PRO165SL/SLE Hardware Manual

Revision: 1.09.00

Global Technical Support

Go to www.aerotech.com/global-technical-support for information and support about your Aerotech, Inc. products. The website supplies software, product manuals, Help files, training schedules, and PC-to-PC remote technical support. If necessary, you can complete Product Return (RMA) forms and get information about repairs and spare or replacement parts. To get help immediately, contact a service office or your sales representative. Include your customer order number in your email or have it available before you call.

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

Table of Contents

PRO165SL/SLE Hardware Manual **1**
Table of Contents 3
List of Figures 4
List of Tables 5
Safety Procedures and Warnings 6
EU Declaration of Incorporation 7

Chapter 1: Overview **9**
1.1. Environmental Specifications 11
1.2. Accuracy and Temperature Effects 11
1.3. Basic Specifications 12
1.4. Vacuum Operation 14

Chapter 2: Installation **15**
2.1. Unpacking and Handling the Stage 15
2.2. Dimensions 17
2.3. Securing the Stage to the Mounting Surface 21
2.4. Attaching the Payload to the Stage 23

Chapter 3: Electrical Installation **27**
3.1. Motor and Feedback Connectors 28
3.2. Motor and Feedback Wiring 33
3.3. Motor and Feedback Specifications 35
3.4. Limits, Marker, and Machine Direction 39
3.5. Motor and Feedback Phasing 40

Chapter 4: Maintenance **43**
4.1. Service and Inspection Schedule 43
4.2. Cleaning and Lubrication 44
4.3. Belt Adjustment 48
4.4. Troubleshooting 51

Appendix A: Warranty and Field Service **53**

Appendix B: Revision History **55**

Index **57**

List of Figures

Figure 2-1: Lifting Features 16
Figure 2-2: PRO165SL Dimensions 17
Figure 2-3: PRO165SLE Dimensions 18
Figure 2-4: PRO165SL/SLE Accessory Tabletop Dimensions (-TT3/-TT6 Option) 19
Figure 2-5: PRO165SL/SLE Z-Axis Bracket Dimensions 20
Figure 2-6: Mounting Hole Locations 22
Figure 2-7: Cantilevered Load Capability 24
Figure 2-8: Stage Orientations 24
Figure 2-9: Load Torque Equation 25
Figure 2-10: Torque Required to Turn Ball Screw in Vertical Orientation 25
Figure 3-1: Motor and Feedback Wiring (-SL Option) 33
Figure 3-2: Motor and Feedback Wiring (-SLE Option) 34
Figure 3-3: Machine Direction 39
Figure 3-4: Hall Phasing 40
Figure 3-5: Analog Encoder Phasing Reference Diagram 41
Figure 3-6: Encoder Phasing Reference Diagram (Standard) 41
Figure 4-1: Hardcover Removal Procedure (Step 2) 46
Figure 4-2: Hardcover Removal Procedure (Step 3) 46
Figure 4-3: Hardcover Removal Procedure (Step 4) 47
Figure 4-4: Foldback Motor Cover Removal 49
Figure 4-5: Foldback Motor Part Callouts 50
Figure 4-6: Lubricate the Pulley Flanges 50

List of Tables

Table 1-1: Model Numbers and Ordering Options 9
Table 1-2: Environmental Specifications 11
Table 1-3: PRO165SL/SLE Series Specifications (-050 to -250) 12
Table 1-4: PRO165SL/SLE Series Specifications (-300 to -600) 13
Table 2-1: Stage Mounting Surface Flatness Requirement 21
Table 2-2: Stage to Mounting Surface Hardware 22
Table 3-1: Motor Connector Pinout 29
Table 3-2: Part Numbers for the Motor Connector 29
Table 3-3: Feedback Connector Pinout 30
Table 3-4: Part Numbers for the Feedback Connector 30
Table 3-5: Linear Encoder Connector Pinout (-SLE only) 31
Table 3-6: Part Numbers for the Encoder Connector 31
Table 3-7: Limit Connector Pinout 32
Table 3-8: Part Numbers for the Limit Connector 32
Table 3-9: Feedback Specifications 35
Table 3-10: PRO165SL/SLE Motor Specifications (BMS100) 36
Table 3-11: PRO165SL/SLEMotor Specifications (BM130) 37
Table 3-12: Rotary Encoder Specifications for PRO165SL Stages 38
Table 3-13: Linear Encoder Specifications for PRO165SLE Stages 38

Safety Procedures and Warnings

This manual tells you how to carefully and correctly use and operate the PRO165SL/SLE. Read all parts of this manual before you install or operate the PRO165SL/SLE or before you do maintenance to your system. To prevent injury to you and damage to the equipment, obey the precautions in this manual. The precautions that follow apply when you see a Danger or Warning symbol in this manual. If you do not obey these precautions, injury to you or damage to the equipment can occur. If you do not understand the information in this manual, contact Aerotech Global Technical Support.

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

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

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

1. Access to the PRO165SL/SLE and component parts must be restricted while connected to a power source.
2. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
3. Disconnect electrical power before servicing equipment.
4. All components must be properly grounded in accordance with local electrical safety requirements.
5. Operator safeguarding requirements must be addressed during final integration of the product.

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

1. Moving parts can cause crushing or shearing injuries. Access to all stage and motor parts must be restricted while connected to a power source.
2. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
3. Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
4. The PRO165SL/SLE stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.
5. Use care when moving the PRO165SL/SLE stage. Lifting or transporting the PRO165SL/SLE stage improperly can result in injury or damage to the PRO165SL/SLE.
6. The motor case temperature may exceed 75°C.
7. Operators must be trained before operating this equipment.
8. All service and maintenance must be performed by qualified personnel.

EU Declaration of Incorporation

Manufacturer: Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2811
USA

herewith declares that the product:

PRO165SL/SLE Stage

is intended to be incorporated into machinery to constitute machinery covered by the Directive 2006/42/EC as amended;
and that the following harmonized European standards have been applied:

EN ISO 12100:2010
Safety of machinery - Basic concepts, general principles for design

EN 60204-1:2010
Safety of machinery - Electrical equipment of machines - Part 1: General requirements

and further more declares that

it is not allowed to put the equipment into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of the Directive 2006/42/EC and with national implementing legislation, i.e., as a whole, including the equipment referred to in this Declaration.

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

2011/65/EU RoHS 2 Directive

Authorized Representative: Simon Smith, European Director
Address: Aerotech Ltd
The Old Brick Kiln, Ramsdell, Tadley
Hampshire RG26 5PR
UK

Name / Alex Weibel
Position Engineer Verifying Compliance
Location Pittsburgh, PA
Date 7/31/2019

CE

This page intentionally left blank.

Chapter 1: Overview

The specifications in this manual pertain to the second generation of PRO SL/SLE stages. Second generation stages can be distinguished from their first generation counterparts by the second generation's curved hardcover. Contact Aerotech if you need a first generation manual.

Table 1-1: Model Numbers and Ordering Options

PRO165SL and PRO165SLE Series Linear Ball-Screw Stage	
Direct Linear Feedback (-SLE only)	
-E1	Incremental linear encoder; 1 Vpp
-E2	Incremental linear encoder; 0.1 µm digital TTL output
-E3	Absolute linear encoder; EnDat 2.2
-E4	Incremental linear encoder; 0.5 µm digital TTL output
Travel (Required)	
-050	50 mm travel stage
-100	100 mm travel stage
-150	150 mm travel stage
-200	200 mm travel stage
-250	250 mm travel stage
-300	300 mm travel stage
-400	400 mm travel stage
-500	500 mm travel stage
-600	600 mm travel stage
Tabletop (Optional for SL Stages; Required for SLE Stages)	
-TT1	Tabletop with metric dimension mounting
-TT2	Tabletop with English dimension mounting
-TT3	Accessory tabletop with mounting for select rotary stages
-TT4	Tabletop with metric dimension mounting and wiper brushes
-TT5	Tabletop with English dimension mounting and wiper brushes
-TT6	Accessory tabletop with mounting pattern for select rotary stages and wipers
Motor (Optional)	
-M1	BMS100 brushless servomotor and 2500-Line TTL encoder
-M2	BMS100 brushless servomotor, 2500-Line TTL encoder, and brake
-M3	BMS100 brushless servomotor and 1000-Line 1 Vpp encoder
-M4	BMS100 brushless servomotor, 1000-Line 1 Vpp encoder, and brake
-M5	BM130 brushless servomotor, 2500-Line 1 Vpp encoder, and brake
-M6	BM130 brushless servomotor, 2500-Line TTL encoder, and brake
-M7	BM130 brushless servomotor and 1000-Line 1 Vpp encoder
-M8	BM130 brushless servomotor, 1000-Line 1 Vpp encoder, and brake

PRO165SL and PRO165SLE Series Linear Ball-Screw Stage (continued)	
Foldback (Optional)	
-FB1	Foldback kit for 1/4" diameter shaft NEMA 23 motor
-FB2	Foldback kit with brake for 1/4" diameter shaft NEMA 23 motor
-FB3	Foldback kit for 3/8" diameter shaft NEMA 23 motor
-FB4	Foldback kit with brake for 3/8" diameter shaft NEMA 23 motor
NOTE: -TT1 option required for lower axis of XY when a foldback kit is used	
Motor Orientation (Optional)	
-2	Bottom cable exit, optional orientation
-3	Left-side cable exit, standard orientation
-4	Top cable exit, optional orientation
-5	Right-side cable exit, optional orientation
-8	Right-side foldback, standard orientation
-12	Left-side foldback, optional orientation
Limits (Required)	
-LI1	Normally-closed limit switches; 5 VDC with 9-pin D connector
-LI2	Normally-open limit switches; 5 VDC with 9-pin D connector
-LI3	Normally-closed limit switches; 24 VDC with 9-pin D connector
Coupling (Optional)	
-CP1	Coupling for 1/4" diameter shaft
-CP2	Coupling for 3/8" diameter shaft
Lifting Hardware (Optional)	
-LF	Lifting hardware
NOTE: Lifting option only available on travels 400 mm and greater. Lifting should never be ordered on the upper-axis of an XY set (only order on lower-axis).	
ThermoComp™ (Optional)	
-TCMP	ThermoComp™ integrated thermal compensation unit
NOTE: An A3200 controller must be used with the -TCMP option	
Metrology (Required)	
-PL0	No metrology performance plots
-PL1	Uncalibrated with performance plots
-PL2	Calibrated with performance plots
Accessories (To be Ordered as a Separate Line Item)	
ALIGN-NPA	Non-precision XY assembly
ALIGN-NPAZ	Non-precision XZ or YZ assembly
ALIGN-PA10	XY assembly; 10 arc sec orthogonality; alignment to within 7 µm orthogonality for short travel stages
ALIGN-PA10Z	XZ or YZ assembly with L-bracket; 10 arc second orthogonality; alignment to within 10 µm orthogonality for short travel stages
ALIGN-PA5	XY assembly; 5 arc sec orthogonality; alignment to within 3 µm orthogonality for short travel stages
ALIGN-PA5Z	XZ or YZ assembly with L-bracket; 5 arc second orthogonality; alignment to within 5 µm orthogonality for short travel stages
HDZ165	Right angle L-bracket for 50 mm, 100 mm, and 150 mm travels only
NOTE: HDZ bracket requires a tabletop when mounting to a PRO series stage	

1.1. Environmental Specifications

WARNING: Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.

Table 1-2: Environmental Specifications

Ambient Temperature	Operating: 10° to 35° C (50° to 95° F) The optimal operating temperature is 20° C ±2° C (68° F ±4° F). If at any time the operating temperature deviates from 20° C degradation in performance could occur.
	Storage: 0° to 40° C (32° to 104° F) in original shipping packaging
Humidity	Operating: 20% to 60% RH
	Storage: 10% to 70% RH, non-condensing in original packaging. The stage should be packaged with desiccant if it is to be stored for an extended time.
Altitude	Operating: 0 m to 2,000 m (0 ft to 6,562 ft) above sea level Contact Aerotech if your specific application involves use above 2,000 m or below sea level.
Vibration	Use the system in a low vibration environment. Excessive floor or acoustical vibration can affect system performance. Contact Aerotech for information regarding your specific application.
Protection Rating	The PRO165SL/SLE stages have limited protection against dust, but not water. This equates to an ingress protection rating of IP50.
Use	Indoor use only

1.2. Accuracy and Temperature Effects

The accuracy specification of PRO165SL/SLE series stages is measured 25 mm above the table with the stage in an unloaded condition. The stage is assumed to be fully supported by a mounting surface meeting or exceeding the specification in Section 2.3.

The accuracy of the screw is a key element in the overall positioning accuracy of the SL stage. A scale error can be expected if temperature of the screw differs from 20° C (68° F). The greater the temperature difference, the greater the error. The temperature of the screw depends on the speed and duty cycle of the stage. The faster the movement and higher the duty cycle, the more the stage accuracy will be affected by heat. The thermal expansion coefficient of the screw is 11.7 ppm/°C.

SLE stages contain a linear encoder for direct feedback of the carriage position. The stage travel as seen by the linear encoder will expand at the rate of 3.25 ppm/°C as the temperature of the encoder scale deviates from 20°C.

The ThermoComp™ option is a hardware and software solution that uses the functionality of the A3200 controller to mitigate the effects of changing temperature by detecting and compensating for thermal changes. ThermoComp™ is effective at compensating for both self-heating and environmental temperature changes.

1.3. Basic Specifications

Resolution is dependent on ball-screw pitch, encoder resolution, and controller interpolation.

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.

