Soloist CL
Hardware Manual

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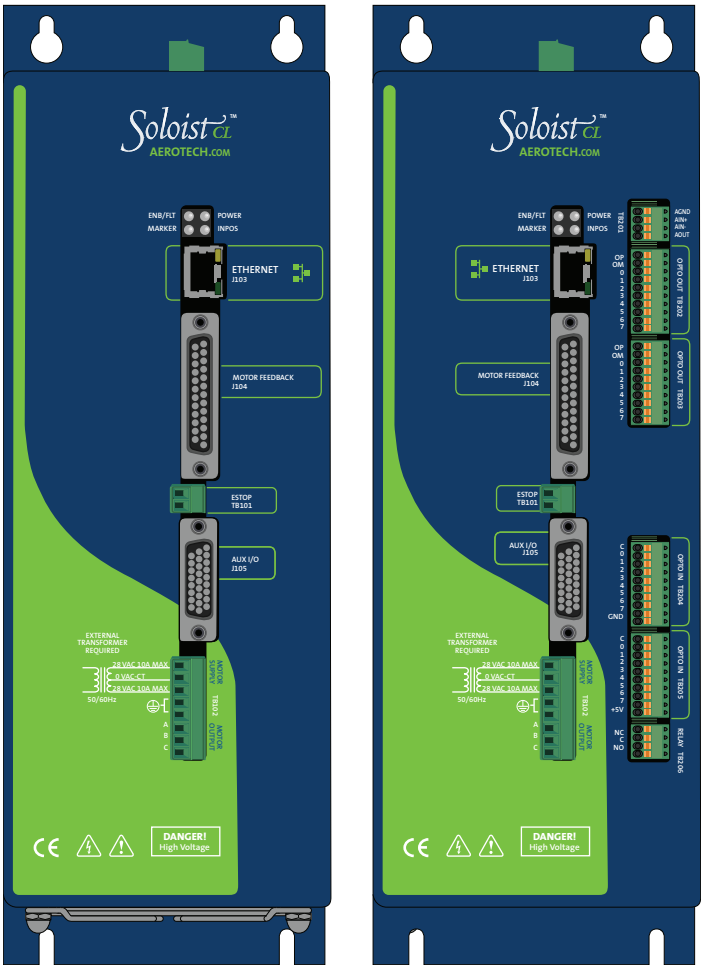

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EC Declaration of Conformity

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

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

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

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

EN 61000-4-3	Radiated RFI/EMI Immunity
EN 61010-1	Safety requirements for electrical equipment

Name	/ Alex Weibel
Position	Engineer Verifying Compliance
Location	Pittsburgh, PA
Date	July 9, 2015

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Safety Procedures and Warnings

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

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

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time.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 Soloist CL 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 Soloist CL inside a rack or enclosure.
6. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
7. Make sure the Soloist CL and all components are properly grounded in accordance with local electrical safety requirements.
8. Operator safeguarding requirements must be addressed during final integration of the product.

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

Quick Installation Guide

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

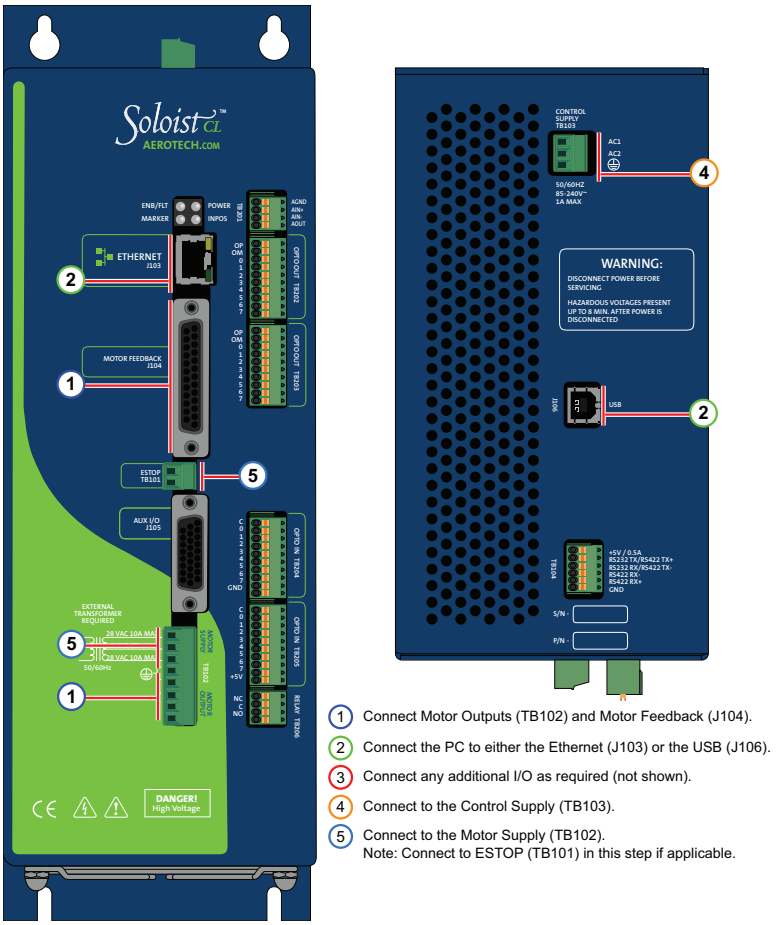

Figure 1: Quick Start Connections

Topic	Section
Motor Output	Section 2.2. Motor Output Connections
Motor Feedback	Section 2.3. Motor Feedback Connections (J104)
Ethernet / USB	No Section / Standard Connection
Control Supply	Section 2.1.1. Control Supply Connections (TB103)
Motor Supply	Section 2.1.2. Motor Supply Connections (TB102)
Additional I/O	User / Application dependent

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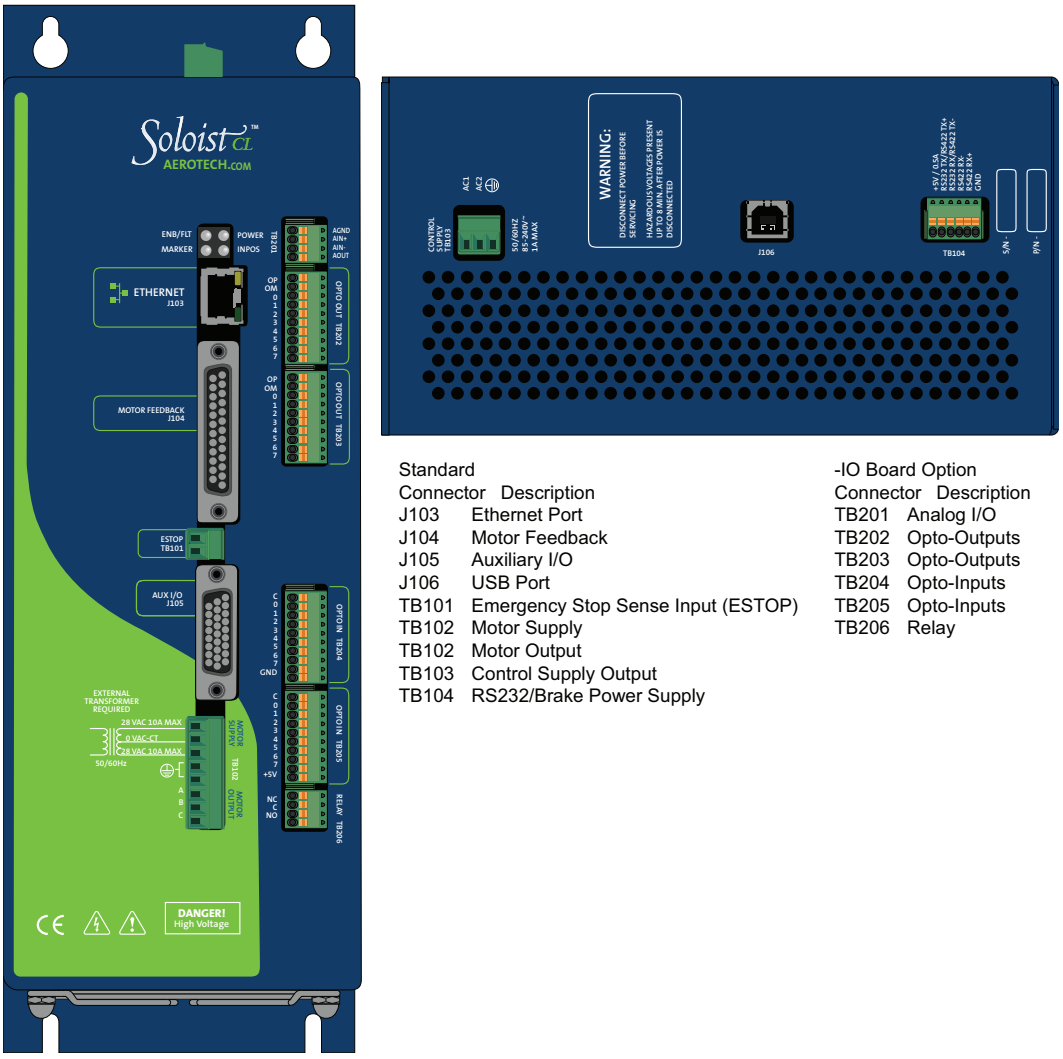
Chapter 1: Introduction

Aerotech's Soloist CL (Compact Linear) network digital drive is a high performance linear amplifier designed to eliminate the nonlinearities common with PWM amplifiers. The drive provides deterministic behavior, auto-identification, and easy software setup. The Soloist CL'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 Soloist CL is offered with an optional encoder interpolation feature (-MXU), an auxiliary square wave encoder input for dual loop control, dedicated analog and digital I/O (expandable with the -IO option), and separate power connections for motor and control supply voltages.



Standard		-IO Board Option	
Connector	Description	Connector	Description
J103	Ethernet Port	TB201	Analog I/O
J104	Motor Feedback	TB202	Opto-Outputs
J105	Auxiliary I/O	TB203	Opto-Outputs
J106	USB Port	TB204	Opto-Inputs
TB101	Emergency Stop Sense Input (ESTOP)	TB205	Opto-Inputs
TB102	Motor Supply	TB206	Relay
TB102	Motor Output		
TB103	Control Supply Output		
TB104	RS232/Brake Power Supply		

Figure 1-1: Soloist CL Networked Digital Drive

Table 1-1: Feature Summary

Standard Features	
• Line driver square wave quadrature encoder input for position and velocity feedback • Line driver square wave auxiliary quadrature encoder input or output for PSO • Four opto-isolated user outputs • Six opto-isolated user inputs (two high speed) • One 16-bit differential analog input (± 10 V) • One 16-bit analog output (±10 V) • Dedicated 5-24 V Emergency Stop sense input • Single axis Position Synchronized Output (PSO) • Absolute Encoder support • Calibration (refer to the Soloist Help file for more information) • Camming (refer to the Soloist Help file for more information) • 10/100 BASE-T Ethernet port for use with Ethernet I/O modules	
Options	
-IO	• One 16-bit analog output (±10 V) • One 12-bit differential analog input • One fail-safe brake or user relay output • 16 optically isolated logic inputs (5 - 24 VDC), may be connected in current sourcing or sinking mode • 16 optically isolated logic outputs (5 - 24 VDC), user defined as current sourcing or sinking
-MXU	Interpolation circuit allowing for analog sine wave input on the standard encoder channel. Interpolation factor: 8,192

Table 1-2: Accessories

Accessories	
MCK-NDRIVE	Mating connector kit for J104 (J105 mate is always provided)
JI	Industrial Joystick (NEMA12 (IP54) rated); refer to Section 4.1.
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 4.1. or Section 4.2.

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

DANGER: An external center-tapped power transformer is required! Do not connect the motor power supply to a voltage greater than 28 VAC (2Ø).

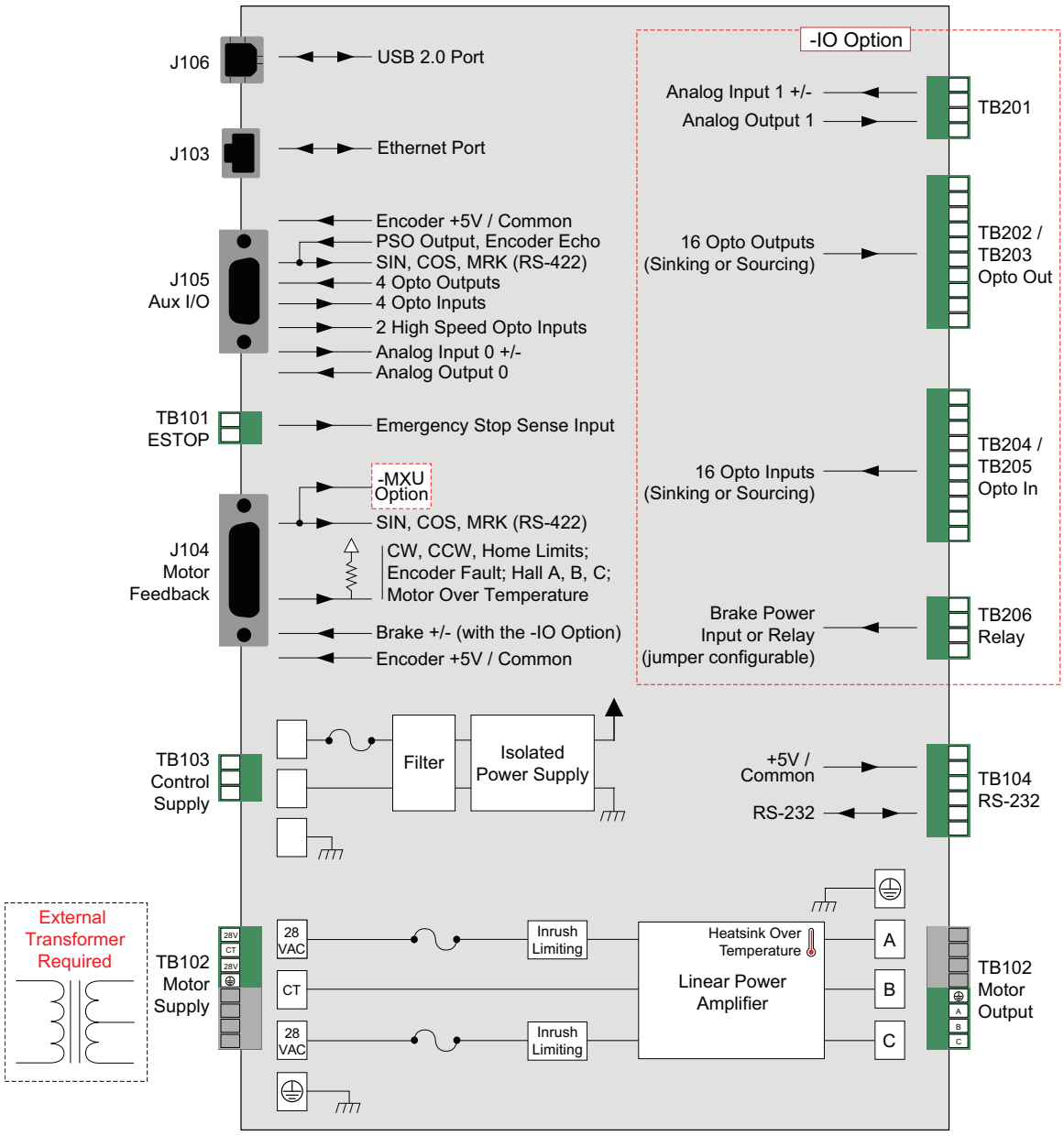


Figure 1-2: Functional Diagram

1.1. Drive and Software Compatibility

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

Table 1-3: Soloist Drive and Software Compatibility

Drive Type	Firmware Revision	First Software Version	Last Software Version
CL	-	2.06	Current
	A	2.55	Current
CP	-	1.00	Current
	A	2.01	Current
	B	2.54	Current
HLe	-	2.51	Current
HPe	-	2.51	Current
ML	-	3.00	Current
MP	-	2.01	Current
	A	2.55	Current

1.2. Electrical Specifications

The safe operating range is load dependent.

Table 1-4: Electrical Specifications

Description		CL 10
Motor Supply	Input Voltage	Two Phase 28 VAC (56 VAC with a center tap)
	Input Frequency	50-60 Hz
	Inrush Current	4 A
	Maximum Continuous Input Current	5 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	.25 A max
Output Voltage (1)		±38V @ 10A
Peak Output Current (2)		10
Continuous Output Current (2)		5
Power Amplifier Bandwidth (selectable via parameters)		2500 Hz maximum (software selectable)
Minimum Load Resistance		0.5 Ω
Output Impedance		0.2 Ω (each phase)
User Power Supply Output		5 VDC (@ 500 mA)
Modes of Operation		Brushless; Brush; Stepper
Protective Features		Peak current limit; Over temperature; RMS current limit; Dynamic power dissipation limit; Designed to EN61010/UL61010-1
Isolation		Optical and transformer isolation between control and power stages.

(1) Load Dependent
(2) Peak and continuous output current is load dependent (the amplifier will limit its output current based on velocity and motor resistance).

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 50% should be used in the following equations.

Linear Motor

Pdiss[W] = MotorCurrentPeak[A] * TotalBusVoltage[V] * 3 / 2

Pin = SUM (Pdiss) / EfficiencyFactor

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.

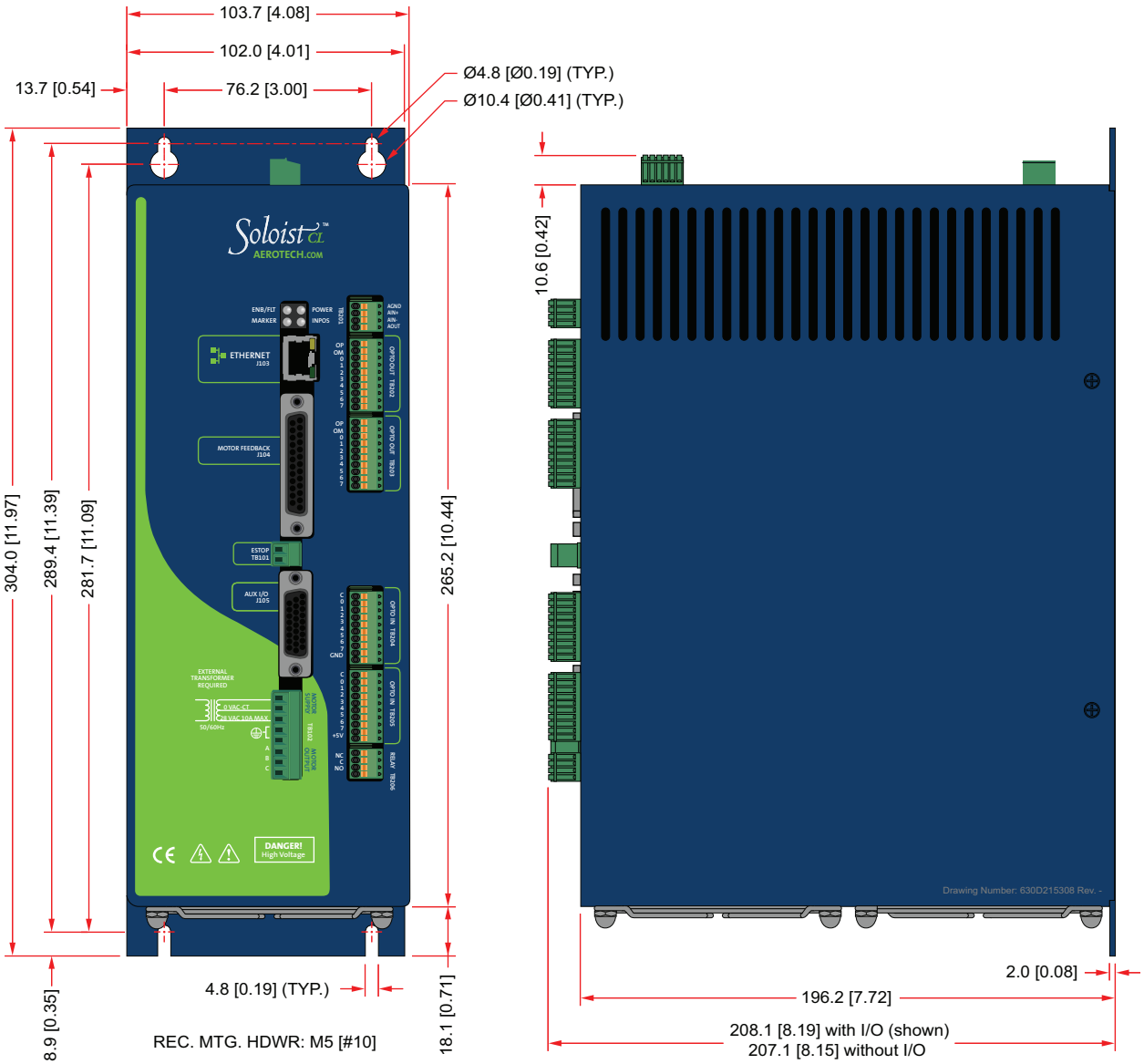


Figure 1-3: Dimensions

Table 1-5: Physical Specifications

	Weight
Standard	3.54 kg (7.8 lb)
w/ -IO option	3.63 kg (8.0 lb)

1.4. Environmental Specifications

The environmental specifications for the Soloist CL 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.

