector Pinouts [-EB1]

Pin#	Description	Connector
1	Input Common for Inputs 0-3	
2	Input 0 (Optically-Isolated)	
3	Input 1 (Optically-Isolated)	
4	Input 2 (Optically-Isolated)	
5	Input 3 (Optically-Isolated)	
6	Input Common for Inputs 4-7	
7	Input 4 (Optically-Isolated)	
8	Input 5 (Optically-Isolated)	
9	Input 6 (Optically-Isolated)	
10	Input 7 (Optically-Isolated)	
1	Input Common for Inputs 8-11	
2	Input 8 (Optically-Isolated)	
3	Input 9 (Optically-Isolated)	
4	Input 10 (Optically-Isolated)	
5	Input 11 (Optically-Isolated)	
6	Input Common for Inputs 12-15	
7	Input 12 (Optically-Isolated)	
8	Input 13 (Optically-Isolated)	
9	Input 14 (Optically-Isolated)	
10	Input 15 (Optically-Isolated)	

Table 3-8: Digital Inputs Mating Connector Ratings [-EB1]

Specification	Description
Type	10-Pin Terminal Block
Part Numbers	Aerotech: ECK02750
	Phoenix: 1821177
Conductor Cross Section	Solid or stranded 20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve 22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length	7 mm

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

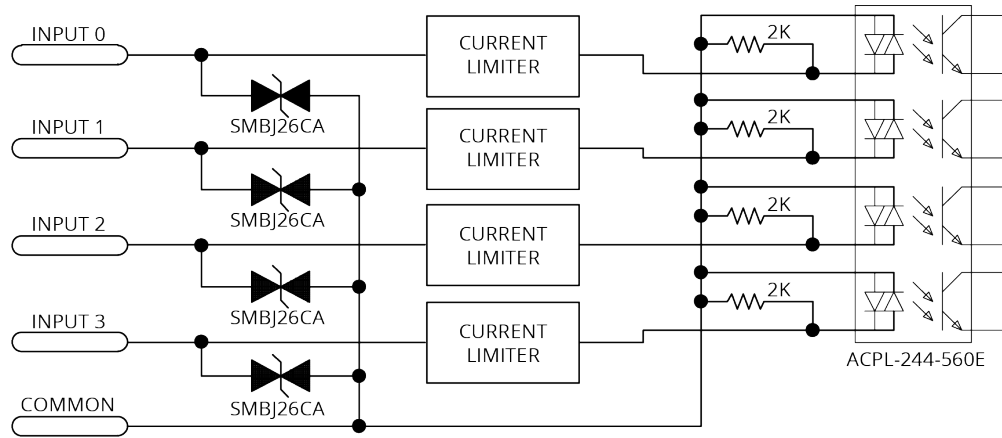
Table 3-9: Digital Input Connectors Pinout [-EB2]

Pin#	Description	Pin#	Description	Connector	
11	Input Common for Inputs 0-3	1	Input Common for Inputs 16-19		
12	Input 0 (Optically-Isolated)	2	Input 16 (Optically-Isolated)		
13	Input 1 (Optically-Isolated)	3	Input 17 (Optically-Isolated)		
14	Input 2 (Optically-Isolated)	4	Input 18 (Optically-Isolated)		
15	Input 3 (Optically-Isolated)	5	Input 19 (Optically-Isolated)		
16	Input Common for Inputs 4-7	6	Input Common for Inputs 20-23		
17	Input 4 (Optically-Isolated)	7	Input 20 (Optically-Isolated)		
18	Input 5 (Optically-Isolated)	8	Input 21 (Optically-Isolated)		
19	Input 6 (Optically-Isolated)	9	Input 22 (Optically-Isolated)		
20	Input 7 (Optically-Isolated)	10	Input 23 (Optically-Isolated)		
11	Input Common for Inputs 8-11	1	Input Common for Inputs 24-27		
12	Input 8 (Optically-Isolated)	2	Input 24 (Optically-Isolated)		
13	Input 9 (Optically-Isolated)	3	Input 25 (Optically-Isolated)		
14	Input 10 (Optically-Isolated)	4	Input 26 (Optically-Isolated)		
15	Input 11 (Optically-Isolated)	5	Input 27 (Optically-Isolated)		
16	Input Common for Inputs 12-15	6	Input Common for Inputs 28-31		
17	Input 12 (Optically-Isolated)	7	Input 28 (Optically-Isolated)		
18	Input 13 (Optically-Isolated)	8	Input 29 (Optically-Isolated)		
19	Input 14 (Optically-Isolated)	9	Input 30 (Optically-Isolated)		
20	Input 15 (Optically-Isolated)	10	Input 31 (Optically-Isolated)		

Table 3-10: Digital Input Mating Connector Ratings [-EB2]

Specification		Description
Type		20-Pin Terminal Block
Part Numbers		Aerotech: ECK02751
		Phoenix: 1844659
Conductor Cross Section	Solid or stranded	20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve	22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length		7 mm
(1) Refer to the manufacturer website for additional information.		