Table 1-3: PRO165SL/SLE Series Specifications (-050 to -250)

			-050	-100	-150	-200	-250
Travel			50 mm	100 mm	150 mm	200 mm	250 mm
Accuracy (1)	SL	Standard	±6 µm	±6 µm	±8 µm	±8 µm	±9 µm
		Calibrated	±1 µm	±1.25 µm	±1.5 µm	±1.75 µm	±2 µm
	SLE	Standard	±3 µm	±4 µm	±6 µm	±8 µm	±9 µm
		Calibrated	±1 µm	±1 µm	±1 µm	±1.5 µm	±1.5 µm
Resolution (Minimum Incremental Motion)	SL		0.1 µm (2), 1.0 µm (3)				
	SLE		0.05 µm (-E1/-E3 encoder), 0.2 µm (-E2 encoder), 1.0 µm (-E4 encoder)				
Bidirectional Repeatability (1)	SL		±1 µm				
	SLE		±0.5 µm				
Horizontal Straightness (1)			±1.5 µm	±2.5 µm	±3 µm	±4 µm	±5 µm
Vertical Straightness (1)			±1.5 µm	±2.5 µm	±3 µm	±4 µm	±5 µm
Pitch			19 µrad (3.9 arc·sec)	29 µrad (6 arc·sec)	29 µrad (6 arc·sec)	39 µrad (8 arc·sec)	49 µrad (10.1 arc·sec)
Roll			19 µrad (3.9 arc·sec)	29 µrad (6 arc·sec)	29 µrad (6 arc·sec)	39 µrad (8 arc·sec)	49 µrad (10.1 arc·sec)
Yaw			19 µrad (3.9 arc·sec)	29 µrad (6 arc·sec)	29 µrad (6 arc·sec)	39 µrad (8 arc·sec)	49 µrad (10.1 arc·sec)
Maximum Speed (4)			300 m/s				
Maximum Acceleration (4)			Function of motor, amplifier, payload, and maximum axial load				
Load Capacity (5)	Horizontal		45 kg				
	Vertical (Axial)		25 kg				
	Side		45 kg				
Moving Mass (with tabletop)	SL		2.3 kg				
	SLE		2.4 kg				
Stage Mass (no motor)	SL		5.6 kg	6.1 kg	6.6 kg	7.1 kg	7.6 kg
	SLE		6.2 kg	6.7 kg	7.3 kg	7.8 kg	8.3 kg
Material			Anodized Aluminum				
Mean Time Before Failure (MTBF)			20,000 Hours				

1. Certified with -PL1 / -PL2 option.
2. Achieved with Aerotech rotary motor with amplified sine encoder.
3. Achieved with Aerotech rotary motor with 2500 counts/rev digital encoder.
4. Requires the selection of an appropriate amplifier with sufficient voltage and current.
5. Axis orientation for on-axis loading is listed.
6. Specifications are for single-axis systems measured 25 mm above the tabletop; performance of multi-axis system is payload and workpoint dependent. Consult the Aerotech factory for multi-axis or non-standard applications.
7. Specifications listed are non-foldback kit options. Contact factory for specifications when a foldback kit (-FBx) is used.

Table 1-4: PRO165SL/SLE Series Specifications (-300 to -600)

			-300	-400	-500	-600
Travel			300 mm	400 mm	500 mm	600 mm
Accuracy (1)	SL	Standard	±10 µm	±12 µm	±14 µm	±16 µm
		Calibrated	±2.5 µm	±3 µm	±3.5 µm	±4 µm
	SLE	Standard	±10 µm	±12 µm	±14 µm	±15.5 µm
		Calibrated	±1.5 µm	±1.5 µm	±2 µm	±2 µm
Resolution (Minimum Incremental Motion)	SL		0.1 µm (2), 1.0 µm (3)			
	SLE		0.05 µm (-E1/-E3 encoder), 0.2 µm (-E2 encoder), 1.0 µm (-E4 encoder)			
Bidirectional Repeatability (1)	SL		±1 µm			
	SLE		±0.5 µm	±0.5 µm	±0.75 µm	±0.75 µm
Horizontal Straightness (1)			±6 µm	±8 µm	±9 µm	±10 µm
Vertical Straightness (1)			±6 µm	±8 µm	±9 µm	±10 µm
Pitch			58 µrad (12 arc·sec)	70 µrad (14.4 arc·sec)	80 µrad (16.5 arc·sec)	90 µrad (18.6 arc·sec)
Roll			58 µrad (12 arc·sec)	70 µrad (14.4 arc·sec)	80 µrad (16.5 arc·sec)	90 µrad (18.6 arc·sec)
Yaw			58 µrad (12 arc·sec)	70 µrad (14.4 arc·sec)	80 µrad (16.5 arc·sec)	90 µrad (18.6 arc·sec)
Maximum Speed (4)			300 m/s			
Maximum Acceleration (4)			Function of motor, amplifier, payload, and maximum axial load			
Load Capacity (5)	Horizontal		45 kg			
	Vertical (Axial)		25 kg			
	Side		45 kg			
Moving Mass (with tabletop)	SL		2.3 kg			
	SLE		2.4 kg			
Stage Mass (no motor)	SL		8.1 kg	9.1 kg	10.1 kg	11.1 kg
	SLE		8.9 kg	9.9 kg	11.0 kg	12.0 kg
Material			Anodized Aluminum			
Mean Time Before Failure (MTBF)			20,000 Hours			

1. Certified with -PL1 / -PL2 option.
2. Achieved with Aerotech rotary motor with amplified sine encoder.
3. Achieved with Aerotech rotary motor with 2500 counts/rev digital encoder.
4. Requires the selection of an appropriate amplifier with sufficient voltage and current.
5. Axis orientation for on-axis loading is listed.
6. Specifications are for single-axis systems measured 25 mm above the tabletop; performance of multi-axis system is payload and workpoint dependent. Consult the Aerotech factory for multi-axis or non-standard applications.
7. Specifications listed are non-foldback kit options. Contact factory for specifications when a foldback kit (-FBx) is used.

1.4. Vacuum Operation

Aerotech can specially prepare the PRO165SL/SLE for operation in vacuum environments. Aerotech offers two vacuum preparation options; one for low vacuum (for use in atmospheric pressures to 10^{-3} torr) and one for high vacuum (preparation for environments from 10^{-3} to 10^{-6} torr). As part of this preparation, attention to detail during modification, cleaning, and assembly results in products with optimal performance in vacuum applications.

Special Guidelines

To make sure that the PRO165SL/SLE will continue to perform well in the vacuum environment, use the guidelines that follow (in addition to standard handling, installation, and lubrication guidelines outlined in this manual).

1. Do not remove the PRO165SL/SLE from its sealed bag until it is ready to use.
2. Always handle the PRO165SL/SLE in a clean environment and use powder-free polyethylene gloves to prevent any contaminants from adhering to the surface of the PRO165SL/SLE.
3. During installation, use cleaned, vented, stainless steel fasteners when securing the PRO165SL/SLE.
4. Reduced air pressure eliminates significant convective heat transfer. This, coupled with the viscous vacuum-compatible lubricants, could result in excessive motor operating temperatures. Because of this, consider all continuous torque ratings to be 40 to 60% lower than the value specified for operation in normal atmospheric environment. Reduce motor usage accordingly.
5. For vacuum applications, the recommended lubricant is a small quantity of Braycote® 602EF grease or a compatible substitute of equal quality.
6. Baking vacuum components between 100 and 125 °C for 24 to 48 hours significantly reduces outgassing at initial pump-down to vacuum pressure and evaporates water vapor that impregnates porous surfaces on the aluminum and Teflon cables. Aerotech recommends that customers bake out vacuum systems when first installing them in the vacuum chamber.

Chapter 2: Installation

WARNING: PRO165SL/SLE installation must be in accordance to instructions provided by this manual and any accompanying documentation. Failure to follow these instructions could result in injury or damage to the equipment.

2.1. Unpacking and Handling the Stage

DANGER/HEAVY: Refer to Section 1.3. for stage mass specifications.

- Do not attempt to lift heavy loads single handed.
- Do not use the tabletop, drive screw, motor, or cables as lifting points.
- Lift only by the base. Use lifting hardware if it has been provided (refer to Figure 2-1).
- For multi-axis assemblies, always lift the system by the lower axis.

WARNING: It is the customer's responsibility to safely and carefully lift and move the PRO165SL/SLE.

- Secure all moving parts before lifting or moving the PRO165SL/SLE to a new location. Unsecured moving parts could shift and cause bodily injury.
- Improper handling could adversely affect the performance of the PRO165SL/SLE. Use care when moving the PRO165SL/SLE.

NOTE: If any damage has occurred during shipping, report it immediately.

Carefully remove the PRO165SL/SLE from its protective shipping container. Gently set the PRO165SL/SLE on a smooth, flat, and clean surface.

Before operating the PRO165SL/SLE, it is important to let it stabilize at room temperature for at least 12 hours. Allowing it to stabilize to room temperature will ensure that all of the alignments, preloads, and tolerances are the same as they were when tested at Aerotech. Use compressed nitrogen or clean, dry, oil-less air to remove any dust or debris that has collected during shipping.

Each PRO165SL/SLE has a label listing the system part number and serial number. These numbers contain information necessary for maintaining or updating system hardware and software. Locate this label and record the information for later reference.

Lifting Features

The lifting kit includes four eyebolts and four standoffs. Thread the eyebolts onto the standoffs and thread the standoffs into the stage base. Remove the lifting hardware by turning a wrench on the flats of the standoffs (see Figure 2-1). If the stage is part of a multi-axis system, the lifting hardware should be attached to the lower axis. The lifting hardware must be removed before the stage can be operated.

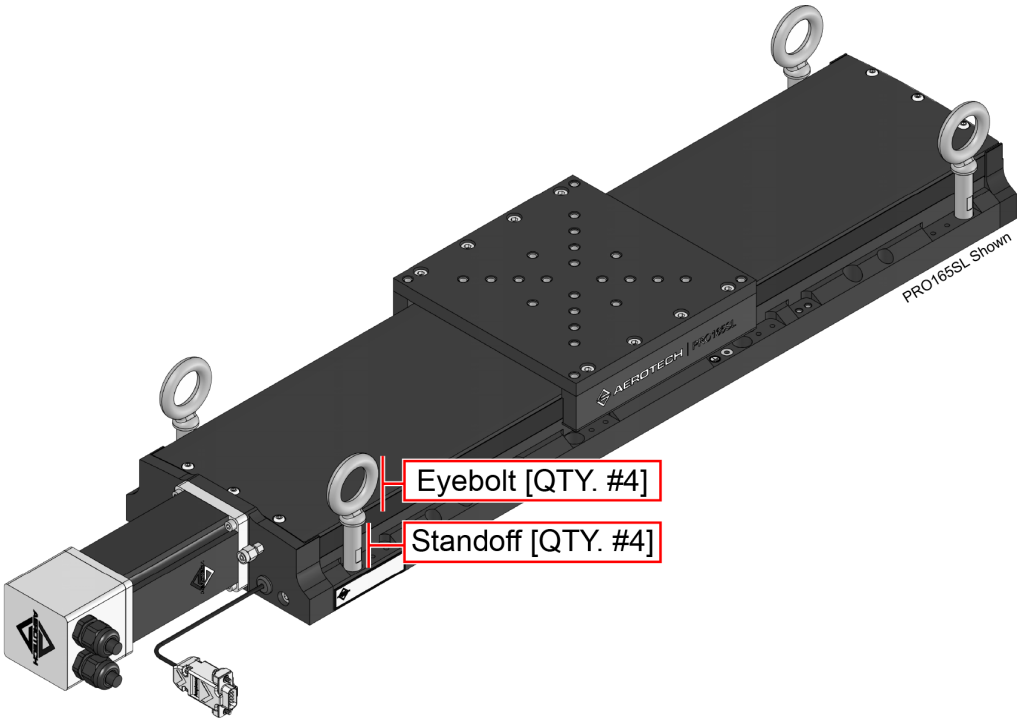
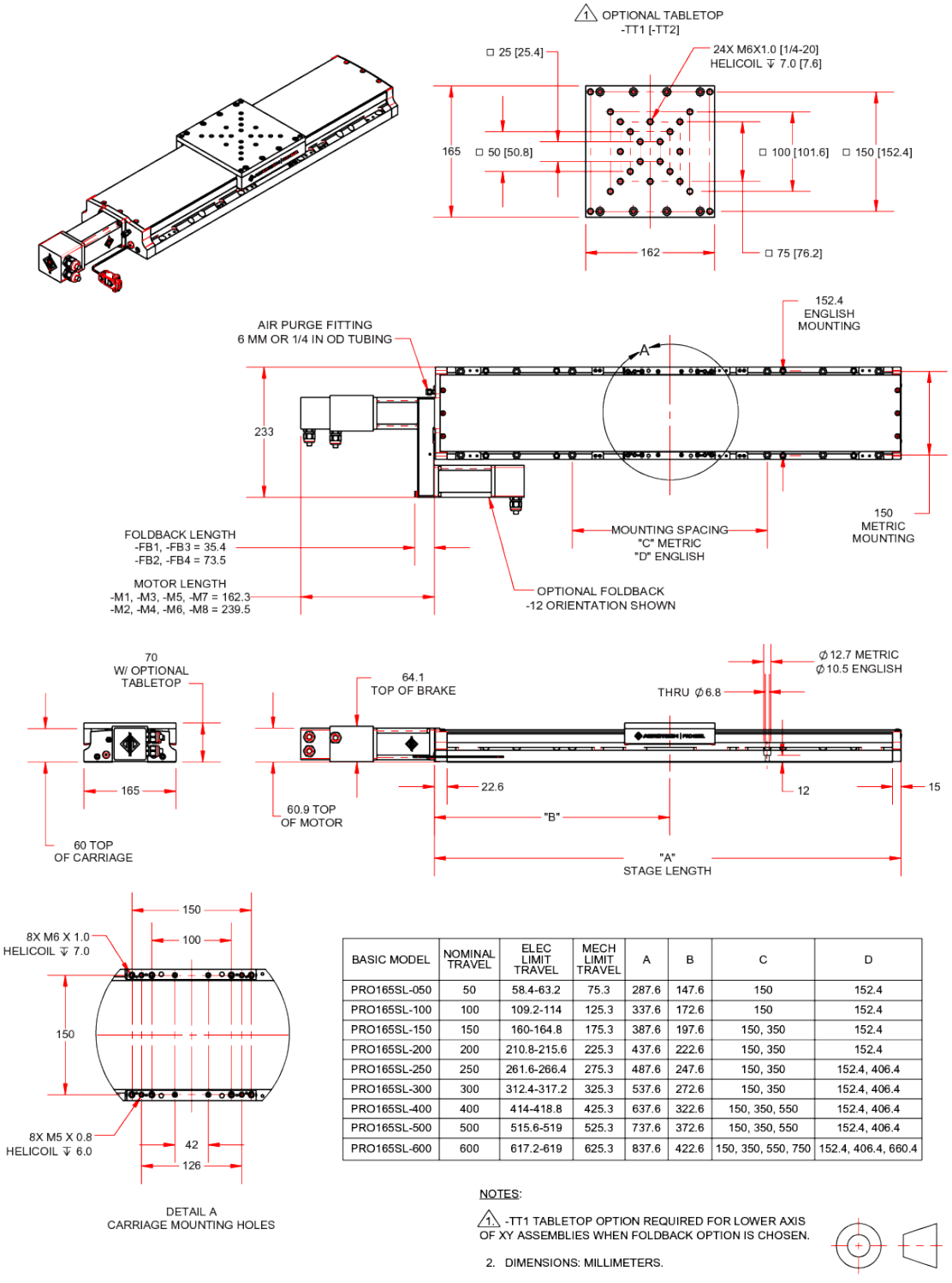


Figure 2-1: Lifting Features

NOTE: After removing the shipping brackets, retain them for future use. Do not transport or ship the PRO165SL/SLE without the shipping brackets attached.