Chapter 2: Installation and Configuration

2.1. Power Connections

The Soloist CL 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 (TB103)

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 Soloist CL 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 Soloist CL may be required for CE compliance (Aerotech recommends Schaffner FN2080).

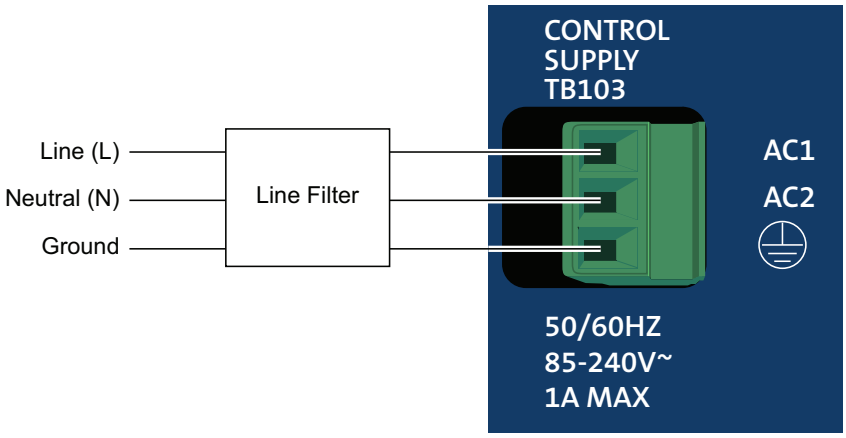


Figure 2-1: Control Supply Connections

Table 2-1: Control Supply AC Input Wiring

Pin	Description	Recommended Wire Size
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) AC1 and AC2 must be supplied from a branch protected source.		

Table 2-2: Control Supply Mating Connector

Type	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
3-Pin Terminal Block	ECK01387	1803581	0.22 - 0.25	2.0 - 0.516 [14-30]

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 Soloist CL Motor Supply connector (refer to Figure 2-2 for locations).

The recommended wire size is 0.5 mm^2 (#20 AWG). The wire must be properly matched to the fuses or circuit breakers and must be sized to meet local electrical safety codes.

An external 56 VAC (max) center tapped transformer must be connected to TB102. This is used to generate the internal voltage used to control the motor. The transformer must be capable of supplying 5 A continuous current and must have primary over-current and over-temperature protection. TB102 also provides the safety ground connection for the CL.

The transformer primary wiring requires external fuses or a circuit breaker.

WARNING: Do not operate the Soloist CL without the safety ground connection in place.

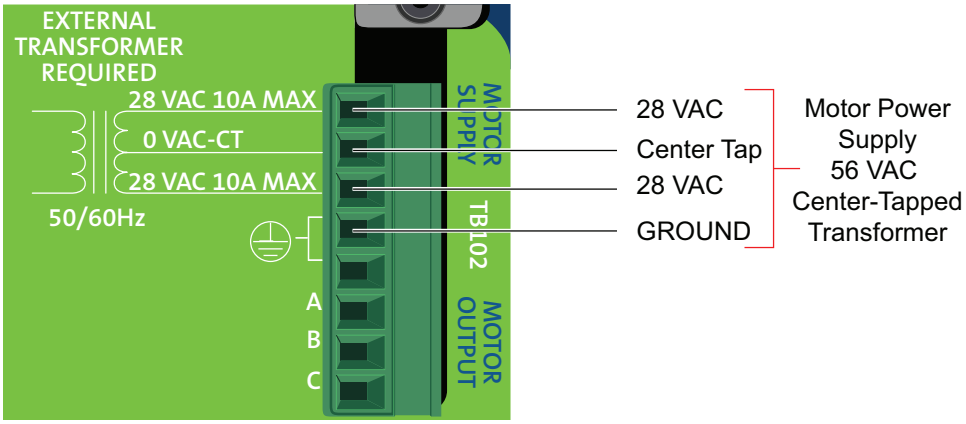


Figure 2-2: Motor Bus Input Connections

Table 2-3: Motor Supply Mating Connector

Type	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
8-Pin Terminal Block	ECK01424	1803633	0.22 - 0.25	2.0 - 0.516 [14-30]

2.1.3. Transformer Options

Aerotech offers three transformer options for the CL: TM3, TM5, and the TV0.3-28-56-ST. Refer to the TM3 or TM5 manuals for interconnection help.

Manuals for the TM3 and TM5 are located on the installation device that came with the A3200 software. For the TM3, the manual part number is EDO117. For the TM5, the manual part number is EDO118.

Table 2-4: 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

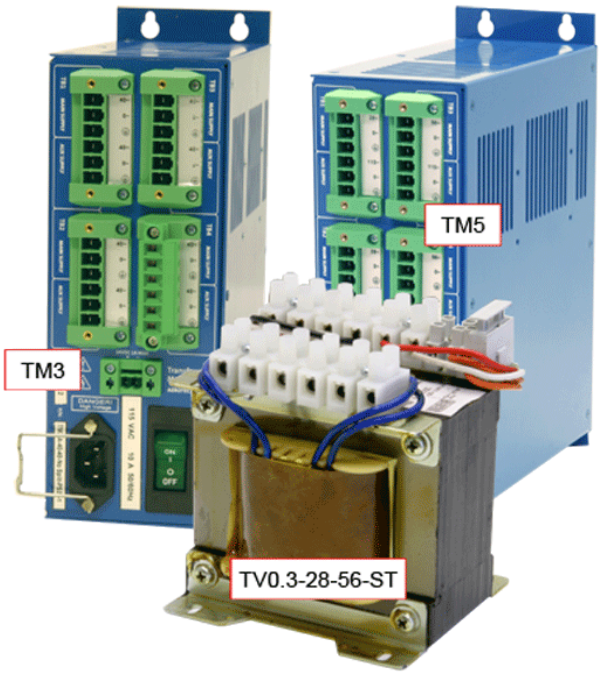


Figure 2-3: Transformer Examples

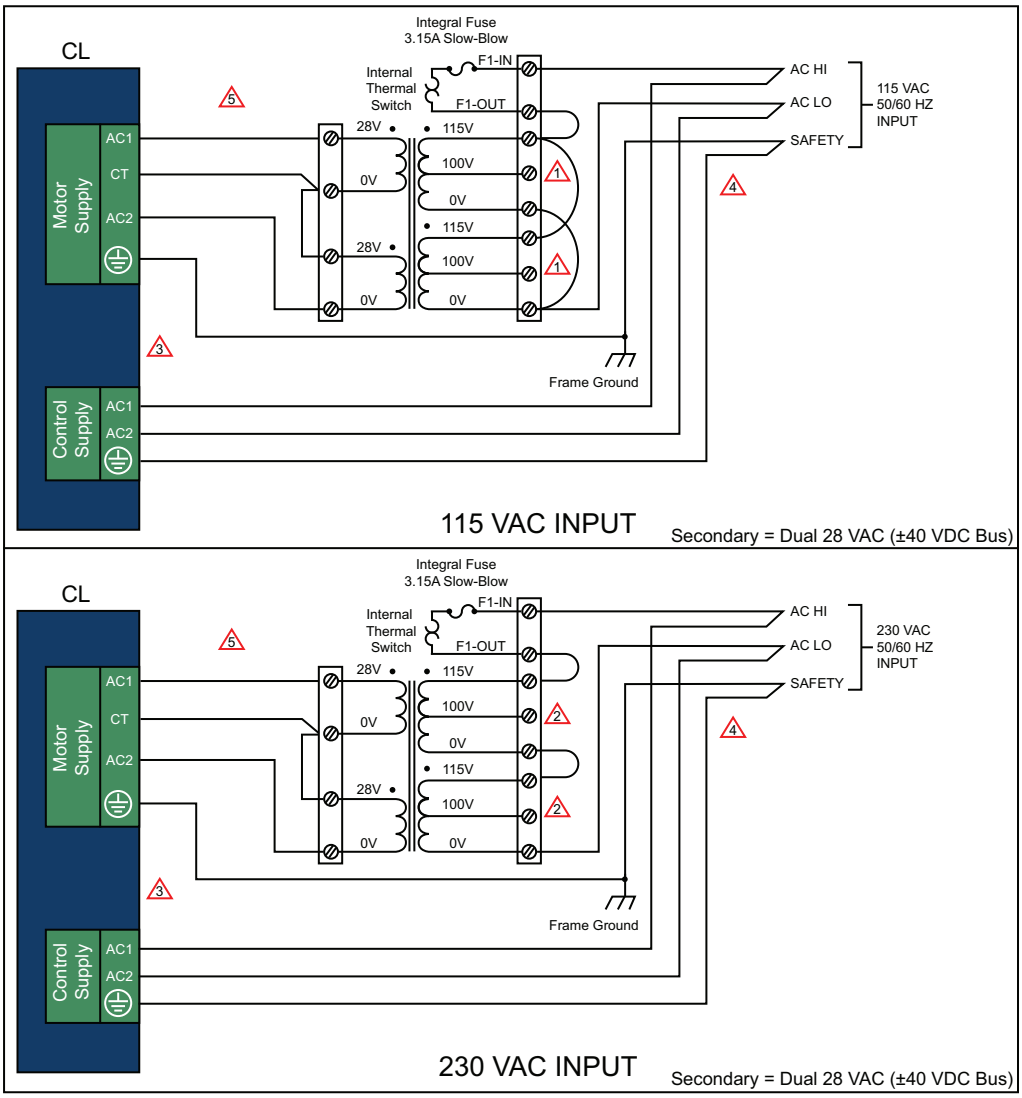
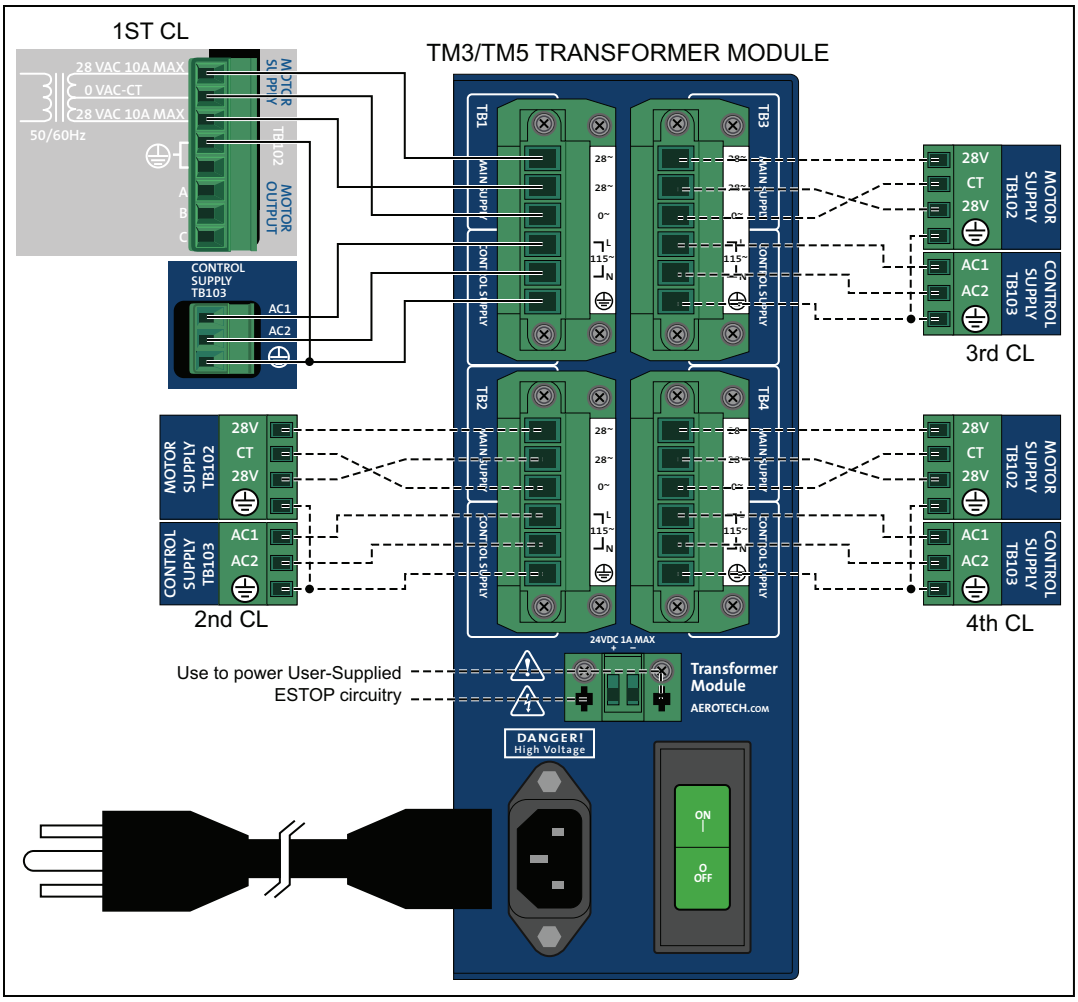


Figure 2-4: 40 VDC Motor Power with a TV0.3-28-56-ST Transformer



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 congfiguration.
2. The TM3 must be configured for 56CT VAC output.
3. Transformer Wiring: 0.5 mm^2 (#20 AWG) 300 V wire.
4. Control Supply output voltage (115 VAC in this example) is always the same as the AC Input Voltage to the unit.

Figure 2-5: Control and Motor Power Wiring using a TM3 or TM5 Transformer

2.2. Motor Output Connections

The Soloist CL 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 2-5: Motor Power Output Connections (TB102)

Pin	Description	Recommended Wire Size
ØA	Phase A Motor Lead	0.5 mm^2 (#20 AWG)
ØB	Phase B Motor Lead	0.5 mm^2 (#20 AWG)
ØC	Phase C Motor Lead	0.5 mm^2 (#20 AWG)
⏚	Earth Ground to Motor (required for safety)	0.5 mm^2 (#20 AWG)

Table 2-6: Motor Power Output Mating Connector

Type	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
8-Pin Terminal Block	ECK01424	1803633	0.22 - 0.25	2.0 - 0.516 [14-30]

2.2.1. Brushless Motor Connections

The configuration shown in Figure 2-6 is an example of a typical brushless motor connection.

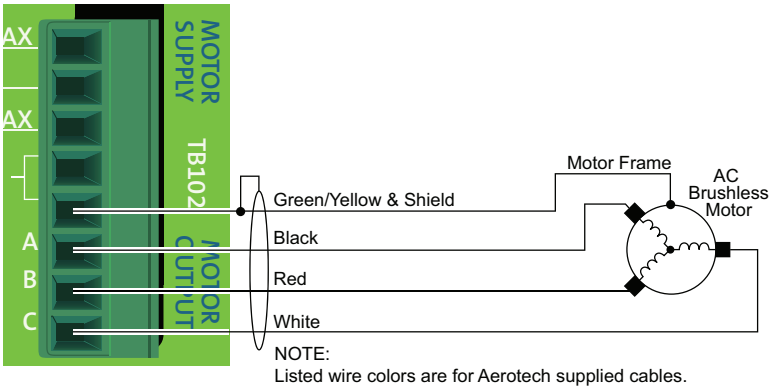


Figure 2-6: Brushless Motor Configuration

Table 2-7: 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 drive requires that the Back-EMF of each motor phase be aligned with the corresponding Hall-effect signal. To ensure proper alignment, motor, Hall, and encoder connections should be verified.

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

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

2.2.1.1. Powered Motor Phasing

To test the initial set of motor connections, run the MotorVerification.ab test program.

The program will attempt to move the motor forward in a positive (CW) direction. Depending on the information that the program gathers during the test, you may be prompted to rearrange motor lead connections and run the test again. Refer to Section 2.2.1. for connector pin output information.

WARNING: The MotorVerification.ab program moves the motor in "Open-Loop" mode, bypassing many of the standard safety faults.

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

Hall Signal Phasing (connections to J104):

With the information gathered while the program is running, the Hall signal wires may have to be swapped. After the Hall sequence is correct, the program will determine if a commutation offset is required (and calculate a value for the CommutationOffset[1] parameter that will have to be entered into the parameter editor). Refer to Section 2.3.2. for more information and connector pin output assignments.

Encoder Phasing (connections to J104):

The MotorVerification.ab program also determines if the feedback wiring is correct. Follow the program prompts to establish the correct feedback wiring. Refer to Section 2.3. for connector pin output assignments and Section 2.3.1.5. for phasing information.

Feedback Monitoring:

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

A "0" for the given Hall input indicates zero voltage or logic low, where a "1" indicates 5V or logic high.

[1] CommutationOffset has replaced CfgMotOffsetAng in software version 3.00.000.

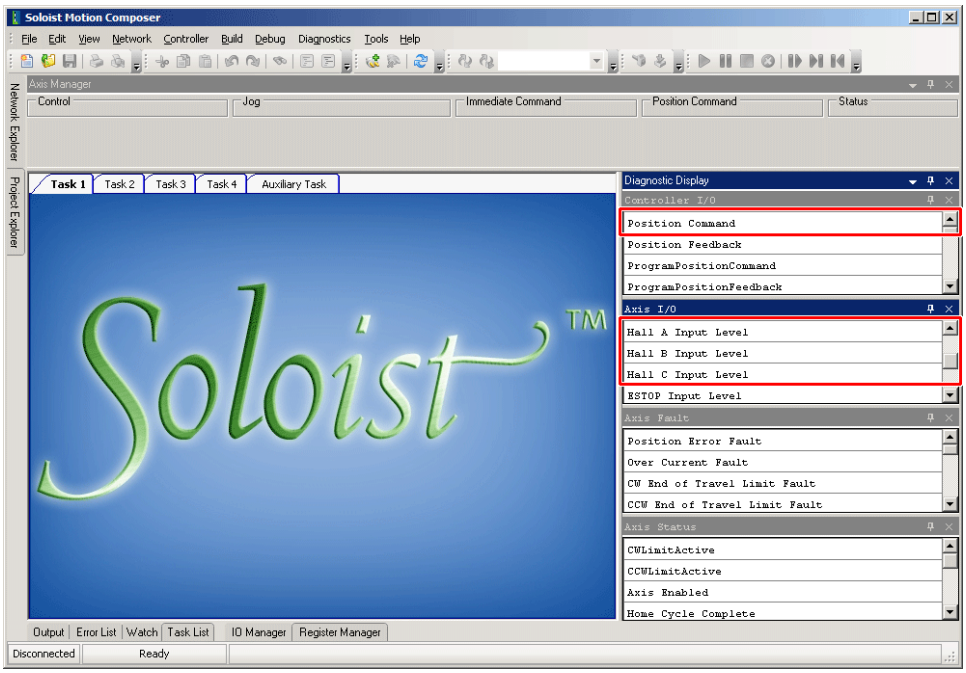


Figure 2-7: Encoder and Hall Signal Diagnostics

2.2.1.2. Unpowered Motor and Feedback Phasing

Disconnect the motor from the controller and connect the motor in the test configuration (as shown in Figure 2-8). 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 2-8).

