Ensemble HPe 10/20/30 Hardware Manual

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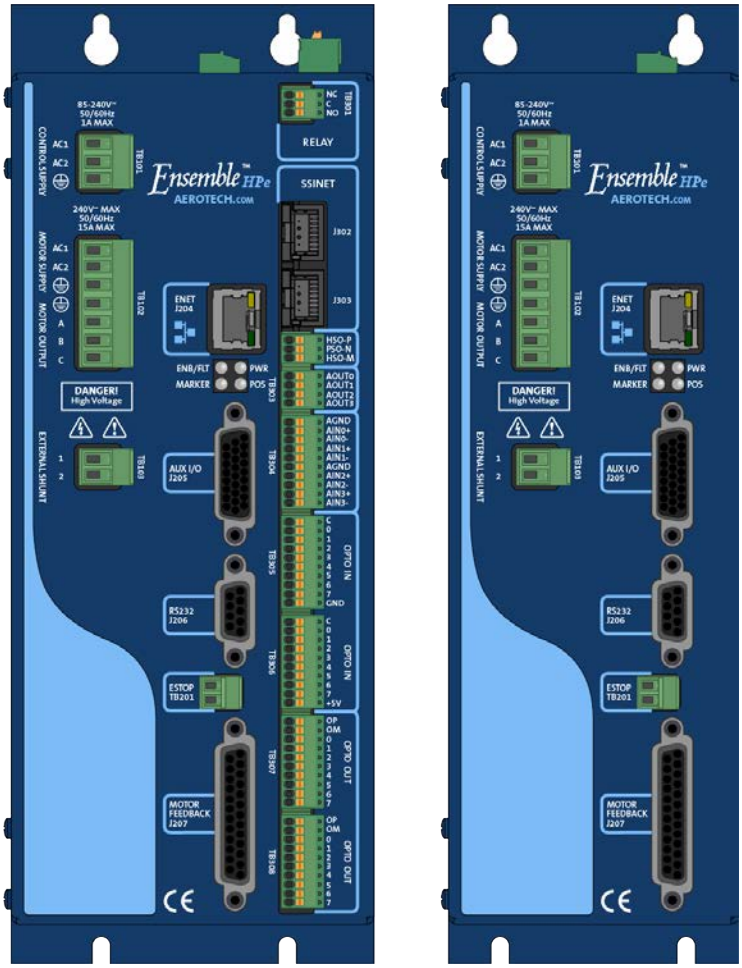

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United States (World Headquarters)	
Email: Support@aerotech.com Phone: +1-412-967-6440 Fax: +1-412-967-6870	101 Zeta Drive Pittsburgh, PA 15238-2811 www.aerotech.com
United Kingdom	**China**
Email: Support@aerotech.com Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649	Email: Support@aerotech.com Phone: +86 (21) 5508 6731
Germany	**Taiwan**
Email: Support@aerotech.com Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720	Email: Support@aerotech.com Phone: +886 (0)2 8751 6690
France	
Email: Support@aerotech.com Phone: +33 2 37 21 87 65	

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EU Declaration of Conformity

Manufacturer	Aerotech, Inc.
Address	101 Zeta Drive Pittsburgh, PA 15238-2811 USA
Product	Ensemble HPe 10/20/30
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 Directive
2014/35/EU	Low Voltage Directive
2011/65/EU	RoHS 2 Directive

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

EN 61800-3:2004	EMC Requirements for Power Drives
EN 61010-1:2010	Safety Requirements for Electrical Equipment

Authorized Representative:	Simon Smith, European Director
Address:	Aerotech Ltd The Old Brick Kiln, Ramsdell, Tadley Hampshire RG26 5PR UK
Name	/ Alex Weibel
Position	Engineer Verifying Compliance
Location	Pittsburgh, PA
Date	6/20/2019

CE

Agency Approvals

Aerotech, Inc. Model Ensemble HPe 10/20/30 Series Digital Drives have been tested and found to be in accordance to the following listed Agency Approvals:

Approval / Certification:	CUS NRTL
Approving Agency:	TUV SUD America Inc.
Certificate #:	U8 17 01 68995 023
Standards:	CAN/CSA-C22.2 No. 61010-1:2012; UL 61010-1:2012

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

Safety Procedures and Warnings

This manual tells you how to carefully and correctly use and operate the Ensemble HPe 10/20/30. Read all parts of this manual before you install or operate the Ensemble HPe 10/20/30 or before you do maintenance to your system. To prevent injury to you and damage to the equipment, obey the precautions in this manual. The precautions that follow apply when you see a Danger or Warning symbol in this manual. If you do not obey these precautions, injury to you or damage to the equipment can occur. If you do not understand the information in this manual, contact Aerotech Global Technical Support.

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

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to www.aerotech.com for the most up-to-date information.

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

1. Disconnect electrical power before servicing equipment.
2. Disconnect electrical power before performing any wiring.
3. Access to the Ensemble HPe 10/20/30 and component parts must be restricted while connected to a power source.
4. To minimize the possibility of electrical shock and bodily injury, extreme care must be exercised when any electrical circuits are in use. Suitable precautions and protection must be provided to warn and prevent persons from making contact with live circuits.
5. Install the Ensemble HPe 10/20/30 inside a rack or enclosure.
6. The shunt resistor temperature can exceed 70°C during normal operation and contains lethal voltage on its terminals and surface. It must be properly enclosed and shielded to avoid risk of fire and operator shock.
7. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
8. All components must be properly grounded in accordance with local electrical safety requirements.
9. Operator safeguarding requirements must be addressed during final integration of the product.

DANGER: The Ensemble HPe 10/20/30 case temperature may exceed 70°C in some applications.

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

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

Quick Installation Guide

This chapter describes the order in which connections and settings should typically be made to the Ensemble HPe 10/20/30. If a custom interconnection drawing was created for your system (look for a line item on your Sales Order under the heading “Integration”), that drawing can be found on your installation device.

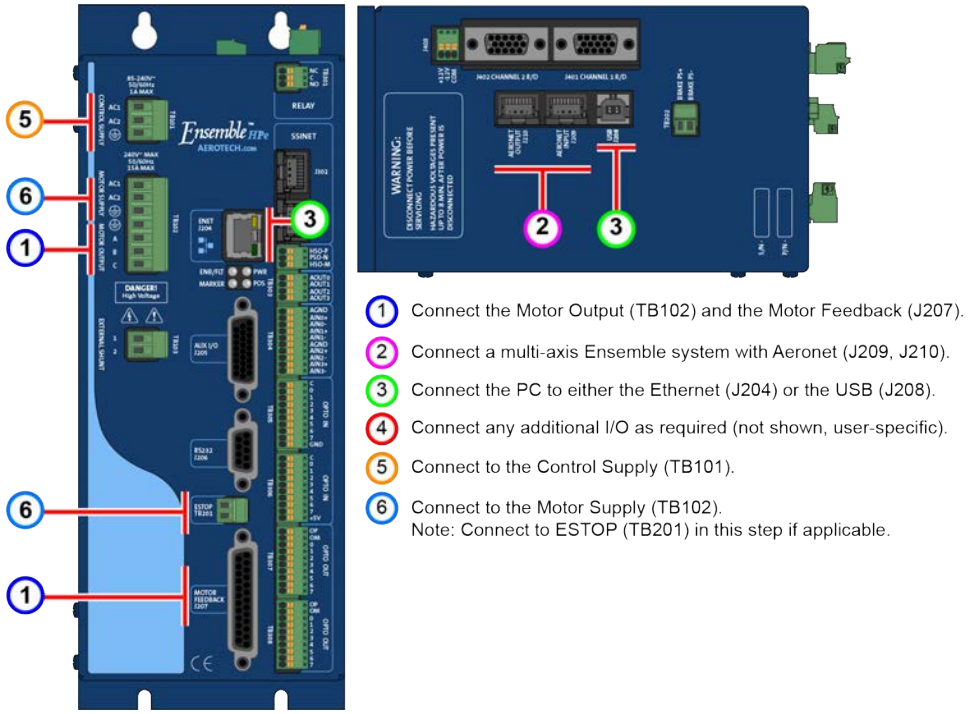

Figure 1: Quick Start Connections

Topic	Section
Motor Output	Section 2.2. Motor Output Connections
Motor Feedback	Section 2.3. Motor Feedback Connector (J207)
Aeronet	Section 2.7. Aeronet Interface (J209/J210)
Ethernet / USB	No Section / Standard Connection
Control Supply	Section 2.1.1. Control Supply Connections (TB101)
Motor Supply	Section 2.1.2. Motor Supply Connections (TB102)
Additional I/O	User / Application dependent

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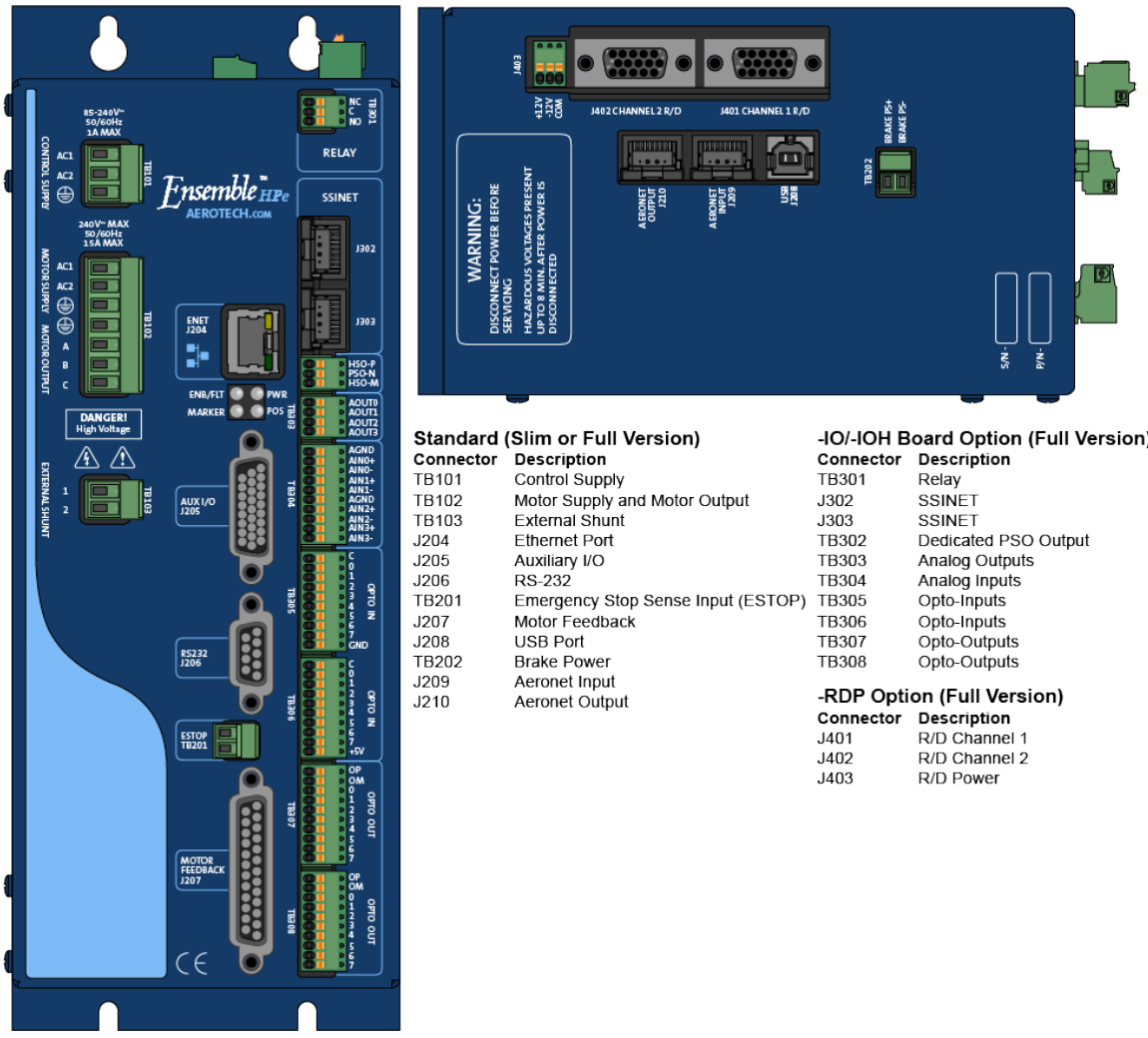
Chapter 1: Introduction

Aerotech's Ensemble HPe 10/20/30 (High Power PWM) network digital drive is a high performance amplifier. The drive provides deterministic behavior, auto-identification, and easy software setup. The Ensemble HPe 10/20/30's high performance double precision floating point DSP controls the digital PID and current loops. All system configuration is done using software-settable parameters, including control loop gains and system safety functions.

The Ensemble HPe 10/20/30 is offered with an optional encoder interpolation feature (-MXH), an auxiliary square wave encoder input for dual loop control, dedicated analog and digital I/O (expandable with the -IO option), a resolver input, and separate power connections for motor and control supply voltages.



Standard (Slim or Full Version)

Connector	Description
TB101	Control Supply
TB102	Motor Supply and Motor Output
TB103	External Shunt
J204	Ethernet Port
J205	Auxiliary I/O
J206	RS-232
TB201	Emergency Stop Sense Input (ESTOP)
J207	Motor Feedback
J208	USB Port
TB202	Brake Power
J209	Aeronet Input
J210	Aeronet Output

-IO/-IOH Board Option (Full Version)

Connector	Description
TB301	Relay
J302	SSINET
J303	SSINET
TB302	Dedicated PSO Output
TB303	Analog Outputs
TB304	Analog Inputs
TB305	Opto-Inputs
TB306	Opto-Inputs
TB307	Opto-Outputs
TB308	Opto-Outputs

-RDP Option (Full Version)

Connector	Description
J401	R/D Channel 1
J402	R/D Channel 2
J403	R/D Power

Figure 1-1: Ensemble HPe 10/20/30 Networked Digital Drive

Table 1-1: Feature Summary

Standard Features	
• 85 - 240 VAC control supply inputs	Section 2.1.1.
• 14 - 240 VAC motor supply inputs (producing 20-320 VDC)	Section 2.1.2.
• Primary quadrature encoder input channels	Section 2.3.1.
• Absolute Encoder support	Section 2.3.1.2.
• Dedicated Home and Limit inputs	Section 2.3.5.
• Dedicated 5-24 V Emergency Stop sense input	Section 2.4.
• Auxiliary quadrature encoder input channels	Section 2.5.1.
• Single-axis PSO capability	Section 2.5.2.
• Four digital outputs (opto-isolated)	Section 2.5.3.
• Four digital inputs (opto-isolated)	Section 2.5.4.
• Two high-speed digital inputs (opto-isolated)	Section 2.5.5.
• One 16-bit analog output (±10 VDC)	Section 2.5.6.
• One 16-bit analog differential input (±10 VDC)	Section 2.5.7.
• One 24 VDC, 1 A brake relay	Section 2.6.
• Calibration	Refer to the Help file
• Camming	Refer to the Help file
• 10/100 BASE-T Ethernet port for use with Ethernet I/O modules	Refer to the Help file

Table 1-2: Ordering Options

Options	
Power Stage Options (Section 1.2.)	
10	10 A peak; 5 A continuous
20	20 A peak; 10 A continuous
30-S	30 A peak; 10 A continuous; 40 W continuous internal shunt resistor
I/O (Chapter 3) and Feedback (Section 2.3.1.3.) Options	
-IO	Expansion board with 16 digital inputs (opto-isolated); 16 digital outputs (opto-isolated); three 16-bit differential analog inputs (±10 V); three 16-bit analog outputs (±10 V); 2 SSI Net; absolute encoder interface; one mechanical brake relay
-MXH	Programmable encoder multiplier up to x16384 (x65,536 after quadrature); supports single/dual axis PSO and real-time encoder quadrature output
PSO Options (Section 3.2.)	
-DUALPSO	Two axis Position Synchronized Output (PSO)
-TRIPLEPSO	Three axis Position Synchronized Output (PSO); requires I/O option
-PSONC	Normally closed PSO output (default normally open); requires I/O option
Drive Options	
-S	Internal shunt resistor (standard on HPe 30). 50 Ohm, 40 W Continuous; 400 W Peak (5 seconds), (Manufacturer's P/N: Ohmite F40J50RE or equivalent) NOTE: Excludes -EXTSHUNT option
-EXTSHUNT	Two-pin connector for external shunt resistor network (Section 2.9.). NOTE: Excludes -S option.

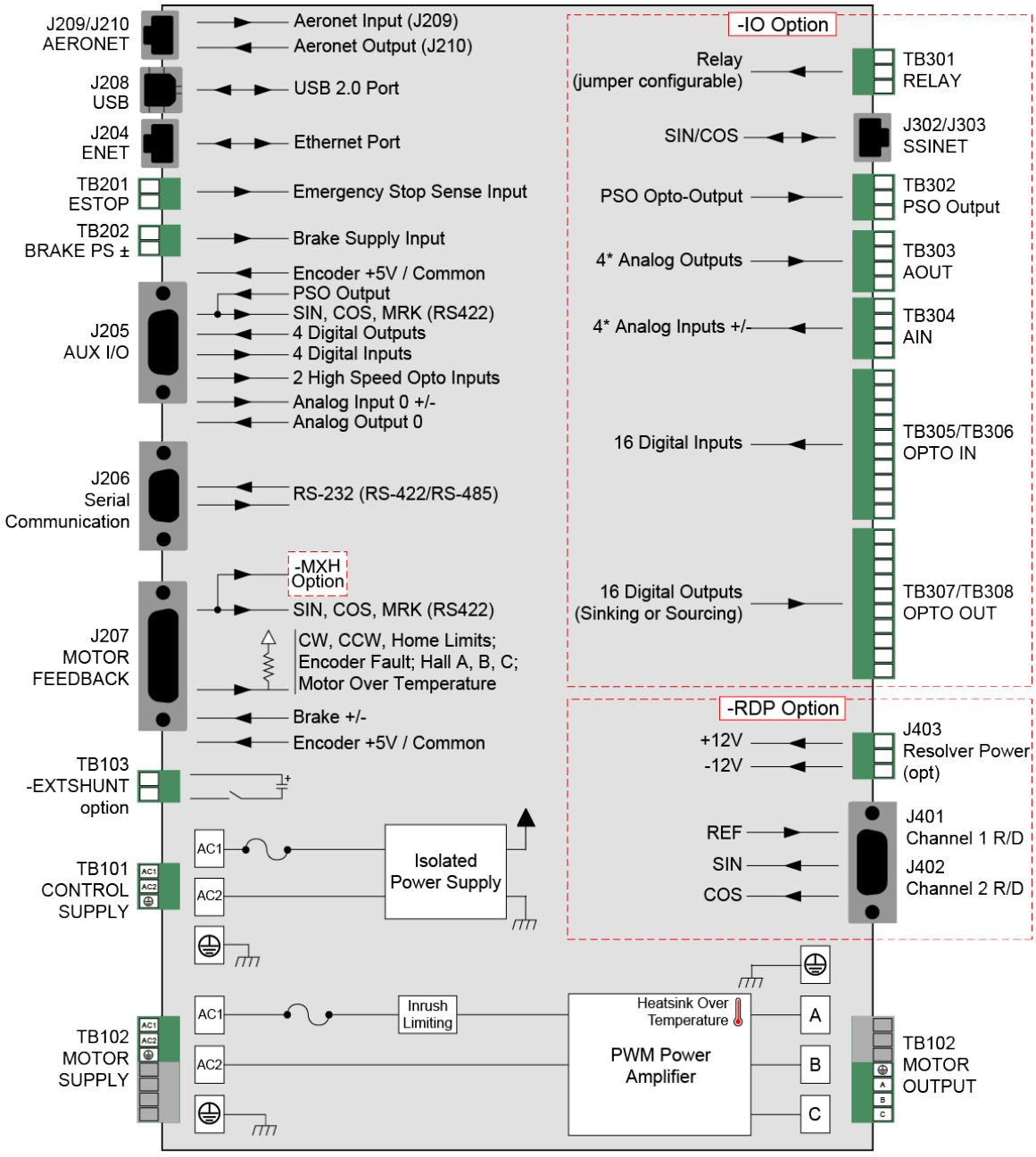
Table 1-3: Ordering Options (continued)

Options	
Software Options (refer to the Ensemble Help file for more information)	
-5AX	Enable Five-Axis Contouring on the master drive; ENSEMBLE-MC software must be configured with the FIVE AXIS CONTOURING option
-EIP	Enable EtherNet/IP™ on the master drive; ENSEMBLE-MC software must be configured with the ETHERNET/IP option
-DCT	Enable the Dynamic Controls Toolbox on the master drive; ENSEMBLE-MC software must be configured with the DYNAMIC CONTROLS TOOLBOX option
-ETM	Enable the Enhanced Throughput Module on the master drive; ENSEMBLE-MC software must be configured with the ENHANCED THROUGHPUT MODULE option
-LCK	Locked drive; firmware and calibration data on the drive cannot be modified by the user after the product leaves Aerotech; the drive must be returned to Aerotech if firmware/calibration updates are required; read/write access to parameters and programs is supported
Resolver Options (Chapter 4)	
-RDP1-10K	One-channel resolver to digital converter input; 10 kHz carrier frequency
-RDP1-7.5K	One-channel resolver to digital converter input; 7.5 kHz carrier frequency
-RDP1-5K	One-channel resolver to digital converter input; 5 kHz carrier frequency
-RDP2-10K	Two-channel resolver to digital converter input; 10 kHz carrier frequency
-RDP2-7.5K	Two-channel resolver to digital converter input; 7.5 kHz carrier frequency
-RDP2-5K	Two-channel resolver to digital converter input; 5 kHz carrier frequency.

Table 1-4: Accessories

Accessories	
UFM-ST	AC Line Filter Module (required for CE compliance; refer to Section 2.1.)
MCK-NDRIVE	Mating connector kit for J206 (J205 mate is always provided)
JI	Industrial Joystick (NEMA12 (IP54) rated); refer to Section 5.1.
PS24-1	24 VDC, 1 A power supply for optional brake/relay output
BRAKE24-2	24 VDC, 2 A power supply for optional brake
Transformers	
	Refer to Section 2.1.3. for listings, wiring, and specifications
Cables	
Interconnection	A complete list of Aerotech cables can be found on the website at http://www.aerotechmotioncontrol.com/manuals/index.aspx
Joystick/Handwheel	Refer to Section 5.1. or Section 5.2.

The following block diagram shows a connection summary. For detailed connection information, refer to Chapter 2 and Chapter 3.



* There are a total of four analog inputs and four analog outputs available if the -IO Option has been purchased.The analog I/O normally available on J205 is accessed through TB303 and TB304.

Figure 1-2: Functional Diagram

1.1. Drive and Software Compatibility

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

Table 1-5: Drive and Software Compatibility

Drive Type	Firmware Revision	First Software Version	Last Software Version
HPe	-	2.51	Current

1.2. Electrical Specifications

Table 1-6: Electrical Specifications

Description		HPe 10	HPe 20	HPe 30
Motor Supply	Input Voltage	14-240 VAC		
	Input Frequency	50-60 Hz		
	Inrush Current	34 A		
	Max Continuous Input Current	5 A_{rms}	10 A_{rms}	10 A_{rms}
	Input Current	Refer to Section 1.2.1. System Power Requirements		
Control Supply	Input Voltage	85-240 VAC		
	Input Frequency	50-60 Hz		
	Inrush Current	16 A		
	Input Current	1 A max		
Output Voltage (1)		20-340 VDC		
Peak Output Current (1 second)		10 A	20 A	30 A
Continuous Output Current		5 A	10 A	10 A
Power Amplifier Bandwidth		2500 Hz maximum (software selectable)		
Power Amplifier Efficiency		85% - 95% (2)		
PWM Switching Frequency		20 kHz		
Minimum Load Inductance		0.1 mH @ 160 VDC (1 mH @ 320 VDC)		
User Power Supply Output		5 VDC (@ 500 mA)		
Modes of Operation		Brushless; Brush; Stepper		
Protective Features		Output short circuit; Peak over current; DC bus over voltage; RMS over current;Over temperature; Control power supply under voltage; Power stage bias supply under voltage		
Isolation		Optical and transformer isolation between control and power stages.		

(1) AC input voltage and load dependent.
(2) Dependent on total output power: efficiency increases with increasing output power.

1.2.1. 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. An EfficiencyFactor of approximately 90% should be used in the following equations.

Brushless Motor

Output Power

Rotary Motors	Pout [W] = Torque [N·m] * Angular velocity[rad/sec]
Linear Motors	Pout [W] = Force [N] * Linear velocity[m/sec]
Rotary or Linear Motors	Pout [W] = Bemf [V] * I(rms) * 3

Ploss = 3 * I(rms)^2 * R(line-line)/2

Pin = SUM (Pout + Ploss) / EfficiencyFactor

DC Brush Motor

Pout [W] = Torque [N·m] * Angular velocity[rad/sec]

Ploss = I(rms)^2 * R

Pin = SUM (Pout + Ploss) / EfficiencyFactor

1.2.2. Power Dissipation

The amplifier power dissipation under continuous power supply and output current conditions is shown in Figure 1-3. The values on the graph represent the peak current that the amplifier would provide during operation. When the bus voltage and output current are known, the amplifier power dissipation is found using this graph. Figure 1-4 shows the maximum recommended ambient temperature as a function of amplifier power dissipation. Use this graph along with the power dissipation obtained from the first graph to determine the maximum ambient temperature. If the result is lower than the known operating ambient temperature, additional measures are required to cool the Ensemble HPe 10/20/30. Mounting it to a large metal plate for extra heat-sinking and providing additional fan flow are suggested.

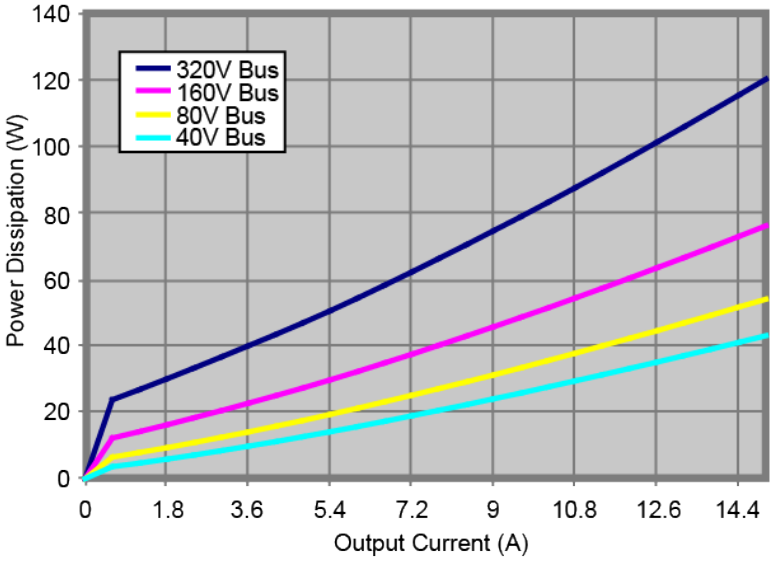


Figure 1-3: Power Dissipation vs. Output Current

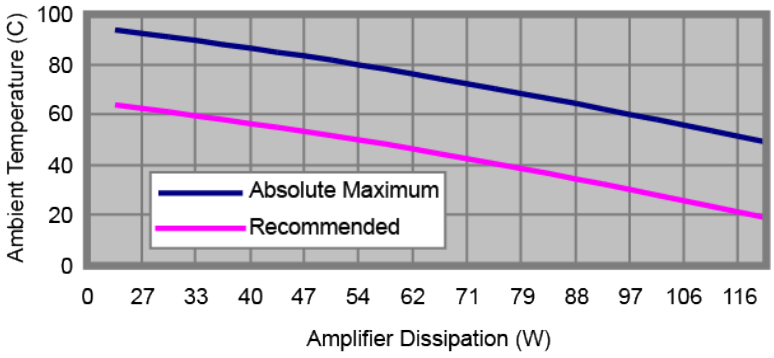


Figure 1-4: Ambient Temperature vs. Power Dissipation

EXAMPLE:

320 VDC Bus operation at 5 A
Power Dissipation = 47 Watts
Maximum Ambient Temperature = 54°C

1.3. Mechanical Design

Install the unit into a construction compliant for unlimited circuits enclosure. Each unit should be separated from other drives and surrounded by 25 mm (1") of free air space. A space of 100 mm (4") should be allowed along the front of the unit for cable connections.

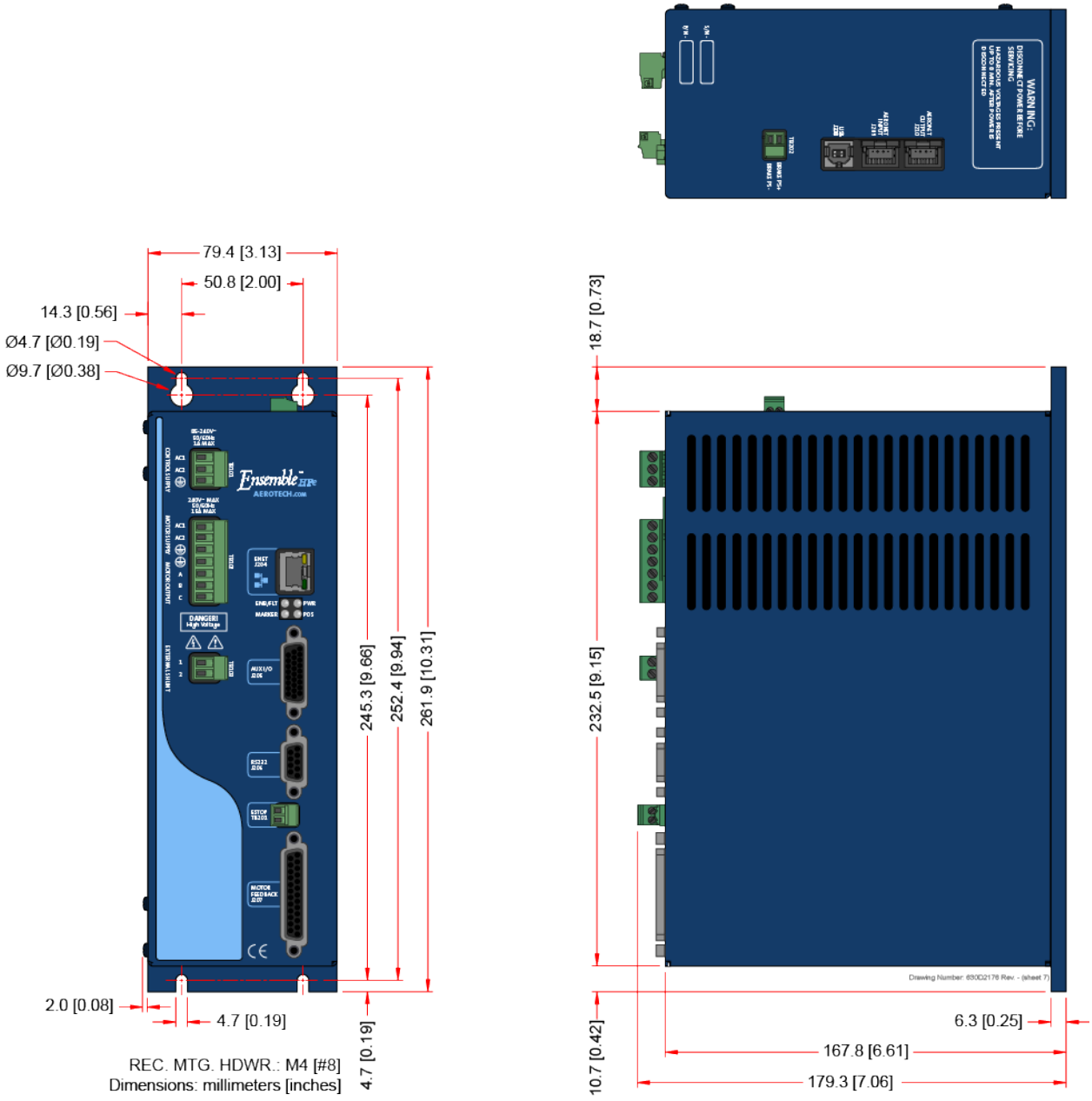


Figure 1-5: Dimensions (Slim Version)

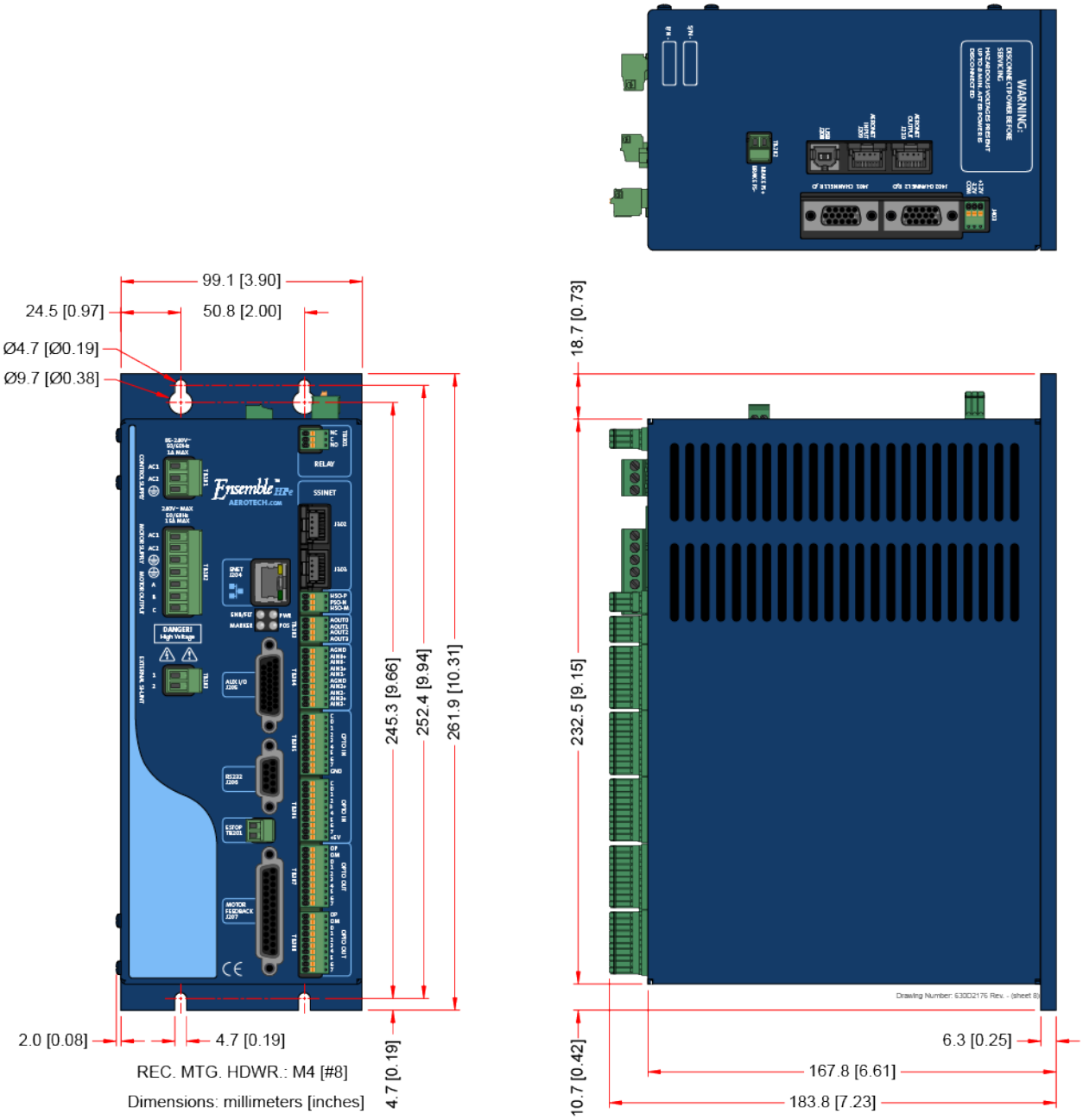


Figure 1-6: Dimensions (Full Version with -IO and -RDP options)

Table 1-7: Physical Specifications

	Weight
Slim	2.27 kg [5.0 lb]
w/ -IO option	2.45 kg [5.4 lb]
w/ -RDP option	2.45 kg [5.4 lb]

1.4. Environmental Specifications

The environmental specifications for the Ensemble HPe 10/20/30 are listed below.