Figure 3-5: Digital Inputs Schematic [-EB1/-EB2]





IMPORTANT: Each bank of four inputs must be connected in an all sourcing or all sinking configuration.

Figure 3-6: Digital Inputs Connected to Current Sourcing (PNP) Devices [-EB1/-EB2]

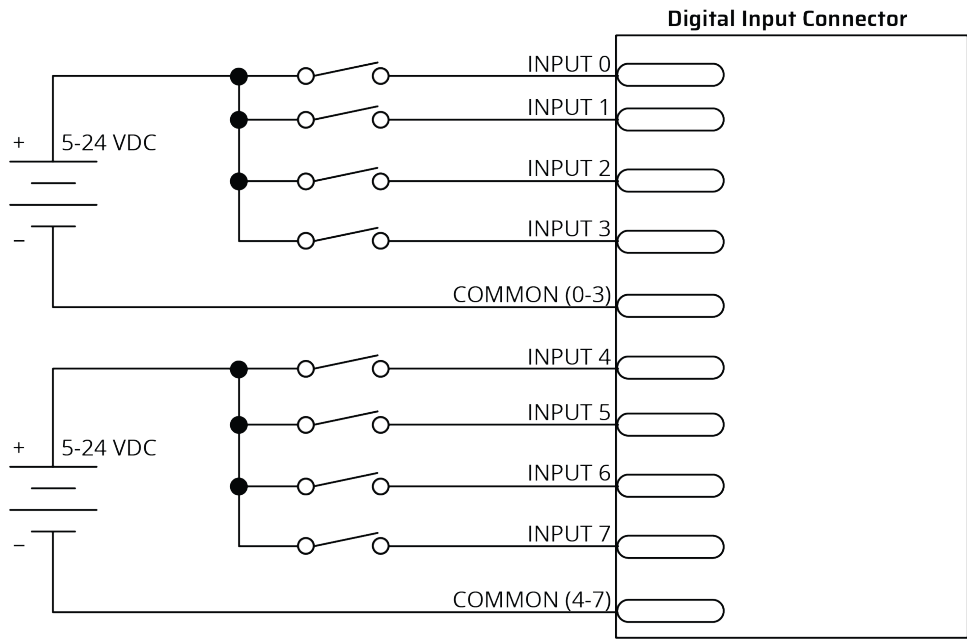
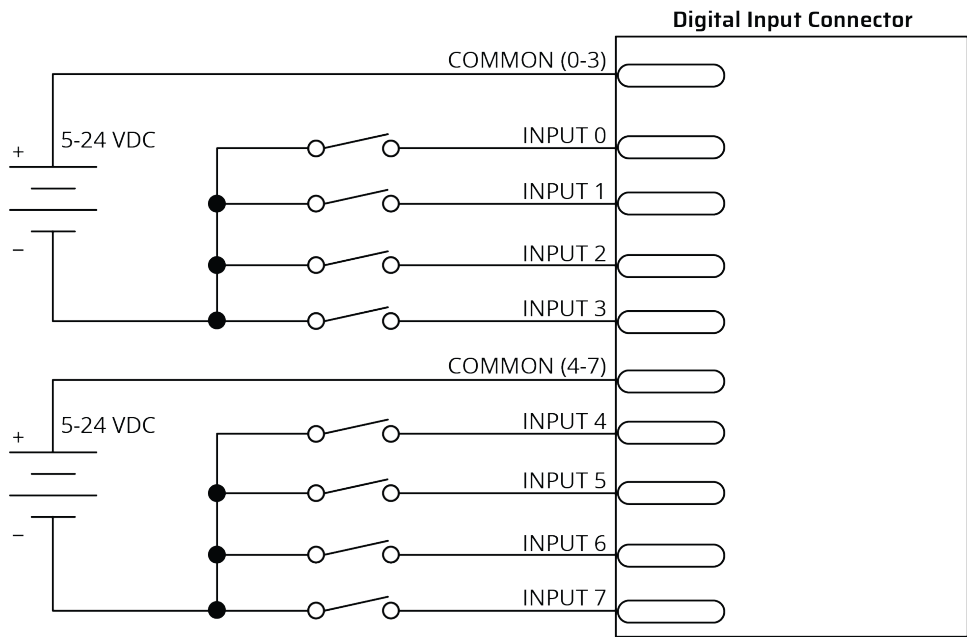


Figure 3-7: Digital Inputs Connected to Current Sinking (NPN) Devices [-EB1/-EB2]



3.3. Analog Outputs [-EB1/-EB2]

The analog outputs can be set from within a program or they can be configured to echo the state of select servo loop nodes.