2.2. Dimensions

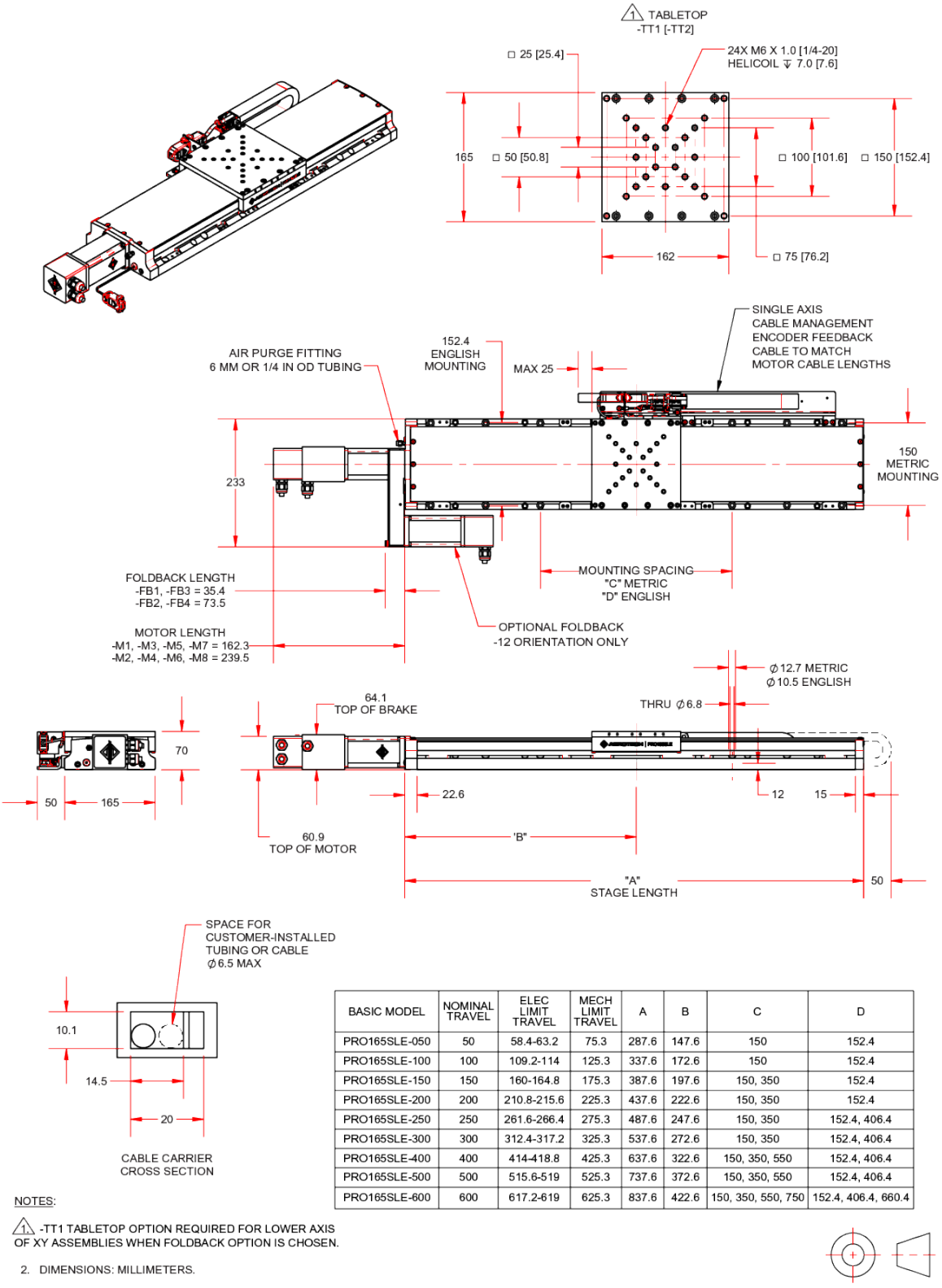


BASIC MODEL	NOMINAL TRAVEL	ELEC LIMIT TRAVEL	MECH LIMIT TRAVEL	A	B	C	D
PRO165SL-050	50	58.4-63.2	75.3	287.6	147.6	150	152.4
PRO165SL-100	100	109.2-114	125.3	337.6	172.6	150	152.4
PRO165SL-150	150	160-164.8	175.3	387.6	197.6	150, 350	152.4
PRO165SL-200	200	210.8-215.6	225.3	437.6	222.6	150, 350	152.4
PRO165SL-250	250	261.6-266.4	275.3	487.6	247.6	150, 350	152.4, 406.4
PRO165SL-300	300	312.4-317.2	325.3	537.6	272.6	150, 350	152.4, 406.4
PRO165SL-400	400	414-418.8	425.3	637.6	322.6	150, 350, 550	152.4, 406.4
PRO165SL-500	500	515.6-519	525.3	737.6	372.6	150, 350, 550	152.4, 406.4
PRO165SL-600	600	617.2-619	625.3	837.6	422.6	150, 350, 550, 750	152.4, 406.4, 660.4

NOTES:

1. -TT1 TABLETOP OPTION REQUIRED FOR LOWER AXIS OF XY ASSEMBLIES WHEN FOLDBACK OPTION IS CHOSEN.
2. DIMENSIONS: MILLIMETERS.

Figure 2-2: PRO165SL Dimensions



BASIC MODEL	NOMINAL TRAVEL	ELEC LIMIT TRAVEL	MECH LIMIT TRAVEL	A	B	C	D
PRO165SLE-050	50	58.4-63.2	75.3	287.6	147.6	150	152.4
PRO165SLE-100	100	109.2-114	125.3	337.6	172.6	150	152.4
PRO165SLE-150	150	160-164.8	175.3	387.6	197.6	150, 350	152.4
PRO165SLE-200	200	210.8-215.6	225.3	437.6	222.6	150, 350	152.4
PRO165SLE-250	250	261.6-266.4	275.3	487.6	247.6	150, 350	152.4, 406.4
PRO165SLE-300	300	312.4-317.2	325.3	537.6	272.6	150, 350	152.4, 406.4
PRO165SLE-400	400	414-418.8	425.3	637.6	322.6	150, 350, 550	152.4, 406.4
PRO165SLE-500	500	515.6-519	525.3	737.6	372.6	150, 350, 550	152.4, 406.4
PRO165SLE-600	600	617.2-619	625.3	837.6	422.6	150, 350, 550, 750	152.4, 406.4, 660.4

NOTES:

1. -TT1 TABLETOP OPTION REQUIRED FOR LOWER AXIS OF XY ASSEMBLIES WHEN FOLDBACK OPTION IS CHOSEN.
2. DIMENSIONS: MILLIMETERS.

Figure 2-3: PRO165SLE Dimensions

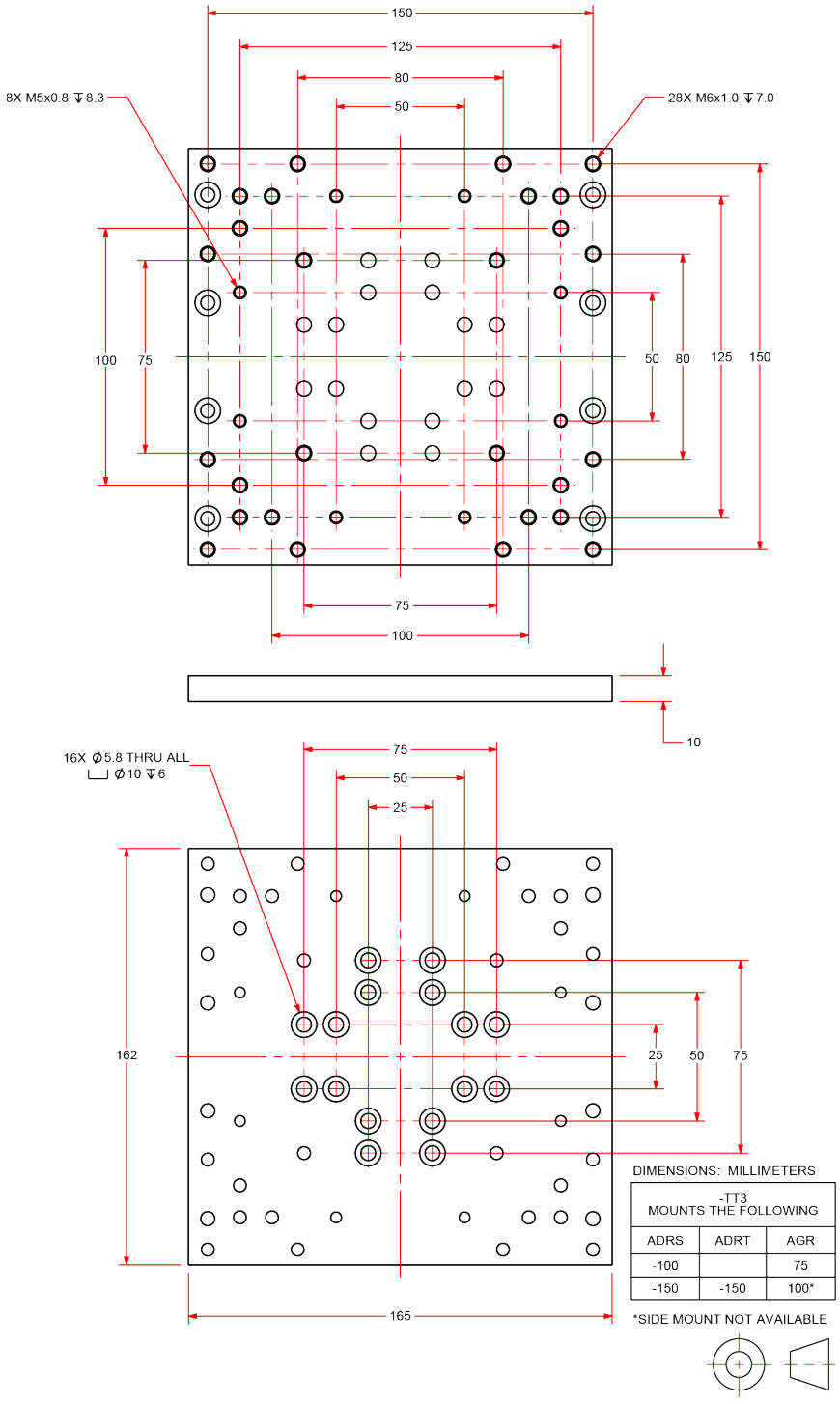
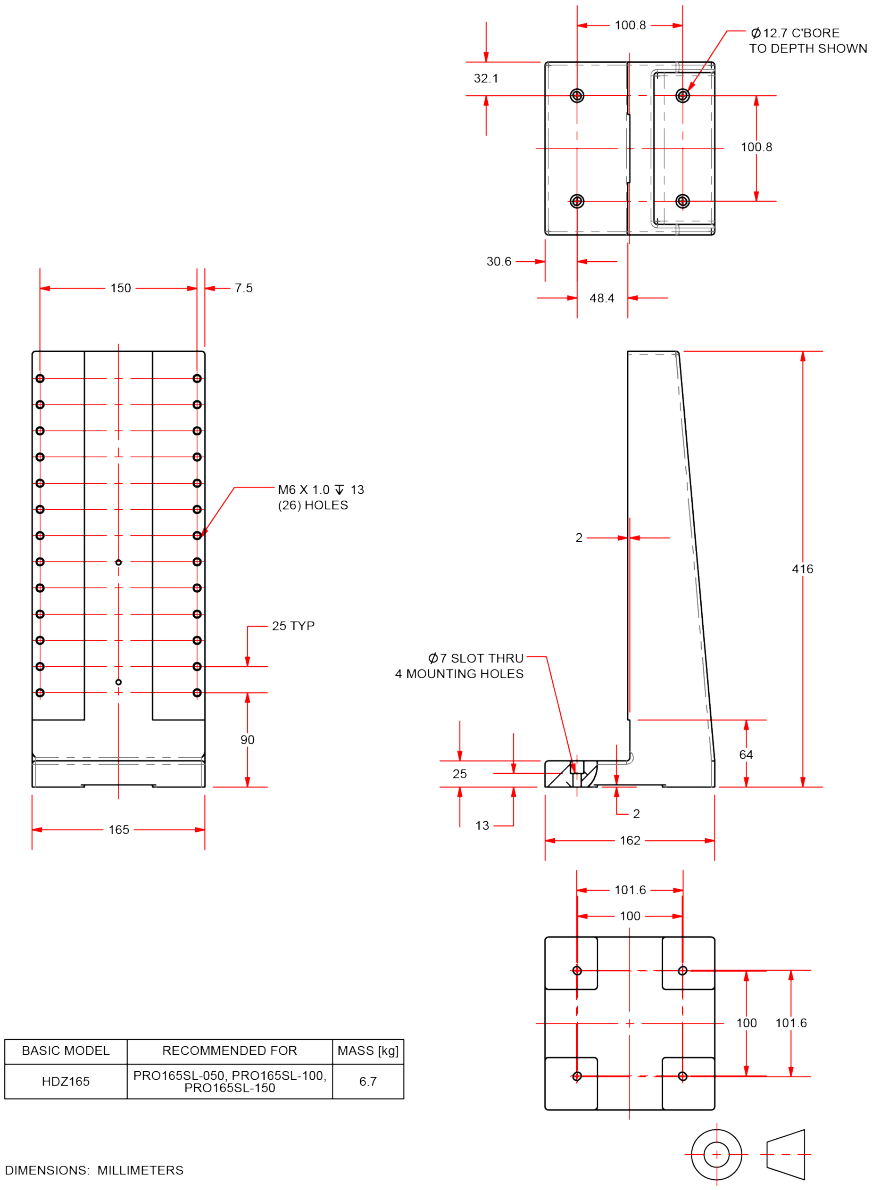


Figure 2-4: PRO165SL/SLE Accessory Tabletop Dimensions (-TT3/-TT6 Option)



BASIC MODEL	RECOMMENDED FOR	MASS [kg]
HDZ165	PRO165SL-050, PRO165SL-100, PRO165SL-150	6.7

Figure 2-5: PRO165SL/SLE Z-Axis Bracket Dimensions

2.3. Securing the Stage to the Mounting Surface

WARNING: The PRO165SL/SLE must be mounted securely. Improper mounting can result in injury and damage to the equipment.