Ambient Temperature	Operating: 0° to 50°C (32° to 122° F)
	Storage: -30° to 85°C (-22° to 185° F)
Humidity	Maximum relative humidity is 80% for temperatures up to 31°C. Decreasing linearly to 50% relative humidity at 40°C. Non condensing.
Altitude	Up to 2000 meters.
Pollution	Pollution degree 2 (normally only non-conductive pollution).
Use	Indoor use only.

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Chapter 2: Installation and Configuration

2.1. Power Connections

The Ensemble HPe 10/20/30 has two AC input connectors; one for control power and a second for motor power. For a complete list of electrical specifications, refer to Section 1.2.

NOTE: The machine integrator, OEM or end user is responsible for meeting the final protective grounding requirements of the system.

2.1.1. Control Supply Connections (TB101)

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

The control power supply input allows the Ensemble HPe 10/20/30 to maintain communications if the motor power is removed, such as in an Emergency Stop condition. The control power supply requires a minimum of 85 VAC input to operate properly. The AC1 input is internally fused. The AC2 input is not internally fused but can be connected to a voltage source other than Neutral if an external 2 A time-delay fuse is used.

Although the control power supply contains an internal filter, an additional external filter located as close as possible to the Ensemble HPe 10/20/30 may be required for CE compliance (Aerotech recommends Schaffner FN2080 or Aerotech UFM-ST).

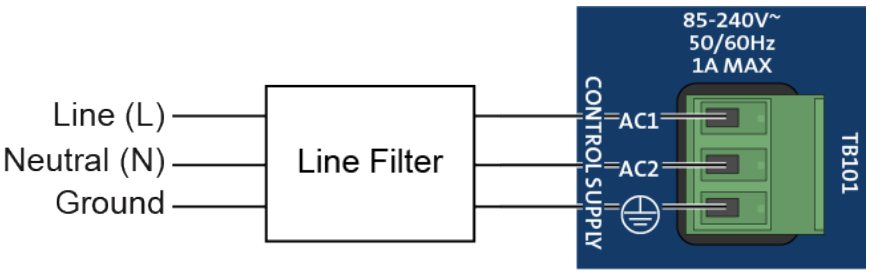


Figure 2-1: Control Supply Connections

Table 2-1: Control Supply AC Input Wiring

Pin	Description	Recommended Wire Size (1)
AC1	Line (L): 85-240 VAC Control Power Input	0.8 mm^2 (#18 AWG)
AC2	Neutral (0V) or 85-240 VAC Control Power Input with external fuse	0.8 mm^2 (#18 AWG)
⏚	Protective Ground (Required for Safety)	0.8 mm^2 (#18 AWG)
(1) Refer to local electrical safety requirements to correctly size external system wires.		

Table 2-2: Mating Supply Connector Part Numbers for the Control Supply Connector

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

2.1.2. Motor Supply Connections (TB102)

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

Motor power is applied to the Ensemble HPe 10/20/30 Motor Supply connector (refer to Figure 2-2 for locations).

Refer to local electrical safety requirements to correctly size external system wires and match wires to fuses or circuit breakers.

The AC1 input is internally fused (5A HPe10, 10A HPe20/30). External fuses or a circuit breaker (15 A maximum, time delay type) are required for the AC1 and AC2 inputs. The AC2 input can be connected directly to Neutral without a fuse for single phase power systems.

WARNING: Do not operate the Ensemble HPe 10/20/30 without the safety ground connection in place.

WARNING: Do not operate the Ensemble HPe 10/20/30 without proper branch protection.

An AC Line Filter may be required for CE compliance and should be located as close as possible to the drive. For more information about the AC Line Filter, refer to Section 2.1.4. Wiring between the filter and drive can be twisted and/or shielded to reduce radiated emissions.

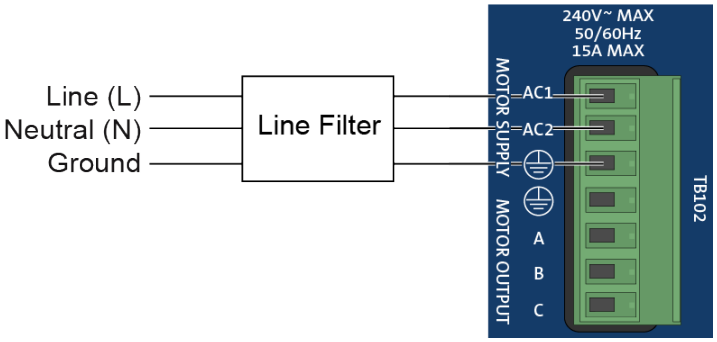


Figure 2-2: Motor Bus Input Connections

Table 2-3: Motor Supply Input Connections (TB102)

Pin	Description	Recommended Wire Size (1)
AC1	240 VAC Motor Power Input	1.3 mm^2 (#16 AWG)
AC2	240 VAC Motor Power Input	1.3 mm^2 (#16 AWG)
⏚	Protective Ground (required for safety)	1.3 mm^2 (#16 AWG)
(1) Refer to local electrical safety requirements to correctly size external system wires.		

Table 2-4: Mating Supply Part Numbers for the Motor Supply Connector (TB102)

Description	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
7-Pin Terminal Block	ECK01114	1754546	0.5 - 0.6	3.3 - 0.516 [12-30]

2.1.3. Transformer Options

An external isolation transformer can be connected to the motor supply AC input. This is done to reduce the operating voltage of the motor and may also reduce electrical noise.

Table 2-5: Nominal Motor Operating Voltages / Required AC Voltages

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

Table 2-6: 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

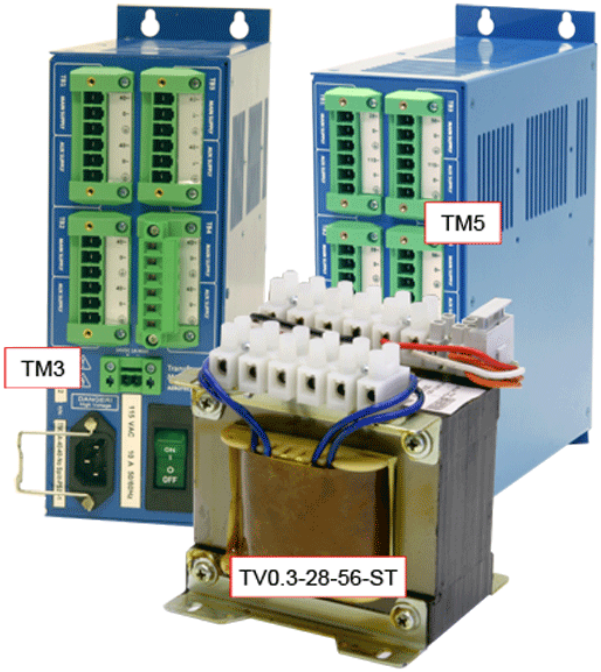


Figure 2-3: Transformer Examples

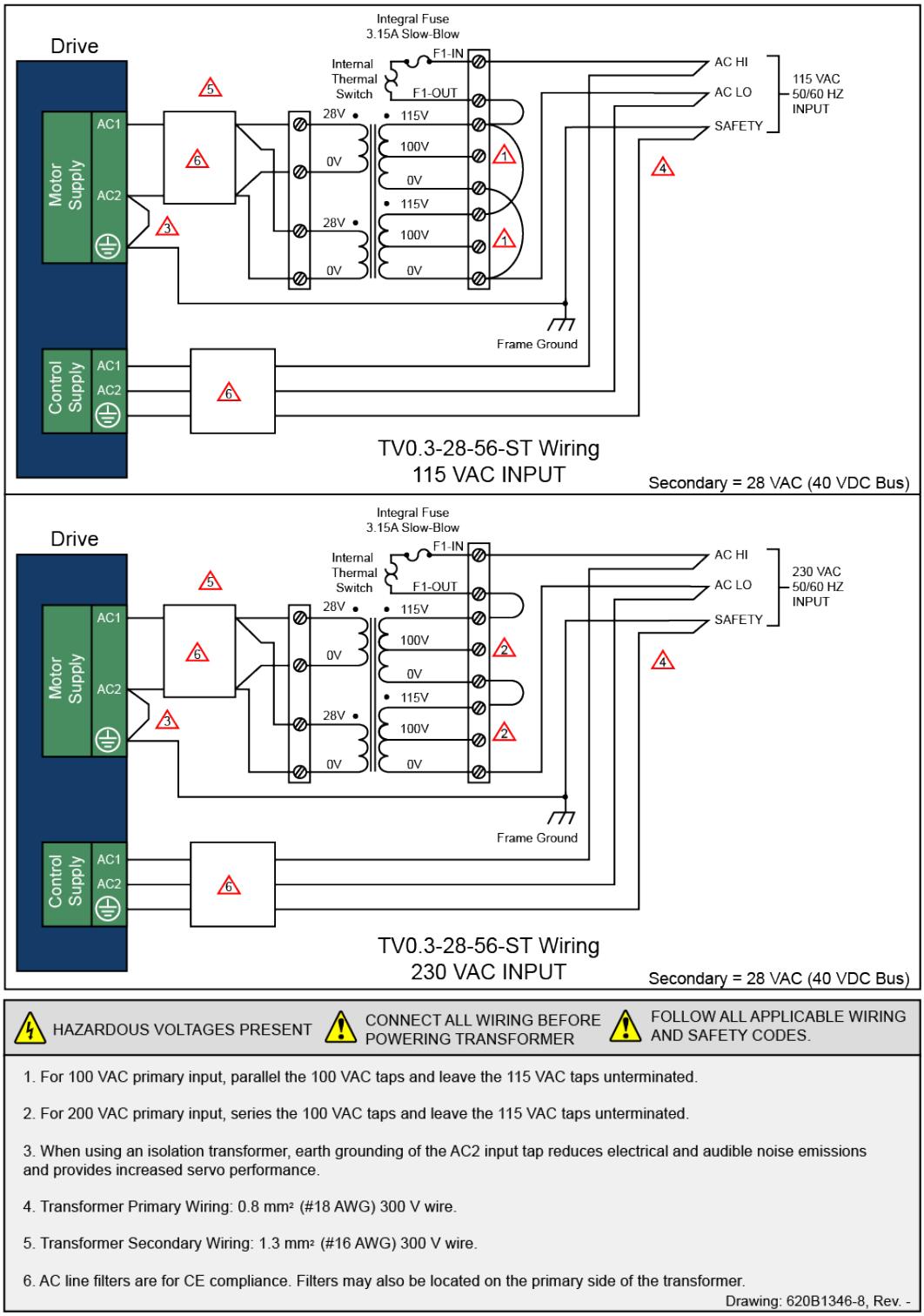


Figure 2-4: 40 VDC Motor Power with a TV0.3-28-56-ST Transformer

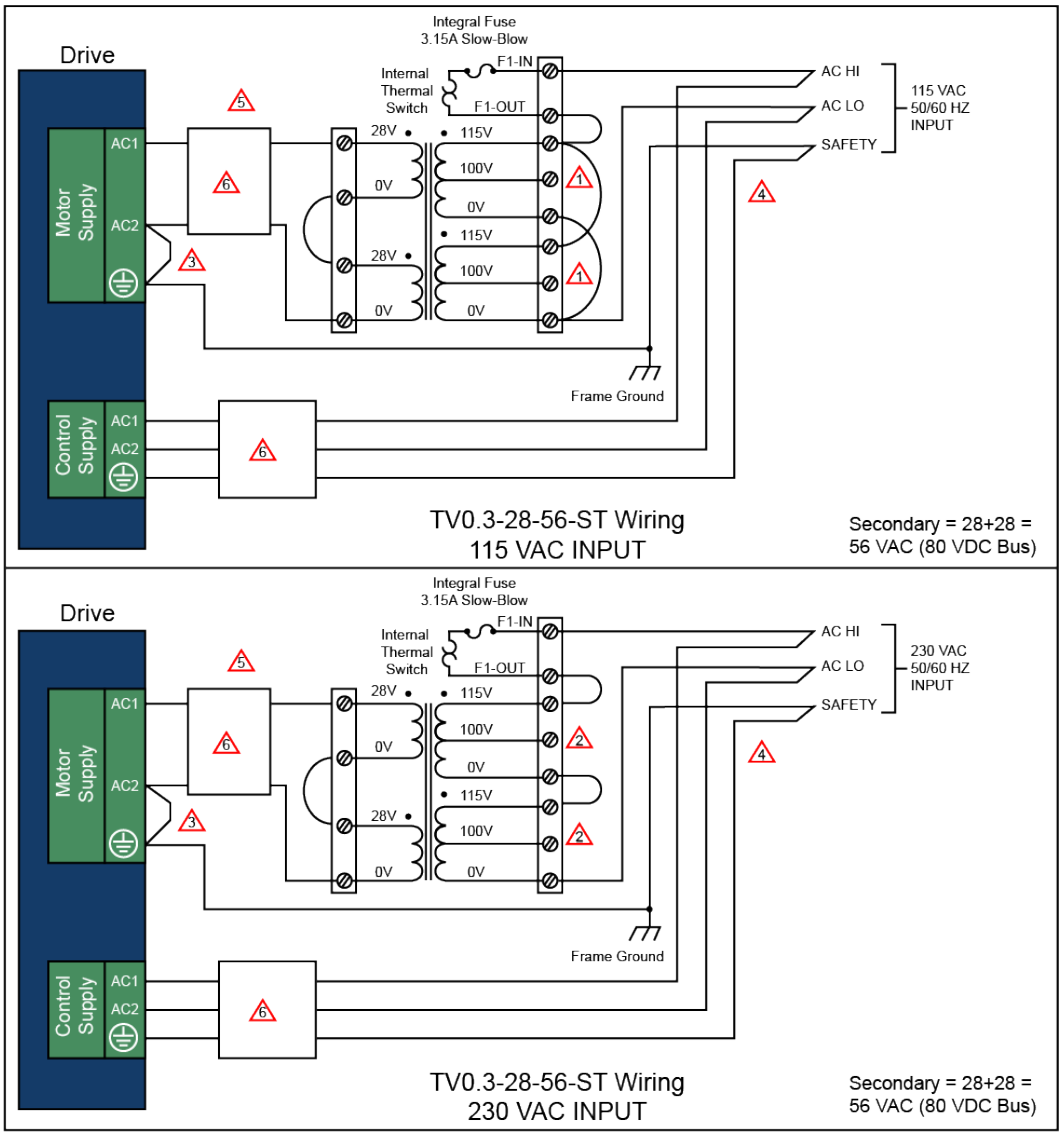


Figure 2-5: 80 VDC Motor Power with a TV0.3-28-56-ST Transformer

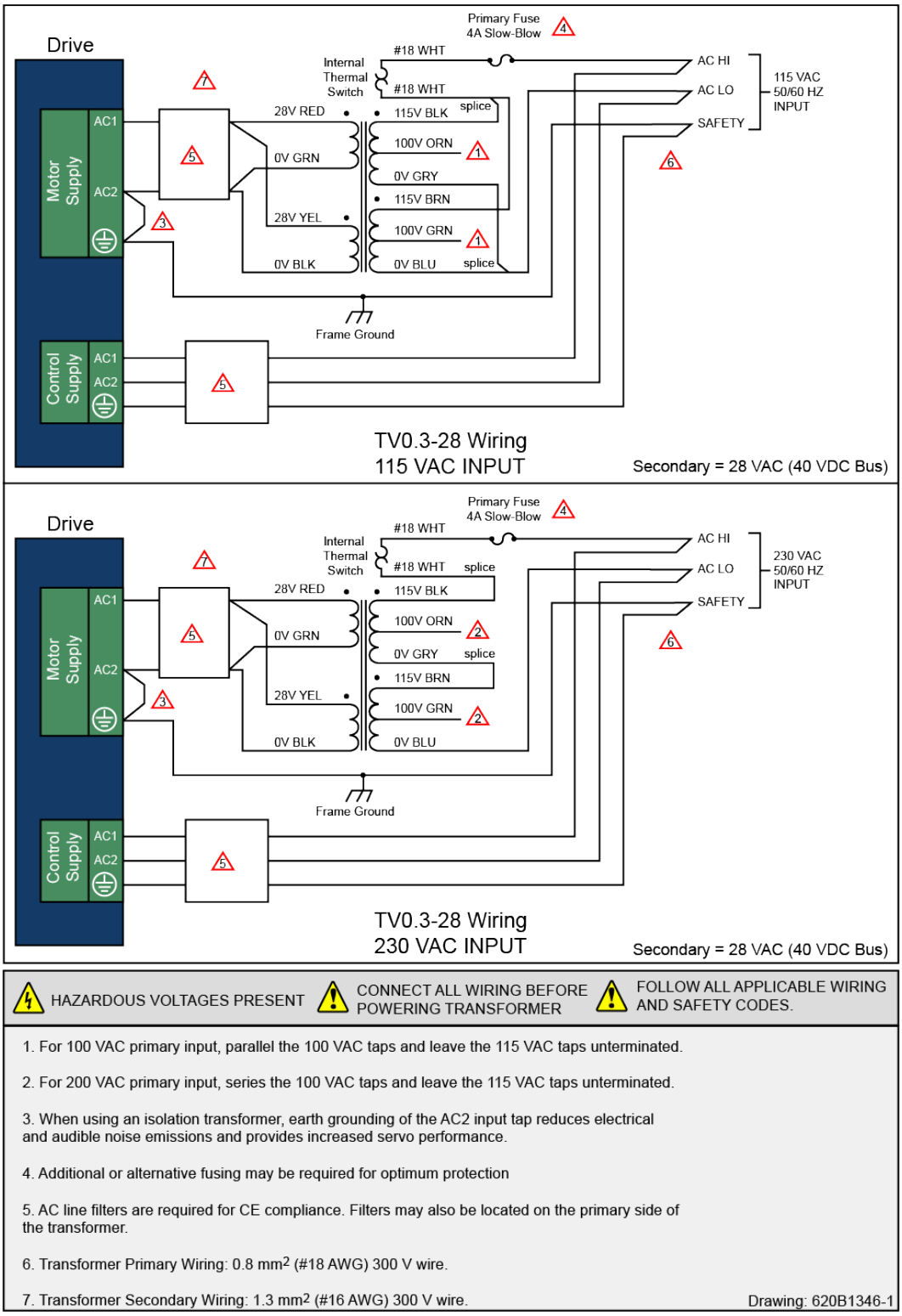
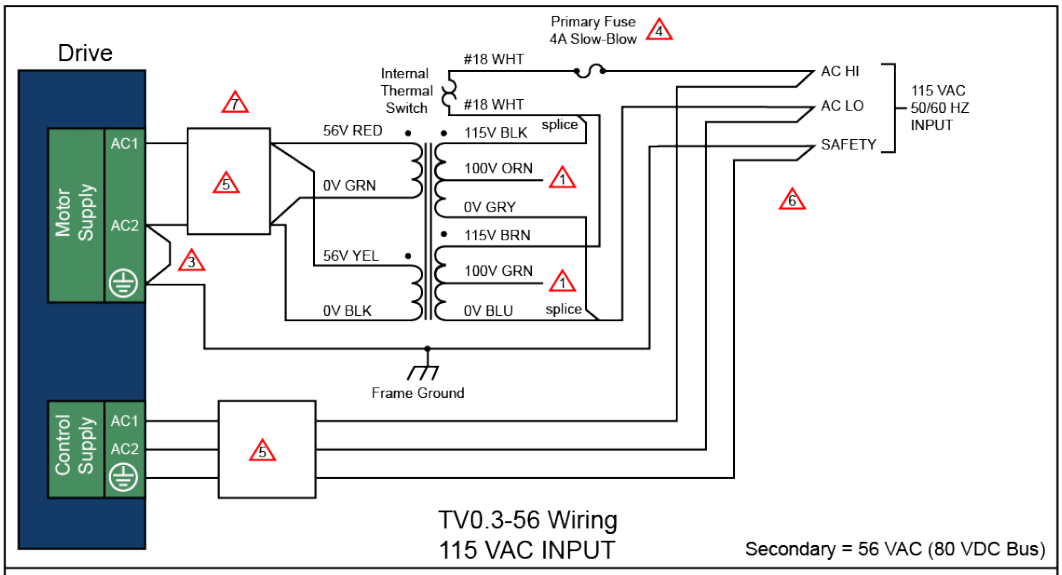
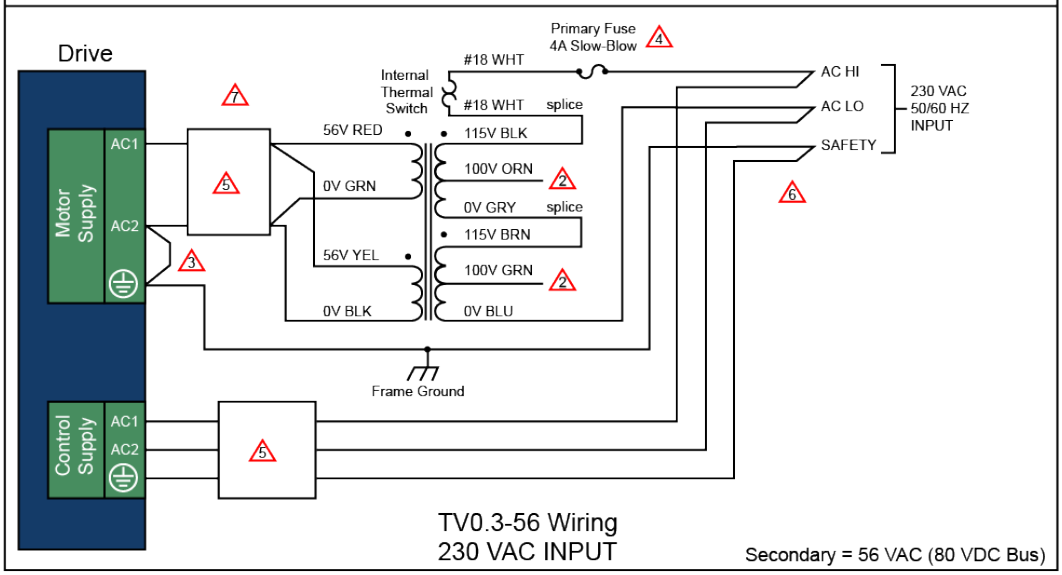


Figure 2-6: 40 Volt DC Bus from 115 and 230 VAC Source





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 mm^2 (#18 AWG) 300 V wire.
7. Transformer Secondary Wiring: 1.3 mm^2 (#16 AWG) 300 V wire.

Figure 2-7: 80 Volt DC Bus from 115 and 230 VAC Source (TV0.3-56)

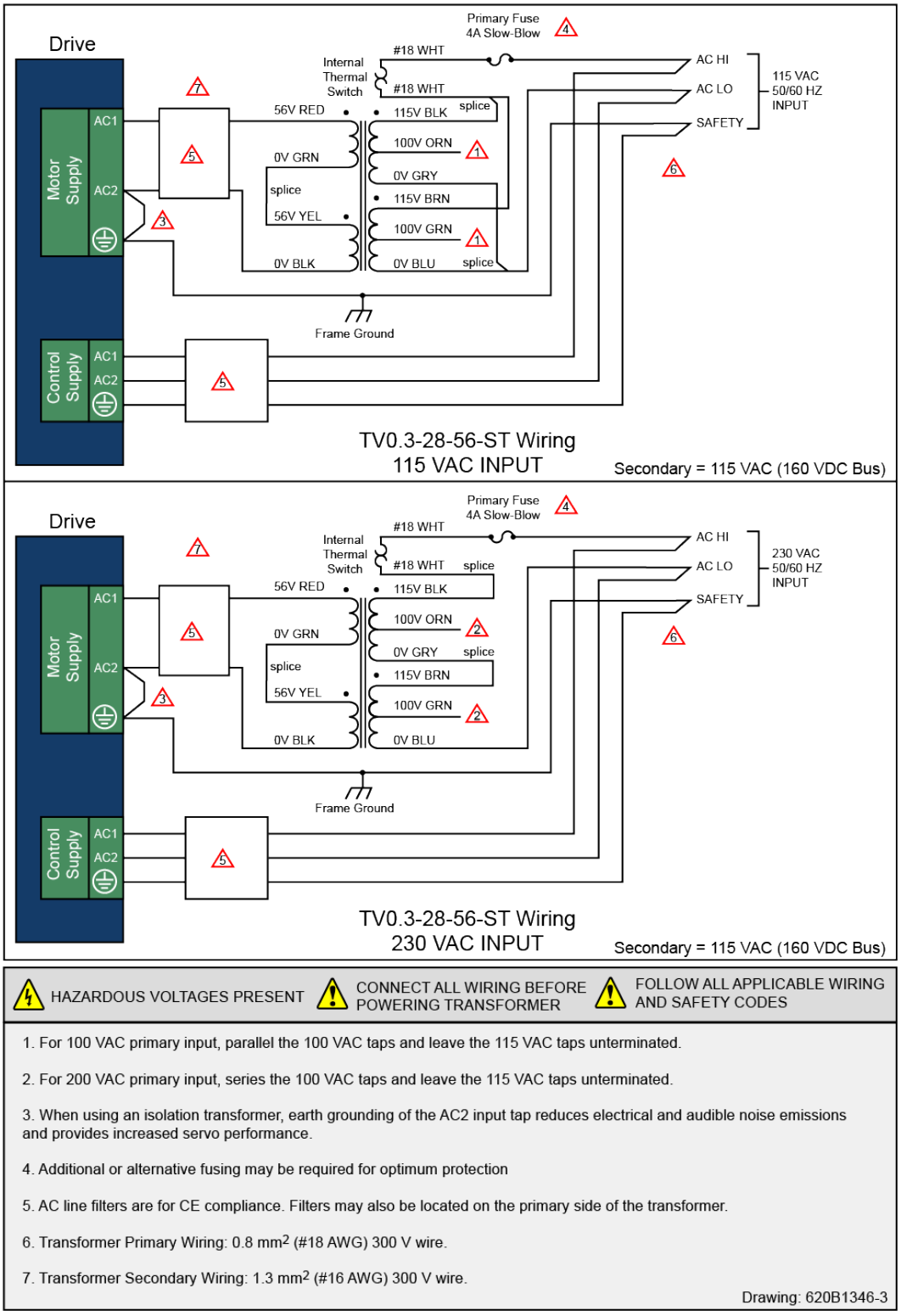
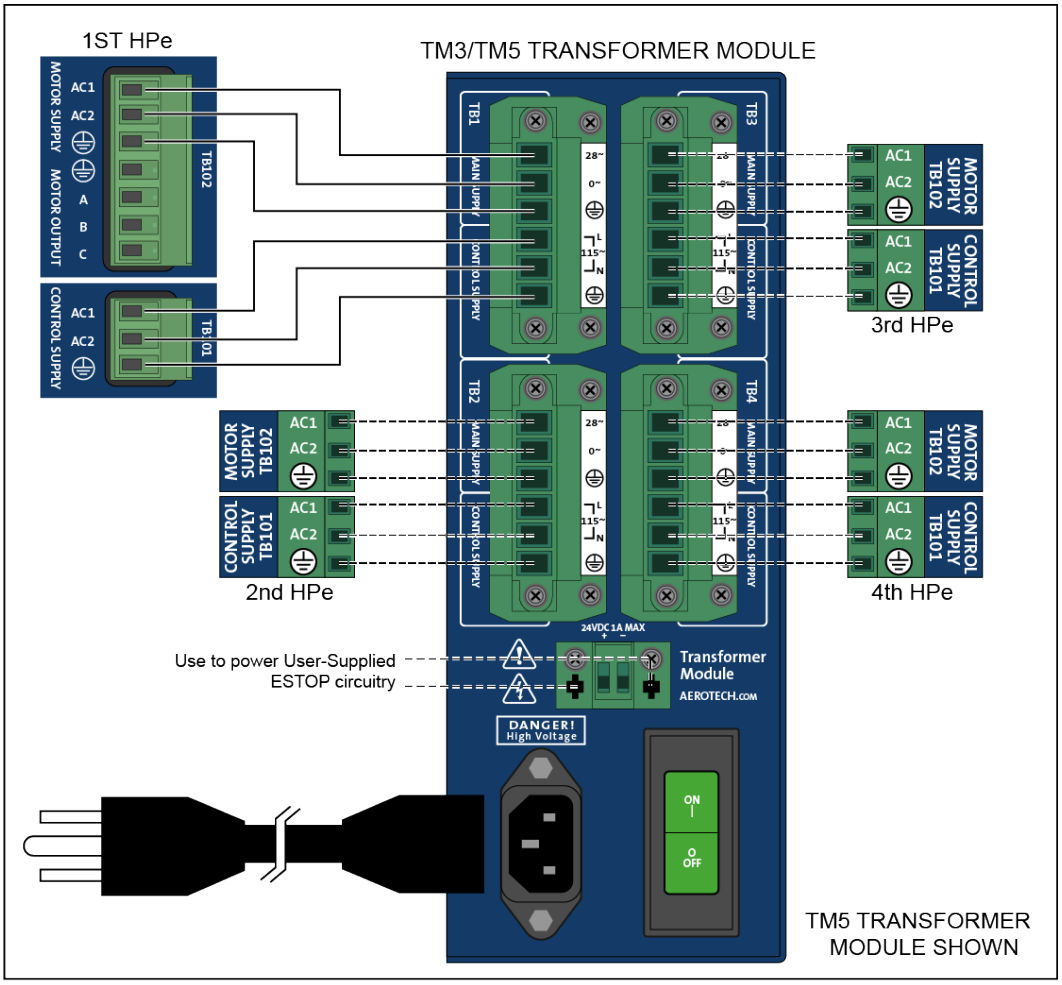


Figure 2-8: 160 Volt DC Bus from 115 and 230 VAC Source (TV0.3-56)



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 mm^2 (#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.