The analog outputs are set to zero when you power on the system or reset the drive.

Table 3-11: Analog Output Specifications [-EB1/-EB2]

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

Table 3-12: Analog Output Connector Pinout [-EB1]


Pin #	Description	In/Out/Bi	Connector
1	Analog Input 1+	Input	
2	Analog Input 1-	Input	
3	Analog Input 2+	Input	
4	Analog Input 2-	Input	
5	Analog Output 0	Output	
6	Analog Output 1	Output	
7	Auxiliary Encoder Sine +	Bidirectional	
8	Auxiliary Encoder Sine -	Bidirectional	
9	Auxiliary Encoder Cosine +	Bidirectional	
10	Auxiliary Encoder Cosine -	Bidirectional	

Table 3-13: Analog Outputs Mating Connector Ratings [-EB1]

Specification	Description
Type	10-Pin Terminal Block
Part Numbers	Aerotech: ECK02750
	Phoenix: 1821177
Conductor Cross Section	Solid or stranded
	Stranded, with ferrule, without plastic sleeve
Conductor Insulation Strip Length	7 mm
(1) Refer to the manufacturer website for additional information.	

Table 3-14: Analog Output Connector Pinout [-EB2]

Pin #	Description	Pin #	Description	Connector		
11	Analog Input 1+	IN	1	Analog Input 3+	IN	
12	Analog Input 1-	IN	2	Analog Input 3-	IN	
13	Analog Input 2+	IN	3	Analog Output 2	OUT	
14	Analog Input 2-	IN	4	Analog Output 3	OUT	
15	Analog Output 0	OUT	5	Analog Output 4	OUT	
16	Analog Output 1	OUT	6	Analog Output 5	OUT	
17	Aux Sine +	BI	7	+5V (500 mA max)	OUT	
18	Aux Sine -	BI	8	+5V (500 mA max)	OUT	
19	Aux Cosine +	BI	9	Ground	N/A	
20	Aux Cosine -	BI	10	Ground	N/A	

Table 3-15: Analog Outputs Mating Connector Ratings [-EB2]

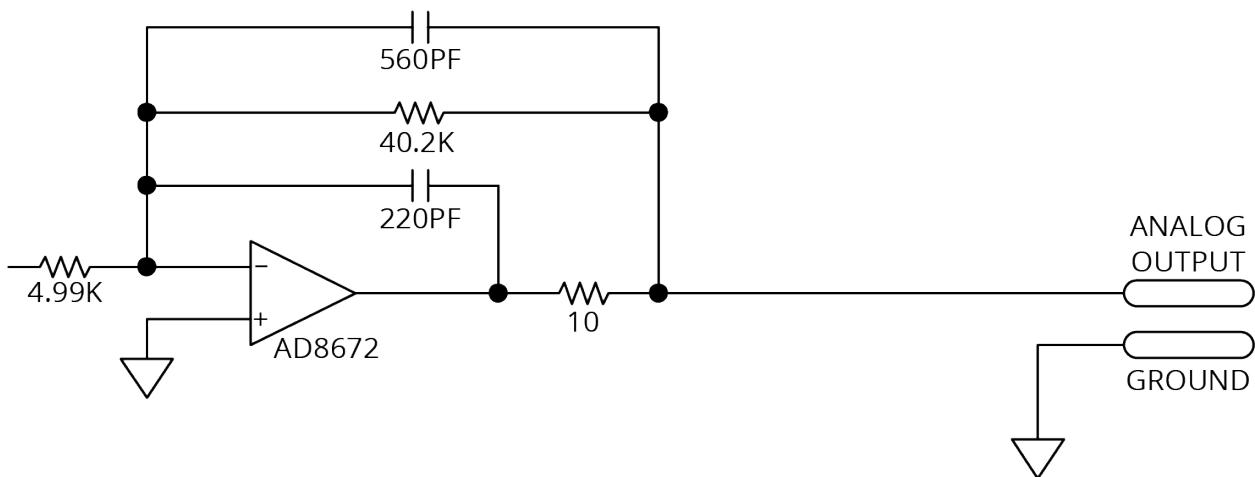
Specification		Description
Type		20-Pin Terminal Block
Part Numbers		Aerotech: ECK02751 Phoenix: 1844659
Conductor Cross Section	Solid or stranded	20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve	22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length		7 mm

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



IMPORTANT: -EB2 Analog Output connector includes ground (GND) pins that can be used to reference the analog outputs. For -EB1, you should use the GND pins that are accessible on the axis feedback connector(s).