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

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

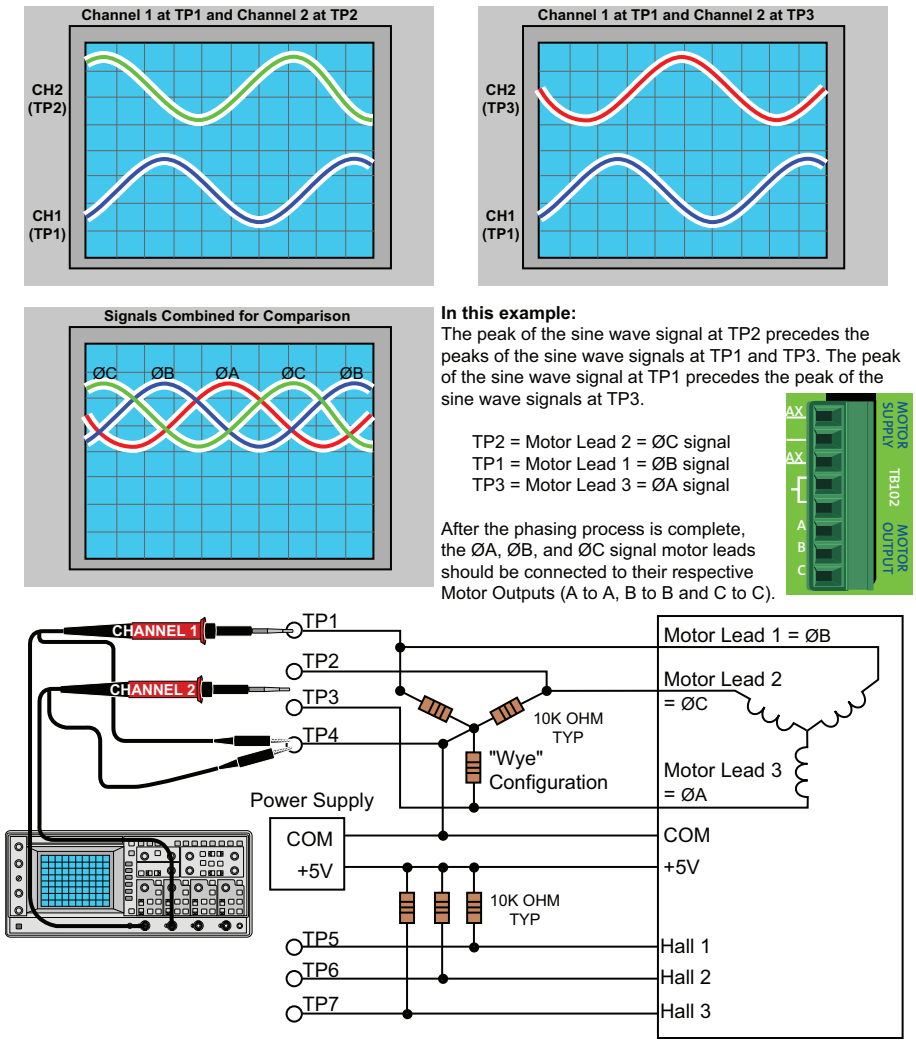
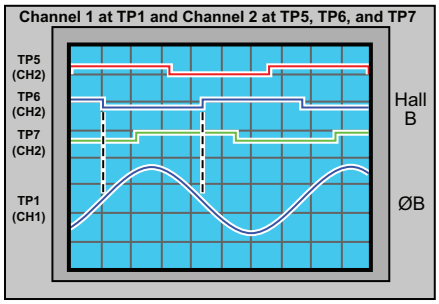


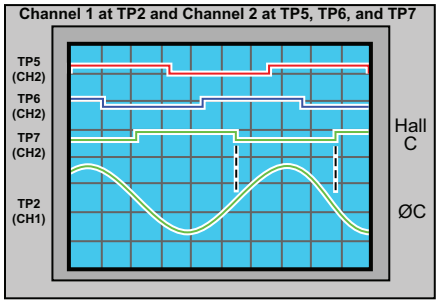
Figure 2-8: Motor Phasing Oscilloscope Example

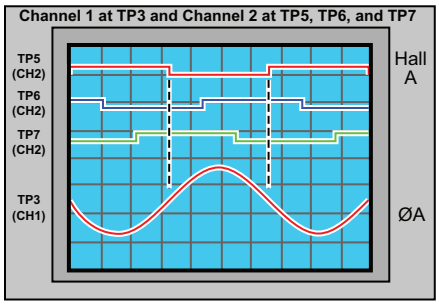
After the motor leads have been tested, the next step is to determine the phase of the Hall signals. The required (by an Aerotech system) relationship between motor and Hall leads is that the peak of a motor lead signal should correspond to the low voltage phase of the Hall signal (as shown in Figure 2-9).

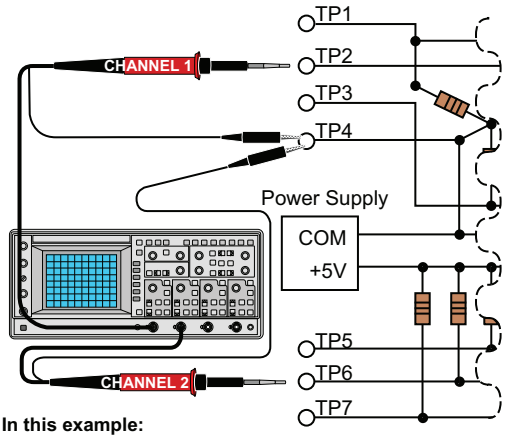
With channel 1 still connected to one of the motor leads, connect channel 2 of the oscilloscope to TP5, TP6, and then TP7, while advancing the motor in the positive direction after each connection. Note which of the three Hall signals has the complimentary phase relationship to the motor lead that channel 1 is connected to (as shown in Figure 2-9).

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









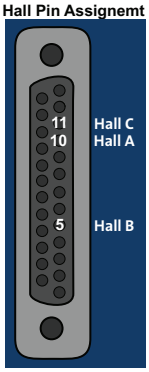
In this example:
The low voltage phase of the TP6 Hall signal corresponds with the peak phase of the motor sine wave of TP1 (in the previous example designated as ØB). The signal at TP6 should be designated as Hall B.

The low voltage phase of the TP7 Hall signal corresponds with the peak phase of the motor sine wave of TP2 (in the previous example designated as ØC). The signal at TP7 should be designated as Hall C.

The low voltage phase of the TP5 Hall signal corresponds with the peak phase of the motor sine wave of TP3 (in the previous example designated as ØA). The signal at TP5 should be designated as Hall A.

After the phasing process is complete, the Hall A, Hall B, and Hall C signal leads should be connected to their respective Motor Feedback connector inputs (Hall A to Pin 10, Hall B to Pin 5, and Hall C to Pin 11).

Motor Feedback Hall Pin Assignemt

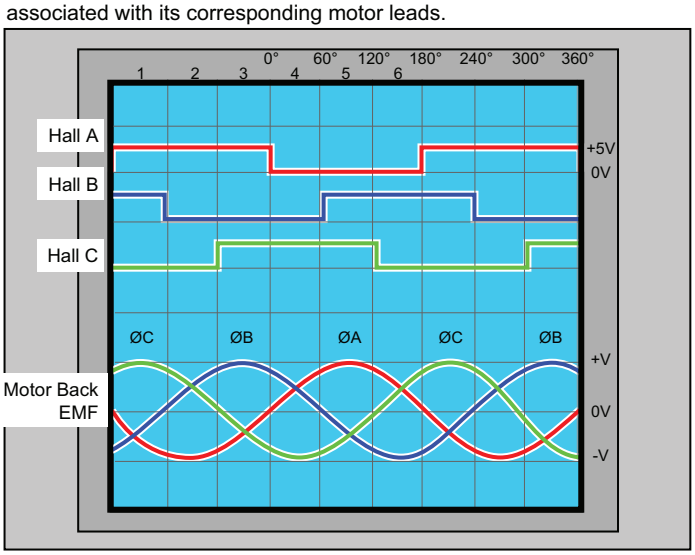


Pin	Hall Positions
10	Hall A
5	Hall B
11	Hall C

Figure 2-9: Hall Phasing with Oscilloscope

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

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



Motor Feedback Connector	Hall Positions	Corresponding Motor Lead	Motor Output Connector
Pin 10	Hall A	→	ØA
Pin 5	Hall B	→	ØB
Pin 11	Hall C	→	ØC

Figure 2-10: Brushless Motor Phasing Goal

2.2.2. DC Brush Motor Connections

The configuration shown in Figure 2-11 is an example of a typical DC brush motor connection. Refer to Section 2.2.2.1. for information on motor phasing.

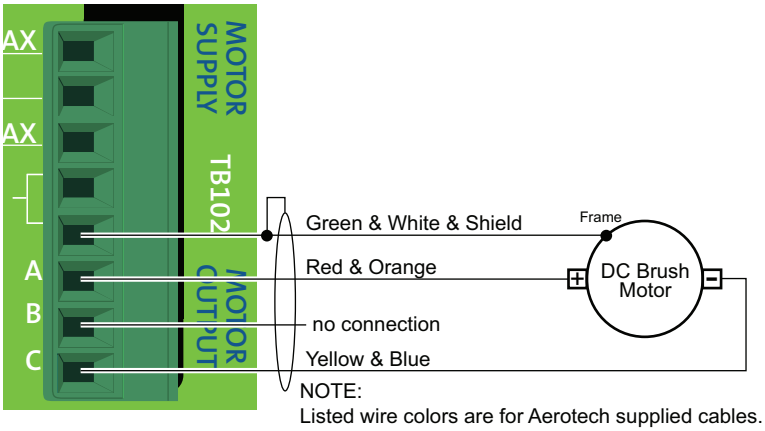


Figure 2-11: DC Brush Motor Configuration

Table 2-8: 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.

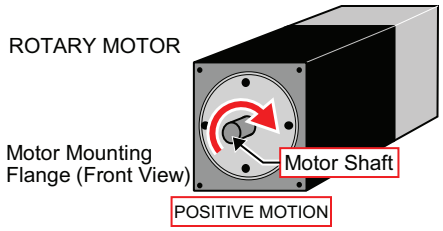


Figure 2-12: Clockwise Motor Rotation

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 Soloist CL. Connect the motor lead from the negative lead of the voltmeter to the ØC motor terminal on the Soloist CL.

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 2-13 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.

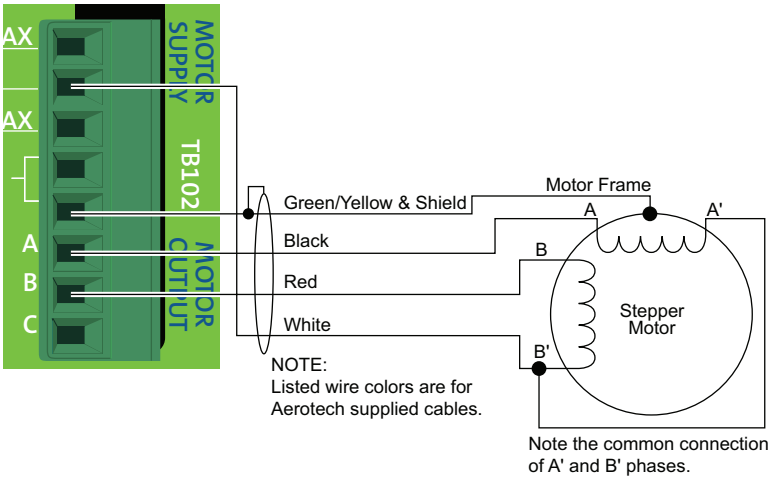


Figure 2-13: Stepper Motor Configuration

Table 2-9: 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
0VAC-CT	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[1] 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.

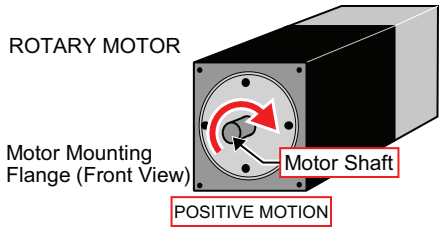


Figure 2-14: Clockwise Motor Rotation

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

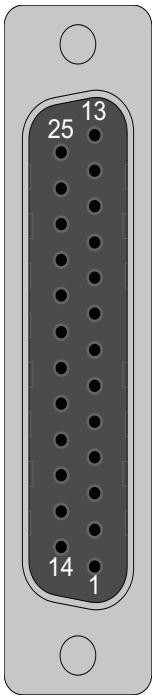
NOTE: After the motor has been phased, use the ReverseMotionDirection[2] parameter to change the direction of "positive" motion.

[1] CountsPerUnit has replaced PosScaleFactor in software version 3.00.000.
[2] ReverseMotionDirection has replaced the functionality of reversing the sign on the PosScaleFactor to change the direction of positive motion in software version 3.00.000.

2.3. Motor Feedback Connections (J104)

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 2-10: Motor Feedback Connector Pin Assignment (J104)

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	Optional 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	Optional Brake + Output	Output	

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 (J104)

The Soloist CL is equipped with standard and auxiliary encoder feedback channels. The standard encoder interface is accessible through the Motor Feedback (J104) connector. The standard encoder interface will accept an RS-422 differential line driver signal. If the Soloist CL has been purchased with the -MXU option, the standard encoder interface can optionally be configured for an analog encoder input via parameter settings.

Refer to Section 2.3.1.5. 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.

NOTE: The PSO feature is **not** compatible with the -MXU option. The PSO feature operates with the -MXH option and with square wave encoders.

Table 2-11: Encoder Interface Pin Assignment

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 in the range of 0 to 5 Volts. It accepts a 10 MHz (max) encoder signal frequency (25 nsec minimum edge separation), producing 40 million counts per second after times four (x4) quadrature decoding.

An analog encoder is used with the -MXU option (refer to Section 2.3.1.4. for more information).

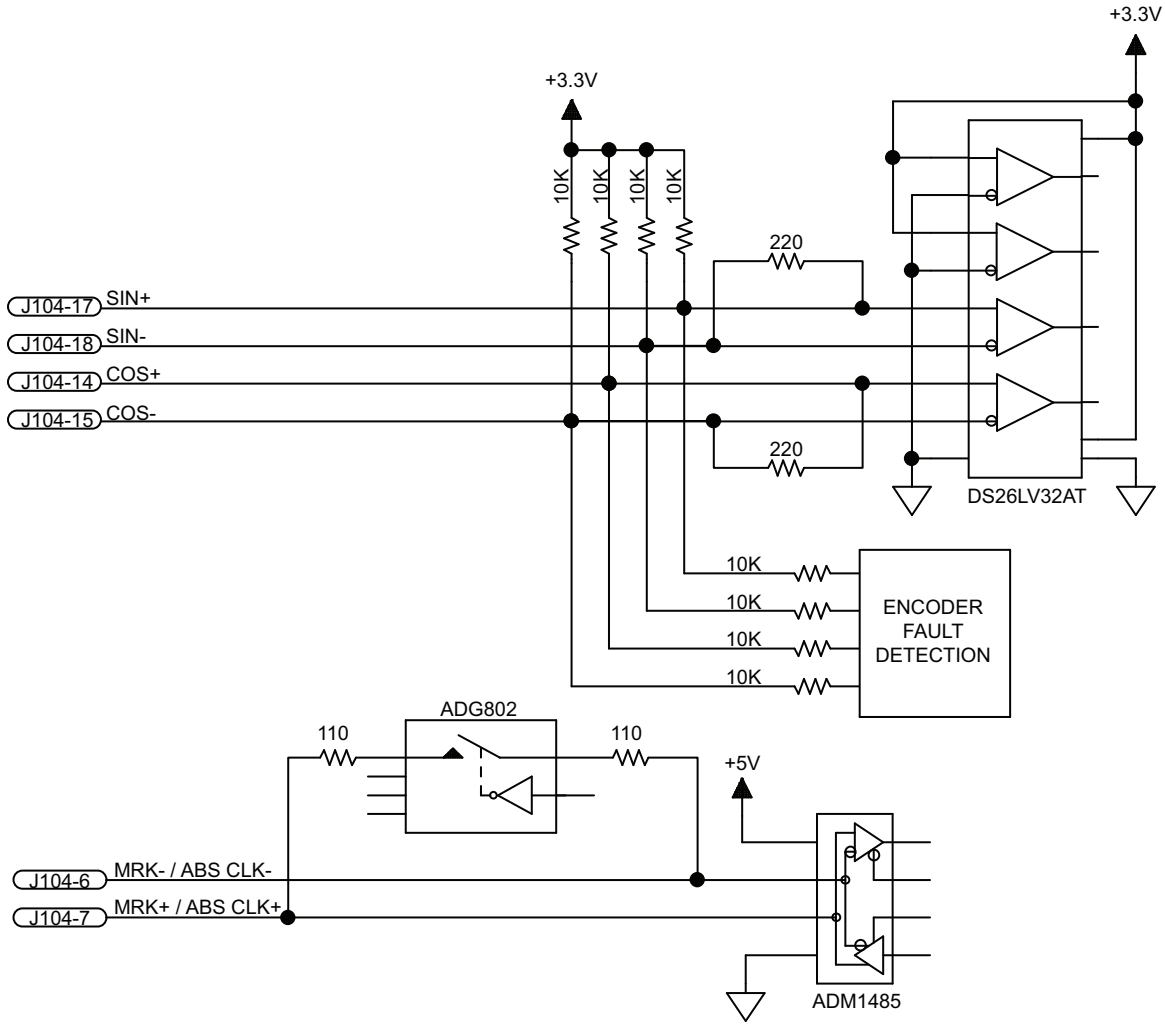


Figure 2-15: Line Driver Encoder Interface (J104)

2.3.1.2. EnDat Encoder Interface (J104)

The Soloist CL retrieves absolute position data along with encoder fault information via a serial data stream from the absolute encoder. See Figure 2-16 for the serial data stream interface. Set up of this interface requires setting parameters EnDatEncoderResolution[1], EnDatEncoderSetup[2], EnDatEncoderTurns[3].

The encoder interface pin assignment is indicated in Section 2.3.1.

NOTE: The PSO feature is **not** compatible with the -MXU option. The PSO feature operates with the -MXH option and with square wave encoders.

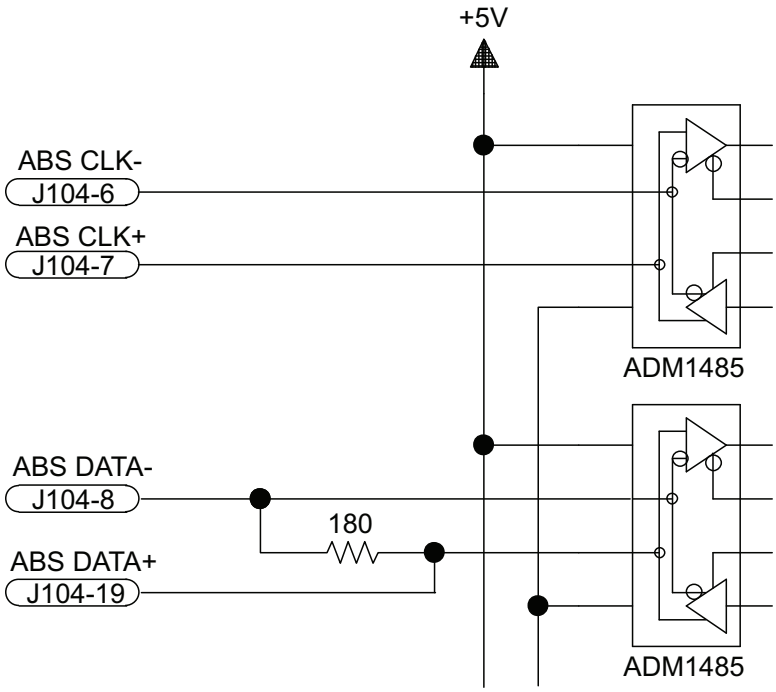


Figure 2-16: Serial Data Stream Interface

[1]EnDatEncoderResolution has replaced CfgFbkEncAbsPosBits in software version 3.00.000.
[2]EnDatEncoderSetup has replaced CfgFbkEncAbsSetup in software version 3.00.000.
[3]EnDatEncoderTurns has replaced CfgFbkEncAbsRevBits in software version 3.00.000.

2.3.1.3. Resolute Encoder Interface (J104)

The Soloist CL retrieves absolute position data along with encoder fault information via a serial data stream from the resolute encoder. See Figure 2-17 for the serial data stream interface. Set up of this interface requires setting parameters ResoluteEncoderResolution, ResoluteEncoderSetup, and ResoluteEncoderUserResolution.

The encoder interface pin assignment is indicated in Section 2.3.1.

NOTE: The Absolute Encoder Interface requires the -PLUS option.

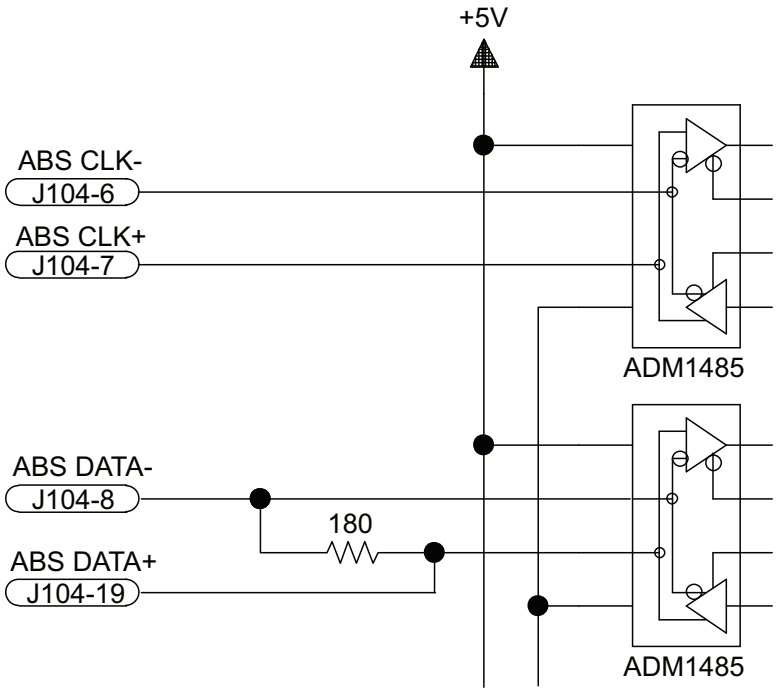


Figure 2-17: Serial Data Stream Interface

2.3.1.4. Analog Encoder Interface

If the -MXU option has been purchased, the standard encoder channel will accept an analog encoder input signal. The multiplication (interpolation) factor is determined by the EncoderMultiplicationFactor[1] parameter.