Figure 2-9: Control and Motor Power Wiring using a TM3 or TM5 Transformer

2.1.4. Minimizing Conducted, Radiated, and System Noise for EMC/CE Compliance

Connections to the drive must be made using shielded cables. D-type connectors must use conductive back shells with the cable shield clamped to the back shell at each end of the cable.

Aerotech recommends mounting drives and filter components on a conductive panel. The filter should be mounted close to the drive, minimizing the wire length between the drive and filter.

AC input wiring must be physically separated from motor wiring. High voltage wiring must be physically separated from low level wires.

Using the lowest possible motor voltage will reduce radiated emission. An isolation transformer with grounded secondary can be used to minimize the effects of high frequency PWM amplifier currents.

A line filter such as Aerotech's UFM-ST must be used on the Motor Supply and Control Supply AC inputs.

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

1. Add clamp-on ferrite to the Aeronet cables, one at each end of the cable close to the drive. Aerotech PN ECZ02347, Fair-rite PN 0446164281
2. Add clamp-on ferrite to the motor feedback cable close to the drive. Aerotech PN ECZ02348, Fair-rite PN 0446167281
3. Add 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
4. Add a ferrite core to the UFM-ST AC input wires. The AC wires and ground wire should be wrapped around the core one time. Ferrite core: Aerotech PN ECZ02350, Fair-rite PN 2646102002.
5. Add a ferrite core to the motor phase and ground wires close to the drive. All four wires should be wrapped around the ferrite core once. Ferrite core Aerotech PN ECZ02349, Fair-rite PN 2646626402. Remove ferrite beads from Aerotech supplied cables if installed.
6. Install a motor filter module MFM10-1 close to the drive. The ferrite core from 5) above should be located between the drive and the MFM10-1.

NOTE: The Ensemble HPe 10/20/30 is a component designed to be integrated with other electronics. EMC testing must be conducted on the final product configuration.

2.2. Motor Output Connections

The Ensemble HPe 10/20/30 is capable of controlling three motor types:

- Brushless (see Section 2.2.1.)
- DC Brush (see Section 2.2.2.)
- Stepper (see Section 2.2.3.)

For a complete list of electrical specifications, refer to Section 1.2.

Table 2-7: Motor Power Output Connections (TB102)

Pin	Description	Recommended Wire Size
ØA	Phase A Motor Lead	1.3 mm^2 (#16 AWG)
ØB	Phase B Motor Lead	1.3 mm^2 (#16 AWG)
ØC	Phase C Motor Lead	1.3 mm^2 (#16 AWG)
⏚	Earth Ground to Motor (required for safety)	1.3 mm^2 (#16 AWG)
(1) It is the user's responsibility to properly size external wires.		

Table 2-8: Mating Connector Part Numbers for the Motor Output Connector (TB102)

Description	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
7-Pin Terminal Block	ECK01114	1754546	0.5 - 0.6	3.3 - 0.516 [12-30]

2.2.1. Brushless Motor Connections

The configuration shown in Figure 2-10 is an example of a typical brushless motor connection.

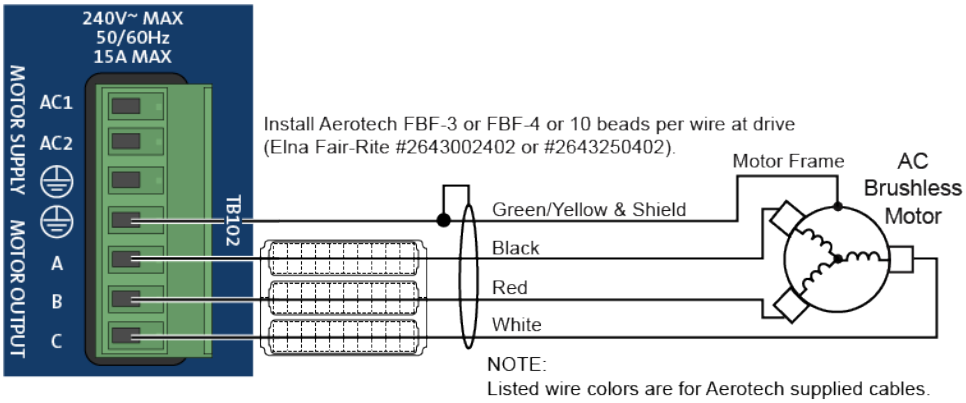


Figure 2-10: Brushless Motor Configuration

Table 2-9: Wire Colors for Aerotech Supplied Cables (Brushless)

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 typical Aerotech wire set used by Aerotech.
(2) "&" (Red & Orange) indicates two wires; " / " (Green/White) indicates a single wire

NOTE: 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.

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

2.2.1.1. Powered Motor Phasing

Refer to the Motor Phasing Calculator in the Configuration Manager for motor, Hall, and encoder phasing.

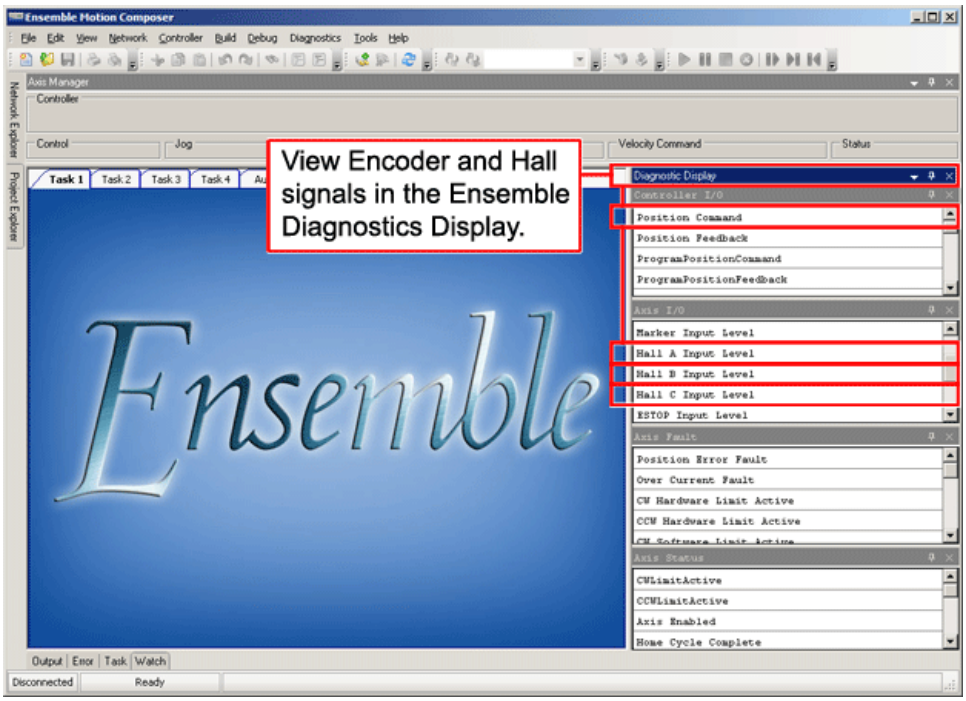


Figure 2-11: Encoder and Hall Signal Diagnostics

2.2.1.2. Unpowered Motor and Feedback Phasing

Disconnect the motor from the controller and connect the motor in the test configuration shown in Figure 2-12. 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 2-12). Wave forms are shown while moving the motor in the positive direction.

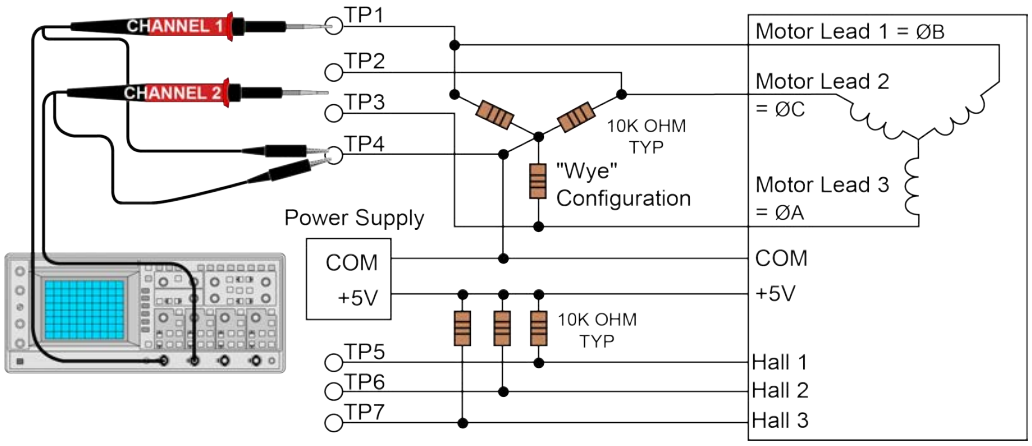


Figure 2-12: Motor Phasing Oscilloscope Example

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 2-13). Use the CommutationOffset parameter to correct for Hall signal misalignment.

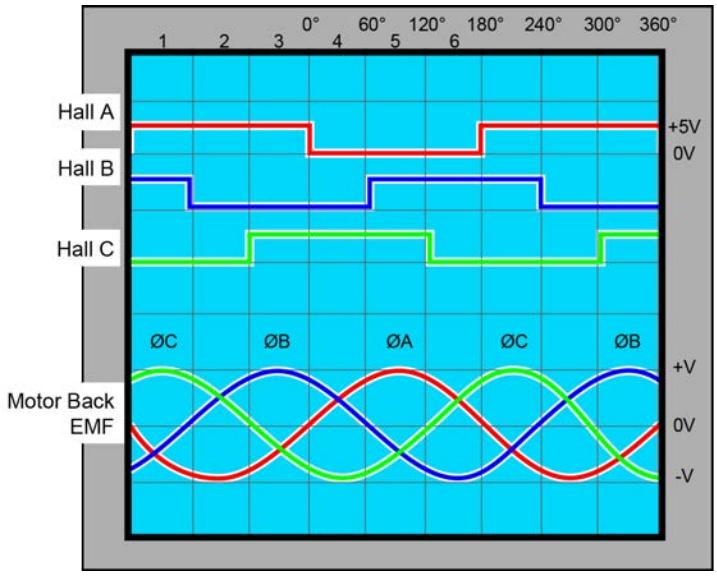


Figure 2-13: Brushless Motor Phasing Goal

2.2.2. DC Brush Motor Connections

The configuration shown in Figure 2-14 is an example of a typical DC brush motor connection. Refer to Section 2.2.2.1. for information on motor phasing.

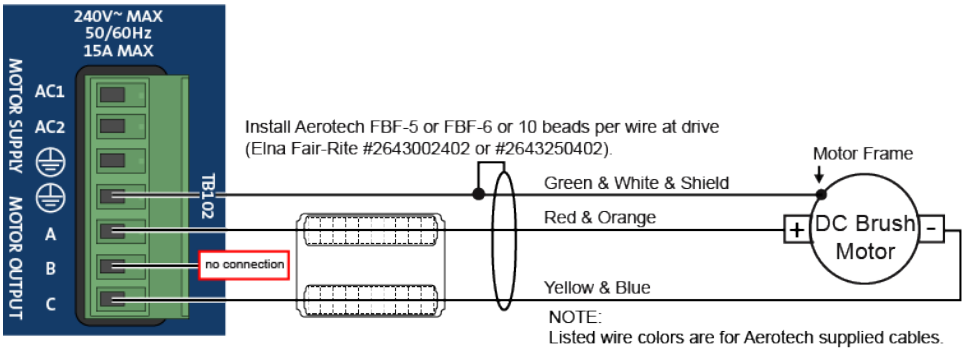


Figure 2-14: DC Brush Motor Configuration

Table 2-10: Wire Colors for Aerotech Supplied Cables (DC Brush)

Pin	Wire Color Set 1 (1)	Wire Color Set 2	Wire Color Set 3
⏚	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 Aerotech 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. Rotate the motor clockwise by hand.

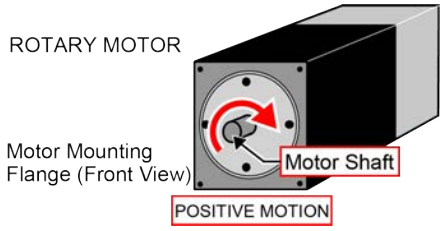


Figure 2-15: Clockwise Motor Rotation

4. If the voltmeter indicates a negative value, swap the motor leads and rotate the motor (CW, by hand) again. When the voltmeter indicates a positive value, the motor leads have been identified.
5. Connect the motor lead from the voltmeter to the ØA motor terminal on the Ensemble HPe 10/20/30. Connect the motor lead from the negative lead of the voltmeter to the ØC motor terminal on the Ensemble HPe 10/20/30.

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

2.2.3. Stepper Motor Connections

The configuration shown in Figure 2-16 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 80V motor bus supply is needed to get 40V across the motor.

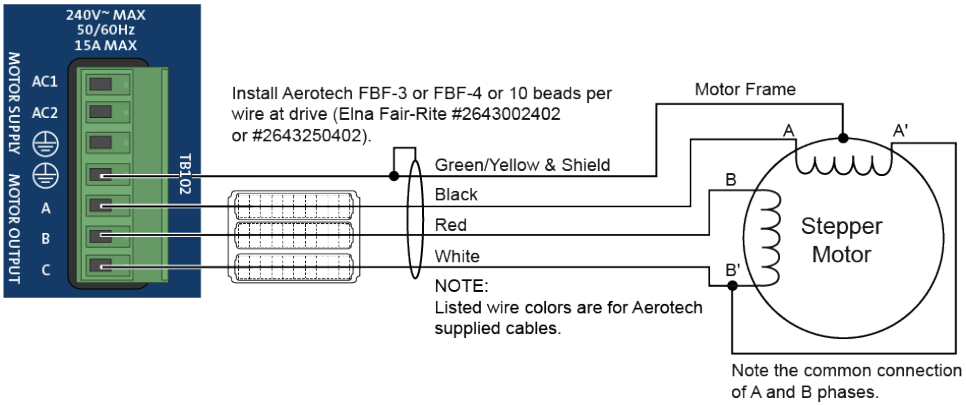


Figure 2-16: Stepper Motor Configuration

Table 2-11: Wire Colors for Aerotech Supplied Cables (Stepper)

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 Aerotech 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. If an encoder is not being used, phasing is not necessary. With an encoder, test for proper motor phasing by running a positive motion command.

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

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

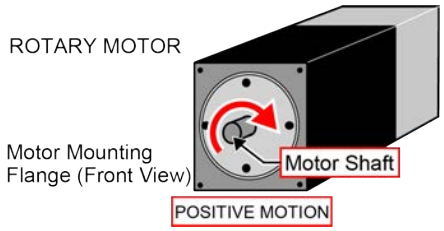


Figure 2-17: Clockwise Motor Rotation

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

NOTE: After the motor has been phased, use the ReverseMotionDirection parameter to change the direction of “positive” motion.

2.3. Motor Feedback Connector (J207)

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

Table 2-12: Motor Feedback Connector Pinout (J207)

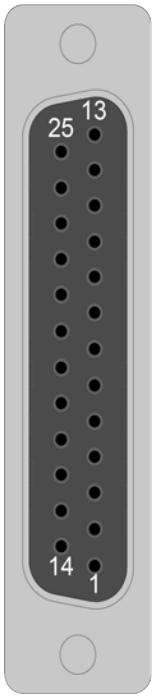
Pin#	Description	In/Out/Bi	Connector
1	Chassis Frame Ground	N/A	
2	Motor Over Temperature Thermistor	Input	
3	+5V Power for Encoder (500 mA max)	Output	
4	Reserved	N/A	
5	Hall-Effect Sensor B (brushless motors only)	Input	
6	Encoder Marker Reference Pulse -	Input	
	Absolute Encoder Interface Clock -	Output	
7	Encoder Marker Reference Pulse +	Input	
	Absolute Encoder Interface Clock +	Output	
8	Absolute Encoder Interface Data -	Bidirectional	
9	Reserved	N/A	
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 for Limit Switches (500 mA max)	Output	
17	Encoder Sine +	Input	
18	Encoder Sine -	Input	
19	Absolute Encoder Interface Data +	Bidirectional	
20	Signal Common for Limit Switches	N/A	
21	Signal Common for Encoder	N/A	
22	Home Switch Input	Input	
23	Encoder Fault Input	Input	
24	Counterclockwise End of Travel Limit	Input	
25	Brake Output +	Output	

Table 2-13: Mating Connector Part Numbers for the Motor Feedback Connector

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

2.3.1. Encoder Interface (J207)

The Ensemble HPe 10/20/30 is equipped with standard and auxiliary encoder feedback channels. The standard encoder interface is accessible through the Motor Feedback (J207) connector. The standard encoder interface will accept an RS-422 differential line driver signal. If the Ensemble HPe 10/20/30 has been purchased with the -MXH option, the standard encoder interface can be configured for an analog encoder input via parameter settings.

Refer to Section 2.3.1.4. for encoder feedback phasing. Refer to Section 2.5. for the auxiliary encoder channel.

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

Table 2-14: Encoder Interface Pins on the Motor Feedback Connector

Pin#	Description	In/Out/Bi
1	Chassis Frame Ground	N/A
3	+5V Power for Encoder (500 mA max)	Output
6	Encoder Marker Reference Pulse -	Input
	Absolute Encoder Interface Clock -	Output
7	Encoder Marker Reference Pulse +	Input
	Absolute Encoder Interface Clock +	Output
14	Encoder Cosine +	Input
15	Encoder Cosine -	Input
17	Encoder Sine +	Input
18	Encoder Sine -	Input
21	Signal Common for Encoder	N/A

2.3.1.1. RS-422 Line Driver Encoder (Standard)

The standard encoder interface accepts an RS-422 differential quadrature line driver signal. Invalid or missing signals will cause a feedback fault when the axis is enabled.

An analog encoder is used with the -MXH option (refer to Section 2.3.1.3. for more information).

Table 2-15: Encoder Specifications

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

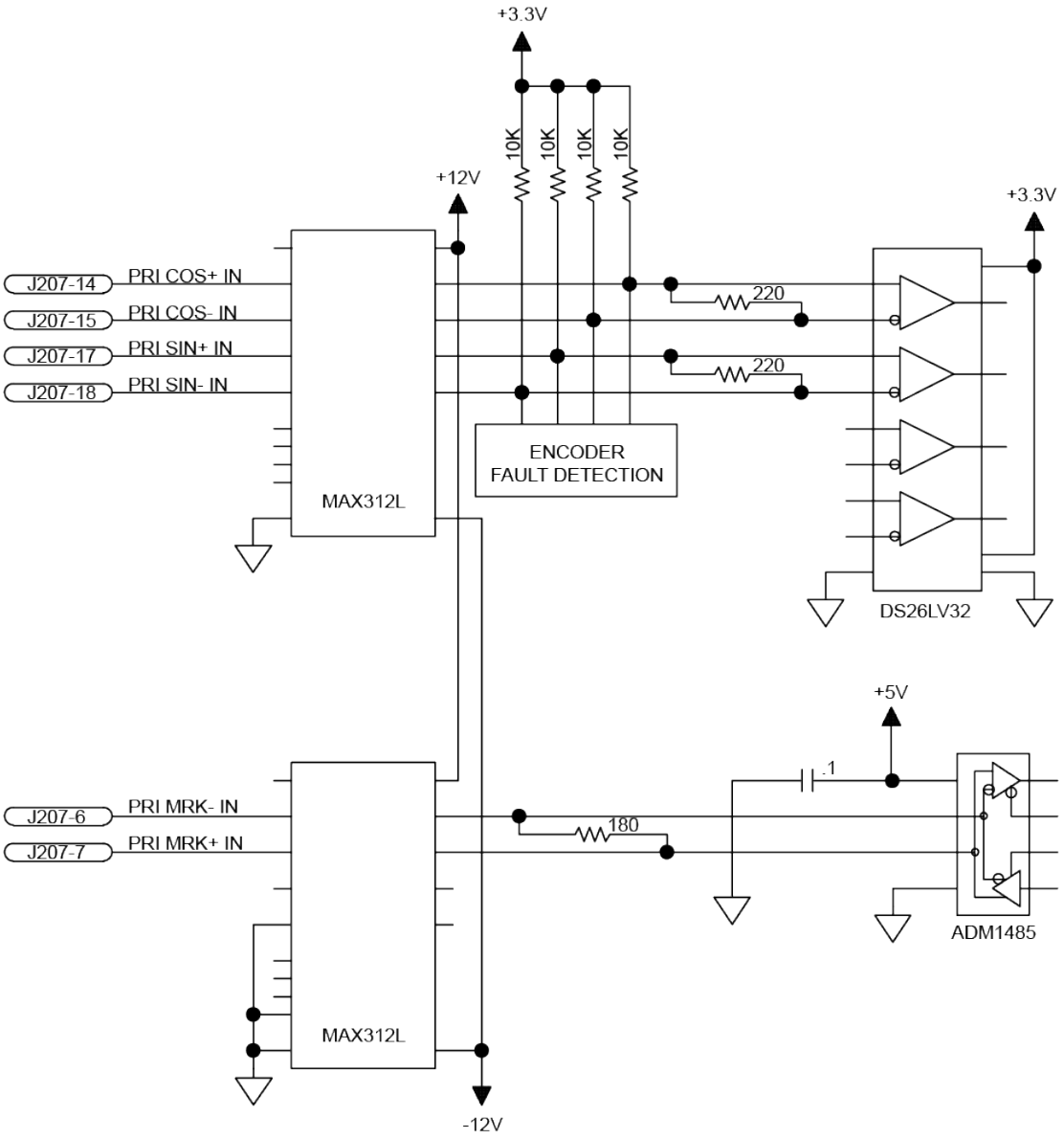


Figure 2-18: Line Driver Encoder Interface (J207)

2.3.1.2. Absolute Encoder Interface (J207)

The Ensemble HPe 10/20/30 retrieves absolute position data along with encoder fault information via a serial data stream from the absolute encoder. See Figure 2-19 for the serial data stream interface. Refer to the Help file for information on how to set up your EnDat or Resolute absolute encoder parameters.

The encoder interface pinout is indicated in Section 2.3.1.

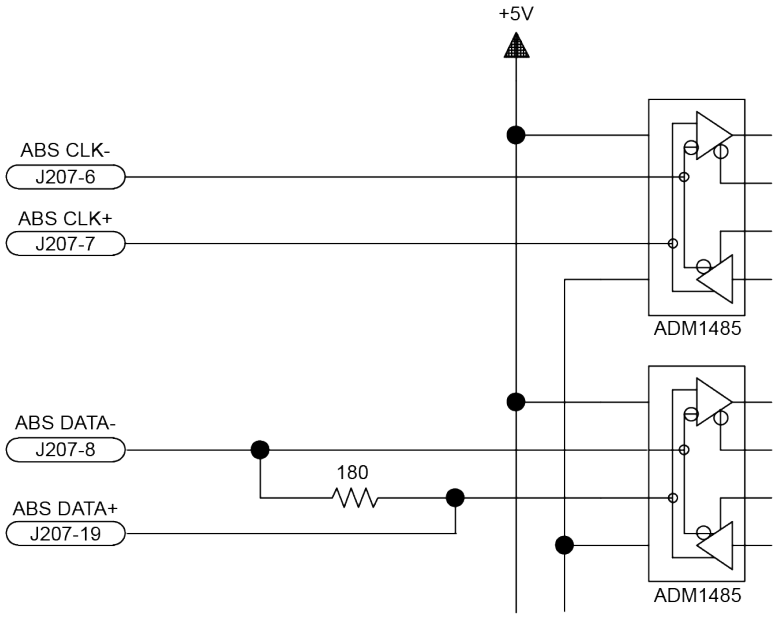


Figure 2-19: Serial Data Stream Interface

2.3.1.3. Analog Encoder Interface

If the -MXH option has been purchased, the standard encoder channel will accept a differential analog encoder input signal. The interpolation factor is determined by the EncoderMultiplicationFactor parameter and is software selectable (refer to the Ensemble Help file).

Table 2-16: Analog Encoder Specifications

Specification	MXH
Input Frequency (max)	500 kHz
Input Amplitude	0.6 to 2.25 Vpk-Vpk
Interpolation Factor (software selectable)	65,536
MXH Interpolation Latency	~ 3.25 µsec (analog input to quadrature output)

Refer to Figure 2-20 for the typical input circuitry.

The encoder interface pin assignment is indicated in Section 2.3.1.

The gain, offset, and phase balance of the analog Sine and Cosine encoder input signals can all be adjusted via controller parameters. Encoder signals should be adjusted using the Feedback Tuning tab of the Digital Scope, which will automatically adjust the encoder parameters for optimum performance. See the Ensemble Help file for more information.

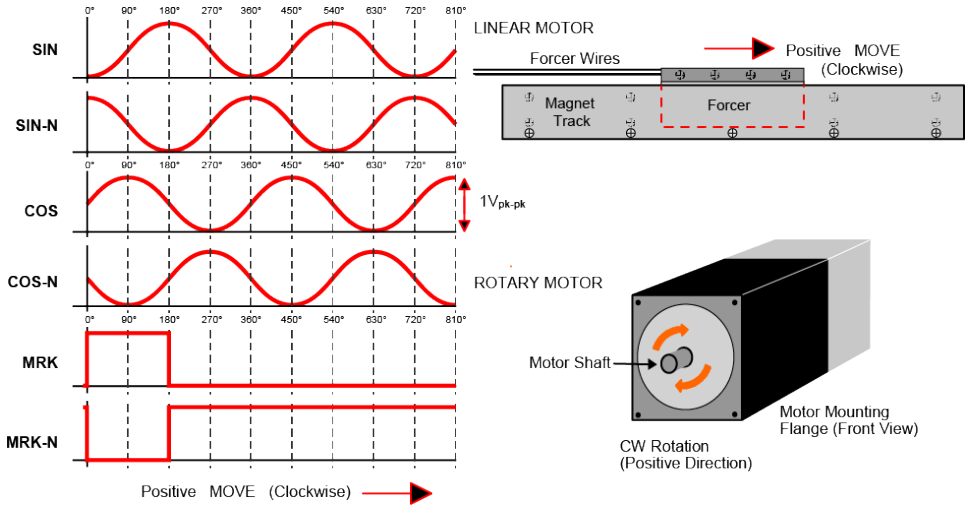


Figure 2-20: Analog Encoder Phasing Reference Diagram

NOTE: The input amplitude is measured peak to peak for any encoder signal (sin, sin-n, cos, cos-n) relative to signal common. These signals have a typical offset voltage of 2V to 2.5V.

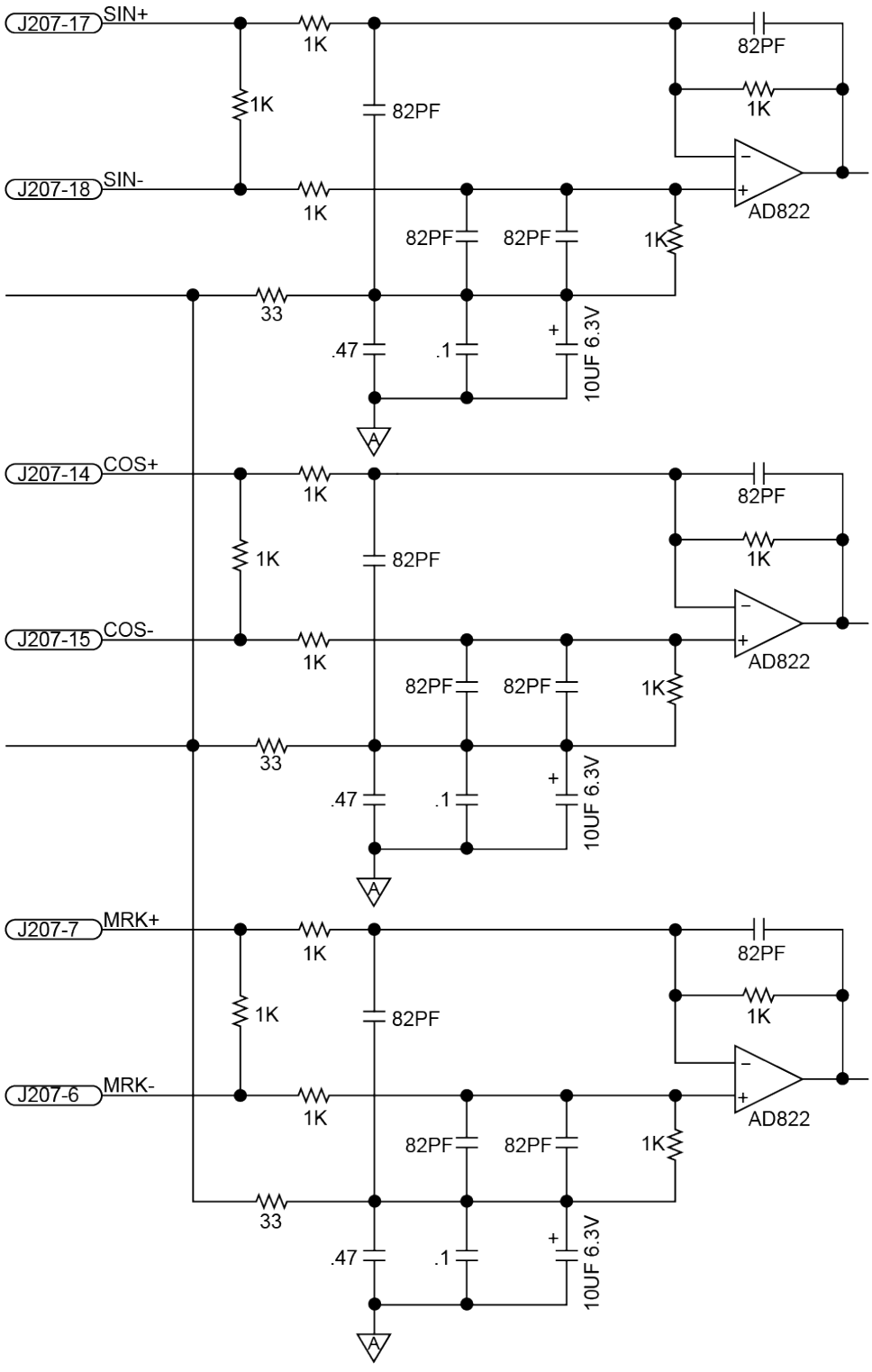


Figure 2-21: Analog Encoder Interface (J207)

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 2-22 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 2-23). The Motor Phasing Calculator in the Configuration Manager can be used to determine proper encoder polarity.

For dual loop systems, the velocity feedback encoder is displayed in the diagnostic display (Figure 2-23).

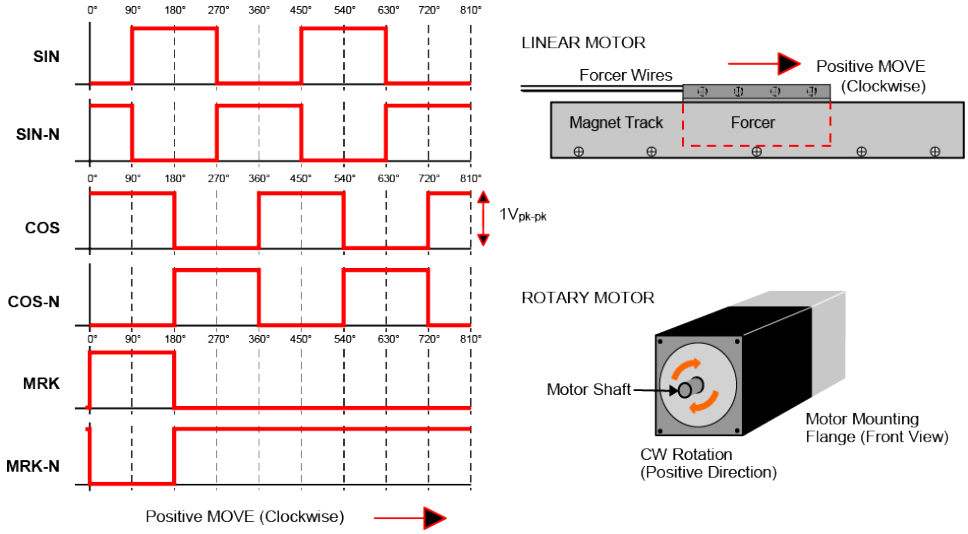


Figure 2-22: Encoder Phasing Reference Diagram (Standard)

NOTE: Encoder manufacturers may refer to the encoder signals as A, B, and Z. The proper phase relationship between signals is shown in Figure 2-22.