Figure 3-8: Analog Output Typical Connection



3.4. Analog Inputs [-EB1/-EB2]

To interface to a single-ended, non-differential voltage source, connect the signal common of the source to the negative input and connect the analog source signal to the positive input. A floating signal source must be referenced to the analog common. Refer to [Figure 3-9](#).

Table 3-16: Differential Analog Input Specifications [-EB1/-EB2]

Specification	Value
(AI+) - (AI-)	+10 V to -10 V ⁽¹⁾
Resolution (bits)	16 bits
Input Impedance	1 M Ω
1. Signals outside of this range may damage the input	

Table 3-17: Analog Input Connector Pinout [-EB1]


Pin #	Description	In/Out/Bi	Connector
1	Analog Input 1+	Input	
2	Analog Input 1-	Input	
3	Analog Input 2+	Input	
4	Analog Input 2-	Input	
5	Analog Output 0	Output	
6	Analog Output 1	Output	
7	Auxiliary Encoder Sine +	Bidirectional	
8	Auxiliary Encoder Sine -	Bidirectional	
9	Auxiliary Encoder Cosine +	Bidirectional	
10	Auxiliary Encoder Cosine -	Bidirectional	

Table 3-18: Analog Inputs Mating Connector Ratings [-EB1]

Specification	Description
Type	10-Pin Terminal Block
Part Numbers	Aerotech: ECK02750
	Phoenix: 1821177
Conductor Cross Section	Solid or stranded 20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve 22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length	7 mm
(1) Refer to the manufacturer website for additional information.	

Table 3-19: Analog Inputs Connector Pinout [-EB2]

Pin #	Description	Pin #	Description	Connector		
11	Analog Input 1+	IN	1	Analog Input 3+	IN	
12	Analog Input 1-	IN	2	Analog Input 3-	IN	
13	Analog Input 2+	IN	3	Analog Output 2	OUT	
14	Analog Input 2-	IN	4	Analog Output 3	OUT	
15	Analog Output 0	OUT	5	Analog Output 4	OUT	
16	Analog Output 1	OUT	6	Analog Output 5	OUT	
17	Aux Sine +	BI	7	+5V (500 mA max)	OUT	
18	Aux Sine -	BI	8	+5V (500 mA max)	OUT	
19	Aux Cosine +	BI	9	Ground	N/A	
20	Aux Cosine -	BI	10	Ground	N/A	

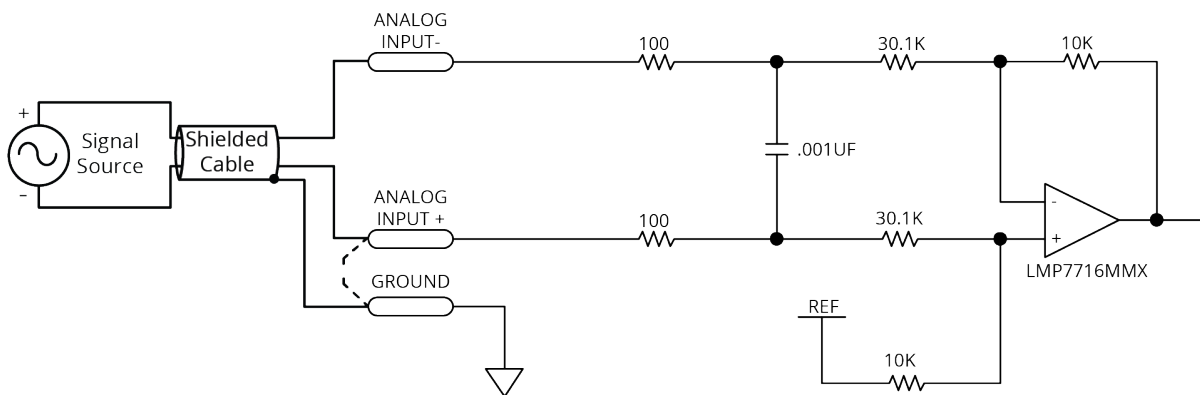
Table 3-20: Analog Inputs Mating Connector Ratings [-EB2]

Specification		Description
Type		20-Pin Terminal Block
Part Numbers		Aerotech: ECK02751 Phoenix: 1844659
Conductor Cross Section	Solid or stranded	20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve	22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length		7 mm
(1) Refer to the manufacturer website for additional information.		



IMPORTANT: -EB2 Analog Input connector includes ground (GND) pins that can be used to reference the analog inputs. For -EB1, you should use the GND pins that are accessible on the axis feedback connector(s).

Figure 3-9: Analog Input Typical Connection



3.5. Auxiliary Encoder Interface [-EB1/-EB2]

The Auxiliary Encoder connector gives you a second encoder channel. This channel is typically used for dual loop applications.

Use the AuxiliaryFeedbackType [A3200: PositionFeedbackType or VelocityFeedbackType] parameter to configure the drive to accept an encoder signal type.