Table 2-12: Analog Encoder Specifications

Specification	Description
Input Frequency (max)	200 kHz
Input Amplitude	0.6 to 2.25 Vpk-Vpk
Interpolation Factor (software selectable)	8,192

Refer to Figure 2-18 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 Soloist Help file for more information.

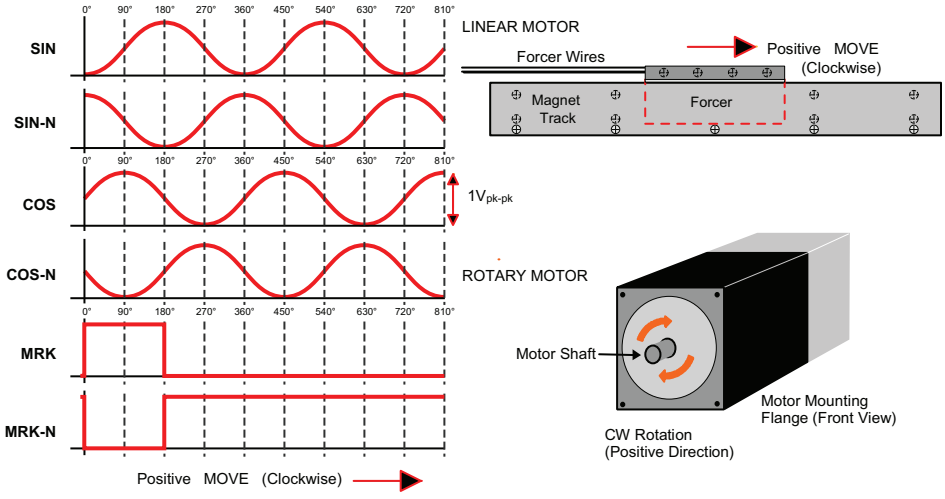


Figure 2-18: Analog Encoder Phasing Reference Diagram

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.

[1] EncoderMultiplicationFactor has replaced CfgFbkEncMultFactorMxu in software version 3.00.000.

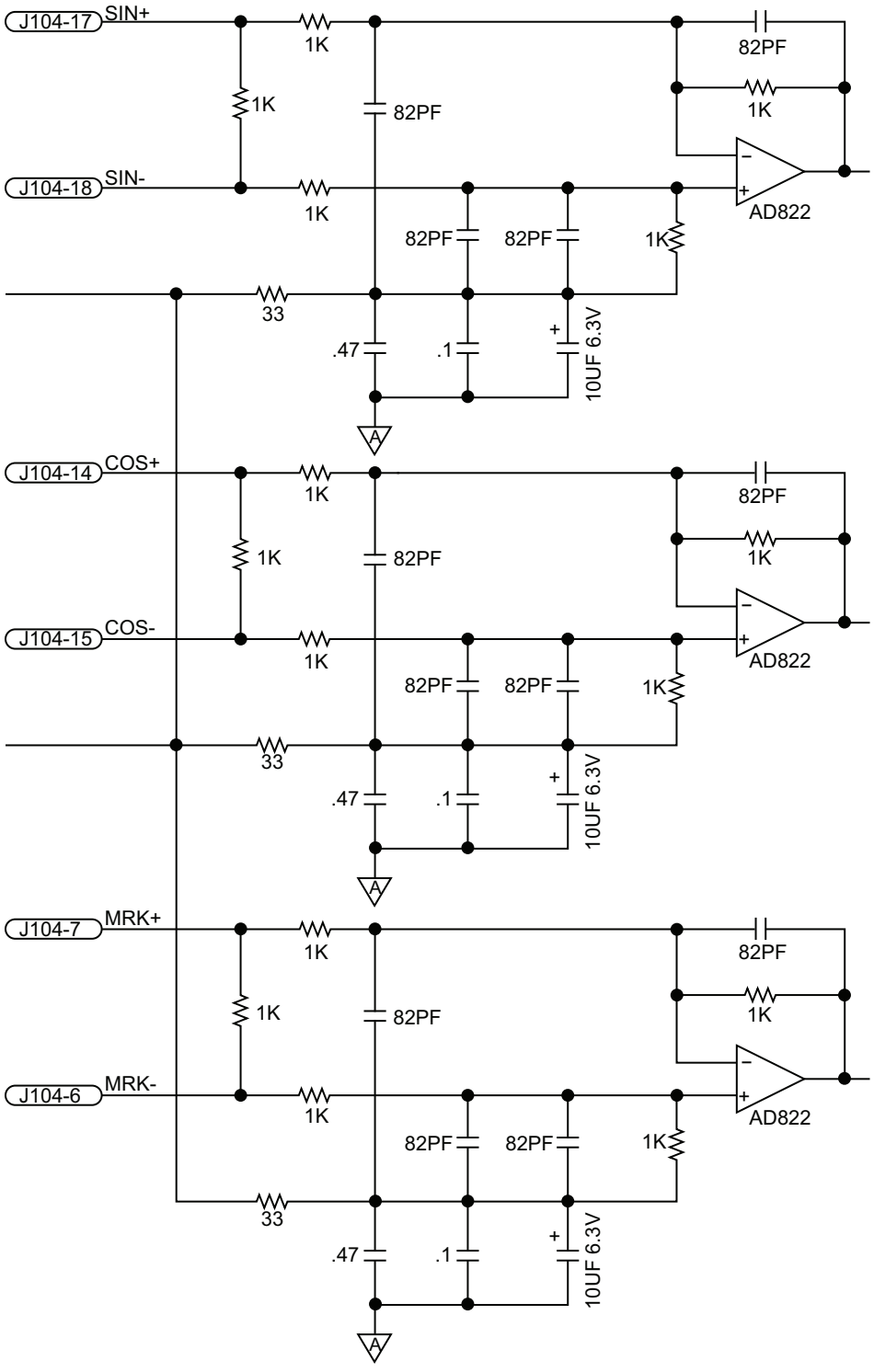


Figure 2-19: Analog Encoder Interface (J104)

2.3.1.5. Encoder Phasing

Incorrect encoder polarity will cause the system to fault when enabled or when a move command is issued. Figure 2-20 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 2-21). The MotorVerification.ab program can be used if the motor can not be moved by hand. If the program causes the Position Feedback to count more negative, swap the connections to the controllers SIN and the SIN-N encoder inputs.

For dual loop systems, the velocity feedback encoder is displayed in the diagnostic display (Figure 2-21).

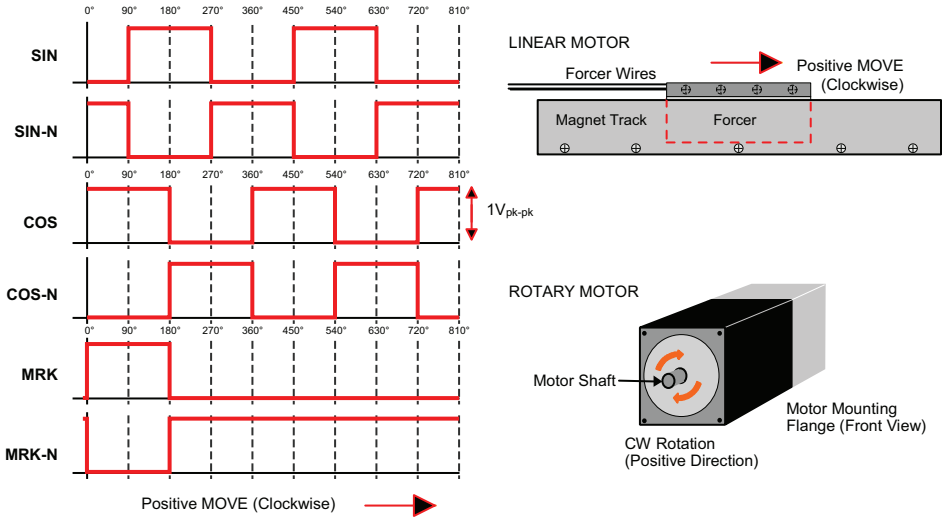


Figure 2-20: Encoder Phasing Reference Diagram (Standard)

NOTE: Encoder manufacturers may refer to the encoder signals as A, B, and Z. The proper phase relationship between signals is shown in Figure 2-20.

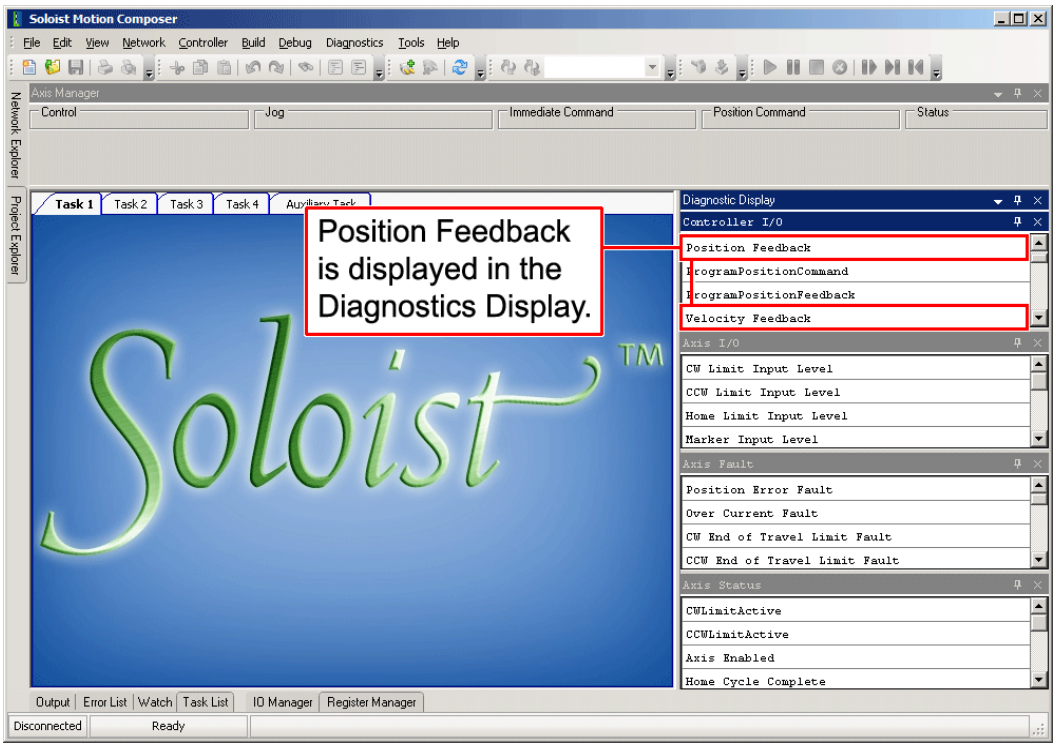


Figure 2-21: Position Feedback in the Diagnostic Display

2.3.2. Hall-Effect Interface (J104)

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.

Refer to Section 2.2.1.1. for Hall-effect device phasing.

Table 2-13: Hall-Effect Feedback Interface Pin Assignment (J104)

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

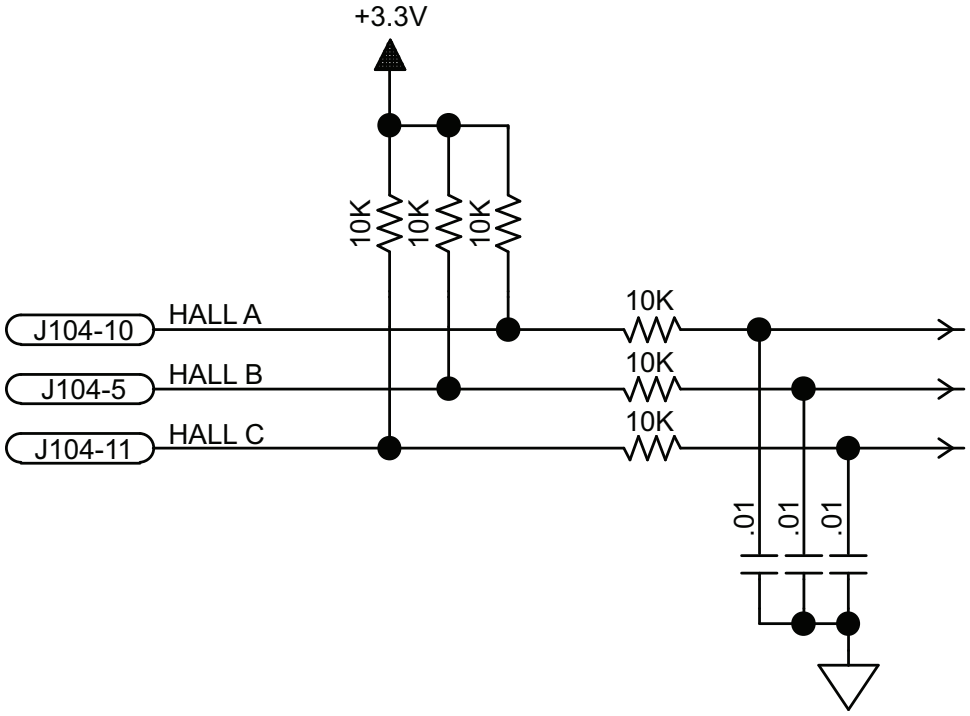


Figure 2-22: Hall-Effect Inputs (J104)

2.3.3. Thermistor Interface (J104)

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

Table 2-14: Hall-Effect Feedback Interface Pin Assignment (J104)

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

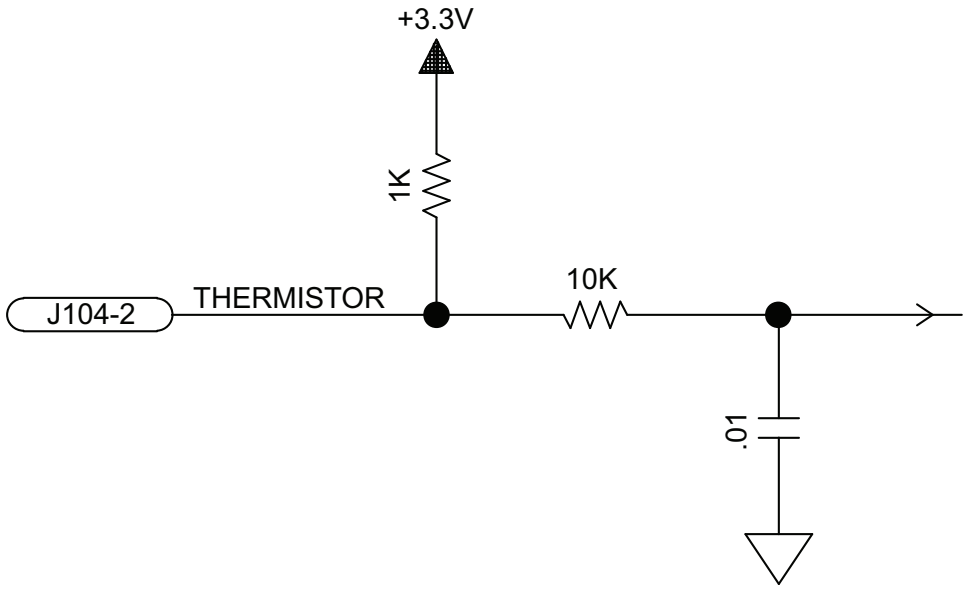


Figure 2-23: Thermistor Interface Input (J104)

2.3.4. Encoder Fault Interface (J104)

The encoder fault input is used with encoders having a fault output. Each manufacturer uses this signal to indicate different faults.

Table 2-15: Encoder Fault Interface Pin Assignment (J104)

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

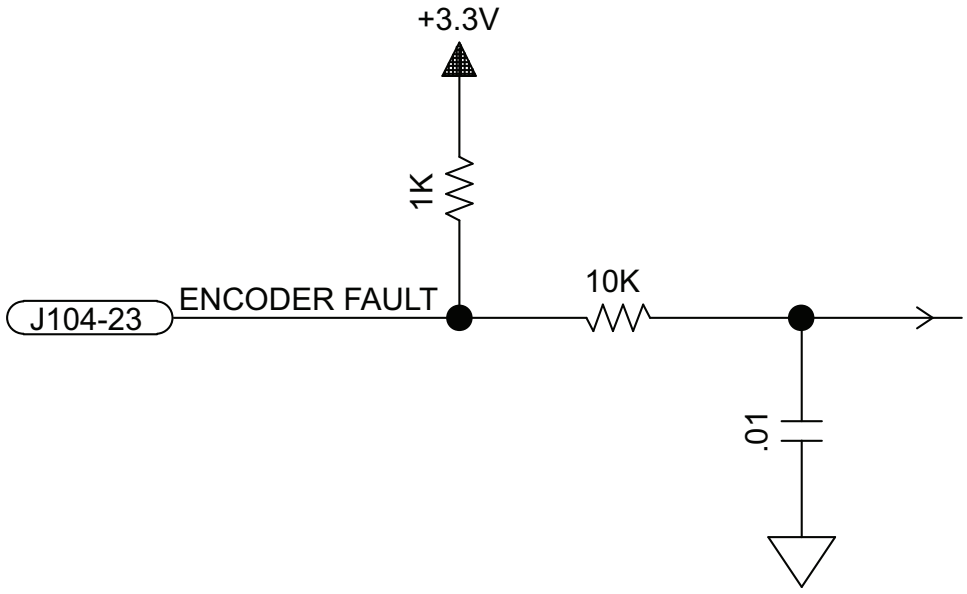


Figure 2-24: Encoder Fault Interface Input (J104)

2.3.5. End Of Travel Limit Input Interface (J104)

End of Travel (EOT) limits are required to define the end of the physical travel on linear axes. Positive or clockwise motion is stopped by the clockwise (CW) end of travel limit input. Negative or counterclockwise motion is stopped by the counterclockwise (CCW) end of travel limit input. The Home Limit switch can be parameter configured for use during the home cycle, however, the CW or CCW EOT limit is typically used instead. All of the end-of-travel limit inputs accept 5-24 VDC level signals. Limit directions are relative to the encoder polarity in the status display (refer to Figure 2-27).

The active state of the EOT limits is software selectable (by the EndOfTravelLimitSetup[1] parameter).

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

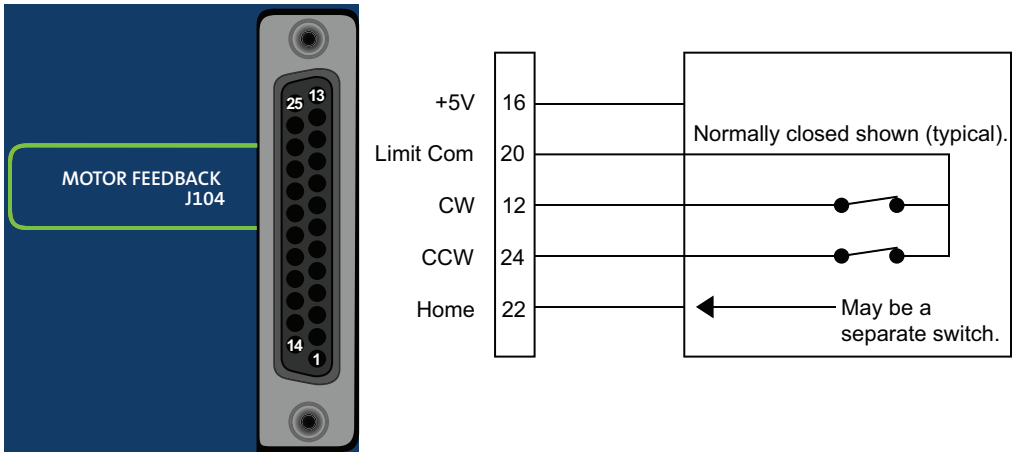


Figure 2-25: End of Travel Limit Input Connections

Table 2-16: End of Travel Limit Input Interface Pin Assignment (J104)

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

[1] EndofTravelLimitSetup has replaced LimitLevelMask in software version 3.00.000.

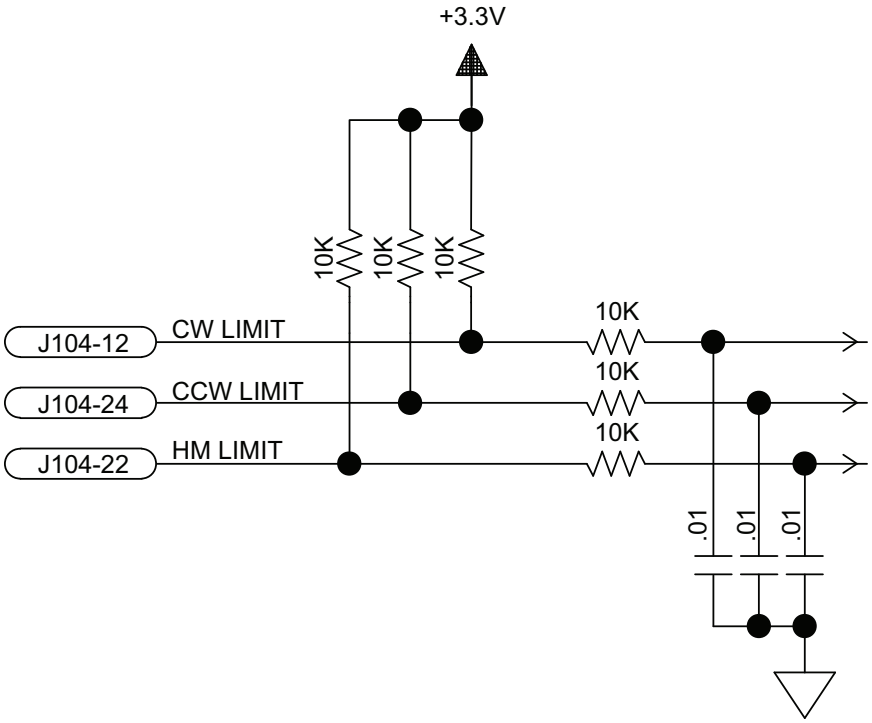


Figure 2-26: End of Travel Limit Interface Input (J104)

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 J104 connector. The logic level of the EOT limit inputs may be viewed in the diagnostic display (shown in Figure 2-27).