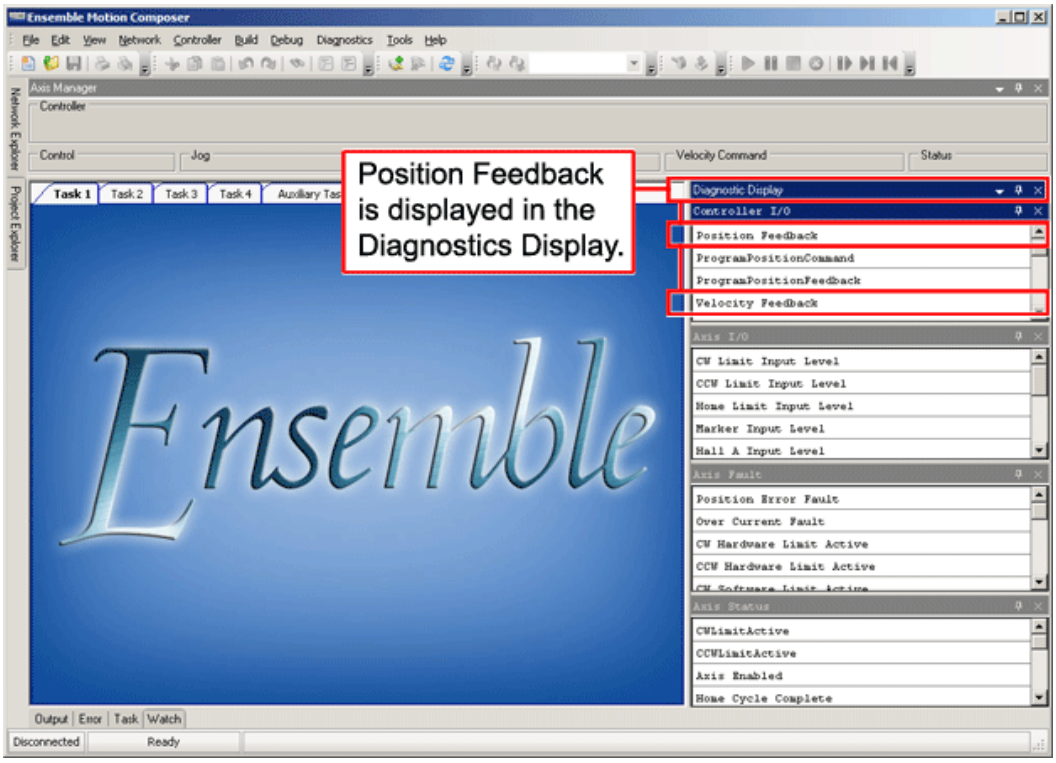


Figure 2-23: Position Feedback in the Diagnostic Display

2.3.2. Hall-Effect Interface (J207)

The Hall-effect switch inputs are recommended for AC brushless motor commutation but not absolutely required. The Hall-effect inputs accept 5-24 VDC level signals. 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 2-17: Hall-Effect Feedback Interface Pins on the Motor Feedback Connector (J207)

Pin#	Description	In/Out/Bi
1	Chassis Frame Ground	N/A
3	+5V Power for Encoder (500 mA max)	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
21	Signal Common for Encoder	N/A

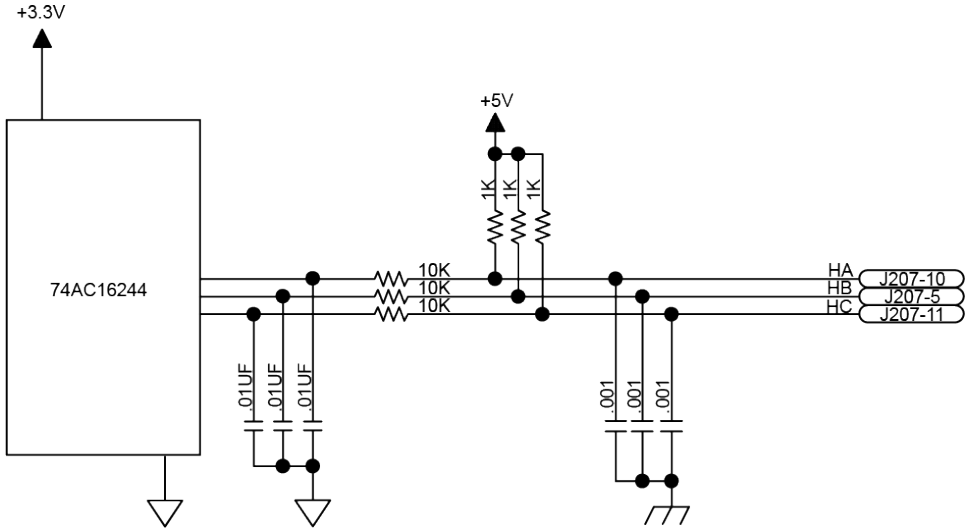


Figure 2-24: Hall-Effect Inputs (J207)

2.3.3. Thermistor Interface (J207)

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 (i.e., 100 ohms) which will result in a low input signal. As the increasing temperature causes the thermistor's resistance to increase, the signal will be seen as a logic high triggering an over temperature fault. The nominal trip value of the sensor is 1k Ohm.

Table 2-18: Thermistor Interface Pins on the Motor Feedback Connector (J207)

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

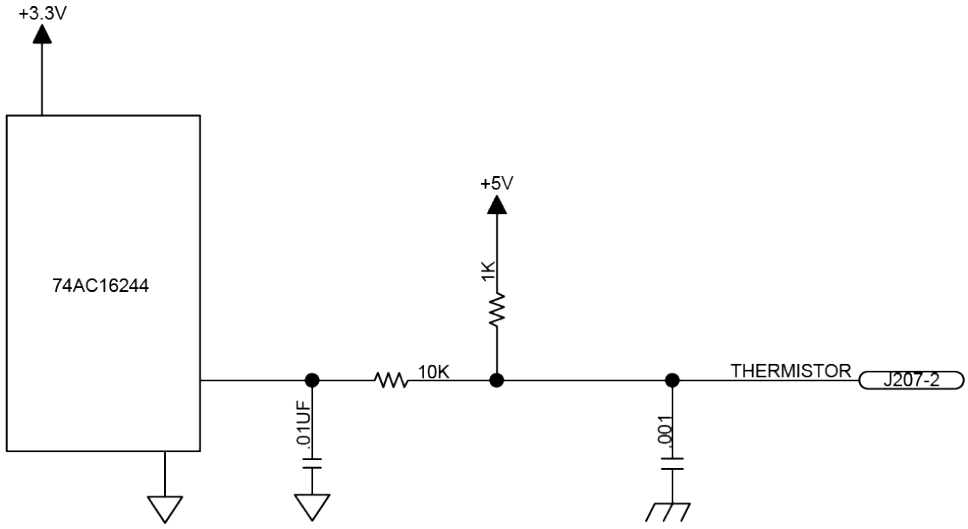


Figure 2-25: Thermistor Interface Input (J207)

2.3.4. Encoder Fault Interface (J207)

The encoder fault input is for use with encoders that have a fault output. This is provided by some manufactures 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.

Table 2-19: Encoder Fault Interface Pins on the Motor Feedback Connector (J207)

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

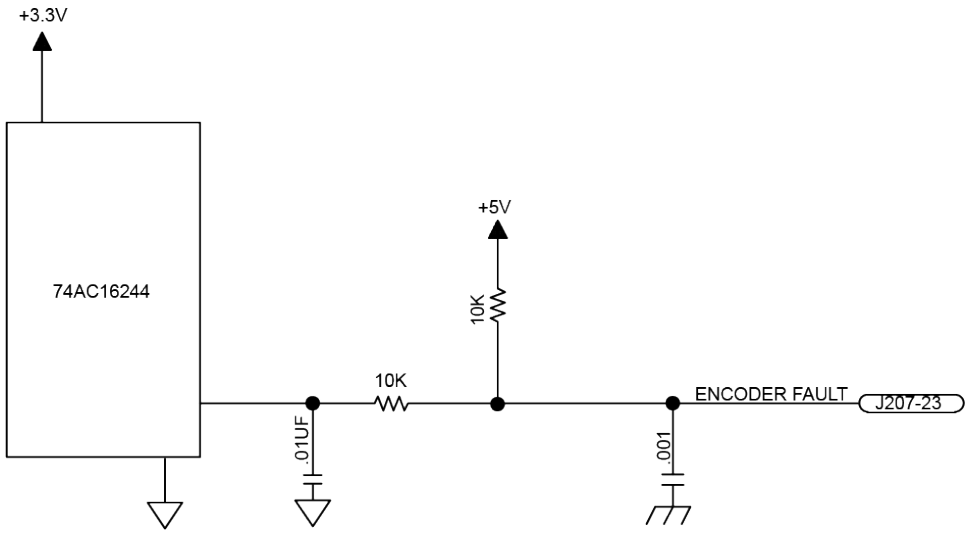


Figure 2-26: Encoder Fault Interface Input (J207)

2.3.5. End Of Travel Limit Input Interface (J207)

End of Travel (EOT) limits are used to define the end of physical travel. The EOT limit inputs accept 5-24 VDC level signals. The active state of the EOT limits is software selectable by the EndOfTravelLimitSetup axis parameter (refer to the Ensemble Help file). Limit directions are relative to the encoder polarity in the diagnostics display (refer to Figure 2-29).

Positive motion is stopped by the clockwise (CW) end of travel limit input. Negative 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.

Opto-isolated user inputs 0-3 can also be used as the end-of-travel limit inputs, see Section 2.5.4.

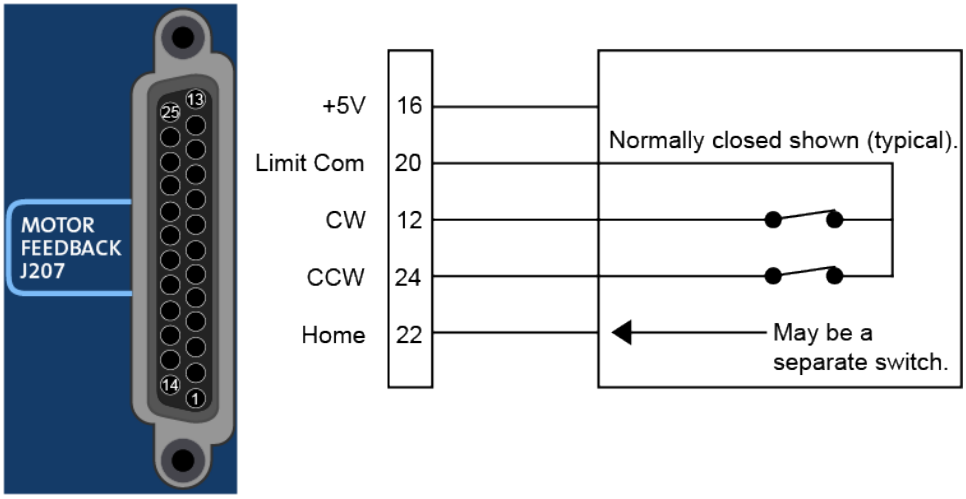


Figure 2-27: End of Travel Limit Input Connections

Table 2-20: End of Travel Limit Input Interface Pins on the Motor Feedback Connector (J207)

Pin#	Description	In/Out/Bi
12	Clockwise End of Travel Limit	Input
16	+5V Power for Limit Switches (500 mA max)	Output
20	Signal Common for Limit Switches	N/A
22	Home Switch Input	Input
24	Counterclockwise End of Travel Limit	Input

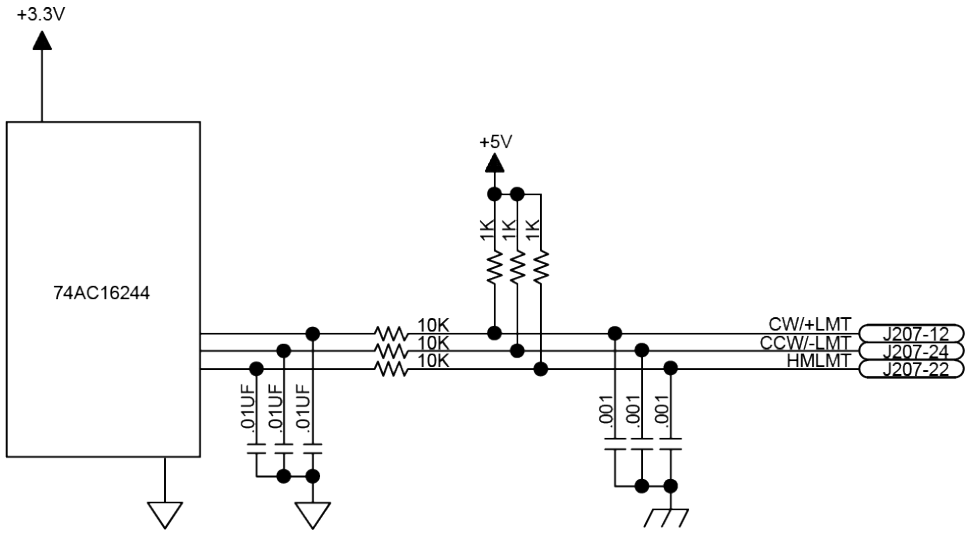


Figure 2-28: End of Travel Limit Interface Input (J207)

2.3.5.1. End Of Travel Limit Phasing

If the EOT limits are reversed, you will be able to move further into a limit but be unable to move out. To correct this, swap the connections to the CW and CCW inputs at the motor feedback connector. The logic level of the EOT limit inputs may be viewed in the Diagnostic Display (shown in Figure 2-29).

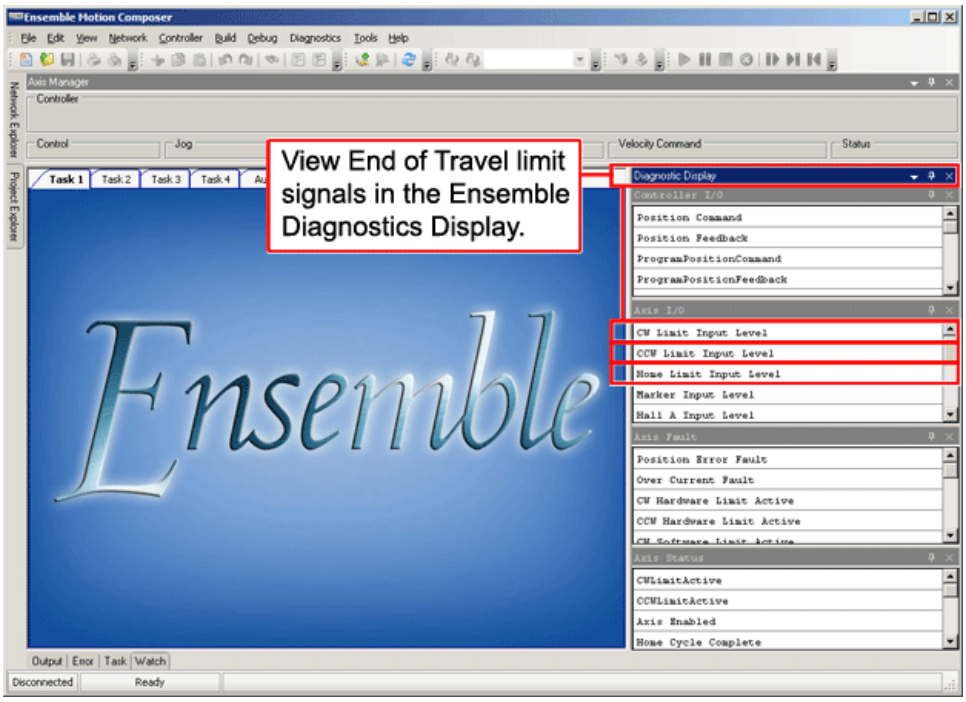


Figure 2-29: Limit Input Diagnostic Display

2.3.6. Brake Output (J207)

The Brake Output pins provide a direct connection to either the solid state relay on the Ensemble HPe 10/20/30 or the mechanical relay on the optional -IO board. The brake output pins in J207 permit the brake to be wired with other signals in the feedback cable. The brake is configured for automatic or manual control using controller parameters (refer to the Ensemble Help file for more information).

Use either the solid state relay on the Ensemble HPe 10/20/30 or the mechanical relay on the -IO board when connecting a power supply to the brake outputs on J207. Do not use both relays at the same time.

Refer to Section 2.6. for more information on using the brake output with the solid-state relay.

Refer to Section 3.1. for more information on using the brake output with the mechanical relay.

Table 2-21: Brake Output Pins on the Motor Feedback Connector (J207)

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

2.4. Emergency Stop Sense Input Connector (TB201)

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

Refer to Section 2.4.1. for interconnection details.

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

WARNING: Opening the motor leads at the Motor Output while the axis is enabled will damage the drive. To protect the drive, the ESTOP circuit should open the AC motor power input (Motor Supply). Refer to Figure 2-31 for interconnection details.

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

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

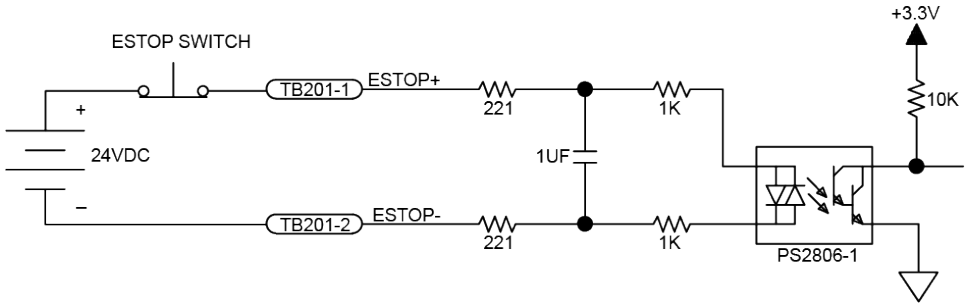


Figure 2-30: ESTOP Sense Input (TB201)

NOTE: Connecting the ESTOP input to a relay or other noise producing device requires the use of noise suppression devices such as those in Table 2-22. These devices are applied across the switched coil to suppress transient voltages.

Table 2-22: Electrical Noise Suppression Devices

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

Table 2-23: Mating Connector Part Numbers for the ESTOP Connector (TB201)

Description	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: AWG [mm^2]
2-Pin Terminal Block	ECK01250	1803578	0.22 - 0.25	0.14 - 1.5 [26-16]

2.4.1. Typical ESTOP Interface

The user can connect an external emergency stop relay circuit to the Ensemble HPe 10/20/30's motor power supply input. This will remove power to the motor while maintaining control power, as shown in the Figure 2-31.

The external relay must be sized based on the number of the Ensemble HPe 10/20/30s connected and the peak current rating of each drive.

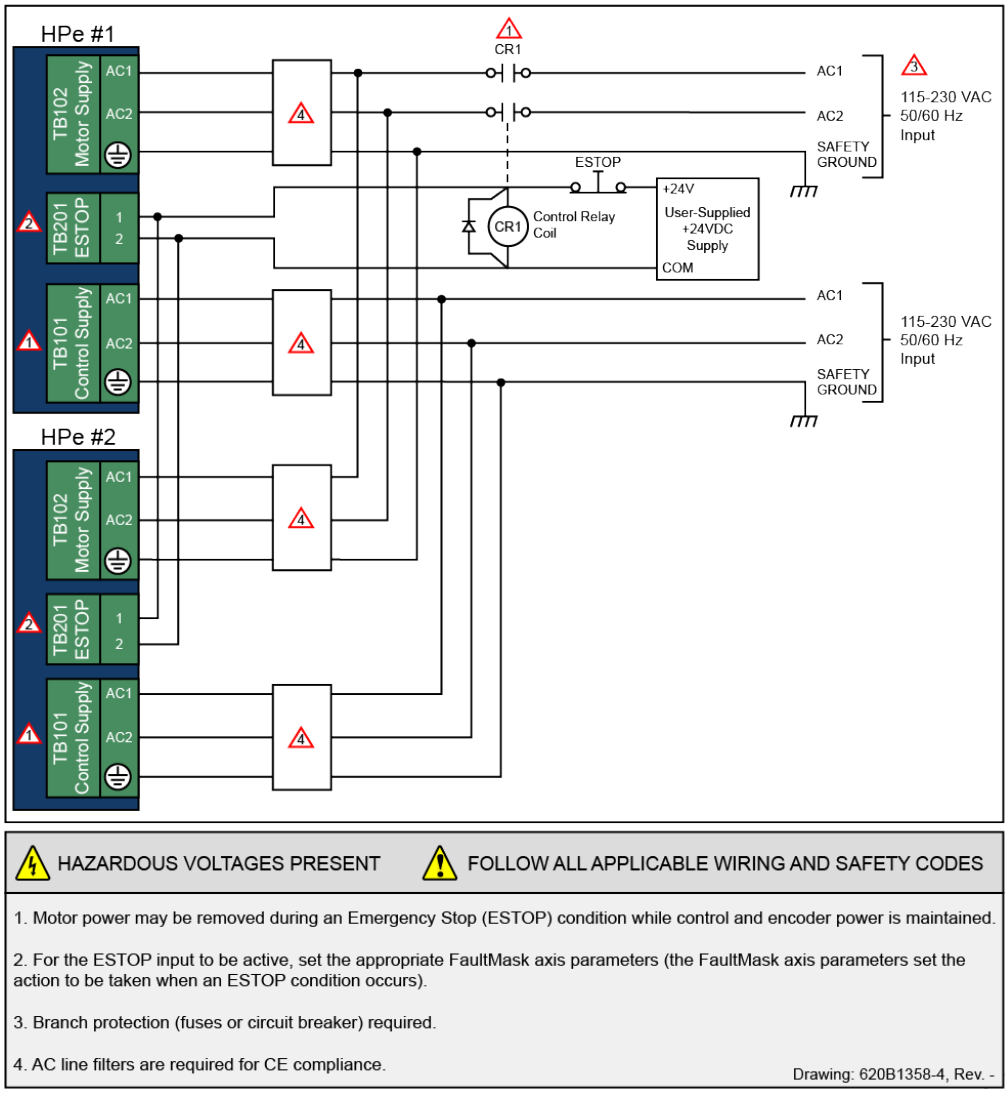


Figure 2-31: Typical Emergency Stop Circuit

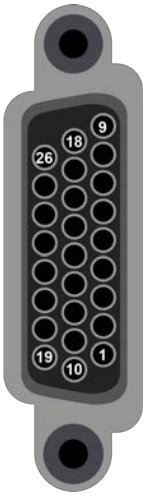
Table 2-24: Typical ESTOP Relay Ratings

Axes	AC1	AC3	Aerotech P/N	Third Party P/N
1	32	16	ECW1018	Sprecher & Schuh CA7-16C-xx-xxx
2 to 5	85	43	ECW1019	Sprecher & Schuh CA7-43C-xx-xxx

2.5. Auxiliary I/O Connector (J205)

The Auxiliary I/O connector (J205) provides 1 analog and 6 digital inputs, 1 analog and 4 digital outputs, and a secondary RS-422 line driver encoder input.

Table 2-25: Auxiliary I/O Connector Pinout (J205)

Pin#	Description	In/Out/Bi	Connector
1	Auxiliary Sine+	Bidirectional	
2	Auxiliary Sine-	Bidirectional	
3	High-Speed Input 4 + user interrupt	Input	
4	High-Speed Input 4 - user interrupt	Input	
5	High-Speed Input 5 + user interrupt	Input	
6	High-Speed Input 5 - user interrupt	Input	
7	Digital Output 0	Output	
8	Digital Output 1	Output	
9	Digital Output 2	Output	
10	Auxiliary Cosine+	Bidirectional	
11	Auxiliary Cosine-	Bidirectional	
12	+5 Volt (500 mA max)	Output	
13	Analog Input 0 + (Differential)	Input	
14	Analog Input 0- (Differential)	Input	
15	Output Common	-	
16	Digital Output 3	Output	
17	Digital Input 0 / CCW EOT Input (1)	Input	
18	Digital Input 1 / CW EOT Input (1)	Input	
19	Auxiliary Marker- / PSO output (2)	Bidirectional	
20	Auxiliary Marker+ / PSO output (2)	Bidirectional	
21	Common (+5 Volt User Supply, 500 mA max)	-	
22	Analog Output 0	Output	
23	Analog Common	-	
24	Input Common	-	
25	Digital Input 2 / Home Input (1)	Input	
26	Digital Input 3	Input	

(1) Software configured option
(2) For PSO, see Section 2.5.2.

Table 2-26: Mating Connector Part Numbers for the Auxiliary I/O Connector

Mating Connector	Aerotech P/N	Third Party P/N
Connector	ECK01259	Kycon K86-AA-26P
Backshell	ECK01022	Amphenol 17E-1725-2
NOTE: These items are provided as a set under the Aerotech P/N: MCK-26HDD.		

2.5.1. Auxiliary Encoder Channel (J205)

The auxiliary encoder interface accepts an RS-422 differential quadrature line driver signal. Invalid or missing signals will cause a feedback fault when the axis is enabled.

This encoder channel can be used as an input for master/slave operation (handwheel) or for dual feedback systems. The auxiliary encoder interface does not support analog encoders and cannot be used as an input for the -MXH option.

The auxiliary encoder channel can also be used to echo the standard encoder signals or as the PSO output. Configuring the PSO hardware will automatically configure this encoder channel as an output (refer to Section 2.5.2.) and will remove the 180 ohm terminator resistors.

Table 2-27: Auxiliary Encoder Specifications

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

NOTE: Use the EncoderDivider parameter to configure the bi-directional encoder interface on the auxiliary I/O connector. The EncoderDivider parameter converts the auxiliary encoder interface to an output and defines a divisor for the encoder echo. Refer to the Ensemble Help file for more information.

Table 2-28: Auxiliary Encoder Channel Pins on the Auxiliary I/O Connector (J205)

Pin#	Description	In/Out/Bi
1	Auxiliary Sine+	Bidirectional
2	Auxiliary Sine-	Bidirectional
10	Auxiliary Cosine+	Bidirectional
11	Auxiliary Cosine-	Bidirectional
12	+5 Volt (500 mA max)	Output
19	Auxiliary Marker- / PSO output (2)	Bidirectional
20	Auxiliary Marker+ / PSO output (2)	Bidirectional
21	Common (+5 Volt User Supply, 500 mA max)	-

(2) For PSO, see Section 2.5.2.

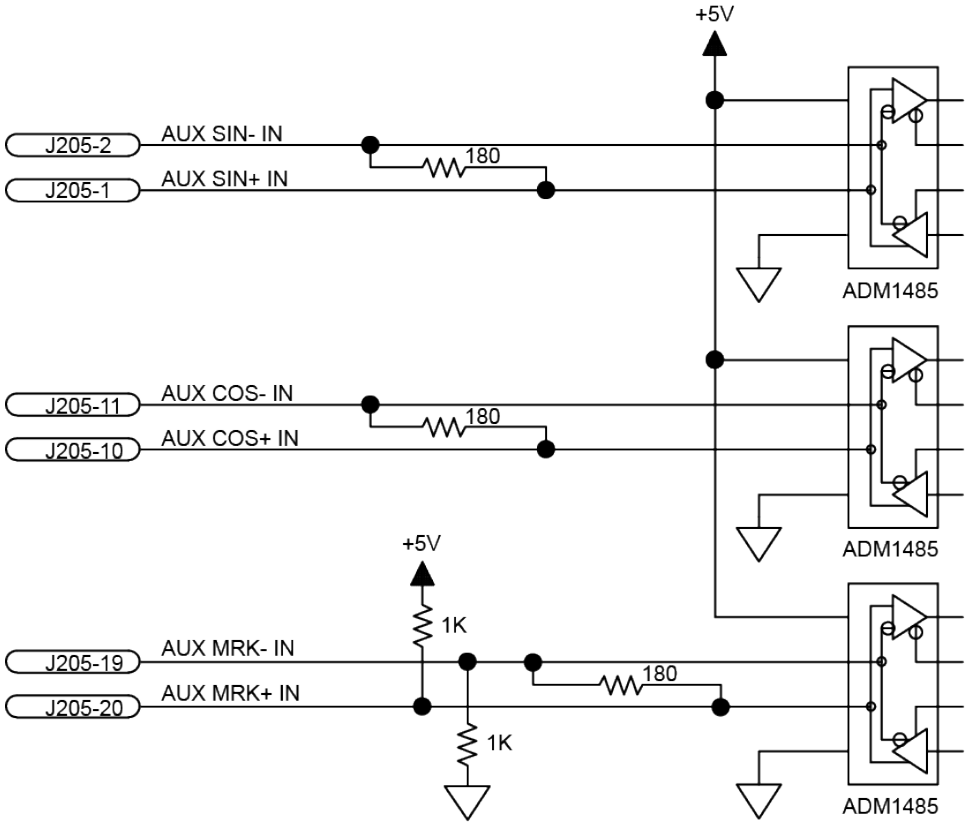


Figure 2-32: Auxiliary Encoder Channel (J205)

2.5.2. Position Synchronized Output (PSO)/Laser Firing (J205)

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

The PSO output is available on the dual-function AUX Marker/PSO signal lines. The auxiliary marker must be configured as an output using the PSOOUTPUT CONTROL command. Refer to the Help File for more information.

An opto-isolated output is available on the TB302 connector of the -IO option (see Section 3.2. for more information).

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

Table 2-29: PSO Specifications

Specification		Value
Maximum Input Tracking Rate (1)	Single-Axis Tracking	16.6 MHz
	Dual-Axis Tracking	8.33 MHz
	Triple-Axis Tracking	8.33 MHz
Maximum Quadrature Encoder Output Frequency	Standard Feedback	40 MHz
	-MXH Feedback	25 MHz
Maximum PSO Output (Fire) Frequency (2)		12.5 MHz
Firing Latency(3)	Single-Axis Tracking	160 nsec
	Dual-Axis Tracking	220 nsec
	Triple-Axis Tracking	220 nsec

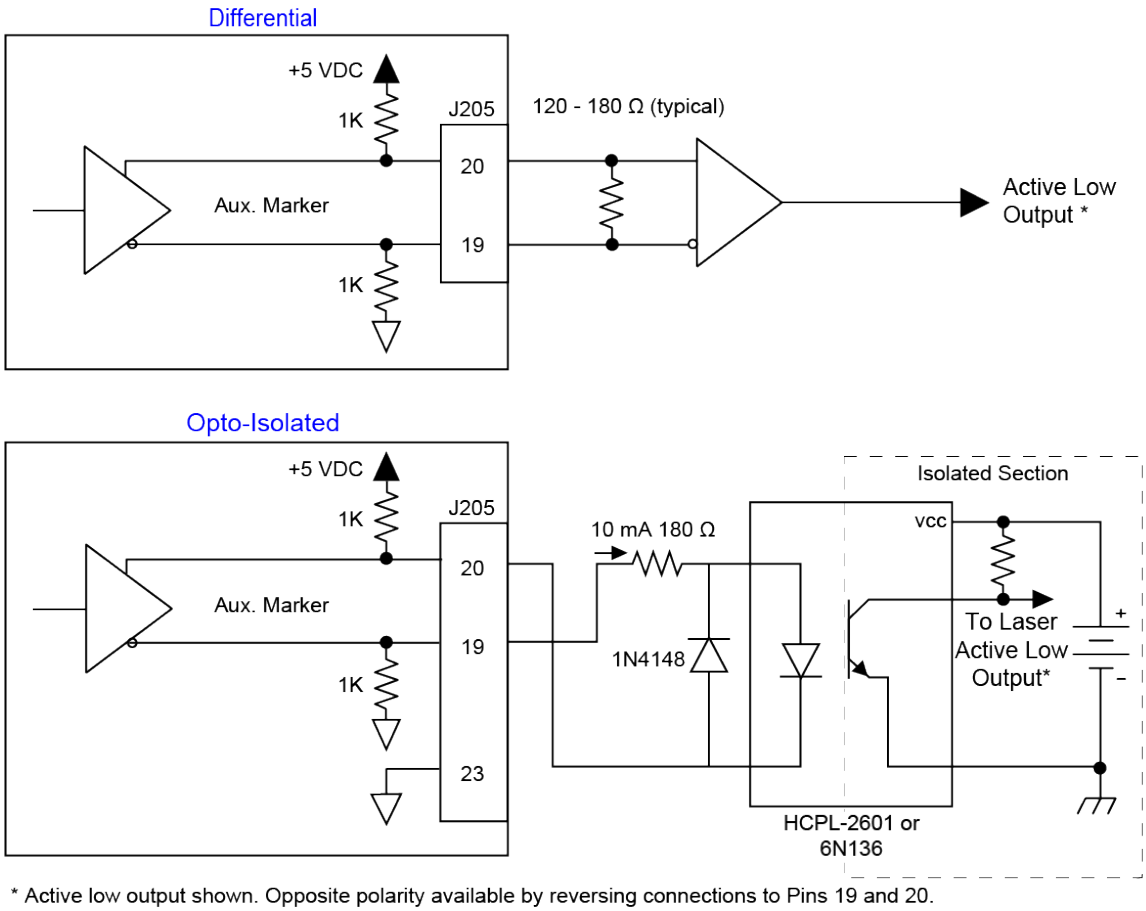
1. Signals in excess of this rate will cause a loss of PSO accuracy.
2. The optocoupler that you use on the output might have an effect on this rate.
3. MXH encoder multiplier options have an additional latency of ~3.25 microseconds between the measurement position and the update of the PSO hardware.