Square Wave encoder signals: [Section 3.5.1](#).

You can configure the Auxiliary Encoder interface as an output that will transmit encoder signals for external use. Use the DriveEncoderOutputConfigureInput() function [A3200: EncoderDivider parameter] to configure the Sine ± and Cosine ± connector pins as RS-422 outputs. You can only echo incremental square wave primary encoder inputs.

Table 3-21: Auxiliary Encoder Connector Pinout [-EB1]

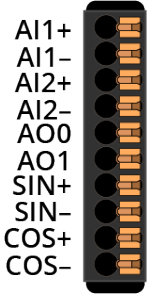
Pin #	Description	In/Out/Bi	Connector
1	Analog Input 1+	Input	
2	Analog Input 1-	Input	
3	Analog Input 2+	Input	
4	Analog Input 2-	Input	
5	Analog Output 0	Output	
6	Analog Output 1	Output	
7	Auxiliary Encoder Sine +	Bidirectional	
8	Auxiliary Encoder Sine -	Bidirectional	
9	Auxiliary Encoder Cosine +	Bidirectional	
10	Auxiliary Encoder Cosine -	Bidirectional	

Table 3-22: Analog Inputs Mating Connector Ratings [-EB1]

Specification		Description
Type		10-Pin Terminal Block
Part Numbers		Aerotech: ECK02750 Phoenix: 1821177
Conductor Cross Section	Solid or stranded	20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve	22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length		7 mm
(1) Refer to the manufacturer website for additional information.		

Table 3-23: Auxiliary Encoder Connector Pinout [-EB2]

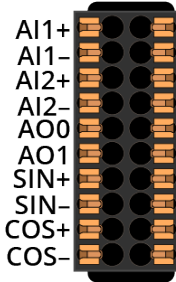
Pin #	Description	Pin #	Description	Connector		
11	Analog Input 1+	IN	1	Analog Input 3+	IN	
12	Analog Input 1-	IN	2	Analog Input 3-	IN	
13	Analog Input 2+	IN	3	Analog Output 2	OUT	
14	Analog Input 2-	IN	4	Analog Output 3	OUT	
15	Analog Output 0	OUT	5	Analog Output 4	OUT	
16	Analog Output 1	OUT	6	Analog Output 5	OUT	
17	Aux Sine +	BI	7	+5V (500 mA max)	OUT	
18	Aux Sine -	BI	8	+5V (500 mA max)	OUT	
19	Aux Cosine +	BI	9	Ground	N/A	
20	Aux Cosine -	BI	10	Ground	N/A	

Table 3-24: Analog Inputs Mating Connector Ratings [-EB2]

Specification		Description
Type		20-Pin Terminal Block
Part Numbers		Aerotech: ECK02751 Phoenix: 1844659
Conductor Cross Section	Solid or stranded	20...26 AWG (0.14...0.5 mm ²)
	Stranded, with ferrule, without plastic sleeve	22...24 AWG (0.25...0.34 mm ²)
Conductor Insulation Strip Length		7 mm
(1) Refer to the manufacturer website for additional information.		

3.5.1. Square Wave Encoder (Auxiliary)[-EB1/-EB2]

The drive accepts RS-422 square wave encoder signals. The drive will generate a feedback fault if it detects an invalid signal state caused by an open or shorted signal connection. Use twisted-pair wiring for the highest performance and noise immunity.

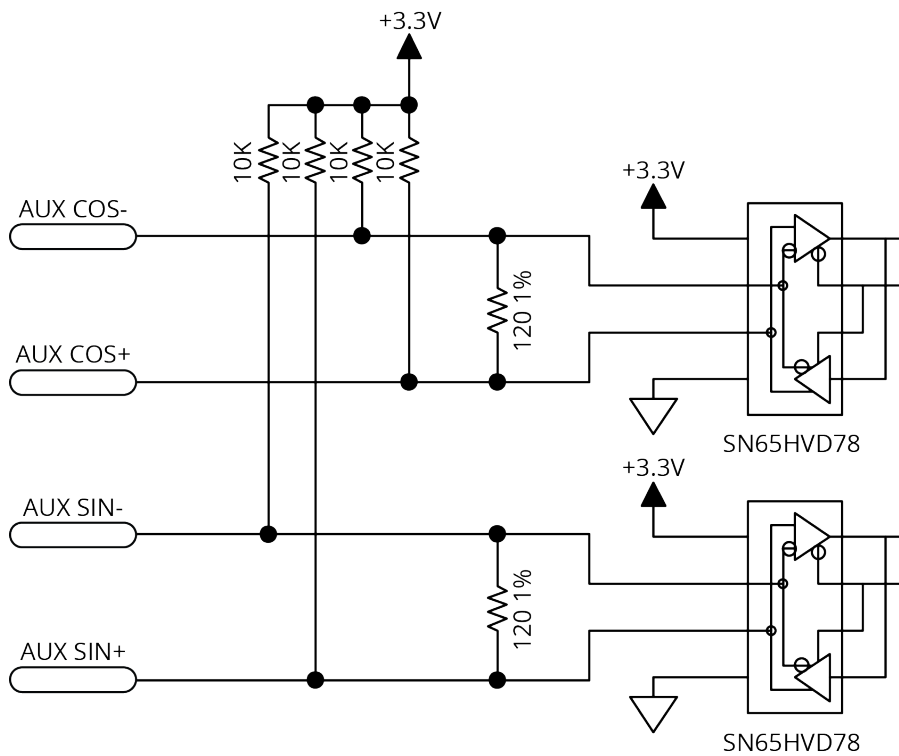
Table 3-25: Square Wave Encoder Specifications