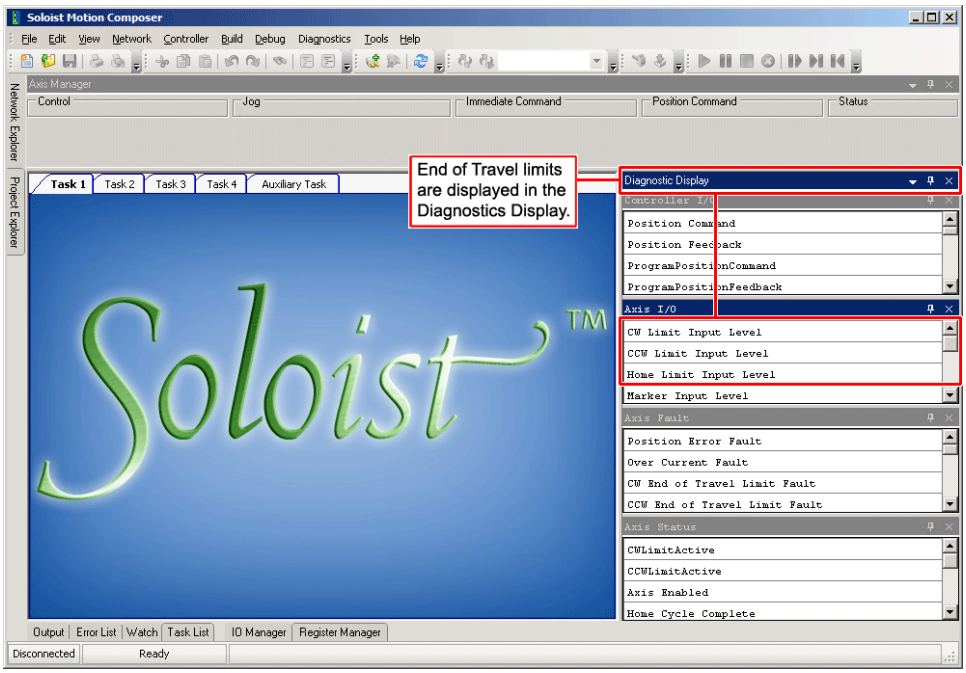


Figure 2-27: Limit Input Diagnostic Display

2.3.6. Brake Output (J104)

The Brake Output pins provide a direct connection to the mechanical relay on the optional -IO board. The brake output pins in J104 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 Soloist Help file for more information).

Refer to Section 3.6. for more information on using the brake output with the mechanical relay.

Table 2-17: Brake Output Pin Assignment (J104)

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

2.4. Emergency Stop Sense Input (TB101)

The ESTOP sense input (TB101) 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. The ESTOP sense input should be driven by the user's ESTOP circuit to either force the drive to disable, or decelerate to a stop then disable. Refer to Section 2.4.1. for interconnection details.

WARNING: The user is responsible for accessing 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 2-29 for interconnection details

TB101 is scaled for an input voltage of 5-24 volts. Using a higher input voltage requires adding an external series resistor to limit the current to 10 mA.

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

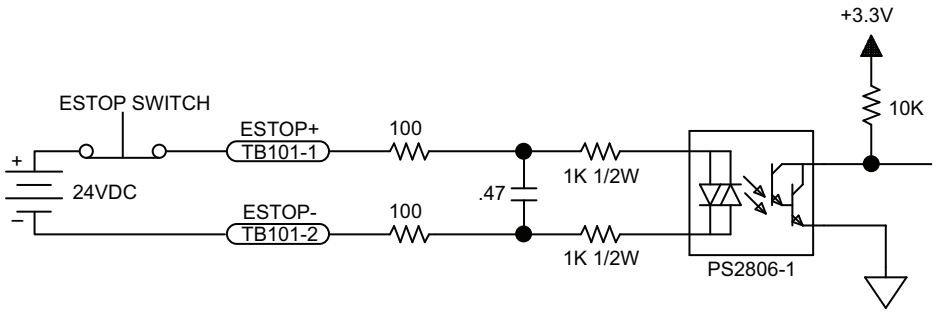


Figure 2-28: ESTOP Sense Input (TB101)

Table 2-18: Electrical Noise Suppression Devices

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 2-18. These devices are applied across the switched coil to suppress transient voltages.

Table 2-19: Electrical Noise Suppression Devices

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

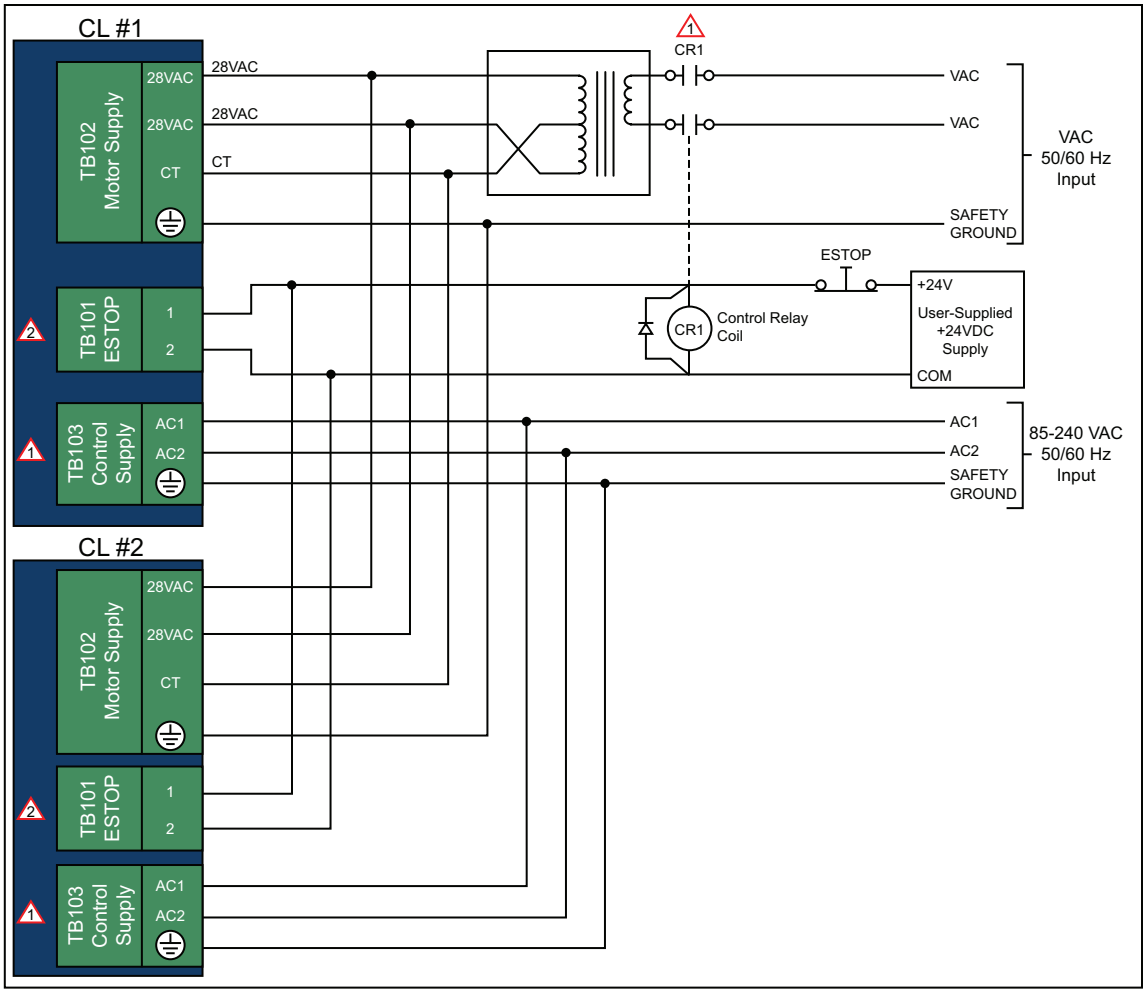
Table 2-20: TB101 Mating Connector

Type	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
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 Soloist CL's motor power supply input. This will remove power to the motor while maintaining control power, as shown in the Figure 2-29.

The external relay must be sized based on the number of the Soloist CLs connected and the peak current rating of each drive.



HAZARDOUS VOLTAGES PRESENT FOLLOW ALL APPLICABLE WIRING AND SAFETY CODES

1. Motor power may be removed during an Emergency Stop (ESTOP) condition while control and encoder power is maintained.

2. For the ESTOP input to be active, set the appropriate FaultMask axis parameters (the FaultMask axis parameters set the action to be taken when an ESTOP condition occurs).

Figure 2-29: Typical Emergency Stop Circuit

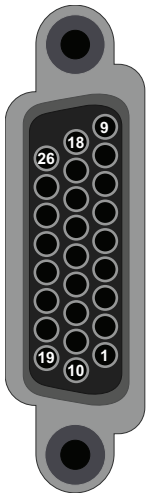
Table 2-21: Typical ESTOP Relay Ratings

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 (J105)

The Auxiliary I/O connector (J105) provides 1 analog and 6 digital inputs, 1 analog and 4 digital outputs, and a secondary RS-422 line driver encoder input.

Table 2-22: Auxiliary I/O Connector Pin Assignment (J105)

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	Opto-Isolated Output 0	Output	
8	Opto-Isolated Output 1	Output	
9	Opto-Isolated 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	Opto-Isolated Output 3	Output	
17	Opto-Isolated Input 0 / CCW EOT Input (1)	Input	
18	Opto-Isolated 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	Opto-Isolated Input 2 / Home Input (1)	Input	
26	Opto-Isolated Input 3	Input	

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

Mating Connector	Aerotech P/N	Third Party P/N
Connector	ECK01259	Kycon K86-AA-26P
Backshell	ECK01022	Amphenol 17-1725-2

NOTE: These items are provided as a set under the Aerotech P/N: MCK-26HDD.

2.5.1. Auxiliary Encoder Channel (J105)

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

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

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 Soloist Help file for more information.

NOTE: You cannot echo the standard encoder signals on the CL with the -MXU option.

Table 2-23: Auxiliary Encoder Channel Pin Assignment (J105)

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.		

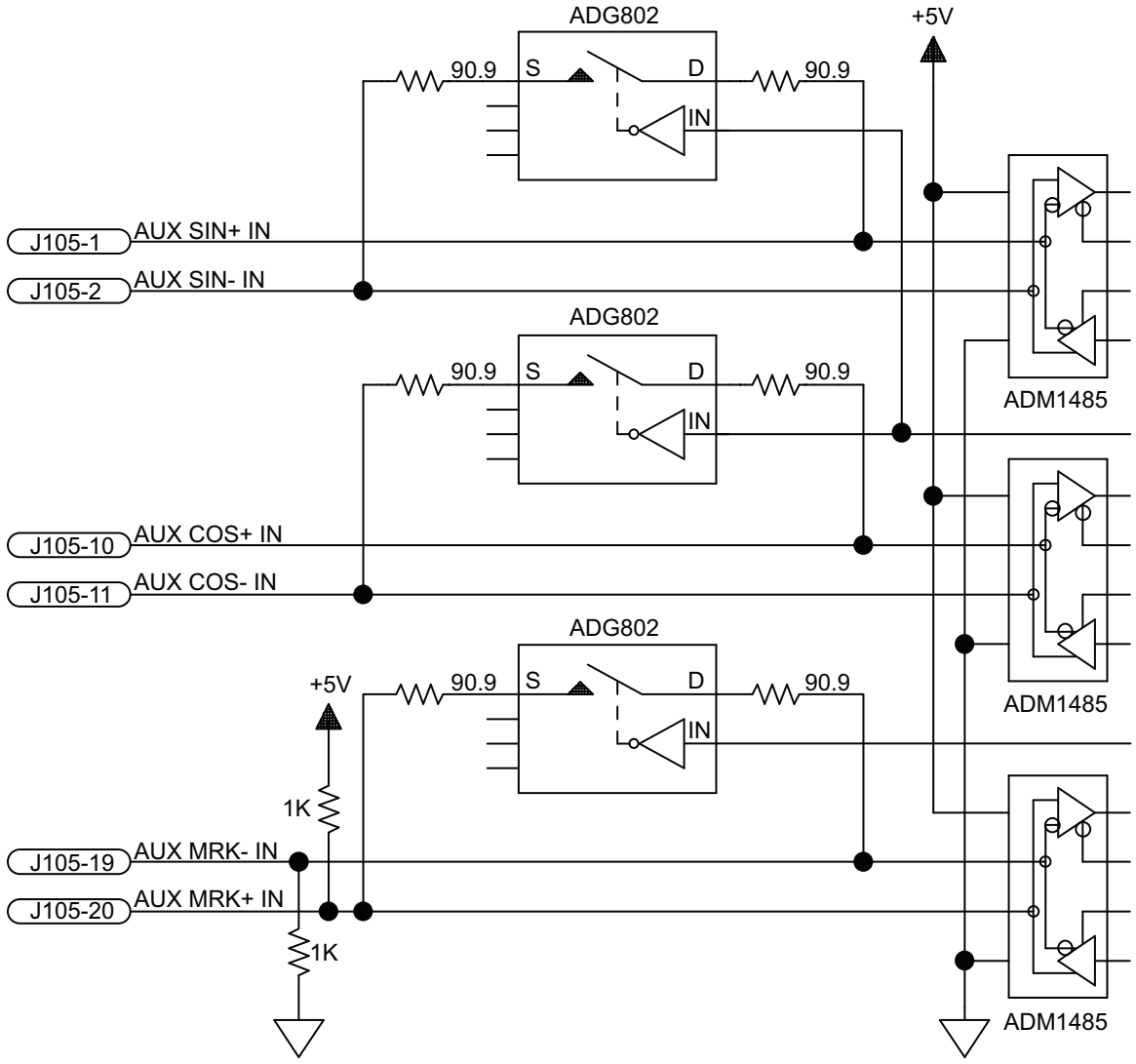


Figure 2-30: Auxiliary Encoder Channel (J105)

2.5.2. Position Synchronized Output (PSO)/Laser Firing (J105)

The Soloist CL includes a Position Synchronized Output (PSO) feature. The PSO output is available on the dual function AUXMRK± differential signal lines (use of an RS-422 line receiver or opto-isolator is recommended). The auxiliary marker must be configured as an output using the PSOOUTPUT CONTROL command, see the Soloist Help file for specific details.

The PSO can be programmed to generate an output synchronized to the encoder position, typically used to fire a laser or sequence an external device. Trigger signals may be derived from the standard encoder channel, auxiliary encoder channel, or a software trigger. The synchronized output pulse is generated using high-speed hardware, allowing minimal latency (200 nanoseconds) between the trigger condition and the output.

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

NOTE: The PSO feature is **not** compatible with the -MXU option. The PSO feature operates with the -MXH option and with square wave encoders.

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

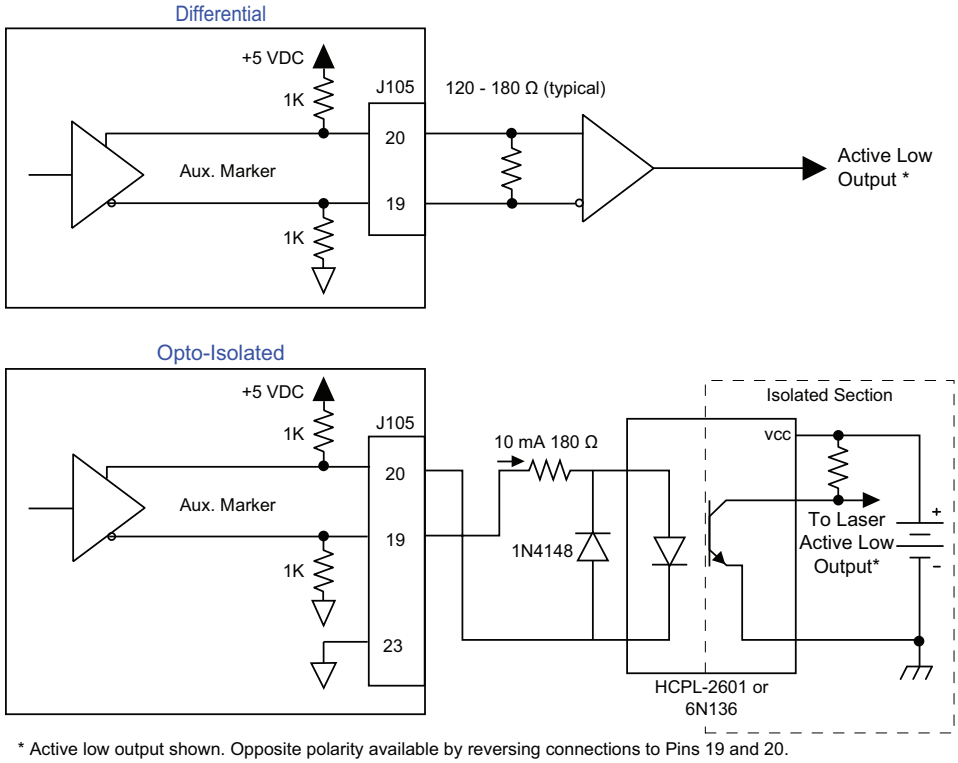
Multi-axis PSO can track encoder signals with a maximum data rate of 8.33 MHz. Signals in excess of this rate will cause a loss of PSO accuracy. Software controlled PSO pre-scalars may be used to limit the data rate of each encoder being tracked without affecting the servo loop data rate.

Table 2-24: PSO Output Pin Assignment (J105)

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

Table 2-25: PSO Output Sources

PSO Output Type	Max Frequency	See Also
RS-422 Marker (1)	12.5 MHz	Section 2.5.1.
(1) software configurable as the PSO output or Marker input Refer to the Soloist Help File for programming information.		



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

Figure 2-31: PSO Interface

2.5.3. Opto-Isolated Outputs (J105)

All outputs are rated for 24 VDC and 80 mA per output. The outputs are software configurable as current sinking (see Figure 2-32) or current sourcing (see Figure 2-33) .