WARNING: Make sure that all moving parts are secure before moving the PRO165SL/SLE. Unsecured moving parts may shift and cause bodily injury.

DANGER: PINCH POINT! Keep Hands Clear while the stage is in motion.

The mounting surface must be flat and have adequate stiffness to achieve the maximum performance from the PRO165SL/SLE stage. When it is mounted to a non-flat surface, the stage can be distorted while the mounting screws are tightened. This distortion will decrease overall accuracy. Adjustments to the mounting surface must be done before the stage is secured.

Inspect the mounting surface for dirt or unwanted residue and clean if necessary. Use precision flatstones on the mounting surface to remove any burrs or high spots. Clean the mounting surface with a lint-free cloth and acetone or isopropyl alcohol and allow the cleaning solvent to completely dry. Gently place the stage on the mounting surface.

NOTE: The PRO165SL/SLE is precision machined and verified for flatness prior to product assembly at the factory. If machining is required to achieve the desired flatness, it should be performed on the mounting surface rather than the PRO165SL/SLE. Shimming should be avoided if possible. If shimming is required, it should be minimized to retain maximum rigidity of the system.

Table 2-1: Stage Mounting Surface Flatness Requirement

Stage Travel	Flatness Requirement
All Travels	7.5 µm

If necessary, manually move the stage table to access the mounting holes along the edges of the stage (refer to Figure 2-6).

NOTE: The stage table may offer a considerable amount of resistance when it is moved manually. This is especially true if the stage is fitted with a motor assembly.

NOTE: If the stage is not connected to a power source, the stage should move freely by hand. Do not attempt to manually move the stage if it is connected to a power source or includes an integrated brake.

Tightening torque values for the mounting hardware are dependent on the properties of the surface to which the stage is being mounted. Values provided in Table 2-2 are typical values and may not be accurate for your mounting surface. Refer to Section 2.2. for specific model mounting locations and dimensions.

Table 2-2: Stage to Mounting Surface Hardware

Mounting Hardware	Typical Screw Torque
M6 x 22 mm (or 1/4" x 7/8") SHCS with flat washers	7 N·m [5 ft·lb]

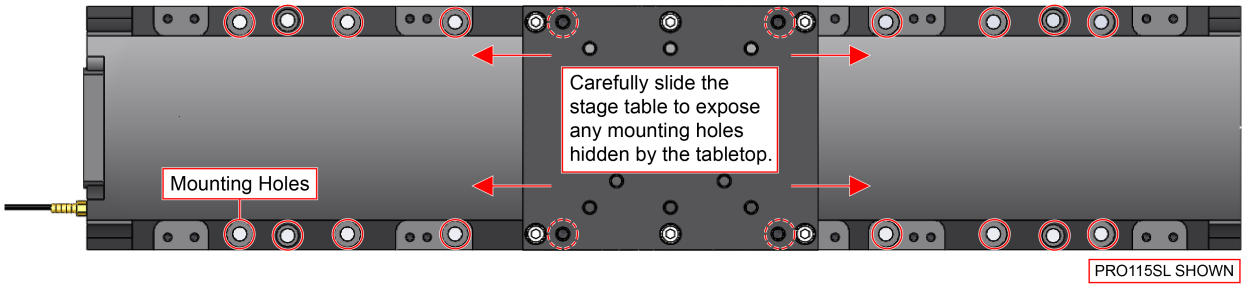


Figure 2-6: Mounting Hole Locations

2.4. Attaching the Payload to the Stage

Inspect the mounting surface for dirt or unwanted residue and clean if necessary. Clean the mounting surface with a lint-free cloth and acetone or isopropyl alcohol and allow the cleaning solvent to completely dry.

Aerotech recommends that customers use a representative payload during start-up to prevent accidental damage to the stage and the payload. Proceed with the electrical installation and test the motion control system in accordance with the system documentation. Document all results for future reference. For information on electrical installation refer to Chapter 3 and the documentation delivered with the stage.

NOTE: If your PRO165SL/SLE was purchased with Aerotech controls, it might have been tuned with a representative payload based on the information provided at the time of order. If the PRO165SL/SLE is started up without a payload, the servo gains provided by Aerotech with the shipment may not be appropriate and servo instability can occur. Refer to the controller help file for tuning assistance.

The payload must be flat, rigid, and comparable to the stage in quality to maintain optimum performance.

NOTE: For valid system performance, the mounting interface should be flat within 12 µm.

WARNING: Refer to the dimensions in Section 2.2. for maximum allowable thread engagement. A screw extending through the stage table can affect travel and damage the stage.

Applied loads should be symmetrically distributed whenever possible (i.e., the payload should be centered on the stage table and the entire stage should be centered on the support structure).

For a cantilevered load, first determine if it is a Vertical, Horizontal, or a Side cantilever system. Measure the cantilever length, then find the corresponding load value from Figure 2-7.

The **Vertical** curve is for situations where the stage is mounted in a vertical orientation and the payload is mounted to the table top with its center of gravity extended outward in a direction normal to the tabletop surface. Refer to Figure 2-9 or Figure 2-10 for torque requirements on a vertical orientation.

The **Horizontal** curve assumes a horizontal stage orientation with the payload offset extending outwards along the surface of the tabletop.

The **Side** curve is for situations where the stage is mounted on its side and the offset load extends outwards in a direction normal to the tabletop surface.

Refer to Figure 2-8 for clarification on Vertical, Horizontal, or a Side orientations.

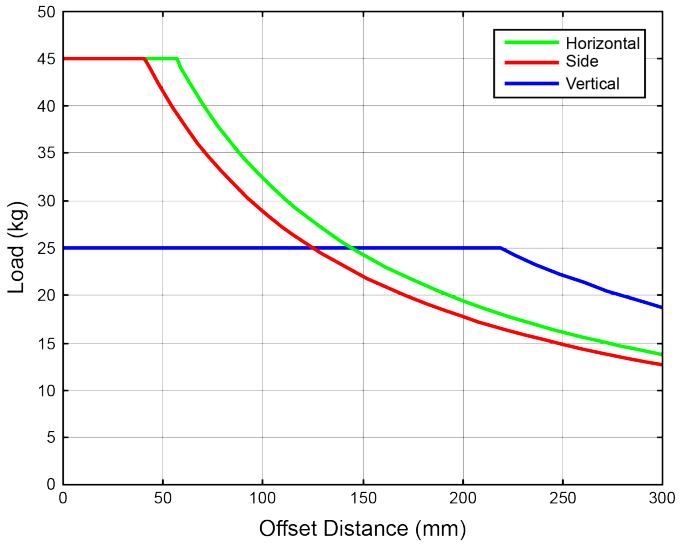


Figure 2-7: Cantilevered Load Capability

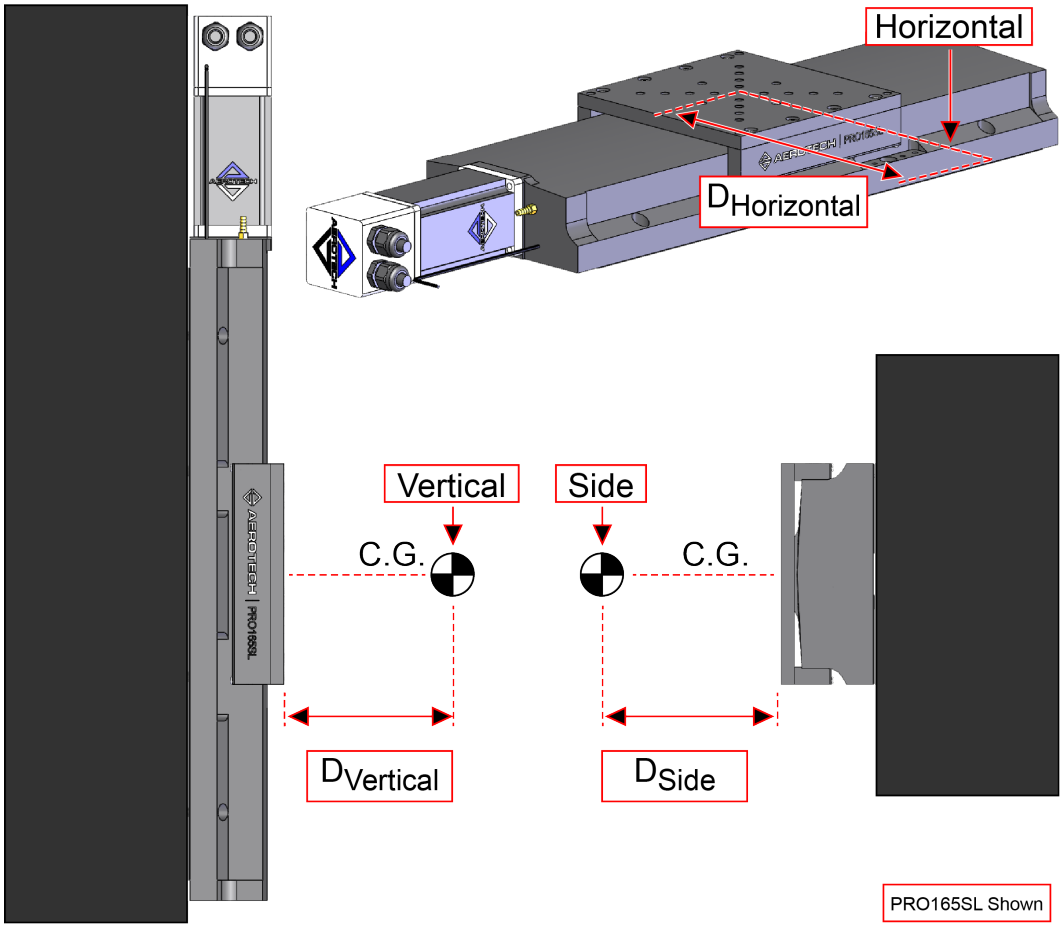


Figure 2-8: Stage Orientations

The approximate amount of torque required to turn the ball screw of PRO165SL/SLE series stages can be found from Figure 2-10 or the following equation:

$$Torque_{REQ} = \frac{(AxialLoad)\ x\ (LeadofScrew)}{2\ x\ \pi\ x\ (Efficiency)}$$

Figure 2-9: Load Torque Equation

For PRO165SL/SLE series stages, the ball screw efficiency is rated at 90% (0.90).

The maximum axial load carrying capacity of PRO165SL/SLE stages is 25 kg (55 lb).

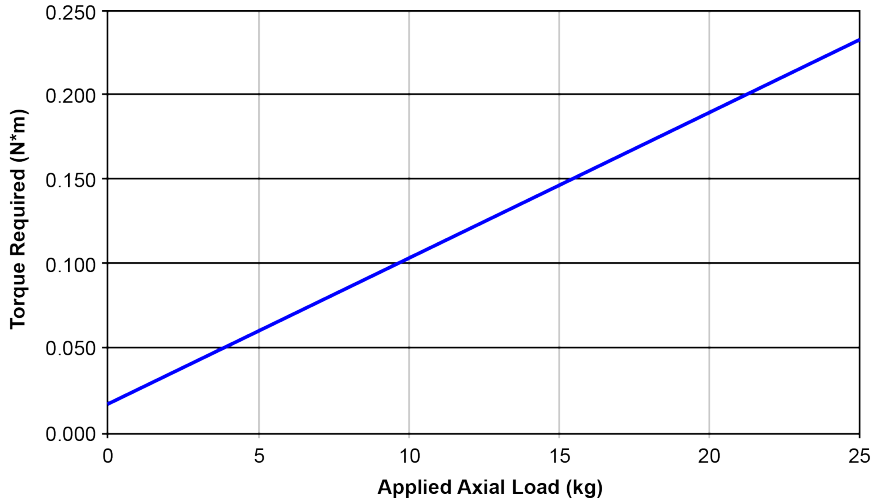


Figure 2-10: Torque Required to Turn Ball Screw in Vertical Orientation

This page intentionally left blank.

Chapter 3: Electrical Installation

WARNING: Electrical installation must be performed by properly qualified personnel.

Electrical installation requirements will vary depending on product options. Installation instructions in this section are for PRO165SL/SLE stages equipped with standard Aerotech motors intended for use with an Aerotech motion control system. Contact Aerotech for further information regarding products that are otherwise configured.

Aerotech motion control systems are adjusted at the factory for optimum performance. When the PRO165SL/SLE is part of a complete Aerotech motion control system, setup usually involves connecting the PRO165SL/SLE to the appropriate drive chassis with the cables provided. Labels on the system components usually indicate the appropriate connections.

If system level integration was purchased, an electrical drawing showing system interconnects has been supplied with the system (separate from this documentation).

The electrical wiring from the motor and encoder are integrated at the factory. Refer to the sections that follow for standard motor wiring and connector pinouts.

WARNING: Applications requiring access to the stage while it is energized will require additional grounding and safeguards. The System Integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements necessary for the integration of this stage into the final application.

DANGER: Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock or damage to the equipment.

3.1. Motor and Feedback Connectors

Stages equipped with standard motors and encoders come from the factory completely wired and assembled.

NOTE: Refer to the other documentation accompanying your Aerotech equipment. Call your Aerotech representative if there are any questions on system configuration.

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

The protective ground connection of the PRO165SL/SLE provides motor frame ground protection only. Additional grounding and safety precautions are required for applications requiring access to the stage while it is energized. The System Integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements necessary for the integration of this stage into the final application.

DANGER: Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock or damage to the equipment.

WARNING: The protective ground connection must be properly installed to minimize the possibility of electric shock.

CAUTION: The stage controller must provide over-current and over-speed protection. Failure to do so may result in permanent damage to the motor and stage components.