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



IMPORTANT: -EB2 Aux Encoder connector includes 5 V and GND pins that you can use to power the auxiliary encoder. For -EB1, you should use the +5 V and GND pins that are accessible on the axis feedback connector(s).

Figure 3-10: Square Wave Encoder Interface (Auxiliary)



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Chapter 4: Cables and Accessories

Table 3-1: Standard Interconnection Cables

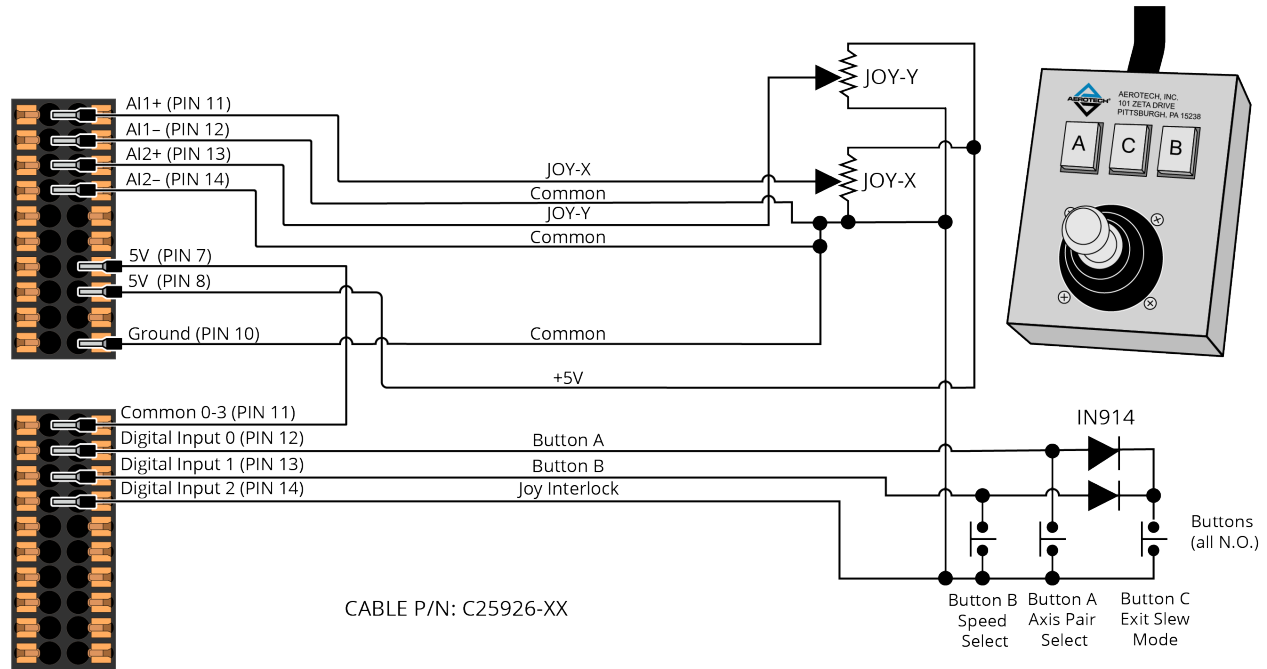
Cable Part #	Description
ENET-CAT5e-xx ^(1, 2)	Ethernet CAT5e Cable
USB-AMCM-xx ^(1, 2, 3)	USB Cable A-Male to C-Male
HyperWire	Refer to Section 2.7 .
Joystick	Refer to Section 4.1. Joystick Interface
Handwheel	Refer to Section 4.2. Handwheel Interface
(1) The "-xx" indicates length in decimeters.	
(2) iXA4 Only	
(3) Make sure that you are using a shielded USB-C cable that is designed for data transfer.	

4.1. Joystick Interface

Aerotech Multi-Axis Joystick (NEMA12 (IP54) rated) is powered from 5 V and has a nominal 2.5 V 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 -10 V to +10 V.