NOTE: When using the MRK± signals with single-ended systems, **do not** connect MRK+ or MRK- to GROUND (GND).

Software controlled PSO pre-scalars may be used to limit the data rate of each encoder being tracked without affecting the servo loop data rate.

Table 2-30: PSO Output Pins on the Auxiliary I/O Connector (J205)

Pin#	Description	In/Out/Bi
19	Auxiliary Marker- / PSO output	Bidirectional
20	Auxiliary Marker+ / PSO output	Bidirectional
23	Analog Common	-



* Active low output shown. Opposite polarity available by reversing connections to Pins 19 and 20.

Figure 2-33: PSO Interface

2.5.3. Digital Outputs 0-3 (J205)

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

The outputs are software-configurable and must be connected in either all sinking or all sourcing mode. Figure 2-34 and Figure 2-35 illustrate how to connect to an output in current sourcing and current sinking modes.

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

Table 2-31: Digital Output Specifications

Opto Device Specifications	Value
Maximum Voltage	24 V maximum
Maximum Sink/Source Current	60 mA/channel @ 50°C
Output Saturation Voltage	2.75 V at maximum current
Output Resistance	33 Ω
Rise / Fall Time	250 usec (typical)
Reset State	Output Off (High Impedance State)

Table 2-32: Port 0 Digital Output Connector Pins on the Auxiliary I/O Connector (J205)

Pin#	Description	In/Out/Bi
7	Digital Output 0	Output
8	Digital Output 1	Output
9	Digital Output 2	Output
15	Output Common	-
16	Digital Output 3	Output

NOTE: Outputs must be connected as all sourcing or all sinking.

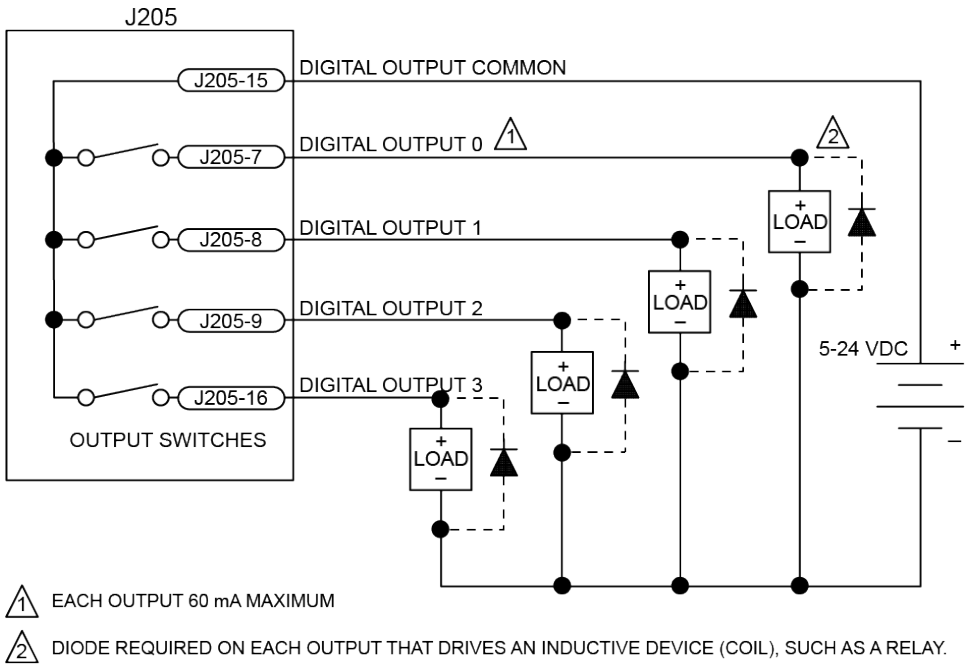


Figure 2-34: Digital Outputs Connected in Current Sourcing Mode (J205)

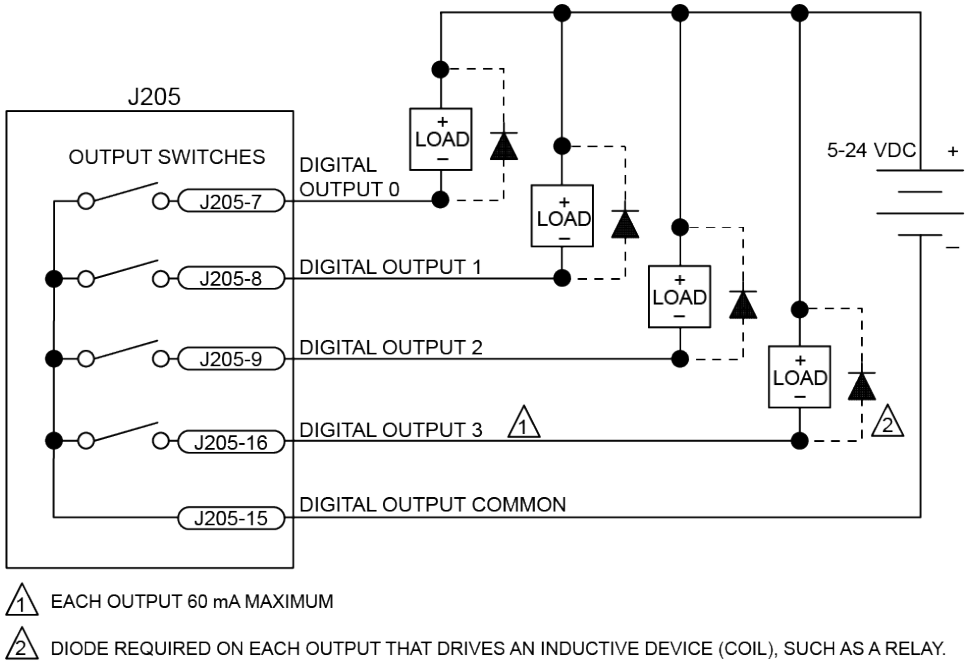


Figure 2-35: Digital Outputs Connected in Current Sinking Mode (J205)

2.5.4. Digital Inputs 0-3 (J205)

The digital inputs are opto-isolated and may be connected to current sourcing or current sinking devices, as shown in Figure 2-36 and Figure 2-37. These inputs are designed to connect to other ground-referenced circuits and are not intended for high-voltage isolation.

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

Table 2-33: Digital Input Specifications

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

Table 2-34: Port 0 Digital Input Connector Pins on the Auxiliary I/O Connector (J205)

Pin#	Description	In/Out/Bi
17	Digital Input 0 / CCW EOT Input (1)	Input
18	Digital Input 1 / CW EOT Input (1)	Input
24	Input Common	-
25	Digital Input 2 / Home Input (1)	Input
26	Digital Input 3	Input
(1) Software configured option		

NOTE: Each bank of 8 Inputs must be connected in the all sourcing or all sinking configuration.

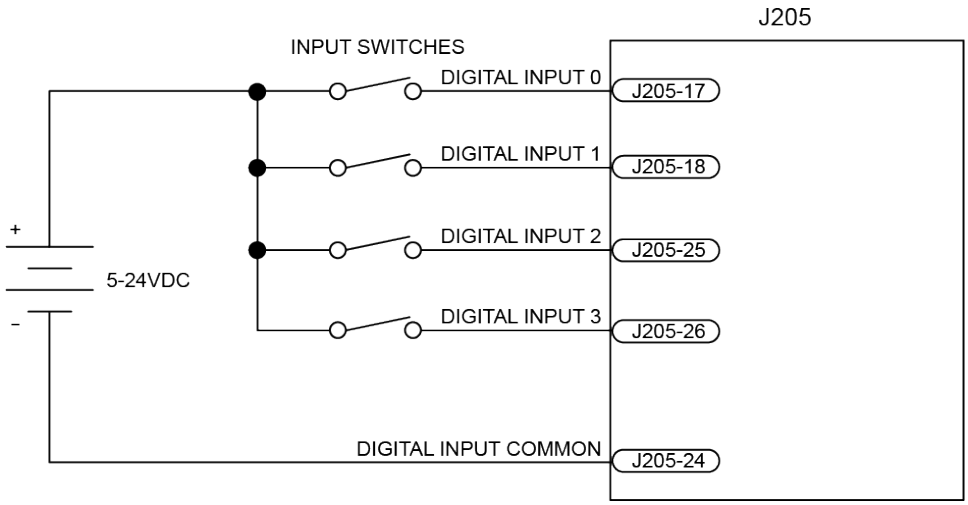


Figure 2-36: Digital Inputs Connected in Current Sourcing Mode (J205)

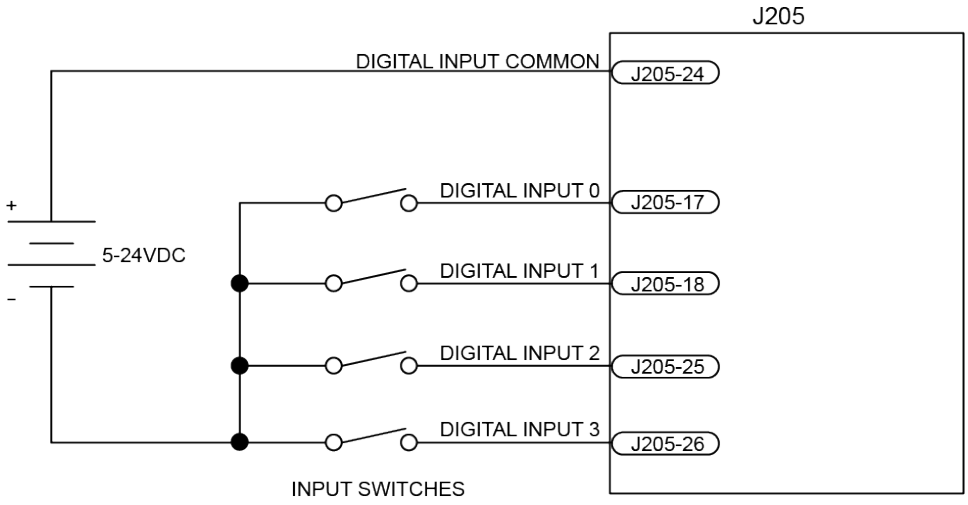


Figure 2-37: Digital Inputs Connected in Current Sinking Mode (J205)

2.5.5. High-Speed User Inputs 4-5 (J205)

The high-speed inputs 4-5 are typically used as a sample signal for data collection.

Table 2-35: High-Speed Input Specifications

Specification	Value
Input Voltage	5V or 24 V input voltages based on a jumper setting (Table 2-37)
Input Current	10 mA
Input Device	HCPL-0630
Delay	50 nsec

Table 2-36: Port 0 High Speed Digital Input Connector Pins on the Auxiliary I/O Connector (J205)

Pin#	Description	In/Out/Bi
3	High-Speed Input 4 + user interrupt	Input
4	High-Speed Input 4 - user interrupt	Input
5	High-Speed Input 5 + user interrupt	Input
6	High-Speed Input 5 - user interrupt	Input

Table 2-37: Input Voltage Jumper Configuration

Jumper	Setting	Description
JP3	1-2 (1)	24 V operation (High Speed Input 5)
	2-3	5 V operation (High Speed Input 5)
JP4	1-2 (1)	24 V operation (High Speed Input 4)
	2-3	5 V operation(High Speed Input 4)
(1) Default		

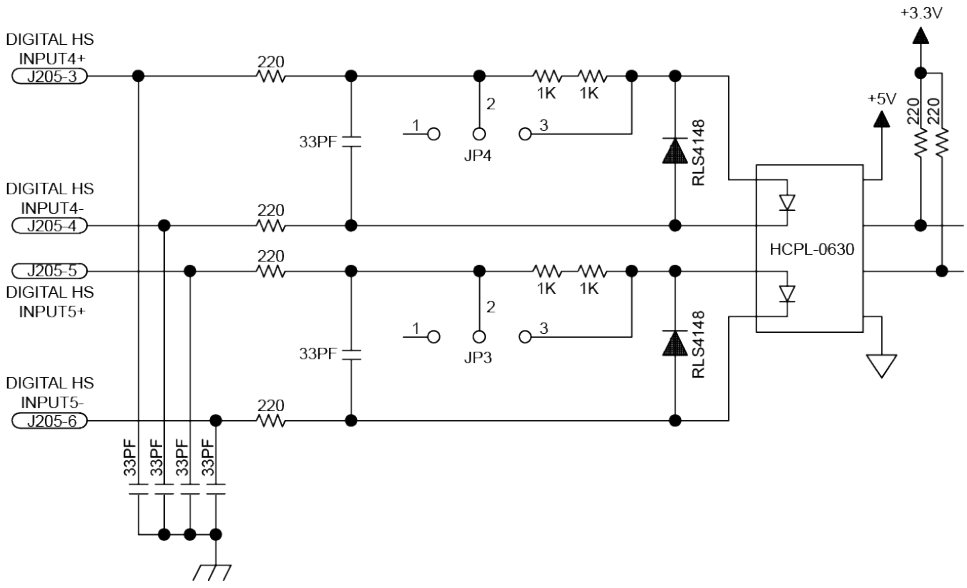


Figure 2-38: High-Speed User Inputs (J205)

2.5.6. Analog Output 0 (J205)

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

Table 2-38: Analog Output 0 Specifications (TB102 B)

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

Table 2-39: Analog Output Connector Pins on the Auxiliary I/O Connector (J205)

Pin#	Description	In/Out/Bi
22	Analog Output 0	Output
23	Analog Common	-

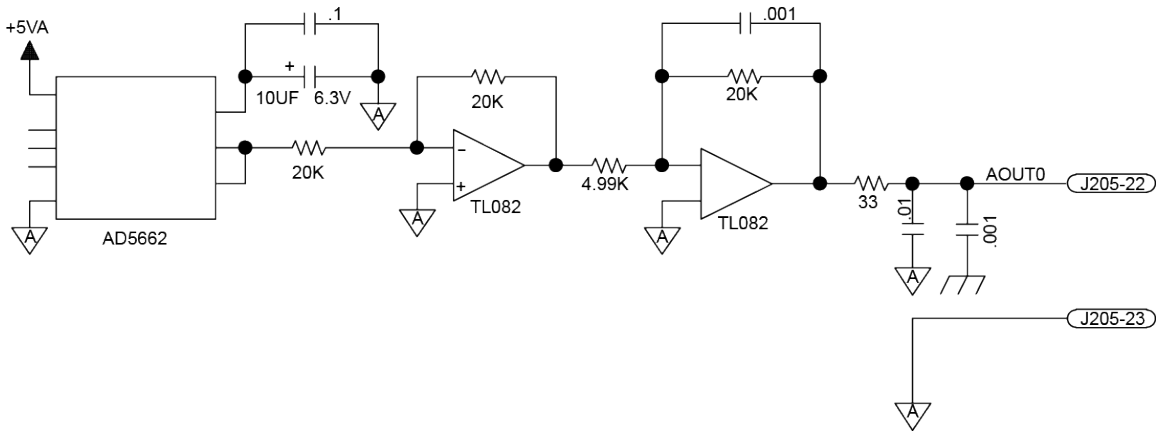


Figure 2-39: Analog Output 0 (J205)

2.5.7. Differential Analog Input 0 (J205)

To interface to a single-ended (non-differential) voltage source, connect the signal common of the source to the negative input and the analog source signal to the positive input. A floating signal source should be referenced to the analog common as shown in Figure 2-40.

Table 2-40: Differential Analog Input 0 Specifications

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

Table 2-41: Analog Input Connector Pins on the Auxiliary I/O Connector (J205)

Pin#	Description	In/Out/Bi
13	Analog Input 0 + (Differential)	Input
14	Analog Input 0- (Differential)	Input
23	Analog Common	-

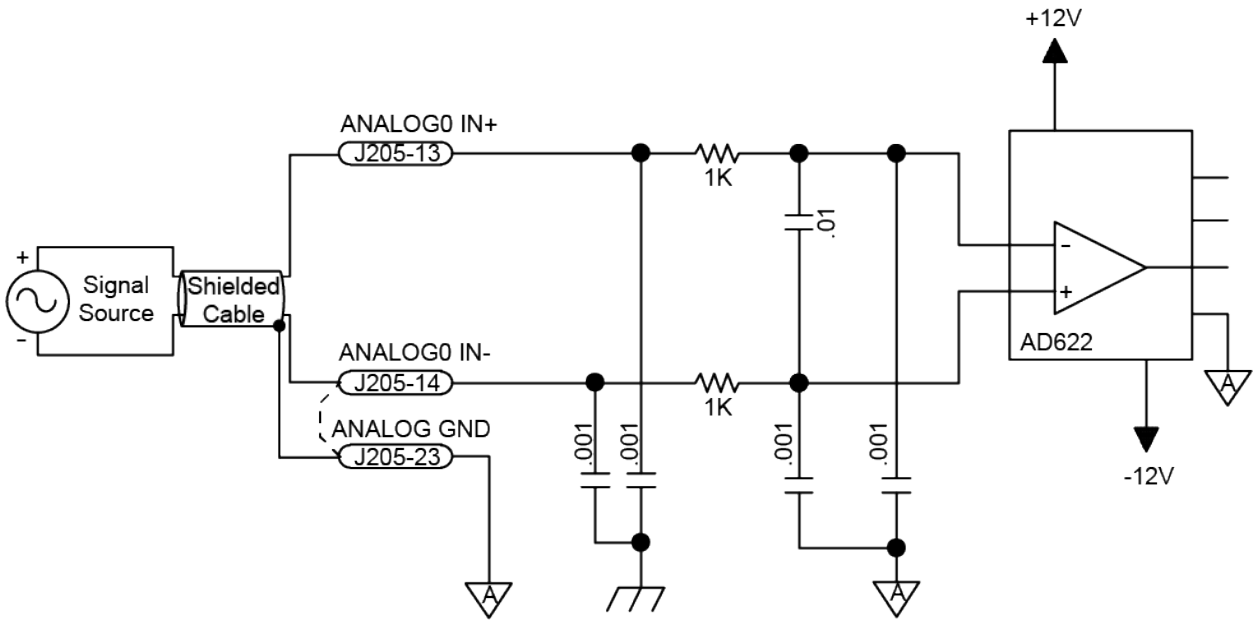


Figure 2-40: Analog Input 0 (J205)

2.6. Brake Power Supply Connector (TB202)

TB202 is the power supply connection to the onboard solid state brake control relay.The relay can be used to automatically control a fail-safe brake on a vertical axis. It can also be used as a general purpose output.

The brake is typically wired directly to the Motor Feedback connector and the brake power supply is connected to TB202 (Figure 2-41). The brake can also be connected in series with the Brake Power Supply and interlocked using Motor Feedback brake pins (Figure 2-42). A varistor must be connected across the brake to minimize high voltage transients.

The brake output can be software configured; refer to the Ensemble Help file for more information (see topics for the EnableBrakeControl parameter and the BRAKE command).

When TB202 is used to power the solid state brake control relay, the mechanical brake control relay present on the I/O board should not be used.

NOTE: The brake power supply must be externally fused.

The user must verify that the brake power requirements are within the specifications of the brake control relay.

Table 2-42: Relay Specifications

Solid State Relay Rating	
Maximum Voltage	24 VDC
Maximum Current	2.5 Amps
Turn-On/Turn-Off Time	< 3.2 ms Turn-On (typical) / 0.1 ms Turn-Off (typical)

WARNING: Do not exceed the maximum specifications.

Table 2-43: Brake Output Connector Pinout (TB202)

Pin#	Description	In/Out/Bi
1	Brake Power Supply (+)	Input
2	Brake Power Supply (-)	Input

Table 2-44: Mating Connector Part Numbers for the Brake Power Supply Connector (TB202)

Description	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: AWG [mm^2]
2-Pin Terminal Block	ECK01250	1803578	0.22 - 0.25	0.14 - 1.5 [26-16]

Figure 2-41 is an example of a +24 VDC brake connected to the Motor Feedback connector. In this example the external +24 VDC power source is connected to TB202.

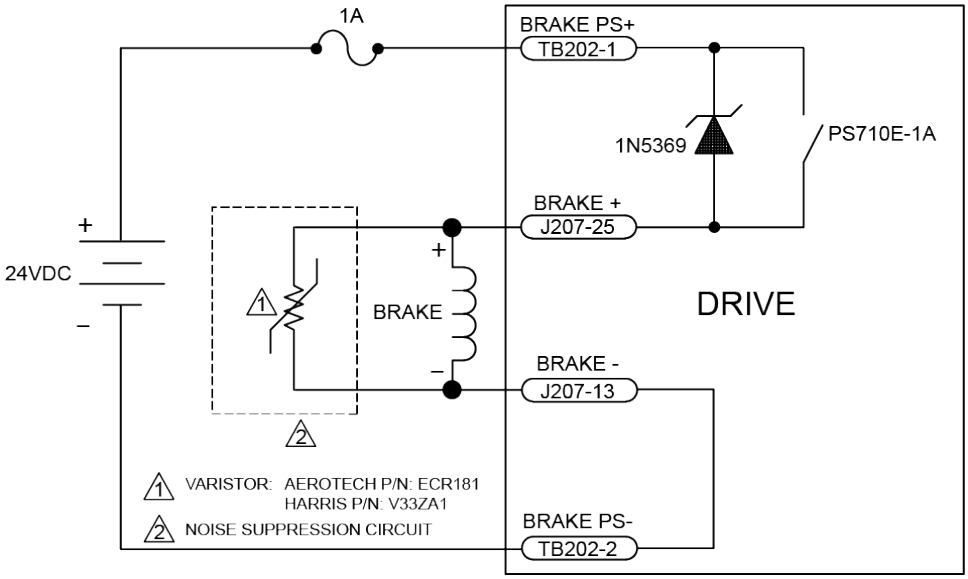


Figure 2-41: Brake Connected to J207

NOTE: The user is responsible for providing fuse protection for the brake circuit.

Figure 2-42 is an example of a 24 VDC brake connected to TB202. The user must connect J207 pin 13 to J207 pin 25. In this case, J207 would function as an interlock to prevent the brake from releasing if the Motor Feedback connector is not connected.

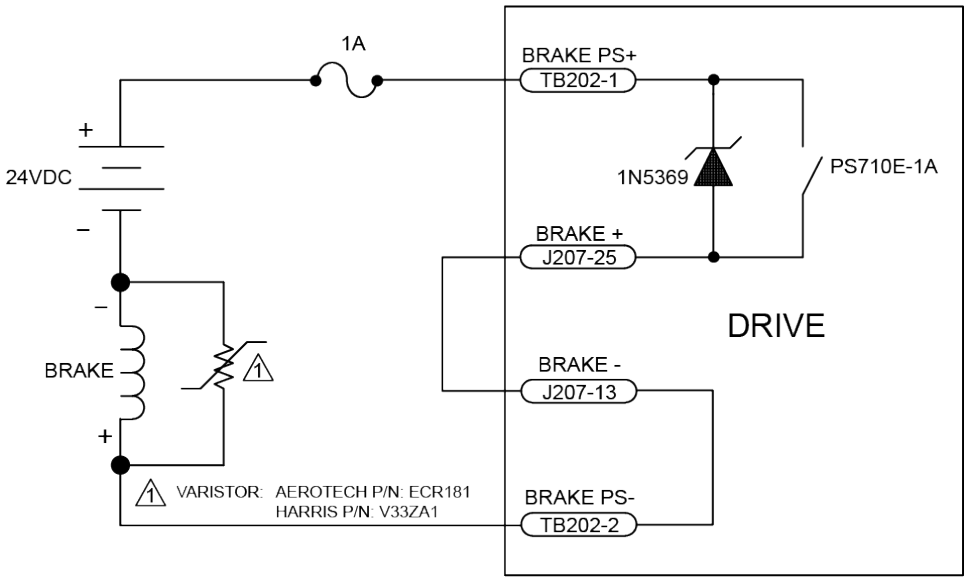


Figure 2-42: Brake Connected to TB202

2.7. Aeronet Interface (J209/J210)

The Aeronet interface is used to connect discrete Ensemble HPe 10/20/30s to make a multi-axis system. The Aeronet connection requires a shielded CAT-6 Ethernet cable. If a non-shielded cable is used, communication failures will likely occur.

When connecting a PC using Ethernet or USB to a multi-axis system, you must connect the PC to the primary Ensemble HPe 10/20/30 using the standard Ethernet or USB connectors. Connecting the PC to any of the secondary units will result in a connection failure.

Any discrete unit is capable of acting as the primary Ensemble HPe 10/20/30. The unit acting as the primary is dictated by the connection of the Aeronet. A primary drive will only act as an output. A secondary drive (in a configuration with three or more drives) will act as an input and output. The last drive connected in any configuration will only act as an input.

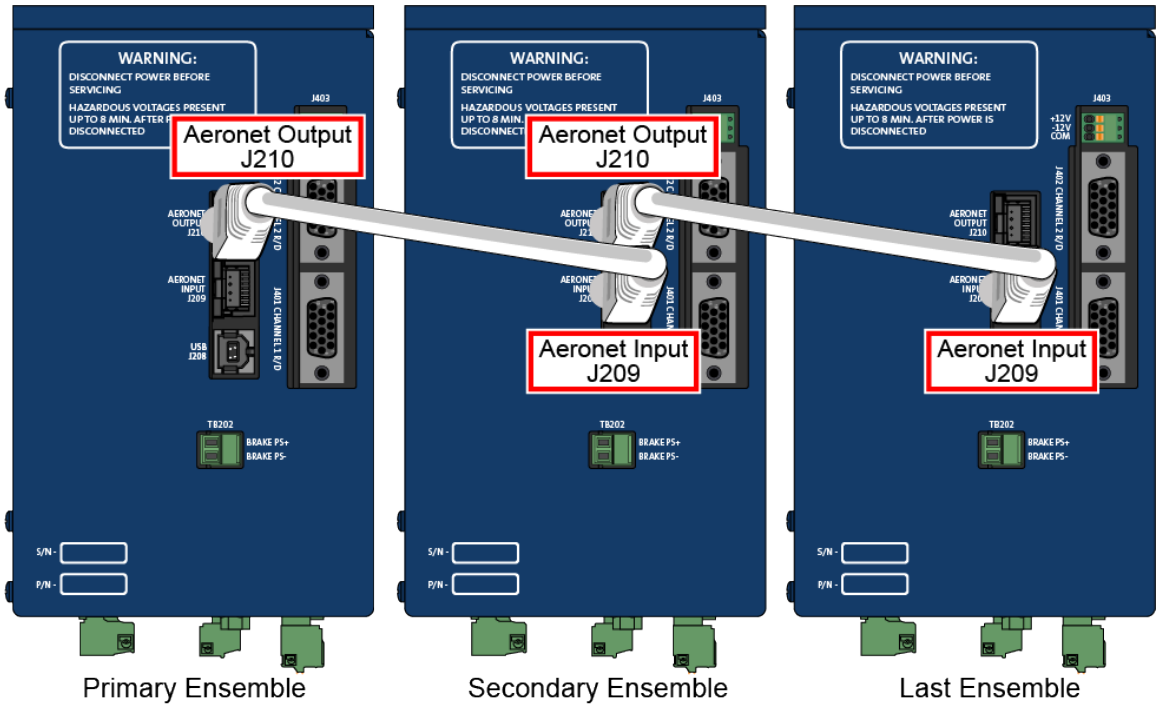


Figure 2-43: Aeronet Connection with Three Discrete Drives

Table 2-45: Aeronet Cable Part Numbers

Cable Part Number	Length
ENET-CAT6-x	A CAT6 cable; length is x decimeters
1) x = 3, 10, 20, 30, 45, 76, or 90 2) Cable lengths are in decimeters, 10dm = 1 meter = 3.28 feet	

2.8. RS-232 Interface (J206)

Connecting the RS-232 port to a user's PC requires a standard cable (not a null modem).

Table 2-46: RS-232 Connector Pinout (J206)

Pin#	Description	In/Out/Bi	Connector
1	+5 Volt Power Output (1)	Output	
2	RS-232 Transmit	Output	
3	RS-232 Receive	Input	
4	Reserved	Output	
5	Ground	N/A	
6	Reserved	Output	
7	Reserved	Input	
8	Reserved	Input	
9	Reserved	N/A	
(1) Total user +5 V power is limited to 500 mA.			

Table 2-47: Mating Connector Part Numbers for the RS-232 Port Connector (J206)

Mating Connector	Aerotech P/N	Third Party P/N
9-Pin D-Connector	ECK00137	FCI# DE09P064TXLF
Backshell	ECK01021	Amphenol 17E-1724-2

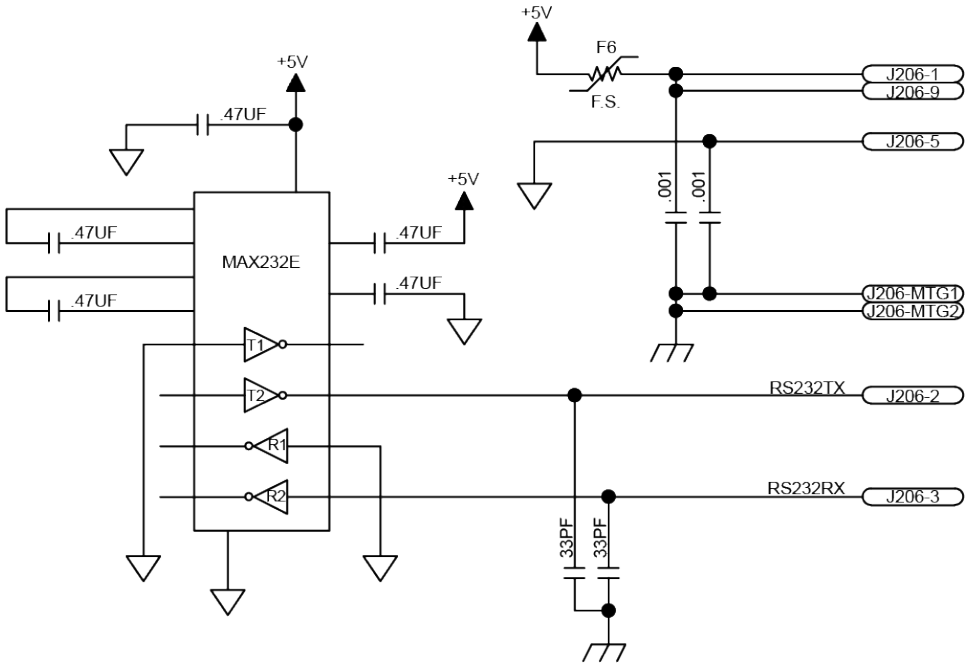


Figure 2-44: RS-232 Interface (J206)

2.9. -EXTSHUNT Option (TB103)

The -EXTSHUNT option provides a connection for a user-provided shunt resistor to dissipate excess energy and keep the internal drive voltage within safe levels. The drive switches this resistor "ON" when the internal bus voltage reaches approximately 380 VDC. This option is generally required for systems that have a large amount of stored mechanical energy (i.e. large rotating drums).