Table 3-1: Motor Connector Pinout

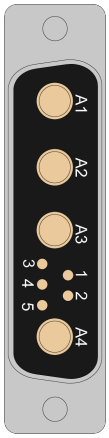
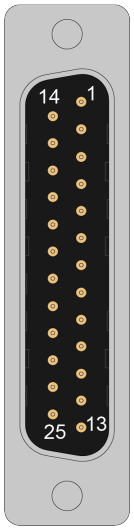
Pin	Description	Connector
Case	Shield connection	
A1	Motor Phase A	
A2	Motor Phase B	
A3	Motor Phase C	
1	Reserved	
2	Reserved	
3	Reserved	
4	Reserved	
5	Reserved	
A4	Frame ground (motor protective ground)	

Table 3-2: Part Numbers for the Motor Connector

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK00656	Amphenol #17E-1726-2
Sockets [QTY. 4]	ECK00659	ITT Cannon #DM53744-6
Connector	ECK00657	ITT Cannon #DBM9W4SA197

Table 3-3: Feedback Connector Pinout

Pin	Description	Connector
Case	Shield connection	
1	Reserved	
2	Over-Temperature Thermistor sensor(1)	
3	+5 V power supply	
4	Reserved	
5	Hall Effect sensor, phase B	
6	Marker-N	
7	Marker	
8	Reserved	
9	Reserved	
10	Hall Effect sensor, phase A	
11	Hall Effect sensor, phase C	
12	Reserved	
13	Brake -(2)	
14	Cosine	
15	Cosine-N	
16	Reserved	
17	Sine	
18	Sine-N	
19	Reserved	
20	Common ground	
21	Common ground	
22	Reserved	
23	Reserved	
24	Reserved	
25	Brake +(2)	

1. BMS motors only (otherwise Reserved)
2. With Brake option only

Table 3-4: Part Numbers for the Feedback Connector

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK00656	Amphenol #17E-1726-2
Connector	ECK00300	FCI DB25S064TLF

Table 3-5: Linear Encoder Connector Pinout (-SLE only)

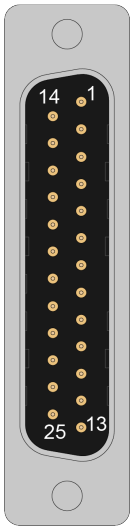
Pin	-E1, -E2, and -E4 Encoder Option	-E3 Encoder Option	Connector
Case	Shield connection	Shield connection	
1	Reserved	Reserved	
2	Reserved	Reserved	
3	+5 V power supply	+5 V power supply	
4	Reserved	Reserved	
5	Reserved	Reserved	
6	Marker-N	Clock -	
7	Marker	Clock +	
8	Reserved	Data -	
9	Reserved	Reserved	
10	Reserved	Reserved	
11	Reserved	Reserved	
12	Reserved	Reserved	
13	Reserved	Reserved	
14	Cosine	Reserved	
15	Cosine-N	Reserved	
16	+5 V power supply	+5 V power supply	
17	Sine	Reserved	
18	Sine-N	Reserved	
19	Reserved	Data +	
20	Common ground	Common ground	
21	Common ground	Common ground	
22	Reserved	Reserved	
23	Reserved	Reserved	
24	Reserved	Reserved	
25	Reserved	Reserved	

Table 3-6: Part Numbers for the Encoder Connector

Mating Connector	Aerotech P/N	Third Party P/N
Backshell	ECK00656	Amphenol #17E-1726-2
Connector	ECK00300	FCI DB25S064TLF

Table 3-7: Limit Connector Pinout

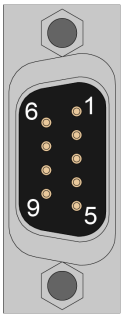
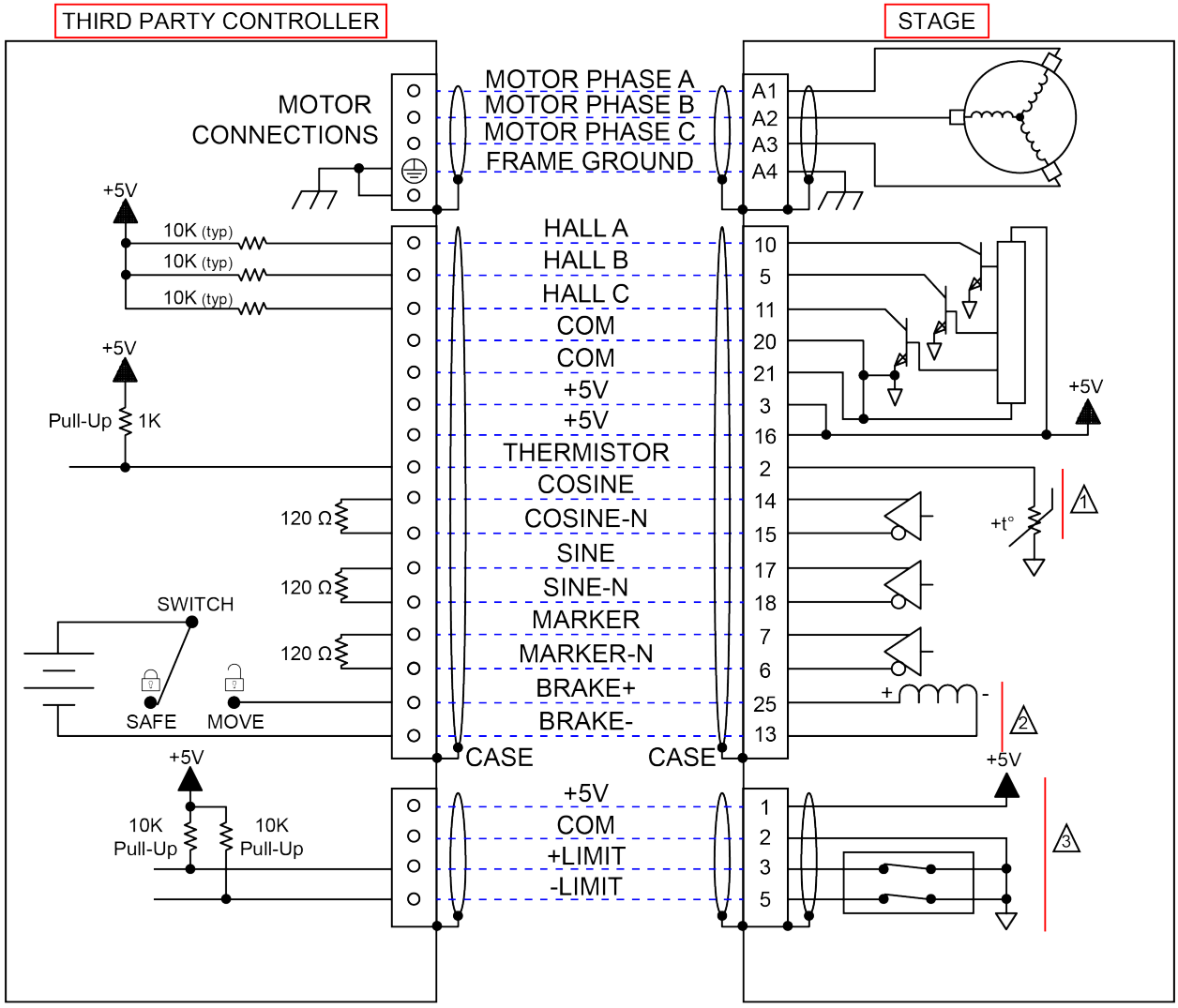
Pin #	Description	Connector
Case	Shield connection	
1	-LI1/-LI2 Option: +5V supply input for optical limit switch boards -LI3 Option: +24V supply input for optical limit switch boards	
2	Common ground to limit switch	
3	Signal indicating maximum travel produced by positive/CW stage direction	
4	Reserved	
5	Signal indicating stage maximum travel produced by negative/CCW stage direction	
6	Reserved	
7	Common ground	
8	Reserved	
9	Reserved	

Table 3-8: Part Numbers for the Limit Connector

Mating Connector	Aerotech P/N	Third Party P/N
9-Pin D-Connector	ECK00340	FCI DE09S064TLF
Backshell	ECK01021	Amphenol 17E-1724-2

3.2. Motor and Feedback Wiring

Shielded cables are required for the motor and feedback connections.

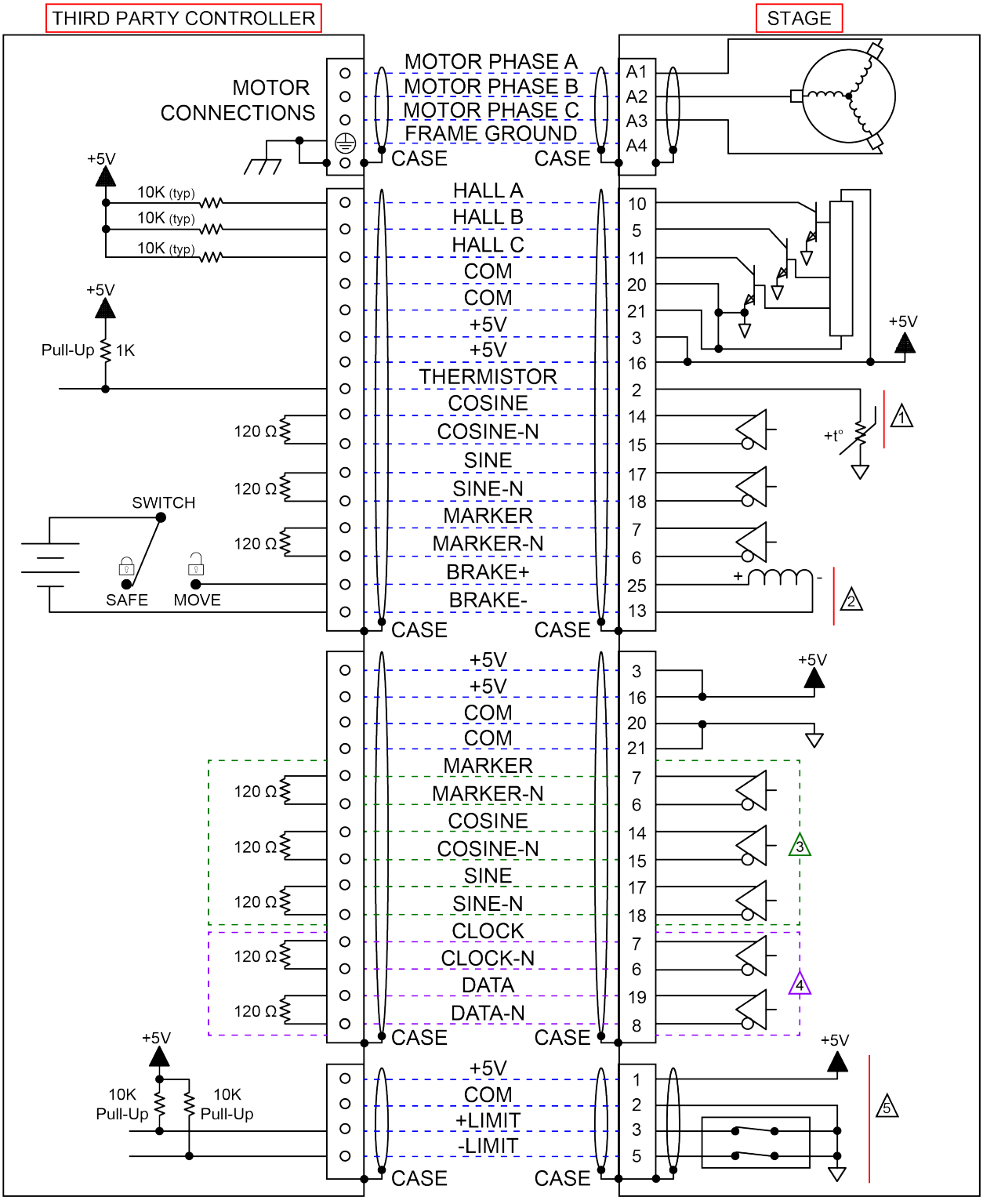


1 Thermistor is only available on BMS motors.

2 Brake is optional.

3 Limit options are factory-configured as normally closed or normally open.

Figure 3-1: Motor and Feedback Wiring (-SL Option)



1 Thermistor is only available on BMS motors.

2 Brake is optional.

3 -E1, -E2, -E4 Encoder Option ONLY.

4 -E3 Encoder Option ONLY.

5 Limit options are factory-configured as normally closed or normally open.

Figure 3-2: Motor and Feedback Wiring (-SLE Option)

3.3. Motor and Feedback Specifications

Table 3-9: Feedback Specifications

Hall-Effect Sensors Specifications	
Supply Voltage	5 V ±5%
Supply Current	50 mA
Output Type	Open Collector
Output Voltage	24 V max (pull up)
Output Current	5 mA (sinking)

Thermistor Specifications [BMS motors options only]	
Polarity	Logic "0" (no fault)
	Logic "1" (over-temperature fault)
Cold Resistance	~100 Ω
Hot Resistance	~10 K
Note: 1K pull-up to +5V recommended.	

Encoder Specifications	
Supply Voltage	5 V ±5%
Supply Current	250 mA Typical
Output Signals	**Sinusoidal Type (Incremental Encoder)**: 1 V_{pk-pk} into 120 Ω Load (differential signals SIN+, SIN-, COS+, COS- are .5 V_{pk-pk} relative to ground.)
	Digital Output (Incremental Encoder): RS422/485 compatible
	Serial Output (Absolute Encoder): EnDat 2.2 with 36 bit word

Limit Switch Specifications			
Option	-LI1	-LI2	-LI3
Supply Voltage	5 V	5 V	24 V
Supply Current	25 mA		
Output Type	Open Collector		
Output Voltage	5 V	5 V	24 V
Output Current	10 mA (sinking)	10 mA (sinking)	10 mA (sourcing)
Output Polarity (Factory Configured)	**Normally Closed (NC)** • Sinks current to ground (Logic "0") when not in limit • High impedance (Logic "1") when in limit • Requires external pull-up to +5 V (10 kΩ recommended)	**Normally Open (NO)** • Sinks current to ground (Logic "0") when in limit • High impedance (Logic "1") when not in limit • Requires external pull-up to +5 V (10 kΩ recommended)	**Normally Closed (NC)** • 24 V output when not in limit • High impedance when in limit
Note: If the PRO165SL/SLE is driven beyond the electrical limit, it will encounter a mechanical stop. Impacting the mechanical stop could cause damage to the stage even at low speeds.			

Brake Specifications	
Supply Voltage	24 VDC
Supply Current (typical)	250 mA (Current required to release the brake and allow motion.)