Connecting joystick with an Aerotech cable, all Aerotech cables are labeled to identify the connector and connections. The joystick parameters must be set to match the analog and digital I/O connections. Refer to the Help file for programming information about how to change joystick parameters.

Figure 3-1: Two Axis Joystick Interface (to the -EB2 I/O Board)



4.2. Handwheel Interface

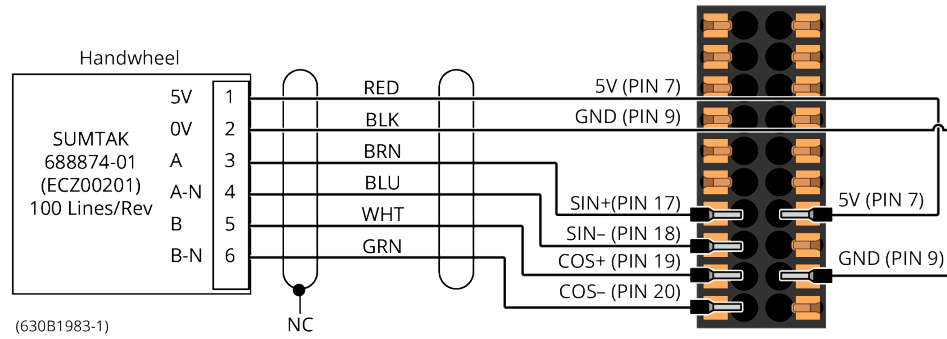
A handwheel can be used to manually control axis position. The handwheel must provide 5V differential quadrature signals to the drive.



IMPORTANT: You can find instructions on how to enable the handwheel in the online Help file.

Connect a handwheel to the Aux connector as shown in [Figure 3-2](#).

Figure 3-2: Handwheel Interconnection to the -EB2 I/O Board



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Chapter 5: Maintenance



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

- Do not remove the cover of the iXA4/XA4.
- Do not attempt to access the internal components.

A fuse that needs to be replaced indicates that there is a more serious problem with the system or setup. Contact Global Technical Support for assistance.



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

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

Table 4-1: LED Description

LED	Color	Description
PWR	GREEN	The drive is powered on.
	RED ⁽¹⁾	The light will turn red when power is first applied, a communication problem occurs, or a drive reset is initiated. It will remain red during drive initialization.
EN/FLT	GREEN	Any axis is Enabled.
	RED	Any axis is in a Fault Condition.
	GREEN/RED (alternates)	Any axis is Enabled in a Fault Condition. or The light is configured to blink for setup.

Table 4-2: Troubleshooting

Symptom	Possible Cause and Solution
No Communication	Make sure the power LED is illuminated (this indicates that power is present).
	Make sure that all communication cables (HyperWire, for example) are fully inserted in their ports.

5.1. Preventative Maintenance

Do an inspection of the iXA4/XA4 and the external wiring one time each month. It might be necessary to do more frequent inspections based on:

- The operating conditions of the system.
- How you use the system.

Table 4-3: Preventative Maintenance

Check	Action to be Taken
Examine the chassis for hardware and parts that are damaged or loose. It is not necessary to do an internal inspection unless you think internal damage occurred.	Repair all damaged parts.
Do an inspection of the cooling vents.	Remove all material that collected in the vents.
Examine the work area to make sure there are no fluids and no electrically conductive materials.	Do not let fluids and electrically conductive material go into the chassis.
Examine all cables and connections to make sure they are correct.	Make sure that all connections are correctly attached and not loose. Replace cables that are worn. Replace all broken connectors.

Cleaning



DANGER: Before you clean the iXA4/XA4, disconnect the electrical power from the drive.

Use a clean, dry, soft cloth to clean the iXA4/XA4. If necessary, use a cloth that is moist with water or isopropyl alcohol. If you use a moist cloth, make sure that moisture does not go into the drive. Also make sure that it does not go onto the outer connectors and components. Internal contamination from the cleaning solution can cause corrosion and electrical short circuits.

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

5.2. Fuse Specifications



WARNING: Replace fuses only with the same type and value.