Proper sizing, mounting, and protection of the shunt resistor is critical due to the potentially large amounts of power dissipated.

DANGER: The shunt resistor temperature can exceed 70°C during normal operation and contains lethal voltage on its terminals and surface. It must be properly enclosed and shielded to avoid risk of fire and operator shock.

Table 2-48: -EXTSHUNT Component Information

Component	Description	Aerotech P/N
Recommended Shunt Resistor	50 Ω (min), 300 W Vishay/Dale: RBEF030050R00KFBVT	ECR01039
2-Pin Mating Connector	**Screw Torque Value**: 0.5 - 0.6 N·m **Wire Size**: 12-30 AWG [3.3 - 0.0516 mm^2] Phoenix:175449	ECK01110
Fuse (F2 on the Power Board)	2.5 A S.B. Littelfuse: 21502.5P	EIF01053
Recommended Wire Size	16 AWG (1.3 mm^2) High Temperature	--

The first step in sizing the external shunt resistor is to calculate the kinetic energy of the system (**Equation 1**). Neglecting the system's losses, this is the energy that can potentially be regenerated to the DC bus.

Equation 1:

$$E_M = \left[\frac{1}{2}\right]\left[J_M + J_L\right]\omega_M^2$$

(for rotary motors)

or

$$E_M = \left[\frac{1}{2}\right]\left[M_M + M_L\right]v_M^2$$

(for linear motors)

J_M rotor inertia ($kg \cdot m^2$)
J_L load inertia ($kg \cdot m^2$)
ω_m motor speed before deceleration (rad/s)

M_M forcer mass (kg)
M_L load mass (kg)
v_m velocity (m/s)

A shunt resistor is required if the regenerated energy is greater than the additional energy that the internal bus capacitor can store (**Equation 2**).

Equation 2:

$$E_{Ca} = \frac{1}{2} C \left(V_M^2 - V_{NOM}^2 \right)$$

C bus capacitor (F) [1,200 uF]
V_M turn on voltage for shunt circuit (V) [380 V]
V_{NOM} nominal bus voltage (V) [160 V or 320 V, Typical]

For a standard Ensemble HPe 10/20/30, the maximum additional energy the internal bus capacitor can store without requiring a shunt resistor is indicated in Table 2-49.

Table 2-49: Maximum Additional Storage Energy

Bus Voltage	Maximum Additional Energy
160 V	71.3 J
320 V	25.2 J

If a shunt resistor is required, the next step is to calculate the value of resistance necessary to dissipate the energy. Use **Equations 3**, **4**, and **5** to calculate the parameters of the shunt resistor.

Equation 3:

$$P_{PEAK} = \frac{E_M - E_{Ca}}{t_D}$$

P_{PEAK} peak power that the regeneration circuit must accommodate (W)
t_D deceleration time (s)

Equation 4:

$$P_{AV} = \frac{E_M - E_{Ca}}{t_{CYCLE}}$$

P_{AV} average power dissipated on shunt resistor (W)
t_{CYCLE} time between deceleration events (s)

Equation 5:

$$R = \frac{(2V_M - V_{HYS})^2}{4P_{PEAK}}$$

V_{HYS} hysteresis voltage of regeneration circuit (V) [10 V, Typical]

Additional useful equations:

1 lb·ft = 1.356 N·m
1 rad/s = 9.55 rpm

2.10. PC Configuration and Operation Information

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

Chapter 3: -I/O Expansion Board

The -IO option board is 16 digital opto-inputs, 16 digital opto-outputs, 2 SSINET connections, 3 analog inputs, 3 analog outputs, and a brake/relay output.

DANGER: Always disconnect the Mains power connection before opening the Ensemble HPe 10/20/30 chassis.

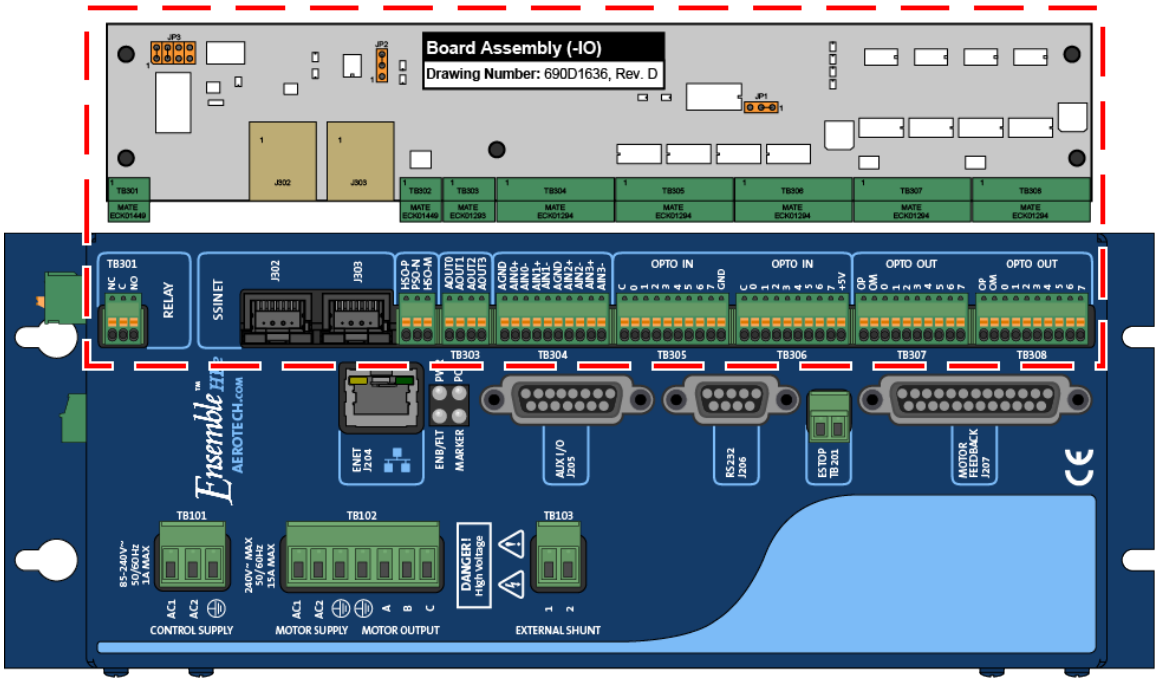


Figure 3-1: Ensemble HPe 10/20/30 with -IO Option Board

Table 3-1: -IO Expansion Board Jumper Configuration

Jumper	Setting	Description
JP2	1-2	PSO Output Active High, Low Z during reset
	2-3 (1)	PSO Output Active Low, High Z during reset
JP3	1-2, 3-4	Switch Brake +
	5-6, 7-8 (1)	Switch Brake -
	1-3	Relay Only
(1) default		

Table 3-2: -IO Option Board Fuse Information

Fuse	Description	Size	Aerotech P/N	Manufacturer's P/N
F1	+5 VDC User Power	3 A, resettable	EIF01001	Raychem RGE300

3.1. Relay Connector (TB301)

The relay can be used to automatically control a fail-safe brake on a vertical axis. It can also be used as a general purpose relay. The normally-open relay contacts are accessible through TB301 and the Motor Feedback (J207) connector. The normally-closed relay contact is only accessible through TB301 (Figure 3-3). The Motor Feedback connector allows the brake wires to be included in the motor feedback cable and eliminate the need for a separate brake cable.

The brake output can be software configured; refer to the Ensemble Help file for more information (see topics for the EnableBrakeControl parameter and the BRAKE command).

When TB301 is used to power the mechanical brake control relay, the solid state brake control relay (TB202) should not be used.

The user must verify that the application will be within the specifications of the Brake/Relay contacts.

Table 3-3: Voltage and Current Specifications (TB301)

Relay K1 Contact Ratings	
Maximum Switched Voltage	150 VDC, 125 VAC
Maximum Switched Current	1A
Maximum Carrying Current	1A
Maximum Switched Power	30 W (DC), 60 VA (AC)

NOTE: Do not exceed Maximum Current or Maximum Power specifications.

Table 3-4: Relay Connector Pinout (TB301)

Pin#	Description	In/Out/Bi
1	Brake Relay Output Normally Closed Contact	Output
2	Brake Relay Output Common Contact	Output
3	Brake Relay Output Normally Open Contact (1)	Output
(1) For JP3 jumper configuration, refer to Table 1-1.		

Table 3-5: Mating Connector Part Numbers for the Relay Connector (TB301)

Description	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm^2]
3-Pin Terminal Block	ECK01449	1881338	0.5 - 0.080 [20-28]

The configuration of JP3 (Table 3-6) allows either the Brake + or the Brake - output to be switched by the relay and connected at the Motor Feedback connector or for the brake to be connected at TB301. Refer to Section . for more information.

Table 3-6: -IO Expansion Board Brake Jumper Configuration

Jumper	Setting	Description
JP3	1-2, 3-4	Switch Brake +
	5-6, 7-8 (1)	Switch Brake -
	1-3	Relay Only
(1) default		

NOTE: The user is responsible for providing fuse protection for the brake circuit.

Figure 3-2 is an example of a +24 VDC Brake connected to the Motor Feedback connector. In this example the external +24 power source is connected to TB301. Note that JP3 is set 1-2 and 3-4 with all others removed.

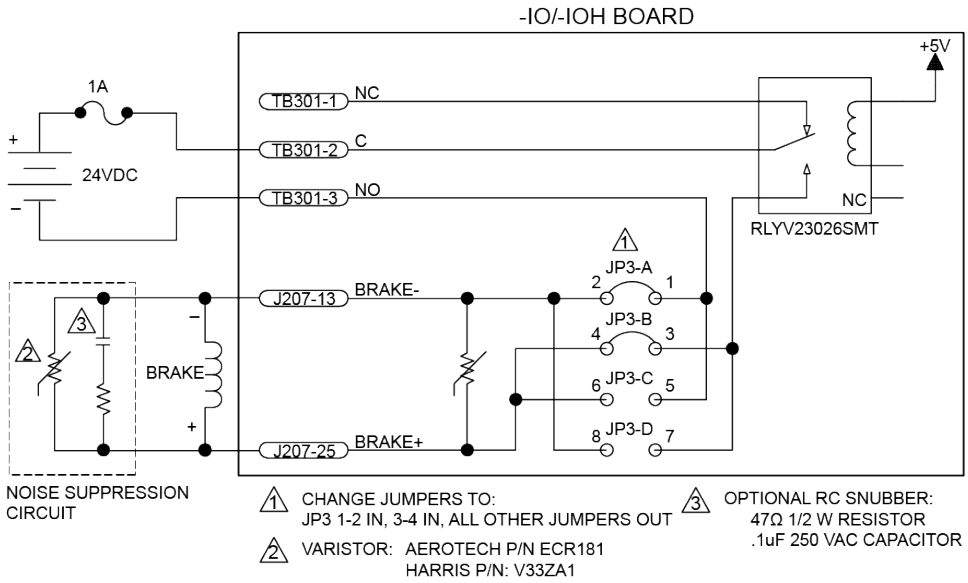


Figure 3-2: Brake Connected to J207

Figure 3-3 is an example of a +24 VDC Brake connected to TB301. In this example, JP3 must be set 1-3 and all other jumpers removed. Otherwise, the user must connect J207 pin 13 to J207 pin 25. In this case, J207 would function as an interlock to prevent the Brake from releasing if the Motor Feedback connector is not connected.

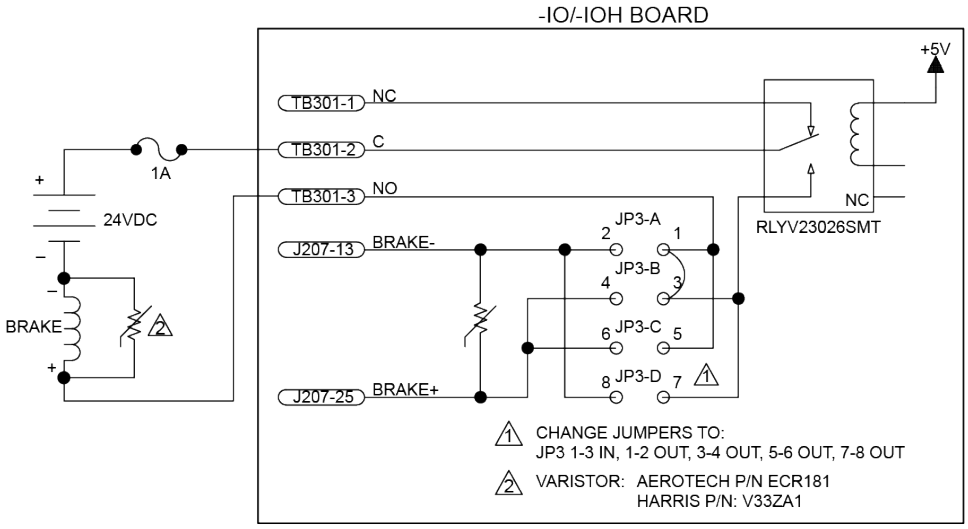


Figure 3-3: Brake Connected to TB301

3.2. PSO Output Interface (TB302)

The output can be used to source or sink current (as shown in Figure 3-4 and Figure 3-5).

By default, JP2 is installed in the 2-3 position for normally open operation. If the PSO-NC option is ordered, JP2 is installed in the 1-2 position giving normally-closed operation. This mode should be used with caution since the Ensemble HPe 10/20/30 cannot maintain the closed state when its AC mains power is turned off. The PSO-NC (JP2 1-2 setting) should not be used when fail-safe operation is required. JP2 jumper settings are shown in Table 3-9. For the JP2 jumper location, refer to Figure 3-1

Table 3-7: PSO Output Interface Connector Pinout (TB302)

Pin #	Description	In/Out/Bi
1	Reserved	--
2	PSO Output	Output
3	Opto-Isolator Common	Input

Table 3-8: Mating Connector Part Numbers for the PSO Output Connector (TB302)

Description	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm^2]
3-Pin Terminal Block	ECK01449	1881338	0.5 - 0.080 [20-28]

Table 3-9: PSO Output Polarity Settings for JP2

PSO Output Polarity	JP2 Setting
Normally Open	2-3 (Recommended)
Normally Closed	1-2

Table 3-10: PSO Output Specifications

Description	Specification
Maximum Voltage	24 V
Current	250 mA
Latency	120 ns
Maximum Frequency	5 MHz

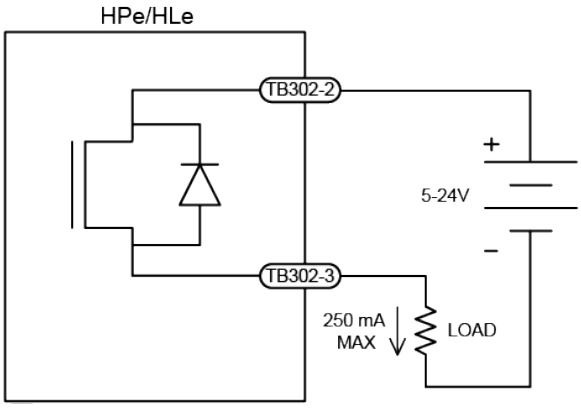


Figure 3-4: PSO Output Sources Current

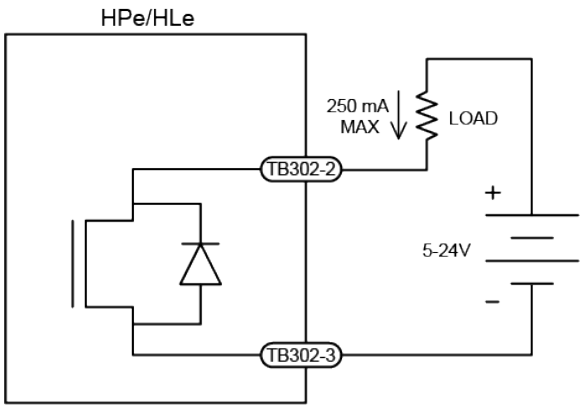


Figure 3-5: PSO Output Sinks Current

3.2.1. -DUALPSO and -TRIPLEPSO Laser Firing Options

The -TRIPLEPSO option is only available on the -IO option board.

The Ensemble HPe 10/20/30 allows two and three-axis laser firing via its -DUALPSO and -TRIPLEPSO options. To accomplish this, the encoder signals from a second/third drive must be jumpered (or daisy-chained) from that Ensemble HPe 10/20/30 to the drive with the -DUALPSO or -TRIPLEPSO options. This requires an encoder signal from another axis via the J205 connector or via one of the two SSINet connectors. If the SSINet is used it requires a cable (see Table 3-11 and Figure 3-6) from J302 to J302 of each HPe (J302 to J302 or J303 to J303 of the other Ensemble HPe 10/20/30, both connectors have two bi-directional ports). Refer to the Ensemble Help File for programming information.

Software controlled PSO pre-scalars may be used to limit the data rate of each encoder being tracked without affecting the servo loop data rate.

See Section 3.2.1.1. for an example of two and three-axis firing. See the Ensemble Help file for more information on parameter configurations.

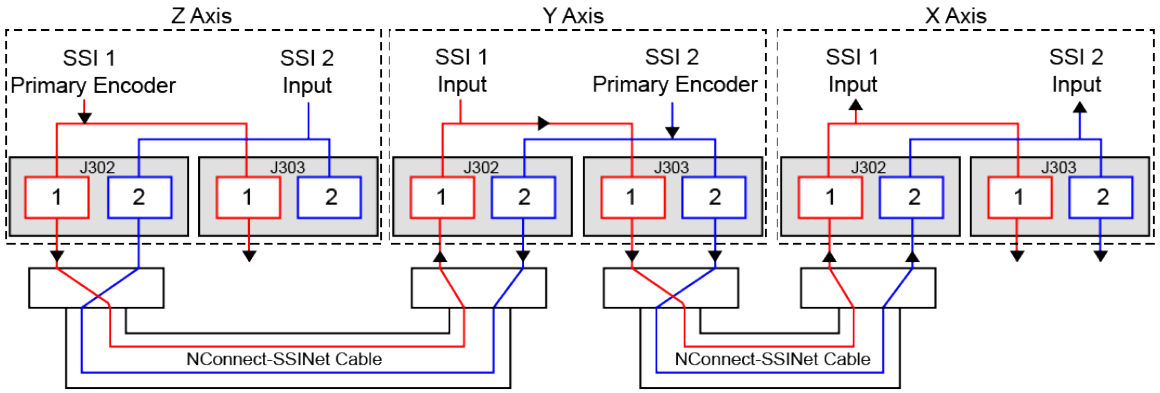
3.2.1.1. Multi-Axis Firing

In this example, the X axis has the -TRIPLEPSO option and the Y and Z axes represent the other two axes that will be tracked. The Y and Z axes output their encoder feedback through SSINet ports 1 and 2, respectively, to the X axis. The Z axis must have its SSINet port 1 configured as an output for its encoder feedback signal, and the Y axis must have its SSINet port 2 configured as an output for its encoder feedback signal. Since the Z axis does not use its SSINet port 2, it should be configured as an Input. Similarly, the Y axis does not use its SSINet port 1 so it should also be configured as an Input. The X axis must have both SSINet ports 1 and 2 configured as Inputs.

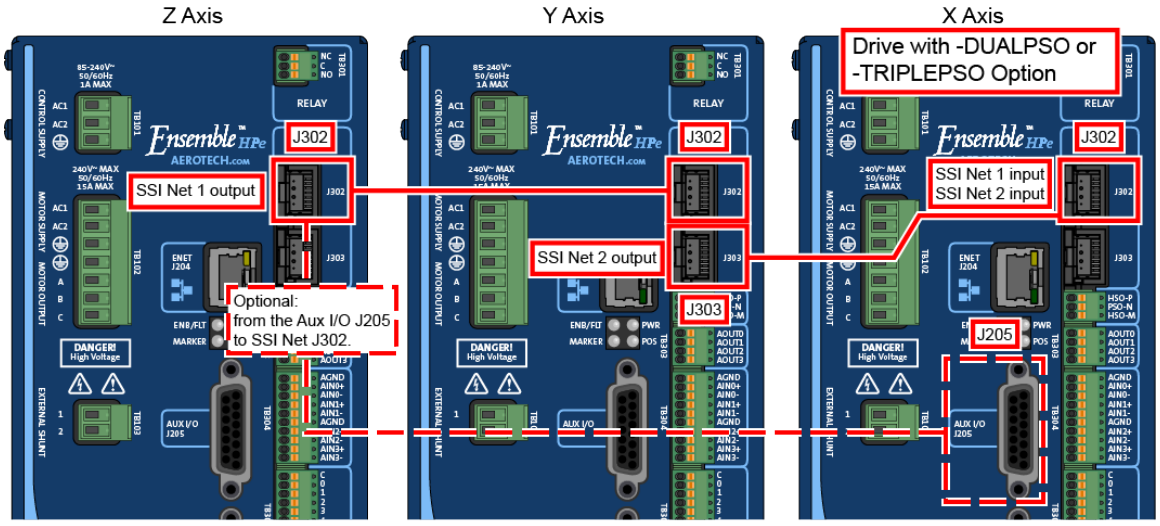
In general, if an axis has an SSINet port configured as an output, then that SSINet port must be configured as an input on all other axes which it is connected to. Otherwise, encoder or marker data may be faulty.

Table 3-11: SSINet Cable Part Numbers

Part #	Description
NConnect-SSINet-4500	4.5 M (15 FT) SSINet Cable
NConnect-SSINet-3000	3.0 M (10 FT) SSINet Cable
NConnect-SSINet-1500	1.5 M (5 FT) SSINet Cable
NConnect-SSINet-900	0.9 M (3 FT) SSINet Cable
C19891-X	J302/J303 to J205 Cable
C19892-X	J302/J303 to J205 Cable



NOTES:
Z axis is routing its primary encoder data to X axis (as well as Y axis) through SSI port 1.
Y axis is routing its primary encoder data to X axis (as well as Z axis) through SSI port 2.



NOTES:
J302 and J303 contain both SSI Net ports 1 and 2.
Use Nconnect-SSINet-XX cable between J302 and J303.
Use C19891-X or C19892-X cable between J302/J303 and J205.

Figure 3-6: Two/Three Axis Laser Firing Interconnection

3.3. Analog Outputs (TB303)

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

Table 3-12: Analog Output Specifications (TB303)

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

NOTE: Analog Output 0 on TB303 is tied to Analog Output 0 on J205 (see Section 2.5.6.). TB303 lets you connect to all of the analog outputs from one connector (do not connect to AOUT0 at both TB303 and J205).

Table 3-13: Analog Output Connector Pinout (TB303)

Pin#	Description	In/Out/Bi
1	Analog Output 0	Output
2	Analog Output 1	Output
3	Analog Output 2	Output
4	Analog Output 3	Output

Table 3-14: Mating Connector Part Numbers for the Analog Output Connector (TB303)

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

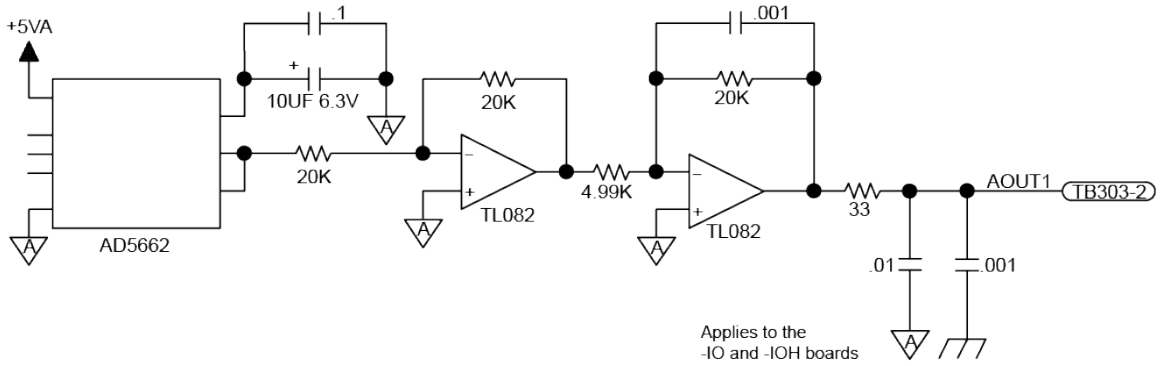


Figure 3-7: Analog Output Connector (TB303)

3.4. Differential Analog Inputs (TB304)

To interface to a single-ended (non-differential) voltage source, connect the signal common of the source to the negative input and the analog source signal to the positive input. A floating signal source should be referenced to the analog common as shown in Figure 3-8.

Table 3-15: Differential Analog Input Specifications

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

NOTE: Analog Input 0 on the I/O board is tied to Analog Input 0 on J205 (see Section 2.5.7.). TB304 lets you connect to all of the analog inputs in one place (do not connect to AIN0 at both TB304 and J205).

Table 3-16: Analog Inputs Connector Pinout (TB304)

Pin#	Description	In/Out/Bi
1	Analog Common	N/A
2	Non-Inverting Analog Input 0	Input
3	Inverting Analog Input 0	Input
4	Non-Inverting Analog Input 1	Input
5	Inverting Analog Input 1	Input
6	Analog Common	N/A
7	Non-Inverting Analog Input 2	Input
8	Inverting Analog Input 2	Input
9	Non-Inverting Analog Input 3	Input
10	Inverting Analog Input 3	Input

Table 3-17: Mating Connector Part Numbers for the Analog Input Connector (TB304)

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

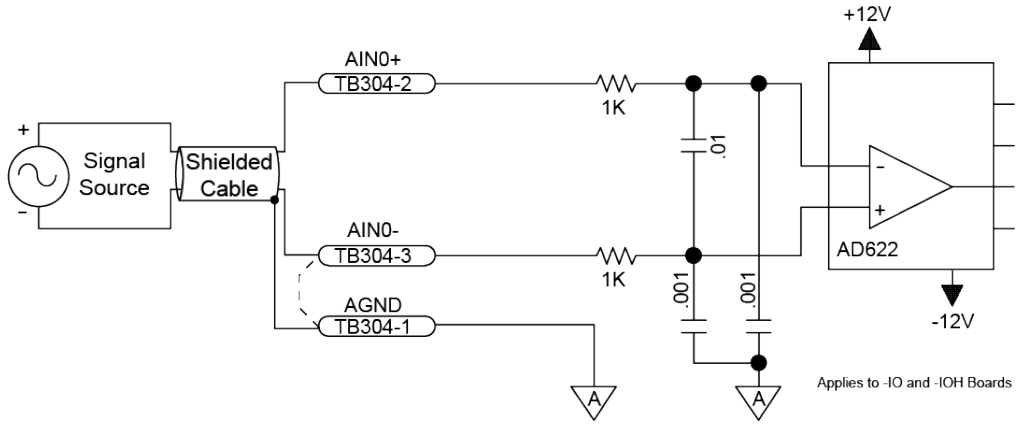


Figure 3-8: Analog Input Typical Connection (TB304)

3.5. User Power (TB305, TB306)

A user accessible power supply (+5V at 0.5 A) is available between the TB306 +5V terminal and TB305 GND terminal.

Table 3-18: User Common Pin on the Opto In Connector (TB305)

Pin#	Description	In/Out/Bi
10	Signal Common	N/A

Table 3-19: +5 Volt Power Pin on the Opto In Connector (TB306)

Pin#	Description	In/Out/Bi
10	Internal +5 Volt Power Supply (0.5 A max)	N/A

WARNING: Opto-isolated inputs and outputs should not be powered by the user output power. Doing so would compromise the isolation provided by the opto-isolator.

3.6. Opto In Connectors (Digital Inputs) (TB305, TB306)

The digital inputs are opto-isolated and may be connected to current sourcing or current sinking devices, as shown in Figure 3-10 and Figure 3-11. These inputs are designed to connect to other ground-referenced circuits and are not intended for high-voltage isolation.

Port 1 and Port 2 inputs have separate common inputs (refer to Table 3-21 for TB305 and Table 3-22 for TB306). Each port can be referenced independently.

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

Table 3-20: Digital Input Device Specifications

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

Table 3-21: Port 1 Opto In Connector Pinout (TB305)

Pin#	Description	In/Out/Bi
1	Digital Input Common for inputs 0 - 7	Input
2	Digital Input 0 (Optically-Isolated)	Input
3	Digital Input 1 (Optically-Isolated)	Input
4	Digital Input 2 (Optically-Isolated)	Input
5	Digital Input 3 (Optically-Isolated)	Input
6	Digital Input 4 (Optically-Isolated)	Input
7	Digital Input 5 (Optically-Isolated)	Input
8	Digital Input 6 (Optically-Isolated)	Input
9	Digital Input 7 (Optically-Isolated)	Input
10	Signal Common	N/A

Table 3-22: Port 2 Opto In Connector Pinout (TB306)

Pin#	Description	In/Out/Bi
1	Digital Input Common for inputs 0-7	Input
2	Digital Input 0 (Optically-Isolated)	Input
3	Digital Input 1 (Optically-Isolated)	Input
4	Digital Input 2 (Optically-Isolated)	Input
5	Digital Input 3 (Optically-Isolated)	Input
6	Digital Input 4 (Optically-Isolated)	Input
7	Digital Input 5 (Optically-Isolated)	Input
8	Digital Input 6 (Optically-Isolated)	Input
9	Digital Input 7 (Optically-Isolated)	Input
10	Internal +5 Volt Power Supply (0.5 A max)	N/A

Table 3-23: Mating Connector Part Numbers for the Opto In Connectors (TB305/TB306)

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

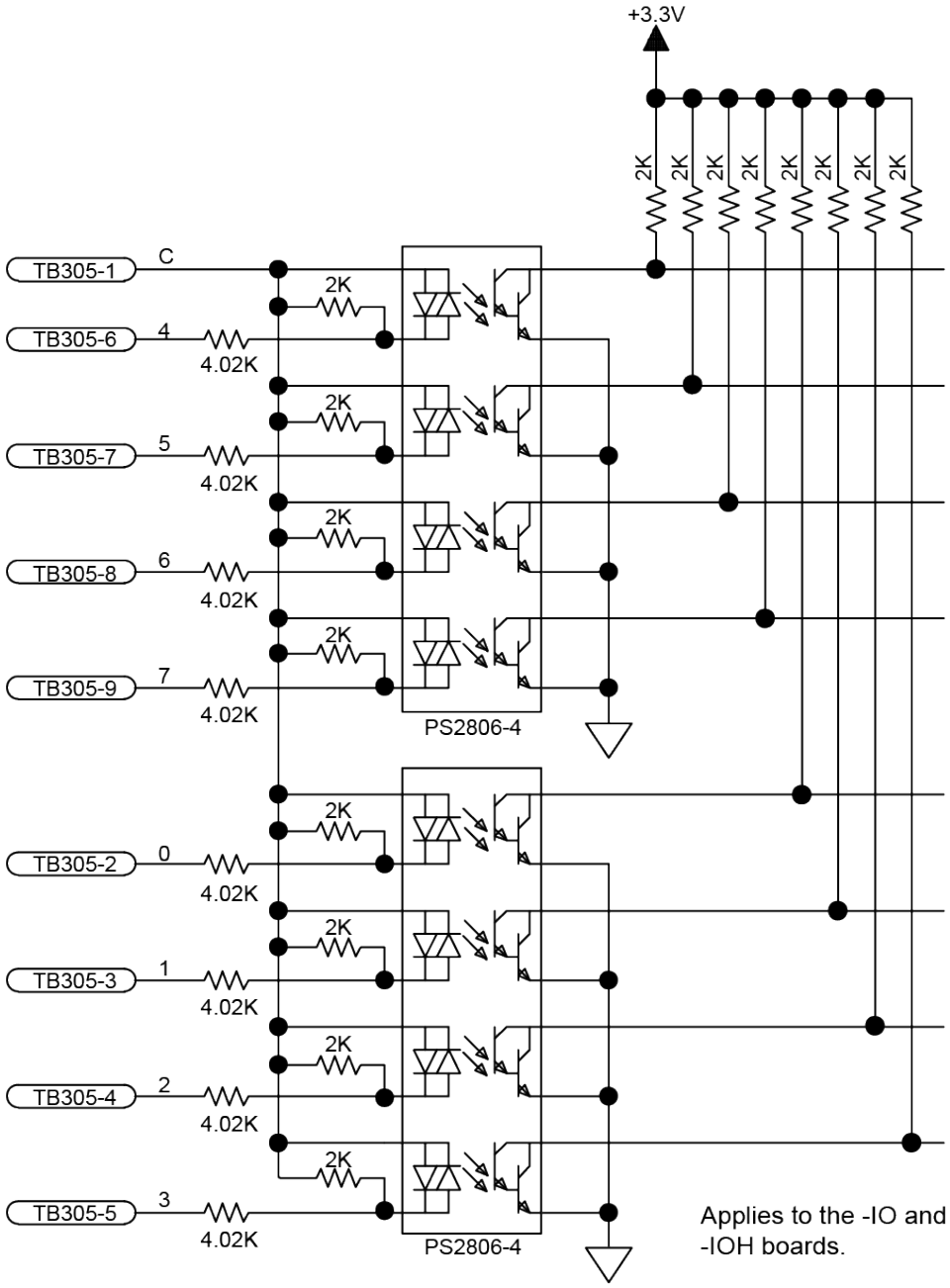


Figure 3-9: Digital Inputs

NOTE: Each bank of 8 Inputs must be connected in the all sourcing or all sinking configuration.