Table 3-10: PRO165SL/SLE Motor Specifications (BMS100)

		BMS100
Performance Specifications (1, 5)		
Stall Torque, Continuous (2)	N·m (oz·in)	0.56 (80.0)
Peak Torque (3)	N·m (oz·in)	2.26 (320.0)
Rated Power Output, Continuous	W	133
Electrical Specifications (5)		
Winding Designation		-A
BEMF Constant (Line-Line, Max)	V_{pk}/k_{rpm}	40.0
Continuous Current, Stall (2)	A_{pk} (A_{rms})	2.1 (1.5)
Peak Current, Stall (3)	A_{pk} (A_{rms})	8.4 (5.9)
Torque Constant (4, 8)	N·m/A_{pk} (oz·in/A_{pk})	0.270 (38.10)
	N·m/A_{rms} (oz·in/A_{rms})	0.380 (53.90)
Motor Constant (2, 4)	N·m/√W (oz·in/√W)	0.076 (10.74)
Resistance, 25°C (Line-Line)	Ω	12.90
Inductance (Line-Line)	mH	2.40
Maximum Bus Voltage	V_{DC}	340
Thermal Resistance	°C/W	1.35
Number of Poles	--	8

1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
2. Values shown @ 75°C rise above a 25 °C ambient temperature, with housed motor mounted to a 250 mm x 250 mm x 6 mm aluminum heat sink
3. Peak torque assumes correct rms current; consult Aerotech
4. Force constant and motor constant specified at stall
5. All performance and electrical specifications ±10%
6. Maximum winding temperature is 100 °C (thermistor trips at 100 °C)
7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated A_{pk}; use torque constant in N·m/A_{pk} when sizing

WARNING: The motor case temperature may exceed 75°C.

Table 3-11: PRO165SL/SLEMotor Specifications (BM130)

		BM130
Performance Specifications (1,2)		
Stall Torque, Continuous (3)	N·m (oz·in)	1.02 (144.0)
Peak Torque(4)	N·m (oz·in)	2.50 (361.0)
Rated Power Output, Continuous	W	333
Electrical Specifications (2)		
BEMF Constant (Line-Line, Max)	V_{pk}/k_{rpm}	19.0
Continuous Current, Stall (3)	A_{pk} (A_{rms})	6.9 (4.9)
Peak Current, Stall (4)	A_{pk} (A_{rms})	17.3 (12.2)
Torque Constant (5)	N·m/A_{pk} (oz·in/A_{pk})	0.150 (20.90)
	N·m/A_{rms} (oz·in/A_{rms})	0.210 (29.60)
Motor Constant (3,5)	N·m/√W (oz·in/√W)	0.101 (14.30)
Resistance, 25°C (Line-Line)	Ω	2.00
Inductance (Line-Line)	mH	3.52
Maximum Bus Voltage	V_{DC}	340
Thermal Resistance	°C/W	1.04
Number of Poles	--	8

1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
2. All performance and electrical specifications ±10%
3. Values shown @ 105°C rise above a 25 °C ambient temperature, with housed motor mounted to a 250 mm x 250 mm x 6 mm aluminum heat sink
4. Peak torque assumes correct rms current; consult Aerotech
5. Torque constant and motor constant specified at stall
6. Maximum winding temperature is 130 °C
7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated A_{pk}; use torque constant in N·m/A_{pk} when sizing

WARNING: The motor case temperature may exceed 75°C.

Table 3-12: Rotary Encoder Specifications for PRO165SL Stages

Encoder Option	Fundamental Signal Period	Digital Resolution
-M1, -M2, -M5, -M6 (2500 line RS422 signal)	2 µm	0.5 µm
-M3, -M4, -M7, -M8 (1000 line 1Vpp Amplified Sine signal)	5 µm	--
-M3, -M4, -M7, -M8 with 1000x Interpolation (1) (1000 line 1Vpp Amplified Sine signal)	5 µm	5 nm
-M3, -M4, -M7, -M8 with 4000x Interpolation (1) (1000 line 1Vpp Amplified Sine signal)	5 µm	1.25 nm
1. Quadrature decoding included in interpolated resolution calculations		

Table 3-13: Linear Encoder Specifications for PRO165SLE Stages

Encoder Option	Fundamental Signal Period	Digital Resolution
-E1	20 µm	--
-E1 with x4000 Interpolation (1)	20 µm	5 nm
-E1 with x16000 Interpolation (1)	20 µm	1.25 nm
-E2	20 µm	100 nm
-E3	--	1 nm
-E4	20 µm	0.5 µm
1. Quadrature decoding included in interpolated resolution calculations		

3.4. Limits, Marker, and Machine Direction

Aerotech stages are configured to have positive and negative "machine" directions. The machine direction defines the phasing of the feedback and motor signals and is dictated by the stage wiring (refer to Section 3.5. for Motor and Feedback phasing information). Programming direction of a stage is set by the controller that is used to move the stage. Programming direction is typically selectable in the controller, while machine direction is hardwired in the stage. Figure 3-3 shows the machine direction of PRO165SL/SLE stages.

The home marker is located near the center of travel on stages with a linear encoder (SLE models). For stages without the linear encoder option (SL models), the marker is located in the rotary motor and will be triggered near the designated home limit.

When the foldback motor option is used with the -E3 Encoder Option, the encoder machine direction is negative relative to the motor's CW direction. Inverting the controller's "Position Feedback Direction" is required for proper operation.

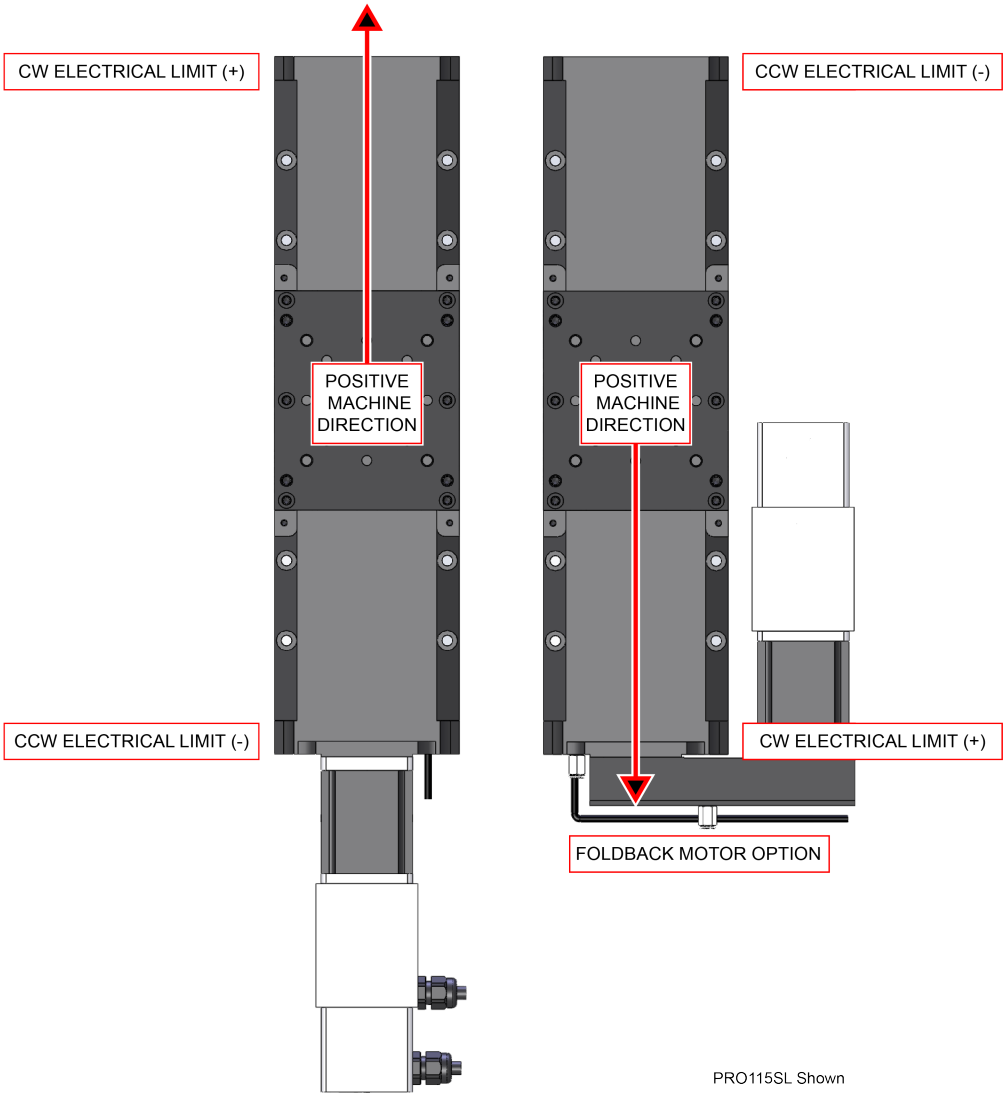


Figure 3-3: Machine Direction

3.5. Motor and Feedback Phasing

Motor phase voltage is measured relative to the virtual wye common point.