Table 4-4: Control Board Fuse Specifications

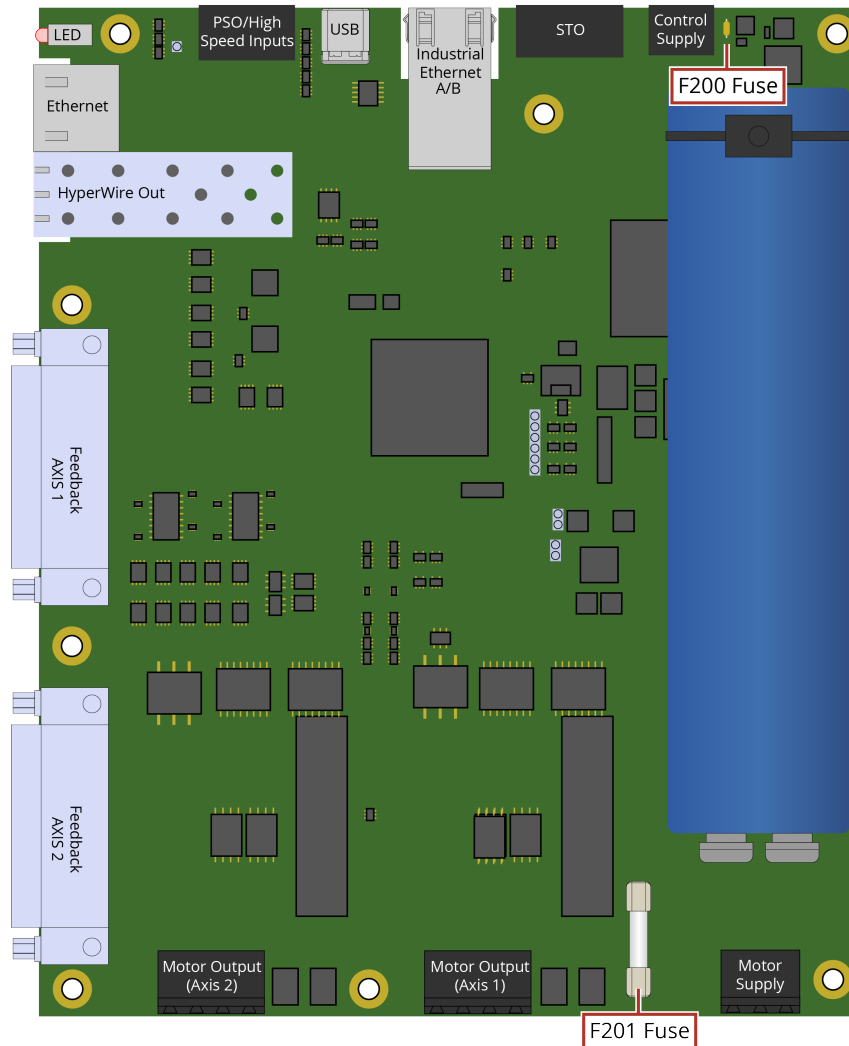
Fuse	Description	Size	SCCR ⁽¹⁾	Aerotech P/N	Third Party P/N
F200 ⁽²⁾	Control Power at +24 V Input	5 A S.B.	35 A	EIF01076	Littelfuse 0473005.MRT1L
F201	Motor Bus Supply at AC1 (-10 Peak Current Option)	5 A S.B.	1500 A	EIF01023	Littelfuse 215005.HXP
	Motor Bus Supply at AC1 (-20 Peak Current Option)	10 A S.B.		EIF01020	Littelfuse 0215010.HXP
	Motor Bus Supply at DC+ (-10 Peak Current Option)	5 A S.B.		EIF01023	Littelfuse 215005.HXP

(1) Short circuit current rating

(2) F200 is soldered into the PCB and is not user replaceable.

Figure 4-1: Fuse Locations on the iXA4 Control Board

NOTE: iXA4 2-Axis Control board is shown. The fuse locations are the same on the XA4.



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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). Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than thirty (30) days after the issuance of a return authorization number will be subject to review.

Visit [Global Technical Support Portal](#) for the location of your nearest Aerotech Service center.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an expedited method of return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Fixed Fee Repairs - Products having fixed-fee pricing will require a valid purchase order or credit card particulars before any service work can begin.

All Other Repairs - After Aerotech's evaluation, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within thirty (30) days of notification will result in the product(s) being returned as is, at the buyer's expense.

Repair work is warranted for ninety (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-site Non-Warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

Service Locations

<https://www.aerotech.com/contact-sales.aspx?mapState=showMap>

USA, CANADA, MEXICO

Aerotech, Inc.
Global Headquarters

CHINA

Aerotech China
Full-Service Subsidiary

GERMANY

Aerotech Germany
Full-Service Subsidiary

TAIWAN

Aerotech Taiwan
Full-Service Subsidiary

UNITED KINGDOM

Aerotech United Kingdom
Full-Service Subsidiary

Appendix B: Revision History

Revision	Description
1.04	Updated -DC option configurations
1.03	Updated: <ul style="list-style-type: none">• Feature Summary (Section 1.1.)• Electrical Specifications (Section 1.4.)• Table 4-1 (red power description)
1.02	Update to Section 1.4. Electrical Specifications
1.01	Updated Section 2.1.1. Control Supply Connector Added Section 2.10. System Interconnection
1.00	New Manual

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