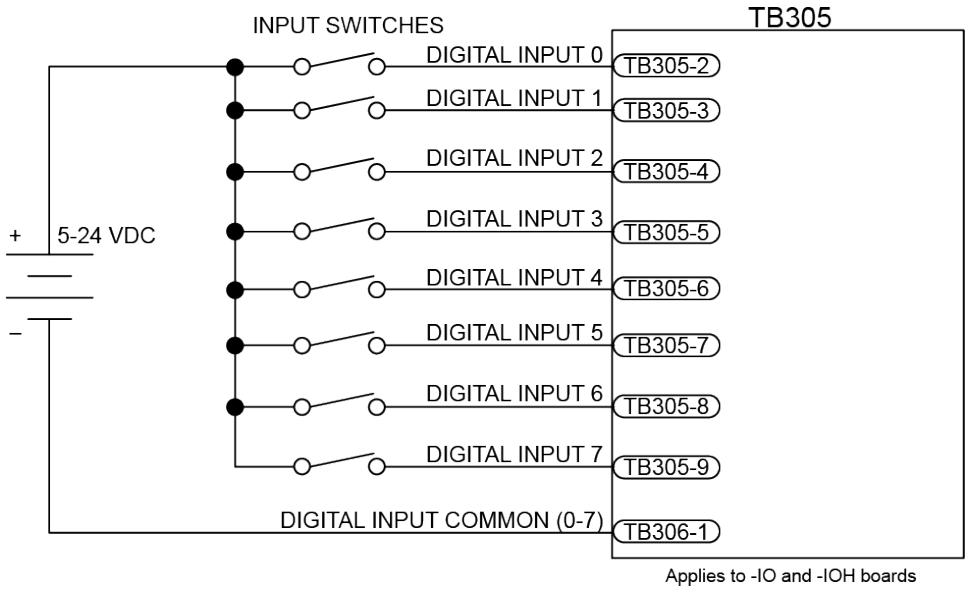


Figure 3-10: Digital Inputs Connected to a Current Sourcing Device

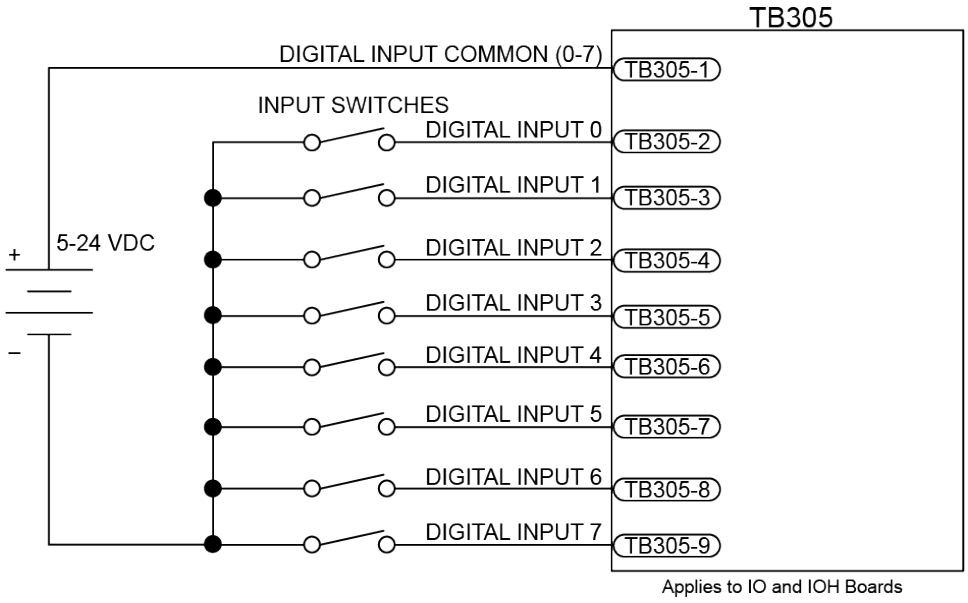


Figure 3-11: Digital Inputs Connected to a Current Sinking Device

3.7. Opto Out Connectors (Digital Outputs) (TB307, TB308)

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

The outputs are software-configurable and must be connected in either all sinking or all sourcing mode. Figure 3-13 and Figure 3-14 illustrate how to connect to an output in current sourcing and current sinking modes.

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

Table 3-24: Digital Output Specifications (TB307, TB308)

Opto Device Specifications	Value
Maximum Voltage	24 V maximum
Maximum Sink/Source Current	60 mA/channel @ 50°C
Output Saturation Voltage	2.75 V at maximum current
Output Resistance	33 Ω
Rise / Fall Time	250 usec (typical)
Reset State	Output Off (High Impedance State)

Suppression diodes must be installed on outputs driving relays or other inductive devices. This protects the outputs from damage caused by inductive spikes. Suppressor diodes, such as the 1N914, can be installed on all outputs to provide protection. It is important that the diode be installed correctly (normally reversed biased). Refer to Figure 3-14 for an example of a current sinking output with diode suppression and Figure 3-13 for an example of a current sourcing output with diode suppression.

NOTE: Power supply connections must always be made to both the Output Common Plus (OP) and Output Common Minus (OM) pins as shown in Figure 3-13 and Figure 3-14.

NOTE: Outputs must be connected as all sourcing or all sinking.

Table 3-25: Port 1 Opto Out Connector Pinout (TB307)

Pin#	Description	In/Out/Bi
1	Digital Output Common Plus	Input
2	Digital Output Common Minus	Input
3	Digital Output 0 (Optically-Isolated)	Output
4	Digital Output 1 (Optically-Isolated)	Output
5	Digital Output 2 (Optically-Isolated)	Output
6	Digital Output 3 (Optically-Isolated)	Output
7	Digital Output 4 (Optically-Isolated)	Output
8	Digital Output 5 (Optically-Isolated)	Output
9	Digital Output 6 (Optically-Isolated)	Output
10	Digital Output 7 (Optically-Isolated)	Output

Table 3-26: Port 2 Opto Out Connector Pinout (TB308)

Pin#	Description	In/Out/Bi
1	Digital Output Common Plus	Input
2	Digital Output Common Minus	Input
3	Digital Output 0 (Optically-Isolated)	Output
4	Digital Output 1 (Optically-Isolated)	Output
5	Digital Output 2 (Optically-Isolated)	Output
6	Digital Output 3 (Optically-Isolated)	Output
7	Digital Output 4 (Optically-Isolated)	Output
8	Digital Output 5 (Optically-Isolated)	Output
9	Digital Output 6 (Optically-Isolated)	Output
10	Digital Output 7 (Optically-Isolated)	Output

Table 3-27: Mating Connector Part Numbers for the Opto Out Connectors (TB307/TB308)

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

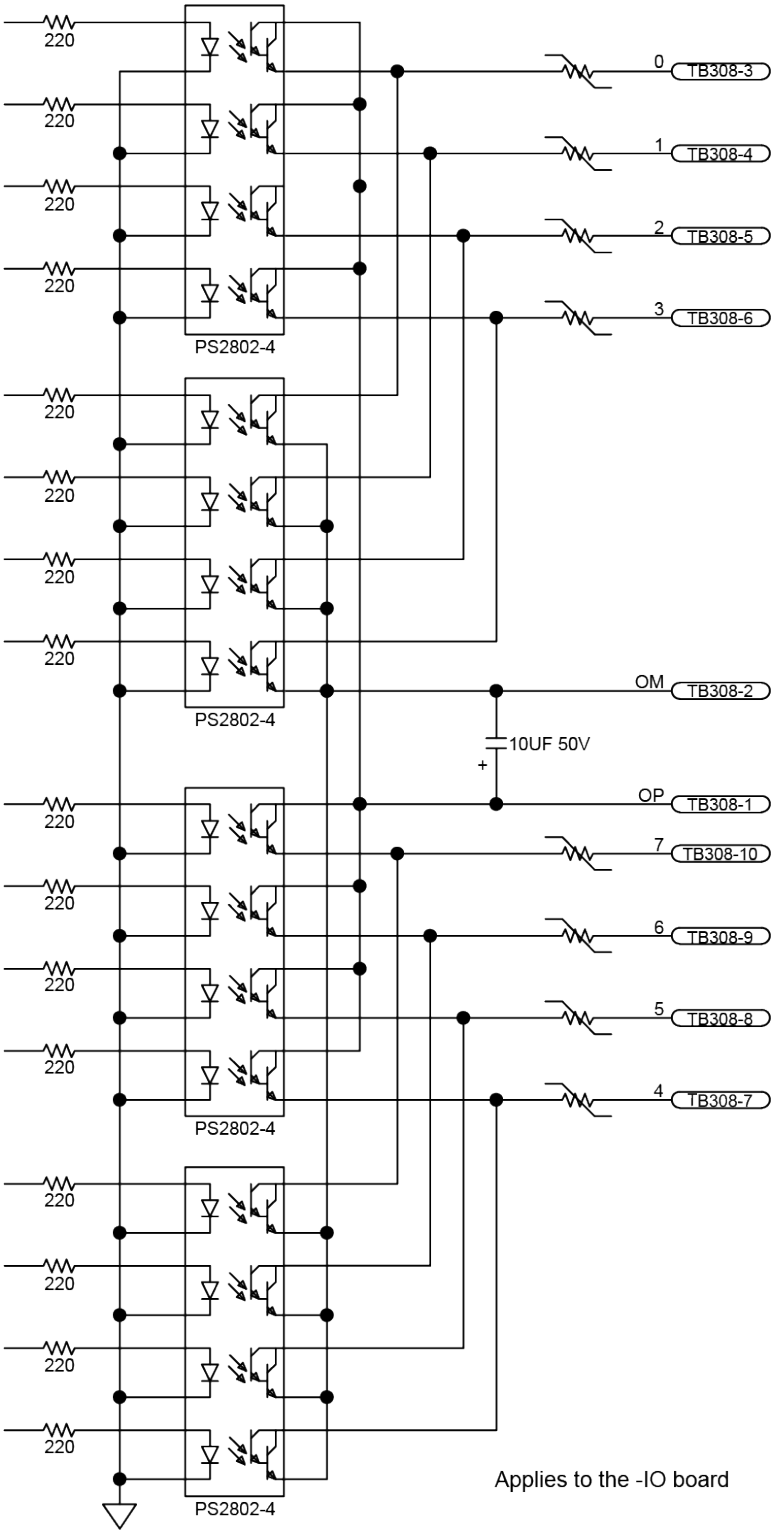


Figure 3-12: Digital Opto-Isolated Outputs (-IO Board)

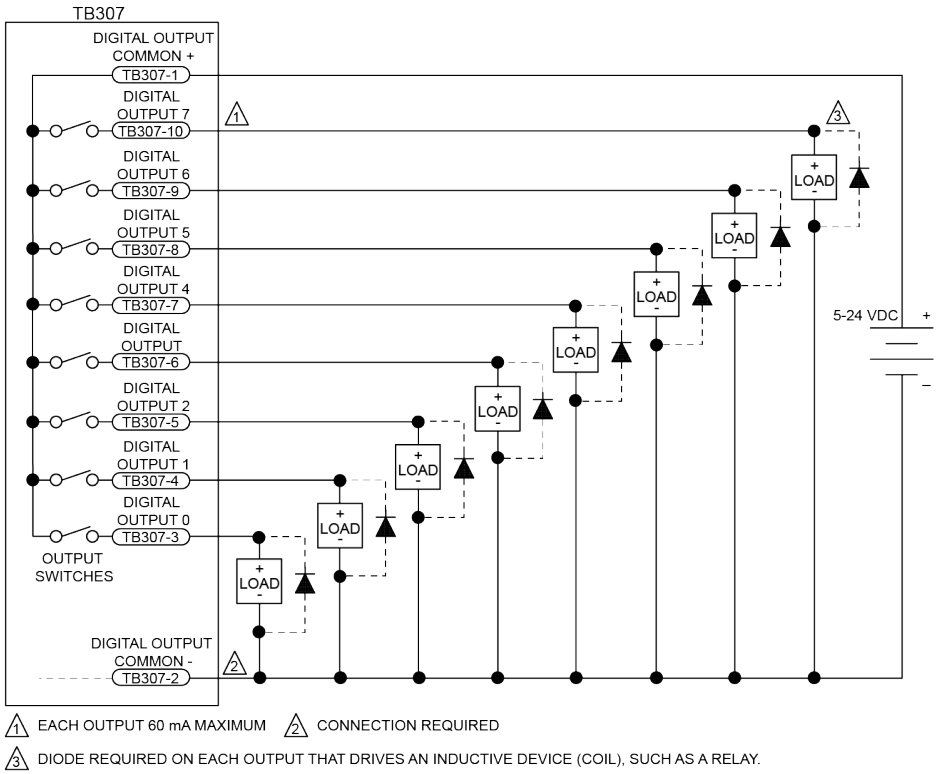


Figure 3-13: Digital Outputs Connected in Current Sourcing Mode

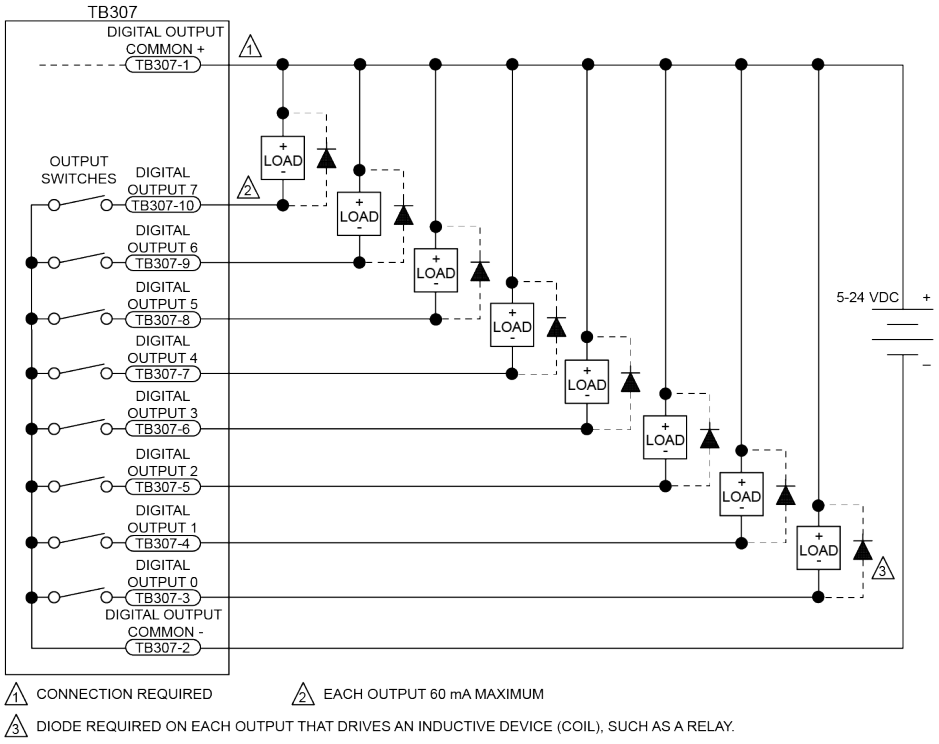


Figure 3-14: Digital Outputs Connected in Current Sinking Mode

3.8. SSINET (J302/J303)

The SSINet is designed for daisy-chaining encoder signals from one Ensemble HPe 10/20/30 to another for two/three-axis PSO (laser firing). This allows one Ensemble HPe 10/20/30 containing the -DUALPSO or -TRIPLEPSO options to track the vectorial position change of two/three axes in real-time. These encoder signals may also be used for user-defined purposes. Refer to Figure 3-15 and Figure 3-6. These four channels are bi-directional and configured via the SSINet1Setup and SSINet2Setup parameters; refer to the Ensemble Help File for more information. The signals from these ports will be the same as the differential line driver encoder signal input to the Ensemble HPe 10/20/30, unless the -MXH option is present.

NOTE: The SSINet #1 and #2 interfaces are both physically hardwired to the J302 and J303 connectors. If SSINet #1 is configured as an input, a signal driven into the SSINet #1 connections on J302 will also be present on the SSINet #1 connections of J303, effectively making SSINet #1 on J303 an (un-buffered) output of this same signal. Likewise, this would also be true for the SSINet #2 interface.

Table 3-28: 2-Channel SSINet Connector Pinout (J302/J303)

Pin#	Description	In/Out/Bi
1	SSINet #1 Sin-N	Bidirectional
2	SSINet #1 Sin	Bidirectional
3	SSINet #2 Cosine-N / Marker-N	Bidirectional
4	SSINet #2 Sin-N	Bidirectional
5	SSINet #2 Sin	Bidirectional
6	SSINet #2 Cosine / Marker	Bidirectional
7	SSINet #1 Cosine-N / Marker-N	Bidirectional
8	SSINet #1 Cosine / Marker	Bidirectional

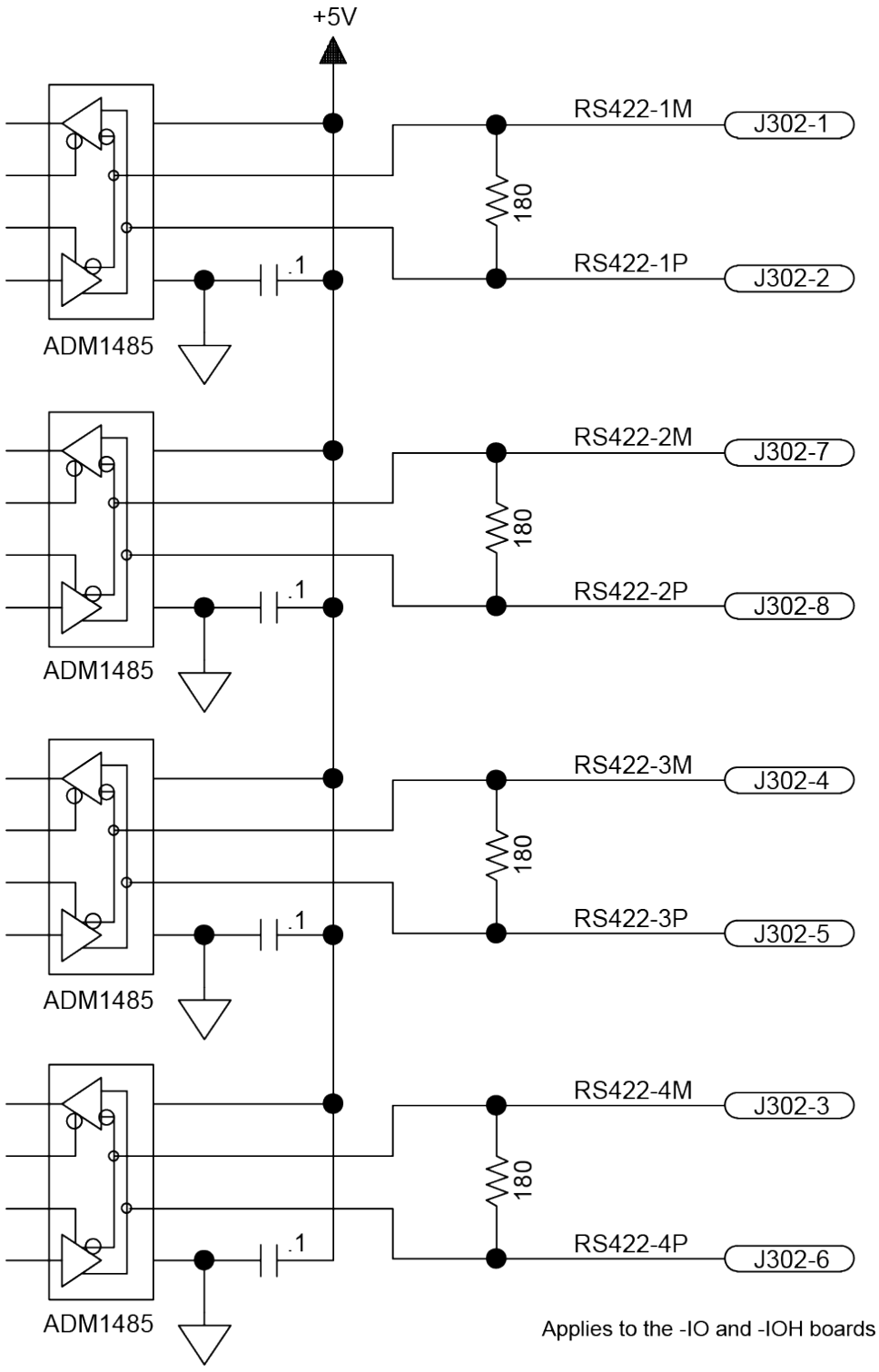


Figure 3-15: J302/J303

Chapter 4: -RDP Expansion Board

The resolver to digital option (-RDP) provides up to two industry standard resolver or inductosyn channels that can be used as a feedback device. The standard reference frequency output is 5 kHz, with factory options for either 7.5 kHz or 10.0 kHz. The amplitude of this signal can be adjusted on both channels through a single setting in the software. The -RDP can also be configured to generate encoder emulation signals.

For correct commutation of the motor, the alignment between the resolver and motor must be known. This alignment can be determined by using the controller's software. Refer to the Ensemble Help file for information on configuring parameters for an axis with resolver feedback.

Channel 1 is on J401 and channel 2 is on J402. The -RDP option can supply up to 7 VRMS reference voltage and requires 2 VRMS on the sine and cosine inputs.

DANGER: Always disconnect the Mains power connection before opening the Ensemble HPe 10/20/30 chassis.

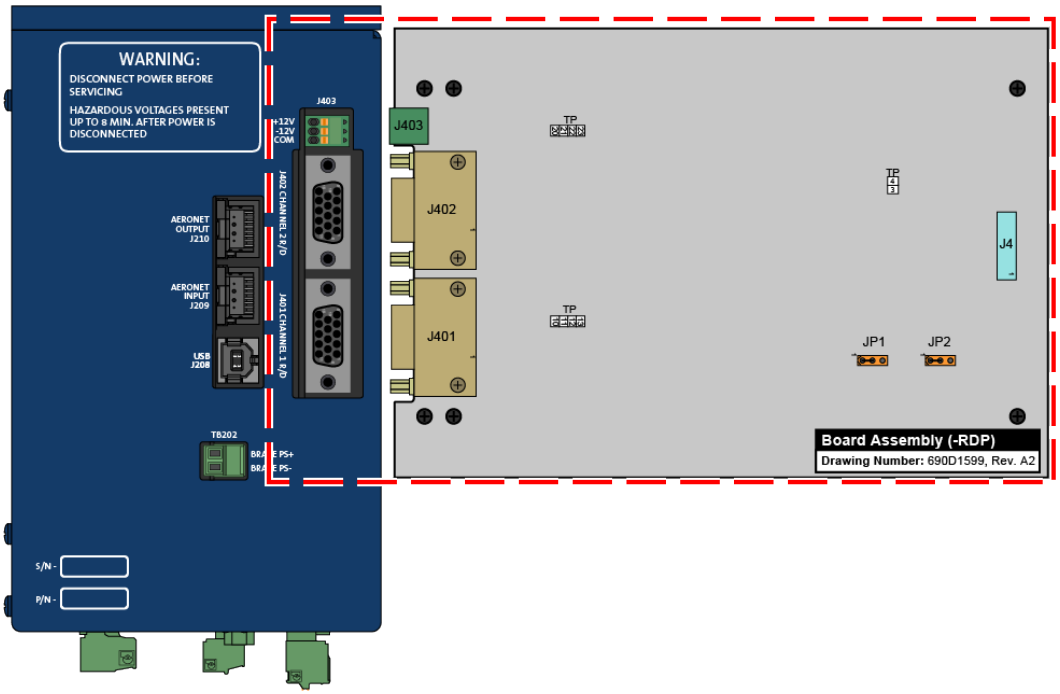


Figure 4-1: -RDP Option Board

Table 4-1: -RDP Expansion Board Jumper Configuration

Jumper	Setting	Description
JP1	1-2	Resolver (default)
	2-3	Inductosyn
JP2	1-2	Resolver (default)
	2-3	Inductosyn

Table 4-2: -RDP Connector Pinout (J401/J402)

Pin#	Label	Description	In/Out/Bi
Shell	Shield	Connecter shell for cable shield termination	Input
4	SIN+	Resolver Sine +	Input
5	SIN-	Resolver Sine -	Input
3	Shield	Resolver Sine Shield	Shield
14	COS+	Resolver Cosine +	Input
15	COS-	Resolver Cosine -	Input
13	Shield	Resolver Cosine Shield	Sheild
10	REF+	Resolver Reference +	Output
9	REF-	Resolver Reference -	Output
8	Shield	Reference Shield	
7	ENC SIN+	Encoder Emulation Sine + (optional)	Output
11	ENC SIN-	Encoder Emulation Sine - (optional)	Output
1	ENC COS+	Encoder Emulation Cosine + (optional)	Output
6	ENC COS-	Encoder Emulation Cosine - (optional)	Output
2	ENC MRK+	Encoder Emulation Marker + (optional)	Output
12	ENC MRK-	Encoder Emulation Marker - (optional)	Output

Table 4-3: Mating Connector Part Numbers for the Resolver Connectors (J401/J402)

15-Pin Male D-style	Aerotech P/N	Third Party P/N
Connector	ECK01287	Amphenol 17EHD-015P-AA000
Backshell	ECK01021	Amphenol 17E-1724-2

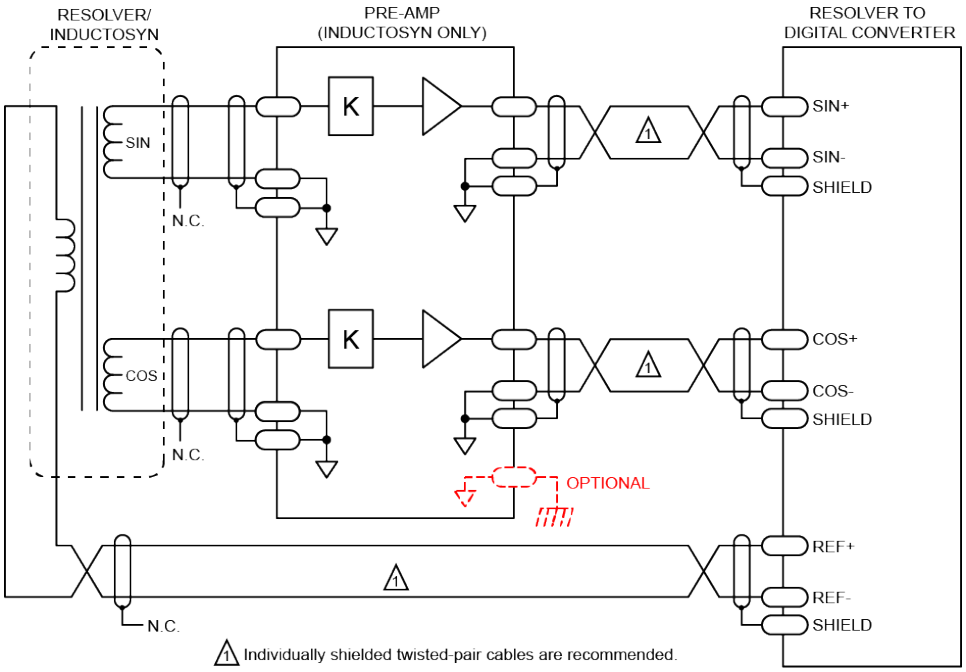


Figure 4-2: Resolver/Inductosyn Recommended Wiring

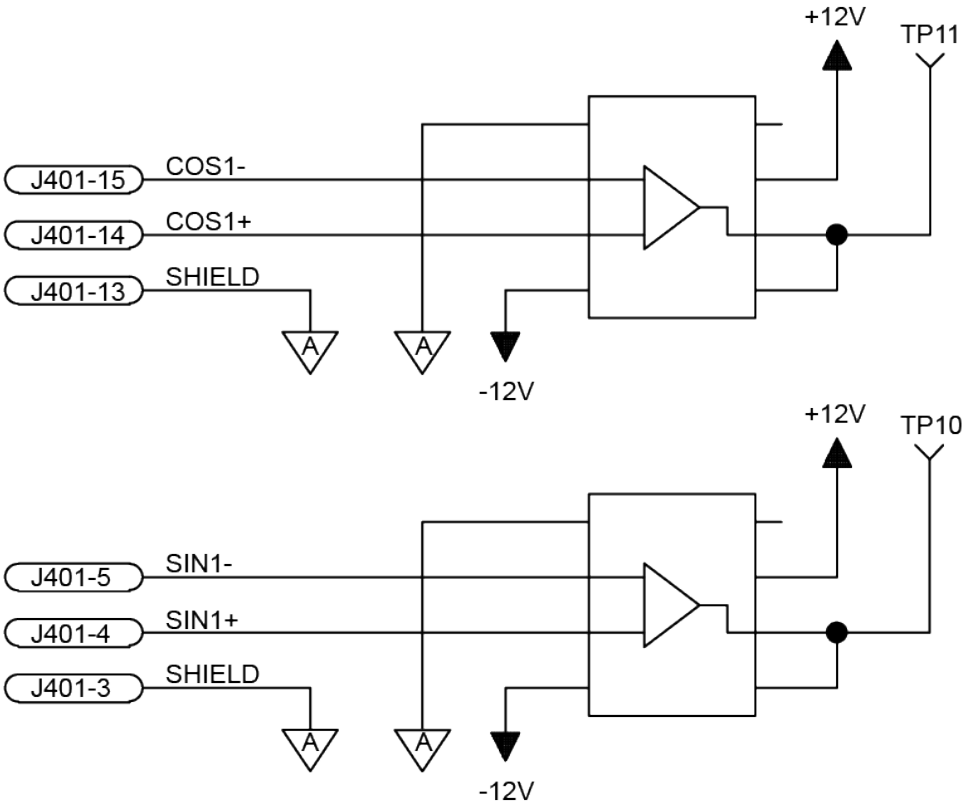


Figure 4-3: Resolver Inputs

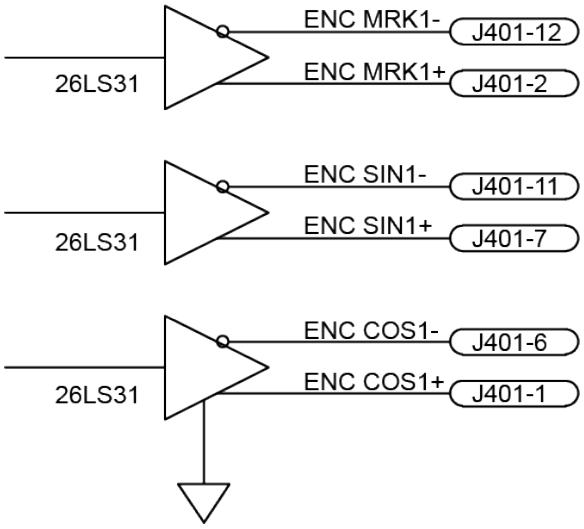


Figure 4-4: Encoder Emulation Outputs

The external power connector (J403) is a factory-select configuration and is not available on all drives.

Table 4-4: External Power Pinout (J403)

Pin#	Label	Description	In/Out/Bi
1	+12V	+12 Volts DC	Input
2	-12V	-12 Volts DC	Input
3	COM	Signal Common	N/A

Table 4-5: Mating Connector Part Numbers for the External Power Connector (J403)

Description	Aerotech P/N	Phoenix P/N	Wire Size: AWG [mm^2]
3-Pin Terminal Block	ECK01449	1881338	0.5 - 0.080 [20-28]

Table 4-6: Resolver Test Points

Test Point #	Description
TP4	Signal Common
TP10	Sine Input Channel 1
TP11	Cosine Input Channel 1
TOP	Reference Signal Channel 1
TP13	Resolver Channel 1 Error
TP20	Sine Input Channel 2
TP21	Cosine Input Channel 2
TP22	Reference Signal Channel 2
TP23	Resolver Channel 2 Error

Chapter 5: Standard Interconnection Cables

NOTE: A complete list of Aerotech cables can be found on the website at http://www.aerotechmotioncontrol.com/manuals/index.aspx.