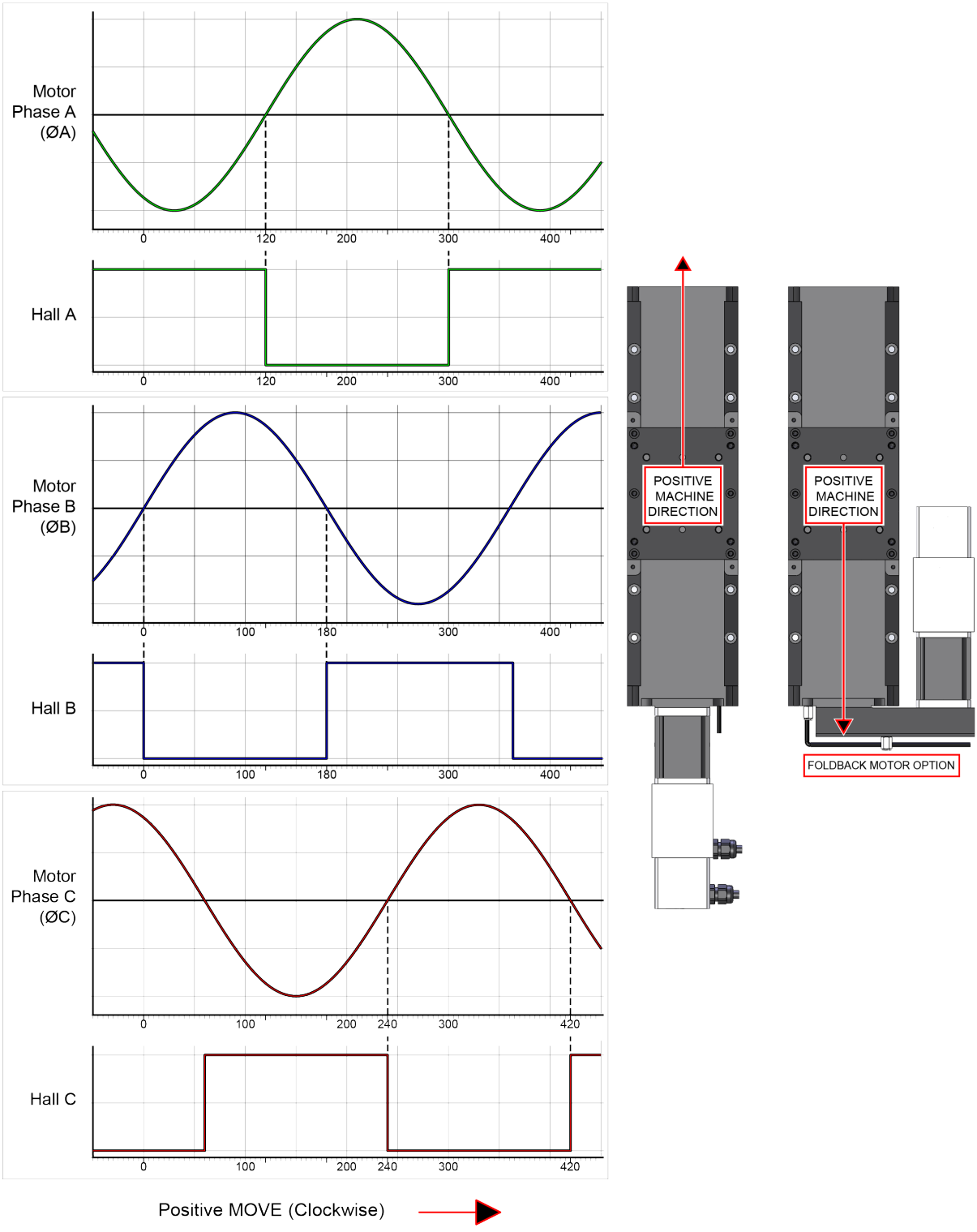


Figure 3-4: Hall Phasing

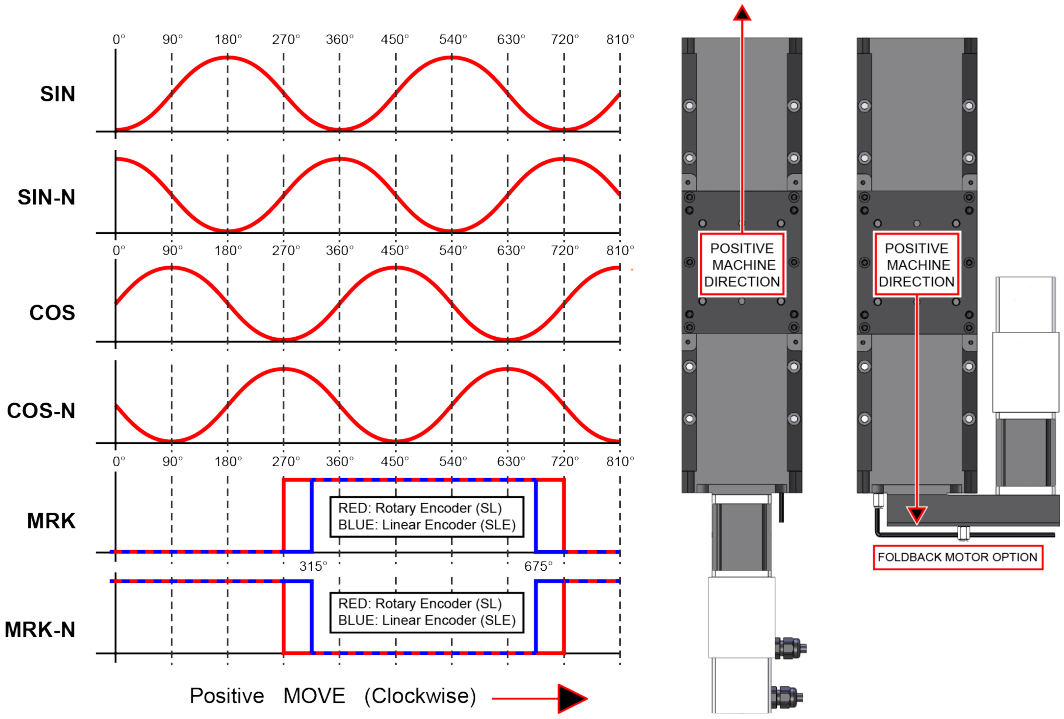


Figure 3-5: Analog Encoder Phasing Reference Diagram

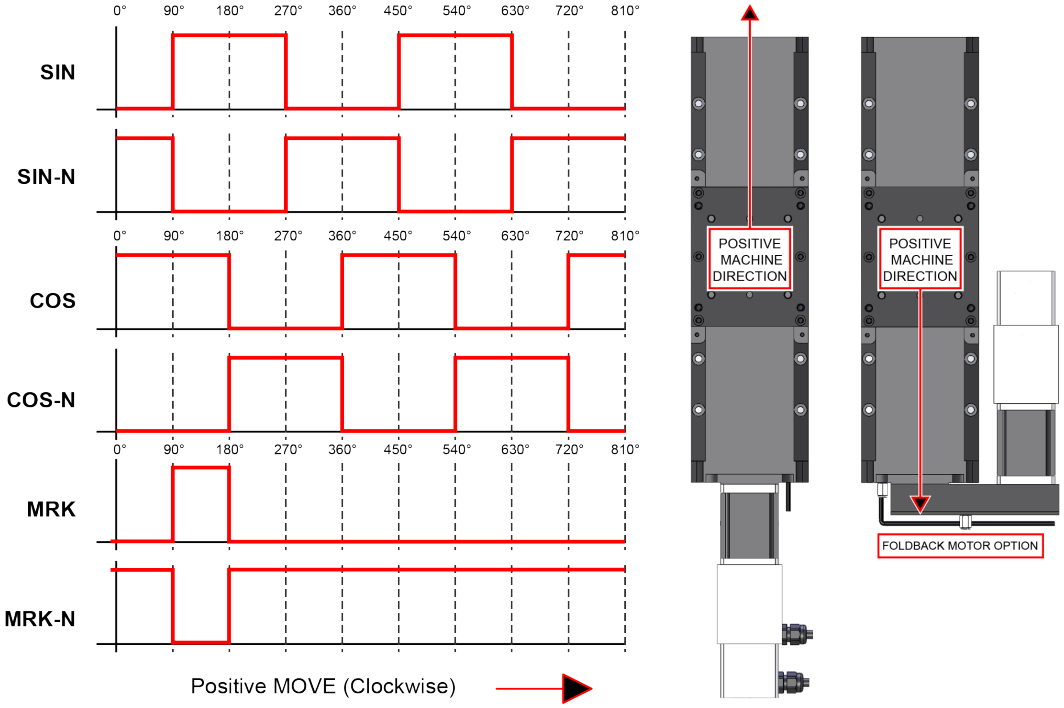


Figure 3-6: Encoder Phasing Reference Diagram (Standard)

This page intentionally left blank.

Chapter 4: Maintenance

NOTE: If the bearing area is not kept free of foreign matter and moisture, the performance and life expectancy of the stage will be reduced.

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.

4.1. Service and Inspection Schedule

Inspect the PRO165SL/SLE at least once per month. A longer or shorter inspection interval may be required depending on the application and conditions, such as the duty cycle, speed, and environment.

In general, stages operating in a clean environment should be cleaned and lubricated annually or every 500 km (whichever comes first). For stages operating under conditions involving excessive debris, the stage should be cleaned every six months. For high-speed applications (those near max speed at a duty cycle of 50%), frequent maintenance with standard lubricants is required.

Monthly inspections should include but not be limited to:

- Visually inspect the stage and cables.
- Re-tighten loose connectors.
- Replace or repair damaged cables.
- Clean the PRO165SL/SLE and any components and cables as needed.
- Repair any damage before operating the PRO165SL/SLE.
- Inspect and perform an operational check on all safeguards and protective devices.

4.2. Cleaning and Lubrication

When cleaning and/or lubricating components of the PRO165SL/SLE series stages:

1. Be sure to use a clean, dry, soft, lint-free cloth for cleaning.
2. Before using a cleaning solvent on any part of the PRO165SL/SLE, blow away small particles and dust with clean, dry, compressed air.
3. Take the opportunity during the lubrication procedure to inspect the motion guides or bearings for any damage or signs of wear.
4. In applications that have multiple stages bolted together to form multi-axis systems, the orthogonality may be lost if the stage tables of the support stages are loosened. Precision aligned stages should not be loosened or disassembled.
5. Further disassembly of the stage is not recommended because proper assembly and calibration can only be done at the factory . In addition, an autocollimator is required for post assembly verification to maintain warranties. Contact Aerotech for more information.

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.

Cleaning

If a solvent is necessary for cleaning the stage, Aerotech recommends using isopropyl alcohol. Harsher solvents, such as acetone, may damage the plastic and rubber seals on the ball screw and bearing trucks.

WARNING: Make sure that all solvent has completely evaporated before attempting to move the stage.

Lubrication

Aerotech recommends that you use only Kluberplex BEM 34-132 as the standard lubricant for second generation PRO165SL/SLE stages. Second generation stages can be distinguished from first generation stages by the curved hardcover on the second generation stage.

WARNING: First generation stages were manufactured with THK AFE-CA grease as the standard lubricant. THK AFE-CA grease is not chemically compatible with Kluberplex BEM 34-132 and the two should not be used interchangeably. First generation stages in the field should continue to use THK AFE-CA grease for regular maintenance lubrication.

For high-speed applications (i.e., near maximum speed at a duty cycle of 50%), frequent maintenance with standard lubricants is required.

If the application process uses only a small portion of travel for most of the duty cycle, periodically drive the stage through full travel to redistribute the lubrication in the bearings.

NOTE: During the lubrication procedure, inspect the bearings and ball screw for any damage or signs of wear.

1. Drive the stage table to one end of travel and remove power to the stage.

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.

2. Remove the cover attached to the rear end plate on the side opposite of the motor (Figure 4-1).
3. Remove the hardcover screws (Figure 4-2).
4. Carefully slide the hardcover away from the stage (Figure 4-3). This can be done without removing the table.
5. Remove any accumulated dust or debris from the inside of the assembly.
6. Remove any dirty or dried lubricant from the ball screw. Use a clean, lint-free cloth with a side-to-side motion. Manually turn the ball screw to clean its entire circumference. A swab soaked in Isopropyl Alcohol may be used to remove stubborn debris.
7. Clean the end of the ball-screw nut and wiper with a clean, lint-free cloth or swab.
8. Clean the linear bearing guides using a similar technique.
9. Apply a thin, continuous film of lubricant to the ball-screw threads and linear bearing guides. A good quality, natural bristle artist's brush makes an excellent applicator.
10. For stages without an optional brake, manually move the stage to the opposite end of travel. This will work the grease into the ball screw and linear bearing guides. If the stage has an optional brake, the stage cannot be moved by hand. In this case, restore power to the stage, drive it to the desired position, then remove power and continue to Step 9. Be sure to use extreme caution while operating the stage temporarily without the hardcover installed.
11. Repeat steps 3 through 9 for any areas covered by the original table position.
12. Refasten the hardcover.
13. Restore power to the stage; drive the stage table back to its original position to redistribute lubricants.

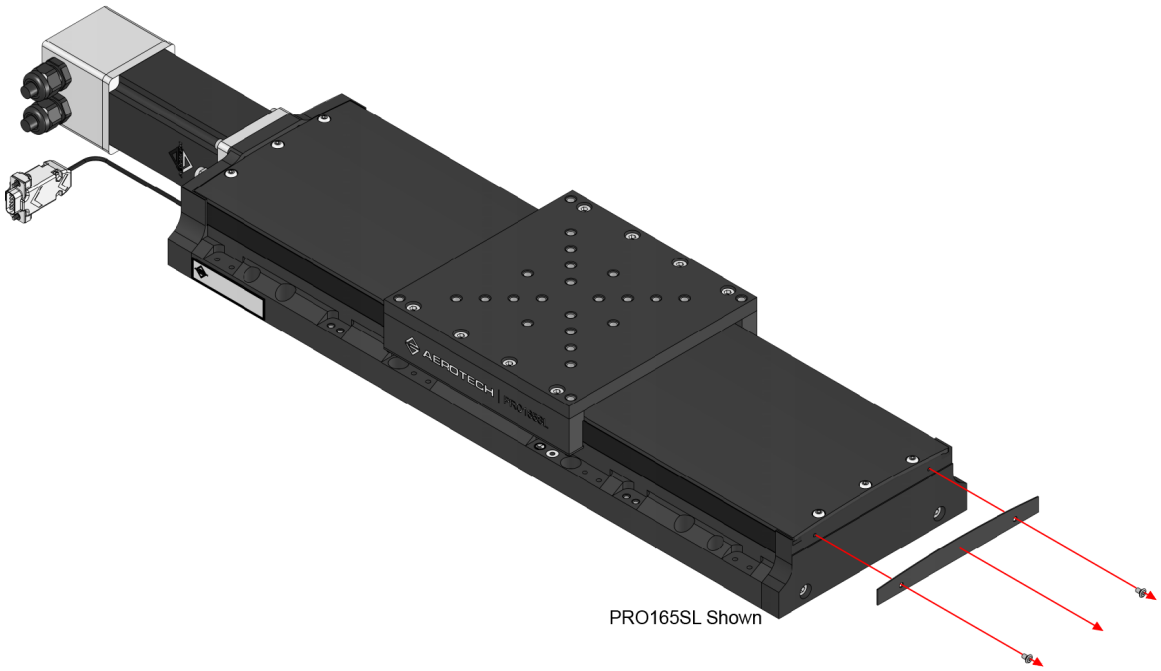


Figure 4-1: Hardcover Removal Procedure (Step 2)

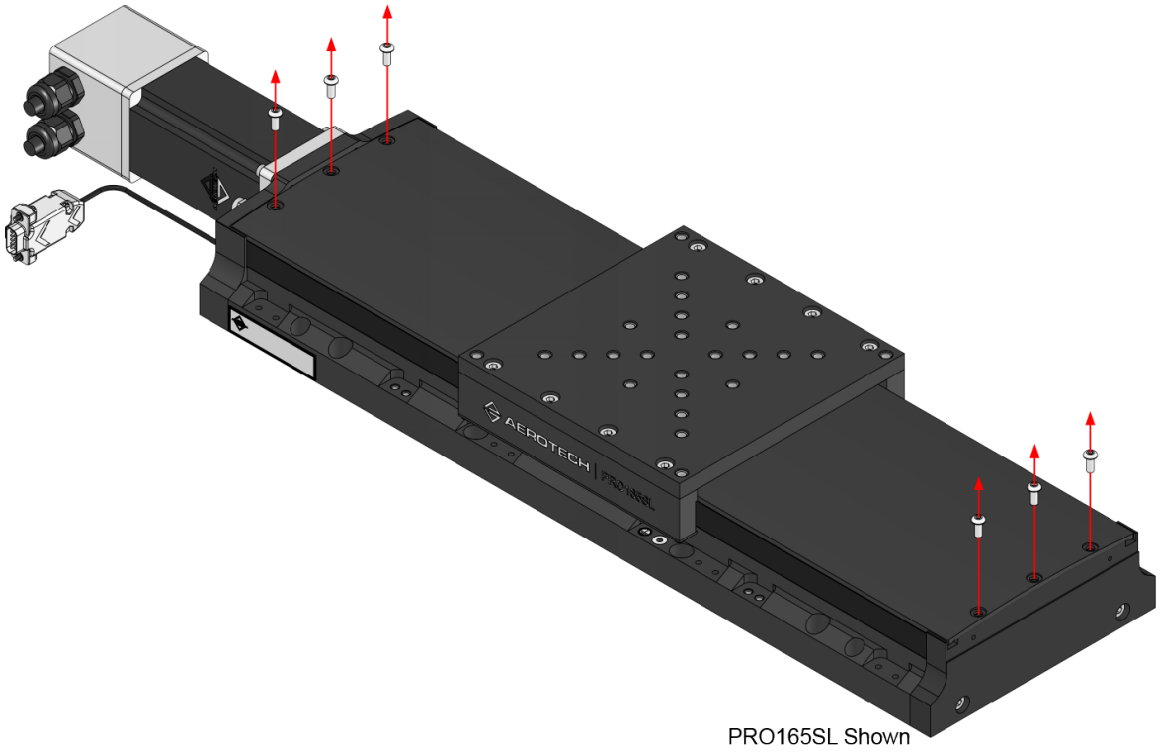


Figure 4-2: Hardcover Removal Procedure (Step 3)

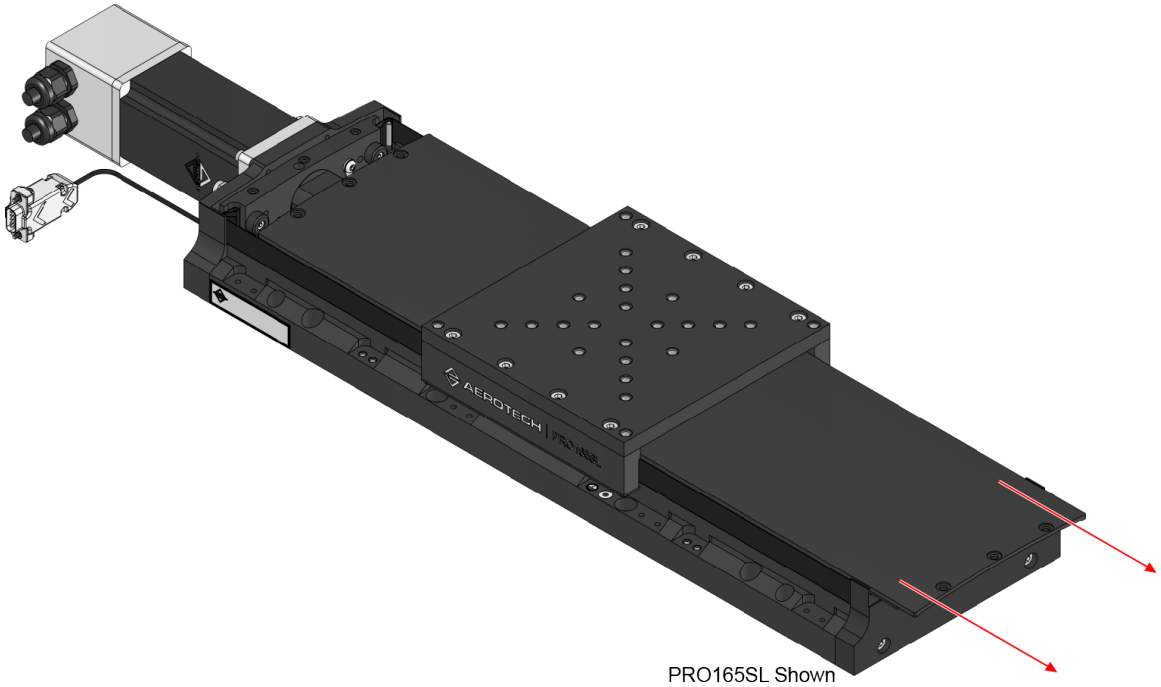


Figure 4-3: Hardcover Removal Procedure (Step 4)

4.3. Belt Adjustment

This section applies to stages equipped with foldback motor options. On foldback stages, the motor torque is transferred to the ball screw via a timing belt. Belt tension is critical to stage performance and accuracy.