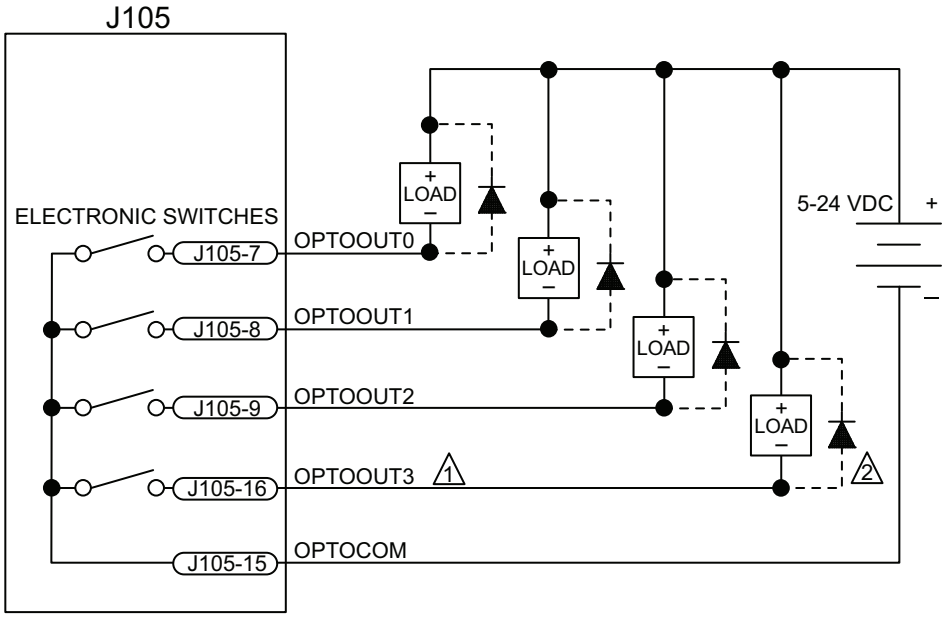
Table 2-26: Port 0 Digital Output Connector Pin Assignment (J105)

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

Table 2-27: Digital Output Specifications

PS2802-4 Opto Device Specifications	Value
Maximum Voltage	24 V maximum
Maximum Sink/Source Current	80 mA/channel @ 20°C; 60 mA/channel @ 50°C
Output Saturation Voltage	2.75 V at maximum current
Output Resistance	33 Ω
Rise / Fall Time	250 usec (typical)
Maximum Output Frequency	1 kHz

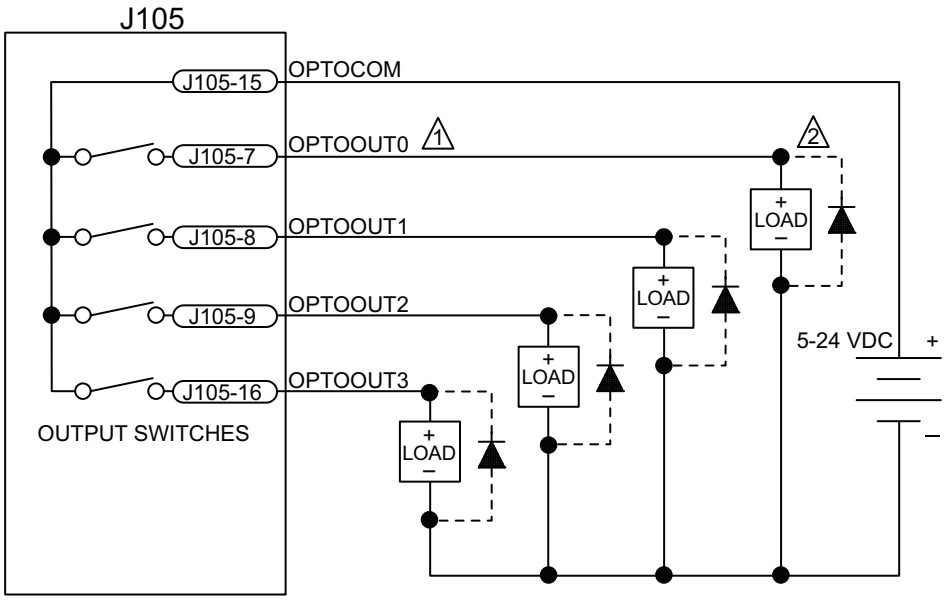
NOTE: Outputs must be connected as all sourcing or all sinking.



1 EACH OUTPUT 80 mA MAXIMUM

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

Figure 2-32: Outputs Connected in Current Sinking Mode (J105)



1 EACH OUTPUT 80 mA MAXIMUM

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

Figure 2-33: Outputs Connected in Current Sourcing Mode (J105)

2.5.4. Opto-Isolated Inputs (J105)

User inputs are scaled for an input voltage of 5-24 VDC. Figure 2-34 and Figure 2-35, respectively, illustrate how to connect a device in current sinking and sourcing current modes.

Table 2-28: Port 0 Digital Input Connector Pin Assignment (J105)

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

Table 2-29: PS2806-4 Opto-Device Specifications

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

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

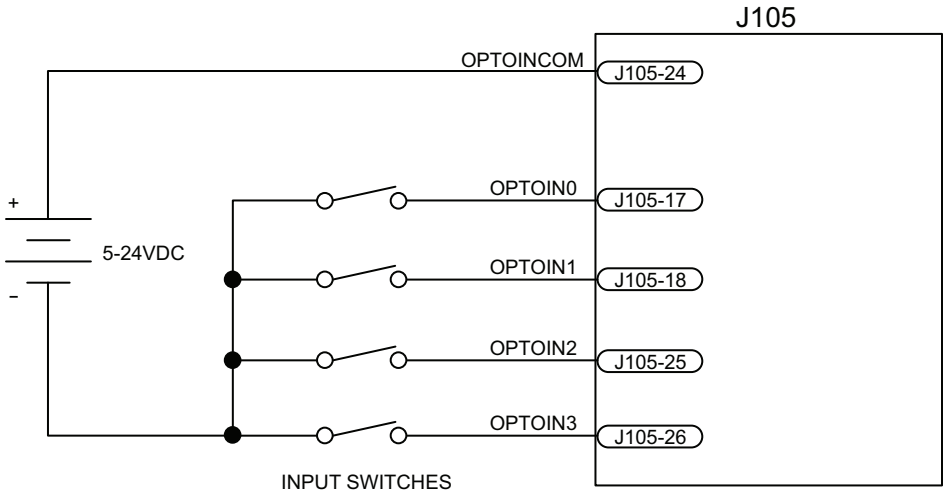


Figure 2-34: Inputs Connected in Current Sinking Mode (J105)

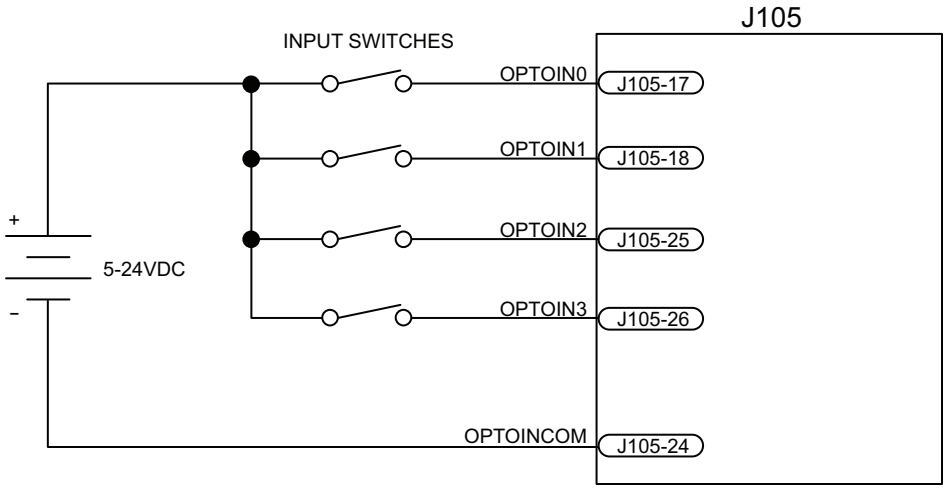


Figure 2-35: Inputs Connected in Current Sourcing Mode (J105)

2.5.5. High Speed User Inputs 4-5 (J105)

The high-speed inputs are scaled for 5 V or 24 V input voltages based on a jumper setting (Table 2-31). A higher input voltage requires adding external series resistors to limit the current to 10 mA. The high-speed inputs are isolated by an HCPL-0630 and have a typical delay of 50 nanoseconds.

Table 2-30: Port 0 High Speed Digital Input Connector Pin Assignment (J105)

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 2-31: 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		

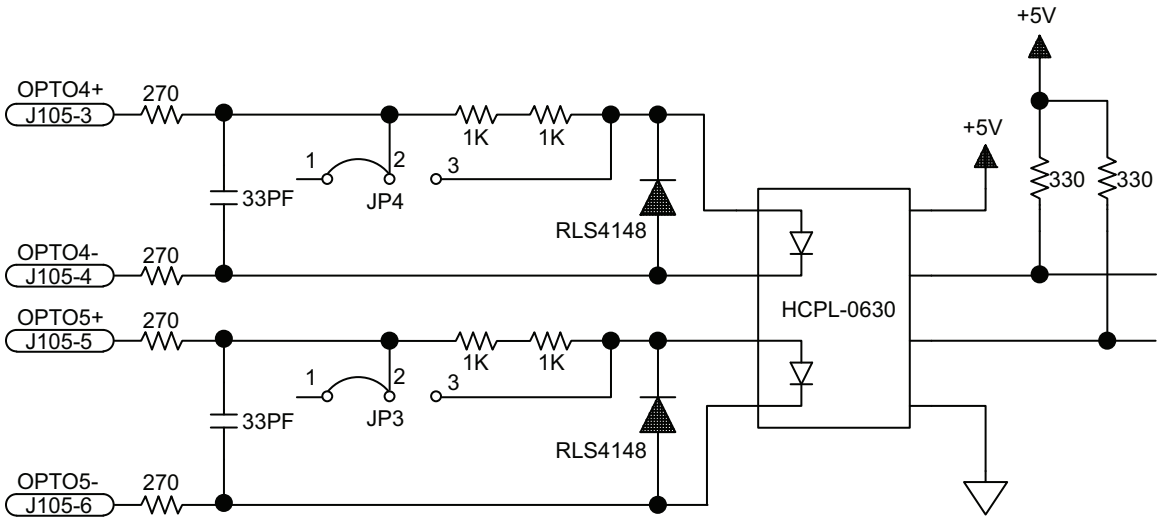


Figure 2-36: High Speed User Inputs (J105)

2.5.6. Analog Output 0 (J105)

Analog Output 0 produces a single ended output in the range of ±10 volts with a resolution of 305 µV (16-bit). The maximum recommended output current is 5 mA (2 k Ohm load). The analog output voltage is referenced to J105-23.

Table 2-32: Analog Output Connector Pin Assignment (J105)

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

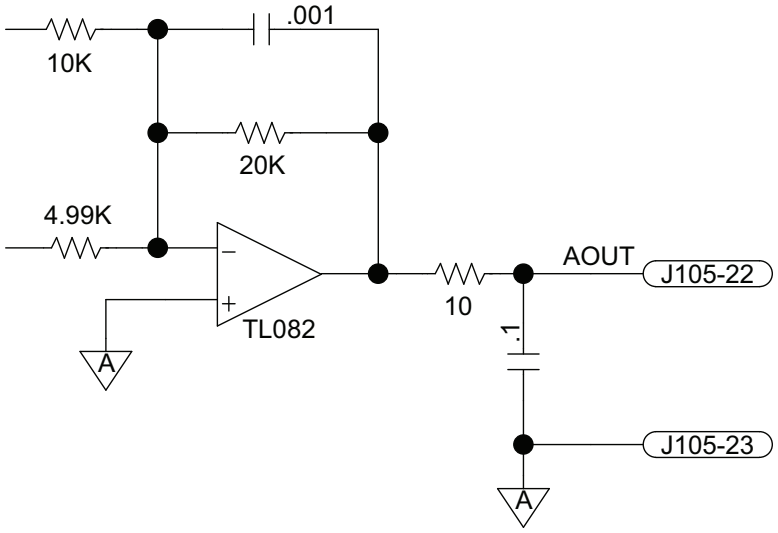


Figure 2-37: Analog Output 0 (J105)

2.5.7. Analog Input 0 (J105)

Analog Input 0 is a 16-bit differential input that accepts a voltage in the range of ±10 V with a resolution of 305 µV. Signals outside of this range may damage the input. To interface to a single-ended (non-differential) voltage source, connect the signal common of the source to the negative input (pin 14, ANALOG_IN-) and the analog source signal to the positive input (pin 13, ANALOG_IN+). A floating signal source should be referenced to the signal common (pin 23, AGND) as shown in Figure 2-38.

Table 2-33: Analog Input Connector Pin Assignment (J105)

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

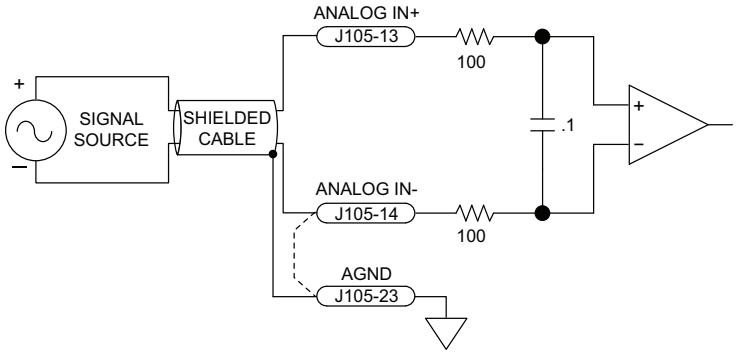


Figure 2-38: Analog Input 0 (J105)

2.6. RS-232 Interface (TB104)

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

Table 2-34: RS-232 Connector Pin Assignment (TB104)

Pin#	Description	In/Out/Bi
1	+5 Volt Power Output (1)	Output
2	RS-232 Transmit / RS-422 Transmit +	Output
3	RS-232 Receive / RS-422 Receive -	Bidirectional
4	RS-422 Receive -	Input
5	RS-422 Receive +	Input
6	Signal Common	N/A
(1) Total user +5 V power is limited to 500 mA.		

Table 2-35: RS-232 Port Connector Mating Connector (TB104)

Type	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
6-Pin Terminal Block	ECK01364	1881367	N/A	0.5 - 0.080 [20-28]

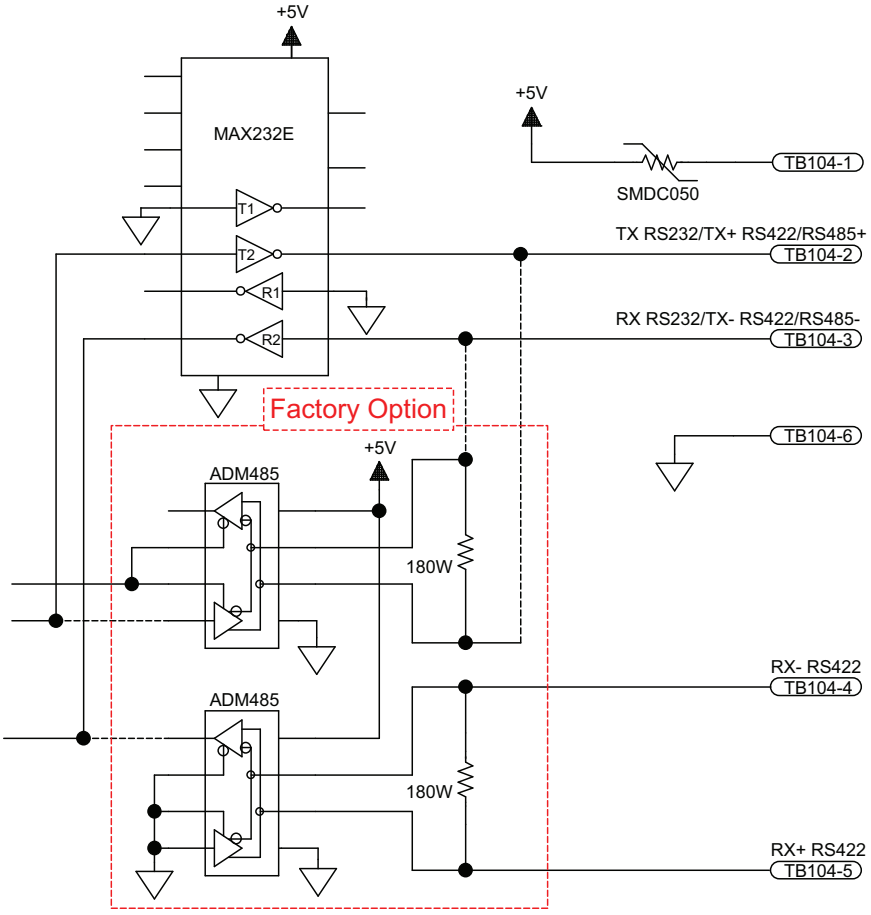


Figure 2-39: RS-232 Interface (TB104)

2.7. PC Configuration and Operation Information

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

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Chapter 3: -I/O Expansion Board

The -IO option board is 16 digital opto-inputs, 16 digital opto-outputs, 1 analog input, 1 analog output, and a brake/relay output.

DANGER: Always disconnect the Mains power connection before opening the Soloist CL chassis.

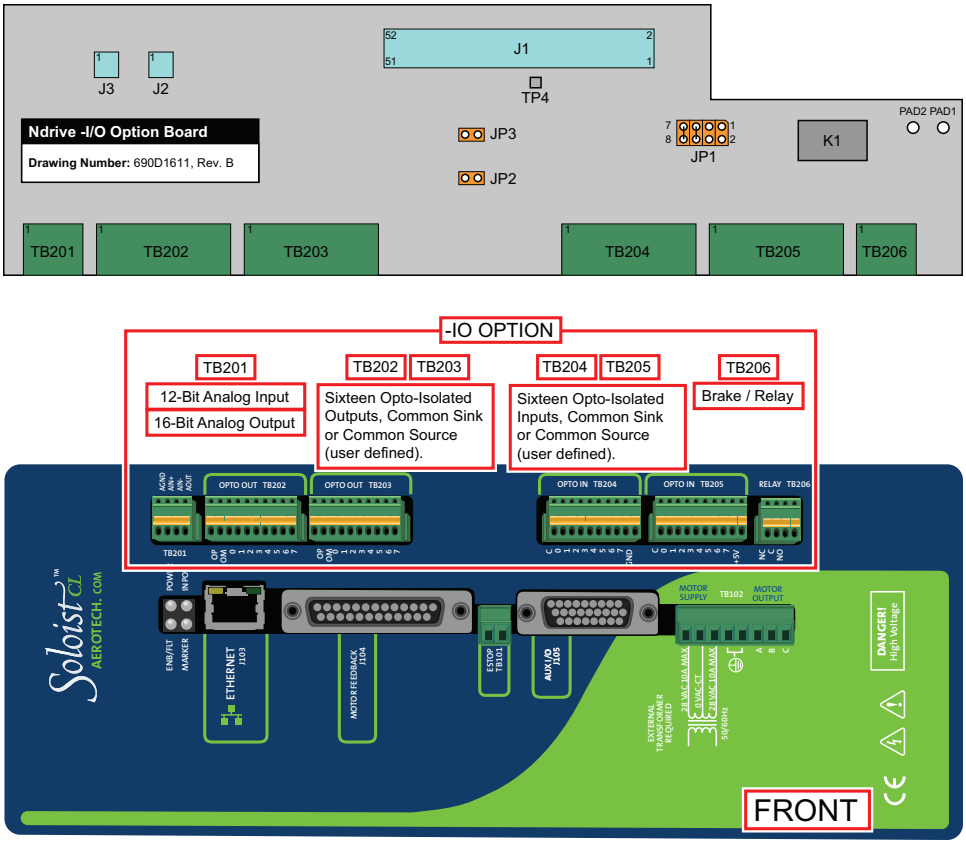

Figure 3-1: Soloist CL with -IO Option Board

Table 3-1: -IO Expansion Board Jumper Configuration

Jumper	Setting	Description
JP1	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. Analog Output (TB201)

The 16-bit analog output produces a single-ended output voltage in the range of ±10 V with a resolution of 305 µV. The maximum recommended output current is 5 mA. Analog outputs are referenced to TB201-1. The analog output is set to zero when the system is powered-up or during a system reset.

NOTE: Analog Output 0 is available on J105 (see Section 2.5.7.).

Table 3-3: Analog Output Connector Pin Assignment (TB201)

Pin#	Description	In/Out/Bi
1	Analog Common	N/A
4	Analog Output 1	Output

Table 3-4: Analog Output Mating Connector

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

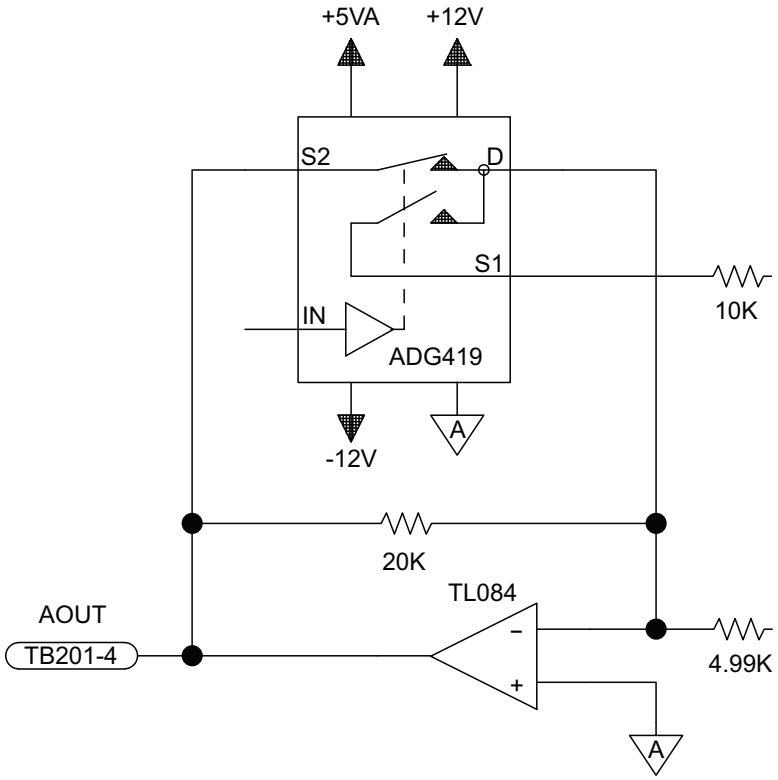

Figure 3-2: Analog Output 1 Connector (TB201)

3.2. Analog Input (TB201)

The I/O board analog input is a 12-bit differential input that accepts a voltage in the range of ±10 volts with a resolution of 4.88 millivolts. Signals outside of this range may damage the input. To interface to a single-ended (non-differential) voltage source, connect the signal common of the source to the negative input, and the analog source signal to the positive input. A floating signal source should be referenced to the signal common (pin 1, AGND) as shown in Figure 3-3.