Table 5-1: Standard Interconnection Cables

Cable Part #	Description
Joystick	See Section 5.1.
ECZ01231	BBA32 Interconnect Cable
ENET-XOVER-xx(1)	Ethernet cross-over cable
USB-AMBM-xx(1)	USB cable A-male to B-male
(1) The “-xx” indicates length in decimeters. “-yy” would indicate length in feet.	

5.1. Joystick Interface

Aerotech joysticks JI (NEMA12 (IP54) rated) and JBV are powered from 5V and have a nominal 2.5V output in the center detent position. Three buttons are used to select axis pairs and speed ranges. An optional interlock signal is used to indicate to the controller that the joystick is present. Joystick control will not activate unless the joystick is in the center location. Third party devices can be used provided they produce a symmetric output voltage within the range of -10V to +10V.

The following drawings illustrate how to connect a single- or two-axis joystick . For cable details refer to Table 5-2. Refer to the Ensemble Help file for programming information about how to change joystick parameters (see the Joystick2D.ab or Joystick3D.ab examples).

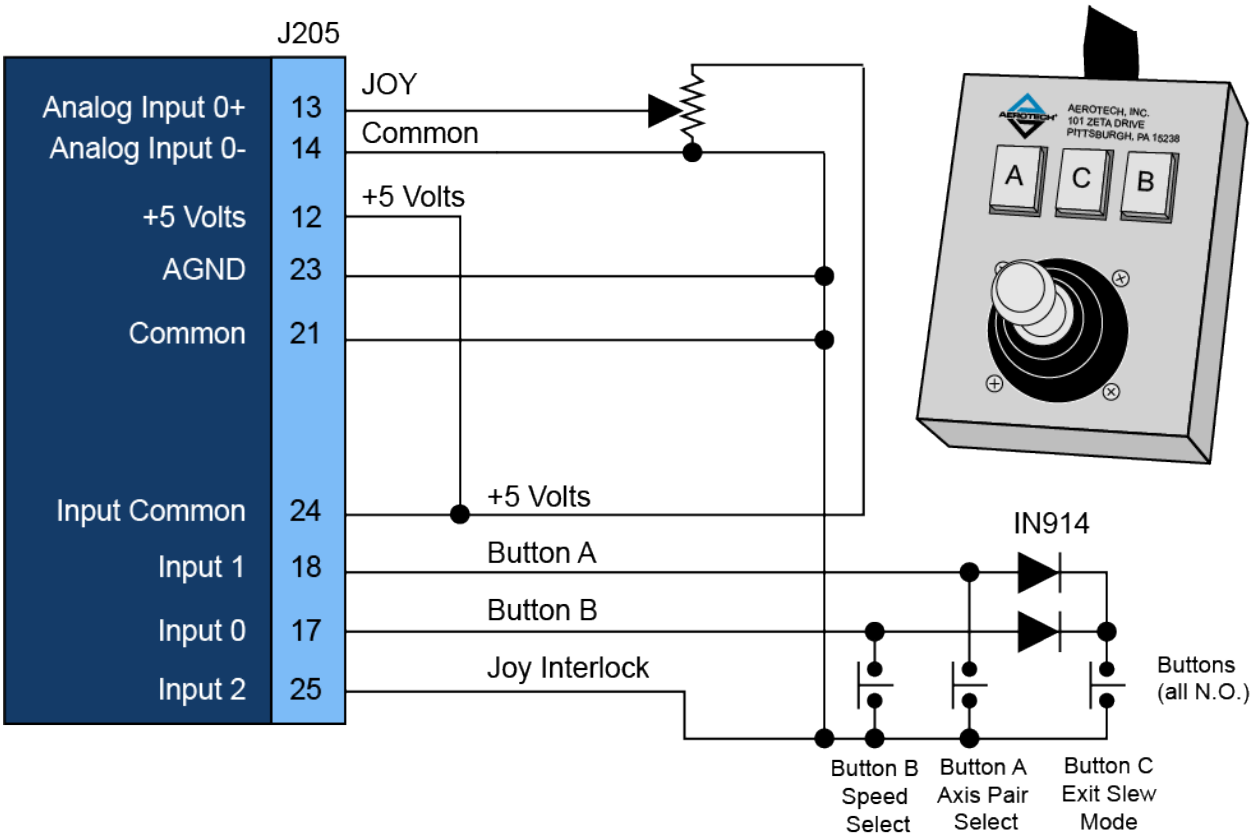


Figure 5-1: Single Axis Joystick Interface (to Aux I/O)

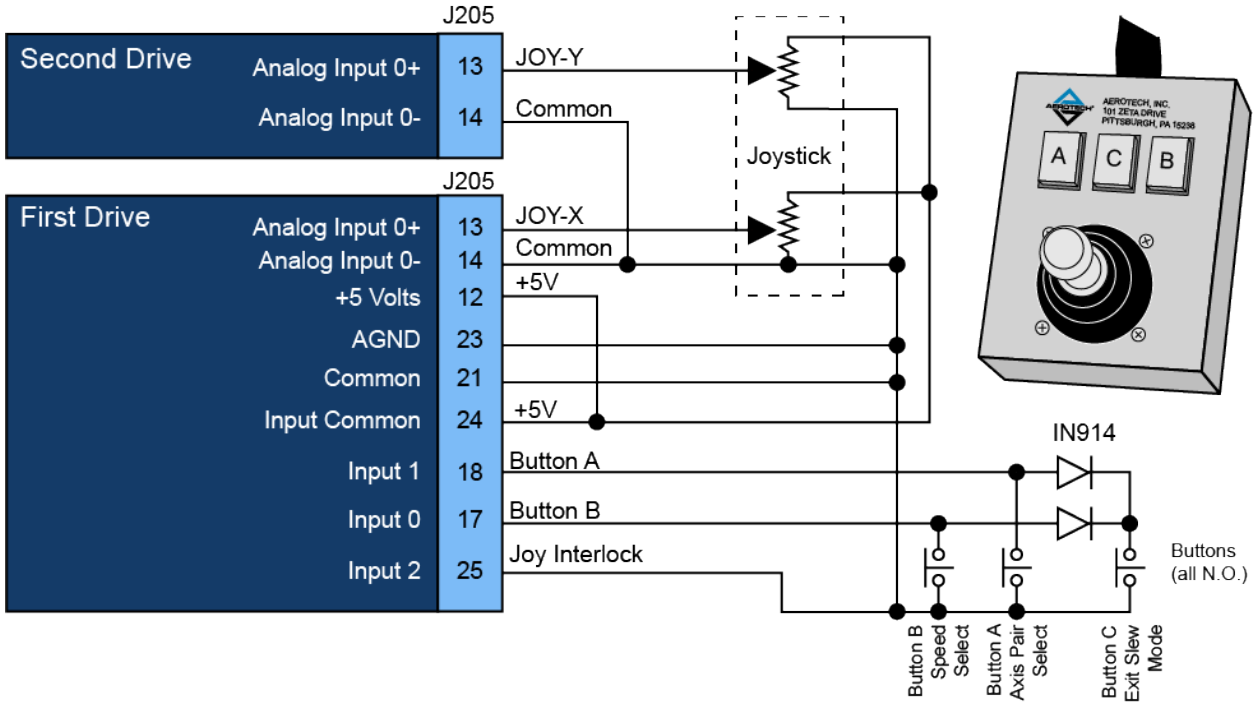


Figure 5-2: Two Axis Joystick Interface (to the Aux I/O of two drives)

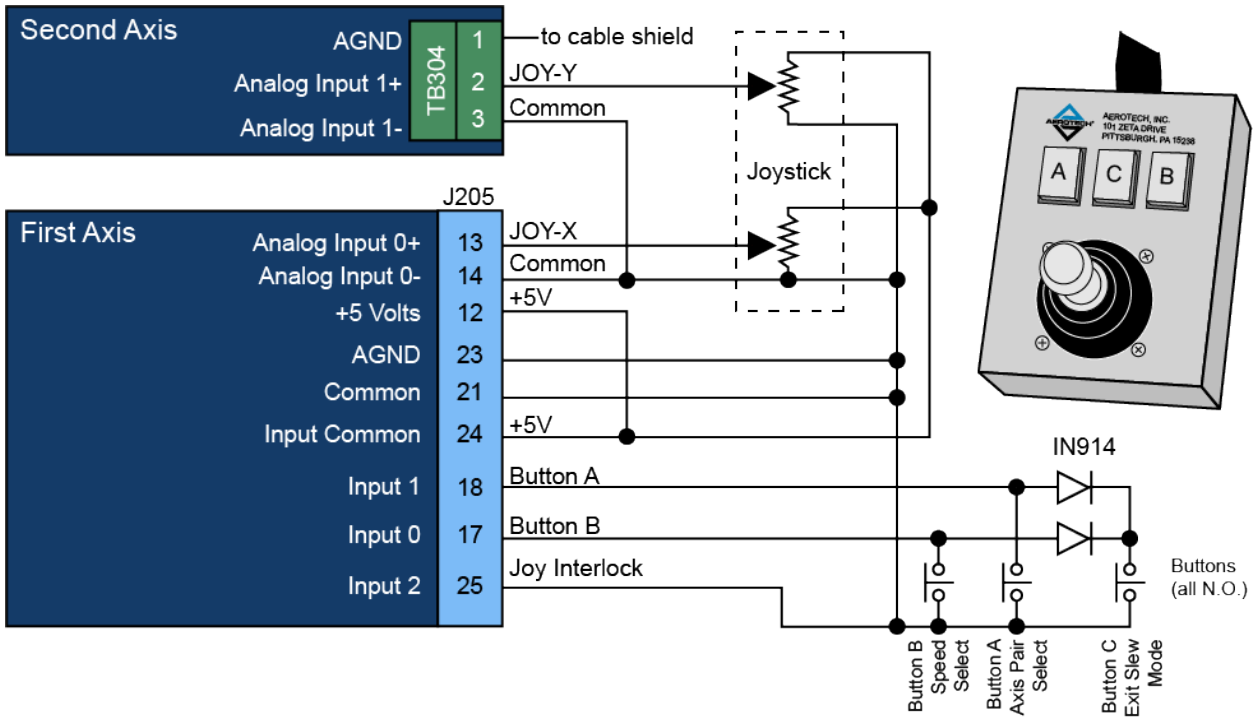


Figure 5-3: Two Axis Joystick Interface (to the Aux I/O and I/O Board)

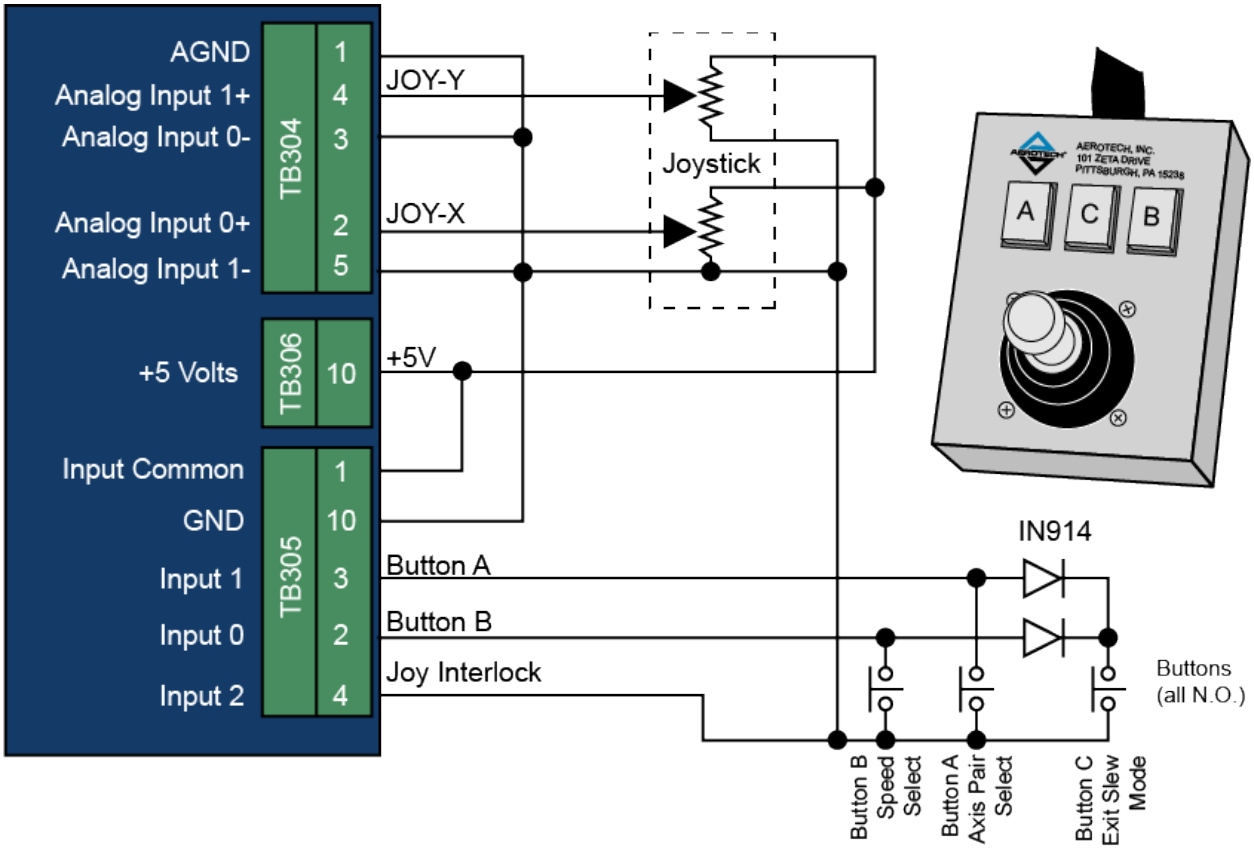


Figure 5-4: Two Axis Joystick Interface (to the I/O Board)

Table 5-2: Cable Part Numbers

Part #	Cable Description	UPC #
C22779-XX	JSXT-FLY 26HD-15DU-MAX300DM ENSEMBLEHPE DUAL AXIS	630B2277-9
C227710-XX	JSXT-26HD-15DU-MAX300DM ENSEMBLEHPE SINGLE AXIS	630B2277-10
C227711-XX	JSXT-26HD 26HD-15DU-MAX300DM ENSEMBLEHPE DUAL AXIS	630B2277-11
C227715-XX	JSXT-FLY-15DU-MAX 300 DM ENSEMBLEHPE DUAL AXIS	630B2277-15

5.2. Handwheel Interface

A handwheel (such as the Aerotech HW-xxx-xx) can be used to manually control axis position. The handwheel must provide 5V differential quadrature signals to the Ensemble HPe 10/20/30.

A handwheel can be connected to the Aux I/O as shown in Figure 5-5 or Figure 5-6.

NOTE: See the Ensemble Help file for information on enabling the handwheel.

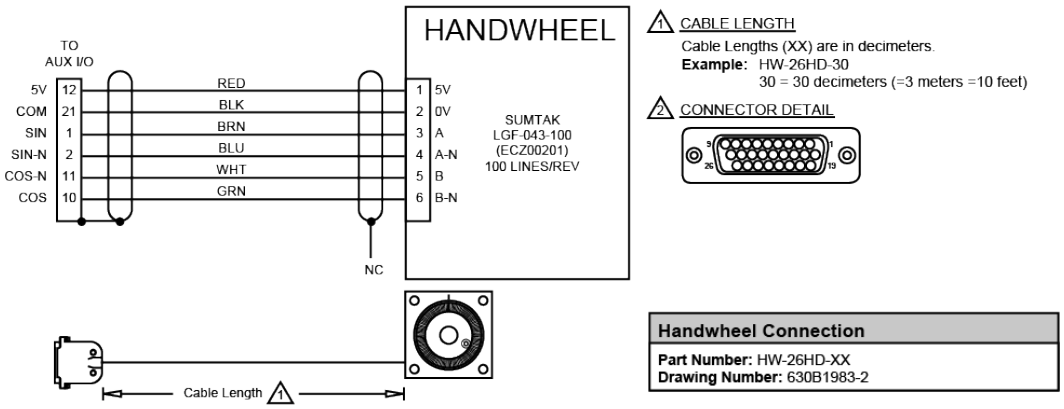


Figure 5-5: Handwheel Interconnection (to Aux I/O)

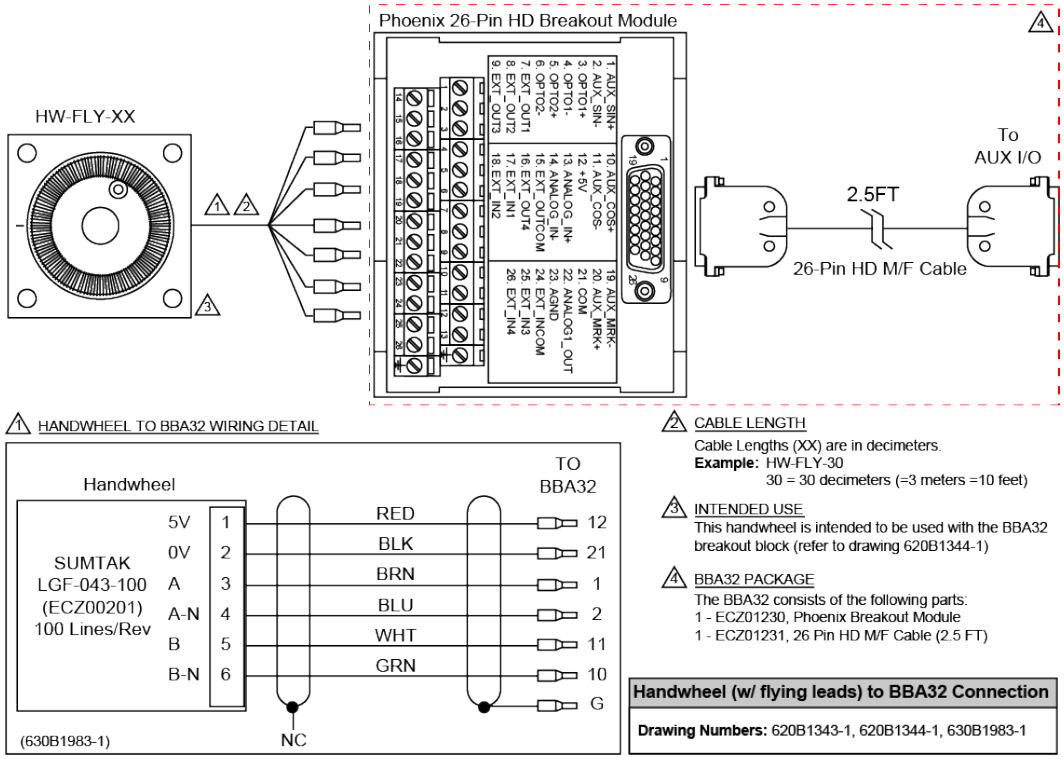


Figure 5-6: Handwheel Interconnection (to Aux I/O via a BBA32 Module)

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Chapter 6: Maintenance

DANGER: Always disconnect the Mains power connection before opening the Ensemble HPe 10/20/30 chassis.

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

Table 6-1: LED Description

LED	Description
ENB/FLT	Turns green to indicate that the axis is enabled. Turns red to indicate a fault condition. The ENB/FLT LED will flash between RED and GREEN if the drive is enabled and in a fault condition.
MARKER	Turns green to indicate that the marker input is high.
PWR*	Turns green when power is applied.
POS	Turns green to indicate that the axis is in position.
* If the power light flashes continuously and the unit does not operate, there is too much current draw from the 5V power supply or the control supply voltage level is low.	

6.1. Power Board

DANGER: Always disconnect the Mains power connection before opening the Ensemble HPe 10/20/30 chassis.

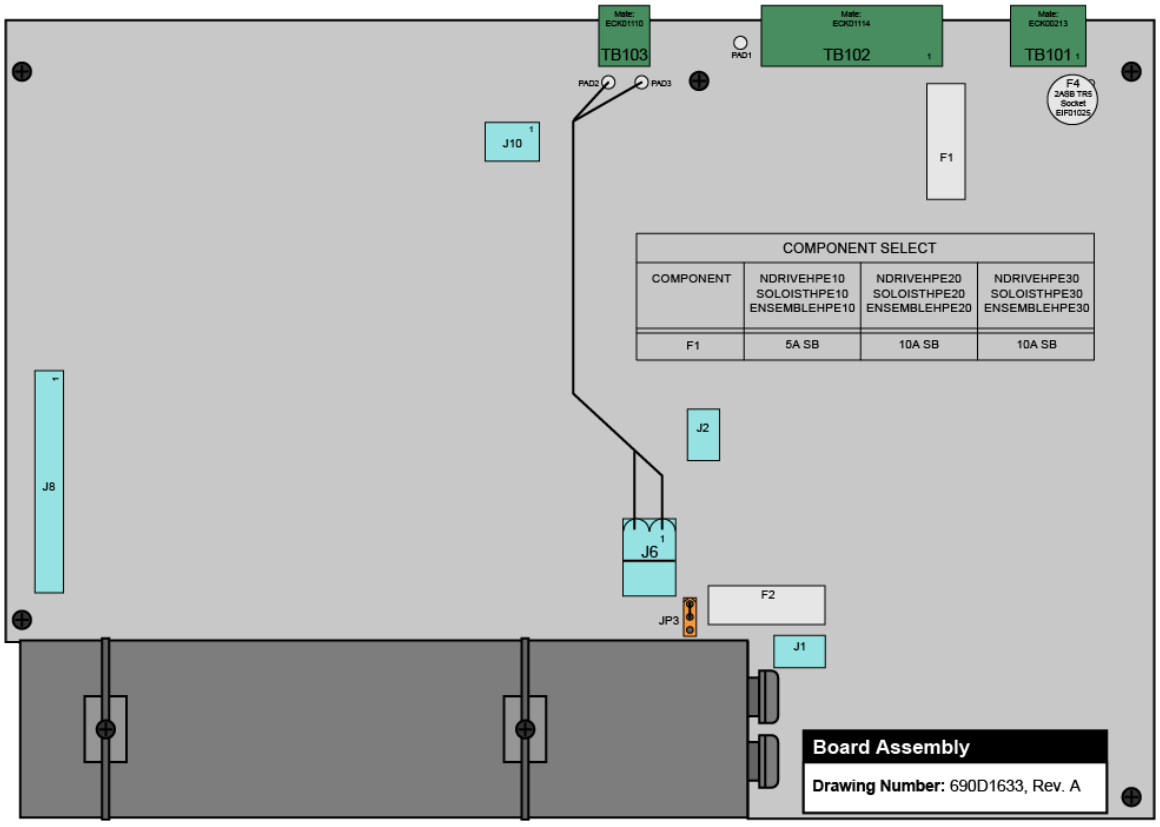

Figure 6-1: Power Board Assembly

Table 6-2: Power Board Jumper Configuration

Jumper	Setting	Description
JP3	1-2 (1)	No Shunt Option present (HPe10/20)
	2-3	Shunt Option present (standard on HPe30)
(1) Default		

Table 6-3: Fuse Information

Fuse	Description	Size	Aerotech P/N	Manufacturer's P/N
F1	HPe 10: VAC input at TB102-1	5 A SB (5 mm)	EIF00179	Wickman: 1951500
	HPe 20: VAC input at TB102-1	10 A SB (5 mm)	EIF1006	Littelfuse: 218010
	HPe 30: VAC input at TB102-1	10 A SB (5 mm)	EIF1006	Littelfuse: 218010
F2	-S option shunt fuse	1 A SB (5 mm)	EIF01052	Littelfuse: 0215001.P
	-EXTSHUNT option external shunt fuse	2.5 A SB	EIF01053	Littelfuse: 21502.5P
F4	Control Supply (AC)	2 A SB	EIF01029	Littelfuse: 3721200041

6.2. Control Board

DANGER: Always disconnect the Mains power connection before opening the Ensemble HPe 10/20/30 chassis.

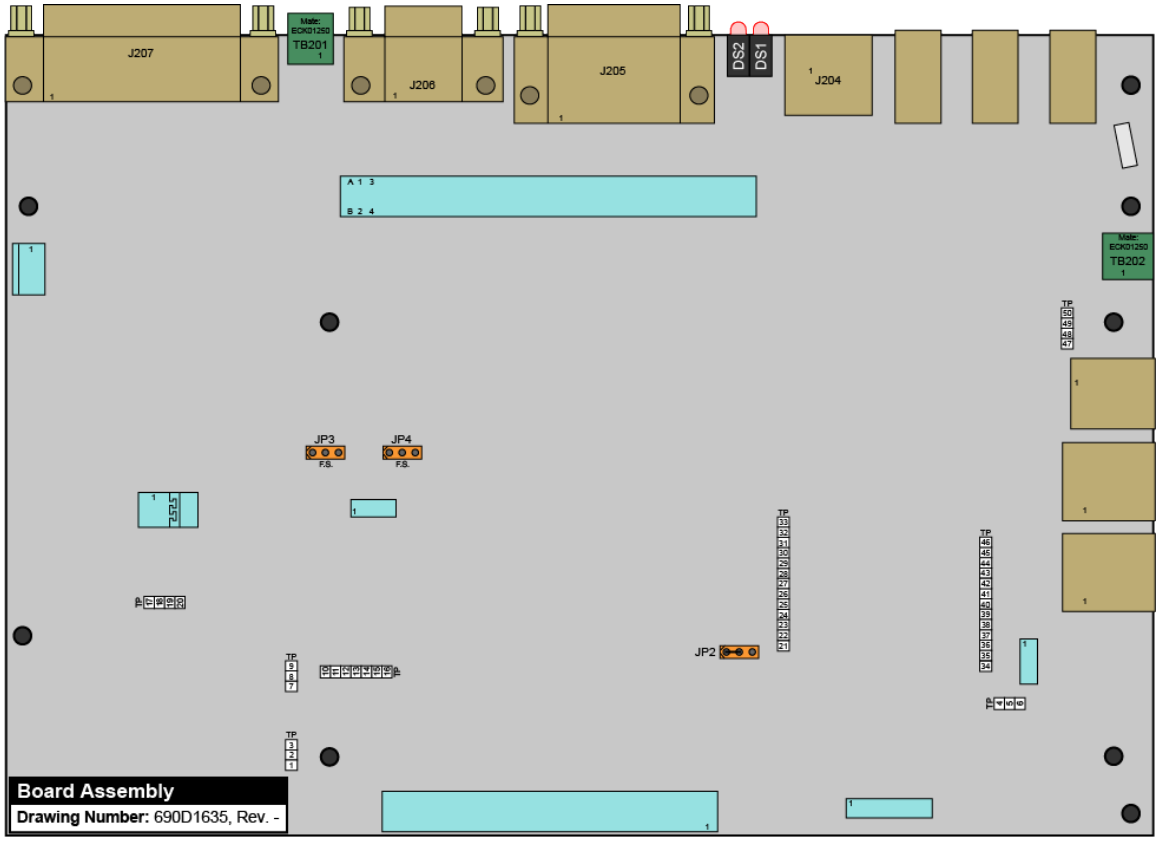

Figure 6-2: Control Board Assembly

Table 6-4: Control Board Jumper Configuration

Jumper	Setting	Description
JP2	1-2 (1)	Watchdog enabled
	2-3	Watchdog disabled
JP3	1-2 (1)	24 V operation (High Speed Input 5)
	2-3	5 V operation (High Speed Input 5)
JP4	1-2 (1)	24 V operation (High Speed Input 4)
	2-3	5 V operation(High Speed Input 4)
(1) Default		

Table 6-5: Control Board Fuse Information

Fuse	Description	Size	Aerotech P/N	Manufacturer's P/N
F1	Radial Lead Resettable Fuse	3 A	EIF01001	Raychem RGE300
F2	Surface Mount Fuse	.05 A	EIF01028	Raychem MICROSMD005F-2
F3	Surface Mount Fuse	.05 A	EIF01028	Raychem MICROSMD005F-2
F4	Surface Mount Fuse	.05 A	EIF01028	Raychem MICROSMD005F-2
F5	Surface Mount Fuse	.05 A	EIF01028	Raychem MICROSMD005F-2
F6	Resettable Fuse	.5 A	EIF01002	Raychem MINISMDC050

Table 6-6: LED Description

LED	Description
ENB/FLT	Turns green to indicate that the axis is enabled. Turns red to indicate a fault condition. The ENB/FLT LED will flash between RED and GREEN if the drive is enabled and in a fault condition.
MARKER	Turns green to indicate that the marker input is high.
PWR*	Turns green when power is applied.
POS	Turns green to indicate that the axis is in position.
* If the power light flashes continuously and the unit does not operate, there is too much current draw from the 5V power supply or the control supply voltage level is low.	

6.3. Preventative Maintenance

The Ensemble HPe 10/20/30 and external wiring should be inspected monthly. Inspections may be required at more frequent intervals, depending on the environment and use of the system.

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

Table 6-7: Preventative Maintenance

Check	Action to be Taken
Visually Check chassis for loose or damaged parts / hardware. **Note**: Internal inspection is not required.	Parts should be repaired as required. If internal damage is suspected, these parts should be checked and repairs made if necessary.
Inspect cooling vents.	Remove any accumulated material from vents.
Check for fluids or electrically conductive material exposure.	Any fluids or electrically conductive material must not be permitted to enter the Ensemble HPe 10/20/30.
Visually inspect all cables and connections.	Tighten or re-secure any loose connections. Replace worn or frayed cables. Replace broken connectors.

Cleaning

The Ensemble HPe 10/20/30 chassis can be wiped with a clean, dry, soft cloth. The cloth may be slightly moistened if required with water or isopropyl alcohol to aid in cleaning if necessary. In this case, be careful not to allow moisture to enter the Ensemble HPe 10/20/30 or onto exposed connectors / components. Fluids and sprays are not recommended because of the chance for internal contamination, which may result in electrical shorts and/or corrosion. The electrical power must be disconnected from the Ensemble HPe 10/20/30 while cleaning. Do not allow cleaning substances or other fluids to enter the Ensemble HPe 10/20/30 or to get on to any of the connectors. Avoid cleaning labels to prevent removing the label information.

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Appendix A: Warranty and Field Service

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

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

Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within thirty (30) days of shipment of incorrect material. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. A "Return Materials Authorization (RMA)" number must accompany any returned product(s). The RMA number may be obtained by calling an Aerotech service center or by submitting the appropriate request available on our website (www.aerotech.com). Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than thirty (30) days after the issuance of a return authorization number will be subject to review.

Visit https://www.aerotech.com/global-technical-support.aspx for the location of your nearest Aerotech Service center.

Returned Product Warranty Determination

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

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

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

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

Rush Service

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

On-site Warranty Repair

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

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

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

On-site Non-Warranty Repair

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

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

Service Locations

http://www.aerotech.com/contact-sales.aspx?mapState=showMap

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 5508 6731	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720

TAIWAN	UNITED KINGDOM
Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649

Have your customer order number ready before calling.

Appendix B: Revision History

Revision	Description
4.09.00	The following sections have been updated: • Section 2.9. -EXTSHUNT Option (TB103)
4.08.00	The following sections have been updated: • EU Declaration of Conformity • Safety Procedures and Warnings • Section 2.2. Motor Output Connections • Section 2.2.1.1. Powered Motor Phasing • Section 2.2.1.2. Unpowered Motor and Feedback Phasing • Section 2.3.1.1. RS-422 Line Driver Encoder (Standard) • Section 2.3.2. Hall-Effect Interface (J207) • Section 2.3.4. Encoder Fault Interface (J207) • Section 2.5.1. Auxiliary Encoder Channel (J205) • Section 2.5.2. Position Synchronized Output (PSO)/Laser Firing (J205) • Section 2.5.3. Digital Outputs 0-3 (J205) • Section 2.5.4. Digital Inputs 0-3 (J205) • Section 2.5.5. High-Speed User Inputs 4-5 (J205) • Section 2.5.6. Analog Output 0 (J205) • Section 2.5.7. Differential Analog Input 0 (J205) • Section 2.9. -EXTSHUNT Option (TB103) • Section 3.2. PSO Output Interface (TB302) • Section 3.3. Analog Outputs (TB303) • Section 3.4. Differential Analog Inputs (TB304) • Section 3.6. Opto In Connectors (Digital Inputs) (TB305, TB306) • Section 3.7. Opto Out Connectors (Digital Outputs) (TB307, TB308) • Section 6.1. Power Board
4.07.00	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
4.06.00	
4.05.00	
4.04.00	
4.03.00	
4.02.00	
4.01.00	
4.00.00	

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