Check the belt tension when lubricating and cleaning the stage. Deflection in the belt should be within ±10% of 1.5 mm when applying a 5 N downward force directly between the pulleys. If the deflection exceeds this value, the belt tension needs to be adjusted.

You will also need to apply lubricant to the inside flanges of the pulleys if the flanges are dry. The flanges should have a thin film of lubricant to reduce belt wear as the belt contacts the flanges. Parker Super O-Lube (silicone-based) is the approved lubricant for standard polyurethane belts.

Belt Tension Adjustment Procedure

1. Remove power to the stage.
2. Remove the four mounting screws for the foldback cover (Figure 4-4).
3. Check that the pulleys are tight on their respective shafts (Figure 4-5).
    a. Each pulley is held in position with two set screws.
    b. Ensure that the set screws are tight and centered over the shaft flats.
4. Check the tension in the belt to determine if adjustment is necessary (Figure 4-5).
5. If adjustment is required, loosen (but do not remove) the mounting screws for the idler pulley mounting bracket (Figure 4-5).
6. Remove the M4 set screw to gain access to the tapped hole above the idler pulley mounting bracket (Figure 4-5).
7. Insert an M4 screw or threaded stud long enough to contact the idler pulley mounting bracket (Figure 4-5).
8. Use the threaded stud to drive the idler pulley mounting bracket downward and increase belt tension.
9. Tighten the mounting screws for the idler pulley mounting bracket.
10. Measure the belt deflection again and repeat the previous steps until the belt tension adjustment is complete.
11. Check the pulley flanges for lubrication.
12. Add small amounts of Parker Super O-Lube lubricant around the circumference of both pulley flanges (Figure 4-6).
13. Replace the foldback cover and mounting screws.
14. Restore power to the stage and resume normal use.

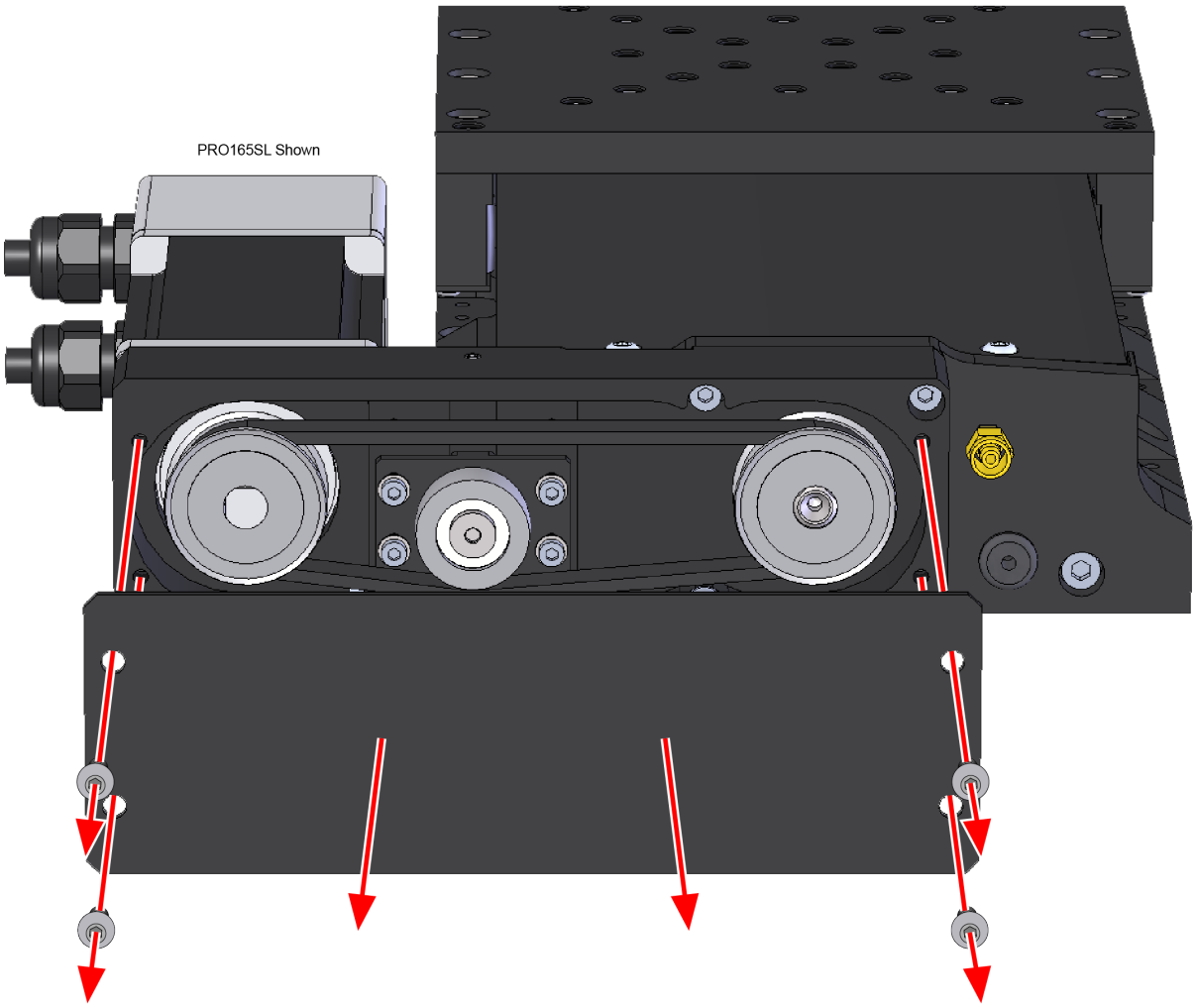


Figure 4-4: Foldback Motor Cover Removal

NOTE: If the stage has been calibrated (-PL2 option), note the orientation of the two pulleys with regard to each other or recalibration might be required.

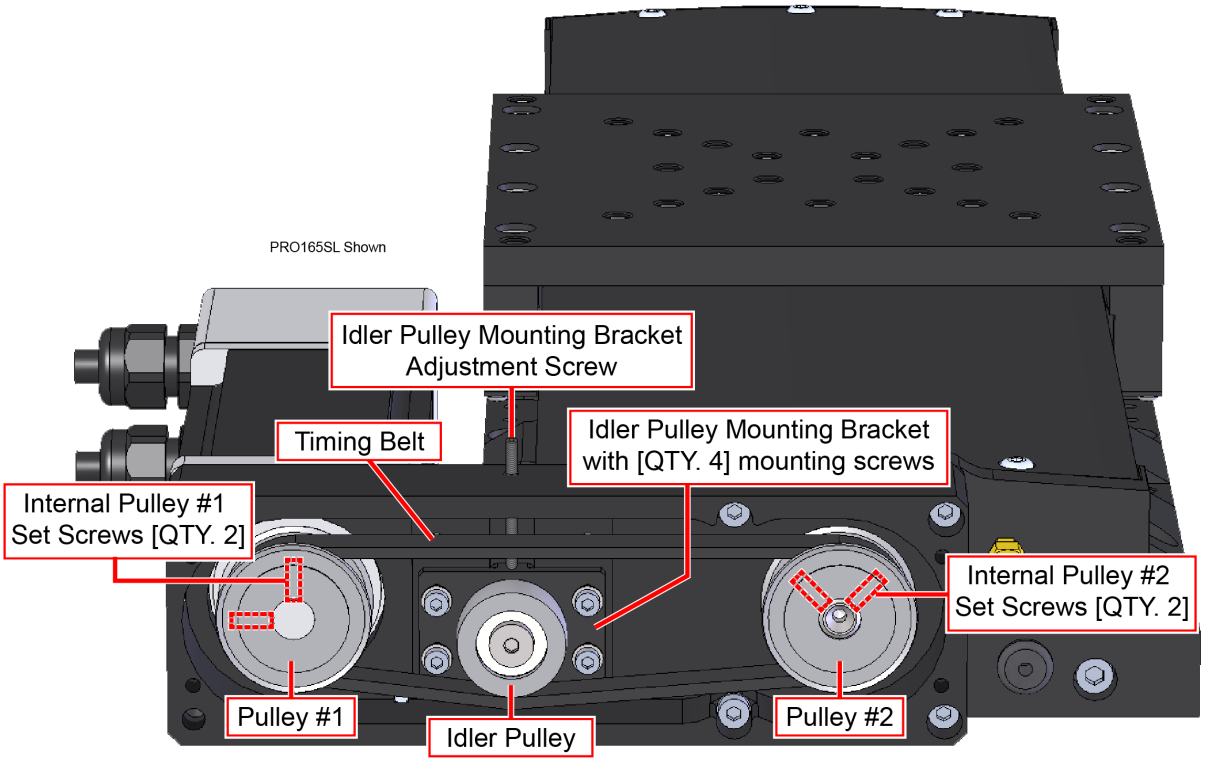


Figure 4-5: Foldback Motor Part Callouts

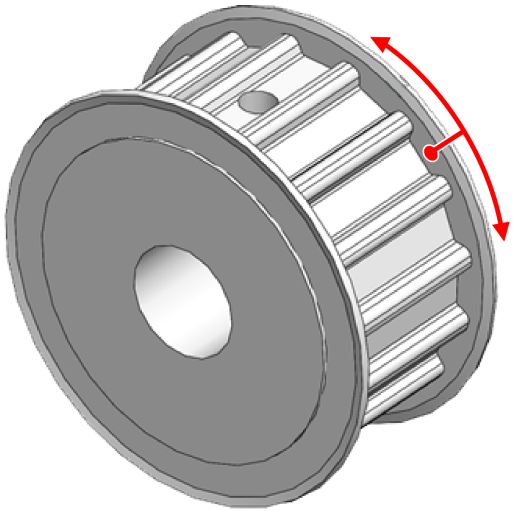


Figure 4-6: Lubricate the Pulley Flanges

4.4. Troubleshooting

Symptom	Possible Cause and Solution
Stage will not move	Brake not released (if equipped with brake; refer to stage documentation). In Limit condition. Check limits (refer to Chapter 3) and refer to the Controller documentation for polarity and compatibility requirements (Example: voltage requirements). Controller trap or fault (refer to the Controller documentation).
Stage moves uncontrollably	Encoder (sine and cosine) signal connections (refer to Chapter 3 and Controller documentation). Motor Connections (refer to Chapter 3 and the Controller documentation).
Stage oscillates or squeals	Gains misadjusted (refer to the Controller documentation). Encoder signals (refer to the Controller documentation).

This page intentionally left blank.

Appendix A: Warranty and Field Service

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

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

Return Products Procedure

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

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

Returned Product Warranty Determination

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

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

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

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

Rush Service

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

On-site Warranty Repair

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

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

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

On-site Non-Warranty Repair

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

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

Service Locations

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

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

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

Have your customer order number ready before calling.

Appendix B: Revision History

Revision	Description
1.09.00	• Product update • Dimension drawing updated: Section 2.2. • Foldback dimensions updated: Figure 2-2 and Figure 2-3
1.08.00	• General revision / Product redesign • New configuration (SL and SLE) • Safety information updated • Order and part number specifications updated: Chapter 1 • Tabletop option dimensions updated: Section 2.2. • Basic specifications updated: Section 1.3. • Added ThermoComp™ information
1.07.00	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
1.06.00	
1.05.00	
1.04.00	
1.03.00	
1.02.00	
1.01.00	
1.00.00	

This page intentionally left blank.

Index

2

2010 7

A

Accuracy and Temperature Effects 11
Accuracy of the Ballscrew 11
acetone (caution) 44
Altitude 11
Ambient Temperature 11
Attaching the Payload 23

B

Belt Adjustment 48
belt tension 48
Belt Tension Adjustment Procedure 48
BM130 Motor Specifications (PRO165) 37
BMS100 Motor Specifications (PRO165) 36
Brake Specifications 35
Braycote® 602EF 14

C

cleaning
  mounting surface 21
Cleaning 44
cleaning solvent 44

D

Dimensions 17

E

Electrical Installation 27
EN 60204-1 7
EN ISO 12100 7
Encoder Specifications 35
eyebolts 16

F

foldback 48

G

Global Technical Support 2
grease 14

H

Hall-Effect Sensors Specifications 35
Humidity 11

I

Inspection Schedule 43
isopropyl alcohol 44

L

label 15
Lifting Features 16
Limit Switch Specifications 35
lubricants
  vacuum operation 14
Lubrication 44

M

mounting surface
  cleaning 21
  securing stage 21
multiaxis combinations 44

N

NEMA23 36-37

P

part number 15
Possible Cause 51
PRO165
  Motor Specifications (BM130) 37
  Motor Specifications (BMS100) 36
Protection Rating 11

protective ground connection 28

S

serial number 15

shimming 21

Solution 51

Specifications 12

stabilizing stage 15

stage

distortion 21

stabilizing 15

standoffs 16

Support 2

Symptom 51

T

Technical Support 2

Temperature Effects 11

thermal expansion coefficient 11

Thermistor Specifications 35

torque 25

Troubleshooting 51

U

Unpacking and Handling the Stage 15

V

vacuum 14

vacuum guidelines 14

Vacuum Operation 14

Vibration 11

W

Warranty and Field Service 53