NOTE: Analog Input 0 is available on J105 (see Section 2.5.7.).

Table 3-5: Analog Inputs Connector Pin Assignment (TB201)

Pin#	Description	In/Out/Bi
1	Analog Common	N/A
2	Non-inverting Analog Input 1	Input
3	Inverting Analog Input 1	Input

Table 3-6: Analog Input Mating Connector

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

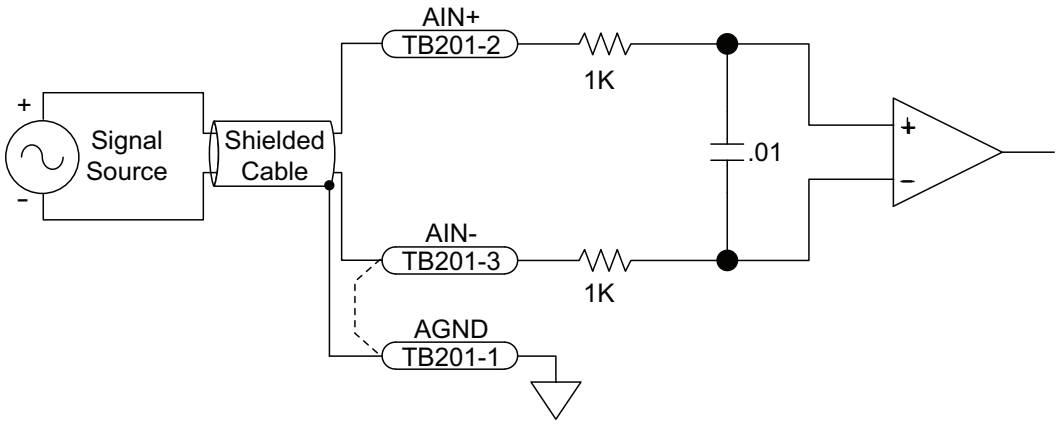

Figure 3-3: Analog Input Typical Connection (TB201)

3.3. Opto-Isolated Inputs (TB204, TB205)

These opto-isolated inputs use a PS2806-4 device and are configured for 5-24 volt input levels. The inputs may be connected to current sourcing or current sinking devices, as shown in Figure 3-5 and Figure 3-6. See Section 2.3.5. for opto-isolated EOT limits.

Port 1 and Port 2 inputs have separate common inputs, pin 1 on TB204 and TB205, respectively. Each port can be referenced independently.

Table 3-7: PS2806-4 Opto-Device Specifications

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

Table 3-8: Port 1 Opto-Isolated Input Connector Pin Assignment (TB204)

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

Table 3-9: Port 2 Opto-Isolated Input Connector Pin Assignment (TB205)

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

Table 3-10: Opto-Isolated Input Mating Connector

Type	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
10-Pin Terminal Block	ECK01294	1881406	N/A	0.5 - 0.080 [20-28]

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.

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

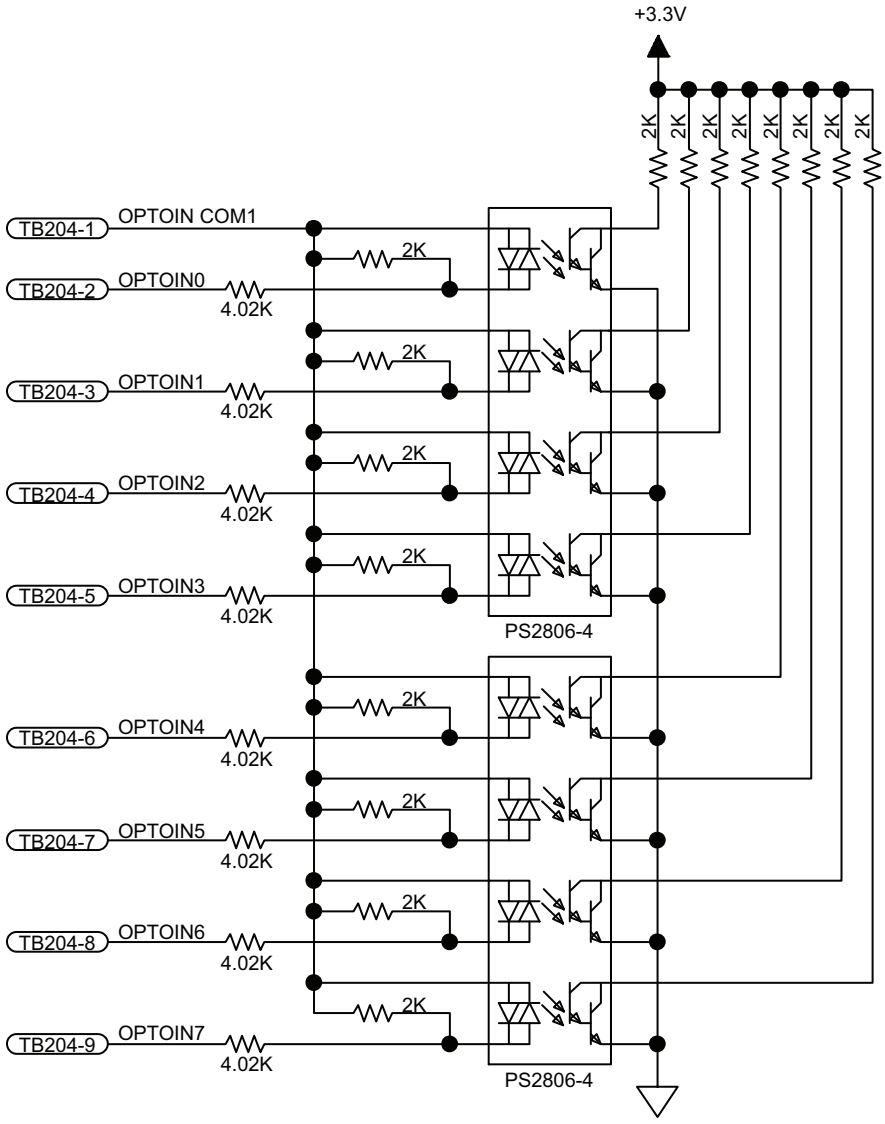

Figure 3-4: Opto-Isolated Inputs

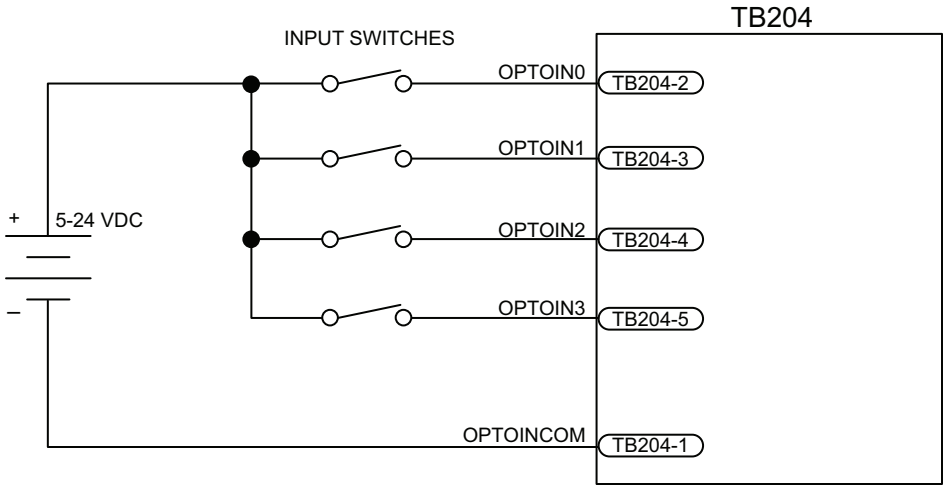

Figure 3-5: Inputs Connected to a Current Sourcing Device

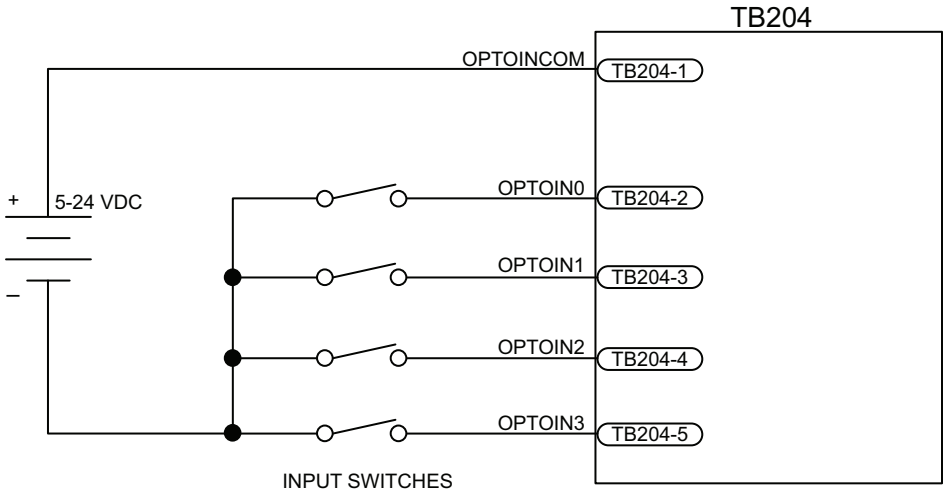

Figure 3-6: Inputs Connected to a Current Sinking Device

3.4. Opto-Isolated Outputs (TB202, TB203)

The outputs are software configurable as sourcing or sinking. The outputs are driven by PS2802-4 opto-isolators rated for 24 volts maximum and up to 80 mA/output @ 20°C.

Outputs must be connected in either all sinking or all sourcing mode. Figure 3-8 and Figure 3-9 illustrate how to connect to an output in current sourcing and current sinking modes, respectively.

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 3-8 and Figure 3-9.

Table 3-11: Port 1 Opto-Isolated Output Connector Pin Assignment (TB202)

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

Table 3-12: Port 2 Opto-Isolated Output Connector Pin Assignment (TB203)

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

Table 3-13: Opto-Isolated Output Mating Connector

Type	Aerotech P/N	Phoenix P/N	Tightening Torque (Nm)	Wire Size: mm^2 [AWG]
10-Pin Terminal Block	ECK01294	1881406	N/A	0.5 - 0.080 [20-28]

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.

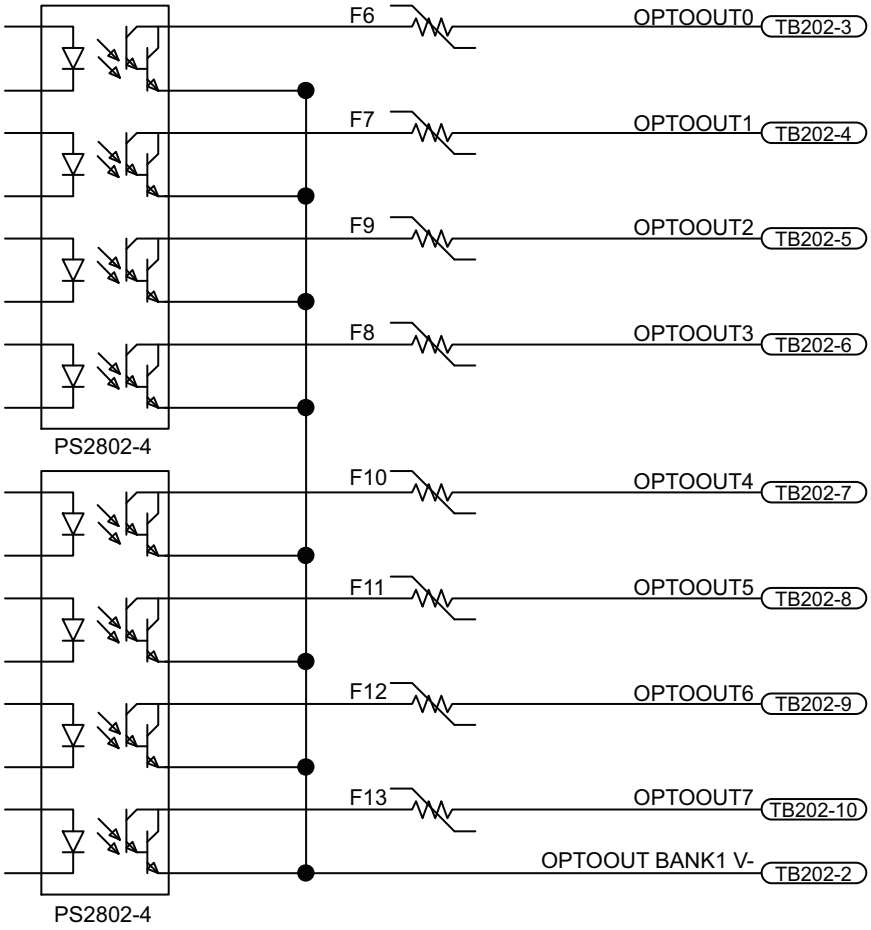

Figure 3-7: Opto-Isolated Outputs (-IO Board)

Table 3-14: Output Specifications (TB202, TB203)

PS2802-4 Opto Device Specifications	Value
Maximum Voltage	24 V maximum
Maximum Sink/Source Current	80 mA/channel @ 20°C; 60 mA/channel @ 50°C
Output Saturation Voltage	2.75 V at maximum current
Output Resistance	33 Ω
Rise / Fall Time	250 usec (typical)
Maximum Output Frequency	1 kHz

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

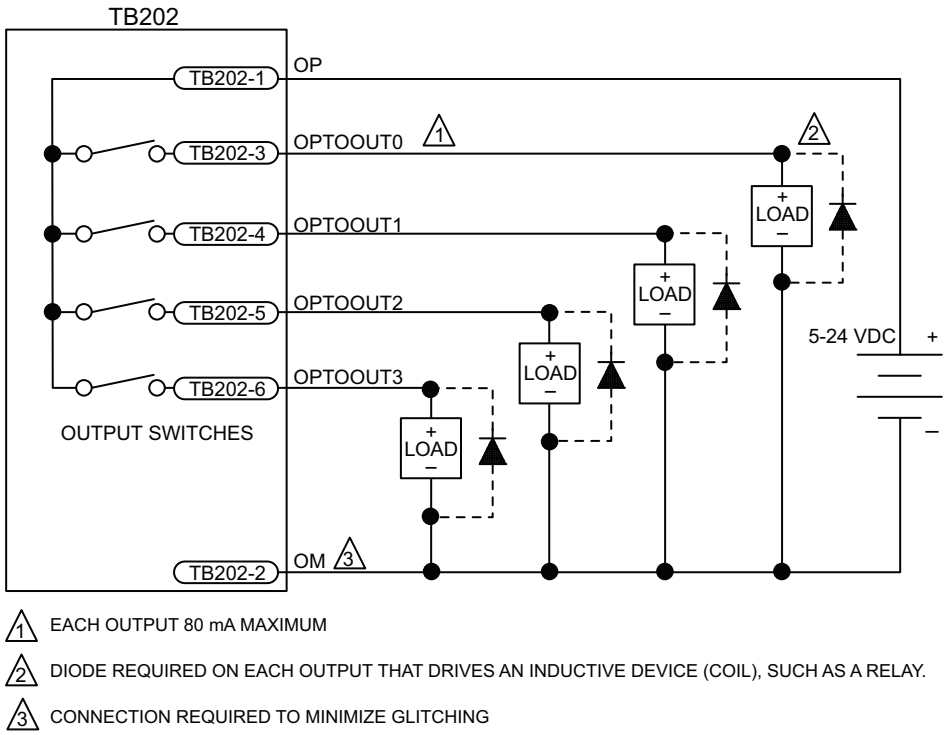

Figure 3-8: Outputs Connected in Current Sourcing Mode

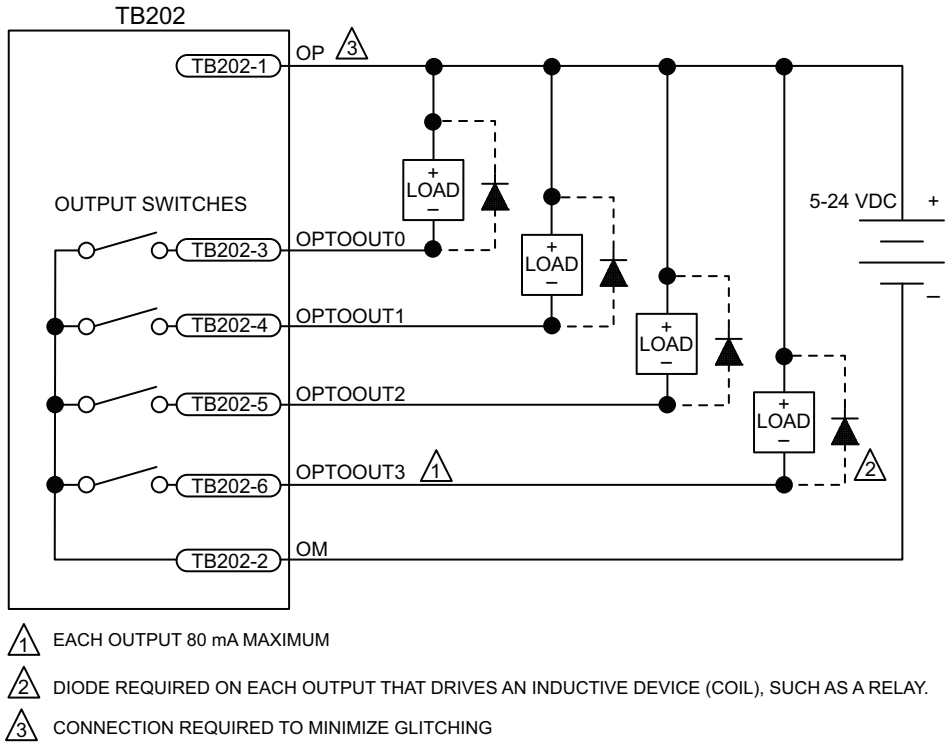

Figure 3-9: Outputs Connected in Current Sinking Mode

Suppression diodes must be installed on outputs driving relays or other inductive devices. This protects the outputs from damage caused by inductive spikes. Suppressor diodes, such as the 1N914, can be installed on all outputs to provide protection. It is important that the diode be installed correctly (normally reversed biased). See Figure 3-9 for an example of a current sinking output with diode suppression and Figure 3-8 for an example of a current sourcing output with diode suppression.

3.5. User Power (TB204, TB205)

A user accessible power supply (+5V at 0.5 A) is available between the TB205 +5V terminal and TB204 GND terminal.

Table 3-15: User Common Connector Pin Assignment (TB204)

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

Table 3-16: +5 Volt Power Connector Pin Assignment (TB205)

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

3.6. Brake / Mechanical Relay (TB206)

The relay output is typically used for automatic control of a fail-safe brake on a vertical axis. It can also be used as a general purpose relay.

The brake output can be software configured; refer to the Soloist Help file for more information (see topics for the EnableBrakeControl[1] parameter and the BRAKE command).

3.6.1. Brake Configuration Jumpers

The configuration of JP1 (Table 3-17) allows either the Brake + or the Brake - output to be switched by the relay and connected at the Motor Feedback connector (J104), or for the brake to be connected at TB206. Refer to Section 3.6.3. for more information.

JP1 is located on the -IO board (refer to Chapter 3).

Table 3-17: -IO Expansion Board Brake Jumper Configuration

Jumper	Setting	Description
JP1	1-2, 3-4	Switch Brake +
	5-6, 7-8 (1)	Switch Brake -
	1-3	Relay Only
(1) default		

3.6.2. Mechanical Relay Specifications

The user must verify that the application will be within the specifications of the Brake/Relay contacts. These specifications are provided below in Table 3-18.

Table 3-18: Voltage and Current Specifications (TB206)

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: The maximum power that may be switched is voltage dependent.	
Initial Contact Resistance	50 milliohms max @ 10 mA, 6 VDC

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

[1] EnableBrakeControl has replaced BrakeOnDriveDisable in software version 3.00.000.

3.6.3. Brake / Mechanical Relay Interface Connector

The normally-open relay contacts are accessible through TB206 and the Motor Feedback connector (J104). The normally-closed relay contact is only accessible through TB206 (see Figure 3-11). 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.

Table 3-19: Brake / Mechanical Relay Connector Pin Assignment (TB206)

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 JP1 jumper configuration, refer to Table 3-17		

Table 3-20: Mating Connector

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

Table 3-21: Brake / Mechanical Relay Connector Pin Assignment (J104)

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

Figure 3-10 is an example of a +24 VDC Brake connected to J104, the Motor Feedback connector. In this example the external +24 power source is connected to TB206. Note that JP1 is set 1-2 and 3-4 with all others removed.

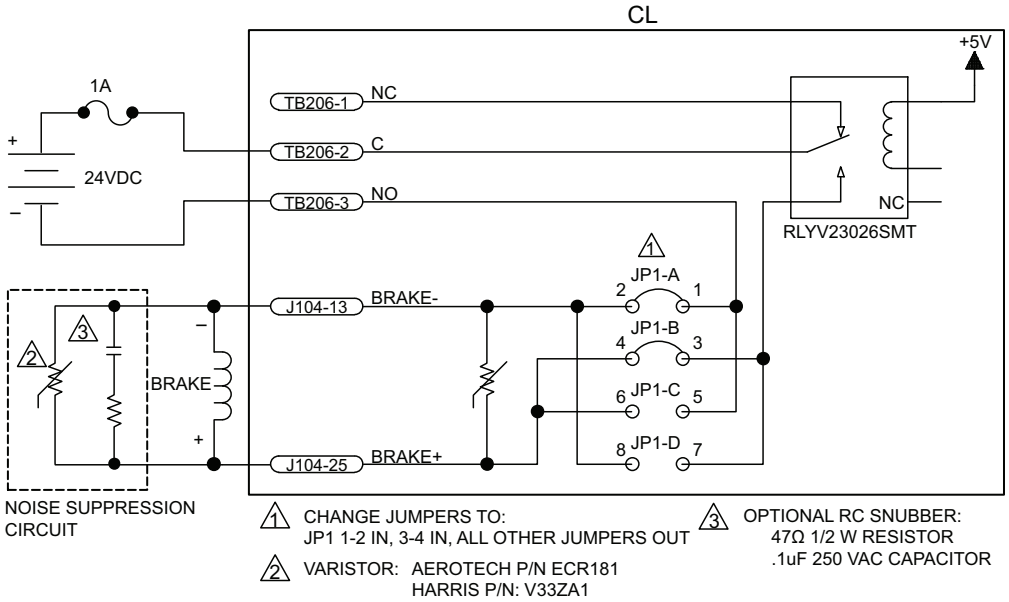

Figure 3-10: Brake Connected to J104

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

Figure 3-11 is an example of a +24 VDC Brake connected to TB206. In this example, JP1 must be set 1-3 and all other jumpers removed. Otherwise, the user must connect J104 pin 13 to J104 pin 25. In this case, J104 would function as an interlock to prevent the Brake from releasing if the Motor Feedback connector is not connected.

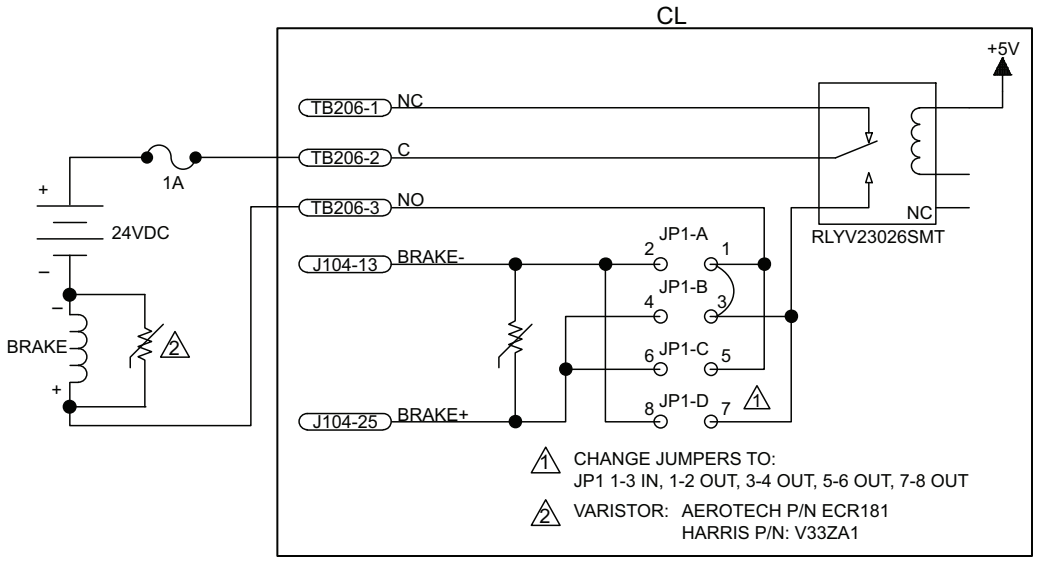

Figure 3-11: Brake Connected to TB206

Chapter 4: 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 4-1: Standard Interconnection Cables

Cable Part #	Description
Joystick	See Section 4.1.
ECZ01231	BBA32 Interconnect Cable
(1) The “-xx” indicates length in decimeters. “-yy” would indicate length in feet.	

4.1. Joystick Interface

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

Refer to the Soloist Help file for programming information about how to change joystick parameters (see the Joystick.ab example). The following drawings illustrate how to connect a single- or two-axis joystick (a two-axis joystick requires two Soloist CLs). For cable details refer to Table 4-2.

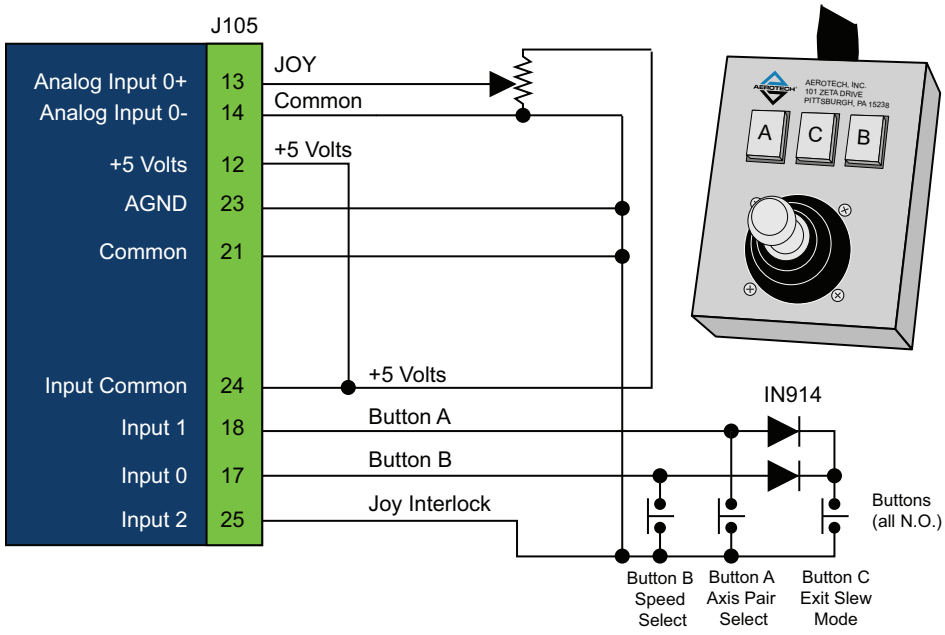

Figure 4-1: Single Axis Joystick Interface (to Aux I/O)

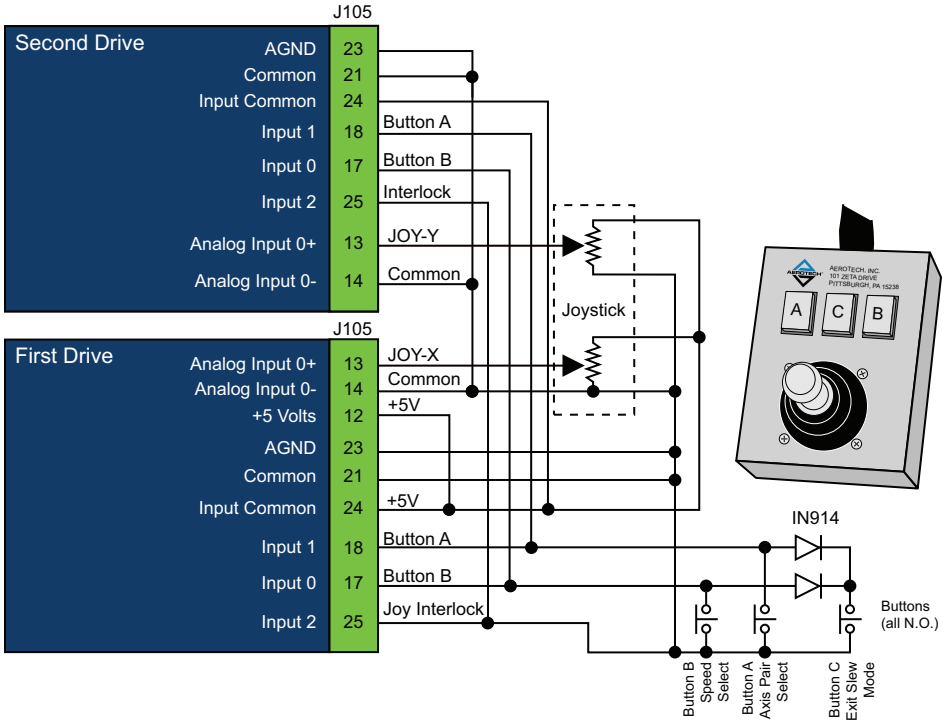

Figure 4-2: Two Axis Joystick Interface (to the Aux I/O of two drives)

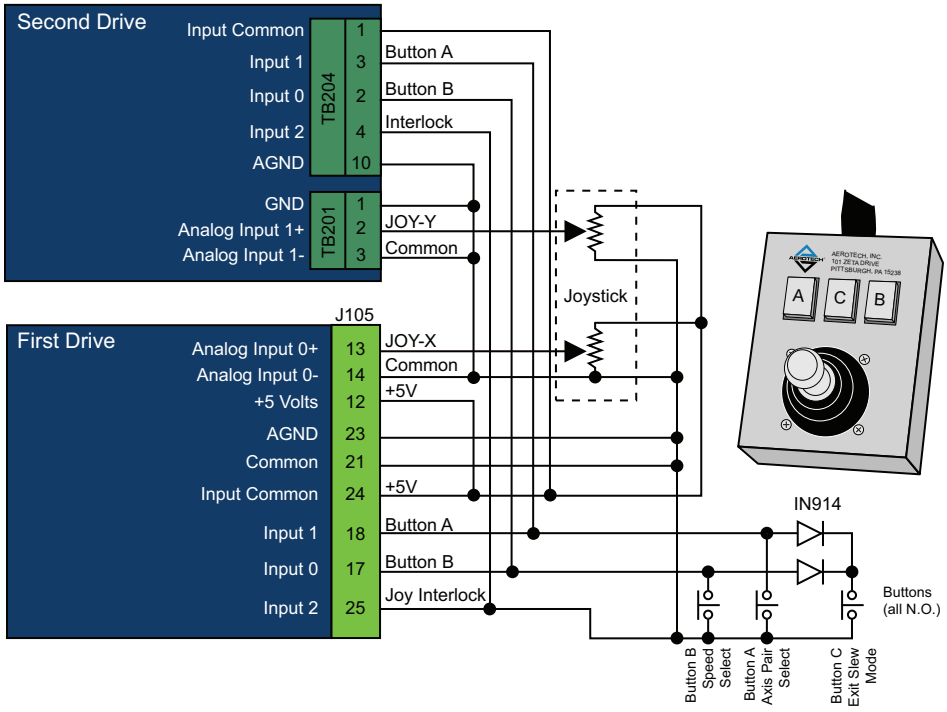

Figure 4-3: Two Axis Joystick Interface (to the Aux I/O and I/O Board)

Table 4-2: Cable Part Numbers

Part #	Cable Description	UPC #
C22766-XX	JSXT-FLY 26HD-15DU-MAX300DM SOLOISTCL DUAL AXIS	630B2276-6
C22767-XX	JSXT-26HD-15DU-MAX300DM SOLOISTCL SINGLE AXIS	630B2276-7
C22768-XX	JSXT-26HD 26HD-15DU-MAX300DM SOLOISTCL DUAL AXIS	630B2276-8

4.2. Handwheel Interface

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

A handwheel can be connected to the Aux I/O as shown in Figure 4-4 or Figure 4-5.

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

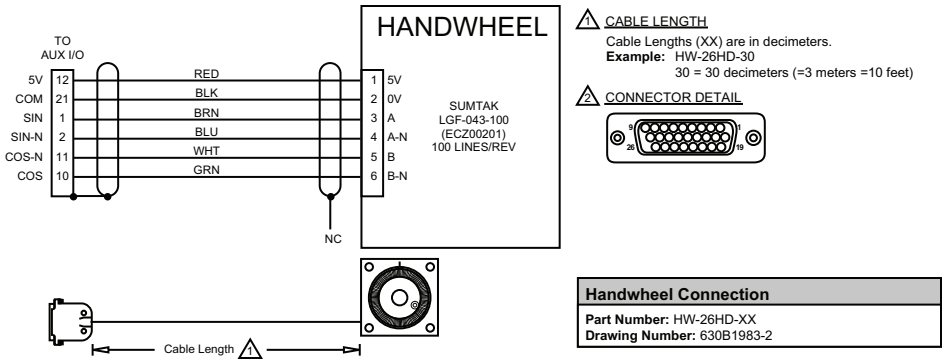

Figure 4-4: Handwheel Interconnection (to Aux I/O)

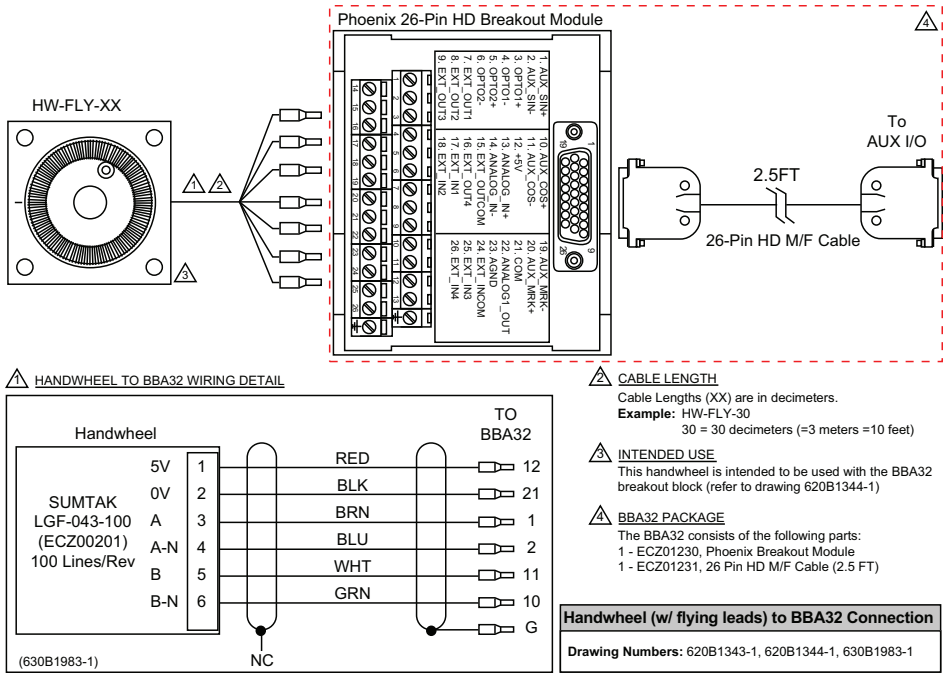

Figure 4-5: Handwheel Interconnection (to Aux I/O via a BBA32 Module)

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Chapter 5: Maintenance

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

DANGER: Always disconnect the Mains power connection before opening the Soloist CL 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 5-1: 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.	

5.1. Control Board

The figure below highlights the important components located on the control board.

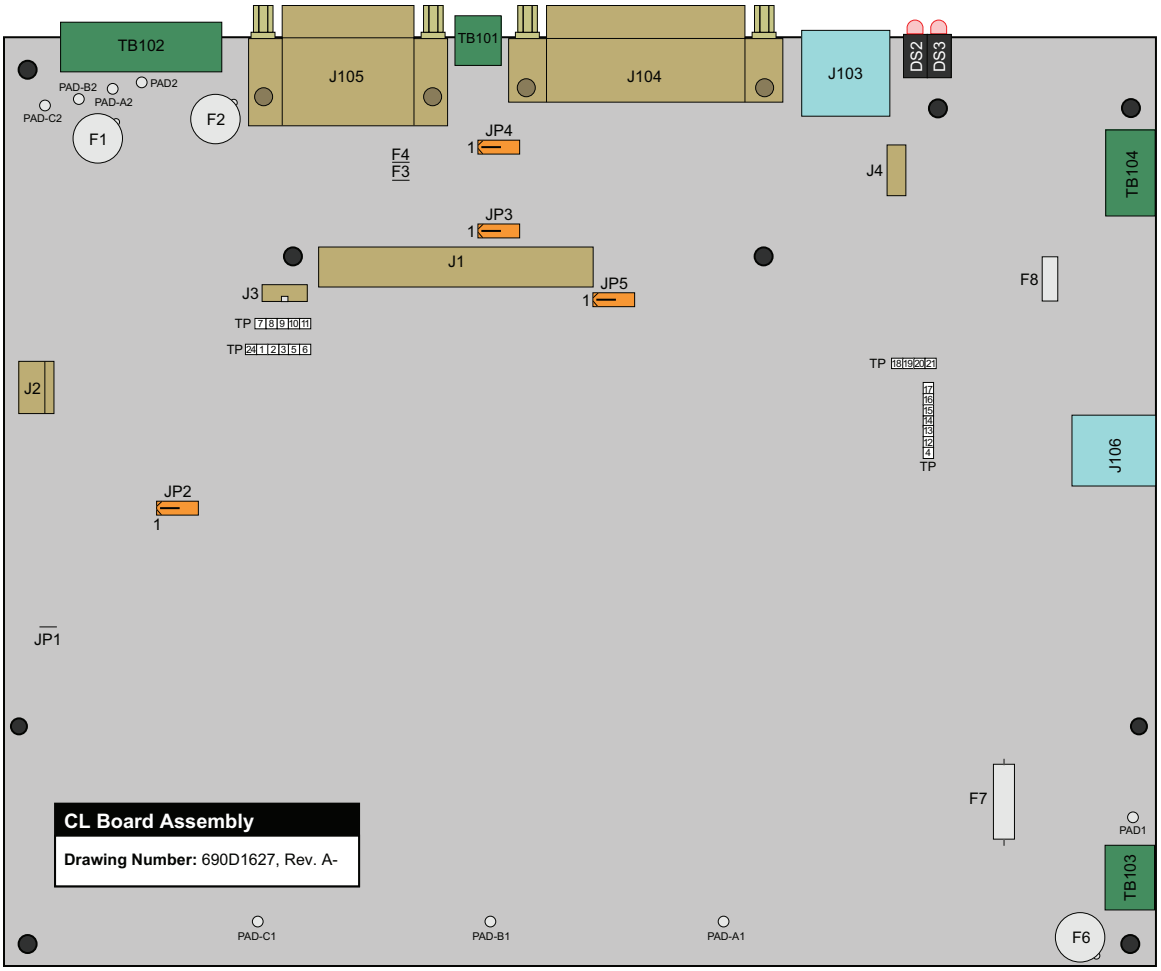

Figure 5-1: Control Board Assembly

DANGER: Always disconnect the Mains power connection before opening the Soloist CL chassis.

Table 5-2: 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 5-3: Control Board Fuse Information

Fuse	Description	Size	Aerotech P/N	Manufacturer's P/N
F1	TB102; AC Input Motor Power Fuse	5 A S.B.	EIF1026	LittelFuse 3721500041
F2	TB102; AC Input Motor Power Fuse	5 A S.B.	EIF1026	LittelFuse 3721500041
F6	TB103-1; AC Input Control Power Fuse	2 A S.B.	EIF1029	LittelFuse 3721200041

Table 5-4: 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.	

5.2. Preventative Maintenance

The Soloist CL 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 5-5: 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 Soloist CL.
Visually inspect all cables and connections.	Tighten or re-secure any loose connections. Replace worn or frayed cables. Replace broken connectors.

Cleaning

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

Appendix A: Warranty and Field Service

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

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

Return Products Procedure

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

Visit http://www.aerotech.com/service-and-support.aspx for the location of your nearest Aerotech Service center.

Returned Product Warranty Determination

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

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

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

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

Rush Service

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

On-site Warranty Repair

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

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

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

On-site Non-Warranty Repair

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

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

Service Locations

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

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 3319 7715	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720

JAPAN	TAIWAN	UNITED KINGDOM
Aerotech Japan Full-Service Subsidiary Phone: +81 (0)50 5830 6814 Fax: +81 (0)43 306 3773	Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649

Have your customer order number ready before calling.

Appendix B: Revision History

Revision	Date	Description
4.09.00	July 9, 2015	• Updated the Electrical Specifications (Input Power and related equation): Section 1.2. • Updated PSO maximum frequency specification: Table 2-25
4.08.00	March 31, 2015	Added RoHS statement to Declaration of Conformity
4.07.00	April 22, 2014	Updated Wire Color table: Table 2-9
4.06.00	September 7, 2012	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
4.05.00	May 09, 2011	
4.04.00	December 30, 2010	
4.03.00	July 01, 2010	
4.02.00	April 23, 2010	
4.00.00	February 12, 2009	
2.04.00	November 05, 2008	
2.03.00	September 10, 2008	
2.02.00	August 19, 2008	
2.01.00	September 04, 2007	
2.00.00	August 24, 2007	
1.00	May 24, 2007	

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